SMALL SCIENCE

A series in primary science

Teacher's Book
Class 5

Developed by
Homi Bhabha Centre for Science Education

Homi Bhabha Curriculum for Primary Science

SMALL SCIENCE

Teacher's Book
Class 5

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Small Science
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GENERAL PREFACE

Not a day passes in our country when somebody somewhere has not criticized our system of education, particularly our school education. A great many ills and inadequacies of the system probably flow from extraneous causes and need socio-political initiatives that go beyond mere reforms in school curriculum. But some problems do arise directly from the curriculum - text books, teaching and evaluation practices. There is then a need to keep these problems in view and continually try to devise new curricula to overcome them.

Efforts in curricular reforms and innovations are not new to our country. Nearly every decade or so, there have been initiatives at the Central and State levels to effect changes in curricula. Several independent school networks and voluntary groups have brought out their own textbooks and related materials. There is no doubt that significant progress has been made by the country in increasingly better conceptualization of the school curriculum at primary, middle and secondary levels. The paradigms of school curriculum in India have steadily evolved and become more relevant and modern. Unfortunately, the over-all deterioration of the system due to extraneous factors has tended to obscure these gains. Also, and most important for our purpose here, there is a large gap between the generally agreed objectives of the curriculum and their actual translation into textbooks and teaching practices.

Homi Bhabha Curriculum is basically an attempt to close this gap as much as possible. It is not conceived to be a revolutionary curriculum. The broad aims of the curriculum are much the same as those articulated in countless reports and articles of different education departments and agencies. The idea is not to produce a fanciful, 'museum-piece' curriculum that nobody would adopt, but to attempt to discover a sound and wholesome curriculum that is practical to implement in our school system. 'Practical' is, however, not to be regarded as a euphemism for the status quo. As the users will find out, the alternative textbooks of the Homi Bhabha Curriculum are full of radical unconventional ideas that we believe are both urgent, necessary and, given enough efforts, feasible. But rather than describe here what we believe to be these innovative aspects, we leave the users, students and teachers, to find and experience them. In the simplest and most favourable situations, devising a curriculum and translating it into books, laboratories and teacher manuals is a daunting task. In the complex parameters and constraints that govern our country's educational system, the task is formidable. Only time will tell if and to what extent the Homi Bhabha Curriculum is an effort in the right direction.

Arvind Kumar

PREFACE TO SMALL SCIENCE CLASS 5

The class V book of the Homi Bhabha Curriculum, like others in this series, attempts to encourage the natural curiosity and powers of observation which children have. It uses these qualities to help children learn about the world around them.

The emphasis in the books is on the process of science - observing, asking questions, trying to find the answers through further observations and experiments - rather than on information that children are expected to memorize without any real understanding. Needless to add, it would be difficult to use this book meaningfully without doing the activities.

The activities have been designed such that easily available materials can be used; sometimes low cost materials may have to be purchased, but this small investment is unavoidable, and certainly worthwhile if it makes learning fun and easy.

The material in this book has been tested and incorporated in the book when it was found to be successful in our classroom. We would like to know how you found it in yours. Please send us your feedback and suggestions by e-mail, or use the form in the Teacher's book.

I hope the teachers and children have as much fun with this book as I did in developing it.

Jyotsna Vijapurkar

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ACKNOWLEDGEMENTS

My sincere thanks to Arvind Kumar for his active interest in this work, for constant encouragement and for making time for discussions despite his busy schedule.

Jayashree Ramadas pointed the way in the beginning ,and the pitfalls along the way.

Madhugandha Damle contributed much more than the illustrations; she gave many inputs all through the text. I am very fortunate indeed to have had the pleasure of collaborating with her.

I would have been grateful to the biology folks - Shilpa Pathak, Rekha Vartak, Anupama Ronad, Ritesh Khunyakari, Abhijeet Bardapurkar- had they just tolerated my many questions; they welcomed them! Sandhya Thulasidas shared her naturalist's knowledge with me.

G. Nagarjuna and Chitra Natarajan gave valuable feedback. I often went straight to them after the classroom trials, with much to share. Thanks for always keeping the door open.

Many thanks to V. G. Gambhir, to whom I turned for answers unlikely to be found in any book.

Manoj Nair and R. S. Patwardhan made innumerable troubleshooting trips to the Cognitive Lab where the layout work was done. We could not have proceeded without their help.

Swati Mehrotra was a great sounding board, and gave helpful comments.

Suchitra Varde in the initial stages, then Gouri Patil and Fouzia Dohadwalla carried out trials of the activities,, maintained logs, and aided in the research. Archana Shinde and Aisha Kawalkar gave valuable help during the final stages of production.

I thank Mariona Gomes and her colleagues of the NGO 'PATH', Madhavan Nair and his colleagues at the National Institute of Nutrition, Hyderabad for their help. Madhav Gadgil gave very helpful and detailed comments and suggestions on the first two chapters.

The principals and teachers of Atomic Energy Central Schools and Childrens Aid Society school accomodated us in their schedules, making the classroom trials of the material possible. The children of these schools were enthusiastic participants, and taught me much.

Photographs from Space are by NASA and ISRO. A. Ghaisas provided photographs of the globe.

I thank all my other colleagues at HBCSE whom I consulted from time to time. I am grateful for the computer and administrative support at HBCSE.

Thanks to many friends, and friends of friends - who contributed in many ways.

My mother, Sharada, is one of the best teachers I have ever had. She inculcated in me a love of learning. I dedicate this effort to her.

Jyotsna Vijapurkar

Dear Teachers,

With every batch of students in our research and classroom trials, we found that initially only a handful of students, often just one or two, would raise their hands in response to questions. No other child would actively participate in the class. Perhaps this practice is what they carried over from their regular classes. With time, however, we saw to it that all children got involved. The initiative to establish this atmosphere had to come from us, the teachers. Sometimes a bright child would give a very good answer right at the beginning, with all the 'ifs' and 'buts' covered; had we acknowledged that right away, the rest of the class would not have been motivated to think about the question. So my response would be - 'that is what s/he thinks, what do **you** think?' At the end I would say something in appreciation of the child who gave the good answer, or else s/he may feel ignored.

I think many of us hesitate to speak in large groups for fear of ridicule. I made a rule in my class that no one should laugh at any answer or question. Of course this is hard to enforce, given how spontaneous laughter is. But again, finding something good to say about the child's statement quickly corrected the situation. If nothing else - 'I am so glad you pointed that out' or 'good point!' will do the trick. It serves to bring children out of their diffidence.

Controversial questions, which may not have unique clear cut answers (for example, the position of the mango tree in the Venn diagram in chapter 1), are also very useful in encouraging shy children to contribute to the class discussion. Incidentally, addressing such questions is very much a part of doing science!

Lastly, bear in mind that it is in the very nature of science and technology that they are constantly evolving. The information in this book is as up to date as possible - the status of Pluto made it necessary to change the sections on the Solar system in chapter 7, just a day or two before the book went to the printers! In the same way, the materials used in making different parts of a bicycle (chapter 10) will change as newer materials and technology become available. But then this book is not about information, but about the way we go about finding answers. Why Pluto is no longer considered a planet is more interesting and important than the number of planets in our solar system. However, do keep in mind that with time some information will need to be revised.

Jyotsna Vijapurkar

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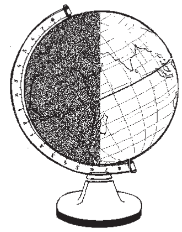
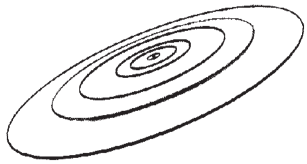
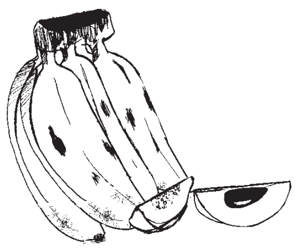
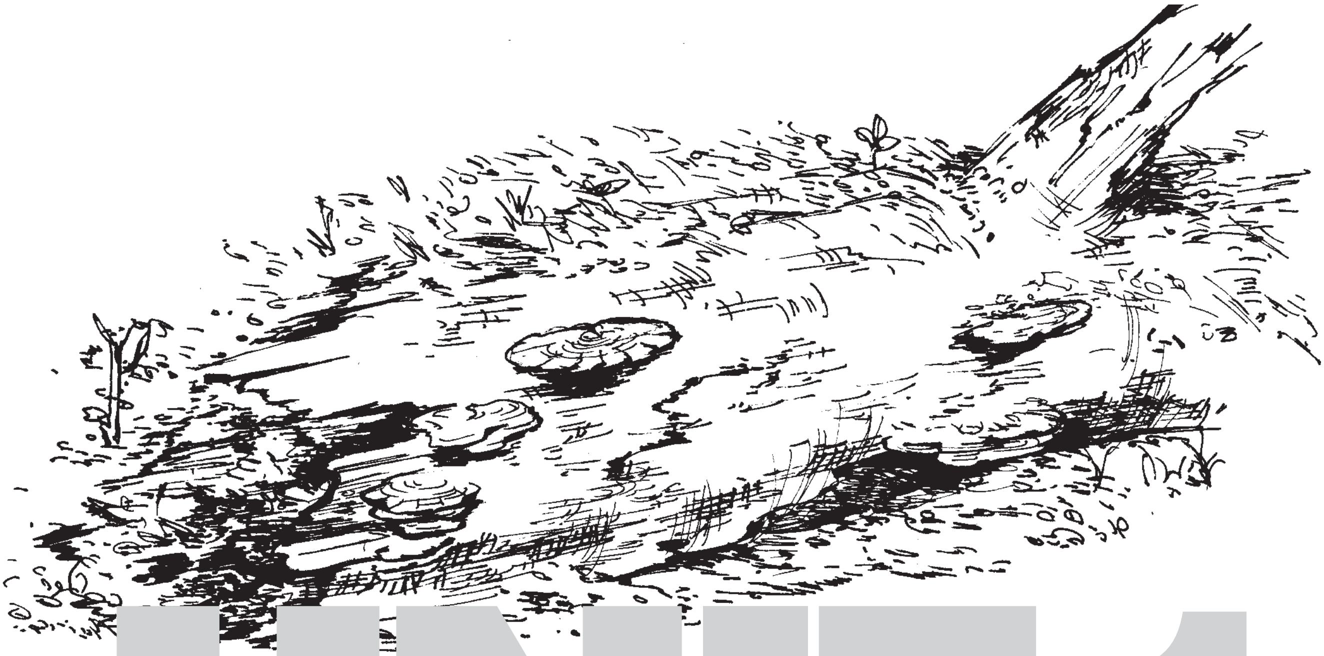


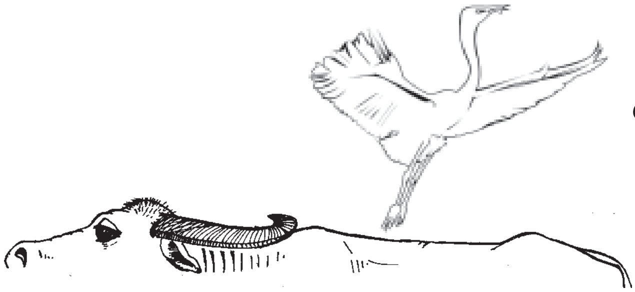






UNIT 1

THE WEB OF LIFE



CHAPTER 1
LIVING TOGETHER

Why I developed this chapter

Children tend to be very anthropocentric - they look at every plant and animal in terms of its uses to humans. In this chapter I was trying to get them to look at how animals and plants are dependent on others around them. No matter which tree or animal I picked as an example, they came up with some use to us. I decided to ask them to think of all that an ant takes from and gives to its environment; I was sure they could not come up with any use to humans. To my surprise and great amusement, they came up with two "it teaches us the value of hard work" and "it helps us in learning - 'A' for ant"!

Main objectives

To get children to

1. Appreciate the variety of life around them.

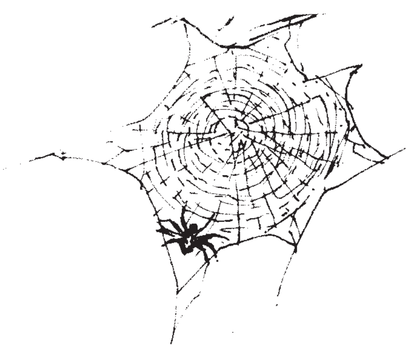
2. Understand that each living thing depends on others, to see it as part of a complex web, not simply as something that is 'useful to humans' or 'harmful to humans'.

3. Observe flowers and their parts, and to learn about pollination.

A green branch
A spider's web
A patient spider in the web

A hungry aphid sucking leaves
A busy bulbul in the bush
With twigs and cobwebs for its nest

Living things everywhere, need others too
For food, for homes, for so much more...



Students were unfamiliar with the words aphid and twigs, but did understand the overall content of the poem. Aphids are small insects which suck the sap from stems and leaves; rose plants often have aphids as pests.

Animals and their food

Preparation:

Allot about 1 hour for this activity - a double period is preferable, so they can make the list and the drawings while it is still fresh in their minds. Before going to the plot, remind them to carry the workbook and a pencil, and remind them that they have to be quiet (or they will scare away birds and other animals).

1. Find a plot of land in or near your school which has some grass, other plants, one or more trees and which has a lot of insects and other living things. You are likely to find more kinds of living things if your plot has a pond, *nullah* or some other water body in it. Mark the boundary of your plot with stones, twigs and sticks etc.

In the next section, they actually make a measurement of the plot boundaries, so it would help to leave the markers there.

a. On page 3 of your WorkBook, make a list of all living things, parts of living things and homes of animals you find there. Look for birds, birds' nests, different kinds of worms, ants, ants' nests, spiders, spider webs and anything that is caught in them, etc.

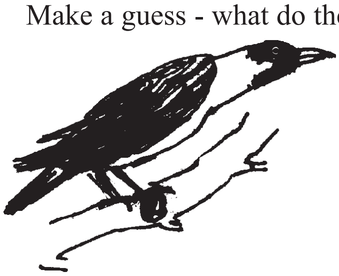
Be sure to look inside flowers, under leaves and in cracks in the bark.

If you find any living thing whose name you do not know, write a short description of it.
How big (or small) was it? Draw it.

Suggestion:

Big or small is relative, so comparison with a common animal helps. For example, As big as, or slightly bigger/smaller than a fly (or lizard or crow or ....whatever) The sizes of birds in Salim Ali's field guide, for example, are given in comparison to common ones like mynah, bulbul, sparrow, crow, pigeon.

Observe carefully where you saw the animals - both large animals and small ones like tiny insects and worms.
Make a guess - what do they eat? In the list, circle the animals, as shown.



Field experience:

> The food of some commonly found animals is given in Appendix 1. In our trial, we selected a somewhat wild part of a garden, and found a rich variety of living things, including bracket fungi growing on the bark of a tree and several kinds of ants.

Think! Think!
Where do plants get their food from?

> Plants make their 'food' in their leaves in the presence of sunlight, using carbon dioxide in the air, and water. The statement 'plants make their own food' often causes confusion - humans 'make' their own food too as in cooking. The difference of course is that plants make it from inorganic matter (i.e. from non living things) - such as carbon dioxide from the air, water and minerals. They convert this into glucose, then starch (complex carbohydrate). This is then used for functions such as growth and transport of material through the plant. Herbivores and omnivores get energy mostly from carbohydrates which they get by eating plants. Carnivores get energy mostly from protein and fats which they get by eating animals.
>
> If we simply agree to call things that are taken in as food, then plant food would be carbon dioxide, water, minerals; animal food would be parts of plants or of other animals.

b. The plot where you found these living things.

On page 5 of your WorkBook, describe the shape of your plot. How big or small was it? Draw it. Measure the lengths of the boundaries. Draw a map of your plot.
Mark the lengths of the boundaries on it. Draw the map to scale - decide how many centimetres on the map show one metre on the ground. In the map, show where the trees and bushes were and write their names. Write the names of the animals where you found them.

Classroom/Field experience:

> We tested this activity with a very difficult shape in our garden - with curved boundaries. Yet the students did a very good job - they said, for example, one side was shaped like a 'C' etc.

c. Here is a list of some living things.

ant-lion	human being	elephant	wall spider
frog	oyster	fish	rabbit
bee	flea	sparrow	dung beetle
earthworm	root bacteria	rat	crab
red ant	bat	monkey	water hyacinth

Where is each one found most often - under the ground…on the ground, or in some other place?
Mark the correct column with a (✓) for each one on page 7 of your WorkBook.
If you mark the column 'in some other place', write in which place you find that living thing.
Are there living things which have a mark in more than one column? Now write all the names in the correct places in the diagram.

Think! Think!

Where would you put a mango tree in this diagram?

> Different parts of the mango tree span all these habitats - an interesting question. I would put it at the intersection of all the sets. Raising such debatable points makes the class lively, making even the usually quiet and shy children participate.

Living things depend on each other.

2. Every animal depends on other living things for its food.

> A few species of bacteria called archaebacteria get their nutrition directly from inorganic sources; all other living things depend on others in a very complex web.

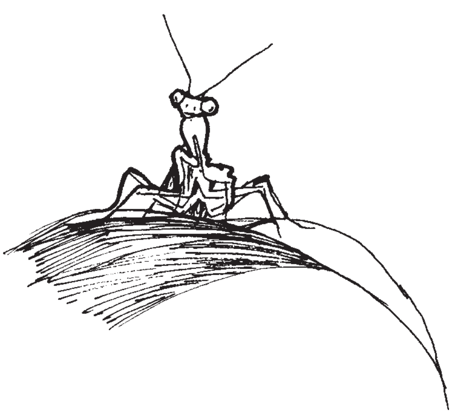
a. On page 9 of your WorkBook, select an animal from your list and write some things it eats:
Animal: __
Eats: __, __, __, __, __ etc.
Now all the animals which eat the animal you selected.
It is eaten by:__,__,__,

b. Food chain:
Draw arrows between the following living things, showing which eats the other. The arrow should always point from the plant or animal that is eaten (food) to the animal that eats it.

Here are two examples.

A cow eats grass
grass ⟶ cow

An owl eats a mouse, a mouse eats rice
owl ⟵ mouse ⟵ rice



mynah	earthworm	decaying leaves
koel	caterpillar	fresh leaves
wheat	mouse	snake
snake	frog	fly
mosquito	frog	stork
seagull	*bombil* fish	prawns

c. Make a web:
On page 10 of your WorkBook is a part of a web showing some living things, showing who eats whom. Add more living things to this to make a larger web by asking questions like these:

> Who else eats a grasshopper?
> What else does a frog eat?

Now....
weave (!) a story about five of the living things in your web.
Imagine that they can talk to each other.

3. Animals depend on other animals and plants for many things, not just food.

> For example, one plant may provide support for climbers, tree trunks can be a place for mushrooms to grow, or for insects to live in cracks; material for nests such as leaves, twigs, cobwebs, feathers come from other living things, trees provide the shade some plants or animals may need, animals help move seeds from one place to another, some animals are hosts for parasites such as ticks and fleas. This can grow into a very long list indeed!

a. Pick one living thing from your list, and write down some other living things it needs.
What does it need them for? Think of where it lives, whether it builds its home, and with what.

> I drew a tree on the blackboard and did this activity involving the whole class. This is a good exercise to do to get many ideas from children and start them thinking about interdependences.

b. Look at the picture of a banyan tree on page 12 of your WorkBook. It shows

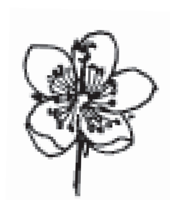
i) some things the tree uses from its surroundings and the living things in the surroundings.

ii) some things that the tree gives to its surroundings and the living things in the surroundings.

Add as many things as you can to this picture. Remember - the arrows have to point in the correct direction!
Now in your WorkBook draw a similar picture for an ant.

> It was at first difficult to get children to think of the role of any plant or animal in its environment; they were accustomed to thinking of them only as useful or harmful to humans. That is why I asked them to do this exercise with an ant, and I still got pretty imaginative answers (see the introduction to this chapter).

Animals need plants. Do plants need animals?

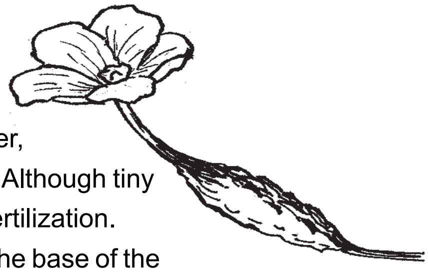


4. Pollination

Classroom experience:

> To introduce this topic I took tender *turai* which still had parts of the flowers attached [Many thanks to Mrs. Sakhubai Kadam, a vegetable vendor, who gladly brought such vegetables from the fields on her way every time I requested her].

a. Refer to the text book for the picture story.



> Fertilization is a must for ovaries to develop into fruits; however, there are some exceptions to this - the banana, for example. Although tiny black 'seeds' can be seen inside, the fruit develops without fertilization. The plant reproduces without seeds - new shoots appear at the base of the old plant. In some cases, when seedless fruits are desired, ovaries can be induced to develop into fruit without fertilization by spraying flowers with a hormone. In one variety of grape - Thompson seedless grape - fertilization does take place, but the ovules fail to develop. See appendix 2 for more on some 'fruits'

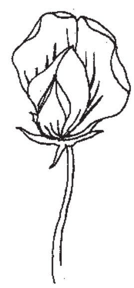
The pollen grains are very small. You need a microscope to see each pollen grain. The yellow powder that rubs off on your hand has hundreds or thousands of grains.
This is how *karela* pollen grains look under a microscope, if magnified a hundred times. (See the text book.)

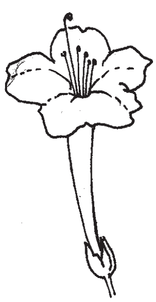
Flowers of many plants, like the hibiscus and gulmohar, have both the male parts (stamen, anthers, pollen) and the female parts (stigma, style, ovary) in the same flower.

On the next page are a few more flowers showing the male and female parts.
The flowers of most plants, even those with both male and female parts in the same flower, need insects or other animals for pollination.

Note: If you pick up fully opened gulmohar flowers which have fallen from the tree, the anthers and stigma may have fallen off.

b. On pages 13 and 14 of your WorkBook drawings of oxalis, pea, mirabilis (Gulab bas), talinum (Ceylon basali) flowers are shown.
In these flowers, can the pollen reach the stigma without the help of insects or other animals?





> In oxalis and pea, yes (the oxalis stigma is long, as shown in the drawing, and pollen from the anthers touching it anywhere along its length can fertilize it); in mirabilis and talinum, the pollen cannot reach the stigma unless an insect or other agent moves it. Interestingly, most flowers are cross-pollinated, meaning that fertilization takes place when pollen from one flower falls on the stigma of another flower (of the same kind!). In many flowers, the male and female parts mature at different times, so self pollination cannot take place...

c. Find any flower that has only a few petals and draw it; show where the anthers, ovary and stigma are. Does your flower have both the male and the female parts?

Some plants, like *karela*, bear both male and female flowers on the same plant; in others, such as papaya, different trees bear male and female flowers.

d. Which animals, other than bees, pollinate flowers?

This is a good exercise to encourage children to be observant: Many birds suck nectar, such as sun birds and mynas; wasps and ants can be found in many flowers; bumble bees (*bhaonra*), some bats and butterflies, visit flowers - all these transfer pollen from one flower to another.

5. Dispersal of seeds

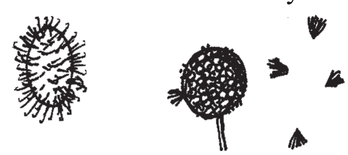
Slowly the fruit ripens and the seeds are ready to grow into plants. How do they go from the plant to some other place in the soil? Make a guess.

a. You learned last year how some seeds can be carried by the wind or water. Think of some seeds which cannot be carried by the wind or water. How can they travel from the plant to other places where they can grow?

b. Many animals eat fruits and their faeces contain the undigested seeds. The seeds grow where the faeces are dropped.

c. Some seeds stick in different ways to the hair or skin of animals. Walk through an area where grass grows wild (not lawns).

Check your clothes and legs (and *chappals* or shoes and socks) for seeds that got stuck there. How did they cling to you?
Pick out these seeds and fruits. Draw them. Show which part of the seed or fruit attached itself to you or your clothes.



Take care!

Be careful not to step on thorns; be alert for snakes, ants etc. which may bite you.
Don't walk into thorny plants.

Think! Think!

Plants and animals die, parts of plants like leaves and branches fall off.
What happens to all these dead plants?

They decay, until only the minerals of which they are formed remain; these are recycled - they are taken up by plants.

Know these words

pollination, pollen, stigma, anther, ovary, style, ovule, dispersal

EXERCISES

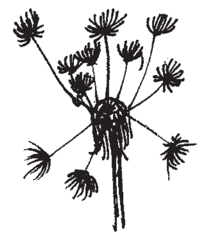
Interesting questions

1. In the following, fill in the blanks. One is filled out for you.

More snakes → ____________ → more grain.
More ____________ → fewer rats → less plague.
More ____________ → fewer mosquito larvae → less malaria.
More snakes → fewer frogs → more ____________ .
More bulbuls → fewer ____________ → more grain.
Less bees → less pollination → fewer ____________ .
More people → more ____________ → less trees.
Less trees → fewer bulbuls → more ____________ → less ____________ .
Add similar lines of your own.

2. Suppose two flowers are very far apart. How can pollen from one flower reach the stigma of the other? Can this happen without the help of insects? How?

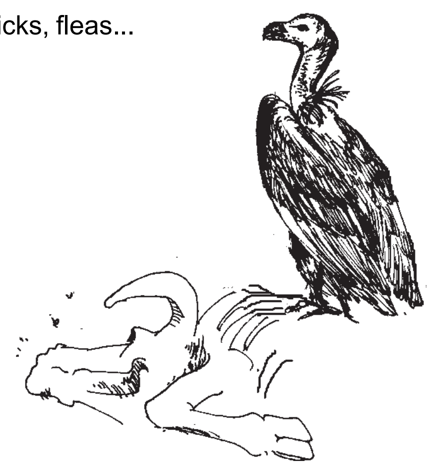
> Wind carries pollen - many grasses, including the plants of cereals, are wind pollinated.



3. What would happen to leaves if snails and earthworms did not eat them?

4. Name some animals which

a) drink the blood of other animals
    mosquitoes, leeches, vampire bats, bed bugs, lice, ticks, fleas...



b) eat grain
    sparrows, humans, rodents...

c) eat dead animals
    vultures, hyenas, ants, flies...

d) eat wood
    termites, some kinds of beetles

e) eat insects

frogs, lizards, bee-eater, drongo...

f) eat decaying leaves

snails, earthworms , crabs...

5. Now what would happen if you used insecticides to kill off all insects? If you burned all dead leaves?

6. What did people eat before they started farming?

Animal meat, fruits

7. Do all fruits grow from flowers?

Yes

8. Do all flowers grow into fruit?

Not necessarily - the male flowers, for example, won't; also the unfertilised female flowers, in most species, won't.

9. What would happen if the pollen from the *karela* falls on the stigma of a papaya flower?

Nothing.

10. Which of these vegetables are fruits, and which ones are not? How do you know?
Bhindi, tomato, potato, brinjal, ginger, beet-root, chilli, *palak*, green peas, radish

Bhindi, tomato, brinjal, chilli, green peas are fruits - they have seeds in them. The meaning of the scientific term fruit is different from the one in everyday usage, in which a fruit is something that is mostly sweet, and can be eaten without cooking. The word fruit, as the scientific term, means that part of the plant which is the result of fertilization, and which bears seeds. There are exceptions, as mentioned earlier, in which fruits may not bear seeds.

Observe and draw

Flowers of as many fruits as you can, like those of *ber*, papaya, mango, *neem*, tamarind, drumstick, tomato, *bhindi.*

Act it out

Pretend to be any animal of your choice. Describe it, then act like it.
a) How does this animal move?
b) Does it make any sound you can hear?
c) Does it build its home? Where, and with what?

d) How does it eat?
e) Does it hunt other animals? How?
f) Is it hunted by any animal? How does it try to escape?

\Ask and find out

Are there places near your school or house that had less animals and plants than they do now? How did this happen?
Are there places that had **more** animals and plants than they do now? How did this happen?

Play with words

Write a poem on your favourite living thing.

Show and tell

Bring to class and show any baby fruit with part of the flower still attached.
You may find such tender vegetables in the market (or garden or field).

Figure it out

1. On page 19 of your WorkBook is a map of Apu's plot. Study the map and answer the questions.

a) Give your answers in metres for the questions below:
How far is the plant with big leaves from the tamarind tree? You can measure from the base of the tree to the base of the plant.
How far is the lizard from the ant?

b) There is a banyan tree 30 m from the shoe flower plant.
Can you show this on the map? If not, what can you change about the map so that you can show the tree on it?
2. A rat's tale (Page 20 of your WorkBook)
Read the story first, then answer the questions.

Play this game

Ask your friend to choose one of the animals from this list:
Owl, eagle, crow, sparrow, cat, squirrel, mosquito, fly, spider, cobra, lizard, butterfly, frog, fish, cow, horse, sunbird, earthworm, moth.

Your friend will not tell you his or her choice right now.
Ask questions which have 'yes' or 'no' answers to find out what your friend chose.
Q1._____
Ans _____ (yes or no)
So the animal can be one of these -________
Keep asking questions till you guess what your friend chose. Each time, write down the question, the

answer and the list of animals.

Ask a question

Ask a question about any living thing around you. Think of how you would find the answer.

Classroom discussion:

From your web, remove any two living things. Will the rest of the living things get affected? Which ones? How?

DID YOU KNOW?

1. A kind of bird called the dodo used to live on the island of Mauritius. This bird could not fly. Dodos were easily hunted by sailors, and dodos' eggs were eaten by rats and dogs which the sailors brought with them.

In 1681, the last dodo was killed; i.e. the dodo became extinct. The dodo ate the fruit of a tree called Calvaria (also called tambalacoque). The seeds of the tree could sprout and grow into trees only after they passed through the dodo's digestive system.

So after the dodo became extinct, no new Calvaria trees could grow on the island.

There are only 13 Calvaria trees on the island now, and all are more than 300 years old. Scientists are now trying to make the seeds sprout by making another bird, the turkey, eat it. Some seeds have sprouted, but the plants are still too young to grow fruits of their own.

2. Some plants, like the sundew and the venus fly trap shown here, trap and digest insects.

The sundew flowers are very sticky. When insects land on them, they get stuck and cannot fly away.

3. The cheetah became extinct in India about 50 years ago, because people hunted and killed all the cheetahs we had.

4. There are about 9000 kinds of birds in the world. 13% of them (about 1200) are found in India though it occupies less than 2% of the land in the world! See how many different kinds of birds you can see in one morning in the area where you live.

PLAY THIS GAME.

Ask your friend to choose one of the animals from this list..

Owl, eagle, crow, sparrow, cat, squirrel, mosquito, fly, spider, cobra, lizard, butterfly, frog, fish, cow, horse, sunbird, earthworm, moth.

Your friend will not tell you her/ his choice **yet** ....
Ask questions which have 'yes' or 'no' answers to find out what your friend chose.

Q1. Is it a bird?

Ans NO (Yes or No) Cat, Squirrel, Spider, cobra, lizard, frog, horse, Cow, Moth,
So the animal can be one of these: - fish, butterfly, earthworm, mosquito.

Q2. Does it lay eggs?

Ans No (Yes or No)
So the animal can be one of these: -
Cat, Squirrel, horse, Cow,

Keep asking questions till you guess what your friend chose.
Write down the questions, the answers, and the animals.

Q3. Does it eat flesh?

No (Yes or No)

So the animal can be one of these :-

Squirrel, horse, Cow.

Q4. Does it climb tree?

Yes (Yes or No)

So the animals can be one of these :-

Squirrel

Ans = [Squirrel]

CHAPTER 2
SOIL

Why I developed this chapter

Most of the water we use comes from ground water sources. In this age of rapidly worsening water scarcity, lowering of the water table and pollution of ground water, this topic is very important indeed. I heard the following conversation one monsoon between two moderately educated adults after a particularly wet spell:

1st person: I hope the rain stops now. We have had enough. Why does one need all this rain?
2nd person: But the farmers need the rain.
1st person: Who needs the rain when there is water under the ground? There is plenty there. No need for rain at all.

Could it be that he thought there was a limitless source underground which had nothing to do with the rain, and did not need to be replenished?

I was really glad I developed this chapter!

Main objectives

To get children to

1. Understand that plants need minerals; that minerals are recycled; that innumerable soil creatures play an invaluable role in this cycle.

2. Learn about groundwater, water cycle and water conservation.

3. Learn about soil erosion, and how roots of plants help prevent it.

The compost pit

The rain had stopped this morning, and the sun was shining. The ground was still a little wet, but Mini and Apu didn't care!
They went to the playground with their new ball.

Mini threw the ball really hard, and Apu had to run very far, almost to the other side of the ground, to catch it. He missed; walking slowly back, out of breath, he noticed a mound of soil on the edge of the field. He went closer, and saw the pit from which the soil had been removed.

"Look, Mini, someone has dug a pit here! It's so deep - I don't think I can touch the bottom...look at how much mud they removed!"

He quickly lay down on the grass on the edge of the pit, and put his hand in. It was so deep; his fingers just touched the bottom.
"Careful Apu! Don't fall into it! And wait there - I am coming too!"
Apu didn't hear a word - he was already looking at all the wonderful things in the pit and in the mound of soil nearby.
"Look Mini!' he said excitedly. 'Look at this big earthworm. Oh, look there's something else moving here."

By now Mini had come running to look too. They saw lots of interesting things - earthworms, millipedes, snail shells, insects and many more...

Just then the gardener came with a heap of leaves and put them in the pit.
He then covered it with some of the soil and sprinkled water over it.

Apu and Mini were full of questions, as usual. 'Who dug the pit?' 'Why?' 'Why are you putting leaves in it?' 'What are you going to do with all the mud that was dug out?'

'I am putting leaves in here, but in just a few weeks I'll have some really nice compost; my plants will grow well in it. You see all these worms? They are going to help me!'

"How?" Apu asked immediately.
"What's compost?" asked Mini.
"You are going to learn all that soon." said the gardener.

1. Living things in the soil

> This is best done in the monsoon, when the soil is moist and teeming with life. If a plot is not available in your school, a pot with humus rich soil will do, though you may not see as rich a variety of animals. You need a pot of soil in which vegetable matter has been added, such as leaves and kitchen waste, and which has been kept moist (watered daily). Yo grow a plant in it.

a. Find an area in your school ground where a tree, bush or other plants grow.
Carefully examine all that you find there. Mark a square of side of about half a metre

Loosen the soil in this square by digging a few centimetres deep.

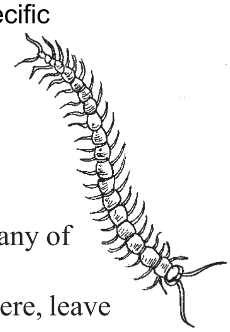
Take care!

Try not to hurt soil animals as you dig and turn the soil. Watch for ants, and other insects which might bite you. Wash your hands after this activity.

Look for animals, plants and their parts in the soil. You may have to turn the soil a little from time to time. If you have a hand lens, you can see the soil creatures better.

Field experience:

> We saw earthworms, millipedes, larvae, partially decomposed but recognisable leaves, twigs and seeds, fungus mycelae (white or grey root like networks which are found to be powdery on touch) , moulted millipedes (smaller and white in colour), roots from neighbouring/old plants, different kinds of ants, and strange little creatures we couldn't identify (we have drawn some of them on pages 19-23). One just balled up and lay still when disturbed, most others just scurried away.
>
> It is difficult to identify soil creatures; one would need comprehensive guidebooks for specific regions. So drawings and descriptions, than naming them, are important.



Draw them and write their descriptions on pages 24 and 25 of your WorkBook.

Write their names if you know them (in any language).
Write down anything interesting you observed about these animals and how they behaved. Did any of them curl up and lie still when disturbed? Were any of them carrying anything?
Many animals, like beetles, earthworms, millipedes and mites live in the soil - eat things found there, leave their faeces there, and lay their eggs in the soil.

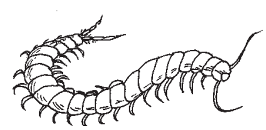
Some build their homes in the soil - guess which ones!
Some animals, like crickets and grasshoppers, some bees and wasps don't live in the soil, but lay their eggs in the soil.
When larvae hatch from the eggs, they too live and eat in the soil.

Many of the soil animals eat the dead and decaying plant and animal parts.
For example, earthworms eat decayed leaves along with mud.

Faeces of earthworms are rich in nutrients that plants need.

Some animals, like the centipede, hunt other animals in the soil.

The soil also has microbes, millions of them, of many kinds, which you can only see under a microscope. Many of these microbes - bacteria and fungi - live on the roots of plants. The food of many microbes is the dead and decaying parts of plants and animals and the faeces of animals.



The mushrooms which you see on the ground are parts of some kinds of fungi.
Their other parts, which look like threads, are in the soil.

> The following is simply to recall the activity done in class IV, and meant as an oral introduction in class for the activity that follows.

b. Last year you had buried banana peels in the soil.
What happened to them?
Could you recognize the peels after a week? After many weeks?
In what ways did they change?

Field experience:

> I planned the following as a group activity, with a few students per group. But they were compulsive foragers, and every child ended up collecting a whole bunch of leaves. So it turned into an individual activity, which was fine. However, they made the arrangement in a group, interacting with each other and pooling their leaves. It was important to set a challenge - which group has the most decayed leaf - so they picked up pieces of leaves in advanced stages of decay, when they crumble.

Collect some leaves which have fallen on the ground. They should all be of the same plant and of roughly the same size. Collect some fresh ones and some decaying ones. See which of you collects the most decayed leaf. Arrange the leaves from the freshest to the most decayed one. Guess how it would look when even more decayed - draw it. How is the first and last leaf different?

> This drawing task is rather challenging... the leaf that is 'even more decayed' won't quite look like a leaf! But that is the point we are trying to make here. Some children said only veins would remain; I asked - what happens to the veins? Finally they said it mixes with the soil, and most attributed this to bacteria or germs. I reminded them of other (macro) soil creatures...
>
> Although kids easily pointed out that the last leaf had holes, that its colour has changed, not all noticed the change in thickness, texture, and the difference in smell. **Do** draw children's attention to these changes. Also, are there any spots on the decayed leaves, such as those of mould?

Take two of the most decayed leaves; place one in the soil in the ground or a flowerpot, where it is always moist. Keep the other in a dry place. After a few days see how the two leaves changed.

> Draw attention to whether you can recognize which leaf it was before it decayed to this extent.

Think! Think!

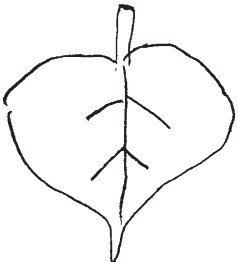
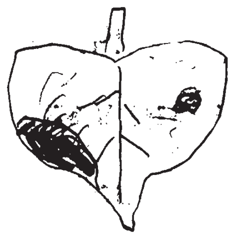
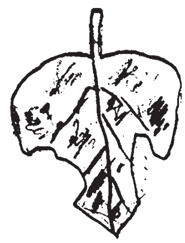
What happens to the leaves which fall in dry wheather and dry up?

Children's work - an example

Collect 8 to 10 leaves which have fallen on the ground. They should all be of the same plant. Collect some fresh ones and some which are not fresh, but are rotting.

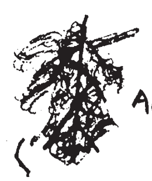
Arrange the leaves from the freshest to the most decayed one. Guess how it would look when even more decayed - draw it. How are the first and last leaf different?

I collected leaves of Indian coral tree

Draw the first Leaf	Draw the middle Leaf	Draw the last Leaf
		
Describe it	Describe it	Describe it
It is green and thick It is has not having holes. This could prepare food. or	It is becoming yellow. It becomes thin or strengthless	It is getting holes. It is getting more rottened.

What do you think happens to the dry leaves?

After some time this leaves would be eaten by bacteria. It would smell bad and would not be full shaped. It would be becoming manure.



AFTER SOME TIME

It will look like muddy. It will be like soil. It will not look paper. It has very bad smell.

> They decay slowly, staying mostly dry, then decay quickly when they get wet, for example, after it rains.

The dead plant and animal parts keep decaying, and turn into dark lumps. You cannot recognize which plant or animal part it was. This dark, decayed matter is called **humus**. Humus also contains faeces of earthworms and other animals in the soil.

Plants grow well in soil which has humus.
Soil rich in humus is called **compost**.
When humus decays even more, the minerals from it, like potassium, magnesium, calcium etc. mix with the soil. These minerals are some of the nutrients that plants need.

> Fungi and bacteria mineralise humus i.e. they further break it down into the minerals of which it is made.

The roots of plants take the minerals in along with water.
Our bodies too need minerals like iron, calcium, potassium, zinc, magnesium and many others.

Think! Think!

From where do we get the minerals our bodies need?

Write your answer in the oval on page 27 of your WorkBook. Now think - from where did **this** get minerals? Keep asking this question and answering it as many times as you can.

Think! Think!

Leaves fall on the ground. After some time, you don't see these leaves, even decayed ones, on the ground. Where do they go? How do they get mixed with the soil?

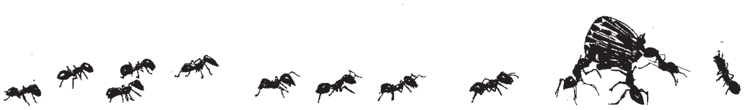
c. Earthworms make burrows in the soil. As they burrow, they mix the dead and decaying things from the surface into the soil.

Make a guess - which other animals might mix the dead parts of plants and animals from the surface into the soil?

> Ants, beetles like dung beetles etc. The dissolved minerals also enter lower soil layers with rainwater.

Soil animals live in the soil at different depths. If you dig deep into the soil here is what you might find at different depths.

How deep have the roots of this tree grown into the soil?
How deep are the earthworm burrows? How deep do you find ants, snails?



If you keep digging the soil you may find small rocks, then bigger rocks in the soil. If you dig deeper, you will find only rock, no soil. This layer of rock under the soil is called **bedrock**. In some places bedrock may be only one or two metres deep, in other places more than 100 or 200 meters deep. Different places have different kinds of rock as bedrock.

2. Other things that make up soil

a. Collect a handful of soil from 3 different places.
Pack them separately and bring them to school.

> Alternatively, you can 'supply' the samples as was done in our trial. Also, you need to prepare for this if done in wet weather - this activity needs dry soil!

Write about the soil you collected on page 28 of your WorkBook. For this activity you will need a dropper, a tea strainer, some water, a container like a bottle cap for measuring small amounts of soil, a larger plastic or metal container, old newspapers. Spread old newspapers on the desk to keep it from getting dirty.

Sift 3 capfuls of the soil through a tea strainer or a wire mesh.
Look closely at what fell through the strainer - which soil had the largest, and which the smallest, particles?
Take a capful of soil and add water to it drop by drop.
Keep adding drops of water until the water starts to flow out.

> This activity is to be done with the original, unsifted soil with the larger pebbles removed.

How many drops of water could it absorb (i.e. how many drops added before the water starts to separate from the soil)?

Classroom experience:

> This took some explaining and a demonstration - the idea is that when the soil can absorb no more, the drops start flowing out. They need to count the number of drops it takes to reach this stage. We had the whole class join in the counting.

b. Look at the picture of soil on page 22. What is there in the gaps between the soil particles, where no microbes or animals are shown?

Take two cups or glasses which are alike. Put equal amounts of the same kind of soil in each. Press the soil down in one of the glasses.

You can press it down with the other glass.

Now add water to the glasses gently. Add enough water to completely cover the soil. Look carefully at the water - count the bubbles that come up in it.

Which glass had more bubbles? Where did the air in the bubbles come from?

Plant roots breathe. They need air. Other living things in the soil too need air. When earthworms and other animals burrow or dig, they loosen the soil.
Which soil has more air - packed or loose? Why?

c. Take a large plastic bottle and lay it on its side. Keep the mouth of the bottle closed. Cut out a rectangle from the cylindrical part of the bottle as shown. Spread a layer of small stones on the bottom of the bottle. Cover with fine soil until about half the bottle is filled.

Pack the soil down by pressing with your hand or some flat object. Take the piece of rectangle which you cut out. Put it back in the bottle vertically, as shown. Do not push it all the way down, just about halfway into the soil.

Take a small plastic bag and make a few holes with a pin in the bottom of the bag.
Fill it with water and use it to make 'rain' on the side of the bottle where the mouth is. Make just enough rain to thoroughly wet the soil on this side. The water should not come up above the soil.

Watch the soil on both sides of the divider in the bottle. Make a drawing of your bottle. Show where the soil is. In your drawing show which part was wet after 5 minutes, then 10 minutes. Did water get to the other side of the plastic divider as well?

On the side on which water was not poured, dig a little 'well' by pressing the back of a pencil into the soil. Did you see water fill part of the well? If not, dig deeper.

Add more water on the other side. When you added more water, did the level of water change?

Did the soil just above the water in the well get wet? Did the surface of the soil get wet on that side? How did water get into the well?
Open the bottle and tilt it slightly by putting a folded paper at its base end. Now make more rain on the same side as before. Did any water flow off from the surface? Was it clear water or did soil flow off too?
Did the water level in the well rise? Without changing the tilt of the bottle, can you do anything to stop the water from flowing off? Try your ideas. Did the water level in the well change when you stopped the water from flowing off?

When it rains, the soil soaks up some of the water. Some water just flows off on the surface, along with some soil, into streams, rivers and seas. Water soaked up by soil goes deep into the ground.

> In sprawling urban areas, most soil is covered by concrete or some other kind of pavement. Water cannot enter the ground. Ground water cannot be replenished. Some cities (not yet in India) are using and planning streets such that the edges remain unpaved, allowing plants to grow and letting rainwater go into the soil. Some are using different materials to pave streets – interlocking tiles or porous concrete. Another problem that results from extensive paving is the floods caused by even moderate rainfall

Some kinds of bedrock too can soak up water - they are **porous**.

> Rocks like laterite, shale and sandstone.

Even if the bedrock is not porous, it may have cracks and gaps in it. Water enters these cracks. If at the bottom there is rock in which water cannot enter, it starts to collect underground. This water is called groundwater.
Groundwater too flows slowly underground. The water in many streams and rivers comes from this flow. Groundwater from very far away may be flowing into the stream or river.

Suppose you use up the water in the well, and it doesn't rain for a long time.
What would happen to the level of water in the well? Can the water level in the well go down even if it rains? How?

> If the use is more than the rainfall.
> In many areas, where people have started growing crops which require a lot more water than traditional crops for that region, and which could not be grown before they could tap ground water by using pumps, the level of water has been going down alarmingly. An example: in Jalagaon, in Maharashtra, water was found 50-60 feet below the ground; now, after they started farming bananas, the level has gone down to 200-250 feet!

Are there ways you can keep the rainwater from flowing off, and make it enter the ground? Give some ideas.

> Groundwater recharging is done in many places, and there are many barren-land-to-riches stories of villages which used these techniques to conserve water. The exact method depends on the kind of soil and rocks in the area, and is too difficult to deal with at this stage. You can, however, look for such stories which occasionally come in the newspaper or magazines.

Think! Think!

Sheela thinks groundwater is like a lake or river of clear water underground.
What do you think? How will you convince her that it is not a clear lake or river?

> This is a very commonly held picture of groundwater - actually it is water mixed with whatever kind of soil is present. It is when you remove the mud and create an empty hollow that clear water fills the hollow, as in the experiment above. If any of your children have ever seen a well being dug, ask them to relate what they observed. Sometimes you even find small streams trickling into the well from its sides.

d. Top layers of the soil are rich in humus. Plants depend on it. If rains keep carrying off soil year after year from some place, plants cannot grow well there.

Cut out a small clod of a grassy patch of ground, a square of side 10 cm.
Get a similar piece of bare ground.
Keep each in a large container - a *thali*, a bucket, an old tray or something similar which can hold water.

Take a little water in a glass, and pour it slowly on the grassy clod.

Look at the water that flowed out in the tray. Pour the same amount of water slowly on the bare clod.

Look at the water in the tray.
Which tray had more water? In which tray was the water muddier? Why?
From which place can soil flow off more easily - bare ground, or where many plants grow?

When it rains and the ground is wet, walk on grass and on bare ground - which is more slippery?
Did some of the mud slip as you walked?
On which path did this happen? Why?

> This simple exercise rather dramatically demonstrates how even the roots of small plants like grass can keep mud from sliding or washing away.

e. In most places where there are farms, fertilizers and pesticides are used. These get into the soil. Can they get into the groundwater too? How?

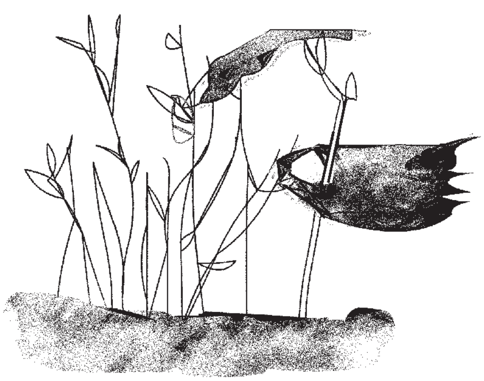
Plastic in the ground decomposes slowly. Some chemicals in the plastic are poisonous. When they mix with the soil they get into the water.

> Plastic decays to the following things in the soil:
> Polymers——> monomers. (Nitrogen bacteria bring this conversion in 2-10s of year.)
>
> Monomers are further broken down by microbial action:
> Monomers——> Carbon, Hydrogen and Oxygen.
> Plastic also has binders and dyes which are toxic to plants and animals. They harm the soil organisms and contaminate groundwater.

When wastes from factories are dumped in the ground, harmful things in them can enter the groundwater. Plants can take up such harmful things from the soil. They can cause harm to the animals who get their food from these plants.

Know these words

nutrients, minerals, humus, compost, burrow, bedrock, groundwater



EXERCISES

What's the same? What's different?

Have you travelled to a city or town far from where you live? Was the soil there different in any way?
In what way or ways can they be alike?
In what way or ways can they be different?

Interesting questions

1. Name some things which make up soil. Which of these are living things, which are not?
2. In which of these places do you think soil has more air?
On a path where people walk, and the soil is packed tight, or in a ploughed field?
3. Where would most plants grow better - in packed clay or loose soil? Why?
4. Name 3 things which are porous.
5. Does it have to rain into a well for the water in the well to rise?
6. Does water in different villages and towns taste different?
Why do you think this is so?
7. No one waters large trees in the forests or by the roadside, yet they don't dry up even in the dry season. How do they get water?

> Roots of large trees branch extensively into the soil and absorb the moisture in the soil. Leaves of some trees fall off in the dry season. This helps these trees to conserve water because loss due to transpiration is prevented.

8. In which of these climates will leaves decay the fastest?

Cold and dry,	Hot and dry,
Hot and humid,	Cold and humid

9. Where else have you seen the word 'minerals'?
Are some of them the same as the minerals which plants, our bodies and other animals need?

Complete the cycle

Look at the picture on page 34 of your WorkBook. 3 things which can happen to the rainwater that falls on land are shown. Choose any of these as a starting point.
Think of what happens to the water after that, then after that...and so on till it falls back as rain. Can this water rain somewhere else, or will it rain right back here?

Classroom discussion

In what ways is it useful to make compost pits?
Which of these things would you put in it - glass bottles, vegetable peels, leaves, newspaper, spoilt food, plastic bags, fruit seeds?
If you don't put them in the compost pit, where do you throw them?

What happens to them after you throw them away?
Are there any difficulties in making compost pits where you live?
Are there ways to solve them?
Start a compost pit in your school or near your house. Tell your class about this pit.

Ask a question

Ask a question about soil. Think of how you will try to find the answer.

Ask and find out

Is there a well or borewell near your school or house? Ask and find out how deep (how many meters) they had to dig or drill to hit rock. F ind out how deep the water level is. Was this level higher or lower some years ago?
Why did the level change?
If the water level has been going down, ask and find out what kind of crops were grown in the area before? What kinds of crops are grown now?
Which crops needs more water?
Are there any programmes in your village or town which help in getting more water into the ground?

DID YOU KNOW

1. Air in soil has less oxygen and more carbon dioxide than in the atmosphere.

2. About 5000 kinds of bacteria have been named and described. Experts think that there are many more kinds in the world - 50,000, maybe even 3 million (1 million =10,00,000). 69000 kinds of fungi are described but there may be 1.5 million kinds of fungi. 1 gram of soil near roots can contain a billion (1000 million) bacteria of many different kinds.

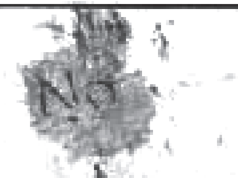
3. An earthworm can ingest up to 36 times its own weight of soil each day!

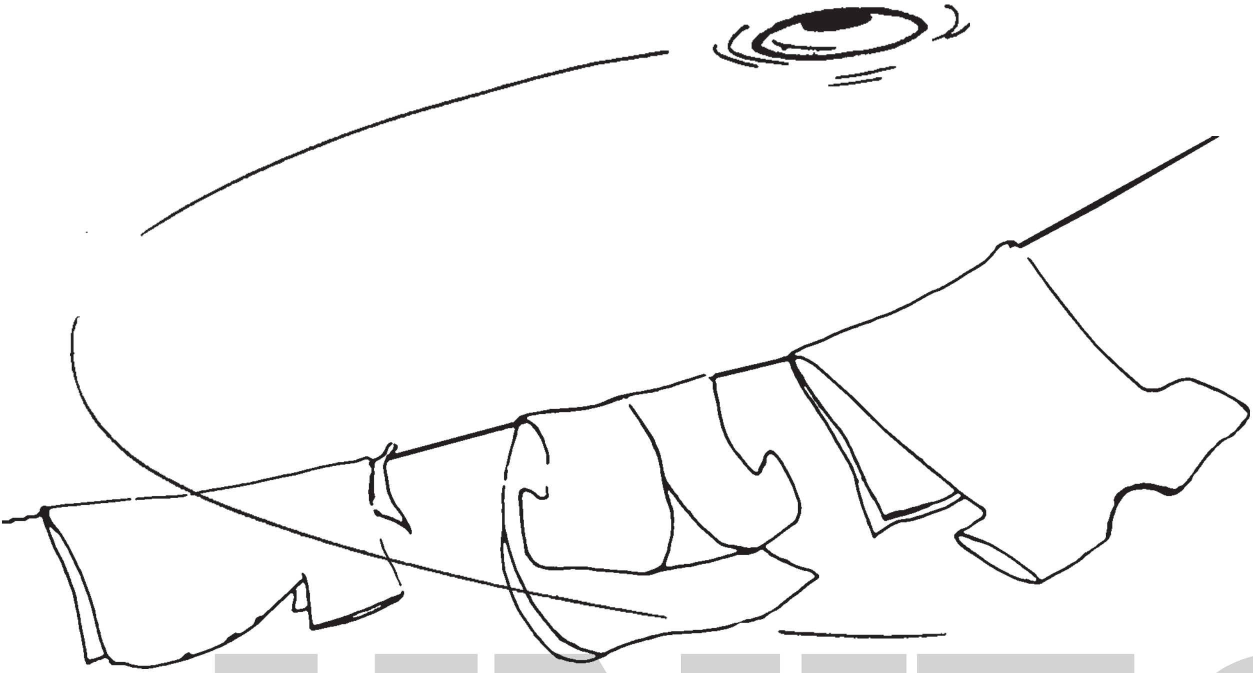
4. Soil forms from bedrock. The bedrock which is now covered by soil was once the ground surface. First lichens - which are groups of fungi and small plants called algae - grow on the rock. They break up the surface of the bedrock into small grains of soil. Larger plants can grow in the layer of soil formed on the top. Their roots break more of the rock. The rock keeps breaking as more and more plants grow.

Some chemicals from humus also change the surface of the rocks and grains.

Creating a few centimetres of new topsoil from bedrock can take many hundreds of years - sometimes even a thousand years.

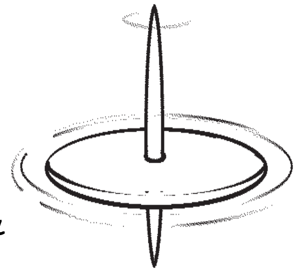
Children's work - an example

Soil Analysis			
Soil Samples	1	2	3
Collected from	garden	beach	pot Maker
Colour	brown	Light brown	dark brown
How it feels	hard	Soft	garty
What it contains	rock	very small rock	water
How it smells	good	bad	bad
What is left on sieving	~~hard~~ little	small rock	~~clayey~~ ~~small~~ Stone
No. of drops of water it holds	~~10~~ 9	No 0	Yes 8
Smudge of wet soil	 No	 Yes	 Yes
Give name for this type of soil	~~Clayey~~ Sandy Soil ~~Clayey~~ Soil	Sandy Soil	clayey -Soil



UNIT 2

MOVING THINGS



CHAPTER 3
HOW THINGS MOVE

Why I developed this chapter

Children of this age group have difficulty understanding inverse relationships such as speed, which is distance/time. Speed ***increases*** *as time taken to cover a fixed distance* ***decreases****. The concept of speed needs to be developed for later concepts in physics. In the next few years they will learn about force, acceleration and Newton's laws. The one hurdle in understanding these ideas is friction. Friction and speed are introduced at an experiential level here so they can form the foundations for later abstractions.*

Main objectives

To get children to

1. Notice how things move, and build vocabulary for accurate descriptions of motion.

2. Develop the concept of speed, and see how it depends on distance and time.

3. Develop a feel for friction through various investigations, and to see how friction affects moving things.

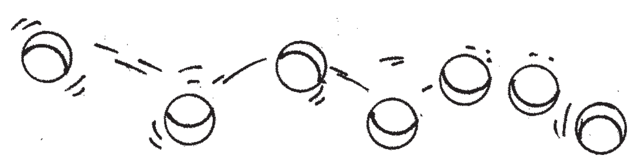
Describing movement

1. Different kinds of movement

a. Think of some things that move. On page 39 of your WorkBook list some words and phrases which describe how these things move. You may choose from the words or phrases given in your WorkBook, or use your own.

Preparation:

> In our trials, I gathered a lot of moving toys - small frisbees, tops, rings, cars, bouncing balls, a bob attached to a string which can be swung, a spring etc. for the following activity. Some things can of course be made to move in more than one way - rolling a ball or bouncing it, for example. You could also ask kids to bring something as is written in the text book, but if you gather it yourself you will be able to introduce many different kinds of motion. Perhaps you would like to combine both these approaches.



b. Bring to class some things that can move. Look at all the things that everyone brought. Watch how they move. Sort them into different groups by asking questions like these:
Does it slide, roll, spin, or move in some other way?
Does it move in a straight line or in a curve?
Does it also move up and down?
Does it vibrate?
Give a name to each group. On page 40 of your WorkBook, write the names of the groups. For each group, write the names of things which you put in this group.

> Each child may group things in a different way - there are many ways to do this. Just make sure they are consistent; giving a name to the group will help them check this. Watch out for groupings based on colour or size and not movement.

Think! Think!

Name some things which move but, at the same time, remain in the same place.

Classroom experience:

> I expected answers like the fan or a pendulum but kids gave surprising answers like school bag - which is always kept in the same place, but is carried out to school and brought back to that place. I pointed out that the school bag physically did move...then they started thinking of fans, trees swaying etc. An interesting situation where this description applies (not necessarily to be shared with children) - suppose you are in train for example, and keep a book on the seat or rack. It may remain the same place as far a person on the train is concerned, but the train itself has moved as someone NOT on train will say, and therefore the book with it.

2. Movements of your body

Classroom experience:

> Children thoroughly enjoyed this activity; young children often associate the word movement with the movement of their own bodies. Initially I did not introduce the words horizontal and vertical, but found through the exercises that they had the concept, not the vocabulary. This led me to introduce the terms in the book.

a. Move your arm (from the shoulder) in as many ways as you can. Make as many different circles as you can.
How many different vertical circles can you make?

> Infinite, really ... they can rotate it as in swimming (front to back) or circles in front of body.

How many different horizontal circles can you make?

b. Try to move your leg from the hip in the same way you moved your arm.
Can you move your leg (from the hip) in the same way? In which ways can you move your arm but not your leg?

> The front-to-back vertical circle that arms can do

In which ways can you move your leg but not your arm?

> None, actually - the arms have a much greater freedom of movement.

c. This is how the shoulder and hip joints are - they are called **ball and socket** joints.

Take something round like a ball or *mosambi* or orange. Attach a stick firmly to it. Cup one palm - fit the ball in it. Now hold the stick and turn the ball. If you make the cup of your palm shallow, does the ball turn more or less? If you hold the ball more loosely, does it move more or less?

Make a guess - which socket is deeper, the shoulder or the hip? Why do you think so?

d. Describe the ways in which you can move
i) your head
ii) your arm at the elbow
iii) your leg at the knee

Do you think the elbow and knee joints are ball and socket joints too? Why do you think so?

> The elbow and knee are not ball and socket joints, of course, as can be seen from the kind and range of movement; neither is the head-neck joint. The movement of the head is actually because of the joint at the skull and first vertebra (allowing nodding up and down motion) and the joint at the first and second vertebra which is a pivot joint, allowing us to turn our head from one side to another, as we do to indicate 'no'.

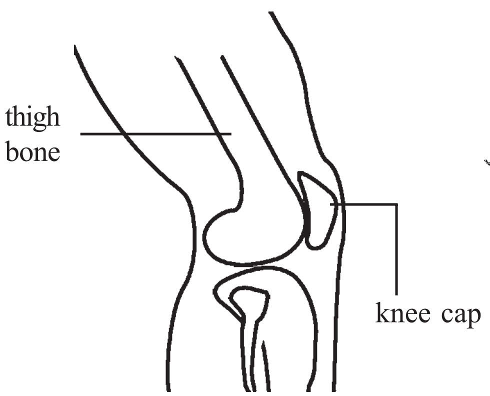


Fig. 1 Knee joint

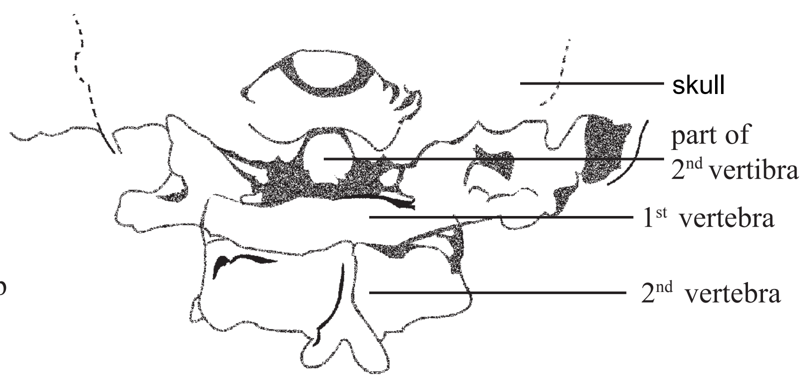


Fig. 2 Head & Neck joint

3. Slow or fast

> The idea in this section is to get them to look at how speed depends on distance and time. Speed *increases* if the **same** distance is to be covered in **less** time.

For this activity make your own 'measuring string' - on a long string make marks at every metre by tying knots or marking with a pen.
Now in the open ground mark out a race track and measure its length with your measuring string.
a. Hold a running race - run on the track with your friend, have the rest of the group measure the time by counting tik-tik 1, tik-tik 2.
Which of you needed more time to run from one end of the track to the other?
Who ran faster?

b. Now hold the race again. As you start the race, have your friends count
tik-tik 1, tik-tik 2 ....till tik-tik 10. This time, each of you run for only 10 seconds. In 10 seconds, who ran more distance? Who ran faster?

c. Look at the picture on page 43 of your WorkBook. Read the story and answer these questions:

i) Mini and Apu are walking to school together. Asma and her mother are ahead of them, much closer to the gate. They all hear the first bell; and they all have to be at the gate just before the second bell rings. Mini, Apu and Asma start running.

Who is closer to the gate? Who is farther from the gate?
Who has to run more distance?
They all reach the gate at the same time.
Who ran slower?

ii) The next day, the first bell rings just as Asma reaches the gate. She doesn't have to run at all. But Mini and Apu, walking together, are far from the gate. They both start running. Mini reaches the gate 30 seconds before Apu.

Did Mini and Apu have to run the same distance? Who reached first?
Who took more time? Who ran faster?

d. Look at the picture on page 44 of your WorkBook and answer these questions.
In this picture, what is the distance between the palm tree and the flagpole?
Between the flagpole and the lamp post?
Between the bus stop and the tower?

i) A bus comes down the road. It takes 10 seconds to go from the palm tree to the flag-pole. It keeps moving at the same speed (it does not speed up or slow down) along the road.
Where will the bus be exactly 10 seconds after it crosses the flagpole? Draw the bus there and write 1a next to your drawing.
In your WorkBook, draw the bus where it will be exactly 20 and 30 seconds after it crosses the flagpole.

Write '1b' (for 20 seconds) next to your drawing and '1c' (for 30 seconds) next to your drawing.

ii) Another bus (bus no. 2) comes along. This bus also takes 10 seconds to go from the palm tree to the flagpole.

If the second bus has to be at the lamp post in less than 10 seconds after it crosses the flagpole, what should it do? (Speed up? Slow down? Do nothing?) Why?

iii) One more bus comes along (a lot of buses today!) This bus (bus no. 3) too takes 10 seconds to go from the palm tree to the flagpole. But, when it reaches the flagpole, it starts going faster.
Draw where this bus can be 10 seconds after it crosses the flagpole. Write '3a' next to your drawing of this bus.

iv) If, instead of speeding up, the bus slows down at the flagpole, where can it be exactly 10 seconds after it crosses the flagpole?

v) Remember, the first bus travelled 100 metres in 10 seconds. How many metres did it travel in 1 sec? Write your answer as _______ metres per second. This is the speed of the bus.

vi) Find out the speed of any bus or train or any other vehicle by which you travel.

Making things move, making them stop

4. How to slow things down and make them stop
a. Take an object with at least one flat surface, like a wooden duster. Place it on the table or floor with the flat surface down, and give a gentle push. How far did it move before it stopped?

Think! Think!

What made it stop?

This question is asked more to get them to think in terms of 'something is needed to make things stop' (not just to make them move). It also helps to set the stage for the next section on friction. Although space is provided in the workbook, that answer is not for evaluation.
Kids said the wall (or some obstruction) stopped it; children we worked with who had already covered force in their other classes said 'the force in it got over'. That answer is not correct (the concept of force is being introduced in class VI)

FOR TEACHER'S ONLY!! Just a reminder of Newton's laws which we have all studied: 'an object in a state of rest or uniform motion continues in that state unless acted on by an external force.'
When you strike something, you apply a force on it momentarily, and that causes it to change speed, or direction (depending on the direction of the force), or both. If it is at rest, and starts moving, then its speed changes from 0 to some other value. IF NO OTHER FORCE ACTS ON IT, it will continue to move at this new speed, and maintain it's direction, forever. In the real world however, the force of friction is always present, which acts on the object constantly, and

> so keeps changing its speed, making it lower and lower until it finally becomes 0 (it stops). The following sections are designed to get students to experience this.

b. Friction slows things down

i) When magnified many times, this is what the surface of a duster or table looks like. Even surfaces that look very smooth, like glass, actually have tiny bumps and ridges.
This is how the surface of a smooth sheet of glass looks when magnified many times. [See text book]

When you try to slide a duster, coin or any other object on the table, the bumps hit against each other, get stuck, and make it difficult for it to slide.

> This is actually only part of the story. The force of friction depends on not just the smoothness or roughness, but also the material. Friction is present because of adhesive forces between the particles (atoms) of the surfaces in contact - they bond together. Since children at this stage are not yet ready for the concept of all matter being made up of atoms, we cannot introduce this aspect here.
>
> Students often described surfaces as 'it has more friction' or 'less friction'. Care should be taken to introduce friction as something *between* two surfaces - not as some property of one object.

Classroom experience:

> We did the following activity in small groups in class; groups which finished fast went over to others who had some difficulty, eager to help. I allowed this, and allowed discussions within and between groups as long as they kept their voices low.

ii) Take a ruler and a coin. Feel the flat side of the ruler with your finger. How smooth or rough is the surface?
Put the ruler on the table. The flat side of the ruler should be facing up. Lift one end of the ruler to a height of about 5 cms. Place a coin near this end.
Now keep increasing the height of this end until the coin just starts to slide down the ruler. Place some things like books and boxes under the ruler's end to keep it at this tilt. Without changing the tilt of the ruler, place a few other objects, like erasers, sharpeners (which have at least one flat surface) on the ruler. The flat surface should touch the ruler.
Which of these could slide easily? Which ones did not slide at all?
Between which object and the ruler was friction the least?

iii) Now remove the coin, and dust talcum powder on the ruler. Keep the tilt of the ruler as before. Spread the powder lightly with your finger. Put the coin back at the top end.
Describe how the coin moved now.
Place the other objects again on the ruler. Which of these could slide now?
Feel the surface of the ruler now, with the powder on it. How did it feel?

iv) Repeat (ii) and (iii) with a ruler made of some other material (wooden, plastic, metal). Always keep the ruler at the same tilt as the first time.

Did anything slide down one kind of ruler but not down the other?

> ***Think! Think!***
> *Why did putting talcum powder make the coin slide easily?*

> Adding a lubricant like oil or in this case talcum powder helps in part by 'filling' the valleys between the bumps, and by causing the object to move on a thin layer of the lubricant, with lower friction.

Is sliding easy on a soapy surface? Why? Where have you experienced this?

c. Things made of rubber
Even when an object made of rubber has a smooth surface, the friction between that object and any surface is very large.
Press your eraser, made of rubber, with your finger. What happened to the eraser?

Rubber changes shape easily. When an object made of rubber is placed on any surface, the bottom surface changes shape, because of the rubber's weight. That makes sliding things made of rubber on any surface harder - there is more friction.
Think of things which are made of rubber -
do you need to have more friction in these places? Why?

d. Friction and rolling:

Classroom experience:

> The kids with whom we worked had already learnt in their other classes that 'friction opposes motion'. What they found here, that without friction there is skidding rather than rolling, came as a surprise to them, and piqued their interest.

i) Take a large plate or thali with a smooth, flat bottom. Take a thread reel, bobbin, or a plastic bottle cap with a hole in it, or a wheel from a toy car. Put a small stick, like a refill or pen, through the hole, and roll it on the thali. Watch closely how it rolls.

Now spread some soap solution evenly on the thali - it should feel slippery. Guess how these objects will move on the plate now. Now roll them again, like you did on the dry thali.

For each object, answer these questions in the last column on page 49 of your WorkBook. Was anything different in the way it moved now? Did it roll or slide? Or slip?
Was the friction between the plate and the things you rolled more or less after spreading soap water on the plate?
Why do you think so?

ii) Look at new tires of bicycles or other vehicles.
Are they smooth or treaded?
Why do you think they have to be made that way?

e. Try to write your name on smooth glossy (smooth and shiny) paper, like the back of a photograph, or old glossy calendars with a pencil. Write as you normally do. Write again with a ball pen, and sketch pen or fountain pen.
With which ones could you write easily? With which ones was it difficult? Why? In what ways does friction help us in writing? Does friction between the paper and the tip of the pencil help? Does friction between the pencil and your fingers help?

Think! Think!
Why do pencil leads and chalk pieces get shorter as you write with them?

> The lead actually rubs off because of friction, which is why it's hard to write with a pencil or ball point pen on smooth surfaces (ball point pens have a roller tip which needs to roll for the ink to come out); I invited children to come and try writing on the window glass with chalk - it's hardly visible. It's much easier to write on a rough surface.

f. Set a ball rolling in the classroom. Now do something to make it go slower and to make it stop. Don't make the ball bounce back, just make it go slower and stop. On page 50 of your WorkBook write down what you tried.
Does the ball slow down on its own too? Why?

Classroom experience:

> I was absolutely impressed by the various solutions children came up with. I rolled a ball across the floor between the teacher's table and their desks. I invited each row to come and try the task. Some of what they did - they put a handkerchief in the path, they put a rough cardboard sheet, leftover from their craft class in the path, they blew on it in the direction opposite to its motion, lightly touched the ball with their hands; one child put an inclined plane - he had actually observed that balls slow down as they climb. I wanted kids to start thinking in terms of something needs to slow the ball down. It slows down on its own because of friction between the ball and the floor.

5. How to make things move:

a. This is a map of Mini's classroom. On page 50 of your WorkBook, draw a map of your classroom. Roll a ball on the floor. In your map, show how the ball moved -
Where did it start?
Where did it come to a stop?
Which path did it go along?

Draw the path.
Did it move in a straight line?
If it didn't, how can you make it go in a straight line? Try it.

Did it also bounce up and down?
If it did, how can you make it move without bouncing?

b. Gently set a ball rolling on a long table or platform (if you don't have a long table or platform, roll it on the floor). Now make it move faster. Try as many different ways as you can to make it move faster.

Classroom experience:

> We did this activity in the sequence in which it is presented here - after they slowed the ball down. The children's solution were basically the reverse of what they had done in the previous activity - blow in the direction of motion, give a gentle push in that direction, have it move down a slope etc. But they got one thing wrong - they dusted powder in the path, and thought that lowering friction would increase its speed. Recall Newton's law, which we discussed earlier in section 'a' - if friction becomes zero, there are no forces acting on the ball, so it will move with the speed it had just before it hit the patch with zero friction. The children only lowered the friction a little, so the force in the direction opposite to the ball's motion was less, and it slowed less. It cannot speed up (unless it goes into a skid and instead of rolling i.e. it slides).

c. Start something moving so it keeps moving along a circle. It should keep moving along the circle even after you take your hand off it.

Classroom experience:

> This was a very amusing task, and to our surprise all kids began with the same strategy - they would hold the ball we gave them and move it in circles on the table, and were surprised when it went off on a straight trajectory when released. Only then did they feel compelled to come up with other solutions - and they were nothing short of brilliant. Using a rim, making whirlpools in water and floating something on it (a child related this experience). No one came up with attaching it to a string and turning it, or putting it in a circular dish or lid and turning it. This works well with small spheres - marbles or beads. Do suggest this in class if they don't come up with it.

Know these words

glossy, friction, smooth, polished, rough, bumpy, tread

EXERCISES

Name and draw

a) A ball that is not moving, and one that is moving. Your drawing should show it moving

b) A ball that is slowing down

c) A ball that is speeding up

d) A person who is not moving

e) A person who is moving

What's the same? What's different?

Give two similarities and two differences between:

a) The wheel of a moving bicycle and a ceiling fan that has been switched on.

b) A rubber ball and an eraser both dropped from a table.

c) The way you can move your hand at the wrist, and the way you can move your arm at the elbow.

Interesting questions

1. Name at least three things or places

a) Which need to be rough; does the roughness in each case slow down movement or prevent movement?

b) Which should be smooth? Why?

2. Name some things or places where oil is used to make movement easier.

3. Which is easier to hold without slipping - a bar of wet soap or a comb? Why?

4. Would you want your bathroom floor of smooth polished stone or a rough surface? Why?

5. Look at how the brakes of a bicycle work and answer these questions:

a) What are they made of?

b) Which part of the wheel do they touch?

c) How do you operate them?

d) Does it matter if they touch the wheel lightly or press hard against them?

6. Suppose you push a wooden duster or some other object on the floor, and there is no friction at all. How far will the duster move? Will it slow down?

7. Name some parts of your body which move, or which you can move, without moving any bone.

8. a) Arrange these surfaces from the roughest to the smoothest:
Tar road, sheet of glass, wooden table, the floor of your classroom

b) Suppose each of the following is moving at its top speed. Arrange from the slowest to the fastest:
bullock cart, car, plane, bicycle, bullet

Classroom discussion

Think of places which are slippery to walk on -
Why is it difficult to walk?
Do you need more friction or less than there is between these surfaces and your foot?
How will the things you do everyday be different if there were no friction?

Play with words

1. Write down some things that
vibrate, spin, roll, slide, wobble, walk, flutter, glide, bounce, swing, crawl

2. The words on the left describe the way some animals move.
Match the words with the animals.

scurrying	snakes
hopping	mice
slithering	kangaroos
crawling	elephants
soaring	monkeys
swinging	eagles
swaying	worms

> They can match more than one word on the left with an animal, or more than one animal with the words on the left.

Name at least 3 other animals and give words describing how they move.

Recall and write

a) The story of the hare and the tortoise

b) Suppose the hare does not stop to rest or sleep. Think of a way in which the tortoise can still win the race. Write a new story using your idea.

> Sadly, many themes were of some kind of malpractice. This might be a good opportunity to discuss the ethics of such suggestions.

Figure it out

The hare and the tortoise decide to hold another race.
The tortoise says he wants to start closer to the finish line because, being a tortoise, he can only run slowly.
If he starts closer to the finish line the race would be fair. The hare agrees.
In this race either the hare or the tortoise can win. Look at the pictures on page 59 of your WorkBook and make a guess: who will win the race?
Now draw the hare and the tortoise where they will be after every 5 seconds to see who wins. Was your guess correct?
Did the hare run faster than the tortoise?

Write in your own words who won the race and how. Use these words in your description:
speed, distance, time, slow, fast.

The tortoise says he wants to race again. The hare readily agrees.
This time the tortoise starts even closer to the finish line. Again we do not know who will win. Look at the pictures and make a guess - who will reach the finish line first?
Now draw the hare and the tortoise where they will be after every 5 seconds to see who wins. Was your guess correct?
Did the hare run faster than the tortoise?

Write in your own words who won the race and how. Use these words in your description:

speed, distance, time, slow, fast.

Play this game

Your friend will think of a moving thing. Guess what it is by asking questions about how it moves. Do not ask questions about size, colour, use etc. Ask only about the way it moves.

DID YOU KNOW?

1. The moon is about 400,000 km from the earth. In 1969 three astronauts went to the moon, in the spacecraft Apollo 11. They spent 21 hours on the moon, from where they collected about 20 kg of rocks and soil to bring to earth. This whole journey took 8 days

- they left on the 16th of July and returned to earth on the 24th. In this journey, the speed of the spacecraft was sometimes as much as 38,000 km per hour.

2. The spacecraft Pioneer 10 was launched from the earth in March 1972 to take photographs of Jupiter and send them to earth by radio signals. It will keep moving away from the earth, heading generally for the red star Aldebaran. Pioneer 10 will take over 2 million years to reach Aldebaran.

3. Boomerangs:

In Australia, the native people, who had been living there for thousands of years, made boomerangs of wood for hunting. They also made a kind of boomerang, called the 'returning boomerang', which may not have been used for hunting, but was fun to throw.

If you throw a returning boomerang, it will come back to you if it doesn't hit anything.

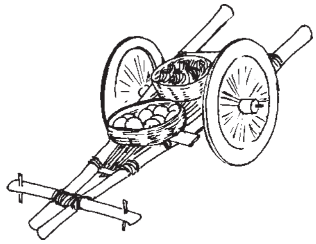
But you have to know how to hold it, in which direction to throw it if a wind is blowing, how to throw it so it spins, and how hard you should throw it. It needs a lot of practice to make a boomerang, and to learn how to throw it so it comes back!

Children's work - some examples

The Hare falls down and breaks his leg. The hare loses the match.

Onec there was a hare he was raising with tortoise. Then the tortoise was Just behind the hare.. So the tortoise told the hare that your mother has come. Then the Hare Stoped and saw behind Then the tortoise went front. And the Hare was behind. Lik that the tortoise won.

~~Once upon a time~~ The hare was running and running. But then the slop come at the end the tortoise take his head and body in the shelland rotls down the slops and comes first.



CHAPTER 4
MAKING A CART

Why I developed this chapter

School children are so used to making thermocole models that are not working models, that it took us two days to get them to understand that the cart was actually supposed to move! Particularly in the early years, children love working with their hands, but rarely get an opportunity to develop systematic planning and analytical skills. This exercise helped them to do that, and also encouraged observation and analysis of products of technology in their environment.

Main objectives

To get children to

1. Design a simple working model, and modify the design as necessary

2. Develop the skills to work with the available material to make the model

3. Analyse their own and others' designs

4. Become aware of the mechanical designs of vehicles they may commonly encounter.

A day at the Mela

Mini and Apu were very excited - the Mela was coming quite close to their house, and they couldn't wait to go and look at all the things there. They went to the Mela on the very first day.

It was bustling with activity. There was a giant wheel and a merry-go-round; there were many vendors selling snacks, colourful clothes, bangles, caps, balloons of different shapes, pots, and many other things.

What attracted Mini and Apu the most were the toy sellers. They were selling musical instruments, games and puzzles, bows and arrows, dolls of wood and clay and plastic, catty-sticks (guler), pin-wheels, toys of reed, whistles - it seemed like they had every toy you would ever want!

Mini saw a beautiful toy cart, complete with wheels which actually turned. When she pulled it with the yoke, it moved just like a real cart does. “That is such a lovely cart!” Mini said.
The toy seller looked at it and said with pride, “Do you like it? My daughter made it. I don’t think I can sell that one!”

Mini and Apu, always looking for something to do, decided to make a toy cart of their own. When they got home, they told Dada about the cart they had seen in the mela.

“We want to make one too, Dada.”
“That’s a good idea!” Said Dada.
“It will keep you busy for some time! But, you must not buy anything for your cart. Find things around the house which no one needs, and use them to make your cart.”

Apu and Mini started rummaging for things they needed something they could use to make the wheels, to make other parts of the cart, something to attach the wheels to the cart body - they had to plan so many things!

They got busy, just as Dada had said.

Preparation:

> A few days before we started this activity in class, I told the class that we would be making carts and they had to collect material for them. So they got some time to come up with ideas for what they would use. In class itself, I provided a cardboard box which contained some material that might be useful - old refills, pins, nails, a hammer, glue, scissors, old newspapers, etc. It took them a long time to understand that their carts had to be working models, although we had repeatedly told them so. I suppose they were used to making thermocole models which were just replicas that did not have to work. I wrote this story hoping to inspire them!
>
> They eventually came up with very good models indeed.
>
> Children brought wheels from old toys, bottle caps etc; I did not allow ready made wheel-axle assemblies (from old toys etc) since the main challenge in making the cart was to get this part right.

1. Plan how you will make your cart. You can make any kind of cart; it does not have to be a bullock cart. You should only use material you can find easily, and which no one needs. Do not buy anything for this activity.

a. How many wheels will your cart have?

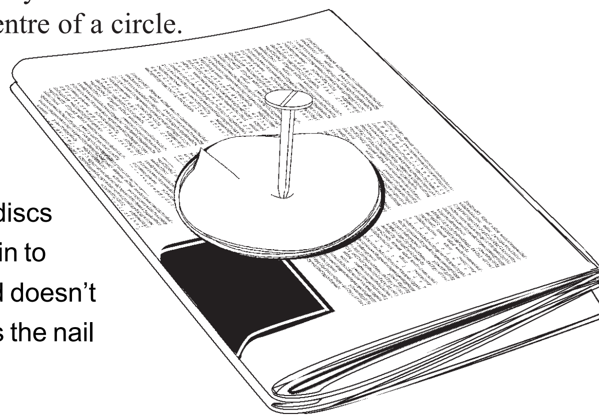
b. Think of some things you can use to make the wheels ____. If you think of something later, or find something better, you can use that.

i) You may want to cut circles, out of paper or cardboard. How would you do that?

Classroom experience:

> Many children used cardboard circles to make wheels, and some actually used 2 layers glued together to get a stronger and more rigid wheel. Some children did have difficulty with simple tasks like cutting out a circle. I had to draw their attention to things they had, such as bangles and water bottle caps, which could be used to draw circles. But then it's harder to find the centre (using a compass, it's trivial). The following instructions should help.

ii) If you need to make holes in the centre of the wheels, how can you find the centre?
On page 62 of your WorkBook you can see one way to find the centre of a circle.



Suggestion:

> We used piles of old newspaper on which we placed the discs (of cardboard or plastic) and then hammered a nail or pin in to make holes. This way the nail goes through the paper and doesn't hit the hard floor. This protects the floor, and also prevents the nail from slipping and causing injuries.

c. The wheel rotates around an axle which passes through its centre.

i) Think of some things you can use to make your axle or axles. If you think of something later, or find something better, you can use that.

Classroom experience:

> Some children used empty ball point pens (not refills) in which they inserted a thinner stick; they fixed wheels to this stick; I saw one girl trying different things to keep her wheels from slipping along this wheel – finally she settled on rubber bands wound on either side of the wheel. This is exactly the kind of experience I wanted them to have in this activity!

ii) How will you fix the wheels or axle to the cart body?

d. Think of some things you can use to make the cart body.

e. Are there some other things you may need to make your cart?
What? Bring to class all the things you collected to make your cart.

2. Now make your cart.

Classroom experience:

> Major challenges for the children were:
> fixing wheel to axle, axle to cart body, keeping wheel from tilting, keeping wheel from slipping out from the axle (matching axle diameter to hole diameter) matching wheel size to cart body (some carts were touching the floor, the wheels were so small).

a. What did you make the wheels with? Was this in your list in 1b? If you used something which was not in your list, explain why.

b. What did you use as an axle? Was this in your list in 1c? If you used something which was not in your list, explain why.

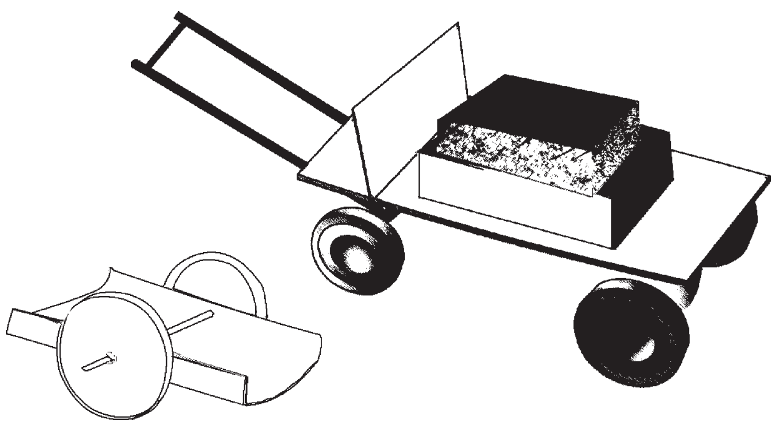
c. Set your cart in motion. Watch closely how it moves and answer these questions:

i) Do the wheels rotate smoothly? Do both wheels rotate when the cart moves? If they do not, what can you do to make the wheels rotate smoothly? Try it. If you need to make the surface of the axle smoother, you can use a nail file or sandpaper or something similar.
Do they wobble? If they wobble, what can you do to make them stop wobbling?

ii) When the wheels rotate, does the axle rotate too?

Suggestion:

> This was the most common design; some of the axles were actually on the top, in the body of the cart in which the load is carried. Not a very practical solution, but I did not intervene; later, in the exercises, this design detail is addressed, encouraging some analysis of their design. I wanted to encourage everyone to design and make their own carts and analyze them, not have everybody make what I thought was okay. This approach proved to be very fruitful- some children came up with great designs of which I was sceptical at first, but they made them work!



iii) Does it move in a straight line?

iv) Find something whose weight you know.
Put it on your cart, and set it in motion.
Guess - how much weight can your cart carry without any of its parts breaking or bending?

Suggestion:

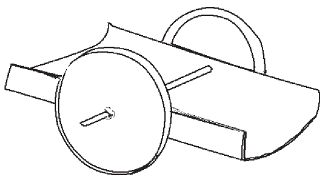
> Small tubes of toothpaste etc., whose net and gross weight are marked on the package. Soaps weigh 50 to 100 grams. If the gross weight (weight of product + packaging) is not given, look for things whose package weight is negligible.

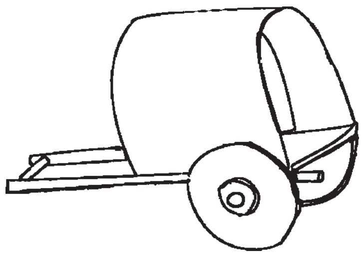
d. Compare your cart with that of a friend.

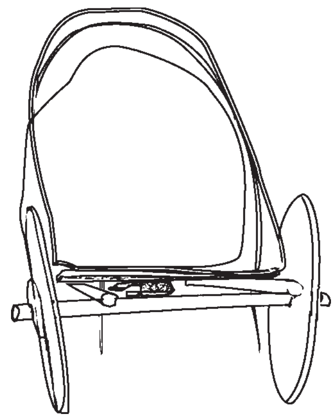
i) Are the 2 carts similar in some ways? How are they similar?

ii) Are they different? How are they different?

3. Look at all the carts in the class. Sort them into carts which move and carts which do not. Divide yourselves into groups; each group takes a cart which does not move, and repair it.







On page 65 of your WorkBook, write down

a) Why the cart did not move; you can explain using a drawing of the cart or a part of the cart.

b) What you did to repair it.

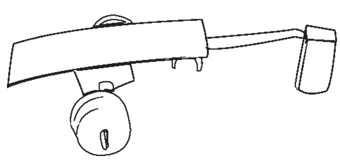
c) Could the cart move after you repaired it?

4. Write a set of instructions for someone (your friend, brother or sister) to make a cart. If you wish, you can use drawings to explain the instructions.

Suggestion:

> I started by telling them that they had made very nice carts, and though some of them had problems, they had repaired them and learned how to solve those problems. So today they had to tell someone (a friend, a brother/sister) how to make a cart. I went over the things they should write about, and on the black board I wrote:

Write about
Things they could use as parts,
How to make a cart,
Problems they might have,
and how to solve them.
If there is anything they should **not** do.



Know these words

Axle, yoke

EXERCISES

What is the same, what is different?

Give two similarities and two differences between a bicycle and a bullock cart.

Name and Draw

A cart you see often.

Interesting questions

1. Write about the carts you have seen
   a) which had only 1 wheel.
   b) which had only 2 turning wheels.
   c) which had only 3 turning wheels.
   d) which had only 4 turning wheels
   e) which had only 5 turning wheels

For each of the carts, write: Where did you see it? What was it used for?
How was it pushed or pulled? Could it balance on its wheels when it was not moving, or was anything else used to support it? Could it balance on its wheels when it was moving?

2. Look closely at how the wheels of a 4-wheeled push-cart (*thela*) and a bullock cart are fixed, and how the carts move. Then answer these questions:
Bullock cart: Is the axle under the cart-body, or above it? Does the axle also rotate with the wheels? Why do you think it is this way?

4-wheeled push-cart (*thela*): How many axles does it have? 4

Are the axles under the cart-body, or above it? Do the axles also rotate with the wheels?

Always under the body, and they do not rotate with the wheel.

Ask and find out

How much weight can a bullock cart carry?

Depending on how many and how strong the bullocks are, about 500 to 1000 kilograms

How much weight can a truck carry?

This information is written on the passenger side door of the driver's cabin of the truck; they are required to write the empty weight as well as the load they are allowed to carry, which depends on the truck model. It is usually a few tons.

Classroom Discussion

Look at how a bus or jeep is made to turn. Suppose a bus is turning to the left. Do only the front wheels turn to the left first? Or all the wheels at the same time?
When you want to turn the 4-wheeled cart, do you have to turn the whole cart or can you turn only the front wheels?
What is different between the way the cart and the bus turn? Why can't you turn a bus or jeep the way you turn a cart?

Jeeps, buses etc have mechanisms for steering - where the front wheels can be turned to the left or right together, independent of the rear wheels. They have complicated joints and/or gear systems to accomplish this; you might have seen the differential gear box under large trucks - as the truck turns, the left and right wheels cover different lengths of arcs; the differential gear compensates for it by making the wheel on the outer arc rotate a little faster than the inner one.

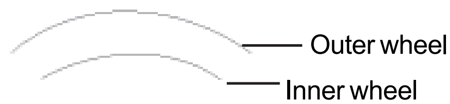


Figure it out

1) Take any cylindrical object like a tin can. Following the instructions on pages 70 and 71 of your WorkBook,

a) Measure its circumference

b) Figure out how much distance it moves in one turn as it rolls.

2) The circumference of a cart wheel is 6 metres. How many times does the wheel of the cart have to rotate if the cart has to travel 60 metres?

3) Another cart has smaller wheels. The circumference of the wheel is only 3 metres. Compared to the wheel in Q2, will this smaller wheel turn more times, or fewer times to cover the same distance (60 metres)? How many times should it turn?

DID YOU KNOW?

(1) The earliest wheels that we know about were used 5500 years ago in Sumeria (the area now known as Iraq). Before that, people had to use sledges instead of carts to move things from one place to another.

Wheels were first made of discs of wood, without spokes. About 4000 years ago people started making wheels with spokes. Spoked wheels are strong, but lighter than disc wheels.

> Something to think about - rolling friction is much less than sliding friction, which is why wheels are so effective. In other words, the friction between the wheel and the road when the wheel is rolling is hundreds of times less than the friction between the road and the wheel if it were to slide instead of rolling.

(2) Traditional bullock carts carry a load of 500 to 1000 kgs. The bullock pulls this weight with the yoke resting on its neck. The yoke rubs against its neck, chafing and hurting the animal, especially on a bumpy trip.

Scientists in India have designed new carts which are lighter, and have less wobbly wheels. Their wheels are made with rubber tires. These carts move smoothly. The animals pulling these carts don't get hurt as much.

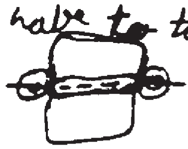
How to make a cart

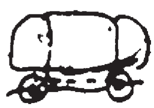
1. If we have take readymade tire or make a tire

2. Then we have to take a cardbord ands measure.

3. Then we have to take a stick and hole the tire and put to the tire like this 

4. Then we have to take a paper and stick to the stick like this 

5. Then we have to take the cardbord and stick over this like this 

6. Then we have to take thick paper and stick cover like this 

The perorblems are

1. The tire should be round becase if it is not round then it will not turn

2. The stick should not be tight or lose because if it is tight the tire will not turn if lose it will woble

UNIT 3

EARTH AND ITS NEIGHBOURS

CHAPTER 5
OUR EARTH

Why I developed this chapter

While trying out a unit on day and night, I found that children had fundamental problems in their picture of the earth - they had no idea that the circle depicting the earth in their books, in diagrams of eclipses, had anything to do with the earth they lived on! They asked whether we live inside or on the earth, initially expressed doubts about the globe being a model of the earth (globe is too smooth!), wondered why people in the southern hemisphere don't fall off, and even asked why the earth doesn't fall off! Research with children in other countries too has shown that children, whose experience is of a seemingly flat earth, make up in their minds models to resolve this conflict between their belief and what they are taught. One such model is of two earths - one in the sky (which is depicted in the diagrams in their science and geography books) and the one on which they live. So I decided that a chapter on the round earth should be included in the curriculum.

Main Objectives

1. To develop in children the concept of the round earth through activities which make them confront their own ideas.

2. To get them to appreciate scaling

The planet on which we live

1. This big round earth

The earth is a very big ball. We live on this ball. The shape of a ball is called a **sphere**.

a. Refer to the text book for the photograph of Earth taken from a spacecraft. The spacecraft was very far from the earth when this photograph was taken. Describe what you see in this photograph.

Make a guess -What are the white things you see in the photograph?

Clouds

Look at a globe or an atlas. Then look at this photograph again. Which countries or continents are seen in this photograph?

b. Here are more pictures of the earth -
Which countries, continents and oceans do you see in them?

Think! Think!

Why don't you see people, houses, trees and hills in these pictures?

> They are far too tiny to be seen; the next section is a scaling exercise to clarify this point.

c. Find a large tree in your school ground or anywhere nearby. Make a drawing of the tree - draw what is under and near the tree. Draw yourself or your friend under the tree. Draw this person in such a way that his or her height looks correct compared to the tree.
Does your drawing have as many leaves as the tree has?
Show an ant on one leaf of the tree. Is the ant of the right size compared to the leaf? To the tree?

The pictures of the earth on pages 63 and 64 are much, much, smaller than the earth.
The diameter of the earth is 120 million times the diameter of the photograph of the earth on page 63.

2. A model of the earth

The globe is a model of the earth. It shows the different continents and oceans on the earth.

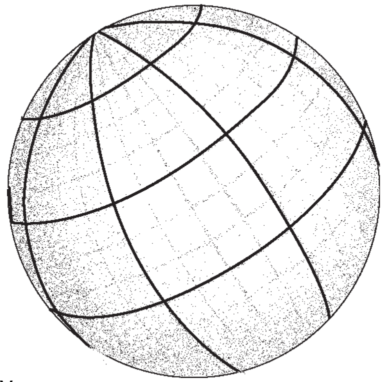
The **equator** is a circle that divides the globe into two halves. Half of a sphere is called a **hemisphere**.
The two halves of the globe are called the Northern and Southern hemispheres.
Find the seven continents on the globe: Asia, Africa, Europe, Australia, Antarctica, North America, and South America.
Find out the name of one or two countries in each continent.

Think! Think!

Vasundhara asked, "The earth around me is so bumpy - it is full of hills and valleys. Then why does the globe looks so smooth?" How will you answer Vasundhara?

> The hills and valleys (the bumps) are actually too small compared to the earth's diameter. Take Mt. Everest – it is less than 9km tall; compare it to the earth's diameter of 12,757 km. On a globe of 25 cm diameter, the tallest mountain would be about 0.17 mm. You could fold a piece of paper and place it on your globe to show the height of Mt. Everest!

3. Make your own globe



Classroom experience:

> Allow at least one double period for this activity.
>
> Some of the continents are not easy to draw correctly, and we even found that in some cases kids found they had no place left to draw Australia! Even if their globes are not perfect, it is important that they do this activity. As you read Magellan's story (section 4) and follow the journey on your globe, have the children do so on their own globes.

a. Look at page 78 of your WorkBook to find out how to make a globe. Follow the instructions there to make your own globe. Show these parts of your globe:

The North Pole	The South Pole	The Northern Hemisphere
The Pacific Ocean	The Atlantic Ocean	

On the globe, show where your city is. From here, how would you reach the equator?

Think! Think!

Prithvi said mischievously to Mini, I know how to reach the equator - you go straight East, then you turn South, and then you get into a ship and keep going till you come to a blue line. That is the Equator.

Mini laughed loudly.

What do you think - are the equator, the North and South poles, and names of continents, countries, oceans etc marked on the earth too, as they are on the globe?

b. Make a small doll. You can make one with a matchstick, or use a common pin by sticking a bead for the head.
Make the arms of the doll with a strip of stiff paper.

If you make one with a pin, stick it into a small, thick piece of rubber. Be sure that the pin's point does not come out on the other side. This rubber is the 'feet' of your doll.
Now put your doll at these places on the globe:
Remember - wherever your place your doll, its feet should be on the ground!

North America	Antarctica	Russia
India	Near the north pole	Near the south pole
Anywhere on the equator	Australia	

For each place, answer the following questions:
In which direction would the doll have to look to see the ground near his or her feet?

If he or she throws a ball straight up, in which direction will it go?
In which direction will it fall?
Make your doll walk from the southwest part of North America to its northeast part. Remember that your doll always has to have his/her feet on the ground!
Now make your doll walk from the northern edge of Africa to its southern tip. Again, remember, your doll's feet should always be on the ground.
Turn to page 82 of your WorkBook.
Show how you placed the doll at the equator and near the South Pole.

Think! Think!

Do you think your doll is of the right size compared to the globe?
If not, should it be larger or smaller? Why?

c. Take a string and mark a segment of about 8 cm on it. Collect many spheres of different sizes. First place the segment on the smallest sphere, as shown. Then place it on larger and larger ones.
On which sphere did the string look the least curved? How would the string look if you took an even larger sphere? Make a guess - how big a sphere would you need to make it look straight?

> The child may say a sphere of 10 m or, some may say 'as big as the earth'. I would accept all those answers – as long as they understand that curvature gets smaller as the sphere gets bigger. They get this point much better if they have to answer this question, rather than being told that 'that is why the earth looks flat – because it is a big sphere'.

Going around the earth

4. Magellan's story
Your teacher will read out the story of Magellan. Follow the path of Magellan's voyage on your globe.

> This is the story of Magellan's journey to be read out to the class.
> There are many places which are somewhat unfamiliar, so their latitudes and longitudes, and other information are given in parenthesis. These are best left out while reading the story - they are given only as an aid in finding the places.
>
> I marked these points first, and traced the route as I read the story out. I used *bindis* for marking, but stuck them on soft paper first, before sticking them on the globe so that they become less sticky and are less likely to damage the globe.
> Note that Magellan didn't sail directly westward - Columbus had already discovered, in 1492, that there was a continent there (America).

Magellan's story

> In the 15th century, people knew of the eastward sea route from Spain and Portugal to the Spice Islands (the group of islands between Indonesia and Papua New Guinea). From Spain, they could sail in the Atlantic, south along the eastern coast of Africa, around the Cape of

Good Hope, and East across the Indian Ocean to reach these islands where many spices were grown. These spices were in great demand in Europe.

Magellan thought, if the earth is round like a ball, he should be able to reach the Indian Ocean and these islands even if he travelled westward. So he set out to find a westward route to the Spice Islands.

Magellan started his journey from Spain with five ships and 250 men on Sep 20 1519. He travelled towards Brazil, and crossed the equator. Thirteen days after he started his journey, he reached the eastern coast of Brazil (on the easternmost bump of S. America).

Q: In which ocean did his ships travel?

Here, in Brazil, there were storms, which took his ships southwards - along the eastern coast of S. America.

Q: Which countries did he travel along?

He reached the bay of Rio de Janeiro on Dec 13th 1519. From there, he continued South. After struggling against cold weather and rough seas, he reached the port of St. Julian (Puerto San Julian lat 49° 20 min S), close to the southern tip of South America on March 31, 1520.

Q: What kind of weather do we have in March here?

(In the Southern hemisphere it is winter when we have summer in the Northern hemisphere). He decided to wait there until winter was over but this made the crew very angry.
So he tried to leave on August 24 1520 but could not - he had to stop a little South at Santa Cruz which he left finally on Oct 18th 1520.

A storm blew his ships into the strait we now call the Strait of Magellan. He took many weeks to cross this strait.

Q: Which ocean did he reach when crossed the strait?

He reached the Pacific Ocean on Nov 28 1520. He travelled for some time along the coast of Chile.

Q: In which direction did he travel?

On Dec 18 1520 he turned NW and then landed on the Pukapuka island (approx 140 W 12S) on Jan 24 1521. He crossed the equator at 158 W on Feb 13 1521 and landed on Guam

(Mariana island, 145E 12N). He left for Philippines on March 9, where a war was going on. He died there. Only 2 ships - Victoria and Trinidad - had survived the long journey to the Philippines.The crew continued to the Spice Islands and loaded the ships. Trinidad went back along the route they had taken. The ship Victoria crossed the Indian Ocean.

Q: In which direction did they travel?

It then went around the Cape of Good Hope, and returned to Spain on Sept 8 1522, with 75 crew members under the command of Sebastian Del Cano.

This was the first time that someone went all the way around the earth!!

It is not clear exactly how he died – perhaps of illness, perhaps in the war. One child asked us what the war was about – then answered it himself – 'it was about whether the earth is round or flat' ! We don't know what it was about.

Know these words

sphere, hemisphere, equator, continent

EXERCISES

Name and draw

Draw a map of the area surrounding your house. Draw what is to the east, west, north and south. Mark these directions clearly on the map. On your map, show in which direction you see sunrise. (If you face north, east is to your right and west is to your left.)

Remind them that they will need to use this map in the next chapter too.

What's the same? What's different?

Give two similarities and two differences between the earth and the globe.

Some answers from children - differences: man made vs. natural, spins on its own while globe has to be spun, hollow vs. solid; similarities: both are round, both can spin, both havecontinents etc.

Interesting questions

1. a) Name the ocean which is

i) to the East of South America
ii) to the West of South America
iii) to the West of North America
iv) to East of Asia
v) to the West of Australia

b) Name a continent
i) which lies only in the Southern hemisphere?
ii) which lies only in the Northern hemisphere?
iii) a part of which lies in the Northern hemisphere, and part of which lies in the Southern hemisphere?

Africa, South America

c) Name two continents connected by land.

North and South America; Africa and Asia; the Suez and Panama canals are shallow man made canals that were dug to shorten ships' journeys from one side to the other.

d) Name a sea which is completely surrounded by land.
2. Which of these things is nearest in shape to the earth - a chapati, a puri, an orange or a banana?

3. Look at the picture of the earth on page 84 of your WorkBook. Mini, Chand, Aftab, Vasundhara, Bhoomi and Prithvi are standing at the places shown.

a) Shade the sky for Aftab, Prithvi, Vasundhara, Bhoomi and Chand.

Children did this easily

Where is Mini's sky?

Straight up, out of the page

b) Chand thinks Bhoomi is upside down; Bhoomi thinks Chand is upside down. Which one of them is right? Are they both right? Are both wrong?

Both are right, each is upside down for the other

c) Which of these children is in a ship?

Vasundhara

d) Prithvi throws a ball towards the North. Show the direction in which the ball goes.

4. Turn to page 85 of your WorkBook. Mini and Badal are facing each other. Badal is facing South.

Often children think that E,W are fixed as right or left; they think that if E is to your right, then you turn around so as to face the opposite direction, then E is on the right again. This exercise was included for this reason.

a) Which direction is Mini facing?

North

b) Mini throws a ball to her right. In which direction does it go - E, W, N or S?

E

c) Badal throws a ball to his right. In which direction does it go - E, W, N or S?

W

5. Did Magellan's ships ever travel eastward in their journey from Spain to the Spice Islands?

Classroom discussion

Akash has an interesting idea - he thinks that people live inside the earth, not on it. How will you convince Akash that we live on the earth?

Children's arguments – there is mud inside the earth, you can't breathe or eat there, there is no space, there will be tree roots there, you can't see the sky….

Ask and find out

On the globe, find your town or a large city near your town. Find another city in India on the globe.

a) Find out the distance between these two cities.

b) Find out how much time a train takes to go from one city to the other.

c) What is the distance between your house and your school (or bus stop)?

d) How much time do you take to walk this distance?

e) Suppose you can walk 20 km a day. Guess - how long will it take you to walk between the two cities you found on the globe?

Write a play

An ant and a mouse are on a large ball, of diameter 2 m. They argue about whether they are on a sphere or on a flat surface. Write a play giving their arguments. Which one of them do you think knows that they are on a sphere? Why?

Figure it out

1. Magellan's ship *Victoria* left Spain on Sep 20, 1519, and returned on Sep 6, 1522 after going completely around the earth. How long (how many years, months, days) did this journey take?

Some children even accounted for the leap year in solving this problem; I accepted both answers

2. There are about 1,000,000,000 people in India. If about 5 people can live in 1 house, how many houses would you need?

If you make tiny toy houses, each measuring a square 1 cm by 1 cm, would you be able to place all these houses in India shown on your globe?

3. The radius of the earth is about 7000 km. Mt Everest is about 9 km tall.
How many times the height of Everest is the earth's radius?

Act it out

Children are fascinated by the way the moon, sun and clouds seem to follow as you walk....in our classes they even asked why this happens. This activity should answer their questions

1. Do this activity outdoors.

Draw a line 5 metres long. Ask your friend to stand 1 m from the centre of this line. Walk on this line. Keep looking at your friend as you walk. Now ask your friend to stand 4 metres from this line. Again walk along the same line as before; again keep looking at your friend as you walk.
When did you have to turn your head more - when your friend was closer or farther away?
What if your friend is even farther away?
What is the farthest thing you can see (a tree, a hill, a building) in the direction in which your friend is standing? When you walk along the same line, looking at it, do you have to turn your head more or less?
How much do you have to turn your head when you look at the moon or stars as you walk?

2. Hold a ball close to your eye; take a small object, like your eraser and hold it on the other side of the ball. Now, very slowly, move it on the ball so you can see it. Describe what you see - did the eraser come into view all at once? Why or why not?

Ask a question

Ask a question about the earth. Think of how you will find the answer.

DID YOU KNOW?

1. Long before Magellan went around the earth, people knew that the earth was round. People living near the sea guessed this because, when they watched ships coming in to port, they could first see only the tall mast (flag-pole). They could see more and more of the ship as it moved closer to the port.

2. At the centre of the earth there is a hot solid core. The diameter of the core is about 2400 km. Geologists think the temperature at the earth's centre is 6000 degrees centigrade!

Surrounding the core there are metals which have melted because of the heat.

Around this liquid part there is the solid ***mantle****. It is made of very hard rocks. These rocks move slowly, about 1 cm per year.*

Around the mantle is the ***crust*** *- the top 12 to 60 km of the earth.*

No one so far has dug more than 15 km deep into the ground. The rocks at that depth are so hard that drilling machines get damaged quickly. Ocean beds are about 4 to 5 km below the ocean surface.

3. Every object is attracted to other objects. This attraction is stronger when the amount of matter in the objects is more. It is also stronger when the objects are closer to each other. We call this attraction 'gravity'.

We don't notice this attraction between the things in our daily lives, because the amount of matter in them is small and so this attraction is very weak.

But when one of the objects is very massive, like the earth, (6,000 billion billion metric tons!), we can easily see the attraction between it and other objects - between the earth and us, for example. It is because of this attraction that we, and other objects, stay on the earth.

Children's work - an example

Conversation.
of
Ant and Mouse.

Mouse:- Do you now we live or the ball

Ant :- How you can proove.

Mouse:- By going round and come back.

Ant :- It will take Days to come back.

Mouse:- I will go and come back.

Ant:- But no cheating.

Mouse :- ok.

Ant :- Do you have another way in which you can't do cheating.

Mouse:- Ya, I have.

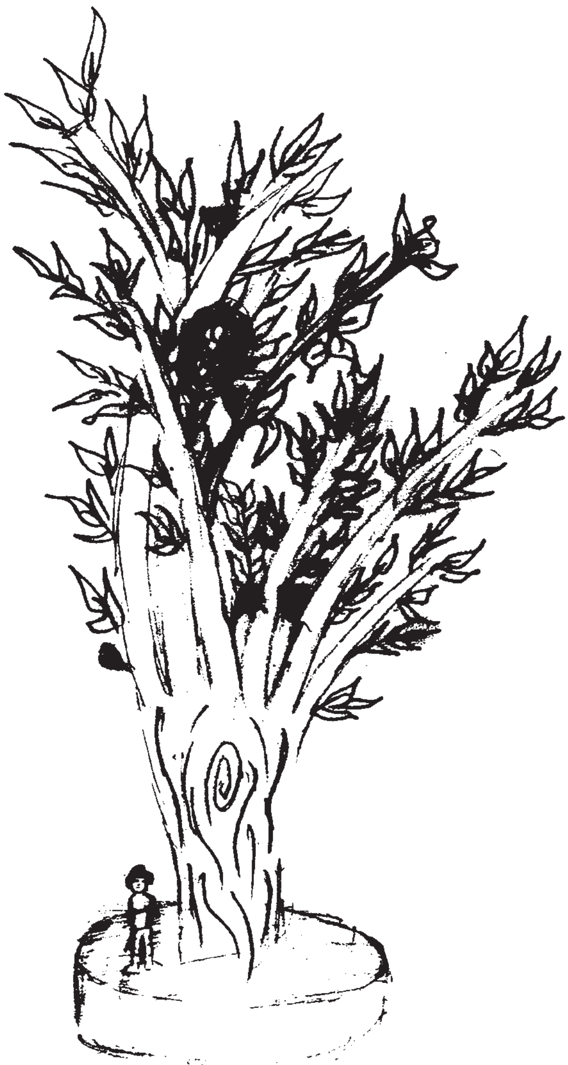
Ant:- what is it.

Mouse:- See, I'am going back when I'll return first you will see my face and then body it will prove that we live on a ball.

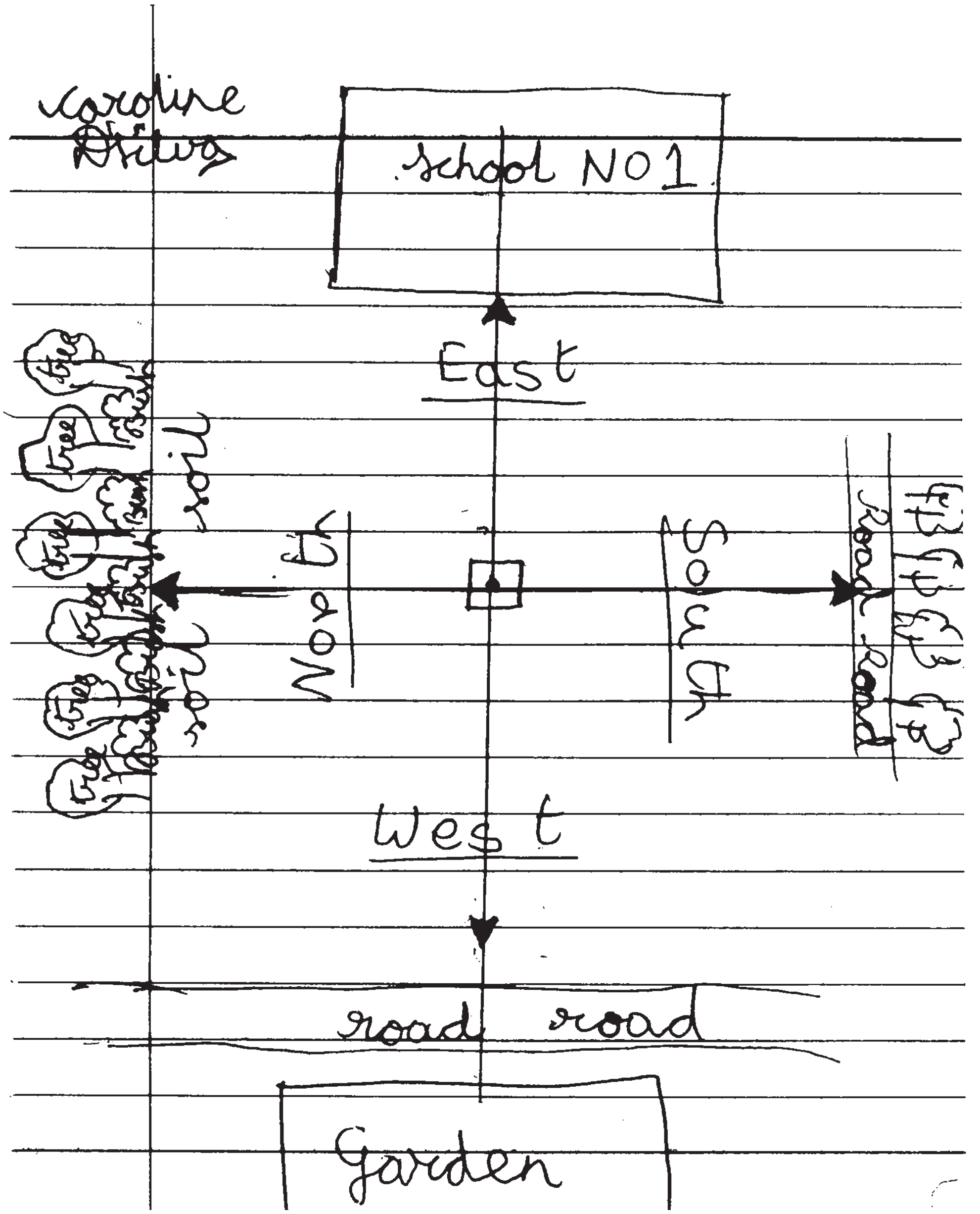
Ant:- ok.

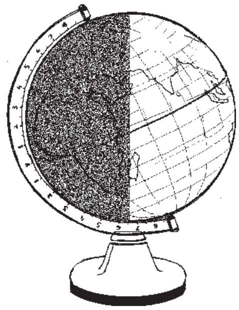
Children's work - an example

Ans because the ant is so small it will be two dots on the paper and its legs will be like niddle it can't be seen so we can't show the ant on a paper



Children's work - an example





CHAPTER 6
DAY AND NIGHT

Why I developed this chapter

Children often think that the sun actually does go around the earth. Now that they have learned of the earth in space, they are ready to appreciate that the motion of the sun across the sky is only apparent motion, caused by the motion of the earth.

Main Objectives

To teach that

1. The earth spins, and that this causes day and night, and makes the Sun, moon, stars and planets appear to move from east to west.

2. The earth also goes around the sun .

Apu and Mini were outside, munching on some snacks and watching the sunset. "I love watching sunsets!" Mini said. "Me too," said Apu. "Let's call Amma quickly - or she'll miss this."
He ran in to call her. She came out just in time.

"That really is beautiful!" Amma said. "You know, I saw the sunrise too this morning but you two were fast asleep at that time!" said Amma.

"Will you wake me up tomorrow Amma? I want to see it too," said Apu.
"Does it look the same?"

"See for yourself if it looks the same or different," Amma smiled. "But remember to look in that direction," she said, pointing to the East.

Apu woke up early the next day and ran out to see the sunrise. He wondered – "Last evening I saw the Sun there, now I see it here. How did this happen, Amma?"

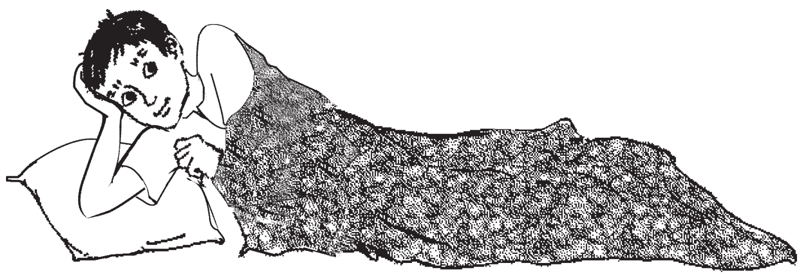
The sun is on the horizon
far in the east.
Where was it before that?
Why couldn't we see it all night?

In the middle of the day it's high in the sky
Then slowly more westward till its low in the sky
Then no longer in view till it appears again
Over in the east to start a new day.

How did this happen, how indeed?

About the illustrations in this chapter:

> The sky is shown dark in the drawings. From outside the earth's atmosphere that is exactly how it looks. The daytime sky on earth looks bright everywhere, even away from the direction of the Sun, because tiny particles in the atmosphere scatter sunlight in all directions (they scatter blue light more, so the sky looks blue!). If there were no atmosphere, the sun would look bright, but the rest of the daytime sky would be dark.
>
> A little experiment to show scattering - take a glass of water and shine light from a laser pointer through it. In clear water you won't even see the beam. If you now add a couple of drops of milk, some of the light is scattered and a part of this reaches your eye - you can see the beam. If you add more milk, you will see the red light throughout the volume of milk.



The spinning earth

1. a. The earth rotates (spins). It makes one complete turn in one day (24 hours). As it rotates, different parts of the earth face the Sun.
It is daytime on the half which faces the Sun. It is night-time on the other half of the earth, which faces away from the Sun.

Look at the pictures on the next page. The first picture shows that it is daytime in Asia. On which continent is it daytime in the second picture?
Where would this continent be in the first picture? In each picture, do you see all parts of the earth which have daytime?

The pictures on this page are not to scale. The sun is much bigger than the earth, and much farther away from the earth. If we draw the pictures to scale, it will not fit on this page.

b. Your teacher will show how we have day and night using a globe and a candle.

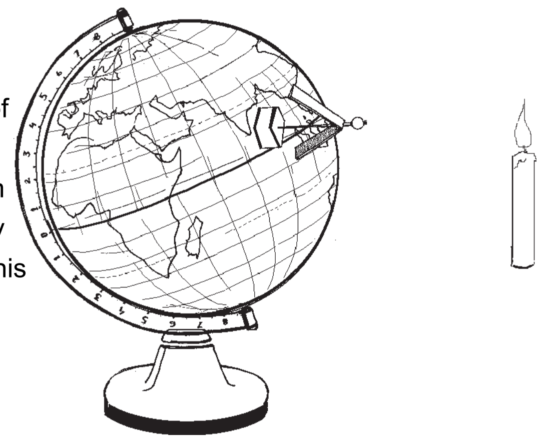
Suggestion:

> This activity is best done in a dark room; if you cannot darken the classroom, you could use a large cardboard carton or chart sheets etc to make some relatively darkened space where this demo is better seen. I called out children's name for the answer as I did this, to make sure that all children paid attention.
>
> It will help to remember that the direction in which you rotate the globe should be counter-clockwise as you look down on the globe's North Pole, i.e. W to E for this activity.

On the part of the globe which is lit by the candle, it is daytime. On the part of the globe which is not lit by the candle, it is night-time.
In the same way, on the part of the earth that is lit by the Sun's light, it is day time.

Suggestion:

> The candle flame should be at the about the level of the centre of the globe. Start by placing the doll in India. If you place the doll at high latitudes (far from the equator), as we once did, children don't identify noon because 'the sun is not overhead'. More on this detail later in the chapter.



Your teacher will place a pin or matchstick doll at some point on the globe. As the globe turns, tell your teacher if it is night or day for this person on the globe.
As the globe rotates, tell your teacher when it is sunrise for the person on the globe. When is it noon? Sunset? Midnight?

c. Pretend that you and your friend are the earth and the Sun. Ask your friend to be the Sun. You be the earth. Stand a few feet from your friend, facing him or her.

Now slowly turn around; make one complete turn so you face your friend again. As you turn, note when you are able to see your friend (the Sun). Keep looking straight ahead; do not turn your head to see her or him! (You can move your eyes, though).

Turn 2 or 3 times more, and as you turn call out sunrise, sunset, noon, and midnight at the correct points.
If you call out something wrong (ask your teacher to be the judge) switch places with your friend - you be the Sun and she or he gets to be the earth.

2. From sunrise to sunset

a. Draw a map like the one you have drawn on page 83 of your WorkBook.

This time, stand at a place where your view is not blocked by nearby buildings or trees. You should be able to see very far in almost all directions - E, W, N and S.
What are the farthest things you can see in each direction? Show these on your map. These things are on your **horizon**.

Note:

> In big cities, the farthest thing may be the building next door! What is meant here is 'as far as the eye can see'; the horizon is about 3-4 km away

b. In your classroom, look straight up, so you can see what is overhead.
Tell your teacher what you see straight overhead.

> This activity is just to get across what 'straight overhead' means. The point overhead in the sky is called the zenith. An interesting aside - even experienced stargazers will make an error of a couple of degrees in judging where the zenith is; you can test this at night by pointing to a star you think is at the zenith, then turn around to face the opposite direction, and repeat. You will find that you pointed to different stars!
>
> The idea of zenith and horizon, once understood, provides an easier language for understanding the apparent motion of stars and planets and other objects in the sky, so it has been introduced here.

Now do this activity outdoors:
Stand facing North, looking straight ahead. Which direction (to your right or to your left) is East? Which direction is West?

Take Care
Never *look straight at the Sun. It will seriously hurt and damage your eyes.*

Everything on the right of this dotted curve is in the eastern half of the sky. Everything on the left is in the western half of the sky.

Stand facing South, looking straight ahead. Which direction (to your right or to your left) is East? Which direction is West? Now slowly raise your head till you see straight overhead.

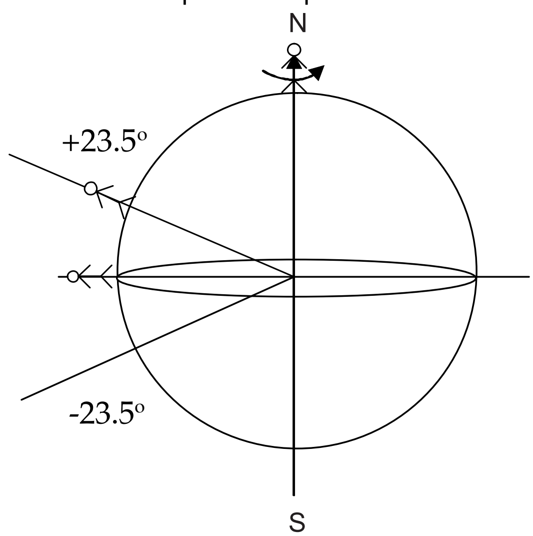
Everything on the left of the dotted curve is in the eastern half of the sky. Everything on the right is in the western half of the sky.

c. Complete this paragraph:

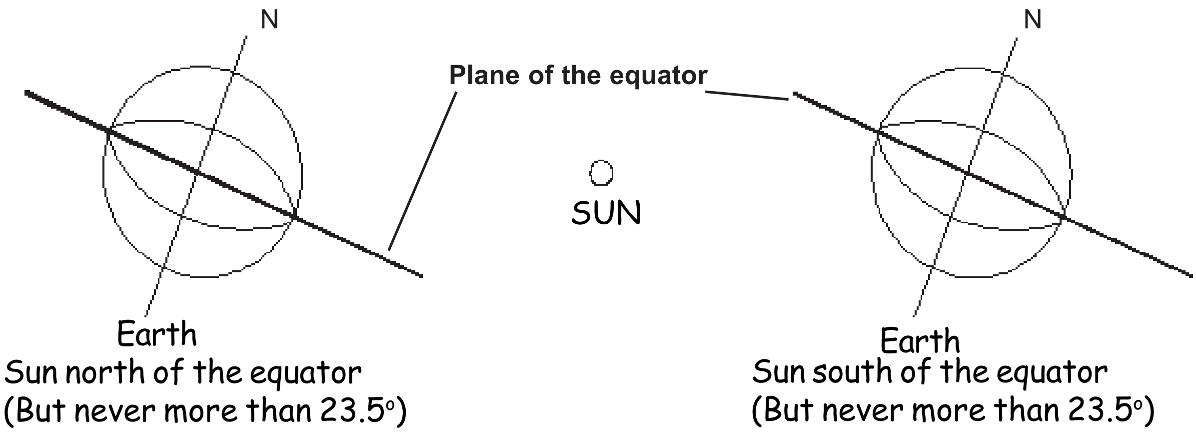
As the earth rotates, the Sun comes into view on the horizon in the East (it rises); then we see it higher and higher above the horizon in the eastern half of the sky. Then, after ______ (what time?) it is in the western half of the sky. Then it is seen ______(higher or lower?) in the western sky until it goes out of our view in the West (it sets).

Two important points to note:

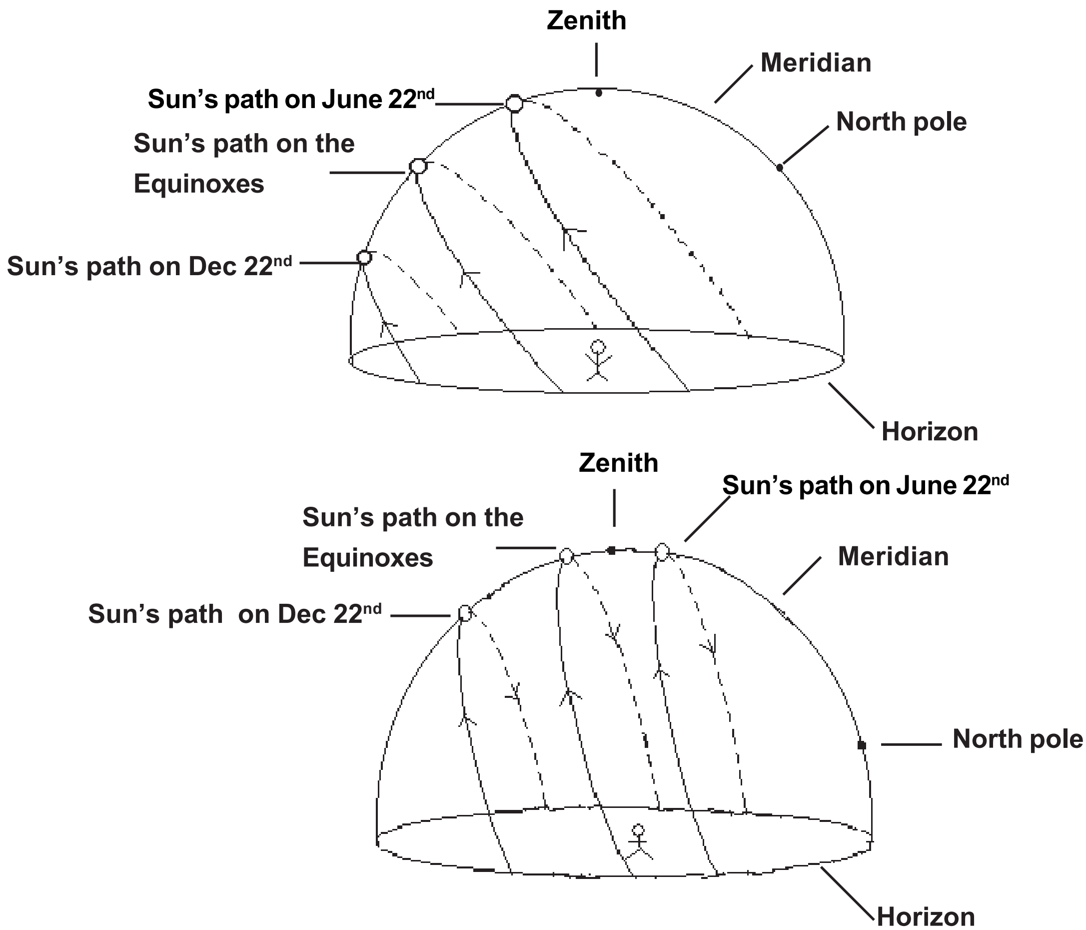
1. The sun is not necessarily at the zenith when it is at its highest point in the sky as is commonly believed; it just crosses from the E to W half of the sky (i.e. it is on the meridian, and casts the shortest shadow of that day). Imagine that you are at the North or South Pole - the Sun will never be overhead for you, because over a year, the Sun is always between 23.5° North of the equator to 23.5° South of the plane of equator.



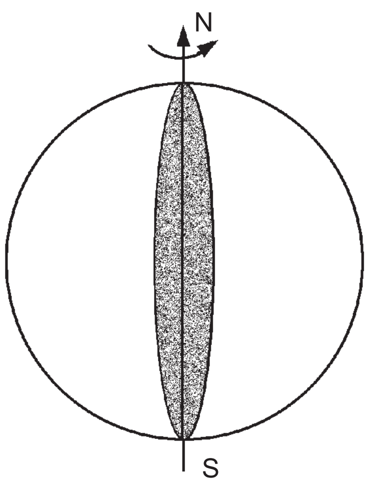
Now imagine yourself moving toward the equator. The Sun can never be at your Zenith unless you enter the region between latitudes 23.5° North and 23.5° South. See the following figure.



As the earth revolves around the Sun, with its axis always pointing in the same direction in space, the Sun appears to move from 23.5°N (around June 22) to 23.5° S (around Dec 22) and back again in a year. As it moves between these points in the sky, it will be overhead for a person in the region between these latitudes twice in a year. For example, for a person on the equator, the Sun is at the Zenith on the days of the equinox (around March 21 and Sept 23) Many books (written by authors in the Northern temperate zone) simply state that the Sun is highest in the sky at noon on June 22; this is only true if you are at a latitude North of 23.5° N.



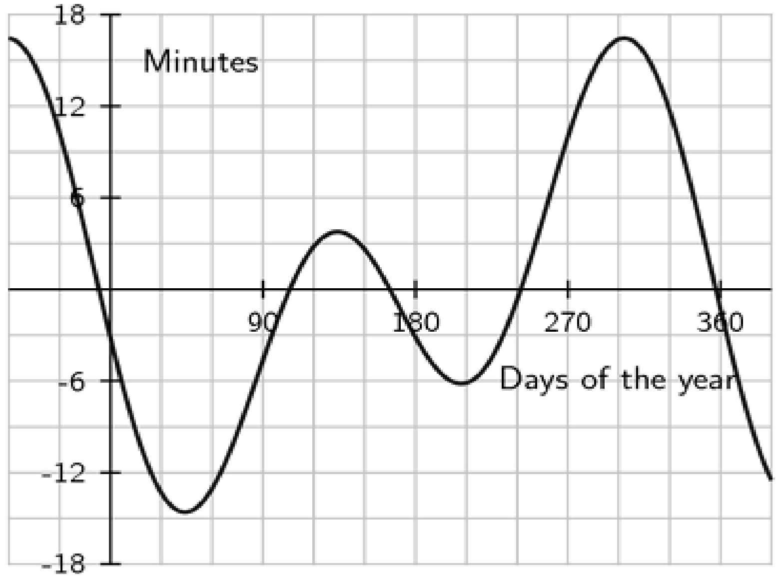
Apparent paths of the Sun at different lattitudes (Approx. 45° and 18°)



2. If you look at your watch to see when the Sun goes from East to West, i.e. when it is on the meridian, it is most likely to be some time before or after noon according to your watch (standard time). There are two reasons for this - the standard time is fixed for a given longitude, and generally applies to a 15 degree zone centred on this longitude.(82.5° E is the longitude for India). When the Sun is on the meridian as seen by people along this central longitude, it will be East of the meridian for people on the West of it, and vice versa. You can find time zones marked on world maps in atlases.

The other reason is that the Sun's apparent motion is not very uniform over a year. Standard time is therefore set based on the apparent motion, not of the Sun, but of an imaginary Sun which moves more regularly than the actual Sun. The difference between the standard time and the time based on the actual Sun is called 'the equation of time'. It is usually given as a plot of the difference in time over a year.

Equation of Time:



Sun time faster than clock time (Sun on meridian before noon according to your watch)

Sun time slower than clock time

All the preceding information is too detailed and at too high a level for kids, and in this chapter we only draw their attention to some of these observations.

Think! Think!

In which direction does the earth rotate? East to west, or West to East?

Slowly spin the globe to show what you think. Place a doll (or imagine one) at some point on the globe. What direction is east for this' person'? As you turn the globe, will this person on the globe see the Sun rise in the East? As seen from the top, did you have to spin the globe clockwise or anti-clockwise?

3. Watching the moon and stars

a. Mini observed the moon at 7 O'clock one evening. She stood facing North and saw the moon in the western half of the sky. She made the following drawings to show her teacher where she had seen the moon at 7 pm.

Look at the moon on any day or night. Mark the place where you were standing. Stand facing North or South. Note where you see the moon - you can note its position with respect to a nearby tree or building or hill etc. Is the moon in the eastern or western half of the sky?
On page 92 of your WorkBook show how high the moon was by pointing the arm of the figure. Mark East and West in the drawing.

After one or two hours, stand in the **same** place again, facing in the same direction as before, and look at the moon. Note in which direction it is, and how high it is.

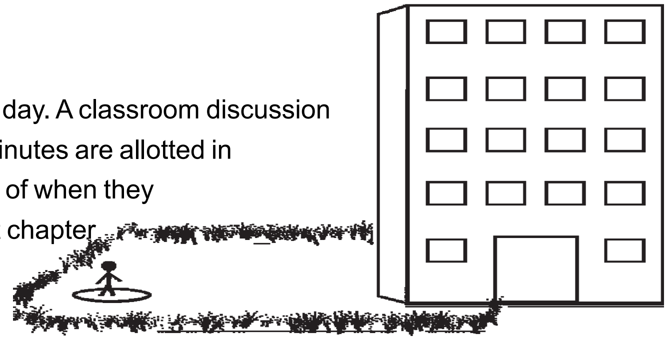
Show your teacher how you were standing - facing which direction - and where the moon was the first and the second time you saw it.

Do this activity on three different days or nights.

They have to stand in the same place because it is easier to use a reference such as the top of a tree or wall to look for changes in position of the moon, and in the next section, of the stars.

Additional Information:

The moon rises about 50 minutes later each day. A classroom discussion before the activity might help. Also if a few minutes are allotted in class for kids to talk about their observations of when they saw the moon. More on the moon in the next chapter.



Think! Think!

Mini and Apu see a crescent moon at 8 pm, near the horizon in the west. Mini thinks the moon is going to set soon, Apu thinks it is rising. How can they figure out who is right?

Classroom Experience:

We could not get a sky watching session in the night. However, I myself had become familiar with the sky and so could tell if children were pointing in the correct direction when they reported their observations the next day. With some practice, it is quite easy to tell which star or planet the child is describing-I could even tell if they were talking about Mars or Antares, which are both red, and were in roughly the same part of the sky during our trials. So do take a little time to familiarise yourself with the sky.

b. Look at some of the constellations you learned about in class IV. Maps of the sky at different times of the year are on pages 92 - 98. You can use these maps to help you find the constellations.
Two sets of maps are given - for big towns and cities and for rural areas. From cities and towns you cannot see the fainter stars (except when there is a power cut!)
So these maps show only the brighter stars. You will not see the stars on the edges of the maps - they are too low in the sky.

Note that these maps are upside-down!
Hold the map upside down, over your head, pointing N to the North.
Then the stars and constellations on the map will appear as they do in the sky.

When the moon is bright, you will not see the faint stars shown in the map. Choose a night when the moon is not bright, or not up, to observe the sky.
If you go out in the dark from a brightly lit room, you will not be able to see the fainter stars.
Wait for some time - several minutes - to let your eyes adjust to the darkness.
You can use the star maps outside if you have a torch and red transparent paper like cellophane paper.
Wrap the paper on the torch as shown, then use the torch to read the map.

Look first soon after dark. For each constellation, note in which part of the sky you see it - in the East, West, North or South? Or between any two of these directions - SE, SW, etc? Is it in the eastern or western half of the sky? How high above the horizon did you see it?
Show your teacher how you were standing - facing which direction - and where the constellation was the first and the second time you saw it.

Look at the same constellations again after one or two hours. Stand in the same place as you did before.
Were they in a different part of the sky?
In which direction?
Where were they compared to the horizon (higher than before, lower than before or the same)?
Is it in the eastern or western half of the sky now?
Learn to recognize some more constellations in the sky using the star maps.

c. Stand in the centre of the classroom or playground with a friend as the Sun and you as the earth.

Have all your classmates stand all around you, far away; pretend that they are stars. Now turn as you did before (section 1b). Pick any star from among your friends.

Does it appear and disappear from view as you turn?
Look at some other stars too as you turn. Are some of them in the same part of your 'sky' as the Sun?
Are you able to see the Sun and the stars at the same time?

> Note that in reality this should be in 3 dimensions - there are stars all around the solar system but here we have to 'scrunch' them all to one surface ... the classroom floor. If it is possible in your school to use different floors or you can think of any other way to create a more realistic model, please do try!

Classroom experience:

> Children refused to believe that stars rise and set - perhaps because you never really see them that low on the horizon in the first place from most places, and perhaps because they do not see the dramatic visual effects of the rising/setting moon and Sun. I decided not to push this point and let it go.

Think! Think!

Why don't you see stars in the daytime?

The revolving earth

4. The earth goes around the Sun. The earth spins, and revolves around the Sun at the same time. It takes the earth a year to make one complete revolution around the Sun.
The earth's path around the Sun is shown in this drawing. It is like a circle.
This is the earths orbit.
Six months later, the earth is at a different position in the orbit.

Where would the earth be 3 months later? A year later?
Show this on page 96 of your WorkBook

a. Refer to the text book for the side views of the earth's orbit, with the earth, at different times of the year:
Again ask a friend to be the Sun. You be the earth. Walk along a circle around your friend, the way the earth revolves around the Sun.
Remember - you should spin at the same time!

> The sense of rotation and revolution is the same - counter clockwise as you look down on the North Pole

How many rotations does the earth complete while it revolves around the Sun once?
Did you spin as many times as the earth does?

They'd get dizzy if they tried it, of course! They can't, and are not to try!

Know these words

horizon, zenith, rotate, revolve, revolution, clockwise, anti-clockwise, orbit.

EXERCISES

What's the same? What's different?

Give two similarities and two differences between
a) Sunrise and sunset

b) Your shadow early in the morning and late in the evening

Interesting questions

1. Name some things you see in the sky, other than the moon, Sun and stars, which appear to rise and set.

2. Why is it hotter during the day than it is at night?

3. Hold a pencil upright. Using a torch, make shadows of different lengths.
Where do you have to hold the torch to make the shadow the shortest?

4. Suppose the sun is at the zenith. If you fix a stick upright, in which direction will its shadow be? How long will the shadow be?

5. Does the moon ever rise in the West? Why do you think so?

6. Answer the following questions with the help of a globe:

a) Suppose Akash sees the Sun rising in Kolkata. At the same time, would Vasundhara in Mumbai see the Sun rising too? If not, would she have to wait, or would the Sun have already risen in Mumbai?

b) A cricket match in England starts at 9:30 am. When you watch it live on TV from India, what time would it be here - earlier or later than 9:30?

c) Suppose it is 7 am in India, and Apu and Mini are just waking up. For the following children, guess what time it would be in their countries - much earlier or later than 7 am? Or a little earlier or later then 7 am? What time of day or night would that be?
Then guess what these children would be doing at that moment - match them with the activities on the right as shown:

i) Hakim and Arida in Senegal (NW Africa)	waking up
ii) Akihiro and Keiko in Japan	sleeping
iii)Gonzalo and Maria in Chile	studying in school.
iv) Emil and Eva in Sweden	having dinner
v) Mini and Apu in India	....

Classroom discussion

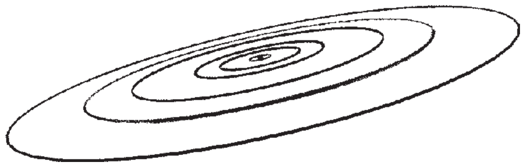
Do stars rise and set? Do they appear to move from East to West?
Do they disappear below the horizon in the west like the Sun does?

Figure it out

Is the Sun overhead at noon everyday? How can you find out, without looking directly at the Sun? Try your ideas. You may want to make something to try to answer this question. What materials do you need for this?

DID YOU KNOW?

1. All of India follows only one time - the Indian Standard Time. Russia is such a vast country, that when it is morning in its western parts, it is already evening in the eastern parts. They have 11 different standard time zones across the country. Each zone has its own standard time. The part of the United States between Canada and Mexico has 4 time zones.



CHAPTER 7
EARTH'S NEIGHBOURS

Why I developed this chapter

Most people, particularly children, find astronomy absolutely fascinating. That would be reason enough to introduce a chapter on objects in the solar system, building on the earlier two chapters in this unit. The way the orbits of planets are depicted in most books, gives the wrong and lasting impression of the kind of ellipse the orbit is. This leads even many educated adults to incorrectly attribute seasons to the shape of the orbit. In this chapter, as in chapter 6, much effort has gone into getting these basics right.

Main Objectives

1. To introduce children to the other planets around the Sun

2. To introduce them to other members of the solar system, including our moon.

3. To encourage them to follow astronomical events reported in the media

Suggestion:

> In this chapter, point it to kids that they should think of how the earth, moon, planets etc would appear if they could go very very far from the earth.

Earth's nearest neighbour

1. The Moon

a. The moon is Earth's nearest neighbour. It revolves around the earth. It takes a little less than one month to go around the earth. It also rotates very slowly.
Together, Earth and moon go around the Sun.

Ask your friend to stand in one place as the earth, as Apu did in the drawing.
Pretend to be the moon, like Chandrika. Stand facing the earth and slowly start to go around the earth;

remember to spin slowly at the same time. Always face the earth as you go around.

Now get someone to be the Sun like Ravi. Have the earth go around the Sun.
The earth should spin at the same time. You, the moon, go around the earth.

The moon is smaller than the earth. Earth's diameter is about 4 times as large as the moon's diameter.

Make a drawing of the earth and moon. Draw the orbit of the moon. In your drawing the size of the moon should be correct compared to the earth. The distance to the moon is about 40 times the earth's diameter. In your drawing, if you show the correct distance, will it fit on the page of your book? If not, how big a sheet would you need to fit the drawing on it?

b. Here is a picture of the moon.
The dark areas are made of dark rocks. These rocks formed from volcanoes on the moon a long time ago.
Many years ago, people thought these were seas, so they named them 'Sea of Tranquillity', 'Sea of Serenity' etc. We now know that there is no water on the moon.

Additional information:

> Basaltic rock, such as the rock found in the Sahyadris, formed from solidified lava. Volcanic activity on Earth took place after the heavy bombardment of meteoroids, hence few craters here. Also, many smaller meteoroids burn up in the atmosphere. However some craters on Earth are known.

Look at the moon when it is a full moon or almost a full moon. Do you see these dark areas? On page 101 of your WorkBook, show where you saw the dark areas.

This photograph is a close-up of the moon's surface taken by astronauts from Apollo 17.

What do you see in these photographs?

Here is another close up taken by the Hubble Space Telescope.

The craters on the moon were formed when meteors hit the moon's surface.

You will learn about meteors in section 3.

c. Make craters

Take a plate of dry sand. Make the surface smooth with your finger. Take some heavy marbles or ball bearings (chharra).
Now drop these in the plate.

Do your craters look like the craters on the moon?
Moon is made up of rocks and sand, just like the earth.

Astronauts have brought back rocks and soil from the moon.

Our other neighbours

2. The planets

a. There are eight planets which go around the Sun. Earth is one of them. The others are Mercury, Venus, Mars, Jupiter, Saturn, Uranus, and Neptune.

Until August 2006, Pluto was counted as one of the planets - it was the ninth one. But Pluto is tiny compared to these eight planets, and different in many other ways. Astronomers have decided that it will be called a **dwarf planet.**

Additional information:

> Pluto belongs to a group of icy objects called the Kuiper belt, which extends from 30 to 50 AU from the Sun. Pluto's orbit is inclined with respect to the Earth's orbit by 17 °. The orbits of the planets all lie within 4 ° of the earth's orbit, with the exception of Mercury, whose orbit is inclined by 7 °. About 1100 objects of the Kuiper belt are known. It is believed that many of the comets (those which take less than 200 years to go around the sun) come from the Kuiper belt.

We can see Mercury, Venus, Mars, Jupiter and Saturn in the sky without telescopes. They are so far away that, without telescopes, they look like shining dots. They look like stars, but do not twinkle. We need telescopes to see Uranus, Neptune and Pluto. Like Earth, all planets rotate.

Name some planets you have seen. For each planet, answer these questions:
When did you see it? (time and date)
Where in the sky was it when you saw it? (near which constellation? Or in which direction, and how high in the sky?)
Describe it (faint or bright? How bright compared to some stars you know like the stars of the Great Bear or Sirius? What was its colour? Was it twinkling or not?)

Mercury is closest to the sun. Then, nearest to the farthest from the sun are Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune.

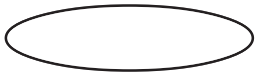
> Planets move across the background of the stars. 'Planet' is in fact a Greek word which means 'wanderer'. If we know the constellations of the zodiac, we can confirm if an object is a planet by watching over a couple of weeks, and seeing its position change with respect to the stars of these constellations. Another way to tell a planet from a star is that planets don't generally twinkle while stars do. There are exceptions - for example, Venus when it is a thin crescent.

To know the positions of planets, check your newspapers; some carry fortnightly maps of the sky with moon and planet positions. You can also contact local amateur astronomy groups, or look it up on the web.

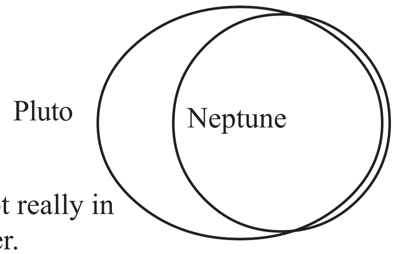
Think! Think!

Apu asked Mini mischievously - there is one planet you never see up in the sky, even with a telescope. Which one is it?
What do you think Mini's answer should be?

b. The orbits of all planets and dwarf planets are like stretched circles - like this.



This shape is called an ellipse.
Ellipses can be almost like circles, like Earth's orbit or thinner.
Here are the orbits of Neptune and Pluto, drawn to scale.
The orbit of Pluto is a much more stretched circle than that of the planets. The orbits of planets are almost like circles.



Please point out to your children that the orbits are not really in the same plane - they are tilted about 15 ^{o} to each other.

Look carefully at the orbits in the picture from the text book. Can Pluto ever be closer to the Sun than Neptune?

c. Draw the orbits of the planets and Pluto to scale. You can draw all the orbits as circles. The distance of Mercury from the sun is 58 million km. If we measure the distances of the other planets from the sun in units of the Mercury-Sun distance, they are

Mercury 1	Venus 1.9	Earth 2.6
Mars 3.9	Jupiter 13.4	Saturn 24.6
Uranus 49.5	Neptune 78	Pluto 102

Decide how many centimetres you will take as the distance between Mercury and Sun.
Then how many centimetres will the distance between the Sun and the other planets be in your model?
Write this in the table on page 102 of your WorkBook.
Now draw a dot for the Sun and draw the orbits around it. The planets are so small compared to the size of the orbits that you cannot show them in this drawing. Just write the name of the planet on the orbit.

Make a guess - how far is the nearest star (other than the sun) in this model?

If the earth-Sun distance is 1 cm, the nearest star on this scale would be at 2.8 km. Space is quite empty – something that will become clear when a model of the solar system is made later in the chapter.

Think! Think!

What is the Earth-Sun distance in kilometres?
This is called 1 Astronomical Unit (AU).

Distances to planets are usually measured in this unit.

Planets go around the Sun, satellites go around the planets.

Like the earth's moon, some planets have their own moons.

d. The planets are all different from each other. No planet is exactly like any other, as the photographs in the text book show. They were taken by spacecraft which went close to the planets, or by powerful telescopes.

The photograph of Mercury from text book was taken by the spacecraft Mariner 10.

Mercury is smaller than the earth. Its surface is like the moon's surface, with many craters.
There is no air on Mercury.
It gets very hot in the part facing the sun, where the temperature is about 230 degrees Celsius (^{o}C).
The part facing away from the sun gets very cold - much colder than the icy continent of Antarctica on Earth.

The photograph of Venus from text book was taken by the spacecraft Galileo.
Venus is about the same size as the earth.

If you look at its rotation from the north, it is in the clockwise direction. It takes longer to complete one rotation than it does to complete one revolution around the sun!

The air on Venus is made up mostly of carbon dioxide (96%).
It has small amounts of water vapour and some acids.
Its surface is hidden by thick clouds.
Spacecraft had to land on Venus to take photographs of its surface.
It is so hot on Venus that these spacecrafts were quickly destroyed after landing, but managed to photograph the surface before that. They show that it is made up of rocks.
You can sometimes see Venus as a bright object in the east before sunrise, and sometimes in the west soon after sunset. It is called 'morning star' or 'evening star', though it is a planet, not a star.
Look for Venus in the sky. Did you see it in the morning or evening?

The photograph of Mars from text book was taken by Hubble Space Telescope. The diameter of Mars is about half the diameter of the earth.
The air on Mars is made up mostly of carbon dioxide.
It also has some nitrogen, and some other gases, but almost no oxygen or water vapour.
It has ice at its poles. The ice is made of water and also carbon dioxide.
The warmest temperature is about 20 ^{o}C, the coldest is much colder than ice.

The soil on Mars is red. There are huge dust storms on Mars; some storms have been photographed by spacecraft. Mars also has craters on it.
Look for Mars in the sky. It looks red. Mars has two satellites - Phobos and Deimos, which go around it.

Jupiter is the largest and most massive of all planets - its diameter is about 11 times the diameter of the earth. But it rotates very fast - once in about 10 hours!

Jupiter is made mostly of hydrogen and helium gases.
It does not have a solid rock surface.
This photograph taken by Cassini spacecraft shows a storm on Jupiter - known as the Great Red Spot, which has been seen for more than 300 years.

It is colder on Jupiter than on Mars. Jupiter has many satellites - more than any other planet. There are 4 large satellites and many small ones. Some are as small as 2 to 4 km across. New satellites are constantly being discovered.

The photograph of Saturn from text book was taken by the Hubble Telescope.
Saturn is the second largest planet. It has very bright rings. The rings are made up of small particles of ice.

Jupiter, Neptune and Uranus too have rings around them, but they are not as bright as Saturn's rings.

Saturn itself is made up mostly of hydrogen and helium. It is colder than Jupiter.
Saturn too has many satellites. Titan is the largest. It was discovered more than 350 years ago.
The photograph of Uranus from text book is taken by Voyager 2 spacecraft. Uranus is the third largest planet. Like Jupiter and Saturn, Uranus too does not have a solid rock surface. It is made up mostly of hydrogen, some helium, water vapour and other gases. The centre of the planet is all liquid.
It is even colder on Uranus than it is on Saturn.

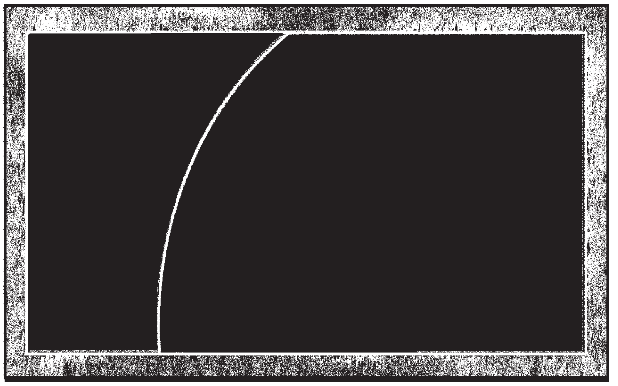
Unlike other planets, the equator of Uranus is tilted about 90 degrees to its orbit. It too has many moons; the largest is Titania.
Uranus was discovered in 1781.
Neptune is the fourth largest planet.
It is even colder than Uranus.
Neptune too is made of mostly hydrogen and helium and other gases like methane.
It does not have a solid rock surface - no astronaut or spacecraft can land on this planet or others like it.
It has at least 8 moons.
Neptune was discovered in 1846.
Pluto is a dwarf planet; it is even smaller than our moon. It is made of rocks and ice.
Pluto has never been photographed from close by a spacecraft. In January 2006, a spacecraft called New Horizons took off for Pluto, and will reach close to it in 2015.
Pluto was discovered in 1930. The other dwarf planets are Ceres and Xena. This list will get longer as more objects are discovered and named. When Xena was discovered recently, people thought it may be the 10th planet, until astronomers decided it was a dwarf planet.

e. Make a model of the planets and Pluto.
The planets are all much smaller than the sun. If the sun were a ball of diameter 1 m, the sizes of the planets would be as shown on the previous page.
The diameters of the planets and Pluto would be (in cm)

Jupiter	10.3	Saturn	8.67	Mars	0.49
Earth	0.91	Venus	0.87	Mercury	0.35
Uranus	3.6	Neptune	3.5	Pluto	0.17

Suggestion:

> I drew an arc of radius 0.5 metre on the board, because it could not accommodate the whole circle. Students will learn to appreciate units and estimate lengths correctly if exposed to such quantitative exercises.Please do emphasize that this is a part of a sphere, not a circle.



Find spheres of different sizes, and find one, of the right size for each planet. You can choose from balls, beads, even round fruits, dried peas, mustard, pepper ... anything that is almost a sphere.

Carefully measure the diameter as shown in the drawing.
Is the diameter the mark you read on the scale, or do you have to make a correction?
Look carefully at your scale.
Which of these scales has markings like yours?

For which kind of scale would you have to make a correction to find the correct diameter? How will you make that correction - will you add or subtract the length of the blank strip to the reading on the scale?

For the smaller planets, you can directly put the sphere on the picture to see if it fits.

After you have all the model planets, do the following activity outdoors.
Get one student to be the sun.
Some of you act as planets, and go around the sun along with your satellites. Each planet hold your model planet in your hand. Venus spins in the opposite direction compared to other planets. How should Uranus spin? Do not spin that way, just tell you teacher what you think.

If you did this to scale, Earth would have to be 100 m from the sun.
Mark a metre on the ground. Walking as you normally do, count how many steps you take to cover a distance of 1 m.
If you measure a metre this way, will your measurement be exact? Why or why not?

How many steps do you have to take to cover 100 metres?
Find a point on the ground which is 100 m from the sun. That is where the model Earth would have to be.

3. Other objects

In addition to the planets, comets, asteroids and meteoroids too go around the sun in different orbits.

Comets are made of rock and frozen water and carbon dioxide and other gases. Many comets go around the sun in orbits which are thin ellipses.

When a comet comes close to the sun, some of it evaporates to form beautiful tails.

Many comets get very bright when they come close to the sun. Then we can see them without using telescopes.

> When they come close to the sun, ice turns to water, evaporates, and along with other vapours forms the 'tail'. Bits of rock can break away from the comets

Asteroids are small and rocky. Their orbits are between the orbits of Jupiter and Mars. You cannot see them without telescopes.

Meteoroids are even smaller pieces of rock and dust.
As earth moves in its orbit, and there are meteoroids in its path, they rush into the air at high speeds - between 10 and 30 km per second.
They burn in the air high up, and we see them as meteors - or 'shooting stars'.

Many times in a year, you can see lots of meteors - sometimes as many as hundreds per hour. These are called meteor showers.

Tell your teacher about any meteors you have seen.
Some meteors are large and do not all burn up in the air. Then they strike the earth.
Some are big enough to make large craters, but they are very rare.
The Sun, the planets, their satellites (moons), the asteroids, comets and meteoroids together make up the solar system.

Know these words

satellite, meteor, comet, solar system, ellipse, asteroid

EXERCISES

What's the same? What's different?

Give two similarities and two differences between
The earth and the moon

> Both are round, both have rock and sand, both rotate one goes around sun, one goes around earth up in sky, difference of air, water, life...

Interesting questions

1. Arrange from the nearest to the farthest (from Earth):
Moon, sun, clouds, Pole Star

2. Are there days and nights on other planets? On the moon? Why do you think so?

3. When you look at the moon (without a telescope), why don't you see the craters on it?

4. Why can we not see Uranus, Neptune, and Pluto without a telescope while we can see stars which are even farther away?

Brighter objects can be seen from farther away - think of candles and searchlights.

5. From the eight planets, choose some which have something in common.
For example, Guru chose Venus and Mercury - these planets do not have satellites.
You can make a group of any kind you want. Your group can have any number of planets. You can think of their sizes, the sizes of their orbits, or anything else you know about the planet. Write down what they have in common.

6. Neptune is colder than Uranus, which is colder than Saturn, which is colder than Jupiter, which is colder than Mars. Why do you think it is so?

Talk and write

There is one planet about which nothing is written in section 2d. Which one is it? Write a few sentences about this planet.

Ask and find out

Watch for news reports of comets or meteor showers. Look for meteor showers at the predicted time. If there are any bright comets you learned about from news reports, look for them.

Play with words

The planets, from the closest to the farthest from Sun are:
Mercury Venus Earth Mars Jupiter Saturn Uranus Neptune

The first letters of the planets, in this order, are

M_____ V_____ E_____ M_____ J_____ S_____ U_____ N______

Make a sentence by writing words, each word starting with the letter as shown above.
If you can remember any such sentence, you can remember the order of the planets!

> Insist on something other than the standard ones; when I was a student I learned Matilda Visits Every Monday, Just Stays Until Noon, Period. Many kids knew My Very Eager Mother Just Showed Us Nine Planets (when Pluto was still counted among the planets). When I insisted on a new sentence, they came up with very amusing ones (one kid wrote My Varun Eats Undigested Nuts...). It is admittedly a difficult exercise but fun nonetheless

Figure it out

The orbits of Earth and Jupiter are shown on page 108 of your WorkBook.
The position of the earth in its orbit is marked. The distance between the Sun and Earth is called

1 Astronomical Unit or AU.

a) How many AU is Jupiter from the Sun?

b) Where would Jupiter be in its orbit when it is nearest to the earth?
How far would it be from Earth then? Give your answer in AU

c) For the earth in the same position, where would Jupiter have to be for it to be farthest from the earth?
How far would it be from Earth then?

Give your answer in AU.

DID YOU KNOW?

1. Our Sun is a star which is very close to us. Astronomers have discovered that there are planets around other stars too, which are very far from us. The first such discovery was of a planet around a star named 51 Pegasi, in the constellation of Pegasus.

2. The largest mountain in the Solar system is Olympus Mons on Mars - it is 25 km high! Mt. Everest, the tallest mountain on Earth is slightly more than 8.8 km high.

3. There are some meteor craters on earth too - we know of about 120 meteor craters so far. Like the craters on the moon, they were formed when meteors hit the surface.

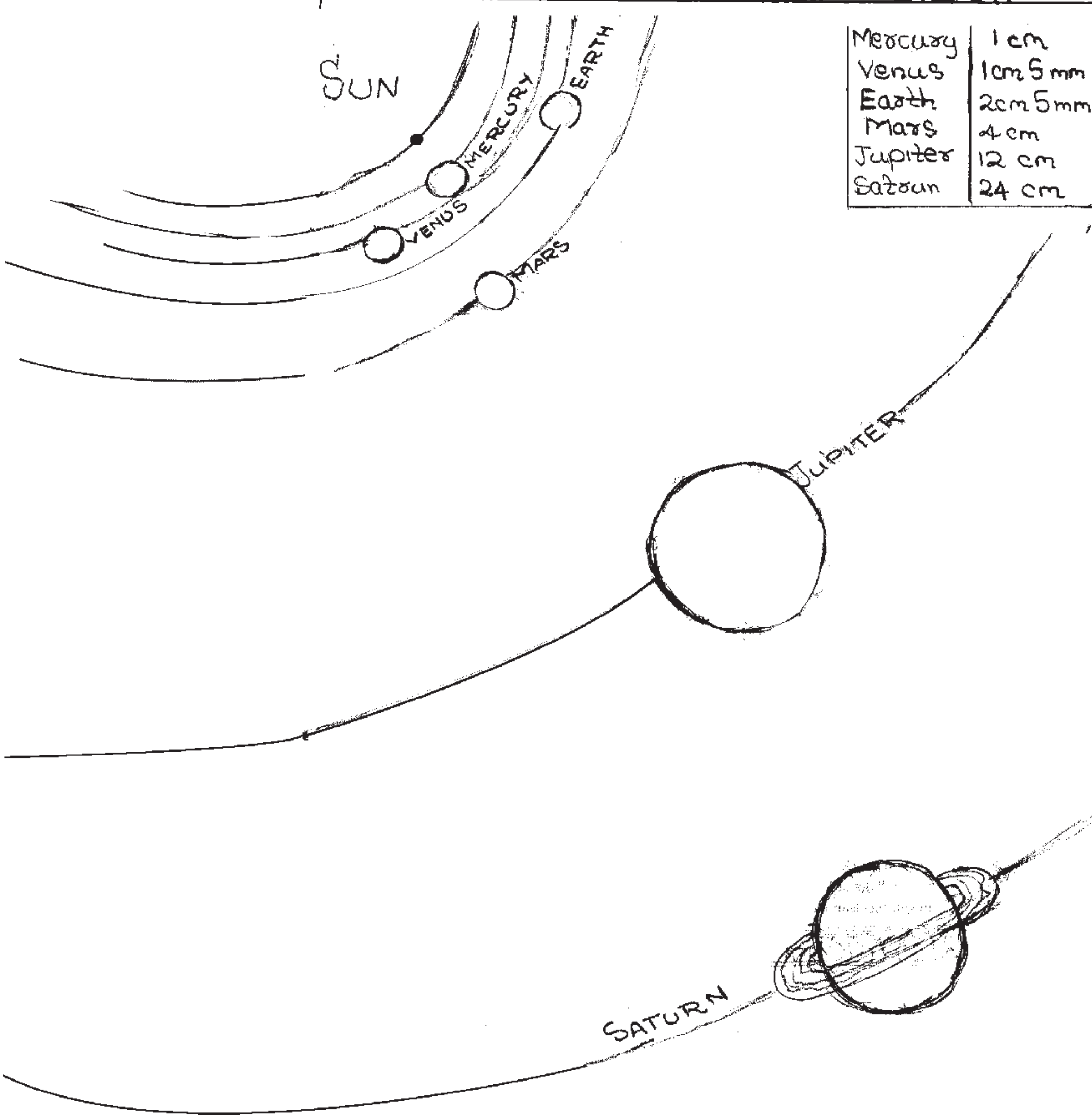
There is one such crater in Lonar, Maharashtra. It is now a lake. Lonar crater was formed when a meteor hit the area 50,000 years ago.

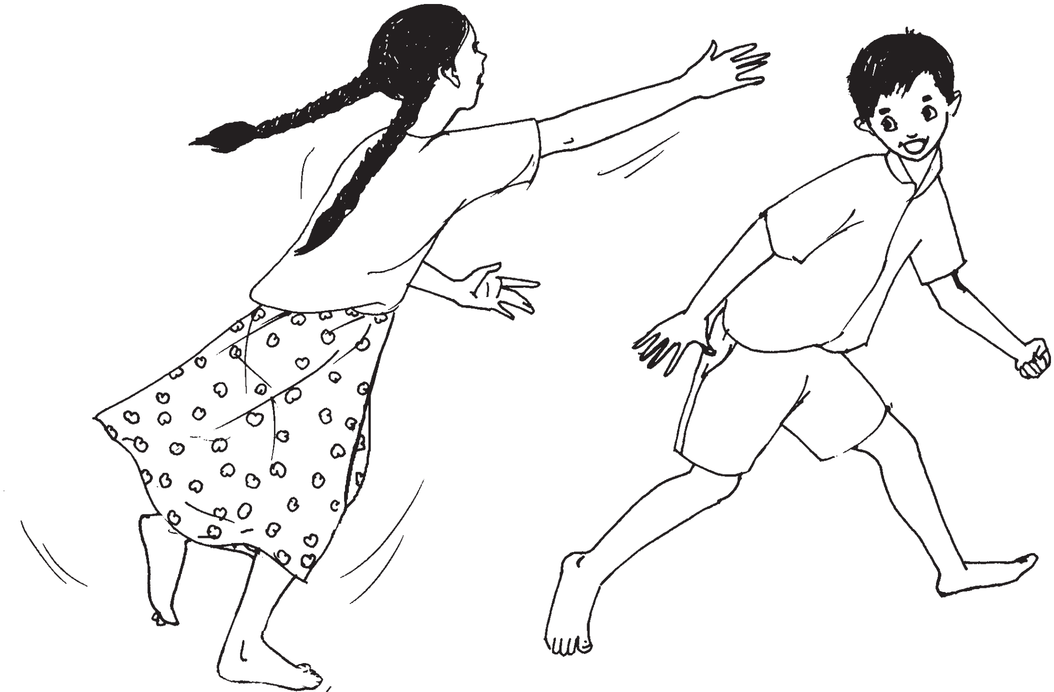
4. An Italian scientist named Galileo was the first to see the 4 large moons of Jupiter - Io, Europa, Ganymede and Callisto. He saw them through his telescope about 400 years ago, and discovered that they go around the planet. The spacecraft Galileo was named after him.

Children's work - an example

Make a model solar system:
In the table, the distance between the sun & the planets are given in units of the mercury sun distance. In your model if the distance between the mercury and the sun is 1 m, how far from the sun should the other planets be?
Be sure to write the units (meter or centimeter in your answer).

Planet	Distance from sun in AU	Distance in your model	
Mercury	~~0.4~~ 1	0.2	1m
Venus	~~0.7~~ 1·5	0.35	1m 50cm
Earth	~~1~~ 2·5	~~0.5~~ 1	2m 50cm
Mars	~~1.5~~ 4		4 m
Jupiter	~~5~~ 12		12cm
Saturn	~~9.5~~ 24		24cm





UNIT 4

OUR BODIES

CHAPTER 8
WHAT IS IN OUR BODIES?

Why I developed this chapter

The fact that blood constantly circulates, and that it goes from the heart and lungs in tubes which again bring the blood back to the heart and lungs (i.e. in a closed system of tubes) is a very difficult concept for children. One child in the class, the youngest, kept asking me 'but where is it stored' in the beginning, in great consternation.

Research has also shown that most children who are taught about circulation leave the lungs out of the picture, thinking that blood goes from the heart to 'all parts of the body' and back to the heart. It became clear from our research that part of the reason for this idea was that children had not yet been introduced to the idea of cells. Once that is done, it becomes clear that oxygen taken into the lungs has to reach the cells via the blood (why else would one need circulation?); and the heart merely pumps the blood. The activities and exercises in this chapter give a feel for the pressure maintained in the veins and arteries, without using the term "Pressure".

Since the idea that the heart purifies blood is widespread, perhaps arising from the incorrect use of the terms pure and impure blood, care has been taken not to use those terms at all in this chapter.

Main Objectives

1. To introduce cells as the basic units making up all living things.

2. To teach about circulation, with emphasis on the function of the heart as a physical one.

Lub dub lub dub lub dub

All night, all day
While you sleep, while you play
From before you are born
till the moment you die

never stopping, always working.....

Lub dub lub dub lub dub

Faster than the clock ticks!
Even faster when you exercise!

Lubdub lubdub lubdub lubdub lubdub

What is it? ....

Classroom experience:

> I read this poem out during the class trials, before children saw it placed before the section titled 'your heart'. Very few could guess the answer. The reason others rejected 'heart' as the answer was because of the phrase 'from before you are born'. I asked if they knew any one who was going to have a baby. I told them that the doctor listens to the baby's heart; at this point they all had stories to tell about an aunt or someone else they knew who was pregnant. The heartbeat of a foetus can be detected (seen, not heard) by ultrasound in the about 5 weeks of pregnancy; it can be heard with a sensitive stethoscope called a foetoscope between the 4th and 5th month of pregnancy, and a little earlier with more modern instruments.

1. a. Your heart

Feel with your hand where in your chest your heart is.
Ask your friend to place her or his ear there and listen to your heart.
Listen to your friend's heart.
How would you describe the sound?
Count the number of times your friend's heart beats in 15 seconds.
Ask your friend to run fast for a few minutes (or run in place in your class). Count his or her heart rate again.
Run fast for a few minutes yourself, and ask your friend to again count your heartbeats.

Classroom experience:

> Some kids counted one lub-dub cycle as 2 beats. I explained that lub-dub was one beat, and as I called out 'lubdub lubdub', I had the class count the 'beats' as practice.

Your heart is about the size of your fist.
About 2/3 of it is in the left side of the chest, 1/3 in the right side.

This is how the inside of the heart looks.

Blood cannot flow directly from one side to the other.
Each side is divided into two chambers - the upper and the lower.

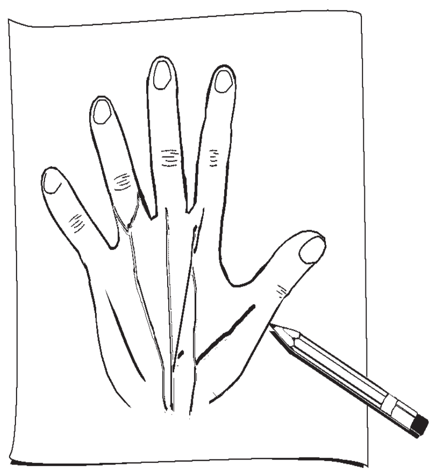
The heart has four chambers in all.

Think!   Think!

This drawing of the heart is labelled correctly. It is the heart of the person facing you. Whose left is shown here - your left or the left side of the person who is facing you?

b. The heart pumps blood. It makes the blood flow through the body. Blood is continuously flowing in our bodies.
It flows from the heart to the lungs, back to the heart, then to every part of our body, then to the heart, then to the lung...….and so on.
Blood flows in tubes.
The tubes which carry blood away from the heart - to the lungs and to the other parts of the body - are called **arteries.**
Tubes which carry blood to the heart - from the lungs and other parts of the body - are called **veins.**

You can see some of the veins in the body. Look at the back of your hand or of someone older. You should be able to see some veins there. Draw the outline of the hand.
Then draw the veins you could see.
Look carefully at how they branch or join together.
Could you see veins anywhere else in the body? Where?
Arteries are deeper under the skin.
You cannot see them the way you can see veins.
In some places the arteries are closer to the skin -in the wrist, in the neck and other spots shown in this drawing.
If you place your finger at these spots, you can feel the pulse.



Find your friend's pulse on his (or her) wrist.
Listen to his (or her) heart, and at the same time feel his (or her) pulse.
How many heart beats (lub dub) did you hear each time you felt a pulse?

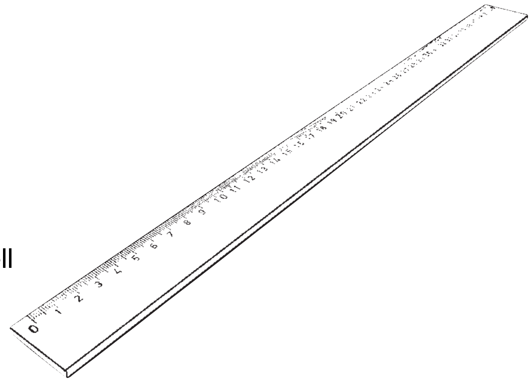
Think!   Think!

Why are heart rates and pulse rates the same?

> You feel the pulse when you press gently on an artery; when the lower chambers of the heart contract, the pressure increases (the upper number in a blood pressure reading, called systolic pressure) and you feel it as a pulse. When the chambers relax, the pressure decreases (the lower number in the BP reading, called diastolic pressure). The blood of course is flowing constantly. With children, simpler language should be used as is done above.

2. Our bodies are made of cells.
Cells are so small that you need a microscope to see them. The liver cell shown below measures 30 microns. 1000 microns make a millimetre.
On your ruler, look at how long a millimetre is.
If you divide this into 1000 parts, each part would be 1 micron long.

Classroom experience:

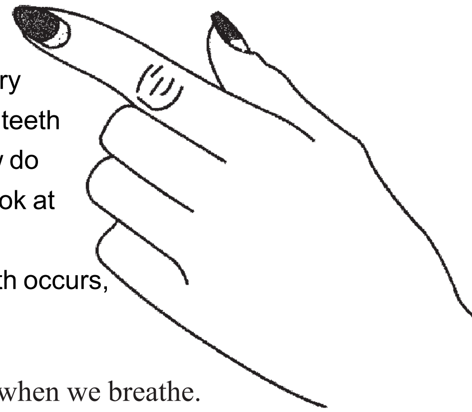


> I asked them to take their rulers out and look at 1 mm.
> I then told them 'if you divide it into 100 parts, the smallest cell is the size of that part'. Unless kids go through these steps, measure such as a mm or cm have no meaning at all.

All our organs such as heart, lungs, digestive system, skin ... all are made of cells.

All living things are made of cells. Bacteria, and some of the other microbes you learned about last year, are made of just one cell each! Make a guess - how many cells are there in your body?
The part of the nails which can be cut without pain, are made up of dead cells. All hair seen above the skin is made of dead cells.

Additional Information:



> Cells of the hair and nail get filled with a protein called keratin. It is very interesting that when I taught this unit, children asked if hair, nail and teeth are also made of cells. They are indeed. The next question was - how do hair and nails grow if they are made of dead cells? I asked them to look at how nails grow - if you put henna on your nails, after some days the undyed part near the bottom can be clearly seen. This is where growth occurs, and they push the nails out from the bottom. The same is true of hair.

b. All the living cells in our bodies need oxygen. We get oxygen from the air when we breathe.
Measure your friend's chest as he or she breathes in, and then breathes out.
Ask your friend to measure your chest as you breathe in, and then breathe out.

Classroom experience:

> Although many kids told me that the chest 'expands' they had no idea what 'expand' means. It took a lot of effort to get them to figure out how they will show that it does 'get bigger'. I gave them hints about what tailors measure etc. before they realised they could measure it with a string. But, some kids measured from the left armpit to the right one. The mechanism of breathing is the following: the diaphragm moves down, increasing the volume of the chest cavity; the pressure in the cavity decreases, becoming less than the atmospheric pressure. The air rushes in, filling the lungs, because of this pressure difference.
>
> I got a goat's lung from a butcher for Rs. 20 or 30. I bought it the day before class and kept it preserved in formalin solution (1 ml of formalin in 100 ml water) overnight. The next day I inserted a plastic tube, the kind you get for fixing tubes to taps, and blew into it to show how lungs expand. This sparked a lot of interest in the topic. Many kids wanted to touch and feel the lungs, which I encouraged. Needless to add, we have to be sure we all wash our hands thoroughly with soap after this!

Think!   Think!

Do you think lungs are hollow like bags and balloons, or like sponges? Have you ever felt the lungs of any animal? If you have, tell your class what they felt like.

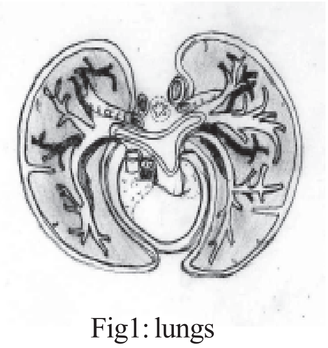


Fig1: lungs

Children who are not vegetarians may have had occasion to see and feel lungs of animals whose meat is eaten. Lungs are spongy. They are often incorrectly pictured as bags.

When we breathe in, our chests expand. Lungs expand and air fills the lungs.
There are many tiny air sacs in the lungs. The air fills these air sacs.
The lungs have arteries which branch into thinner and thinner tubes. These tubes are called **capillaries.**
The oxygen in the air mixes with blood in the capillaries.
This blood, rich in oxygen, flows to veins in the lungs, and then to the left side of the heart.
These drawings show what happens to the blood after this.

When the lower chamber squeezes, it pushes the blood through the arteries to all parts of the body. The arteries branch into thinner and thinner tubes (capillaries). Capillaries are so thin; their walls are made of just one layer of cells. Blood flows through them to all the cells in the body.

In the cells, the oxygen is used up and carbon dioxide is made. Carbon dioxide mixes with the blood in tiny veins (capillaries), which flows to larger veins.

Look at your drawing of the veins in the hand. On it draw arrows to show which way the blood flows in all the veins you have drawn.

Think!   Think!

Look at the picture of the veins in the body on page 121. Do you think blood from different parts of your body mixes as it enters the heart?

The blood, rich in carbon dioxide, flows back to the right side of the heart.
When the lower chamber squeezes, the blood in it flows to the lungs.

In the lungs, the blood gives up carbon dioxide and takes in oxygen. Write down where the blood goes after that.
This is what happens in one 'Lub dub' cycle:

Think!   Think!

Does a blood cell which was in some part of your body, for example, your eye, come always right back to the eye after it goes through the heart and lung?

Blood carries many things to all the cells of the body. Living cells need nutrients. Blood carries the nutrients we get from food. Blood carries wastes produced by cells to the skin and kidneys - they remove it from the blood when it flows through them. These wastes are taken out of the body as sweat and urine. If there are poisonous gases in the air we breathe, blood carries that too to all the cells.

Play the game described on page 129.

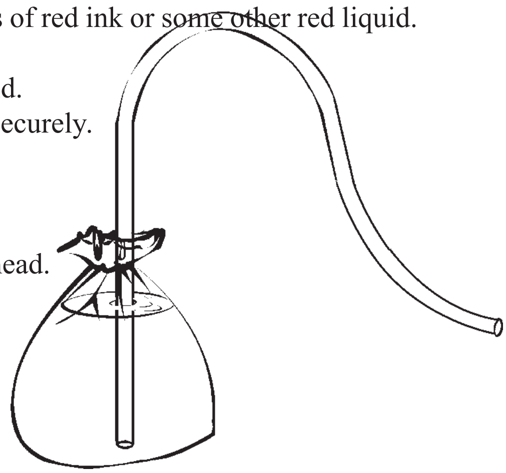
Field / Classroom experience:

> Children enjoyed this game a lot, and made the rather expected errors - from one body part (say arm) to heart to lung to heart and back to the arm again. I intervened and, acting as blood, moved from arm -heart-lung-heart and then to some other body part too.This is how nutrients,for example,can go from intestines to other parts of the body.

c. How the heart makes the blood flow

For this activity you will need: a clear plastic bag, a clear plastic tube about 1 meter long, a red liquid, and a container like a mug, to catch spills.

Fill the bag with some red liquid. You can use water with a few drops of red ink or some other red liquid.



Put one end of the tube into the bag; make sure this end is in the liquid.
Tie the end of the bag or use a rubber band. Make sure it is closed securely.

Squeeze the bag once so the liquid fills the tube.
Close the end of the tube with your finger.
Hold the bag at chest level, and the other end of the tube near your head.
Take your finger off the end.

What is the level of the liquid in the tube?
How can you make it reach the level of your head?
Squeeze the bag and see what happens to the level of the liquid.

Draw the bag and tube.
In your drawing show the level of the liquid before you squeezed the bag.

Show the level to which the liquid reached after you squeezed the bag.
Tell your class how this model is similar to the real heart, and how it is different from the real heart. Think of as many answers as you can.

Classroom Experience:

> There was not a student in class who did not contribute to this discussion. It occurred to me that we had pretty much completely revised the structure and function of the heart! A visitor who had come to observe the class could not believe that the children were from a regular class, and had not been selected for high scholastic performance. I was really proud of them!

Think! Think!

Would the blood from the lungs reach the cells in your head, ears, neck or shoulders if your heart did not pump it?

Would it reach your legs, stomach, intestines?

These parts do not have pumps - then how does the blood from these parts come back up to your heart?

Classroom Experience:

> Some children explained this very well ... that the blood keeps getting pushed all along.

Additional Information:

> Veins have thinner walls and lower pressure than arteries. They have valves which prevent the flow of blood in the direction away from the heart. Arteries however have no valves and have thicker walls. The blood flow in veins is aided by a light pumping action of muscles as we normal move about. When we do not move a leg for a long time, circulation is affected; we experience discomfort and cannot feel any sensation in that leg until we move it about a bit,.

Know these words

Artery, vein, chamber, capillary circulate, circulation

When blood flows from parts of the body to the heart, lungs, heart and then again to the rest of the body, we say blood **circulates.**

EXERCISES

Interesting questions

1. Name some things blood carries (other than those given on pages 125 - 126)

    Medicine (both oral and by injection), water, snake venom, IV saline/glucose

2. Which of these has blood richer in oxygen –

a) blood flowing from the heart to the toe or blood flowing from the toe to the heart?

b) blood flowing from the heart to the lungs or blood flowing from the lungs to the heart?

3. Why don't your nails bleed when you clip them?
Why is there no blood when you cut your hair?

4. Have you ever got scratches on your skin which did not bleed? Does is mean there are no capillaries there?

What can you say about the cells you must have scraped off - are they alive or dead?

5. How do the cells which make up the heart, the arteries and veins get oxygen and nutrients?

6. Why do we breathe faster and deeper when we run (or do some other exercise)?
Why does our heart rate increase then?

7. Jigar thinks that your heartbeat stops when you hold your breath. What do you think? How can you find out? Try your idea.

Classroom discussion

Wounds and deep cuts anywhere on your body bleed. Does this mean that blood does not flow in tubes, but fills all the cells and the space between the cells? Or does blood flow in tubes, but the capillaries are very thin and there are many of them? Would some of them always get cut when you get hurt? Would blood then flow out of the wound? What do you think?

Figure it out

Recall you heart rate; does the blood that fills the heart stay in the lower chambers of your heart for more than 1 second or less than 1 second?

Act it out

Do this activity when you are having a bath. Fill you mouth with water, look up, then open your mouth and let the water flow out. Again fill your mouth with water, look up, and squeeze your cheeks with your hand. Was there anything different in the way the water came out?

Play with words

Write a poem on heart

Play this game

Take some leaves or beads or seeds - about 100 of them - pretend they are oxygen molecules.
Use something else as molecules of carbon dioxide.
On the playground, draw a large human figure - head, neck, arms, heart and lungs in the proper places.
Some students should stand at different body parts - at the hand, the head, the toe etc. They will be acting as that body part. A few students act as the heart - form a circle by joining their hands. Some act as the lungs.
All the students acting as the different parts of the body should have a few carbon dioxide molecules in their hands.
The teacher will hand the ‘lungs’ oxygen, and take away carbon dioxide from them.
The teacher will pick a student as blood. Take turns to act as blood.

When the teacher says ‘go’, that student should
i) run to one body part, take carbon dioxide from the student there,
ii) run into the heart. After the heart says ‘lubdub’,
iii) go to the lung, give out carbon dioxide, take oxygen,
iv) go back to the heart, and when the heart says lub dub,
v) go back to any body part, give the oxygen there and pick up carbon dioxide
vi) and back to the heart, and so on as before.

The student’s turn ends when he or she delivers oxygen to the cells twice.
If the student does this without a mistake, he or she gets a point.
Any student who makes a mistake (runs to the wrong place) is out.
Anyone who points out the mistake gets a point - so all the body parts should pay attention!

Ask a question

Ask a question about the body.
Think of how you will try to find the answer.

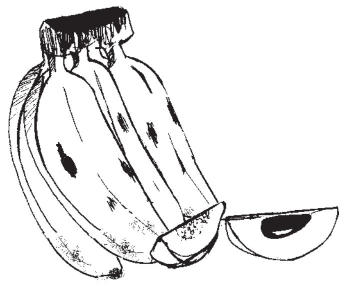
> This unit drew so many questions from children, there were days when we could not even start our trial, the whole class was spent in answering questions. I finally made a rule that they should give me their questions in writing unless it was about something we had discussed in the last class. I still have a collection of questions, some on scraps of paper, which they handed to me. I could not answer some of them, and suggested that they ask their doctor if they could.

DID YOU KNOW

1. An adult’s body has about 50 million million (50 trillion) cells. Every minute, about 30,000 dead cells are shed from the skin.

2. Larger animals have more cells, but the cell size remains about the same.

3. There are about 5 litres of blood in an adult human body.The heart pumps about 80ml with each heartbeat.



CHAPTER 9
STAYING HEALTHY

Why I developed this chapter

Nutrition and hygiene are among the factors which are under our control in maintaining good health. Sadly, a very large fraction of our children do not get adequate nutrition. However, even with limited money, we can choose to buy the more nutritious of the choices we have in the market. Many of our traditional grains, example, which are rich in minerals, are now being replaced with rice or wheat. While there are many factors which have brought this about, the younger generation should, at the very least, be aware of these foods. The same is true of many vegetables too. In the part on communicable diseases, I have tried to encourage simple changes in behaviour which go a long way in preventing infections.

Many of our habits form in childhood, hence the introduction of these topics at the primary level. I have included only material that can influence habits. Another reason for including this chapter in class V is that many children unfortunately, do not get schooling beyond this class. This is a completely unacceptable. However if we ensure in the current situation that children are equipped with this knowledge, they, and their families, can be better better nourished and healthier.

Main Objectives

1. To teach about proper nutrition, with special attention to strategies for low cost food

2. To teach about communicable diseases and the habits/behaviours they can adopt to stay healthy

Eating well

1. To keep healthy, our bodies need many nutrients. We need starches, proteins, vitamins and minerals. We get them from the food we eat. Choose your food well to get all the nutrients your body needs!

a. Starches give us energy. Cereals like *jowar*, *bajra*, wheat, *ragi* and rice contain a lot of starches.

Are there any other cereals which are eaten in your area? Bring this cereal (or these cereals) to class and show it to everyone. Tell your class the name of the cereal and what is made from it.

Classroom experience:

> In a school in Bombay only a few kids in class knew anything other than rice and wheat. I brought all the cereals to class and showed them, drawing particular attention to the appearance of raw and parboiled rice.

Many vegetables like potatoes, sweet potatoes, plantains, tapioca contain a lot of starches.

Starches and sugars are called **carbohydrates** (pronounced as carbo-high-drates).
They give us energy.

Additional information:

> Starches and sugars are both made of units of Carbon, Hydrogen and Oxygen. A molecule of glucose is made of 6C, 12H, 6O. There are other sugars too, such as sucrose which is the common sugar we use regularly and lactose which is found in milk. That is why the word 'sugar' is used in the plural form here. Starches are made of many such units. They are called **complex** carbohydrates. Sugars are **simple** carbohydrate. Sugars are soluble in water, starches are not.

Most cereals also contain other nutrients which our bodies need. They contain protein; they contain minerals like iron and calcium. They contain some **vitamins** too. Look at the table on page 117 of your WorkBook. It shows some of the things that cereals contain. It shows how much of these nutrients are in 100 grams of cereal.

The weight of minerals is very small compared to the weight of cereals. It is measured in milligrams.
1000 milligrams = 1 gram. We write mg for milligrams, g for grams.
About 70 to 110 grains of rice weigh 1 gram.

> A rough guide to small weights –
>
> | | |
> |---|---|
> | a new 50p coin weighs | 3.8 g, |
> | 5 Re coin ('dollar') | 9g, |
> | a 1 inch marble | 19g, |
>
> about 80 grains of medium sized rice grain weigh 1g, so about 12 mg per grain

Think! Think!

Why is the number of rice grains in 1 gram of rice not exact?

It will depend on the kind of rice - weight and length of grains differ a lot from variety to variety

What makes up most of the weight of cereals?
Which of these cereals has the most iron? Which has the least?
Which of these cereals has the most calcium? Which has the least?
Which cereals have the most protein? Which has the least?
Which cereal is the least nutritious?
What cereals do you eat? What is made from them?

Make a guess - how many grams of cereals do you eat at one meal?

Guess the weight of the cereals before cooking. Does cooked cereal weigh more or less? Why?
b. Proteins are body builders.
Pulses like *dals* (name some), *chana*, *rajma* and *lobia* contain protein. Pulses also have starch in them. How can you check if they do?

Meat, fish and eggs are rich in protein.

Milk and things made from milk too are rich in protein. Name some things made from milk. When we eat these foods, the proteins in them get broken down into smaller parts in our digestive systems.

These broken down proteins are absorbed by the intestines. They are carried to the different cells of the body (how?).

The cells use these to make other kinds of proteins that make up the body. Cells of hair, nails, muscles and blood contain large amounts of proteins.

100 grams of mutton, with most of the fat removed, contains 74 grams of water, about 21 grams of protein and 4 grams of fat.
Other things make up the rest (how many grams)?

Other than water, what makes up most of the weight of meat?

Think! Think!

Do you think the muscles of our bodies are similar to the muscles of other animals?
Do you think our muscles too are made up of a lot of protein?

Have you grown taller and heavier since last year? How do you know this?

From measuring or some other way such as clothes not fitting … you may need to give these hints in class.

By how much? Where did this extra weight come from?

New cells grow in your body as your body grows. The body needs proteins to make new cells.

Think! Think!

Are there parts of an adult's body which keep growing? Name them.

> Hair and nails are the obvious answers!

Our bodies constantly lose cells. Many cells die. Dead cells are shed from the skin and from the intestines. Other cells which die are eaten up by special cells in the body. New cells grow to take their place.

What kinds of food do you and your family eat which contain proteins?
If you eat only vegetarian food, you must eat cereals along with pulses to get all the proteins your body needs.

Additional information:

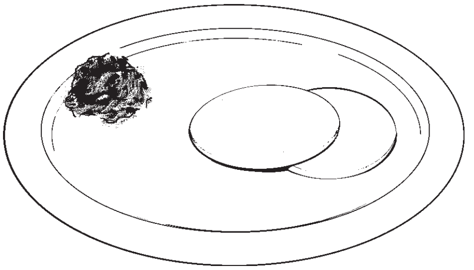
> The proteins we eat get broken down into chemicals called **amino acids**. These are then used to make the different kinds of proteins - such as hormones, proteins in the muscle, digestive enzymes, haemoglobin and keratin of nails and hair. If all the amino acids are not present, in the correct proportion for making a certain protein, then they are used up for energy. Some of the amino acids we get from our diet are called **essential** amino acids; our bodies cannot synthesize them. The quality or 'biological value' of protein depends on the presence of these amino acids in the right proportion. The highest quality protein in an infant's diet comes from mother's milk; the egg also consists of high quality protein. The protein found in grains lacks an amino acid called lysine, which is present in pulses. Eating them together gives us complete protein. Incidentally, if you recall the iodine test for starch from class IV, *dals* do turn blue. Not all of *dal* is protein! It contains about 60% of carbohydrates. Protein makes up about 20% of the weight; the rest is moisture, fibre and some minerals. Soya contains about 45% protein, 20% carbohydrates and 20% fat.

c. Our bodies need vitamins and minerals. Some vitamins help our bodies to use up the starch and protein we eat.

Minerals, along with proteins, make up a large part of our bodies. Bones have calcium and phosphorous. The red cells in our blood, which carry oxygen to the cells of our bodies, have iron.

Green leafy vegetables contain a lot of iron. Eat plenty of these tasty vegetables.
They have a lot of vitamin A too. What dishes do you eat made from leafy vegetables?

Fresh green leaves
tied up in a bunch
washed well, chopped up
cooked with dals (or by themselves)
Add a dash of lemon
And...Mmmmmm slurpy good!



Sprouts, and fermented foods too contain vitamins.
Name some fermented food eaten in your house.
Name some cereals and pulses you eat after sprouting.

Eat lots of fresh fruits and vegetables - they have minerals and vitamins which our bodies need.

We measure the cereals we eat in grams. Recall how many grams of cereals you eat every day. We measure minerals and vitamins in milligrams.

Suggestion:

> A little discussion on the choice of meter or millimeter for example would help enormously. You could do this with questions like 'would you measure the distance from your house to school in km, m or mm? Why?'

Though we need only small amounts of vitamins and minerals, we can get sick if we don't get them.

For example, if we don't get enough vitamin A (which we get from leafy vegetables and yellow and orange fruits and vegetables), we can slowly become blind. If we don't get enough iron (found in leafy vegetables, meat and some cereals), the blood cannot carry oxygen to the cells. If we don't get enough calcium (found in milk, leafy vegetables), our bones become weak.
If we don't get enough iodine (from vegetables, sea food and iodised salt) we get a disease called goitre.

> Iodine is present in vegetables if the soil in which they are grown has adequate iodine. Large areas of India have soils deficient in iodine. That is why use of iodised salt is recommended

Vitamins also help us fight diseases caused by microbes.

Additional information:

> Iron found in vegetarian diets is not absorbed easily by the body, because these diets also contain other compounds which prevent iron absorption. Eating vitamin C with iron rich foods increases iron absorption. But vitamin C is easily destroyed by heating; adding fresh lemon juice in the plate rather than while cooking will ensure that vitamin C is not all destroyed.

We also need to eat some fats as part of our food. Some vitamins like vitamin A dissolve in fat, and then get absorbed by the intestines. Butter, ghee and oils are fats.
What cooking oil do you use at home?
Take a few seeds from which that oil is pressed. Crush them between sheets of paper. See if you find oil smears on the paper.
Which of these has oil you can press out – polished rice, groundnut, *til*, potato, *moong dal*, clove?
Does milk contain fat? How can you find out? Try your idea.

Remember this

Our bodies need many different minerals and vitamins. No single food we eat has all the nutrients we need. To get all the nurtrients, eat a variety of foods - eat different cereals, *dals* and vegetable and fruits. Eat plenty of fruits, vegetables and sprouts. Eat cereals which are rich in minerals such as *ragi*, *bajra*, and *jowar*. If you eat mainly rice, choose parboiled rice, or rice which is not polished much.

e. You should eat starches, protein and vegetables every day.
Look at pages 119-120 of your WorkBook.
In each plate, some dishes have been served.
Add one or two dishes to the plate to make the meal complete.

Additional Information:

> A large number of people eat diets deficient in protein. The recommended amount is 1 g of protein per kilogram of body weight per day for adults. The requirement is higher for children, pregnant and lactating women and also if protein quality is poor. For example, infants need 1.2 g/kg of egg protein, or about 2g/kg of vegetable protein. Note that 1 g of *dal* does not have 1 g of protein! You should account for this when calculating how much *dal* a healthy diet should contain.

How diseases spread

2. Getting Sick

a. Recall the last time you were ill.
On page 121 of your WorkBook, answer these questions:
When did you fall ill?
How did you know you were ill?
Describe some things which you experienced because of the illness - fever, vomiting, pain or anything else?
Did you go to a doctor?
Did you find out what had made you ill?
Is there anything else you want to say about the experience?
Did others in your family fall sick around the same time?
Did they have the same illness?
Who got sick first?
How do you think that so many people got sick around the same time (or one after another)?

b. Did you ever catch a cold or flu when everyone in class had it too? Why do you think many people got sick one after another?

c. Look for stories in the newspaper of diseases spreading through a city or town or locality. It is usually called an outbreak, such as an 'outbreak of cholera'. Find out what causes this disease.
Ask and find out if this happens every year.
Does this happen in the same season every year?

If so, in which season?

3. Many diseases are caused by microbes. You learned about some of these microbes last year. Here are pictures of some microbes which cause common diseases:

You cannot see them without a microscope, but they are there - in the air, and in unclean food and water. Anyone who breathes them in, or eats or drinks such food and water can get sick.

Think! Think!

From where do these microbes get into the air, water and food? How do they get into the air? How do they get into your food and water?

a. Microbes which cause diseases like tuberculosis (TB), flu and cold get into the air from someone who has these diseases. Guess how. Think of two things they can do to prevent the microbes from getting into the air.

b. If you handle food and water with dirty hands, microbes can get into food and water.

i) Get two clean glasses. Fill about three fourths of each glass with water.
Look at your hands in class. Do they look clean?

Keep one glass with the teacher. Pass the other around. Each of the students who said their hands were clean should dip one hand in the glass. Compare the water with the one in the teacher's glass each time.

Did the water look any different after one person dipped his hand in it?
After two people dipped their hands in it?

After how many people dipped their hands did it look dirty?
Would you drink this water?
Would you have drunk this water after the first time a hand was dipped in it?
Do you think everyone's hands really were clean?

Additional Information:

> Of course, microbes may be present even if the water does **look** clean. I decided to do this activity because even adults often simply look at their hands and declare that they are clean!

Look at the water pot on page 122 of your WorkBook.
What would you choose to take water from the pot - the glass or the dipper? Why?

ii) Microbes which cause cholera, jaundice, polio and some other diseases often get into our water and food. People who have these microbes in their bodies pass some of them in their stools. Stools passed in the open can easily get into water bodies.
Can they enter into the groundwater too?

Sometimes, sewage and water pipes have leaks. In the rainy season, rainwater covers the pipes. Sewage

water, with the microbes in it flows into this water, and into the drinking water pipes. If you drink this water without boiling, you can get sick.
Boil drinking water in the rainy season; bring the water to a vigorous boil, then keep it boiling for at least one minute. Boil water whenever there is an outbreak of any diseases whose germs spread by water.

> Boiling kills most of the microbes.

If someone doesn't wash dirty hands with soap after passing stools, and touches food, the microbes get from the stools into the food. Don't eat any food touched or served with dirty hands!

Some diseases of the skin caused by fungus, such as ringworm (caused by a fungus, not a worm!) spread by touch. The microbes get on the clothes of the infected person. If you share these clothes, your skin can get infected too.

Some other diseases too, such as red eye, measles and chickenpox spread by touch.
Make a guess -how can the microbes causing red eye spread by touch?

Diseases can also spread if a person gets an injection from an infected needle. Microbes which cause AIDS and some kinds of jaundice only spread when blood and other liquids from an infected person enter our bodies.

This can happen if the same injection needle is used for everyone without first boiling it.

Microbes also spread when flies sit on stools and other places where they are found, and then sit on your food. Flies can also spread microbes which cause red eye when they fly from a red eye to a healthy eye.

If mosquitoes bite someone with malaria or dengue, then bite others, others can get these diseases too. Rats spread diseases too, such as plague.

4. a. Some diseases are caused by larger animals - like worms which live in intestines.
The drawing shows one such worm - the roundworm.

If you eat food which has its eggs, they get into your intestine, hatch and grow there.

Classroom experience:

> When I first introduced this topic, some kids thought eating breakfast (chicken) eggs can cause intestinal worms! It is a common belief that eating too many sweets causes worms; the children's idea then is no more illogical! That is when I decided to include the life cycle of one intestinal parasite in the book. In class I made the point by saying "if you eat food handled by hands which have these eggs on them, 'from the toilet', you will get the worms too". There was a loud, unanimous exclamation of disgust at this. But I had made my point. It is also important to point out that some of these worms cause intense itching in the anal region, and scratching can lead to contaminated hands, and therefore food.

They eat the fully digested food in the intestine, and suck blood. They take away the nutrients your body needs!

Additional information:

> Intestinal parasites have very simple digestive systems. They take in already digested food through their skin as well as mouth. This might be of interest to kids as they were shown digestive systems of humans and other animals in class IV.

The female worm lays thousands of eggs in the intestine every day.
These tiny eggs are passed in the stools. The eggs are so small, about 20 of them can fit side by side in 1 mm. These eggs then can get into food, and if someone eats this food, the eggs now enter that person's intestine and grow and lay eggs which are passed in the stools.
How can the eggs get from the stools into someone's food?
Have you or anyone in your family ever had worms? How did you (or they) know you (or they) had worms? Did you get help from a doctor?

b. Lice can spread from one person to another if they share combs, caps and hair bands, or sit or play with their heads close together.

Remember this

Always wash your hands before eating or handling food, and eat nothing others handle with unclean hands. Don't eat any food on which flies have been sitting. Wash vegetables and fruits well before eating them.

5. Not all diseases are caused by microbes. People who smoke, or chew tobacco can become seriously ill. If the air where we live or work is not clean, if our food and water contain harmful chemicals, we can become seriously ill.
To be healthy we need exercise, clean air, water and food. Our food should have all the nutrients for our bodies.

Know these words

vitamins, minerals, proteins, carbohydrate, nutrients, nutritious, contaminate, contamination: When food and water have harmful chemicals or microbes in them we say they are contaminated.

EXERCISES

Interesting questions

1. Name 5 leafy vegetables available in your area. You can write their names in any language. Which of these do you like the most? How often do you eat it?

2. If you eat 50 g of leafy vegetables a day, you'll get enough vitamin A.
How many grams does a bunch of palak or any other leafy vegetable weigh?
How many people can share this bunch so each person can have at least 50 g?

3. The table on page 123 of your WorkBook, shows the amount of vitamins in 100 g each of apple, banana and guava. Which of these grows near your city or town? Which one is cheaper? Which one would you buy? Why?

4. Did you or anyone in your family ever have to take vitamin, iron or calcium tablets or tonic? How much of these were in each dose?

5. Does everyone in your family eat together? If not, who eats last? Do you think this person (or persons) gets enough food? What can be done so every one gets a fair share?

6. Name a plant or plants you can grow for fruits or vegetables. These plants should need only a small place, be easy to grow and give enough fruits or vegetables for your family for at least one meal at a time.

7. a) Point out in which of these cases we should wash our hands before eating or handling food. Why? After a trip to the toilet; after travel in crowded buses; after sneezing or coughing into your hands; after playing; after returning from school.

Trick question! You should wash hands in all these cases.

b) The drawings on page 124 of your WorkBook, show a man who has just returned from the toilet, and who later shares a papaya with the boy. But there are things he should do before he cuts the papaya. Number them in the correct order. Write your number in the circle next to each drawing.
There are things the boy should do before he takes the papaya. In the same way, number them in order too.

8. Name some things sold outside your school which you or your friends buy and eat. Which of these are good for you? Do you think they are clean (do you often find flies on them, are the hands of the person who sells them clean, do people cough or sneeze on them)?
If you buy fruits, do you wash them before you eat them?

9. Think of a guava growing on a tree in a field. Think of all the steps in its journey to the market and finally to your hand when you buy it. How can this guava get germs on it?
Explain to your friend why he or she should wash the guava well before eating it.

10. Name some places or things which attract flies. What can you do to keep flies away from your area?

11. Did you or anyone you know had to get blood or stool tested? Why was this test needed?

12. Circle the diseases which spread from one person to another:

diabetes, heart disease, anaemia, cataract, polio, hepatitis, flu, cold, cancer.

13. Suppose someone in your house has a cold. How can you catch it?

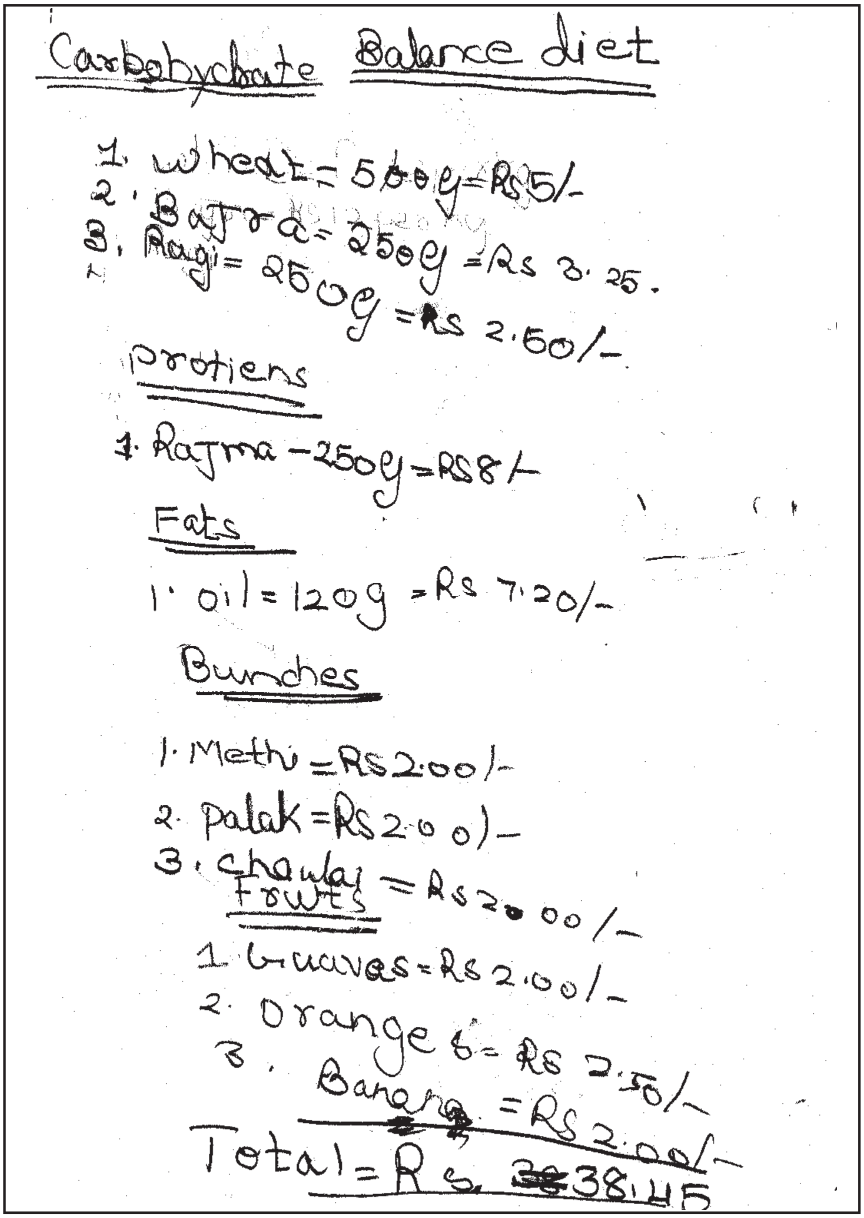
What can they do to prevent it from spreading to others in the family?

14. Is it true that if even one child has polio, others can get it? Why?
15. Did your parents or grandparents get smallpox vaccinations? Why do you think no one needs to get smallpox vaccinations now?

Ask and find out

1. Something other than vitamins and minerals which we take and which is measured in mg.....but which has a very strong effect on our bodies.
2. Was the cereal eaten in your family or your area different when your parents were little? Which cereal was eaten then? What was made from it? Why did they start eating a different cereal? Which of these cereals is better for you?

Children's work - an example



Carbohydrate Balance diet

1. wheat = 500g = Rs 5/-
2. Bajra = 250g = Rs 3.25.
3. Ragi = 250g = Rs 2.50/-

protiens

1. Rajma - 250g = RS 8/-

Fats

1. oil = 120g = Rs 7.20/-

Bunches

1. Methi = RS 2.00/-
2. palak = RS 2.00/-
3. chawlai = Rs 2.00/-

Frowts

1. Guavas = Rs 2.00/-
2. Oranges = Rs 2.50/-
3. Banana = Rs 2.00/-

Total = Rs. 38.45

Figure it out

Classroom experience:

> I thought this would be a very difficult exercise, requiring mathematical skills and paying attention to many different factors. I was glad though that it was easier than I expected. Some children gave in to temptation - I had one kid who added an ice cream cup to her list! Some children went overboard - buying 50 grams of *ragi* flour, 50 of *jowar* etc, which would be difficult to cook. But that is OK; you could ask if they could use one kind one day, another next. Writing down their solutions on the board and discussing it got the whole class involved. Be sure to find something to praise in what the kids do - they deserve it for attempting a difficult problem!

Find out the price of things given in the list below. Be sure to write it as Rs _ per kg or per bunch etc.

Now suppose you have only Rs. 40 with you. You have to buy a day's food for a small family. You need to buy at least

1 kg of cereals
300 grams of dal or some other source of protein
120 grams of fat
1 kg or 2-4 bunches of vegetables
As many fruits as you can buy.

Try to buy things which are rich in minerals and vitamins.

Wheat	bajra	rice	ragi	boiled rice	sprouts
groundnuts	tur dal	rajma	beef	mutton	chicken
bangra	bombil	pomfret	prawn	eggs	potatoes
methi	palak	radish	chaulai	green peas	dudhi
pumpkin	tomatoes	cabbage	brinjal	green beans	carrot
lemon	apples	grapes	guavas	orange	papaya
banana	milk	oil	ghee	ice cream	
potato chips	cold drinks				

Classroom discussion

Your teacher will write on the board the things that some of you planned to buy. Is there anything missing in their list? Could they have chosen some thing even better? What?

Show and tell

1. There are many plants which are not grown as a crop, but some of their parts can be eaten as vegetables. You don't have to buy them from the market. Find out about such plants which grow in your area. Find out their names, which parts are eaten and what dish is made from them.
Bring to class this plant or its part which is eaten. Example: the leaves of drumstick tree make a tasty vegetable, and are a good source of calcium and iron.

2. Parts of some plants which are grown as crops, but are not usually found in the market, can be eaten as vegetables. Find out about such plants.
Bring to class one such vegetable. Example: flowers of the pumpkin plant.
Tell the class what dish is made from it.

Recall and write

Did you or anyone you know ever have a scratch, wound or a fracture?
How long did it take for the wound to heal? Where did this new skin and muscle come from?

Play with words

a) Use some of these words to describe each of the food items below:
crisp, crunchy, tangy, chewy, light, fluffy, soft, tasty, slurpy, creamy. You may also use other words if you like.

Sprouts, roti, idli, mango, dried and roasted chana, groundnuts, orange, cucumber, curd (dahi). Add three of your favourite foods to this list.

b) Read the story and tell your teacher which one you would rather buy.

Sunita and Meena each had a rupee to spend. After school, Sunita bought an orange with her rupee and Meena bought an ice candy with hers - she loved to suck the sweet frozen candy in the plastic packet.
As Sunita starts peeling her orange, the lovely smell spreads all around, making everyone at the bus stop want to eat one too. Meena tries to tear the plastic of her ice candy, and finally tears it open with her teeth, and spits out the bit in her mouth. She gets a scolding for it!
After some time, while Sunita is still enjoying her fresh, sweet and tangy orange, Meena is sucking on only ice left in the plastic packet.
That packet was not very clean, and she gets an upset tummy the next day.
But Sunita is fine and goes to play while Meena has to go to the doctor.
Suppose there is a fair at the school and you and your friend have to manage stalls selling different foods.

i) Your friend has soft drinks to sell, you have tender coconut water. How will you convince people to buy the tender coconut instead of soft drinks?

ii) Suppose he has chocolates to sell, and you have oranges.
How will you convince people to buy oranges instead of chocolates?
You do not have to write a story.

Ask a question

Ask a question about microbes and diseases. Think of how you can find the answer.

DID YOU KNOW

1. Vitamin C is found in fresh fruits and vegetables. Sailors who travelled by ship for long periods could not get fresh fruits and vegetables for many days. They suffered from a disease called scurvy caused by not having enough vitamin C. But at that time no one knew what caused the disease. James Lind, a surgeon on the ship Salisbury, tried to find out what could cure them. He chose 12 sailors who had the disease, and treated them with different things; two of these sailors were given oranges and lemons. They got much better, the others did not. Almost two hundred years later it was discovered that it was vitamin C in lemons which helped to prevent scurvy.

During times of drought, when you cannot get fresh fruits and vegetables, the only way to get enough of this vitamin is from sprouts.

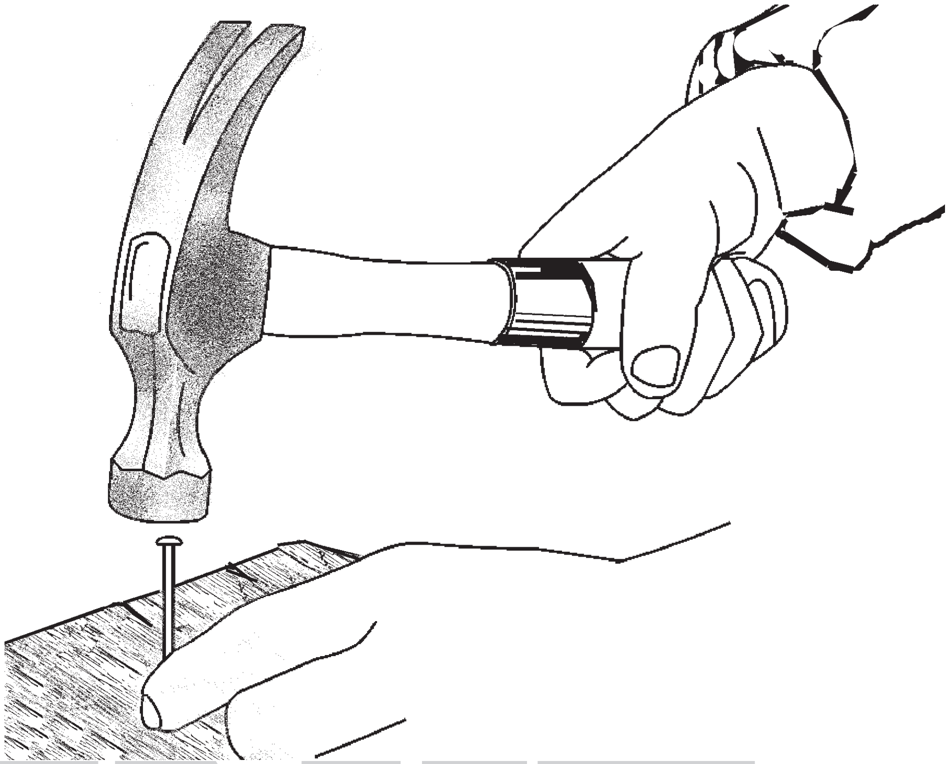
2. Getting vitamins and minerals from food is always better than getting it from tablets and tonics - unless a doctor asks you to.

3. In many parts of the world, diseases became fewer when people started to keep their surroundings clean, when they had sewage systems and learned how important it was to wash hands and keep food and water clean.

4. When people have diarrhoea, and pass watery stools often, their bodies lose a lot of water. They can become very seriously ill if they don't take water to make up for what they lose. A little salt and sugar should be added to the water - a pinch of salt and a teaspoon of sugar for every glass of clean water. This can save their lives. This water should be given in small quantities many times.

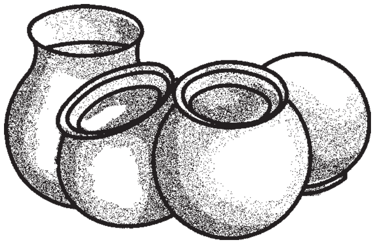
5. Just by eating a lot of protein you can't build strong muscles - you need to exercise those muscles!

In the same way, eating a lot of starch doesn't make you very energetic - you may become fat if you eat more than your body uses up!



UNIT 5

MATERIALS



CHAPTER 10
THE THINGS WE USE

Why I developed this chapter

Many state syllabi have a unit on materials. It is difficult to teach what is a material and what is a thing if we try to do so by defining them. In this chapter I have tried to bring this out entirely by tasks and activities. The properties of different materials are brought out through a game, and without using difficult and abstract terms.

Use of non-biodegradable objects such as plastic bags for a one time or short term use is very common, and the environmental problems that arise from this, such as the problem of disposal, are enormous. Therefore this aspect is emphasised in this chapter.

Often school text books cover the topic 'states of matter' by defining solids, liquids and gases. Consider something like sand - it takes the shape of the container too, and it 'flows' in some sense. The physics of sand is actually a relatively new and interesting area of research. In this chapter I have tried to bring out some of the properties of sand that make it so interesting.

Main Objectives

1. To draw children's attention to different materials and their properties, and how the choice of materials has changed with time, influenced by newly developed technology.

2. To teach about biodegradable and non-biodegradable materials, and so to sensitize children to environmental issues arising from our choices

1. We use things made of many different materials.

a. Choose any one thing that you have with you - like an umbrella, a pencil, a bag, etc. Look at it closely. Is this thing made of many parts? What is each of these parts made of?

Write this down on page 133 of your WorkBook.

b. Why we choose different materials to make different things.

Here's a list of materials:
paper, clay, wool, gold, wood, plastic, wax, leather, glass, cotton, rubber

Write each on a slip of paper and fold it.
Put the folded slips in a box or bowl.

Here's a list of things:

Broom, pencil, umbrella, spectacle lenses, towel, road surface, bat, chair, bell, shoes/slippers, plate

Write each on a slip of paper and fold it. Put the folded slips in a different box or bowl.

Divide the class into two groups. One student from the first group should pick a slip from the first bowl (material). One student from the second group pick a slip from the second bowl (thing). Read the slips and put them back in the bowls. The student who has picked the thing has to tell if that thing can be made from the material that the first group picked, and why or why not.

Classroom experience:

> Children enjoyed this game very much. I insisted on every child in the group contributing a statement. Many at first were very reluctant, but gentle persuasion and encouragement worked.

Suggestion for blackboard work:

> Each time they described a property - for example, if someone said 'you cannot make an umbrella out of clay because it soaks up water' I would write 'clay - soaks up (absorbs) water; or 'you can make spectacle lenses out of glass because you can see through it' - I would write "you can see through it - it is transparent'. I never once used the word 'property' - I never had to!

The group gets a point if the student gives answers.
If no one in the second group can answer, the first one can try and win the point.

Switch bowls for the second round.
c. Think of a picnic you have been on, or plan one. Think of everything you do from the time you wake up to the time you return.
What different things do you use all day and what are they made of? What do you use to pack food and drinks? What do you use to eat and drink from? What do you do with the leftovers and with the used containers, plates and glasses, and things like wrappers and packets?
If you throw them away, what happens to them after you throw them in the garbage?
Which ones will decompose without adding harmful things to our soil and water?

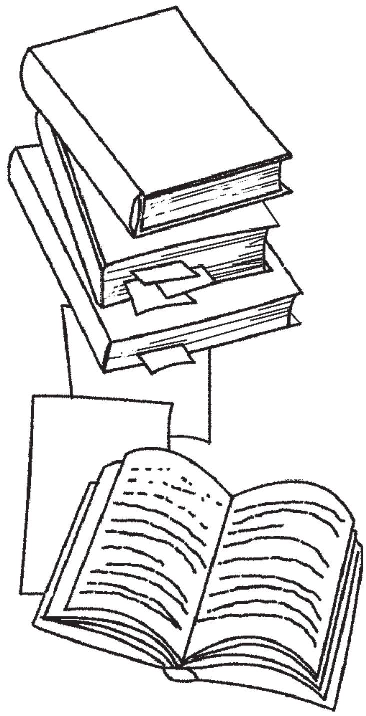
Which ones will not decompose?
Does anyone collect them from the garbage?
Guess what they do with them.
Suppose you didn't throw all kinds of waste in the same bin. Will it be easier for the people who collect some of them? How?

d. Make a cup with a leaf:
You may use a leaf and small sticks as pins if you need any.
What kind of a leaf did you use?
Write down the name of the plant from which you plucked the leaf if you know it.
Was it soft or stiff, thin or thick?
On pages 134-135 of your WorkBook write down how to make a leaf cup. What kinds of leaves are easy to work with?
What kinds are difficult to make into cups?

Can you use leaves of banana or canna? Try it. Write down whether it worked, and why if it didn't.

Remember to wash your hands well after this activity!

2. From materials to a final product
a. This is how paper is made from wood in factories:



i) Wood is chopped into small pieces, about the size of a matchbox.

These pieces are put into a tank along with hot water and chemicals.

> Sulphite salts with excess of sulphurdioxide; sometimes sodium sulphide and caustic soda are also used

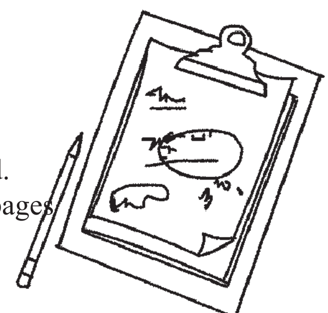
ii) After some hours wood turns into a soft cottony pulp; to this pulp lots of water is added to rinse the pulp so that the chemicals are removed.
iii) Then the pulp is bleached white by adding some chemicals.

> Chlorine sometimes nascent oxygen

iv) This pulp is then spread on a wire mesh to make thin sheets. These sheets are pressed to remove water.

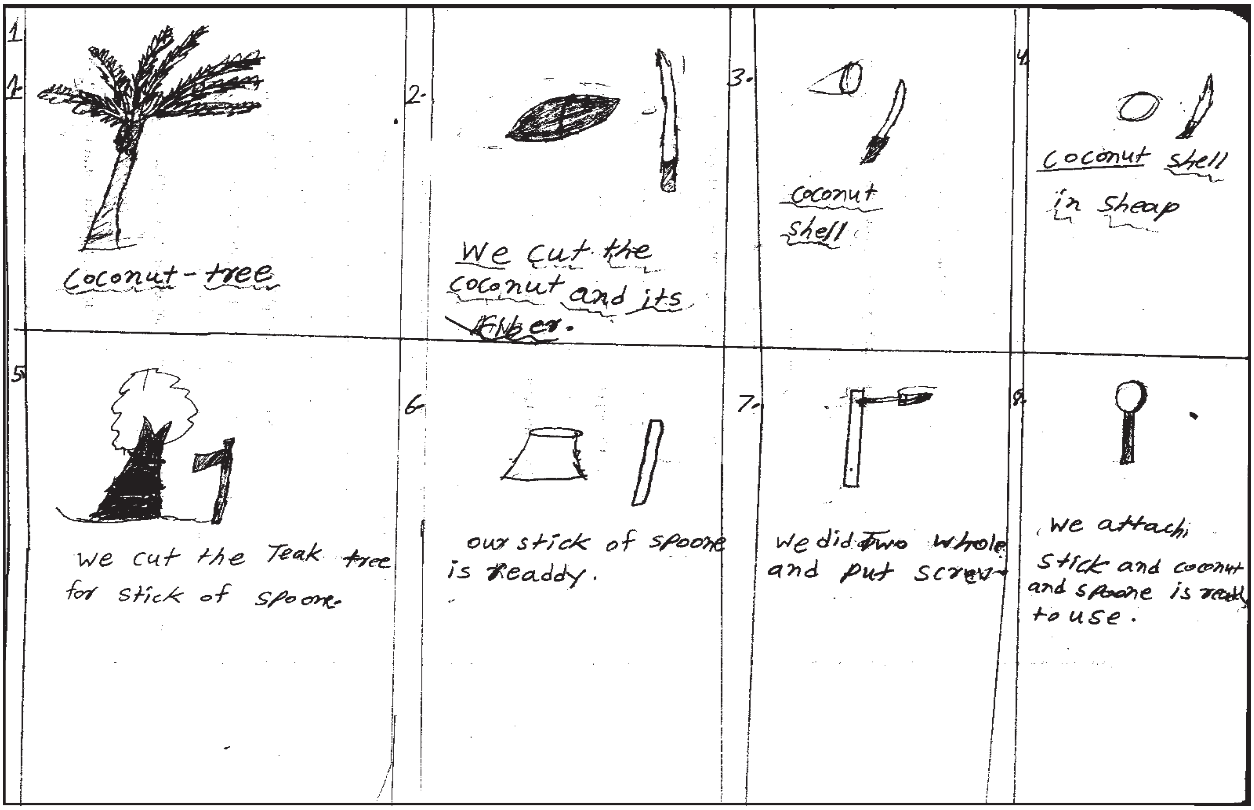
v) This pulp sheet (which is still a little moist) is passed through one roller after another to remove all the water.

vi) The paper is then passed over heated rollers to make it absolutely dry.



vii) The finished paper is rolled up and then the rolls are cut to the size we need.
b. Now write a picture story of how to make a spoon from a coconut shell on pages 135 - 136 of your WorkBook.

Children's work - an example



Classroom experience:

> I took a green coconut, the kind you can get from a vendor of coconut water, a coconut with the outer fibres removed, and a spoon made from the shell. It was amazing - once they saw the raw material, the children drew lovely picture stories complete with the tools they would need at each step.

3. Solids, liquids, gases
Think of a stone, a handful of fine sand, water and water vapour.

If you put each of these in a glass, which will take up the shape of the glass?

Which of them can you make into a heap -
stones, sand, water, water vapour?
Which one (or which ones) can you never make into a heap?
Which one (or which ones) can flow?

Which one expands to fill all the space it can get?
Which of these can you hold between two fingers and turn as shown?

Know these words

bleach, moist, mesh,
recycle: when something, such as paper, is made into something which can be used again, it is recycled;
bio-degradable: things such as plant and animal parts or things made only of these parts, which rot are called **bio-degradable.**

EXERCISES

Interesting questions

1. a) Name some things which you have seen sometimes as a solid and sometimes as a liquid.

b) Are they liquids when they are warmer or colder? How do you know?

> Possible ways of knowing temperature (touch, associating liquid/solid state with the weather (ghee, coconut oil), or watching something melt because of heating)

2. Which of them have you seen disappear into vapour? Did any of them turn from a solid directly to vapour?

> Naphthalene balls, camphor. Iodine and frozen carbon dioxide are other examples but are not common.

3. Name some old or used things you give to someone who collects them for recycling.

4. When your parents or grandparents were little, in what did they pack their food when they went on picnics or travelled?

5. Look at the different parts of a bicycle and write down what they are made of. Tell your teacher why you think that material is used for that part.
Look at some bicycle parts which are made of metal. Is the same metal used for all these parts?

> Bicycle frame: mostly made from steel, newer and race bikes from aluminium (for lighter weight)
> Wheels: rim, spokes and hub made from steel due to strength
> Tyres: tire, inner tube made of rubber, inner tube valve: brass, alve cap: plastic
> Saddle: leather (old), plastic with steel springs and frame: (new) foam for cushioning
> Chain transmission: chain wheel, sprocket wheel (back), chain: steel
> Chain guard: sheet metal (old), plastic (new)
> Headlamp, bicycle lamp: steel + glass (old), plastic (new)
> Front and rear mudguard: sheet metal (old), plastic (new)
> Brake: hand grip: aluminium, cable: steel, pads: rubber
> Pedal: steel and rubber/plastic

6. In which of these places should you throw trash?

a) In nallahs, through the window from buses and trains, on the streets, in garbage bins, on lawns, on playgrounds, over compound walls.

b) If you do not find garbage bins when you have trash to throw, what will you do?

I hold on to it and throw it in a trash can when I find one.

7. Thin polythene bags are used for shopping even though they are not bio-degradable, are used only once and thrown. In the garbage cows eat them and get sick or die. Sometimes people throw them in water, where they harm fish and other creatures. They also clog drains in cities and towns. They make a mess everywhere!

a) Does anyone in your house use polythene bags?

b) What do they use them for? How often do they use them?

c) These polythene bags came into use about 15 years ago. What did people use before that?

d) If we had to stop using them, what can we use instead?

Ask and find out

Think of some things made of plastic. Were they made of some other material earlier? If so, what was the material?

What happens to the old newspapers that get collected by the 'raddiwala'?

Play with words

1. Name

3 things which are soft and 3 things which are hard

soft: cotton, wool,foam, flesh, hard: wood, steel, stone, bone

3 things which are smooth and 3 things which are rough

smooth: mirror/glass, polished marble, new steel plates , rough: sandpaper, some rocks, scrubber (for cleaning dishes, utensils)

3 things which absorb water

cloth, clay, sponge, soil, grains of rice/dals...

3 things which dissolve in water

salt, sugar, potassium permanganate, citric acid...

2. Name

Some things which are made into a pulp

mango, tomato and many other food items

Some things which are gritty

sooji, sand …

Some things which can be crumpled

paper, clothes …

Some things which can crumble

bread, biscuit, bricks...

3. Name some things which can be twisted,

wire, rope …

and some which cannot be twisted

wooden rod, stone pillar …

which can bend and some which cannot bend

which can be folded and some which cannot be folded.

Classroom discussion

1. Is sand soft or hard?

In appendix 3 a transcript of our classroom discussion is given. The discussion lasted an entire hour. I insisted that every child participate; sometimes I had to prompt them, sometimes deviate a little from the topic to get them started. Classroom discussions tend to veer from the topic. I allow some of it, but always bring it back to the topic. Although students explored this question in many directions, in very interesting ways, the next day when I asked them what they had decided, they were unsure what to answer – they thought I expected one of the two choices as the answer. The answers they had come up with were absolutely right. This is a great example of a question that does not have a single one word answer; that was the point of this discussion!

2. Did you ever see anyone collecting garbage from garbage bins?
Were the bins smelly? What things in the bin make them smell?
What can you do so that they can pick up the things they collect without rummaging through garbage bins?
Do you think it would help to have separate bins for dry waste and bio-degradable waste? How?
How does the garbage from your house go to the garbage bin on the streets, and where does it go from there? How often is it collected?
What can be done with bio-degradable waste?

DID YOU KNOW

1. Glass is made from sand, soda and lime which are mixed and heated to a very high temperature to melt them. Glass was first made many thousands of years ago.

2. It takes 12 kg of wood to make enough paper for a book like this. Factories which make paper use a lot of water, and can pollute rivers and streams. Save trees and water - do not waste paper!

3. In 1987, a small city in New York found that it had no place to dump its garbage - all the garbage dumps were full! In March that year, a barge carrying 3,200 metric tons of garbage went south, all along the coast looking for a place to dump it. Not a single city in the country agreed to take that garbage. So the barge went to Mexico, but they too refused to take the garbage. So it went all the way back, and finally, in October they burned the garbage and dumped the 430 metric tons of ash in the city.

4. For hundreds of years before pens were invented, people wrote with quill feathers by dipping their tips in ink. Metallic pens with nibs were made in 1828, but they too had to be dipped in ink for writing. Fountain pens were first made in 1884, with tubes which were filled with ink.

Ball point pens, which have been made for about 50 years now, have tiny balls at the tip which roll on paper, and ink flows around this ball while writing. Felt tip pens such as sketch pens have porous tips which are always wet with ink and you can write on even smooth surfaces like glass with them.

APPENDIX 1

Who eats what

(References are given at the end of this appendix. Reference numbers are given in parenthesis)

1. **Ant:** Eats: any starchy or sugary food material, oil & oily substances, seeds, dead creatures etc. Some ants eat slow moving insects.
   Eaten by: ant-eater, spider, black bear, lizards, birds
   (Ref. 1, 8).

2. **Aphid:** Eats: feeds on sap of flowers, leaves & stem.
   Eaten by: disguise & food for the larvae of lacewing fly, lady bird also feed on aphids, larvae of butter fly, beetles
   (Ref. 3)

3. **Ashy wren warbler:** Eats: insects like grasshopper, beetles, caterpillars etc.
   Ref. (5)

4. **Bat:** Eats: insects, fruits & nectar. Vampire bats suck the blood of other warm blooded vertebrates
   Eaten by: Brahminy kites
   (Ref. 10)

5. **Bear:** Eats: fruits, nuts, honey, flesh, red and black ants, berries, grasshoppers and wasps.
   Eaten by: other black bears and human beings.
   (Ref. 1, 3, 5, 10)

6. **Bumble bee:** Eats : nectar from the flowers.
   Eaten by: crickets, lizards, scorpions

7. **Carpenter bee:** Carpenter bees resemble bumblebees, but most of the top part of their abdomen is without hairs.
   Eats: wood
   Eaten by lizards, frogs, some birds, snakes
   (Ref. 3, 9)

8. **Beetle:** Eats: crops & stored food, nectar, pollen, some eat wood; lady bird beetle eats aphids & small insects
   (Ref. 1, 4, 9)

9. **Buffalo:** Eats : grasses, leaves from trees, reed barks near swamps, weeds, Eaten by: Human beings and other carnivores
   (Ref. 4)

10. Bulbul: Eats: fruits & berries and also insect & flower nectar (Ref. 5)

11. Butterfly: Eats: Nectar
Eaten by: praying mantis, birds
(Ref. 1, 9)

12. Caterpillar: Eats: leaves, aphids
Eaten by: frogs, snakes, wasp
(Ref. 3)

13. Centipede: Eats: hunts prey such as insects, crustaceans, snails & worms. Only in exceptional circumstances it eats plant matter.
Eaten by: snakes, lizards
(Ref. 3, 9)

14. Cockroach: Eats: feeds on carbohydrate food stuffs (it is a common pest in mills, bakeries & kitchens), plant matter
Eaten by: lizards
(Ref. 1, 3)

15. Crab: Eats: small molluscs and crustaceans & algae
Eaten by: Human beings & some marine animals
(Ref. 1, 3, 9)

16. Cricket: Eats: insects, plants & their roots. Some may be a menace in lawns.
Eaten by: lizards, frogs, Brahminy kites, toads & snakes
(Ref. 9)

17. Common Crow: (Has no particular food preference, will eat almost anything)
Eats: i.rats, offal, carrion, kitchen scraps & refuse, locusts, termites, fruits, grains
ii. eggs or fledging birds pilfered from nests

Jungle Crow: Eats: small animals like lizards, rats & mice, insects & debris of animal origin
(Ref. 1, 3, 4, 5)

18. Cuckoo: Eats: caterpillars & bugs.
Koel (a type of cuckoo) eats largely fruits & berries & also caterpillars & insects
Eaten by: Human beings
(Ref. 5)

19. 21. **Dog:** Eats: eats all types of foodstuff which human beings eat (omnivorous).
Eaten by: hunted by higher carnivore
(Ref. 4)

20. **Dove:** Eats: seeds gleaned on the ground, small fruits & berries.
Eaten by: higher animals like some eagles
(Ref. 5)

21. **Dragon fly:** Eats: flies & small insects like mosquitoes & aphids
Eaten by: lizards, frogs, toads, grasshoppers
(Ref. 3)

22. **Ducks:** Eats: vegetable matter, crustaceans (prawns, shrimps, lobsters), molluscs, aquatic insects, fishes
Eaten by: crocodiles & other carnivores in water

23. **Dung beetle:** Eats: larvae eat fine & coarse particles of dung. The adult scarab may also feed on dung but only on the fluids & finest particulate matter. Some scarabs can utilise any dung encountered, while others specialise according to texture, wetness, pad size, fibre content, geographic area & climate.

24. **Eagle:** Eats: frogs, rodents, ground dwelling birds, large insects, snakes & other reptiles, fishes, crabs; rarely jungle fowl & peacock, animals like young monkeys. Food is also obtained through piracy of other hawks.
(Ref. 5, 10)

25. **Earth worm:** Eats: humus in the soil
Eaten by: some snakes, hens, other birds
(Ref. 3)

26. **Egrets:** Eats: insects, fishes, frogs

27. **Fish:** Eats: microscopic plants & animals, animal waste in water & fishes smaller than itself.
Eaten by: larger fishes in the water body
(Ref. 4)

28. **Fox:** Eats: small animals and birds

29. **Frog:** Eats: insects, spiders, small fishes, slugs & other small worms
Eaten by: owls & snails
(Ref. 1, 2, 3, 9)

30. **Goat & Sheep:** Eats: all small herbs, & small grasses
Eaten by: higher carnivores like lion and tiger
(Ref. 4)

31. **Hen & cock:** Eats: seeds and worms
Eaten by: Human beings & other higher carnivores

32. **Heron**: Eats: mainly small shelled animals in water like prawns, lobsters, crabs, molluscs (snails, mussels) & fishes.

33. Honey bee: Eats: nectar, honey
Eaten by: bee eater

[The colony of honey bee consists of workers, drones & females. The workers collect nectar from the flower & make honey. They feed the nymphs & drones with the honey & the queen with royal honey. The workers are divided into various classes depending upon the function they do for the colony, there are only some workers engaged in the task of collecting nectar.]
(Ref. 1)

34. House fly: Eats: Sucks up fluid from rotting material or dissolves sugary food with saliva before sucking it up
Eaten by: spiders, centipedes, lizards & frogs
(Ref. 1, 3)

35. King fisher: Eats: fishes, tadpoles, frogs, aquatic insects, reptiles.
White breasted king fisher is less dependent on water & eats lizards
(Ref. 5)

36. Kite: (**Brahminy**) Eats: carrion, small snakes, bats, locusts, crickets, mice, lizards, fishes, frogs
(Pariah) Eats: locusts, crickets, mice, lizards, fishes
(Ref. 5)

37. Leech: Eats: sucks blood, decaying leaves. (Ref. 10)

38. Lizard: Eats: insects, spiders, small worms, ants
Eaten by: snakes, crows, kingfisher
(Ref. 1, 3, 4, 9)

39. Magpie robin: Eats: insects chiefly picked off the ground, & flower nectar as of Salmalia & Erythrina.
(Ref. 5)

40. Millipede: Eats: leaf litter & decaying vegetation
(Ref. 3, 9)

41. Monkeys: Eats: fruits, nuts, vegetables, leaves.
Eaten by: higher carnivore like lion and leopard
(Ref. 1, 4, 5)

42. Mosquito: Eats: nectar and sap of plants (both males and females), blood (females only for egg development) .
Eaten by: spiders, centipedes & geckos
(Ref. 1, 2, 3)

43. **Mouse:** Eats: stored food, plant parts etc.
Eaten by: weasels & stouts, owls, cats, mongoose, occasionally by bandicoots rats
(Ref. 1, 3, 8, 9)

44. **Mussel:** Eats: algae, animal debris & microscopic animals.
(Ref. 1, 3, 9)

45. **Mynah:** Eats: Fruits, insects & flower nectar.
Eaten by: higher birds like eagle
(Ref. 5)

46. **Owl:** Eats: Rodents, lizards, sometimes small birds & occasionally fishes.
Eagle owl catches mammals up to the size of hare, birds & occasionally fishes.
(Ref. 3, 4, 5, 8)

47. **Parakeet:** Eats: Fruits, paddy & other grains, wild figs, leaf buds, fleshy petals & nectar of butea (flame of forest) & other such trees.
(Ref. 5)

48. **Peacock:** Eats: Vegetables, grains, shoots, insects, lizards, snakes, rats etc.
(Ref.5)

49. **Pigeon:** Eats: Small fruits, berries, figs, cereals, pulses, groundnuts.
Hunted by: man, eagles & other carnivores.
(Ref. 5)

50. **Praying mantis:** Eats: small insects.
Eaten by: snakes.
(Ref. 3)

51. **Salamander:** Eats: small insects, spiders, worms & small molluscs.
(Ref. 1, 2, 3, 9)

52. **Slug:** Eats: roots of plants and small animals.
Eaten by: owls, peacocks, eagles.
(Ref. 1, 3, 9)

53. **Snake:** Eats: feeds exclusively on living prey.

54. **Sparrow:** Eats: Grains & cereals, seeds & buds, sometimes sparrows eat insects during the summer season, ants, kitchen scrap, basically an omnivore. (Young sparrow mainly feeds on insects.)
(Ref. 5, 9)

55. **Silver fish:** Eats: Fungi, lichens & other algae growing on tree trunk as well as decomposing plant matter, paper.
Eaten by: lizards.

56. **Spider:** Eats: Insects that are regarded as pests by man, some spiders hunt their prey.
Eaten by: birds, lizards, toad.
(Ref.1, 3, 6, 8, 9)

57. **Squirrel:** Eats: fruits, nuts, bark, gum, resins, larvae.
Eaten by: mongoose, bandicoot rats & other carnivores.
(Ref. 3, 4, 8, 9)

58. **Sunbird:** Eats: nectar & insects in flowers.
(Ref. 5)

59. **Tailor bird:** Eats: tiny insects, their eggs & larvae, flower nectar.

60. **Termite:** Eats: Wood & any plant material, wood fungi & humus.
(Ref. 1, 3)

61. **Toad:** Eats: Small aquatic animals, mosquito larvae, spiders, small insects.
(Ref. 1, 2, 3, 9)

62. **Turtle:** Eats: Insects, worms, molluscs, small fishes & some plant material.
(Ref. 3,6,4,9)

63. **Vulture:** Eats: Flesh of dead animals.
(Ref. 2, 5)

64. **Wagtail:** Eats: insects, spiders, invertebrates (small animals without back bone).

65. **Water hen:** Eats: insects, worms, molluscs, grain & shoots of paddy & marsh plants.
(Ref. 5)

66. **Water stick insect**: Eats: aquatic insects & larvae.
(Ref. 3, 6)

67. **Weevil:** Eats: Cotton, peas, apples, cereals & many other crops.
Eaten by: monkeys, sparrow & other insect eating birds.

68. **Woodpecker:** Eats: Ants, grubs of wood boring beetles, termites.
Pigmy woodpecker eats flower nectar, berries, banyan & peepal figs.

69. **Scorpion:** Eats: Crickets, grasshoppers & other insects which they can overpower. Can live without food or water for a very long time.
Eaten by: snakes.

70. **Moth:** Eats: turnips, cereals, grass, leaves.
(Ref. 9)

71. **Wasp:** Eats: Small hairless caterpillars, House flies, gadflies & hover-flies. (paralyses & drags any kind of prey they can)
Adult fire wasp lives on nectar.
(Ref. 9)

72. **Crane:** Eats: Shoots of grass & cereal crops, tubers, grains, insects & small reptiles.
(Ref. 5)

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Appendix 2

More on fruits

A fruit is the fully developed ovary, in most cases after fertilisation. The ovules turn into seeds.

A unit of a flower's female part - made up of a stigma, style, and ovary is called a carpel. A flower can have one or many carpel, sometimes fused together as in *bhindi* or hibiscus which have 5 carpel - you can see 5 distinct stigmas in their flowers. Flowers of the mango, *Ber* and all legumes are examples of those with one carpel.

To look at the parts of a fruit, consider the mango: the outer skin, which is peeled off before eating, is the exocarp (exo - outer); the fleshy part we eat is the mesocarp (meso - middle) and the inner hard shell-like part which encloses the seed is the endocarp (endo -inner). All these together are called the pericarp, which develops from the wall of the ovary.

The following are some fruits which are not as simple as the mango, and hence rather interesting:

Coconut - The coconut is a fruit whose exocarp is the smooth thin cover, which is green when fresh and turns brown as the fruit matures and dries; the mesocarp is fibrous. The endocarp is the hard shell that has to be cracked open, and contains the seed. What we eat is actually the endosperm (the fleshy part of the seed).

Pineapple - It is formed from several matured ovaries from the florets of an inflorescence (a group of many flowers borne on a single stalk or peduncle) united into a mass. The hard, fibrous but somewhat juicy stalk in the centre of the pineapple is the stalk of the inflorescence. The fruit develops without fertilisation, but if fertilised, as it sometimes is in some regions of the world, seeds may be present. It is pollinated by humming birds.

Custard apple or *sitafal* - like the pineapple, is made of many matured ovaries of a single inflorescence, arranged on a conical receptacle.

Pomegranate - The flower of the pomegranate has many carpel, fused together.
The walls of the carpel can be seen as thin, pale membranes in the mature fruits, forming many chambers each of which has many seeds. The edible part is the covering of the seed, which is fleshy and juicy. The pericarp is the tough leathery 'peel'.

Fig - The fruit develops from a specially adapted inflorescence, which has a bulbous shape with a small opening in the end and a hollow area inside lined with small florets. The flowers are pollinated by wasps. The female wasp lays eggs in the inflorescence, from which wasps emerge and pollinate the flowers on their way out through the opening. The seeds formed give the fig its crunchiness.

Cashew - Interestingly, what is called the fruit from which the cashew hangs is not the fruit at all but the peduncle or the stalk of the fruit that is fleshy.
The fruit is actually the hard cashew "nut", most of which is the large seed.
The other parts are not edible and are removed.

Apple, pear, *nashpati* - The actual fruit of the apple is the central portion that is called the 'core': it consists of a thin, transparent, papery exocarp, a thin fleshy mesocarp inside it and an inconspicuous endocarp; the seeds are present in this. Most of the fleshy edible part is actually not the fruit at all, but formed from the thalamus, the disc at the end of the stalk to which the petals and other parts of the flower are attached. The pear and *nashpati* are similar.

Orange and other citrus fruits - Each fruit is formed from a flower which has many carpel. Each segment enclosed in the thin transparent membrane develops from a single carpel. We eat the fibres inside which are swollen with juice and fill up the carpel's hollow interiors. The skin of the fruit, the rind, is leathery and has oil glands.

Wheat and other grains - most people don't think of them as fruits; but each grain is a fruit, in which the seed coat and pericarp are fused together and cannot be separated. The husk, or hull, in which the grains are housed are actually bracts. We eat the entire fruit, including the seed!!

Jackfruit: This fruit is also formed from an inflorescence. The fleshy part we eat are actually the part of the flowers called perianth - fused petals and sepals. The fibrous parts, which are not eaten, are undeveloped perianths. What we call the 'seed' inside is the fruit, the papery whitish covering is the exocarp, and inside it is white seed covered by the endocarp. It's the fully developed perianths that are eaten.

APPENDIX 3

Classroom Discussion

In order to maintain confidentiality, the children's names are not given here; they are replaced by one or two letters of a name. This is a slightly edited transcript.

Me: I have a question for you - is sand hard or soft?

Sh: My father says it is hard, my brother says it is soft but small grains of sand are hard.

M: When we put our hands in the sand it is soft but if we punch it, it is hard.

H: Sand & soil are same ... (*frowns*) ... like sandy soil.

Me: Is it hard or soft?

Ri: If we take only one sand particle it is hard, but it is impossible to take one sand particle. *(On the right track in his analysis. He keeps coming back to this point, but I still keep the discussion open)*

Sa: So the sand is soft.

A: Sand is hard, we make glass from it.

Me: Wood is hard but wood pulp is soft. Don't you think that some hard things can be made from something soft? (*and vice versa*).

{There was some more discussion, then silence}. I prompted with

Me: Why do we have sand on the playground?

An: Playgrounds are made of cement.

{There was some argument & finally 'An' agreed that the boundary is made of cement not the ground}.

Me: So why is there sand on the playground?

Sa: If we do long jump on sand we are not hurt but if we do it on cement then we are hurt so playground is made of sand.

Ri: There are many sand particles on the ground so we are not hurt....many sand particles are soft; sand is flexible.*(Back to his point…'flexible' is not quite the right word, but I knew what he meant)*

Me: What if there are many stones? *(Number is not the only thing that matters)*

Ri: We will be hurt. If there is more sand we are not hurt but if there is less sand we are hurt.

Sa: Sand does not absorb water so it is hard *(This is a new one!)*

M: When less, sand is hard but when more, it is soft *(this idea is taking hold)*

Sat: *(When specifically asked for a comment)* It is soft.

Ka: Same as 'M'.

A: If sand is soft then we should go down when we are walking on it.

Sh: It slips from our hands when we hold it so it is slippery.

Me: What is slippery?

Sh: It goes away softly from our hands.

Me: Can we run fast on sand? *(coming back to the excellent point made by 'A')*

Ri: While running we cannot pull out the leg easily.

Me: Pull or Push?

Ri: Pull also & push (*gives a practical demonstration*).

{At this point, I asked a child who had not said a word, but whose home town was on the coast}

Me: So ... is it easy to walk on dry sand or wet sand?

C: Wet sand. *(Everyone agrees, except 'Ak').*

Ak: It will be like a dog walking with splattering water.

SS: Wet sand is hard.

Ak: It is hard to walk on wet sand.

Sh: Where the sea starts the sand is hard.

Vi: When we walk on less sand our legs don't get hurt.

K: The sand burns in hot sun, our legs feel the burn.

Mm: Little sand is hard but if we take more sand we feel it soft.

Ca: same.

Anu: Sand is soft.

Ra: If we take little it is hard.

Sh: We try to press it … we cannot press it.

Sa: We do not fall in sand ground while jumping, so it is hard.

Sh: A pot of wet sand looks hard, but when I hold it. It breaks into pieces.

Ra: Loses shape when wet, it also loses shape when we hold it.

Kr: Sand is pressable, sand is wet inside *(pressable - what an expressive word!)*

Ar: Inside the sand it is hard soil.

Sa: Because of coldness on the beach the sand is wet *(Another new one!)*

Me: Is it cold because it is wet or wet because it is cold?

Ri: If it is hard when cold then at 12 noon it should be soft *{countering the proposed connection between temperature and hardness}*

Sh: It is cold because of the waves.

Me: What will happen when sand is rubbed on plastic?

X : The plastic will get torned *(this is the word the child used; the correct one is ' torn').*

Me: What will happen when sand is rubbed on wood?

SS: It will become hot & scratches will be seeing on it.

Sh: The sand becomes wet at night by high tide, but during the day time the upper sand dries by the sun rays & the sand is wet inside.

Sa: Sand does not absorb water.

A: If it is soft we should go down but we don't so is little hard & soft. *(starting to realise that it may be both)*

Me: We don't go down?

{There was a lot of argument and lively discussion, with demos and acting, about whether our feet sink in the sand, and exactly how many cms}

Chr: When we dig 20 cm in the ground it is soft.

Ar: Sand becomes hard after rains.

Ri: How sand is formed? *{Another digression – we delved into it for a bit}*

Me: Stones break & sand is formed.

Many: How do stones break?

Me: One way may be by air. The big stones fall & rub on each other; tiny pieces fall off & sand is formed.

Mn: When big stones fall sand is formed.

Ka: Nails when hammered on rocks soil is formed.

Many: During winters the water in the rocks freezes & turns to ice. The rocks crack & sand is formed. *(This was in their text books; they could not explain why & how the rock cracks).*

Ak: When lava comes out it melts & rocks are formed. Due to sun's heat it melts & sand pieces are formed.

Me: The Sun's heat is not enough to melt lava.

{After a few more contributions from kids on this topic, the discussion ended}

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Useful websites:

For information on communicable diseases:

http://www.who.int/en/ (of the World Health Organisation)

http://www.cdc.gov (The Center for Disease Control and Prevention)

For skymaps for your location (including positions of planets):

http://www.fourmilab.ch/yoursky/

Of general interest in astronomy:

http://apod.nasa.gov/apod/

FEEDBACK TO AUTHOR
(Small Science)

Name: …………………… Profession: …………………Relationship to pupil:………………..

School/
Institution:………………………………………………………………………………..

I have read the books ☐ partially ☐ completely ☐ tried the books with children.

1. Activities that are easy:………………………………………………………........................

…………………………………………………………………………………………………

2. Activities that are difficult:……………………………………………………………………

…………………………………………………………………………………………………

Why? (time limitation, material not available, any other):…………………………………

....

…………………………………………………………………………………………………

3. Class strength: ………………

4. Number of children in this curriculum with overall grade of:

Excellent: Good: Fair: Other:

Which of the units/chapters/activities were able to hold the children's interest/attention/enthusiasm all through?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

Which didn't?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

How can they be changed to make them interesting?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

5. How much did you depend on the teacher's book throughout the year?

☐ totally ☐ partially ☐ not at all

6. Give some examples of children's questions:……………………………………………

…...

……………………………………………………………………………………………

……………………………………………………………………………………………

7. Some examples of children's observations (apart from the specific ones they were asked to make in the book) :…………………………………………… …

……………………………………………………………………………………………

……………………………………………………………………………………………

Were the children able to use the work book on their own? If not, how much help/ guidance was required from the teacher?..

……………………………………………………………………………………………

……………………………………………………………………………………………

8. Any other comments on

a. The TextBook: ………………………………………………………….................................

b. The WorkBook: ……………………………………………………….................................

c. The Teacher's Book: ………………………………………………………..........................

9. Which other textbooks for Class 5 have you used?

…………………………………………..

……………………………………………………………………………………………

10. How do these books compare with them?...

……………………………………………………………………………………………

……………………………………………………………………………………………

…………..…………………………….
(Signature and Date)

Please mail to:
Homi Bhabha Centre for Science Education,
V. N. Purav Marg,
Mankhurd,
Mumbai 400088.

Mark the envelope 'Small Science Class 5'.

OUTLINE OF SMALL SCIENCE

CLASS I and II

Unit 1: Me and My Family
Unit 2: Plants and Animals
Unit 3: Our Food
Unit 4: People and Places
Unit 5: Time
Unit 6: Things around Us

CLASS III

Unit 1: The Living World
- Chapter 1. So many living things!
- Chapter 2. Looking at plants
- Chapter 3. Grow your own plant
- Chapter 4. Looking at animals

Unit 2: Our Bodies, Our Food
- Chapter 5. Our Bodies
- Chapter 6. Our Food
- Chapter 7. Our Teeth
- Chapter 8. Taking care of our body

Unit 3: Measurement
- Chapter 9. How many, how much?
- Chapter 10.How long, how high, how far?

Unit 4: Making Houses
- Chapter 11. Houses of all kinds
- Chapter 12. Make your own house

CLASS IV

Unit 1: Sky and Weather
- Chapter 1. Sun, wind, clouds and rain
- Chapter 2. Day sky, night sky

Unit 2: Air

Chapter 3. Fun with air!

Chapter 4. What's in the air?

Unit 3: Water

Chapter 5. Fun with water!

Chapter 6. Water and life

Chapter 7. Water and us

Unit 4: Food

Chapter 8. Where our food comes from

Chapter 9. Food in our bodies

Chapter 10.What is thrown out

CLASS V

Unit 1: The Web of Life

Chapter 1. Living together

Chapter 2. Soil

Unit 2: Moving Things

Chapter 3. How things move

Chapter 4. Making a cart

Unit 3: Earth and its Neighbours

Chapter 5. Our earth

Chapter 6. Day and night

Chapter 7. Earth's neighbours

Unit 4: Our Bodies

Chapter 8. What is in our bodies

Chapter 9. Staying healthy

Unit 5: Materials

Chapter 10. The things we use

Note: The topics in Class I and II cover environmental studies. Classes III - V are primarily concerned with science, though keeping in view social and cultural perspectives. The topics begin with everyday experiences and immediate surroundings in Classes I - III, moving gradually outwards. Classes IV and V make increasing use of measurement concepts