New Oxford Primary Science 5

Teacher's Guide

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A Course for Pakistani Schools

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Introduction

The Concept of the Course

This Teacher's Guide has been written to show you how to go about teaching the text in the pupil's book. Do not think of it as the last word in the matter of teaching science, but use it where you feel it will help. Don't be afraid to try out your own ideas and diverge where appropriate. Use additional material where you feel it is necessary, and always be aware that you have to relate what is being taught to the child's experience and environment.

Science is such a broad subject that it is impossible to cover each and every topic in a series of books like this one. We must begin by studying things that the child is familiar with. The teacher must not assume that the child knows or should know about certain things. A correct attitude must be developed, and one way of doing this is by encouraging the child to ask questions. If the child asks a question (no matter how simple or obvious) do not denigrate it in any way. This will surely put the child off asking further questions, and the whole purpose of science is to encourage a questioning attitutde about the world around us.

In general, the aims of learning science consist of the following:

* To learn about the immediate environment, man-made and natural.
* To develop an understanding of scientific terminology, and to learn that classification of objects and ideas makes it easier to understand them.
* To develop an open, questioning attitude towards the environment.
* To develop observation.
* To develop skills of experimentation, analysis, collection of data and the presentation of data.
* To develop inference: solving problems by using previously gained knowledge about a related subject.
* To develop an understanding of basic concepts.

Trying to give the child information is successful only to a certain extent. The power of memory is such that much of what is learnt by heart will soon be forgotten, not a few years from now, but within a

few months or even weeks. It is far better to encourage the child to be curious and observant, and to develop the right skills with which to tackle any problem. With these skills the children wiwhen it is necessary, be able to apply themselves to a given problem and learn the information that may be needed to solve the problem, or delve deeper into the same subject.

Encourage the children to read around the subject. You should be aware of the concepts and subject matter that the children are to be introduced to at any given time. The child need not be aware of 'concepts' and 'definitions', but must absorb such knowledge unconsciously. For example, it is not necessary for the child to learn the words, 'The Sun is a source of energy.' However, the child must learn about the Sun, must learn that it gives out heat and light, and must try to understand what energy means. And this takes longer than merely learning to say the words in the textbook. This awareness of what words actually mean (real understanding) can only come about by reading and discussing any given topic in a variety of different forms and over a period of time. One lesson on solar energy does not mean that the child will know all about that subject or that he has understood it.

Before dealing with the actual text in the textbook it is important for you to discuss the subject matter with the children, using stimuli and examples which you know are not mentioned in the text. Talking about the subject and introducing additional questions to those already stated in the textbook, are both important. Use examples from the immediate environment and from the child's personal knowledge and experience. When you ask a question, you probably already know the answer or have some idea of what conclusion you want the child to reach. If a wrong answer is given, listen and then question further. You can easily bring the child round to giving a more appropriate answer by further questioning. Do not assume that you know all about the subject: and do not take the stance that *you* have to give the correct answer and only then can the child learn it and repeat it after you. Science is more about questions than answers. The great scientist knows how to ask questions, but doesn't necessarily know all the answers.

Good teaching does not imply that you have to know everything there is to know about the subject and that you have to do the talking all the time. If the interaction in class is not two sided, and if the role of the children is passive (that is, if they do not take part in what is going on, whether it is activity, thinking or conversation)

then not much will be achieve. Boredom will creep in, and the child will begin to feel that only the teacher can give all the right answers. When faced with a problem that has to be solved without the teacher's help the child becomes incapable of finding a solution on his own. To prevent this situation from arising allow the children to think for themselves and gie their own answers. The satisfaction and encouragement they will get fro feeling that they have contributed to a particular solution is immeasurable.

The Course Structure

The subject matter in Pupil's Book 5 has been divided into eight broad categories or parts (see next column).

In science, and especially at this level, many of the topics overlap and are interrelated. To categorize them too rigidly would be inappropriate.

The eight parts will enable you to organize your work effectively. Please look carefully at the topics covered in Book 4. There is a wealth of material you could use to pursue any particular topic in greater depth.

At this stage the children must be made increasingly aware of certain scientific ideas or concepts. These concepts and ideas are mentioned under separate headings as they occur below.

Primary school children can solve problems, but their attempts require though as well as action. The emphasis of this science programme, therefore, is concentrated on **thinking** and **doing,** and not merely on the acquisition of facts. It is vital that the pupils are presented with a certain amount of information; but it is even more important that they are initiated into the practice of solving problems so that they may develop the right approach and may acquire useful skills in the process.

You will find in the textbook that the information is presented in simple language; language which children at this level can easily understand. The questions require some thought and are designed so that the child has to provide his/her own answers. Many of the questions many be dealt with orally, and can be used to initiate some kind of discussion. Supplement these questions with ones you have thought of yourself, based upon what you have talked about in class.

Do get the children to read around the subject, using source material from your school library.

In addition to acquiring a certain amount of information, the pupil has to develop certain skills. Skills, in this context, would include the ability to observe, gather information, sort, compare, classify, measure, question, probe, propose an enquiry, plan, experiment, solve a problem by conducting an experiment, design apparatus, infer, predict and guess, control and manipulate variables, find a pattern, interpret information, show results or communicate findings through recordings, charts, graphs, tables, drawings, descriptions (oral and written), models and displays.

Through the active exploration of the school, the home and the home and the local surroundings, and with the help of these books, you should be able to encourage a scientific way of thinking, help the children to acquire basic scientific concepts and develop a healthy attitude to learning.

NOTE:

1 Do not expect the children to *write* answers for all the questions. These can be discussed and talked about where you feel this is sufficient.

2 Add to the questions any you feel are important and have a bearing on what you have talked about in class. The questions need not relate directly to the text. When questions are put which relate directly to the text, the children tend to learn things by heart and do not learn how to think. Remember that open-ended questions are always better. Lead the children twoards such questions.

3 Make sure that the children have the opportunity of answering the questions themselves. This is very important. Otherwise they will always depend on you to give the answers. It is very easy to repeat what you have heard, it is ot so easy to think of and then give an answer on your own.

4 If you think some questions have been answered incorrectly and that the wrong information has been learnt, summarize and give the correct answer.

5 Please do look into the content of Book 4. You will see from this book where a topic is first taken up.

6 Before you get the children to read the text try to deal with the content in a different way. By talking about the topic (bearing in mind the main points to mention) you will give the children the opportunity to become familiar with some of the new ideas as well as revise some they already know. The reading and understanding of the text will then be less difficult.

7 If you wish to approach the topics by first tackling one of the suggestions from the TTD section, feel free to do so. There is no rule which says that the topic has to be tackled in a particular order.

8 You are strongly recommended to practice the experiments given in the textbook before hand, so as to find out how to make the various stages work effectively.

Teacher,s Notes

Part 1: Ourselves

Unit 1: All about the body (*pages 1-3 of Pupil,s Book*)

The main ideas to develop are:

1 The body consists of independent parts: these have various functions. (Revision)
2 The body consists of systems. These are built up from cells and tissues. (Revision)
3 The heart is the most important muscle in the body.
4 The heart is an involuntary muscle which controls the circulation system.
5 the heart consists of artia and ventricles. Blood flowing through the heart is controlled by valves.

* Revise all that has been learnt in Book 4.

Discuss the functions of the various parts of the body. Do not limit your discussion to the parts illustrated at the top of page 1; include other body parts too.

Find out if the children can name all the major organs of the body. Talk about their main functions, not forgetting to mention which systems they form a part of.

How are all these systems built up? How are they related to each other? Show the children pictures of different kinds of cells. Cells build up to form tissues. Tissues form organs such as the heart (and other muscles), bone, the lungs, liver, stomach, etc.

* Get the children to make their own tessellated patterns showing how cells may join to form tissues.

In your discussions about the heart, make sure you have some large pictures to illustrate what you are talking about. A model of the heart which can be broken up into various parts will prove a useful aid. The children will be able to understand the functioning of the heart much better by seeing a life-sized model.

Get the children to do their own drawings of the heart, using

different colours (red and blue) the show how the blood travels through the various chambers.

Make sure that they actually do TTD 4. A stethoscope will greatly enhance the sound that they will be able to hear from the heartbeat. Time spent on this activity will not be wasted.

Questions (*page 3*)

A1 Which system is the stomach a part of?

The digestive system.

2 Which system are the biceps and triceps a part of?

The muscular system.

3 What are your tissues and organs made up of?

Cells of different kinds.

5 Give some examples of involuntary muscles in the body.

The cardiac muscle and *visceral* muscles. (The children need not learn this word now.) Cardiac simply means *of the heart,* and visceral muscles are those which are found in the internal organs of the body (the brain, heart, liver, the intestines). They are involuntary muscles, and are stimulated by nerves.

4 What kind of muscle is the heart made from?

Cardiac muscle.

6 Which part of the heart sends blood to the lungs?

The right ventricle.

7 How big is an adult‚s heart?

About the size of a clenched fist.

B1 Why are the walls of the ventricles thicker than those of the atria?

The blood from the ventricles has to be forced out of the heart to all parts of the body. The pressure here is quite great, so the walls have to be thick.

2 In which part of the heart is there oxygenated blood? *(Oxygenated* means *mixed with oxygen)*

Blood that comes from the lungs has been oxygenated. Oxygenated blood comes into the left atrium.

(Be sure to point out which is left and which is right in any diagram of the heart. Also note: the *singular* of atria is atrium).

Things to do (*page 3*)

1 Draw a picture of the heart and label all the parts.

The labelled parts should include the atria, the ventricles, muscles, valves, veins and arteries. (Veins taking blood to the heart and arteries taking blood away from the heart).

2 Find out what a *pacemaker* is. Some people who have a weak heart have a pacemaker fitted.

The heart's pacemaker is a small section of specialized heart muscle that initiates heartbeat. It is in the right atrium. It contracts spontaneously. If this pacemaker stops functioning (heart block), it may be replaced with an artificial pacemaker. This is operated by a battery and stimulates the heart to contract regularly.

3 What is a *heart transplant?* Find out what you can about heart transplants.

The heart may stop functioning properly due to a number of reasons. The main forms of heart disease are when the arteries become blocked with fatty tissue, the valves cease to function, or other diseases occur which are present at birth. Surgeons can now perform heart transplants. A healthy heart from a person who has just died of other causes may be inserted into the body of a person

with a diseased heart. The first heart transplant was done by a South African, Dr Christian Barnard, in Cape Town, in December 1967. The patient did not live long. Today there are many people living with transplanted hearts.

4 **Put your ear to a friend,s chest and listen carefully. You will hear the valves slamming shut. How many sounds can you hear? Try to think of the ways in which you may hear the heartbeat more clearly.**

With a stethoscope the children should be able to hear the cardiac cycle. Each cycle (about 70 times a minute) consists of the atria contracting to send blood into the relaxed ventricles, followed by the ventricles contracting to pump blood out. There is a short pause after the ventricles contract to push blood out. The cycle is then repeated.

Unit 2: The brain (*pages 4-5*)

The main ideas to develop are:

1 The body, and the brain in particular, is an amazing machine.
2 The brain is a delicate organ protected by the skull.
3 The brain consists of various parts which perform different functions.
4 Information comes to the brain and is sent out through a complicated system of nerves.
5 The medulla, a part of the brain, continues down into the spinal cord.
6 The brain is made up of millions of cells and is fed with blood and oxygen by an extensive system of capillaries.

In Book 3 the body was compared to a machine. Continue this analogy with reference to the brain. Our brains are extremely complicated structures. They can perform an amazing number of functions. Bring this out by discussing what the brain can do. How do the children know how to do various things? What happens when they see something for the first time? Can they remember things which happened a long time ago? What emotions do they feel from time to time? What happens when they feel anger, fear, excitement, sadness, and so on? How are the other parts of their

body affected by such feelings?

The bone which protects the brain is called the skull. If the children feel down the middle of their backs, they will be able to discern the interlocking bones (the vertebrae), which protect the spinal cord.

If you are adventurous enough you can obtain an animal's brain from the meat market and dissect this for the children.

By looking at the size of the heads of some other animals, compare the brain sizes. Can the children work out which animals have intelligent brains and which have less intelligence? Which animals are most like humans?

If it is possible bring a skull to class and show this to the children. Even an animal skull will do.

Questions (*page 5*)

1 What can the brain do that a computer cannot do?

A brain can feel emotions such as anger, jealousy, fear, happiness, excitement, etc.

2 Where is the cerebrum? What happens in the cerebrum?

The cerebrum is the top part of the brain. The cerebrum controls movement (the senses, and association). The cerebrum is the centre for mental activities such as speech, learning, memory and imagination. It also controls all physical activities.

3 What work is done by the cerebellum?

The cerebellum controls movement, balance and coordination.

4 What is important about the medulla?

The medulla deals with involuntary muscles of the body. It is the part of the brain which keeps working even when you are asleep.

5 Which part of your brain helps you to:

a control your breathing	medulla
b balance when you are cycling	cerebellum

c think cerebrum

Thing to do *(page 5)*

1 Feel your head. Can you feel the hard bone of your skull? Your brain is inside the top part.

Get the children to also draw an outline sketch of the skull showing where the brain is placed.

2 Have you ever fainted? If so, what happened? Why do you think you fainted? Why do you think people fall down when they faint? Think about this.

When someone faints it usually means that there is a sudden loss of blood to the brain. The capillaries feeding the brain with oxygen fail to do so and this lack of oxygen causes the brain to cease functioning. The body then falls to the ground so that the capillaries can once again quite easily transport blood to the brain. It is easier for the blood to flow to the brain if the body is horizontal.

3 Part of your brain deals with memory. How good is your own memory? Look at these pictures for one minute. Then cover the page and make a list of the things you can remember. How did you score?

Get the children to invent their own puzzles of this kind. Reduce the time allowed or, alternatively, increase the number of objects. Can they tabulate the results?

Unit 3: All about breathing (*pages 6-8*)

The main ideas to develop are:

1 Breathing in and out is called respiration.
2 Air is taken into the lungs through the nose (and mouth).
3 The diaphragm is a sheet of muscle which separates the lungs from the abdomen.
4 Sound is produced in the larynx.
5 The lungs are large and spongy. Oxygen from inhaled air is

absorbed into the bloodstream in the lungs.

Some words to use: respiration, breathe in (out), inhale (exhale), expand, contract, choke, swallow.

Get the children to breathe in deeply and breathe out again. While they are doing this get them to feel their chest and their diaphragm. Draw large pictures on the board to show what happens to the lungs and diaphragm when they inhale and exhale. Ask them to describe what is happening. What happens to their air when we breathe in? What is air made up of? Why do we have to breath out? What do we breathe out? What happens to the air in our lungs? What would happen if we could not breathe? How does the air enter the body? Can they breathe with their noses closed? Why do we choke sometimes when we are eating food? Discuss all these questions.

It is better to breathe in through the nose because the air we breathe in is not always pure. Show this by getting the children to look at their air in a room when a beam of sunlight is filtering through the window. They will be able to see all the particles of dust floating in the air. The fine hairs and the mucus in the nasal passages stop these particles from entering the lungs. Breathing through the mouth is possible when the nasal passages are blocked, but more particles can enter the trachea if we constantly breathe through the mouth.

Say something about the composition of air. (There is more about this in Unit 18).

Say something about how air is needed in order to produce sound. What kinds of sounds can the children make by shutting their mouth and holding their nose? Sounds are made by air travelling over the vocal cords.

Questions (*page 8*)

A Copy these sentences into your notebook. Fill in the blank spaces.

1 There are cells in the trachea which produce a sticky liquid called *mucus.*

2 The *diaphragm* **is a sheet of muscle which separates the**

lungs from the *abdomen.*

3 **Breathing in and out is called** *respiration.*

4 *Trachea* **is another name for the windpipe.**

5 **At the ends of the small air tubes in the lungs there are tiny** *air sacs* **which are surrounded by narrow** *capillaries.*

B1 Why are there hairs in your nostrils? Do they behave in the same way as the hairs in the trachea?

The hairs in the nostrils prevent fine particles of dust from entering the windpipe. They act like a filter. The hairs in the windpipe also prevent particles from going to the lungs, but these ripple like waves. They carry the dust back up the throat.

2 Where and how are sounds produced when you talk?

Sounds are produced in the larynx. When air is forced over the stretched vocal cords, sounds are produced.

3 What will happen if you do not take air into your lungs?

You will die. No air in the lungs means that the air sacs cannot absorb the oxygen in the air. The body cannot live without oxygen.

4 Why is smoking harmful?

Smoke from cigarettes contains tar and nicotine. Tar clogs the usual passages, and nicotine is addictive. Smoking causes main diseases such as cancer.

Things to do (*page 8*)

1 Find out how many times you respire in one minute. Time your friend,s respiration, but be careful to do this when she does not know she is being watched. How does her breathing change if she knows you are timing her?

A table can be made to show the increased rate of respiration after exertion of some kind. People tend to control their breathing when they are aware of it.

2 Blow out deeply on to a windowpane or mirror. What do you notice?

The air contains water vapour.

Make sure the children realize that even noxious gases are taken into the lungs and can enter the blood stream. Breathing is controlled by nerves in the medulla. This acts when it detects too high a level of carbon dioxide in the blood. It then prompts the lungs to act faster.

3 Find out what to do when somebody has breathed in water by mistake. Have you ever done this while swimming? What happened?

Normally the epiglottis (a flap) closes the trachea while food is going down the oesophagus. Sometimes it can be slow to close and food can get stuck in the trachea. When this happens we choke and cough to remove the food. When someone is drowning he gasps for air and in so doing can easily inhale water. If someone has stopped breathing he should be given mouth to mouth respiration. There are also other methods of helping a person to recover from drowning. This may be a good time to get a nurse or doctor to come in to talk to the class about simple first aid in such circumstances.

Unit 4: Teeth *(pages 09-10)*

The main ideas to develop are:

(Pupils already know a certain amount of information from Book 3. Revise.)

1 An adult has 32 teeth.
2 Incisors (8) are used for cutting; canines (4) are for ripping; premolars (8) for chewing; and molars (12) for grinding.
3 The tooth consists of various parts: enamel, dentine, pulp.
4 The part of a tooth outside the gum is called the crown; that below the gum is called the root.
5 Teeth can decay and rot if they are not brushed regularly.

It is advisable to have some real teeth (animal teeth, a set of dentures) to show the children. Also make sure there is a mirror in the classroom.

Activities could include making a set of teeth (from plasticine or clay); drawing teeth; studying the teeth of various animals; a demonstration of how teeth should be brushed properly. Study and discuss the various kinds and sizes of teeth. Explain what a filling is and why some teeth have to be filled, get the children to describe to the others what happened the last time they went to see a dentist. If possible ask a dentist to come to the class and talk to the children about his/her work, and also to show them some of the tools used in dentistry.

Explain also how some foods contain acids which can eat into (or rot) the teeth. Some adults never grow the last set of molars (called wisdom teeth). They remain below the gum.

Question (*page 10*)

A1 Which teeth are used for chewing and grinding food?

The premolars and molars.

2 What is contained in the pulp of a tooth?

Nerves and blood vessels.

3 What is plaque?

A layer of germs.

4 How is plaque formed?

Plaque (a sticky layer of germs) forms on the teeth if they are not brushed well or cleaned after meals.

B Match the following:

incisor	a tooth used for cutting
pulp	the soft inner part of a tooth
dentine	the part of a tooth which is like bone
dentist	a person who repairs damaged teeth

decay	rotting of the tooth
plaque	a thin sticky layer of germs
canine	tooth used for ripping

Things to do (*page 10*)

1 Make a list of food you eat. Without incisors, which of these foods would be difficult to eat?

The children will add different words to their lists. Discuss the food, their consistency and strength, and then decide. There may be some differences of opinion.

2 Read what is written on the packets and containers of foods you usually eat. Make a list of the food which contain sugar.

Ask pupils to each bring an empty container to class. Discuss the food and the ingredients. Which food are likely to be a source of danger to the teeth?

Unit 5: Digestion (*pages 11-12*)

The main ideas to develop are:

1 We eat food to give us energy.
2 Food comes in many forms, but in order to enter the blood (and be useful to the body) it has to go through a number of processes.
3 The breaking down of food is accomplished by the teeth, tongue, saliva, stomach juices, and intestines.
4 Some parts of foods cannot be digested, these parts pass through the digestive system and are excreted.
5 The pancreas, liver and kidneys are all major organs of the body. They each perform different functions.

Do not spend too much time discussing food and what it contains.

This topic is taken up in Unit 6. It is enough to speak generally about the importance of good food.

The children will be able to describe in simple terms how food is digested.

What happens to the mouth when you think about some delicious food? Saliva is produced. We use the expression 'mouth-watering' when we talk about some tasty dish. Saliva helps to break down the food and soften it. The children have already learnt something about the different kinds of teeth we have. Can they remember what these are called and what functions they perform?

What happens to food when it is put in the mouth? Is all food the same? Are there soft food and hard food? Take some different kinds of food to class and discuss how easy or how difficult they are to chew and swallow it? Is it easier to chew and swallow a banana?

By chewing a small piece of bread and keeping it in the mouth, the children can see how long it takes to turn into a pulp. If the chewed bread is kept in the mouth for about two minutes, the children may well notice a sweet taste as the ptyalin in the saliva begins to break the starch down into sugars. Talk about the necessity to chew food well before swallowing it. What happens to food if it is gulped down?

Explain a little about glands in the body. The salivary glands produce saliva. The saliva travels to the floor and roof of the mouth through passages called ducts. Saliva contains juices which help in digestion. All digestive juices help to break up different kinds of food. For example, saliva contains an enzyme which breaks up carbohydrates and starch. Further digestive juices secreted by the stomach, liver, pancreas and intestines break up other foods.

Here is a short guide to the digestive juices. There is no need to give all this information to the children. It is for you to read and understand so that you may explain the process better.

Saliva: produced by salivary glands in the mouth, starts the breakdown of carbohydrates and starch.

Gastric juices: produced in the stomach lining by gastric glands, the enzymes are pepsin, renin, hydrochloric acid and gastric lipase. These start the breakdown of proteins and fat. They curdle milk and kill bacteria.

Bile: produced by the liver, it contains bile salts and bile acids. It helps to break down fats.

Pancreatic juices: are produced by the pancreas, they contain a number of enzymes which help to further break down proteins, carbohydrates and fat.

Intestinal juices: these are produced in the intestinal glands in the

small intestine, they further break down food, finally producing sugars and amino acids needed by the body.

Finally, do not feel embarrassed to use the terms faeces, anus, excretion, urine, urethra, penis, etc. Talking about the organs of the body and their functions should be done in a matter-of-fact way.

Questions (*page 12*)

A1 What is the oesophagus?

The tube which leads down from the mouth to the stomach.

2 What does the liver do?

The liver helps to clean the blood and store food energy.

3 What happens to the food in the small intestine?

The food in the small intestine is made softer by digestive juices. The small intestine absorbs food that the body needs.

4 How does food get to the cells of the body?

The food passes through the thin walls of the small intestine and enters the blood vessels.

5 Where is saliva produced?

Saliva is produced by the salivary glands in the mouth.

6 What do the kidneys help to remove from the body?

The kidneys help to remove waste materials and excess water.

B1 How does drinking liquids help digestion?

Liquids help to make hard food soft. Hard food dissolve more easily in liquids.

2 Why do we sometimes get a pain in the stomach?

By gulping down food too fast, by not chewing food properly and by taking in air as we eat. Some food are not broken down easily, so we have to help our digestive system by chewing food well, eating at regular intervals, not eating too much food of one kind, and by drinking plenty of liquids. We also get a pain in the stomach from food poisoning, i.e. if we eat food which has gone bad.

3 How long does food take to pass through the body?

Food remains in the stomach for up to four hours, and can remain in the intestines for 36 hours before being passed on the rectum, where it is stored briefly. The time food takes to pass through the system depends on the kind of food being eaten, and the health of the person eating the food.

Things to do (*page 12*)

1 Make your own drawing of the human digestive system. Remember to put in some labels.

Let the children do a number of drawings; to show the position of the organs, and to show the individual organs themselves.

2 Did you know that the average person produces about 1.5 litres of saliva every day? You need not have food in your mouth to produce saliva. Just think about some delicious food and see what happens! Take a dry biscuit and chew it without swallowing it. Notice how saliva is produced automatically.

Get the children to try some other kinds of food too. When do they produce the most saliva?

Unit 6: Food (*pages 13-16*)

The main ideas to develop are:

1 There are many different kinds of food: these can be classed

under vegetables, fruit, grains, meat, dairy products, and so on.

2 People have different tastes in food.
3 Food gives us energy to work and play.
4 Even when the body is not exerting energy, the systems continue to work and therefore require food.
5 Food contain different food values.
6 Food can be classified as proteins, carbohydrates, fats, vitamins and minerals.
7 The body needs water.
8 Wastes and dietary fibre pass through the body and are excreted.

Perhaps you can start the topic by finding out what kinds of food the children like. What do people in Pakistan like eating? Why do they eat certain foods? (Don't forget to mention availability due to growing conditions). What do people in other countries like eating? You will need to make lists and show the children lots of pictures. What do we mean when we say that someone has 'a sweet tooth'?

Discuss what is meant by a balanced diet. Bring out the fact that food can be classified according to their food values. The table on page 14 will give you an overall picture.

Get the children to make up their favourite menus. Get them also to check whether the menus are well-balanced. Do they know how various dishes are prepared? Why is food cooked? In which ways can it be cooked?

Play a game: Get the children to name foods beginning with each letter of the alphabet. Make an alphabet book of food for the children in the pre-primary section of your school. The pictures for this can be cut out of magazines or traced or copied from books.

Note: Minerals are needed for various functions of the body.

Iron	oxygen carrier
Calcium	clotting; present in bone
Phosphorus	present in bone and enamel
Iodine	controls hormones
Salt	membrane functions

Deficiency in any of these or the many other minerals present in the body may cause diseases, muscular cramp, anaemia, poor bone development, etc.

Questions (*page 16*)

A1 What do proteins do for your body?

Proteins give you energy. They also help to build you up, and make you grow. They enable your body to replace dead cells.

2 How do dietary fibres help the digestive system?

Dietary fibres help to keep the waste moving through the digestive system.

3 How much water do you drink every day? How much water does a person need?

The children should try to work out how many glasses of water they drink. Water is also present in many foods. A person needs between 2 and 3 litres of water a day. Also ask the children whether they think that water consumption changes with the season, and if so, how and why.

4 What percentage of water is there in a cucumber?

98% water.

5 Why does the body need carbohydrates?

The body needs carbohydrates to provide energy.

6 Do you need energy at night when you are asleep? Explain why.

Yes, in order to breathe. All the systems of the body keep working when you are sleeping. Energy is also needed while one is asleep to maintain the body temperature.

7 What happens if you eat too little?

You become weak, and have little energy to do anything. This can also lead to illness, because the body cannot fight off attacks from germs.

8 What happens if you eat too much?

You become fat. People who work hard use up a lot of energy, they can replace this by eating good food. Too much fat is bad for you.

B Tick the correct answer. Try to explain your choice:

1 Dietary fibre can be found in:

a milk **b** *grapes* **c** eggs **d** salt
The skins of grapes form the dietary fibre.

2 The system which uses the most water is:

a skeletal **b** *digestive* **c** nervous
The digestive system uses the most water.

3 This vitamin builds up teeth and bones:

a vitamin A **b** vitamin B **c** vitamin C **d** *vitamin D*

Vitamin C keeps teeth and bones healthy, but vitamin D is needed to build healthy bones. Lack of vitamin D causes rickets.

4 This food is one of the best for a young person:

a salt **b** beans **c** mangoes **d** *milk*
Milk contains proteins, fats, vitamins and minerals.

Things to do (*page 16*)

1 Make lists under the headings *Vegetables, Fruit, Meat, Nuts, Grain.* How many items can you think of for each of the headings?

Vegetables **carrots, peas ÷**

Fruit

Meat

Nuts

Grain

The children can make their own lists and then collectively produce a chart for the classroom wall.

2 Make your own chart like that on page 14. Instead of writing a list of the food, put in pictures. Remember to include pictures of the vegetables and other food which contain dietary fibre.

3 Make a list of the food you eat every day. Do it like this. When you have finished your list, discuss it with the others in your class. Check to see if you have a well-balanced diet.

Breakfast	**tea (2 cups), toast (2 slices), jam**
Lunch	**rice, meat, vegetable**
Tea	
Dinner	
Other snacks	

There is no point in this exercise if you give the children the 'ideal list'. Let them make up their own, so that these can be discussed.

Unit 7: Looking after yourself (*pages 17-20*)

The main ideas to develop are:

1 Germs cause illness and disease.
2 Germs enter the body in a number of ways, but do so mainly through the mouth and nose.
3 Food can be kept clean, preserved and sterilized in various ways.

4 There are a number of ways in which one can prevent illnesses and remain healthy.
5 Infections are caused in a number of ways by viruses, bacteria, fungi, protozoa, worms and germs.

Have the children been ill at all? What were they suffering from? How did they fall ill? What were the symptoms which affected them? How did their bodies react? Did they have to take any medicines? For how long?

Discuss illness and how it affects the different systems of the body.

The children will have heard the names of various diseases. Talk about these and write up any words on the board. You are not expected to know all the spellings! Check the spellings in a dictionary; get the children to find the words and read out the meanings.

How many school days did they miss through illness? Make a table to see who has missed the most days.

When you do read the list of do's and don'ts on page 18, make sure each point is discussed. There is little use in saying that the children should not do something, unless reasons are discussed.

Make sure you illustrate and discuss the harmful effects of smoking, drinking alcohol and taking drugs. (Also see Unit 20, on Pollution)

The children may not be familiar with some of the words on page 19. By using such terms frequently, they will begin to understand what these words mean.

There is very little information given in the Unit on various topics. Supplement this information with any material you can find on these topics in other books from the library.

Grow some fungus on moist bread.

Put some food out and see how long it is before flies arrive on the scene. Watch what they do.

You need to get the following ideas across clearly (i) Heating, as in boiling or cooking, kills germs (ii) Cooling, as in a freezer or refrigerator, does not kill germs, but it stops them multiplying (and therefore stops the food from going bad) (iii) Once sterilized, food can be kept sterile by keeping it out of contact with the air, as with canned food (iv) Food can be infected/reinfected with germs, by flies, from a dirty knife, from spores in their air, etc. And perhaps (v) Get them to suggest reasons why it is particularly dangerous to eat

food which has been frozen and not properly cooked through, or food which has been frozen and thawed several times.

Questions (*page 20*)

A1 What are some of the ways in which we can preserve food?

Food can be preserved by cooking or boiling, adding chemical preservatives, freezing and sealing it away from the air.

2 What does sterilization mean?

Sterilization means to make sterile. When we sterilize something we are making it free from germs.

3 How can flies cause you harm?

Flies pick up diseases from animals. These can be passed on to man. Flies eat off rubbish and open food. They pick up germs and transfer these to food that we may be eating. When germs enter the body we become ill.

4 What are the main kinds of germs which cause infections?

Viruses, bacteria, protozoa and fungi.

5 What is a parasite?

An organism that lives off healthy cells and multiplies.

6 What are some of the ways in which you can keep healthy?

See the list on page 18.

B Find these words in a dictionary. Write down what they mean.
a sterilize **b** germ **c** preserve **d** infection **e** disease

Different dictionaries will give slightly different meanings, let the children do this exercise for themselves. Can they then tell you the

difference between the words infection and disease?

1 Here is some information about a famous scientist.

Louis Pasteur (1822-1895)

Pasteur was a French chemist and microbiologist. He found that by removing the microorganisms from liquids such as milk, the liquid could be protected from going bad (going sour or decaying). The process was named *pasteurization*. Pasteur also produced vaccines to prevent cholera and rabies. He found the Pasteur Institute in 1888.

Find out what you can about these famous people:

a Edward Jenner **b** Madame Curie

The children should find out what they can from an encyclopedia or another book on famous figures in science. Encourage them to find out some information and write it out neatly and also make some drawings. Their work can be displayed in the classroom. Do not restrict them to the two scientists mentioned on this page. Encourage them to find out about other scientists too.

Environment watch

The chart shows how diseases can be spread through the environment. Can you make a similar chart to show how any other disease or infection may be spread? How can we prevent diseases and infections from being spread? Discuss this topic in class.

Let the children to first list some diseases and infections. Then discuss how these are communicated or spread. Finally get them to make a choice and prepare a chart.

During the discussion make them aware of the need to maintain cleanliness of body and the environment in which they live. For example, a person with a cough and cold can easily spread germs. How may this be controlled or limited?

Part 2: Living things

Unit 8: Living things *(pages 21-24)*

The main ideas to develop are:

1 Plants and animals are living things: they take in food, respire, produce waste substances, have sensitivity, move, grow and reproduce.
2 Plants make their own food by photosynthesis.
3 Animals and plants move and sense things in a variety of ways. Their bodies are adapted to their surroundings.

Go through the list of functions at the top of page 21 and ask yourself questions like those on page 22. The children are asked to do this same exercise so it is a good idea if you go through the list first and try to frame your own questions. Don't give your list of questions to the children, but prompt them into asking similar questions. When you have asked a question, (for example, How do animals breathe?) make a list of animals and check whether you know how they breathe. How does a fish breathe? How does a tadpole breathe? How does a giraffe breathe? Do they have a nose? What is it shaped like? Can I draw the nose of a snake? By this kind of questioning, a lot can be achieved.

When you have framed your questions, try to find out the answers by looking in books about plants and animals.

Perhaps you might start the children off by asking them a few questions, so that they get the idea. Remember that neither they nor you are expected to already know all the answers. You should be ready to admit that you do not now all the answers. The main thing is to have an open mind, and be prepared and knowledgable enough to know where to find the correct answers.

A certain amount of information has been given to the children about sensitivity and movement. There are interesting facts about other animals and plants not mentioned in the text. The children should try to find out about other creatures and plants and share this information with the class. For example, you could talk about the cuttlefish which uses jet-propulsion to move, the grasshopper which uses its hind legs to leap great distances; the rain tree whose leaves hang down at night to catch the dew, and then let it fall like drops of rain, and many other interesting plants and creatures.

Do the children remember what the fives senses are? How do they use these senses? How do they use a combination of senses?

Questions (*page 24*)

A1 What is one important thing that plants can do but animals cannot?

Make their own food.

2 Why do animals move from place to place?

They move in search of food and water. They also move in search of mates, and to escape from predators.

3 What is the lateral line on a fish? What does it do?

The lateral line is a line along the side of a fish. This line enables the fish to sense movements in water. The fish can tell by these movements whether there is food or danger nearby.

4 What is locomotion?

Locomotion is movement or motion from place to place.

5 What senses does a zebra use to tell if there is danger nearby?

The zebra uses its sight, hearing and smell.

B1 What are some of the different ways in which living things breathe?

A human breathes (or respires) through the nose; mammals breathe through the nose; fishes breathe through gills; an earthworm breathes through the skin; insects breathe through their trachea; plants take in air through the leaves.

2 Do you remember what the word migration means? What happens when animals migrate?

Migration is the periodic movement of animals from one place to another. This movement is usually associated with seasonal climatic changes or breeding cycles. Migration is best known among birds.

Things to do (*page 24*)

1 Do you remember reading about food chains? Animals need food to give them energy. They cannot produce their own food so they depend on other animals and plants for food. Here is a food chain.

(The illustration shows:
a lettuce –> slug –> beetle –> shrew –> barn owl)

The illustration shows how the lettuce is at the bottom of the food chain. It is called the primary producer (of energy). The barn owl is at the top. It does not have any predators. It is a consumer. What would the slug be?

Make your own illustrations of food chains. Do one for each of the following:

a Your garden **b** A lake or pond **c** The seashore **d** A thick forest

If the children think about it, there are thousands of different kinds of food chains. Every living thing forms a part of a food chain. Naturally, not all creatures and plants grow and live in one environment or habitat. The creatures which live in the garden are not the same as those living by the seashore or in a desert. Similarly, the kinds of plants found in one area are quite different from those found in another. The children can investigate this and discover what it is that some creatures live on. They can then try to find out what larger creatures eat.

Remember that there are also food pyramids (a large number of primary producers and a much smaller number of consumers) and there are food webs, in which there is much more interdependence between the various groups.

A garden food chain might include: primary producers = grass and leaves; primary consumers = mouse, snail, aphid; secondary consumers = sparrows, cat, mongoose, ladybird, crow.

A lake food chain might include: pp = algae, waterweed, weeds lilies; pc = water fleas, snails, tadpoles, clams, small fish; sc =

bigger fish, frogs, herons, wagtails, kingfishers.

A thick forest: pp = leaves, nuts, berries, fruit; pc = birds, monkeys, bats, insects; sc = birds, frogs (eat insects), larger animals feeding on smaller animals. When discussing food chains, you might like to introduce the idea of *decomposers*. These are micro-organisms (fungi and bacteria) which break down dead animals and vegetable matter, and take the cycle back to square one. Decomposers first produce digestive juices. These juices make dead things rot or decompose. The decomposed matter is liquid; it is absorbed by the decomposer. Decomposers fertilize the soil (by releasing chemicals into it) and they get rid of dead animals and plants.

2 Can you think of examples of how plants move? Do not confuse moving with growing. The picture on the right will give you a clue.

Also mention the rain tree, flowers which close around insects, flowers and plants which turn towards the sun, etc.

3 Find a worm, a beetle, an ant, and any other small creature and watch them move. Make a chart to show how each one moves.

If there is room in the classroom, and you can obtain an empty aquarium, get the children to build a mini garden in it. Catch various insects and put these in the tank. Make sure the tank contains some water, soil and plants. The children will be able to observe how these small creatures move and behave.

(See also TTD1, Unit 9)

Unit 9: Life cycles (*pages 25-27*)

The main ideas to develop are:

1 Animals are divided into groups.
2 All living things reproduce, if this were the not case then the species would die out.
3 Some species have become extinct; there are a number of reasons why this might happen.

4 Reproduction is carried out in different ways.
a) by cell division (asexual reproduction)
b) by fertilization (sexual reproduction)

Revise what the children did in the previous book. Do they remember the terms vertebrate and invertebrate? What are the other ways in which the animal kingdom may be divided? Why is it necessary for us to make such divisions? When they have made the divisions, ask them to suggest examples to be put under the various headings.

In Book 4 you learnt about how the animal kingdom can be divided into many groups. Try to remember how this was done. Copy the top part of the diagram given, into your notebook and complete the part under vertebrates.

Discuss reproduction in plants and animals. (Plant reproduction is dealt with more thoroughly in Unit 11). By drawing a few family trees show how some species multiply in much larger numbers.

What are the different ways in which animals reproduce? Talk about eggs and giving birth to live babies.

How do some species become extinct? What happened to the dinosaurs? (Many animals died in the ice age).

Animals can become extinct in a number of ways. This means their numbers decrease and eventually none survive. A plague can wipe out animals, hunters can kill particular species in great numbers, drought or flooding can also reduce numbers. Climatic changes over a long period of time can drive animals away from their usual habitat. Their habitat can change too for example, animals depend on plants for their survival. If for some reason those plants cease to exist, then the animals have to migrate. They may not find a similar habitat and will gradually die out.

Point out that the kind of wildlife found in any habitat can change drastically if the plant life or if the primary producers are eliminated. For example, some birds may not frequent a pond anymore if particular insects are killed off by sprays and pesticides. They could also be asked what would happen if predators are removed, or what happened in Australia when rabbits were introduced, but their natural predators were not. This would be a good place to talk about the growth and decline of population, factors limiting population size, etc.

Discuss some life cycles. Try to find examples in your area, bring these to class, and see how the different stages develop.

Questions (*page 27*)

A1 What are the five main groups that vertebrates can be divided into?

Fish, amphibia, reptiles, birds, mammals.

2 Why is animal reproduction important?

If animals did not reproduce their species would come to an end.

3 What do these words mean? (Look in a dictionary if you are not sure).

Get the children to look up the meanings in a dictionary.

a **extinct:** (of family, class, species) that has died out
b **reproduce:** multiply by generation
c **vertebrate:** (of animals) having a spinal column
d **fertilization**: making fertile or productive. This occurs when a sperm, or male sex cell enters an egg, or female sex cell.

4 How are the young of birds and mammals able to survive?

They are looked after by the parent(s).

5 Why do you think an insect lays so many eggs?

Insects lay many eggs because the eggs and baby insects are usually defenceless. Many of them will not survive, but at least some will. In this way the species is sure of surviving.

6 How do micro-organisms usually reproduce?

By cell division.

B Look carefully at the life cycles shown on page 26. For each animal shown, describe what happens at each stage. Choose one of the animals and write and draw pictures to show what happens.

Animals which reproduce sexually begin life when an ovum from the female is fertilized by a sperm from the male. When the young of a species develops outside the mother's body, they often have to pass through various stages of development. Young which hatch from an egg are called larvae. Insect larvae often take the form of grubs, maggots or caterpillars. Butterflies and moths pass through a pupal stage (forming a cocoon around themselves). Butterfly = egg, caterpillar, pupa, adult.

Things to do (*page 27*)

1 **Study the life cycle of a fly. To do this you will need a large glass bottle. Put some meat, some sugar and some other food scraps in the bottle. (The sugar and the food scraps are for the flies to eat. What is the meat for?) Cut out a piece of muslin to use as a cover. If the jar has a lid, due it instead, but first punch lots of tiny holes in it. (Why?)**
Catch some flies and put them in the bottle. Look at them every day. Make a note of how many days it takes for the eggs to be laid and for them to hatch. How long do the larvae take to grow into adult flies?

2 **Repeat the experiment. This time collect some frogs„ eggs (spawn). Remember that frogs are amphibians. They live on land as well as in water. Fertilized spawn will hatch into tadpoles. These need to live in water. When they get a bit bigger they can sit on land. You will have to build an aquarium of a some kind. Don‚t forget to let the frogs (or tadpoles) go back to their habitat after you have observed the life cycle.**

No matter how small the creature is and no matter how insignificant it may appear, help the children to learn that it should be treated with care and consideration.

Unit 10: Plant distribution (*page 28-31*)

The main ideas to develop are:

1 The plant kingdom is divided into many subgroups.
2 Plants are dispersed or spread in a number of ways.
3 Plants are adapted to their environment in a number of ways.

Remind the children how the plant kingdom is divided into subgroups. Can they find examples of plants to go under each heading?

Revise what the children know about the conditions necessary for a plant to grow. Can all plants grow in one place? Some plants grow better in special conditions. In order to survive in a particular environment plants have evolved various means of survival. They adapt themselves to the environment. For example, if there is little water about, plants might grow long roots or grow thick fleshy leaves in order to store water. Some plants survive by living off other plants they are parasites. There are many examples in the text.

Distribution and adaptation are closely linked. A seed or spore may be transported in a number of ways. When it finally lands at one particular place it may survive due to the local conditions. If these conditions are not met completely, the plant may begin to adapt to the new conditions. This may initial changes to the plant itself, and these changes may only occur over a very long period of time. Make it clear to the children that changes in animals or plants **a)** take place over many generations and **b)** are due to *evolutionary* change, rather than a conscious act on their part.

The class can do a project based on a local site in the environs of the school of close by. (See TTD2). Much can be learnt from such a study.

Questions (*page 31*)

A Which of these statements are true? Rewrite those that are untrue.

1 Most simple plants produce seeds.

F…produce spores

2 Animals help to spread seeds

F

3 Plankton is found in water.
T

4 Liverworts grow from seeds
F…bits of the parent plant.

5 A puffball is a kind of algae.
F…of fungus

B1 What are some of the main ways in which spores are spread?

By water or wind action.

2 What are some of the main ways in which seeds are spread?

Wind, explosion, water, birds, animals (on fur and through deposits).

3 How are some plants adapted for survival? Can you think of other ways in which plants adapt themselves?

They produce thousands of seeds. They grow thick leaves to retain moisture, some produce gums and resins to keep away insects, some have tough barks, some grow thorns and spikes, some produce poisons.

4 What experiments have you done to show that plants can only grow in certain conditions?

If the children have not done any experiments, you may do some now. Look in Books 2, 3 and 4. The experiments should show that plants need sunlight, water, good soil and air, in order to grow well.

Things to do (*page 31*)

1 Make a list of animals, birds and insects which you think might help to disperse (spread) seeds. Watch these creatures eating and moving about. Are they carrying seeds? Make a collection of seeds, too. How do you think they are dispersed?

The children should be encouraged to collect some wild seeds. Seeds from fruit that they normally eat are not transported in the ways described, because they are usually transported and planted by man.

2 Look carefully at some waste ground near your school and see which flowers grow there. How did the flowers get there?

It is a good idea to get the children to do a survey of such land. Get them to draw a map of the area, find out what plants grow there and what animals and insects live there (plot their positions and numbers), and to note any changes that occur in the physical and natural environment. They will learn to deduce how changes in one aspect of the environment have a bearing on other aspects.

3 Place a tray of good compost (mitti) in an open position in your garden. Keep it watered so that it stays moist but not too wet. Watch for several weeks to see what grows in it. If nothing grows, try placing various seeds in it. Watch your plants grow. Transfer them to where you want them to grow, water them and look after them.

Get the children to do it!

3 Find a thistle and blow on it in the wind. Each of the heads develops into a seed, and each has a hairy parachute. How far do the seeds travel?

Find out by experimenting.

Unit 11: Plant reproduction (*pages 32-35*)

The main ideas to develop are:

1 Plants reproduce in a number of ways, usually they do this from seeds or spores.
2 Plants may also reproduce through tubers, stems, rhizomes, bulbs, leaves and runners.
3 Plants reproduce sexually or asexually.

4 Insects and the wind transport pollen from one flower to another.
5 Fertilized seeds grow into new plants.

The children already know something about how seeds are spread. Revise what they already know. In understanding how plants reproduce there are some difficult words to comprehend, so go slowly in your explanations. You will need to supplement your talk with clear diagrams to show how fertilization takes places.

When going through the examples on page 32, be sure to have some real examples to show the children. Many of these can be planted in pots and cared for by the children. For example, some of the vegetables mentioned can actually be put into water in glass jars, and the children can be asked to note down the changes as they occur.

The children will get a better grasp of what pollination means if they are taken outside and actually watch bees and other insects going about the business of collecting nectar from flowers. If these insects are observed carefully the children will actually see how the flower is probed for nectar.

Questions (*page 35*)

1 What is a bulb?

A bulb is a bud which is surrounded by thick swollen leaves, e.g. a tulip.

2 What are the two different ways in which plants can reproduce?

Sexually and asexually.

3 What is the female part of a flower called?

The carpel. The carpel contains a stigma, a style, the ovary and ovules.

4 What is the male part of a flower called?

The male part of a flower is called a stamen. (It consists of the anther and pollen grains, which contain the male sex cells).

5 How is the pollen from a flower transferred to the stigma of another flower?

Mostly by insects or by wind.

6 What is a fruit?

Fruits are the ripened ovaries of flowers. They contain one or more seeds.

7 Why do you think flowers have bright colours, special shapes and strong scents? (Think about this carefully).

These are used to attract bees, and other insects. By attracting insects the plant species is sure of survival.

8 In your own words try to describe how a flower is pollinated and fertilized.

Let the children write about it in their own way. When they have finished, check to see whether they have written it in a systematic way, illustrated what they have said with suitable diagrams, and have understood what they have written.

Things to do (*page 35*)

1 Watch the bees in your garden or in a park. Bees like to take the nectar from flowers. If you watch carefully you will see a bee settle on a flower and push the petals apart to get at the nectar. While it is doing this the underside of its body brushes against the stamens and is dusted with pollen. The pollen is carried to the next flower, where some of it brushes onto the stigma.

Which are the most popular flowers for bees and butterflies? Make a list of the flowers and the insects which visit them.

By watching the bees carefully and making a note of which flowers they sit on the children will be able to identify the male flowers on a plant. Insect-pollinated flowers have large, coloured, scented petals and nectar, to attract insects. They also have large

pollen grains that can stick to the insect's body, and anthers and stigmas inside the flower, so that the insect can brush against them when it is drinking nectar.

2 **Mix plenty of sugar with some warm water, and pour the mixture into a plate or saucer. Collect some pollen from different flowers and sprinkle this on the mixture. Cover the plate with a sheet of glass to keep the dust out. After a few days study the pollen under a magnifying glass. Can you see the pollen tubes?**

3 **Cut open a large flower and press it. Mark the parts and label them. Compare different flowers in this way. Find out the names of the flowers.**

Each child should be encouraged to keep a scrapbook in which to press flowers and make notes about them.

Unit 12: Crops (*pages 36-39)*

The main ideas to develop are:

1 When early man learned how to plant crops, he settled in one place.
2 Healthy seeds produce healthy crops.
3 Healthy crops also require good soil, a supply of water and favourable climatic conditions.
4 Crops first cultivated in one area are these days cultivated in different areas.
5 Selective breeding ensures healthy and good crops.
6 Crops need to be protected in a number of ways.
7 There are many kinds of pests which are harmful to crops.

Talk about the kinds of food the children eat. What do they eat most often? Explain what a staple food is. Which crops are grown in your locality?

The children will be able to give you some suggestions as to how crops may be improved and protected. Discuss how we can produce better crops from healthy seeds.

What kinds of plants are grown as crop? Talk about grains and market gardens.

Can the children make a collection of small garden pests? (These may be difficult to identify).

In your discussions make sure you use the words in Question B.

Questions (*page 39*)

A1 Which insects and other small creatures are pests? How do we protect crops from pests?

Weevil, sawfly, mite, aphid, beetles (of various kinds), slugs, chafer grubs, caterpillars, millipedes and woodlice are some pests. Rats, fieldmice and other larger insects such as locusts are also pests. We protect crops from such pests by spraying crops with insecticides. We also put down poisons to kill some pests.

2 What are some of the ways, that you can think of to protect crops? (First think of some of the ways in which they can be harmed, apart from harm by insects. Then think of how they can be protected).

By building ditches and putting up strong fences we can protect crops in the fields from animals. Some farmers put up scarecrows to scare away the birds. Some build little shelters above the ground and keep watch over their crops. Crops can also be covered (with polythene or sacking) to prevent birds from feeding off the crop, or to shield them against too much sunshine. Some farmers cover whole trees with nets to keep birds off. In some countries farmers grow crops in greenhouses; these protect the plants from frost, keep the warmth in, and also offer protection from birds and animals.

3 Young plants are looked after in a nursery. They are also provided with the best conditions. Can you say what these conditions might be?

Plenty of water, good soil with nutrients (manure and compost), sunshine.

4 Where was maize first grown? Does maize grow in Pakistan?

Maize was first grown in Central and South America. It grows in Pakistan.

5 What grains and cereals do you eat every day? (Ask your parents if you don,t know).

Get the children to find out for themselves.

B For each of the words below give the best explanation or definition. Look in the text, as well as in a dictionary.

Brief explanations are given here. Let the children find out for themselves what these terms mean.

1 **nomad:** (member of a tribe) roaming from place to place for pasture.
2 **pesticide:** insect or pest killer.
3 **fertilizer:** a medicine or chemical that helps plants to grow better.
4 **Manure:** any substance spread over soil to fertilize it.
5 **Settlement:** a colony or group of houses where people live.

Things to do (*page 39*)

1 Find a large map of Pakistan. Make a tracing of it and mark on it where various crops are grown. Use symbols to show where the crops are grown. Try to think of reasons why certain crops grow better in some places than in others.

See *Oxford Atlas for Pakistan* (OUP 1981) (pages 5 and 6) Look also at the maps showing rainfall and temperature (page 3), and the irrigation map, (page 4). The children should be able to deduce that a crop grows well or not depending on the amount of water available, the temperature and the kind of soil present.

2 Visit a farm or market-garden centre (where vegetables are grown). Try growing some vegetables of your own.

Encourage the children to grow some tomatoes or other vegetable from seeds. This is easily done in a flower pot, if the plants can be regularly watered. Flower pots dry out quickly in hot

weather. The plants may need to be watered twice a day. How can they be kept watered over the weekend? Can the children devise a drip feed of some kind?

3 Look carefully for leaves, fruit, nuts and flowers which have been attacked by pests or disease. Make a collection. Observe the plants from which your specimens have been taken. Are the plants dying? How can you help them?

Get the children to collect leaves which have spots on them or are discoloured in some way. It will be impossible for you to identify what each disease is, and how it is caused. Nuts and berries with diseases, and those which have been attacked by pests are quite recognizable. The children should learn to recognize the abnormalities and compare these with the healthy plant. A gardener or horticulturist may be able to help with identifying the kind of disease present. Washing the leaves and providing better compost is about all the children can do for ailing plants. If these are identified, however, a more knowledgable person may be able to do something to preserve the plants.

Part 3: Materials and matter

Unit 13: Useful measurements (*pages 40-43*)

The main ideas to develop are:

1 Measurements (and accurate measurements) are very necessary in science.
2 Different measurements and scale are used depending on what is being measured.
3 A formula is a rule or statement. It is shown with symbols and is useful for working out unknown quantities.

The children will already be familiar with some of the terms and standard measures. If they are already familiar with some covered in this Unit, use the opportunity to check whether they have understood the topic and can handle the various formulas given. This can be done by setting them various tasks. Make sure that they get the chance to actually weigh, measure, and test various

materials. Practical work will help them understand much better.

One important aspect of this whole Unit, as far as scientific thinking is concerned, is the ability to guess and estimate. After using a formula and obtaining an answer, the children should be able to estimate whether their answer is approximately correct.

Can the children guess the approximate height of the classroom ceiling or the tree outside? Can they estimate how far it is from one corner of the class to the other? Can they tell whether a bag of apples weighs approximately one kilogram or two? Can they guess how many cups of water it will take to fill a larger container? Can they estimate how much carpet they will need to cover the classroom floor?

All the questions above are important in real life. Getting a sum right is only part of the task; being able to estimate and guess correctly is only possible if the children begin to get the idea of what these measurements *actually* mean.

Formulas:

The plural form is also *formulae*. The two formulas shown are:

volume = length x width x height

speed = distance - time

Mass:

Also point out local measures *maunds* and *seers*. Can the children pick up a weight and say how heavy it is? First guess, then actually weigh it and see.

Get them to draw their own plans for a weighing machine.

Discuss each plan, and possibly make them to see if they work.

Length:

Can the children convert (approximately) from inches to centimetres and vice versa?

The wavy lines can be measured with a piece of string.

Measuring a playing field with a foot-ruler will be a tedious and back-breaking task! What about using a rope which has already been measured (and knotted at regular intervals). Better still would be to measure the circumference of a wheel, and to push this along the side of the field.

Area:

Set the children problems such as this:

How many square centimetres of blue paper will you need to cover you exercise book? (They will have to not only measure the surface area but also allow for the overlapping parts).

Time:

Experiment with the pendulum. Vary the length of the string.

Increase the swing.

Can the children estimate how long it will take to do a particular task.

Can they shut their eyes and tell you when one minute has passed? (How will they estimate this, without using a watch?)

Pressure:

Do the exercise.

Also talk about pressure in tyres and tubes. What is the pressure in a car tyre?

Volume:

Do the exercise.

Let the children estimate how many small mugs of water it will take to fill a larger container.

Unit 14: What makes up matter (*pages 44-49*)

The main ideas to develop are:

1 Material objects are made from a variety of substances.
2 In ancient times philosophers believed that there were four basic substances: fire, water, air and earth.
3 All substances are made of small particles called molecules.
4 Molecules group together to form lattices.
5 A molecule consists of even smaller particles called atoms.
6 Molecules of one kind come together to form a substance.
7 An atom consists of a nucleus surrounded by electrons.

Much of the vocabulary used in this Unit may be new to the children. Do not worry too much if the children do not fully understand the topic. This is an introduction; the children will be re-introduced to the same subject in later classes.

They should understand, however, that the basic blocks of all

substances are very tiny particles called atoms. When atoms of the same kind come together they form a particular kind of substance called an element. The composition, form, colour, shape, smell, texture, weight, etc., of these substances depends on the type of particles that come together. The type of particle and the number have a bearing on the 'state' of the substance; these two factors determine whether the substance is a solid, a liquid or a gas.

Perhaps you can begin by showing the children lumps of various materials such as coal, granite, limestone, chalk, etc. When these are broken up they form small particles. They can be broken up till the particles are so small that they can only be seen through a magnifying glass.

For your explanation about molecules you will need models. Try to make sure that these relate to real examples and are not made up of a random collection of coloured balls of different sizes, joined together. You will also need additional pictures showing models of an atom. Make sure you point out that they are only models; actual molecules and atoms do not look like these.

Ice, water and steam (water vapour) can be used to illustrate how the same kind of molecules come together in different ways to form different states of the same substance (H_2O).

Questions (*page 47*)

A Look at these words.

atom theory molecule nucleus electron

Which word goes with each of these descriptions?

a It consists of a single atom or several atoms grouped together. *molecule*
b It is the central part of an atom. *nucleus*
c It is tiny particle of matter which orbits the nucleus. *electron*
d It is a scientist,s idea for explaining something that has been discovered. *theory*
e It is a tiny particle of matter which rarely exists on its own. *atom*

B1 What is a theory? What was the theory of the ancient Greek philosophers about matter?

A theory is a scientist's idea for explaining what has been discovered. The ancient Greek philosophers had a theory that all substances were made from earth, fire, air and water.

2 Give two properties for each of these: a solid, a liquid and a gas.

Solids have a fixed shape. They have a fixed volume.
Liquids can change their shape. They cannot change their volume.
Gases have no fixed volume. They have no fixed shape.
(The answers may consists of other properties).

3 In which states can water exist?

Solid (ice), liquid (water), or gas (steam)

4 Explain why a) it is easy to pour a liquid, b) a gas will completely fill any container, c) a solid expands when it is heated.

a) It is easy to pour a liquid because in a liquid the molecules are not fixed in a particular pattern. The molecules move and slide about.
b) In a gas the molecules are far apart and the attraction between them is weak. The molecules are moving about all the time, and bouncing off in all directions. This is why a gas will completely fill any container.
c) When a solid is heated the atoms and molecules vibrate more strongly and therefore take up more space.

5 Why is it that a gas can be compressed into a smaller volume, but a solid cannot?

In a solid there is no space between the molecules. They cannot be pushed any closer together. In a gas there is lots of space between the molecules. They can be compressed.

Things to do (*pages 48-49*)

1 Experiment

Find out what happens to copper sulphate crystals when they are mixed with water. You will need:

- **a large beaker**
- **copper sulphate crystals**
- **water**
- **a glass stirring rod**

a Half fill the beaker with water.
b Add a few copper sulphate crystals and stir. Does anything happen? Write down what you see.
c Keep adding more crystals, stirring all the time. Does anything happen? Write down what you see.

Scientists think:

- **When copper sulphate crystals are added to water, they dissolve. Their particles spread and begin to fill up the spaces between the water molecules. This is why the blue colour spreads.**

- **The substance that dissolves (copper sulphate) is called the *solute.* The substance in which it dissolves (water) is the *solvent*. The mixture of copper sulphate and water is called a *solution*.**

- **If more and more copper sulphate is added, all the space between the particles becomes filled up. The solution has become a *saturated solution.* If you add more crystals, they cannot dissolve because there is no more room between the particles. So the crystals sink to the bottom of the beaker.**

The explanation of what happens is given above. Use this model to get the children to write about any other experiments that they do. Remember to revise the key words; solute, solvent, solution and saturated solution.

Note: Use smaller vessels (100 cm^3 beakers) if you do not have much copper sulphate. You may also recover the copper sulphate by evaporating the solutions.

2 Find out what you can about crystals. Draw some of the shapes in your book.

For this you will need some colourful books from the library.

3 Make some models of molecules. You will need small balls of plasticine of different colours and sizes, and some toothpicks. Join these together to form molecules. Join the molecules together to form lattices.

Make some of the models shown in the Pupil's Book. To make some other more adventurous models, try to find these in books from the library.

4 Make your own crystals. Pour some magnesium sulphate into a beaker of hot water. Stir the mixture. Add more salt and keep stirring until no more dissolves. Take the beaker off the heat and allow the solution to cool.
Tie a piece of thread to a pencil, and allow it to dangle in the solution. Look at the string every day. What happens? Write about your experiment.

Get the children to write a report. This should include an account of: What we wanted to show; What materials were used; What we did; What happened; Why it happened. The report should include illustrations of how the apparatus was set up.

Note: You may use the saturated copper sulphate solution, prepared in TTD1, to grow the crystals. The crystals can be made by *cooling* or by *evaporating* the saturated solution. Evaporation is a slower process and produces bigger crystals.

In this experiment, a lot of saturated solution of magnesium sulphate is cooled. Plenty of small crystals can be expected to form during cooling. The so-called supernatant liquor should be poured off at this stage, and the string dipped into it. Crystals will grow as the solvent evaporates. As an alternative, one of the small crystals can be tied to the end of the string and used as a seed, for a really good crystal to grow on.

Unit 15: Elements (*pages 50-53*)

The main ideas to develop are:

1 An element is a simple substance which cannot be split into simpler substances.
2 An element is a substance made up from only one kind of atom.
3 Symbols are used to represent elements.
4 Some elements were made by man, most elements come from the Earth.
5 Elements can be divided into metals and non-metals.
6 A compound is a substance that consists of different elements.

This is an introduction to the subject, so don't go too fast. The children will take some time to grasp the idea of what an element actually is.

Spend some time talking about various objects. It is a good idea to use examples of things which can be broken down into smaller parts made from different substances. An old torch taken apart will reveal that there are a number of different kinds of metal (the colour difference will be obvious), there may be plastic, glass and rubber, too. Each of these parts is made from different substances. Show the children how one of these substances is made. For example, natural rubber is obtained from trees. It contains a molecule called isoprene. The gum formed in the tree is called latex. This compound is removed and treated and dried to form rubber. Artificial rubber is made from hydrocarbons (petroleum chemicals). Even if the children do not understand the processes or remember the different compounds and elements, they will at least understand that eventually all substances can be broken down into basic substances consisting of molecules of one kind. (Later on they will understand better why certain substances have long chemical formulas represented by symbols).

You might like to write out an equation for the children, e.g. leather + cloth + cotton thread + plastic (zip) + bone (buttons) = a leather jacket. Each of these components can be represented by symbols or letters. A formula works in the same way, the difference being that in a regular chemical formula the components are elements or compounds.

It is worthwhile spending a little time in consulting a good dictionary to find out how words are derived. A good dictionary will

give you the root form of a word. For example, the word *copper* comes from the Latin word *Cuprum.* Hence the symbol Cu. The children should begin to realize that the symbols may not always be derived from the current form of the word.

When the children are familiar with some of the symbols write out a few equations of various compounds (make these up if you like). They should then be asked to decipher what you have written! Then use real examples.

Questions (*page 52*)

A1 Can you match these elements with the correct symbols?

Chlorine Copper (Cuprum)
Calcium Cobalt
Carbon Chromium
C1 Co
Ca Cu
C Cr

What do you notice about the symbols?

All the symbols begin with C. A second letter is used to differentiate one from the other. The second letter is usually (but not always) the second letter of the word. The symbol can be derived from the original Latin word (Cu).

2 Which of the following are not elements?
<u>stone</u> nitrogen gold <u>plastic</u> <u>wood</u> <u>tin</u> <u>brass</u> lead <u>steel</u>
(Those underlined are not elements).

B1 What is an element? Give three examples of elements.

An element is a simple substance which cannot be split into simpler substances. It contains one type of atom only. (There are many examples in the text).

2 Is brass an element? What is brass made of?

No. It is made of copper and zinc.

3 Your hair is made up of a combination of four elements. What are they?

Oxygen, hydrogen, carbon and nitrogen.

4 What does the symbol Fe stand for?

Iron.

5 What is a compound?

A compound is a substance which consists of different elements, chemically combined together.

Things to do (*page 53*)

1 Two of the elements mentioned in the Unit are named after famous people. These elements are Nobelium (named after Alfred Nobel) and Einsteinium (named after Albert Einstein). Find out what you can about these two men.

2 You can usually tell when substances are metals. Metals shine when you polish them. Metals can also conduct electricity, and they are good conductors of heat. This means that heat and electricity can flow through them quite easily.
Try this heat test for metals.
Fill a mug with boiling water. Place spoons made of silver, wood, steel and plastic in the mug. Put a small smear of butter on each spoon. Stick a bean on the butter on each one, at the same height.

Heat from the water will travel up the spoons.
What will happen to the butter? (It will melt.)
Which bean will fall of first? (The one on the best conductor of heat, a metal.)

3 In this experiment you can break water down into the elements it is made of.

Fill a dish with water.
Add a few spoonfuls of vinegar to the water, to make it a better conductor of electricity.
Attach wires to a battery and dip the ends in the water (Use insulated wires with the ends 4.5 cms bared. These will form the electrodes.) Bubbles will soon start to rise from the wires. This is because the electricity is decomposing the water into hydrogen and oxygen.
Fill two test-tubes with water and place these upside down over the wires. The gas will displace the water and collect in the tubes.
Which tube has more gas in it?
Is the gas hydrogen or oxygen?
Remove the second tube with your thumb over the end of it, turn it so that the open end is upwards, take your thumb off the end and put the glowing end of a splint into the gas. What happens?

Remind the children of the formula for water (H_2O). This means that each molecule contains 2 atoms of Hydrogen and 1 atom of Oxygen (H + O + H). Therefore, when the water has been decomposed there will be a greater volume of hydrogen than of oxygen, in fact, the volume of hydrogen collected will be twice the volume of oxygen.

A lighted match held over the hydrogen will go 'pop'. The glowing splint, put into oxygen, will relight.

Unit 16: Water (*pages 54-57*)

The main ideas to develop are:

1 Water exists in different states and is found on the earth and in the atmosphere.
2 Water power is used to generate electricity.
3 Water always settles at the lowest level it can reach.
4 Water can travel upwards in some materials due to capillary action; it can also rise due to variations in pressure.
5 Objects float or sink in water depending on their density.
6 Water is displaced by objects placed in it.
7 The pushing force of water is called upthrust or buoyancy.

8 Water has a ‘stretchy skin’. This is called surface tension.

From the above list there seems to be a lot that the children have to learn in this Unit. Although much of what has been listed above is already known by the children, here we are trying to explain some more properties of water, how it behaves under different conditions, and what happens when objects are placed in water. The children should have already done quite a number of exercises related to floating and sinking. If they have not done so already, please do some of these exercise now.

Revise what the children already know about the properties of water.

The first part of the text contains information which the children are already familiar with, except perhaps the experiment with the siphon. If any of them have been in a car which has run out of petrol they may have seen how petrol has been transferred from one car to another by means of a siphon, here is a chance to explain how this happens. Most of the children will have experienced this action when drinking a soft drink with the help of a straw. Explain that the weight of the water in the tube going down pulls the smaller weight in the tube going up.

To understand density and displacement the children will have to experiment by placing objects in water. Plasticine is a good material to use as the shape can be changed while the same volume is retained.

The children are not expected to understand everything about surface tension, recognizing that there is such a thing a surface tension is enough at this point. The experiments in TTD should help them towards an idea of what this is about.

Questions (*page 56*)

1 Make a list of the properties of water. (You will have to remember what you learnt last year!)

Water can exist in three states: when cooled (frozen) water changes from liquid to ice and its volume increases; ice is less dense than water (it floats); it is a solvent; it evaporates when heated; cooling condenses the water vapour in air to form water droplets; water contains air; water exerts pressure; etc.!

2 What action causes water to rise in some materials?

Capillary action (Check this by using absorbent paper or cloth dipped in water.)

3 How does a siphon work?

See Introduction.

4 Why does water find its own level?

Like everything else water is pulled down by the force of gravity. Water always finds the lowest level it can possibly reach. (Get the children to test this. Look at the level of water in a glass. Tilt the glass. What happens to the surface? It remains parallel to the earth. Also do an experiment to show that two separate bodies of water can have different surface levels. When the two bodies are connected the water finds one level. This is how canals are built. Locks enable boats to travel along a canal which may drop many metres.)

5 Why is a raindrop a sphere?

Because the surface is held together by surface tension.

6 What is the ‚stretchy skin„ of water due to?

Surface tension.

7 Why do some objects float while others do not?

Objects which have a density which is lower than that of water can float. Objects that weigh less than the water they displace can float.

Things to do (*pages 56-57*)

1 Can you float a needle on water?
Drop a needle into a bowl of water. What happens?

Remove the needle from the water and gently put it back in the bowl on the end of a fork. What happens?

This will help to explain Qs 6 and 7 and above. When the needle is thrown into the water, a) it breaks the surface tension and, b) its surface area when it comes in contact with the water is not very great. It sinks. If it is lowered in gently, it will not break the surface tension.

2 Fill a jar right up to the top with water. Soak a handkerchief and then stretch it over the surface of the jar. Fix it with an elastic band. Turn the jar upside down. Does the water pour out? Touch the surface. What happens?

Have the children ever been camping in a tent? When rain falls on a tent it runs off the surface. If you put your finger against the surface of the tent where there is any collected water, the surface tension will be broken and water will start to drip through. Perhaps this shouldn't be tried while camping in wet weather!

3 Can you float a sieve on water?
Take a tin lid and punch some small holes in it with a thin nail. Gently place the lid on some water in a bowl. What happens? Does the water come through the holes? Does the lid sink? Put a small piece of tissue paper on the lid. Watch what happens.

The lid with holes should float so long as the surface tension is not broken. The addition of the tissue paper means that due to capillary action it absorbs the water from the small surfaces revealed by the holes. Once the water has been absorbed the surface tension breaks and the lid will fill with water and sink.

4 Soap weakens the pull or tension in water. Fill a large clean plate with water.
When the water is quite still, sprinkle some talcum powder over the surface. Does it float? Now wet your finger (not in the plate!) and rub some soap on it. Put your finger in the water at one side of the plate. What happens to the talcum powder?

The soap on your finger weakness the tension. The tension is stronger at the other end of the plate, so the talcum powder is drawn over there.

5 **Ships have a mark on the side. This is called the *Plimsoll line*. It tells us how low the ship can float in the water without being in danger of sinking.**

Make your own boat out of plasticine. How many paper clips can you put in it before it sinks?

Experiment with different shapes to see which one floats the best. Get the children to mark lines on the side, like the Plimsoll line on ships. Try to find some pictures of real ships which show the Plimsoll line.

Part 4: Sky and space

Unit 17: The Sun and the Moon (*page 58*)

The main ideas to develop are:

1 The Sun, a star, is an immense ball of glowing (or white-hot) gases.
2 The Sun, the stars, the planets and Earth are all part of a galaxy called the Milky Way.
3 A process called nuclear fusion is taking place all the time in the Sun. This process is the cause of heat and light energy.
4 The Moon is the nearest body to the Earth.
5 The Moon is much smaller than the Earth.
6 The gravity on the Moon is one-sixth of that on the Earth.
7 There is no life on the Moon, as there is no air or water.
8 Tides are caused due to the gravitational pull of the Moon.

Again there is a lot to learn in this Unit. Do not expect the children to understand completely about nuclear fusion or tides. This is an introduction to the subject and they will learn more about this in later classes. Use this opportunity to interest them in the study of the stars and planets, and to read about the subject. There is much fascinating information to interest the inquiring mind, even

if all of it is not understood immediately.

Before you tackle the main subject matter of this Unit, review what the children already know about the Sun, Moon, stars and planets. Can they tell you some of the differences between a star and a planet? Can they tell you roughly the relative sizes of the Earth, Sun and Moon? Do they know how the planets orbit the Earth? Discuss these and associated questions before you proceed with the matter in the text.

The children are not expected to remember all the facts presented in the Unit.

Perhaps the children have never seenhow large an explosion is caused by a hydrogen bomb going off (few people have!). Show them what pictures you can.

Try to find out more about the Pakistan space programme. Even if you cannot find out much information make the children aware that there is such a programme and that Pakistani scientists do work at finding out more about space. (More about this in the next Unit.)

If it is possible to investigate the tide levels, do so. If you live far from the coast this may not be possible. It should be possible, however, to make the children aware of tides by talking about the topic and by showing them pictures from books. If they have been to the seashore, perhaps they will remember swimming in the sea at hightide, and being able to see a greater expanse of sand on the beach at lowtide.

Questions (*page 62*)

A Some of these statements are not true. Find and correct them.

1 The surface of the Sun is smooth.
(F)…not smooth.

2 The Sun produces Gamma rays and X-rays.
(T)

3 The two main gases in the Sun are helium and oxygen.
(F)…helium and hydrogen.

4 The Sun is about half way through its life.
(T)

5 The Sun is about thirty times as heavy as the Earth.
(F)…330,000 times as heavy.

6 Tides happen because of the Earth,s gravitational pull.
(F)…the Moon's gravitational pull.

B1 What is the name of our galaxy?

The Milky Way.

2 What is the surface temperature of the Sun?

Approximately 6000 degree C.

3 What is a solar flare?

Sudden bursts or explosions on the surface of the Sun.

4 Which body has the weakest gravity, the Sun, Earth or Moon?

The Moon. (It is the smallest body of the three.)

5 How are tides caused? How often do they occur?

Tides are caused by the gravitational pull of the Moon. They occur approximately twice a day, ($12^1/_2$ hours between one high tide and the next, with a low tide in between.)

6 Why is there no life on the Moon?

There is no air or water on the Moon. Living things need air and water to survive.

Things to do (*pages 62-63*)

1 Do you remember making a sundial? Here is another sundial that you can make.

Groups could be formed to make these.

2 To see how big the Sun really is, draw a circle with a diameter of about 4 mm. On the same piece of paper, about 10.5 cm away, draw a small dot. The big circle represents the Earth, and the dot represents the Moon. On another piece of paper draw a circle with a diameter of 40 cm. This represents the Sun. Go outside and place the two pieces of paper 43 cm apart. You will then have some idea of how far apart the Sun is from the Earth, and how large it is in relation to the Moon and the Earth.

This will give the children a good idea of the relative sizes of these three bodies. This will help them to understand eclipses and the phases of the Moon, too.

Note the following facts:

Diameter of Moon :	3476km	(1 mm)
Earth :	12756 km	(3.66 mm)
Sun :	139200 km	(40 cm)
Distance Earth/Moon :	375000 km	(10.8 cm)
Earth/Sun :	149600000	(43 metres)

Taking 1 mm = 3476 you get the figures in brackets.

3 Observe the different setting positions of the Sun. Find a place from where you can watch the sunset. Make a sketch of the horizon. Mark the place you see the Sun set. Do this once a week, every week, for a few months.

Get the children to do the outline silhouette of the horizon from a place close to where they live. They will then be able to check the position early in the morning and in the evening. There is no point in doing this at school because the children will not be at school at these times.

4 If you have a pair of binoculars you can observe the craters and seas on the Moon. For a good view, steady the binoculars against something firm.

Point out that the dark areas on the Moon (marias or seas) are not seas as we have on earth, in the sense that they have no water in them. They are areas where basaltic rock has flooded over the Moon's surface and then solidified. This process has covered over

any craters which were there beforehand. You may be able to see a few 'late' craters on the maria.

5 You must never look directly at the Sun. Never look at it with your naked eyes, and never look at it through a telescope or a pair of binoculars. The only safe way to look at the Sun is to observe the image of the Sun. Can you see the sunspots? Mark the sunspots on a piece of tracing paper. Watch them change from day to day.

Unit 18: Space travel (*pages 64-67*)

The main ideas to develop are:

1 There have been many theories about the Earth and its position in space.
2 Scientists and astronomers study the planets and stars in a number of ways. Through various developments in science and space technology scientists have discovered many things about space.
3 Satellites are used to find out information about space, the Earth, the weather; they are also used for communications.
4 Astronauts (or consmonauts) have been sent into space in a variety of space satellites.
5 Spacecrafts are launched into space with the help of rockets.

This is a wide subject and full of interest, especially when there is a current space programme in operation.

Perhaps you can begin the topic by saying something about the early theories of the Earth and its place in the solar system. Early thinkers believed that the Earth was at the centre of the universe. It was only when astronomers began to study the movement of the planets and the stars across the night skies that they came up with new theories. It took a long time for man to work out that the Earth was rotating on its axis and revolving round the Sun! This is still a difficult concept for young children to understand fully.

In talking about space exploration the children may also like to make models of some of the spacecrafts and rockets. Use time in the Art/Craft classes to relate what you are doing in the science class. Build your own model of a space station or even a futuristic city.

Put up pictures on the classroom walls and get the children to transfer some of the information given in the text onto wallcharts.

Show the children pictures of the Earth taken from satellites. Weather pictures are also useful.

Can the children design and make their own model of a weather balloon? Can a kite be used instead of a balloon?

Questions (*page 66)*

A1 What theories did people have about the Earth hundreds of years ago?

People thought the Earth was flat. They also thought that the Sun and other stars and planets revolved around the Earth.

2 Why are observatories usually built on high mountains?

The atmosphere is clearer and there is less pollution in the air. There may be less cloud cover.

3 How are balloons useful?

Balloons are used to find out about the middle layers of the atmosphere. They do not cost as much as aeroplanes or rockets.

4 Which was the first manned spaceflight?

The first manned space flight was the Russian spaceflight (Vostok I) in 1961. This took Yuri Gagarin into space.

5 Who was the first man to walk on the Moon?

Neil Armstrong.

6 What are satellites used for today?

They are used to tell us about the weather, to relay signals, to deal with communications, to help ships navigate at sea, and also to spy!

7 How are astronauts able to live on board a spacecraft?

Astronauts live and work in the command module. Inside the spacecraft they have lifesupport systems. (This means that they have all the necessary things to keep them alive; oxygen, water, food, etc.)

B1 Try to write a brief description of each of the following:

a space module **b astronaut**
c weightlessness **d life support systems**

The children should use these headings to find out what they can from books and other sources. What they find out will depend on the books available and their interest and aptitude.

2 Why is a parachute no help to a spaceman landing on the moon?

Because there is no air on the moon to slow down the descent of the parachute.

Things to do (*page 67*)

1 Make your own rocket.
Slide the straw on to the string. Tie the string to two places, quite far apart. Make sure the string is taut. Blow up a long balloon and tape it to the straw. Let the balloon go. How far does it travel. Repeat the experiment, blowing a different amount of air into the balloon each time. Record the experiment, blowing a different amount of air into the balloon each time. Record the distance it travels.

The experiment will prove a point, however, it is very important that the children actually work (individually, in pairs or in groups) to do the experiment and write about it. Putting the apparatus together, making it work (and failing to do so), seeing what happens, recording what happens, modifying the apparatus to suit varying conditions, and coming to some kind of conclusion are all important processes of science.

Scientists say that *every action has an equal and opposite reaction.* Jet and rocket engines work because of this rule. Rockets have engines which are millions of times more powerful than your balloon rocket. The gas in a rocket engine causes *thrust*. Thus a rocket or a jet engine exerts a force to push a jet of hot gases backwards; and the hot gases therefore exert an equal force to push the rocket or jet engine forward. The difference between rocket engines and jet engines is that rockets have to carry their own oxygen. There is no air in space. A jet engine takes in air from the atmosphere.

2 Find out what you can about spacecraft. Draw pictures of rockets and space modules.

3 Design your own rocket boat.

Get the children to first make their own drawings. Discuss the feasibility of each. Can they modify the rocket boat in the picture? Can they come up with any alternatives or improvements?

Part 5: Earth and atmosphere

Unit 19: Changes in the atmosphere (*pages 68-76*)

The main ideas to develop are:

1 Changes in the climate take place all the time.
2 The position of the Earth, its rotation and revolution, and the presence of atmosphere round the Earth are the causes of many climatic changes.
3 The atmosphere consists of various gases, nitrogen and oxygen being the main constituents.
4 The various layers of the atmosphere have different names.
5 Radiation from the Sun reaches the Earth: it is reflected in different ways.
6 Weather changes occur due to moving air.
7 There are different forms of precipitation.
8 Weather conditions are measured in a number of ways by the use of special instruments.

Note:

The temperature falls steadily as you go higher in the troposphere, but rises as you go higher in the stratosphere (this is the scientific distinction between these two layers. The tropopause lies between them, and is the level where the temperature gradient changes from negative to positive).

For this Unit is a good idea to have a large globe in the classroom. With this the children will be able to understand better the tilt of the Earth and its rotation on its axis, its revolution round the Sun, and how seasons are caused.

Revise all the basic facts that the children have learnt in the previous class.

It is a good idea to introduce some of the ideas contained in this Unit quite early on in the year, so that some of the experiments and checks on the weather can be conducted regularly over a long period of time. (See TTD 1. And in order to check these properly some of the instruments described will have to first be made!)

In order to understand convection better (see page 69) you could set up the following experiment.

For this you will need a box (an old shoe box will do). Cut a large window out of the lid of the box. Cover this with clear plastic.

Make two cardboard chimneys. (Use the centres of toilet rolls.)

Place these over two holes made in the side of the box.

Set the box on its side.

Place a lighted candle under one chimney.

Put the lid in place.

Smoke from a piece of smouldering brown paper held over the other chimney will travel through the box and will show the air currents.

Questions (*page 74*)

1 What is the study of the weather called?

Meteorology.

2 What is the troposphere?

The layer of atmosphere closest to the Earth.

3 What is meant by precipitation?

Precipitation is when water vapour turns into droplets of rain, snow or ice, which then fall to the ground (precipitate).

4 How are clouds formed?

Clouds are formed when hot air rises, and the water vapour in the air condenses to form tiny droplets of water. These collect together to form clouds.

5 What is hail? How is it formed?

Hail is round particles of ice, which is formed in tall clouds called cumulonimbus clouds. The bottom of such clouds is warm, but the top can be freezing. Air currents in such clouds are strong, and these currents toss the drops of rain about. They freeze at the top and thaw when they come to the bottom of the clouds. When the droplets get bigger they fall out of the cloud as hail.

6 Which instruments are used to measure weather?

Wind vane, anemometer, thermometer, rain gauge, barometer, hygrometer.

Things to do (*pages 74-75*)

1 Are you keeping a weather chart? If not, start one now. Your teacher can help you. When you have been keeping it for some time, see if you can make some predictions or forecasts of what the weather will be like the next day, the next week, and the next month.

Get the children to the weather forecast on the radio or television, and to report this to you. When the temperature begins to rise in the summer, the children will be able to see this on their chart.

2 Make some instruments to measure the weather.

A wind vane
This will tell you the direction of the wind. You will need a compass to set the directions, below the wind vane.

Are there any wind vanes on tall buildings in your city?

A rain gauge
Pour 2.5 centimetres of water into a narrow jar. Mark the side of the jar with paint at five points, each 5mm apart. Pour out the water and allow the paint to dry.

Place another jar, of the same width as the measuring jar, outside in the soil with a plastic funnel over its opening. The funnel should be the same size as the opening of the jar.

After it rains, pour the water from this jar into your measuring jar. Measure how much rain has fallen and enter the figure on your chart. If there is a lot of rainfall in your area, you can mark more points on your measuring jar.

An anemometer
This will tell you the speed of the wind.

A barometer
This measures air pressure. When air pressure rises it is a sign of good weather. Air pressure falls when bad weather is approaching.

Cut a piece out of a rubber balloon wide enough to stretch over the mouth of a jar. Stretch the balloon and fix it in place with a strong rubber band.

Put a drop of glue in the centre of the stretched rubber. Hold one end of a straw over the glue until the straw is stuck down well.

Write HIGH and LOW on a piece of card and place this close to the straw. As the pressure increases it will press down on the rubber, and will lift the end of the straw.

Point out that changes *may* occur not due to pressure changes but due to temperature changes. The straw needs to be quite long to record slight changes.

A hygrometer
This measures the amount of moisture in the air. We call this humidity. Hair stretches and lengthens on a humid day. On a dry day it contracts. Use this idea to make a hygrometer.

Unit 20: Changes on Earth (*pages 77-82*)

The main ideas to develop are:

1 The Earth is about 4600 million years old.
2 There are different kinds of rock on the Earth; these were formed in different ways.
3 Fossils help us to determine when rocks were formed.
4 The Earth at one time was one mass of land. The continents drifted apart about 200 million year ago.
5 The face of the Earth has changed in many ways; continental drift, currents, waves, tides, the action of ice and wind, chemical action and man have all contributed to changes.

This Unit is about change. There are many forces acting upon the Earth, the change can be quick and dramatic, but more often change takes place over many thousands of years.

In order to talk about the various kinds of rock and how they were formed it is a good idea to show the children some examples and also pictures of volcanoes (and volcanic rock being formed from lava), sedimentary rock and metamorphic rock.

There are some good pieces of rock available in Pakistan which show fossils of one kind or another. Show some of these to the children.

When you are talking about the continental drift (see page 76) also tell the children about the fact that the Indian subcontinent moved northwards (and is still moving) to bump into southern Asia. This is how the Himalaya mountains were formed. (Near Gilgit there is a plaque on the cliff by the Karakoram Highway which says 'HERE THE CONTINENTS COLLIDED').

You will also need to collect pictures showing glaciers and the valleys they have carved out, desert feaures, the effects of weathering, and man-made changes.

Chemical changes (when water dissolves limestone or chalk) cause shallow holes, underground streams, pillars, underground lakes, stalactites (hanging from above) and stalagmites (rising from below), gorges and caves. When erosion takes place underground the surface layers can collapse.

Questions (*page 81*)

1 In your own words describe what kinds of rocks there are and how they are formed.

Igneous rocks: from hot, molten magma out of volcanoes.

Sedimentary rocks: from layers of sediment.

Metamorphic rocks: (*metamorphosis* means change) formed from existing rocks which have changed due to heat, pressure or chemical action.

2 How have fossils helped scientists?

They tell scientists about the shape of living creatures, now extinct, and help to date rocks. They also helped scientists to form theories about the continents.

3 How have the continents changes?

The continents at one time formed one land mass. Over millions of years they have drifted apart, and together, in various ways. This drift has caused changes in the coast lines and has given rise to mountains. The movement has also caused faults in the Earth's crust.

4 What is a glacier?

A glacier is a large mass of moving ice, found high up in the mountains.

5 What is mechanical weathering?

When rocks crack, split or crumble due to changes in temperature or pressure, mechanical weathering takes place.

6 What is a stalactite? How is it formed?

A stalactite is a deposit of lime (carbonate of lime) usually in the form of a large hanging from the roof of a cave, and formed by trickling water.

7 How has man changed the earth?

Man-made changes are occurring more frequently, especially as populations increase, and the building of dams, canals, the plantation of crops, deforestation, animal rearing, and collection of building materials (granite, sand, clay) are some of the reasons why the surface of the earth has changed.

Things to do (*page 82*)

1 Look carefully at the buildings near your school. Have these been weathered in any way? Draw pictures and write about what you think has happened.

Heavy rain can cause damage to buildings and can dissolve bricks and other materials which have not been protected well. If there are any old ruins nearby, take the children to see them.

2 Make a collection of different types of rock. Try to find out what they are and how they were formed.

Name small samples and make up an exhibition. Pebbles from the beach or a river bed will form a fascinating and colourful exhibition.

3 Make your own stalactites and stalagmites.

a Fill two jars with warm water. Dissolve as much washing soda in each one as you can.

b Make a long cord by twisting together some strands of wool.

c Place the jars in a warm place with a saucer between them. Put the ends of the cord in the jars, leaving the middle hanging over the saucer.

d The solution will rise up the cord and will begin to drip into the saucer. After a few days you should be able to see a tiny stalactite and stalagmite form.

Remember that stalactites hang from above and that stalagmites are pillars rising upwards.

Recall work done in Unit 14.

Unit 21: Pollution (*pages 83-87*)

The main ideas to develop are:

1 The environment is everything around us.
2 We are responsible for keeping our own environment clean and healthy.
3 Waste is created in number of different ways.
4 The manufacture of most industrial products creates some waste.
5 Pollution is caused in a number of ways. There are ways of controlling pollution and we have to all play our part in this.

Pollution is one of the biggest problems faced by mankind in this age of industrialization. The waste products created by mankind have increased tremendously due to industrialization, consumerism and the rapid increase in population. The children must be made aware of the causes of pollution and think carefully about ways in which they can contribute their efforts to control waste and pollution. The need for action is becoming more urgent as the situation is gradually reaching the level where control will soon not be possible.

Part of the reason why children learn science is to enable them to understand their environment better. There has to be a balance between the human world and the natural world. There is no use bringing up children who can answer questions in science with accuracy but who have not learnt how to relate what they have learnt to every-day life and the environment. This is a good topic to take up, with this objective in mind.

There are many examples of wasteful methods and practices

that we employ. One only has to buy a box of chocolates or any other pre-packed product in the shops to realize how much of the packaging is cosmetic. One only has to walk down a street and count the number of black plastic bags floating about in the breeze to realize that perhaps these bags were unnecessarily used. There are many such examples of waste, and wasteful practices. Discuss this with the children.

Point out the difference between between biodegradable waste and non-biodegradable waste. Some things are naturally recycled by nature. Man-made products are usually not biodegradable and have to be recycled in different ways. Get the children to bury various things to see which rot and therefore most easily recycle naturally. Try paper, various plastics, a tin can sacking, etc. Keep the ground moist with regular watering, and dig them up after a month to see what has happened.

Questions (*page 87*)

A1 What is the environment?

Everything around you; the roads, the houses, the people, the air, nature.

2 Name at least five items which you waste or throw away at home.

The children can make up their own lists. These will probably include, food (of various kinds), sweet wrappers, boxes (shoes, toothpaste, biscuits, etc), old clothes, empty plastic and glass containers (bottles, jars, tubes), tins and cans, half-used pencils, and many other things!

3 In your own words try to describe what acid rain is.

Coal is burned and smoke is produced. Fuel contains sulphur. When the sulphur combines with oxygen and water in the air, acids are formed, which fall to the earth as acid rain. Acid rain causes more pollution, destroys nature and causes diseases in humans and animals.

4 What wastes are produced in industry?

Most forms of energy also produce waste. Gases, chemicals, and other substances are wasted when these things are produced.

5 Why should we not use too many aerosols?

The spray propellant from aerosols mixes with the atmosphere and reaches the ozone layer. This gradually eats away the ozone layer, and enables harmful rays from the Sun to reach the Earth. These rays cause diseases in humans and animals, and abnormal growth conditions in plants.

B1 Which of the things shown below are biodegradable.

The biodegradable things are: rat, leaf, (some kinds of) paper, banana skin, dead tree trunk.

Things to do (*page 87*)

1 Here are some of the things we can do the reduce waste. Talk about each idea and then design a poster for one of them. Your poster must be colourful. It must get your message across to the people who are going to read it.

- **Don‚Ä‡ waste food. Take only as much as you need.**
- **Don‚Ä‡ accept extra wrapping (paper or plastic) when it is unnecessary.**
- **Don‚Ä‡ go by car or bus when you can walk.**
- **Don‚Ä‡ throw litter around.**
- **Don‚Ä‡ buy drinks in cans when returnable bottles are available.**
- **Don't leave lights on when you leave a room, or during the daytime.**
- **Don't throw waste food away. Put it on a compost heap.**
- **Don't waste paper. Write on both sides.**

There are many other don'ts too. If the children understand the reasons behind some of these statements then they would become more caring, thoughtful and environment-conscious members of

society.

Discuss each point. There are circumstances which prevent us from following some of these suggestions; but if we feel strongly enough about something and know why we should behave in a particular way we can change our ways.

2 Design another poster to warn people about the effects of pollution.

Let different groups of children take up particular issues. Concentrate on one issue and produce a poster related to that. Trying to put all the ideas about pollution into one poster may lead to problems.

3 Plan a campaign to clean up a particular area. This can be your school grounds, a rubbish tip, a dirty pond, or a street. How will you clean it up? How will you make sure it is kept clean?

Cleaning it up is only part of the task; maintaining the cleanliness and beauty of the place is more difficult.

4 Think of ways to recycle the waste products from your house.

Ask the children to look around and report on ways things have been recycled. People in Pakistan even build small shacks out of cut up cans and tins, so there is no lack of ingenuity as far as recycling is concerned! At the roadside there are cobblers who make up sandals from old tyres.

5 Try burying various things to see which rot and therefore most easily recycle naturallyfl paper, various plastics, a can, sacking, etc. Keep the ground moist with regular watering, and dig all the things up after a month to see what has happened.

Part 6: Electricity and magnetism

Unit 22: Electricity (*pages 88-93*)

The main ideas to develop are:

1 Electric current passes more easily through some materials; metals are good conductors of electric current.
2 Metals like all other substances, are made of atoms. In metals, unlike other substances, some of the electrons of the atoms are free to move about.
3 An electric current is the movement or drift of these free electrons from one end of the conductor to the other.
4 Resistors slow down electric current.
5 Fuses are used to protect circuits. They prevent damage to electrical equipment.
6 Electricity is produced in a number of ways in nature.

The Unit deals with some of the theories behind electric current. It also introduces the children to a number of new words. The TTD section will familiarize the children with these terms, so make sure you actually tackle all the TTD exercises. It may be a good way to introduce the children to some of these ideas by first tackling some of the TTD exercises.

For this Unit you will need to plan carefully what apparatus and materials you will need for the class. It is a good idea to ask the children to bring whatever electrical components they may have at home. You may be surprised at what they come to class with! It is always more fun if they can actually do some of the experiments themselves, so if you have only one set of materials make sure they get the opportunity to handle them.

It is also much easier to explain what is happening when you have the materials in front of you. Fuses, for example, come in all different sizes and shapes. They should have the opportunity of taking some apart and examining them carefully. Similarly, there is no use saying that this material is a good conductor and that material is a good conductor and that material is a bad conductor. It is much more useful if they can actually try out various materials and see for themselves.

Circuit problems can be made up and given to the children. For example, use some of the symbols to make up certain circuits. Get

the children to label the diagrams you have made and perhaps construct some of them with actual materials.

More information on electricity in nature can be found in books from the library. Encourage the children to find out more about the subject.

If the children are unfamiliar with some of the basic ideas, review what was done in the previous book.

Questions (*page 91*).

1 What is a conductor? Can you give some examples good conductors?

Materials such as metals which allow electric current to pass through quite freely are called conductors. (Good conductors of electricity are also good conductors of hat.) Copper, iron, and aluminium are good conductors of electricity.

2 In your own words try to describe how current passes through a wire.

Allow the children to use their own words to describe this. The correct explanation is given on page 88/89 of the text. They might simply state that electric current is a flow of electrons through a cable or wire.

3 In what ways do we see electricity in nature?

In thunderstorms (lightning), in the body, in the electric eel. Static electricity can be experienced in many situations, for example, from doorknobs in air-conditioned hotel rooms!

4 What is a fuse? Why is it a useful component of a circuit?

A fuse is a short piece of thin wire which is connected to a circuit. It fuses (or melts) if there is too much current passing through the circuit, thus preventing damage to components or expensive equipment.

5 What is a resistor? Why are resistors needed?

A reistor 'resists' the flow of current. They are used to allow different components to receive different voltages.

Things to do (*pages 91-93*)

The first few experiments deal with static electricity. Static electricity is not the same as ordinary electricity. Static means *still* or *not moving*. Static electricity works best on cold, dry days. Plastic and nylon are the best materials to experiment with.

1 Rub a plastic comb several times on a woollen sweater. Hold this over some small bits of paper. What happens?

- **The comb and the paper are both changed.**

  When two materials are rubbed together, electrons may be transferred from one surface to the other. Both surfaces then become changed, but one ha a negative (fi) charge, and the other has a positive (+) charge. This is why they attract each other. In most materials the fi and + charges are mixed up, and cancel each other out.

2a Tie two balloons to a string, so that they are touching each other. Ask a friend to rub one balloon against a woollen pullover, and you rub the second one.
Then allow both balloons to hang freely.
Do the balloons attract or repel each other?
Can you remember the rule you learn about the poles of a magnet?
Which poles attract each other and which ones repel each other?

Like poles repel, opposite poles attract. If both surfaces are similarly charged they will repel each other.

Also try rubbing two strips of thin plastic. Pull them briskly between the fingers. Do they repel each other or attract?

2b Rub a balloon several times on a woollen sweater. Hold it against a wall, and see what happens.

The balloon should stick to the wall for some time.

- **The current electricity which we use in our homes and in your experiments with cells may appear to be different from static electricity. They are, in fact, both basically the same, but whereas current electricity flows round a circuit through conductors, static electricity stays in the same place on an insulator.**

3 When a light is switched on, it lights up immediately. Why does this happen?

Place about eight marbles between two books. (See the illustration.)
Take the marble at one end and push it against the next marble. Do the other marbles move? Does the marble at the end move?

- **Electrons work in the same way. They all begin to move at the same time, when a circuit is complete. The completed circuit means that they have a return path open to the cell or battery. So, when you switch a light on, it comes on immediately, and we do not have to wait for the electricity to get from the switch to the lamp.**

4 Make a circuit as shown.
For the fuse use a thin piece of metal foil from a bar of chocolate. Touch another wire from A to B. This will cause a short-circuit, and the metal foil will burn through.

The fuse, like all fuses, should contain wire (in this case metal foil) which is thinner (and therefore weaker) than the main wire in the circuit. (It is a very dangerous practice to put a solid metal nail into the fuse box at home, simply because a weak fuse keeps 'blowing'!)

5 Does the lead in your pencil conduct electric current? First find out, do the following experiment. It will help you to understand what a resistor is.

Cut half of a pencil away like this.
Glue the pencil to a flat piece of wood.
Attach a wire to the point of the pencil (A).
Wire the pencil into a circuit, but leave the end of the wire (B) free.
Press the end of the wire (B) onto the lead in the pencil.
Does the bulb light up?
Move the wire nearer to (A).
Does the bulb shine more brightly?

Unit 23: Electromagnets (*pages 94-97*)

The main ideas to develop are:

1 Electromagnets have many applications in science.
2 Using an electromagnet for a practical purpose.

This Unit contains a useful exercise dealing with an electromagnet. The children will have fun making the buzzer but in the process will learn how to follow instructions, solve problems while constructing the model, and learn how to make adjustments where and when necessary. It is best that they work in small groups or in pairs.

As full instructions are given in the Pupil's book, there is no need for any further details here.

Here is a list of the components you will need. Modify these where appropriate, depending on what you have available.

A soft iron nail (about 10 cm long x 1 cm thick)
100 gm insulated wire (standard gauge, this will amount to about 20 metres)
2 pieces of tin (2 cm x 10 cm)
2 small blocks of wood
1 screw
1 rubber band
two or three nails
1 flat block of wood (15 cm x 15 cm x 2 cm)
1 flat block of wood (6 cm x 4 cm x 1 cm)
a switch (make one) and a cell (or battery)

When the children have finished making the buzzer, get them to

write answers for the questions. They will undoubtedly use their own words, but sample answers are given below.

Note:
Tin is actually a piece of steel with tin plating over it. It is the steel which is magnetic. The key points to get across in the answers to questions are (i) The buzzer makes a buzzing sound because the piece of tin is vibrating; (ii) When A touches G, the circuit is complete, so the electric current makes the soft iron nail into an electromagnet, which attracts the tin towards itself and away from G; (iii) Once the contact between A and G is broken, the current is switched off, and the electromagnet ceases to attract the 'tin', which is pulled back against G by the elastic band, and the cycle repeats itself ad inf.

Questions (*page 97*)

1 How does the buzzer make a buzzing sound?

When the current is switched on the electromagnet will work. It will attract the piece of tin. The rubber band will pull the piece of tin will make a buzzing noise as it virbates backwards and forwards.

2 If (A) is touching (G), and not touching (B), what happens when you switch on the current?

For your benefit, the question has been rewritten: If the piece of tin is touching the screw, and not touching the electromagnet, what happens when you switch on the current?

Answer: The electromagnet will pull the piece of tin towards it, and the rubber band will pull back.

3 If (B) is touching (A), and (G) is not touching (A), what happens when you switch on the current?

The question rewritten: If the electromagnet is touching the piece of tin, and the screw is not touching the tin, what happens when you switch on the current?

Answer: Nothing. The electromagnet will hold the piece of tin. The tension in the rubber band will have to be increased.

4 What use can you make of the buzzer? Could you use it as a burglar alarm?

If the switch is replaced by a pad of some kind it can be used as a burglar alarm. The burglar will have to complete the circuit in some way. This can either be done by connecting the two wires to two points close to each other on a sliding window, or placed under a doormat. This will have to be discussed with the children. Allow them to come up with solutions of their own. Will it work? Try out some of their idea.

5 Draw diagrams to show how you would use the buzzer to make:
a a burglar alarm
b a device to tell you when a tank is full

Again, ask for plans in writing and with illustrations.

Part 7: Machines, force and energy

Unit 24: Forces (*pages 98-103*)

The main ideas to develop are:

1 The wind, running water and gravity all produce natural forces.
2 Forces can also be produced by people and machines.
3 forces can change the direction or speed of motion; they can change the shape of an object.
4 Friction is a force.
5 Most things have several forces acting on them; balanced forces are important in buildings and machines.
6 Springs, rubber bands and other materials can produce an elastic force.
7 Even object has a centre of gravity.

Important words to use: pull, push, shape (as a verb), slow down, speed up, turn, accelerate, twist, friction, move, balance. All these words imply that there are forces acting. Use them constantly and emphasize that they are related to force.

It is quite easy for the children to understand that when they are

exerting pressure on a wall (pushing it) there is a force acting upon it. It is not so easy for the children to understand that the wall is exerting a force too. This idea will take some time to sink in, but if you discuss it and go through all the examples given in the TTD section the children should begin to get the idea that several forces act on all objects.

While the children are engaged in the activities, get them to say what they are doing and to give some kind of verbal explanation.

Friction is something that slows things down, but make sure the children realize that this is also a *force.*

Questions (*page 102*)

A1 What are some of the things that a force can do?

A force can change the way things move. A force can speed up motion, slow it down, change the direction of an object in motion, change the shape of an object. Equal and opposing forces can balance an object.

2 What forces are most likely to slow down an object travelling through the air?

The friction between the air and the object.

3 What force is exerted on you, when you push against a brick wall?

An equal force in the opposite direction.

4 In what way can metal and wood be made to exert an elastic force?

Metal coiled into a spring can produce an elastic force. Press on the metal spring and it exerts an elastic force. A length of wood can also act like a spring in the same way, e.g. a diving board.

B1 Will these levers balance?

The coins in *a* are exerting equal turning forces about the

pivot, but in opposite directions. The coins are at the same distance from the pivot. The single coin in *b* is exerting the same turning force as the two other coins about the pivot, but look at where they are placed!
In *c*, the single coin is exerting the same turning force as four coins. They are even closer to the pivot.
(Tape the ruler to the pencil, so that it balances. Place coins on the ruler, and do the experiment yourself.)

What does this experiment tell you about force?
What does the experiment tell you about levers (and pivots)?

Get the children to do these and similar exercises. If there is a seesaw in the playground get the children to see how that can be balanced in the same way, using themselves as weights. In order to balance a lever, an equal (or balancing) force must be exerted on each side of the pivot. It is important to know where this force has to be applied. The children should see that the force needed is least when it is further away from the pivot. In the following Unit they will be able to see how some machines with levers actually work.

Things to do (*page 103*)

1 **Balanced forces**
Get some of your friends to line up near a wall. Even though the first person is against the wall, the others will not be able to push him against the wall. This is because he, and everyone else in the line, is exerting a balancing force on the person behind.

2 **Now try sitting in a circle like this. As long as everyone sits down at the same time (and gets up at same time) no one should fall over! This time the ground is exerting a balancing force on everyone,s feet.**
If everyone shuffles their feet forward, the circle will move round!

3 **Stand as close to a wall as possible, with your right shoulder and right foot touching the wall. Now lift your left foot off the ground. What happens? Why does this happen?**

Make sure that the children stand to attention with their right ankle actually touching the wall. The left foot is preventing the body from falling over. The centre of gravity is exactly over the left foot. When this foot is lifted the object (the child's body) falls over.

4 An object with a low centre of gravity is more stable than one with a centre of gravity that is higher up.

a Sit in a chair with your arms hanging down. Keep your back upright, and without moving your arms, try to stand up. Impossible! Where is your centre of gravity?

The centre of gravity is in the centre of the body or straight down the backbone. It will be impossible from this position to shift the centre of gravity to the legs, and stand up.

b Sit down again, but this time hold your arms out in form of you. Now stand up. Can you explain why you are able to stand?
Where is your centre of gravity now?

The outstretched arms enable the person to shift the centre of gravity to a point over the feet. The person can stand up easily.

Unit 25: Machines (*pages 104-110*)

The main ideas to develop are:

1 Weight is a force exerted by gravity.
2 To lift an object a greater force (than that exerted by gravity) has to be applied. When a force moves it is said to do work. (The scientific definition is work = force x distance.
3 Machines help us to do work.
4 There are different kinds of machines; these include levers, inclined planes, pulleys, screws, wedges and wheels.
5 Wheels with teeth around them are called gears.

This Unit contains a lot of practical work, and it is best that all explanations are made with various pieces of apparatus at hand so that practical demonstrations can be conducted.

You will need to recall certain things introduced in the previous Unit as well as in the previous book.

Bring to class as many tools and machines that you can collect. All of these will make use of one or more of the devices mentioned in the text.

Questions (*page 108*)

A1 What use are machines?

Machines help us to do work, machines can exert greater forces than we can.

2 How many classes of levers are there? Give an example of each.

Three.

1st class lever : pliers (fulcrum in middle).

2nd class lever : wheelbarrow (load/weight in middle).

3rd class lever : tweezers (effort/power in middle).

Note that a lever is a straight bar or other rigid structure of which one point (fulcrum) is fixed, another is connected with the force (weight or load) to be resisted or acted upon, and a third is connected with the force (power or effort) applied.

3 What use are inclined planes? Have you seen any in use?

Inclined planes are used as ramps to unload goods from the backs of lorries, for easy access of wheelchairs into buildings, for pleasure (slides), and for many other jobs.

4 How are pulleys useful?

Pulleys are used to lift heavy objects. (Cranes on building sites use levers and pulleys, heavy containers are loaded onto ships with pulleys; felled trees and buckets of water from wells are also lifted by pulleys.) Pulleys are also particularly useful for changing the direction of a force.

5 What is a screw used for?

A screw is used to hold things down. A screw can also be used to move a weight from one place to another (see a monkey-wrench or car jack).

6 What is a wedge? Give some examples.

A wedge is a piece of wood or metal with an angled (acute-angled) edge. It is used to cut, split or widen an opening. It exerts force in various ways. Knives and axes are wedges.

7 In what ways are wheels useful?

Wheels are used in many machines with rotary movement, such as clocks, vehicles, engines and toys. Wheels are used to make things move forward; they can also be used to change direction.

B1 Make a list of all the things you can see which have screws in them.

Have the children noticed that screws have a slit in the head (to take the wedged end of a screwdriver) and that nails have flat heads? If they look at all the wooden furniture, windows, cupboards, watches or clocks, pencil boxes and other objects in the class room they will be able to find a number of screws.

2 Why is an oar a Class 2 lever?

Because the blade, not the rowlock, is really the fulcrum.

Note:
Watts Planetary Gear: This is a gear-wheel which goes round another gearwheel (roughly as the planet goes round the Sun). The gearwheel is moved backwards and forwards by a piston; it moves round the middle gearwheel (which is fixed o a big wheel) and so turns this gearwheel and the big wheel. A band joins the two wheels together.

3 What kind of levers do you think these are?

Get the children to make their own drawings and mark each lever with the letters F (fulcrum), E (effort), and L (load).

1st class: (fulcrum in middle) bat, scissors, forceps
2nd class: (load in middle) bottle opener, nutcracker.
3rd class: (effort in middle) arm, fishing rod, tongs.

Things to do (*pages 109-110*)

1 **Make a list of all the machines or tools that you know of. Put them into different groups. Call these groups Levers, Inclined Planes, Pulleys, Screws, Wedges and Wheels. Some of the machines may include two or more of the devices mentioned above.**

2 **Make a model pulley.**

Set up your pulley as shown.
Fill the carton with marbles, or any other heavy material. Feel how heavy it is. Measure how much of the cloth tape you pull. Measure how far the carton rises from the table.

Problems:
- **Will the carton remain balanced?**
- **How will you measure the tape?**
- **Will the tape slip off the reel?**
- **How can the effort be further reduced?**
  (How will it be possible for you to use even less force? Can you attach another wheel to the bar at the top?)

Many problems will have to be solved on the spot. Do not feel discouraged if the pulley does not work immediately. Persevere!

Part 8: Sound, light and colour

Unit 26: Sounds (*pages 111-114*)

The main ideas to develop are:

1 Sounds are made by vibrations, these virbations travel in waves.
2 The distance between successive (or neighbouring) sound waves is called the wavelength.

3 The speed at which the waves are travelling is the velocity.
4 The number of waves passing a point each second is the frequency. The unit for measuring this is hertz (Hz)
5 The height of each sound waves is the amplitude.
6 Musical instruments produce a variety of sounds.
7 Echoes occur when sound waves bounce off surfaces.
8 There are various means of controlling sounds.

Here again there are a number of new words for the children to learn. These words will only become familiar to the children if they are used constantly, during discussions, explanations, and while talking about actual musical instruments and sounds.

Questions (*page 113*)

1 In your own words try to describe how sounds are made and how they travel through the air.

Let the children use their own words, but make sure the ideas are correct. The information they can use is contained in the first two paragraphs of the Unit.

2 How do we measure the amplitude of sound? What does amplitude mean?

Amplitude means loudness. The amplitude of a sound wave refers to the height of each wave. This is measured in decibels (dB).

3 How do we measure wavelength?

Wavelength is measured in millimetres and metres. It is the distance between each wave of sound.

4 Do low sounds have a high frequency or a low frequency?

A low frequency.

5 In what conditions do echoes occur?

Echoes occur where there are no objects to absorb sound, but

there are hard surfaces to reflect sound. In large empty rooms or in the mountains, sounds echo or bounce back.

6 How do bats find their way?

Bats make a high pitched squeaking noise. This sound bounces off objects and returns to the bat's ears. Bats have sharp ears to hear these sounds.

7 In what ways do we control sounds in a city?

Cars have silencers to stop too much noise from coming out of engines. Buildings have thick walls and special sound-proofed windows. Near hospitals there are signs for motorists telling them not to blow their horns!

8 Why are pressure horns harmful?

They are so loud and sprill that they can burst one's eardrums.

Things to do (*page 114*)

1 Take a skipping rope and hold one end. Ask a friend to hold the other end. Ask a friend to hold the other end. Pull the rope so that it is fairly tight. Move your hand up and down to start a wave. Watch it go to the other end of the rope. If you keep shaking your hand, the waves will continue. Can you make the waves bigger and further apart? Can you make the waves shorter and quicker?

Try different movements, some quick and sharp others long and continuous.

2 Get any stringed instrument (a guitar will be ideal) and examine the strings carefully. Are the strings all of the same thickness? How do you make high-pitched sounds?
Read all the statements at the top of page 110, and check if they are true. If you cannot find a guitar, check the statements by making your own rubber band instrument.

By pressing down on one of the lower frets on the neck of a guitar, the length of the string is reduced When the string is plucked it produces a high pitched sound. Let the children try for themselves. If a guitar is not available get any other stringed instrument. Have the children seen the inside of a piano? If not show them how the strings are struck by hammers.

3 **If you have a few musical instruments (even if these are ones you have made) you can do this test. Can you recognize the sounds they make?**
Put on a blindfold.
Ask a friend to play a note from each instrument.
See if you can guess how the sound is being made.
You can also do this with objects that are dropped on a table. Each sound is different.

4 **Test materials to see which one is the best insulator of sound. Use an alarm clock. Put various materials under it. Put a loud radio in a box. Surround the radio with different materials. Which is the best insulator?**

Try a variety of materials.

Unit 27: Light (*pages 115-116*)

The main ideas to develop are:

These are contained in the experiments, as outlined below.

Experiment 1: Light travels in straight lines.

Experiment 2: Light falling on an object produces a shadow. Shadows vary according to the direction and distance of the source of light from the object. Shadows are produced when light falls on opaque objects.

Experiment 3: Mirrors reflect light. This light is reflected at an angle, depending on the direction of the source.

Experiment 4: Light can be reflected. Smooth, flat, light coloured surfaces reflect more light than dull, uneven, dark coloured surfaces.

Experiment 5: Reflections in a mirror.

Experiment 6: Light rays are refracted when they pass through transparent substances.

Experiment 7: Light rays bend when they pass through liquids.

Experiment 8: Lenses change the direction of light rays.