Primary Science for the Caribbean

Teacher’s Guide Books 4–6

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This Teacher's Book is designed to support the use of the Pupils' Books in Grades 4 to 6 of the Nelson Thornes Primary Science for the Caribbean series. The content of the curriculum covered in those books is taken from the Revised Primary Science Curriculum, Grades 4–6, published by the Ministry of Education and Culture, Jamaica. However, they are suitable for primary children in schools across the Caribbean.

The curriculum for Grades 1–3 adopted an integrated approach to teaching young children, as explained in its rationale:

The revised curriculum is designed to be delivered in such a way that children will be able to make connections between what they learn in all subjects, and between school and the world outside. Education at this level should be a process through which children construct meaning for themselves, begin to understand the world and to make wise choices.

The integrated curriculum is therefore designed to facilitate a more child-centred approach to teaching and learning, in an effort to empower the child to face the challenges of the new millennium.

The authors expand on the application of these principles:

- base the curriculum on the needs of the child and the society, not on the requirements of a particular subject
- let the focus be on learning rather than teaching
- give children opportunities to work together and to discuss their work
- recognise that there are many different ways of being intelligent and provide opportunities for the development of all the intelligences
- children need to be educated about many important social, cultural and health issues. The curriculum should cater to these needs.

The Pupils' Books 4–6 have also been written with those principles in mind. Every Unit is learned through activities of various kinds, which are designed for individuals, groups or the whole class to carry out. There are frequent opportunities for pupils to discuss what they will do and to talk about what they have done, with particular emphasis on what they have found out through their activities. At the same time as they are learning useful scientific ideas and facts, they are also developing practical skills. These are useful in everyday life and are not confined to science lessons, e.g. estimating, observing and comparing. The content and the skills are set within the limited world of the young child, drawing on their experiences at home and in the local community. At the same time, the units draw on links with the wider world and contribute to the expanding mental horizons of the children.

The authors of the Science Curriculum state in the introduction that:

Science at the primary level should be seen primarily by the pupils as fun, while they engage in satisfying their curiosity about the environment and themselves and get an understanding of their important place/role in the society and the world.

Structure of the Teacher's Book

The Teacher's Book is made up of the units that correspond to the units in the science syllabus for Grades 4–6. The units covered in this series vary in length, as the curriculum units contain unequal amounts of content.

Should you wish to make links with other subjects in the curriculum, along the lines of the approach taken in the Teacher's Guide for books 1–3 of this series, icons alongside the pupil activities and references to text in the pupils' books show where these can be made. The icons are as follows:

- maths
- language
- music
- drama
- art
- physical education
- technology
- social studies
- religious education
- geography
- history
The units in the Teacher’s Book begin with the objectives for the unit, taken from the curriculum document. They are expressed as the outcomes that pupils should achieve at the end of the unit. For example,

pupils will: talk about the changes that occur over time.

Each unit is then introduced with a brief discussion of the concepts and skills that it contains and a suggestion for the number of weeks to spend on teaching the unit. (It should be noted that this number is drawn from the Curriculum document, but you may wish to vary the number of weeks to suit your own programme of teaching.)

The content of the Pupils’ Book is then dealt with, topic by topic, under the headings set out below:

- The general concepts of the topic are briefly stated and the materials needed for the activities are listed, so that you can see easily what you need to prepare for the classroom.
- Background information to help you understand the scientific ideas and facts is then provided. This is not intended to be passed on to the pupils, as it is not suitable for their level of understanding.
- Using the Pupils’ Book provides a page-by-page commentary, with advice and suggestions about how the Pupils’ Book can be used. Each Activity in the Pupils’ Book is explained, with points to emphasise, things to prepare beforehand and how to make use of the outcome of the activity. There are also some additional activities, which are not found in the Pupils’ Books. These do not have to be carried out by your pupils, but you may choose to use some of them when appropriate.

The approach to learning outlined in the Curriculum document places great emphasis on pupils being active and science provides many such opportunities, as it deals with the natural world. The raw materials of science are all around you and so it is going to be very rare that you cannot use the activity approach adopted by these books. As pupils do things, they learn skills, of hand and eye and mind. Such skills are generally useful, but they are essential in science.

For instance, drawing graphs is one example of how results can be presented. This is a convention that mathematicians have developed to convert numbers into pictures, of one kind or another. A graph is a picture, rather than just a list of numbers. Children need to be taught the skills of drawing and reading (interpreting) graphs. These are obviously skills that are common to maths and science, with applications in other subjects too. Pictograms, using small drawings to represent the items being counted, through to bar charts, where the length of the column is directly related to the number of items it represents, to pie charts, where the size of the sector in the circle reflects the size of the particular factor represented – these are the introductory versions of graphs that children in Grades 1 to 3 began to learn. In Grades 4 to 6, their graph-making skills are extended to include the drawing and reading of line graphs.

Other process skills that the books introduce are:

- Observing – using all the senses to collect information. It is used when pupils are describing objects or events. Observation makes use of prior knowledge.
- Comparing – is a particular type of observation, where similarities and differences are observed.
- Sorting – using observations to put things into sets, based on various criteria, e.g. colour, shape or material. Observation must come first. Simple sorting should be developed into the more complex process skill of classifying, using scientific labels for the sets, e.g. proteins, plants.
- Measuring – is a particular kind of observation, which involves quantities. The first type of measuring done by young children is in the form of comparisons (e.g. this is longer than that.) Then real measuring, using non-standard units, such as hand-spans and foot length, can be developed. In Grades 4 to 6 these are replaced with standard units, i.e. centimetres, kilograms etc.
- Estimating – is a part of the skill of measuring. As children learn the sizes of the standard units through practice, they can use their knowledge to estimate the sizes of objects etc. This is a very useful skill in everyday life.
- Recording – can be done in various ways and should normally follow every activity. Drawing pictures is often suitable for young children, but in Grades 4 to 6, writing, collecting figures in tables and drawing graphs become the standard forms of recording.
- Investigating – includes testing, experimenting and collecting evidence. It includes the skills of planning and carrying out investigations. Investigations arise from questions, so it is important to encourage children to ask questions and then to carry out activities to find the answers.
- Predicting – is part of planning and carrying out investigations. Children should be encouraged to think about what they have observed previously and use that knowledge to ‘predict’ what they think will happen in an investigation.
- Interpreting – is essential, if the results of investigations and observations are to be used to answer questions. Pupils should look at the results and ask ‘What do they tell us? What do they mean?’ This includes looking for patterns in the results.
Interpretation leads to conclusions, which lead to explanations or reasons.

The whole Curriculum is based on the concerns about the environment that the authors have. These are shared by individuals, communities and governments around the world. This series of books lays great emphasis on caring for the environment and attempts to help the children to be aware of its importance and to suggest ways in which they can begin to play their part.

The three Glossaries from the Pupils’ Books are included in this Teacher’s Book. These words are highlighted in the pupil texts where they appear for the first time.

Structure of the Pupils’ Books
The three Pupils’ Books have the same structure and this will help pupils to become familiar with how they are to be used.

The text ‘addresses’ them directly, in a conversational style. The language level changes across the three books, matching the development of the children’s language skills. The sentences and the vocabulary are carefully controlled. It is necessary to teach new words, especially those with a particular, scientific meaning and these are highlighted in red and listed in the Glossary at the back of each Pupils’ Book. You will need to teach the pupils how to use the glossary and to recognise that words in red can be found in it.

Every Activity that requires pupils to use equipment or materials of some kind is headed with a coloured box containing the activity number. This is followed by a coloured strip containing the list of what ‘You will need:’ Generally these items are common, everyday things that the school can provide. Occasionally, you and the pupils could bring items from home, or they can be found in the environment around the school.

The steps for the pupils to follow are then set out in a numbered sequence. These frequently include questions, addressed to the pupils. The intention is that you should use these to focus the attention of pupils on what they are doing and what the results are. Sometimes the answers will be oral, but as the children get older, there are more questions that require a written answer. This habit of recording things as they carry out activities is a good one to develop and it makes the task of writing more connected to experience.

These activities are not ‘extra’ to the teaching, they are the main vehicles for the teaching – it is through the doing that pupils will understand and learn much of the content of the lessons and develop the skills. The books do not supply all the information that the pupils should learn – much of it will have to come from the practical activities. This is the intention behind the form and content of the Curriculum and the Nelson Thornes Primary Science for the Caribbean series is written to match that intention.

Some activities are based on the books, rather than on the use of equipment. They usually involve looking at pictures, graphs or tables to find the answers to questions set out in the text.

The books are very well illustrated with drawings and photographs. These are not for decoration. They are a vital part of the teaching and learning process. You should make use of them wherever they occur, as they have been included for a particular purpose. There are suggestions for their use throughout this book.

There are a number of writing exercises, which involve copying and completing words or sentences. The convention used is that each missing letter is represented by a dash. You will have to teach the pupils this, so that they understand the tasks correctly.

These books cannot be used correctly or effectively if you stay in the classroom the whole time – they are written with the intention of pupils going outside, into the immediate environment of the school and further afield on occasions. The environment is the classroom to a large extent. It is where the children spend most of their time and it is the place where they can best make sense of the natural world and their place in it.
Discussion of concepts and skills

This unit recalls what the pupils learned about their senses in earlier grades and then extends that knowledge. In particular it emphasizes the role that each sense organ plays, as part of the body’s ‘communication’ with the outside world – the environment in which it lives. Each organ has a special function, collecting information about particular features of the body’s surroundings. All the information collected by the sense organs is converted into electrical signals that travel along the nerves to the brain. It is the brain that can interpret and understand the messages from the sense organs. The eye, the ear etc. do not have any ‘understanding’ at all – they are merely different types of information gathering devices. This is a very important and probably new idea for the pupils to understand. The brain often reacts to the information it receives from the sense organs, by sending messages to the muscles, which cause them to contract and so produce a movement of some kind. This sequence of collecting information – sending it to the brain – interpreting it – and reacting with a movement, is basic to the way we live. For this reason, pupils will not be aware of it – it is just ‘normal’ and does not require thought for every part of it. This unit draws attention to this process and the vital part that the sense organs play in it.

The unit also focuses on the fact that all our senses have limits and that people have invented various instruments as ‘aids’ to extend and improve our senses, such as the microscope, the thermometer, the microphone and the gas detector. Our sense organs can be ‘tricked’. Optical illusions are the most commonly known example. Human senses are compared with those of other animals and the unit reveals the greater sensitivity of some senses in some animals.

The issue of protecting and caring for our sense organs is the last element of the unit and it should be
emphasized, as damage to our sense organs is often not reversible. To be blinded or deafened as a child is a real danger and it leads to a lifetime of disablement. It is because we take our senses for granted, that we do not always value them enough to take good care of them. The unit attempts to remind pupils of their responsibility towards themselves.

The unit provides many opportunities for pupils to use and develop their science process skills. There are investigations that require them to work systematically through a procedure and then to interpret the results that they have collected. In addition, there are several book-based activities that are intended to gather information about specific topics. This type of research from books, CD-ROMS etc. is very important, as it helps to develop pupils’ independent learning skills, but they will have to be taught how to carry it out. There is also the chance to interview a specialist visitor. This means that they will have to prepare precise, clear questions so that they can extract the information they need from the visitor. This is excellent practice of communication skills.

**THE ROLE OF THE SENSE ORGANS**

**General concepts**

There are five senses, each one located in a special sense organ. Each sense responds to a particular type of stimulus. The brain interprets the messages from the sense organs and may respond by sending messages to other parts of the body. All the senses have limitations and we can use special instruments to aid them. The senses of some animals are more sensitive than ours.

**Materials needed**

1. Three different foods
2. Three different objects
3. A bag or cloth
4. Three plastic pots or jars
5. Paper
6. Elastic bands
7. Three materials that each have a strong smell
8. A blindfold
9. A pen or pencil
10. Three bowls or buckets
11. Water at three different temperatures
12. A thermometer
13. Sweet fruit
14. Sour fruit
15. Sugar
16. A cup or glass
17. A knife
18. Three plates
19. Books about smoke and gas alarms
20. Modelling materials
21. A computer

**Background**

The ideas in this unit are fundamental to our view of who we are – our consciousness, our identity, our ‘being’. Such questions are common to philosophy, the arts and religion, as well as to science. The debate about ‘mind’ and ‘brain’ continues, in spite of it having been an issue for a very long time. Science says that the sense organs send messages to the brain and this is easy to demonstrate. The stimulation of the sense organs produces nerve impulses – bursts of electricity – and these can be tracked as they speed towards the brain. The activity of the brain is also electrical and chemical, providing evidence of hidden processes. However, when we try to understand what ‘thought’ is, we have difficulties and yet often we do have to think about what our eyes and our ears, for instance, are ‘telling’ us. The body, the physical being, seems to be ‘inhabited’ by another ‘being’, the true ‘self’, the thinking, feeling ‘me’, who must make choices and carry out actions: the ‘me’ who has desires, ideas, plans, morals, imagination, intentions and some store of knowledge and experience. Yes, the senses inform ‘me’ about the world around my body – and even the world inside my body, to some extent – but it is as if I am located somewhere within that physical object, which is my body.

There is a mystery here, which science has so far been unable to solve. What we do know for certain, is that without our sense organs ‘we’ would be completely cut off from the outside world, unable to know, or to learn, isolated and ignorant. The senses are our ‘lifeline’, bringing us the raw material from which we fashion our identity throughout our lifetime. Loss of one or more of our senses deprives us of valuable experiences.

Science and technology have long tackled the limitations that are inherent in our senses. The telescope and the microscope are two good examples: one helping us to see large things that are too far away for our eyes to focus on and the other helping us to see things that are close, but too small for our eyes to focus on. Each instrument extends the range of our sense of sight. Aids of other kinds have been developed for our other senses and so we can use them to collect even more information about the world around us. (Imagine the excitement when
people first used the microscope and were able to see tiny creatures that no human had ever been able to see before!

Human senses are not as well developed as some of the senses of some other animals. We have better sight than a rhinoceros, but it is not as good as that of a hawk. We can detect smells better than an earthworm, but not as well as a dog. Science has investigated and compared the senses of thousands of animals and the results show an enormous variety. Humans do not have the ‘best’ sense organs, but we do have brains that are able to learn, remember, interpret and understand what the senses are telling them. This is our most valuable characteristic in the battle to stay alive.

**Using the Pupils’ Book**

**Activity 1**

This activity should be done by the pupils individually, as it is a way of helping them to recall what they learned in earlier grades and to extend their knowledge of the sense organs. The pictures are to be matched with the names of the organs and their senses. Each child should record their answers in an exercise book as a list. The answers are: 1. tongue, taste 2. nose, smell 3. skin, touch. Once everyone has finished, ask for volunteers to share their answers with the class.

When all are sure of the correct answers, read the text at the bottom of Page 4, which introduces the idea of a ‘stimulus’. This word will be new and it should be emphasized. Ask pupils to give their explanation of its meaning and examples of stimuli that our sense organs can respond to. The answers for the organs shown are: tongue – chemicals, nose – chemicals, skin – pressure, heat.

The word ‘stimulus’ also introduces the idea of the Glossary, which is at the back of the book. Get the class to look up the word stimulus and read out its meaning. This will be good practice in using the Glossary. You need to explain that all words in **red** are found in the Glossary.

**Activity 2**

This is a group activity. If you have enough materials, all the pupils should do it in groups of 4 to 6. If you have only enough for one group, let each group use them in turn and

when all have carried out the investigation, let them share their results.

However you organise it, the pupils must be free to set up the tests for themselves – you should not do it for them. TEST A is for the skin. TEST B is for the tongue. TEST C is for the nose. It is important that pupils in the groups do not see what one another are doing. If they know what is being used in each test, the results will not tell you anything about the senses being tested. The contents of the pots and the bag should not be visible and the small pieces of food should be hidden under a cover until the blindfold has been put on the child being tested.

It is very important that each group keeps clear and accurate records of what they do and what the results are. Before they begin testing their classmates, they should draw a table, as shown on Page 6. Do not let them begin the testing until the table is ready. The group must add the names of the senses and the organs used in the three tests.

When individuals compare their results, they will probably find differences. This is what you should expect and no one should be made to feel that they were ‘wrong’. Each person’s senses are different and so some find it harder or easier to identify smells, tastes and objects using only touch.

Page 6 has information about how the sense organs usually work together, rather than one at a time. The tests were a way of isolating the three senses as much as possible, so that only one set of information was being sent to the brain during each test. This made it much harder for the brain to identify the materials in the tests. Pupils can read the text in groups, or individually and then answer questions from you, as a way of demonstrating that they have understood it. Or, you could read it together as a class and follow it up with questions. Pupils should also have the chance to ask about anything that they do not fully understand.

**Activity 3**

The key idea in this role-play is the way our senses help to keep us safe, by protecting us from danger. It is essential that each group has time to discuss which sense or senses they will deal with. You could share out the senses, one or two to each group, but letting the pupils choose for themselves helps with their motivation and interest.
Allow only a short time to choose the sense or senses then give them a fixed time to devise the scene, practise it and finalise it. Stop the groups when the time is up and let groups volunteer to act their scenes to the class. They must not reveal the senses being illustrated – that is for the class to identify. Each group should gather the answers from the class and then reveal who was correct. The activity highlights how we depend on our senses to alert us to dangers that are all around us. Thinking and acting are two active ways of understanding and learning this important fact: this is not just a ‘game’.

Page 7 has pictures that extend this idea. Ask the pupils to look at them carefully and identify the senses that are shown and how they are working to protect the children from harm:

- sight used to read the warning on the bottle of medicine
- temperature sensors in the skin being used to safely test if the pot is too hot to touch
- the nose detecting the smell of gas that has not been lit
- sense of taste telling the child that the fruit is not good to eat
- hearing detects the fire alarm and the child knows she must leave the building.

The concept of response is also introduced through these pictures. You can use the pictures to ask the pupils what the responses are to the various stimuli shown:

- child is careful about how much medicine is taken
- child does not touch the pot without a protective glove or cloth
- child turns off the unlit gas and opens the windows
- child spits out all the fruit and washes out her mouth
- child moves immediately and safely outside.

Activity 4

This activity is for pupils to do individually. Let each one choose the form of their writing for themselves. The writing must focus on only one sense organ, otherwise it will be too long. It is very important that they know the class will hear what they write. This means they should write with an audience in mind – making it clear and interesting to listen to.

The discussion after the readings can be done after each four or five examples, or delay it until everyone has had the chance to read their work to the class.

You should put the writing up somewhere in the classroom for all to see; display it on the walls or hang it up.

Page 8 introduces the terms sensors and nerves and you should remind pupils to use the Glossary at the back of the book to find their meanings. Either read the text together as a class, or allow pupils time to read it for themselves. Answer any questions that they may have.

It is only certain parts of each organ that are sensitive to the stimulus – the light, the sound etc. Those sensitive parts are called the sensors. That is one important fact that you need to help pupils to understand.

The nerves are like paths, or roads, or wires that are familiar to us all. We all know that such things connect one place with another and that things can move along them. This is parallel to the function of the nerves. The messages that the sensors create are in the form of electricity and it moves very quickly along the nerves to the brain, which can interpret the messages. The brain’s control of the muscles is also by electrical impulses sent through the nerves. The ideas that you should help the class to understand are the nature and function of messages to and from the brain, plus the fact that the nerves link the sense organs to the brain. If those nerves are damaged, the sense organs will be unable to communicate with the brain and the person may be blind, or deaf etc.

Activity 5

This is based on the pictures on Pages 8 and 9 and should be done separately by each child. You can use it as a form of assessment, to find out who has understood the important ideas introduced so far in this unit. Each child should write the list of numbers in the correct order for the sequence. It is: 4, 6, 2, 7, 1, 5, 3.

The discussion that follows the sharing of the answers is important as it will reveal why pupils have wrong answers and you can then focus your help on those points of misunderstanding.
Page 9 extends the information about the nervous system by introducing the spinal cord, which is the ‘main road’ along which much of the ‘traffic’ to and from the brain travels. The eyes, ears, tongue and nose have short, more direct connections to the brain as they are all close to it. They do not send their messages along the spinal cord.

Use the diagram to identify the main parts of the nervous system – the brain, the spinal cord and the nerves. Only an example of the nerves is shown, so that the diagram is not too complicated. There are really thousands of nerves throughout the body. Let pupils talk about the diagram and listen to what they say about it. This will help you to find out whether or not they have understood what it shows.

Page 10 has important text that adds more detail to the ‘story’ of the brain and the sense organs. Pupils should read it a paragraph at a time, either as a class, or individually. After each paragraph, ask them questions that test their understanding of the text – not just recalling what it says, e.g. What is different about reflex actions, compared with most of our actions?

Having to think before we respond to some messages from the sense organs slows the process down and when in danger, this can be fatal. So, the reflex action ‘cuts out’ the thinking part of the process and we react ‘automatically’ to certain stimuli. Blinking, when an object such as a hand comes quickly towards our eyes, is another example.

The key ideas in the rest of the text are:

- many messages are ignored and not responded to at all. They are a kind of background to our life, which we do not need to pay attention to all the time
- experience builds up memories in the brain and these are used to help us recognise and understand later messages from the sense organs, e.g. we can name objects we have seen before, we can identify foods we have tasted before.

Activity 6

You will have to let the groups take turns to do this activity and delay the sharing of results and the discussion until after all have had their turn.

This is a way of demonstrating that the sense organs have limitations and can be ‘tricked’.

The three temperatures should be as different as possible, so that there is a greater contrast for the two hands, but TAKE CARE not to make the warm water dangerously hot. It is very important that the hands are put into the two containers at the same time, as the instructions make clear and that they are then transferred quickly to the middle container, once the time has passed.

Pupils should experience the strange effect of the hand that had been in the cold water feeling very hot and the hand that had been in the hot water feeling cold, when put into the middle container. The temperature sensors in the skin are ‘tricked’ by the sudden change from being in one container of water, then the other. They do not immediately recover and do not send accurate information to the brain.

Page 11 Give pupils time to read the text about the water activity, either as a class or individually, then let them ask questions about anything that is not clear for them.

Look at the picture of the mirage before reading the text about it. If pupils have seen a mirage, let them tell the class about it.

Look at the pictures of camouflaged animals, after reading the text above them. Let pupils share any experience they have of camouflaged animals – which include fish, insects and all other types, of course.

Activity 7

This is a second example of how the senses can be ‘tricked’. In this case it is taste that is having its limits tested. Each child should do this activity, either in groups or one after the other until all have had their turn. Each should record what they found as they taste the three fruits. The sugar interferes with the taste of the second fruit. It can make the sour fruit seem sweet, or the sweet fruit not so sweet. The reason is the same as with the skin and the temperature of the water. The sensors on the tongue do not recover immediately and so they send incorrect information to the brain.

Pupils should share their results and also their attempts to explain what happened. Do not try to stop any ‘wrong’ ideas which pupils may have – all must be encouraged to express their thoughts. If there are different ideas from different pupils, let them question one another and try to convince one another of their ideas.
Page 12 extends this idea of how our senses have limits, by introducing the concept of devices that can aid them in some way. Such instruments can be used at home, as well as at school or in science laboratories. Two examples are shown in the pictures. Both detect small amounts of materials in the air, which our noses would not be able to sense. Gas and smoke can both be very dangerous, so these detectors are used to protect us. Every home should have a smoke detector. Read the text and look at the pictures, dealing with any questions from the pupils. If possible, bring a detector to class for the pupils to see and handle.

Activity 8

If you can find someone in the community who has special knowledge of alarms, invite them to the class so that the pupils can question them, e.g. a fireman. It is important that the pupils prepare their questions before the visitor comes, so that their time is not wasted and the same questions asked over and over again. You should listen to the questions first and decide which ones should be used on the day of the visit. Answers must be written down, as a record of what pupils learned from the visitor. If there is no visitor, use books and other sources of information for the pupils to do research about the alarms. Making notes is not easy for young children, so you will need to support them in extracting the important details from the texts etc.

If you have enough materials, each pupil could make a model of their own. If not, let the groups produce one each. Scrap materials such as clean food containers, string, wire, plastic bags, foil and card are suitable for the models. Scissors and glue will also be needed. Make a display of the models so that pupils can look at what has been made and then question one another about how they work. These models do not have to be accurate copies of real alarms – they are an opportunity for the pupils to be imaginative and creative.

Page 13 has text about animal senses, which should be read before looking at the pictures. Our senses are not as sensitive as those of some animals and the pictures show just a few examples. After reading the text, the groups should carry out Activity 9.

Activity 9

For each picture, the groups should record what they think about the organs used and the reasons for using them. They should produce two lists of answers. Do not let them read the text on Page 14 before doing the activity. Use it after the pupils have written their answers, to check on what they wrote.

The second part of the activity is very important as it involves direct observation of animals – not relying on books, but first-hand experience. This is the basic approach of scientists, so we should develop the skills whenever we can, so that pupils will have a good understanding of how science works.

It is important to choose a place where you can be sure of seeing some animals – pets, farm animals or wild creatures. This includes birds, insects and fish etc., not just mammals. Once in position, the pupils should be as quiet as possible so that they do not disturb the animals they are trying to observe. It is best to spread the class out, so that they are not all together in one place. This will reduce the noise.

Pupils must record what they observe – in drawings or notes. They do not need to be neat or ‘finished’. Field notes like these are rough sketches and incomplete sentences. Back in class, after the results have been shared and compared, pupils could make fair copies of their notes and drawings, but this is not essential. The comparison of reports will show if different animals use their sense organs differently – perhaps relying more on sight than hearing or vice versa.

Additional Activity

1. If there is time, let pupils draw pictures in which camouflaged animals are hidden. Let them swap the drawings so that they can find the animals.
CARE OF THE SENSE ORGANS

General concepts

Our sense organs are very important to us, so we need to take good care of them. Keeping them clean and protecting them from damage are the two ways to care for them.

Materials needed

1. A pencil or pen
2. Chart paper
3. A notebook

Background

This very short sub-unit is easy to understand and should not take much time, but it contains a very important message to the pupils about their sense organs. They need protection and care. This is particularly true of the eyes and the ears. Both can be destroyed by sharp objects. Both can become infected with germs that can permanently damage them. The eyes can also be damaged by liquids or small particles being splashed or flung into them, which is why protective goggles or glasses are worn when there is danger of such things happening. In science laboratories, the workers wear such protection so that chemicals do not get into the eyes by accident. Workers cutting stone, wood or metal also protect their eyes from small flying pieces of material that can damage the cornea – the transparent covering of the eye.

Ears are harder to damage, but small children do like to push pencils and other hard objects into their ears and this can tear the eardrum, making the ear unable to detect sound. The other common damage is harder to detect, as it is done slowly over time. Loud sounds can lead to deafness. Very loud music, as well as noisy machines, can do the damage and children must be warned about this. Good employers, who care about the health of their employees, insist that workers have ear protectors to prevent the damage from loud machines, such as road drills and equipment in many factories.

Using the Pupils’ Book

Pages 15, 16 and 17 Begin by reading the text about the dangers to the individual sense organs. This could be a class, group or individual task. Sort out any points that pupils may not have understood from the text. You should only move on to the activity when they are clear. Use the pictures to help pupils to understand the ideas involved.

Activity 10

The groups should pool their ideas about the care and protection of sense organs, using the text that they have just read to give them some ideas. A table is the best way to set out the lists of things they should and should not do for each organ.

When all the groups have listed their ideas, bring the class together to share them and then to choose the ideas which they think are best – most likely to protect and care for the sense organs. If possible, include one idea from each group, so that all pupils feel that they have made a contribution to the class product. You can write them out on the chart paper, but it would be better if the pupils did it for themselves. Display the chart as a reminder of what the pupils need to do each day to prevent damage to their sense organs.

Activity 11

This activity follows on naturally from the last, dealing with the care of the skin. Pupils are very familiar with washing, but they may not fully understand why it is such an important habit.

The checklist could be provided completely by you, or from ideas gathered from the pupils in discussion. It could include:

- washing our hands after going to the toilet
- washing our hands before eating
- washing our bodies every day
- covering wounds to our skin to stop infection
- closing or covering our eyes when the wind blows dust or sand into our face
- wearing goggles or protective glasses when we work with tools or machines that produce small, flying pieces
- blowing our nose into a handkerchief regularly to remove the mucus, germs and dust that collect in the nose
- using a fork or spoon, rather than a knife, to put food into the mouth.

The idea is for each pupil to keep a record each day of which actions they carry out. At the end of the week they should share their results and compare them. Some actions should be found in everyone’s lists, e.g.
washing hands, but others may only be done by some people. The groups should be allowed to choose the message for their hygiene posters. Just check that they are not all about the same thing. Lettering should be large and clear. Colours should be bright. Pictures should be large and simple. If possible, display the posters around the school, so that the messages are seen by other pupils.

Page 18 has a brief summary of the main points of the unit. It can be used by you to check that pupils have understood and remembered these ideas. It is also a way of giving a final emphasis to the unit’s content.

Term 1  Unit 2
Simple and complex machines

Objectives

Pupils will:
- demonstrate an understanding of simple machines, e.g. wheels, levers, pulleys
- identify a situation and relate how technology has changed over the years, e.g. at a building site or garment-making establishment
- explain how levers are involved in such tools as scissors, pliers, crowbars, tongs, fishing rods, can openers, wheelbarrows, parts of body, e.g. the arm
- explain how parts of the body and their movement are similar to levers
- infer that the body is a complex machine
- analyse complex machines and give simple explanations of their operations
- compare a simple and a complex machine that do the same job and state the differences observed
- identify materials that are suitable for making levers, wheels and pulleys.

Time allocation: 6 weeks

Discussion of concepts and skills

Effort has to be used to carry out work. When experiments were done to explore how simple machines made work easier, the concepts of ‘effort’, ‘load’ and ‘fulcrum’ were developed. This unit introduces these concepts, through simple experiments that reveal how the three are related. Pupils are then given the task of applying what they have learned, to various common tools, to identify which simple machines are involved.

The practical activities are essential for the pupils to understand the rather abstract ideas of the unit. They will need to make careful measurements, keep records of their results and then interpret them, so that they can come to a conclusion about their meaning. These are important science process skills. The unit cannot be taught successfully without the practical activities, because it is through them that pupils will see the principles at work and so understand better what is happening.
The Importance of Machines

General concepts
Simple machines help us to do work more easily. They are very common in everyday life. Many tools and other devices are simple machines.

Materials needed
1. A wheelbarrow
2. A large basket
3. A heavy object
4. A flagpole and flag
5. Rope or string
6. A pulley

Background
Over the long history of human society, people have discovered ways of making it easier for them to carry out some tasks. They did this by a process of ‘trial and error’, without understanding the scientific principles that explain how they help. Science eventually explored how the machines helped to make tasks easier to perform. Three elements are always involved – the load which has to be moved, the effort which has to be applied to move it and the distances over which the load and effort move. A simple example is a ramp, which is a type of ‘inclined plane’. If a man tried to raise a wheelbarrow full of bricks 3 metres off the ground by lifting it, he would fail. The effort required would be more than he could provide. But, if he sets up a plank as a ramp, he will be able to raise the wheelbarrow and bricks easily to the 3-metre level, by pushing it up the ramp. The longer the plank, the gentler the slope and the easier it is to push the load up it. The shorter the plank, the steeper the slope and the harder it is to push the load up it. This illustrates the issue of distance. The ramp increases the distance over which the effort has to be made, but it reduces the size of the effort needed to move the load. As the slope gets longer and longer, the distance also gets longer, but the necessary effort becomes less and less. This is the basic principle of all simple machines.

People have applied these relationships in the design of many tools, such as crowbars and scissors, as well as devices such as door handles and wheelbarrows. The pupils are familiar with most of these things, but they will not have looked at them in the scientific way, which reveals the principles involved. Imagine life without such devices. This will emphasize just how essential they are to the way human beings live.

Using the Pupils’ Book

Activity 1
Groups should look at the two pictures, comparing what they see going on in the two building sites. The purpose of the activity is to focus on the changes in the ways work is carried out. At the same time, it is an introduction to the idea of simple machines. Give groups a fixed amount of time to list all the machines they can find, then bring the class together to share what they have found. You should make a record on the board so that a complete list is built up. Pupils will probably not identify some of the simple machines in the first picture, e.g. the ramp. You will have to add these to the list, once the groups have all reported to the class. This will be your introduction to the concept of ‘simple machines’, which will be new for the pupils.

Page 20 has text about them, which you should use at this point. There are several new words that pupils should look for in the Glossary.

Activity 2
It is vital that pupils do this practical task. There is no better way for them to understand the difference that a simple machine, such as the wheelbarrow, can make to the effort they have to apply to move a heavy load. TAKE CARE with the heavy load, such as a large stone or collection of kilogram weights.

The pupils should do the carrying and pushing tasks individually and then note what it feels like each time. Only allow sharing and discussion once the tasks have been carried out by everyone.

They should discover that the loaded basket was harder to move than the empty one and that the wheelbarrow made it easier to transport the load, than when it was in the basket. This illustrates the principle of the simple machine – it makes work easier to carry out.

This is the first example of a lever, so spend time looking the word up in the Glossary and identifying the three elements – load, effort and fulcrum.
**Page 20** ends with text that summarises the results of the activity, so only read it after the class have reported and discussed their results. This text continues, with more details about load, effort and fulcrum, on **Page 21**. It is very important to check that all the pupils have grasped these concepts at this point in the unit, because all the rest of the unit depends on the ideas being understood. So, do not rush through **Page 21**.

The pictures of the pulley and inclined plane introduce the important fact that the distance travelled by the effort is increased, but less effort is required to move the load.

**Activity 3**

If the school has a flagpole in the yard, then it would be ideal to compare the ‘real thing’ with the models. A model will have to be made by each group. If you do not have enough materials for all groups to work at the same time, let them take turns at making the model. When all have had their turn, let the groups share their results. DO NOT tell the groups how to make the model. It is important for them to struggle to solve the problem of fixing the pulley and string correctly to raise the flag.

Focus on the diagram of the flagpole in use (**Page 22**), asking pupils what the arrows mean. This is good practice for them in using the terms ‘load’ and ‘effort’.

## Combining Simple Machines**

**pages 22 to 28**

**General concepts**

There are three types of levers, each one with a typical arrangement of load, effort and fulcrum.

Simple machines can be combined in various ways to operate as complex machines. The human body is a complex machine, with its many joints and muscles.

**Materials needed**

1. A ruler
2. A stone
3. A pencil or pen
4. Paper
5. A tool that uses a lever
6. A ball to kick or throw
7. String and wire
8. Sticks
9. Glue
10. Elastic bands
11. Wheels (cotton reels, bottle tops etc.)
12. Card
13. Scissors
14. A saw
15. Pliers

**Background**

Levers can be classified on the basis of where the load and effort are in relation to the fulcrum. Each of the three types is suited to solving particular practical problems. The fulcrum may be between the load and the effort, as in the seesaw and the beam balance. In another type (class) of lever, the load and effort are on the same side of the fulcrum, with the load nearer to it, as in the wheelbarrow or a pair of nutcrackers. The third class of levers has both effort and load on the same side of the fulcrum, but the effort is nearer the fulcrum, as in tongs and tweezers. The arrangements may vary, but the purpose remains the same – to produce ‘mechanical advantage’, or to ‘multiply the force’, thus making the work easier to complete.

Pulleys, inclined planes, screws and levers – all simple machines – can be combined in a great variety of ways to create complex machines. The motor car is the example used in the unit text, but there are thousands of others that are common in our everyday lives, e.g. the bicycle, sewing machine, water pump, various types of engines and motors, mechanical excavator and crane. Each complex machine can perform a number of tasks, using the simple machines that it contains.

The human body is such a ‘complex machine’, as it has many levers as part of its skeleton. Where two bones come together in a joint, it forms a fulcrum. The muscles attached to the bones can then pull against the bones and the movement is pivoted around the joint. The jaw is one such lever. The lower jaw pivots against the skull on either side, just in front of the ears. The effort that the muscles apply to the jaw, is able to do the work of cracking nuts or biting tough food, for instance. The jaw is a very good lever and it exerts a great force, even though it only moves over a short distance. Other joints, such as the elbow and the knee, allow the bones to travel much greater distances and can be used to push or pull loads in various directions.
Using the Pupils’ Book

**Activity 4**

The equipment needed is very simple, so all groups should be able to do this activity at the same time. The pupils are supposed to discover that the position of the ruler has an effect on the amount of effort needed to lift the load (stone). This is a basic feature of levers, so it is very important that all pupils see and feel this for themselves. Encourage pupils to use the correct terms when they share their results – load, effort and fulcrum.

The text on Page 23 should be read as a class, after the sharing and discussion.

**Activity 5**

This should follow immediately from the reading of Page 23 and it is for each pupil to do individually. It forms a kind of assessment of their understanding of the concepts involved in levers.

Pupils should draw the table shown on Page 24 before they begin to answer the questions. They should record the letters that are written on the diagrams of the levers, in the correct columns in the table. The levers on Page 23 all have the load and effort on opposite sides of the fulcrum, just like the ruler and the stone activity.

The levers on Page 24 are different:

- the door has the fulcrum, load, effort arrangement
- the tongs have the fulcrum, effort, load arrangement
- the nutcrackers have the fulcrum, load, effort arrangement.

You should let individuals share their answers with the class, once everyone has recorded their ideas.

**Activity 6**

The first part involves moving various joints of the body, so you may want to do this in a PE session out in the yard, so that pupils have more space and freedom. Pupils should be able to recognize levers in their movements, particularly of the limbs.

Back in class let them say what they think and then question one another if they disagree or do not understand.

Once everyone is clear that the joints are part of the body’s system of levers, let each pupil choose one to draw. They should add the labels themselves, so that you can see if they have understood what load, effort and fulcrum are.

Ideally you should be able to give a tool that is a lever to each pupil. Their first task is to operate it and identify the lever. Then they should compare it with the lever that they identified in their body, looking for similarities and differences. Lastly they should draw a diagram of the tool and label it. The pictures should be side by side, or one above the other, so that the basic features of the levers are seen to match.

**Activity 7**

This class activity is useful for reinforcing what has been done already about the joints as levers. Remind pupils to think about how they are using their limbs as they throw and kick the ball. Back in class, ask them to share what they thought about their actions. Let pupils question and disagree with one another, as this will help them to think more carefully and give clear explanations.

**Activity 8**

Groups or individuals could do the sorting into pairs – the simple with the complex – then record the pairs in charts. These could then be displayed for all the class to see and make comparisons; or you could put up one chart paper and each group/pair writes their answers on it, for the class to see.

The pairs are:

- needle and sewing machine
- hand saw and power saw
- hand drill and power drill

Page 25 ends with another assessment of their understanding of levers found in the body. Each example has a fulcrum, load and effort to be identified. You could ask for volunteers to point to the three parts on each diagram whilst the class watch and then comment.

Page 26 has the first use of the term ‘complex machine’, so pupils should use the Glossary to check on its meaning. The picture of the simple and complex machines is for Activity 8, on the opposite page.
• simple pulley and mechanical lift
• a ladder and an escalator.

Page 27 has a picture of the car, showing some of its many parts. Some of them are simple machines. Let the pupils spend time in pairs or groups looking at the picture and talking about what it shows. Focus their attention on the simple machines they can see, e.g. steering wheel, door handle, hand brake, window winder, door hinge, seat adjustment lever, windscreen wiper and knobs on the dashboard.

Once they have had time for the identification of the simple machines, each pupil should choose one and draw it, adding short notes about what it is used for and how it does its work as a simple machine.

Display the pupils’ work and let the class have time to look at it.

**Activity 9**

This activity is a test of whether or not the pupils can choose suitable materials for making a device that includes pulleys, levers or wheels. So, do not choose materials for them, but let them first decide in their groups what device they will make and then make a list of all the materials that they think are suitable.

The activity could be done in two parts, on separate days. First, the discussion, choosing and listing should be completed. Then, second, the gathering of materials and the construction of the device.

It is important to get the groups to demonstrate their devices, say why they chose the particular materials and to explain how the simple machines work. Let pupils question one another. Create a display of the finished models.

Page 28 ends with pictures of four models that include simple machines:

• the crane has levers and pulleys
• the kitchen scales have a pulley
• the seesaw is a lever
• the flagpole has a pulley.

They can be used to stimulate the pupils’ thinking when discussing what to make and/or you can use them at the end of the unit, to assess if pupils can apply their knowledge of simple machines, by identifying them in the models.

**Additional Activity**

1. Balance a ruler across a pencil and mark the position of the pencil on the ruler. This is the fulcrum of the lever, which will be used to balance coins on either side. Place a coin on one end of the ruler, observe what happens and record it. Place a coin of the same type on the other end of the ruler. Observe and record what happens. Add another coin to one end of the ruler, observe and record. Now move the pencil carefully towards the end with the most coins. Observe what happens and record your observation. Try to explain what you have seen.

The ruler and pencil behave like a seesaw. A lighter weight, far from the fulcrum, can balance a heavier weight, near to the fulcrum. There is a relationship between the distances of the load and effort from the fulcrum. Pupils will learn the mathematical relationship in secondary school.

2. Demonstrate the use of various tools that involve levers. Pupils should watch each tool being used and draw a diagram of at least two different tools, labelling the load, effort and fulcrum on each one.

3. Look at a bicycle and identify all the simple machines that it includes. Draw the bicycle, with at least one simple machine labelled.
Discussion of concepts and skills

Water is another of life’s familiar things, which children seldom think about. In this unit, the focus at first is on water’s properties. The fact that water takes up the shape of the container is so obvious that we never notice it! But it is a significant fact for scientists, because this is a characteristic of all liquids. Another well-known fact is that pure water is clean and transparent, but it can be dirty, coloured and even opaque. The activities focus pupils’ attention on these characteristics by comparing one with another. One particular feature of dirty water is given special attention later in the unit: the issue of water-borne diseases. Although invisible, there is air in water. It is able to dissolve into the water. This is what fish and other aquatic animals and plants depend on for their lives. As the temperature of the water rises, not so much air can be contained in the water. This is why we see bubbles of air on the inside of pots and kettles when we heat the water in them. The air is driven out.

Sometimes ponds or aquaria get too hot and the animals living in them die, because there is not enough air in the water.

All living things need water and it is simple to investigate the effect of water-shortage on plants. We do not test this on animals as it would be cruel to stop them having water.

A very big concept in the unit is the water cycle. This is an attempt to bring together several events and processes that are very familiar and see how they are all connected, forming an endless ‘cycle’, or circulation. This is quite a difficult concept for pupils to grasp, so it must be made as practical as possible as this will help them to understand the ‘big idea’. The cycle is made up of several separate processes and so this is the way to teach it, step by step and then all put together.

Last of all, the issue of diseases carried by water is dealt with. This is all tied up with clean and polluted
water, so the various methods of making water safe to drink are explored.

The unit uses a large number of activities and these are essential for the pupils’ proper understanding of the ideas and for them to use and develop their science process skills, as well as their ability to cooperate and carry out group work successfully. There are many opportunities for observation and comparisons and these should always produce a record and report of some kind.

**WATER AND ITS IMPORTANCE**

**General concepts**
Water is a liquid that takes the shape of the container it is in. Water is a colourless, transparent liquid, without a smell, which has air dissolved in it. All life on Earth depends on having a supply of water.

**Materials needed**
1. Tap water
2. A container with 100 ml level marked
3. Three transparent containers of different shapes
4. Pure (distilled) water
5. Two transparent containers of the same size
6. Books newspapers and magazines with information about living things and water
7. CD-ROM with information about living things and water

**Background**
All materials have characteristics, which science uses to identify them. Water, being a liquid, has the characteristic of taking up the shape of the container it is in. Unlike solids, liquids have no fixed shape. They flow and they are fluid. Pure water, which does not exist in nature, is a completely colourless, transparent liquid that has no smell or taste. In nature, water has other materials mixed with it. They dissolve into it but some of them, like air, are not visible, so we are not normally aware that they are in the water. The gases that pollute water and turn it into acid rain are more examples of invisible additions to water. The amount of air that can be held in solution by the water, depends on its temperature. The colder the water, the greater the volume of air it can have dissolved in it. So, as the temperature of the water rises, less and less air can stay in solution. It is pushed out in the form of bubbles of gas, which first form on the sides of the container, then float free and rise to the surface. If the water is boiled, all the air is driven out and the result is to make the water taste ‘flat’. We can tell that something is missing.

Tap water has been taken from the surface of the Earth, or from underground, so it has minerals dissolved in it. In some areas, where the rocks may be limestone, there will be a higher amount of calcium carbonate (lime) in the water, for example. If the amounts of such minerals are small, then we will not be able to see any change in the water’s appearance, but if the concentrations of minerals are high, the colour of the water may change and it will be less transparent and clear. The insides of kettles become covered in lime-scale in areas where the water contains high levels of lime. Minerals will also add taste and sometimes smell to the water. Tap water will have been treated with chemicals to kill the germs in it and sometimes these chemicals (based on chlorine) can be detected by their characteristic smell. This is especially true in swimming pools, where the concentration of the chemicals is higher.

Plants and animals depend on water to keep them alive. This is because all the processes of life that go on in the cells of the plant or animal, take place in solution. Chemicals move about the body of the organism by dissolving in various liquids, such as blood and sap. Water is the main ingredient of these liquids. Most of our body is water. Because water is lost from the bodies of plants (by transpiration) and animals (by breathing and excretion, for example), it has to be replaced regularly so that the creature does not dry out and die. Plants take water from the soil, through their roots. Animals vary in the ways they obtain water. Those that live on the land must find it and take it into their bodies through openings, such as the mouth. Much of the water is taken in as part of the food that the animal eats, e.g. in leaves, fruits or flesh.

If water is not available, the various processes that keep the creature alive are halted. Plants wilt and animals collapse. Death follows very quickly. In the case of humans, it takes only a few days, as compared with starvation, which can be survived for many weeks.

**Using the Pupils’ Book**

**Activity I**

This simple group activity is designed to focus pupils’ attention on the way that water takes the shape of the container it is in. The level will be different in each one, even though the volume of the water is the same each time (100 ml). After the groups discuss their
observations, each pupil should draw and write their own explanation of the results. This will help you to see who has a good understanding of this characteristic of water and all other liquids.

Page 30 has a picture of Activity 2 in progress. Use it to start pupils thinking about the next activity.

**Activity 2**

The pure (distilled) water can be bought from garages, which sell it for car batteries. The tap water will not be pure, as it has various substances dissolved in it. These may make it slightly less clear and transparent than the pure water. Tap water also has air dissolved in it, so when it is left in the sunshine, it will be heated and the air will be driven out. Bubbles of gas will form on the sides of the container and some will float to the surface, where they may burst or remain around the edge. This is the most important observation that pupils should make, so if they seem to be missing it, draw their attention to it.

Page 31 has a picture follow-up task, which pupils should be able to do easily if they made careful observations in Activity 2. The jar with bubbles is the one that had been in the sun. The text is a summary of what has been done so far in the unit, so you can use it to check that pupils have understood all the ideas involved.

**Activity 3**

Collect as many books and other resources as you can for pupils to use for their research. You could allow each pupil to work on their chosen topic, or share out the topics amongst the class so that they are all being done by someone. If you do the latter, it is even more important that the class shares the information they have collected.

Page 32 has a series of pictures for pupils to interpret. Let the groups discuss what they can see, then ask them to share their ideas with the class.

a) Marine plants and animals using the water to support them and to move about in, searching for food.
b) Germinating seeds, which have taken water in through their coats to begin their growth
c) Mangrove trees in water are taking in water through their roots to keep them alive
d) A field of rice in which the plants are standing in water for some of the time as they grow. The roots take in water to keep them alive
e) Frogs have laid their eggs (spawn) in water to prevent them drying out while they develop into tadpoles
f) A farm animal is drinking water to keep it alive
g) A bird is drinking water to keep it alive

The text should be read after the picture activity and you should ask pupils questions based on the text to find out if they have understood it correctly.

The two plants in the final picture are to be compared by pupils and an explanation of the differences given. This should be carried out by pupils individually. You could ask them to write their ideas down, so that you can use it as a form of assessment of how well they have followed the ideas about water and living things. When a plant loses too much water, the cells are not filled with water and so they do not stay firm and rigid. They become soft and this is why the plant ‘wilts’. It droops because it cannot hold itself upright without its stems and leaves being full of water.

Page 33 completes this sub-unit with further text about various ways water is obtained and used by organisms. Let the class read it, either individually or as a whole class activity. Answer any questions that the pupils may have, before looking at the diagram of the uptake of water by a plant. This should be done as a class, working through it step by step, following the water on its journey from the soil, through the plants and out into the air. This movement of water through plants is a very important concept, which will be used later in the water cycle part of the unit. You should help pupils to understand the processes in the diagram. The evaporation of water from the leaves, through thousands of tiny holes on their undersides, ‘pulls’ the water up through the stems of the plant and this in turn ‘sucks’ the water in from the soil, through the roots.
General concepts

There are many different sources of water on the Earth. Some are on the surface and others are from underground. The processes of evaporation and condensation are the basis of the water cycle. This is a continuous circulation of water from and to the Earth’s surface. Water from different sources may have different characteristics of colour, taste and smell.

Materials needed

1. A pen or pencil
2. Paper
3. Water
4. A plate and a plastic bag
5. A small piece of fabric
6. A kettle
7. A bowl
8. A cloth
9. Modelling materials, e.g. cotton wool, aluminium foil, a large sheet of paper, card, glue, colouring materials
10. Three filter funnels
11. Three jars or bottles
12. Three filter papers, or clean cloth, or cotton wool, or tissues
13. Water from three different sources

Background

In one sense, all the water sources on Earth are the same – the water came to Earth from the sky at some stage. But we speak of different sources because we collect water from different places, either on the surface or underground. When water falls to Earth it either runs over the rocks and soils that cover its surface, on its way to the oceans of the world, or it soaks into the ground and disappears from sight. People can take water directly from those places where it collects or flows along, such as ponds, lakes, streams and rivers. As long as the water in these is replaced by rainfall and other forms of precipitation, the supply is easy to use. In times of drought there may be such a reduction in precipitation that the water source dries up. In many tropical areas this is a regular event and so people have had to devise other ways of obtaining water.

There are vast amounts of water stored underground in the rocks below the soil. Some rocks have spaces between the particles, such as in sandstone, and the water can fill them. These are called porous rocks. Other rocks are not porous and so they act as a barrier to the movement of water. They can trap the water above them and stop it travelling deeper and deeper into the ground. This is very fortunate for people who depend on ground water for their supplies. Two things become possible. In some places the water is diverted along the top of the non-porous layer of rock and it bursts out of the ground as a spring. This is usually in a low-lying place at the foot of mountains or hills. Spring water is normally always available, even if there has been no rain in the area for a long time. The water may have travelled great distances underground, before coming out as a spring. It is also very often much cleaner than water which collects in lake, rivers etc.

The second thing that is possible, is to make a hole in the ground that goes deep enough to reach the water that is stored there. Humans have been digging wells for thousands of years; it is a very old technology that has allowed people to live in the deserts of Africa and Arabia, for example. Wells are often dug by machines these days, to avoid the very hard and dangerous work of digging them by hand. An alternative, which is vital where the water is very deep below the surface, is to drill a borehole and attach a pump to it. This is a much smaller hole than a well, but it usually goes much deeper. The hole has a pipe lowered into it and the pump, either mechanical or electric, is set up on top of the pipe. When the pump is operated, the water is pulled up the pipe to the surface. Wells are dangerous, as people, especially children, can fall into them and die. Boreholes are much safer. Wells can also easily be polluted, if materials fall into them. Boreholes are cleaner as the top is sealed with a pump.

Where towns and cities have large populations, the use of wells or surface water is both inadequate and dangerous. Large numbers of people in one place produce large amounts of waste – rubbish from homes and factories and the bodily wastes of urine and faeces. The water supply for such crowds of people has to be large enough and clean enough to keep everyone alive and healthy. Some cities have enough underground water to extract through boreholes, but most have to build dams outside of the city, to trap the water of rivers, or build pipelines from lakes, which may be far away. Once collected, the water must be transported and cleaned, before being pumped through the network of pipes to all those who need it. Pipes and taps make the most efficient use of this vital natural resource, as they carry it safely and cleanly over long distances and can be opened and closed as needed, which prevents waste.

The renewal of water on the Earth depends on what scientists call ‘the water cycle’. The process of evaporation takes place wherever water is in contact
with the atmosphere. It is happening over the surface of the world’s oceans, which cover about two thirds of the Earth’s surface. This is the source of most of the water vapour in the air. Plants are the second largest contributor to the water vapour in the air. Vapour passes out through the millions of tiny holes on the undersides of leaves. The water that passes out of the plants was originally absorbed by their roots, from the water in the ground. Generally, the hotter the atmosphere, the faster the water evaporates. So, in the tropics and on hot days anywhere on Earth, water dries up quickly after it has rained, or from wet washing, or from our skin when we have been swimming. In cold climates and on cold days, water is much slower to evaporate. Energy is needed to lift the water molecules from the surface of the liquid water and turn them into vapour. The sun provides the energy in natural conditions. People have invented all kinds of machines that can speed up the process of evaporation, such as hair driers, tumble driers for clothes and fans.

Condensation is the reverse of evaporation.

**Using the Pupils’ Book**

**Activity 4**

Only allow groups a minute or so to brainstorm all the sources of water, then quickly collect their ideas on the board, taking one source from each group in turn until there are no more sources left. Let the groups decide who will draw any particular source. Again, do not allow an extended period for this, as the most important ideas are to follow this introductory activity. Display the pictures and give pupils time to look at all of them.

**Page 34** is a summary of facts about various sources of water. It could be read as a class, then discussed, or used as an individual task, followed by questions from pupils and from you. The main ideas are very straightforward and deal with familiar things. The particular experience of the pupils will obviously depend on where they are living and the source of water that they make use of. Let them talk about what they have seen and done, so that they can learn from one another. Maybe some have visited grandparents who live away from towns and have no tap water. They may have compared their own home situation with those of their families in rural areas, or vice versa. All these are worth sharing, as it helps to focus attention on the ways people deal with the essential issue of having water available every day. This is a good opportunity to teach and practice the vocabulary dealing with water sources. Make sure that the Glossary is used to find definitions of the key words.

**Activity 5**

This is a group activity. If you do not have enough equipment for every group to do all three things, allocate them to different groups and then bring the class together at the end to share the results. The three activities are all exploring the basic process of evaporation, so it is essential that pupils have this opportunity to observe it for themselves and then to discuss what they think has happened. Liquid water changes into invisible water vapour, which is a gas. This process of evaporation is best seen by its result, rather than directly. The result is that water disappears. Wet things become dry. These events are very familiar to pupils from their everyday experience, so you must extend their knowledge and understanding by emphasizing the scientific words and explanation involved in the process.

**Page 36** After listening to their attempts to explain what they observed, outline the process in scientific terms, using the text and pictures. The ideas here are basic to their understanding of later ideas in the unit, so it is very important to allow the pupils enough time to read, think, discuss with their groups, ask questions and really understand what is involved. If you hurry through this page, many pupils will have difficulties later in the unit, when these ideas are applied to the concept of the water cycle. Although water disappears when it evaporates, it is still there – it has not ceased to exist, it is just not visible as a liquid. This is an idea which children find hard to understand, so let them spend time talking about it.

**Activity 6**

This is NOT a pupil activity. You must set it up as a demonstration for pupils to observe, at a safe distance. If you are concerned about safety, or you do not think all the class will have a good view of the processes, you could carry out the activity a number of times, with only part of the class each time.

Before starting, read through the outline of the activity, from point (1) to point (5). Check
that everyone understands what he or she should be looking for when the demonstration is happening.

Remind the pupils of each point, as you carry out the steps of the activity. You could interrupt the steps to ask what pupils have observed at each one.

The boiling water is turned from a liquid into an invisible gas, called steam. This is not the same as water vapour, because steam only forms when the water reaches its boiling point – a temperature of 100 degrees Celsius (°C). This process of boiling leads to the evaporation of the water.

The steam cannot be seen. Careful observation reveals a space or gap between the spout of the kettle and the cloud that forms close to it. The gap is where the steam is. As it leaves the kettle, its temperature drops and so it changes back from a gas to a liquid, by the process called condensation.

The cloud is NOT gas; it is made of millions of tiny droplets of liquid water. That is why we can see it. In everyday speech we call it a ‘cloud of steam’, but this is not scientifically correct.

The cold plate cools the cloud even more and this helps to make the tiny droplets join together and form drops on the plate. Pupils should easily see this happening and if the plate is held at an angle, the drops run over the plate and water drips into the bowl. This process of condensation and falling water drops is basically the same as happens in clouds in the sky, except that the air is not filled with steam (water at 100 °C), but with water vapour at normal air temperatures.

Page 37 has the explanation in simple terms, for the pupils to read after the demonstration and their attempts to explain what they have seen. Use the pictures of the first two familiar situations, to help make the process of condensation clear to the pupils. Then ask them to apply that understanding to the clouds in the sky. The temperature falls as you travel away from the Earth’s surface. So, the water vapour in the air is cooled as the air rises and it condenses back to liquid water and becomes visible as clouds.

Page 38 continues with the twin processes of evaporation and condensation, by emphasizing the key issue of the temperature. Pupils should study the diagram, with its two arrows and give their own explanations of why the two processes happen.

Once this sharing of ideas is over, work together as a class looking at the three everyday examples of evaporation that are shown in the pictures.

- The leaf has many small holes in its lower surface and the water inside the leaf leaves through these holes in the form of water vapour – it evaporates.
- The child loses water vapour in their breath (it comes from the wet inside surfaces of the lungs etc.) and by sweating through the many small holes in the skin (pores). Sweat evaporates off the skin and this helps to cool the body.
- The puddle of water ‘dries up’ as it evaporates in the heat of the sun.

Ask the pupils to give you other examples of water ‘disappearing’ through evaporation. This will reveal to you whether or not they are able to apply the concept more widely than the few examples given in the text and pictures.

Page 39 develops the process of cloud formation and the production of rain. The diagram is very helpful in helping pupils to imagine what is going on in the clouds above their heads. They see the clouds. They see and feel the rain. What they cannot see is the process of drops getting bigger and bigger and heavier inside the cloud. This process eventually leads to rain falling out of the cloud, as the force of gravity pulls it towards the Earth. Any falling water – as rain, hail or snow – is called precipitation, a word that will need to be taught to the class, along with several other new terms. All these terms should be looked up in the Glossary to help pupils to understand and remember them.

All the processes dealt with so far can be put together to form the water cycle, as shown in the diagram at the bottom of the page. If pupils have followed the steps and ideas of the unit so far, they should see how all the parts fit together to keep water circulating from and to the Earth.

Activity 7

Each individual pupil should match the labels to the correct parts of the diagram. Get them to write down the list of letters (a) to (n) first.
then write the labels alongside them where they think they belong. The correct labels are:

(a) ocean  (b) clouds  (c) condensation  
(d) stream  (e) evaporation  (f) rain  (g) river  
(h) snow  (i) lake  (j) hail  (k) invisible water vapour  (l) cooling  (m) heating  (n) plants  

When everyone has finished, let some pupils share their answers with the class. After hearing some of the answers, correct whatever was wrong and make sure that all pupils have the full, correct list.

Page 40 adds the point that it is the sun’s energy that lifts the water into the sky and so it is this that ‘drives’ the cycle. If the sun were to disappear, the water cycle would stop.

**Activity 8**

This is a creative group activity, where pupils can use their imaginations as well as their knowledge about the water cycle. It is not just ‘play’ – it has the important function of allowing pupils to express their ideas about the cycle in visual form. Let groups choose which form of illustration they will use. Before they begin making the models, they should plan them and tell you what they have planned, so that you can provide the necessary materials. The role-players will also need to let you know what they will need for costumes and props. It will be best to divide the activity into two parts, with the planning done on one day and the making of models and role-plays on another. The model should be labelled so that everyone can see what the processes and products of the cycle are. Display the models and give the class time to look at them, ask questions and make comments. The role-plays should be presented to the class one by one and then discussed, to see if pupils felt they were accurate illustrations of the cycle.

Page 41 tests pupils’ ability to identify water sources, so the pictures should be looked at by pupils individually, not as groups. Each pupil should record his or her own answers. Then they must sort them into natural and not-natural sets. Ask some pupils to share their answers with the class.

**Natural:** a stream, a spring, a river  
**Not natural:** a dam and reservoir, a well, a borehole with pump, a tap, rainwater collected in a tank

**Activity 9**

If possible, let the class collect the water from the three sources. If this is not possible, you can provide them, or ask pupils to bring water from different places in their communities. If you do not have enough equipment for the whole class to do the activity at the same time, let the groups take turns in carrying it out.

Before the comparisons are made, each group should draw a table for recording their observations. Steps (4) and (5) involve **filtering**, a process that may be new to some pupils. The process is easily understood as a way of catching and separating solids from the liquid water. The holes in the filter paper, or cotton wool, or cloth, or tissues are too small to let the solids pass through, but big enough for the water molecules to pass through them.

Comparing is a very important science skill that the pupils should apply in this activity. Pupils will not have a measure of the solids, so they will have to use comparative terms (more, less, most). Each pupil should write their own report of the investigation, describing what they did, how they did it and what the results were.

Page 42 outlines the conclusion that pupils should have arrived at from the activity – that water can vary from source to source. Tap water has always been treated with germ-killing chemicals, so it often has a slight smell and taste of chlorine. The photograph shows a typical West Indian water treatment works, where water is filtered, made safe to drink, then pumped into the supply network of pipes that travel under the ground to houses, shops, offices and factories.

The text on Page 43 explains that it is not safe to simply collect water from a natural source and distribute it through pipes to people for drinking, cooking and washing. Germs and poisonous materials may be carried from the source and these could harm everyone who used the water. Those pupils who have no access to tap water need to learn how water from natural sources can be made safe. That is the topic of the next sub-unit.
CLEANING WATER

General concepts
Water can be polluted by solid materials, by poisonous chemicals and by various types of germ. Cleaning processes include filtration, decanting, boiling and chemical treatments.

Materials needed
1. A pen or pencil
2. Paper
3. Water with solids in it
4. Two transparent containers
5. Books and other resources with information about waterborne diseases
6. Costumes and other items for a performance

Background
Dirty-looking water is not attractive or appealing to drink and so people have devised ways of removing, or at least reducing, the dirt. Solids can be trapped, as in filtration, or allowed to sink to the bottom of a container, allowing the ‘clean’ water to be separated from them, as in decanting. These are the two simple methods that have been used for thousands of years, all over the world.

Filtration is more successful if the size of the holes in the filter is as small as possible. Filter papers are specially made for the purpose, as are some ceramic (pottery) filters. The problem with such filters is that the water passes through very slowly and the large amounts of water used in a home would take a very long time to be cleaned.

Decanting is also a slow method, as the water must stand for some hours before it is poured out into another container. It requires a routine of collecting, standing and decanting, so that the family is never without clean water.

However, dirty-looking water is not the most threatening. We can see solids that float or settle and we can take the necessary action to get rid of them. The real danger to health comes more from the invisible pollutants. These are of two kinds, the chemical pollutants that can poison us and the living pollutants – the organisms that cause diseases.

Some chemical pollutants cannot be removed in domestic, or even industrial, settings. Once they are in the water it is virtually useless for human purposes. Such chemicals often get into the water from industrial sources, or from agriculture, e.g. poisons sprayed on crops to kill pests. People have to take greater care over how they dispose of wastes from industry and how they use dangerous chemicals on the land. The problem with such pollution is that there is no way we can tell just by looking at the water that there is anything wrong with it. Whole communities can be poisoned before anyone realizes the danger.

By far the most common source of water pollution is human wastes – faeces and urine – which, together with water and other materials that flow into the drains, are referred to as sewage. If this material gets mixed somehow with the water supply, then the germs living in the sewage will travel into the bodies of people who drink the water. This means that wells, springs, ponds, lakes, rivers and reservoirs must not be contaminated with sewage. In towns and cities where water is distributed in pipes under the ground, the drains carrying the sewage are kept separate from the water pipes and so there is little danger that the water will be polluted. However, when there are earthquakes or other serious disruptions of the ground, drains and water pipes get broken and then sewage can get into the water supply. Water engineers and public health workers then have to use chemicals to treat the water until the system has been repaired and the water is declared safe again.

Chemicals to kill germs in water are effective, but they do add a taste and smell to the water and of course they cost money. The simplest and cheapest way to clean water is to use our knowledge of living things to attack the germs with heat. The vital processes in every organism are damaged by heat and if the heating continues for long enough, the processes stop completely and cannot be started again – the organism is dead. This will leave the water safe to drink, but only if there are no poisons in it!

Boiling must be vigorous and must last for several minutes otherwise the temperature will not be high enough to kill all the germs.

Waterborne diseases kill millions of people around the world, especially babies and young children. The most common are dealt with in this unit and pupils should be warned of the dangers, especially the concept that using the hands to wipe their bottoms after defecating, means that there is the risk of transferring faeces to food, water, cups and dishes. The simple habit of washing their hands every time they use the toilet is very important as it can stop the spread of germs in a family.

Using the Pupils’ Book

Activity 10
Before taking the class out, you should choose the best place – one which will provide pupils
with the opportunity to see pollution and which is safe. The pupils must know before setting out what they are to look for and that you expect notes on what they observe. Sketches are a perfect form of making notes.

Back in class it is essential that all the observations are shared and listed and a list of all the pupils’ ideas for reducing or removing pollution is gathered on the board. This list is then to be used by the individuals as the basis for writing their report. Pupils who do not participate at any stage will not be in a strong position when it comes to the writing, so you can use this reminder to keep them focused on the tasks.

Page 44 has illustrations of four sources of social studies pollution. Let pupils look at them, individually or in groups, then ask them to explain what they think the pictures show. Go on to read the text below them and get pupils to relate it to the pictures, e.g. In what ways are people being careless in the pictures? In what ways are they ignorant?

The second illustration introduces the language process of filtration, which is the first approach to cleaning water. Ask pupils to share any personal experiences they have of using filtration, either with cloths etc. or the commercial equipment. The main concept that pupils need to have clear is that filtration deals only with solid pollutants. The liquid water (plus germs and poisonous chemicals) will pass through the filter and only the solid particles are trapped by it. This idea is reinforced by the next activity, which introduces the process of decanting.

Activity 11

You can use actual polluted water, or ‘make’ some for this activity by mixing tap water with soil and dead leaves etc.

Once the container of polluted water is set up, it should not be touched for some hours. This means that you can either start the activity on one day and finish the next, or set it up first thing in the school day and finish it last thing in the same day. The solids will mostly sink to the bottom of the container and the water above them will be clearer, without obvious solid particles making it look dirty.

Decanting needs to be done slowly and carefully so that the solids are not disturbed.

Pupils will be more or less successful, but this is a valuable result as it will allow them to compare the outcomes of the various groups. The very smallest solid particles will take days to finally settle, so the water is still likely to be a little cloudy.

Page 45 has text that sums up the two activities and the ideas of filtration and decanting, together with their limitations: they cannot get rid of chemical and germ pollution.

The picture shows some of the chemicals that are used to deal with germs. It is important to stress that they are DANGEROUS and must be used carefully, following the instructions on the packaging. Compounds of chlorine, or chlorine gas itself, are the most common chemicals used. Chlorine has a distinctive smell and swimming pools are the places where it is most noticeable.

Page 46 extends the concept of killing germs, by moving on to the most common form of water cleaning – boiling. The main idea here is that germs are living things and their processes of life, like ours, are damaged by very high temperatures. Boiling the water for several minutes destroys the living processes. It means that water that may still be cloudy after filtration or decanting, can still be made safe to use, once it has been boiled.

Activity 12

This is a group activity, gathering information about diseases that are spread by polluted water. If you can find a health worker who is willing to come to class, this would add to what the books and other sources will provide. Pupils should be given time before the visitor comes to decide what to ask. This avoids the visitor’s time being wasted. Each group could be assigned the task of asking about particular diseases, or particular aspects of how they are controlled or treated. This will help to break down the very large task into smaller pieces that can be fitted together at the end.

It is essential that pupils write down what they are told by the health worker, so that they can use the information when writing their report. All their notes should be under headings, so that their report is easier to complete. A table is the simplest way to present so much information.

When each group reports on their portion of the research, the class should make a note of what they are told. The simplest way is for
them to have a blank table already drawn, into which they write the information from each group.

Page 47 has greatly enlarged pictures of some bacteria and viruses that are found in polluted water. Emphasize that the organisms are invisible, so we cannot tell that they are in the water just by looking at it. This is why they are such a danger and why boiling is always a good idea, even if the water looks safe to use.

Our bodies make faeces every day, which is normal and good. But, when large numbers of people live together in towns and cities, the faeces and urine they produce (the sewage) is a problem. It carries millions of germs and we have to keep them out of the water sources that the community depends on.

Page 48 has more on this very important link between sewage and diseases. Look at the diagrams together as a class and read the text. Let pupils ask you questions to help them understand them. Then you can check their understanding by describing real life situations where the rules of hygiene are not being followed and see if they can spot what is wrong and explain what should happen.

Activity 13

Pupils are encouraged to be imaginative and creative in expressing their understanding of the issues of waterborne diseases. Let each group choose what it will do for its role-play. When you think they are ready, let each group perform for the class and then ask for comments and questions from the pupils who were watching.

The following table is not for the pupils to copy or to learn, but you can use it to check on what they find from other sources and to add any details that they are unable to find.

| Disease                        | Transmitted                              | Major symptoms                                                         | Prevention                                                                 | Quarantine period | Immunity                     |
|--------------------------------|------------------------------------------|                                                                      |                                                                          |                  |                              |
| Cholera                        | By water through faecal contamination    | Severe diarrhoea with ‘rice-water stools’, then extreme dehydration, vomiting, cramps | Quarantine of known cases. Careful hygiene and general sanitation to prevent contamination of water supplies. Vaccination | 2 weeks if patient is properly treated | At least 3 months but has to be repeated |
| Typhoid fever (enteric fever)  | Through infected food, milk, water (usually contaminated by sewage). It can also be spread by flies and by direct contact with infected material | After incubation period (usually 10–14 days) headache, loss of appetite, constipation followed by fever, abdominal pain, nose bleeds, spots on abdomen, then diarrhoea as fever subsides | Purification of water supplies and pasteurization of milk. Quarantine of known cases. Vaccination | 4–6 weeks | Small ‘booster’ doses given every 3–4 years |
| Infectious hepatitis (epidemic hepatitis, catarrhal jaundice, hepatitis A or B) | Poor sanitation, contaminated food or water, malnutrition, use of contaminated needles | Loss of appetite, nausea, slight fever. Then follows tenderness and enlargement of liver, pain in abdomen and eventually jaundice. Possibly also vomiting and diarrhoea | Proper disposal of faeces and urine. Gamma globulin injection given early enough after exposure | 6–10 weeks | 4–6 weeks |
Disease | Transmitted | Major symptoms | Prevention | Quarantine period | Immunity
---|---|---|---|---|---
Poliomyelitis (infantile paralysis) | From person to person through direct contact, i.e. through coughing or sneezing. Also through milk or water contaminated by sewage | Fever, nausea, vomiting, sore throat, headache, diarrhoea, stiff neck, muscle pains, paralysis | Polio vaccine | 10–30 days | Permanent

**Term 2  Unit 2**

**Air: part of the Earth’s atmosphere**

**Objectives**

Pupils will:
- demonstrate an understanding that air takes up space, is all around us, has weight, is colourless and exerts pressure
- identify some components of air
- investigate how some components of air are utilized
- identify sources of air pollution and explain ways of reducing their detrimental/harmful effects
- plan, design and construct a device for filtering air
- identify some common airborne diseases and explain how these can be prevented/treated
- participate effectively in group/class activities.

**Time allocation: 6 weeks**

**Discussion of concepts and skills**

**WHAT IS AIR?** pages 49 to 57

**General concepts**

Air is a mixture of gases, which is all around us, though we cannot see it. We only feel it when it is moving in the form of wind, or when it is being pushed by some other force. Air has no smell, but it has weight and this produces pressure on the Earth’s
surface, called atmospheric pressure. Air inside things can also push against their sides with more or less pressure.

Materials needed
1. A plastic bag and tie
2. A bowl of water
3. A transparent jar or glass
4. A sheet of paper
5. A pen or pencil
6. Two balloons
7. String
8. A straight stick or meter rule
9. Chalk
10. Scissors
11. An inflatable ball or bicycle inner tube
12. A bicycle pump
13. Books and other sources of information about the air

Background
Scientists are always interested in defining the characteristics of whatever they are studying in the physical world. The same applies to air, as to animals or plants or rocks, or soils etc. Air is invisible and has no smell or taste and, being a gas, we cannot feel it when it is still. Our senses are very bad at telling us much about air. It is only when air moves that we become really aware of it – feeling it pushing against our skin and creating sounds as it moves over and through things. Doors bang, flags and clothes flap, rubbish takes off and lands noisily – these alert us to the presence of the air, which we all live in, but which we forget about most of the time.

This is the problem which the unit addresses – it tries to get pupils to ‘look’ at air in different ways, which are more like the scientific ways. Air is very familiar, but neglected, as we just ‘take it for granted’. Your main task in this unit is to shift pupils’ thinking and understanding about air.

The Earth’s atmosphere is hundreds of kilometres deep, but the amount (density) of air changes as the distance from the surface increases. This is why humans who climb the highest mountains must take cylinders of oxygen with them, so that they can breathe, and airliners full of passengers have to be sealed and have air pumped into them to keep everyone alive. This huge ‘sea’ of air that is wrapped around the Earth is heavy and it pushes down on us and everything else on Earth. Scientists call this pushing ‘atmospheric pressure’. Our bodies are designed to live under these conditions. Our heart pumps the blood at a pressure that counteracts the external pressure on our bodies and so we are able to live. Under water, the pressure of the sea becomes greater and greater the deeper we go and so, eventually, we have to use cylinders of gas under pressure and then to wear pressurised suits to stop our bodies being crushed by the sea’s pressure.

Air is spoken of as if it is one gas, but actually it is a mixture. It is not a pure substance. It varies from place to place and from one hour to another. At present, people are becoming more aware of the changes to the air caused by pollution and the ‘quality’ of the air is being monitored, i.e. air is sampled to find out how much there is of gases like nitrous oxide or sulphur dioxide, for instance. These are gases that contribute to acid rain and they may also damage people’s lungs.

The basic proportions of the mixture remain more or less the same, with nitrogen being by far the biggest component. This gas is essential to life, as all living things use it to build their proteins, but humans cannot use it as a gas. We breathe it in and out again. It is not used and it does us no harm. Only plants can absorb it and that is through their roots, in the form of various minerals dissolved in the water.

The gas that almost all living things do absorb in some way is oxygen. We take it in through the lungs, as do many land animals. Fish and other water creatures absorb it from the water. The gills of fish act like our lungs. Oxygen is also essential for burning. If we need to put out a fire we must try to cut off the supply of air (containing the essential gas oxygen). We can do this by throwing material on the flames that covers the fire and stops the oxygen reaching it, e.g. sand, soil, a blanket, a wet cloth.

All living things produce the gas carbon dioxide and this is excreted into the air, where it mixes with all the other gases. In spite of this, the air has only a relatively small amount, because plants absorb it to manufacture food and it becomes ‘locked up’ in carbohydrates and in some rocks, such as limestone and chalk. The problem that people have caused by burning so much ‘fossil fuel’, such as coal, oil and gas, is that the amount of carbon dioxide is increasing and the greenhouse effect is causing the Earth’s temperature to rise (‘global warming’). It seems that even a small increase in the total amount of carbon dioxide is able to raise global temperatures and this is bad for everyone on Earth as it leads to climate and weather changes.

Using the Pupils’ Book
Page 49 introduces the topic with pictures of examples of air being used in various ways. Let pupils discuss these in groups and then feed back their ideas to the class. The bird and the plane are kept in flight by the air. The yacht is pushed forward by the air pushing against the sail and the washing is being moved by the moving air – the wind.
Activity 1

Pupils must know why they are moving around with the plastic bags, so emphasize the two questions in point (1). The groups must discuss their plans before they begin to go in search of air. They have to have a plan before you allow them to move about. In this way, their activity will have a clear purpose – it is to find answers to the questions. The picture should help them to come up with a plan.

Each group must note what they do as they move about from place to place. Encourage them to explore inside spaces, as well as out in the open space of the room, e.g. in cupboards, desks and boxes.

Once each group has answers, get the class together and let them share their findings. The conclusions should be made by the pupils, not by you. Air will have been found in every place they searched and it was only felt when pupils made it move in some way, e.g. by blowing or waving something.

Page 50 has text that sums up the outcome of the activity and adds information about air in the soil. Read it after the class discussion of results is over.

Page 51 continues to explain why we can sometimes feel the air – when it is being acted on by forces that push or pull it. Common examples are given. Ask pupils for others they can think of, after reading the text as a class.

Activity 2

This activity is designed to convince pupils that air takes up space – it fills things that we call ‘empty’. As you read through the steps of the activity, refer pupils to the pictures to help them understand what to do.

It is very important that they do not tip the container as they push it into the water and that the paper is tightly wedged into it. If the paper gets wet it will not prove that the space was filled with air.

Groups should discuss their results and try to explain why the paper remained dry when it was under water. Let every group tell their ideas to the class, then draw a conclusion before reading the first part of the text on Page 52.

We have difficulty in realizing that air takes up space because we cannot see or feel it, so do not be surprised if pupils have some problems with the ideas in this activity.

Activity 3

This should be done before looking at the pictures of the diver and the boat, or reading the second paragraph on Page 52.

The purpose is again to show that air occupies space, this time through seeing and feeling the hands being separated by air filling the balloon. If you do not have enough balloons for all the groups, let them do it in turn, or carry it out as a demonstration.

Page 52 has the text explaining the result of the balloon activity; then it sets pupils two problems in the pictures of the diver and the upturned boat. In both cases, the people survive because the space is filled with air and so they do not drown even though they are under water – like the paper in the jar. The whole class could look at them and suggest explanations, or it could be an individual task, used as an assessment of how well pupils have understood the concept so far.

Page 53 has labelled diagrams that summarise the concept explored in the activities. Use them as a check, by asking pupils to describe what they show.

Activity 4

The other big problem young children have about air, is the idea that it can be weighed. This seems very strange – to weigh something that cannot be seen or felt! Ideally each group should do this activity at the same time, but if you have limited materials, let them do it in turn, before you have the sharing of results and the discussion of what they mean.

It is vital that the stick is balanced and that the two pieces of string are exactly the same length/mass. Ask pupils why these are important points (to make the test fair, only one factor should be different, i.e. air in one balloon and none in the other.) Each time something is added to the stick, it should be re-balanced before going on to the next stage of the activity. Bursting one balloon will be fun for the pupils, but actually it might spoil the result, if large pieces of the balloon fly off, making that side lighter than the other. A better way is to release the air from one balloon by untying the string enough to let the
air escape. Either way, the result should be that the stick tips down towards the end with the inflated balloon, as it weighs more than the empty one. Pupils must try to arrive at this explanation for themselves. You should only move on to the text and picture on Page 54 when they have made their best attempt to explain the result. Individuals should write and draw an account of the activity.

At the bottom of Page 54 is a short summary of three facts about air that pupils should know.

Activity 5

This will be a familiar process for many pupils, but the intention is to focus on what changes as the air is pushed into the ball or inner tube. The key points are that pushing the pump causes the air to be pushed out of the pump and into the ball or tube and that the condition of the inflated object changes from soft and flexible, to hard and much more rigid. The pupils should feel the object several times in the process of inflation so that they are more aware of how it is changing. The fully inflated object is filled with air that is pushing against its wall – the pressure of the air makes the object hard and more rigid.

Groups should give their explanations of what they observed, before the class reads the text and looks at the diagram on Page 55. Some arrows represent forces: on the pump, on the air in the pump and on the wall of the ball. Others represent movement of air: from the pump into the ball. Check that pupils understand the meaning of the arrows.

Page 56 continues with the explanation of the diagram and relates it to what the pupils should have observed in Activity 5. Use this text to round off the discussion about air pressure inside closed objects, dealing with any queries that pupils may have. The word ‘pressure’ should be used frequently by you and you should insist that pupils try to use it correctly when they contribute to the discussion etc.

The four pictures show instruments that are designed to help us to measure air pressure. The pressure gauges will probably be familiar to some pupils, so let them tell the class about their experience of such things. They are common at garages where tyres are inflated to particular pressures to keep them safe for driving.

The two types of barometer measure atmospheric pressure. The aneroid type is most common in homes and the mercury type is used by meteorologists who must have more accurate readings to use for weather forecasting. They both work through the pressure of the atmosphere pushing on a sealed container and causing changes in the contents. These changes are matched against a scale that matches them to a particular pressure.

Activity 6

Groups could choose which component of the air to research, or you could assign groups to the separate gases of the air. It would be more difficult, from the resource point of view, if all groups tried to research all the gases. If you can find a person with specialist knowledge, the pupils must prepare questions for them before they come to class, so that the time is not wasted. Every pupil should make notes of their own about what they discover from the books etc. The group must then decide how to present their information to the class. Let them choose, if possible. It would be better if there was a variety of ways of presenting the information, as it would be more interesting for the class.

Page 57 gives brief facts about the main components of the air. Read through them together to check what the groups have found out – they should have more detail than is here. The diagram should be discussed so that you can assess whether or not everyone has understood its meaning. The blank square represents the water vapour and all the other minor gases, some of which are named in the text.
THE USES OF AIR  

General concepts
All living things use air to keep them alive. People also use air in other ways to make their lives easier.

Materials needed
1. Books and other resources about air

Background
Apart from air being essential to living processes (because of the use of oxygen in cell respiration and the use of carbon dioxide by plants in the process of photosynthesis), it is also a very useful material that helps us to do various things. Wind, which is moving air, can be "harnessed" to drive machines such as windmills and sailing ships. Hot air can be blown by fans to dry things, such as clothes and hair, or to heat buildings. In contrast, cold air can be used to cool places down. As objects filled with air will float on water, people use them to keep themselves or other things afloat. This is essential in things like life jackets and boats. If the air is driven out of a boat it sinks.

Using the Pupils’ Book

Activity 7
This activity begins by using the pictures on Page 58 of air being used in various ways. Groups should look and discuss what they think the uses are. They should then move on to a search for different examples of air being used, using the books and other resources.
Individuals should make their own notes on what they find. The group should then combine their findings in a diagram like that on Page 59. This must be looked at before the groups start their own diagrams.

AIR POLLUTION AND FILTERS

General concepts
Many materials become mixed with the air. Some are produced by human activity, such as burning fuels. Just as water pollution can be reduced by filtering, the same can be done to air to make it less dangerous to breathe.

Materials needed
1. Books and other sources of information about air pollution
2. A bottle
3. A cork
4. Plastic or rubber tubes
5. Cotton wool
6. Something that makes sooty smoke when it burns

Background
Burning fuels produces waste products – solids and gases – that are often released into the air. Most are not visible, but they are harmful to people breathing the polluted air and they are harmful to the environment, as factors which contribute to global warming and acid rain.
Vehicles all have exhaust systems that trap some of the solid particles from the engine exhaust. More modern cars may have catalytic converters attached that reduce the polluting gases released into the atmosphere.
Most governments use the law to control pollution by factories and power stations. Tall chimneys are built to raise the smoke etc. high above the ground and filters are built into the system to clean the smoke before it is released. Unfortunately, not all countries have such controls and the laws are not always enforced, so there is still a lot of unfiltered smoke going up into the air.
People who live in cities and towns, especially children, are more likely to be damaged by air pollution produced by the traffic. Unleaded petrol has been developed to replace petrol that contains lead. Lead is a very poisonous metal, which does terrible damage to several organs, particularly the brains of young children. Some governments have made unleaded petrol the cheapest to buy, so that drivers choose to use it.

Using the Pupils’ Book

Page 59 contains a word puzzle for individual pupils to solve. The answers are: (a) smoke (b) fumes (c) pollution (d) poisonous (e) contaminate.
This will focus pupils’ attention on the new topic, so make good use of the puzzle to stimulate interest.

Activity 8
Let each group choose the question for their research. This will motivate them better than having the choice made by you. It is important for the members of the class to listen carefully
to what each group has found out, especially about the question that was not their choice. They should make notes on what they are told. It will help them if you write on the board as the groups give their reports to the class.

Page 60 provides information about the causes and prevention of air pollution. This text should be read as a class after the groups have reported. It can be used as a check on what they have discovered for themselves. It may fill in some of the gaps in their research.

Stress the social aspect of pollution control – we are all involved, both as producers and as victims. Children are in the greatest danger and they can be a powerful force in changing adult behaviour, especially of parents. The picture should be discussed, as some pupils will be able to tell about their own family cars.

Page 61 continues with details of industrial filters that some governments now insist are fitted to chimneys. One such system is shown in the picture. Although it looks unfamiliar, its function is the same as the water filters used in an earlier unit. Air is passed through liquids and various types of solid materials that absorb gases or solid particles, such as soot, leaving the air much cleaner before it is released into the atmosphere.

**Activity 9**

The pupils can use the materials to construct a simple air filter. The principle is that air is sucked into the bottle and it enters through a tube that is submerged in cotton wool. The soot particles that are in the smoke should be trapped by the cotton wool so that they do not enter the person doing the sucking. You can allow the groups to design their own system without help from you, or you can give more or less guidance. Obviously, if groups have no idea how to begin, you will have to give them some ideas to set them off.

Groups can compare their filters and decide which they think does its work best.

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**DISEASES IN THE AIR**

**General concepts**

People have to breathe throughout their lives, both day and night. This provides germs with a perfect route into the body and many diseases are spread through the air.

**Materials needed**

1. Books and other sources of information about airborne diseases

**Background**

It is impossible for all the air to be filtered and cleansed of germs before we breathe it in.

So, we are always at risk of catching diseases. Prevention sometimes involves the isolation of the sick, infected person so that the air they breathe out is not breathed in by others. Medical staff often wear face masks, to reduce the number of germs they breathe in whilst doing their work. Fresh air in homes and other buildings helps to move germs out of them, reducing the chances of infection. Good hygiene is a simple and effective way of controlling the spread of infections. Sneezing and coughing throw large numbers of germs out of the lungs, nose and throat and, without handkerchiefs to catch them, they can easily fly straight to another person.

**Using the Pupils’ Book**

Page 62 introduces the topic with pictures, illustrating familiar diseases that are transmitted through the air. Encourage pupils to talk about their own experience of such illnesses. Ask them if they have any idea how they became infected.

**Activity 10**

The research has three questions to answer – what causes airborne diseases, how their spread can be prevented and how sick people should be treated. Let the groups decide how they record the facts they find, then get them to choose the form in which they will share them with the class. The whole class should pay careful attention to what each group reports. You could keep a record on the board of what the groups tell the class. This will be a useful summary of the pupils’ research at the end of the sharing session.

Page 63 summarises information on causes, prevention and treatment. The whole class could read the text together, one paragraph at a time, followed by questions from the pupils and then from you. In this way you can correct any misunderstandings or fill any gaps.
Term 3  Unit 1
Rocks, minerals and soils

Objectives

Pupils will:
- define rocks and minerals
- identify the components of a rock, using a magnifier
- classify samples of locally obtained rocks, according to colour, hardness, reaction to different substances
- identify the characteristics exhibited by igneous, sedimentary and metamorphic rocks – colour, texture, lustre, hardness
- explain volcanic activity and its detrimental effects on the environment
- state ways to minimise the detrimental/harmful effects of volcanoes on the environment
- describe the properties of minerals in terms of shape, colour, lustre, transparency and hardness
- state some minerals found in the West Indies and describe some of their uses
- compare samples of soil types – sand, clay and loam (garden soil)
- interpret data to determine which soil type is best suited for seed germination/plant growth
- describe the process of weathering
- describe measures to conserve/preserve soil.

Time allocation: 10 weeks

Discussion of concepts and skills

The unit deals with the familiar – soils and rocks – and deepens pupils’ understanding of their origins and their uses. It introduces the concept of minerals, which are the basic ‘building blocks’ of rocks and soils. The geologist’s view of rocks is presented, taking their formation as the basis of scientific classification. The unit focuses on some of the minerals found in the rocks of the West Indies.

Soil is a familiar part of pupils’ lives and the concept of plants growing in soil is well known. However, pupils may not understand the vital part that soil plays and this is the emphasis to put on the part of the unit dealing with soil. In addition, soils of various kinds can be put to other uses, such as building, glass making and pottery.

There are numerous activities that allow pupils to apply skills of observation, recording and drawing conclusions. These are essential to their proper understanding of the content of the unit. The group discussions and sharing with the class are also vital parts of the process of understanding the concepts included in the unit.
ROCKS, MINERALS AND THEIR USES  

General concepts
Rocks are composed of minerals, mixed together in a great variety of ways to produce a wide range of different rocks. Rocks are classified as igneous, metamorphic or sedimentary, on the basis of their formation. Rocks have characteristics that are used to sort and identify them. Many minerals can be extracted from the Earth’s rocks and these have various uses.

Materials needed
1. A pen or pencil
2. Sheets of paper
3. A hand lens
4. Five to seven samples of local rocks and other rocks, including sedimentary, igneous and metamorphic rocks
5. Colouring pens or pencils
6. A nail
7. Vinegar
8. Pure (distilled) water
9. Dilute bleach
10. Tap water
11. A hammer
12. A dropper
13. Books and other sources of information about volcanoes
14. Samples of minerals

Background
Ultimately, all rocks are the product of the liquid interior of the Earth.

Igneous rocks arise directly from this liquid – the magma – either by bursting through the crust in volcanic activity, or being pushed into the layers of rock that make up the crust. Sedimentary rocks are formed indirectly from the original rocks of the crust, which were all igneous, or from the skeletons of millions of marine creatures that sank to the bottom of seas and became consolidated into layers of limestone and chalk. Sedimentary rocks are made of countless fragments, cemented together in some way. This is often some soluble mineral, such as quartz or calcium carbonate, which crystallizes out and binds the particles of the rock together.

Sandstones are an example of this kind of sedimentary rock. Such rocks very often form as sediments (hence their name) at the bottom of seas or lakes, but some are the result of grains being blown by the wind and accumulating in large, deep layers that are then compacted by other material being deposited on top of them.

Metamorphic rocks are so named because they have been changed from one form to another. They also are ultimately derived from igneous rocks, but they may have been changed from a sedimentary rock, rather than directly from an igneous one. The natural forces of enormous heat and pressure are the causes of rocks being converted from one form to another. This happens to the rocks wherever they happen to be located in the crust.

Minerals are often found in impure forms, but science and technology have devised processes to extract and refine the minerals that we need for many purposes in the modern world. Metals have been extracted by people for thousands of years and, as the technology has developed, so we have been able to refine more and more materials from the Earth’s rocks.

Limestone rocks, for example, can be crushed, heated and treated in various ways to convert them into cement powder, plaster, quicklime and slaked lime, as well as fertilizers for use on the land in areas where the soils are lacking in calcium.

Using the Pupils’ Book

Activity 1
This introductory activity is designed to focus pupils’ minds on the new unit and also to help you to assess their ideas before the teaching begins. Encourage the groups to write down whatever comes to their minds when they think of the three materials – soil, rock and mineral. The papers should all be displayed or circulated so that everyone can see what ideas pupils have. The picture is a small ‘test’ of pupils’ ability to recognize the three types of material. Pupils should explain how they decide what each one is, e.g. the soil is made of loose pieces of many different shapes and sizes.

Activity 2
If possible, take the class out to collect rock samples. If not, ask pupils to bring samples to school and you provide others, so that there is a variety and enough for everyone. If you do not have enough hand lenses for all groups to use at the same time, rotate them from group to group. The drawings should be larger than life, so that the details of the rock structure and composition can easily be seen. Check
that pupils are using the Glossary to find the meanings of words introduced in this activity: components, texture and hardness.

Hardness can be compared by rubbing one rock against another to see which one gets scratched. The scratched one is softer. In this way a set of rocks can be arranged in order from softest to hardest. Using a nail is another way of estimating hardness.

Page 65 outlines the meaning of rocks, minerals and soils, followed by an explanation of the scale of rock hardness. This text should be read as a class, after the activity, a paragraph at a time. Allow pupils to ask questions about things that are not clear to them. They should compare the answers written on the sheets in Activity 1, with the information in the text. The basic concepts are that minerals are one substance, rocks are a mixture of several minerals and soils are a mixture of mineral and non-mineral materials. Soils are the most varied as the composition of the various mixtures is limitless, depending on what is added to them.

Page 66 has pictures of three minerals found in the West Indies. Let pupils talk about them, particularly if anyone has relatives who work in the mineral extraction process.

Stress the difference between the minerals and the pure substances that can be obtained from them: they look nothing like one another.

Activity 3

Before giving out the vinegar and bleach, warn the pupils about using them carefully. It is very important to keep both liquids out of the eyes. If you have safety goggles, then they should be worn. The weak bleach solution should also be kept off the hands as much as possible, though at low concentration it will not attack the skin. The ‘neat’ bleach should be kept away from the pupils completely, preferably locked away. It is a very dangerous substance and young children must not handle it.

The table for the results should be drawn before the activity begins.

Tap water should produce no reactions from any of the rocks tested. Vinegar is a weak acid (acetic acid) and so it will react with some minerals to produce the gas, carbon dioxide. This will be seen as bubbling (effervescence) on the rock surface. It will be most obvious in rocks that contain compounds of calcium, such as chalk and limestone. Bleach may remove the colour from some rocks, but this is not very likely. The dropper must be washed with distilled water after each test so that the liquids do not get mixed up and spoil the results of the test.

It is important to compare the results of the various groups, as some may be different and that will require some thought and explanation by the pupils.

Page 67 gives pupils the basic information about the way scientists classify rocks. It is not by colour, or location, or any other obvious characteristic. It is based on their formation. This is the central concept that you must help pupils to understand. The three types are described in the text and some examples of each type are shown in the photographs. It is not important that the pupils know the names of these particular rocks, but they must learn the names of the three types and know what they mean. Ensure that they use the Glossary and that they speak, read and write the words as often as possible. This will help them to have a secure grasp of the ideas and the vocabulary. The class could read the text together, or in groups, followed by questions for clarification.

Activity 4

If you can obtain samples of the three rock types locally, this would be ideal. If you cannot find all three, ask the local secondary school if you can borrow some, assuring them that they will be returned unharmed! It is vital that you have at least one sample of each kind, because the pupils will need them for making comparisons with their collected rocks. The aim of the activity is to use the features of the known rocks to identify and sort the pupils’ own rocks. This will involve them in a lot of close observation, discussion and comparison. There is a lot of language learning potential in this activity.

The display of the rocks at the end is a way of allowing groups to compare the sorting done by others and this should lead to discussion and explanation of why rocks were sorted in particular ways.

The definitions of ‘rock’ will reveal to you how much pupils have realized that rocks are composed of various minerals, mixed together in numerous ways.
Page 68 focuses on volcanic activity, which is closely connected with the igneous rocks. However, many igneous rocks did not come out of volcanoes. They formed under the surface and only when the layers of rock above them were removed in some way did the igneous rocks become visible.

Volcanoes are relatively rare, though they are more common in certain parts of the Earth’s crust. Major eruptions are even rarer, so pupils should not be alarmed by the information in the picture. Encourage groups to give their explanations to the class after they have had time to discuss their ideas and come to some agreement. The text on page 70 should not be used until after the completion of Activity 5.

**Activity 5**

Leave the groups to choose which aspect of volcanoes they want to research. This choice could be done after a class discussion to introduce the activity. The three basic aspects are set out in the pupils’ book, but they may think of others. Notes and drawings are essential as records. Remind pupils that they have to set up a display at the end of the activity and it has to be attractive and interesting for the class to look at.

Give the class time to look at the displays and to make notes on those aspects that they did not research themselves.

Page 69 has the diagram that should be looked at as the text on Page 70 is being read. It may be best for you to read out the text as pupils look at the diagram, or for individual pupils to do the reading aloud in turns whilst the rest look at the diagram.

Page 70 has the most important facts about volcanoes and how people try to deal with their activity. If any pupils have personal experience, or have seen relevant things on the television, let them share these things at this point.

The text about minerals should be used after Activity 6.

**Activity 6**

Again, this activity depends on having samples of minerals. It does not matter which ones you use, but they cannot just be rocks – they must be samples of particular minerals, e.g., gypsum, bauxite and iron ore. If necessary, ask the local secondary school or any industrial site nearby for help.

The table for results should be drawn first, before you give out the materials for the investigation. The characteristics are defined in the Glossary, so this is another opportunity for pupils to practice using it.

When the groups report, you could collate their findings in a table on the board, so that it will be simple for the class to compare the results. If there are disagreements, let pupils defend and explain their observations.

The text about minerals on Pages 70 and 71 should be read after the sharing of results.

Some pupils may have relatives who work in the extraction or processing of some mineral, so let them talk about what they know.

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**WHY WE NEED SOIL**

**General concepts**

Soil is essential for the growth of plants and so it is vital for humanity, as we depend on plants to keep us alive. Soils vary in characteristics and usefulness. Bricks, cement and concrete make use of various types of soil components, and buildings depend on their foundations in the soil to prevent them from falling over.

**Materials needed**

1. Three identical jars with lids
2. Water
3. Labels
4. Garden soil, clay and sand
5. A hand lens
6. Paper
7. A pen or pencil
8. Colouring pens or pencils
9. Three identical plant pots or other containers
10. Seeds

**Background**

The common misunderstanding about plants and soil is that they ‘feed’ on it. This is not correct, in scientific terms, as the food that keeps plants alive is actually manufactured by them in their leaves, by the process of photosynthesis. Soil provides minerals, particularly nitrogen compounds, which are essential for plants to build the various food products in their cells – the proteins, oils, minerals and vitamins that all animals,
as well as people, depend on for life. Plants are not like us. We have to take in ready-made complex materials, break them down in digestion into their simpler parts and then use those parts to build our own bodies and to provide our cells with energy. Plants take in the simpler materials – the carbon dioxide gas, the water and the minerals from the soil – and they build the complex materials from them. The process is the reverse of what we and all animals have to do to live. Soil only provides plants with raw materials for building complex materials.

In addition to being the source of water and minerals, soil also helps to keep plants anchored so that they do not fall or get blown down. The many branches of the roots ‘hold on’ to soil particles and this has a good effect on the soil too, as it stabilises it and makes it less likely to be washed or blown away. Soil erosion is a terrible problem, especially in tropical areas where the rainfall is heavy and the land is sloped, as on hills and mountainsides. Plants covering the soil prevent soil being lost. Areas of rain forest that are cleared of all trees are in danger of losing their soil if left without vegetation.

The minerals of which soils are composed, are found in different concentrations in different soils. Some have a high concentration of clay particles and little sand, for instance. Such clay soils can be used for brick and pot making. Other soils have a high concentration of quartz grains, which can be separated and used for glass making, or added to clays for bricks, or mixed with cement to make concrete.

Using the Pupils’ Book

**Activity 7**

Use the picture on Page 71 as the introduction to this activity. If you have limited resources, let the groups take turns to do the investigation and delay the sharing and class discussion of results. If possible, let the pupils collect the three soils for themselves. If not, ask them to bring soils from home, or collect some yourself. The soils should be very obviously sandy, clay and dark garden soil (loam). This will make the results easier to see, as they will behave differently when shaken with the water.

It is essential that the jars are put somewhere safe and out of the way where they will not be disturbed. It is best if points (1) to (4) are done on the first day and then the remaining points are done the next day. This will make the result easier to see, as the particles that were floating will have had time to sink to the bottom and settle.

The garden soil should have several layers of different particles on the bottom, with the largest particles under layers of progressively smaller and smaller particles. The water may be coloured a pale brown or yellow and on the surface there may be organic matter floating (e.g. pieces of leaf, stem, root, dead animals).

The sand will also be in layers, with the largest grains at the bottom. The water may be stained orange or yellow. There should be little or nothing floating on the surface.

The clay will be the last to settle completely, as the clay particles are very small. The water may still be cloudy even after a day. The layers will be less obvious, as clay is a very uniform material, with little or no organic matter in it. The water may be stained by the colour of the clay, as well as being cloudy.

The pupils’ pictures should show such differences clearly and be well labelled.

Let the class see them all in a display and then discuss why there are differences. It is mostly to do with the sizes and weights of the soil particles being different in the different soils.

**Activity 8**

The characteristics of the three soil types that will emerge from Activity 7 should be used by pupils to make predictions about how the growth of seedlings will be affected by the three soil types. Get the groups to write down their predictions before they plant the seeds.

The fairness of the comparison depends on all the factors being kept the same for each pot of seedlings – except the one that is being compared, i.e. the soil. This is the important concept of scientific experiments that this activity can help you to make clear. Ask pupils to explain why it is necessary to control all the other factors. This will reveal to you how well they understand the concept of ‘a fair test’.

The table can be drawn after the seeds are planted. It should be used each day once the seedlings begin to show above the soil. Recording zero for those that have not emerged is essential, as the growth rates are to be compared.

Graph paper is best for the construction of a graph, but pupils could use lined paper and construct a grid using a ruler and pencil. It is essential that the intervals on the two axes are kept constant and numbered accurately.

Let each group use their graphs to come to
a conclusion about which soil is best for seedling growth (NOT for germination), then ask them to share their conclusions with the class. If there are disagreements, make sure that groups use their evidence – the measurements – to support their conclusions.

The garden soil should prove to be the best, as it has mineral nutrients and has a good crumb structure that allows air and water to be held in the spaces and so the roots can grow well. The clay will get waterlogged and this stunts the growth of the roots and makes it difficult for the seedlings to absorb water and nutrients. The sandy soil will drain quickly and so the seedlings may not be able to absorb enough water to grow at maximum speed. Sandy soils are also often very low in nutrients and so seedlings do not thrive, often appearing pale and weak.

Page 73 has a picture that introduces some of the other ways in which soils are used by people. Let the groups look at it and discuss what is shown, before asking for ideas from the class.

Page 74 has text that should be read by everyone after the pupils have given their ideas. If anyone has experience of foundations being dug for a building, let them share their experience with the class.

WEATHERING

General concepts
Rocks may appear to be permanent, but actually they are being slowly changed all the time by the effects of the weather. Physical and chemical attack occurs where rocks are exposed and this may be made worse by pollution caused by the activities of people.

Materials needed
1. Books and other sources of information about weathering, erosion and soil conservation
2. Modelling materials
3. Colouring materials
4. A pencil
5. Paper

Background
Weathering is the natural breakdown of rocks, which is part of the process converting igneous rocks into sedimentary rocks. The various elements of the weather can attack the bare rocks exposed on the surface and either dissolve the cementing minerals, so that the rock particles become loosened, or physically break them off, e.g. ice splits rocks, water rubs against the surface, knocking pebbles and other rocks against it. Human activity has quickened the pace of these processes in places where we have added pollution to the air or the water, e.g. acid rain.

Using the Pupils’ Book

Activity 9
The research element of this activity should be done before taking the class out to look at examples in the neighbourhood. In this way, pupils will be well informed enough to know what to look for and to recognize examples when they see them. The three aspects should be dealt with separately, even though they are connected in practice. Erosion may be fast and dramatic, compared to the slow process of weathering. This is one big difference that pupils should discover from their research.

The field trip must be well planned, which means you should have chosen places to visit before setting out. If pupils think they know of good places to go, let them make their suggestions. Notes and drawings are essential outcomes of any field trip, so make sure pupils are actively recording as you move from place to place. Back in class the groups must choose their way of sharing their information. Give them plenty of time to prepare an interesting and attractive form of presentation.

Page 75 has pictures of various examples of weathering and erosion, as well as soil conservation. Do not tell pupils what is shown. Ask individuals to give their explanations of what they see in the pictures. This will help you to assess how well they have understood the ideas in the topic. Everyone should read the text after the pictures have been discussed.

Page 76 completes the explanations of erosion and conservation. Answer any questions that pupils may have about the unit, before bringing it to an end.
Discussion of concepts and skills

The unit begins with familiar concepts related to the weather and extends them with the introduction of symbols, weather observations and their use to produce maps, reports and forecasts. The use of instruments by meteorologists is ‘simulated’ by pupils, through their making of simple examples. The instruments are then used to collect data over a period, so that comparisons can be made and trends and patterns can be revealed. These are then used to ‘forecast’ weather and the predictions are compared with what actually happens. The water cycle is revisited as the fundamental ‘engine’ of the weather, driven by the energy from the sun.

This part of the unit offers many good, interesting opportunities for pupils to apply and extend their science process skills. Observing, measuring, recording, comparing, predicting, interpreting and concluding are all practised in the activities of the unit and they should not be left out. It is through the activities that pupils’ understanding and interest will be developed.

The second part of the unit is a much more ‘abstract’ set of notions, related to how human activity has damaging effects on the weather/climate. The problem is that so many of these effects are slow, far away and not easy to link with their causes. These issues have emerged because scientists have collected data over long periods and so the changes, though slow, have been seen in the patterns of the measurements. Global warming, acid rain and destruction of the ozone layer are the issues considered in this unit. Their causes are revealed as arising largely from human activity.
General concepts
There are a number of elements that make up the weather. These can be measured with instruments and the measurements can be used to make forecasts. Meteorologists use symbols to represent weather elements on forecasting maps and charts.

Materials needed
1. Large sheets of paper
2. Colouring materials
3. A pen or pencil
4. Modelling materials
5. A map of the island
6. Newspapers and other sources of weather reports
7. Materials for making weather instruments
8. A ruler
9. A notebook or paper
10. Two transparent plastic cups

Background
Climate and weather are directly related to the Earth’s atmosphere and surface – land and water – and the sun’s enormous output of energy. All these factors interact to produce the local weather conditions and the global climatic regions. This means that changes in one factor have effects somewhere else in the system.

The weather is part of our daily experience from the day that we are born and we become familiar with its elements, but we may not understand how they are connected to one another and to other factors, such as those listed above. Each element should not be thought of as independent or separate, except the sun itself. This supplier of energy is so far from us that nothing that humanity does can change it. This is fortunate, because if the sun was damaged or removed, life on Earth would be fatally damaged. We can change and damage the land, the water and the atmosphere and so there are effects on the weather and even climate change happens slowly, over long periods of time. Scientists have helped people to become aware of these effects. They have collected measurements of many features of the weather from numerous points on the Earth and from the atmosphere. This evidence has been used to produce forecasts, some short-term and, increasingly, long-term ones too. Added to this use of the weather data, has been the exposure of patterns that have important and worrying messages for humanity. We are doing slow, long-term damage to the climate by the way we live. This has mostly been caused in the last hundred and fifty years, since we discovered how to use oil to power machines and since we have removed more and more of the Earth’s vegetation to grow food for the ever-growing world population. Less sex and fewer babies would certainly reduce the pressure on the environment!

Using the Pupils’ Book
Page 4 begins with a picture, which serves as an introduction to the topic of weather. Let pupils look at it together and ask them what they see happening. Use it as the way into the first activity.

Activity 1
Plan this outdoor activity before you take the class outside. You may choose to take them out of the school yard to some place where there is a better view of the sky, but this may not be necessary. Pupils must know before going out, what the purpose is and what they will be expected to produce from the visit. Some form of recording is essential.

Let the groups choose how to share their observations and give them time to prepare their presentation. When ready, ask the groups in turn to share their work and allow the class to ask questions and to comment. The results should produce a list of all the common weather elements: sun, clouds, wind speed and direction, rain, temperature. Someone may include humidity, which is correct, but not part of the Year 5 syllabus.

Page 5 supplies basic facts about weather symbols that are used in forecasts and reports. Let pupils study the pictures of the symbols and become familiar with their meanings. You could ‘test’ them after time to learn them, by drawing examples on the board and asking pupils to identify them. Use the Glossary together, to look up the new words and remind pupils that this is what they should do for themselves throughout the year.

Activity 2
In the days before this activity, ask pupils to bring newspapers from home so that they will have enough examples of forecasts and reports to work with.

You should provide pupils with an outline map of the island so that they can draw the symbols on it. You could make a cardboard
template of the island which pupils then draw round on their sheets of paper.

Let each pupil choose the forecast or report that they want to illustrate with symbols on their map. It is essential that a key is added to the map. When displayed, the class should look at all the maps and compare how well the symbols have been used.

Page 6 has text that should be read by the class before going on to the next activity. The pictures show professional instruments that produce accurate measurements.

**Activity 3**

You will have to have examples of the five instruments ready for the introduction to this activity. Make them yourself, borrow them from another class or ask a local weather station to show their instruments to the class.

Use the correct names for the instruments right from the start, as this will encourage and help the pupils to use them and learn them.

You should begin the collection of ‘junk’ items some days before the activity so that you have enough of everything for all the groups to make their own instrument. Each group should choose for themselves the particular instrument they want to make. It has to be planned before the making begins. The materials should be made available for this planning stage, as it helps pupils to make their plans more effective if they can see and handle the materials.

When a group finishes their instrument, let them take it outside for testing. Some may need to be changed because they do not work properly. The wind vanes and anemometers are particularly difficult to get right. The rain gauge will have to be tested with water from a watering can/hose so that it can be seen collecting water, if there is no rain at the time of testing. Pupils should look at Page 7, which shows pupils setting up their instruments in good places, away from buildings and trees.

Once satisfied with their work, groups should carry out demonstrations in front of the class, adding explanations of how their instruments do their jobs and how the measurements are made.

The wind vane points in the direction from which the wind has come, not the way it is going. So, northerly winds are coming from the north, not going to the north.

The anemometer will have to have a mark on one of the cups so that it is easy to count the number of times it spins round. It is essential that the spinning part can turn freely, otherwise it will need very strong winds to register any movement at all.

The rain gauge will either have to have measurements in millilitres marked on the container into which the rain runs from the collecting funnel, or you will need a measuring cylinder. The collected water will then be poured into the cylinder and the measurement read off the scale.

The thermometer will have to be well sealed at the top, where the tube/straw comes through the lid of the bottle. If it leaks, the expansion of the liquid will not push the liquid up the tube, but out through the hole in the lid. The readings will not be actual temperatures, in degrees, but comparisons—‘hotter than’, ‘colder than’, ‘hottest’, ‘coldest’.

The barometer will be hard to set up, as the vertical tube of liquid has to be inverted with its open end into a container of liquid. This container should be checked each day to keep it topped up, so that evaporation does not spoil the readings.

The wind vane will be most accurate, followed by the rain gauge and anemometer. The thermometer and barometer are very inaccurate, as they do not give real measurements, but simply show changes up or down.

Page 7 introduces the idea that collecting data over a period is valuable because it reveals patterns of weather and these are essential for forecasting. The data over a number of years can then be used to predict what is likely to happen next when the weather changes in particular ways. Check that pupils know the meaning of prediction.

**Activity 4**

This is a group activity where all pupils should play a part in using the instruments, recording measurements and discussing the pattern that emerges. The predictions can either be made by the groups or by individual pupils. They must be written down, for comparison later with the actual weather observations. The results of this activity should be put on display so that all pupils can see what other groups were doing and also to compare predictions with actual results. Let them discuss why some predictions were more accurate or easier to make than others.

Page 8 gives more background information about the
collection of weather data and how it is used. Let the class read the text together and deal with any queries, before going on to the sub-topic of the water cycle.

Start with a recap of what pupils can remember from Grade 4. Write what they recall on the board, so that a picture of their present knowledge is built up.

Activity 5

The hope is that the cup outside will cool down more than the one inside and that water will condense on the outside, as dew. You may not get such a result if the temperature and humidity are not right. If there is no difference in the cups the next day, just accept the result and tell pupils to repeat it a few more times to see if they do observe differences.

Page 8 has text about the expected result, so this should be read when all attempts to see a difference have ended. Let pupils give their ideas about where the water could be from, before turning to Page 9. The whole class should read this text and ask you questions about anything that is unclear to them. The most important idea is the relationship between the temperature and the twin processes of evaporation and condensation. Let pupils give you examples of when they have noticed either process and what they remember about the temperature, e.g. puddles dry up faster in the sun than the shade, water condenses on the inside of widows when the kitchen or bathroom gets hot and humid (‘steamy’).

Groups should look at the pictures of the grass and the car, discuss what they see and try to explain why there is water on them.

The text then explains the process of condensation that occurs at night when the temperature falls and the water vapour in the air condenses back into liquid as the air cools down. Dew must be understood as quite different from rain – it does not fall out of the air, it just ‘appears’, by condensation.

Activity 6

This is a very quick exercise in assessing how well the pupils have understood the essential differences between rain and dew. Do not give them more than a couple of minutes to make their lists of similarities and differences.

Dew does not fall, it only forms when the temperature falls and this is during the night. Rain and dew are both made from water vapour that condenses from the air. Dew comes out of the layer of air close to the ground, whereas rain can come from clouds very high in the sky.

Additional Activities

1. Take the class to visit a weather station. Pupils should prepare their questions for the staff before they leave the school. They must record what they are told. If possible, ask the staff to let the pupils draw the instruments and to see examples of weather records.

2. Use shapes, arrows and labels made from card to construct the water cycle diagram. If you have enough sets each group could be given one to make their own diagram. If not, do it as a class activity, or let groups take turns in building the cycle diagram.

**My actions and the weather**

**General concepts**

Human activity can cause changes in the weather, which can have damaging effects on the environment. Global warming, acid rain and damage to the ozone layer are examples considered in this unit.

**Materials needed**

1. Books and other resources about climate
2. Paper
3. A pen or pencil
4. Modelling materials
5. Costumes and props for a performance

**Background**

Changes in the weather and the climate are facts and so are their links to human behaviour. The problem is not the science, the problem is with us – the people. We do not have the personal and the political will to change our way of life. It is in the so-called ‘developed’ world that most of the damage is done to the environment. The population is generally wasteful and careless, out of step with the natural cycles of the Earth, living in an almost totally ‘artificial’ way, detached from the growth of food, collection of water, death and renewal, even ‘cocooned’ in ‘micro-climates’ produced by air-conditioned buildings and
cars. It is not the poor of the world whose life-style is doing most damage. It is the rich and greedy ‘educated’ ones, who devour and spit out the Earth’s resources – out of ignorance, or carelessness?

Informing the young will at least remove the excuse of being ignorant, but it will not solve the problems of environmental damage until there is enough moral pressure to bring about changes in how societies live. This part of the unit attempts to address these issues by giving information, but it will be wasted if it is not used to provoke discussion of what is to be done. The scientific evidence is established. Only the self-serving are refusing to accept the overwhelming body of evidence: people are threatening the survival of life on the Earth.

Using the Pupils’ Book

Page 10 shows a picture in two parts, which is intended to focus the pupils on the issue of climate change and the effects it has on people.

Activity 7

Use the pictures to set the groups thinking about which aspect of human activity they want to research. You will need to provide a wide range of resources – books, magazines, CD-ROMS, charts, posters – to allow all the groups to do their research at the same time. If this is not possible, give each group a turn.

Each group should try to answer the questions in point (3), about prevention, reduction and correction, as well as describing what the damage is and how it is caused.

The presentations should be chosen by the groups themselves and you will need to allow them time to devise and rehearse them before sharing them with the class. As each group will only have made notes etc. about one aspect of human damage to climate, it is essential that they make notes as other groups make their presentations. You could ask the class to tell you what they learned after each presentation and note on the board what they say. This would help pupils to make their own record of what they were told.

Page 12 has a picture of the most common ways in which people add to global warming. Let the pupils look closely at it and tell you what they think helps to worsen global warming. Their ideas will reveal to you how well they have understood the concept. The text should only be read after the conversation about the picture. It should confirm or correct what the pupils have said about the picture.

It is important for pupils to understand that the greenhouse effect is NOT caused by people and that it is absolutely essential for our survival. The greenhouse effect is natural and is a very good thing – it keeps the planet warm enough for life to survive. The bad thing is that people are adding huge amounts of carbon dioxide to the air and this is trapping more and more of the heat – leading to global warming. It is this that worries scientists and governments and people – especially those living on low islands that may disappear completely if the seas go on rising.

Page 13 goes on to give very clear facts about how human activity is having a big effect on the atmosphere. The text makes the link between one factor and another, in a chain of cause and effect. It starts with us human beings and it will end up with us too – suffering floods, or drought, or crop failure, or some other serious disruption of our lives. There is a lot of text to be read. So let pupils read it in small sections and then allow questions and discussion to help them, and to help you check how well they are following the ideas.

Page 14 introduces another issue, using the picture to illustrate it. Cancer, which kills large numbers of people all over the world, is able to develop in the skin as well as other organs. Exposure to the ultra-violet radiation in sunlight has been proved to increase the outbreak of such cancer. The ozone layer protects us from the full intensity of this damaging part of sunlight, but as the layer is damaged, more harm will be done to people’s skin, especially in the tropics, where the sun’s radiation is at its most intense.

Page 15 provides more information about the causes of ozone layer depletion (destruction). The pictures should be looked at first and the items identified by the pupils, then the text should be read. A useful discussion of the choices facing governments and individual people could follow the reading. There is a moral issue here, as well as scientific, technological and political issues.

Page 16 deals with yet another human activity that affects the climate. Let pupils talk about the picture first, giving their explanations of what it shows, then read the text. Make sure that pupils appreciate the two problems arising from the removal of large areas of tropical forest – the reduction of water vapour in the air (with reductions in rainfall) and the erosion of soil that has been exposed to the heavy tropical rains. Burning adds to the gases in the air that have side
effects – the carbon dioxide adds to global warming and the others add to acid rain. Read the text across this page and Page 17, which shows the link between smoke from high chimneys and the death of forests far away. Like so many other issues to do with human damage to the climate, these links are not obvious and so pupils will need time to read, discuss and think so that the concepts are better grasped and understood. There are many moral issues attached to all these human activities and pupils may well differ in what they think should be done to change the way the human race behaves. Science does not supply the answers to these questions – it simply supplies the facts.

Additional Activity

Have a discussion with the class about the differences between weather and climate. Do not let pupils refer to the Glossary until after the discussion has got under way – it is important to have the pupils’ own ideas first. They should be encouraged to recall what they learned in earlier grades.

Term 1  Unit 2
Forces

Objectives

Pupils will:
- demonstrate that a force can give a push, pull or turn
- demonstrate that pushes/pulls/turns can make things start, move, speed up, swerve, stop or float
- identify situations in which a force acts – push/pull/turn – and describe the resulting effects
- analyse the effects of forces on objects and infer that work occurs if the force acting results in movement
- differentiate between situations when work/no work is done, even with forces acting
- construct devices that are powered by simple pushes, pulls or turns
- describe the effect of friction on moving objects
- carry out an investigation with due regard to safety.

Time allocation: 7 weeks

Discussion of concepts and skills

Some of this unit’s concepts are very familiar and pupils will have a well-developed understanding of them, e.g. what a push and a pull are. However, other concepts will be new and rather difficult, as they go against common sense, or use everyday terms in very particular (scientific) ways, e.g. work.
Definitions for the concepts are given and these will have to be learned and used correctly throughout the unit, in precise ways. The Glossary should be used whenever such terms are found in the text and then pupils should be expected to try using them when speaking and writing.

Movement is shown to be the result of forces acting on an object. Any changes in the movement are also shown to be due to forces, so slowing down, speeding up, changing direction etc. are all explained as the result of forces. These ideas are applied to familiar, everyday activities and situations, to help pupils understand them. The notion of balanced and unbalanced forces is one that causes confusion and problems, even for adult students of forces. When there is movement, it is easier to see that forces are at work, yet an object at rest on a table, for instance, also has forces acting on it. There is no movement, because the forces are balanced. The most difficult context is when an object is moving, but there is no change of speed or direction: the forces are said to be balanced here too.

Work is defined and this will be a new way of thinking about it, as it shows that exerting force, alone, is not seen by the scientist as work. Such redefinitions will be hard for pupils to accept, so you can expect some reluctance, or even opposition to these very strict meanings.

Friction is a force with which we are familiar, but most of the time we do not identify it, or even think that it is involved in what we are doing. It is one of the hardest concepts for such young pupils to understand and so this part of the unit will need to be taken at the pace that is suited to their rate of learning.

This is a difficult unit, pushing many pupils to the limit, or beyond, of their intellectual development. Physics is based on abstractions, derived from concrete experiences, but many of its ideas are 'counter intuitive' – they are contrary to what we understand ‘by common sense’.

This means that the practical activities are even more essential for the pupils in their attempts to understand these complex ideas. There are many opportunities for investigations where they can vary one factor (variable) and see what effect it has on another factor. Observing, recording, interpreting and drawing conclusions are all used throughout the unit.

### Changing the Motion of an Object

#### General Concepts

A force is either a push or a pull. The movement of objects is the result of a force, or forces, acting on them. The movement may be started, speeded up, slowed down, changed in direction or stopped altogether. Forces can be balanced, which either prevents movement, or maintains movement without changing it in any way. Gravity is a force that acts on all objects, pulling them towards the Earth. When a force makes something move, work is done. The amount of work done depends on the distance moved in the direction of the force and the size of the force used.

#### Materials Needed

1. Paper  
2. A pencil or pen  
3. A coin  
4. A ruler  
5. An empty soda bottle and top  
6. A bowl or bucket  
7. Water  
8. A collection of objects of various sizes, shapes, materials and masses  
9. A needle  
10. Tissue paper  
11. A ball for netball or basketball
12. A bicycle  
13. A broom  
14. Shoe brushes  
15. Oranges to peel  
16. A fallen tree  
17. A car  
18. A wall

#### Background

Forces are only of two kinds – pushes or pulls. This much is simple, though in practice it is sometimes hard to tell which type is actually at work. A force may act alone, but generally two or more are operating. The background force at work everywhere on Earth is gravity. Some people have the mistaken idea that it is a PUSH downwards, from above. This is totally wrong. Gravity PULLS everything, including the atmosphere, down towards the Earth. Theoretically, gravity pulls towards the Earth’s centre. We all know that if we let go of a stone at the top of a deep hole, like a well for instance, the stone will travel downwards, towards the centre of the Earth. It only stops when it hits the bottom of the hole.

Forces may oppose one another. In some cases this results in no movement, even though the forces may be strong. The forces are said to be ‘balanced’, so the object remains still. Objects on surfaces, such as desks,
the floor or a shelf are all being pulled downwards by gravity, so why don’t they move? Science says that there must be another force acting upwards, against the downward gravitational force, which balances it and stops any movement. This is a very strange idea, especially for young children!

We are familiar with the idea of different surfaces or materials being more or less able to ‘support the weight’ of something we may want to put on them. Another way of thinking about this, is to say that some materials exert more upward force than others and so they can oppose the pull of gravity and the object is supported. If they do not produce enough force, the object falls through the material and only stops falling when it reaches a surface that has enough upward force to stop it moving down towards the centre of the Earth. So, a sheet of newspaper laid across a hole in the ground would not exert enough upward force to support you walking across it. But a plank of wood could support you. Gravity is the same in both cases, your mass is the same both times, so the only difference must be in the force that the paper and plank produce. This is a small example of how ‘strange’ these scientific ideas are. We do not think like this in our everyday lives, even though we know about the relative merits of paper and wood for bridge building!

Work, another everyday term, is given a very strict meaning by science. Work is done when movement results from the application of a force. Consequently, sitting still and thinking hard is not seen as ‘work’ at all, since nothing moves. Even when we exert our maximum force pushing or pulling on something, work is absent until there is movement. The effort is not considered to be work. Here again, the words and their meanings will present pupils with problems, so be patient as their minds adjust to the new ways of thinking about the natural world, as seen by scientists. After all, it has taken humanity thousands of years to arrive at these concepts, so one short lesson is not likely to be enough for your pupils!

Using the Pupils’ Book

Activity 1

This is a book-based activity. Groups should talk about the situations shown on Page 18 before sorting them into four lists, as set out in point (2). A table will help pupils to keep the lists clear. Sharing the lists after the sorting will reveal to you what pupils understand about pushing and pulling, before you begin teaching the ideas in this unit.

(i) No movement: coin on fingers, block floating on water, a basketball in hand.
(ii) Movement: coin on fingers, ball flying out of water, basketball in hand.
(iii) Pulls: none.
(iv) Pushes and pulls: bottle top, block floating on water, parachute, stone sinking, hot-air balloon.

Page 19 has the definition of force and how it is related to movement. This is the central concept of the unit and so it should be constantly referred to by you and you should expect the pupils to use it when talking about the many activities in the unit.

Activity 2

This exploration of how forces relate to movement is very important. It will help pupils to experience for themselves (through their fingers) how the size of the force is linked to the size of the movement – the speed and distance travelled by the coin.

Process skills are to be used and developed in the activity. The size of the force used will not be measured – it will be a subjective estimate by the child flicking the coin. To make the investigation as fair as possible, the method must be the same each time the coin is flicked. A table of results must be produced by each group, with at least three ‘flicks’ using each level of force. Average distances should then be calculated. Ask pupils why it is necessary to do each ‘flick’ more than once. It will be easier to measure the distance travelled by the coin if a ruler or other scale is set up close to the hand of the pupil flicking the coin. The same pupil should do all the flicking at least for one complete set of results. If there is time, others in the group could repeat the process, then compare the results.

The sharing of results should reveal a pattern: the greater the force applied by the fingers, the further the coin travelled.

Activity 3

This is a simple, familiar process, which should not take long for everyone to do. The difficulty is to think about the forces being used. Let pupils give their answers before moving on to the next activity. DO NOT give the explanation of the unscrewing at this point.
Activity 4

This is another attempt to extend pupils’ awareness of what is very familiar to them – floating and sinking. The added dimension is to think in terms of forces – the pulls and pushes involved. Before the groups begin they should draw the table for the recording of their results.

The needle and paper should float, until the paper becomes waterlogged, when it will probably sink and leave the needle on the surface. This is possible because the surface layer of the water pushes up against the needle, balancing the downward pull of gravity.

Pupils should be free to choose a variety of objects, so each group may end up testing completely different things. This is good.

The results will show that some float on the surface, some sink to the bottom of the container and others go below the surface but do not sink to the bottom.

In each case, there is a balancing of the downward pull of gravity and the upward push of upthrust from the water. Depending on the mass and volume of the object (the density), it will either sink totally, float on the surface or float below the surface. Do not introduce the concept of density to the pupils. Just help them to see that sinking is NOT caused by things being heavy (big ships are heavy, but they float), nor is it caused by things being big (small things like coins or marbles sink, whereas a tree trunk floats.)

When groups talk about their results you must insist that they use these words correctly – push, pull and force. The objects tested would make a good display, especially if they were set out in their sets – the ‘sinkers’, the ‘floaters’ and the ‘underwater floaters’.

Pages 21 and 22 provide explanations for the three activities just completed. The text and pictures should be used to clarify and consolidate what the activities have been revealing about forces. Work through the pages slowly, giving pupils the time to ask about things that are difficult for them to understand.

The bottle top movement uses a combination of forces and this may not be immediately clear to some pupils. Use the diagram to show exactly what the thumb and finger are doing. It is important for pupils to begin recognising and using arrows to show direction and strength of forces. The arrows are different for each meaning and you should check that pupils are ‘reading’ them correctly.

The concept of balanced forces is introduced in the context of the floating and sinking activity. This is an essential concept, but it is hard for such young pupils to grasp. The case of floating objects is the easiest example for them to understand, so that is why the unit introduces it first, before going on to more difficult examples.

The first aspect that will be most problematic is the concept of water ‘pushing’ up against any object put into it. Encourage pupils to talk about what they have noticed when having a bath, or in the swimming pool, or the sea. They will have felt the water pushing against them and they know that it ‘keeps them up’. This is what science calls the force ‘upthrust’. Without it, ships, as well as children, would not be able to float.

The second concept that is hard to accept is that the wall of the container is ‘pushing’ against the object when it sinks to the bottom. This is ‘counter intuitive’ – it goes against ‘common-sense’ to think of the static wall of a bucket ‘pushing’ against the stone. There is no movement and anyway, how can a wall produce a force – it is not alive, it is not driven by a machine, it is not moving! These are all quite reasonable objections that the children (and many adults) will have to the idea of a bucket exerting an upward push.

Science says that without such a force, the stone or other object that sank, would just go on moving downwards, towards the centre of the Earth, pulled by gravity. The only reason it STOPS MOVING is because another, opposite and equal force has cancelled out the pull of gravity, producing a balanced force situation.

You must allow a lot of discussion and questioning about these ideas before moving on to the next activity. If you do not give pupils time to sort out these difficult ideas, there will be more and more confusion as the unit goes on. These ideas are central to the rest of the unit.

Activity 5

This is another activity that is intended to help pupils think about familiar things in a more scientific way. Let them carry out only one or two moves before you stop them to ask for
explanations of the forces involved. When this has been done, correct any wrong ideas, and then let the game go on for a longer period. As they play, circulate from pupil to pupil and ask them to say what forces are acting at that particular moment.

Back in class, the groups must choose how to express their ideas on a chart. Drawings, arrows and labels will be most effective, but allow groups to use their own ways.

Give the class time to look at one another’s charts, then have a discussion about what they show.

When everyone is still and the ball is being held, all the forces are balanced. Movement of ball and pupils is caused by forces in the muscles that push against the ground or the ball. Slowing down and stopping also use forces, partly from the muscles and partly from the shoes in contact with the ground. The ball stops rolling or flying when its movement is met by another force, from a hand maybe or from the ground. These are the ideas that you hope to find in the pupils’ charts and discussion.

Page 24 has an activity based on the two scenes at the top. This can be done by individual pupils, who then feedback their answers to the class. You should write lists on the board as pupils read out their answers.

Picture 1
Movement: cutting food (work), lifting from shelf (work), washing machine (work), electric fan (work), wood being chopped (work), tap being turned (work), child taking shirt off (work).
No movement: person sitting, flowers in vase, ball on floor.

Picture 2
Movement: vehicles moving (work), digging the garden (work), dog running (work), aircraft flying (work), climbing ladder (work), flying birds (work).
No movement: people standing, boxes piled by roadside, fruit on tree, birds sitting.

This is the first time the scientific term ‘work’ has been used so do not expect pupils to be able to identify it correctly. Check the meaning in the Glossary.

Activity 6
This is simply an extension of the activity above, but it uses real situations in the room, rather than in a pictures. Pupils should be better able to identify work now that there has been some discussion about it. The explanation at the bottom of the Page 24 could be read before the activity starts, to act as reminder of what work involves, i.e. NOT just the application of a force, but movement caused by the force.

Activity 7
If possible, have enough items to allow all the groups to be active at the same time. If this is impossible, rotate the groups until everyone has finished, then have the sharing session.

Predictions are an important part of this activity and they are common in scientific investigations, so get pupils to record them before beginning the practical work.

A table for answers is the best way of organising the results.

Work: riding the bicycle, or even just turning the pedals; peeling the skin off the fruit; sweeping the floor with the broom, especially if dust etc. is pushed by the broom; moving the brushes across the shoes.

Pushes: feet/hands on pedals; tyres on ground; hands on broom; broom on floor; finger into skin of fruit; hand on shoe brush; brush on shoe.

Pulls: hands on brakes; hands on broom; fingers taking peel off fruit; hands on shoe brush.

Activity 8
If the objects are available, then use them. Otherwise this must be done using the pictures and imagination. Pupils will be unable to move any of the three objects as the force they can apply (even in large numbers) will not be enough to cause them to move. So, according to the definition, work will not be done. This goes against the way we normally think and speak. We would say that if the pupils are all pushing as hard as they can, then they are ‘working hard’. But science sees no work, because the force is not producing movement.
Page 26 has text that sums up what has been taught about work. Use it to check the pupils’ understanding.

**Additional Activity**

Ask pupils to bring in the materials from home to make a button yo-yo. They will need a large button and some thin string or strong cotton thread. When it has been made, let them play with it and ask them to think about the forces operating and to draw diagrams with arrows to show what they think. Let the class share their results.

**FACTORS THAT AFFECT MOTION**

*pages 26 to 30*

**General concepts**

Friction is a force that arises where two surfaces are touching. This may be two solid surfaces, or solids and liquids or solids and gases. The greater the force of friction, the harder it is to start movement, but the easier it is to stop. The weaker the friction, the easier it is to start moving, but the harder it is to stop. Different surfaces produce different amounts of friction.

**Materials needed**

1. Materials for making toys
2. Tools to cut and connect materials
3. Paper
4. A pen or pencil
5. Two rough sticks
6. Two stones
7. Marbles or balls of different sizes
8. A slope
9. Various materials to cover the slope
10. A watch or stop clock

**Background**

We know that when we try to move something by pulling or pushing it on some kind of surface, the amount of force we need to use is not always the same. Some surfaces let the object slide easily over them – smooth, polished, hard, oily or icy surfaces, for example. Other surfaces seem to resist the movement we are trying to produce. They seem to ‘grip’ the object and completely or partially stop it – rough, dry or soft surfaces, for example. The characteristics of the surface have a large effect on the amount of force needed to start the object moving.

Scientists call this resistance to movement ‘friction’ and identify it as another force altogether, just as gravity and upthrust are both separate forces. The size of the frictional force depends on the physical characteristics of the surfaces that are in contact and also on the mass of the object in contact with the surface.

Dragging a boat over the beach and into the sea is probably impossible for a Grade 5 child to do alone, but that same child could easily pull the same boat through the water to tie it up at the jetty. The difference is not in the child or the boat – it is in the size of the frictional force between the boat and the surface it is on. Water produces much less friction than sand or stones on the beach, so it is much easier to start the boat moving and to keep it moving. However, it is also much harder to make the boat stop! Children have to learn when to stop exerting the force and allow the boat to slow down as it approaches the jetty or the shore.

We make use of friction in tyres and brakes, where we need to be able to slow down and stop quickly. Tyres also make use of friction to get the vehicle moving. Without the grip of the tyre on the road, the wheels would just spin and the vehicle would stay exactly where it is! So, friction can help to get us moving as well as slowing or stopping us. Pupils will know about shoes and friction, from playing all sorts of games where the ability to start, stop, slow down and speed up as well as change direction, are vital to winning. Sports shoemakers use all we know about high and low friction materials, to produce the most effective products for the many different sports that depend on reliable grip.

**Using the Pupils’ Book**

Page 26 starts the unit with pictures of models that pupils could make. It is simply to act as stimulus for their own model making, not to be copied.
demonstration at the end are essential, for groups to share their work and to check that there is a force at play somewhere in each one.

**Activity 10**

This starts with the picture on Page 27. All three are familiar actions, which you should allow pupils to do outside, if possible. As they do them they should observe and think and especially, feel through their hands, the differences in the forces.

They should conclude that the smoother the surfaces, the easier it was to move the objects over one another. This is the introduction to the notion of friction.

Page 28 has text that should be read after the class have shared their results and conclusions. Refer to the diagram of the ball as the text is read. Focus on the meanings of the arrows, so that they are clear to the pupils. Friction acts where the ball is touching the surface and it opposes the forward movement of the ball.

The text links this with the three actions that pupils did, reminding them that some were easier than others and applying the term ‘friction’ to them. This is the key idea of this section of the unit, so spend enough time on it to allow pupils to ask for help in understanding what it means.

**Activity 11**

This investigation puts the ideas into practice and compares one surface with another to see if they have different effects on the balls as they roll down the slope. It is important that groups draw a table for results before they begin. The whole activity needs to be carried out systematically, with good control of all the factors involved, e.g. the place from which the balls start rolling, the angle of the slope and the way in which the distances and time are measured. If pupils are ‘sloppy’ about these things, the results will be meaningless and will tell them nothing. So, as the groups carry out the investigation, you should move around and check that pupils are controlling the way they carry it out.

Ask them why they are rolling each ball three times on a surface and then calculating the average times.

The results should show a pattern – some surfaces slow the balls down and others speed them up. The differences are caused by the roughness/smoothness of the surfaces and the amount of friction each one produces.

Pages 29 and 30 have a series of questions about familiar situations, mixed in with information about the control of friction to slow down and speed up certain movements.

You could use the questions as a class, allowing pupils to give their answers to the class and using them to lead to discussion. As this happens, you can assess how well they have understood the concept.

Pupils can use their understanding of forces, especially friction, in a story involving road safety. Once written, let the class share their stories, either by reading them out or passing them around for pupils to read for themselves. You could decide which one has the best use of the scientific ideas of the unit.
Term 2   Unit 1
Energy forms

Objectives

Pupils will:

- relate some sources of energy to their corresponding energy forms (heat, light, sound, electrical, chemical, magnetic, mechanical, energy of movement)
- explain how some common electrical/electronic devices work and say how they improve the quality of life
- identify the energy transformations that occur in selected devices/chosen situations. (Note that only one-step transformations should be done, e.g. electricity to heat/light/sound for television.)
- construct sound-producing devices that involve vibrating strings/striking objects/blowing air, to illustrate energy changes
- sequence the energy transformations in given situations and infer that the sun is the ultimate energy source
- categorise various sources of heat energy
- examine the effect of heat on various materials
- explain how heat is transmitted from source to other areas – through conduction, convection and radiation
- describe how heat is circulated in the school building and in their homes
- demonstrate an understanding that the temperature of a body is affected by its properties
- identify safety practices (rules) for handling hot/cold materials
- design and construct a device to keep something hot/cold
- display an awareness of safety for self and others.

Time allocation: 6 weeks

Discussion of concepts and skills

This unit is even more intellectually challenging than the last and so it will be necessary to keep this in mind as the class works through its content. Pupils’ own ideas will often clash with the scientific ones and you should not ignore what they think, as your task will be to get them to open their minds to new explanations of what they think they already understand about energy. The terminology of this topic is a terrible problem, as we all use the term ‘energy’ very loosely and in a number of different ways, none of which match that used in science.

Energy is defined and its various manifestations are identified. The older notion of many ‘forms of energy’, is replaced with the present orthodoxy, that all these ‘forms’ can be thought of as variants of either ‘potential’ or ‘kinetic’ energy. Potential energy is latent, stored, and ready to produce some kind of event or process. Food, fuels, wound up springs and
stretched elastic are common examples. Kinetic energy, by contrast, involves movement of some kind. Falling objects, electrons racing through a wire, sound waves travelling through the air, pushing the molecules of gas against one another until they eventually push on the eardrums, setting them moving — these are common examples of kinetic energy.

Energy is one ‘thing’, but it is encountered in a variety of effects. This unit deals with this notion at a relatively simple level, but even this is difficult for such young pupils.

The sun is identified as the main source of the energy found on Earth. Its past input has been trapped in the leaves of plants and some of these now provide us with fuels extracted from the ground, or cut from trees. Our food is just another form of solar energy, transferred through the plants and animals that we eat.

Energy is called potential if it is not producing any effects. It is stored, with the potential to produce effects such as heating, movement and sound. Food is a form of potential energy. We eat and digest it, sending the chemicals released in the process through the blood supply to all the body’s cells. They use the fuel – the fat and carbohydrate molecules — to provide them with the energy they need to maintain the processes of life. Similarly, wood and oil are also stores of potential energy that can be released and transferred to produce heating, movement, light and sound. Other less obvious examples of potential energy are springs and elastic, both of which can be ‘given’ energy through winding and stretching. The energy we use in the actions of winding and pulling is transferred to the spring and the elastic and until it is released in some way, it remains stored as potential energy in the items.

Once energy is ‘on the move’ it ceases to be potential and is described as ‘kinetic’. This may be electricity flowing through a wire, or sound waves travelling through the air, or light and other forms of electro-magnetic radiation travelling through space, or

### Forms of energy

**General concepts**

Scientists recognize two forms of energy. They are potential and kinetic. It is possible to obtain energy from various sources in the natural world.

**Materials needed**

1. Paper
2. A pen or pencil
3. An exercise book
4. A ruler
5. Books and other sources of information about energy sources

**Background**

Sources of energy exist naturally in the environment – the sun, the waves moving, the running of rivers, the wind blowing and fuels such as wood and coal. The challenge for humanity over the centuries has been how to harness the energy and use it to do work for us. Water wheels, windmills, steam engines and sailing ships are examples of machines that have been using such natural energy for a long time. In more recent times, scientists and technologists have devised ways of releasing energy from other sources and transferring it from place to place in convenient forms.

Two great ‘leaps forward’ were the discovery of electricity and the ways in which it could be generated and the invention of the internal combustion engine. Hundreds of devices have been produced which use electricity and engines to perform numerous functions. ‘Manufactured energy’ is now far more important than natural energy, but the warning is that its sources will ultimately finish – the oil and gas will all be used – then we will have to go back to using the natural sources, such as wind, waves and the sun. So, in recent years there has been a lot of research and development of such renewable energy sources. Wind turbines, hydroelectric power stations, solar generators and other devices are now more common and efficient, adding increasingly to the total energy production of the world.

Energy is called potential if it is not producing any effects. It is stored, with the potential to produce effects such as heating, movement and sound. Food is a form of potential energy. We eat and digest it, sending the chemicals released in the process through the blood supply to all the body’s cells. They use the fuel — the fat and carbohydrate molecules — to provide them with the energy they need to maintain the processes of life. Similarly, wood and oil are also stores of potential energy that can be released and transferred to produce heating, movement, light and sound. Other less obvious examples of potential energy are springs and elastic, both of which can be ‘given’ energy through winding and stretching. The energy we use in the actions of winding and pulling are transferred to the spring and the elastic and until it is released in some way, it remains stored as potential energy in the items.

Once energy is ‘on the move’ it ceases to be potential and is described as ‘kinetic’. This may be electricity flowing through a wire, or sound waves travelling through the air, or light and other forms of electro-magnetic radiation travelling through space, or...
energy flowing from a hotter to a colder material. When energy is on the move it is kinetic and it can be used to perform many different tasks.

**Using the Pupils' Book**

**Activity 1**

*Activity 1* begins with the pictures on *Page 31*, so give pupils time to look at them before each one draws their own table for recording their answers. This is not a group activity. It will allow you to find out what each pupil knows/thinks, before you start the teaching. The words are there for them to copy, so that they do not have to depend on you for them.

Once they have finished filling the table, let them compare their answers in groups. Where there are differences, let pupils explain to one another why they have particular answers.

The group should then produce two lists – sources of *natural* energy and sources of *manufactured* energy. The sun, wind, waves and rivers are examples of natural energy sources. Electricity generators, petrol, springs and nuclear power stations are sources of manufactured energy.

*Page 32* has text that introduces the first of the two forms of energy that pupils will need to know about and recognize – *potential energy*. Make use of the Glossary and let pupils give other examples of this form of energy if they can. It is essential that pupils understand that all the examples given in the text are actually potential energy, just different in their outward appearances and uses. Read the text as a class and deal with queries and problems, before moving on to the next page.

**Activity 2**

This is a research activity, so the more sources of information you can gather the better, as all pupils will be able to do the activity at the same time. If there is a shortage of books etc. the groups will have to take turns using them. When all have had their turn, then have a whole class session when groups can share what they have found.

There are two questions each group must discuss and try to answer with evidence.

1. What is the most plentiful source of energy on Earth?
2. Is the sun the main source of energy for the Earth?

It will not be enough just to have opinions about these questions, they must produce information that they have found in the resources to support their point of view.

This is good practice at using facts to argue and defend a position, which is a central scientific process.

The sources of fuel that we use at present are all finite (they will run out one day). So, the most plentiful source cannot be coal, oil, gas, wood, uranium or any other fuel that we use at present to generate electricity, or drive our machines.

Solar power (heat and light from the sun) is much more plentiful and it leads to secondary energy sources – the wind, the waves on the sea and the flowing of rivers. All these have been and are being harnessed, to drive machines directly, or to generate electricity.

Yes, the sun is the main source of energy on Earth. It transfers enormous amounts of energy to Earth every day, as it has always done since the solar system came into being.

Millions of years have passed and in that time plants, and then the animals, have used some of that energy to keep themselves alive. When they died, their bodies became buried and now we are extracting their remains – as coal, oil and gas – from the ground and releasing the energy once more. So, today’s incoming energy from the sun, is added to by these ancient stores of solar energy (‘fossil fuels’), to provide Earth with its main energy source.

*Page 33* ends with a picture of familiar devices that use electricity, for individual pupils to use as a starting point in the drawing and naming activity that closes this introductory section. Encourage pupils to make the pictures large and colourful, with clear labels and explanations of how useful the devices are.

Display the drawings and give pupils time to look at them. They could be used to create sets, each set using energy to produce a different effect – light, sound, movement etc.
General concepts
The ultimate source of all energy on Earth is the sun. Energy can be transferred to produce a number of different effects, such as movements, light and sounds.

Materials needed
1. Materials to make a sound-maker, e.g. string, elastic bands, boxes, stones, seeds, plastic bottle, plastic bag
2. Scissors

Background
We are familiar with food, from our earliest days, but the science of food is not something that we think much about. From the point of view of food as a source of energy, it is actually a way of transferring light energy from the sun to the cells of our bodies. People, like all other animals on Earth, cannot absorb energy directly from the sun to keep us alive. Only the plants can do that, through the process of photosynthesis in their leaves. This ’catches’ the light energy and ’locks it up’ in the glucose and other food materials that they produce.

The same is true of fuels that we extract from the ground. Coal, oil and gas are all the product of plant and animal remains that have been changed over a very long period. They are often called ’fossil fuels’. Wood and other plant materials can also be used to transfer energy for heating our buildings and for cooking.

Every day, this process of energy transfer from the sun to the Earth goes on. The Earth is lit and heated and flooded with invisible rays, such as ultra-violet and infrared. Such ’moving’ energy is called ’kinetic’ by scientists. Sound, movement, light, electricity, invisible radiation transferring energy from one place to another – all these are examples of kinetic energy.

The only other energy around is ’potential’. This is not ’on the move’, but in reserve, stored, with the potential of becoming kinetic when the conditions allow it. Foods containing fats or carbohydrates are examples of potential energy. Other components of food are not energy sources for the body. The energy is ’locked up’ in the plant and animal matter that we eat. Our digestive systems can break this material down, send the products to the cells of the body via the blood and there, the potential energy is released by the process of respiration. The body can then use it as kinetic energy – to keep warm, to move or to produce sound.

In this way, the kinetic energy of the sun is transferred, through the plants and then the animals, to our bodies in the form of potential energy contained in our food. When digested and acted on by chemicals in our cells, that kinetic energy appears once more for us to use in several ways. This process is the same for all living things on Earth – the sun keeps us all alive.

Using the Pupils’ Book
Page 34 begins with reference to the old and the new ways in which science refers to energy. In the past the term ’transformed’ was used, but now scientists prefer ’transferred’. This is because energy is energy – there are not several, it is all one. So, there cannot be transformation. The change is not in the energy, but in the effects it produces when it is transferred. So, it is important to spend time using this page to clarify the way pupils should talk and think about energy.

The picture activity is for individuals to do. They should then be given the chance to share their answers with the group and/or class. This should lead to discussion and the attempts to explain their points of view.

a) candle → wax fuel → light, heating
b) spring pulled back by hand → movement of hand stores potential energy in spring
c) bell being shaken by hand → movement of bell → sound
d) drummer using sticks to beat drum → movement of hands, sticks, skin → sound
e) TV plugged in to power supply → electricity → light, sound, heating

Each pupil should illustrate at least two of the transfers, with diagrams or drawings, or models or mimes. Share the pupils’ work and allow them to comment on one another’s presentations.

Activity 3
If you have enough materials, allow each child to make a sound maker of their own. You should ask them to bring in junk materials from home in the days before you plan to do this activity.

There will be a variety of items made, using percussion (hitting, shaking), strings of different kinds, and wind. The class have to observe their demonstrations and identify how the energy is being transferred. Each pupil should be able to explain this for their own sound maker, so they will need to think about it before sharing it with the class.
Page 35 has text explaining how sounds are produced and transmitted through the air to our ears. The key idea is that movement of one kind, made by the person playing the ‘instrument’ (hitting, shaking, blowing or plucking) produces another movement – the sound waves that travel out and away from the instrument to our ears. Sound is just one particular type of movement and, as such, it is KINETIC energy, as kinetic means ‘movement’. Spend time on the statements at the bottom of the page, as it is not obvious that electricity and sound, for example, are really both forms of movement – energy being transferred from one place to another. Read the text as a class and give pupils time to ask for help with anything that is not clear.

Page 36 applies the ideas about energy transfer to several examples from everyday life that will be familiar to pupils. The groups must have plenty of time to look carefully at them and work out their meaning, as this is a new concept and the diagrams are also unfamiliar. The purpose of the diagrams is to draw attention to the fact that the sun is the original source of the energy that is transferred through the chains. If pupils understand this concept, then they should be able to produce some examples of their own.

**Activity 4**

Groups or individuals should use the same type of diagrams, drawing, models or actions to illustrate other examples of the sun’s energy being transferred. Give them time to prepare at least one and then let them share them with the class.

Once all groups have finished, ask the class to vote about the statement that the sun is the ultimate energy source on Earth. The hope is that they will agree with it, having spent time thinking about the many examples in the text and from the groups in class.

Page 37 gives some more facts about the sun’s energy transfer. It introduces the term ‘radiation’, so use the Glossary to check on its meaning and give pupils the chance to use this word in their answers and questions. Stress that we only see the visible part (the light) but there is much more radiation, some of it being very dangerous and damaging to our health.

The other very important idea is that of stored energy. Ask pupils to recall what they know of plants ‘catching’ light energy to make food in their leaves and how all other living things, including humans, depend on the plants for their food, either directly or indirectly. This will help pupils to grasp the idea of how absolutely we all depend on the sun’s energy to stay alive.

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**TRANSFERRING ENERGY BY HEATING**

**General concepts**

Heating is a very important method of transferring energy. Energy always moves from the hotter to the colder materials, cooling the one and heating the other. Such energy can be transferred by conduction, convection or radiation. Some materials are better conductors of energy than others. Those that are poor conductors are called thermal insulators. We can use thermal conductors and insulators in many ways.

**Materials needed**

1. Paper
2. A pen or pencil
3. A candle in a sand tray
4. Butter
5. Ice
6. A coin
7. Gelatine
8. Hot water
9. A bowl
10. A metal spoon
11. A ruler
12. A refrigerator
13. Matches
14. Tongs
15. A dish or saucer
16. Cubes of plastic, metal and black painted wood
17. A thermometer
18. A string or rope
19. Three clothes pins
20. Pairs of similar objects that are of different colours and materials (e.g. a white cloth and a black cloth, a metal spoon and a wooden spoon)
21. A large sheet of paper
22. Colouring materials
23. Modelling materials
24. Costumes and props for a performance
25. Books and other sources of information about keeping things hot or cold
26. Materials that can insulate the hands when lifting hot objects
27. Scissors
28. Hot objects
29. Cups made of various materials
30. A watch or clock
31. Graph paper
32. Insulating materials

Background
Heating and cooling are the result of energy being transferred into or out of an object or place. In the past this energy was referred to as heat, but physicists prefer to think of it as ‘energy on the move’. This is actually a useful and helpful way of ‘visualising’ what is happening. The basic principle about energy transfer that leads to temperature rise or fall is that energy always moves from the hotter (higher energy) to the cooler (lower energy).

Some materials allow energy to flow through them easily, passing it on from atom to atom. These are called ‘thermal conductors’. Other materials resist the flow of energy through them. These are called ‘thermal insulators’, as they form a barrier to the movement of the energy. Both types of material are very useful, either helping us to transfer energy (e.g. metal pots put on the stove or fire), or helping us to stop the transfer of energy (e.g. wooden handles on kitchen tools).

Conduction, through the particles of the solid material, convection through the liquid or gas and radiation through space or the atmosphere, are the three means of energy transfer that cause heating. Sometimes there is more than one process going on at the same time, e.g. heating a pot of water on the stove.

Using the Pupils’ Book

Activity 5

The pictures are supposed to set pupils thinking about the many sources of heating that are familiar to them. Pupils could do this individually. The two ways of ordering their answers are very different: (a) asks pupils to compare the amounts of energy being transferred (e.g. a fire compared to a candle) and (b) asks them to compare how common the sources are (e.g. an electric kettle and a nuclear reactor).

Display the tables produced so that two longer total lists can be compiled. You could record them on a chart or on the board.

Page 38 states the basic fact about heating, that the energy always gets transferred in one direction – from the more energetic (the hotter) to the less energetic (the colder). Make sure that pupils understand this. It seems simple, but actually the way we talk and think about heating and cooling in everyday life does not match with this scientific view of the process. For example, we talk about ice ‘cooling’ a drink, as if the ice is ADDING ‘coldness’ to the drink, whereas it is actually TAKING energy out of the drink. This is why the drink cools down, because some of the energy has been transferred to the ice, which makes it melt.

Activity 6

You will need to prepare for this activity at least a day in advance so that the materials are cold enough for when they are needed.

Warn pupils about the danger of the hot water, before giving them access to it. Set up the gelatine activity in a place where pupils will not be cramped or likely to be bumped into, so that the chance of accidents is reduced.

The same control needs to be used for the activity with the candle and coin. The sand tray is important to minimise the risk of the candle causing a fire.

One way to share the resources is to have the different parts of this large investigation going on at the same time on different desks, with the groups of pupils moving around, from activity to activity. This will make it easier for you to provide materials for the whole class. Predictions MUST be written down before the testing starts and then compared later with the actual results.

The gelatine will melt and disappear in the hot water and then as it cools, it will ‘set’ into a solid. This is the basis of fruit flavoured ‘jelly’ and jelly sweets.

The coin will not appear to change at all, either when it is heated or cooled. It will certainly not melt at the low temperature of a candle flame. Soot may appear on the coin, but this is from the flame, not a change in the coin.

The butter will melt, as energy is transferred into it from the warm air of the room.

The same will happen to the ice.

The wax on the spoon will be melted as energy from the candle flame is transferred into it through the metal spoon. Once the energy transfer stops, the wax will solidify again.
At the end, the groups must compare predictions with results and tell the class how often they were correct.

You should keep a record on the board as each group reports and then use the full set of results to come to a conclusion about materials and heating. (Some melt at low temperatures – ‘room temperature’ – whilst others need the heating from a candle flame to make them melt. These materials quickly go back to the solid state when the heating stops. They are solid at room temperature. A third group of materials are not melted at low temperatures. They require much more energy to be transferred into them to make them melt.)

Page 40 shows pictures of an activity that you will have to do as a demonstration. Take a metal rod/piece of stiff wire and stick drawing pins/thumbtacks to it with wax. If possible, set the rod up so that it can be heated from one end by a candle, or some other source of heating. Once the heating starts, the rod should not be moved, as it is important for pupils to see that the energy must be travelling along the metal from the heated end.

The tacks should fall off one by one, starting with the one nearest the heater. This is a demonstration of conduction through metal.

Let pupils watch, write down their ideas and then tell one another what they think was happening. It is not likely that they will use the term conduction, but they may be able to talk about energy moving along, or through the metal and this is perfectly correct.

Read the text as a class, once the discussion of the results is finished. The first part is a recap of the activity carried out previously, with conclusions about the ways in which materials behave when they are heated or cooled.

The final paragraph gives more details about melting points. Let pupils share experiences of materials that they have had. This will add to the examples in the text and help them to understand and remember the concepts.

The diagram at the bottom of the page gives an explanation of the thumbtack activity. Use it to begin a comparison of pupils’ ideas with the scientific explanation.

Page 41 gives an explanation of the conduction process. It is important for pupils to use the Glossary to check on the meaning of conduction.

The second demonstration for you to set up requires a heatproof beaker or other transparent container. You could use an ovenproof glass dish or bowl from home, or borrow a beaker from a secondary school. DO NOT heat an ordinary glass jar, as it could break violently when heated. The sawdust can be substituted by any small pieces of material that can be seen and that will not dissolve in the water. The sawdust is only there to allow pupils to see that there is movement. It plays no part in the process of energy transfer.

Before you begin the heating, pupils must write their predictions down, for comparison with their observations.

As the water is heated by the candle, the sawdust will rise through the water, carried by the heated water, which is rising. When the heating stops, the circulation of hotter and colder water also stops and the sawdust falls to rest at the bottom.

Let the class share their observations and explanations, before reading the text at the bottom of the page and looking at the diagram. Again, the Glossary should be used for defining the new term, convection. Density is a difficult concept and it is not one that must be taught in primary science, but pupils will be very familiar with its effects. Hot air rises, as seen above a fire carrying ash and small pieces of solid material up and away from the fire. Once they get far enough from the fire, they fall again due to the cooling of the air.

Valleys and dips in the landscape fill with mist at night and they are noticeably cooler than the higher land around them. This is caused by the colder, denser air, falling to the lowest place available – the valley or dip, in this case. These are two examples of situations where density is ‘at work’. Objects floating or sinking is another very obvious one, which was part of the unit on forces.

Page 42 completes the explanation of convection currents in the demonstration.

Activity 7

You will probably have only a limited number of thermometers, so all the groups will not be able to do this activity at the same time. Either give one thermometer and one cube to each group, or let the groups take turns to carry out the full investigation. The tables can be drawn whilst the cubes are out in the sun being
heated. Ask pupils why they measure the temperatures before and after the time in the sun. (It will allow them to compare the increases in temperature.) Ask them why the thermometer should be left for a minute before being read. (It takes time for the thermometer to react to the different temperature inside the cubes.)

The nearer in time that the temperatures of all the cubes are measured, the better, as this will improve the accuracy of the comparisons. Once the measurements have been taken and written down, pupils should calculate the RISE in temperature for each cube and compare these rises to see if the cubes have all reacted in the same way to being in the sunshine. The groups should compare their predictions with their observations. It is very likely that their predictions were not correct for all the cubes. This is good, because it can encourage them to think about why they were wrong.

The results should show that energy from the sun is absorbed (transferred into) the blocks and so the temperatures of all blocks went up. But, they did not all rise to the same extent. The metal block should heat up most, followed by the black-painted wood and then the plastic. This investigation shows the different properties of the three materials – wood, metal and plastic.

Page 43 gives the scientific explanation of these differences and introduces the process of radiation, as the third form of energy transfer. Once the class has shared and discussed their results, they should read the text and have the chance to ask you questions to help them understand it.

Page 44 uses pictures to test the pupils’ understanding of the three ways in which heating/cooling takes place – conduction, convection and radiation. Individuals should do this, so that you can assess how well they have understood these concepts. The answers and explanations are:

i) conduction ii) convection iii) conduction, radiation iv) conduction, radiation v) conduction, radiation vi) convection, radiation, conduction

i) the spoon gets hotter and the water is cooled slightly

ii) the fire heats the air inside the heater, it rises and leaves the heater at the top. Colder air is drawn into the heater at the bottom, is heated and rises etc.

iii) the hot water from the engine enters the radiator and the energy is transferred through the metal of the radiator (conduction) to the air around it (radiation).

iv) the metal cooker ring heats up, the energy travels through the ring by conduction and this energy is passed to the air by radiation

v) the energy is conducted through the metal element in the kettle, into the water in the kettle

vi) the liquid in the cup is hot, so there is a convection current, caused by the hotter and less dense liquid rising to the top and the cooler, more dense liquid, falling to the bottom. The energy is conducted through the cup and radiated into the surrounding air. There is also radiation from the surface of the liquid.

Activity 8

The actual pairs do not matter, so long as they are made up of similar objects that are different in colour and material.

The columns in the table should be drawn before the measurements are made.

If you do not have enough thermometers for all the groups, let each group use them in turn.

The activity builds on the results and discussion of Activity 7 (cubes in the sun). Pupils should be asked to recall what they learned from it and use that knowledge to help them make predictions of what will happen. These must be written down, for comparison later.

The choice of items is for the groups to make, from the things you provide, so the exact results cannot be given here, but basically, metal objects (as good thermal conductors) will be heated more than other materials. Wood, wool and plastic objects (as good thermal insulators) will be heated less than other materials. Dark objects absorb energy more quickly than light-coloured ones.

Activity 9

This uses the pictures on page 45. Let the groups have time to look at them and discuss what they show. The task is to come up with solutions to the problems of handling hot and cold things safely, then to demonstrate them to the class somehow. Let each group choose their own method.

i) The metal handles will become hot, as they are good thermal conductors. Some form of insulating material (e.g. cloth) will
have to be used to pick it up safely.

ii) The metal tool on the barbecue will also become hot for the same reason and the solution is the same.

iii) The dish in the oven will become hot and needs handling with oven gloves or a cloth that is made of insulating material.

iv) The frozen food packets will damage the hands of the workers if they are handled one after another for some time. The temperature of the hands will fall as energy is transferred into the packets and this can cause frostbite. Thick, insulated gloves have to be worn to prevent this damage.

v) The hot bread will burn the hands, so insulating material – a cloth or oven gloves – will have to be used to lift it safely.

Page 46 shows pictures of some objects that make use of insulating materials. Let pupils look at them and talk about them before they begin the research from books etc. in the next activity.

Activity 10

Try to provide enough resources for all the groups to do this at the same time. You could ask pupils to bring books etc. from home to add to your resources. Let the groups choose their own object for research. It must be something that uses insulation, either to keep things hot or to keep them cold. The outcome of the activity must be a clear diagram/drawing plus some text explaining how it does its job. Do not accept any answers that talk about ‘the cold’ as though it were a kind of ‘thing’, almost a negative energy. Emphasize that energy moves, heating things it moves into and cooling things it moves out of.

Give the class time to look at the display of the work produced by all the groups, followed by time for questions and discussion.

Page 47 has text that explains how insulators work, in terms of slowing down the flow of energy from the hotter to the colder place or material. Read the text together as a class and use it to check on how well pupils have understood what they have been doing in the activities so far. The key idea is that energy always transfers in the same direction – from the hotter to the colder – never the other way round.

Page 48 uses a set of diagrams to show how energy is transferred in a very familiar situation. Use it as the text is being read out, checking that pupils understand the meaning of the arrows, i.e. energy being transferred into the cup and then the air from the hot liquid.

The text on this page deals with a common mistake about ‘warm’ clothes, blankets etc. They do not warm us, they just slow down the movement of our body’s energy away from us, so that we do not cool down. They are insulators, not heaters! We are our own heaters.

Page 49 extends the principle of insulation to a common, but less well understood context – the refrigerator. There is an outer and an inner wall, with insulating material between them. This is how the energy in the room is prevented from moving into the space inside the fridge. The cooling system, driven by a motor, is filled with a liquid that can absorb the energy from inside the fridge and transfer it to the air through the radiator at the back of the fridge. Both these processes help to keep the food inside the fridge cool, even in a very hot kitchen.

Insulation in roofs may be more familiar to some pupils. If so let them tell the class about it. If there is a building site near school, it may be possible to take the class to see the builders putting insulation materials into the building as it is put up.

Activity 11

The first decision by the groups has to be what their hot object will be. Only allow things that can be tested in class. Emphasize the WARNING about hot objects being dangerous.

The pictures on Page 50 can act as a guide to what is possible.

Once the objects have been made, they should be tried out, improved if necessary, then demonstrated as the class watches. Each group must be able to explain how their object works.

Activity 12

Each group must do this activity at the same time, so you will be limited by the number of thermometers you have. The challenge is set up as a kind of competition. The cups must all be exactly the same, the amount of water
must be the same and the position in the room as close as possible. Ask the pupils why these factors are all kept the same (it makes the test ‘fair’ and allows the results to tell you about the one factor that is different – the way the cups are insulated.) The table for results must be drawn before the test begins.

Once all the cups are insulated, the water should be added by you to each of them. Pupils must measure the temperature at the very start and record it in their table of results. You could call out the time every minute or two so that all groups read the temperatures at the same times, recording the results each time in the table.

Every pupil should have paper for drawing a graph of their group’s results. Remind them about how to draw the axes, scales and plot the points (time should be on the horizontal axis and temperature on the vertical axis.)

When the graphs are displayed, pupils will have to compare them to know who ‘won’ the challenge. The steepest line is the loser and the ‘gentlest slope’ is the winner. This group should show how they insulated their cup. The difference may have been their choice of materials or the way they added them to the cup, or both! This will reveal how well the groups had understood the concept of insulation and the properties of different materials.

Page 51 ends the unit with more examples of energy transfer, which contradict the ‘common sense’ view. It is important to challenge pupils’ ideas, which they will have learned from their everyday life, with the scientific ideas taught in this unit.

**Additional Activities**

1. Ask pupils to find out about the heating and/or cooling systems at home or in school. Let them report back to the class, using charts, pictures, models or a performance.

2. Arrange class visits to places where hot and/or cold materials are handled. Let the pupils prepare questions to ask the workers there, how they do their work safely. Focus particularly on the use of insulating materials. In class, pupils should compare what they have found out with what they discovered in their own classwork. A written report should be produced.
Discussion of concepts and skills

Food provides us with a variety of nutrients and it does not matter what we eat, so long as we have all the essential nutrients that our bodies must have to be healthy and supplied with energy. The concept of a ‘balanced diet’ is based on this biological fact. One nutrient cannot substitute the function of another nutrient – we need all of them. The nutrient groups are introduced as carbohydrates, fats, proteins, vitamins and minerals. They have particular functions in the body. If the diet is deficient in a particular nutrient, diseases can develop. These deficiency diseases are not caused by germs, but by the lack of some component in the diet.

This unit allows pupils to identify nutrients in their own diets and challenges them to plan balanced meals, using the ideas that they are learning. Practical investigations are an important part of the learning. The energy content of different foods is compared in a simple way. This is followed by simple food tests, for starch and for fats, which help pupils to identify them in various foods.

All our foods are traced back to the creators of food – the plants. Their leaves are the location for food making, using the energy of sunlight to combine water with carbon dioxide. All animals depend on this process for their life and we are no exception. Animals may eat only plants, or only other animals, or as we do, a mixture of the two. This is the subject of the last unit in the year.

Process skills are applied in several ways and you should expect pupils to be able to observe, measure, record, compare and use evidence to come to conclusions. Challenge them to develop these skills by being more demanding, giving them less time and asking for higher standards.
General concepts

Nutrients are of five types – fats, proteins, carbohydrates, vitamins and minerals. Each type has a particular function in the body. The nutrients are found in different amounts in a great variety of foods. A balanced diet contains enough of each type of nutrient to keep the body healthy. If the diet lacks a particular nutrient, a deficiency disease will develop.

Materials needed

1. Books and other sources of information about food nutrients and deficiency diseases
2. Paper
3. A pen or pencil
4. A ruler
5. A collection of clean food containers
6. Peanuts and other nuts
7. Dry white bread
8. Cheese
9. Other foods
10. Water
11. A test tube
12. A measuring cylinder or jug
13. A pin
14. A cork
15. Matches
16. A thermometer
17. Scales and gram weights

Background

Very few foodstuffs are pure materials. Most are a mixture of many substances, so it is not very helpful to sort foods in terms of where they come from, e.g. plants/animals, fruits/vegetables. From the body’s point of view, the origin of the food is not important at all as digestion will break down whatever is eaten into the basic substances and the result will be the same regardless of where the food came from. The body’s main concern is that it has all the chemicals (nutrients) that it needs to keep itself alive, healthy and able to grow and develop whilst it is young. These nutrients come from many sources and so there is no one diet that is necessary. We can eat a very wide range of foods, so long as we eat the full range of nutrients.

These substances are of five types – fats, carbohydrates, proteins, vitamins and minerals.

The first three are defined by their chemical composition and structure. As nutrients, fats and carbohydrates perform the same role in the body, supplying it with energy, so one can be substituted for the other. Proteins cannot be substituted by anything else. They are the essential materials from which our tissues and organs are made. If we do not have enough of the correct proteins, we will suffer from a deficiency disease, or even die. Animal foods provide the most concentrated supply of protein, but vegetarians, and others who choose not to eat meat, obtain their vital supplies of protein from plant foods such as various pulses (beans, peas, etc.) and vegetables of many kinds. So far as the body is concerned, the key issue is one of having enough of the full range of amino acids, which are the building blocks of protein. It is with these amino acids that our bodies are able to build new cells and repair those that are damaged, as well as maintaining all the processes of life.

Minerals are even more basic, in the sense that they are natural elements, derived from rocks and soils. Plants absorb them through their roots and they get stored or passed on through the food chain to our bodies, in the plants and animals that we eat. Our bodies must have many of these elements to remain healthy, but the amounts are very small compared with the quantities of other nutrients that we need. If our diets are varied and the quantities of food are adequate, then we should not suffer any mineral deficiencies. Certain people who have particular diseases, such as anaemia, will need to add specific minerals to their diet by taking tablets or other medicines. Pregnant women are another group who may need to supplement the minerals in their diet, by taking iron tablets, for instance. The skeleton and teeth require regular supplies of calcium to remain strong and healthy. Children obviously need particularly large amounts, as their bones and teeth are still growing.

Vitamins are unusual, as they are not used by the body to become part of the tissues and organs. They are needed as enzymes to support the many processes of life that are constantly going on throughout the body. If we are not eating enough of them, our body does not function properly and various symptoms develop, which doctors call deficiency diseases. Some enzymes can be stored for a time in the body, but most are not, so we have to keep renewing our supply each day in our food.
Using the Pupils’ Book

**Activity 1**

This activity is based on the picture at the top of Page 52, which is a repeat of the one seen in Book 3. It is there to act as a reminder of what pupils learned in Grade 2 about food. Do not spend much time on this activity as it is simply intended to remind pupils of how they grouped foods in earlier years. The idea of groups is then to be applied to their own meals, as a way of using reality, rather than only book-based material.

The activity then moves on to the more scientific concept of nutrients. Their names are given in jumbled form, for pupils to sort out. This could be a class, group or individual task. The table for nutrients in meals must be drawn by each pupil so that each can enter details of their own meals.

The last part deals with the functions of the nutrients. If pupils do not recall them, let them use books and other resources to find out. It is useful for pupils to share what they have written about their meals and the ideas about nutrient functions.

Page 53 ends with a picture of food packaging, which is an introduction to the next activity. The important information on these is the list of nutrients.

**Activity 2**

You should warn pupils some days before, that they will need CLEAN food packaging. – you do not need the whole containers. Labels from jars, cans and packets are all that is necessary. Groups can share what they have, so that each group has a wide variety.

The table should be drawn by each pupil and filled in individually. Remind them that some columns will be empty, as foods do not usually contain all the nutrients.

When the groups report back to the class, pupils must extend their tables to add new information from these reports.

Page 54 has a short ‘test’ of pupils’ understanding of foods and nutrients. The glass of milk and the biscuits is a more nutritious snack.

**Activity 3**

Pupils are asked to apply their knowledge to four different meals, shown in the pictures. This is an individual task and only involves the group when pupils have finished their writing. You can use it as a form of assessment of individuals.

a) Beef burger: protein, fat, vitamins, minerals, carbohydrates. Chips: carbohydrates, fat, minerals
c) Meat: protein, fat, minerals, vitamins
d) Sweet potatoes: carbohydrates, minerals. Chicken: protein, vitamins, fat, minerals. Salad: vitamins, minerals, carbohydrates, proteins

Let groups compare what they have written. You could collate their ideas on the board and then add or correct items.

The widest range of nutrients is found in meals (a) and (d).

Page 55 ends with text that brings together the ‘food groups’ and the ‘food nutrients’ ways of sorting foods. Obviously, the foods in each ‘group’ contain a variety of ‘nutrients’. Do not allow pupils to continue speaking and writing about ‘food groups’, as this is not a scientific basis for classifying foods.

Page 56 has a large amount of detailed text, which will have to be read and discussed one paragraph at a time. Let pupils ask questions as you go along.

It includes two important points that need to be added to the list of essential nutrients. Water is actually more essential than food, in the sense that we cannot live for many days without water, but we can survive for weeks without food. Fibre in the food is important too, but for a totally different reason. Manufactured foods are often made without fibre, so it is important to include fruit and vegetables and meat in the diet so that there is enough fibre for the health of the intestines.

The last concept on the page, the balanced diet, is introduced in simple terms. Actually it is a rather difficult concept for young pupils to understand.

**Activity 4**

This is a chance for pupils to apply the concept of a balanced diet. They should refer back to the information in the book and their own work on the meals and snacks, to help them plan the day’s menu. The hope is that they will include examples of all the nutrients, with the carbohydrates as the largest ingredient. Fats are good for providing energy, but we cannot eat large amounts – they are unpalatable on their own. Check that there are fruits and vegetables, as these provide many
of the vitamins and minerals, as well as most of the fibre we need. Water, in one form or another, should also be part of the menu.

When pupils list the nutrients, they may see that some are missing or in very small amounts, so they should add other foods to their meals to produce the balanced diet they need.

The class should have the chance to comment on the menus, focusing on the issue of balance, rather than anything else, e.g. whether or not they would like to eat such meals!

Page 57 ends with the introduction to deficiency diseases. This concept was first used in Grade 3, but here the treatment is more detailed. Use the illustrations of what the conditions do to the appearance of people and then use the table of facts on Page 58.

Focus on the fact that most of these diseases are due to a lack of vitamins. These are never eaten in large amounts, but they are obviously essential for health. Kwashiorkor and starvation are diseases of the poor and those hit by natural disasters, such as drought.

Activity 5

You will need to find resources that have information on these diseases, so that all pupils can do the activity. If there are not enough, let each group use them in turn. The hope is that a class portfolio/big book’ will be produced, containing information on all the deficiency diseases. You could make the portfolio/big book’ with blank pages and pupils could stick their work into it. You will need to organise it in sections so that the information is easy to find.

Page 59 has more details about these diseases and what the World Health Organisation is doing to help cure them, or prevent them, with feeding programmes. Stress that the diseases can all be cured by eating a balanced diet. The class could read this text together and then ask questions about any points that are not clear.

The second part of the page introduces the concept of energy from food and what our bodies use it for. Use the pictures to focus on the two issues in the text – food (like wood and gas) contains potential energy. Like these fuels, the energy has to be released in some process. They are burned in air to release the energy. Food is not burned – the temperature in the body is not hot enough! The process of energy release is respiration, which also depends on oxygen from the air. Just as the fire and the stove are used for heating, so is the energy released from our food. Our body needs to be kept warm so that all the living processes can continue to work properly. People can die if their bodies cool down too much.

Page 60 makes use of the ideas from the previous unit, where the concept of energy transfer that causes heating was taught. Measures of temperature are used to reveal if energy has been transferred in or out. If the temperature goes up, then energy has been transferred in. If the temperature falls, then energy has been transferred out.

Activity 6

WARN pupils about the dangers of flames before giving out the materials for this activity. The groups could each have a different food for testing and then bring their results together as a class for comparison. This is a very inaccurate way of comparing the heating produced by different foods as much of the energy released from the burning foods is transferred into the air, rather than into the tube with the water. However, you should get a rough idea of the big differences between foods.

The tube MUST be emptied, cleaned (of soot) and cooled between each test, if groups test more than just one food. If these things are not done, the results will be meaningless and will tell the pupils nothing.

The important information is the rise in temperature, so before the groups report their results, they need to calculate this change. Write their results on the board and get the class to compare, then sort them in order, from the least change to the greatest change. You should find that the fatty/oily foods produced the highest rises.

Additional Activities

1. Describe to the class a person who is suffering from a deficiency disease and ask the pupils to identify the disease from the description of the symptoms. They should refer to the table on Page 58.

2. Discuss the idea that some nutrients have a higher energy content than others, recording the points made by pupils. They should back up their opinions with evidence, drawn from personal experience if possible.
FOOD TESTS  pages 62 to 64

General concepts
Fats and starch can be detected by simple tests.

Materials needed
1. Paper
2. A pen or pencil
3. Iodine solution
4. A dropper
5. Small samples of at least four foods
6. Brown paper
7. A ruler

Background
Chemists have devised many tests to detect particular chemicals. These are used in a variety of contexts – the police use them to detect drugs, women use them to check for pregnancy, doctors use them to check the blood for many illnesses and mechanics use them to check how polluting a car’s exhaust gas may be. We are very familiar with the concept of testing for certain materials.

The simple tests for starch and fats are suitable for young children, as they do not require special equipment or dangerous chemicals. The results are also easy to see. Fats make paper translucent. The molecules of the fat soak into the paper and change its properties. Instead of being opaque, or very slightly translucent, the paper becomes able to allow much more light to pass through it.

Starch, which is made in plants from the glucose that they produce in their leaves, is a white material found in many plant foods. We eat vast amounts as our ‘staples’, which form the bulk of most meals, e.g. rice, potatoes, pasta, bread and yams. Iodine, which is a rather dangerous solid element, can be dissolved to produce a weak solution. This is sometimes used by nurses and doctors to disinfect wounds. It is this iodine solution that can be used to test for starch. The normal white colour of starch is changed to blue when iodine is added to it. This happens even in foods that are not white, but contain starch. The chemistry of this colour change is not suitable for the pupils, so just accept that starch plus iodine solution equals blue colour!

Using the Pupils’ Book
Page 62 introduces the idea of food tests, so the class should read the text before the practical work.

Activity 7
Your demonstration of the starch test should be immediately followed by the pupils’ own testing. Try to give them different foods to the one you used in the demonstration, as this will make it more interesting for them.

When the groups report back to the class, write their results in two lists on the board, so that the full set of findings is available for the class to see and then to copy. Any foods containing flour – such as bread, cake, biscuits, pasta and tortillas – will test positive. Many root vegetables – such as sweet potato, yam and potato – will also be starchy. It will be interesting to test some processed foods, where the presence of starch will not always be obvious, or expected.

Activity 8
Your demonstration should be short, as this activity is so simple to do and to interpret, but long enough for the paper to dry. Give groups as many different foodstuffs as possible, with some non-fatty as well as fatty. Without both types, the results will not be so useful.

When groups report back, record their findings on the board, in two lists. Let pupils look for results that do not agree and let them discuss why this might be, e.g. the paper was not allowed to dry.

Pages 63 and 64 give detailed information about fats and oils in our foods. Read the text through as a class and deal with any queries that might emerge. Stress the health issue. North American habits of eating large amounts of fatty and sugary foods are doing terrible damage to millions of people and this way of eating is being spread around the world. Pupils need to be taught how to eat more sensibly and to take better care of their health.
LEAVES AND FOOD PRODUCTION

General concepts
Plants make glucose in their leaves and some of this is stored as starch or some form of sugar. The light energy of the sun is stored in the foods that the plants make.

Materials needed
1. A plant in the school yard
2. Aluminium foil
3. Iodine solution
4. A dropper
5. A dish or lid
6. Paper
7. A pen or pencil
8. Various edible roots, stems, fruits and seeds
9. A knife

Background
Nutrients, like all other materials on Earth, are chemicals. Chemicals react with one another in certain ways, producing particular outcomes. This fact is used by chemists to devise tests for particular substances. There are tests for proteins and various types of sugars, but these require the use of chemicals and procedures that are not suitable for primary school pupils. So, the starch and fats tests are the only ones in this unit, as they are simple to do.

If paper is made wet with water or watery solutions, e.g. soft drinks, it will change colour and become softer, easy to tear. However, if it is allowed to dry, it returns to its previous condition. Fats (including oils) have a special effect on paper that does not change as the paper dries. These materials make the paper translucent and this is a permanent change. So, any food that produces this change must contain some form of fat, even if we cannot see or taste it.

Starch is the most common form in which plants store surplus food that they have made in their leaves. The starch is stored in various plant parts, but particularly seeds and roots. In its pure form, starch is a white solid. In nature it may often be coloured by the presence of other chemicals, such as pigments, so we do not always recognise it. The iodine solution is a pale yellowy brown liquid and when it is added to starch, a deep blue colour is produced. Even in foods that are not starchy in appearance, the blue will still be clearly visible. This is a simple and clear test for starch. If iodine solution is added to cane sugar (sucrose), for example, it will not turn blue, even though starch and sucrose are both built up from the same simple molecules of glucose, which leaves make when light shines on them.

Using the Pupils’ Book

Activity 9
This is a simple and rather ‘crude’ test of the idea that leaves need light if they are to make food – in this case, starch. Actually, starch is a by-product. Leaves make glucose when light falls on them. This simple sugar can then be converted into starch for storage. The test for glucose is not suitable for Grade 5 pupils, so the starch test is used.

It is very important that the part of the leaf covered by the foil is completely covered. Failure to do this will spoil the results.

Ideally, the green colouring of the leaf should be removed before the starch test is done, as this makes it easier to see if there is a blue colour when the iodine is added. The problem is that the removal of the green pigment is not something that such young pupils are able to do. So, it will be best to use leaves that are thin and not covered with a shiny, waxy layer, which can prevent the iodine solution from reacting with the starch inside the leaf.

The conclusion should be that where the light fell on the leaf, it was able to make starch and in the darkened areas it could not.

Activity 10
In this activity, pupils are testing various foods to find out if they contain starch. The pictures on Page 65 give them some suggestions for foods to test.

WARN pupils about the danger of using the knives. The outcome of the testing should be two sets of foods. Each group could test different foods, so that you will eventually have two sets covering a large variety of foods.

Cereals all store starch, as do many root vegetables and these should be easily identified by the pupils.

Page 66 gives more information about starch in plants and the ways in which we make use of it. Read it as a class and let pupils share their own experiences.

Page 67 extends the information into a simple description of ‘sugars’. This is used in the scientific
sense. Sugars are a large set of chemicals, found in many plant parts as well as milk and meat. The particular type of sugar depends on its place of origin. Pupils do not need to know any more than the few details given here about these materials.

Additional Activity

At the end of the unit, let the class discuss the statement ‘Plants make their own food.’
You should be able to assess how well pupils have remembered and understood what this unit has taught them about plants and food production.

(N.B. There is no need to say green plants, as plants are by definition, green. If an organism contains chlorophyll (the green pigment), then it will be able to make its own food. That is the definition of a plant. So, the old classification that had green plants and non-green plants is now seen to be wrong. Fungi, which do not make their own food, are therefore not called plants any more. They are classified separately.)

**Term 3  Unit 1**

**Food/energy chains**

**Objectives**

Pupils will:
- construct food chains involving plants, herbivores, carnivores and omnivores
- interpret food chains to indicate the energy flow from producers to consumers including humans
- explain how plants and animals are interdependent in relation to the food chain
- appreciate the interdependence of all living things
- outline the path that food travels from mouth to anus.

**Time allocation: 5 weeks**

**Discussion of concepts and skills**

The unit draws together ideas and facts that have been learned in previous units and in past grades.

New links are made between concepts and the result is a more complete picture of the whole – the living and the non-living, the plants and the animals. Our connections to the other elements in the total picture are made more obvious and are shown to be vital. Human beings are part of a network of ‘food chains’ and ‘food webs’. These use the feeding habits of animals to show how one particular animal eats, or is eaten by, another. Most animals are in several such ‘chains’ and ‘webs’.

The starting point of all chains is plants. There would be no animal life without plants, as they alone can make food.

Pupils know that we need to eat food regularly if we are to remain healthy and alive. Our nutrients can be obtained from a great variety of foodstuffs, but when they are digested, their origins are not important because the processes in the digestive system break them all down into their simpler ‘building blocks’.

There are no investigations or tests in this unit. All the activities are based on paper and pencil or
modelling tasks. These are used to help pupils understand and remember the concepts of the unit.

**How plants and animals interact**

**General concepts**

Animals are all consumers. Only plants are producers. This means that all animal life depends on plants. Food chains and food webs are diagrams that show how animals feed on one another and on plants. Animals are grouped as primary, secondary, or tertiary consumers, depending on where they are in the food chain.

**Materials needed**

1. Cards with pictures of animals, plants, people, the sun and arrows
2. A notebook
3. A pen or pencil
4. A ball of string
5. Scissors
6. Card
7. Pins

**Background**

Plants, as the producers of food, are at the start of all food chains. Herbivorous animals, (the primary consumers), eat plants. These animals are then eaten by other animals (the secondary consumers). The tertiary consumers are at the top of the food chain, as they eat the secondary consumers. In fact, all animals are part of many chains and these are interconnected to form networks of food webs.

The effect of these networks is to make creatures dependent on one another. If for any reason, one animal is removed or reduced in numbers, it has effects on others in the chains and webs. People are now more aware of this and, realizing that killing animals of one kind has 'knock-on' effects on many others, they are trying to take more care of the natural world. We do not have to go out and literally kill every one of any animal. We can do it through drastic changes in the environment, which may wipe out a particular plant. This can then lead to the death of the animals that depended on that plant.

Soil, water, atmosphere, plants and animals – it is not possible to separate them, as they are all elements in the total ‘ecosystem’ here on Earth. Now that we realize this much better than in the past, we have to act with much more care and thought.

**Using the Pupils’ Book**

**Page 68** introduces the unit with a picture-language based activity for each pupil to do on their own. It will focus them on the new topic and tell you what they have remembered from earlier grades and units. Once the sets have been made, let pupils report back to the class. Write their sets on the board, so that pupils can compare them. The final sets should be:

- **plant eaters**: tortoise, seed-eating bird, slug, donkey
- **animal eaters**: bird of prey, snake, bat, mosquito
- **plant and animal eaters**: rat, fish, chicken, pig

Pupils should use the Glossary to find the definitions of the names for the three sets, then match them up to the sets they have produced.

Read the text as a class and check that these very important ideas are understood. The key one is that only plants can make food, so all animal life depends on plants, either directly or indirectly.

**Page 69** takes the process one stage back, by showing that the sun is the ultimate sustainer of life on Earth, as it is the energy of sunlight which plants use in food making. Loss of this light would kill everything.

**Activity 1**

You will need to prepare cards with pictures (or words only, if pictures are not available), showing the sun etc. Make other cards with arrows to act as links. There must be enough for the groups to build up at least one chain of feeding. Each member of the groups must copy the chain made by their group, so that they have a record of it. Let the groups exchange sets of cards so that they can build other chains.

Let groups demonstrate their chains to the class at the end and encourage discussion and comments.

**Page 70** explains the meaning of the chain, with particular attention given to the arrows. It is important that pupils understand that they represent energy being passed from one creature to another. At each stage, some energy is not passed on, so there is a limit to how long the chains can be.

Ask pupils to use the three terms for the sets of feeders, so that they become familiar with them.

**Activity 2**

This can be an individual or group activity. You could do the first one as a class to give
pupils the idea of what the task is:

a) sun → grass → grasshopper → lizard → eagle
b) sun → maize → hen → meat and eggs → people
c) sun → sunflower → mouse → cat
d) sun → pond weed → small fish → bigger fish → fish eagle

Pupils’ chains should be shared with the class and corrected by you if necessary, so that they have correct versions in their notebooks. Their explanations of the statement should also be shared and discussed by the pupils, to see which one they think is the clearest.

Page 71 takes the idea of food webs and builds yet more links, to produce the concept of food webs. These are a much more realistic way of representing feeding relationships, as they reveal the complexity, which chains do not have. Use the diagram to help pupils to see the many feeding chains that animals belong to, e.g. the heron is in four chains.

Activity 3

This could be done as a whole class activity. You will have to do it in the school yard to allow enough space for the pupils to be spread out. Cut the strings before the activity begins, making them about 150 cm so that the pupils will be clearly separated when holding them. It will be easier if you build up the web gradually, from sun, to plants, to primary consumers etc.

It should be clear that all animals are connected to plants, either directly or indirectly and that all plants are connected directly to the sun. Remind the pupils that the connections (the string) represent energy being transferred from one part of the web to another.

The removal of one element of the web will have consequences for those animals that fed on it. Removal of more and more elements has greater and greater effects.

These are the points that pupils should try to record in their summary of what the activity has illustrated for them.

Ask some pupils to read out their summaries and allow the class to question and to comment.

Page 73 has a summary of the concepts of food chains and webs and links it to the issue of conservation. This should be easier for pupils to understand now that they have done the web-building activity.

Additional Activities

1. Have a class discussion about how plants use energy to make their own food. Pupils should then write a summary of the points that come out of the discussion. It would help if you kept a record on the board, of what pupils say.
2. Make a mobile from card and thread to illustrate a food chain. Each group could choose a chain to make. Hang the chains up and ask groups to explain one another’s chains to the class.

DIGESTION OF FOOD  

General concepts

Foods are eaten and enter the digestive system through the mouth. As they pass through the different sections of the system, they are digested by chemicals that break them down into smaller and simpler parts. These products of digestion are absorbed into the blood and carried to all parts of the body, where they provide energy and all the materials for keeping the body alive and healthy.

Materials needed

1. Card
2. Paper
3. Glue
4. Scissors
5. String
6. Clay
7. Plasticine
8. Other modelling materials

Background

The digestive system is simply a tube, fatter in some places and thinner in others, which begins at the mouth and ends at the anus. Digestion is the function of the system and this process begins in the mouth, where the food is chewed into smaller pieces and mixed with saliva, before it is swallowed. The stomach is where the digestive attack on the various foodstuffs begins to turn the solid foods into a creamy, thick liquid that can then pass easily through the intestines. Particular chemicals (enzymes and others) are made by cells and glands in the walls of the system, or
connected to them, e.g. the gall bladder and the pancreas. Each liquid chemical digests particular nutrients – the carbohydrates, the fats or the proteins. The minerals and vitamins are released in this process of breaking down the tissues of the plants and animals that have been eaten and they are not broken down into simpler substances.

Once the nutrients have been reduced to smaller and simpler materials, they can pass through the walls of the intestines and enter the blood stream. Nutrients in the digestive system are useless for the body – they have to be distributed to every cell to keep the processes of life going. So, the digestive system has an efficient way of passing the nutrients, in solution rather than as solid pieces of food, into the blood vessels in the walls of the intestines.

Water is such a valuable material for the body, that the last function of the system is to extract as much as possible from the waste materials – the fibre and the wastes from the liver – before they are pushed out of the system through the anus. The waste appears as faeces and they are normally quite solid, after most of the water has been absorbed back into the blood. If we have an infection of the digestive system, we may have diarrhoea, when the faeces are very liquid. This is because the infection prevents the water from being absorbed back into the blood.

Using the Pupils’ Book

Page 73 introduces the topic of digestion with pictures of the parts of the human digestive system. These will not be familiar to the pupils, so you can expect some of their answers to be wrong when they try to arrange them in order.

The correct order is: mouth with tongue, gullet (oesophagus), stomach, small intestine, large intestine (with anus).

Page 74 has text describing the processes that take place in the digestive system. As there is a lot of detailed information here, read it as a class, a paragraph at a time and deal with any difficulties that pupils may have with the information.

The key concept is that digestion is a breaking down of complex foodstuffs into simpler, smaller pieces, which can be absorbed into the blood, then carried around to all parts of the body, supplying them with energy and the materials they need for life, growth and repair.

Let pupils study the diagram of the system in place and talk about it in their groups.

Page 75 completes the explanation of digestion and how the body gets rid of the undigested parts of the foods that were eaten. Deal with any questions pupils may have, before allowing them to begin the last activity.

Activity 4

Let the groups discuss and choose how they will make their models. Different groups will choose to use different materials. In the days before this activity, ask pupils to start bringing materials from home for the modelling. This will ensure that you have enough and that there is a greater variety of materials for them to work with.

Display the models once all the parts have been correctly labelled. Then let the class have time to look at them.

Additional Activity

Prepare a body outline for each pupil and a sheet with the outlines of the parts of the digestive system for pupils to colour and cut out. These should then be stuck in place on the body outline and then labelled.
Term 1  Unit 1
Sense organs: human eyes and ears

Objectives

Pupils will:
- identify the major parts of the eye and their functions
- infer that a lens/mirror will change the direction of light
- describe in simple terms how the parts of the eye cause light from an object to be seen by us (i.e. light from the object to the image in the brain)
- describe ways to take care of the eyes/vision
- explain how humans adapt to limited/no vision
- identify situations/examples in which the eyes can mislead us
- explain the role of the major parts of the ear in hearing (i.e. sound from source to recognition/comprehension in brain)
- discuss the range of hearing for humans, compared to that of other animals, e.g. dogs and cats
- describe ways to take care of the ears (hearing)
- identify situations/examples in which the ears can mislead us
- describe how humans adapt to limited hearing, or lack of hearing
- explain why sounds may be classified/interpreted as pleasant/unpleasant
- identify sources of noise pollution and ways to eliminate them
- state reasons why loud sounds are detrimental/harmful to continued good hearing
- explain ways in which technology can extend the senses
- take part in group activities
- demonstrate the behaviour of light with selected materials – shiny, dull, transparent, translucent, opaque, reflection and refraction
- infer that light travels in a straight line
- distinguish between objects/organisms that make their own light (luminous) and those that require an external source to be seen (non-luminous/illuminated)
- demonstrate the behaviour of sound (energy) with selected materials and different media – air, water, solids
- infer that light/sound travel in all directions from the source.

Time allocation: 12 weeks
Discussion of concepts and skills

The unit deals with two very familiar sense organs and their senses, but it goes much deeper into how they perform their roles as collectors of information about the world surrounding the body. It introduces many new terms to the pupils’ vocabulary and expects them to know about the detailed structures of the eyes and ears. This is relatively complex and pupils will need time to absorb all the new information.

In addition, it deals with the two types of kinetic energy that stimulate the organs – light and sound and considers how they travel from their sources to our sense organs.

There are many opportunities for pupils to use and develop their process skills, particularly observation, recording, measuring and comparing. In addition, there are several research-based activities that involve writing notes and drawing diagrams and pictures.

THE STRUCTURE AND FUNCTIONS OF HUMAN EYES AND EARS  
pages 4 to 18

General concepts
The eyes allow light to enter the body and stimulate nerves that are sensitive to light. Images formed in the eyes are converted into nerve impulses that the brain is able to interpret. Vision is our most active sense.

Ears house the sense of hearing, though the visible ears are not important. Vibrations travelling through the air stimulate nerves deep inside the skull and these send impulses to the brain for interpretation.

Both senses have limits and can be ‘tricked’.

Materials needed
1. Paper and pencils
2. Model of an eye
3. Animals’ eyes
4. Dishes
5. Alcohol or other preservative
6. Jars with lids
7. Tweezers or mounted needles
8. Resources about eyes and vision
9. Convex lenses
10. Torches or other light sources
11. Model making materials
12. Large sheets of paper for posters/charts
13. Colouring materials
14. Cloth for a blindfold
15. Various small objects
16. Trays
17. Timers or watches
18. Resources about visually challenged people
19. Mirrors
20. Various lenses
21. Resources about ears and hearing
22. Items for a performance piece on taking care of hearing
23. Objects that can be used to make sounds
24. A tape player
25. A tape of different sounds

Background
The basic similarity between the two very different sense organs is that the energy stimulates nerves in the organs and these nerves produce impulses that are transmitted to the brain. It is the brain that truly ‘sees’ and ‘hears’, in the sense that it has the capacity to understand, remember and give meaning to the incoming images and sounds. The sense organs are ‘senseless’; they know nothing. They do not even know what they are doing, let alone what they are ‘seeing’ or ‘hearing’. They merely provide holes in the body, through which energy can travel until it reaches nerves that can react to it.

Using the Pupils’ Book

Activity 1

Before beginning the activity, remind pupils that they must NOT touch the eyes of their partners. Put pupils in pairs or allow them to choose partners. Give them time to observe the movements of the eyes and then to record their observations in drawings and notes. Expect pupils to notice different details, so it is well worth the sharing session when all these differences can be put together to build up a more complete picture of the eye’s structure and functioning.

Pupils should notice that the eye can move in all directions, that its surface is shiny and very smooth, that the coloured ring around the black centre can shrink and grow, reacting to the amount of light, that the eyelids close regularly (blinking) and that there are tiny blood vessels in the white of the eye.

Page 5 gives facts about the eye that should be read whilst looking at the diagrams on Page 4.
Activity 2

If possible, borrow a model of the eye from a secondary school or a clinic. Because it is on a bigger scale, it is easier for pupils to see and to understand the parts and how they are connected. This will help them when they begin to look at the animal’s eye.

Their drawings should be as large as possible, as this helps to make them clear.

Warn pupils about the dangers of handling the eyes. They should use the tweezers and needles all the time.

The preservative is necessary if the eyes are to be kept and used on another day. If you finish using them in just one session, then you do not need to put them in a jar of alcohol etc.

The experience of the real eye will help pupils understand what they find in the books and other resources. The notes should explain the functions of the various parts of the eye, rather than just describe what they are.

Let pupils share their findings and tell them to add information that other pupils provide.

Page 6 introduces several new words and these should be looked up in the Glossary. The text outlines more details of the eye’s structure and function. Let pupils read it and check the points against what they have observed and read in other sources.

Activity 3

The same pairs could work together again to observe the effects of changing light intensity on the eyes. The changes happen very quickly, so pupils must be ready and must concentrate so that they are not missed.

Each pupil must observe the eyes of the other and note changes without telling what they have seen.

When the class reports back, most should have seen that the iris moves and makes the pupil larger or smaller, in response to the amount of light entering the eyes. Pupils should attempt their own explanations before reading the one in the text.

Page 7 supplies the explanation of how and why the iris changes. Ask pupils if what they observed agrees with what the text says. Let them ask for help with anything that is not clear and then move on to the text about the ‘cleaning system’ of the eyes. This completes the consideration of the external parts of the eye.

Activity 4

If possible, darken the room, or at least part of it in a corner for example, in which to explore the behaviour of light.

Lenses may have to be borrowed from secondary schools. The light source should be as bright as possible. The image produced should be seen as upside down and turned round, from left to right. Pupils’ drawings and notes should record these changes.

Try to help pupils consider how their investigation of the lens connects to the functioning of the eye. It is probably the first time they will have discovered that lenses change images, so they may have difficulties with applying this to the eyes.

Page 8 has a diagram of how light rays pass through the lens and create the image on a screen. Make sure that the pupils understand that there are also light rays travelling away from the object in other directions, but only some of the rays that go towards the lens are shown. The diagram shows clearly how the image becomes inverted and reversed. Look at the diagram and read the text alongside it, so that the role of the brain in ‘correcting’ the image is emphasized.

You could illustrate the flexible shape of the lens by filling a balloon with water and changing its shape by pulling on it and relaxing it.

Activity 5

Groups should decide which product to make. The intention is that the models and posters should help to make the eye’s structure clear.

The harder part is to illustrate the function. Remind pupils of the diagrams on previous pages that show image formation.

Each group should use their product as a teaching aid for the benefit of the class.

Page 9 has text and a diagram explaining binocular vision – two eyes with slightly different points of view and therefore images, of the objects they are looking at. This is easily tested by everyone. Get pupils to close one eye and look at some object, whilst opening and closing each eye in turn. They should notice that the ‘picture’ changes slightly from the left eye view to the right eye view. Again, the brain has a vital role in producing one three-dimensional view of the world.
Activity 6

If possible, each group should have their own tray etc. and do this activity at the same time. It does not matter what the objects on the trays are. The test compares individual performance with and without vision and it compares pupils. The results should show that the eyes help us to recognize things very quickly.

The resources should provide information about how people manage with damaged eyesight. If possible, invite a visually challenged person to class to be interviewed by pupils. Pupils also need to research the causes of blindness and visual impairment and how to care for the eyes.

Page 11 starts with pictures of simple methods of caring for our eyesight. Let groups discuss them and explain how they can all help protect their vision. Their lists should have other suggestions not illustrated.

Activity 7

This should be presented as a challenge. There is no one, correct answer. Groups will devise their own ‘tricks’. The mirrors will be particularly useful as they reverse images and these can be reflected in various ways. The groups should circulate and see if they are ‘tricked’ by others.

Encourage pupils to tell of their own experience of being misled by their eyes.

Page 12 has examples of drawings that are designed to trick the eyes. They are called optical illusions. Pupils will not all see the same things when they look at them, so allow them to tell one another. The ruler will reveal what is really the case, in spite of what the eyes ‘tell us’ (actually the brain makes the mistake, not the eyes.)

The other example of ‘misleading’ the eyes is the mirage. Pupils may have seen small examples of this on very hot days. Let them talk about them.

Activity 8

Each pupil needs to copy the diagram of the ear from Page 13, with labels on all parts. The books etc. will supply information about what each part does and how it does it. As with vision, hearing is a brain function. The ears only respond to sounds – the brain hears and understands them.

Page 13 has pictures of the ears of other animals for pupils to compare with their own. Their notes should record differences and similarities (e.g. two ears, on either side of the head). If pupils already know things about the ears (e.g. of dogs and cats), then they should add these to their notes.

Activity 9

This is for each pupil to do individually. Ask pupils to bring in books etc. some days before, so that you have enough for the whole class.

Pupils should research their own chosen animal and then add general notes about hearing and the brain and finish with a comparison of animal and human hearing. Let some read their notes aloud, or let pupils exchange their notes.

Page 14 has details of the hearing of some of the animals shown on Page 13. Let pupils read it for themselves, then ask them questions to assess how well they have understood it.

For example: Why don’t we hear a sound when a dog whistle is blown? Why don’t bats bump into trees and walls etc. when flying?

Page 15 gives values for the different frequencies heard by people and other animals.

(The frequency is a measure of the vibrations per second, as an indication of the pitch of the sound – low or high.)

Let pupils compare the figures and discuss any differences (e.g. elephants can hear lower sounds, but cannot hear some of the higher ones we can hear; whales have hearing over a very wide range (70–150,000 Hz).

Activity 10

This is a role-play about caring for our hearing. Pupils will need to decide how care can be taken (e.g. wearing ear-plugs or keeping ears clean).

Give them time to prepare, then let each group perform. The class should watch, listen and then ask questions and make comments.

Page 16 has suggestions about caring for hearing, so if groups cannot think of anything for their performance, let them read this text. Otherwise, use it as a summary of what the presentations have shown.
**Activity 11**

This is a class activity, to test the hearing skills of individual pupils. The objects can be given to pupils to make the sounds, when you signal to them one by one. It is important to keep a record of pupils’ answers, as this will allow comparisons of sounds and pupils. Draw a table on the board, with pupil names down the rows and the names of objects on the columns. You could get a pupil to enter ticks and crosses for each pupil and each sound. Use the table of results to look for patterns and answers to questions such as:

‘Which sound was most difficult to recognize?’

‘Did boys and girls answer differently?’

Round off with the sharing of ideas about how aurally challenged people (those without hearing, or with impaired hearing) adapt to being without this sense.

**Activity 12**

You will need to make a tape with at least 10 different, everyday sounds. Leave a space between each recording so that the tape can be stopped and started more easily. The class should all listen and record their reactions in columns that they have drawn ready for the activity.

The reactions of pupils will differ and they should explain to one another what features of the sounds make them pleasant and unpleasant for them. Pupils should tell you what they think of as noise pollution and you can record this on the board. Then look at the list and try to identify the features that make it ‘pollution’.

Finally put pupils in groups to discuss how noise can be reduced or removed.

Page 17 should be looked at immediately after or during the discussion. Stress the improvements over time.

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**Page 18 gives the complete sequence of events involved in hearing a sound.** As with all the senses, it is the brain that actually ‘hears’, in terms of knowing that a sound has been detected by the ears and using memories of past experiences to identify it.

Read the text as a class and deal with any queries that might arise.

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**THE TRANSMISSION OF LIGHT AND SOUND**

**General concepts**

Energy on the move (kinetic) can be experienced through the senses as light or sound. Sources of light are called luminous. Everything reflects light, though some do it more than others. Materials can be sorted into three sets according to how light behaves when it strikes them. Light can be blocked, forming shadows, or refracted, changing the images of things.

Sound and light travel away from their sources and eventually our senses cannot detect them. Light travels in straight lines.

**Materials needed**

1. Materials of various kinds
2. Light sources
3. Paper and pencils
4. Window or lamp as light source
5. White sheet
6. Pegs or pins
7. Straws or other flexible tubes
8. Flexible mirrors
9. Resources about light sources and reflections
10. Transparent containers with water
11. Sticks
12. A source of sound
13. Pairs of objects made of different materials
14. Musical instruments

**Background**

Energy can be transferred from place to place as light and as sound. Light travels much faster and it is just one part of a wide range of electro-magnetic radiation, which includes non-visible waves such as radio, X-rays and ultra-violet radiation. Our eyes have the ability to respond to part of the spectrum and other animals have eyes that see more or less of the spectrum. Similarly, our ears have a particular range of frequencies that can be heard and other animals can hear different ranges. In both cases, our sense organs have limits, beyond which they cannot detect the energy. They also have limits over distance. A source of light or sound may be too far away for our sense organs to detect the energy coming from them.

However, other animals and some machines can detect what we cannot, which reminds us that just because we are not aware of it, does not mean that the light or sound is not there.

Both light and sound come from sources. Energy
moves away from the source and travels through the atmosphere. If we happen to be ‘in the way’ of the energy as it travels, we will see or hear things. The energy is absorbed by our sense organs and it is transferred to the brain as another type of kinetic energy – electricity.

Materials differ in the way energy is absorbed by them. Light can pass straight through some materials and very little is absorbed in the process. These materials can be ‘seen through’ by us and we call them transparent. Others absorb and scatter the energy as it enters them and only some of it emerges from the other side of the material. These are called translucent, as some light does pass through, but not enough for us to see the object emitting/reflecting the light. Other materials absorb all the light falling on them and so we see no light coming through them. A brick wall is a simple example. Such materials are called opaque. Shadows are formed because they prevent the light from carrying on its way. They block the light and so it is dark on the other side.

Light is more or less reflected by the surfaces of objects. We call some things ‘shiny’ because most of the light is reflected in a particular direction, maintaining the image more or less unaltered. Most surfaces are not so smooth, so when the light rays hit them, they are reflected in every direction, breaking up the image into disconnected pieces, travelling away in many directions. This means that our eyes cannot see the image on such surfaces. They appear dull, or at best slightly shiny. The incoming light is scattered by the uneven surface. Most objects and materials are like this and we do not immediately realize that they are reflecting any light at all. However, if they did not reflect light, we would not be able to see them. It is only because objects, when lit, are able to reflect light towards our eyes, that we see them. If they are not lit, as when the light in a room is switched off, we do not see them, even though they are still there! Light has to strike them and bounce off them towards our eyes, for us to see them. This, combined with the fact that light travels in straight lines, means that we may still not see things when they are well lit, because if they are round the corner, the light they are reflecting cannot travel to our eyes, so we do not see them.

Light travels at different speeds through solids, liquids and gases. So, when we see something under water, the light travels more slowly than when we see it in the air. If part of the object is in water and part in air, we can see a difference in the two parts. The straight object appears bent. The position of the object in the water is in the ‘wrong’ place. Fishermen know this from their experience of looking down into water and trying to spear or net fish. They appear to be where they are not, so the aim has to take this into account. These effects are called refraction. Light has its direction changed when it passes from one type of material to another – in this case water to air. Lenses are another case where refraction occurs. The natural lenses of our eyes are not made of glass or plastic, but they have the same effect on light passing through them. Depending on the exact size and shape of the lens, it has a particular effect on the path of the light as it goes through it and out the other side. It is because lenses do this that they can be used to focus the image on a small area, such as the retina in the eyeballs. We can look at an enormous scene, such as the coastline and the sea and this vast image can be made small enough to fit inside our very small eyeballs! It is the process of refraction that makes this possible.

**Using the Pupils’ Book**

**Page 18** has a short ‘test’ of pupils’ knowledge and understanding of the three terms applied to materials, which refer to how light behaves. For each situation, the pupils have to complete the sentence, using the correct word each time. The answers are:

(i) transparent (ii) translucent (iii) opaque

**Activity 13**

The groups can either choose their own set of materials for testing, or you can give the same set, or different sets, to the groups. If they all test the same things, then their results can be compared. Check that pupils understand why they must test each material in the same way – the concept of fair testing. Each pupil should record the answers for themselves and be ready to share them with the class.

**Page 19** has explanatory text about the three types of materials. When pupils have read it, you could ask them for more examples of each type, to check that they are using the terms correctly.

The picture shows a familiar situation and it acts as an introduction to the next activity.

**Activity 14**

This is an imaginative, creative activity, using the properties of the sheet and pupils’ bodies to create shadows on the sheet. The science in the activity is in the explanations given by the pupils of the shadow formation. The bodies and other objects used in the plays are opaque, so they do not let light pass through.
them, blocking it and forming a shadow where there is no light. Because the sheet is translucent, the shadow can be seen falling on the sheet.

Activity 15

This simple and short activity is used to demonstrate that light travels in straight lines, so it cannot go round bends or corners. Pupils should observe that when it is straight, the light from the object they are looking at could travel to their eye down the tube. When the tube is bent, the object cannot be seen because the light cannot reach the eye. Groups should share their explanations with the class before reading the text on Page 21.

Page 21 has the scientific explanation of why we cannot see round corners etc. The diagram uses lines to show how the light rays travel from the object to the eye and this makes clear that it is blocked by the wall of the tube when the tube is bent.

Activity 16

Reflection of light is the new concept that is explored in this activity. Flexible mirrors, made of plastic and covered with a shiny surface material, allow pupils to see how the reflections can be changed by the curvature of the mirror. They should draw what they see each time and note the shape of the mirror each time, e.g. curved outwards, curved inwards.

Explanations of why the images are changed, should all refer to the fact that light travels in straight lines from the object to the mirror and then from the mirror to the eyes.

Page 22 explains that reflection is not only about mirrors and very shiny things. Everything reflects light. If it did not, it would be invisible! Most objects scatter the light in all directions, so they do not shine and we cannot see our faces reflected in them when we look at the objects.

Activity 17

The whole class can do this activity if you have enough space to move further and further away from the light source. If not, do it outside, or let each group do it in turn. Pupils should notice that the light becomes more and more dim/less and less bright. Let them try to explain this observation. The light does not ‘wear out’ or get finished as it travels. Our eyes are not so able to detect light as the distance from the source increases. The sun is very, very far away and yet we can still see its light. This illustrates that the intensity/strength of the light source is obviously another factor in how far away a light can be and still be seen by our eyes. The other factor is how much light there is all around. This test will have to be done in daylight, so the light source is ‘competing’ with the background light of the sun, which is very bright. Ask pupils if they would see the light source even further away at night and why.

Page 23 This picture sorting activity is for pupils to do individually. This will reveal how well they understand the difference between luminous and non-luminous.

Luminous: firefly, candle, sun, TV, fire
Non-luminous: moon, open book, mirror, the sea, road sign, safety clothing

Activity 18

Warn pupils that they will need to bring books and other resources, so that you will have enough for everyone. Notes and drawings should be large and clear for display. Encourage pupils to choose items that are different, so that you end up with a wide range.

Page 23 The text explains how objects are defined as being luminous or not. After reading it, let pupils ask questions for clarification. Then give them the names of more objects for them to sort. This will reveal how well they have grasped the concept of ‘luminous’.

Activity 19

The drawings of the stick without the water are important, because they can later be compared with the stick in water.

Pupils should notice that the stick appears to be bent, even though it is not.

The four pictures present a challenge and pupils should use their own drawings to help them choose the correct one, (a).

Page 25 has the explanation of the ‘bent’ stick. The concept/term ‘refraction’ will be new, even though some pupils may have noticed it before. It is important because all lenses, including those in our eyes, use refraction to produce the changes in images.
Activity 20

This whole-class activity introduces the investigation of sound. Carry it out as you did for the light activity. Make the sound quite soft, so that it will not be heard from far away. Eventually, the sound becomes very faint or even impossible to hear, as the distance from the source increases. Our ears cannot detect sound beyond a certain distance, depending on the loudness/volume of the sound.

Activity 21

The objects shown in the picture are paired in various ways. Pupils should use them to give them ideas for what they will compare. Characteristics such as material, shape and size can be used to make comparisons.

The table should be drawn after pupils have chosen their objects for testing.

As far as possible, they should hit and blow with the same amount of force each time, so that the comparisons are fair.

The groups should notice that hollow/large objects made of wood or metal produce the loudest sounds. Larger objects make lower pitched sounds than smaller objects. Empty bottles make lower pitched sounds than partly or totally filled bottles.

Page 27 The text summarises the facts about light and sound travelling away from sources. In addition, it reminds pupils about sound travelling through solids and liquids, as well as gases, like the air. The class could read the text and then ask questions about anything that is not clear to them.

Additional Activity

Pupils each write a story on coping with hearing loss. They read them out to the class and discuss them.
All living things have specialized parts of their bodies that carry out particular functions. In higher order organisms, like the flowering plants and humans, there are a number of systems, made up of particular organs that operate together in certain ways. The unit deals with some of the systems found in plants or humans.

The structure of the system parts and how they are connected is dealt with in each case and the link with their functions is emphasized. Detailed terminology and arrangement of the parts is taught in the unit, taking pupils much further with their knowledge and understanding of these familiar plant and body parts. One outcome should be that pupils will be able to talk and write about these systems with more understanding, whilst using the scientific terms correctly.

The unit reveals how different systems are related and reminds pupils that none of them operate in isolation from the others.

Practical tasks give pupils many chances to cooperate, share, plan and report together. These social aspects of learning are particularly important in the topic dealing with human reproduction.

Skills of investigation are needed for work on roots and shoots, in particular, with graph drawing included in the many processes that have to be carried out.
Roots, shoots and flowers

General concepts

Plants have root, shoot and reproductive systems. Each has particular functions and is structured in ways that enable it to perform its functions.

Materials needed

1. Spades or garden forks
2. Paper and pencils
3. Transparent containers for water
4. Water
5. Plastic bags with ties
6. Complete plants
7. Rulers
8. Graph paper
9. Large seeds, e.g. beans, maize
10. Cotton wool or absorbent paper
11. Books etc. about roots, shoots and flowers
12. Soft stems
13. Knives or scissors
14. Hand lenses
15. Coloured water
16. Bags for collecting flowers
17. Flowers
18. Glue
19. Flower worksheets

Background

Plants, like all other living things, depend on materials from the surrounding world to sustain their lives. Animals are forced to gather food, in various ways. Plants make food for themselves, but they still need to collect water and minerals from the soil, so that they can be used in the manufacture of food. The root system has the role of collecting these materials, whether the form of the system is fibrous or taproot. The larger parts of the system that we can easily see are not actively absorbing water and minerals. This function is carried out by vast numbers of tiny ‘root hairs’, which cover the skin of the finest branches of the system. They are not hairs, but extensions of the cells of the root wall, which are very thin walled and able to absorb water easily from the surrounding soil. Minerals, dissolved in the water, are taken into the root hairs at the same time. Once inside the cells of the root wall, the water and minerals travel towards the tubes that run the length of the roots and through which the water rises to the parts of the plant above the ground. A parallel set of tubes runs down the roots from the stems above, carrying the foods made in the leaves. The roots are living, so they need to be fed. They are not green and are in the dark, so they cannot feed themselves. Surplus food is often stored in the roots, particularly in taproots, such as carrot, sugar beet and beetroot. This can be used to keep the plant alive at times when it is not able to make so much food, for some reason, or it is needed for fruit and seed production. Roots are sensitive to water in the soil and grow towards it. It is the tips of the roots that are still growing, the older parts further back become thickened and lose their root hairs. The second role of roots is anchorage. Put simply, the wider and deeper the roots can spread, the more ‘hold’ they have on the soil and so the harder it is for any force to remove the plant from the soil.

Shoots are really just the framework and transport route of the plant. They provide the location for the leaves and flowers to develop and in most plants, they hold the leaves up in the best positions to catch the sunlight, to maximise food production. As they are the link between the roots and the leaves, they contain two sets of tubes, used for the transportation of liquids up and down the plant. As explained above, water and minerals move up in one set of tubes and dissolved foods move down in another set. All parts of the plant are connected to this network of tubes and in this way they are provided with water and food. Unlike us, gases enter and leave the plants through holes in their leaves, so they do not need a special system to perform this role, which is what our lungs are designed to do. Shoots are able to grow in various forms and may be very short lived or persist for hundreds of years. Some great trees in the forests of north and south America are able to live longer than any other living thing on Earth. The trunks of trees are mostly dead and only a thin layer around the tree, just under the bark, remains alive and growing. Each year this layer is surrounded by another, new layer and gradually the inner layers die and are filled with the plant’s solid waste products. Shoots grow against gravity and they are light sensitive, changing the direction of their growth to move towards the light. We do not normally see shoots moving, except when the wind or some other force pushes them, but movement is one of the characteristics of living things and, like roots, they move very slowly, but definitely.

Flowers develop on the shoots, in particular places and usually only at certain times of the year. This is in response to the seasons, being triggered by a combination of the light intensity and the temperature. The form of flowers can vary tremendously, from the almost unrecognisable flowers of the grasses, to the massive and very noticeable flowers of the tropical forest. Whatever their size, shape, colour and form, all flowers have the same
function. Their role is to reproduce the plant. To succeed in this, they have to bring two very different and special cells together. Some flowers make both kinds of cell and seeds can be made by combining them. Other flowers only make one of the special cells – the ovules (eggs), or the pollen. In that case, to make seeds the flowers need to make contact with other flowers in order to bring the two types of cell together. These flowers use agents to bring this about. The wind blows the pollen of the grasses, for instance, and it is carried away from its source. By chance, some of it lands on the flowers that need it and it sticks to the special parts of the flowers, where it is able to germinate and deliver its contents to the ovules, which remain inside their special part of the flowers. Other flowers depend on insects, or birds, or other animals to carry the pollen to where it is needed. In all cases, the intention of flowers is to combine pollen cells and ovules in a form of sexual reproduction, very similar to that used by humans and other animals, to produce new individuals. Petals play no direct part in this process. They are there to increase the chances of an insect etc. choosing to visit the flower and pick up or deposit pollen.

Using the Pupils’ Book

Activity 1

It is important that pupils dig deep and carefully, so that the roots are not broken off. They may have to dig up several weeds before they find the two types – the tap and the fibrous.

The pupils should spend time examining the structure of the root systems back in class, before they draw them, making the drawings as large as possible. Pupils should note that the taproot has small roots coming out of it, whereas the fibrous roots all emerge from the base of the stem and then branch lower down.

The drawings on Page 28 are for comparison with the pupils’ own. They should be able to add the words ‘tap’ and ‘fibrous’ to their own drawings.

Page 29 has text describing the main facts about root systems, which should be read once the drawings are complete.

Activity 2

This activity is supposed to demonstrate that the level of the water will gradually fall as time goes by. For this reason, it is very important that the plastic bag is tied as tightly as possible around the stem, so that water cannot escape by evaporation from the jar. Look at the pictures on Page 30 to see how it should be done.

The measurements are to be turned into a graph, so check that pupils are clear about how to draw the axes and put on the scales. Time should be on the horizontal axis and the height of the water on the vertical axis.

The conclusion should be that water was removed from the jar by the roots. This raises the question of what happened to the water once it was inside the plant. Let pupils share their ideas about this, but do not try to resolve the question at this stage.

Pupils should have worked out why the jar was covered in plastic (to stop evaporation) and that cutting the roots off would have reduced (if not stopped) the water loss.

Page 30 has a book-based activity for each pupil to do individually. The incomplete sentences should be written and completed after the class have discussed the pictures above them.

a) It was easy to pull up most weeds because their roots did not have many branches.

b) The plant that was hard to pull up was holding onto a lot of soil.

Page 31 outlines the two functions of roots, with a picture to show how anchorage sometimes fails and the plant falls over. This is more of a problem for trees, as their height and large tops are strongly pushed by high winds. This force has to be balanced by the force with which the roots push against the soil. The wider and deeper the roots, the better they anchor the tree.

Activity 3

Pupils will observe the growth and development of roots, starting with the germinating seed. They will keep records in drawings and measurements of how the roots lengthen and develop into a branched system. It is essential that water is added regularly to keep the seedlings alive, but not too much water, as this can drown them. The type of system that develops will depend on the particular type of seeds that pupils use.

The records should be kept by every pupil, so that all will have their own for using to
form conclusions and descriptions of root growth.

The books and other resources should only be used after pupils have tried to write down their own ideas.

Page 32 has text that gives some details of root growth, which should be read after the pupils have completed their sharing and discussion of the results of the last activity. The two issues of collecting water and minerals, and the need to anchor the plant, are both emphasized as the reasons for the roots’ growth and increasing development over time. Check that pupils have understood these twin functions of roots.

**Activity 4**

Begin with a class discussion about shoots and then let groups choose what they will research from the books and other resources. You may want two groups to research the same topics, so that their findings can be compared.

The research should involve the forms, structures and functions of shoots. There is much more variety of shoots than roots, so there is plenty to research. A few of these are shown in the pictures on Page 32.

Drawings should be as large as possible and labelled. When groups have shared their findings, make a display of their work.

**Activity 5**

It is hard to see water and minerals moving through the shoot system, from the roots to the leaves. This activity helps to show that the movement must have happened. Add dye of some kind to the water before giving it to the pupils. The soft-stemmed plants are easier to cut and to split, than woody stems. The shoots should have leaves on them if possible, as this will help to keep the water flowing up the shoots and out through the leaves. Flowers on long stalks can also be used and, if the flowers are white or another pale colour, they may also show the colour change, as the dye reaches them.

When the stems are cut across or split along their length, pupils will see that the colour is only in certain places. This is because the water with the dye moves inside bundles of tubes, not through the whole of the stem. These tubes can be seen when the stem is split lengthwise. Obviously, the colour will move in at the bottom and gradually be drawn up through the stem. Pupils will be able to see this when they cut across the stems in different places.

Page 33 begins the explanation and description of shoots and their functions. The two main types are the permanent – woody, and the temporary – non-woody. Functions are several and these are reflected in the forms of the shoots.

Page 34 completes this outline of shoot forms and functions, with a diagram to illustrate how liquids move in both directions in the stems: up from the roots and down from the leaves. This may be a completely new idea for pupils, so give them time to read, think, discuss and ask questions.

Flowers are the third plant system – the reproductive system. Their function is very different from those of the roots and shoots. The text introduces some of the scientific terms that are used to name the parts. Pupils will have to learn and use these correctly.

**Activity 6**

The pupils should all draw the table before the flower collecting starts. Plan where you will take the class to collect flowers, choosing a place where there are plenty of flowering weeds. Three flowers for each group will be enough, as the groups can exchange their flowers when they return to class.

Remind pupils how to use a hand lens, holding it close to the eye and bringing the object towards it until it is in focus. Encourage pupils to make the drawings as accurate and clear as possible.

When the groups report to the class, a pattern should emerge, which shows the relationship between sepals and petal. They are usually equal in number, or one is a multiple of the other. Another conclusion should be that petals vary enormously in size and shape. Some flowers have scent and others do not.

**Activity 7**

As pupils copy the diagram from the book, they are beginning to look at the details of flower structure and also to learn the names of the parts as they copy them. Pupils then do research on each of the parts to discover their functions. All the information collected should be entered in the table for easy reference.
Once they have collected these details, they should be able to do the colouring of the male and female parts, as well as the petals and sepals.

Page 36 has a lot of detailed information about the reproductive process in plants. Much will be new for pupils, so it should be read in separate paragraphs and pupils should have the chance to ask you for help with anything that is not clear.

Stress that it is the male sex cells, the pollen, which travel. The female sex cells, the ovules, are kept inside the ovary, awaiting the arrival of pollen. This situation is parallel to what happens in mammals, including humans, where sperm travel to the eggs.

Page 37 completes the outline of the process, with examples of how the ovaries of some fruits are totally changed after fertilisation has happened. Emphasize that the role of the fruits is to house the seeds as they develop and mature.

**Activity 8**

You will have to make copies of a flower diagram, to give to pupils at the start of this activity. The idea is to take a flower to pieces and identify them from the diagram, then glue them in place alongside their names.

**Additional Activities**

1. Pupils make a personal topic-folder into which they put all their work on plant systems, including the two worksheets that you produced for them.
2. Each group produces a concept map of the parts of the flower. This could be done before the pupils are taught about its structure and function, then revised after the lessons have been completed. This will reveal the changes in their ideas.
3. Each group designs a card or domino-type game that demonstrates the structure of a flower. Groups could exchange their games to try them out and give feedback.

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**Human body systems**

**General concepts**

The skeletal/muscular system provides the body with a flexible framework, allowing movement by means of joints and muscles. The excretory system deals with various waste products. It is composed of several organs, each one dealing with particular types of waste.

Reproductive systems are of two kinds, the female and the male. Their function is to produce sex cells, bring them together and, in the female system, to support the development of the baby.

**Materials needed**

1. Books etc. about the skeletal and muscular systems
2. Paper and pencils
3. Colouring materials
4. Scissors
5. Glue
6. Human body outline diagrams
7. Books etc. about the excretory and reproductive systems
8. Modelling materials

**Background**

Three of the body’s systems are considered in this topic. Each one is vital to the survival of the human race, though once a person is born, reproduction is not vital to the survival of that person.

The **skeleton** is formed of minerals of calcium and phosphorus combined with living cells and tissues that produce and maintain the bones. Blood vessels and nerves keep the living components of bones alive and connected to the heart and nervous systems. If bones were totally dead minerals, we would be unable to mend them when they get broken. In fact, fractures of most bones heal without doctors doing anything, apart from holding them in a fixed position for some time, to allow the broken ends to grow back together. If the bones were all part of one rigid framework, like the metal girders of a large building or ship, we would not be able to move. **Muscles** create movement, but to do this they have to pull against something that is firm and strong and does not just bend as it has the force applied to it. Bones provide this and because they are connected to one another in places called joints, the pulling of one set of muscles will produce one type of movement and the pulling against the joint by another set of muscles will produce a different movement. Opening and closing the hand, for example, depends on these two opposing sets of muscles. Joints act as levers, and this means that they can be used to do work – lifting, pulling, pushing and...
moving the body or other objects. Even breathing, coughing, urinating, defecating, sneezing, laughing and singing depend on this collaboration between the muscles and the skeleton. That is why they are considered as being parts of the same system.

**Excretion** is an unavoidable necessity for any living thing. Living always produces waste products and these have to be disposed of somehow. A complex organism like a human being has to have several organs devoted to waste disposal, as the wastes are in the form of gases, liquids and solids. The skin is the largest excretory organ, but it does its work so ‘quietly’ that we can forget its vital function. Pores (holes) cover it and allow water vapour and liquid water to escape from the body. Wastes such as urea and some salts are dissolved in that water. It is the job of the kidneys to excrete most of the urea, in the form of large volumes of urine. However, the skin provides another form of disposal. We can see evidence of the urea on our underclothes, where the sweat builds up and leaves yellowish stains. One reason that we need to wash sweat off regularly is that bacteria can live and feed on the urea and other materials contained in the sweat, causing us to smell!

The two kidneys are essential to our survival. People who develop kidney disease or lose their kidneys through accidents must either be kept alive by machines that do the work of the kidneys, or have a kidney transplanted into their bodies from another person. Without the continuous washing of the blood, carried out by the kidneys, the poisonous wastes from all the cells of the body would become more and more concentrated in the blood and eventually they would kill us. The bladder is nothing more than a storage bag, with a valve that allows us to empty the bag when necessary. Nerves in the wall of the bladder can respond to pressure and this information is sent to the brain, telling us whether or not we need to urinate. The meaning of the information has to be learned. Babies do not understand what their bladders are telling them, so they have no control over them, as any parent will know!

The pair of lungs is another vital part of the system, without which we cannot live. Those who lose their lungs in one way or another must have transplanted lungs put into them, or they will die. Every cell in the body, many of them deep inside and far away from the air all around, desperately needs a constant supply of oxygen and a way of getting rid of the carbon dioxide which it produces all the time, as a waste product of staying alive. The lungs provide the ‘interface’, where the blood carrying the waste gas can be brought into contact with the atmosphere. The only thing that separates the blood from the air is the incredibly thin wall of the air sac, in which a network of tiny blood vessels carries the carbon dioxide, dissolved in the liquid part of the blood. As the blood moves through the vessels in the air sacs, it releases the carbon dioxide into the space inside the sacs and the squeezing muscles of the chest push the gas out and away from the body. In addition to this waste gas, water vapour is also breathed out, as the lining of the lung walls is always wet with water.

**Reproduction** is only vital to the survival of humanity, rather than the individual. We live for years without reproducing, have a relatively short time when we reproduce and then whatever is left of our lifespan is spent without reproducing. Men can reproduce from puberty until the day they die, in most cases. However, women have a limited reproductive phase, which ends with the onset of the menopause, when egg production stops. For the years leading up to puberty, the human child is incapable of reproduction, as the various parts of the system are not operational. Puberty marks the time in the development of the individual when certain hormones begin to be released into the body and they produce changes, particularly to the sexual organs and the physical form of the body. Before puberty, the sex organs are present, but inactive, waiting for the chemical signal to switch them on.

Sperm are made in the testes and stored in special sacs attached to the outside of the testes. The scrotum is just a muscular bag, outside the body, in which the testes hang. This keeps them cooler than body temperature and it helps the sperm to develop and survive. Millions of sperm are made each day by a man or a boy once puberty has taken place. The large numbers are essential for successful reproduction, as most will never get anywhere near the egg, which is kept deep inside the female body. To increase the chances of the egg being fertilised by a sperm, vast numbers of sperm are released each time there is an ejaculation.

The penis is used for two purposes – to pass urine from the bladder to the outside and to deliver sperm into the female body. It is not needed for urination: half the human race has no penis, but they can still urinate. The shape, size, position and behaviour of the penis are all related to its main function, which is sexual – sperm delivery. In its normal condition it is short and soft and is quite unable to deliver sperm. The structure of the penis allows it to be filled with blood and in that condition it grows in length, thickness and hardness. It is this erection of the penis that is essential for the delivery of sperm, as it can be pushed into the opening of the vagina and the sperm can be pushed out into the vagina, close to the...
opening of the womb (uterus). Sperm are able to swim in the liquids that cover the walls of the vagina and womb and in this way they attempt to reach the egg, which is somewhere in the upper reaches of the reproductive system. This is usually in the fallopian tubes, which connect the ovaries to the womb. Whereas sperm are made every day, in very large numbers, eggs are generally released from the ovaries at a rate of one each month. This means that the fertilisation of an egg is most unlikely each time a couple have sex. In fact, most sexual intercourse has nothing to do with reproduction. It is for pleasure. The extraordinary ability of the vagina and vulva to stretch wide enough to allow a baby to leave the womb, is matched by the womb's own ability to grow from the size of a pear to a container large enough for a baby of say 3.5 kg! Because pregnancy and birth are amongst the most common and natural events, we find it easy to forget the wonder of the whole process.

Using the Pupils’ Book

Activity 9

If possible, do this activity outside, where there will be more room for pupils to explore the movement of their bodies. The focus should be on doing the maximum number of different movements, using all the joints. We do not normally think about our joints and how we are using them, so this will require concentration and thought.

The members of the groups should tell one another what they noticed as they moved various parts of their bodies. It should lead them to the conclusion that bone and muscles are always involved in movements.

The resources will give them factual information to support what they have experienced themselves. Each pupil should make notes and drawings of their own. Display the products and let pupils have time to look at and read what others have found out, asking questions of one another.

Page 39 has text that summarises the form and functions of the skeleton and the muscles that are attached to it. This should be used to check what pupils have found out for themselves from the books etc.

It also has the introduction to the next system – the excretory system. Remind pupils to use the Glossary for new words.

Activity 10

Individuals should create their own lists before sharing them with their groups. Pupils will include many different things, some peculiar to them or their families. However, there should be references to excretion (though not that term), by everybody. Pupils will probably not connect breathing with going to the toilet, or eating with sweating. This section of the unit will show them that all are part of excretion.

Individuals should sort out the jumbled words and this will help them focus on the fact that they are all connected with excretion – waste disposal.

Organs: skin, kidneys, lungs, liver
Wastes: bile, sweat, urine, carbon dioxide

Page 40 begins the detailed description of the various parts of the excretory system. Because of the large amount of new information and unfamiliar vocabulary, this text must be read slowly, a paragraph at a time, with questions and clarification after each one. Obviously, pupils are all very familiar with urination, but they are probably not aware of how the organs carry out their function, or why their work is so important for the body. Damage to the kidneys is life threatening and if they fail, owing to disease or accident, the person will die if they do not have the chance of a kidney transplant.

Page 41 provides similar details of two other parts of the system, the lungs and the skin. The actual processes involved in the kidneys and the lungs are very complex and require knowledge of chemistry that pupils in Grade 6 do not have. So, the explanations are simplified. The key idea in the lungs is that air and blood have to be brought as close to one another as possible. Blood is the transporter, the carrier, of vital oxygen and waste carbon dioxide. Cells are far from the lungs and they depend on blood for the bringing and taking of these gases.

Skin is not normally thought of as ‘an organ’ – it’s just the outside covering of our bodies! The text makes clear that it excretes, as well as protects and contains.

Page 42 attempts to correct the common error about faeces, which are often referred to as ‘excrement’. As they are not made of materials produced by the body (in contrast to urea and carbon dioxide, for instance), they are not seen as excretory products by scientists. It
is obvious that science will not be able to stop the way people refer to faeces in everyday contexts, but within science there is a ‘correct’ view and this is the one pupils have to learn.

**Activity 11**

Groups should be free to choose which option they choose to illustrate the excretory system. You should provide copies of the body outline. Make them as large as possible. Display the products and let the class have time to look at them and comment. You should be expecting the work to be accurate, complete and labelled.

**Page 43** introduces the last of the body systems in this unit. In one sense, it is just another body system, with a particular function. Reproduction is just an essential process, shared by all living things. However, for humans, sex is more than just reproduction and that is why you will have to handle the topic with care and sensitivity. It is important that you treat the information as totally ‘proper’ and encourage the class to read and talk freely. Lack of facts in this area of social life is a serious problem for society, but the consequences can be even more damaging for individuals. The pupils in Grade 6 are not too young to be given these facts, as their own bodies are already moving into, or through, puberty and knowledge of the processes they experience will be of great help to them.

Make the link with sexual reproduction in plants very clear, as this will help pupils to realize that it is a universal process in all living things.

**Page 44** starts with a picture-based activity that should be done by individuals or pairs to begin with and then at group level. This will encourage pupils to overcome any embarrassment or reluctance to look at such pictures and talk about them. There is nothing shameful in this and you have to create a climate in the classroom that will reassure pupils of this.

The text could be read in single sex groups, so that they can relate it to themselves, or with the opposite sex. As there is so much text, let pupils read it through paragraph by paragraph and then ask questions.

**Page 45** continues the detailed description of structures and functions. You could continue to deal with it in the same way as you did for Page 44.

The key idea about mammalian reproduction is that fertilisation has to be internal, as the young develop inside the womb/uterus of the mother’s body. This fact explains the size, shape position and functioning of the sex organs.

**Page 46** in later printings of Book 6 this page was revised. If you are working from the later printings, you can find an alternative page 46 that includes a simplified diagram of sexual intercourse for use with your class if you wish. The diagram (available at the end of this guide) shows how the various parts of the female and male reproductive systems work together to complete their function of bringing the egg and sperm close to one another.

Help pupils with the sectional drawing of birth, so that they realize what they are looking at.

**Activity 12**

Warn pupils some days earlier, that you will need books and other resources for this research activity. The clinic or health professionals in the community may be able to help with leaflets and posters. Let the groups choose which system to study.

This is a group activity in which each person should have a specific process or body part to investigate, so that the large scope of the systems is covered by the group.

Display is essential, as groups will only have studied one of the two systems and they should learn from the work of other groups.

**Additional Activity**

Let pupils observe the operation of the ballcock mechanism in a toilet cistern and use this as an analogy for the way in which urine is stored in and released from the bladder. Ask them to think of other analogies for parts of the excretory system.
Term 3  Unit 1
The environment and us

Objectives

Pupils will:
- explain why a disease is called communicable
- identify factors that cause communicable diseases to become epidemic/pandemic
- define a drug
- identify some common drugs
- explain the importance of following guidelines on the proper use of a drug
- explain why people take drugs
- state behaviours and attitudes that help prevent or delay the onset of misuse of drugs
- describe the effects of drugs on the body
- examine local/national/global environmental problems (pesticides, smog, deforestation, industrial and domestic waste, endangered species, noise pollution, misuse of water resources, CFCs, greenhouse effect, acid rain)
- explain how environmental problems (global, regional, national, local) affect the natural cycles
- suggest solutions to environmental problems, e.g. 3Rs of reduce, re-use, recycle.

Time allocation: 10 weeks

Discussion of concepts and skills

This unit combines three quite separate issues – communicable diseases, misuse of drugs and caring for the environment. Each has concepts that are particular to them, but there are activities connected to all three that make use of the same skills. There is no experimentation or practical investigation in the unit. The tasks are mostly book-based research, data collecting and sorting tasks, with a large degree of group cooperation, planning and recording. These skills are not particular to science, so they are of general benefit to the pupils’ learning. One task involves practical skills, applied in efforts to actually care for the environment.

Communicable diseases are defined, as distinct from other types of diseases, and then there is a consideration of the various means of transmission. Some are direct, through physical contact, and others are indirect, through the air, water or food, for example. Pupils are helped to consider how such diseases can be prevented from spreading and becoming epidemic or pandemic in proportions.

The term ‘drug’ is defined and three sets of drugs are identified – over the counter drugs, prescription drugs and prohibited drugs. Any can be misused and the consequences are outlined, with an emphasis on the great dangers, for the individual and society, posed by prohibited drugs.

The natural world is shown to be changed by human societies. Some change is damaging and over time will lead to irreversible damage. Various types of
environmental damage are dealt with and solutions to the problems are suggested. Pupils have the chance to apply some of these ideas in practical tasks over an extended period, in the hope that they will learn the skills and also be convinced that everyone can play a part in reducing damage to the environment. These tasks will also help pupils to understand the concept of sustainable development.

The unit introduces the concept of the carbon cycle and draws parallels with the water cycle, which pupils are already familiar with.

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**COMMUNICABLE DISEASES**

**General concepts**

Some diseases are passed on from one person to another. Water, food, sneezing, coughing and various kinds of physical contact, are the means of transmission. Epidemics and pandemics can develop when infections are not treated quickly and their spread is not halted.

**Materials needed**

1. Paper and pencils
2. Books etc. about diseases

**Background**

Communicable diseases are all caused by some living thing invading a person’s body and setting up home there. The organisms may be bacteria or viruses, which are often called ‘germs’ and are too small to be seen without microscopes. Others are caused by worms and other parasites, some of which can be seen without magnification. The different organisms settle in different parts of the body, feed off the body’s tissues, or its food supply and develop, grow and reproduce.

Apart from identifying, naming and studying each organism, medical scientists focus attention on how the organisms get into the body and how they later get passed on to other bodies. The body is not sealed off from the outside world. It has many holes in it – the mouth, the nose, the ears, the anus, the vulva, the urethra, the pores in the skin, for example. We must open these at times, to feed, drink, breathe, urinate, defecate, have sexual intercourse, sweat etc. Disease organisms use these opportunities to enter our bodies, usually without us knowing. Some do it by direct contact with an infected person, who touches us in some way – holds our hand, kisses us, hugs us and breathes over us, sneezes or coughs in our face, has sex with us, for instance. Often we know a person is infected and so we avoid these kinds of close contact, because we want to remain free of infection. However, it is not always possible to tell who is infected and who is not. This is especially true of deadly infections like HIV, which leads to AIDS and virtually certain death.

Some organisms use indirect methods to gain entry. They float in the air, from the breath, sneezes and coughs of diseased people. Some float in the water, from the diseased urine and faeces of diseased people. Some are carried on the hands and added to food and drink as the diseased person prepares food and drink for others. Organisms can be transmitted by other organisms that bite and sting people, such as ‘mad dogs’ that carry rabies and mosquitoes that carry malaria. It does not matter how the disease organism ‘jumps’ from person to person, so long as it does it is able to go on living in one host after another.

**Using the Pupils’ Book**

Page 47 uses pictures of common childhood diseases to introduce the unit. Let pupils talk about their own experiences of such diseases and this will lead into Activity 1.

**Activity 1**

Once in their groups, the conversation should widen to include any illnesses that the pupils have had. They should be listed and then the groups should decide which they think are communicable and record their reasons for thinking that they are. Their ideas may not be correct, but this does not matter at this stage. The point of the activity is to get them thinking and talking about what defines a disease as communicable. Their answers will reveal to you what they already know and what they understand. The sharing will produce a list of diseases that you could record on the board, together with the opinions of the groups about whether or not they are communicable. Ask pupils to defend their points of view, using evidence from personal experience.

Page 48 explains the basic differences between communicable diseases and other types of disease. Make sure that pupils understand the differences, as this is central to the unit’s treatment of the topic.
Activity 2
The present knowledge of the groups is the starting point for this activity. This is then followed up by research, which should extend their knowledge of how diseases are spread. When groups report back, pupils should add information to their own lists. It would help if you keep a list on the board as groups share their findings.

Page 49 begins with a picture-based task for pupils to do individually. In later printings of Book 6 this page was revised. If you are working from the later printings and wish to make the point to the class that sexual contact is the major cause of spreading the HIV virus, you can find an alternative page 49 with a relevant illustration (h), at the end of this guide. If your version of Book 6 includes (h), the answer is as listed here.

a) Food poisoning – flies on food
b) Malaria – mosquitoes
c) Flu – child sneezing over another child
d) Dysentery – dirty water being collected
e) AIDS – injecting with dirty needle
f) TB – drinking milk from infected cow
g) Measles – infected child close to another one
h) AIDS – couple having sexual intercourse

When everyone has finished the matching, let pupils share their answers and come to a complete set of correct pairs.

Activity 3
Groups could share out the two issues of epidemics and pandemics, concentrating on only one of them. When the research is finished, they should share their findings and pupils should add new information to their personal notes. A class chart could be produced, summarising all that has been found out, with dates, places and types of disease tabulated, or added to a map.

Page 51 gives background information about these widespread outbreaks, setting them in typical contexts.

Page 52 completes the coverage of communicable disease. The text could be read by individuals and you could then ask questions to assess how well they have understood its contents.

The misuse of drugs

General concepts
Drugs alter the body in some way. Those prescribed by doctors and pharmacists are used to treat illnesses. Some people misuse such drugs. Prohibited drugs are not needed to treat diseases. They are dangerous and some can be addictive. Criminals are very involved in the supply and distribution of prohibited drugs.

Materials needed
1. Paper and pencils
2. Empty drug packets and bottles
3. Books and other resources about drug use and misuse

Background
Drugs are designed to produce changes in the body. Most have been developed to treat, or even cure, particular illnesses. The drugs may kill the organism that has invaded the body. The drugs may counteract the effects that the invaders produce. The drugs may treat the symptoms of a disease, without being able to cure it. Some drugs correct failures in the body’s own processes, e.g. insulin is used to treat people with diabetes, a disease which has nothing to do with infections. The body is unable to make enough insulin naturally and without it the person would die. Drugs that are cheap to make and that are relatively safe to use, are made available for people to buy, in pharmacies and shops, when they feel ill in some mild way. More expensive and dangerous drugs are only available through going to a doctor, who must decide which one is needed to treat the particular illness.
These are called ‘prescription drugs’ because they are prescribed by a doctor, i.e. the medicine is matched to the illness.

All such drugs can still harm us, if misused. Some would only make us sick or uncomfortable. Others can kill us if they are not used in a controlled way. The amount we take and the number of times we take it are vitally important. The instructions given on containers and by doctors are to be followed. It is also very dangerous to give some drugs to babies or very young children. The rule is to follow the instructions.

Prohibited drugs have nothing to do with treating or curing illness. Like alcohol and tobacco, which are recreational drugs legally available in most places in the world, many substances, both natural and manufactured, can be used to change a person’s feelings and physical state. Governments try to control the manufacture, distribution, sale and use of these drugs, such as heroin, cocaine, crack, marihuana and many chemicals manufactured for their use as ‘mood modifiers’. Two big issues arise from such drugs. One is addiction, which is good for the drug dealers who have a ‘captive market’, but very bad for the individuals whose lives are totally taken over by their desire to have more of the drug.

The second issue is crime. Drug dealing is a criminal activity and it leads to all kinds of other serious crimes, including murder. Vast amounts of money are made by greedy, ruthless individuals, out of the weakness and misery of others, many of whom are young people.

The message of the unit is to use only legal drugs, in ways that help, rather than harm, the body and mind.

Using the Pupils’ Book

Page 52 introduces the topic with the definition of drugs that will be used throughout the topic. It makes clear distinctions between legally available drugs and those prohibited by governments. The same term ‘drugs’ is used for all of them, so help pupils to understand this.

Activity 4

Groups will produce lists that are different in their details, but some drugs will probably be on every list, because they are given so much attention on TV, on the street and in the newspapers. Pupils’ ideas about why some drugs are prohibited and others are not, will be very useful for you in giving the necessary emphasis to your teaching.

Groups should extend their lists as each group shares its report.

Page 53 has a book-based activity for each pupil to do alone. The sorting should lead to two sets of letters, which match the items in the pictures.

When the pupils share their answers, keep a record on the board and use it to discuss any differences between them.

Activity 5

Warn pupils that you will need clean, empty items some days in advance of this activity.

CHECK that all the containers are empty before giving them out to the class for the data collection task. If items in the table are missing from the containers, tell the pupils to choose a different one, which has the complete set of details.

Allow each group to sort their items in their own way and then to present the information in their chosen way too. This will make it more interesting for the class to watch and listen to.

The proper use of drugs should include the size and frequency of doses, the age of the person taking it and the type of illness being treated. These are the issues that you will encourage pupils to focus upon.

Page 54 has text that sums up how drugs should be used safely. Let the class read it for themselves, then ask you for clarification of any points which are not immediately understood.

Activity 6

This is a discussion that must focus on the two language questions and attempt to come to conclusions about them both. Pupils’ opinions will vary, but this is acceptable, so long as they are not based on wrong information or neglect of evidence.

When groups share their ideas, let them challenge anything with which they do not agree and ask for reasons.

Page 55 is a very full page of text, with many key facts and ideas. It is important to let pupils read it slowly and carefully, asking questions about things which are not clear.

Apart from the scientific facts about drugs, there are several social and moral aspects that are included in the text. These will provide many opportunities for discussion and
consideration of the personal, set in the wider context within the community. Schools obviously have a heavy responsibility to inform pupils of the truth about drugs, so that they are well informed enough to make wise choices, which help them to avoid harm to themselves and others in the community.

**Activity 7**

This can be done individually and then presented to the class on a group basis, or it can be a group task from the start.

The two issues in point (2) should form the basis of the research and the reporting to the class. This means that the work will be focused on two key aspects, rather than just generalised information about drugs. Let groups choose their own form of presentation.

**Additional Activity**

Invite medical or police representatives to come to class to give more details of drugs, both medicinal and prohibited. Pupils should prepare questions in advance, to ask them when in the classroom, noting down their answers.

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**Caring for the Environment** pages 56 to 65

**General Concepts**

The natural environment is changed by human activity. If it is done carelessly or without understanding, it damages the environment. We should aim for sustainable development. Pollution, extinction of living things and major changes to the climate are some of the results of human actions. Harm can be reduced by reducing certain activities, re-using commodities, recycling waste materials and conserving the plants and animals of the world.

**Materials Needed**

1. Paper and pencils
2. Books and other resources about the environment
3. Materials to make a display
4. Items for a performance
5. Wood, plastic sheeting, garden tools, wire netting – for compost heap
6. Young trees, spade, watering can or bucket, water – for tree planting
7. Plastic bags, disposable gloves, rubbish bin or pit, spade – for rubbish disposal
8. Books etc. about compost, tree planting and rubbish disposal

**Background**

Many of the ideas in this sub-unit are not new, as they have been part of units in previous grades. They are related to one another in many ways and the unit tries to bring them together so that pupils have a ‘bigger picture’.

People are part of the natural world and as such, the way we behave has effects on it, for good or ill. Human society has made enormous changes to the world over a long period of time and this process of development will continue. However, we are now very aware that all development is at a cost to the environment and there is a limit to what it can sustain. The aim for the whole world community must now be ‘sustainable development’ – that which can be kept going over time and does not destroy the earth’s resources once and for all.

Extinction of a species of animal or plant is one form of damage that is easy to understand and it is a very definite, clear and irreversible consequence of human activity. Children seem very affected by the fact that it is possible to destroy all members of a species – no more will ever be seen. Apply this to some animal that they are familiar with and it has a powerful, emotive effect. People have that power, to kill, to wipe out, to remove totally from the face of the earth; it is not matched with the power to create such life.

The carbon cycle reveals the ways in which the element carbon is moving around the natural world, sometimes in gases, sometimes in rocks and soils, sometimes in the bodies of plants and animals, sometimes locked up in fuels for thousands of years, then suddenly released to go on its way in the never-ending cycle which sustains life on earth.

**Using the Pupils’ Book**

**Activity 8**

The two pictures contrast the natural with the developed environment and you could use them to start a discussion about how we can/should care for the environment.

The activity is research about the group’s
chosen aspects of the environment, with emphasis on its sustainable development. This will be a new term, so use the glossary.

Members of each group should share out the searching in books and other resources so that the information is gathered more quickly.

A class portfolio can be created for the results of the research. This portfolio should be available in the classroom for pupils to look at.

**Page 57** has text which brings together many of the ideas which pupils have learned in this grade and earlier ones. It attempts to link them together and use arguments that show how we must act responsibly to preserve the natural world.

Let pupils read the text in two stages and ask questions after each one.

**Activity 9**

This activity presents groups with a limited number of environmental issues, from which they must choose one for deeper investigation. Whichever one they choose, they must try to answer certain questions, which are set out in points (2), (3) and (4).

Groups should be free to choose how they report their findings to the class and they will need time to prepare for this.

The class should make notes of what they are told by each group, so that they have information about several issues.

**Page 58** begins the coverage of the issue of pollution. Some of the concepts involved have been included in earlier grades, so there is a chance for pupils to recall what they learned. Let pupils read the text and ask questions if it is not all clear for them.

**Page 59** continues with more examples of how people have damaged the natural world, through ignorance and carelessness.

**Page 60** extends pupils’ concept of cycles, by introducing the carbon cycle to add to the familiar water cycle. The carbon cycle is much more complex, so pupils will need time to look carefully at the diagram. The best way to cope with it is to follow one complete part of the cycle at a time (e.g. CO$_2$ in the air → plants → photosynthesis → food → animals → energy → breathe out → CO$_2$ in air.) When this has been done successfully, combine the two parts to make the complete cycle.

Pupils are asked to apply their knowledge of environmental problems to the carbon cycle, e.g. clear forests → increase the amount of CO$_2$ in the air
burn more fuels → increase the amount of CO$_2$ in the air

The same process then needs to be done with the water cycle. E.g. spray pesticides on the land → chemicals go into ground water → streams and rivers become polluted → water cannot be used by people.

**Page 61** completes the coverage of environmental damage done by people. It contains the key idea that we all live on one planet and what we do can affect people far away, whom we never see, or know anything about.

**Activity 10**

The groups have to decide how they will get their message across to an audience, using the information that they collected in Activity 9.

Let them have enough time to prepare, so that it will be worth inviting parents, the whole school or others, to watch the presentation.

Posters are a good form of presentation and they can be displayed around the school or community, after the presentation is finished.

Encourage the audience to ask the pupils questions.

**Page 62** has pictures that serve as the introduction to the Activity below. Clockwise they show a compost heap, planting a tree and collecting litter from the school grounds. Let pupils look at them and discuss what they show.

**Activity 11**

Groups have to choose which of the three options they want to carry out, then immediately begin to search in the books etc. for guidance about how to be successful.

Do not let a group begin the practical task until they can show you their plan of the steps they will take, from start to finish. Of course, as the activity goes along they may need to change some of their planning, but at least they should have a plan before starting.

Once the tasks begin, groups should write
down everything they do, with dates, so that they will end up with a complete record of the process, spread over the term.

They may not be successful, or they may find it hard to tell if they have made any difference to the environment. This is just as valid an outcome as obvious success. The pupils will learn valuable lessons about caring for the environment, e.g. it is hard work, it is a slow process, it is not always obvious that it makes any difference etc.

Page 63 begins the summary of key ideas about caring for the environment. The text should be read and discussed by the class, focusing on the four ways of improving the situation.

Page 64 continues dealing with the key ideas, with illustrations of two ways of caring that are easy to carry out, even for children.

Page 65 completes the outline of methods of caring for the environment, with the focus on conservation of wildlife.

Throughout these summary pages, encourage pupils to give local examples of what people are doing to care for their environment. They are more likely to know about these aspects than those involving the government, or international bodies. You could add information about these aspects, drawing on news from TV and newspapers.
**Glossary (Key Vocabulary) Pupils’ Book 4**

**Action** – something that is done, e.g. the result of the brain’s message to the muscles

**Aid** – to help, assist

**Air** – a mixture of gases

**Airborne** – carried in the air, spread through the air

**Alarm** – something that warns us of danger

**Atmosphere** – the layer of air around the Earth

**Axle** – rod passing through the centre of a wheel

**Barometer** – a piece of equipment that measures the atmospheric pressure

**Boiling** – water at 100 degrees Celsius (C) is boiling, changing from liquid (water) to gas (steam)

**Camouflage** – colours, patterns or shapes on an animal that make it hard to see in its natural surroundings, e.g. on a stick insect or a tiger

**Carbon dioxide** – a gas in the air, used by plants to make food. We make it in our bodies and breathe it out

**Chemicals** – substances, which may be natural or manufactured

**Cholera** – a serious disease of the digestive system that is spread in water

**Clay** – a type of soil or rock with very fine particles that is sticky when wet and hard when fired

**Colourless** – without colour, transparent

**Complex machine** – a combination of simple machines

**Component** – a part

**Condensation** – the process of changing from gas to liquid

**Condense** – to change from gas to liquid

**Conservation** – the process of keeping safe, saving, preventing loss

**Contaminated** – polluted, dirty, impure

**Dams** – walls built across valleys to block the flow of rivers, to collect the water in reservoirs

**Decant** – to pour liquid carefully from one container to another without disturbing the solids that have settled

**Define** – give a clear meaning, to give the definition

**Detector** – anything that senses something

**Detrimental** – harmful, negative, dangerous, damaging

**Distilled water** – water without impurities, made from condensed steam

**Earth** – the world, our planet

**Effort** – the force used to move a load

**Erosion** – removal of soils or rocks by water, ice or wind, as well as by the feet of animals and people

**Evaporation** – the process of changing from a liquid to a gas

**Filtration** – the process of passing a liquid through a mesh or screen to remove solid impurities

**Fulcrum** – balancing point, pivot

**Gases** – materials that are not solids or liquids

**Hardness** – the resistance to scratching, i.e. harder substances are more difficult to scratch

**Hygiene** – clean or healthy practices, e.g. washing, careful waste disposal

**Igneous** – rocks that were formed from the liquid material at the Earth’s core

**Immunisation** – injection of dead or weakened germs to stimulate the body’s production of antibodies, to protect it against the disease

**Inclined plane** – a slope, stairs or a ladder. A type of simple machine

**Industrial waste** – materials produced and thrown away by industries, which can be gases, liquids or solids

**Infectious hepatitis** – a serious disease of the liver, which can be spread in water

**Inflated** – blown up, filled with air

**Lever** – a simple machine, which has a fulcrum

**Liquid** – the state of materials between solid and gas

**Load** – the force produced by a mass, which needs an effort to overcome and move

**Loam** – garden soil

**Lustre** – shine, reflective quality

**Machine** – a device that can be used to do work, through the transmission of forces

**Melting** – the process of changing from a solid into a liquid

**Metamorphic** – rocks that have been changed by heat and/or pressure

**Mineral** – the materials from which rocks are made. They form most of the soil and are used by plants

**Mirage** – an image of water in the distance that is an illusion, caused by hot air

**Motion** – movement
Nerves – parts of the body that carry information from the sense organs and other body parts to the brain and from the brain to all parts of the body.

Nitrogen – a gas that forms the largest part of the air.

Organism – a living thing.

Oxygen – a gas in the air, used in respiration by living organisms and in burning.

Perception – awareness, produced by the sense organs.

Pesticide – a chemical that kills insects, weeds, or fungi, which are harmful to crops.

Poliomyelitis – a serious disease caused by a virus that damages the brain, nerves and muscles. It is spread by water.

Pollutants – materials that spoil, or damage, the environment, e.g. water, soil or air.

Precipitation – water falling back to Earth from the atmosphere, as rain, hail or snow.

Predict – to tell what will happen before doing something.

Pressure – a pressing force acting over an area of surface, e.g. atmospheric pressure on the Earth, air inside a ball, or a bicycle tyre.

Pulley – a simple machine composed of a wheel and axle, over which a rope can be pulled.

Pure – clean, without pollution or contamination with other substances.

Purification – the process of making something pure, clean, free of pollutants.

Push – a force applied to an object that may move it.

Quarantine – a period of being kept apart from others because of an infectious disease.

Reservoir – a large, man-made store of water, usually behind a dam.

Response – the reaction of the body to a stimulus.

Rocks – the solid materials that form the Earth’s crust.

Sand – a material formed from the erosion of rocks, composed mostly of the mineral quartz.

Sedimentary – rocks formed from particles eroded from earlier rocks and built up in layers under water, or through wind action.

Senses – sight, hearing, touch, smell and taste.

Sense organ – a part of the body that is sensitive to a particular stimulus (i.e. eyes, ears, skin, tongue, nose).

Sensor – something that receives and responds to a stimulus, e.g. taste buds on the tongue.

Sensory aids – anything that increases the powers of the sense organs, e.g. binoculars, microscope.

Simple machine – any tool or item that makes a job easier to do.

Sources – where something is found, starts, or comes from.

Space – volume.

Springs – natural sources of water which bubble up out of the ground.

Steam – water at 100 degrees Celsius (C).

Sties – growths on the eyelids caused by infection, a form of boil.

Stimulus/stimuli – something that produces a response in a sense organ.

Symptoms – changes in the body that are caused by a disease, e.g. spots, temperature rise.

Technology – the application of science to improve how things are made or done.

Texture – the physical characteristics of the surface.

Transmitted – spread, carried.

Typhoid – a disease of the digestive system, spread by water.

Visuals – used in seeing, visible.

Volcano – an opening in the Earth’s crust through which lava flows, or is thrown.

Volume – the three-dimensional space taken up by an object, or contained in it.

Waterborne – carried, spread by water.

Water cycle – the continuous movement of water from the Earth’s surface, into the atmosphere and back again in some form of precipitation.

Water vapour – water in its gas form/state.

Weathering – various processes that cause rocks to break down into smaller and smaller particles.

Weight – a force due to gravity acting on an object’s mass.

Well – a hole in the ground from which water can be obtained.
Acid rain – rain that has been made into a weak acid through chemicals in smoke
Air pressure – the result of the weight of the atmosphere pushing down on the Earth’s surface
Alimentary canal – the gut, the digestive system, the tube inside the body, from the mouth to the anus, in which food is digested
Anemometer – an instrument for measuring the speed of the wind
Anus – the hole at the lower end of the gut, through which the faeces pass out of the body
Balanced diet – a diet that contains adequate amounts of all the nutrients
Barometer – an instrument for measuring atmospheric pressure
Boiling – water at 100 °C is boiling and turning into steam
Bowel – the lower part of the large intestine, the rectum, where faeces are stored
Burning – a chemical process in which substances are combined with oxygen and they transfer energy that heats the surroundings
Carbohydrates – nutrients that contain carbon, hydrogen and oxygen, e.g. sugar, starch
Carnivores – animals that eat other animals
Climate – the sum of all the weather conditions in an area over an extended period of time
Condense – change from a gas into a liquid
Conduction – the transfer of energy through a solid material, from a hotter to a colder part
Consumers – animals that eat plants or animals as food
Contact – touch, a point where two objects meet
Convection – the transfer of energy in fluids (liquids and gases) by circulation of currents
Deficiency – lack, shortage
Deficiency disease – a disease caused by the lack of a particular nutrient in the diet
Device – machine or tool used for a particular purpose
Dew – liquid water that condenses out of the air at night
Diet – the total of all the foods eaten by any particular person or animal
Digestion – the process of breaking down food into small, soluble particles for the body to absorb and use
Electrical device – a device that uses electricity to power it, e.g. a torch, a kettle or an iron
Electronic device – a device that uses electricity and contains transistors, e.g. a computer
Elements – parts, e.g. rain, wind and temperature are elements of the weather
Energy – the ability to do work. It is needed to make things happen
Energy forms – heat, light, sound, movement (kinetic), potential, chemical, electrical, nuclear
Energy transformation – the common name for the transfer of energy
Enzymes – chemicals that digest certain foods
Equilibrium – balance, equal, a settled state, not changing
Evaporation – the process of changing from a liquid to a gas, e.g. water to water vapour
Fats – nutrients that contain carbon, oxygen and hydrogen, e.g. sunflower oil or butter
Fibre – plant materials in food that are hard or impossible to digest, good for health
Floating – the downward pull of gravity is balanced by the upthrust (upward force) of the liquid or gas
Fluids – liquids and gases
Food chain – a chain of plants and animals that feed on one another
Food from animals – meat, milk, eggs, fish, honey, cheese, butter, blood
Food groups – an everyday way of sorting foods, based on their use by the body: energy, growth, protection
Food nutrients – the scientific sets into which foods are divided, based on what they are chemically: proteins, fats, carbohydrates, vitamins, minerals
Food web – several interconnected food chains linked together
Force – a push or a pull
Freezing – the process of changing from a liquid into a solid, e.g. water freezes into ice at 0°C
Friction – a force produced between two surfaces, which opposes the movement of one over the other
Fruits – the parts of plants that contain the seeds
Function – the work done by something, its purpose, what it is used for
Gravity – a pulling force exerted by a large mass such as the Earth
Grease spot test – a test for fats and oils that looks for a translucent spot on paper

Greenhouse effect – the trapping of the sun’s heat by the atmosphere around the Earth

Gullet – the tube from the mouth to the stomach, the oesophagus

Heat transmission – the ways in which energy flows from hotter to colder objects and materials

Herbivores – animals that eat plants only

Insulate – the process of preventing or reducing the transfer of heat energy

Insulator – a material that is used to insulate, e.g. wool or plastic foam

Iodine – an element used in testing foods for starch

Large intestine – the part of the digestive system where water is absorbed, and faeces are produced and stored; the colon and rectum

Legumes – plants that belong to the pea and bean family

Machine – a device that uses forces to perform some function

Melting – the process of changing from a solid to a liquid state, e.g. ice changing into water

Menu – a list of all the meals eaten in a day, or served by a restaurant

Meteorologist – a scientist who studies climates and weather

Mineral – a natural element or compound that has a crystalline structure

Mouth – the hole at the top end of the digestive system into which food is put

Movement – the result of a force or forces, acting on an object

Nutrients – Substances needed for keeping the body alive and growing

Nutritious – providing the widest range of nutrients

Obesity – an overweight body, being fat

Oesophagus – gullet, the tube that carries food from the mouth to the stomach

Oils – types of fats produced from plants and some animals, e.g. palm oil or cod liver oil

Omnivores – animals that eat foods from plants and animals, e.g. humans or pigs

Ozone layer – a layer in the upper atmosphere that has a high proportion of the gas ozone: it protects living things on Earth from the sun’s radiation

Photosynthesis – the process in plants that makes food from carbon dioxide, water and light

Potential energy – stored energy, e.g. in food, in a spring, in fuels

Precipitation – some form of water coming from the atmosphere

Prediction – using present knowledge to say what will happen in a test before carrying it out

Producers – plants: only they can take the sun’s energy and produce food

Protein – nutrient that contains nitrogen, oxygen, hydrogen and carbon. It is found in meat, fish, beans, nuts etc. and is essential for life

Pull – a force that moves an object towards the source of the force

Push – a force that moves an object away from the source of the force

Radiation – the transfer of energy from a source in the form of waves or particles, e.g. light, atomic. The sun sends out several forms of radiated energy

Rainfall – liquid water that falls back to Earth from the clouds

Rain gauge – an instrument that is used to collect and measure the volume of rainfall

Rectum – the last part of the digestive system, where the waste is formed into faeces

Respiration – the process in the cells of living things that releases the energy stored in the food. It depends on oxygen and produces carbon dioxide

Sinking – the process of being pulled under the surface of a liquid by the force of gravity

Small intestine – the part of the digestive system below the stomach, where foods are digested and absorbed

Source – the origin of something, where it comes from, where it is found

Staples – foods that form the bulk of our diet, providing energy, e.g. rice, pasta or bread

Stomach – the part of the digestive system into which foods pass when swallowed, where they are mixed and digestion begins

Sun – the star around which the Earth and the other planets of the solar system orbit

Sunshine – the light, heat and other forms of radiation from the sun

Swerve – a sudden change in the direction of movement

Temperature – a measure of how hot a substance is

Thermometer – an instrument used to measure temperature

Transfer – to carry, to transport, to move

Transmission – the process of passing on, sending

Transpiration – the process of losing water vapour from tiny holes in the leaves of plants
Translucent – allows light to pass through, but cannot be seen through, e.g. a china plate

Turn – to move to one side or another of the direction of movement

Ultimate energy source – in the solar system this is the sun

Ultra-violet radiation – a form of dangerous radiation, part of the sunshine

Upthrust – an upward force of water, pushing objects up

Vapour – a substance in the state of a gas, below the boiling point of the liquid

Vegetables – a non-scientific name for certain foods from plants, e.g. cabbage, carrot, onion, yam

Vitamins – nutrients that are essential for good health, protective nutrients. They are only needed in small amounts

Water – a compound that exists on Earth as a liquid, a solid (ice) and gas (water vapour and steam). Two thirds of the Earth’s surface is covered by water

Water cycle – the continuous movement of water vapour from the Earth’s surface into the atmosphere and back again, as rain, snow and hail

Weather – the hour by hour changes in atmospheric conditions in any place

Weather elements – rain, temperature, wind and clouds are some of the elements

Weather forecast – predictions of the future weather conditions

Weather instruments – devices used to make observations of the weather elements

Weather symbols – symbols used on weather maps to indicate the conditions of the weather elements

Weight – the force produced by the action of gravity on the mass of an object

Wind direction – the direction from which the wind is coming

Wind speed – the speed at which air is moving over the surface of the Earth, e.g. 30 km/hour

Wind vane – an instrument that shows the direction from which the wind is blowing

Work – this is the product of a force acting to move something over a distance
Acid rain – rain polluted with gases from burning oil, gas and coal
Addictive – making the person dependent, unable to live without the substance
Anchorage – holding on to the soil that prevents the plant falling over
Anther – the part of the flower that makes pollen, the male sex cells
Auditory nerve – the nerve from the ear to the brain, which carries the impulses generated by sounds
Aurally challenged – unable to hear sounds across the normal range of pitch and volume
Bladder – the elastic bag in which urine is collected before being released from the body
Carbon cycle – the circulation of carbon from the atmosphere into living things and, after their death, back again
CFCs (chlorofluorocarbons) – chemicals used in refrigerators, aerosols, cleaning fluids and plastics. They damage the ozone layer and are banned in some countries
Communicable disease – also called infectious disease because the virus, bacteria or parasites causing the disease can be passed on (communicated) to another person in various ways
Cornea – the transparent ‘window’ that covers the front of the eye
Decibel (dB) – a measure of sound volume, the level of sound
Deforestation – cutting all the trees in an area and leaving the land in danger of erosion
Drug – any substance, other than food, that causes changes in the body, when it is swallowed, inhaled or applied to the body
Drug abuse – using drugs for the wrong purpose, or in doses that are excessive
Drug use – the use of drugs, either as medicines or for the effects they have on feelings
Ear drum – the thin membrane (skin) at the bottom of the ear canal, which vibrates when sound waves hit it
Egg – the female sex cell, made in the ovary
Endangered species – any plant or animal that is in danger of being made extinct
Environment – the surroundings in which organisms live, including the weather, soil and competition with other organisms
Epidemic – an outbreak of a disease amongst people in a particular area, limited in area and time
Excretion – the process of removing waste products from the body. Includes urinating, sweating and breathing
Eyesight – the ability to see
Faeces – solid undigested food materials that are pushed out of the body through the anus
Fertilisation – the process of combining the male and female sex cells
Gaseous exchange – a process that occurs in the lungs, when oxygen is absorbed into the blood and carbon dioxide is removed from it
Greenhouse effect – the natural trapping of the sun’s energy by the earth’s atmosphere. Burning fossil fuels has increased this effect and global warming has resulted
Hearing aid – a device that helps a person to hear
Illuminated – lit by light from a source such as a candle or torch
Inner ear – the innermost part of the ear, where the vibrations heard as sounds are converted into nerve impulses and sent to the brain
Insect pollination – the transfer of pollen onto the stigma, which is done by insects visiting the flower
Intestine – the part of the digestive system where most of the processes of digestion and absorption take place
Iris – the coloured part of the eye, which can expand and contract to control the amount of light entering the eye
Joint – a point in the skeleton where two bones meet and are joined in a way that allows movement, e.g. knee, hip, jaw
Kidney – the excretory organ that removes urea and other materials from the blood, producing urine
Lens – the part of the eye that focuses the light entering the eye to produce an image on the retina
Lenses – the plural of lens
Liver – a large organ with many functions connected with nutrition, including the excretion of waste products into the intestine, or the blood. It is above the stomach and below the lungs
Locomotion – movement from one place to another, e.g. walking, hopping

Luminous – producing light, a light source

Middle ear – the part of the ear containing the ear bones, connecting the ear drum to the inner ear

Mirage – an image of water or an object in the distance, which is an illusion caused by the refraction of light passing through hot air

Mirror – a surface that reflects an image of an object in front of it

Misperception – when the sensation detected by the sense organ is wrongly interpreted by the brain, e.g. a mirage, the direction of a sound

Muscle – tissue that can contract and relax. Bundles of this tissue are attached to bones and produce movement. Muscle is also present in other organs where movement is necessary, e.g. the heart, eyeball, digestive system

Non-luminous – not producing light

Opaque – light does not pass through

Optical illusion – image that tricks the eyes, appearing different to what it is

Optic nerve – the nerve that connects the eye to the brain and carries the impulses generated by light in the eye

Organ – a part of a plant or animal that has a particular function, e.g. flower, brain

Outer ear – the flaps of cartilage and skin on the sides of the head that help to pick up sounds, but have no sense of hearing

Ovaries – a pair of small organs inside female animals and humans that make the eggs (the female sex cells)

Ovules – the female sex cells made in the ovary of a plant

Ozone layer – a layer of ozone gas high up in the atmosphere that protects the Earth from the Sun’s very dangerous ultra-violet radiation

Pandemic – a worldwide outbreak of an infectious disease, which continues for a long period over a wide area

Penis – the male reproductive organ that delivers the sperm inside the female vagina. It is also used for urination

Perception – an awareness; detecting and interpreting information about the surroundings

Pesticides – chemicals used to kill insects, weeds, fungi or other pests

Petals – the part of the flower that is often colourful, large and attractive to insects, surrounding the reproductive organs

Pollen – the male sex cells of flowering plants, made in the anthers

Puberty – the period in the human life cycle when the reproductive system begins to function, i.e. eggs or sperm are made

Pupil – the hole at the front of the eyeball through which light enters the eye

Range of hearing – the sounds, from the highest to the lowest pitch, that any particular animal can hear

Range of vision – the distance over which any particular animal can see

Rectum – the last part of the digestive system, where faeces collect before being pushed out through the anus

Reflection – bouncing back. Light hitting a surface is more or less returned (reflected), or absorbed

Refraction – bending light as it passes from one material to another, e.g. air to water, air to glass. It may lead to the separation of the colours in light to produce the rainbow effect

Reproduction – the process in living things that produces new individuals

Reproductive – concerned with or relating to reproduction

Retina – the inner lining of the eyeball, which is sensitive to light

Root – the part of the plant that absorbs water and minerals from the soil and anchors it

Scrotum – a bag of skin between the legs of boys and men, which contains the testes

Sensory aids – any device that supports the function of a sense organ, to improve its performance, e.g. spectacles, hearing aid

Sepals – the outer part of a flower. They are often green and cover the petals when the flower is closed in the bud

Sexual intercourse – the process by which the penis delivers sperm inside the vagina

Shoot – the part of the plant that connects the roots to the leaves, through which water, minerals and food travel

Skeleton – the framework of bones on which the body is built. It allows movement and provides support and protection

Smog – a mixture of fog, smoke and chemical fumes

Sound transmitters – any object or material through which sound can travel

Sperm – the male sex cells, which are made in the testes

Stigma – the female sex organ in a flower, which has a sticky surface to trap the pollen grains

Sustainable development – using the natural
environment in ways that do not destroy its
resources, e.g. soil, water, air, living organisms

**System** – parts that are related to one another by their
function, e.g. the nervous system consists of brain,
spinal cord, nerves and sense organs

**Testes** – a pair of small organs in male animals and
humans that make the sperm. In humans they are
housed in the scrotum

**Toxic** – poisonous

**Translucent** – some light passes through but we cannot
see a clear image through such material

**Transparent** – light passes straight through and we can
see through such material

**Urea** – a waste product that is disposed of in the urine
that is produced by the kidneys

**Urine** – a pale yellow liquid excreted by the kidneys
to remove waste products from the body

**Uterus** – the womb, the organ in female humans and
other mammals, where the baby grows and
develops before birth. Part of the reproductive
system

**Vagina** – the tube that connects the uterus to the vulva
in female humans and other mammals. Part of the
reproductive system. The penis delivers sperm into
the vagina

**Vision** – the ability to see, sight

**Visually challenged** – unable to see normally over the
range of distances and colours

**Vulva** – the external sexual organs in female humans
and other mammals, the opening to the vagina

**Water cycle** – the continuous movement of water from
the Earth’s surface into the atmosphere as water
vapour and back again as rain, snow, hail and dew

**Weather patterns** – repeated features of elements of
the weather in a particular area, e.g. rainfall,
temperature
longer, fatter and stiffer) and it is pushed through the opening of the vulva into the vagina. The movement of the penis during sexual intercourse leads to millions of sperm being pushed out from the penis into the vagina.

If there is an egg in one of the tubes leading from the ovaries to the uterus, then it may be found by a sperm cell and fertilised. If this happens, the egg then settles in the uterus and begins its growth and development into a new human being. This process is called pregnancy and it lasts about nine months.

When the baby is fully developed it has to leave the body of its mother. This is when the vagina and vulva carry out their second function. They can both stretch wide enough for the baby to come out from the mother’s body. It is delivered through the vulva and begins its independent life as a new human being.

Activity 12

1. Discuss with your group which system you will investigate using the resources available.

2. Share out the work of collecting detailed information about your chosen system.

3. Make notes and drawings as records of what you find out.

4. Produce a display of your findings to share with the class. Answer any questions that other pupils may have.

5. Look at the displays of work from other groups and ask them questions about what you see.
The pictures show the different ways in which diseases can be communicated/transmitted. Match the methods with the names of the diseases listed below. Write down the letters on the pictures and the names of the diseases.

measles   TB   flu   AIDS   dysentery   malaria   food poisoning

Our bodies are open to the outside world. We have many holes through which we can be invaded by other organisms, which can then live in our bodies.

We cannot stop breathing: we have to take in air all the time and this gives some organisms the chance to be carried into our mouths, noses and lungs. Flu, the common cold and TB are examples of diseases that use this route into our bodies, in contaminated air.

We cannot stop eating: we have to take food into our bodies every day and this gives other organisms their chance to get inside us. They are carried in the food. Some types of worms, plus the germs that cause food poisoning and dysentery can be passed on in this way. Flies can carry the germs from place to place, landing on faeces from infected people and then on our food.