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This Teaching Guide has been written with the purpose of assisting teachers in transmitting concepts clearly, correctly and effectively in a limited period of time. Ideas to begin, build and conclude a lesson have been given; yet, these are not the only and best way to teach. A good teacher comes up with new ideas and strategies.

When teaching science, in fact any subject, to young pupils, one must never forget that pupils at this stage can only make sense of concrete things and not abstract ones. For example, during a lesson on air, if they do not actually experience the air in a balloon being released, causing it to deflate, they will never truly understand the concept of air since they cannot hold or see it.

A successful teacher uses a number of strategies in the classroom:

• **Posing questions and inviting pupils’ questions**

In order to keep the pupils engaged in the class, ask short, relevant questions. Write a summary of different responses on the board and then sum it up. For example:

*When you look in the mirror, what do you see?*

Expected responses are: *I see myself.*

  *I see my body.*

  *I see my face, eyes, nose…*

Write the responses on the board and then sum up. e.g. *We see our body, face, eyes, nose in the mirror.* Before beginning a lesson, tell the class the topic and then ask them to think of any question that comes to their mind regarding it.

• **Conducting interactive demonstration**

The teacher should be well aware of the purpose of the demonstration and should have conducted it *beforehand* to ensure that the results are as desired. Ask a question and have the pupils predict the outcome of the demonstration. They could respond before or after discussing with another child. For example:

*Which one do you think will sink in water; an egg or an egg shell?*

There could be various responses to this. Practically demonstrate and then conduct a class discussion. Conclude the discussion by summarizing all the ideas shared.
Using cooperative learning in the classroom

Two examples of cooperative learning strategies are described below:

**Think-Pair-Share**

Begin by first posing a question to the class that requires the pupils to think critically.

a. **Think**

Give a certain specified amount of time to the class to think alone about the answer to the question. Pupils will write their own answer.

b. **Pair**

Pupils pair up with a partner to discuss the question, listen to, and expand on one another’s ideas.

c. **Share**

Pupils share their answers to the question with the entire class.

**Jigsaw**

Research shows that pupils learn best when they teach others what they have learned. Jigsaw helps pupils learn and teach one another. It has four steps:

1. Form cooperative groups called HOME groups with each group member being given different material to read or learn. For example, the first group member is given page 1 of an assigned text, the second member page 2, etc.

2. **EXPERT** groups are formed by grouping pupils with the same assigned material together. This group must study the material together and plan ways to teach the material to their HOME group members and check for understanding.

3. Pupils return to their own HOME groups and take turns teaching their HOME group members the material they were assigned and are now experts on. The goal is that every member of the group should master all the material presented.

4. Check how well the pupils have worked together by taking a quiz or asking them to make a presentation.

**How to do Circus Format Activity**

This activity usually requires two consecutive periods.

Arrange some tables and chairs (according to the number of pupils) in the class. Name each table as a ‘station’.

Activities must relate to the current topic. Instructions must be written along with the activity. If the pupils are young, give them verbal instructions. Remind the pupils to handle things with care and to leave the station as soon as the bell rings.
Grouping the class

Arrange the pupil into five groups according to the strength of your class.

Allocate time (usually five minutes).

- Group 1 will sit at station 1.
- Group 2 will sit at station 2.
- Group 3 will sit on station 3.
- Group 4 will sit on station 4.
- Group 5 will sit on station 5.

Pupils will perform the activities and record their observations in their notebooks. After five minutes, ring the bell.

- Group 1 will move to station 2.
- Group 2 will move to station 3.
- Group 3 will move to station 4.
- Group 4 will move to station 5.
- Group 5 will move to station 1.

In the same way, pupils will perform all the activities, moving from station to station.

At the end of the activity, they will give a presentation on what they learned. Give them ten minutes to prepare for their presentations.

Presentations:

- Group 1 will give presentation on station 1 activity.
- Group 2 will give presentation on station 2 activity, and so on.

You can give your input where necessary, encouraging them with prompting words, etc.

In this entire process, the primary objective is that the pupils are actively involved in the learning process and are not being ‘lectured’. In all cases, do not begin to read the lesson from the textbook before you begin a discussion leading up to it. Reading the text comes after the discussion and brainstorming has taken place.

Using the photocopy masters

The worksheets are a reinforcement of the lesson and can be used for homework or classwork.
Unit 1

Building units of the body

**Teaching objectives:**
- To introduce the cell as the basic building block of life
- To define with examples, and to compare, unicellular and multicellular organisms
- To name and explain the functions of some basic organelles of animal and plant cells
- To compare animal and plant cells

**Key vocabulary:** organelle, nucleus, vacuole, chloroplast, cell wall, cell membrane, cytoplasm, microscope

**Materials:** microscope, prepared slides of animal and plant cells, cut-outs of cell parts, removable labels of cell parts, outline of cell on a large poster, markers, coloured pencils, glue stick

**Advanced preparation:**
- Prepare cut-outs of cell parts on coloured paper; place the slides of animal and plant cells onto the microscope before the lesson.
- Collect empty match boxes, join them together with sticky tape, and wrap them in a sheet of paper. Paint or draw bricks on it to resemble a brick wall.

**Lesson 1: 40 min**

**Introduction:** 5 min
- Show the pupils the ‘brick wall’ that you have prepared. *Bricks are the building units of this wall.*
- Introduce the term *cell.* Explain: *Just as a wall is made of small units called bricks, living things are made of small units called cells. They are so small that you need a microscope to view them. Animals and plants are made of cells. Cells form the basic ‘building blocks’ of living things. Some cells have specialized functions. Organs are made from tissues, and systems are made from several organs working together.*

**Main teaching:** 30 min
- Ask the pupils to guess how many cells an organ is made up of. Explain that all living organisms are made up of millions of cells.
• Now cut a leaf into pieces so tiny that you can cut them no smaller. Explain that even the smallest piece of leaf is made up of thousands of cells.
• Introduce the terms unicellular and multicellular organisms. Ask the pupils to find out the meanings of the terms and share their ideas with the class.
• Discuss unicellular and multicellular organisms:

  **Unicellular organisms** are made up of a single cell, e.g. amoeba. Such organisms are so tiny that they can only be observed through a microscope.

  **Multicellular organisms** are made up of many cells of different types, e.g. humans, other animals, plants and fungi. Such organisms are usually large in size, have specialized functions, and can actually grow in size.

• Direct the pupils to the prepared slides of animal and plant cells on the microscopes. They should be labelled as A and B, but not identified as plant or animal cells.
• Explain that they are going to observe two cells; cell A and cell B.
• Allow them to observe the slides and draw their observations in their notebooks. Ask a few pupils to share their drawings with the rest of the class.
• Now display the large chart of a cell on the board. Stick the cut-outs of the parts of the cell in the correct places, remembering to attach the removable labelling also.
• Finally, read and discuss the lesson on pages 2-4 of the textbook.

**Wind up: 5 min**
• You can prepare a parcel game. Write some questions related to the parts of the cell and their functions on slips of paper. Put the slips inside an empty box. Tell the pupils that they are going to play “Pass the parcel”. Give the box to the first pupil and begin to clap. As soon as you stop clapping, the pupil who is holding the box should take out a slip and attempt to answer the question written on it.
• Alternatively, ask the pupils to attempt Exercise A on page 5.

**Lesson 2: 40 min**

**Introduction: 5 min**
• Recall what the pupils learned about cells in the previous lesson by asking them to attempt Exercise B on page 5 of the textbook.

**Main teaching: 30 min**
• Read and discuss the information provided on pages 3 and 4 of the textbook. Many new terms are introduced here, so go slowly, and help the students organize the information into a table like the one shown below. Include in it all the parts of both animal and plant cells.

<table>
<thead>
<tr>
<th>Part of cell</th>
<th>Function</th>
<th>Found in</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g. nucleus</td>
<td>carries information and controls what happens inside the cell.</td>
<td>plant and animal cells</td>
</tr>
</tbody>
</table>
• It is easy to explain the different parts of a cell with the help of a diagram. Draw diagrams on a large sheet of white card paper, labelling them Plant cell and Animal cell. Attach the card paper to the board and draw the two different cells using coloured markers.
• Make sure you label the diagrams of animal and plant cells, like these shown below:

```
Animal cell:
- Cell membrane
- Cytoplasm
- Nucleus

Plant cell:
- Cell membrane
- Cytoplasm
- Nucleus
- Chloroplast
- Vacuole
- Cell wall
```

Wind up: 5 min
• Explain that the following perform the same functions in daily life as some of the cell parts.
  1. Traffic constable (nucleus)
  2. Mineral water bottles (vacuole)
  3. The Sun (to show the presence of chloroplast)
  4. Brick wall (cell wall)
  5. A door (cell membrane)
• Stick them on the board one by one and ask the pupils to match them with the relevant cell parts.

EXERCISE (pages 5–6)
C  1. The amoeba is a unicellular organism that lives in water and wet soil.
   2. Cells make up living things in the same way that bricks are used to build a house.
3. Venn diagram

```
Features found
in animal cells

<table>
<thead>
<tr>
<th>Features found</th>
</tr>
</thead>
<tbody>
<tr>
<td>cell membrane</td>
</tr>
<tr>
<td>vacuole</td>
</tr>
<tr>
<td>cytoplasm</td>
</tr>
<tr>
<td>nucleus</td>
</tr>
</tbody>
</table>

Features found
in plant cells

<table>
<thead>
<tr>
<th>Features found</th>
</tr>
</thead>
<tbody>
<tr>
<td>vacuole</td>
</tr>
<tr>
<td>cell membrane</td>
</tr>
<tr>
<td>cell wall</td>
</tr>
<tr>
<td>nucleus</td>
</tr>
<tr>
<td>cytoplasm</td>
</tr>
</tbody>
</table>

Common features

<table>
<thead>
<tr>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>It allows certain materials to go in and out of the cell.</td>
</tr>
<tr>
<td>It absorbs the Sun’s energy and helps the plant to make its food.</td>
</tr>
<tr>
<td>It stores food, water, and waste substances.</td>
</tr>
<tr>
<td>All the organelles are suspended or floating in it.</td>
</tr>
<tr>
<td>It controls all the activities of the cell.</td>
</tr>
</tbody>
</table>
```

4. 

### Organelles | Functions
--- | ---
Cell membrane | It allows certain materials to go in and out of the cell.
Chloroplast | It absorbs the Sun’s energy and helps the plant to make its food.
Vacuole | It stores food, water, and waste substances.
Cytoplasm | All the organelles are suspended or floating in it.
Nucleus | It controls all the activities of the cell.

5. Pupils’ work will vary. Pay close attention to ensure correct labelling of the diagrams.

**ACTIVITY (page 7)**

1. a) The cut edges of tin can be very sharp. It is best to come to class with a number of pieces already cut to size, but demonstrate on at least one piece and show the children how a piece of tin can be cut with a tin cutter.

b) If a hole is made in the tin while it is on a desk, you will ruin the desk as the nail will go into it.

c) The grease is to keep the drop of water there: the water will not drop through the hole too easily.

d) Only one drop is necessary.

e) Make sure there is sufficient light in the classroom.

f) The setting up of all this takes some time and patience. If the children cannot see anything at first, try again. The point of focus will vary, so experiment, by pressing on the tin to increase or decrease the height of the ‘lens’. 
Unit 2
The brain

Teaching objectives:
• To emphasize that the brain is a very important organ of the body
• To identify its location in the body and its three main parts
• To describe its appearance and its structure
• To explain the distinct functions of the three main parts of the human brain

Key vocabulary: cerebrum, cerebellum, medulla

Materials:
• model and chart of brain
• If possible, provide a real sheep’s brain for the pupils to observe.

Lesson 1: 40 min

Introduction: 5 min
• Call up one pupil and blindfold him/her. Ask him/her to touch any warm or cold object.
  What have you touched?
• Now ask him/her to smell a fruit, perfume, an onion, etc. Can you identify and describe the object that you can smell?
• Take away the blindfold. Ask: How were you able to recognize the objects when you could not see them? Explain: The human brain is the organ that makes us different from other living things. When you described the object that you could not see, the brain helped you to recognize, remember, and speak. When you touched an object, the brain sent signals informing you whether the object was hot or cold. The brain is the organ that is responsible for our:
  • thoughts
  • movements and actions (voluntary and involuntary)
  • feelings
  • memories
  • the five senses

Main teaching: 30 min
• Before reading the textbook, put up on the board a fact file chart with the appropriate headings.
• Read pages 8 to 10 of the textbook with the pupils and with their feedback, fill in the chart with facts about the brain.

What is the brain? ________________________________________________________________
What are its functions? ____________________________________________________________
It is divided into _________________________________________________________________
It is protected by _________________________________________________________________
Part 1 | Ourselves

Wind up: 5 min
- Ask questions to assess their learning:
  - *What is the brain?*
  - *Where is it located in the body?*
  - *How is it protected?*
  - *What are neurons?*

Lesson 2: 40 min

Introduction: 5 min
- Ask the pupils to make a list of the activities they do as daily routine.
- Write these activities on the board. Draw three columns and name them A, B and C. (At this stage do not write any other headings for these columns.)
- Write the activities which are controlled by the cerebrum in Column A. In Column B write those activities which are controlled by the cerebellum, and in Column C, write the activities which are controlled by the medulla. Involve the pupils when discussing their responses.
- Explain that since we have to perform so many different activities, our brain has different parts to control and to help us perform these. Now, name the columns accordingly.

Main teaching: 30 min
- Conduct the following short activities that should not take more than two minutes each.
  a) Recite a poem or read a few lines from a book to the pupils. *Which part of your brain was the most active when you were listening to this poem?* (cerebrum)
  b) Display a set of coloured pencils and ask a pupil to pick out a pencil of his/her choice. *Which part of the brain helped you to decide which colour to choose?* (cerebrum)
  c) Ask a pupil to bend down to touch his/her toes. *What part of the brain helped you to do this action?* (cerebellum)
  d) Give a pupil a biscuit to eat. *You swallowed the biscuit and now you are digesting it. Which part of the brain helps you to digest food?* (cerebellum)
  e) Ask a pupil to jog or exercise for a minute. *Which part of the brain helped you to do this?* (medulla)
- Feel your skull and ask the pupils to do the same. Explain: *Both the brain and the spinal cord are protected by bones: the brain by the bones of the skull, and the spinal cord by a set of ring-shaped bones called vertebrae.*
- Ask the pupils to put their two fists together to resemble the brain.
- Compare the brain with the computer. Some points of comparison that can be discussed are:
  a) A computer sends information through electric wires, while the brain sends signals through the nerves to the rest of the body.
  b) It is much easier and faster for the brain to learn new things, but it is difficult for it to do multi-tasking (the ability to do several things at the same time). The computer on the other hand, can do many complex tasks at the same time.
c) The brain records human feelings and thoughts, but the computer is a machine that has no feelings. It cannot feel anger, joy, fear, etc.

- Try to obtain a sheep’s brain from the butcher to show the class. This will give them a good idea of the appearance of the brain.

Wind up: 5 min
- The pupils should now, either independently or in pairs, be able to answer any of the related exercises on page 11 of the textbook.

EXERCISE (pages 10–11)

B 1. b) reproduce 2. a) cerebrum 3. c) cerebrum
   4. a) cerebrum 5. c) medulla
C 1. Neurons are the nerve cells which make up the brain. They are linked together to control all of the body’s activities.
   2. Discuss the points of comparison between the computer and the human brain, mentioned in this lesson plan and in the Teacher’s notes. Encourage the pupils to suggest others.
   3. The pupils can use the illustration of the human brain on page 9 of the textbook as a reference to draw their own illustration.
   4. Answers will vary. This can be an interesting exercise for the pupils, especially if they work in pairs. They will come up with some funny outcomes of having two brains.
   5. Answers will vary. The table below is a sample of possible responses.

<table>
<thead>
<tr>
<th>Cerebrum</th>
<th>Cerebellum</th>
<th>Medulla</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 reading a book</td>
<td>walking</td>
<td>breathing</td>
</tr>
<tr>
<td>2 solving a math problem</td>
<td>jumping</td>
<td>digesting</td>
</tr>
<tr>
<td>3 writing a story</td>
<td>taking exercise</td>
<td>heart beating</td>
</tr>
<tr>
<td>4 listening to music</td>
<td>running</td>
<td></td>
</tr>
<tr>
<td>5 eating my favourite dish</td>
<td>boxing</td>
<td></td>
</tr>
</tbody>
</table>

ACTIVITY (page 12)

1. The heading of this project can be ‘The cerebrum controls our feelings and actions’.
2. Neuroscience is the scientific study of the nervous system. Encourage the pupils to search the Internet to find out names of notable neuroscientists. You, as a teacher can also discover more about this specialized branch of biology, in order to help you discuss this topic with ease in the class.
3. Allow the pupils to discuss the causes and effects of fainting, giving them some time to give their own opinions. Explain that sometimes people can faint when not enough oxygen or blood supply is reaching the brain.
4. This is a game to improve visual short term memory skills. It is beneficial and is fun to play.
Unit 3
The lungs

Teaching objectives:
• To define respiration
• To explain in detail the working of the three main organs of the respiratory system
• To explain, using a diagram, the process of inhalation and exhalation
• To emphasize the harmful effects of tobacco on the health

Key vocabulary: inhale, exhale, ribcage, diaphragm, trachea, bronchi, alveoli, mucus, cilia, contract, expand

Materials needed: large chart of lungs, goat’s lungs, rubber pipe, tub of water, balloons, rubber bands, a two-litre plastic bottle, flexible plastic tubing, Y-shaped hose connector

Advanced preparation:
Arrange for goat’s lungs to be brought to the lab from the butcher before Lesson 2.

Lesson 1: 40 min

Introduction: 5 min

Exploratory activity
• Ask the pupils to draw an outline of the human body and trace the path of the air inside the body. Since this is an exploratory activity, the pupils should be given the freedom to draw their own understanding of the journey of air inside the body.
• Ask a few volunteers to share their ideas.

Main teaching
• Ask the pupils to take deep breaths. Do you know where the air that you breathe in goes?
Discuss: Why do we need to breathe? All the cells in our body require oxygen. Without it, they could not move, build, reproduce, or turn food into energy. In fact, without oxygen, we would die! How do we get oxygen? We get oxygen from breathing in air which our blood circulates to all the parts of the body.
• Show them a clearly-labelled diagram of the human lungs. The diagram on page 13 of the textbook can be enlarged and shaded lightly with coloured pencils to make it more eye-catching.
• Discuss: Just as the brain is an organ of the nervous system, the lungs are organs of the respiratory system. Here is a diagram of the lungs.
If you could see them, they would look pink and rubbery on the outside. Inside they look a lot like sponges. Air comes down the trachea, or windpipe, into two large tubes called the bronchi. One bronchus goes into the left lung and the other into the right lung.
• Each bronchus is rather like the trunk of a tree because it has what look like branches and twigs growing from it. The smallest ‘twigs’ are called bronchioles. They are so tiny that they are like hair.
At the end of these bronchioles there are little bunches called **alveoli**. These are sacs, or little bags, full of air. There are millions of them in the lungs, so you can imagine how very tiny they must be and what a powerful microscope you would need to look at them!

Draw the pupils’ attention to the diaphragm on the chart. **The diaphragm is a big sheet of muscle that is situated below the lungs. It helps to get air in and out of the lungs by moving up and down.**

Ask the pupils to find out the meaning of the term **respiration** from the dictionary or glossary and share it with the class.

**DART Activity**

Divide the pupils into small groups. Ask them to read pages 13–15 of the textbook, ‘The lungs’. Give them enough time to understand and absorb the content.

Put them into pairs and ask them the following questions based on the text, allowing them to discuss these with their partner.

a) **What is the function of the nose and trachea?** (They warm, moisten and filter the air.)

b) **What is in the trachea and the nose that helps them to perform their job?** (Tiny hairs called cilia, and a sticky substance called mucus, trap the dust and bacteria present in the air.)

c) **What is the diaphragm and what is its job?** (It is a muscle that helps the lungs to expand and contract.)

d) **What are bronchioles?** (They are smaller branches of the bronchi.)

e) **Where in the lungs does the exchange of gases take place? Explain the process of the exchange of gases.** (The exchange of gases takes place in the alveoli. Oxygen is absorbed into the blood, while carbon dioxide passes out of the blood into the air in the alveoli.)

f) **What happens to your lungs when you inhale and exhale?** (As we inhale oxygen, our lungs expand. When we exhale carbon dioxide, our lungs contract.)

**Wind up: 5 min**

Ask them to summarize what they have learned about the lungs in this lesson.

**Lesson 2: 40 min**

**Introduction: 5 min**

 Blow up a balloon and explain that the lungs work the same way when they take in air. **When people breathe in, their lungs expand.** Let the air out of the balloon and explain that when we breathe out, our lungs contract similarly to the way the balloon has deflated.

**Main teaching: 30 min**

Let the pupils experience how their lungs expand and contract. Ask them to put their hands on their chest and breathe deeply, so that they can feel their chest moving.

Explain effectively the functions of the diaphragm and ribs in inhalation and exhalation, with the help of a 3-D animation clip found at the various websites.

Show them the goat’s lungs. Keep the lungs in a tub of water.

Ask them to blow up the lungs using a rubber pipe and to observe how they expand and contract when they ‘inhale’ or ‘exhale’.
Wind up: 5 min
• Ask the pupils to attempt Exercise A on page 16 of the textbook. Alternatively, the related worksheet can be attempted.

Lesson 3: 40 min

Introduction: 5 min
• Review the main points of the topic by making a fact file of the lungs on the board with the feedback of the pupils:

<table>
<thead>
<tr>
<th>The lungs are:</th>
<th>Location:</th>
<th>Protected by:</th>
<th>Function:</th>
<th>Main organs:</th>
</tr>
</thead>
</table>

Main teaching: 30 min

Activity
a) Ask the pupils to work on Activity 1 on page 18 of the textbook. Detailed instructions for this activity are on page 12 of this guide.

b) Ask them to demonstrate how their model works.

• Engage them in a discussion about the harmful effects of smoking on the health.

As soon as people become regular smokers, they become addicted to the nicotine in cigarettes. This makes them want to continue smoking. There are many different chemicals in cigarette smoke, some of which are poisonous, and some can cause lung cancer.

What is passive smoking? When someone is smoking, the smoke they blow out into the air can be breathed in by anyone who is near them. The smoker is actively inhaling this poisonous smoke, while people near him are passive smokers. Although they are not smoking, they are actually inhaling the smoke of the active smoker. Passive smoking is as harmful as active smoking.

Wind up: 5 min
• The pupils can attempt any of the exercises on pages 16 and 17 of the textbook to reinforce the concepts that they have learned.

**EXERCISE (pages 16–17)**

A

B
1. mucus  2. diaphragm  3. trachea  4. oxygen, carbon dioxide  5. exhaled  6. alveoli or air sacs  7. ribcage

C
1. Respiration is the process of obtaining oxygen from the air and its use by cells to produce energy.
2. The lungs are located within the chest and are protected by the ribcage. The main function of the lungs is to provide the body with the oxygen it needs to produce energy from food.

3. Oxygen is needed to produce energy from food.

4. Mucus is a sticky substance produced by the nose and trachea. Its function is to trap dust particles and some bacteria before the air enters the lungs.

5. The tiny hairs in the trachea, called cilia, sweep out the dust caught in the mucus. They help to keep the lungs clean.

6. The diaphragm is a sheet of muscle which separates the lungs from the abdomen. It helps the lungs to expand and contract when we breathe in and out.

7. nose —— trachea —— bronchus —— lungs —— alveoli

---

**ACTIVITY (page 18)**

1. **Working model of the lungs**
   
   **Procedure**
   
   a) Gather the materials listed on page 8 of this Teaching Guide and refer to the diagram on page 18 of the textbook.
   
   b) Fit the plastic tubing into one of the openings of the hose connector. Use the tape to make an airtight seal around the area where the tubing and the hose connector meet.
c) Place a balloon around each of the remaining two openings of the hose connector. Tightly wrap the rubber bands round the places where the balloons and hose connector meet. The seals should be airtight.

d) Measure two inches from the bottom of the 2 litre bottle and cut off the bottom.

e) Place the balloons and hose connector structure inside the bottle, threading the plastic tubing through the neck of the bottle.

f) Use the tape to seal the opening where the plastic tubing goes through the narrow opening of the bottle at the neck. The seal should be airtight.

g) Tie a knot at the end of the remaining balloon, and cut the large part of the balloon in half, horizontally.

h) Using knotted half of the balloon, stretch the open end over the bottom of the bottle.

i) Gently pull down on the balloon from the knot. This should cause air to flow into the balloons within your lung model. What did you observe?

j) Release the balloon with the knot and watch as the air is expelled from your ‘lung’. What did you observe?

2. Your breath contains water vapour. When this water vapour comes into contact with a cold surface, such as a windowpane, it condenses, forming many small water droplets on the glass.

3. People breathe in water when it accidentally goes into the windpipe rather than into the food pipe. Discuss any experiences pupils may have had of accidentally breathing in water.

4. The pupils should prepare their own anti-smoking posters.

5. The health of our lungs and the entire respiratory system is affected by the quality of the air we breathe. In addition to oxygen, this air contains other substances such as pollutants, which can be harmful. Some health problems caused by air pollution are difficulty in breathing, wheezing, and coughing.

Unit 4

The human heart

**Teaching objectives:**
- To introduce the heart as a muscular organ which pumps blood around the body
- To explain the structure of the heart and identify its components
- To introduce, step by step, the basic process of the circulation of the blood in the heart

**Key vocabulary:** chamber, atrium, ventricle, valve, septum, stethoscope, heartbeat, pulse rate

**Materials:** chart of heart, stethoscope, stop watch, goat’s heart, magnifying glass, red and blue inflated balloons

**Optional:** Invite a heart specialist as a guest speaker to talk to the pupils about some heart disorders and to give some practical advice on how to help keep the heart healthy.
Lesson 1: 40 min

Introduction: 5 min

- Ask the pupils to make a fist with their hand, and to hold it between their lungs. Model this to them. Ask them which organ in the body is about the size of a fist. Explain: The heart is about the size of your fist and is located between your lungs. It is a muscular pump whose function is to pump blood to all parts of the body. The blood carries oxygen from the air we breathe, and nutrients from the food we eat, to all of the cells of the body. The blood travels through tubes called blood vessels. There are two kinds of blood vessels, arteries and veins. Sometimes we can see the arteries and veins in our arms and hands.

Main teaching: 5 min

- Explain that by checking their pulse, they can find out how many times their heart beats each minute. Help the pupils find their pulse by placing the index and middle fingers of their right hands on their left wrists, on the side nearest to the thumb. This could be challenging for some pupils, and you will have to circulate and help them. If they cannot find it in the wrist, see if they can find it in the throat.
- Once all of them have found their pulse, ask them to count the number of times the pulse beats in 15 seconds. Record the numbers in a table on the board. Ask the pupils to predict what will happen to their pulse rate when they exercise. Will it get faster, slower, or stay the same? The pulse rate increases while exercising.
- Explain: Even in your sleep, the heart keeps beating, or pumping blood. If it stopped, a person would quickly die.

    The heart is divided into two sides, separated by the septum. The left side of the heart is filled with oxygen-rich (oxygenated) blood, while the right side of the heart is filled with oxygen-poor (deoxygenated) blood. Each side of your heart is divided further into two chambers known as the atrium, and the ventricle, which means there is a total of four chambers in the heart.
- Read pages 19 and 20 of the textbook.

Wind up: 5 min

- Explain, step by step, the structure of the heart in order to review all that the pupils have learned in this lesson.
  a) The heart has four chambers.
  b) The two atria collect the blood.
  c) The two ventricles pump the blood out of the heart.
  d) The valves prevent the blood from flowing backwards.
  e) The septum separates the two sides of the heart.
- Remind the pupils of the process of the exchange of gases taking place in the alveoli. The right side of the heart pumps deoxygenated blood (blood containing no oxygen) to the lungs to pick up oxygen. The left side of the heart pumps the oxygenated blood from the lungs around the body.
Lesson 2: 40 min

Introduction: 5 min
- Review the vocabulary of this topic which was introduced in Lesson 1.
  1. the heart – a powerful involuntary muscle that pumps blood round the body
  2. the circulatory system – a network of veins and arteries that distributes blood throughout the body
  3. blood vessels – interconnected tubes that carry blood throughout the body
  4. arteries – vessels that move blood away from the heart
  5. veins – vessels that return blood to the heart
  6. pulse – caused by blood stopping and starting as it travels through arteries in the body
  7. valves – control the flow of blood in the right direction

Main teaching: 30 min
- Engage the pupils in a discussion about the heart. Ask the following questions to lead the discussion:
  What is the heart?
  What is its function?
  Why is it important for blood to circulate to all the parts of the body?
  How does the heart pump the blood?
  What is a heartbeat?
  Does the heart always beat at the same rate?
- Ask the pupils to construct a flow chart on the board to show the flow of the blood through the heart. Pupils should take turns to add one step in the correct order. For example, if the first pupil writes, ‘Blood enters the right atrium from the body’, the next one should write where the blood goes when it leaves the right atrium, and so on.
- Show the class a stethoscope. What is this instrument called? What is it used for?
- Let each child listen to his/her heartbeat. Ask: Can you describe what you heard? You hear two sounds during every heartbeat. Doctors call them ‘lub-dub’ noises. Your pulse tells you how fast your heart is beating. The throb you feel is the blood rushing through the blood vessels with each heartbeat. During exercise, your heart beats faster in order to pump more blood. When you stop, your heart rate slows down again.
- Ask the pupils to list some activities that they think may increase a person’s heart rate.

Group Activity
- For this activity the pupils will need stop watches, stethoscopes, and their notebooks to record their observations.
- Arrange the pupils in groups of four or five and give each group some watches with the seconds’ hand.
- Ask them to write their prediction about what change will they observe in the heartbeat or pulse rate before and after running. Will it increase or decrease?
Part 1 | Ourselves

- Explain to the pupils that they have to take each other's pulse.
- Ask them to draw a table in their notebook to record their partner’s pulse rate and heartbeat before and after running.
- Ask them to record the pulse rate and heartbeat of their group members before leaving the class for the outdoor activity. This will be counted as the resting heart beat and pulse rate.
- Now take the pupils to an open area.
- Ask them to run on the spot for 25 seconds and then take each other’s pulse again.
- Ask the pupils to complete the table by adding the new heart and pulse rates, and to share their results with the other groups.

Wind up: 5 min
- Ask them about the pulse rate. How does your pulse rate change when you do exercise or run? Why does this happen?

Lesson 3: 40 min

Introduction: 5 min
- Ask the pupils to recall what they have learned about the heart so far.

Main teaching: 30 min

Demonstration: Dissection of a heart
- Arrange for a goat’s heart to be bought from the butcher. Wear gloves and cut open the heart to show the chambers and the valves.
- Wash your hands thoroughly with soap after the activity.
- Give the pupils magnifying glasses so that they can examine the inside of the heart.
- After they have done this activity, and washed their hands thoroughly, ask them to perform the following role-play that will take only a few minutes.

Role-play
- Show the pupils a diagram of the circulatory system and explain that they are going to turn the room into a circulatory system.
- Ask for volunteers to be the lungs, capillaries, left chamber of the heart, and right chamber of the heart. Discuss with them where they should stand and what their jobs will be.
- Explain to the remaining pupils that they represent the blood in the circulatory system.
- Ask the pupils to follow you through the classroom circulatory system, exchanging the inflated red balloons (oxygen) for blue balloons (carbon dioxide) and explain what is happening along the way. The red balloons should move from the heart to other parts of the body. The blue balloons should move from different parts of the body to the heart and lungs.
- Once everyone is back at the starting point, ask them to follow you through the sequence again, but faster, and explain that this represents a faster heartbeat.
- Collect all the balloons and let the pupils return to their seats.
Wind up: 5 min

- The pupils should now be able to attempt to answer any of the questions on page 21 of the textbook.

**EXERCISE (pages 21–22)**

A

1. E  
2. A  
3. D  
4. B  
5. C

B

1. a  
2. b  
3. c  
4. c  
5. c  
6. b  
7. a

C

1. The function of the heart is to pump oxygenated blood to all parts of the body.
2. a) Oxygenated blood means blood rich in oxygen. It is also called pure blood.
   b) Deoxygenated blood means blood which has more carbon dioxide and less oxygen. It is also called impure blood.
3. The lungs play an important role in the circulation of blood. The exchange of gases takes place in the lungs: oxygen is absorbed into the blood and carbon dioxide is released from the blood.
4. a) The pulmonary artery takes the deoxygenated blood from the heart to the lungs.
   b) The pulmonary vein takes the oxygenated blood from the lungs to the heart.
   c) The aorta is the largest artery of the body and sends blood to all parts of the body.
   d) The coronary artery provides the blood to the heart.
5. Answers will vary. The following are some suggested ways:
   1. Eat a balanced and healthy diet.
   2. Exercise regularly or be physically active.
   3. Do not smoke.
   4. Maintain a healthy weight.
   5. Be screened by your doctor to determine your risk of heart disease. Know your blood pressure and cholesterol level.
   6. Reduce intake of fizzy drinks and energy drinks.
Unit 5
Digestion

Teaching objectives:
• To explain the digestive system
• To identify all the organs that make up the digestive system and explain their functions
• To explain the digestion process with the help of a diagram

Key vocabulary: digestion, saliva, oesophagus, stomach, digestive juices, hydrochloric acid, intestine, pancreas, gall bladder, liver

Materials: a biscuit and a large, clearly-labelled diagram of the digestive system

Lesson 1

Introduction: 10 min
• For the sake of continuity and to optimize learning, the introduction to this topic should be spread over two consecutive periods.
• Engage the pupils in a discussion in order to recall their existing knowledge about food. Why do we need food? What types of food should we eat? How does food provide energy to the body? Revise the role of the blood in providing energy to the body. Oxygenated blood is needed to produce energy from food.

Main teaching: 60 min

Exploratory activity
The journey of a biscuit inside the body
• Show the pupils a biscuit. Ask them to draw an outline of a human body in their notebooks and mark on it the journey of this biscuit inside the body. Since this is an exploratory activity, the pupils should be given the freedom to draw their own understanding of the biscuit’s journey inside the body.
• Ask a few volunteers to share their ideas.
• Divide the pupils into small groups. Ask them to read pages 23 and 24 of the textbook and discuss with their group some questions which the teacher should write on the board in advance. These questions are basic, but they will help to build the pupils’ understanding of the process of digestion.
  a) What does food contain? (nutrients)
  b) What is meant by the digestion of food? (It is the breaking down of food into substances which can be absorbed by the cells.)
  c) Name some organs that make up the digestive system. (liver, kidneys, pancreas, gall bladder, large and small intestines)
  d) Which two organs help to push the food down into the stomach? (the tongue and the oesophagus)
e) Where is food stored in the body? (in the stomach)
f) How do the juices and the acid released by the stomach help in the digestion of food? (The digestive juices help to soften the food and the acid kills harmful bacteria.)
g) What happens to food that cannot be digested? (It is flushed out of the body through the large intestine.)

Why is digestion important?

Explain: When you eat foods such as bread, meat, and vegetables, they are not in a form that the body can use as nourishment. Food and drink must be changed into smaller molecules of nutrients before they can be absorbed into the blood and carried to cells throughout the body. Digestion is the process by which food and drink are broken down into their smallest parts, so the body can use them to build and nourish cells and to provide energy.

The stomach

The stomach, which is attached to the end of the oesophagus, is a stretchy sack, shaped like the letter J. It has three important jobs:
1. to store the food you have eaten
2. to break down the mixture into a soft pulp
3. to slowly push the food into the small intestine

Wind up: 10 min
• Ask the pupils to draw the journey of the biscuit again in their notebooks and check if their drawings are more accurate after the learning activity.

Lesson 2: 40 min

Introduction: 5 min
• Review the key points of this topic:
  Each organ of the digestive system works to help in the digestion of food. What is the job of the saliva?........the tongue?....the oesophagus? Continue to recall the tasks of all the digestive organs.

Main teaching: 5 min
• Bring the focus of the lesson to the role of the kidneys, pancreas and the liver by reading about them on page 24 of the textbook. Ask the pupils to draw and complete a table like the one shown below.

<table>
<thead>
<tr>
<th>Organ</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>kidneys</td>
<td></td>
</tr>
<tr>
<td>pancreas</td>
<td></td>
</tr>
<tr>
<td>liver</td>
<td></td>
</tr>
</tbody>
</table>

• The information in the Do you know? feature should be of interest to the pupils. Explain that every morsel of food we eat has to be broken down into nutrients that can be absorbed by the body, which is why it takes many hours to fully digest food.
• To assess their understanding of the digestive system, ask the pupils to complete Exercise A and the related worksheet.
Wind up: 5 min
Write the process of digestion on the board in the incorrect sequence. Ask the pupils to correct the sequence.

**EXERCISE (pages 25–26)**

A  The mouth has special glands that produce saliva which softens and moistens food. The tongue pushes the food into the throat, from where it passes into a tube, called the oesophagus. It is then pushed into the stomach which works like a mixer. The stomach releases hydrochloric acid which kills harmful bacteria. The food now enters a long, narrow tube called the small intestine. Here, more juices are added to the food by other organs like the liver, the pancreas and the gall bladder. Now the food gets absorbed into the blood, while the waste material is passed into the large intestine.

B  1. b) digestive system
2. c) stomach
3. a) mouth
4. c) simply moved to the next organ
5. c) is absorbed into the blood
6. c) small intestine
7. b) large intestine

C  1. We need to digest food because food cannot go straight to the cells. It has to be broken down into simpler substances so that it can be absorbed into the blood easily.
2. a) The muscles of the oesophagus squeeze and relax to push the food into the stomach.
   b) Food is stored in the stomach where it is mixed with some digestive juices and hydrochloric acid. The juices and hydrochloric acid help to soften the food. The acid kills the harmful bacteria present in the food.
   c) In the small intestine, more juices that are produced by the liver, pancreas and gall bladder are added to the food. These juices make the food even softer and simpler. Then the food is absorbed into the blood through the walls of the small intestine.
3. Saliva helps to moisten and soften the food and starts the digestion of starches.
4. The kidneys help to remove the waste materials and excess water from the body.
5. The digestive juices in the small intestine come from other organs such as the liver, pancreas and gall bladder.
6. The pupils should draw a neat, clearly-labelled diagram of the digestive system.

**ACTIVITY (page 26)**

1. The pupils will enjoy this piece of writing where they will describe the journey of a sandwich bite inside the body. It would be helpful if the teacher could provide them with an opening line, e.g. I suddenly felt myself being picked up and crushed, and then pushed into a deep, dark throat…
2. Explain that saliva is produced by the salivary glands in the mouth. Saliva lubricates the mouth, helping us to chew, swallow and speak. It is important for the digestion of food because it softens and moistens the food before it is pushed into the oesophagus.
Unit 6
Looking after yourself

Teaching objectives:
• To create an understanding of microorganisms
• To distinguish between some common useful and harmful microorganisms
• To classify microorganisms
• To explain how microorganisms can enter the body
• To identify ways of preserving food

Key vocabulary: microorganism, protozoa, virus, bacteria, fungi

Materials: microscope, glass slides, slide cover, dropper

Optional: Invite a health professional to talk to the pupils and answer their questions about illnesses e.g. stomach upsets, spots, measles, and flu.

Lesson 1: 40 min

Introduction: 5 min
• Display a microscope and explain the term ‘micro’: Explain: Micro means ‘extremely tiny’. A microscope is an instrument that has lenses which can magnify an object so that it is possible to see it; since it is so small, it cannot be seen with the naked eye. This instrument helped in the discovery of cells and other microorganisms.

What are microorganisms?
Microorganisms are very tiny living things. They are so small that they can only be seen through a microscope. They are present everywhere: in the air, in our bodies and in the water. Some microorganisms are harmful to us, but others are helpful.

There are four types of microorganism:
• viruses
• bacteria
• fungi
• protozoa

Main teaching: 30 min
• Show the pupils the microscope, slide, and slide cover. We will observe a drop of water under the microscope. Write down your predictions of what you think the organism will look like.
• Now put the drop of water onto the glass slide. Put the cover slip onto the drop of water and adjust it under the microscope.
• Invite the pupils, one by one, to look through the microscope, drawing their attention to the shape and movement of the microorganisms on the slide. Ask them to draw what they see in their science notebooks.
• Nowadays, children are familiar with the term ‘germs’. Many diseases are caused by germs. ‘Germ’ is a word commonly used for harmful microorganisms.
What are infectious diseases?
Some diseases spread through contact or through other organisms. You can become infected by touching, eating, drinking or breathing something that contains harmful bacteria. Microorganisms can also spread diseases through animal and insect bites.

- Read pages 27 and 28 of the textbook.

Wind up: 5 min
- Ask these questions.
  - What is meant by the term ‘microorganism’?
  - What is the term more commonly used for harmful microorganisms?
  - How can microorganisms harm us?
  - How are infectious diseases spread?

Lesson 2: 40 min

Introduction: 5 min
- Recall the harmful microorganism that the pupils learned about in the previous lesson. Explain that not all microorganisms are harmful. Read the Do you know? feature on page 29.

Main teaching: 30 min

Helpful microorganisms
Here are some examples of useful microorganisms:

a) Yeast is a microorganism that is added to bread dough to make it rise.

b) Several fungi are used to make medicines, including antibiotics.

c) Yogurt is made by boiling milk and adding special bacteria to it. The bacteria turn the sugar in the milk into acid. The acid makes the milk go thick and sterilizes it.

d) Inside a pile of dead leaves there are millions of tiny bacteria. These bacteria feed on the dead, rotting leaves, breaking them down into nutrients. These nutrients are important as they keep the soil healthy. Plants grow well in healthy soil.

- Show the pupils some examples of mouldy food; bread, apples and cheese, and ask them what has caused these foods to decay. (Microorganisms cause food to decay.)
- Discuss the effects of eating mouldy food. (Microorganisms grow and reproduce on food and can be a cause of food poisoning.)
- Read pages 29 and 30 of the textbook and discuss the contents with the pupils. Explain the importance of preserving food, and ways of doing this.
- Discuss some ways to prevent food poisoning. (Washing hands before and after preparing food, checking expiry date of foods, covering food that is kept in the fridge, are some preventive measures that could be discussed.)

Note: Moulds are visible. However, other microorganisms which cause food to go bad, e.g. bacteria, may not be. Since many microorganisms release large quantities of spores into the air and some people are allergic to these, foods should be kept in closed plastic bags or containers. Caution the pupils that food in plastic bags or containers should never be heated in microwave ovens.
Group activity

- Now divide the pupils into six groups. Four groups should work on the four types of microorganism. The fifth group should work on how microorganisms enter the body and the sixth group should work on ways of keeping healthy.
- Assign each group its task. Give the pupils time to read about or research their assigned topic.
- Ask the pupils to prepare group presentations. Provide them with materials to do this; they may need large sheets of card and markers to make posters.
- Call each group in turn to share what they have learned about their assigned topic.
- After each presentation, ask the pupils in the audience to summarize the presentation.

Wind up: 5 min

- Summarize all that has been taught and discussed by pairing pupils and asking them the following questions:
  
  Name some helpful bacteria.
  
  In what ways are some microorganisms helpful to humans?
  
  How can bacteria cause food poisoning?
  
  Give any two examples of bacteria that cause disease. How can these diseases be prevented?
  
  In what ways can food be preserved?

EXERCISE (pages 31–33)

A  a) X  b) X  c) ✓  d) ✓  e) ✓

B  1. Some bacteria are harmful, while some are useful.
  2. Typhoid is caused by a microorganism called bacteria.
  3. The study of microorganisms is known as microbiology.
  4. Athlete’s foot is caused by fungi.
  5. A useful type of bacteria is used in making yogurt.
  6. Milk is preserved by a process called pasteurization.
  7. Protozoan is a unicellular organism, while fungus is a multicellular organism.
  8. A mushroom is an example of an edible fungi.
  9. Food can be preserved by freezing, canning through chemical preservation.
  10. Harmful microorganisms are commonly called germs.

C  1. b) microorganisms
  2. a) dysentery
  3. b) tooth decay
  4. c) fungi
  5. b) bacteria
  6. a) fungi
  7. c) 60 degrees Centigrade
8. b) dry and frozen
9. a) food
10. a) Microorganisms are all around us.

D 1. a) Microorganisms are tiny living things that can only be seen through a microscope.
   b) Something that is so small that it can only be seen through a microscope is called microscopic.
   
2. Answers will vary.
3. Answers will vary.
4. Answers will vary.
5. If food is not preserved, it decays and becomes inedible. (Any other suitable answer should be accepted.)
6. milk – pasteurization
   chicken – chemical preservative and freezing
   fruit juice – canning and bottling
   ice cream – freezing
   tomato paste – canning and bottling
   yogurt – pasteurization
   fruit jam – chemical preservatives, canning and bottling

ACTIVITY (page 33)

1. Encourage the pupils to find out about these famous scientists. They can do project work on the discoveries made by them. It is important that the teacher, too has some knowledge of the achievements of these scientists. This will ease class discussion.

Answers to Worksheet Unit 6

A 1) Bacteria can spread from one food to another.
2) Wash and dry you hands before you make or eat a meal.
3) Wash fruits and vegetables with cold water before you eat them.
4) Keep dairy and meat products in the refrigerator.
5) Foods can spoil and decay when bacteria and fungi begin to grow in them.
6) Canned, bottled, and packaged food does not allow microorganisms to enter it.

B A broken arm ✗
   Toothache ✔
   Food poisoning ✔
   Headache ✗
   Cholera ✔
   Cough and cold ✔
Unit 7
Living things

**Teaching objectives:**

- To classify living things on the basis of common characteristics
- To highlight the seven characteristics of living things – nutrition, respiration, excretion, sensitivity, movement, growth, and reproduction
- To explain that the ways in which living organisms live and behave reflect these characteristics

**Key vocabulary:** respiration, excretion, growth, nutrition, reproduction, sensitivity, movement

**Lesson 1: 40 min**

**Introduction: 5 min**

- Engage the pupils in a discussion. *How does something in the world qualify as a living thing?*
- Show the pupils a small rock: *Is a rock a living thing? Why or why not? Do rocks move? Gravity certainly moves them and so can an earthquake, but this movement is not self-directed. Do rocks grow? Do they breathe?* Continue asking questions on these lines.
- Give the pupils some time to think and then discuss their answers. Accept all answers but try to steer them towards ideas that distinguish between living and non-living. Lead this into a discussion of what the characteristics of living things are. Help the pupils discover that these characteristics are nutrition, respiration, reproduction, sensitivity, growth, excretion, and movement. Explain that the focus of this unit is the seven characteristics that all living things, small and large, must have.

**Main teaching: 30 min**

- Let the pupils work in small groups to create a matrix of the characteristics of living things, an example of which is shown on the next page:
• After giving the pupils some time to finish the matrix, discuss any grey areas with them. Do not highlight right or wrong answers, rather focus on the thinking process and the backing up of opinions. *If you think a rock grows, what makes you think so?* (Sedimentary rocks do grow, but only in size, they do not have any cells that can reproduce or multiply.)

• Remind them throughout this discussion that a living thing must have all the seven characteristics.

• Ask each pupil to name one living and one non-living thing.

• Write their contributions on the board.

• Read pages 34 to 36 of the textbook. Divide the class into seven groups. Each group should be given one characteristic of living things to work on. Each group will read about its assigned characteristic in the book and present the information to the whole class.

**Wind up: 5 min**

• Ask the following questions to assess the pupils’ understanding.

  *What characteristics do all living things have in common?*
  *Do any non-living things share some characteristics of a living thing? Which ones?*
  *Do all living things move?*
  *Which non-living things move?*
  *How is the movement of living things different from that of non-living things? What kinds of living things move? What kinds do not move?*

**Lesson 2: 40 min**

**Introduction: 5 min**

• Ask the pupils to recall what they learned in the previous lesson.

  *Why do living things move?*
  *Do plants move?*
  *Do all living things eat?*
  *Plants do not eat, but they need energy. How do they get this energy?*
  *Anticipate questions about growth and movement. For example, The Moon also seems to grow. Is it a living thing?*
  *Trains and airplanes also move. Are they living things?*
Main teaching: 30 min

- Take the pupils for a walk around the school.
- Ask each pupil to make a list of all the living things he/she sees.
- On returning from the walk, begin the lesson by discussing living organisms. Ask: What distinguishes a living thing from a non-living thing? Talk about the characteristics living things share in order to perform the functions necessary to sustain life: movement, sensitivity, respiration, nutrition, growth, excretion, and reproduction.
- Ask the pupils to think about familiar living organisms: trees, humans, snails, and bacteria. What do they have in common? How are they different from one another? How do we group them?
- Now divide the pupils into five groups. Give each group a statement to discuss. Explain: Your task is to think about your statement, discuss it with the other members of your group, and say if you agree or not. In either case, you must justify your point of view with a scientific explanation.
  1. A river is living because it moves. Soil is non-living because it does not move.
  2. Clouds are living things because they seem to grow and move.
  3. Plants are non-living because they do not appear to move.
  4. Fire is a living thing because it needs oxygen, it moves, it grows, and it needs fuel.
  5. Plants are non-living because they do not eat food.
- After the group discussion, invite each group to share its problem and point of view with the class. Encourage the others to ask questions and comment on their ideas.

Wind up: 5 min

Activity 1 on page 38 of the textbook is a good way of concluding this topic.

EXERCISE (pages 37–38)

A 1) D sensitivity 2) C excretion 3) B nutrition 4) A reproduction

B 1. Plants can make their own food by a process called photosynthesis.
  2. All living organisms have seven characteristics that make them different from non-living things.
  3. Plants and animals take in oxygen and let out carbon dioxide. This process is called respiration.
  4. Animals can move from place to place. This movement is called locomotion.

C 1. b) sensitivity
  2. b) plants make their own food
  3. a) grow and change
  4. b) reacting to one’s environment
  5. a) for energy to grow and be active

D 1. Plants can make their own food.
  2. Animals move from place to place in search of food.
  3. Animals’ movements are called locomotion. Plants do not move from place to place in search of food as they are able to make their own food.
4. Answers will vary.
5. The list should include all the seven characteristics.

**ACTIVITY (page 38)**

1. Some possible answers could be:

<table>
<thead>
<tr>
<th>Item</th>
<th>Source</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) leather</td>
<td>animal hide and skin</td>
<td>shoes and belts</td>
</tr>
<tr>
<td>b) wood</td>
<td>tree trunk</td>
<td>furniture</td>
</tr>
</tbody>
</table>

2. Children enjoy observing and tracking movements of insects and this activity will help them to observe and note the organisms around them.

**Unit 8**

**Life cycles of animals**

**Teaching objectives:**
- To explain reproduction from a single parent cell and from the fusion of two parent cells
- To define life cycle: birth, developing into an adult, reproduction, and eventual death
- To compare the life cycles of different organisms
- To observe the changes that occur during the growth and development of insects and frogs

**Key vocabulary:** sexual and asexual reproduction, metamorphosis (plural: metamorphoses)

**Materials:** flashcards of animals’ life cycles

**Advanced preparation:** access to PowerPoint presentation

**Lesson 1: 40 min**

**Introduction: 5 min**
- Ask the pupils to recall the characteristics of living things. *Which characteristic of living things ensures that the organism will continue?* (reproduction)

   Explain the term reproduction. *When living things reproduce, they make new living things.* *Sometimes organisms reproduce by one cell only. This single cell divides into two and two into four and so on. This type of reproduction is called asexual reproduction.* *But sometimes, two different cells join together; one from the male parent and the other from the female parent. This type of reproduction is called sexual reproduction.*

**Main teaching 30 min**
- Explain these terms in detail:

  **Sexual reproduction:** *This requires a male and female of the same species to participate in bringing together a sperm cell and an egg cell to create a new living being. This form of reproduction combines the genetics of two members of the species.*
Asexual reproduction: It is important to note that all forms of asexual reproduction use the genetics of one living being; therefore the offspring will be identical to the parent.

- Remind the pupils of the processes of pollination and fertilization. Which were the female and male cells in that case?
- Involve the pupils in the activity of matching animals’ babies with the adults.
- Collect pictures of a caterpillar and butterfly, tadpole and frog, puppy and dog, chick and hen, baby and man. Display the pictures on the board. Ask the pupils to match the babies with the adult animals.

Engage the pupils in a discussion:
Which animal was easy to identify and match with the parent?
Why was it easy to match them?
Which animal baby is totally different from its parent?
How does it change when it grows into an adult?
Encourage them to describe the changes in growing animals for each of the animals you have shown them in this activity.

- Now introduce the term life cycle. Plants and animals have life cycles that include being born, developing into adults, reproducing, and dying. Life cycles are different for different organisms.
- Ask them to read page 39–40 of the textbook and summarize what they read.

Wind up: 5 min
- Ask the pupils the following questions to summarize and to assess their understanding of the concepts taught.
  What is reproduction?
  Why is reproduction important?
  What is meant by the term ‘life cycle’?

Lesson 2: 40 min

Introduction: 5 min
- Recall with the pupils what they learned about reproduction in the previous lesson.
- Ask them to look up and share the meaning of the term metamorphosis from the glossary or a dictionary.

Main teaching: 30 min
- Display ready-made flashcards of the life cycles of the frog, butterfly and dragonfly which can be found on the following website:
  http://www.teachersdomain.org
- Ask the pupils to describe the changes at each stage.
  How do the animals change at each stage?
  Note: At this point the flashcards should be displayed without any labelling. The pupils should describe the changes just by looking at the pictures.
• A very useful video can be used to show the developmental stages of frogs, dragonflies and butterflies in order to compare the insect and frog life cycles. Watching a video of the process of metamorphosis will evoke interest and excitement amongst young pupils. The link is: http://www.teachersdomain.org

• Now introduce the terms complete and incomplete metamorphosis with examples of animals which go through complete or incomplete metamorphoses.

**Complete metamorphosis** has four stages of growth: egg, larva, pupa and adult. As the insect grows, its shape changes completely. During the pupa (chrysalis) stage, the body undergoes a complete reorganization, transforming into the adult. As the larva looks completely different from the adult, this is termed complete metamorphosis.

**Incomplete metamorphosis** has only three stages: egg, nymph, and adult. The insects hatch from their eggs looking like miniature adults. These young insects are called nymphs. As they grow, they shed their skin several times before they become adults. At each shedding of the skin, the nymph enters a new stage of growth.

• Ask the pupils to read pages 41 and 42 of the textbook and share what they learn from reading these two pages. Read the feature ‘Environment watch’ on page 41 of the textbook and discuss why reproduction is so important for all living organisms. If an organism stops reproducing, it will become extinct (die out).

**Wind up: 5 min**

Draw the following table on the board and together with the pupils, compare the two types of metamorphosis.

<table>
<thead>
<tr>
<th>Complete metamorphosis</th>
<th>Incomplete metamorphosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following website has an excellent short presentation on this topic in PowerPoint: http://www.docstoc.com

**EXERCISE (pages 43–45)**

| A | 1. reproduction 2. metamorphosis 3. incomplete 4. complete 5. gills 6. copy 7. egg, sperm |
| B | 1. c reproduction 2. b three 3. b gills 4. c become extinct 5. c pupa 6. b microorganism |
| C | 1. a) Reproduction is the process by which plants and animals make copies of themselves. b) The physical changes that happen to an organism during its life cycle are known as metamorphosis. |
2. Reproduction is very important in animals because without it the animal species would die out, or become extinct.

3. a) **Two ways of reproduction in living things:**

<table>
<thead>
<tr>
<th>Sexual reproduction</th>
<th>Asexual reproduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>This needs two parent cells to reproduce a new organism. One cell, the sperm, comes from the male parent, and the other cell, the egg, comes from the female parent. The new organism has the qualities of both of the parents.</td>
<td>This needs only one cell in order to reproduce the new organism. The new organism is an exact copy of its parent.</td>
</tr>
</tbody>
</table>

b) **Complete and incomplete metamorphosis:**

<table>
<thead>
<tr>
<th>Complete Metamorphosis</th>
<th>Incomplete Metamorphosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the complete form of metamorphosis an insect passes through four separate stages of growth, as embryo or egg, larva, pupa, and adult.</td>
<td>The life cycle of certain insects, such as crickets and grasshoppers, is characterized by the absence of a pupa stage between the immature and adult stages. Such a life cycle is known as incomplete metamorphosis.</td>
</tr>
</tbody>
</table>

4. **Life cycle of a grasshopper**

The female grasshopper lays eggs.
1. The nymph hatches from an egg.
2. As the nymph grows, it sheds its ‘skin’ or exoskeleton.
3. An adult grasshopper emerges after the nymph stage.

**Life cycle of a butterfly**

1. The female butterfly lays its eggs on a leaf or stem.
2. The caterpillar (or larva) is the long, worm-like stage of the butterfly or moth. It is the feeding and growth stage.
3. This caterpillar changes into a pupa.
4. A colourful adult butterfly or moth appears from the case of the pupa.

5. d) The frog lays its eggs in water.  
   c) The baby frog, called a tadpole, hatches from the egg and starts swimming in water with the help of its tail. It breathes through its gills.  
   e) It grows the hind legs first and then the fore legs. It is now called a froglet.  
   b) Then the gills and tail disappear. The lungs grow.  
   a) The tadpole turns into an adult frog and is capable of reproducing new frogs. Now it can live both on land and in water.
6. **Caterpillar**
   
   i) The caterpillar has a long, visibly segmented body with many pairs of legs.
   
   ii) It is the larva stage of butterflies and moths.
   
   iii) It has no wings so it is unable to fly.
   
   iv) It is green.

---

**Butterfly**

The butterfly has a body composed of a head, thorax and abdomen, two antennae and two eyes.

It is a flying insect having four stages in its life.

Its wings make it possible for it to fly.

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It is colourful.

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**ACTIVITY (page 45)**

The overall life cycle of the house fly (from egg to adult) is about 7–10 days in the summer in a warm temperature.

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**Unit 9**

**Flowering and non-flowering plants**

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**Teaching objectives:**

- To explain the classification of plants into various groups
- To identify and discuss the distinguishing characteristics of flowering and non-flowering plants
- To classify flowering plants into dicot and monocot plants
- To compare monocot and dicot plants

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**Key vocabulary:** gymnosperm, angiosperm, dicot, monocot, seed coat, endosperm, embryo, cotyledon, xylem, phloem, tap root, fibrous root

**Materials:** live plants, magnifying glasses, parts of monocot and dicot flowers for examination, soaked seeds of dicot and monocot plants

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**Lesson 1: 40 min**

**Introduction: 5 min**

- Begin the lesson by asking the pupils to recall the parts of a plant and characteristics of simple and higher plants they read about in Book 4. Review the basic vocabulary of this topic:

  1. **stem** – the part of a plant that supports the other parts, such as leaves, flowers, buds; it carries water and nutrients from the ground to the other parts of the plant
  2. **root** – the underground part of a plant which anchors the plant in place; roots also deliver water and nutrients from the ground to the stem.
3. leaf – lateral (from the side) outgrowth from the stem, whose main function is to manufacture food.
4. bud - an unopened flower.
5. flower – the part of a plant that is usually colourful and protrudes from the stem; it is important for reproduction

Main teaching: 30 min
- If there is a variety of plants in your school grounds, take the pupils outdoors for observation.
- If your school does not have plants, a visit to a nearby plant nursery or greenhouse will enable the pupils to bring back detailed descriptions and sketches of a variety of plants. After this, engage them in a discussion:
  
  Are all plants the same?
  How are they different from each other?
  Do all plants have the same kind of leaves?
  Do all plants have the same parts?
  Is there any plant which is lacking some parts?
  Which is that plant?
  How can you tell which is a vascular plant and which is non-vascular?
- Explain that plant life comes in many forms. Some plants are sponge-like formations on the forest or ocean floor; others rise high above the ground. Some have colourful flowers and others produce edible fruits and vegetables. Two categories of plant are most common among them all: flowering plants and non-flowering plants.
- Ask the pupils to read pages 46–47 of the textbook in groups and discuss with their group members and the whole class what they have understood. Encourage them to use a dictionary or the glossary to look up the definitions of new terms.

Wind up: 5 min
- Ask the following questions:
  What is meant by the terms gymnosperm and angiosperm?
  What is the seed coat and what does it do for the seed?
  What is the endosperm?
  What is the embryo of the seed and where is it found inside the seed?
  What is meant by the term ‘cotyledon’?

Lesson 2: 40 min
This lesson should be spread over two consecutive periods to ensure continuity and to optimize learning.

Introduction: 5 min
- Recap the main points of the previous lesson by asking the pupils some basic questions on flowering and non-flowering plants:
  1. What is the main difference between flowering and non-flowering plants?
Part 2 | Living things

2. Do you think the following statement is correct?
   Non-flowering plants are seedless. (No, they can be seedless as well as seed-bearing.)

3. Why are non-flowering plants called ‘naked seed plants’? (Their seeds are not enclosed in
   fruits and flowers.)

4. A seed coat consists of which three main parts? (seed coat, endosperm, embryo)

5. What does the embryo of a plant look like and what is it called? (The embryo is a small,
   whitish, leaf-like structure and is called the cotyledon.)

Main teaching: 70 min

• Divide the pupils into groups.

• Give each group a set of materials. This set should consist of a magnifying glass, samples of real
  dicot and monocot flowers, stems, leaves, roots and seeds. The vascular bundles can be made
  visible by standing the stems in dyed water for a few hours. Next, cut them into thin slices. The
  vascular bundles then can be clearly seen using a magnifying glass.

• Ask the pupils to take turns to examine each flower closely. Do not use the term monocot and
  dicot at this stage. Name the flowers A and B. Consider sample A as monocot and sample B as
  dicot.

• Remove and count the outer row of sepals. Do both of the flowers have the same number of
  sepals?

• Do the same with the petals.

• Ask the pupils to examine the soaked seeds. Cut open a seed to observe the embryo. Does this
  plant have one cotyledon or two cotyledons?

• Ask them to examine the leaves. What do they notice about the patterns of different leaves?

• Now draw this table on the board and complete it with the help of the pupils’ feedback.

<table>
<thead>
<tr>
<th></th>
<th>Number of sepals</th>
<th>Number of petals</th>
<th>Number of cotyledons</th>
<th>Pattern on leaves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

• Ask the pupils to read pages 47-49 of the textbook in their groups.

• When they have finished reading, ask them to decide which heading is correct for sample A
  and for B. They should suggest the terms monocot and dicot.

Wind up: 5 min

• Ask the pupils to summarize the differences between monocot and dicot plants. The teacher
  may also evaluate their learning with the help of any exercises on pages 49 and 50 of the
  textbook.

EXERCISE (pages 49–51)

Part 2 | Living things

1. a) two
d. a) gram
3. b) wheat
4. 
| C | two cotyledons | net-like veins | taproot |
5. c) cotyledon
6. 
| A | one cotyledon | parallel veins | fibrous |
7. a) monocot
d. b) dicot
C 1. a) seed coat:
   the outer covering of the seed which protects the internal structure from injury and drying out
b) endosperm:
   the plant’s food supply; it surrounds the growing embryo and provides food for it
c) embryo:
   a baby plant that grows into a new plant when conditions are suitable
d) angiosperm:
   the group of plants having seeds enclosed in their fruits or flowers
e) gymnosperm:
   the group of plants having naked seeds, which means that their seeds are not enclosed in their fruits or flowers
2. A stem of dicot plant: the xylem and phloem are very organized inside the stem.
   B stem of monocot plant: the xylem and phloem are scattered throughout the stem.
3. A leaf of a monocot: has parallel venation
   B leaf of a dicot: has net venation
4. 
<table>
<thead>
<tr>
<th>Seeds</th>
<th>Leaves</th>
<th>Flowers</th>
<th>Stems</th>
<th>Roots</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Monocot</strong></td>
<td>one seed leaf</td>
<td>parallel venation</td>
<td>petals in multiples of three.</td>
<td>vascular bundles scattered throughout the stem</td>
</tr>
<tr>
<td><strong>Dicot</strong></td>
<td>two seed leaves</td>
<td>net venation</td>
<td>petals in multiples of four or five</td>
<td>vascular bundles are very organized</td>
</tr>
</tbody>
</table>
Activity (page 52)

All these activities will facilitate the pupils’ understanding of their natural environment. The pupils should be encouraged to make careful and accurate observations and use appropriate language to talk about the features observed.

They should be able to sort items and make groups, and begin to give reasons for the separations that are being made.
Unit 10
Soil

Teaching objectives:
• To examine and explain the components of soil
• To explain that soil is composed of three distinct layers
• To discuss the differences between sand, silt and clay

Key vocabulary: mineral, humus, subsoil, bedrock, texture, silt

Materials: samples of sand, clay and silt, old newspapers, magnifying glasses, white sheets

Lesson 1: 40 min

Introduction: 5 min
• Assess the pupils’ existing knowledge by asking questions about soil in the environment.
  Where can you find soil?
  What do you think it is made of?
  What is in soil?
  Why is soil important?
  What colour is soil?

Main teachings: 30 min

DART Activity
• Divide the pupils into groups. Ask them to read pages 53–54 of the textbook and find out the answers to these questions.
  What is soil?
  What is the soil made up of?
  How is soil useful or helpful for living things?
  How many layers of soil are there?
  How are these layers different from each other?
How do small animals, such as millipedes and earthworms help the soil?

• After giving the pupils appropriate reading time, ask each group to share their answers with the whole class.

Explain: Soil is an essential natural resource. There are different types of soil, and it is a living, breathing world. Why? Soil supports a large group of living organisms. Why is soil so important? Crops grow in the soil, making it necessary for farming, and also for building materials. Besides this, soil can be home to animals and insects, like rabbits, moles, snakes, and ants.

What is soil made of? Soil is a combination of materials, both living (rotting plants and decaying remains of animals) and non-living (rocks, minerals, water). One part of the soil is broken down rock. Another is organic matter made up of decaying plants and animals. Water and air are also a part of the soil. These materials help support plant life by providing them with nutrients, water, and air. Soil also keeps the plants’ roots in the ground.

How do living things aerate and enrich the soil? The soil is full of many living creatures, all of which are responsible for keeping the soil healthy. The living creature most commonly found in soil is the earthworm. Earthworms create tunnels in the soil, helping to provide air and water. They also eat decaying plant material which passes through their digestive system and fertilizes the soil.

Wind up: 5 min
• Ask the pupils the following questions to evaluate their learning.

In what ways is soil important for living things? (supply of nutrients, place for shelter, supporting and growing plants, moles, snakes, earthworms, rabbit, etc.)

What four things is soil made up of? (water, air, particles of minerals, organic matter)

What are the three layers of the soil? (top soil, subsoil, bedrock)

Name at least five animals which make their homes in the soil? (rat, mole, rabbit, earthworm, ant, etc.)

Describe any two features of each layer of the soil.

Lesson 2: 40 min

Introduction: 5 min
• Recap what was learned in the previous lesson regarding components and types of soil.
• Before you begin the hands-on activity on soil, explain the importance of always washing hands after handling soil samples.

Main teaching: 30 min
• You can conduct activities 1 and 2 explained on page 57 of the textbook.
• Divide the class into groups. Provide each group with samples of clay, sand and silt, a magnifying glass, and old newspapers.
• Do not name the soils; label them as A, B and C, for clay, sand and silt respectively. Let the pupils examine and explore the samples by themselves. Avoid giving your own input at this point.
Part 3 | Materials and matter

- Ask the pupils to lay sheets of an old newspaper on their tables and put the samples on it. They should draw three columns in their notebook and label them A, B and C.
- Ask them to examine each sample of soil. Take a small amount of the sample. Put it on the newspaper. Spread it out so you can examine it closely through the magnifying glass.
- Help them to think about what they are observing by asking:
  What differences do you notice?
  Is the soil wet or dry?
  What colour is each of the samples? Are they all the same colour, or different?
  Can you see any remains of living things, (animal and plant matter) in any of your samples? Does it smell?
- Ask them to press the soil between their forefingers and thumb to feel the texture.
- After all the samples have been examined, ask for feedback. Draw three columns on the board with the headings A, B and C, the same as they have drawn in their notebooks. Then share their observations and write them on the board under the appropriate letter headings.
- Now give the pupils some time to read page 55 of the textbook. Can you decide the headings for these three columns? They should be able to tell you the heading according to the characteristics of each soil sample they have read about in their textbook.

Wind up: 5 min
- To assess the pupils’ understanding, ask them to do Exercise B or C on page 56 of the textbook.

**EXERCISE (pages 56–57)**

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th></th>
<th>B</th>
<th></th>
<th>C</th>
<th></th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td></td>
<td>F</td>
<td></td>
<td>F</td>
<td></td>
<td>F</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>2</td>
<td>clay</td>
<td></td>
<td>subsoil</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>3</td>
<td></td>
<td>sand</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>4</td>
<td></td>
<td>clay</td>
<td></td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>5</td>
<td></td>
<td>roots</td>
<td></td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td>c</td>
<td></td>
</tr>
</tbody>
</table>

**D**

1. Soil is the topmost layer of the surface of the Earth. It is composed of four things: water, air, particles of minerals and organic matter.
   2. topsoil
      subsoil
      bedrock.
   3. Soil is important for living things as plants and crops grow in the soil. It is a place of shelter for small animals and insects.
   4. Small animals help to aerate and enrich the soil.

**ACTIVITY (page 57)**

Children enjoy playing with sand and soil. These are all exploratory activities that they will enjoy doing and will learn in the process.
Unit 11

Matter

Teaching objectives:
• To review the pupils’ existing knowledge of the meaning and forms of matter
• To examine the different properties of the three states of matter in terms of the arrangement of their particles
• To examine the effect of heat on the movement and density of particles
• To define and identify these changes of states in their environment: evaporation, condensation, sublimation, melting and freezing
• To provide a simple explanation of the water cycle and to emphasize the roles played by condensation and evaporation
• To compare reversible and irreversible changes

Key vocabulary: definite, volume, mass, melting, freezing, condensation, sublimation, evaporation, reversible, irreversible

Materials: collection of solid, liquid, and gaseous materials including a balloon, a piece of wood, cotton wool, syringes, set of three baskets or boxes labelled Solid, Liquid and Gas, quantities of flour, salt, talcum powder, sugar grains, rice and lentils, clear containers of different shapes

Lesson 1: 40 min

Introduction: 5 min
• Review the pupils’ existing knowledge of this topic by reading and discussing the feature Do you remember? on page 59 of the textbook.

Main teaching: 30 min
• Display a collection of some materials or make a list of some materials on the board. Ask the pupils to classify them as solid, liquid or gas. The materials could include honey, oil, water, wood, a piece of stone, tissue paper, an inflated balloon or beach ball. Ask them what is inside this balloon/ beach ball; solid, liquid or a gas? What are the bubbles in boiling water, or the bubbles in fizzy drinks?
• Ask the pupils to draw three columns in their science notebooks to record their decisions and reasons, as shown in the example below.

<table>
<thead>
<tr>
<th>Material</th>
<th>State</th>
<th>Reason for identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>oil</td>
<td>liquid</td>
<td>It does not have a definite shape.</td>
</tr>
</tbody>
</table>

• Ask the pupils to read pages 58, 59 and 60 of the textbook. Give them some time to think about the information on these pages.
• Next, ask them to discuss in pairs the following questions which should be written on the board:
  1. What is meant by a) mass, b) definite shape, c) volume?
2. How do you know if something is solid? (It will have a fixed shape and volume.)
3. How do you know if something is liquid? (It does not have a fixed shape, but has a fixed volume.)
4. How do you know if something is gaseous? (It has no fixed shape or volume.)
5. What do you know about the arrangement of particles in the three states of matter?
6. What are these particles called? Are they present everywhere?
   • Discuss the pupils’ answers.

Wind up: 5 min
• The pupils can attempt Exercise D 4 on page 67 of the textbook.

Lesson 2: 40 min

Introduction: 5 min
• Recap the key concepts taught in the last lesson. Why do solids have a definite shape but liquids and gases do not?
• Show the pupils a balloon that is half-filled with air. What is inside the balloon? Ask them to describe and explain what happens to the balloon when you press it. Encourage them to use the word compressible to explain the behaviour of the air inside it.
• Now ask: What if I put stones or a block of wood inside the balloon? Will it compress in the same way as it does with air inside?
• Repeat the same question for water.

Main teaching: 30 min
• Ask the pupils if it is possible to compress a solid or a liquid into a smaller space.
• Explain the arrangement of particles in all three states of matter by involving the pupils in the following three activities.
  a) Divide them into groups. Give each group a syringe (without a needle), a ball of cotton wool, some water and a piece of wood.
  Ask them to try to put a piece of wood into the syringe. Position the plunger on top of the wooden piece. Try to push it down. Is it easy to compress a piece of wood?
  b) Repeat the same activity but this time put a ball of cotton wool inside the syringe.
  c) Repeat the same activity. This time put water inside the syringe. Was it easy to compress water? No. Why was it more difficult to compress a solid like wood, than the cotton wool?
  • Explain that it was not the solid cotton wool, but the air trapped inside the cotton wool that was compressed.
  • Ask them to read page 60 of the textbook in their groups. Are they able to make the connection between the arrangement of the particles in solids, liquids and gases and their properties?
  • Follow up by asking questions about the distance, movement, and arrangement of particles in the three states of matter.
Wind up: 5 min
- Divide the pupils into three groups. Explain that each group represents one state of matter.
- Ask them to pretend that they are the particles of matter and perform role-plays to show the arrangement of the particles in the state of matter that their group represents. Allow them some time to organize their role-play.
- Their role-plays should demonstrate a clear understanding of the differences in the distance and movement of particles in the states of matter.

Lesson 3: 40 min

Introduction: 5 min
The focus of this lesson is to explore why some solids behave like liquids.
- Take three baskets/ boxes. Label them as Solid, Liquid and Gas.
- Display a collection of pictures, or real solid, liquid and gas objects. Ask each pupil to select one item or picture. Call the pupils one by one or circulate the basket round the class, and ask the pupils to place their item or picture in the relevant basket. If it is solid, it should go into the basket labelled ‘Solid’, and so on. Ask them to explain the reason behind their decision.
- Ask the pupils to recall the properties of liquids. Make sure that the fact that liquids take the shape of their container is understood. Write this property on the board.

Main teaching: 30 min
- Now show the pupils a collection of materials. This collection should include flour, salt, talcum powder, sugar grains, rice and lentils.
- Ask: Which baskets would you put these materials into?
- Pour all the materials, one by one, from one container to another one of a different shape and ask: Did it change its shape? Yes. So should I put this into solid, liquid or gas?
- Now show them one lentil and ask them if it is solid, liquid or gas. (After observing a single lentil, grain of rice or a single grain of sugar, it is easier for them to identify its state as solid.)
- Explain: Sometimes solids also seem to change their shape when they are transferred from one container to another. Some of them can be poured, like liquids. Why? They behave like liquids because they consist of very fine particles. However, they are solids. If you look closely, you will notice that each tiny particle or grain has a definite shape and volume which cannot be changed just by pouring it from one container to another.

Wind up: 5 min
- Draw three boxes on the board illustrating the particle arrangements of solid, liquid and gas.
- Label them as A, B and C.
- Ask the pupils to identify the illustrations as solid, liquid and gas.

Lesson 4: 80 min

Reversible and irreversible changes

Materials: ice cubes, saucer, wet handkerchief or shirt, a bottle of cold water
Introduction: 5 min
- Show the pupils a melted chocolate bar. What might have happened to it? Listen to their responses.
- Ask the pupils about other experiences they have had of the same nature. They may think of melting ice cream, candle wax, butter, etc.

Main teaching: 70 min
- Introduce the terms reversible and irreversible changes of matter to the pupils by sharing some examples of changes taking place in their environment.

Reversible changes
A reversible change is a change that can be undone or reversed.
A reversible change might change how a material looks or feels, but it does not create new materials. Melting is an example of a reversible change. For example, melted chocolate can be changed back into solid chocolate by cooling. Freezing is also a reversible change, as water can turn to ice and then back to water.

Irreversible changes
A change is called irreversible if it cannot be changed back again. For example, you cannot change a cake back into its ingredients again.
Irreversible changes are permanent. They cannot be undone. In an irreversible change, new materials are always formed.

Teacher demonstration
The teacher will perform the activities that will be observed and recorded by the pupils.

Activity 1: (Evaporation)
- Show the pupils a wet handkerchief or shirt. How can this be dried quickly? I will need to hang it in the sunlight. Where does the water go?
- Ask them to look up the meaning of the term ‘evaporation’ in the glossary.
- Read page 61 of the textbook and read the paragraph on evaporation.
- Engage them in a discussion by asking these questions. What is the role of heat or energy in the process of evaporation of liquids? Can you think how the particles will behave when they are heated in this case? Ask them to describe this verbally. (They should talk about the movement and distance of particles.)
- Ask the pupils to think of some common examples of situations in daily life where these changes are taking place.

Evaporation
Evaporation is the change from a liquid into a gas. Evaporation happens all around us. A puddle on the road which begins to disappear is evaporating. The evaporation is speeded up by the temperature getting warmer and by the air moving quickly. The process of evaporation takes place when steam is released from a boiling kettle. Sometimes you can see steam rising from the road after it has rained on a hot day. This is also an example of evaporation taking place. Another example includes blowing on ink to dry it.
Activity 2: (Melting and freezing)
• Put some ice cubes in a saucer. What is the physical state of this ice? How are the particles arranged in this state? Ask the pupils to draw a particle diagram of the water in solid form i.e. ice.
• Invite the pupils to share their illustrations with the whole class. What will happen to an ice cube kept at room temperature for a few minutes? Leave it for a few minutes.
• Meanwhile, ask the pupils to look up the meaning of the term melting in the dictionary and encourage them to share their findings with the class.
Explain: When a solid substance is heated, it will begin to melt (become liquid). The temperature at which it does this is known as its melting point.
• Again draw the pupils’ attention to the melting ice cubes and ask them to describe what is happening to its particles. (They should talk about the movement and distance of particles.)
• Emphasize that energy is being absorbed, and this energy is making the ice melt. By now the ice cube has changed into water. How can I change it back into solid? (by freezing) How will the particles behave when they start to freeze? Will they lose or gain energy? Will they move faster or more slowly? Will they come closer or move apart from each other? When a liquid is cooled, it will begin to freeze (become solid). The temperature at which it does this is its freezing point.

Activity 3: (Condensation and sublimation)
• Take out an item from the refrigerator, e.g. a bottle of cold water or a can of drink. Keep it at room temperature. After a while, tiny droplets will be visible on the outer surface of the container.
• Ask the pupils where these water droplets have come from. Is the bottle or can leaking?
• Now ask them to look up the meaning of the term ‘condensation’ in the dictionary or the glossary and share their findings with the class.
• Ask them to read page 62 of the textbook and explain what condensation is. What happens to the particles when a gas condenses? Is energy lost or gained during condensation?
• Ask the pupils if they have ever observed condensation in their environment.

Condensation
Condensation is the opposite of evaporation. It is the changing of a gas into a liquid. This happens when the temperature of a gas drops to a certain point. Some examples of condensation are breathing onto a cold surface, which makes it wet, or when kitchen windows steam up on a cold day if someone is cooking.

Sublimation
Ask them to look up the meaning of the term ‘sublimation’ in the glossary. Explain: Sublimation is the change of a solid substance directly into gas without first passing through the liquid state.

Wind up: 5 min
• In order to assess the pupils’ understanding, ask them to attempt Exercise A on page 65 of the textbook.
Lesson 5: 40 min

Water cycle

Materials: ice cubes, saucers, cling film, transparent bowl, a poster of the water cycle

Introduction: 5 min

- Explain the water cycle to the pupils. The term 'cycle' denotes a series of events being repeated many times, always in the same order. We have already studied the life cycles of animals and the cycle of the seasons that happens over and over again in the same sequence. The water cycle is the journey water takes as it circulates from the land to the sky and back again.

Main teaching 30 min

- Divide the pupils into groups.
- Give each group a transparent bowl and ask the group members to sit around the bowl.
- Pour some warm (not hot) water into each bowl.
- Cover the bowl with a sheet of cling film and put two or three ice cubes in the centre of the cling film. Place this next to a window in direct sunlight.
- Ask the pupils to sketch what they observe. (Water will appear on the plastic wrap.)
- Now invite a representative from each group to share with the whole class what they observed in this activity. Which two processes were involved in this activity?
- Now ask them to read page 63 of the textbook which explains the whole process of the water cycle.
- After reading time, ask a volunteer to explain what the water cycle is. What is the role of evaporation and condensation in this process?

Wind up: 5 min

- The pupils should attempt the related worksheet.

**EXERCISE (pages 65–67)**

|---|---|---|---|---|---|

<table>
<thead>
<tr>
<th>B</th>
<th>1. matter</th>
<th>2. mass</th>
<th>3. definite</th>
<th>4. volume</th>
<th>5. shape, volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.</td>
<td>regular</td>
<td>7. sublimation</td>
<td>8. condensation</td>
<td>9. physical</td>
<td>10. solid</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C</th>
<th>1. a</th>
<th>2. c</th>
<th>3. a</th>
<th>4. a</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.</td>
<td>b</td>
<td>6. b</td>
<td>7. b</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D</th>
<th>1. A physical change of matter means a temporary change. In these changes only the state of the matter changes. No new substance is formed. It can easily be reversed to its original state. (Accept any response that is factually correct.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Some examples:</td>
<td></td>
</tr>
<tr>
<td>a) boiling milk / water</td>
<td></td>
</tr>
<tr>
<td>b) cutting or crumpling paper or cloth</td>
<td></td>
</tr>
<tr>
<td>c) melting ice cream</td>
<td></td>
</tr>
</tbody>
</table>
2. Ensure that the distances between the particles, and their movement is correctly shown in the diagrams.

3. Refer to page 63 of the textbook for the answer.

4.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Solid</th>
<th>Liquid</th>
<th>Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance between particles</td>
<td>tightly packed</td>
<td>loosely arranged</td>
<td>apart from each other</td>
</tr>
<tr>
<td>Motion of particles</td>
<td>vibrate about a fixed position</td>
<td>slide on each other</td>
<td>high speed</td>
</tr>
<tr>
<td>Energy of particles</td>
<td>less energy</td>
<td>more than solid and less than gas</td>
<td>high</td>
</tr>
<tr>
<td>Volume</td>
<td>definite</td>
<td>definite</td>
<td>not definite</td>
</tr>
<tr>
<td>Shape</td>
<td>definite</td>
<td>not definite</td>
<td>not definite</td>
</tr>
<tr>
<td>Two examples</td>
<td>stone, block of wood</td>
<td>oil, water</td>
<td>oxygen, carbon dioxide</td>
</tr>
</tbody>
</table>

**ACTIVITY (page 67)**

1. Many scientists now consider plasma to be the fourth state of matter. Plasma is a gas that has been energized to the point that some of the electrons break free from, but travel with their nucleus. Gases can become plasma in several ways, but all include pumping the gas with energy. A spark in a gas will create plasma. A hot gas passing through a big spark will turn the gas stream into plasma.

   Since plasma only exists at very high temperatures, it is rarely found on the Earth, except near lightning and in flames and fires. However, 99% of all matter in the universe exists in this state.

2. The activity has been explained step by step on page 67 of the textbook. The purpose is for the pupils to actually experience the processes of evaporation and condensation.

**Answers to Worksheet Unit 11**

Unit 12

The Sun and the Moon

**Teaching objectives:**
- To investigate the composition of the Sun and the Moon and explore the Moon’s phases
- To explain the effect of the forces of the Sun and the Moon’s gravity on the Earth

**Vocabulary:** hydrogen, helium, nuclear, solar system, crater, gravity, orbit

**Materials:** sheets of white paper or card; rubber band

**Advanced preparation:** The pupils should keep a notebook of their observations of the Moon beginning from the new Moon.

**Lesson 1: 40 min**

**Introduction: 5 min**
- Discuss the enormous size of the Sun in comparison to that of the Earth and the Moon. Emphasize the importance of the Sun’s energy to the Earth:
  - a) *The Sun is the brightest and the most familiar object in the sky. Life on Earth would not be possible without it. The food we eat exists because of sunlight falling on green plants.*
  - b) *Sunlight contains energy, which warms up the Earth and creates weather and climate.*
  - c) *Light energy is used by animals to see and keep warm, and by plants to make food. Animals, in turn, eat plants and breathe the oxygen plants produce. So life exists on this planet due to the Sun.*
- *The solar energy of the Sun is produced in its core (inner centre).*

**Main teaching: 30 min**
- Read pages 68 and 69 of the textbook, focusing on the Sun. Make a fact file with the help of the pupils and display it on the soft board for later reference:
**The Sun**
The Sun is a star.
It is made up of hot gases, like hydrogen and helium.
It is at a distance of about 150 million kilometres from the Earth.
The temperature of the Sun's surface is about 6000 degrees Celsius.
It provides heat, light and solar energy to the planets.
Life on Earth would not be possible without the Sun.
The Sun holds the Earth in its orbit due to its strong gravity.

• Next, read about the Moon and its influence on the Earth, on pages 69 and 70 of the textbook.

**Writing Moon Facts**
Discuss with the pupils the features of the Moon. List their ideas on the board as they are presented. An effective way to do this would be to divide the pupils into small groups and ask each group to find out several facts about the Moon from reference books. When all the ideas are on the board, ask each pupil to trace and cut out a medium-sized, white paper circle. Demonstrate how to write facts about the Moon, beginning around the circumference of the circle and turning it after every few words to spiral towards the centre, until they run out of facts or space. Some facts to include are:

1. The Moon is smaller than the Earth.
2. The Moon has no light of its own, but reflects light from the Sun.
3. There is no air or water on the Moon.
4. The Moon’s surface is dusty and rocky.
5. There are many craters on the Moon.
6. It takes about twenty-nine days for the Moon to complete its orbit around the Earth.
7. The Moon is the only body in space that has been visited by humans.
8. The Moon is the Earth’s natural satellite.

**Wind up: 5 min**
• Summarize the learning by asking:

  *What new facts did you learn about the Sun and the Moon?*

  *What else would you like to find out about these objects?*

**Lesson 2: 40 min**

**Introduction: 5 min**
• The focus of this lesson is:
  i) The effect of the pull of the Moon's gravity on the Earth.
  ii) The phases of the Moon.

Ask the pupils what they understand by the term ‘gravity’. Explain that gravity is a force of nature that acts on two bodies in the universe to try and pull them together. You know that the Sun’s gravity is strong enough to prevent all the eight planets from straying away from their orbits. The Moon too has gravity. Since the Moon is much smaller than the Earth, its gravity is much weaker
than that of the Earth. Both the Moon and the Earth are constantly moving through space. As the Earth spins on its own axis, the oceans' water is kept balanced on all sides of the planet through a force (centrifugal force). The Moon's gravitational force is strong enough to disrupt this balance by ‘pulling’ the water towards the Moon. This causes the water to ‘bulge’ in the direction of the Moon. The Earth is able to hold on to everything, except water.

**What is the effect of the Moon’s gravitational pull on the oceans?**

Tidal movements are a result of the Moon and Sun’s gravitational pull on the Earth’s oceans. The cycle of high and low tides happens twice a day. Each day there are two extreme tides called **high tide** and **low tide**.

- The following simple activity should help the young pupils understand this phenomenon.
  Place a rubber band on a table in a circular shape. Explain that the area inside the rubber band represents the oceans. Now place one finger (e) in the middle of the rubber band. The finger represents the centre of gravity of the Earth and the oceans. Place a finger from your other hand along the inside edge of the rubber band. This finger (m) represents the force the Moon exerts on the Earth’s oceans. Following a straight line, slowly pull ‘m’ away from ‘e’. At this point, the rubber band stretches, signifying the oceans’ bulge.

- Shift the lesson’s focus to the Moon’s phases. **What is meant by the term ‘phases of the Moon’?** By this term we mean the cycle of the Moon, which is divided into four parts: new Moon (where you see no Moon at all), first quarter (only half of the Moon can be seen), full Moon (the entire Moon can be seen), and third quarter (only half of the Moon can be seen).

Read and discuss the text and the illustrations on pages 71, 72 and 73 of the textbook.

- Ask the pupils to show you their record of the changing phases of the Moon.

**Wind up: 5 min**

- Ask the following questions to recap the lesson:
  
  * **What are tides?** (Tides are the rise and fall of the Earth’s ocean surface.)
  * **What makes tides go up and down?** (the Moon’s gravitational pull)
  * **What effect does the Moon’s gravity have on the oceans?** (It causes a tidal bulge on the side of the Earth closest to the Moon.)

  **The Moon appears in phases because:**
  
  a) The Earth orbits around the Sun.
  b) The Moon’s gravity pulls the Earth.
  c) The Moon orbits around the Earth. (√)

**EXERCISE (pages 74–75)**

|----|---------|--------|----------|----------|-------|----------|--------|---------|---------|-------|

Note: The pupils may need to refer to pages 72 and 73 of the textbook when attempting to complete some sentences related to the Moon’s phases.
C 1. a) **Sun’s gravity**
   The pull of the Sun’s gravity is so strong that it keeps all of the planets orbiting around it. The Sun holds the Earth in its orbit.

   b) **Moon’s gravity**
   The Moon’s gravity causes the oceans to rise to high tides and fall to low tides.

2. Answers will vary.

3. The pupils can create their own fact file using reference books and the Internet.

4. A galaxy is made of millions of stars, dust and gas. (Encourage the pupils to discover interesting facts about the Milky Way).

5. b) about twenty-nine days.
   This period is called a lunar month.

**ACTIVITY (page 75)**

1. The pupils will enjoy making their postcards. Encourage them to use the following vocabulary when describing the Moon’s landscape: crater, phases, dark, atmosphere, rocky, silent, etc.

2. The instructions in the textbook are self-explanatory.

**Answers to Worksheet Unit 12**

A Refer to page 71 of the textbook for the labels.

B

<table>
<thead>
<tr>
<th>Image</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Moon" /></td>
<td>The Moon is invisible from the Earth.</td>
</tr>
<tr>
<td><img src="image2.png" alt="Moon" /></td>
<td>This is a waxing crescent.</td>
</tr>
<tr>
<td><img src="image3.png" alt="Moon" /></td>
<td>The first quarter has half of the Moon lit up.</td>
</tr>
<tr>
<td><img src="image4.png" alt="Moon" /></td>
<td>The Moon is a waxing gibbous.</td>
</tr>
<tr>
<td><img src="image5.png" alt="Moon" /></td>
<td>The full Moon is fully illuminated by the Sun.</td>
</tr>
<tr>
<td><img src="image6.png" alt="Moon" /></td>
<td>The waning gibbous becomes less illuminated.</td>
</tr>
<tr>
<td><img src="image7.png" alt="Moon" /></td>
<td>The Moon continues to wane in the last quarter.</td>
</tr>
<tr>
<td><img src="image8.png" alt="Moon" /></td>
<td>This is a waning crescent.</td>
</tr>
</tbody>
</table>
Unit 13
Air

Teaching objectives:
• To introduce the two main properties of air: weight and mass
• To explain the importance of the ozone layer
• To examine the composition of the air
• To identify the uses of some important gases
• To study examples of how wind and compressed air are used

Key vocabulary: atmosphere, troposphere, stratosphere, mesosphere, thermosphere, exosphere

Lesson 1: 40 min

Introduction: 5 min
• Show the pupils a beach ball or an inflated balloon, and a glass full of water. Ask: What is inside the balloon? (air) What is inside the glass? (water).
• Discuss with your partner any similarities you notice between water and air. (The purpose of this activity is to help the pupils recall the definition of matter. They should conclude that both water and air are examples of matter. Both of them have weight and occupy space.)

Main teaching: 30 min
• Engage the pupils in a discussion on the topic:
  What is air? (Possible answers may be: It is a colourless, odourless gas.)
  How can you tell that air is all around us? (It can fill up objects or make them move.)
  Why is air important for us? (We breathe in the air.)
  Which gas do you take in while breathing? (oxygen)
  Does air only consist of oxygen gas? (It consists of nitrogen, oxygen, carbon dioxide, water vapour, helium, krypton, hydrogen, neon, xenon and argon.)
• **Air has mass and exerts pressure**
  
  Explain: Although it may feel as though air does not have mass, it does. The air presses down on us and against us from all sides. About a tonne of air is pressing against you now. You are not aware of this because the pressure within your body balances the pressure of the air outside of it.

**Open Book Test**

- This is another strategy to use the textbook effectively in class. It helps the pupils read the textbook with full attention, and to find out the relevant information quickly and efficiently.
  
  The teacher writes the relevant questions on the board or gives the pupils a question sheet. They read the questions, search for the answers in the text, then close the book and share their answers in either written or verbal form.

- Ask the pupils to read pages 77 and 78 of the textbook and answer the following questions:

  - What is the atmosphere?
  - Why is the atmosphere important to us?
  - How many layers of the atmosphere are there? What are their names?
  - What is the ozone layer? Where in the atmosphere is it found?
  - Name the gases that are contained in air.
  - Which is the most abundant gas in the atmosphere?
  - Give two examples each of how the following gases are used: oxygen, nitrogen and carbon dioxide.

- **The ozone layer**

  **Stratospheric ozone**

  Ask the pupils to study the diagram on page 77 of the textbook, showing the atmospheric layers. As is shown in the figure on the right, the stratosphere is the layer of the atmosphere above the troposphere. It contains a thin layer of ozone. The stratospheric ozone layer occurs naturally. It protects life on the Earth by filtering out and absorbing the Sun’s harmful ultraviolet radiation.

  *How harmful is ultraviolet radiation?*
  
  The Sun’s ultraviolet radiation can cause skin cancer, cataracts (clouding of the lens of the eye), damage to crops, and other problems.

**Wind up: 5 min**

- Ask the following questions to recap the lesson’s main points:

  - Which of the following words correctly describe the properties of air?
    - *length, pressure, mass, height, weight* (pressure, mass, weight)
  
  - How does the atmosphere support life? (It contains oxygen which all the living things need to live.)

  *If the ozone layer continues to become depleted, what harmful effects will it have on the planet?*

**Lesson 2: 40 min**

**Introduction: 5 min**

- Brainstorm other ways in which we use air, apart from breathing. Ask the pupils to list things that they can think of, or see in the room that are full of air. Ask them if they have ever felt the
force or pressure of air. Discuss experiences they have had blowing up balloons or beach balls, or bicycle tyres.

Main teaching: 30 min
- Ask the pupils to look carefully at the illustration on page 79 of the textbook.
- Ask them to name the objects they can see in this picture. Write their responses on the board. Ask them how air is helping each of these things. Listen to their responses.
- Explain: *The wind has the power to move things, so the kite is flying in the air. The bicycle’s tyres contain compressed air, and so does the football. The force of the wind pushes the sailboat forward. The airplane and the hot air balloon fly using the wind’s force. Compressed air is used to inflate a swimming tube.*
- Next, ask pupils to select any one item from this list, draw a picture of it in their science notebook and describe in a few sentences how air is helping it to move or to do its job.
- Now ask the pupils to read pages 79–80 of the textbook to learn about more uses of air.
- After they have read, ask every pupil to share any use of air that s/he has read about on this page.
- Finally, discuss some activities that need moving air (wind), for example, flying a kite, drying washing, producing electricity, etc. *Wind is also an increasingly valuable source of energy—helping to bring electricity into our lives. Without electricity, there would be no TV, no video games, and no cell phones.*

Wind up: 5 min
- To assess their learning, ask them to do Exercise A on page 81.

**EXERCISE (pages 81–82)**

**A**
1. atmosphere  
2. burning  
3. carbon dioxide  
4. space  
5. water vapour  
6. wind  
7. compressed  
8. hot  
9. nitrogen  
10. stratosphere

**B**
1. b nitrogen  
2. c argon  
3. a carbon dioxide  
4. c oxygen  
5. a it has mass and occupies space  
6. c 0.03%  
7. a 20.94%  
8. c variable  
9. c nitrogen

**C**
1. a) The Earth is surrounded by a thin layer of air called the atmosphere.  
b) The atmosphere is made up of several layers. These are the:  
   - troposphere  
   - stratosphere  
   - mesosphere  
   - thermosphere  
   - exosphere  
2. Carbon dioxide is used by plants to make food.  
3. Oxygen cylinders are used in hospitals for patients who have difficulty in breathing.
4. **Uses of moving air**
   i) Moving air is used as a form of energy. It supports birds, gliders and airplanes.
   ii) Sailing boats use the power of moving air to move across the water.
   iii) Windmills use the force of wind to draw up water for the fields or to generate electricity.
   iv) Moving air speeds up the drying of the washing.
   v) We use moving air from a fan to cool ourselves.
5. **Uses of compressed air**
   i) Compressed air is used to inflate balloons.
   ii) Compressed air is used to inflate the tyres of bicycles, rubber tubes, cars and aircraft.
   iii) It is used to fill oxygen cylinders.
   iv) It is used to inflate balls.
   v) It is used to create fizz in soft drinks.
6. a) The ozone layer is one of the most important layers of the atmosphere. It is found in the stratosphere.
   b) The ozone layer blocks and absorbs most of the harmful rays of the Sun, preventing them from reaching the Earth. In other words, the ozone layer acts like a protective blanket for the Earth.

**ACTIVITY (page 82)**

The activities are self-explanatory and would be very useful in helping the pupils to understand that air has weight and that the oxygen present in the air helps fire to burn.

**Unit 14**

**Pollution in the environment**

**Teaching objectives:**
- To define waste and compare biodegradable and non-biodegradable waste
- To explain that waste creates pollution
- To classify pollution into three types: land, water and air
- To examine the causes and effects of pollution on the environment
- To explore ways of reducing pollution
- To create awareness of the causes and effects of climate change

**Key vocabulary:** pollution, pollutant, environment, biodegradable, non-biodegradable, typhoid, cholera sewage, toxic, ecosystem, herbicide, pesticide, decompose

**Materials:** a piece of wood, an apple, a Styrofoam cup, a small plant, a coin, a paper napkin, a piece of metal from a tin can, 1 or 1.5 litre soda bottles (with top cut off), a measuring cup, some garden soil
Lesson 1: 80 min

Introduction: 5 min
- Ask the pupils to explore the meanings of the following key terms, using the dictionary/glossary, and share them with the whole class.
  pollution, pollutant, environment, decompose, biodegradable, and non-biodegradable

Main teaching: 70 min
- Ask the pupils to name some things that are thrown away daily at home and at school. List these on the board.
- Discuss: What is meant by waste? Any material that is unwanted and is thrown away is waste. Ask their opinions about the waste and rubbish they see in the park or in the street. Do they think it spoils the neighbourhood? Why is it there? Who drops it? Explain that waste can exist as solid, liquid, or gas.
- Read page 83 of the textbook and discuss the content.

Why is waste harmful?
If waste is not disposed of properly, it causes pollution on land, in water, and in the air.
- Explain that waste can be broadly divided into two types:
  a) **Biodegradable waste** is solid waste produced by plants and animals that will break down into the soil and decay. How does this happen? The waste is eaten by smaller life forms like microbes (moulds and bacteria).
  b) **Non-biodegradable waste** is man-made materials that will not decay or breakdown into simpler forms of matter. This means that when we throw it away, it will remain as pollution in the environment.
- Now read page 84 of the textbook with the class, discussing the illustrations of biodegradable and non-biodegradable items.

Activity
Note: This is an ongoing activity that can be initiated in this session, but its results will only be apparent and observable after some time.
  i) Place the following materials on the table:
     a piece of wood, an apple, a Styrofoam cup, some fresh leaves, a coin, a paper napkin, a piece of metal from a tin can.
  ii) Ask eight volunteers to come to the front of the classroom.
  iii) Give each pupil one of the items from the list above.
  iv) Give them each a soda bottle and ask them to label the bottle with the name of the item that will be buried inside it.
     Make sure the tops of the soda bottles have been cut off.
  v) Each of the pupils should measure out the same amount of garden soil and place it inside the soda bottle. Make sure there is enough soil to completely bury the object.
  vi) The pupils should bury their objects in the soil in the bottles.
  vii) Now ask them to add an amount of water equal to the amount of soil in the bottle.
Every child should then write a hypothesis. This is a guess as to which items they think will decompose and which ones will not. Ask them to give reasons for their decisions.

- After a few weeks, ask the pupils to take the buried items out of the soda bottles. What do they notice? Do any of the items look different from the time they were first buried? The pupils should write their observations in their science notebooks.
- This composting activity should be followed up with a discussion on what each of us can do in our daily lives to minimize waste. Recycling of waste and compost heaps are a key part of this conversation.

**Wind up: 5 min**
- Ask the pupils to recall the meanings of pollution, pollutant, biodegradable, and non-biodegradable.

**Lesson 2: 80 min**

**Introduction: 5 min**
- Display some visual aids relating to air, water and land pollution and discuss them with the pupils. You could also use the photos showing environmental pollution on pages 85–88 of the textbook.
- Ask the pupils to identify the problems illustrated by the pictures. Where is the pollution coming from in these pictures?

**Main teaching: 70 min**
- Ask the pupils whether they have ever caused pollution:
  
  * Do you ever leave the TV on when no one is watching it?
  * Do you ever leave a light on in an empty room?
  * Do you ever leave the door open when the AC is on?
  * Does the exhaust pipe of your car emit black smoke?
  * Do you ever throw wrappers in the water or on the ground when you go for a picnic?

- Explain that if they are involved in any of these activities, they are contributing to environmental pollution.
- Introduce to them the different forms of pollution and divide the class into groups of six pupils who will work as three pairs.
- Give each group one pollution topic to work on. Within each group one pair of pupils should research the causes of the pollution; the second pair should research its effects; the third group should research ways of reducing this form of pollution.
- Note: Lesson 3 is a continuation of Lesson 2.

**Wind up: 5 min**
- What are some of the different forms of pollution?
- How is pollution affecting the environment of Pakistan?
- What is global warming?
- Should we be worried about global warming? Why? Why not?
- How can using Styrofoam boxes or plastic bags cause pollution? (They are not biodegradable.)
Lesson 3: 80 min

Introduction: 15 min
• Make sure that the pupils remember the groups they are working in and their assigned topics and areas of research.
• Ask them to read about their topic on pages 85-87 of the textbook. The reading should be done in two stages: pupils should first work in pairs to read about their own area of research. Then they will join the rest of their group and explain to them what they have learned so that every member of the group has a clear understanding of the topic as a whole.
• Give the pupils appropriate time for the paired reading and the group discussion.
• Monitor their progress throughout the activity.

Preparation of presentations: 30 min
• When the pupils have completed their group work, explain that they are going to share what they have learned with the rest of the class. They can present their work in any form they choose.

Presentations: 30 min
• Invite each group to come to the front of the class and present what it has learned about the assigned topic. Each group should be given three to four minutes to explain the causes, effects and ways to minimize pollution.
• Encourage the pupils in the audience to ask questions at the end of each presentation. Remind them that their questions should be focused and should be relevant to the topic of presentation.

Wind up: 5 min
• Recap the salient points of this lesson by asking some relevant questions:
  What is climate change?
  How have humans contributed to climate change?
  What are the likely effects of climate change?
  What can we do to help reduce climate change?

EXERCISE (page 89)


B 1. a) The environment is everything that is around us, wherever we happen to be.
   b) The contamination of air, water, or soil by substances that are harmful to living things is known as pollution.

2. Answers will vary. Some possible items are: paper, fruit skins, plastic bottles, shopping bags, etc.
3.

<table>
<thead>
<tr>
<th>Type of pollution</th>
<th>Causes</th>
<th>Effects</th>
<th>Ways to reduce</th>
</tr>
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<tbody>
<tr>
<td><strong>Land</strong></td>
<td>chemical waste produced by factories, human sewage, litter,</td>
<td>Toxic chemicals are transferred from one living thing to another.</td>
<td>Dispose of the waste properly; recycle paper, plastic, glass bottles, cardboard and aluminium cans.</td>
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<td>overuse of pesticides and herbicides, construction debris</td>
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<tr>
<td><strong>Air</strong></td>
<td>smoke from factory chimneys, vehicle exhaust fumes, burning of fossil</td>
<td>breathing disorders such as asthma and bronchitis; depletion of protective layer in the atmosphere known as ozone</td>
<td>When possible use public transport or walk or ride a bicycle; use CNG rather than petrol in cars.</td>
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<td>fuels, natural disasters like wild fires, volcanoes, etc.</td>
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<tr>
<td><strong>Water</strong></td>
<td>oil spills, untreated human sewage, use of pesticides, herbicides and</td>
<td>Use of polluted water may cause infectious diseases like cholera and typhoid; oil spills cause immense damage to sea life.</td>
<td>Do not throw litter into rivers, lakes and oceans.</td>
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<td>fertilizers by farmers</td>
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Unit: 15

Electricity

Teaching objectives:
- To introduce the atom, the three subatomic particles and the charges that they carry
- To compare the properties of negative and positive charges
- To explain current and static electricity by examining the movements of the subatomic particles in an atom
- To explain how lightning is caused

Key vocabulary: proton, electron, neutron, terminal, charge, static, electricity, electric current

Materials: plastic ruler or comb, small pieces of paper, small pieces of woollen cloth

Lesson 1: 40 min

Introduction: 5 min
- Begin the lesson by asking the pupils what they understand by the term ‘matter’.
- Also ask them what all matter is made up of.
- Then ask them to look up the meanings of the following words in the dictionary/glossary and share their findings with the class:
  - atom
  - nucleus
  - proton
  - electron
  - neutron

Main teaching: 30 min
- Put the pupils into pairs. Ask them to read pages 91 and 92 of the textbook, giving them enough time to understand and absorb what they are reading. Write the following questions on the board, for each pair of pupils to discuss with their partner before answering them.
  1. What is an atom?
  2. What is it made up of?
  3. Where are electrons, protons and neutrons found?
4. What kinds of electrical charge do protons, electrons, and neutrons have?
5. When do electric charges repel one another? When do they attract one another?
6. What does it mean if an entire atom has a neutral charge? (It has the same number of protons and electrons.)

Wind up: 5 min
• Ask the pupils to draw a picture of an atom and to label the parts.
Note: In preparation for the next lesson, ask each pupil to bring a plastic ruler or comb to class.

Lesson 2: 40 min

Introduction: 5 min
• Review the parts of an atom and their charges. How do the charges react when they are brought closer to each other?

Main teaching: 30 min
• Ask the pupils to take out their plastic ruler or comb. Bring your ruler/comb closer to the bits and pieces of paper. Is anything happening?
• Now ask them to rub the ruler/comb with a piece of woollen cloth. Soon, it will become negatively charged.
• Next, ask them to bring the ruler/comb near the pieces of paper and observe what happens. The pieces of paper should cling to the ruler/comb.
• Ask them: What happened? Why did this happen?
• Now ask the pupils to read pages 92 and 93 of the textbook, again in pairs.
• Afterwards, engage them in a discussion to review what they have read. Some examples of leading questions are given below:
  1. What happens to the atomic particles when you rub two objects together? (It is possible to transfer some of the outer electrons from one object to another.)
  2. What happens to an object that loses electrons? (An object that loses electrons has a deficiency of electrons, leaving it positively charged.)
  3. What happens to an object that gains electrons? (An object that gains electrons is negatively charged.)
  4. What happens when an object with a positive charge and an object with a negative charge are near each other? (The two objects will attract each other because of the electric force between them.)
  5. Describe your experiences playing with magnets. Have you noticed that sometimes two magnets will repel each other? What causes this?
  6. Why do you sometimes get a shock on a cold day when you touch metal?
  7. What other experiences have you had with static electricity?
  8. How is current electricity different from static electricity?
• Answers to all the above questions can be found in the text.
Wind up: 5 min

- A good way of summarizing and assessing understanding of the important concepts of this lesson is to ask the pupils to attempt Exercise D on page 96 of the textbook.

**EXERCISE** *(pages 81–82)*

<table>
<thead>
<tr>
<th>A</th>
<th>B charged object</th>
<th>F proton</th>
<th>E electron</th>
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<tr>
<th>B</th>
<th>electric current</th>
<th>static</th>
<th>negative(-) to positive ( +)</th>
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<th>D</th>
<th>True</th>
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<tr>
<th>E</th>
<th>The flow of electrons in an atom from the negative to the positive terminal is called electric current.</th>
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<tbody>
<tr>
<td>1.</td>
<td>In some materials the electrons are free to move. When such materials are connected to an electricity source these free electrons become energized. They start moving from one end of the material, the other, passing from atom to atom. (Any other answer that is factually correct should be accepted.)</td>
</tr>
<tr>
<td>2.</td>
<td>When an atom comes into contact with another atom, electrons may jump from one atom to another. When this happens, the atom ends up having more electrons than protons. This atom becomes negatively charged, and the atom which gains electrons becomes positively charged. This imbalance of positive and negative charges is called static electricity. The pupils will give their own examples of static electricity.</td>
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<tr>
<td>3.</td>
<td>All matter is made up of tiny particles called atoms.</td>
</tr>
<tr>
<td>4.</td>
<td>An atom is made up of very tiny particles known as subatomic particles. These are protons, electrons, and neutrons.</td>
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**Differences between particles:**

- **Protons** have positive charge and are found in the centre of the atom.
- **Neutrons** have no charge at all. They are also found in the centre of the atom. Protons and neutrons together make up the nucleus of an atom.
- **Electrons** have a negative charge and keep moving round the nucleus of the atom.

| 6.  | The diagram should be correctly labelled. |
| 7.  | We see electricity in nature in the form of sparks and lightning. |
| 8.  | An insulator cannot conduct electricity because it does not have free electrons to move from one end to another end of the material. Conductors have free electrons to move, so they can conduct electricity. |
ACTIVITY (page 97)

All the activities allow the pupils to explore the properties of static and current electricity and to compare the two. Detailed instructions and explanations are given in the textbook.

Unit 16

Electromagnets

Teaching objectives:
• To introduce magnetism as an attracting force
• To discuss the magnetic field
• To demonstrate that like poles repel and unlike poles attract each other
• To investigate electromagnetism by creating an electromagnet
• To identify some uses of electromagnets

Key vocabulary: electromagnet, magnetic field, magnetic compass, repulsion, attraction, demagnetization

Materials: different shaped magnets, beaker, oil, straight pins, paper clips, iron filings, magnetic compass, sheets of white paper, toy car, iron nail, insulated wire, battery

Advanced preparation: Put some straight pins into a beaker of oil.

Lesson 1: 40 min

Introduction: 5 min
• Take the beaker of oil into the class. Ask the pupils to think of a way to take the pins out of the beaker without dipping a hand in or tilting the beaker. They should come up with the idea of using a magnet.
• Move a strong magnet across the outer surface of the beaker and you will take out all the pins without tilting the beaker or dipping into the oil.

Main teaching: 30 min
• Brainstorm what the pupils already know about magnets.
• Ask them if magnets always attract each other.

Activity
Now perform this activity to introduce the interaction of magnetic poles.

You will need a metal toy (matchbox) car, a rubber band and two strong bar magnets.

a) Fix one of the magnets to the car with the rubber band. Hold the other magnet behind the car, about 2 to 3 inches away and watch the car move with the help of magnetic force.

b) Make the car move forwards or backwards by bringing similar and opposite poles closer to the magnet attached to the car.
Part 6 | Electricity and magnetism

- Now, introduce to the pupils the concept that opposite poles attract, while similar poles repel each other. Ask: *Now that you have learned this property of a magnet, can you suggest any way of identifying an unmarked pole of a magnet? Suppose you were given a magnet whose poles were not marked, how would you identify its north and south poles?*

- Give them a bar magnet whose poles are marked and a few other different shaped magnets, such as disc magnet, rod magnet, horseshoe magnet and U-shaped magnet, whose poles are not identified. *Suggest ways to identify the poles of these magnets.* They will identify the poles of these unmarked magnets with the help of the marked bar magnet.

- Give the pupils time to perform the experiment and then ask them to share their observations with the class.

- Warn them not to bring magnets near computers, computer monitors, audio tapes, or other magnetic devices. Strong magnets can destroy materials with magnetic properties.

**Wind up:** 5 min
- Ask the pupils to draw different shaped magnets and label their north and south poles.

**Lesson 2: 40 min**

**Introduction:** 5 min
- Divide the pupils into groups. Provide each group with a magnetic compass to examine.
- Now give them bar magnets and ask them to bring the magnetic compass near the magnet. *Observe how the compass behaves when it is brought closer to the bar magnet.*

**Main teaching:** 30 min
- The pupils should look up and share the meanings of the term *magnetic field* and *magnetic compass* in a dictionary or the glossary.
- Demonstrate to the pupils how a compass works by asking them to hold it so that the disc of the compass is horizontal and the N-S markings are facing up. Next, demonstrate how to align the line marked “N” (for north) on the glass/plastic top with the arrow inside the compass. Talk about how compasses are used to find directions.
- Ask the pupils to draw what they imagine the magnetic field around a single bar magnet looks like. Let them experiment with bringing the compass near their bar magnets.
- Explain: *The needle of a compass is itself a magnet, and so the north pole of the magnet always points north, except when it is near a strong magnet.*
- Can they construct their own magnet? Ask the pupils to arrange their compasses around one of the bar magnets as shown below:

```
 N S
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• Ask the pupils to tape some sheets of white paper together and place the bar magnets in the centre, on top of the paper.

**Activity**

• Explain to the pupils: *You will now trace the shape of the magnetic force field around the bar magnet.*

• To make the tracings, ask the pupils to do the following: (These instructions can be written on the board.)
  a) Draw a dot somewhere near the magnet and place the centre of the compass over the dot.
  b) Draw a dot at the location of the arrow head (or tail) of the compass needle.
  c) Move the compass centre to this new dot, and again draw a dot at the location of the compass needle's head (or tail).
  d) Remove the compass from the paper and draw lines connecting the dots with arrows indicating the direction in which the compass needle points.
  e) Repeat steps b-d until the line meets the magnet or the edge of the paper.
  f) Pick another spot near the magnet and repeat steps a-e.

• Ask the pupils to continue until they have drawn lines surrounding the magnet, as shown in the following figure: a dipole pattern of a force field.

• Introduce the term dipole (two-pole) magnetic field.

• Now ask them to explore the magnetic field of a bar magnet, using iron filings.
• First ask them to hypothesize and draw how they imagine this magnetic field will look.
• Next, give the pupils some iron filings and sheets of thin paper.
• Explain that iron filings are messy and will stick to magnets. It is important to keep the paper between the filings and the magnets.
• Ask the pupils to place the paper on top of one of their bar magnets, trace the outline of the bar magnet and mark the north and south poles. Lightly sprinkle the iron filings uniformly over the paper, and then tap the paper gently so that the filings align with the magnetic field.

• Ask: What did you observe when you sprinkled the iron filings over the paper covering the bar magnet? Draw what you saw.

• Finally, ask the pupils to record their observations in their science notebooks.

• Ask some probing questions to encourage them to think about what they are seeing. Can they explain what is happening? Do they see the same shape as they did with their compass tracings on paper around the bar magnets?

• If you have not already discussed how the filings act like tiny magnets, maybe now some pupils will be able to deduce this fact. Can you explain why the iron filings behaved like this? Do you see the same patterns as you did with the compass tracings?

Wind up: 5 min
• Ask them to summarize what they did and learned in this lesson.

Lesson 3: 40 min

Introduction: 5 min
• Ask the pupils to review what they learned about magnets in their previous lesson.

Before we look at electromagnets let us recap bar magnets.

Bar magnets are permanent magnets. This means that their magnetism is present all the time and cannot be turned on or off. They have two poles:

a) a north pole (or north-seeking pole)
b) a south pole (or south-seeking pole)

• Explain to the pupils that in this lesson they will explore the relationship between magnetism and electricity.

Main teaching: 30 min

Materials needed: a thin insulated wire, iron nail, battery, paper clips and compass

• Display and distribute the materials to construct an electromagnet. The pupils will construct and test the electromagnets within their groups.

• Demonstrate how to wind the wire around the nail, leaving room at each end.

• Next, ask them to make a closed circuit by attaching the free ends of the wire to the battery.

• Then ask the pupils to test their electromagnet by sticking the nail into a pile of paper clips. Ask:

a) What did the electric current do to the nail? (It turned it into a magnet.)
b) What happens to the nail when the electric current is switched off? (The nail loses its magnetism.)
c) Does the number of coils around the nail affect the strength of the electromagnet?

• Finally, ask the pupils what could be done to the nail to make it a stronger magnet.
Part 6 | Electricity and magnetism

Ask each group to design a fair test to explore this question. They should consider the following:

a) Should the wires be wrapped around the nail side by side, or on top of each other?
b) Should the wires be wrapped around the entire length of the nail or just at its head or tip?
c) Should the wires be tightly or loosely wrapped around the nail?

• Let them try out their ideas of how to make their electromagnets stronger.

• Recall the properties of a bar magnet that were discussed at the beginning of this lesson. Shift the focus now to the properties of electromagnets:
  a) The strength of an electromagnet can be increased by increasing the current in the coil.
  b) The strength of the electromagnet can be increased by introducing a soft iron core inside the coil.
  c) Electromagnets are very strong, temporary magnets.
  d) As soon as the current is switched off, the electromagnet becomes demagnetized.
  e) Electromagnets can be made in different shapes and sizes according to requirements.

• Discuss situations where moving things with electromagnets might be useful.

Electromagnets have many uses. Here are some examples:

a) an electric bell – The electromagnets make the hammer vibrate back and forth, ringing the bell.
b) an electric lock – An electromagnet pulls the bolt open. Switch it off and the bolt springs back.
c) a crane – A scrapyard crane can lift a whole car.
d) a surgeon’s tool – An eye surgeon can pull scraps of steel out of a patient’s eye using an electromagnet.
e) Maglev trains work with the help of electromagnets.

Windup: 5 min

• Ask the following questions:
  What is an electromagnet?
  How can the strength of an electromagnet be increased or decreased?
  Where in our daily life are electromagnets used?
  What is meant by demagnetization?
  How can magnets lose their magnetism?

**EXERCISE (page 103)**

A 1. True  2. False (They attract cobalt as well as steel and iron.)
  3. False  4. True  5. False

B 1. magnet  2. magnetic field  3. attract, repel
  4. demagnetization  5. electromagnet

C 1. a) Materials which are attracted by a magnet are called magnetic materials.
Materials which are not attracted by a magnet are called non-magnetic materials.

b) The magnetic field is an area around the magnet where its force of attraction can be felt most strongly.

2. Demagnetization is a method or process by which a magnet loses its magnetism or force of attraction. This can happen if magnets are:
   1. dropped repeatedly
   2. heated
   3. hammered
   4. kept close to each other when not in use.

3. Electricity can be used to convert a magnetic material into a magnet. Such magnets are called electromagnets.

4. An iron nail can be turned into a magnet by passing an electric current through it.

5. The strength of an electromagnet can be increased by increasing the number of coils around the iron nail, or by increasing the flow of current in the wire.

6. Three uses of electromagnets in daily life are:
   • in the speakers of TVs, radios, tape recorders.
   • in doorbells and generators
   • in scrapyards to separate metals.

7. If this train is able to float above the track, it means the track and the toy train contain magnets underneath the train and on the surface of the track. These magnets have been positioned so that the bottom of the train and the surface of the track both face the same poles.

**ACTIVITY (page 104)**

1. This activity has been discussed at length in Lesson 3 of this unit of the Teaching Guide.

2. a) An MRI scan provides a more detailed image of the tissues and organs of the human body than an X-ray.

2. b) Answers will vary.
Unit 17

Forces

Teaching objectives:
- To review the forces of push and pull and their effects on objects
- To identify the spring balance as an instrument used to measure forces, and the Newton as the unit of measuring force
- To explain friction and compare its advantages and disadvantages in daily life
- To explain that gravity is a force of attraction
- To differentiate between the mass and the weight of an object

Key vocabulary: push, pull, spring balance, weight, mass, gravity, friction, newton

Materials: three objects of different masses, balance, ruler, sandpaper, spring balance, aluminium foil, sticky tape, feather, football, ping-pong ball, a sheet of paper, a marble

Lesson 1: 80 min

Introduction: 10 min
- Show the pupils some Plasticine or play dough, a rubber band and a sponge and ask them what they could do to change the shape of these things. Pupils should come up with the words such as squeeze, twist, squash, stretch, press, etc.
- Ask them to suggest a single word for all of these actions. (force)

Main teaching: 60 min
- Read the feature Do you remember? on page 105 of the textbook to recall the definition and the effects of applying force.
- Now ask the pupils to give examples of some actions from their daily life where they apply push, pull or twist to perform a task.
- Introduce the spring balance and the unit used for measuring force.
- Before giving them the hands-on activity involving the spring balance, teach the pupils how to read the scale.
• Provide them with Activity sheet 1 (on page 71 of this guide), and give them enough time to perform the activity.

• After the activity, discuss the difference between mass and weight:

  People often confuse mass and weight. Remember that weight is a force, and is measured in newtons. Mass is measured in kilogrammes (kg). The mass of an object is the **amount of matter** it contains. The more matter an object contains, the greater is its mass. An elephant contains more matter than a mouse, so it has a greater mass. Mass is measured in grams or **kilogrammes**.

  The weight of an object is the **gravitational force** acting between the object and the Earth. The more mass the object has, the greater its weight will be.

  Remember that an object’s mass stays the same wherever it is, but its weight can change. This happens if the object is somewhere where gravity is stronger, or weaker, such as on the Moon.

• Ask the pupils to read and explain in their own words the difference between mass and weight given on page 109 of the textbook.

• Ask: *Why does it take more force to pull an object on sand paper than on aluminium foil?*

• Ask the pupils what they understand by the term ‘friction’. *What does friction do? How does it work?* Ask them to look up the meaning of *friction* in the glossary.

• Explain that the amount of friction depends on the surface materials and the force pressing the objects together. *The sandpaper was rougher than the aluminium foil. The greater the amount of friction, the harder it is for the object to move, so it moves more slowly. The smaller the amount of friction, the more easily and faster an object moves. Friction always slows down moving objects.*

• Ask the pupils to place their hands together lightly and rub them back and forth. As they do so, ask them to press their hands together harder and then even harder. Then ask: *What did you notice?*

  Explain to them that friction produces heat.

• Read the paragraph on friction on page 106 of the textbook.

**Wind up: 10 min**

• Ask the pupils the following questions:

  1. *What is the difference between mass and weight?* (Mass is the amount of matter an object has. Weight is a measurement of how much it is affected by gravity.)

  2. *Which may change with the location or position of the object, mass or weight?* (The weight of a person or an object changes depending upon the strength of gravity, but the mass will remain the same wherever a person or object happens to be.)

  3. *What is friction?* (A force between two surfaces that opposes motion.)

  4. *What force acts when two objects rub together?* (friction)

  5. *What is produced by friction?* (heat)

  6. *Which type of surface produces more friction?* (rough)

  7. *Which type of surface produces less friction?* (smooth and plain)
Lesson 2: 40 min

Introduction: 5 min
- Write the following statements on the board and give the pupils a couple of minutes to complete them.
  a) Friction is a force between ____________. (two surfaces)
  b) Friction always slows a ____________. (moving object)
  c) The rougher the surface, the more friction ____________. (is produced)
  d) When you rub your hands together, the resulting friction produces ____________. (heat)
  e) Sitting on a grassy slope, the force that stops somebody from sliding down is ____________. (friction)

Main teaching: 30 min
- Engage the class in a discussion about how friction is helpful or can become a problem for us.
- Ask the pupils to think of all the things they do on a daily basis, then choose one event or activity and answer the following:
  What two things are rubbing together?
  How is friction either helping or hindering in this case?
  If the friction is harmful, how can it be reduced? If it is helpful, what can be done to increase the friction?
- Ask the pupils to work in pairs to discuss the advantages, disadvantages and some ways to reduce friction. After the pupils have provided their own ideas, explain the following:

Advantages of friction
  a) friction between our shoes and the floor stop us from slipping
  b) friction between tyres and the road stop cars from skidding
  c) friction between the brakes and wheels help cycles and cars slow down
Frictional forces are weaker on smooth surfaces than on rough surfaces, which is why we slide on wet floors.

Disadvantages of friction
Friction can also be unhelpful. If you do not lubricate your bicycle regularly with oil, the friction in the chain and axle increases. Your bicycle will be noisy and difficult to pedal. When there is a lot of friction between moving parts, energy is lost to the surroundings as heat. Think of what happens when you rub your hands together quickly. The friction warms them up. This shows that friction creates heat.

Wind up: 5 min
- Ask the pupils to answer the following questions to evaluate their learning.
  List any three situations where friction is helpful.
  List three problems caused by friction.
  Friction produces heat in moving parts of machinery. Is there a way of reducing friction so that machines work smoothly? (by lubricating the machine parts)
Lesson 3: 40 min

Introduction: 5 min
- Ask the pupils to look up the meaning of gravity in the glossary.
- Relate the story of Isaac Newton’s discovery of the existence of gravitational force.
  
  *How would life be different if there was no gravity?*

Main teaching: 30 min
- Show the pupils a football and a marble and ask: *If I drop a football and a marble at the same time, which one will hit the ground first, and why?*
- **Demonstrate:** Stand on a chair, holding the objects at about shoulder height and drop them. *Which one hit the ground first?* After hearing several answers, repeat the experiment, so that they can see that both hit the ground at the same time.
- Divide the pupils into groups. Explain that they are going to explore what happens when the same is done to other objects.
- Give the pupils Activity Sheet 2 (on page 72 of this guide) and the materials to perform the experiment, and record their observations. They should first predict and then perform the experiment.
  
  The unfolded sheet of paper will hit the ground much later than the ping-pong ball, but once the sheet of paper is crumpled into a ball, they should both hit the ground at the same time. Ask why this happens. Explain that while weight does not affect the rate at which objects fall, shape certainly does.
- Hold up a crumpled piece of paper and an unfolded sheet and ask: *Which one of these will fall to the ground more easily?* The crumpled one because there is less air hitting it.
- Ask: *When the wind is blowing really hard, what is the easiest way to walk into the wind? Do you bundle up (demonstrate wrapping yourself up and hunching down as you move forward), or do you spread your arms wide and try to walk into the wind? Which will make it easier to move?* Listen to their answers. They should say that if you huddle up and hunch over, it will be easier to walk than if you spread your arms out.
- Introduce the term **air resistance.** Explain: *Air resistance is a type of friction between air and another material. When an aeroplane flies through the air, for example, air particles hit it. This makes it more difficult for the aeroplane to move through the air.*
  
  *Some shapes, known as streamlined shapes, create less air resistance than others. Aeroplanes and cars are streamlined, so that they can move through air as easily as possible.*

Wind up: 5 min
- Recap the salient points of this lesson by asking:
  
  *What can be done to reduce friction?*
  *What is streamlining? How does it help to reduce friction?*
  *What is air resistance? How does it affect the movement of cars, aeroplanes or any other moving object?*
Activity sheet 1

Materials: 3 objects of different masses, balance, ruler, sandpaper, spring balance, aluminium foil, sticky tape

What to do:

Procedure 1:
1. Measure the mass of object 1 using the balance and record it in data table 1.
2. Attach the object to the spring scale and pull it along a distance of 100 cm = 1 m. Read the force in newtons (N).
3. Repeat the above steps for the other two objects. Record your measurements.

Data table 1:

<table>
<thead>
<tr>
<th>Object</th>
<th>Mass (grams)</th>
<th>Force (newtons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Which object needed more force to pull it? Why?
Ans. ________________________________________________________________________________
___________________________________________________________________________________

Which object needed least force? Why?
Ans. ________________________________________________________________________________
___________________________________________________________________________________

Procedure 2:
1. Attach the first object to the spring scale and pull it along a distance of 20 cm. Read the force in newtons (N).
2. Tape the piece of sandpaper to the table, and then pull the object along the same distance (20 cm) on the sandpaper. Read the force in newtons (N).
3. Repeat the above, using aluminium foil in place of the sandpaper this time. Record your measurements in data table 2.

Data table 2:

<table>
<thead>
<tr>
<th>Object</th>
<th>Surface type</th>
<th>Force (newtons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

On which surface was more force required to move the object along? Why?
Ans. ________________________________________________________________________________
___________________________________________________________________________________
Activity sheet 2

**Materials:** marble, ping-pong ball, a sheet of paper, an eraser, a pencil, a paperclip, a feather

<table>
<thead>
<tr>
<th>Objects dropped</th>
<th>Which will hit the ground first? (Prediction)</th>
<th>Which actually hit the ground first? (Observation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>marble + ping-pong ball</td>
<td></td>
<td></td>
</tr>
<tr>
<td>eraser + paper clip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>marble + pencil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>flat sheet of paper + feather</td>
<td></td>
<td></td>
</tr>
<tr>
<td>crumpled sheet of paper + feather</td>
<td></td>
<td></td>
</tr>
<tr>
<td>feather + paper clip</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**EXERCISE (page 103)**


D 1.

<table>
<thead>
<tr>
<th>Weight</th>
<th>Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) The gravitational force acting on an object is known as weight.</td>
<td>The measure of the amount of matter in an object is known as mass.</td>
</tr>
<tr>
<td>b) Its SI unit is the newton.</td>
<td>Its SI unit is the kilogramme.</td>
</tr>
<tr>
<td>c) Weight is affected by the force of gravity.</td>
<td>Mass is not affected by the force of gravity.</td>
</tr>
</tbody>
</table>

2. a) Force is a push or pull exerted by one object on another.
   b) The force of attraction between two objects is known as gravity.
3. Actions a, b, d and f involve force while actions c and e do not involve forces.
4. The Sun’s gravitational force holds the Earth in its own orbit as it revolves around the Sun.
5. When a person moves from the Earth to the Moon, his weight decreases because the Moon is smaller than the Earth, so it has less gravity and exerts less force.
6. Rough surfaces have more friction than smooth, plain surfaces.
8. a) Friction between our shoes and the ground helps to walk without slipping.
    Friction between the pencil and paper helps us to write.
    
b) Heat produced by friction can become a problem in machinery. It can be reduced by oiling the moving parts.
    The friction created by a rough surface can become a problem when an object is required to slide easily. In this case the friction can be reduced by making the surface smoother.

8. **How things would be difficult:**
   - If there were no friction at all we would not be able to walk on the ground.
   - There would be traffic accidents due to the absence of friction between the car tyres and the surface of the road.
   - We would not be able to write anything.

**How things would be easy:**
   - Machinery would work more smoothly and would last longer if there were no friction at all.
   - Our shoes would never wear out if there were no friction.
   - Anything we would like to slide easily would work better without friction.
Unit 18
Sound

Teaching objectives:
• To define sound as the vibration of molecules and a form of energy
• To explain that sound travels in waves through a medium that can be solid, liquid or gas
• To explain that because sound is produced by vibration and travels in waves, it cannot travel in vacuum
• To introduce hertz (Hz) as the unit of measurement used to measure the frequency of sound

Key vocabulary: vibration, frequency, hertz, echo, wave

Materials: balloons, a candle, rubber bands, paper cups, clear plastic sheet, salt, sugar or rice grains, pictures of a guitar, drum and flute, skipping rope, water tub, water, small stone, a large bowl (metal works best), two spoons, an alarm clock

Lesson 1: 40 min

Introduction: 5 min
• Ask the pupils to close their eyes and focus on the sounds that can be heard. Ask them to share what sounds they can hear. Write down their responses on the board.
• Now ask them to open their eyes and tell you the sources of all the sounds they have heard.

Main teaching: 30 min
• Brainstorm what they already know about sound. If they tell you that sound is a form of energy, ask them what they understand by ‘energy’.
• After listening to their responses, ask: If energy is the ability to do work, and sound is a form of energy, then what work does sound do? Can sound really do work?
• Now light a candle and place it on a table. Ask: Can you put out this candle without blowing on it? (It can be done by clapping hard near the flame.).
• Explain that this is one proof that sound is a form of energy.
• Ask the pupils if they can explain what happened. *The sound from the hands pushed the air particles between the candle and the hands. These particles hit the flame of the candle hard and caused the candle to go out.*

• Now ask the pupils to look up the meaning of the term ‘vibration’ in the glossary.

**Activity**

• Explain the action of vibration with the help of this activity. You can prepare these cups before the lesson to save time. This is pair work so prepare the number of cups according to the number of pairs in your class.
  a) Take one paper cup. Make a small hole in the centre of the paper cup with a straight pin.
  b) Take a rubber band and cut it to make a straight strip of rubber.
  c) Put one end of the rubber band through the hole in the cup. Tie a knot in the end of the band that is inside the cup.
  d) Cover the mouth of the cup with a sheet of transparent plastic and stretch the other rubber band around it to hold the plastic in place.
  e) Sprinkle a pinch of salt, sugar or rice over the plastic cover.
  f) Ask a pupil to hold the cup firmly and gently stretch the rubber band a little.
  g) The other pupil should pluck the rubber band, watch and listen.

• *Ask your friend to do the same and observe when your friend plucks the rubber band. What happens to the rubber band and the grains?*

• Ask the pupils to touch their throat with the tips of their fingers and hum (or sing a song together). Ask them if they can guess how the humming sound is made. They should be able to feel their larynx vibrating.

• Show them pictures of some musical instruments, e.g. guitar, drum, and flute and ask them how they are played, (by plucking, banging, and blowing). *What vibrates in these instruments to create sound?*

**Wind up: 5 min**

• Conclude the lesson by asking these questions:
  
  *What is sound?*
  
  *How can you prove that sound is a form of energy?*
  
  *Define vibration.*
  
  *Name at least four things which make sound. Describe how they make sounds. What vibrates in each of these objects to make sound?*
  
  *When you talk or sing, which part of your body vibrates?*

**Lesson 2: 40 min**

**Introduction: 5 min**

• Ask the pupils to share what they understand by the term ‘wave’. Invite one of them to draw waves on the board.
Part 8 | Sound / Light and colour

• Make them stand around a tub full of water. Ask them to predict what will happen if a stone is dropped in it. Encourage them to draw it on the board.

• Now drop a stone into this still body of water. The rings of waves spread outwards in a circle. Explain: Sound vibrations spread in all directions in the same way that ripples spread out from a pebble that has been dropped in water. Just like waves created by the vibration of the air.

• Draw on the board a dot and concentric circles around it. Explain that when an object vibrates, the sound waves move away from the object like ripples in a pool.

Main teaching: 30 min
• Invite two pupils to create a wave pattern using a skipping rope.
• Either tie one end of the rope to a fixed place, or ask one pupil to hold the end of the rope as still as possible.
• The second pupil needs to make a running wave along the rope by giving it a gentle flick.
• Ask them to draw the movement of the rope. (It should look like a wave.) Ask: How do you think sound moves?
• Ask them to look up and share the meanings of the terms wave, frequency and hertz in the dictionary.
• Ask them to read pages 114 and 115 of the textbook.
• They should share their understanding of sound waves, frequency and hertz.
• Ask them to draw two pictures in their notebooks, one to show high frequency sound waves, and the other to show low frequency sound waves.

Wind up: 5 min
• Ask these questions:
  What is a wave?
  How does sound travel?
  Define frequency and hertz.
• Discuss the wave lengths drawn on page 117 of the textbook and ask: Which sound wave is showing low frequency and which is showing high frequency?

Lesson 3: 40 min

Introduction: 5 min
• Engage the pupils in a discussion with the help of these questions:
  Can you hear as well when you sit at the back of the class as when you sit at the front? What about in the assembly hall or on the playground? Can you think of other times when you cannot hear as well as somebody else? Which is louder — walking on the carpet or on tiles? Why?
• Ask them to look up the meaning of the term ‘echo’ in the dictionary or in the glossary.

Main teaching: 30 min
• Explain that it is quieter to walk on the carpet because it can absorb sound waves. Sound energy needs molecules to travel through and vibrate, but sometimes sound energy is absorbed by an object or material. Engineers use this idea when designing rooms that are meant to be quiet. Sometimes
when you are in an empty room, your voice echoes or sounds hollow. This is because an empty room has no materials in it that can absorb the sound energy, so the sound bounces back at you off the hard walls. This makes it hard to hear clearly.

• Ask the pupils to set the alarm clock. Let it ring while it is sitting on a hard surface, such as a table. Ask them to describe the sound. Let it ring while it is sitting on a soft rug, the cushion of a chair or sofa, or a pillow. Did you notice any difference? How has the sound changed? Describe it. Explain that sound waves are absorbed by soft materials and echoed by hard materials.

• To introduce the media through which sound travels, ask the pupils if they think sound can move through solids, liquids, and gases. If so, can they give some examples?

  **How can you prove that sound travels through air?** That is how sound energy travels when you speak to someone. How about water? Can you hear sound travel under water? How about a solid? Can sound travel through a solid object? Engineers want to know if sound can travel through solids, liquids and gases so they can develop ways to send messages to people all over the world.

Ask the pupils to predict if sound can move through solids, liquids and gases.

• **Can sound energy travel through solids?** Ask the pupils to place their ears on a desk or table top as they tap it. They should compare what they hear with the same sound made when their ear is not pressed to the table.

• **Can sound energy travel through liquids?** Fill a large metal bowl or bucket with water. One pupil taps two spoons together under the water. Two other pupils compare the tapping sound they hear, as heard through the air and as heard by placing an ear against the bowl.

• **Can sound energy travel through gases (air)?** The pupils feel their throats gently during each of these tasks:

  - Hum with your mouth and nose open.
  - Hum with your mouth open and nose closed.
  - Hum with your mouth closed and nose open.
  - Hum with your mouth and nose closed.

• Explain: Sound needs molecules to help it to travel. Solids, liquids and gases are all made of molecules. A vacuum is an empty space that contains no matter. This means that since space is a vacuum (it contains no molecules), sound cannot travel in space.

• Now read the information on page 117 of the textbook that explains these concepts. When discussing the text in ‘Environment watch’, touch briefly upon noise pollution: Noise is any unwanted sound that can disturb people. Usually loud sounds like machinery working and vehicles moving and sounding their horns contribute to noise pollution.

**Wind up: 5 min**

• Ask the pupils to summarize the main concepts studied in this unit.

**EXERCISE (pages 118–119)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>1. vacuum</td>
<td>2. frequency</td>
<td>3. hertz</td>
<td>4. wave</td>
</tr>
<tr>
<td></td>
<td>6. medium</td>
<td>7. solid</td>
<td>8. gas</td>
<td>9. echo</td>
</tr>
</tbody>
</table>
C 1. both a & b  2. c  3. b  4. b  5. a  
D 1. a) Sound is a form of energy that is produced by vibrations.  
   b) The to and fro movement of an object is known as vibration.  
   c) The vibrations passing from molecule to molecule are called sound waves.  
   d) The number of vibrations per second is called the frequency.  
2. Inside the ear, the cochlea has tiny hair that detects sound waves.  
3. Answers will vary.  
4. An echo is produced when sound waves hit a hard surface. If a sound is made in a large empty room, it echoes. If there are many objects around the sound source, it will not echo because the sound energy will be absorbed by these objects.  
5. Both noise and musical notes are sounds. They are different because noise is disturbing while musical notes provide pleasure to the listener.  
6. Sound needs a medium to travel through. It cannot travel in a vacuum because there are no molecules to pass on the vibrations.  
E Unscrambled words
1. vibration  
2. waves  
3. hertz  
4. frequency  
5. echo  
6. sound  
7. energy

Unit 19
Light

Teaching objectives:
• To explain that shadows are cast because light travels in straight lines  
• To explain the working of the pinhole camera  
• To revise the reflection of light  
• To explain the refraction of light and its effects

Key vocabulary: reflection, refraction, rainbow, spectrum, pinhole camera

Materials: coloured card, torch, pinhole camera, candles, pencil, glass of water

Advanced preparation:  
• Follow the instructions given on pages 124–125 of the textbook to construct a pinhole camera.
Lesson 1: 40 min

Introduction: 5 min

- Ask the pupils to recall their existing knowledge about light. Discuss the importance of light. (Without it we could not see anything.)
- Compile on the board a list of the many different sources of light that help people see at night, such as lamps, torches, stars, car headlights, the Moon, candles, fire, etc.
- Ask the pupils to think about how we see things. Explain: We can see things because light is reflected. Both light and our eyes work together to enable us to see. Some materials reflect light better than others. Light travels in straight lines. When light hits an object, it is reflected (bounced off) and enters our eyes. This is how we see the object.
- Remind them about some of the properties of sound that they learned in the previous unit: Sound is a form of energy and is reflected in the form of echoes. Light is another form of energy and is reflected when it bounces back after hitting a smooth, flat surface.

Main teaching: 30 min

Activity

- Conduct Activity 2 which is explained on page 125 of the textbook.
- Ask the pupils what they deduced about how light travels. Ask questions until they come up with facts supporting the idea that light travels in straight lines and in all directions.
- The pupils should predict how light will be projected on a screen through a small hole. They should conclude that light travels in straight lines.
- Now ask them what they know about the pinhole camera. At this stage, just share the definition of the pinhole camera. It is a camera without a lens. We will be investigating how this camera works without a lens.
- Display the pinhole camera that you have constructed in advance.

Procedure

- Light a candle and place it in a safe place. Close supervision of the candle flame is needed.
- Point the pinhole of the camera towards the burning candle.
- Look at the side of the camera with the greased paper screen.
- Move the box up and down or back and forth to point the pinhole towards the candle.
- Can the pupils see the image on the screen at the back of the box? Ask them to draw in their science notebooks what they see on the screen.
- Ask them to read the explanation of how the pinhole camera works on pages 121 and 122 of the textbook.

Wind up: 5 min

- What special properties of light did we focus upon in this lesson? (Light is reflected when it hits a surface, and it travels in straight rays.)
- Write the following steps (arranged below in the correct order), in the wrong order on the board and ask the pupils to rearrange them in the correct sequence:
  a) Light falls on an object.
b) The object reflects the light.
c) The reflected light enters the pinhole.
d) It goes straight to the other end of the box.
e) An upside down image is formed on the screen.

Lesson 2: 40 min

Introduction: 5 min
• Engage the pupils in a discussion about colours. What is your favourite colour?
  Have you ever seen a rainbow? What does a rainbow look like? What colours do you see in a rainbow? How are they formed?
• Three things must happen for you to see a rainbow. First, the Sun must be shining. Second, the Sun must be behind you, and third, there must be water drops in the air in front of you. Sunlight shines onto the water drops, which act as tiny prisms that bend or refract the light and separate it into colours.

Main teaching: 30 min
• Show the pupils a prism and ask what they think a prism does with the light.
• Shine a beam of light on a white screen and ask them to draw the light rays. Now ask them to predict what will happen if a prism is placed in the path of the beam of light.
• Place the prism in the path of the light and ask the pupils to explain what they observe. Ask them to record their observations in their science notebooks.
• Ask: What happened when you viewed white light through the prism? What colours did you see? What order were the colours in? Explain that ordinary sunlight is called white light.
• Take the pupils outdoors on a sunny day and divide them into groups.
• Gently mix water and detergent in pans.
• The pupils should use straws to blow large bubbles. Observe the bubbles in sunlight and examine the colours that appear on their surface.
• Explain: Due to refraction, white light disperses (scatters) into different colours. What else can refraction do? Let us conduct an experiment that allows us to see the effect of refraction:
  a) Fill a glass 2/3 full of water.
  b) Place a pencil in the glass, holding it vertically (not at an angle). Ask the pupils to draw the pencil as it appears inside the glass.
  c) Now lean the pencil against the side of the glass. Look through the glass at the pencil.
  d) Ask them to draw the pencil. Notice that it appears bent. This is the effect of refraction or bending of light.
• Have you ever reached down into a bucket full of water to pick out a toy or a coin, and found that it was not in the position it appeared to be? What you are experiencing is the effect called refraction. When light enters water (or any transparent material), it slows down slightly. If it enters the water at an angle, then this change in the speed of light causes the light beam to bend away from its original path. This bending of light is called refraction of light.
Wind up: 5 min
• Recap all the properties of light that have been discussed in this unit.
• Differentiate between reflection and refraction of light, so that the two are clearly distinct in the pupils’ minds.

EXERCISE (pages 123–124)
A 1. A pinhole camera has no lens. It has a pinhole at one end and a paper screen at the other end. A very tiny hole at one end of the box is used as a lens. The smaller the hole, the sharper the image. The image produced by a pinhole camera is upside down and reversed.
2. Light is refracted when it bends, and is reflected when it bounces back.
B 1. a 2. b 3. a 4. c
C 1. A pinhole camera is a very simple camera with no lens and a single, small hole. Simply explained, it is a light-proof box with a small hole on one side.
2. Light travels in straight lines. This is the property that is applied in a pinhole camera.
3. When we shine light through a prism, it scatters into different colours. These colours are known as a spectrum or rainbow.
4. Ibn al Haytham was a great Muslim physicist.
   He was the first scientist to study the properties of light.
   He studied dispersion of light, shadow formation, and eclipses. The early foundations of the camera and the microscope were laid by this great scientist.

ACTIVITY (pages 124–125)
All the activities have been explained at length in the textbook.
Unit 1

Building units of the body

A  Complete the following statements.
1. Cells are the ____________________________.
2. The two types of organisms are ____________________________.
3. Cells are so tiny that they can only be seen with the help of the ____________________________.
4. ____________________________ provide the energy needed by cells to do their job.

B  Name the two types of cells shown below and label their organelles:

1. ____________________________  2. ____________________________
Unit 3
The lungs

A  Label the respiratory organs in the following diagram.

B  Draw the diaphragm in the two diagrams below, showing its movement during inhalation and exhalation.

Inhaling air  Exhaling air

The diaphragm pushes  _________  as the lungs  ________.

The diaphragm pushes  _________  as the lungs  ________.
Unit 4
The human heart
Label the diagrams below that show the structure of the human heart.

External structure

Internal structure
Unit 5
Digestion
A  Label the diagram showing the digestive system below.

B  Draw and write about the three organs that work together with the digestive system.
Unit 6
Looking after yourself

A  Connect the start of the sentence to the right ending.

1) Bacteria can • before you make or eat a meal.
2) Wash and dry you hands • in the refrigerator.
3) Wash fruits and vegetables • when bacteria and fungi begin to grow in them.
4) Keep dairy and meat products • food does not allow microorganisms to enter it.
5) Foods can spoil and decay • with cold water before you eat them.
6) Canned, bottled, and packaged • spread from one food to another.

B  Microorganisms can be harmful and cause disease. Which of these illnesses are caused by microorganisms?

<table>
<thead>
<tr>
<th>Illness</th>
<th>Tick (✔) or Cross (✗)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A broken arm</td>
<td></td>
</tr>
<tr>
<td>Toothache</td>
<td></td>
</tr>
<tr>
<td>Food poisoning</td>
<td></td>
</tr>
<tr>
<td>Headache</td>
<td></td>
</tr>
<tr>
<td>Cholera</td>
<td></td>
</tr>
<tr>
<td>Cough and cold</td>
<td></td>
</tr>
</tbody>
</table>
Unit 8
Life cycle of animals
Cut out the pictures in the boxes.
Glue and arrange them in your book to show the life cycles of the grasshopper and the butterfly.
Unit 11

Matter

A Write T for the statements which are true and F for the ones which are false.

1. Sublimation is the process by which gas changes into liquid upon cooling. ________
2. An everyday example of sublimation is dry ice. ________
3. Melting is the process by which solid changes into liquid upon heating. ________
4. Evaporation is the process by which solid changes into gas upon heating. ________
5. Melting of chocolate is a reversible change. ________
6. Freezing of water is an irreversible change. ________

B Draw and label the water cycle in the box below.
Unit 12
The Sun and the Moon

A  Label the phases of the Moon in the boxes.

B  Explain the different phases of the Moon.
Unit 14

Pollution in the environment

A  Classify the following materials into biodegradable and non-biodegradable materials.

<table>
<thead>
<tr>
<th>wood</th>
<th>metal</th>
<th>ceramic</th>
<th>cork</th>
<th>corn</th>
<th>vegetable scraps</th>
<th>paper</th>
<th>glass</th>
<th>foam</th>
<th>cotton</th>
<th>leaves</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>biodegradable</th>
<th>non-biodegradable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B  Use the glossary to find and write the meaning of these words:

<table>
<thead>
<tr>
<th>word</th>
<th>meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) ecosystem</td>
<td></td>
</tr>
<tr>
<td>2) herbicide</td>
<td></td>
</tr>
<tr>
<td>3) pesticide</td>
<td></td>
</tr>
<tr>
<td>4) biodegradable</td>
<td></td>
</tr>
<tr>
<td>5) non-biodegradable</td>
<td></td>
</tr>
</tbody>
</table>