Introduction to Environment:
Science

Class Five

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Preface

For improving the existing quality of Primary Education in Bangladesh, National Curriculum and Textbook Board (NCTB) in collaboration with PEDP-2 initiated an extensive program for development of curriculum and teaching learning materials in 2002. In the light of this program the curriculum, textbooks and other teaching learning materials of Primary levels have been prepared, revised and evaluated.

The textbook entitled, 'Introduction to Environment: Science' has been prepared on the basis of attainable competencies for the students of Class Five. The subject matter of the textbook is derived from the basic elements of the environment and science around familiar to the children. This will facilitate our young learners to know how they can make best use of the scientific knowledge in their day-to-day life.

The contents of the book are analyzed and explained in such a manner with practical examples, illustrations and system of planned activities, that students are inspired to study the subject with a keen interest.

This book is originally published in Bangla. From this year NCTB is publishing the English version of the textbook. English is the language of choice in today's globalized world. To facilitate the verbal and written communication skills of our future citizens and suitably prepare them for international competition, we decided to translate the original Bangla textbooks into English. It's pleasant to note that the number of English medium schools in Bangladesh is increasing very fast. In this context NCTB decided to publish all the textbooks of Primary level in English. This was a big endeavour for us. Despite our all efforts the first edition may not be totally error free. However, in the future editions we shall try to remove all errors and discrepancies.

Finally, I would like to express my heartfelt thanks and gratitude to those who have made their valuable contributions in writing, editing, evaluating and translating this book. I sincerely hope that the book will be useful to those for whom it has been prepared.

Prof. Md. Mostafa Kamaluddin
Chairman
National Curriculum and Textbook Board
Dhaka
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Chapter One

Living World

The living world consists of living things, such as human beings, animals, fish, plants and microorganisms (very small organisms). It is divided mainly into two parts: the plant kingdom and the animal kingdom.

**Plant kingdom**

There are many different kinds of plants around us. These include small plants like algae and fungi; and large trees like mango, jackfruit or jambu. Now, let us learn about plants.

**Classification of plants**

There are many different kinds of plants around us. Some are large, such as mango, jackfruit, betel-nut trees etc. China rose, lemon, rose, rangan etc. are medium-sized plants. Plants like chilli, paddy, water lily, grass, water hyacinth, spinach, bottle gourd, pumpkin etc. are small in size.

Plants are classified into three types based on their size and nature of their stems. These are: herbs, shrubs and trees. You know that the main shoot of a plant is long, strong and thick. It is known as the stem of the plant. Branches and branchlets grow from the stem. The bottom of the stem ends in a thick tap root. This
tap root penetrates deep into the ground. Mango, jackfruit, teak, mahogany are trees we are familiar with.

You also know that shrubs are medium-sized plants. Their stems are hard but not very thick. Many branches and branchlets grow from the stem, giving the plant a bush-like appearance. Shrubs do not have a main stem. The roots of shrubs do not penetrate deep into the ground. China rose, rangan, rose, lemon etc. are examples of shrubs.

Herbs are small in size. They have soft stems, branches and branchlets. The roots of these plants penetrate only the upper layer of the ground. Paddy, mustard, grass, arum etc. are examples of shrubs. Bottle gourd, pumpkin and Indian spinach plants are climbers. They have soft stems. They are also herbs by nature.

In Standard IV, you classified all these plants into three groups - herbs, shrubs and trees - based on their individual characteristics. You may mention different type of plants in your environment on the basis of name and characteristics. Try to arrange the plants mentioned above into the following table:

<table>
<thead>
<tr>
<th>Herb (Pumpkintree)</th>
<th>Shrub (Chilliplants)</th>
<th>Jakfruit Tree</th>
</tr>
</thead>
</table>

Figure 1.1: Different types of plants based on nature of stems
Introduction to Environment: Science

Table 1: Classification of plants according to size

<table>
<thead>
<tr>
<th>Type of plant</th>
<th>Name of plant</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shrub</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tree</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

You have learnt about algae, fungi, moss and ferns in Standard IV. Do these plants have flowers? Do they have any stems, branches and branchlets? How deep do their main roots penetrate into the ground?

Figure 1.2: Different types of non-flowering plants

Algae (spirogyra)  Fungi (M asrum)  Fern (Dhenki shak)  Moss

You know the answers to the above-mentioned questions. You know that none of these plants bear flowers. That is why these plants are known as non-flowering plants. Another characteristic of these plants is that they do not have stems, branches and branchlets. Some of these plants do not even have main roots.
There are some plants which have roots, branches and branchlets. These plants also bear flowers. They are called flowering plants. There are many flowering and non-flowering plants around you.

Now, complete the following table. Write the names of different classes of plants in the column titled 'Name of plant'. In the 'characteristics' column, tick the appropriate box.

**Table 2: Classification of plants: Flowering and Non-flowering**

<table>
<thead>
<tr>
<th>Class of plant</th>
<th>Name of plant</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-flowering</td>
<td></td>
<td>Has a stem, branches and branchlets?</td>
</tr>
<tr>
<td>plants</td>
<td></td>
<td>Has a main root?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Has leaves?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Capable of producing food?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bears flowers?</td>
</tr>
<tr>
<td>Flowering</td>
<td></td>
<td>Has a stem, branches and branchlets?</td>
</tr>
<tr>
<td>plants</td>
<td></td>
<td>Has a main root?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Has leaves?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Capable of producing food?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bears flowers?</td>
</tr>
</tbody>
</table>
Algae, fungi, moss and fern are non-flowering plants. They all have their own characteristics. In Standard IV you observed many characteristics of these plants. Algae grow in water and in damp places. They grow well in well-illuminated places. Algae are green in color because they have chlorophyll in their cell. *Spirogyra* is one of the examples in algae and they can make their own food. Fungi grow on stale food, cow dung and in on heaps of garbage. They prefer dark places. The bodies of fungi and algae cannot be divided into roots, stems and leaves. Each of their body cells is capable of producing reproductive cells. However, fungi are not green, and are thus incapable of making their own food. Ex - mashroom.

Moss grows on moist ground, wet walls and tree bark. Although the body of a moss plant has a stem and leaves, it has no root. Mosses do not have any transport tissue either. They produce multicellular embryo, and they can produce their own food.

Ferns usually grow in shady places. The body of a fern plant is divided into roots, a shoot and leaves. The body contains vascular tissues. They produce multicellular embryo, and are capable of making their own food. Different types of fern present in our environment. *Dhenki Shak* is most familiar of them.

Using the information you know about algae, fungi, moss and ferns, fill in the table below by placing 'tick' marks where appropriate.
Table 3: Classification of non-flowering plants: algae, fungi, moss, and ferns

<table>
<thead>
<tr>
<th>Class of plant</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Algae</strong></td>
<td>Grows in water damp places</td>
</tr>
<tr>
<td></td>
<td>Bears flowers? Yes</td>
</tr>
<tr>
<td></td>
<td>Has a stem, branches and branchlets? Yes</td>
</tr>
<tr>
<td></td>
<td>Has roots? Yes</td>
</tr>
<tr>
<td></td>
<td>Has leaves? Yes</td>
</tr>
<tr>
<td></td>
<td>Capable of producing own food? No</td>
</tr>
<tr>
<td><strong>Fungi</strong></td>
<td>Grows on stale cow dung/garbage</td>
</tr>
<tr>
<td></td>
<td>Bears flowers? Yes</td>
</tr>
<tr>
<td></td>
<td>Has a stem, branches and branchlets? Yes</td>
</tr>
<tr>
<td></td>
<td>Has roots? Yes</td>
</tr>
<tr>
<td></td>
<td>Has leaves? Yes</td>
</tr>
<tr>
<td></td>
<td>Capable of producing own food? No</td>
</tr>
<tr>
<td><strong>Moss</strong></td>
<td>Grows in worn-out damp walls places</td>
</tr>
<tr>
<td></td>
<td>Bears flowers? Yes</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bears flowers?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Has a stem, branches and branchlets?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Has roots?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Has leaves?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Capable of producing own food?</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
You have seen that many plants bear fruits and flowers. Mango trees bear blossoms. They are the flowers of the mango trees. Mangoes grow from the blossoms. There are seeds inside the mangoes. New trees grow from these seeds.

You know that in flowering plants, fruits produced from flowers, and seeds are produced within the fruits. However, some plants do not bear fruits. We shall learn about them later.
You know that the seeds of mangoes, jujubes (kul), coconuts etc stay inside the fruit. Since the seeds are contained inside the fruits, they are known as angiosperms. The stems of these plants are divided into branches and branchlets. There are some plants such as cycus, pinus etc., whose seeds are not contained inside the fruits but on megasporophylls. Since these seeds are not covered by the flesh of the fruits, they are called gymnosperms. These plants usually do not have branches and branchlets.

Trees like mango, jackfruit, coconut etc. are called angiosperms, as their seeds are covered. On the other hand, the seeds of cycus, pinus, etc. are uncovered by nature, so these plants are called gymnosperms. The leaves of cycus are similar to the leaves of coconuts. The leaves of pinus are shaped like needles.

Figure 1.3: A naked-seeded plant (gymnosperm)
Now complete the table given below:

**Table 4: Classification of plants: gymnosperms and angiosperms**

<table>
<thead>
<tr>
<th>Name of plant</th>
<th>Stem</th>
<th>Leaves</th>
<th>Fruits and seeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycus, pinus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mango, jackfruit</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 1.4: Flower, fruit and seed
In Standard IV, you have learnt that lablab seeds, lentils and pigeon peas have two cotyledons. But the seeds of paddy, wheat, and maize have only one cotyledon. Based on the nature of the seeds, angiosperms have been divided into two groups.

Plants which have seeds containing two cotyledons are known as dicotyledonous plants. Mango, jambu, jackfruit and jujube trees are dicotyledonous.

Coconut, pamyra palm, betel-nut, paddy, wheat, maize etc. are monocotyledonous plants. Their seeds contain only one cotyledon.

If you observe closely, you will see that the leaves of monocotyledons and dicotyledons have different characteristics.
Take a mango leaf or a jackfruit leaf and take a paddy leaf or a blade of grass. Observe the fine veins of the mango or jackfruit leaf. The veins are spread like a web throughout the entire leaf. The fine veins of grass or paddy leaves spread parallel to each other from the base of the leaf to its tip.

Figure 1.6: Venation of leaves

Now complete the table below:

Table 5: classification of plants: monocotyledons and dicotyledons

<table>
<thead>
<tr>
<th>Plant</th>
<th>Characteristics of seeds</th>
<th>Characteristics of leaf</th>
<th>Class of plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mango</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lentil</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pigeon pea</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Exercise

A. Multiple-choice questions

Tick (✔) the correct answer:

1. Which of the following is a herb?
   A) mango tree  B) jackfruit tree
   C) rose plant  D) bean plant

2. What type of a plant is cycus?
   A) angiosperms  B) gymnosperms
   C) algae  D) non-flowering plant

3. Which plant has a parallel venation in its leaves?
   A) dicotyledonous plant  B) gymnospermic plant
   C) monocotyledonous plant  D) non-flowering plant

<table>
<thead>
<tr>
<th>Plant</th>
<th>Characteristics of seeds</th>
<th>Characteristics of leaf</th>
<th>Class of plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jackfruit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coconut</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan palm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Betel-nut</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paddy</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**B. Fill in the blanks:**

1. Ferns have stem, _______ and root.
2. Fungi cannot produce ________.
3. ________ are not produced in angiospermae.
4. In the leaves of dicotyledonous plants, a _________ arrangement of veins can be seen.

**C. Short questions**

1. Write down the names of three shrubs.
2. Write down the difference between flowering & nonflowering Plants.
3. Give examples of three monocotyledonous and three dicotyledonous plants.

**D. Broad questions**

1. Explain the characteristics of flowering and nonflowering plants.
2. Explain why a coconut tree is a monocotyledonous plant.
3. Mention the differences between algae and fungi and explain in which ways they are different from moss.
4. Draw and colour diagrams. Write down the name of the plants of the following:
   - A) flowering plant
   - B) non-flowering plant
   - C) monocotyledonous plant
   - D) dicotyledonous plant
   - E) parallel and reticulate venation in leaves
Chapter Two

Cultivation of Flower, Fruit and Vegetable

Bangladesh is a country of six seasons. Every year we experience them one after another: summer, rainy season, autumn, late autumn, winter and spring. During every season, lands, fields, cornfields and yards of houses become filled with flowers and fruits of many different colors and smells.

In summer, it is quite hot during the day and also during the night. In this season, sunflower, jasmine, butterfly pea (aparajita), and different types of lilies bloom.

In the rainy season, the sky is covered with dense clouds, and heavy rainfall occurs. Flowers such as dolonchampa, tagar, kamini, gandharaj, canna, dopati etc. bloom in this season.

Thatch grass (kash) flowers are the speciality of autumn. Apart from this, night jasmine, elengi (bakul) and queen of the night (hasnahena) flowers also bloom during this season.

The greatest diversity of flowers can probably be seen during the winter. Flowers such as calendula, marigold, zinnia, cosmos, dalia, chrysanthemum etc. blossom in winter.

Mountain ebony (kanchan), flame of the forest (palash) and golmohur (krishnachura) are flowers which bloom in spring.
Although different flowers bloom in different seasons, flowers such as rose, china rose, tuberose etc. blossom throughout the year.

In order to plant a flower plant, the soil must first be prepared accordingly. Organic fertilizers such as cow dung, rotten organic substances, powdered bone, ash, faeces of fowls, oil-cake etc. should be mixed with the soil. Flower plants grow well in loamy soil.

Soil prepared in gardens or pots can be used to plant flower seedlings or grafts. A graft can be prepared in a very simple way. Cut and take a branch of a money-plant, rangan or a tagar plant, including the leaves. Immerse the base of the branch in a bottle filled with water. Make sure that the water in the bottle does not dry up. After a few days you will observe that roots have grown from the base of the branch. In higher classes
you will learn about other methods of preparing grafts.

Just as various flowers bloom during the six seasons in our country, various fruits also grow at the same time. We can divide these fruits into three types based on the seasons in which they grow:

1. Summer fruits: mango, jambu, jackfruit, lychee, shaddock, wood-apple, pamyra palm etc.
2. Monsoon fruits: guava, hog-plum, star-apple etc.
3. Winter fruits: orange, jujube, olive etc.

Apart from these, banana, papaya, coconut etc. grow more or less throughout the year.
Like flower trees, fruit plants can also be planted in the soil and in pots. Loamy soil is good for fruit trees. The soil should be prepared by mixing it with fertilizers in order to plant trees. If trees are planted early in the rainy season, they grow quickly because of rainfall. It must be made sure that water does not accumulate at the base of the plant. Weeding should be done regularly. The base of the tree should be watered frequently during the dry season.

You should plant flower plants and fruit trees around your houses and in suitable vacant places in your school. In order to plant a seedling, you should first dig a pit in the ground with a breadth of two feet and a depth of two feet. The upper portion of the soil from the pit should be placed on one side of it, and the lower portion of the soil from the pit should be placed on the other side. The pit should be kept like this for a few days. Later cow dung and other organic fertilizers should be added to this soil, which should be later used to fill up this pit. While filling up the pit, the soil which was on the surface must be put at the
bottom, and the soil which was at the bottom should be put on the surface. Sometimes it is necessary to provide a support for the stems of the seedlings to help it stand upright.

Many different kinds of vegetables also grow in our country. The vegetables which grow in our country can be divided into two types based on the time of their cultivation:

Vegetables that are grown from April to September are known as summer vegetables. Palwal (patal), okra, pumpkin, cucumber, ribbed gourd, kakrol, bitter gourd (karala), amaranth etc. are summer vegetables.

The vegetables which are grown from October to March are called winter vegetables. Tomato, bottle gourd, bean, cauliflower, cabbage, radish, carrot, pea, Indian spinach etc. are winter vegetables.
Plantain, papaya, eggplant, Indian spinach etc. are available almost throughout the year. You can try to grow vegetables or flowers in any empty patches of land around your house or school. If no such places are available at all, you can try planting vegetables in pots.

Loamy soil is ideal for growing vegetables. The soil must be prepared well by adding sufficient organic fertilizer to it. If flowers, fruits and vegetables are cultivated in this soil according to their seasons, they grow well and give good yields.

![Figure 2.5: Scaffold for bottle gourd plant](image)

Plants with tender stems (such as pumpkin, cucumber, bitter gourd, bottle gourd etc.) require a scaffold so that they can grow well and give good yields.
Exercise

A. Multiple-choice questions

Tick (√) the correct answer:

1. In which season do catkins bloom?
   A) summer               B) rainy season
   C) autumn               D) winter

2. Which one is available more or less throughout the year?
   A) papaya               B) A maranth
   C) kakrol               D) Bitter gourd

3. Which one is a winter fruit?
   A) orange               B) Pamyra palm
   C) guava                D) banana

4. When should we plant fruit trees to help them grow well?
   A) during summer        B) during autumn
   C) at the end of winter  D) at the beginning of the rainy season

B. Short questions

1. Describe the process of preparing soil for planting flower plants.
2. How can you prepare grafts easily?
3. Make a list of winter vegetables.
C. Broad questions

1. Describe the flowers which bloom during the different seasons in Bangladesh.
2. Make a list of five fruits of Bangladesh for each of the seasons during which they are available.
3. Describe what measures should be taken for planting fruit trees?
4. How would you take care of fruit trees and flower plants?
Chapter Three

Animal Kingdom

The earth is the only planet in this solar system where living things exist. It is the only planet that bears signs of life. You know that anything that has life is called a living thing. There are two types of living things: animals and plants. In this chapter we will discuss about the animal kingdom. As all the places on the earth are not alike, the creatures living in different places are not the same. Some regions on earth have deep forests, some consist of deserts and some are covered with ice. Heat and light are essential for the survival of living things. The sun is the main source of heat and light for the earth. The intensity of sunlight that falls on different parts of the surface of the earth is not the same. Therefore the temperatures and rainfall levels vary from place to place. Some places receive rainfall throughout the year, while others barely receive any rain. From this we can see that differences in weather lead to differences in environment. For this reason, different creatures live in different environment. Some live in water, some in the sea, some on land, and some happily fly in the sky. The North and South Poles of our planet are covered in ice almost throughout the year, and they receive very low amounts of sunlight. In contrast, the climate of desert areas is completely different. Very little rainfall occurs in these places. In the desert, the days are very hot and the nights are very cold. Different kinds of animals live in different environments, depending on various climatic and environmental
conditions. This means animals are dependent on their environment. The diverse animal kingdom is constituted of all these animals on earth.

**Classification of animals**

You have already learnt that different kinds of animals live in different places on earth. They vary widely in terms of physical structure and size. According to their physical structures, animals can be divided into two major classes: vertebrate and invertebrate. Fish, cow, goat, duck, chicken, man etc. are vertebrate animals (figure 3.1). What is vertebra? Put your hand on your friend's back. Can you feel something hard? If you observe carefully, you will find that this hard object begins from his/her neck and ends at the base of his/her waist. This is called the vertebra. It is not constituted of a single bone, but rather a large number of bones placed one atop another. When you next eat chicken, take a piece of the neck. Now, if you remove the flesh, you will find small pieces of bones. Each of these small bones is known as vertebra.

![Figure 3.1: Vertebrate animals](image)

Dog                                       Frog                     Magpie Robin

Figure 3.1: Vertebrate animals
Earthworm, cockroach, prawn, crab, snail etc. are invertebrate animals (Figure 3.2). Take a prawn and peel off its shell. Now remove the fleshy part. Can you see any hard bones there? Their bodies contain no vertebrae. Animals which have no vertebrae are called invertebrate animals. Remember, prawns are not fish. They are invertebrate animals.

The names of some animals are listed in the table given below. Now make a copy of Table 2 in your notebook and fill it in with the names of the animals listed in Table 1.

**Table 1**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Sparrow</td>
<td>11. Ant</td>
<td>17. Titmouse</td>
</tr>
</tbody>
</table>
You have already learnt that plants are classified into different types based on various characteristics. Similarly, animals are also classified into different types based on various characteristics.

You have also learnt how to distinguish between vertebrate and invertebrate animals. There are different types of invertebrate
animals. Among them, some are so tiny that they can be seen only with the aid of microscopes. A amoeba is an example of such animals. On the other hand, earthworms and leeches fall under the same category. Their bodies are divided into many segments. The soft bodies of animals like snails, oysters etc are covered with hard shells. They belong to another group.

A cockroach is an insect. It has two pairs of wings on its back, and three pairs of legs under its belly. Mosquito, fly, butterfly, termite, cockroach etc. are animals belonging to the insect group (figure 3.3). The number of animals which belong to the insect group is the highest among all categories of animals. Termites harm our houses and furniture. Mosquitoes and flies spread various diseases. Cutworms, beetles, caterpillars and various other small insects damage crops. These are harmful insects.

We get silk from the cocoons of silkworms. Wax and honey are collected from honeycombs or beehives. These are examples of useful insects.
Apart from these, there are many other diverse invertebrates in the world. You will learn about them in higher classes.

Vertebrates can be divided into five classes: pisces, amphibia, reptile, aves and mammalia.

**Pisces**

This class consists of all types of fish. They live both in fresh water and salt water. They are called aquatic animals. Ruhi, katla, pabda, hilsha, koi, catfish etc. are well-known examples of fish.

**Characteristics**

1) Fish have fins which they can use to swim.
2) Fish respire with the aid of gills.
3) Bodies of most fish are covered in scales. However, there are some types of fish which do not have scales.
4) Fish lay eggs in the water. Young fish hatch from the eggs.

Figure 3.5: Amphibian

**Amphibia**

The chordate animal who lives in water in Primary stage and adult stage it lives in land. They are called amphibians. In primary stage of life they have gills and adult stage they respire by lung. Ex: Toad Frog.

**Characteristics**

1) There are no hair or scales on their bodies. They have soft skin.

2) They have four legs.

3) They have gills during their tadpole phase. They respire using gills. When they mature, the gills are replaced by lungs, which they use for respiration.
Reptilia

The vertebrates which move by crawling are called reptiles. Lizard, snake, crocodile, tortoise etc. are examples of reptiles (Figure 3.6).

Characteristics

1) They move by crawling.
2) They have lungs.
3) They have rough skin, and their bodies are covered with scales or hard shells.
Aves

The vertebrates which have feathers are classified as aves. Duck, hen, pigeon, ostrich, magpie robin, crow, shalik, kingfisher, vulture, falcon etc. are examples of this class of animals. You know that birds can fly, but some birds, such as kiwi, penguin, ostrich, emu etc. are incapable of flight.

Characteristics

1) Their bodies are covered with feathers.
2) They have claws on their feet.
3) They have hollow light bones which make it possible for them to fly.
4) They lay eggs, from which their young hatch.
Mammals

Animals which give birth to live young that are suckled by their mothers are classified as mammalian. Man, cow, goat, buffalo, sheep, deer, whale etc. are examples of mammals.

Characteristics

1) Their bodies are covered with hair.

2) Their young are suckled by their mothers.

3) Except humans, nearly all mammals have tails.

You have already learnt that whales and dolphins are mammals. They live in the water, and they have no hair on their bodies. The fin-like parts on their bodies actually are not fins. Those serve as sculls. Also, the wings of bats and titmice are not actual wings. The skin between their fingers expanded to form wing-like flaps.

Among mammals, humans are the most advanced. They can
They have larger and more developed brains than any other animals. Human can use their hands to hold things. They can stand erect and walk on two legs. Humans are the most intelligent animals on earth. Because of this, humans are considered the best creatures of all.

**Adaptation of animals**

Not all animals can survive in adverse conditions. For example, camels live in deserts and polar bears live in the polar regions. They cannot be found in any other environments. Can you identify the reasons behind this? This happens because animals adapt themselves to their native environments.

The environment keeps changing. The change of environment occurs slowly. The characteristics of animals change along with the change of environmental factors. Every animal lives and breeds in its own environmental habitat. Any type of environmental changes causes various changes in the behavioural and physical structures of the animals. This ability of animals to adapt themselves to environmental changes is called adaptation.

Now let us learnt about the characteristics which different types of animal can live naturally in there own environment:

**Polar Bear**
- The body of the polar bear is covered with dense, long, white fur. Besides, they have thick layers of fat underneath their skin. Because of this their bodies can retain more heat compared to other animals. As a result, their bodies remain warm.
They cannot be noticed easily in the ice because of their white fur, which allows them to camouflage themselves from enemy eyes.

**Figure 3.9: Pole animal - white bear**

**Camel:** Camel lives in desert because

**Figure 3.10: Desert animal - camel**
The long legs and neck of a camel keep its body a few feet above the hot desert sands. As a result, less amount of heat reaches its body. Its long legs enable it to run fast.

It can live on small amounts of water, and can store water in its stomach. It can close up their nostrils at will in order to protect itself from sandstorms.

**Fish:** Animals which live in water are called aquatic animals. Fish are aquatic animals. The characteristics of fish are:

- The heads and tails of fish are narrow, but their midsections are broad.
- They have fins which they use to swim.
- They have no lungs - they respire using gills.

**Whale & Dolphin:** You know that whales and dolphins live in water. Many people believe that whales are fish, as they bear an appearance similar to fish. But in reality, they are not fish - they are mammals. The following characteristics enable them to survive in water:

- Their tails help them to steer.
- They can inhale large amounts of oxygen from the air with their lungs and can stay underwater for long periods of time.
- As their nostrils are located on top of their heads, they can easily inhale oxygen from the air. They have fin-like limbs growing from their bodies. Their front legs were transformed into these fin-like limbs to help them swim.
Aves: Animals which fly in the sky are classified as aves. Aves are generally birds. Birds fly in the sky, but they land on the ground or in trees or on water for resting. Their front legs were transformed into wings which enable them to fly.

Arboreal Animals: The animals which live in trees are called arboreal animals. For example, monkey, gorilla, chimpanzee etc. are arboreal animals. Though they live in trees, they sometimes come down on the ground. Their two front hands and their fingers are long, and these help them to grasp tree branches.
Sheels & Spined animals: Snail, oyster, tortoise and many other animals have hard shells on their bodies for added protection. The body of a porcupine is covered with hard quills for protection.

Insects: Cockroach and many other insects have compound eyes which help them to see in multiple directions simultaneously. In this way, factors like habitation, climate and self-defense cause animal bodies to adapt to the environment.

Exercise

A. Multiple-choice questions

Tick (✓) the correct answer:

1. Which one is an invertebrate animal?
   A) Whale       B) Koi fish
   C) Prawn       D) Dolphin

2. Why are titmice and bats classified as mammals?
   A) They eat insects
   B) They can fly
   C) They live with their mothers
   D) They are suckled by their mothers
3. **How do the bodies of polar animals remain warm?**
   A) They are huge in size
   B) They can easily collect food
   C) They have thick layers of fat underneath their skin
   D) Their bodies are covered with hair

4. **Which of these animals respire using gills?**
   A) Crow
   B) Fish
   C) Cow
   D) Snake

5. **Which of the following are useful insects?**
   A) Bees and termites
   B) Termites and silkworms
   C) Silkworms and bees
   D) Cockroaches and silkworms

6. **Why are butterflies and prawns classified as invertebrate animals?**
   A) They can walk erect
   B) They have no vertebrae
   C) They can fly
   D) They are small in size

7. **Which one is a characteristic of insects?**
   A) Have three pairs of legs and two pairs of wings
   B) Are capable of flight
   C) Have two pairs of legs and two pairs of wings
   D) Have no vertebrae
B. Answer in brief:

1. Name three harmful insects. What kind of damages are caused by these insects?
2. Which type of animals are classified as reptiles? Give an example.
3. What is adaptation? What makes an animal adapt to aquatic environment?
4. In how many classes can animals be divided? Name these classes.
5. What are meant by vertebrate and invertebrate animals? Give examples.
6. Mention the reasons why human beings are considered to be the best creatures of all.
7. Why are frogs classified as amphibians?

C. Descriptive questions

1. What are the characteristics of pisces?
2. What are the characteristics which made polar bears to adapt to the environments of the polar regions?
3. Which characteristics allow fish to survive in water?
4. What are the characteristics of animals dwelling in deserts?
Chapter Four

Food and Nutrition

You know that man cannot survive for long without eating. We take food when we become hungry. Everyday you play, go to school and help your parents with household chores. You need energy for doing these tasks. Food supplies the body with energy required to do work. We often suffer from various types of diseases. The immune system of our body protects our body from different diseases. Food helps to build up our immune systems. Therefore, food are the substances which cause our body to grow, compensate for physical decay, supply our bodies with nutrition, give us strength for doing work and help to develop our immune systems.

Food and nutrition

Some foodstuffs we eat are quite tasty, while some are not. Regardless of taste, all types of food contain some food value, which is used for building up our bodies. This is called the nutritional content of the food. It is food which we get nutrition from. The food which we eat is very complex in structure. Our body is composed of numerous living cells. We must keep these cells alive in order to keep ourselves alive. To keep the cells alive, they must be provided with food. But living cells cannot absorb complex food directly. So, complex-structured foods are
digested inside our bodies in order to convert them to simpler forms which can be absorbed by cells. In this way, food provides nutrition to our cells and gives us energy, compensates for physical decay, causes growth, keeps our bodies healthy and protects us from diseases. Nutrition is what forms the relation between food and health. Our body gets necessary nutrition from the foodstuffs we eat, such as rice, fish, meat, pulses, fruits, vegetables etc. We get energy for doing work when we get sufficient nutrition. A child grows up properly only if he/she receives proper nutrition.

Not all foods are equal in terms of providing nutrition. If you know the food value of different types of food, you can eat according to the requirements of your body. As a result you can keep your body healthy. For example, you know that among carbohydrates, such as rice, bread, potato etc. bread is better than rice in terms of nutritional value, because wheat contains more protein and vitamins than rice.

**Harmful effects of malnutrition**

When the nutritional requirements of our body are not properly fulfilled, it results in malnutrition. Most of the children in our country suffer from malnutrition. Malnutrition is harmful for our bodies in many ways. Malnourished children are weak and unhealthy, and their mental development is also impaired. They cannot work hard. They are prone to becoming easily infected by diseases, as their immune systems are weak. In many cases, malnutrition causes early deaths of children.
**Kinds of food**

Everyday you eat foods having different tastes, such as sour, hot, sweet etc. Despite different tastes, foodstuffs can be divided into three main kinds based on their food value - proteins, carbohydrates and fats. These three types of foodstuffs help to build up our bodies, compensate for decay, help our bodies to grow and provide energy.

Apart from these, mineral salts, vitamins and water are three other types of food. These substances are vital for keeping our bodies healthy and free from disease.

Foods are classified into these types according to the types of substances which they are rich in.

**Starch or carbohydrate**

Rice, wheat, maize, molasses, sugar, potatoes etc. contain high amounts of carbohydrate. They are classified as carbohydrate food. These types of food contain little amounts of protein and vitamin. Carbohydrate food provides energy and gives strength for doing work.

Deficiency of carbohydrate results in weight loss of the body, increase in hunger, and tendencies of nausea. The body becomes weak and its capacity for work decreases. If we eat too much carbohydrate, fat accumulates in our body, causing our bodies to become overweight, which in turn makes us prone to various types of diseases.
Protein

Fish, meat, eggs, milk etc. are animal protein. Cow pea, pulses, beans, peas etc. are examples of plant protein.

Protein is used in blood cell production and growth of the body. It compensates for physical decay, builds the body and helps it grow. Physical development of children is often hampered due to protein deficiency. Lack of protein causes muscles to become thin and results in repetitive diarrhoea. These are symptoms of marasmus disease. Deficiency of protein can also cause quashiorkor or swelling of limbs. Symptoms of this disease are browning of hair, infection in tongue and lips, swelling of limbs due to accumulation of water etc.

Oils or fats

There are two types of fats - animal fat and vegetable fat. Foodstuffs containing high amounts of fat are called fatty or oily foodstuffs. Butter, ghee, fish, animal fat etc. are fatty foods obtained from animals. Soybean oil, mustard oil, nut oil, sesame oil, olive oil etc. are fatty food obtained from plants. We get energy from fatty foods. This energy enables us to do work and keep our bodies warm. Deficiency of fat makes the body become rough and may cause skin diseases. Excessive consumption of fatty food results in accumulation of fat in the body. Deposition of excess fat is harmful to our bodies. It may cause various serious illnesses including high blood pressure and cardiac diseases.
Vitamins
Vitamins are food elements which protect our body. Deficiency of vitamins results in many diseases and may even cause death. There are many types of vitamins. Many of us suffer from vitamin deficiencies.

Vitamin A
Deficiency of vitamin A causes night-blindness. One can become blind if he/she does not consume sufficient amounts of vitamin A. All kinds of yellow fruits and green vegetables contain vitamin A. Mala and dhela fish are rich in Vitamin A.

Vitamin B
There are many types of vitamin B. B1, B2, B6 etc are collectively known as vitamin B complex. Deficiency of Vitamin B causes sores on the lips and tongue. It may also cause mental depression. Vitamin B is found in dhenki-husked rice, liver, vegetables, germinated gram seed etc.
Vitamin C

Vitamin C helps in proper excretion of bodily wastes. It strengthens the immunity of the body against diseases, and keeps our skin healthy. Vitamin C is destroyed by heat, so it is a good practice to eat foods rich in vitamin C uncooked where possible. Vitamin C is available in emblic myrobalan, guava, lemon, tomato, hog-plum, carambola, shaddock etc. Vitamin C does not remain stored in the body, so it is necessary to eat foods with vitamin C everyday. Deficiency of vitamin C results in gum diseases, cough and cold.
Introduction to Environment : Science

**Vitamin D**

Vitamin D makes our bodies firm and strong. Oil extracted from the livers of codfish and sharks contains large amounts of Vitamin A and D.

You may have noticed that infants are laid down in sunlight in the morning. This sunlight aids in the synthesis of vitamin D from the layer of fat beneath the skin. Deficiency of vitamin D causes rickets in children. This disease prevents bones from becoming hard, as a result of which bones become bent.

**Vitamin E**

Vitamin E can be found in oils or fats, green vegetables, grains, eggs, milk, liver etc. Anemia is caused as a result of deficiency of vitamin E.
Vitamin K

Vitamin K is found in cauliflowers, cabbages, liver etc. If your hand, leg or any other part of your body is injured, blood flows from the wound. Vitamin K helps the blood to clot, thus preventing loss of blood.

Copy the following table in your notebook and fill it in:

Table 1:

<table>
<thead>
<tr>
<th>Name of vitamin</th>
<th>Source</th>
<th>Effects of deficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin B complex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin E</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin K</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Mineral salts**

Many of us eat myrobalan tamarinds, green mangoes etc. with salt. Mothers use salt while cooking fish, meat or vegetables. This salt is called edible salt. Apart from edible salt, there are other types of salts which are essential for our body. They are called mineral salts. Mineral salts of iron, calcium, iodine, phosphorus, sodium etc. are found in fruits, vegetables, milk, eggs, liver, and sea fish. Deficiency of these salts can cause many diseases.

Look at the following table. A list of important mineral salts are given there. The sources and necessities of various mineral salts are shown here.

**Source and Importance of Mineral Salts:**

<table>
<thead>
<tr>
<th>Mineral salt</th>
<th>Source</th>
<th>Importance of mineral salts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium salt</td>
<td>Milk, meat, eggs, green vegetables</td>
<td>Important for the formation of teeth and bone. Helps blood to clot.</td>
</tr>
<tr>
<td>Phosphorus salt</td>
<td>Meat, milk, eggs</td>
<td>Aids in the formation of teeth and bones.</td>
</tr>
<tr>
<td>Iron salt</td>
<td>Meat, eggs, liver, vegetables</td>
<td>Aids in the formation of red blood cells. Deficiency causes anemia.</td>
</tr>
<tr>
<td>Iodine salt</td>
<td>Fresh sea fish, iodized salt</td>
<td>Deficiency prevents the thyroid gland from functioning properly and causes goitre.</td>
</tr>
<tr>
<td>Sodium salt</td>
<td>Common edible salt</td>
<td>Deficiency causes body to become stiff.</td>
</tr>
</tbody>
</table>
**Water**

Water is a very important element for the digestion of the foods which we eat everyday. Water aids in the digestion of food and excretion of bodily wastes in the form of sweat and urine. Drinking insufficient amounts of water can cause constipation. From this, it is clear that without water our body cannot perform all its functions properly. The foods that we consume everyday contains large amounts of water. In addition to that, we need to drink 6 to 7 glasses of water per day.

Stomach diseases like diarrhoea, cholera etc. cause the amount of water in the body to drop abruptly. This has many adverse effects on the patient's body. In this condition the patient should be fed oral saline. Various complexities can arise if oral saline is not given to the patient in time.

In many cases water can accumulate in one's limbs or face. This may happen if any organs of the body fail to function properly. In this situation it is very urgent to consult a doctor.

**Balanced diet**

An assortment of foodstuffs containing all the essential substances (carbohydrates, proteins, fats, vitamins, minerals and water) required for nutrition, growth and strengthening of the body in right proportions is called a balanced diet. Nutritious and balanced diets are required for maintaining healthy and strong bodies and for production of energy for doing work. Many people believe that only expensive foods have greater nutritional value. But in reality, all foods contain nutrition. Balanced diets contain all types of food elements proportionately.
We need to know which food contains which elements. One food can be mixed with another to increase its food value, and the mix can also be a balanced diet.

Remember that the amounts of balanced diets for children, youths, labourers, doctors, rickshaw-pullers etc. will not be the same. The amount of food eaten by a person will depend on his/her age and occupation.

Look at the following table. Observe the types of food.

**Table: List of different types of foods**

<table>
<thead>
<tr>
<th>Carbohydrate</th>
<th>Protein</th>
<th>Fat</th>
<th>Vitamins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>Mutton</td>
<td>Ghee</td>
<td>A maranth</td>
</tr>
<tr>
<td>Wheat</td>
<td>Beef</td>
<td>Butter</td>
<td>Carrot</td>
</tr>
<tr>
<td>Maize</td>
<td>Chicken</td>
<td>M ustard oil</td>
<td>Arum leaves</td>
</tr>
<tr>
<td>Potato</td>
<td>Large fish</td>
<td>Soybean oil</td>
<td>Red amaranth</td>
</tr>
<tr>
<td>Sweet potato</td>
<td>Small fish</td>
<td>Nut oil</td>
<td>Indian Spinach</td>
</tr>
<tr>
<td>Molasses</td>
<td>P pulses</td>
<td>Sesame oil</td>
<td>Spinach</td>
</tr>
<tr>
<td>Sugar</td>
<td>Cow pea</td>
<td>Sunflower oil</td>
<td>Bottle gourd</td>
</tr>
<tr>
<td>Honey</td>
<td>Milk</td>
<td></td>
<td>Gourd</td>
</tr>
<tr>
<td></td>
<td>Egg</td>
<td></td>
<td>Tomato</td>
</tr>
<tr>
<td></td>
<td>Peanut</td>
<td></td>
<td>Egg-plant</td>
</tr>
<tr>
<td></td>
<td>Dried fish</td>
<td></td>
<td>Cauliflower</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cabbage</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ribbed gourd</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Palwal (Patal)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Snake gourd</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vegetables</th>
</tr>
</thead>
<tbody>
<tr>
<td>A maranth</td>
</tr>
<tr>
<td>Carrot</td>
</tr>
<tr>
<td>Arum leaves</td>
</tr>
<tr>
<td>Red amaranth</td>
</tr>
<tr>
<td>Indian Spinach</td>
</tr>
<tr>
<td>Spinach</td>
</tr>
<tr>
<td>Bottle gourd</td>
</tr>
<tr>
<td>Gourd</td>
</tr>
<tr>
<td>Tomato</td>
</tr>
<tr>
<td>Egg-plant</td>
</tr>
<tr>
<td>Cauliflower</td>
</tr>
<tr>
<td>Cabbage</td>
</tr>
<tr>
<td>Ribbed gourd</td>
</tr>
<tr>
<td>Palwal (Patal)</td>
</tr>
<tr>
<td>Snake gourd</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fruits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grape</td>
</tr>
<tr>
<td>Apple</td>
</tr>
<tr>
<td>M ango</td>
</tr>
<tr>
<td>Jambu</td>
</tr>
<tr>
<td>Jackfruit</td>
</tr>
<tr>
<td>Orange</td>
</tr>
<tr>
<td>Guava</td>
</tr>
<tr>
<td><em>Emblic myrobalan</em></td>
</tr>
<tr>
<td>Hog-plum</td>
</tr>
<tr>
<td>Jujube</td>
</tr>
<tr>
<td>Shaddock</td>
</tr>
<tr>
<td>Carambola</td>
</tr>
</tbody>
</table>


If it is possible for you, go to the market with your father or uncle and know the prices of different foods. If it is not possible for you, take help from others to know the prices of foodstuffs. Now-a-days price of different food items are decelerating in different medias like radio, Television, Newspaper etc.

Now copy the following table in your notebook and fill it in.

**Table 4a: List of expensive foods**

<table>
<thead>
<tr>
<th>Food elements</th>
<th>Name of food</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Carbohydrate</td>
<td></td>
</tr>
<tr>
<td>2. Protein</td>
<td></td>
</tr>
<tr>
<td>3. Fat</td>
<td></td>
</tr>
<tr>
<td>4. Vitamin-rich fruits/vegetables</td>
<td></td>
</tr>
<tr>
<td>5. Mineral-rich fruits/vegetables</td>
<td></td>
</tr>
</tbody>
</table>

**Table 4b: List of inexpensive foods**

<table>
<thead>
<tr>
<th>Food elements</th>
<th>Name of food</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Carbohydrate</td>
<td></td>
</tr>
<tr>
<td>2. Protein</td>
<td></td>
</tr>
<tr>
<td>3. Fat</td>
<td></td>
</tr>
<tr>
<td>4. Vitamin-rich fruits/vegetables</td>
<td></td>
</tr>
<tr>
<td>5. Mineral-rich fruits/vegetables</td>
<td></td>
</tr>
</tbody>
</table>

After filling in the table, show it to your teacher. Now you have learnt how to prepare lists of different kinds of cheap and expensive foods which constitute balanced diets. Remember that it is very important to consume balanced diets in order to keep yourself healthy, strong and active.
Exercise

A. Multiple-choice questions

Tick (✓) the correct answer:

1. Quashiorkor is caused by the deficiency of
   A) carbohydrate  B) vitamins
   C) protein       D) minerals

2. Night-blindness is caused by the deficiency of
   A) vitamin A      B) vitamin B
   C) vitamin C      D) vitamin D

3. Goitre is caused by the deficiency of
   A) vitamin A      B) calcium
   C) sodium       D) iodine

4. Anemia is caused by the deficiency of
   A) sodium       B) iron
   C) iodine       D) calcium

5. Which element is required to compensate for physical decay and make the body grow?
   A) fat        B) carbohydrate
   C) protein       D) minerals

6. Deficiency of vitamin C causes
   A) decay of teeth   B) disease of eyes
   C) bone disease     D) stomach disease
7. Which vitamin is destroyed by heat?
   A) vitamin A      B) vitamin B
   C) vitamin C      D) vitamin D

8. Which type of vitamin is required for development of teeth and bones?
   A) vitamin A      B) vitamin B
   C) vitamin C      D) vitamin D

9. Which of the following is found in high amounts in sea fish?
   A) calcium      B) iodine salt
   C) iron        D) sodium

B. Short questions
1. What do you understand by the term "food"?
2. What do you understand by the term "nutrition"?
3. What is a balanced diet?
4. What causes night-blindness?
5. Mention three examples of animal protein.
6. State the symptoms of rickets.

C. Broad questions
1. What are vitamins? Make a chart listing the different types of vitamins and the diseases caused due to their deficiency.
2. Describe the functions of carbohydrates, proteins and fats.
3. Explain why water is so important for the human body?
4. In what ways are minerals important for the human body?
5. Make a balanced diet chart for your breakfast & lunch.
In order to remain healthy we need to keep ourselves clean, eat nutritious and balanced foods, and follow the rules of hygiene. Still we often suffer from different types of diseases. The reason behind this is the fact that we are surrounded by many kinds of microbes of various diseases. These microbes enter our bodies in different ways. Most of these diseases are carried by water, air and insects. Microbes in water and air cannot be seen with the naked eye. We need powerful microscopes to see these microbes.

You may have noticed that diseases such as measles, chickenpox, diarrhoea, cholera etc. spread quickly across a particular area. These diseases can spread from one person to another very easily. They are known as contagious diseases.

**Diseases which spread by means of water**
Diseases which spread through water are called waterborne diseases, such as typhoid, jaundice, cholera, dysentery, diarrhoea etc.

**Diseases which spread by means of air**
Some diseases enter human bodies with the air when we breathe. They are called airborne diseases, such as tuberculosis, chickenpox, measles, influenza etc.
Disease which spread by insects

Some diseases are caused by insect bites. For example, the female Aedes mosquitoes carry the microbes of dengue, and so dengue is caused by its bite. Again, malaria is caused by the bites of female anopheles mosquitoes which carry the microbes of malaria.

Now let us see why the different diseases occur, how they spread and how they can be prevented.

A. Waterborne diseases

We know that diarrhoea, cholera, typhoid, jaundice, dysentery etc. are waterborne diseases. Now, let us know about their causes, symptoms and how they spread.

Diarrhoea

It is one of the commonest waterborne and food-borne diseases. Every year many people die of this disease. Children under 5 years of age are the main victims of diarrhoea. If anyone experiences loose bowel movements more than three times in a single day, it can be assumed that he or she have been affected by diarrhoea. When affected by diarrhoea, the patient rapidly loses salt and water from his/her body. As a result, the water level of his/her body drops. The patient becomes weak. Loss of water and salt from the patient's body may lead to dehydration, which can even cause the patient to die unless proper treatment is administered.

Symptoms of diarrhoea

- Frequent loose bowel movements
Introduction to Environment : Science

- Frequent vomiting
- Intense thirst: mouth and tongue become dry
- Sunken eyes
- Crowns of infant patients' heads sink when they cry
- Gradual loss of physical strength

**How the disease is spread**
- Drinking polluted water
- Eating stale, decaying or dirty food
- Using dirty plates or utensils
- Using dirty hands to eat

**Remedy of diarrhoea**
- As soon as diarrhoea is diagnosed, the patient should be fed with oral saline.
- Apart from saline, the patient must have his/her normal diet as well. Sucklings must be fed breast milk regularly. They can also be fed saline rice soup and other types of liquid so that their bodies do not become dehydrated.
- If loose bowel movement does not stop even after taking saline, a doctor should be consulted as soon as possible. In cases of severe dehydration, the doctor may administer intravenous saline to the patient.

Nowadays oral saline is available in the market, and the procedures of preparing the saline is written on its packets.
Saline can be prepared very easily by following those instructions. Besides, saline can also be prepared at home.

**Procedure of making oral saline**

The following table shows the ingredients of oral saline and narrates the method of preparing it.

<table>
<thead>
<tr>
<th><strong>Necessary ingredients</strong></th>
<th><strong>Procedure of preparation</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>A teaspoon, a clean pot, edible salt, molasses or sugar, boiled cool water or tube well water.</td>
<td>1. Take half a litre of boiled cool water or safe tube well water in a clean pot.</td>
</tr>
<tr>
<td></td>
<td>2. Wash your hand properly with soap. Take a handful of molasses or sugar and add it to the water.</td>
</tr>
<tr>
<td></td>
<td>3. Take a pinch of salt with the tips of your three fingers and add it to the water.</td>
</tr>
<tr>
<td></td>
<td>4. Stir the mixture using a spoon. This way by mixing sugar or molasses and salt with water, you can prepare oral saline.</td>
</tr>
</tbody>
</table>
Figure 5.1: Procedure of making saline drink with salt and molasses at home

After making the oral saline it should be administered to the patient repeatedly in small quantities. Once prepared, the saline should not be used for more than six hours.

Oral saline helps the patient to regain the water and salt which has been lost from his/her body. As a result, the patient will not become weak. The patient should continue drinking the saline until his/her bowel movements stop.

**Prevention of the disease**

In order to prevent diarrhoea, we must:

- Drink safe water
- Wash utensils with clean water
- Wash our hands with soap before eating and after using toilet
- Avoid eating stale, decaying and fly-contaminated foods

**Dysentery**

Dysentery is a very common disease. Many people in Bangladesh suffer from dysentery. The microbes of this disease
enter human bodies when people consume stale and rotten foods and drink polluted water. After entering the body, the microbes of dysentery start to reproduce. When they are sufficiently great in number, the patient's body begins to show the symptoms of the disease.

**Symptoms of the disease**

- Low fever with continuous bowel movement and discharge of mucus from the bowels
- Pain in the abdomen
- Sometimes blood is excreted with faeces mixed with mucus

Proper treatment should be administered according to the prescription of the doctor as soon as the symptoms of this disease are detected. It may cause damage to the patient's liver if treatment is not received in time.

**Prevention of dysentery**

In order to prevent dysentery, we must:

- Drink safe water
- Use hygienic latrines
- Avoid eating stale and rotten foods
- Wash raw fruits and vegetables properly before eating
- Wash hands with soap before eating and after using toilet

**Jaundice**

Jaundice is a waterborne disease. When liver cells are damaged
or destroyed by viral and bacterial infections, the liver secretes excessive bile into the bloodstream, which in turn causes jaundice. This disease spread quite easily through water.

**Symptoms of jaundice**

- Nausea with little or no fever
- Loss of appetite; smell of food is found nauseating
- Yellow urine, white faeces and loose bowel movements
- Headache and cold feeling
- Pain in the right region of the abdomen where the liver is located
- Within a few days, the white parts of the eyes become yellow - this yellow colour later spreads throughout the entire body including the nails of the patient

**Care of a jaundice patient**

- Complete rest is the best treatment for this disease
- The patient must only eat foods containing little spices
- In the past, it was believed that sugarcane, drinks made of molasses, green coconut juice and ripe papaya should be taken by jaundice patients as much as possible. But nowadays doctors ask patients not to consume these foods in large amounts
- The patient should take rest until he/she is completely cured
- The patient must follow the instructions of the doctor

This disease should never be neglected. The patient should not
resume normal work before being cured completely, otherwise he or she may suffer a relapse and it can cause serious damage to the liver.

You already know that jaundice spreads through water. It is a contagious disease. So, the plates and glasses used by a patient should be separated from other utensils. The excreta of the patient should be buried underground. Remember, the patient must not defecate or urinate here and there. This disease can be prevented by vaccination.

**Typhoid**

Like diarrhoea and cholera, typhoid is also a contagious waterborne disease. It is more prevalent in urban areas than in the rural areas.

**Symptoms of typhoid**

- Persistently increasing fever
- Headache and sweating
- Constipation during the early stages
- Frequent loose bowel movements during the later stages

**Remedy**

A doctor must be consulted as soon as the symptoms of this disease are detected. Medicines should be taken according to the doctor's prescription. In case of high fever, cold water must be poured on the patient's head in order to bring the temperature down.

**Preventive measures for typhoid**

In order to prevent typhoid we should do the following:
Ways to avoid waterborne diseases

The main way to avoid waterborne diseases is to drink pure water. Arsenic-free tube well water can be considered safe. Tube well water does not contain microbes. Drinking tube well water would protect us from diarrhoea, cholera, dysentery, typhoid, jaundice etc. However, the surrounding ground of a tube well should be paved, and there should be no latrines or drains near the tube well.

If there are no tube wells near the house, water from wells can be consumed after it is boiled and cooled. When water is boiled properly, all the microbes in it die, rendering it safe.

Prevention of the spreading of waterborne diseases

- Plates and glasses should be washed with safe water
- Hands should be properly washed with soap before eating
- The water of the pond which is used for washing household utensils should not be used for washing clothes and bathing cattle.
B. Airborne diseases

You have already learnt that cold, cough, influenza, pox, tuberculosis, etc are airborne diseases. The microbes spread through air from the spit, cough and sneeze of the patient. During inhaling, the microbes enter human body with air. These microbes multiply inside the body and cause diseases.

**Tuberculosis**

Tuberculosis is a dangerous and contagious airborne disease. It is also known as TB or decay disease. This disease is caused by a certain kind of bacteria. Many people believe that TB affects only the lungs, but that is not true. Tuberculosis can affect any part of the body, such as lungs, intestines, bones etc.

**Symptoms of tuberculosis**

- Low fever in the afternoon and sweating at night
- Persistent cough for more than three weeks
- Gradual loss of weight and getting weak
- Pain in the chest and in the upper part of the back
- In severe cases coughing up blood

**Remedy for tuberculosis**

A doctor must be consulted as soon as the above symptoms are noticed. Special care of the patient must be taken. Proper medical treatment according to the doctor's prescription and consumption of nutritious food can cure TB completely.

**Prevention of tuberculosis**

In recent times, a vaccine for TB has been developed. It is
called BCG. This vaccine can be given to babies within one year of their birth.

You have learnt that this disease can spread very easily.

**How to stop tuberculosis from spreading**

- Keep the patient in a well-ventilated room
- The patient must not spit here and there – the cough and spit should be collected in sealed containers and buried underground
- The utensils and bedclothes of the patient should be isolated
- The patient should be quarantined until he/she is completely cured
- The treatment of this disease takes place over a span of 8-12 months. Medication must not be stopped unless advised by the doctor

Previously there was no cure for this disease, and most of the patients died of it. But it can now be cured completely through proper treatment.

**Pox**

In the past, it was mistakenly believed that pox was a dangerous airborne contagious disease. It is no longer thought so. There are two types of pox:

1. Smallpox
2. Chickenpox
Smallpox

There was a time when people were very afraid of smallpox. This disease spreads very quickly. In the past many people died from this disease. Through the combined efforts of the World Health Organization and the government, this disease has now been completely eradicated from Bangladesh. From the survey of WHO, it was found that this disease has been eliminated from all the countries in the world. The recent discovery of its vaccine has made this possible.

Chickenpox

Like smallpox, chickenpox is also an epidemic disease. Although chickenpox is not as dangerous as smallpox, it is quite painful. But it is not fatal. It is caused by a type of virus.

Symptoms of chickenpox

- Low fever with severe pain in the entire body
- After two to three days, blisters appear first on the chest and the back of the patient, which eventually spreads all over the body. The blisters are soft, and they contain a watery liquid.

Within a few days the blisters start drying up, and they itch severely at this stage.

Remedy

Do not scratch the blisters with your nails. Put neem leaves in water and boil it. Sponge the patient's body with this water. Instructions of the doctor must be followed.
Prevention

Pox is a contagious disease, so like other contagious diseases, it also needs to be prevented. The measures for preventing pox are:

- Quarantine the patient in a separate room
- The patient's bed or plates should not be used by anyone else
- The patient's bedclothes and pillowcases should be washed with hot water mixed with soda
- Patient should not go out for 2 to 3 weeks even after getting cured

Figure 5.2: Life-cycle of round worm

Stomach diseases caused by worms

In dirty environments worms can grow very easily. That is why many people in our country suffer from stomach diseases caused by worms. Children are more likely to be affected by worms.
There are many types of worms, such as ringworms, threadworms, hookworms etc. People are mostly affected by ringworms.

Worms are generally found in the soil, water and foods. The eggs of worms enter our body through food, water and our skin. Adult worms absorb most of the nutrition of the food eaten by the patient.

**Symptoms of the disease**
- Vomiting tendencies
- Pain around the navel
- Decrease in appetite
- The patient looks pallid
- Patient looks weak and tired

**How the disease spread**
You have already learnt that dirtiness is the main factor behind the spreading of this disease. Ringworms lay egg in the intestine of the patient. These eggs are excreted from the body through the faeces. Inside the eggs, the larvae of the worms slowly mature. In this condition, the eggs can survive for a long time in dirty and moist places. When these eggs enter the human intestine by means of food or water, only then they hatch and the larvae emerge. Now, let us know how these eggs enter the human body:
- Eating food without washing hands first
- Eating fruits and vegetables without washing them
Not washing hands before eating and after using toilet
• Having big nails
• Walking barefoot in places where people excrete

Now you can certainly understand how easily these worms can enter people's bodies.

Remedy
Worms cause malnutrition. Therefore treatment must be received immediately upon detection of the infection.

Prevention
In order to prevent worms, we must follow these rules:
• Stay and eat in a clean environment
• Wash vegetables and fruits before eating
• Always keep the nails short
• Use hygienic sanitation facilities
• Wash hands before eating and after using toilet
• Put on slippers when visiting the toilet

Worms are the main reasons behind malnutrition. If you follow the general hygienic practices you will not be affected by worms.

Rheumatic fever
Rheumatic fever is a common disease in our country. Mostly
children suffer from this disease. Living in an unhygienic, dark and damp room for extended periods of time increase the possibilities of occurrence of this disease. A microbe known as Streptococcus causes this disease.

**Symptoms of rheumatic fever**

- Frequent fever and pain in the throat
- The baby does not like to eat, and it loses weight
- Pain in the joints of hands and legs
- Occasional pain in the chest

**Remedy**

If these symptoms are detected, a doctor must be consulted immediately. The presence of the disease can be confirmed by testing the saliva and blood of the patient. This disease can be cured completely through proper and timely treatment and consumption of nutritious food. If proper treatment is not carried out, it makes the patient greatly prone to heart diseases.

**AIDS**

This disease was first discovered in the USA in 1981. the name of this disease comes from the abbreviated form of 'Acquired Immune Deficiency Syndrome'. AIDS is a lethal disease. According to a report of the World Health Organization, currently there are AIDS patients in approximately 164 countries around the world. A virus called HIV causes this disease. The full name of this virus is **Human Immuno-deficiency Virus**.
People can be infected by AIDS by the following ways:

1. A mother infected by AIDS can pass on the disease to her child by birth or by breastfeeding her child.
2. If the blood of an AIDS patient is transfused to a healthy person, he/she will also be infected with AIDS.
3. If needles and syringes used by AIDS patients are not disinfected properly before they are used by someone else, they can spread AIDS.
4. If an organ of an AIDS patient is transplanted into a healthy person, the healthy person will become infected with AIDS.

Symptoms of AIDS

A healthy person can be infected with AIDS by any of the ways mentioned above. The attacked person exhibits the following symptoms:

- Loss of weight
- Continuous fever for more than a month
- Dry cough lasting for a long time
- Diarrhoea lasting for long time
- Becoming prone to easy infection with different diseases
- Severe pain in the shoulder and in the armpits
- Decrease in intelligence and memory loss

HIV virus enters the human body and destroys its immune system. No medicine has yet been discovered anywhere in the
world which can cure this disease. As a result, an AIDS patient is doomed to die inevitably. But carefulness can help prevent this disease.

**Ways of prevention**

If a patient requires blood, the blood of the donor must be checked prior to transfusion for possible HIV infections. Needles and syringes used by AIDS patients must not be used. No organ of an AIDS patient should be transplanted into a healthy person. Mothers infected with HIV should not breastfeed their babies.

**Taking care of the body**

You all know that health is wealth. Health equals mental and physical fitness. We have also learnt that in order to maintain a good health you have to consume nutritious food, rest and get necessary amounts of sleep. Besides these, one has to take care of one's health. We have to take care of the different parts of our body, such as our eyes, ears, nose, skin, teeth etc. Neglecting these organs of the body may cause different diseases. By taking care of our bodies, we can prevent many diseases.

**How to take care of the different parts of our body**

**Care of skin**

Skin covers our body from head to toe. Ringworm, scabies, eczema etc. are examples of skin diseases. These diseases can easily spread through dirty skin. These are contagious diseases. We can prevent them only by keeping our skin clean. In order to keep our skin clean, we must have baths regularly using soap.
Besides, you should also consult your doctor. Remember, never use a drug without a doctor’s prescription.

**Care of hair**

Hair increases the beauty of our body. It also protects the skin of the head from excessive heat, cold and dust. Dirty hair can cause many different skin diseases and dandruff on our scalp. If hair is not cleaned regularly, lice may appear in it. Lice can cause scalp infections. This way lice, dandruff or skin diseases can damage the skin of the scalp. It is necessary to wash hair with soap or shampoo and comb it regularly. These will prevent dust from depositing in hair and lice from living in it.

**Care of teeth**

Teeth increase the beauty of the face. We chew food using our teeth. Negligence in taking care of teeth can cause many complexities. Among these, tooth decay, pain and swelling of gums are major problems. These are symptoms of a disease called pyoreia. It causes early loss of teeth. It is best to brush teeth after every meal. If teeth are not cleaned properly, the food particles accumulating in the gaps between the teeth begin to rot, and microbes start to multiply there. They damage the gums and cause teeth to decay. This decay of teeth is called dental caries. Children suffer from this disease the most. Another dangerous disease of teeth is gingivitis. The filth accumulating between teeth is called dental plaque. Over time, this plaque becomes as solid as stone and causes gums to bleed. Many people go to quack dentists for treatment. This causes serious damage to teeth and gums. In order to take care of our teeth, we have to:
Hygiene

• Brush teeth regularly before going to sleep and after getting up
• Brush teeth using toothbrush and toothpaste, or neem twigs
• Gargle after each meal - this helps to remove food particles from the gaps between teeth
• While washing, clean our gums using our fingers
• Chocolate is harmful to teeth, so children should brush their teeth after eating chocolate
• Dental pain can be alleviated by gargling warm water mixed with a little salt
• A dentist must be consulted in case of severe dental problems

Care of ears

We use our ears to hear. The inner part of the ear is soft. If dirt accumulates inside the ear and you use something sharp to clean it, it may rupture the eardrum. It may also be ruptured if someone pulls the ear or slap it. If the eardrum is ruptured, it causes hearing to be impaired. Sometimes during bathing, water gets into the ear. While a baby is feeding or vomiting in a lying position, drops of milk may enter its ear. This may cause infections inside the ear. Ear infections are harmful, and they may impair hearing. Also, some children are unable to hear anything since birth. They are called deaf. To protect our ears from common diseases, we have to follow the following rules:

• Clean the ears regularly
• Be careful so as not to hurt the ear
Be careful so that water or milk cannot enter the ears of babies.
Do not clean your ears using pointed objects.
Ask elders for help to clean your ears.
If an insect gets into the ear, consult a doctor in order to have it removed.
Do not apply any medicine to the ear unless instructed by a doctor to do so.

Care of eyes

We see with our eyes. Eyes provide us with our sense of sight. A blind person cannot see this beautiful world. Ophthalmia, sty, cataract etc. are common diseases of the eyes. You have already learnt that people become night-blind due to deficiency of vitamin A. We often unknowingly damage this valuable organ of ours.

Ophthalmia

Ophthalmia is a common disease. It is contagious. The symptoms of this disease are:

- Eyes become red and keep watering
- The eyes itch and hurt
- Catarrh collects in the corners of the eyes

What to do in case of ophthalmia

Mix a little salt with some lukewarm hot water. Soak a piece of cloth in the water and sponge your eyes. This will make your eyes feel better. Do not use any medicine or ointment without
doctor's prescription. Negligence and consulting quack physicians can damage our eyes.

**Sty**

Sometimes a boil is formed on the lower or upper lid of an eye. In many cases this boil gradually disappears by itself. But in some cases it gradually grows bigger and harder. In such case, the patient feels uncomfortable and experiences pain in the eye. If the eye is sponged with lukewarm water mixed with a little salt, it eases the pain of the patient. This treatment can be administered up to 3 or 4 times in a day. A doctor can be consulted if necessary. Sometimes this boil ruptures, and gives out blood and pus.

**Now let us know how to take care of our eyes:**

- Wash eyes with clean cool water several times a day
- Eyeliners such as kohl or collyrium, if used, should be of good quality
- Foods rich in vitamin A should be eaten
- Avoid using sunglasses, handkerchiefs, towels etc. belonging to other people

**Diseases of the nose**

We smell things with our nose. It provides us with our sense of smell. Structural deformities of the nose, such as a twisted nose bone or presence of polyps in the nose can disturb the respiratory procedure. Allergies and colds can block nasal passages. Deposition of large amounts of mucus in nose may
cause infection in children and sinus problems in adults. Accumulation of dirt or mucus in the nose can cause various complexities. To avoid problems of the nose, we have to:

- Clean a child’s nose using droppers or needleless syringes if excessive mucus accumulates in it
- Use soft cloth to clean a runny nose; it is not proper to blow your nose as it may cause pain in the nose or sinus problems
- Those who often suffer from earaches as a side-effect of cold should consult a doctor

**Exercise**

**A. Multiple-choice questions**

Tick (√) the correct answer:

1. Which one is an airborne disease?
   - A) tuberculosis
   - B) dysentery
   - C) jaundice
   - D) cholera

2. In which organ of humans do adult ringworms live?
   - A) liver
   - B) ear
   - C) intestines
   - D) stomach

3. Which one is a waterborne disease?
   - A) tuberculosis
   - B) influenza
   - C) typhoid
   - D) measles
4. Which one is a contagious disease?
   A) rheumatic fever   B) asthma
   C) scabies       D) night-blindness

5. Which disease of the eye is contagious?
   A) night-blindness    B) cataract
   C) sty                  D) ophthalmia

6. Why is saline administered to a diarrhoea patient or a cholera patient?
   A) to allow physical growth
   B) to stop bowel movement
   C) to stop vomiting
   D) to compensate for loss of water and salt

7. What is the best way to keep teeth healthy?
   A) eat food containing vitamin B
   B) brush the teeth regularly
   C) eat soft food
   D) eat protein foods

8. How can eardrums be ruptured?
   A) if medicine is applied to the ear
   B) if one catches cold
   C) if dirt accumulates inside the ear
   D) if the ear is slapped hard
9. Which one is a liver disease?
   A) cholera      B) typhoid
   C) jaundice     D) diarrhoea

10. Which is not an ingredient for the preparation of saline?
   A) water   B) edible salt
   C) molasses D) lemon juice

B. Short questions

1. What is an airborne disease? Write down the names of three airborne diseases.
2. What is a waterborne disease? Write down the names of three waterborne diseases.
3. How are humans infected by ringworms?
4. How does smallpox spread?
5. Write down the names of three eye diseases. Why does night-blindness occur?
6. How does typhoid spread?
7. What is the name of the virus which causes AIDS?

C. Broad questions

1. Describe how you can prepare saline at home.
2. Describe how to take care of skin.
3. Describe the methods of taking care of teeth.
4. How would you keep your eyes healthy?
5. How should you take care of a jaundice patient?

6. Describe the symptoms of tuberculosis.

7. What are the symptoms of AIDS?

8. Mention the ways of preventing dysentery.

9. Why does rheumatic fever occur? What are its symptoms?

10. What should we do to keep our ears healthy?

11. Describe the problems which our noses can be afflicted with.

12. Draw the life cycle of ringworms.
Chapter Six

First Aid

During our daily lives, we can get cut or suffer burns in our arms, legs or other parts of our body. We may also have accidents such as drowning. When these accidents occur, there might not always be a doctor nearby. In such cases, first aid can be given in order to deal with minor accidents. That is why it is necessary for everyone to have some idea about basic medical treatment. Last year, you learnt how to give first aid in case of such accidents. If a doctor is not available during the time of the accident, you will have to administer the first aid.

What is first aid?

When an accident occurs, it is important to take immediate action in order to save the life of the injured person. The immediate actions which are taken to save an injured or ill person after an accident are known as first aid. The pain of an injured person can be reduced with the help of proper first aid.

Fracture of bones

Suppose one of your friends broke his arm or leg while playing football or upon falling from a tree. He starts to moan and scream in pain. He cannot move his arms or legs. What should you do?
In such situations, the steps which should be taken are:

- A small sack full of ice or a strip of cloth soaked in cold water should be applied to the point of injury. This will cause the swelling and pain of the injured place to alleviate.

- After placing the limb in its normal position a thin slab of bamboo or wood wrapped in cotton should be tied on either side of it. This will prevent broken bones from moving, and the patient will feel less pain. A bandage can be used to tie the slabs of wood. If no bandages are available, tear a piece of cloth from a clean sari, lungi or shirt and use it instead.

- Do not use any medicine on the area of fracture.

- Never try to relocate or pull the broken bones in any way in order to straighten it.

- Next the patient should be taken to a hospital or to a doctor as soon as possible.

Figure 6.1: First aid for bone fracture
Snake bite

Not all snakes are poisonous. The most poisonous snakes in Bangladesh are viper and cobra. The appearance of snakes increases during the summer and rainy season in rural areas. Sometimes people or animals die from the bites of poisonous snakes. Whether a snake is poisonous or not can be determined by observing the wound left by its bite. If there are two clear fang marks on the bitten spot, it indicates that the bite is of a poisonous snake. First aid is required immediately after a snakebite occurs. It is possible to save the patient's life if medical treatment is provided immediately.

If anyone gets bitten by a snake on the arms, legs or elsewhere, it is important to tie a rope or piece of cloth tightly above the wound. This will prevent the snake's poison from spreading throughout the body through the bloodstream.

Now the wound must be examined carefully. If the place of wound contains two fang marks, it would indicate that the snake was poisonous. Take a rust-free knife, a pair of scissors or a blade. This should be sterilized by boiling in hot water, wiping it with Dettol or Savlon, or by heating it in a flame. Before using a knife, scissors or a blade, it should be cooled first. Now, the knife, scissors or blade is used to make a small incision in the injured spot, and the blood should be drained from there by pressing. This will cause the poison to come out with the blood. After giving first aid, the patient should be taken to the hospital as soon as possible. You may have heard from your grandparents that in villages conjurors use to drain out poison from the bodies of snakebite victims. Remember that a conjuror can never drain
out poison. This is a wrong method of treatment which is only based on superstition.

Figure 6.2: A venomous snake, tooth of a venomous snake, and first aid for snake bite

**Electric shock**

When electricity causes injury to someone, it is termed as an electric shock. Faulty electrical connections or other electrical disturbances can cause electricity to pass through any object at homes or offices. A person or animal will receive an electric shock if he/she comes in contact with an electrified wire or object like this. If proper steps are not taken in time, the person or animal may die. In such cases the victim of the shock must be separated from the electrified object immediately. For this, the following steps are to be taken:
1. First the main switch must be turned off.

2. If it is not possible to turn off the main switch, then the victim should be pushed away from the source of the shock by a dry piece of wood or bamboo in such a way that would separate him/her from the electrified object.

**Precaution**

1. If anyone receives an electrical shock, that person must not be touched. Remember that the human body is a conductor of electricity. If you touch an electrocuted person, you will also receive an electric shock.

2. Electric currents can pass through wet wood or bamboo, but not through dry wood or bamboo. That is why a piece of dry wood or bamboo should be used to separate the shock victim from the electrified object.

3. In many cases, the shock victim faces breathing problems. If required, an artificial respiration should be arranged for the patient.

4. The victim must be taken to a hospital or to a doctor as soon as possible.
Exercise

A. Multiple-choice questions

Tick (✓) the correct answer:

1. Which of the following is a conductor of electricity?
   A) dry wood      B) dry bamboo
   C) sponge sandals    D) human body

2. Why shouldn't you touch a victim of electric shock?
   A) That person will also receive an electric shock
   B) The shock victim will die
   C) The shock victim will become scared
   D) The shock victim will embrace him

3. How many poison fangs does a poisonous snake have?
   A) two       B) three
   C) one       D) four

4. How should we separate the victim of an electric shock from the electrified object?
   A) hug the person
   B) turn off the main switch
   C) pull him down
   D) call other people for help
**B. Short questions**

1. What is first aid?
2. How can you recognize the bite of a poisonous snake?
3. How can you separate a victim of electric shock from the electrified object?

**C. Broad questions**

1. What precautions should you take while separating a victim of electric shock from the electrified object?
2. Describe how an object can become electrified.
3. Suppose one of your friends breaks his hand. How are you going to provide him with first aid?
Chapter Seven

Matter

We can see many types of objects or things around us. In our rooms there are chairs, tables, beds, almirahs, blankets, mattresses, pillows, books, notebooks, pens, scales etc. Other than these, there are also items like clothing, gold jewellery, plates, glasses, cups, buckets, pitchers and other utensils, oil, water, milk and so on. Whatever the characteristics of the objects are, they are all made of matter. In that case, what is matter? And what is an object? Observe a piece of iron. It occupies some space, it has weight and effort is required in order to push it, i.e. it resists external forces. That is to say, anything which occupies space, has weight and resists when external forces are applied to it is called matter. So, soil, water, air, stone, iron, glass and wood are all matter.

We also need to know what an object is. Yes, a limited part of matter is called an object. For example, iron is a kind of matter, but an iron rod is an object. Again, paper is matter, but a book made of paper is an object. Wood is matter, but a chair made of wood is an object. Do you understand now? Now think - what is rubber? Of course, rubber is a type of matter. And what is a tyre made of rubber? A tyre is an object. Now you can obviously understand what gold is, and what jewellery is. Different objects have different characteristics because they are made of different...
types of matter. Both living and nonliving things are made of matter. For example, plants, human beings and other creatures are all made of some type of matter. Some types of matter are hard, such as wood, while some are soft, such as cotton. Some types of matter are bright in appearance, such as gold, while some types are dull, such as coal. There are some types of matter which stay where they are kept, such as iron. There are some types of matter which flow from one place to another if kept somewhere, such as oil or water. However, no matter what qualities or characteristics different types of matter have, all types of matter possess the two following common properties:

1. It will occupy space, and
2. It will have weight.

**Matter occupies space**

Assume there is just enough space in your study to place a reading table, and your table is placed there. Now will it be possible to place a smaller table at the same spot for your sister? No, because your table is already occupying that space. There is no place left for another table. When you sit in a chair that can accommodate only one person, can anyone else sit in it? No, because you are occupying the space in the chair.

No matter what the shape or size of an object, it occupies space. This means space is required for an object to be placed. A space which is already occupied by an object cannot be occupied by another object. Let us describe an easy experiment to demonstrate the fact that matter occupies space. We know that both stone and water are matter. Take a glass and fill it to the
brim, but make sure no water spills out. Now carefully drop a few pieces of stone into the water in the glass. You will see that the water spills over. Why did the water spill over? Because the pieces of stone occupied some space inside the glass, causing the water in those spaces to spill out.

Figure 7.1: Water spilling out in order to make room for the pieces of stone

**Matter has weight**

Just as matter occupies space, it also has mass. It is a common property of all types of matter. Take a book and suspend it from your hand. You will experience a downward pull. You will also experience a similar pull if you suspend a brick or a pitcher full of water instead of a book. Why are you experiencing this pull?

Scientist Newton discovered the reason behind this pull. As stated by him, all objects attract each other. This means objects attempt to pull other objects toward them. Our planet earth also pulls all objects toward itself. As a result of this, you feel a downward pull by any object you suspend from your hand. If you let go of the object, you will see that it drops to the ground. This occurs due to the attraction of the earth. The strength of the attraction of the
earth toward an object is its weight. The greater the amount of matter in an object, the stronger is the attraction of the earth toward it, and the greater is its weight. When we buy butter, rice, sugar, flour, oil or other things from shops, we weigh them in order to understand how much of it we purchased.

Besides the word 'weight' there is another similar word - 'mass'. Sometimes we mistake them to mean the same thing, but they are not the same. The total amount of matter present in an object is called its 'mass'. On the other hand, the attraction of the earth on the mass of an object is called its 'weight'.

The weight of an object depends on its mass. The greater the mass of an object is, the greater is its weight. The weight of an object also depends on the distance between the object and the center of the earth. Because of this, the weight of an object is different at different locations on the surface of the earth. The higher we rise above the surface of the earth, the lower the attraction of the earth on an object. As a result, the weight of the object gradually decreases. Far away from the earth, where the earth's attraction does not exist, the weight of an object is zero. However, the mass of the object is not zero. Again, if an object is taken to some other planet or satellite, their attraction toward it will be different. Because of this, the same object will have different weights on earth and on other planets or on the moon. Since the moon is much smaller than the earth, it does not attract objects as strongly as the earth does, so the weight of the object on the moon is less than its weight on the earth.

Although the weight of an object varies depending on its location at different places on earth or on different planets or Satellites, its mass will be the same everywhere, because the
amount of matter in the object remains the same all the time. Because of this, if an object is taken to the moon or somewhere else, its weight will change but its mass will not vary.

So, we have learnt about the two general properties of matter—they occupy space and they have weight. There is also another common property of matter—it resists if an external force is applied to it.

Now look around and observe what objects are there around you. Write down the names of the substances they are made of. Look at the sky. You will see the sun, the moon, stars etc. They are all made of different types of matter. Again, milk, water, oil, gas etc. are also matter.

Write down the names of ten types of matter in the table below. Now consider if the above-mentioned properties are present in them.

The three states of matter and their attributes
We know that structurally, matter can be of two types - elements and compounds. However, all substances can exist in three physical states:
1. Solid state
2. Liquid state
3. Gaseous state

These are not classifications of different substances, but three states of matter under different conditions. For example, ice, water and steam are all just different states of the same type of matter, $\text{H}_2\text{O}$ (water). Let us observe the different characteristics of matter in these three different states.

Think of a pen, a piece of wood or a brick. We can place them in any way we like. We can put them in a container or keep them outside. They will not roll away or fly away. Regardless of whether you put a pen in a glass or leave it on the floor, its shape will remain unchanged. No matter how they are stored, their shape will not change. Again, no matter where they are kept, the space they occupy does not change. This means that their volumes are constant. This type of substances are called solids. Wood, paper, coal, books, buckets etc. are solid substances (Figure 7.2a). So, it can be said that the state in which the shape and volume of matter remain constant is called the solid state.

Now let's consider water, milk or oil. We need containers to store them. If they are not kept in containers, they will roll away. If water or milk is put in a jug, it takes on the shape of the jug. Again, if it is poured into a mug, it takes on the shape of the mug. Again, if it is poured into a tub, the wide shape of the tub will be the shape of the water. This means that milk or water takes on the shape of the container they are poured in. They do not have any
definite shape. However, they occupy the same amount of space in all containers. That is to say, their volume is constant, regardless of the container they are put in. These substances are called liquids (Figure 7.2b). Therefore, the state of matter in which it has definite volume but no definite shape is called the liquid state.

![Figure 7.2: The three states of matter](image)

Finally, let us consider air or the gas which we use to fly balloons. If the mouth of a gas cylinder is not closed, the gas will escape from the cylinder by itself. They are called gaseous substances (Figure 7.2c). Regardless of which container they are stored in, they take on the shape of the entire container and occupy it fully. Hence, they have neither any definite shape nor any definite volume. So, the state in which matter has no definite shape or volume, but has a definite weight is called the gaseous state of matter. The air which surrounds us contains oxygen, nitrogen, carbon dioxide and so on, all of which are gaseous substances.
So what have we learnt so far? We have learnt that matter can exist in three different physical states - solid, liquid and gaseous. The same type of matter can exist in all three of these states. For example, as it has been mentioned before, ice, water and steam are the solid, liquid and gaseous forms of the same substance. Now you can obviously give many examples of solid, liquid and gaseous substances. Using these examples, fill in the table given below:

**Table 2: The three states of matter and their properties**

<table>
<thead>
<tr>
<th>State of matter</th>
<th>Properties</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid</td>
<td>1.</td>
<td>1.</td>
</tr>
<tr>
<td></td>
<td>2.</td>
<td>2.</td>
</tr>
<tr>
<td></td>
<td>3.</td>
<td>3.</td>
</tr>
<tr>
<td>Liquid</td>
<td>1.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.</td>
<td></td>
</tr>
<tr>
<td>Gaseous</td>
<td>1.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.</td>
<td></td>
</tr>
</tbody>
</table>

**Change of state upon application of heat**

We know that matter can exist in three states - solid, liquid and gaseous. Now, let us think about these three states of matter a bit more deeply. Do solid objects remain solid at all times at different temperatures? Before trying to find the answer to this question, let us think of a cube of ice. In our country, ice can be made in factories or in refrigerators. Ice is formed by cooling
down water to extremely low temperatures. Ice is the solid state of water. In our country, if ice is kept outside, it slowly melts and turns into water. It is the liquid state of water. If this liquid water is heated on a stove, it turns into steam. It is the gaseous state of water. What can we deduce from this discussion? The same substances, such as water, can exist in nature in solid, liquid or gaseous forms at different temperatures. Not only ice - if we heat lead, copper or iron, we would observe similar changes. If solid iron is heated, it becomes liquid. If heated further, the liquid iron changes into its gaseous form. However, there are some exceptional types of matter, which change into their gaseous state directly from their solid state upon application of heat. For example: naphthalene, camphor, ammonium chloride etc.

We can see the transformation of ice to water and then to steam upon heating by means of a simple experiment. Take a few cubes of ice in a tumbler. This is the solid state of water. If left in air, the ice eventually melts completely and turns into water. This is the liquid state of water.

![Solid state](image1.png) ![Liquid state](image2.png) ![Gaseous state](image3.png)

Figure 7.3: Three states of water
Now, if more heat is applied, the water is turned into steam. This is the gaseous state of water. We can express the results of the above experiment briefly as follows:

\[ \text{Ice} + \text{Heat} = \text{Water} \]

\[ \text{Water} + \text{Heat} = \text{Steam} \]

Now, instead of applying heat to it, we cool it down. Eventually, the steam would cool down and condense, turning into water. If this water is further cooled, it will eventually freeze and turn into ice. We can briefly express the results of this experiment as follows:

\[ \text{Steam} - \text{Heat} = \text{Water} \]

\[ \text{Water} - \text{Heat} = \text{Ice} \]

Just as steam turns into water when cooled and water turns into ice when cooled further, oxygen, nitrogen, hydrogen etc. can also be liquefied by cooling them under pressure. They also can be solidified upon further cooling.

Thus, we can say that the state of matter changes depending on changes in temperature.
Exercise

A. Multiple-choice questions

Tick (✓) the correct answer:

1. What are the two common properties of matter?
   a) They have shape and weight
   b) They occupy space and they have weight
   c) They have shape and volume
   d) They occupy containers and have shape

2. Which one of these is not matter?
   a) Air  b) Sound
   c) Soil  d) Water

3. What changes will an object undergo if it is taken to the moon or to some other planet?
   a) Its mass will remain the same, but its weight will change
   b) Both its mass and weight will change
   c) Its weight will remain the same, but its mass will change
   d) Its mass, weight and volume will all change
4. What are the characteristics of solids?
   a) Solid objects have definite shape but no definite volume
   b) Solid objects have definite volume but no definite shape
   c) Solid objects have definite shape and definite volume
   d) Solid objects have definite volume but no definite weight

5. What are the characteristics of liquids?
   a) Liquids have definite shape but no definite volume
   b) Liquids have definite volume but no definite shape
   c) Liquids have definite shape and definite volume
   d) Liquids have definite volume but no definite weight

6. What are the characteristics of gases?
   a) Gases have definite shape but no definite volume
   b) Gases have definite volume but no definite shape
   c) Gases have definite weight but no definite shape or volume
   d) Gases have definite volume and weight but no definite shape

B. Answer the following short questions:
   1. What is matter?
   2. Give some examples of solid, liquid and gaseous matter.
   3. How many common properties of matter are there and what are they?
   4. How many states of matter are there?
5. What are the characteristics of solids? Give some examples of solids.

6. What are the characteristics of liquids? Give some examples of liquids.

7. What are the characteristics of gases? Give some examples of gases.

8. What is meant by the mass of an object?

9. What is meant by the weight of an object?

10. What changes will the weight of an object undergo if it is taken to the moon or to another planet? Why will this change occur?

11. What happens when ice is heated? What will happen if more heat is applied to it?

C. Answer the following questions in detail:

1. Explain why the weight of objects change.

2. How many states of matter are there? What are they? Describe the characteristics of each of these states.

3. What happens first if steam is cooled or if heat is removed from steam? What will happen upon further removal of heat or further cooling?

4. What will happen if camphor or naphthalene is left uncovered in the open? Why will it so happen?
Classification and Structure of Matter

Elements and compounds

We have already learnt that matter can exist in three physical states—solid, liquid and gaseous. However, structurally, matter can be classified into two types. Let us discuss about these two types of matter.

If we keep breaking a copper wire, we will find that the broken pieces are also made of copper. If we keep breaking them, eventually we will obtain pieces which are so small that they cannot be seen with the naked eye. However, all these tiny pieces are also made of copper. Substances like these, which yield none but smaller pieces of the same substance as they are broken are called elements. For example, copper is an element, as it can be seen here. Iron, gold, silver, oxygen, hydrogen, argon, neon etc. are also elements. A total of 92 elements have been known to exist in nature. In addition, scientists have made a few more new elements. The total number of elements discovered so far is 110.

Now, let us break a piece of chalk into pieces. The larger pieces
obtained at first will appear to be chalk, but if we keep on breaking them, ultimately the pieces obtained will be too small to be seen with the naked eye. At that stage no characteristics or properties of chalk will be found in the broken pieces. Instead, these pieces will bear the properties of calcium, carbon and oxygen. Therefore we see that a number of elements are obtained when we break chalk. So, it can be said that the substances which can be broken down into a number of different elements are called compounds. Here, chalk is a compound. Water, sugar, kerosene, salt, urea fertilizer etc. are also compounds. Oxygen and hydrogen can be chemically combined to produce water. Again, by passing electricity through water mixed with acid, water can be separated into two elements - oxygen and hydrogen. From this it is proved that water is a compound substance which is formed by the combination of the elements oxygen and hydrogen.

So what have we just learnt? Structurally, substances can be divided into two types: elements and compounds.

Now, fill in the table given below by writing down the names of five elements and five compounds. However, do not mention the names of the elements and compounds which have been discussed above.

**Table 1: Elements and compounds**

<table>
<thead>
<tr>
<th>Elements</th>
<th>Compounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1.</td>
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<tr>
<td>2.</td>
<td>2.</td>
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<tr>
<td>3.</td>
<td>3.</td>
</tr>
<tr>
<td>4.</td>
<td>4.</td>
</tr>
<tr>
<td>5.</td>
<td>5.</td>
</tr>
</tbody>
</table>
**Metals and nonmetals**

Have you ever noticed how gold glitters? But does a piece of coal do so? No, it does not. Gold is a metal, and coal is a nonmetal. However, they are both elements.

So, we can divide elements into two types: 1) metals, and 2) nonmetals.

When metal is polished, it glitters. Metal also has another property—it does not break if hammered, and it can be hammered into different shapes in order to make different things. For example, plates, bowls etc. can be made from aluminium. Besides, electricity and heat can flow easily through metal. Because of this, the wire which is generally used to supply electricity to houses, shops, offices etc. is made of copper. Also remember that since the density of metal is higher, metals have more mass than nonmetals. Other than this, most metals are solid at room temperature. For example, iron, silver, gold, tin, copper, zinc are all solid. However, there are exceptions to this, such as mercury, which is found in liquid state at room temperature. So, we have learnt that the elements which glitter, conduct heat and electricity well, and possess high density and elasticity are called metals. For example, gold, silver, iron, aluminium etc. are metals or metallic elements.

Again, elements which do not conduct heat and electricity as well as metals do, lack lustre and possess low density and elasticity are called nonmetals. Hydrogen, oxygen, nitrogen, carbon, iodine etc. are examples of nonmetals. Heat and electricity cannot pass easily through nonmetals. However, even though carbon is a nonmetal, heat and electricity can pass
through a particular form of carbon called graphite, which is generally not the case with any other nonmetal. Nonmetals usually do not glitter even if rubbed. For example, sulphur does not have any lustre. Again, since the density of nonmetals are low, they are lighter than metals. Nonmetals are not very flexible, so they cannot be hammered into flat plates or drawn out into wire. Because of this, you saw copper wires and plates of iron, but you never saw plates or wires made of coal or sulphur. At room temperature, most nonmetals are found in their gaseous form. Gases such as hydrogen, oxygen and nitrogen are examples of these. Some nonmetals also exist in solid state at room temperature, such as sulphur, carbon and iodine. A few nonmetals even exist as liquids at room temperature, such as bromine. Metals are good conductors of heat, but nonmetals are not. Because of this, upon application of heat, metals become heated more quickly than nonmetals do.

Other than metals and nonmetals, there are some elements such as arsenic or silicon which simultaneously bear some characteristics of metals and some characteristics of nonmetals. They are called semimetals or metalloids. Now, fill up the table given below by writing down five features of metals and five features of nonmetals.

**Table 2: Characteristics of metals and nonmetals**

<table>
<thead>
<tr>
<th>Metals</th>
<th>Nonmetals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
<td>2.</td>
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<tr>
<td>3.</td>
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<tr>
<td>4.</td>
<td>4.</td>
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<tr>
<td>5.</td>
<td>5.</td>
</tr>
</tbody>
</table>
**Atoms and molecules**

If an element is broken again and again, eventually particles of minuscule size will be obtained, which cannot be seen even using the most powerful microscopes, let alone the naked eye. These particles retain the original properties of the element. However, they cannot exist independently. They either join with each other or with the smallest particles of other elements. These very small particles are called atoms. So it can be said that the smallest particles of elements which cannot exist separately but participate in reactions are called atoms. Atoms are the basic building blocks of matter. Usually an elemental substance is made of innumerable atoms of the same type. However, different elemental substances are made of different types of atoms. For example, all atoms of copper have identical properties. All atoms of iron are also identical. However, the characteristics of iron atoms and copper atoms are very much different.

In case of gaseous elements, atoms usually do not exist separately, they remain joined to each other in small groups. For example, a single hydrogen atom cannot exist, two atoms of hydrogen join to form a larger particle. These particles can exist freely in nature. They are called molecules. However, in nature, there are exceptions to this. For example, gases such as argon and neon (also known as inert gases) can exist in nature as single atoms. Since they can exist as single atoms, they are also called molecules. However, these molecules consist of only one atom. On the other hand, molecules of hydrogen consist of two atoms. Not only gases - atoms of multiple elements can join and
form molecules of solid or liquid compounds. So it can be said that molecules are the relatively larger particles, formed upon the combination of atoms of the same element or a number of different elements, which can exist freely in nature.

Molecules can be of both elements and compounds. For example, two oxygen atoms can join with each other and form a single molecule of oxygen (Figure 8.1). This molecule will have all the properties of oxygen gas. This is a molecule of the element oxygen. Again, an atom of oxygen and two atoms of hydrogen can combine to form a molecule of water. This molecule of water will possess all the properties of water. Figure 8.1 shows the formation of a molecule of water upon combination of two hydrogen atoms and one oxygen atom has been shown.

![Figure 8.1: Oxygen atom, oxygen molecule, and water molecule formed by the combination of hydrogen and oxygen](image-url)
Similarly, one nitrogen atom and three hydrogen atoms combine to form a molecule of ammonia. On the other hand, 12 carbon atoms, 22 hydrogen atoms and 11 oxygen atoms combine to form a molecule of sugar.

**Force of attraction between the molecules of substances: Its relation to solid, liquid and gaseous states of matter**

You already know that substances can exist in nature in solid, liquid and gaseous physical states. For example, iron is solid, water is liquid and oxygen is gaseous. We know that substances have definite shapes and volumes in their solid states. In their liquid states, substances have definite volumes but no definite shapes. You also know that in their gaseous form, substances have neither definite volumes nor definite shapes. What is the reason behind this? The reason behind this is the structure of matter. All substances are composed of innumerable molecules. These molecules attract each other. However, in their solid state, the attraction between molecules is the greatest. In that state the atoms remain very close to each other and are packed very closely. So, in their solid state, the shape or volume of substances remain constant. In this state the molecules cannot move.

If heat is supplied to solids, the molecules of solids start to vibrate more. At one point the vibration of the molecules increases considerably due to sufficient application of heat. As a result, the forces of attraction between the molecules decrease and the substance achieves liquid state. At this state the atoms can no longer remain attached to each other closely. The
attraction between the molecules decreases which results in the formation of small clusters of molecules. These clusters of molecules rush around separately (Figure 8.2b). However, even in their liquid state, the molecules still stay close to each other within a definite area and attract each other. Because of this the volumes of liquids remain constant. However, since the molecules can move around, liquids do not have definite shapes like solids do.

Figure 8.2: Vibrations of molecules of solids, liquids and gases

If heat is applied to liquid substances the forces of attraction existing between the molecules become even weaker, causing the molecules to drift apart. As they drift further away from each other, at one point the forces of attraction decrease so much that the molecules are separated from each other. This causes the substance to become gaseous. As the molecules are separated from each other, they move further apart. Because of the incessant random motion of the molecules a gaseous substance
occupies all the space inside whatever container it is stored in. So, in its gaseous state, neither the volume nor the shape of a substance is constant.

Now let us see if you have understood what makes matter to assume the three physical states and what is the relationship between these states of matter and the forces of attraction acting between molecules. Demonstrate it by filling out the table given below:

**Table 3: Comparison of solid, liquid and gaseous substances**

<table>
<thead>
<tr>
<th>Properties</th>
<th>Solids</th>
<th>Liquids</th>
<th>Gases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shape</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attraction between molecules</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motion of molecules or clusters of molecules</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Exercise**

**A. Multiple-choice questions**

**Tick (√) the correct answer:**

1. Which one of these is not matter?
   a) Oxygen  
   b) Water  
   c) Nitrogen  
   d) Light
2. Which one of these is an element?
   a) Sugar   b) Water
   c) Neon     d) Salt

3. What is a molecule of ammonia composed of?
   a) One nitrogen atom and one hydrogen atom
   b) One nitrogen atom and three hydrogen atoms
   c) Two nitrogen atoms and one hydrogen atom
   d) Two chlorine atoms and one sodium atom

4. What is a molecule of water composed of?
   a) One hydrogen atom and one oxygen atom
   b) Two hydrogen atoms and one oxygen atom
   c) One hydrogen atom and two oxygen atoms
   d) Two hydrogen atoms and two oxygen atoms

5. Which of these is not a property of metals?
   a) Greater conductivity of heat and electricity
   b) More lustre
   c) More flexibility
   d) Low density
B. Answer the following short questions:

1. What is an element? Give example of an element.
2. What is a compound? Give example of a compound.
3. What is an atom?
4. What is a molecule?
5. What are the properties of metals?
6. Draw the diagram of a water molecule and an ammonia molecule.
7. What is the total number of elements which have been discovered so far? How many of them are natural elements and how many of them are synthesized elements?

C. Answer the following questions in detail:

1. Describe how the molecules of water, ammonia and sugar are formed.
2. Write down five differences between metals and nonmetals.
3. State the names of one exceptional metal and one exceptional nonmetal.
5. Write down the properties of atoms and molecules.
6. What is the force of attraction between the molecules of substances? In which physical state of matter is this force of attraction the greatest and in which state is it the least? Why does the physical state of matter change if the forces of attraction between molecules change?
Chapter Nine

Energy

If you look around ourselves, we see many things moving or in motion. What is the reason behind this motion? It can be said that objects move because of energy. Without energy, the world around us would have been motionless. This applies not only to humans or animals, but to any moving vehicles, machinery and all other moving objects. So it is energy which has kept our world in motion.

Numerous examples of the use of energy can be observed in our daily lives. For example, you want to walk to a place. In order to walk you must exert energy through your muscles. If you go somewhere on a rickshaw, the rickshaw-puller must exert force to pull his rickshaw. If you want to lift water from a tube-well, energy must be applied in order to exert pressure.

Figure 9.1: Energy is required to lift water from wells and tube-wells
In Grade Four, you have become acquainted with electricity, heat and sound energy. There you have seen the application of these types of energy. Some applications of these types of energy will be described here once again. Electrical energy needs to be applied in order to power light bulbs, ceiling fans, televisions and computers. Machines powered by electricity are used to husk paddy, grind wheat and powder spices. Pumps powered by electricity are used for irrigational purposes. From our daily lives we can cite many examples of such machines which are powered by electricity.

We can change ice to water and water to steam by applying heat energy. This is an example of application of heat energy. We also cook our food by applying heat. This is another example of application of heat energy.

Figure 9.2: Different types of energy
In the Fourth Grade, you have seen how sound is created from the vibration of our vocal cords which enables us to speak. This application of sound energy is indispensable in our lives. Without it we would not be able to talk. In the same manner we play different musical instruments and create music. What is the application of the types of energy which we have discussed so far and have been demonstrated in figures 9.1 and 9.2. We use these types of energy to do work.

**Energy and work**

**Work**

Studying, lifting water from tube-wells, pulling rickshaws are all examples of work in our everyday lives. In scientific terms, when displacement of an object occurs upon application of energy, work is done. For example, a rickshaw-puller pulls a rickshaw. The rickshaw-puller exerts force and causes the rickshaw to move forward, displacement of rickshaw occurs, hence work is being done. When a van-puller pulls his van along a bumpy village road and causes the van to move forward, work is done. In this manner, whenever displacement of an object occurs upon the exertion of an external force, work is done. However, in some cases, work can be done without movement or displacement. For example, someone is pushing a wall very hard, but the wall is not moving. In this case, as no displacement is taking place, in scientific terms no work is being done. However, since an effort is exerted to push the wall, we refer to it as work in our everyday lives. In scientific terms, studying is not a type of work either, because no displacement occurs during studying. But practically, studying is a kind of work. So,
it can be said that work is done whenever energy is applied, even if no displacement occurs.

Now let us see when less work is done and when more work is done. Let us consider the amount of work which is done by a van-puller when he covers a certain distance while carrying a load. If he covers the same distance while pulling a load which is twice as heavy as the previous one, he does twice the amount of work. Again, if he pulls the same weight but covers twice the distance he covered before, he does twice the amount of work in that case too. So it can be seen that if the same displacement is made to occur by exerting twice the amount of force, twice the amount of work is done. Similarly, if the same force is applied to cause twice the amount of displacement, twice the amount of work is done as well. So, in brief, we can say that work is the product of force and displacement. That is to say, mathematically,

\[
\text{work} = \text{force} \times \text{displacement}.
\]

**Energy**

The ability to do work is called energy. The greater the ability of an object (or a machine or a person) is to do work, the greater is his/her/ its energy. Let us consider the amount of water which can be lifted by a water pump having a power of 1 (one) horsepower in one second. A water pump having a power of 2 (two) horsepower will be able to lift twice the amount of water in one second. So it can be clearly seen that a water pump having a power of two horsepower can do twice the amount of work which is done by a water pump having a power of one horsepower. That is, the greater the ability of something is to do
work, the greater is its energy. Now let us see how much energy is contained in one litre of oil or one ton of coal. The amount of work which can be done by burning one litre of fuel oil is equivalent to the amount of energy which can be obtained from that oil. Again, the amount of work which can be done by burning one ton of coal is equivalent to the amount of energy which can be obtained from that coal. We also gain energy from food. We can do work because we eat food. The food we eat undergoes combustion in the presence of the oxygen we inhale, generating heat energy. We use this energy to do work.

**Sources of energy**

The main source of energy on the earth is the sun. We obtain different types of energy by converting solar energy in various ways. Energy can also be obtained by burning wood, fuel oil, coal, gas, biogas (gas produced from the excreta of animals) etc. So these are also different sources of energy. Energy can also be generated by utilizing air and water. Just as heat and light energy can be obtained from the sun, energy can also be obtained from matter. This is called nuclear energy. While electrical energy is generated from this, atomic bombs can also be made from it.

We know about the different forms of energy, namely: 1) Mechanical energy, 2) Heat energy, 3) Light energy, 4) Electrical energy, 5) Magnetic energy, 6) Sound energy, 7) Chemical energy.

**1. Mechanical energy**

The energy which is gained by an object due to its being in a
state of motion or in a state of rest is called mechanical energy. There are two types of mechanical energy: potential energy and kinetic energy.

**Kinetic energy and potential energy**

Have you ever thrown stones in order to bring down mangoes from trees? When you throw a stone, you exert a force on it and cause it to gain energy. And if the stone hits the mango properly, the mango drops from the tree. Upon exertion of force, the stone gains motion, and the energy gained from this motion by the stone is expended to make the mango drop. So it can be said that objects (or humans or machines) gain energy or the ability to do work due to motion. The energy gained by objects (or humans or machines) when they are in motion is called kinetic energy.

We often pick up objects lying on the floor and put them on a table or on some other high surface. You need to apply energy and hence do work in order to pick up things from the floor and put them on the table. Where does this energy go? This energy remains stored in the object kept on high surfaces. This type of energy is called potential energy. Imagine someone who is lifting a number of bricks to the rooftop of a building. Work has had to be done in order to lift the bricks against the force of attraction of the earth, which means energy has been expended. Where did this energy go? This energy remains stored in the bricks. The energy which remains stored in the bricks when they are static is called potential energy. Probably all of you have seen people shooting arrows in the Olympics or somewhere else on television. The archer bends the bow before shooting the arrow. In
order to bend it, the archer exerts the strength of his muscles. This muscular energy is used to bend the bow or change the shape of the bow. The energy which is stored in the bent bow is also potential energy. When the arrow is shot, the potential energy is converted into kinetic energy. By utilizing this kinetic energy, the arrow moves forward at high speed toward the target. When a toy car is wound up, potential energy is gathered into it. When the key is released, the potential energy is converted to kinetic energy and the car starts to move. So it can be said that the energy which is stored in objects because of its position or its change of shape is called potential energy.
Conversion of energy from one form into another

We have already discussed the example of taking a brick to the rooftop. The work which is done in order to take the brick to the rooftop is stored inside the brick in the form of potential energy. Now what will happen if we let the brick drop to the ground? The potential energy inside the brick will start to be converted into kinetic energy which will set the brick in motion. The further the brick goes down, the more potential energy is converted into kinetic energy. When the brick travels halfway toward the ground, half of the energy of the brick will be potential energy and half of the energy of the brick will be kinetic energy. At the exact moment before the brick hits the ground all its potential energy will be converted into kinetic energy. As the brick hits the ground, a noise is heard and the place becomes heated, which means that the kinetic energy of the brick is converted into sound energy, heat energy etc. What have we learnt from this example? We have learnt that energy cannot be created or destroyed - it is only converted from one form into another. We can see many other examples like these around us. When petrol or diesel is burnt in cars, the chemical energy in the fuel is converted into heat energy. This heat energy eventually turns into kinetic energy which sets the car in motion, i.e. causes it to move.

2. Heat energy

We already know that heat is a kind of energy. The main source of heat on earth is the sun. The heat which is radiated by the sun is directly absorbed by plants and animals. Later the heat is
converted into chemical energy which is stored in their bodies as chemical energy. Plants make their food in the presence of sunlight. Chemical energy is stored in plants when they take this food. This energy is later converted into various other forms of energy which we can use for various purposes. For example, the wood which is obtained from trees can be burnt to cause the chemical energy to turn into heat energy. Plants which remain buried underground for long periods of time turn into coal. When coal is burnt, the chemical energy contained in it is converted into heat energy. Just like coal, the organic parts of the bodies of animals which lay buried under the ground for very long periods of time turn into mineral oil and natural gases. As is the case with wood and coal, when mineral oil or natural gas is burnt, the chemical energy stored in them is also converted into heat energy.

Figure 9.4: Sunlight and radiation of heat energy
We gain strength from the food we eat. As we eat, the food undergoes combustion by means of the oxygen which we inhale, and the chemical energy of the food generates heat in the human body. This heat supplies us with strength to do work.

**Effect of heat**

(1) When heat is applied, metals expand. Because of this, gaps are left between the segments of railway tracks so that the tracks do not bend due to their expansion during the summer. Again, while putting an iron girdle around a wooden wheel, the iron girdle is heated in order to make it expand. Then, upon cooling, the girdle becomes tightly attached to the wooden wheel. From these two examples it can be seen that metals expand upon application of heat.

(2) If one end of a piece of iron is held in a fire, the other end of it also becomes hot after a while. This happens because heat energy can flow through metals. Thus, conduction of heat occurs. However, heat cannot flow well through wood.

(3) When temperature increases, the volume of gases also increases. The pressure which is produced as a result of this expansion can be used to turn the wheels of heat-operated engines. In such cases, the heat energy is converted into mechanical energy.

(4) We also know about the conversion of heat energy into electrical energy. Water can be turned into steam by applying heat. Electrical energy can be obtained by running generators using the kinetic energy of steam.

(5) Large amounts of heat energy are produced when petrol is burnt in airplanes. This heat energy supplies kinetic energy to
the plane and allows it to fly.

3. **Light**

We can see because there is light. Can anything be seen on moonless nights in places where there are many trees or forests? Nothing can be seen except for absolute darkness. But if the same place is visited during the daytime, everything can be seen clearly. During the daytime, everything can be seen because there is light. Light is a kind of energy using which we can see things.

**Sources of light**

The sun, stars, different types of electric lights, candles, fire etc. are various sources of light. Among them, the sun is the main source of light. We can see many things around us during the daytime because the sun gives light. Even though the sun is situated far away from us, we get heat and light directly from the sun.

**The speed of light**

Actually, light travels the fastest. The speed of light is the fastest among all the types of speed we see around us. Among all the mechanical vehicles around us, rockets are the fastest. These rockets cannot yet travel at a speed of 100 kilometers per second. On the other hand, light travels at a speed of 186,000 miles or 300,000 kilometers per second. So you can clearly understand that it is still far beyond our ability to attain the speed at which light travels. If we could have achieved this speed or a speed close to this, surprising things such as compressing the duration of an event or increasing the mass of an object, would have been possible.
Light travels along a straight line

Assume that you have turned on the light in your room at night, and you can see almost everything inside the room. Your room is bound by walls on all sides. In the light of your room, can you see anything which is on the other side of the walls? No, you cannot. What is the reason behind this? This happens because light travels in straight lines. The walls act as obstructions in the straight paths of the light in your room. So, the light cannot penetrate the walls, and nothing on the other side of the walls can be seen.

![Figure 9.5: Experiment to prove that light travels in a straight line](image)

Imagine that you are sitting some distance away from a source of light. Three identical walls made of hardboard are placed between you and the source of light as shown in figure 9.5. There is a hole in the exact center of each of the hardboard walls. You will be able to see the light only if the source of light, the holes in the hardboard walls and your eye all lie along the same straight line. You will not be able to see the light even if just one of the objects move out of the straight line. This experiment must be performed at night or in a completely dark
Energy room where there are no other source of light except the one used in the experiment. This experiment proves that light travels in straight lines.

**Transparent, semitransparent and opaque substances**

You know that light can pass very easily through glass windows. If the water is very clear, the movement of fish or other aquatic creatures deep in the waters of ponds and other water bodies can be seen. This shows that light can pass through very clear water as well. Now, imagine that one of your classmates is standing some distance away from you and looking at you. You can see your classmate clearly. There is air between you and your classmate. Light can pass through air, which is why you can see your classmate. The substances through which light can easily pass are called transparent substances. Glass, very clear water, air, oxygen, hydrogen gas etc. are examples of transparent substances.

If the water is not very clear, objects lying deep underwater cannot be seen clearly. We can see indistinctly through frosted glass. Dip a white piece of paper (which we use for writing) in oil. Now try to look at an illuminated object through the oil-soaked piece of paper. The illuminated object can be seen hazily through the oil-soaked piece of paper. The objects through which light can pass partially are called semitransparent substances. Slightly dirty water, frosted glass, oil-soaked paper and coloured plastic are examples of semitransparent substances. Now let us consider that there is a brick wall, a wooden door or a steel almirah between you and an illuminated object. All of these would prevent the flow of light, and thus you
will not be able to see the lighted object. The objects through which light cannot pass are called opaque substances. Brick, wood, steel etc. are examples of opaque substances.

![Figure 9.6: Transparent, semitransparent and opaque substances](image)

- a) A burning candle kept on the other side of a sheet of transparent material can be seen quite clearly
- b) A burning candle kept on the other side of a sheet of semitransparent material can be seen hazily
- c) A burning candle kept on the other side of a sheet of opaque material cannot be seen at all

Figure 9.6: Transparent, semitransparent and opaque substances

Fill out the table below by writing the names of three transparent, three semitransparent and three opaque substances:

**Table and 2: Transparent, semitransparent and opaque objects**

<table>
<thead>
<tr>
<th>Transparent</th>
<th>Semitransparent</th>
<th>Opaque</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1.</td>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
<td>2.</td>
<td>2.</td>
</tr>
<tr>
<td>3.</td>
<td>3.</td>
<td>3.</td>
</tr>
</tbody>
</table>
**Electrical energy**

Electricity is a type of energy. This energy can be used to power light bulbs, ceiling fans and various other pieces of machinery.

In the fourth grade, you have learned about various uses of electrical energy. Now you will learn some new things about electricity as well.

Electricity can be classified into two types:

a) Static electricity; b) Current electricity.

**Static electricity**

You have certainly noticed that in winter, when a dry comb is used to comb dry hair, and then it is held near small pieces of paper, the pieces of paper are attracted toward the comb. Why does this so happen? Due to the friction occurring between the plastic comb and the dry hair, electricity of opposite natures is generated on the comb and the hair. The electricity generated on the comb attracts the electricity generated on the pieces of paper, and causes them to be attracted toward the comb. This type of electricity remains wherever they are generated. And so we can say that the electricity generated by friction, which remains static, is called static electricity.

**Kinetic electricity**

If you look around yourself, you will notice that electricity is flowing through a lot of electric wires around you. Wires made of copper or some other types of metal are used to conduct electricity in these cases. So we can say that the electricity
which can move from one place to another by means of wires is called current electricity.

**Sources of electricity**

Electricity can be obtained from electric cells or dynamos (generators). So, these are sources of electricity. You will now learn what these sources of electricity (electric cells and dynamos) are, and how they work.

**Standard electric cell**

Electric cells are devices in which chemical energy is converted into electrical energy which can be stored for later use.

You can make a standard electric cell with the help of your teacher by following the instructions given below. The help of your teacher must be taken because a hazardous chemical called sulphuric acid is used here. Take diluted sulphuric acid in a
glass container. Dip a strip of copper and a strip of zinc partially into the solution in the container. Now connect the outer end of the copper strip to a flashlight bulb using a copper wire. Use another copper wire to connect the flashlight bulb to the outer end of the zinc strip in order to complete the connection. When the connection is complete, the flashlight bulb will light up for some time. Why will it do so? The device which is made by connecting the strips of copper and zinc dipped in the diluted sulphuric acid in the glass container is called an electric cell. Electrical energy is generated by chemical reactions occurring in this cell, causing the bulb to light up. The flashlight bulb glows when electricity flows through it. However, after some time, the bulb stops shining. The cell which we have just learnt about was invented by the Italian scientist named Volta, which is why it is called a Voltaic cell. In this type of cell, chemical energy is converted into electrical energy. For use in our everyday lives, electric cells can be made from a dry paste-like chemical. This is called a dry-cell battery or simply a battery. Flashlight batteries and camera batteries are electric cells. Batteries are also used in motor vehicles.

**Electric dynamos or generators**

Dynamos and generators are a type of machine used to generate current electricity. Dynamo was invented by the scientist Michael Faraday. In a dynamo, a coil of wire spins between the two poles of a fixed magnet. This causes an electric current to be generated in the coil. In dynamos, mechanical energy is formed from the chemical energy of fuel oil. This mechanical energy is later converted into electrical energy. Use of dynamos
in both rural and urban areas of Bangladesh is increasing steadily. During power failures or load-shedding, dynamos or generators are used to temporarily power light bulbs and other electric equipment.

Figure 9.8: Electric generator

Magnetic energy

Almost seven thousand years ago, a shepherd boy called Magnus was said to live in Greece. One day, while resting, he put down his stick on a rock. When he tried to pick up the stick, he found that the iron tip of the stick had got stuck to the stone. This type of stone was named "magnet" after the name of Magnus. According to some people, the Greeks had discovered a type of black stone in a place called Asia Minor or Magnesia. They found that pieces of this type of stone attracted small pieces of iron. These stones were named magnetite or lodestone. The energy by means of which magnets attract iron is called magnetic energy. Magnetite is a type of natural magnet. But since natural magnets are weak and their shapes are not convenient,
scientists make different types of artificial magnets to suit our needs. These magnets are usually made of iron or nickel. Iron bars can be very easily turned into artificial magnets by rubbing them with magnets. Iron can also be magnetized with the aid of electrical energy.

Two special properties of magnets are: 1) They attract iron and other substances similar to it, and 2) When a magnet is suspended freely, its ends point to the north and south. If we observe carefully, we will find that the attracting powers of a magnet are strongest at its two ends. These two ends are called the poles of a magnet. One of these is called the north pole, and the other is called the south pole. When a magnet is freely suspended, one of its poles faces the northern point of the earth and its other pole faces the southern point of the earth. The pole which faces the northern point of the earth is called the North Pole and the pole which faces the southern point of the earth is called the South Pole.

When a powerful U-shaped magnet is held near some iron nails,
some of the nails are attached to both the poles of the magnet.

Heavy loads are often lifted onto ships using magnets. Various types of electrical machinery are made using magnets. For example, magnets are used in the construction of generators. Magnets are also used in compasses and children's toys.

**Sound energy**

You have learnt in your Fourth Grade that sound is a type of energy and it occurs because of vibrations. We will discuss an experiment here to remind you that sound is generated by means of vibration. Each school or college has a bell. The bell is struck with a hammer in order to announce periods and exam timetables. With the permission of your school authority, bring the bell into your classroom for some time. It will be better if this experiment is performed half an hour before your school starts or after your school ends, otherwise the untimely peal of bell may create confusion for the other classes. One of you should hold up the bell and let another one of you strike it. You will see that the bell starts ringing the moment it is struck, i.e. sound is being emitted from it. Now observe the bell very closely. What do you see? The bell is vibrating. If it cannot be seen with your eyes clearly, touch it with your hand. You will understand the moment you touch it that the bell was vibrating while emitting the sound. However, the vibration of the bell stops the moment it is touched, and the sound cannot be heard anymore. So, from this experiment, it is proved that sound is created through vibration. Split yourselves into small groups. Each group should ring the bell and sense the ringing of the
bell visually and through touch.

Make sure that each of you get the chance to take a look at the bell and observe it very closely.

A medium is needed for sound to travel. It can be proved by performing an experiment. Take some water in a transparent bottle made of hard glass which has a tight cork. The bottle must be of such a nature that it does not crack easily when heated. Pierce the cork and insert a hard needle-like stick or metal rod through it. Tie a rattle to the lower end of the rod which will be inside the bottle. The amount of water in the bottle should be such that when corked, the rattle stays clear of the surface of the water (Figure 9.10a). Now if the corked bottle is shaken from side to side, sound will be created upon vibration of the rattle, which you will be able to hear.

Figure 9.10: Experiment to prove that a medium is needed for sound to travel
Now, uncork the bottle and apply heat below it. The heat will cause the air inside the bottle to expand and flow out, along with a certain amount of water which will leave the bottle in the form of water vapour (Figure 9.10b). When some air and water vapour leaves the bottle, remove the source of heat from under the bottle and immediately cork it once again (Figure 9.10c). Wait for some time and allow the bottle to cool down. When it cools, again shake it from side to side in order to shake the rattle and make noise. You will be able to hear the sound of the rattle, but it will be much fainter than before. Why will the sound be fainter? Some water and air left the bottle when heat was applied to it, causing the medium inside the bottle to become thinner. This is why the sound turns faint. The thinner the medium inside the bottle becomes, the fainter the sound becomes. If the bottle could have been completely drained of air, no sound would have been heard. So it can be understood from the experiment that air, i.e. a medium is necessary for sound to travel.

**Electric load-shedding**

The demand for electricity in our country is increasing day by day due to increase in population and improvements in our standard of living. The production of electricity is also increasing gradually. However, the supply of electricity is not yet adequate to keep up with the demand of electricity. So, some shortage of electricity always persists. In order to compensate for this shortage, supply of electricity is cut off temporarily at certain places for certain periods of time in a pre-planned and pre-calculated way. This is called load-shedding.
shedding occurs somewhere, people obviously suffer, but if it is announced beforehand, we can all be prepared to share this temporary problem equally for short periods of time. However, if it becomes possible for us to generate sufficient amounts of electricity in our country, load-shedding will not be required anymore.

**Wastage and conservation of energy**

Wasting energy without purpose is called wastage of energy. Keeping energy from being wasted is called conservation of energy. Everybody should be careful not to waste energy but to preserve it instead. If the lights and fans and other electrical equipment in our houses are left on for nothing, electrical energy is wasted. This type of wastage is not desirable. Therefore, we must all be careful about the use of all types of electrical machinery. As soon as we are done with using them, we must switch them off in order to stop the flow of electricity and conserve electrical energy. In cities, where natural gas is used for cooking, energy is often wasted by leaving gas stoves turned on without purpose. This pollutes the environment and can also cause accidents. So, wastage of energy must be stopped. We shall not leave stoves, electric lights or fans turned on without purpose.
Exercise

A. Multiple-choice questions

Tick (✓) the correct answer:

1. In which of these cases no work is done?
   a) When climbing a mountain
   b) When descending from a mountain
   c) When pushing a standing wall
   d) When a rickshaw-puller pulls a rickshaw

2. When a watch is wound up, it runs. What kind of energy is stored when the watch is wound up?
   a) Chemical energy
   b) Kinetic energy
   c) Heat energy
   d) Potential energy

3. What distance does light cover in a single second?
   a) 30,000 kilometers
   b) 186,000 kilometers
   c) 300,000 kilometers
   d) 1,860,000 kilometers

4. Which of these is transparent?
   a) Dirty water
   b) Wood
   c) Paper soaked in oil
   d) Air
5. How is current electricity generated?
   a) When plants remain buried underground for long periods of time
   b) If electric cells and dynamos are used
   c) When a substance absorbs the heat of the sun
   d) When a substance is rubbed with another

6. Where were natural magnets discovered?
   a) In Russia               b) In Asia Minor
   c) In the United Kingdom   d) In the United States of America

7. When a bar magnet is suspended freely, along which directions will it lie?
   a) East-west               b) North-south
   c) East-south              d) North-west

B. Answer the following short questions:
1. What is energy? Give some examples of energy.
2. What is work? Give some examples of work.
3. What is kinetic energy? Give some examples of kinetic energy.
4. What is potential energy? Give some examples of potential energy.
5. What are the sources of heat?
6. What changes do substances undergo upon application of heat?

7. What are transparent, semitransparent and opaque substances? Give examples of each of them.

8. How many types of electricity are there? What are they?

9. How many poles does a magnet have? State five uses of magnets.

10. How is sound produced?

11. What is needed for sound to travel?

C. Answer the following questions in detail:

1. Explain with examples that it is actually the energy we gain from the sun that can again be found in nature in many different forms.

2. Prove by means of an experiment that light travels in straight lines.

3. Describe with a diagram how an electric cell works.

4. Describe an easy method of identifying the north and south poles of a magnet.

5. Prove by means of an experiment that sound is produced as a result of vibration.

6. Prove by means of an experiment that a medium is needed for sounds to travel.

6. What is load-shedding? How would you prevent the wastage of electrical energy?
Chapter Ten

Air

If you stand in the yard of our house, in the playground of your school or in an open field and look around, what do you see? You will obviously notice trees, houses, the sky above you, the ground under your feet etc. You will also see the leaves of the trees stirring and your clothes fluttering — sometimes faster, sometimes slower. Do you know why the tree leaves or your clothes move or what makes them move? Can you see it? No, it cannot be seen, but its presence can be felt. This is called air. It cannot be grabbed or touched, but it can be felt. Air is all around us. It even surrounds the earth. This huge layer of air is called the atmosphere. Without air, we could not have survived for even two or three minutes. Life does not exist on the moon or on other planets because there is no air there. Without air no animals or plants can survive. Because of this, life is another name for air.

Air is a substance

Air is a substance. Maybe you are wondering how it can be so, since you cannot touch or see air. Well, as you have already learnt, substances have some definite properties. These are: they have weight, they occupy space, and they resist when pressure is applied to them. The fact that air possesses these properties can be proved through the experiments given below:
Experiment: Air has weight

Take a light thin stick which is about 1 foot to 1.5 feet long, 2 balloons and a length of thread. Inflate the balloons equally by blowing into them and tie their mouths with strings. Now, suspend the balloons from both ends of the stick using string. Tie a string lightly to the middle of the stick. Take care so that the string can be moved sideways easily. Tie a loop at the upper end of the string so that your finger can be inserted through it. Now, lift the balloons by using the string tied to the middle of the stick. You may see that the stick is slanting, and is not parallel to the ground.

Now, move the string tied to the stick sideways to balance the ends of the stick so that it becomes parallel to the ground. Ask your friends to confirm that the ends are balanced. If the weights at both ends are equal, the stick will become parallel to the ground like weighing scales do when they are balanced. You obviously know that the inflated balloons contain air, and the weights of the balloons are equal and balanced. Now, puncture one of the suspended balloons with a pin. You will see the air leaking out and the balloon becoming deflated. What else will you see? You will see that the stick is dipping toward the direction of the other balloon which is still filled with air. Why is it dipping? Because that balloon still contains air, but the punctured one does not. The weight of the air inside the balloon causes the stick to dip. This proves that air has weight. You can all perform this experiment very easily by yourselves.
Air occupies space

The things which we can see around us in the environment - such as trees, buildings, human beings, animals, birds - all occupy some space. When your bookshelf or your schoolbag becomes full of books, you cannot keep any more books in them. In such cases, we say that the bookshelf or bag has become full, and there is no more space left in them. Again, when the water bottle you take to school is filled with water, there is no room in it for more water. Much of the space in this huge world is also occupied by plants, animals and inanimate objects. Seas, rivers, canals and ponds are full of water. Other than those, are the huge empty spaces we see on earth really empty? No, they are not empty. These spaces are all occupied by air. Air occupies any blank spaces it finds. Even when there is no water in your bottle, it remains full of air.

You can prove that air occupies space through various experiments. When air is blown into a deflated balloon, it inflates; when air is pumped into a football bladder, it swells. Why does this so happen? Because the air occupies space,
causing the balloon and the bladder to swell. The fact that air occupies space can be proved by two experiments.

Experiment 1

Insert the end of a hollow tube into the mouth of a deflated balloon and tie it with a string. Keep the deflated balloon in a paper box on a table and cover it with dry leaves. Now blow through the tube. You will see the layer of leaves gradually swelling upward. What is actually happening? The air is inflating the balloon, and the air is replacing the space occupied by the dry leaves. If the air is released, the balloon will deflate and the leaves will go back to their original positions. The experiment proves that air occupies space. You can also perform this experiment using pieces of paper, cotton or other light substances instead of dry leaves.

Figure 10.2: Experiment to demonstrate that air occupies space
Experiment 2

Take an uncapped transparent plastic bottle and drill a hole in its bottom. Take a bucket of water. Press your finger tightly on the hole so that air cannot come out. Now, holding the open mouth of the bottle vertically downward, try to dip it in the water. You will not be able to do so easily. You will feel a pressure. Now, lift the bottle from the water. You will find that there is no water inside the bottle, and no water is falling from it. This is because no water had entered the bottle. Now remove your finger from the hole in the bottom of the bottle and try to immerse the bottle into the water as before. This time you will find that the bottle easily goes underwater. You will notice air coming out of the hole in the bottom of the bottle. Why could not water enter the bottle when it was first immersed in the water with your finger pressed on the hole? Because the air inside the bottle occupied space. But during the second time, air was allowed to come out through the hole in the bottom of the bottle, and water could enter. This experiment also shows that air occupies space.

With the hole closed

With the hole open

Figure 10.3: Air occupies space
**Experiment: Air opposes forces applied to it**

Take a deflated balloon and fill it with air by blowing into it. Now tie the mouth of the balloon with a string so that the air cannot escape. Now carefully press the balloon with your hand. It will seem to you that someone from inside the balloon is pushing away your hand and trying to resist it. You can easily feel this resistance. Who is providing the resistance? It is the air inside the balloon. So, air opposes external forces which are applied to it.

From the above experiments we can conclude that air has weight, it occupies space and opposes external forces applied to it. So, air is a substance.

Fill in the table given below by putting tick marks at the appropriate places in it to show which of these are substances and which are not:

**Table 1:**

<table>
<thead>
<tr>
<th>Name</th>
<th>Has Weight</th>
<th>Does not have weight</th>
<th>Does not occupy space</th>
<th>Matter</th>
<th>Non-matter</th>
</tr>
</thead>
<tbody>
<tr>
<td>A brick</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A fish</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading table</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sound</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Air pressure**

**What is air pressure?**

We are actually immersed in a sea of air. Air surrounds us from all sides. It is a type of matter. Like other substances, air has weight. Because of this weight of air a force is exerted on the surface of the earth. The force exerted per unit area is called air pressure. If one Newton of force is exerted on an area of one square meter, it is denoted as one Pascal of air pressure. However, air pressure is usually called "atmosphere" under normal conditions.

**Variations in air pressure**

The air pressure is not the same all the time everywhere. It varies because of a number of reasons. For example: 1) The air pressure decreases and increases on the earth due to different altitudes. The air pressure is maximum at the surface of the earth. The higher we rise above the earth's surface, the lower the air pressure gets. The air pressure also varies because of the amount of water vapour in the air and the temperature of the air. 2) If the amount of water vapour in the air increases, the amount of air decreases, and it becomes thinner. This causes the pressure to decrease. Because of this, before raining air pressure decreases due to the increase in the amount of water vapour in the air. 3) The air pressure can also vary as a result of variation of the heat of the sun. Air expands and becomes thinner as a result of heating. Thinner air exerts less pressure.
barometer. The substance moving inside the barometer shown in the diagram is mercury. The level of mercury inside the barometer rises and falls with the increases and decreases of air pressure.

Figure 10.4: Barometer

Barometers are used to measure the pressure of air. It can also be used to determine how higher or lower than the sea level a place is. As you can see in the diagram, a barometer is made of a glass tube which are calibrated in centimeters along the
length of its body. The tube contains mercury. The level of mercury inside the barometer rises and falls with the increases and decreases of air pressure. Under normal conditions, the height of the mercury inside a barometer at sea level is 76 cm. The higher we go above sea level, the lower the mercury level inside the barometer becomes. Air pressure decreases when water vapour in the air increases, and air expands because of the heat of the sun and becomes thinner. This causes the level of mercury inside the barometer to go below 76 cm. This usually indicates the possibility of rainfalls and storms. If the mercury levels becomes too low, it indicates the possibility of severe storms or cyclones. This way the state of the weather can be forecast from the rise and fall of the mercury in a barometer.

Sailors on sea-going vessels use barometers. They can prepare for storms in time by observing the mercury level of the barometer.

Effect of sun's heat on air pressure and air flow

The heat received from the sun is not equal all over the world. The rays of the sun fall vertically on some places and at an angle at the other places. In the places where the rays of the sun fall vertically, the temperature increases and causes the air to become light and rise upward. So the air pressure in those locations decreases. Again, in the places where the sunlight falls at an angle, the temperature of the air is lower, the air is heavier and the air pressure is high. As a result, the heavy air of the high-pressure zones flow toward the low-pressure zones.

Since most of the time sunlight falls vertically on the equatorial
regions, the air of the equatorial zones becomes heated and rises upward, causing the air pressure to decrease. The further we go toward the northern or southern polar regions, the less the angle at which the sunlight falls on the ground. This causes the rays of the sun to pass through wider parts of the atmosphere and land over a wider area on the earth’s surface. Therefore, the temperature of the air is much less, and it is cold and heavy. This causes the air pressure in these areas to be greater. As a result, the heavy air of the high-pressure polar regions flow toward the low-pressure equatorial regions.

Again, in some places, the land becomes heated faster than the water by sunshine during daytime, causing the air above the land to become lighter and rise upward. As a result, wind blows from the water to the land. However, during the night, the land cools down by radiating heat faster than the water. As a result of this, cold and heavy air flows from the land to the water during night.

**What are winds and how they are useful to us**

Air cannot be seen or touched, but its movement can be felt. Naturally, air travels from high-pressure zones to low-pressure zones. This flow of air is called a wind. If there is a major difference between air pressures, air sometimes blows very fast toward the low-pressure zones. These unusually fast flows of air are called storms. If the speeds of storms are very high, they may even blow our houses away and uproot plants.

The abnormal flow of air is harmful for us. But normal flows of air can be made to serve many purposes. Winds help to maintain
the balance of temperature on the surface of the earth. Winds are used for sailing. In many countries, factories are run by wind power. Windmills are used to generate power and provide irrigation. Winds are useful for drying clothes. We use palm-leaf fans or electric fans during very hot weather. This gives us relief. This is nothing but a way to create waves in the air and remove the hot air. We feel cooler when colder air occupies the area.

Figure 10.5 Uses of wind
Exercise

A. Multiple-choice questions

Tick (✓) the correct answer:

1. Air has weight, it occupies space and opposes external forces exerted on it. So, air is:
   a) Matter   b) Energy
   c) Technology  d) Force

2. Why does air move from one place to another?
   a) It is the nature of air
   b) Because the surrounding air puts pressure on it
   c) Due to variations of temperature
   d) Because wind is matter

3. Why are equatorial regions hotter than polar regions?
   a) Because the sun shines down perpendicularly on equatorial regions
   b) Because the polar regions are very close to the sun
   c) Because the sun never rises in the polar regions
   d) Because the amount of water in equatorial regions is low

4. Where is air pressure the greatest?
   a) On the sea   b) On the surface of the earth
   c) High in the sky  d) On the peak of a mountain
5. **What is the name of the device used to determine the pressure of air?**
   
a) Thermometer   
b) Lactometer   
c) Speedometer   
d) Barometer

**B. Answer the following short questions:**

1. What is the atmosphere?
2. Why is air a type of matter?
3. What is the pressure of air on an area of one square meter on the surface of the earth?
4. What are barometers used for?
5. What is the natural height of the mercury in barometers?

**C. Answer the following questions in detail:**

1. How will you prove that air occupies space? Describe an experiment to do so.
2. State the causes of flow of wind.
3. What are the uses of winds?
4. How can weather forecasts be made from the rise and fall of the mercury level of a barometer?
5. Prove by means of an experiment that air has weight.
6. Why does air flow from the land to the sea at night?
7. What are the causes behind the variations of air pressure on the surface of the earth?
8. How can sunlight alter air pressure?
Chapter Eleven

Weather and Climate

Weather

We all have experiences related to weather. Sometimes, we say that the weather is not good, it is very hot, and we sweat. On very hot days, we say that the air is very humid. If we see clouds in the sky, we say that it may rain. We can also guess about the increase or decrease of coldness during winter days. These can be judged based on the conditions of air, temperature, pressure, humidity and wind flow. Do you now see what weather is? Weather is the everyday state of temperature, pressure, humidity and wind flow of a certain place.

Climate

Weather and climate are two different but related words. Weather is determined based on the conditions of a single day, but the same is not true in case of climate. The average weather condition of a place over a number of years is called the climate of that place.

Components of weather and climate

The weather and the climate of a place are both determined based on more or less the same factors. These factors include the temperature of the air, pressure of the air, humidity of the
air, rainfall, flow of wind among others. This means that weather and climate change according to the changes in these factors. Other factors such as the longitude, sea waves, distance from the sea, the height of the land, position of forests etc. also control the climate.

Change of weather can occur in a day's time. The factors which control weather can change from day to day, causing changes in weather. The weather can again be like it was two days before. But the same cannot be said for climate. Since climate is the mean state of the weather of several years, it takes many years for climatic changes to take place.

**Difference between weather and climate**

Although the elements of weather and climate are the same, there are differences between them:

<table>
<thead>
<tr>
<th>Weather</th>
<th>Climate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The temporary state of the atmosphere of a place is called its weather.</td>
<td>1. The mean state of the weather of a place for many years is called its climate.</td>
</tr>
<tr>
<td>2. The weather is the temporary state of the atmosphere of a small area.</td>
<td>2. The climate is the long-term state of the atmosphere of a large area, such as a country or a continent.</td>
</tr>
<tr>
<td>3. Weather can change over short periods of time.</td>
<td>3. It can take years for the climate of a place to change.</td>
</tr>
</tbody>
</table>
Effect of the heat of the sun on weather and climate

The intensity of the temperature of a place depends on how much sunlight that place gets and at what angle the rays of the sun fall on it. The circular line which is imagined on the surface of the earth at equal distances from the North Pole and the South Pole is called the equator. Almost throughout the year the rays of the sun fall vertically on this line. Therefore, the sunlight pass through a comparatively narrow layer of atmosphere before falling on the surface of the earth, and it is spread over a less wide area. So, these places receive more heat from the sun. As a result, the temperature of the air at equatorial regions is higher than that of other regions. The lengths of the days and nights in these places are also almost equal. The weather of these places is the most warm and humid. Here summer continues throughout the year. Since it is hot in these places, the air pressure is also low. Convection rain occurs in these areas. Since the climate of these places is very hot and humid, it is not very healthy. The further away we go toward the north or south from the equator, the less the angle at which sunlight falls on the surface of the earth. So, the sunlight passes through wider layers of atmosphere, and is spread over a wider area.

Figure 11.1: Sunrays falling on the surface of the earth at an angle and perpendicularly
The lengths of the days and nights also vary. The days become smaller and the nights become longer. As a result, the climate changes from tropical to cold. In this way, the further we go toward the polar regions, the more the temperature decreases and the cooler the weather gets. The temperature is lowest at the polar regions, and it is so low that these places are covered with ice for almost nine months a year. Summer lasts here for only about three months.

Again, if the skies above a place are covered with clouds, the difference between the daytime and nighttime temperatures decreases. Because, during the daytime, the water vapour of the clouds absorb the heat from the sunlight. As a result, the days cannot be very hot. Again, since the warmth is slowly radiated at night, the temperature cannot grow too cold.

Copy the table given below into your notebook and record the times of sunrise and sunset during the summer and the winter:

<table>
<thead>
<tr>
<th>Date</th>
<th>Summer</th>
<th>Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time of sunrise</td>
<td>Length of day (hours)</td>
</tr>
<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>
<tr>
<td>4.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
State of the weather

The force exerted on a unit area (square meters or square centimeters) of the surface of the earth by the atmosphere is called the atmospheric pressure. The air pressure of a place can be measured using a barometer.

The air pressure of all places on the surface of the earth is not the same. It can vary because of different reasons. This also causes the weather to change. Where the sun gives more heat, the air becomes warmer and it expands in volume. This causes the density of the air to decrease and the air rises up. This results in a decrease in the air pressure of that place. When the air pressure of a place drops suddenly, air from its surrounding places start to flow faster toward it. If there is too much decrease in air pressure of a place, the speed of the air flowing...
toward the place also increases accordingly. If air flows very fast in these cases, storms occur. The air pressure also decreases when the amount of water vapour in the air increases. In such cases, the chances of rainfall increase due to the increase of water vapour in the atmosphere. If the air pressure of a place decreases slowly, it is understood that the amount of water vapour in the air is gradually increasing. From this, it can be assumed that the rain can continue for a number of days, i.e. there is the possibility of long-term rainfall. Again, if it is seen from the barometer that the air pressure is increasing, it can be understood that the water vapour in the air is slowly decreasing. From this, it can be said that the weather is getting dry and the chances of rainfall are also low. So it can be seen that you will be able to say what the weather will be like if you can determine the air pressure of a place using a barometer.

Figure 11.3: Relation between the heat of the sun, pressure and wind flow
Rainfall

Winds laden with water vapour cool down high in the sky and condense to form clouds. Clouds contain innumerable droplets of water and snowflakes. The tiny droplets of water and snowflakes join together to form larger drops of water, which drop to the earth's surface due to the gravitational pull of the earth. This is called rainfall.

Water vapour condenses faster in places where there are forests, because the temperature of the air is low in those places. Thus, more rainfall occurs there. In high and mountainous areas, water vapour is obstructed which causes it to rain.

In order to find out if rainfall will occur somewhere, we need to determine the amount of water vapour in the air and the temperature of the air. The climate and weather of a place is also affected by how much rainfall occurs in a certain place. The equipment used to measure the amount of rainfall in a certain place is called a rain gauge.

Rain gauge

A rain gauge can be used to easily measure the amount of rain. It is a cylindrical container which is approximately 51 cm long and has a radius of 21 cm. A funnel with a radius of 21 cm is fitted to the mouth of the container. Rainwater passes through the funnel and is deposited in a bottle kept inside the cylindrical container. After a certain period of time, say, 24 hours later, the rainwater deposited in the bottle is collected in a calibrated container made of glass, from which the amount of rainfall is determined. If the area of the mouth of the funnel is equal to the
area of the mouth of the calibrated cylinder, we can say that if the height of the water inside the calibrated cylinder is 12 cm, the amount of rainfall in that area is 12 cm.

By the fact that 3 cm rainfall has occurred in a place in 24 hours, we understand that if the rainwater deposited there had not drained away somewhere else, the depth of the water deposited there would have been 3 cm. But in reality, rainwater does not remain deposited in one place. That is why, a rain gauge is required to measure the amount of rainfall.

The rain gauge is usually placed in an empty place on plain ground, so that the rainwater can fall in it freely. In order to prevent any other type of water other than rainwater from entering the funnel, the mouth of the funnel has to be placed exactly 30 cm above the ground.

Figure 11.4: Rain gauge
Procedure of measuring rain

In order to measure rainfall, the funnel is carefully removed from the rain gauge and the bottle inside it is taken out. The rainwater is now poured into the calibrated container very slowly so that not even a single drop of water is wasted. The measuring container must be cleaned beforehand. After pouring the water into the container, the container must be placed upright and the measuring must be done by matching the water level with the calibration marks on the wall of the container. In order to avoid errors, the measuring should be done accurately a number of times.

Exercise

A. Multiple-choice questions

Tick (✓) the correct answer:

1. What is understood by the weather of a place?

   a) The everyday state of the air, temperature, pressure, humidity and wind flow

   b) The yearly state of the temperature of the air, pressure, humidity and wind flow

   c) The weekly state of the mean temperature, air pressure, rainfall and wind flow

   d) The daily average of rainfall and wind flow
2. What is understood by the climate of a place?
   a) The average state of weather of a few days
   b) The average state of weather of a few weeks
   c) The average state of weather of a few months
   d) The average state of weather of a few years

3. What is the name of the circular line which runs along the middle point between the North and South Poles of the earth?
   a) Equator    b) Axis
   c) Polar line   d) Temperate line

4. What changes occur in the air pressure if the amount of water vapour in the air increases?
   a) It decreases   b) It increases
   c) It remains the same   d) It becomes zero

B. Fill in the blanks:

1. The rays of the sun fall along the equator _______________ throughout the year.

2. The polar regions are covered with _______________ for almost nine months a year.

3. The weather of the equatorial regions is the most _______________ and _______________.
4. In order to find out if it is going to rain in a certain place, we must know the amount of _______________ in that place as well as the _______________ of the wind.

C. Answer the following short questions:

1. What is climate? Name the elements of the climate.
2. What is air pressure? State the causes behind the increase and decrease in air pressure.
3. Write down three differences between weather and climate.
4. Describe the effect of the heat of the sun on the weather and the climate of a place.
5. What do we understood by the fact that 4 mm of rainfall has occurred in a certain place?
6. Describe a rain gauge with diagram.
Chapter Twelve

Earth and the Universe

The sky we see from the earth is huge and it spreads beyond our limited vision. The name of this wide and infinite expanse of sky is space. There are no limits to space. If we look at space during the daytime, we can see the sun. During night, if we look at the sky, we can see the moon and innumerable tiny specks of light.

Celestial bodies

If we look at the clear blue night sky, we can see countless twinkling points of light. Do you know what the sun of the day, moon of the night and innumerable tiny shining dots of light in the sky are collectively called? Together, these are commonly known as celestial bodies. Some celestial bodies emit their own light, such as the sun. Again, some celestial bodies do not emit their own light, such as the moon.

The celestial bodies which emit their own light are called stars. We can see only a few thousand stars with our naked eyes. Scientists have discovered more than a billion stars using powerful telescopes. The star nearest to earth is the sun.

The sun is the central star of the solar system. It is a medium-sized star among millions of stars. It has an approximate
diameter of 1,384,000 kilometers. It is a rather large and very hot sphere of fire. The sun is the primary source of heat for earth and a number of other planets and satellites. The distance between the sun and the earth is approximately 150 million kilometers. Without the light of the sun, the earth would have been shrouded in eternal darkness. No creatures - plants and animals - would have survived on earth.

If we look at the northern sky in the evening, we can see a bright star. This star can be seen twinkling in the northern sky at the same place throughout the year. This is called the Pole Star. The distance between the earth and the Pole Star is almost 821,100,000 kilometers. Travellers and sailors use the Pole Star for navigation during night. You know that the celestial bodies which have their own light are called stars. Other than stars, there is another type of celestial bodies who do not emit their own light. They are called planets. The earth on which we live is one such planet. The star which we can see in the western sky in the evening and in the southern sky before dawn is actually a planet of the sun. Its name is Venus. Although Venus is mistaken as a star, it is actually a planet.

**The solar system**

The collective name for the sun and the celestial bodies surrounding it is the solar system,. The sun is located at the centre of the solar system. It is a star. This star is a burning steamy sphere. The planet earth on which we live is a planet of the sun. Other than the earth, the sun has eight more planets. The planets revolve around the earth along their own orbits. The
earth revolves around the sun once in 365 days and 6 hours. Some planets have their satellites. For example, the planet earth has the moon as its satellite. Like the earth, some other planets have satellites too. The earth, other planets and satellites have originated the sun. Just as the planets revolve around the sun, the satellites revolve around the planets.

There are 8 planets and 41 satellites in the solar system, as well as innumerable asteroids and hundreds of comets. In the above diagram you can see that the planets arranged in order of their proximity to the sun are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. The planet nearest to the sun is Mercury, while the one farthest from it is Neptune.
According to distance, the earth is in the third position. The solar system is only a very small part of the vast universe.

**Satellites**

You have already learnt that in the solar system, planets revolve around the sun. You have also learnt that some celestial bodies also revolve around the planets in their own orbits. They are called satellites. They are smaller than planets. They have no heat or light of their own. They are illuminated by the reflection of sunlight.

You can see the moon in the night sky. The moon is the only satellite of the earth, and it orbits around the earth. During the night, sunlight is reflected on the surface of the moon and it illuminates the earth. The moon is 384,000 kilometers away from the earth. It is the celestial body which is closest to the earth. The moon orbits the earth once every 27 days and 8 hours. The earth has one satellite, Mars has 2, Jupiter has 16, Saturn has 17, Uranus has 4 and Neptune has 1 satellite. Mercury and Venus have no satellites.

**Other types of celestial bodies in space**

There are seven types of celestial bodies in space. You have already learnt about stars, planets and satellites. There are four more types of celestial bodies, namely nebulae, comets, galaxies and meteors. Some of them are millions of times greater than the sun, while there are stars which are smaller than the sun. Some stars are millions of kilometers away from the earth, because of which they appear like tiny points of light, and their
light looks faint. Because of this, we get much less heat and light from them compared to the sun. In terms of volume, the sun is 1,300,000 times greater than the earth. The moon is rather small in volume. Its volume is 1/50th of that of the earth.

Our planet earth

The earth is one of the most important planets of the solar system. It is the only planet on which life has been found so far. Can you tell what is the shape of the earth like? You have obviously seen a globe. The shape of the globe was actually determined according to the actual shape of the earth. Even though it appears to be flat, the earth is mostly spherical. It has two poles. The northernmost point of the earth is called the North Pole and its southernmost point is called the South Pole. The polar regions of the earth are somewhat flattened, i.e. the earth is not completely spherical. According to the scientist Newton, the rotation of the earth has caused its shape to become like this. We can imagine a straight line passing through the North and South Poles of the almost-spherical earth. This imaginary line is called the axis of the earth.
You already know that the earth is not static in one location. It is continuously rotating on its own axis. Simultaneously, it is also orbiting the sun while following a definite path, known as its orbit. All the planets revolve around the sun following their individual orbits.

How do days and nights occur?

When the sun sets, darkness falls and it becomes night. You sleep during the night, and when you wake up, you find that it is daytime once again, and there is light everywhere. Have you ever thought how days and nights occur alternately? Everyday the sun rises in the east and sets in the west. Therefore, in ancient times people used to think that the earth is static and the sun is orbiting the earth. But with the advancement of science it was later known that the earth is actually orbiting the sun. It does not only orbit the sun, but also rotates on its own axis. The earth is rotating on its axis from the west toward the east. One complete rotation of the earth like this on its axis takes almost 24 hours. These 24 hours are collectively known as a day. This type of motion of the earth is called the diurnal rotation of the earth. During this rotation, the side of the earth which faces the sun experiences daytime, while the other side experiences nighttime. Days and nights thus occur because of the diurnal rotation of the earth.

Experiment to prove the diurnal rotation

A globe is needed for this experiment, along with a source of light. A candle, a lamp, a hurricane lamp or a flashlight can be used as a source of light. Notice that there is a stick passing
through the middle of the globe. This is the imaginary axis of the earth. The earth is rotating from west to east on this axis.

Light the lamp and place it on a table or a flat floor. Next place the lamp in front of the globe. It will be better if the room is dark. Now, consider the source of light as the sun and the globe as the earth. Observe carefully and you will find that the side of the globe on which the source of light is situated has been illuminated. The other side is dark because it is not getting any light. The illuminated side can be considered as day and the dark side can be considered as night. Now, if you rotate the globe slowly, you will see that the illuminated side is moving toward darkness and the dark side is becoming illuminated. In this way, half of the earth experiences day while the other half experiences night. Now, when the side of the globe on which Bangladesh is shown is facing the light, the opposite side of the globe on which America is located is in darkness. This means that when it is daytime in Bangladesh, it is nighttime in America, and the exact opposite situation will occur 12 hours later. So, due to the diurnal rotation of the earth, when on one side of the earth it is daytime, on the opposite side it is nighttime.

Figure 12.3: Experiment demonstrating the diurnal rotation of the earth
**Change of season**

You have obviously noticed that the weather of our country does not stay the same throughout the year. It is hot at times, and colder during the others. At times, we also experience heavy rainfall. The twelve months of the year in our country have been divided into 6 divisions based on the temperature and amounts of rainfall. Each of these divisions is called a season. That is why Bangladesh is called the Land of Six Seasons. The six seasons are: summer, rainy season, autumn, late autumn, winter and spring. These six seasons come one after another in a certain sequence. Why does this so happen? Because the earth is rotating on its axis and also is revolving around the sun once every year along its orbit. This journey of the earth along its orbit is called its annual motion. It takes 356 days and 6 hours (or more precisely—365 days, 5 hours, 48 minutes and 47 seconds) for the earth to revolve around the sun once in its orbit. This time period is called one year or one solar year. Usually, we consider 365 days as one year, which causes a time lag of 6 hours every year. In order to compensate for this, one extra day is added to the month of February every 4 years which makes it 29 days long instead of 28 for that particular year. These years are called leap years. Leap years are 366 days long. Due to the annual motion of the earth, days and nights vary in length and seasons change.

The earth always receives heat and light form the sun. However, not all parts of the earth receive equal amounts of heat and light from the sun throughout the year. This is because the earth revolves around the sun in an elliptical path in a slanted
position. Since it moves along its orbit like this, sometimes the North Pole moves closer to the sun while the South Pole moves away from it - and sometimes the reverse occurs. At certain times, both poles are equal distances away from the sun. When a part of the earth is close to the sun, it gains more heat and light for longer periods of time. As a result, the days become longer and the nights become shorter in those regions. Summer occurs in those parts because they receive more heat. Since the opposite side gains less heat, it experiences winter and the nights become longer there. Due to the annual motion of the earth, the day is the longest and the night is the shortest on June 21 in the northern hemisphere of the earth. On December 22, the southern hemisphere is more slanted toward the sun, so in the southern hemisphere of the earth, the day is the longest and the night is the shortest on that date. On that day, the northern hemisphere experiences the shortest day and the longest night. One March 21 and September 23, the days and nights are equal in length.
Galaxies

Look at the celestial bodies in the sky on a dark cloudless night. What do you see? Bright twinkling stars or constellations are scattered over the sky, right? Observe very carefully, and you will notice a wide area like a white cloud. It will appear as if a long path of light and shadow is sweeping from the northern part of space to the southern part. This is called a galaxy. A galaxy is actually composed of trillions of stars and their planets and satellites. There are innumerable galaxies in space. Each galaxy contains millions of stars.

Nebulae

A nebula is one of the wonders of galaxies. It is filled with gaseous substances. It surrounds the less illuminated constellations of space. It appears as a thin cloud. A nebula can contain millions of stars. There are nebulae of many different sizes in galaxies. They can be of many different shapes. Some nebulae are even larger than the sun.

Meteors

If we look at the cloudless night sky full of stars, we can sometimes see a star rushing across the sky or see a star appearing to drop from the sky. These stars disappear as they fall, and this phenomenon is commonly known as "shooting stars". Actually, these are not stars - they are meteors. They hurtle toward the surface of the earth at very high speeds due to the gravitational pull of the earth, and are ignited as they undergo friction with the air when they enter the atmosphere. They are sometimes reduced to ashes, or they land on earth as
half-burnt masses of matter. These masses are called meteorites. Meteorites that hit the earth can leave huge holes on the ground. In Arizona, USA, a hole with a width of 1.5 kilometers have been left by a meteorite that hit the ground.

**Comets**

Sometimes, a type of celestial body appears in space. These bodies appear for some time and then they disappear. Comets are truly amazing things of the sky. They travel around stars.

They appear as faint clouds when they come close to the sun. They gradually become brighter, and have a broom-like appearance. The British scientist Edmund Halley discovered a comet in the sky in the year 1682. It was named Halley's Comet after him. It can be seen every 76 years. According to his calculations, Halley's Comet has already been seen in 1834, 1910 and 1986, and it will be seen again in the year 2062.

Figure 12.5: Halley's Comet
Universe

You have already learnt that the space around the planet earth is so vast that it is impossible to conceive what its limits must be like. Our planet earth is just one of the planets of the solar system. There is a star at the center of the solar system, which is the sun. We know that there are more than one billion stars like this. There are millions of known and unknown celestial bodies like the solar system surrounding these stars. In space there are also innumerable galaxies, nebulae, comets and other celestial bodies. Again, every galaxy and nebula contains trillions of stars.

It is assumed that there are many celestial bodies millions of light-years away, the light from which has not yet reached us in the millions of years after the creation of the earth. So, we can hardly imagine how large is the number of celestial bodies in space. The world composed of all these celestial bodies is called the universe. Compared to the whole universe, our solar system is barely a dot.

Exercise

A. Multiple-choice questions

Tick (√) the correct answer:

1. What are stars, the sun and the moon are called collectively?
   a) Planets   b) Stars
   c) Celestial bodies   d) Nebulae
2. Which of the following is a satellite?
   a) Sun  b) Moon
c) Mars  d) Venus

3. Which one of these celestial bodies in our solar system emit light of its own?
   a) Earth  b) Moon
c) Sun  d) Venus

4. Which of these is used by sailors for navigation at night?
   a) Pole Star  b) Venus
c) Satellite  d) Meteor

5. From which direction to which direction is the earth rotating on its axis?
   a) East to west  b) West to east
c) North to south  d) South to north

B. Fill in the blanks:
1. The earth is a _______________ of the sun.
2. The earth and other planets orbit the _______________.
3. Venus is actually a _________________.
4. The planet on which life has been found is _________________.
5. A comet looks like a _________________.
6. Days and nights occur on earth due to the _________________ rotation of the earth.
C. Answer the following short questions:

1. What is a celestial body? Write down the names of some celestial bodies.

2. When and where can Venus be seen?

3. How long does it take for the earth to rotate once on its axis and revolve once around the sun? What are these two types of motion called?

4. What is the diurnal rotation of the earth? Describe it.

5. Write down the names of the seasons in Bangladesh.

6. What is a comet? Describe Halley’s Comet.

7. Why do days and nights occur?
Chapter Thirteen

Science and Technology

The current age is the age of science and technology. Man has had many remarkable achievements making use of science and technology. With the help of science and technology man utilizes various resources of nature for their own benefits, and conquer nature in the process.

At the dawn of creation humans were not like this - they were weak and powerless. They had to survive depending only on the kindness of nature. They lived on fruits which grew in the forests or on the flesh of animals. Tree bark and leaves served as their clothes. They lived under trees or on tree branches. Like other animals they suffered from cold, heat, rain and storms. However, in later times, humans used their intelligence to build houses for living to get protection from rain and storms. They wore adequate clothing and introduced methods of air-conditioning into their dwellings in order to protect themselves from the heat and cold of nature.

Humans once ate all their food raw. Then they discovered fire using their intelligence and talent. They began building houses and farming. They started using various types of tools for farming, such as spades, shears, ploughs etc. Thus, humans gradually entered the era of science and technology although they were not aware of it. They learnt to harness the forces of
nature for their own purposes. This way man started to live on earth by conquering nature using their own intelligence.

**Science and technology**

Many things take place in nature. Days and nights occur alternately. The sun rises every morning following a certain pattern. We experience rain and storms, as well as earthquakes and other natural disasters. Summer arrives, followed by winter. We suffer from many diseases and are healed by medicine. The earth revolves around the sun. The moon revolves around the earth. Why and how do all these things of nature occur? Why do we suffer from diseases? Humans have searched for the answers to these questions for ages. They performed many experiments in order to discover the causes behind these events. From this, they acquired different types of knowledge. Science is the process of acquisition of knowledge through research. It helps human beings to acquire new concepts.

With the help of science, man has developed various fields related to his life and means of livelihood. Due to advancements made in the medical sector, many deadly diseases can now be cured. Development of factories now makes it possible to produce large quantities of goods in much less time. Due to innovations in the communication and transportation systems, it is now possible to travel very fast from one country to another. Advancements made in the agricultural sector have helped us to reduce the deficiency of food quite significantly.

Technology is the application of scientific knowledge or the use of scientific discoveries and inventions in order to develop different fields of our lives and livelihoods.
Science and technology are very closely related. They go hand in hand. Technology must be used in order to utilize valuable innovations of the scientists for the benefit of mankind. Therefore, technology is developed for utilizing the scientific discoveries and inventions. For example, in ancient times, humans did not know the uses of fire. Science taught them the use of fire. The knives, scythes, shears, sickles, ploughs etc. were also manufactured using scientific knowledge. These are examples of technology. We will state some examples in order to explain the relationships between science and technology. Do
you know the name of the scientist Sir Isaac Newton? He discovered the laws of gravitation. In his laws, Newton said that all objects attract each other. He stated that different planets revolve around the sun. Rockets and artificial satellites were developed based on Newton's laws of gravitation. Here, the discovery of Newton's laws of gravitation was a scientific act. The development of rockets and artificial satellites are examples of technology.

Let us consider electricity. He scientist who discovered electricity did not have any idea about the numerous ways in which it could be utilized. Technologists have built many types of machines to use electricity for many different purposes. Many types of technology have been developed based on the discovery of electricity. Electricity is used to power fan, lights, factories and many types of electrical devices, such as radios, televisions, computers, VCPs, VCRs etc.

Figure 13.2: Various types of technology
Different applications of science and technology

Technology in the field of education

In the field of education, the uses of computers, radios, televisions, tape recorders and other devices are examples of modern technology. Besides, overhead projectors and multimedia projectors are now used all over the world in order to give lessons in classrooms. We can use the Internet to access libraries all around the world.

Technology in the field of transportation

In ancient times, ox-carts and horse-drawn carriages were used to travel by road. No other forms of transportation existed in those days. Nowadays, there are many types of vehicles with modern technology which can be used to travel by road. Motorcars, trains, steamers and aeroplanes are examples of vehicles which utilize modern technology.

Figure 13.3 A: Various types of transports
Information and communication technology

In the past, people used to transfer information and news from one place to another on foot or on horseback. These ways of exchange of information was very time-consuming. Due to advancements in the field of transportation and the inventions of the telegraph, the telephone and the teleprinter, the process of exchange of information has become much quicker. The advent of modern information and communication technology has now made it possible to communicate from one country to another using computers, faxes, email and the Internet.

Technology in the field of agriculture

The ancient piece of technology known as the plough is still used in many countries. In our country, animal-driven ploughs are used in conjunction with mechanical ploughs or tractors and power tillers, which are examples of modern technology. Low-
lift pumps are used to lift water from deep wells, reservoirs, rivers and streams for irrigation purposes. Drum-seeders are used for seeding. There are also machines used for harvesting and threshing crops. These types of agricultural technology have made the jobs of farmers much easier. The invention of high yielding variety (HYV) of paddy and other food grain seeds are results of science and technology. Plants of HYV food grain have increased our grain yield by many times.

Figure 13.4: Agricultural technology
Pictures of certain types of agricultural technology are shown here. Now mention the names of a few types of agricultural technology which you know about.

**Technology in the field of medicine**

In the field of medicine, science and technology have allowed us to develop new types of medicines and equipment. Previously, only X-rays were used in order to observe the state of the internal organs of the body. Now, sound waves are used in ultrasonography to take pictures of the internal organs of the body. ECGs are used to detect heart diseases. Laser beams are used to perform many complex operations without causing any loss of blood. Modern medical technology allows us to implant or transplant different malfunctioning organs. For example, it is now possible to implant artificial kidneys, or pacemakers in case of heart problems. Injections and vaccinations are used to provide protection from tuberculosis, diphtheria, whooping cough, measles and pox.

As a result, of the discovery of antibiotics, many diseases which were considered fatal in the past, such as tuberculosis, cholera and typhoid, are no longer incurable. Insulin prepared using modern technology has made the lives of diabetes patients easier. These are all products of modern medical technology. A number of examples of medical technology have been illustrated in the following diagram. Now mention a few examples of medical technology which you know about.
In our everyday lives, two widely-used examples of science and technology are automatic doors and remote controls. Now we will discuss about automatic doors and remote controls.

**Automatic doors**

Have you ever stood in front of a closed door and seen it open
by itself? Those of you who have been abroad may have seen doors like this. Doors like this are also found in some places of our country. You will usually see this type of doors in large offices, shops and airports. Large hotels also have this type of doors. Usually, we have to open latches or locks, or push or pull the doors in order to open them. But automatic doors open by themselves, because of which they are known as automatic doors.

Why do automatic doors open by themselves? How do they function? Actually, automatic doors do not open by themselves. When you go in front of such a door, or an object or machine is placed in front of it, a system detects your or the object's presence and turns on the switch which is used to open the door, causing it to open. This machine is called a sensor. There are many types of sensors. Among them, pressure sensors, light sensors and motion sensors are used the most widely. Heron of Alexandria invented the first automatic door. Imagine that a pressure sensor is being used in an automatic door. When you come in front of the door, the pressure sensor is triggered by the pressure of your feet on the floor, causing the door to open automatically. That is to say, pressure sensors are triggered by pressure.

Light sensors are triggered when light is obstructed. When you come in front of the door, your body obstructs light, and the absence of light triggers the light sensor, causing the door to open.
Motion sensors are triggered by your movements or motion. So, when you come in front of the door, it opens. This is how automatic doors work.

**Remote control**

Previously, we have discussed about televisions. In case of some TV sets the power button has to be pressed in order to operate it. Buttons also need to be pressed in order to increase or decrease the volume. However, a small device can now be used to do these things from a distance. Many of you know the name of this device, and many of you have probably used it. It is called a 'remote control'. The meaning of the term 'remote control' is to control something from a distance. It is also called a 'remote' in its shortened form. Apart from turning a TV on or off, changing its channels, or increasing or decreasing its volume, remotes are also used for many other purposes. For example, there are many remote-operated toys, stereo systems, DVD players, calling bells, fans, air-conditioners, doors etc. Many of you probably own remote-controlled toy cars.
The first remote control was invented in the year 1898. It was invented by scientist Nicola Tesla. It is a small device which can be used to perform a number of tasks by pushing a number of buttons on its surface. Some buttons turn switches on or off, some change the channels, some increase or decrease the volume. TV remotes do this by means of beams of a type of invisible light called 'infrared ray'. Some remotes work by using radio signals. The term 'infrared' is new to you. 'Infra' means 'low'. Since the brightness of this ray is less than that of the colour red, it is called infrared ray. It cannot be seen with the naked eye. When a button on the remote control is pressed, an infrared signal is sent from it to the TV, and the task for which the button was pressed is executed. If a button is pressed to change the channel, the channel is changed. If a button is pressed to increase the volume, the volume increases. Infrared rays cannot pass through obstacles. That is why a remote control does not work if there is an obstacle between itself and the TV. Similarly, radio waves are emitted from a remote and ring the bell when a button is pressed on the remote. Radio waves are also used to operate toy cars with remote control. So now you can understand how the remote controls work. The other uses of remote controls are:

- Closing or opening car doors
- Closing or opening the main gate of the house
- Opening and closing the garage door
- Fan switch on or off.
- Air Cooler Switch
- Up / down the temper allure
Improvement in the lifestyles of people due to technology

The advent of science has allowed people to know about what was previously unknown. It has improved our quality of life.

The use of technology in the field of medicine has increased the average lifespan of humans, and has saved them from many diseases. The infant mortality rates have decreased. People are recovering from many complex diseases and regaining healthy lives. With the help of technology, many types of diseases can now be cured, ranging from the simplest to some of the most complex ones.

Technology is being used to grow more food. This has caused the food production in our country to rise. Science and technology have not only contributed to food production, but also to the preservation and distribution of food. Better houses are being built, and people can travel quickly from one place to another.

Many new synthetic substances can be created using science and technology. They include clothes made of nylon, terelyne and polyester; plastic toys, household appliances, chemical fertilizers etc.

We have obtained new sources of energy through the use of science and technology. The use of technology in the extraction of coal, oil and gas is increasing day by day. Solar energy obtained from the sun is being used. Water electricity is being generated by using the kinetic energy of water currents to rotate turbines. Electricity is being generated using wind energy. Wind energy is used to lift water for irrigation. Besides, biogas is generated from cow dung and human faeces, which is used for
cooking and lighting lamps. In this way, biogas, solar energy and wind energy are being used to meet the energy demands of village people.

Television, radio, telephone, fax, email and the Internet have revolutionized the fields of education, information exchange and communication. We can use them to exchange information quickly and economically. These types of information technology have helped to bring the world closer to us. It is as if the world has become smaller.

The use of technology has improved the quality of every aspect of our lives. The use of technology has resulted in increased production in factories. It has increased the quality of products and decreased the cost of production. Robots are used to perform tasks which are dangerous for human beings. They are also performing many intricate tasks in place of humans.

In this manner, the use of technology has increased the comforts of human beings, and has given them the chance to spend happy and healthy lives.

Misuse of technology and problems created by them

Proper use of technology has increased the quality of our lives and our comfort and happiness. However, misuse of technology has also resulted in certain problems. The most serious one among them is environmental pollution - chemical wastes and noxious gases from factories are polluting water, soil and air. Also, fumes emitted from defective motor cars pollute the air, resulting in breathing problems and various types of diseases. Use of too much fertilizer and insecticides in crop fields pollute the air and the water, and also decrease the fertility of the soil.
The misuse of radios, televisions and computers create many problems in the human body. Listening to the radio very loudly, watching TV all day or working at the computer all day long without taking any breaks can create many complications in our body. They include decrease in hearing, aches in the neck or shoulders, tears drying up, poor eyesight etc.

A substance called CFC which is emitted from air-conditioners and refrigerators damage the ozone layer of the earth's atmosphere. This has caused the temperature of the earth to rise at such an alarming rate that is feared that a large part of the earth may become submerged under sea water.

Bombs and chemical weapons used in deadly warfare are products of technology. They can be used to kill millions of people. So, we should be aware of the proper use of technology. We should know about the negative effects of misuse of technology and refrain from misusing it. It is a matter of relief that awareness of these negative effects are rising worldwide day by day.

**Exercise**

A. **Multiple-choice questions**

Tick (√) the correct answer:

1. What is the knowledge obtained from experiments and researches called?
   a) Technology    e) Education
   f) Science       g) Skill
2. **What is the name of the process through which the knowledge discovered by scientists are used to meet the needs of human beings?**
   
a) Skill  
b) Technology  
c) Experiment  
d) Science

3. **Which of these devices are used to take pictures of the internal organs of the body with the help of sound waves?**
   
a) ECG machine  
b) Ultrasoundograph  
c) Camera  
d) Stethoscope

4. **Which of these is used to detect broken bones inside the body?**
   
a) X-ray  
b) Laser  
c) ECG machine  
d) Stethoscope

B. **Fill in the blanks:**
   
1. _____________ waves are used in ultrasoundograph machines.
   
2. The new piece of technology used for seeding crops is called a _____________.
   
3. _____________ signals are used in TV remote controls.

C. **Answer the following short questions:**
   
1. What is science?
2. What is technology?
3. Name a few types of technology used in the field of medical science.

4. State the difference between science and technology with an example.

5. Write down the names of five old types of technology.

6. Write down the names of five types of modern technology in the field of information technology.

7. What are remote controls? What purposes are they used for?

D. Answer in detail:

1. Describe the relationship between science and technology.

2. What is agricultural technology? How does technology help in the field of agriculture?

3. Mention a few examples of medical technology. Write down the names of the diseases which can be treated by them.

4. Describe the effect of technology on the lives of human beings.

5. Discuss the problems which arise out of the misuse of technology.

6. What are automatic doors? How do they open by themselves?
E. Do it yourself:

1. Form groups of 4 or 5 people among yourselves. Now, make lists of the technologies used in the fields of industry, agriculture, medicine, education and communication systems. (You may use the table given below for making the lists.)

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<th>Industrial technology</th>
<th>Agricultural technology</th>
<th>Medical technology</th>
<th>Educational and communication technology</th>
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2. Collect some pictures that show uses of technology (those of you who live in cities can find them in magazines and newspapers, and those of you who live in villages can find them in agricultural or industrial fairs, or at the upazilla agriculture and health offices). Stick the pictures you have collected on the walls or fences of your school building. Now discuss about them with the help of your teacher.
Introduction

You may have noticed that animals and birds or insects send signals to each other for communicating information. Because their intelligence level is low, the nature of their information is also very ordinary and the ways in which they communicate that information are always very simple. Human beings are much more developed, and therefore, the information for their day to day life is also much more complex and interesting. And for communicating that, men have not depended on their bodily activities only, they have invented new and newer technologies. It is said that the modern world is the world of information technology. Therefore, the progress of a nation today depends largely on how fast it can exchange information with others.

Information

Knowing about something is called information. There are many kinds of information in the world and we all need information to live. A farmer needs information about cultivation as a factory worker needs information about machineries and doctor needs information about diseases and their treatment. Again, it's not enough for a farmer, a factory worker or a doctor to know only about the traditional information relating to their work, they need to learn new information, too. Sometimes they even have to give rise to new information.
Thus you see it's not enough to know information. You need to share information with others. When one sends information to another person, one has to find a way to do that. For example, at this moment you are reading this chapter. The person who has written it has used the means of writing to give you some information about information technology. The writer has written it in English. He or she couldn't have sent you the information if you hadn't known English. Which means for communicating information, the person who sends and who receives information both have to know the technique in which information has been sent.

**Information Communication**

Every minute we are exchanging or communicating information with each other. The simplest way of information communication is done through speaking. When a teacher explains something to his or her students in class, he talks to them. And the words he says enter the ears of the students as they listen to him or her. Here information communication is taking place through the means of words. Man's voice can reach up to a limited distance. To communicate information beyond that point one has to use a microphone or a loud speaker, or for farther distance, one has to use the telephone.

By using telephone we can talk to someone next door as well as to someone living in another part of the world. If you have ever talked to someone living at a long distance from you, you may have noticed something. You may have noticed that you hear the words the other person is saying after a while, not immediately.
You may have been curious to know why it is so, but the reason is very simple. When someone talks in a country very far away, the speech cannot travel through telephone wires. It has to be changed into electro-magnetic waves and then sent to the satellite in the space from where it comes back to the earth again. These satellites stay almost 36 thousand kilometers away from the earth. Although the speed of the electro-magnetic waves is very fast, it takes a little while to cross this distance and that's why we hear the speech a little while after it is actually spoken.

Now-a-days along with satellite, fiber optics connection is being used. This connection is given through a very thin thread. The information that we want to send is first turned into light, and then that light is sent through the thin thread or optical fiber. In this process we don't need to send information to a distant satellite. Therefore, sending information through optical fiber is much faster. So, if you are talking long distance and you notice that you can hear the person you are talking to instantly, you would know that the speech is coming through optical fiber. You would be surprised to see that the optical fiber is thin like hair. The optical fiber or the glass thread is so thin that it can break easily, and so, it is covered very carefully inside a thick cable and then sent.

One-Way and Both-Way Information Flow

You all know that cyclones often hit our coastal areas. Usually you get this information through radio and television news. You could get the information in other ways, too. Someone could give you the news through telephone. There is a difference between getting the information from radio and T.V. and getting the news through telephone. Can you guess the difference?
The difference is that the information you receive through radio and television is one-way. That is, the person reading the news is giving information to all the people who are listening to him or her, but the people cannot ask any question or send any information to him or her. This kind of one-way communication is called broadcast. Radio, television, newspaper are examples of broadcast information communication.

But when two people are talking to each other over telephone, they can ask and answer questions and thus communicate information directly. This is called two-way information flow. Computer network is another example of two-way information flow.

**Telephone**

In 1876 Alexander Graham Bell invented telephone and for the first time sent a man's voice from one place to another through electric wires. He couldn't have imagined then that the telephone would one day become such an inseparable part of our daily life. We have become so accustomed to it that we cannot imagine a single day without telephone.

Those of you who have used a telephone would have noticed two types of telephone. With one kind of telephone, there is an electric wire attached to it. This is known as land phone. With the other kind, there is no wire attached to it, and we can carry it in our bags or pocket to wherever we go. This is known as mobile phone. By now you may have realized that when we talk on a land phone, our speech is sent through electric wires. In the case of the mobile phone, it is sent through wireless or through electromagnetic waves.
With every telephone there is a microphone and a speaker. The microphone changes our voice or our speech into electric signs. This electric sign, in the case of a land phone, travels through the wire to the broadcast centre from where it reaches the other telephone. And in the case of a mobile phone, this electric sign turns into electromagnetic wave and through the broadcast centre reaches the other phone. The speaker of the other telephone changes the sign into word and makes it possible for us to hear that.

**Radio**

The machine through which we can hear the sound sent through 'radio wave' is called the radio. When someone reads news sitting in the radio studio or sings a song, then the words are first changed into electric signs by using the microphone. To send these signs to a long distance, they are first turned into electromagnetic waves or radio waves and then are spread around from a high antenna. No medium is needed for the electromagnetic wave, and therefore, it can spread around over a long distance.

The antenna of the radios in our houses or the mobile phones in our pockets again changes the electromagnetic waves into electric signs. When those electric signs are sent to the speaker, they are again changed into words and we can hear them. Once it used to be said that the radio was invented by the Italian scientist Marconi. You will be happy to know that now the Bengali scientist from our country, Jagadish Chandra Basu, too, is given equal credit and honour as the inventor of the radio.

Besides the radio set that we are most familiar with for listening to news or songs, there is another kind of radio set which the police and the military use for communicating with each other.
**Television**

The television is the biggest medium of mass communication in the world today. Although initially there was only the small black and white television, today there is not only colour but also large screened television in the world. Once the television used to be heavy, and large in size, but now the modern television can be hung like picture frames on the wall. Today, you can watch hundreds of channels on television. Not only that, when something happens in any part of the world, we can immediately see it on the television.

We can hear only sound on the radio, but on television we can see pictures as well as hear the sound. In the radio, words were transformed into electric signs trough the microphone. But at the television station we need to have a camera as well as a microphone. This camera shoots a number of pictures in every second and then turns them into electric signs. The electric signs of the sound and pictures are then changed into electro-magnetic waves as in the radio, and then are spread around from a high antenna. The antennas of the televisions in our homes receive those electro-magnetic waves. The electronic circuits inside the television set then separate the pictures and the sound from those, and then show the pictures on the TV screen as well as make us hear the sounds through the microphone. Sometimes the signs in the television are not changed into electro-magnetic waves, instead, they are sent as electric signs through electric cables. In our country, we have quite a few of these television stations and we call them cable television.
Computer Network

All the methods of information communication that we have talked about so far have some limitations or other. The method of information that has revolutionized the modern man's life is the computer network. But before we discuss the computer network, let's learn about what a computer is.

You may have already guessed from the name 'computer' that it has something to do with computing or accounting. When computer was first invented, it was, in fact, made for the purpose of accounting. But day by day, it's being used for many different kinds of works. At present, we can do not just accounts with computers, but we can write with it, can draw pictures, listen to music, operate various kinds of machines with it, and can communicate with a number of people through networking.

There are different kinds of computers. There are huge sized super computers as well as small computers for using in household machineries. But the computer we are most accustomed to seeing is the desktop or laptop computer. These computers are for personal use and we can divide it into three main parts. The first part is the Input Unit where there is the keyboard and the mouse. With these we send information inside the computer. The second part is the C.P.U or the Central Processing Unit. This is the most important part of the computer and this part does all the calculations of the computer. Here the computer saves all its information and analyses that information in many different ways. The part of C.P.U that saves information is called the Memory, and the part which processes the information is called the Microprocessor. The last part of the computer is called the Output Unit. After the computer finishes
doing all the calculations, we can see the results in this part. The Monitor of the computer is the example of its output unit.

So, generally speaking, we enter information into the computer through the keyboard and the mouse. The C.P.U saves that information in the memory and then processes that through the microprocessor. After the processing is done, the result is shown on the monitor.

Besides the three main parts of the computer that we have talked about, there is a port in every computer for communicating. These ports are the inputs and the outputs both at the same time, that is, they can both send and receive information. These ports are called networking ports, and through these networking ports, one computer can be linked with another computer. Then the connected computers can exchange information with each other. In this way, by connecting millions of computers together a worldwide computer network has developed. This has been the most fascinating way for sending and receiving information.
doing all the calculations, we can see the results in this part. The technique of communication information across the world through network is known as the Internet. By using internet we can do everything that a radio, television or telephone can do, and we can do much more than that. We can write a letter or an e-mail, send pictures, search for and find information, buy or sell things, see the map of any place, do library work, have video-conferences, or even make friendship with other people through the internet.

You be glad to know that a countrywide computer network is being developed in Bangladesh so that everyone can use a computer and take advantage of the internet. To connect with the outer world, fiber cable is being used through below the surface of the ocean.

**Conclusion**

The new world, in fact, is the world of information technology. The nation which will be able to use information in the best way will prosper the most. Many new technologies have developed for information communication. You will gradually learn about those and will be able to use them. There was a time when the radio, television, telephone and computer - were all separate machines. Already all of these have been compressed in one and has become smaller. The mobile phone has already the radio, television, camera and even a powerful computer inside it. Not only that, by being connected with the computer network, it can now collect information from all over the world.

When you grow up, we strongly believe that that you will all take part in the revolutionary information technology that have taken place in the world toady.
A. Multiple choice questions

Tick the right answer:

1. What is the modern world called?
   a. The world of chemical technology
   b. The world of biological technology
   c. The world of information technology
   d. The world of agricultural technology

2. What else do we have to do when get information? We have to ________.
   a. save it
   b. communicate it
   c. keep it a secret
   d. wipe it off

3. How can we send information to the satellite?
   a. Through electric wires
   b. Through fiber optic cables
   c. Through electro-magnetic waves
   d. Through space ships

4. What's the nature of information flow through radio and television?
   a. One way          c. Multi-ways
   b. Both ways        d. None of these
5. How does information flow through telephone?
   a. One way            b. Both ways
   c. Multi-way          d. None of these

6. Which medium is needed for electro-magnetic waves to scatter around?
   a. Electric wires  b. Air
   c. Water           d. No medium

7. The part of a computer that processes information is called the _______.
   a. Key Board
   b. Memory
   c. Microprocessor
   d. Monitor

B. Fill in the blanks:

1. The telephone that we carry around in our pockets is called a _______ phone.
2. The optical fiber is a kind of very thin thread of ________.
3. Using ________ and ________ we send information through the computer.
4. The _______ of the computer is an example of its Output Unit.
5. The large sized computer is called the _______ computer.
6. The communication of information through computer network is called the ________.
C. Answer briefly:
1. What is meant by information?
2. Give an example of information communication.
3. What is the difference between the one way and both ways communication?
4. What's the difference between the land telephone and the mobile phone?
5. How many channels can we watch on television today?
6. What is the difference between the electro-magnetic waves and the radio waves?
7. How has the name 'computer' come to be?
8. What is the function of the computer memory?
9. What is 'internet'?

D. Essay questions:
1. Why is information communication so important in the present world?
2. How does the telephone work?
3. How is information sent through the fiber cable?
4. Draw the fundamental structure of a computer and discuss how the different parts work?
5. What are the things we can do by using the internet?
Chapter Fifteen

Environmental Pollution

Nature and its elements

Everything around us—trees, houses, soil, water, air, animals, vehicles, factories etc.—makes up our environment. We also often talk about the environment of houses, schools or marketplaces. That is to say, the environment of a place is composed of everything around it. The things which exist in an environment are called its elements. The elements of environment can be divided into two types: natural elements and manmade or artificial elements. Soil, water, air, mountains, rivers, forests, animals, plants etc. are natural elements of the environment. Manmade elements of the environment include buildings, vehicles, roads and highways, factories, dams etc.
Just as the elements of a place can make it beautiful, they can also pollute it. Buildings and roads constructed in planned ways make the environment beautiful. Keeping buildings and roads and streets clean also keep the environment beautiful. Dirty buildings and roads made without planning pollute the environment. Clean air, fertile soil and pure water keep the environment healthy. On the other hand, polluted air, infertile soil, dirty water etc. pollute the environment. Humans cut down trees, build houses here and there, and build dams and streets to fulfil their own needs, causing the environment to become polluted.
Causes of environmental pollution

Natural disasters like earthquakes, floods, tidal waves, wildfires, volcanic eruptions, tornadoes, cyclones, tsunamis etc. cause great damage to the environment. In most cases, these disasters occur as a result of using the environment in unplanned ways. Wildfires cause plants in the forests to burn, and destroy them. Plants do not grow in the infertile burnt land of the forests. Crops do not grow in the burnt soil either. Humans, animals and birds cannot live in such environments. Cyclones and tornadoes cause great damage to human communities, plants, animals, birds and farms. We can understand how dangerous and devastating these calamities are for the community and the environment if we observe the effects of the hurricane Katrina which recently took place in the state of New Orleans in the United States of America, and the tsunamis which took place before that in Indonesia, Sri Lanka and India in South Asia. Human lives, buildings and plants are destroyed as a result of
floods and tidal waves, which cause massive damage to the environment and pollute it heavily. Humans cause lot of damage to the natural environment for their own benefit. Lots of bricks are needed to build houses, factories, roads etc. Because of this, many brickyards are built around the city. The black smoke from the brickyards pollute the air.

![Figure 16.4: Pollution of air by black smoke from brickyards and factories](image)

The black smoke emitted from factories and mechanical vehicles also pollute the air.

![Figure: Wastes from factories](image)
Many people dispose of garbage here and there - in streets, in rivers and streams etc. This pollutes air and water. This causes rivers and streams to become filled, causing water clogging. In Dhaka, many of you are familiar with the troubles caused by water clogging. Water clogging is also harmful to crops in rural areas.

Also, people dispose of factory waste and urban and rural household garbage here and there. Because of the lack of proper waste disposal facilities, the soil, water and air become polluted.
Negative effects of environmental pollution

Humans cut down trees of forests in order to prepare farmlands and build houses. Because of this, forests and trees in nature are diminishing day by day. You know that plants release oxygen into the atmosphere and absorb carbon dioxide form the atmosphere. If the trees in the environment diminish in number, the balance of oxygen and carbon dioxide in the atmosphere will be upset. If the amount of carbon dioxide in the air increases, temperature will rise, thus increasing the possibilities of occurrences of natural disasters like floods, tidal waves, cyclones etc.

Figure 16.6: Balance of carbon dioxide and oxygen in the atmosphere
Chemical wastes from factories and sewerage wastes from rural and urban areas become mixed with the waters of rivers, streams, canals and marshes and pollute the water. The excessive insecticides and chemical fertilizers used in crop fields are washed into the rivers by rainwater, causing the water to become polluted. Fish and other aquatic creatures cannot live in polluted water. Also, aquatic plants do not grow there. You know that polluted water can spread many types of diseases, such as diarrhoea, jaundice, skin diseases, typhoid etc. Polluted water cannot be used for cooking, cleaning or other household tasks. Bathing in polluted water causes various skin diseases.

If the environment becomes polluted, it becomes harmful for animals, plants and humans. Plants, animals and humans survive by adapting with the environment. This is called natural balance. Environmental pollution ruins the balance of nature and causes natural disasters. Once the environment becomes polluted, it is very difficult and expensive to free it from pollution.

Excessive use and improper disposal of polythene here and there causes serious problems in the sewerage and water disposal systems. Polythene bags dropped here and there can clog up the mouths of water and sewerage pipes. Polythene and plastic do not decompose, and they do not become mixed with the soil. Polythene remain unchanged for years in water or soil. Plants do not grow well in such soil, because the roots of the plants cannot penetrate deep into the soil due to the presence of polythene or plastic under the soil. This stunts the growth of plants. This is a type of soil pollution. Apart from polythene and plastic, different types of wastes from factories also become deposited in soil,
decreasing its fertility and polluting it. No plants grow in polluted soil. Crops cannot be grown in it.

Figure 16.7: The growth of tree roots is hampered by the polythene and plastic in the soil

**Conservation of the environment**

From the previous discussion, we have learnt how the important elements of the environment, namely soil, water and air are being polluted. We have also learnt that polluted soil, water and air is harmful for humans and other animals.

A pollution-free environment is needed in order to live healthily. In order to keep our environment pollution-free, we must refrain from things which may pollute the environment. Waste from
factories must be treated so that they cannot pollute the environment. We must take care of plants in order to prevent pollution of air. We must plant trees around our houses, participate in forestation, participate in tree-planting endeavours regularly, and plant lots of trees. We must take care of plants, and tell people not to cut down trees unnecessarily.

Air becomes polluted if organic wastes are burnt. They should be buried underground by digging holes. This would prevent the environment from becoming polluted. Moreover, the wastes would turn into organic fertilizers which would increase the fertility of the soil, resulting in greater yields of crops.
Plastic, polythene, glass and metal objects cannot be disposed of here and there. They should be recycled and reused. This would help to keep the environment pollution-free. You know that many people earn their living by making cardboard from discarded paper. Therefore we should dispose of waste paper in a separate place.

Observe how the natural environment around your school is being polluted. Make a list of the sources of pollution, and describe methods to get rid of them.

Soil, water, air, plants, animals etc. are natural resources. They are needed in order for us to survive and maintain the balance of nature. We can conserve the environment by preserving and using the resources of the environment properly.

**Exercise**

**A. Multiple-choice questions**

Tick (√) the correct answer:

1. Which one is responsible for soil pollution?
   - a) Plastic
   - b) Paper
   - c) Cloth
   - d) Leather

2. How can we prevent waste from polluting the environment?
   - a) Burning waste
   - b) Treating waste
   - c) Storing waste
   - d) Covering waste
3. **What measures can be taken in order to keep industrial waste from polluting the environment?**
   a) Burning waste      b) Burying waste underground
   c) Treating waste     d) Storing waste

4. **Which of these is a natural cause behind the pollution of the environment?**
   a) Cutting down trees   b) Burning waste
   c) Disposing of waste in rivers d) Floods

B. **Answer the following short questions:**
   1. Name the factors responsible for polluting the soil.
   2. List the causes behind water pollution.
   3. Make a list of the natural causes of environmental pollution.
   4. Draw a picture of a beautiful environment.

C. **Answer in detail:**
   1. Describe how soil can be kept pollution-free.
   2. Describe the causes of air pollution.
   3. Explain how reuse of waste keeps the environment pollution-free.
   4. Describe how the environment can be kept pollution-free.
   5. Describe how you would keep the environment of your school clean.
Chapter Seventeen

Population and the Environment

Bangladesh is a small country. But it has a large population which is increasing day by day. Because of this huge population, our country is suffering from many problems. Our country is plagued by deficiency of food, unemployment problems, lack of medical facilities, environmental pollution and such other problems. In Standard IV you have learnt about some aspects of environmental pollution. In this chapter, we are going to learn more about population and the environment.

Let us know some facts and theories about the population before we begin to discuss the effect of population on the environment. Let us first know what population is and how the population of a country is determined; what population density is and how it is determined; what demography is; how birth and mortality rates are determined; and how per capita land is determined.

**Population**

Do you know what the population of Bangladesh is? How can this population be determined? If you are asked how many people live in your house, you will obviously be able to answer that. How will you be able to answer it? By counting, right? Again, if you are asked what the population of Bangladesh is,
will you be able to tell the answer by counting them by yourself? No, it is not possible. But it is possible to determine it in another way. On a certain day and at a certain time, the government employs a large number of people all over the country to count people of all ages in order to determine the total population of the entire country. This method of counting people to determine the population of a country is called a census. Censuses are usually conducted every 10 years. Censuses are not only used to determine the population of a country. From a census we can find out the total population, and also the number of men and women, adults, children, literate and illiterate people in the country. Moreover, various figures including the number of people employed in different professions, the socio-economic condition of the country, the birth and mortality rates, population density and rate of increase/decrease of population can be known from censuses.

**Population of Bangladesh**

We can say that the total number of people (males and females) who live in a country, ranging from a newborn baby to the oldest man, is the population of that country. Do you know what is the current population of our country, where we were born and we live? According to the census of 1991, the population of our country was 11 crore 14 lac. This means that the total number of men, women, boys, girls, children who lived in Bangladesh in the year 1991 was 11 crore 14 lac. However, ten years later, according to the census held in the year 2001, it was found that the population of Bangladesh increased to 129.3 million. According to the report of the United Nations
Population Fund (UNFPA), the population of Bangladesh in the year 2005 was 141.8 million. Due to various factors, the populations of all countries are not the same. These factors include the geographical location of a country, its geographical features, weather, natural environment, natural resources, positive and negative aspects of lifestyles, literacy rates etc. The populations of SAARC countries are listed in the table below:

**Table 1: Population of SAARC countries**

<table>
<thead>
<tr>
<th>SAARC countries</th>
<th>Population (Crore)</th>
<th>Population density per square kilometer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>16.66</td>
<td>881</td>
</tr>
<tr>
<td>Bhutan</td>
<td>0.1</td>
<td>9</td>
</tr>
<tr>
<td>India</td>
<td>1.51</td>
<td>349</td>
</tr>
<tr>
<td>Maldives</td>
<td>0.3</td>
<td>1264</td>
</tr>
<tr>
<td>Nepal</td>
<td>2.30</td>
<td>161</td>
</tr>
<tr>
<td>Pakistan</td>
<td>13.80</td>
<td>209</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>19.4</td>
<td>322</td>
</tr>
</tbody>
</table>

*Source: World Population Data Sheet 2004
Population census 2001
Bangladesh Bureau of Statistics*

**Demographic concept**

You may have heard that the population of our country was much lower in the past. Now the population of the whole world is much greater than before. The population of our country is increasing day by day along with the population of the world. How is the population increasing? The increase or decrease in the population of a country or its remaining constant mainly depend on three factors - birth, death and migration. If the birth rate of a country is more than the mortality rate, the population
of that country increases. If the birth rate is lower than mortality rate, the population decreases. If the birth and mortality rates are equal, the population will remain constant. Migration can also cause changes in population, but changes in population due to migration is not very significant in the case of our country.

Some people from our country go abroad for educational purposes or for employment. If they stay there permanently, the population of those countries will increase, and that of ours will decrease. If people from other countries come to our country, they will be counted as part of our population—as a result, our population will increase. This permanent transfer of people from one country to another is called migration.

To know the state of population of a country it is necessary to know the birth rate, mortality rate and the rate of migration of that country.

**What is birth rate?**

The number of live children born to every thousand people in a particular year is called the birth rate of that country. To calculate this rate, the number of live children born in one year in a country is divided by the population of that country, and the resulting quotient is multiplied by one thousand.

The formula for calculating birth rate is:

\[
\text{Birth rate} = \frac{\text{The number of live children born in a year}}{\text{Total population of the country}} \times 1000
\]
What is mortality rate?

The number of people of different ages who die among every thousand people of a country in a particular year is called the mortality rate of the country. To calculate the mortality rate, the number of deaths occurring in one year is divided by the total population of that country, and the resulting quotient is multiplied by one thousand.

The formula for calculating mortality rate is:

\[
\text{Mortality rate} = \frac{\text{The number of deaths occurring in one year}}{\text{Total population of the country}} \times 1000
\]

Population density

The number of people living in an area of 1 square kilometer in a country is called the population density of that country. The population density can be calculated by dividing the total population of the country by its total area (square kilometers).

The formula for calculating population density is:

\[
\text{Population density} = \frac{\text{Total population of the country}}{\text{Total land area of the country}}
\]

You can calculate the population density of your own village or union using this formula if you know its population and land area. Suppose Ulipur village has a land area of 2.5 square kilometers and a population of 2000 people. Then, we can see
that the population density is 800. This means that 800 people live in every square kilometer area of Ulipur village.

According to the World Population Data Sheet 2004, a total of 881 people live in every square kilometer area of Bangladesh. Thus, the population density of Bangladesh is 881. The population densities of India, Pakistan, Nepal, Bhutan and Sri Lanka are 349, 209, 161, 9 and 322 respectively. Therefore we can see that the population density of Bangladesh is the highest - it is three times greater than that of India and more than five times greater than that of Pakistan.

**Per capita income**

The average annual income of each person of a country is called its per capita income. Per capita income can be calculated by dividing the total national income by the total population of a country.

$$\text{Per capita income} = \frac{\text{Total annual income}}{\text{Total population}}$$

The per capita income is $520 for the people of Bangladesh, $820 for the people of India, $38,410 for the people of Japan and $6,452 for the people of Malaysia. Among these four countries in Asia, the per capita income for Bangladesh is the least and the per capita income of Japan is the greatest. If the agricultural production, industries, commerce, transport facilities etc of a country are not good and if its population is relatively too
great compared to the area of the country, then the per capita income of the country increases, and the country becomes poor. If the production of a country increases, the national income of that country increases as well. So the per capita income increases as well. This is known as economic development. If the per capita income increases, the people's standard of living also increases.

**Per capita land**

If a country's total amount of area or land is divided by the total population of that country, then the amount of land per capita of that country is obtained.

\[
\text{Land per capita} = \frac{\text{Total amount of land}}{\text{Total population}}
\]

The population of our country is increasing rapidly, so the amount of land per capita is decreasing. If the rate at which our population is increasing continues, then our food crisis will grow worse. The large population will have a negative effect on employment, education, transport facilities etc. Therefore it is necessary for all of us to be aware of this problem.

**Environmental pollution**

You know that the population of the world is continuously increasing. To provide food to the growing population forests are cut down to prepare cultivable land. As a result, the amount of forests and plants decreases and the amount of carbon dioxide increases day by day. Transports and factories are also increasing along with the population. The smoke emitted from
factories and vehicles further increases the amount of carbon dioxide in the air.

The temperature of the atmosphere increases as the amount of carbon dioxide in the air increases. In the recent decades, the population of our country as well as vehicles and factories have increased significantly. On the other hand, the number of plants and forests have decreased. As a result, the amount of carbon dioxide in the atmosphere has also increased, which has led to the increase of atmospheric temperature. Because of this, the summers now are much hotter. In contrast, the winters are not as cold as they were before. If forests and plants decrease, rainfall also decreases. This may cause major changes in the climate. Now you can certainly see how wea
To meet the demands of the growing population, the use of chemical fertilizer and pesticides in agricultural lands has increased. These chemicals are washed into ponds, canals and rivers by rainwater, causing the water to become polluted. Waterborne diseases become more prevalent and production of fish decreases due to premature death of fish. To meet the demands of the growing population, the same land is being used repeatedly for farming. As a result, the fertility of land is decreasing. Grazing lands for livestock cannot be cultivated due to lack of necessary land. As a result, production of livestock, meat and milk is decreasing. This causes a nutrition crisis in our daily lives. If the population were low, these problems would have been less severe. The population density increases due to the increase of population. We destroy cultivable lands and forests and build houses and factories in their places. As a

Figure 17.1: Environmental pollution by factories
result, the agricultural production is declining day by day. Our forest resources are rapidly diminishing as wood is being used for building houses and as fuel. As a result, rainfall has decreased, which is leaving a negative effect on the weather and the climate. You have learnt that if the population of a country increases, the number of industries of that country increases proportionally. The wastes released from these factories are washed into different rivers and canals, polluting the water. Soil erosion cannot be caused easily by rain, water currents or floods if plants, creepers and grass cover the soil. Thus, if the forests and trees of a region diminish, soil erosion increases there. Erosion of soil causes the fertility of soil to decrease and agricultural production to decline. Industrial wastes also pollute the soil.

You have learnt the effect of excessive population on the environment. The impact of population on our daily lives are also quite visible. Not even the school you go to is free from the effects of increasing population. An example will help you understand the fact. Increase in the population of a country equals the increase in the number of newborn children. As a result, the number of young boys and girls also increases. These boys and girls go to the schools for admission which results in huge rush. Many children cannot get themselves admitted into the schools of their choice. If too many children get admitted into a school, it suffers from various problems. Classrooms cannot accommodate the children properly. More students have to be crammed together on the same bench. The teacher cannot take care of all the students equally well. This hampers the
learning process of the students. The environment of the school also gets dirty and unhealthy due to the presence of too many students.
Conservation of the environment

We should protect our environment to live a healthy life and for a prosperous future. Human beings and their various activities cause the destruction and pollution of environment. Again, it is only man who can save the environment. Therefore, all of us should be aware of this matter. We should take care of the plants and animals. We should keep our homes and school premises neat and clean. We can protect our environment if we all work together along with the members of our families, fellow students at schools, and other members of our society.

In order to conserve the environment we should all be careful at national, social, and personal levels about controlling the rising population. If the population is kept under control, a sound environment can be sustained and, as a result, the country will have happy and healthy future generations.

Exercise

A. Multiple-choice questions

Tick (✓) the correct answer:

1. On which one of these the increase or decrease in population of a country depends?
   A) birth rate                      B) rate of migration
   C) difference between birth rate  D) all of the above
      and mortality rate
2. **How often are censuses conducted?**
   A) every 5 years     B) every 10 years
   C) every 15 years    D) every 20 years

3. **What happens if forests and plants diminish?**
   A) rainfall increases
   B) temperature decreases during winter
   C) temperature increases
   D) amount of oxygen in the air increases

4. **How does the smoke from factories and vehicles pollute the air?**
   A) by spreading odours in the air
   B) by causing black rain to occur
   C) by causing the air to become warm
   D) by increasing the amount of carbon dioxide in the air

5. **What was the population density of Bangladesh according to the World Population Data Sheet 2004?**
   A) 876          B) 907
   C) 881        D) 1050

**B. Fill in the blanks**

1. According to the census of 2001, the population of Bangladesh is ____ million.
2. Generally, censuses are conducted once every ____ years.
3. If birth rate and mortality rate of a country are equal, its population will be ______.

4. If the per capita income of a country increases, the standard of ______ of the people of that country also increases.

5. If population increases, per capita land ______.

6. The ratio of oxygen and carbon dioxide in the atmosphere is balanced by ______.

7. Smoke from factories pollutes the ______.

C. Short questions

1. What does population density mean? Among the SAARC countries, which one has the greatest population density?

2. What do you mean by per capita income?

3. What is the per capita income of Bangladeshis?

4. Write down five causes of environmental pollution.

5. What is the effect of increase in population on forests?

6. What happens if the forests and plants diminish?

7. How does water become polluted as a result of excessive population?

8. What are the problems which occur when the number of students in the school increases?

D. Broad questions

1. Describe the methods of calculating birth rate and mortality rate.

2. What steps should we take in order to conserve our environment?
Chapter Seventeen

Neem and the Importance of its Cultivation

There are many types of plants and climbers around us. Everyone loves to eat mango, jackfruit, lychee, pineapple, jambu, star apple and so on. Have you ever observed the characteristics of these plants? Each of these plants have different-looking leaves and flowers. The fruits borne by these trees also smell and taste different. The fruits mentioned above are sweet. But tamarind, myrobalan (amlaki) and olive are sour. Bitter gourd (karala) and neem taste bitter. Although the tastes of these plants vary widely, all of them are useful to us in many ways.

We all know how we are benefited by plants from which we obtain sweet fruits or expensive wood. But it is quite surprising how a plant with bitter-tasting bark, leaves and fruits can help us.

Have you seen neem trees? What does a neem tree look like? What do its leaves, flowers and fruit look like? How do neem trees benefit us?

Let us now get acquainted to the neem tree, and find out how it is benefiting us silently like a friend despite being of such bitter taste.
How to recognize a neem tree

Neem plants are classified as trees. Neem trees usually grow 30 - 40 feet tall. They have many branches. Their leaves are not simple. The small leaf-like growths are actually parts of a leaf. They are arranged along a rachis. These small parts are called 'leaflets'. All the leaflets arranged along a rachis together make a single leaf. Neem flowers are small, white and sweet-smelling. Neem fruits are small and green, but they gain a yellowish green hue when they ripen.

The bark of the trunk and roots, the sap, the leaves and the fruits of neem trees are bitter-tasting. Nimbidine is the one of the main substances responsible for this bitter taste. Two more types of bitter substances are also found in the bitter parts of neem trees. It takes almost ten years for a neem tree to reach maturity. Neem trees have a very long lifespan. Some neem trees live for more than two hundred years.
Scientists have performed extensive research on neem, and have discovered their various useful properties. They have also come to the conclusion that neem trees contain no poisonous or harmful substances. Because of this, the uses of neem are very safe. Research on neem first began in the Indian subcontinent in 1942. In the modern world extensive research on neem is being carried out with great enthusiasm.

Now, let us see in which ways this friendly tree can benefit humans and animals.

- **Medical treatment**: Neem is now widely used in all the established fields of medicine. Neem is used for treating itches, scabies, boils, pox, sores, allergy, jaundice, diabetes, diseases caused by worms, dental diseases etc. All types of skin diseases can be treated by applying a paste of raw
turmeric and neem leaves to the infected region. Bark, sap, leaves and seeds of neem can be used as a remedy for snakebites. Using neem twigs for brushing teeth helps to heal gum diseases and strengthen teeth. Neem is also used to treat diseases contracted by domestic animals. Oil extracted from neem seeds is used to cure indigestion, worms, wounds and other infections of animals.

- **Agriculture:** In the agricultural field, neem is used as an insecticide and a fertilizer. The use of neem decreases the acidity of soil and helps to increase its fertility. Dry neem leaves is useful for storing food grain.

- **Conservation of environment:** The air from neem trees is good for health. Neem plants are ideal for purifying polluted air. Planting neem trees in the yard of a house helps to make it safe from diseases. Neem trees prevent the erosion of soil. They increase the water-retaining abilities of soil and thus prevent desertification.

- **Economic benefits:** From the above discussion, we have learnt about various uses of neem. Now let us see what other valuable things can be obtained from neem. We obtain good-quality wood from neem. This wood can be used for making furniture, wheels of oxcarts, doors, windows etc. Neem can also be used as cattle feed and fuel.

Many of you use neem twigs for brushing your teeth, but most of you do not know how to use it safely. It is more beneficial if the chewed part is cut off every day and a fresh part is chewed anew.
Many types of consumables are being made from neem these days. Neem-flavoured toothpaste and tooth powder, neem oil, neem soap etc. act as disinfectants.

There is high demand for neem in many countries. We can plant more and more neem trees and sell them to foreigners. Both our country and countrymen can be benefited by this.

We all should grow and take care of neem trees. Now, let us learn how to grow and take care of neem trees.

**Growing neem trees**

Neem trees grow in dry and dense clayey soil. Black loamy soil is suitable for planting neem trees. Neem trees do not grow well in areas where water accumulates. Neem trees grow well in places where the water can flow well and the water-retaining capacity of the lower layers of soil is good. Neem seeds should be collected and planted as early as possible during the rainy season (from June to August). The seeds can be planted in nursery beds, polythene bags, or directly in the soil. The seeds can be planted in nursery beds in rows 15 centimeters away from each other. Seeds in each row should be evenly spaced by 2 to 5 centimeters. After planting the seeds, they must be covered loosely by soil and sprinkled with water. When the saplings are two months old, weeding would be beneficial for their normal growth.

We have learnt about the properties, uses and cultivation of neem trees. We can see that the planting of such a useful tree would be highly beneficial for Bangladesh. Considering the
diverse usefulness of neem trees, the World Health Organization has declared neem as "The Tree of the Twenty-first Century". This tree can benefit Bangladesh in many ways. Bangladesh can be turned into a country without environmental pollution by planting neem trees in large numbers on roadsides, yards of schools and other institutions, and around houses in every village and city of our beautiful country.

Exercise

A. Multiple-choice questions

Tick (✓) the correct answer:

1. How long does it take for a neem tree to attain maturity?
   a) five years   b) ten years   c) twenty years   d) fifteen years

2. How long can a neem tree live?
   a) ten years   b) twenty years   c) a hundred years   d) more than two hundred years

3. Bark, sap, leaves and seeds of neem can be used to treat the bites of ____________.
   a) Snakes   b) Cats   c) Tigers   d) Birds
B. Fill in the blanks:

1. Neem plants usually grow ____________ feet tall.
2. Among the substances responsible for the bitter taste of neem, the main one is ____________.
3. Neem trees contain no ____________ or ____________ substances.
4. Research on neem first began in the Indian subcontinent in the year ____________.
5. Planting neem trees in the yard of a house helps to make it safe from ____________.

C. Answer in brief:

1. Write down the names of the different parts of a neem tree.
2. What diseases of humans can be treated using the different parts of neem trees?
3. Describe the uses of neem in treating animal illnesses.
4. How can neem help to conserve the environment?
5. How can neem benefit us economically?
6. What kind of soil is suitable for growing neem?