As per the latest ICSE Curriculum

INNOVATIVE BIOLOGY

FOR ICSE SCHOOLS

TEXTBOOK-CUM-WORKBOOK

6

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The **theme** regarding the cover page of this series: **Cell** is the structural and functional unit of life. After attaining its maximum size, it divides into two equal halves, forming the daughter cells. This is called **cell division**. It is essential for growth, replacement of old cells, repair of injury and reproduction of living organisms.

We are committed to serve students to the best of our knowledge and resources. Further, our endeavour is to ensure an impartial harmonising of the religious and cultural sentiments of all communities. We have taken utmost care in editing and printing this book. However, the author and the publisher will not be held responsible for the mistakes made inadvertently. Errors brought to our notice shall be gratefully acknowledged and attended to in our next edition.

PREFACE

Biology is a science of living organisms, which involves the study of their structures and functions, growth, behaviour and evolution of life. This series is prepared in a systematic manner and aims to develop an interest for biology in the young minds. A special effort has been made to develop the spirit of inquiry, strengthen the power of observation and the urge to perform experiments among the students.

Innovative Biology is a series of Textbook-cum-Workbook that has been revised according to the latest curriculum prescribed by the **Council for the Indian School Certificate Examinations** for the Upper Primary Level.

Salient Features of the Series

- Simple and lucid language
- Student-friendly representation of the chapters
- Learning Objectives focus on the key areas of learning
- Enrichment enhances the scientific knowledge about the topics being taught
- Demonstrations conducted by the teacher to make the concepts easy
- Experiments explained step-wise to strengthen the concepts
- Activities given to understand various concepts taught
- More to Know provides extensive knowledge about the topics
- Fact Zone provides extra facts/information related to the topic being taught
- Think Zone includes questions to hone the student's ability to apply the concepts learnt
- Scientist Zone provides information about the scientists and their inventions/contributions
- Assess Yourself provides in-text questions for practice
- Rough Work enables students to make notes
- Let's Recapitulate provides a quick revision of the chapter
- Evaluate Your Understanding is given to test the level of understanding of the chapter
- Keywords introduce new scientific terms for quick reference

We hope the series will prove to be of immense value not only for the students, but also for the teachers, who are the real judges of our endeavour.

However, suggestions or comments for the improvement of the book, including criticism, if any, will be appreciated and incorporated in the subsequent editions.

—Author

SYLLABUS

Theme 1: Plant Life

Key Concepts	Suggested Transactional Processes
The Leaf	
• External structure (parts of a leaf in detail).	• Revisiting previous concepts and building on past learning. • Promoting children's observation of plants in their surroundings, and drawing pictures with the common names of the plants written below the pictures. • Providing opportunities for children to observe plants, leaves and flowers through organising a visit to a nearby garden or forest area.
• Kinds of leaves (simple and compound). • Types of venation (reticulate and parallel).	• Asking children to draw different types of leaves, their structure and kinds and types of venation and modifications.
• Functions of leaf (main functions).	• Conducting activities to demonstrate photosynthesis and transpiration in leaves.
• Modifications (tendrils, spines, scale leaves).	• Observing a pea plant, noting the tendril which is a modified leaf. • Discussing the function of a tendril.
• Insectivorous plants. Need for modification with an example.	• Observing spines in the Cactus plant and stating their function. • Drawing a diagram of the Cactus plant and labelling it.
• Vegetative propagation in leaf (example: Bryophyllum).	• Organising activities to observe vegetative propagation in leaf and discussing.
The Flower	
• Parts (four whorls), structure and function of each whorl.	• Asking children to observe a flower (such as petunia, china rose or mustard) and studying its different parts and whorls. • Encouraging children to draw pictures of different flowers and labelling the parts observed (only complete flowers showing all the four whorls).
• Pollination (self and cross): An idea about agents of cross pollination (wind, water and insects—their examples).	• Developing a herbarium of flowers/leaves.
• Fertilisation: Process in simple terms.	• Discussing the process of fertilisation in plants using models/charts, etc.
• Formation of fruit—fate of each part (whorl) of flower after fertilisation.	• Studying and drawing pictures of different fruits (like pea, bean, mango, tomato, coconut); and seeds of maize, wheat/paddy (rice).

• Parts of fruits: Dry and fleshy, examples of dry and fleshy parts; parts of the pericarp of fleshy fruits (epicarp, mesocarp, endocarp) and function of each part.	• Asking learners to classify fruits as dry and fleshy.
• Seed—parts (cotyledon, embryo—radicle, plumule) and types (monocot, dicot).	• Conducting simple activities to identify: Cotyledon, monocot seeds, dicot seeds.
• Germination—conditions required for germination (moisture, warmth), seed germination of different seeds.	• Asking children to sow seeds in a petri dish containing a wet blotting paper to observe germination phenomenon. • Setting up experiments for seed germination in different seeds.

Theme 2: The cell

Key Concepts	Suggested Transactional Processes
• Plant cell: Cell organelles and their functions. • Animal cell: Cell organelles and their functions. • Diagrams of plant and animal cells. • Only the following to be included: Cell wall, Cell membrane, Plastids, Nucleus, Vacuole, Cytoplasm—their structure and functions	• Organising visits to the laboratory to show children slides on the theme. • Asking children to observe and draw the structures seen in the permanent slides of: ➢ *cells from onion peel* ➢ *human cheek cells* ➢ *blood cells* ➢ *Amoeba* ➢ *Chlamydomonas* • Showing videos and PPTs on structure of the cell.
• Differences between plant and animal cells.	• Asking children to differentiate between plant and animal cells based on their observations of slides. • Assigning projects and preparation of models (individually or in groups) on plant and animal cell; • Discussing the structure and functions of cell organelles; • Appreciating the discovery and use of the microscope in human life.

Theme 3: Human Body

Key Concepts	Suggested Transactional Processes
Digestive System	
• Revisit previous learning.	• Discussing with children about their own experiences.
• Organs of the digestive system; function of each organ.	• Providing opportunities to: ➢ *draw diagram of digestive system and label its parts.* ➢ *describe functions of each organ.* ➢ *make model/functional model of digestive system.*
• Process of digestion particularly of Carbohydrates Proteins and Fats.	• Discussing the process of digestion in terms of: ➢ *site of components of food.* ➢ *role of enzymes in digestion, end products of the digestive process.*

	• Discussing and finding out: ➢ *causes of indigestion.* ➢ *healthy and unhealthy food habits.* ➢ *ways to keep on oneself healthy.* • Assigning projects either in groups or individually to interview three people and find out about their food habits. Sharing the same in class.
Respiratory System	
• Main parts (nose, pharynx, larynx, trachea, bronchi, lungs); functions of each part of the respiratory system. • Difference between respiration and breathing. • Mechanism of breathing: (Physical process with respect to diaphragm and ribs—inhalation and exhalation).	• Asking children to: ➢ *observe through models and charts different parts of the human respiratory system.* ➢ *draw pictures of respiratory system and label its parts.* ➢ *discuss the process of respiration using working models.* ➢ *discuss the effects of increased physical activity on breathing.* ➢ *inviting a doctor to discuss health issues related to diseases.*
• Mention of common respiratory diseases: Asthma, bronchitis, pneumonia, tuberculosis (T.B.).	• Discussing various causes of diseases related to respiration; • Identifying ways to prevent diseases related to respiration.
Circulatory System	
• Main parts of the circulatory system (heart, blood, blood vessels). • Process of circulation in the body.	• Asking children to: ➢ *observe different parts of the human circulatory system through models and charts.* ➢ *draw the figure of a heart; circulatory system*.
• Components of blood (plasma and blood cells—RBC, WBC, platelets with their functions only).	➢ *identify the different types of blood vessels and components of blood through PPTs/ videos/ permanent slides.*
• Types of Blood groups (A, B, AB, O): mention only.	• Discussing the need for a blood bank, blood donation.
• Blood pressure (concept only); heartbeat, pulse	• Inviting a doctor and/or visiting a doctor to know about blood pressure and observe the instrument used to measure it and how it is done; • Showing children how to measure their pulse.
• Keeping the heart healthy through exercise and good food habits.	• Demonstrating activities related to: process of deep breathing, brisk walking/jogging.

Theme 4: Health and Hygiene

Key Concepts	Suggested Transactional Processes
• Types of diseases (communicable and non-communicable). • Communicable diseases: Bacterial, viral, protozoal, diseases caused by worms (common examples of each). • Modes of transmission of diseases (air, water, food, insects). • Ways to prevent communicable diseases. • Non-communicable diseases: Examples, ways to prevent them.	• Building on previous learning and concepts. • Discussing with children: ➢ names of some diseases and their symptoms; ➢ some non-communicable diseases: their causes and ways to prevent them; ➢ prevention of diseases while sharing their experiences. • Asking children to relate their experiences when they had a particular disease/seen patient in the family.
• Hygiene—ways to keep the surroundings clean, safe disposal of garbage, healthy practices for hygiene.	• Organising brainstorming sessions to discuss: ➢ disposal of garbage, its segregation ➢ healthy practices for hygiene ➢ ways to keep the surroundings clean

Theme 5: Adaptation

Key Concepts	Suggested Transactional Processes
• Habitat—definition. • Adaptations of plants and animals to the following habitats along with characteristics and examples: ➢ *Aquatic habitat—floating, submerged and fixed plants; adaptations in fish.* ➢ *Desert—adaptations in cactus as desert plant and camel as desert animal.* ➢ *Mountain—adaptations in trees like Pine and Fir; mountain goat* ➢ *Air—adaptation for flight in birds, aerial plants.*	• Discussing the concept of habitat and adaptation in plants and animals though examples. • Asking learners to study external features of: ➢ *Water lily and water hyacinth (with floating leaves)* ➢ *Hydrilla (root submerged)* ➢ *Cactus/Opuntia (desert habitat)* ➢ *Babul or Kikar (desert habitat)* ➢ *Pine/Fir (mountain region)* • Drawing pictures of above-named plants and writing down the special features. • Asking children to collect information and study the external features of fish, camel, bird (pigeon) and mountain goat. • Drawing pictures of above mentioned animals and describing their special features.

About the book

ACTIVITY

Activity given for understanding various concepts taught

EXPERIMENT - 1

Experiment explained step-wise to strengthen the concept

DEMONSTRATION - 1

Demonstration conducted by the teacher to make the concept easy

ENRICHMENT

Enrichment enhances the scientific knowledge about the topics being taught

LET'S RECAPITULATE

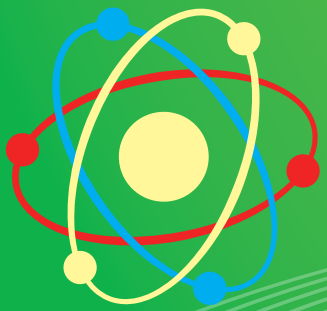
Let's Recapitulate provides a quick revision of the chapter

SCIENTIST ZONE

Scientist Zone provides valuable information about the scientists and their inventions/contributions

ASSESS YOURSELF

Assess Yourself provides in-text questions for practice



ROUGH WORK

Rough Work enables students to make notes

FACT ZONE

Fact Zone provides extra facts/information related to the topic being taught

Keywords

Keywords introduce new scientific terms for quick reference

More to Know

More to Know provides extensive knowledge about the topics

EVALUATE YOUR UNDERSTANDING

Recalling Ideas

Understanding Ideas

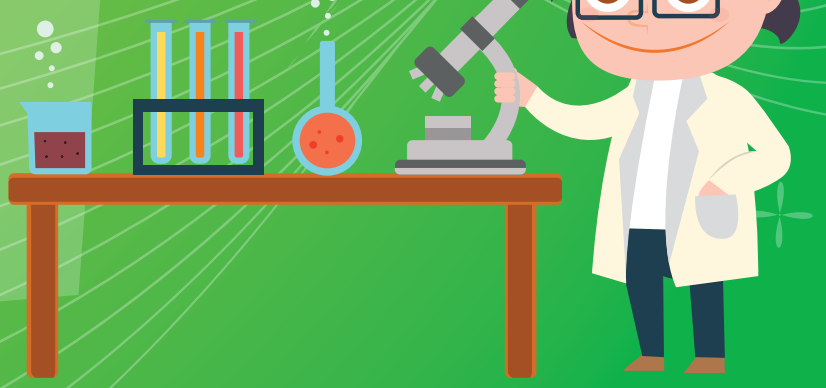
Evaluate Your Understanding is given to test the level of understanding of the chapter

Learning Objectives

Learning Objectives focus on the key areas of learning

THINK ZONE

Think Zone includes questions to hone the student's ability to apply the concepts learnt



CONTENTS

An Introduction to Biology

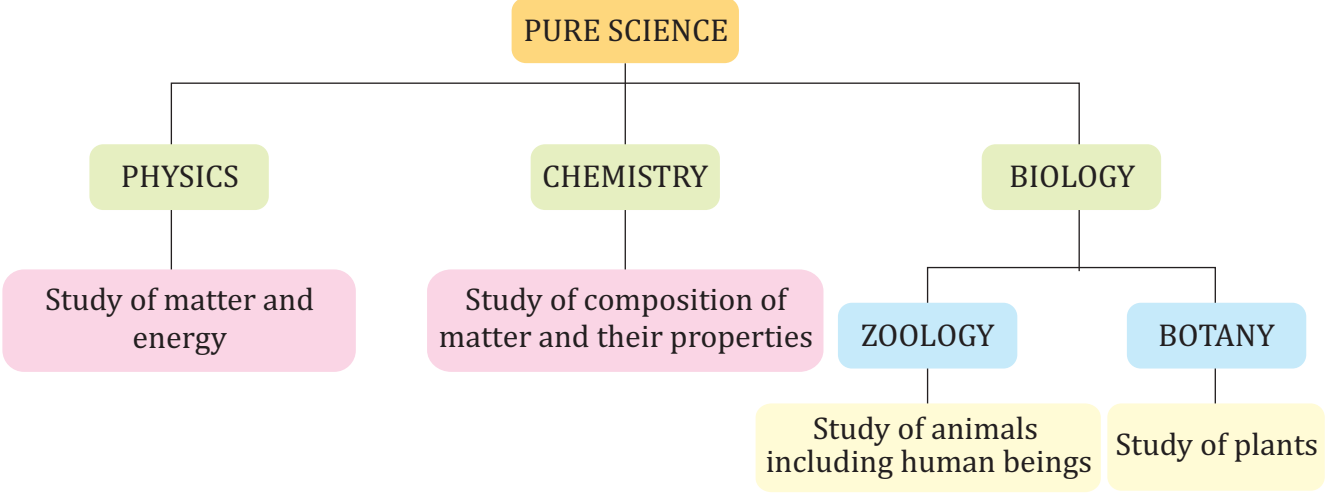
FUNDAMENTALS OF SCIENCE

Humans have always been curious about natural phenomena. This curiosity has led them to explore and study nature. Changing weather, movement of living organisms, formation of plants from seeds and much more have always made us eager to learn more and more about the universe.

Science describes the area of knowledge that can be explained in terms of **scientific method**. Scientific method is a method of inquiry consisting of systematic observation, measurement and experimentation. The process of scientific method comprises of:

- a **phenomenon** is an observable fact or event.
- a **hypothesis** is based on observation. It is a proposed explanation.
- an **experiment** through which the hypothesis is being tested.
- a **scientific theory**, if the results of experiments prove the hypothesis, it is called a theory.

The word 'science' originates from the Latin word *scientia* meaning knowledge. It can be defined as the structure and behaviour of the physical and natural world through observation and experimention. The science that describes the physical universe is categorised into **Pure Science** and **Applied Science**. Pure science explains the phenomenon while applied science determines how a particular phenomenon may be put to use. Generally, pure science is divided as follows:



WHAT IS BIOLOGY?

The scientific study of life is called **Biology** (*bios* meaning life and *logos* meaning to study). The term biology originated in the year 1800. At that time, it was used to refer to the study of the functions of living organisms. Later on, biology was used in reference to the scientific study of life. Today, the biologists study all the functions of organisms, their appearances, habits, interactions with the environment and their changes over a period of time.

BRANCHES OF BIOLOGY

Biology is the science of living organisms that involves the explanation of structure, growth, function and the evolution of life.

It has the following branches:

- **Zoology** Study of animal's life (including human beings)
- **Botany** Study of plants
- **Cytology** Study of the structure and functions of cells
- **Molecular biology** Study of all the biological processes on a molecular level
- **Developmental biology** Study of living organisms from their birth until death
- **Marine biology** Study of marine creatures and their environment
- **Physiology** Study of the functions of living organisms. Depending on the types of organisms, it can be further divided into—*Plant physiology, Animal physiology,* and *Human physiology.*
- **Genetics** Study of biological inheritance
- **Ecology** Study of the relationships of living beings with their environment

WHY IS BIOLOGY IMPORTANT TO US?

Biology explains the very existence of any life form, from the unicellular to the most complex organisms of all, the human beings. The different sub-disciplines of biology refer to human health, as they provide knowledge of human anatomy, study the physical and chemical processes involved and explore how it functions. Biology also studies the origin of diseases, such as the etiology of cancer, infections, functional problems and it arrives at treatments.

Biology affects the discovery and production of medicines. It is essential for the development and enhancement of useful traits in human species. It also selects new agricultural breeds and plants that improve the nutritional value of food. It also investigates the environmental factors that threaten human existence.

Biology can aid in the prevention or cure of diseases and provide tools for managing the environment. It leads to knowledge that helps prolong life and improve its quality. It encompasses the study of the functions of living beings, of enhancement of useful species, factors that cause illnesses, discovery, and production of medicines and sustainable use of natural resources.

CAREER OPPORTUNITIES IN BIOLOGY

- **Microbiologists** The biologists who study about the microorganisms in order to understand their effects on human beings.
- **Horticulturists** The scientists who use scientific knowledge to grow and propagate plants and provide technical information to the farmers.
- **Health and safety inspectors** They deal with health and safety measures in workplaces and make sure that employers follow necessary health and safety laws.
- **Industrial hygienists** They are specialists in the identification and control of health hazards at industrial workplaces.
- **Healthcare social workers** They take care of patients to enable them to recover from illnesses.
- **Physicians** They keep records of patient's medical history and review their test reports.
- **Pharmacists** They provide medicines to the patients on the basis of a doctor's recommendation.
- **Physical therapists** They provide medical help in order to restore their movement function and prevent disability.
- **Endocrinologists** They are specialised in the treatment of malfunctioning of glands and their secretions.

Chapter - 1

Plant Life–The Leaf

Learning Objectives

Let's learn about

- The Plant
- The Root
- The Stem
- The Leaf
- Types of Leaves
- Venations of Leaves
- Functions of Leaves
- Modification of Leaves
- Modifications of Leaves in Insectivorous Plants
- Vegetative Propagation in Leaves

We see a variety of plants around us. Some are small and some are big. Some plants bear flowers while some do not. There is a large variation in the leaves of the plants too. Despite these variations, all plants have some structural similarities.

THE PLANT

Most of the flowering plants grow from a seed. In a seed, the embryo contains an embryonic root called **radicle** and an embryonic shoot called **plumule**. The radicle grows downward into the soil and forms the **root system** while the plumule grows upward above the ground and forms the **shoot system**. The root system consists of roots and shoot system consists of stem, branches, buds, leaves, flowers and fruits.

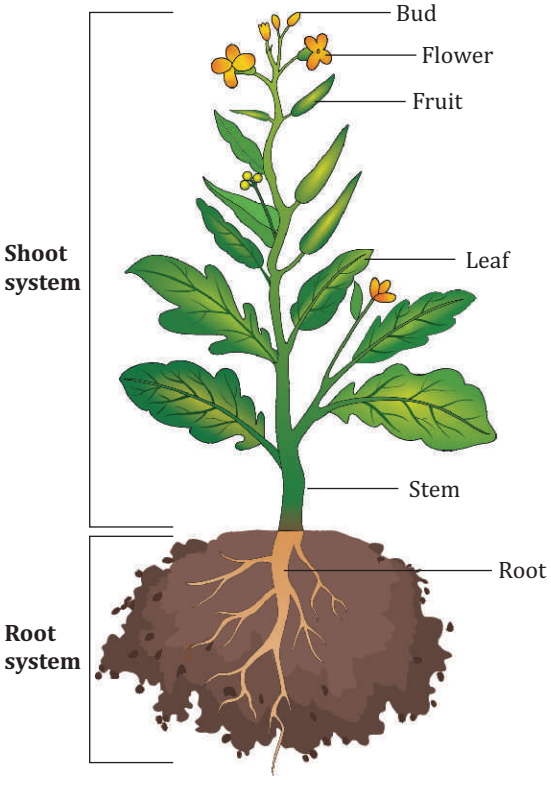


Fig. 1.1 The root system and shoot system of a flowering plant (mustard plant)

FACT ZONE

The root, stem and leaves form the **vegetative part** of a plant while flowers and fruits form the **reproductive part** of a plant. All the flowering plants have **vegetative buds** which give rise to branches and leaves and the **floral buds** which give rise to flowers.

ACTIVITY 1

Aim To study the different types of plants

Visit the school garden or nearby garden with your teacher or parent and observe different types of plants available in that surrounding. Draw their pictures and find out their common names.

ROUGH WORK

DEMONSTRATION 1

Aim To study the different parts of a flowering plant

Materials Required A freshly uprooted plant and a beaker

Procedure Go to the garden and pull out a small flowering plant such as a mustard plant. Gently wash the soil stuck to its roots and put the plant into a beaker containing water.

Demonstrate the different parts like the roots, stem, leaves and flowers of the plant. While demonstrating the plant, ask to compare the plant with the Fig. 1.1 and draw the structure of the plant.

Also ask to think a reason for keeping the plant in a beaker containing water.

FACT ZONE

The single winter rye plant has the world's largest root system. It is grown in central and eastern Turkey. The roots measure up to a total of 622 kilometres in length.

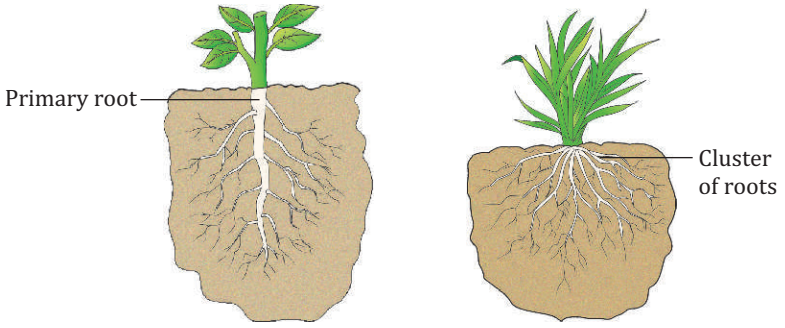
ENRICHMENT

- The **apical buds** present on the tips of a shoot are responsible for the growth of the stem.
- The **axillary buds** produce new leaves and branches on the stem.
- On the stem, the leaves and branches arise from a point called **node**.
- A space between the two successive nodes is called **internode**.

THE ROOT

Roots fix the plant firmly into the soil. They absorb water and minerals for the growth of the plant. There are two types of root systems seen in plants—**tap root system** and **fibrous root system**.

- **Tap root system** In tap root system, one single, primary root elongates and further branch out into fine branches, e.g. roots of pea, balsam and petunia plants.
- **Fibrous root system** In fibrous root system, a cluster of roots arises from the base of the stem, e.g. roots of grass, wheat, rice and onion plants.



(a) Tap root system (b) Fibrous root system

Fig. 1.2 Types of root systems

THE STEM

A **stem** is the main part of a plant that usually grows above the ground. It bears branches, leaves, fruits, buds and flowers. The stem holds the plant upright and exposes the leaves to sunlight and air. It conducts water and dissolved minerals absorbed by the roots to other parts of the plant and also transports food prepared by the leaves throughout the plant body.

Types of Stems

On the basis of their appearance stems are of three types:

1. **Soft stem** These stems are green in colour. Generally, herbs have soft stems.
2. **Hard and woody stem** This type of stem arises from the base of a plant and form a bush. Most of the shrubs have this type of stem.
3. **Trunk** The stem of a tree is called **trunk**. It is a thick, hard and strong stem that is covered with bark. The bark protects the inner parts of the trunk of a tree.

(a) Soft and green stems of spinach

(b) Hard and woody stems of henna

(c) Trunk of a tree

Fig. 1.3 Types of stems

Table 1.1 Differences between the root and the stem

Root	Stem
1. They generally grow under the ground.	1. They generally grow above the ground.
2. Roots are non-green in colour.	2. Young stems are always green in colour and perform the process of photosynthesis.
3. The root does not bear all the vegetative parts like leaves, flowers and fruits.	3. The stem always bears all the vegetative parts of the plant.
4. The root tips are protected by the root caps.	4. The shoot tips are protected by the apical buds.

THE LEAF

A **leaf** is a flat, thin, usually green structure that arises from the node present on the stem. It has an axillary bud in its axil.

A typical leaf has the following main parts:

- **Leaf base** The part joining the leaf to the stem at the end of petiole is called the **leaf base**. It is a small and slightly swollen part by which a leaf is attached to the stem.

FACT ZONE

Origin of Potato

Potato is an underground stem. The people of Peru were the first to cultivate the potato around 4000 years ago. The Andean Mountains of South America are the birth place of the white potato. The name potato is derived from the American-Indian word *'Batata'*.

ASSESS YOURSELF

Answer the following questions.

1. What comprises the root system of a plant?
2. What comprises the shoot system of a plant?
3. What is the function of roots in plants?
4. What is the function of stem in plants?

ROUGH WORK

ACTIVITY 2

Aim To observe patterns of different type of leaves

Take a leaf and apply ink on its surface. Place a paper on the top of it. Pull out the leaf after some time. Observe the leaf-print on the paper. Repeat the activity with different kinds of leaves. Compare the different patterns of leaves.

FACT ZONE

By the counting of axillary buds present, we can find either the plant is single-leafed or multi-leafed. If only one leaf develops after an axillary bud, the plant is **single-leafed** otherwise it is a **multi-leafed** plant.

ROUGH WORK

- **Leaf stalk or petiole** It is a short, narrow and basal part of a leaf which holds up the leaf blade and connects it to the stem. Most of the leaf connect with the stem like this and called as **petiolate leaf**. In some plants, petiole is absent and the leaf directly arises from the stem. such type of leaf is called **sessile leaf**.

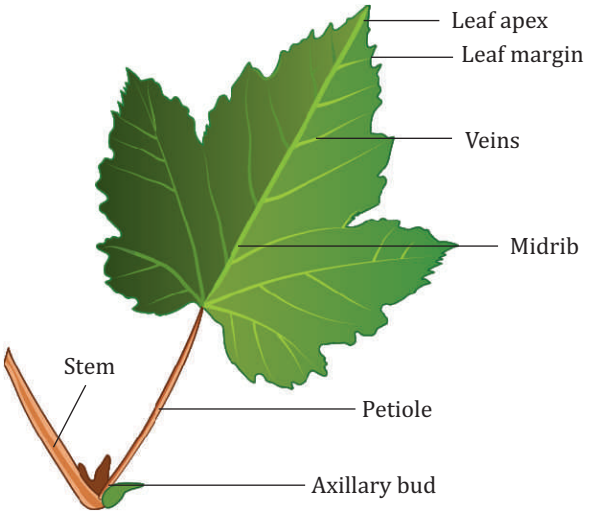


Fig. 1.4 Leaf and its different parts

- **Axillary bud** It is a type of bud developes at the axil of a leaf. It is capable of developing into a branch of the shoot or a cluster of flowers.
- **Leaf blade** The flat, expanded and thin part of the leaf is called **leaf blade** or **lamina**. It is mostly green in colour. Its tip is called **leaf apex**.
- **Leaf margin** The edge of the leaf blade is called **leaf margin**. Different leaves have different types of margins. For example, peepal leaf has complete margin, rose leaf has toothed margin and leaf of ashoka plant has wavy margin.
- **Midrib** The leaf blade has a thick **midrib** along its centre. It extends from the petiole up to the leaf apex.
- **Veins** Lateral branches of the midrib are called **veins**. They further branch out to form **veinlets**. Veins and veinlets conduct water and dissolved minerals absorbed by the roots into the leaf and transport prepared food from the leaves to the stem. The arrangement of veins in a leaf blade is called **venation**.

ACTIVITY 3

Aim To collect the specimens of different types of leaves and make a herbarium

Visit the school garden with your teacher. Collect different types of fresh fallen leaves on the ground and bring them home. Clean off any dirt stuck to them. Before start the pressing of leaves, you may gather the information like:

- The name of the plant from which a particular leaf detached.
- Location where you find a particular leaf
- Shape of the leaf
- Does the leaf have any medicinal value?

For pressing the leaves you may open a thick, heavy book and line its pages with a couple pieces of paper. Gently place the leaves you wish to press on the paper. Be careful while spreading the leaves on the paper. In the same way, you can press different types of leaves in the same book by spacing them several pages apart. Once you have all the leaves you wish to press in the book, close the book very carefully and put something heavy on the top of the book. Set the book aside for 7 to 10 days to let the leaves dry.

Once the leaves are dry take some heavy sheets of paper. With the help of a tape, stick the each dry leaf on it.

Fig. 1.5 A single sheet of herbarium

TYPES OF LEAVES

Leaves may be of two types—**simple** and **compound**.

Simple Leaves

A simple leaf has only one leaf blade or lamina. The leaves of mango, papaya, guava and banyan trees are simple leaves.

Compound Leaves

A compound leaf is one in which the leaf blade is clearly divided into many distinct parts called **leaflets**. The leaves of rose, neem and gulmohar are examples of compound leaves.

(a) Simple leaf (mango) (b) Compound leaf (neem)

Fig. 1.6 Types of leaves

ENRICHMENT

Some plants such as prickly poppy and cotton have simple leaves. In their leaves, the leaf blade is divided or bilobed, but it does not extend to the midrib.

THINK ZONE

1. Most of the leaves are green in colour but some leaves are partially green. Find out the names of such leaves.
2. Which substance makes the leaves green? What is the importance of this substance for plants?

ACTIVITY 4

Aim To study the venation of a leaf.

Take a fresh leaf of peepal and soak it in water for a week. Change the water in every second day so that the leaf does not become perishable. After a week, gently pull the leaf and rub the lamina with your fingers.

Now you may observe that the green colour of the leaf will come off and leave a very fine network of veins showing reticulate venation. You may compare the leaf with the Fig. 1.8 given below.

Fig. 1.8 Reticulate venation of a peepal leaf

SCIENTIST ZONE

Jan Ingenhousz, a Dutch-born British physician and scientist is best known for his discovery of the process of photosynthesis.

(1730-1799)

VENATIONS OF LEAVES

The arrangement of veins and veinlets on the leaf blade is known as **venation**. There are two types of venations—**parallel venation** and **reticulate venation**.

Parallel Venation

In this type of venation, the veins of the leaves run parallel to each other. For example, leaves of maize, fan palm and banana.

Reticulate Venation

In this type of venation, the veins and veinlets of the leaves are interconnected over the entire lamina, forming a web-like network. For example, leaves of castor, peepal and mango.

(a) Parallel venation (b) Reticulate venation

Fig. 1.7 Types of venations in leaves

FUNCTIONS OF LEAVES

- **Manufacture of food** The main function of leaves is to prepare food for the plants. The green leaves prepare food for the plants in the presence of sunlight and chlorophyll by a process called **photosynthesis**. In this process, the leaves use carbon dioxide and water to prepare food in the form of starch. Oxygen gas is released in this process. As the green leaves prepare food for the plants, they are called **food factory of the plants**.

$$\text{Carbon dioxide gas + Water} \xrightarrow[\text{Chlorophyll}]{\text{Sunight}} \text{Starch + Oxygen gas}$$

- **Transpiration** Excess water absorbed by the roots of plants is released into the air through tiny pores present on the lower surface of leaves. These tiny pores are called **stomata**. The process of releasing excess water by the plant is called **transpiration**. It keeps the plants cool.

- **Gaseous exchange** During the day, for performing photosynthesis, plants take carbon dioxide and release oxygen through the stomata. Plants, like other living organisms, respire continuously day and night. In the process of respiration, they take oxygen and release carbon dioxide through the stomata.

During the day, as a result of photosynthesis the oxygen gas released by the plants is used by other living organisms for their respiration. As a result of respiration, the plants release carbon dioxide which is poisonous in nature. Therefore, it is advisable not to sleep under the tree at night.

THINK ZONE

1. Why it is not advisable to sleep under the tree during night?

ROUGH WORK

DEMONSTRATION 2

Aim To prove that during the process of photosynthesis oxygen is evolved in green plants.

Materials Required Hydrilla twigs, beaker, a glass funnel, a test tube, pond water and a glowing splinter.

Procedure

Take a beaker and fill 3/4th of it with pond water. Take some freshly cut hydrilla twigs and insert them in the nozzle from below the stem of a glass funnel. Keep this funnel in an inverted position at the bottom of the beaker. A support arrangement is used in between the base of the funnel and bottom of the beaker. Now a test tube filled with pond water is inverted over the stem of the funnel. While making this arrangement one has to see the level of water in the beaker should be above the level of stem of the inverted funnel. The whole arrangement is kept on a flat surface under bright sunlight for some time.

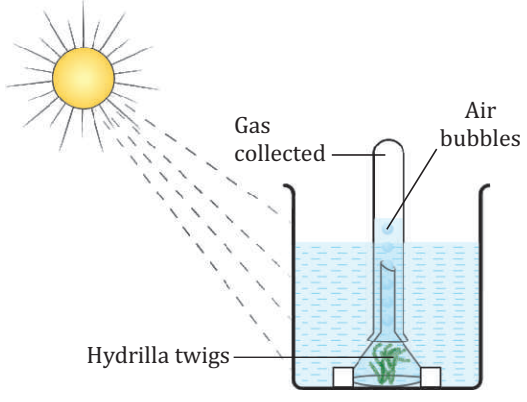


Fig. 1.9 Demonstration to show that during photosynthesis oxygen is evolved

Observation

Air bubbles start moving from the cut end of the hydrilla twigs and get collected at the upper end of the test tube. After some time we find some gas get collected at the top of the inverted test tube by downward displacement of water. To test the nature of the gas collected, the test tube is removed quickly from the stem of the funnel and the mouth is closed with the thumb. Now a glowing splinter is introduced into the test tube by removing the thumb from the mouth of the test tube. The glowing splinter immediately burst into a flame indicating that the gas collected in the test tube is oxygen.

Now answer the following questions:

1. What is the aim of the above experimental setup?
2. Why hydrilla plants are used in this experimental setup?
3. Why pond water only should be used for this experiment?

If a pinch of baking soda is added to the water in the experimental setup what change you can notice in the result of this experiment?

DEMONSTRATION 3

Aim To demonstrate that the process of transpiration takes place through the leaves

Materials Required A potted plant, a polythene bag and some thread

Procedure Take a potted plant and cover it with a clean polythene bag. Keep the whole set up in an open area.

Observation Observe the set up after a few hours. You will observe that the polythene bag covering the plant has some water droplets on its inner surface. Where does this water come from? What is the name of the process?

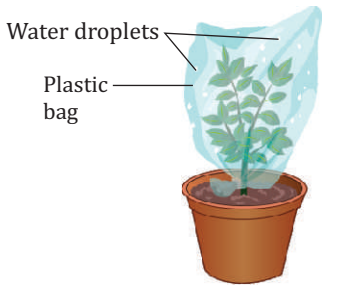


Fig. 1.10 Demonstration to show that transpiration takes place through leaves

ENRICHMENT

Various Modifications of Leaf Tendrils

- In Wild pea, the entire leaf is modified into a tendril.
- In Sweet pea, only upper leaflets are modified into tendrils.
- In Naravelia, the terminal leaflets are modified into leaflets.
- In Glory lily, the leaf-tips are modified into tendrils.

  In Clematis, the petiole of leaf gets modified into tendril.

FACT ZONE

Cactus plants do not have broad, green leaves. In these plants their thick, green stems perform the process of photosynthesis and make food for the plants.

MODIFICATION OF LEAVES

Besides the primary functions such as photosynthesis and transpiration, in some plants, the leaves are modified to carry out some specific functions. Such modifications of leaves are as follows:

Leaf Tendrils

In many weak-stemmed plants, the whole leaf or a part of leaf gets modified into thin, thread-like coiled structure called **leaf tendril**. The tendrils provide suitable support in climbing of the weak stems. They stretch out and coil around any suitable support to help the plant in climbing. For example, the upper leaflets of the sweet pea are modified into tendrils.

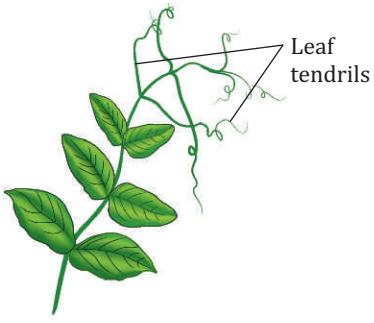


Fig. 1.11 Leaf tendrils of pea plant

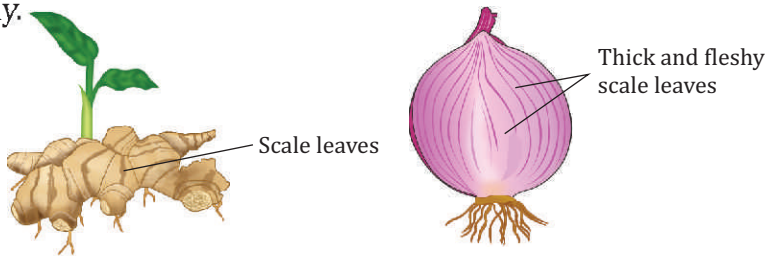
Leaf Spines

Leaves of certain plants get modified to provide protection and to reduce water loss. For example, in cactus plant, leaves are modified into spines and reduce the loss of water by transpiration because the cactus plant is grown in desert areas where there is scarcity of water is present. The leaf spines also protect the plants from the grazing animals like goat and sheep.

Fig. 1.12 Leaf spines of cactus plant

Scale Leaves

Scale leaves are thin and dry structures which are usually brownish in colour or colourless. They take up the function of protecting the axillary buds as in ginger. In onion, they store food prepared by the plant and become thick and fleshy.



(a) Ginger (b) Onion bulb

Fig. 1.13 Scale leaves of ginger and onion bulb

MODIFICATION OF LEAVES IN INSECTIVOROUS PLANTS

Insectivorous plants such as pitcher plant, venus flytrap and bladderwort are adapted to grow in soil which does not have enough minerals, especially nitrogen. These plants feed on insects to obtain minerals. For this, they are modified to trap the insects. They have chlorophyll in their leaves that help them in making of food. Examples of some modified insectivorous plants are as follows:

Pitcher Plant

In the pitcher plant, the lamina of the leaf is modified into a trapping device called **pitcher**. The leaf apex forms the lid of the pitcher and petiole coils like a tendril. As soon as the insect enters the pitcher, the lid closes and insect gets trapped and digested by the juice secreted at the bottom of the pitcher.

Venus Flytrap

In this plant, the edges of the leaves have long pointed hairs. The lamina of the leaf is divided into two parts having a midrib in between like a hinge. When an insect visit the plant, the leaf suddenly closes and the insect gets trapped and digested by the juice secreted by the leaf.

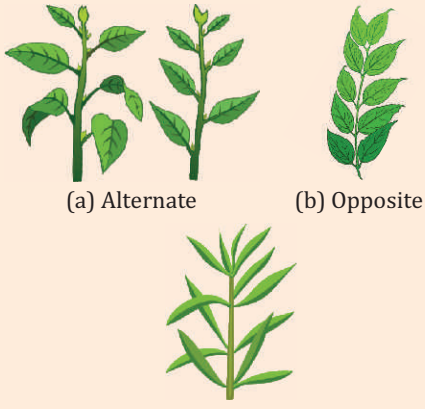
Bladderwort

The leaves of the bladderwort are highly segmented. Some segments form bladder-like structures.

More to Know

Arrangement of Leaves

Leaves are arranging themselves on the branches in such a manner that they get maximum exposure to sunlight. They may be found arranged in the following three different ways:



(a) Alternate (b) Opposite

(c) Whorled

Fig. 1.14 Arrangement of leaves

The term used for the arrangement of leaves on the branches is **phyllotaxy**.

ROUGH WORK

Assess Yourself

1. **Name them.**
   (a) A part joining the leaf to the stem. _____
   (b) A type of leaf venation in which veins are run parallel to each other. _____
   (c) A process by which the green leaves make food for the plant. _____
   (d) A thread-like coiled modification of leaves. _____
   (e) The modified leaves of an onion bulb. _____
   (f) A plant that shows vegetative propagation through their leaves. _____
2. **Fill in the blanks.**
   (a) The air enters a leaf through _____.
   (b) In wild pea, the _____ leaf is modified into a tendril.
   (c) In glory lily, the _____ are modified into tendrils.
   (d) In cactus plants, leaves are modified into _____ .
   (e) Bladderwort is an example of _____ plants.

When an insect enters through the opening, it gets trapped. The insect cannot come out from the opening and get digested by the juice secreted by the leaves.

(a) Pitcher plant (b) Venus flytrap (c) Bladderwort

Fig. 1.15 Modifications of leaves in insectivorous plants

VEGETATIVE PROPAGATION IN LEAVES

In some plants, a new plant can be develops from the vegetative parts like roots, stem or leaves. This is known as **vegetative propagation**. Some plants such as bryophyllum and begonia produce adventitious buds on their leaf margins. When the leaf of such plants fall on the moist soil, these buds develop into new plantlets. The leaves of such plants are thick and fleshy thus, they provide enough food and water to the new plantlets.

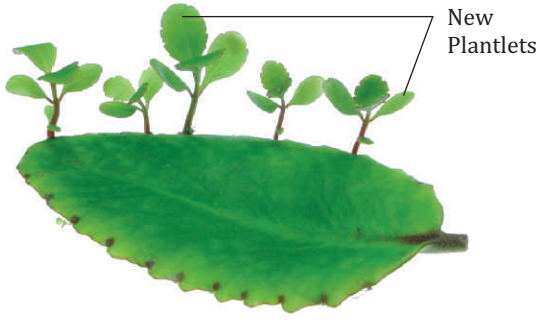


Fig. 1.16 Leaf of bryophyllum shows vegetative propagation

Activity 5

Aim To observe vegetative propagation in leaves

Procedure

1. Take a pot half filled with soil.
2. Take a leaf from bryophyllum plant. Gently pluck some new plantlets sprouting from the margin of the leaf.
3. Now plant them in the pot and leave the pot in an open area where sufficient amount of light and air is available. Do not forget watering the pot. Leave the pot for a few days.
4. After a few days you will see that small new plants sprouting out from the pot.

Let's Recapitulate

- All flowering plants consist of two main parts—the **root system** and the **shoot system**. **Roots** firmly hold the plant into the soil and absorb water from the soil for plants. **Stems** bear branches, buds, leaves, flowers and fruits.
- A **leaf** is a flat, broad and lateral outgrowth of the stem. It has the following parts—leaf base, leaf stalk, leaf blade, axillary bud, veins and midrib.
- There are two types of leaf—**simple leaf** and **compound leaf**.
- The arrangement of veins and veinlets on the leaf blade is called **venation**. It is of two types—**simple venation** and **reticulate venation**.
- Green leaves prepare food for the plants by the process of **photosynthesis**.
- Leaves release excess water through **stomata**, the tiny pores present on the lower surface of leaves. This process is known as **transpiration**.
- The gaseous exchange in plants also takes place through stomata present on the leaves.
- Leaves are modified as **leaf tendrils**, **leaf spines** and **scale leaves** to carry out some special functions in plants.
- **Insectivorous plants** grow in places where the soil does not have enough minerals, especially nitrogen. The leaves of insectivorous plants are modified and get nutrition from trapping and digesting the small insects.
- Leaves of bryophyllum develop adventitious buds on their margins. When they fall off in the moist soil they develop into new plantlets. This is called **vegetative propagation**.

Evaluate Your Understanding

Recalling Ideas

I. Select the correct option.

1. The flat, thin part of a leaf is called
   (a) leaf blade ☐ (b) petiole ☐
   (c) leaf margin ☐ (d) leaf vein ☐
2. A type of leaf in which a single leaf attached by a petiole to the stem is known as
   (a) simple leaf ☐ (b) compound leaf ☐
   (c) dry leaf ☐ (d) green leaf ☐
3. The green leaves make food for the plant by a process called
   (a) transpiration ☐ (b) evaporation ☐
   (c) photosynthesis ☐ (d) none of them ☐
4. In cactus plant, the parts modified into spines are the
   (a) stem ☐ (b) leaves ☐
   (c) buds ☐ (d) flowers ☐

5. Insectivorous plants grow in soil deficient specially in
   (a) nitrogen ☐ (b) oxygen ☐
   (c) iron ☐ (d) water ☐
6. Vegetative propagation is shown by the leaves of
   (a) rose plant ☐ (b) neem plant ☐
   (c) bryophyllum plant ☐ (d) mango plant ☐

II. Fill in the blanks with the correct option.

1. The part of a plant that grows under the ground is called _____. (shoot/root)
2. An example of insectivorous plant is _____. (bladderwort/rose)
3. The banana leaves have _____ venation. (parallel/reticulate)
4. In compound leaves the leaf blade is distinctly divided into _____. (leaflets/petioles)
5. The edge of leaf blade is called _____. (leaf margin/leaf vein)

III. State if the following statements are True or False. Correct the False statement.

1. The leaves of sweet pea plant are modified into spines.
2. The arrangement of veins on the leaf blade is called venation of the leaf.
3. The leaf tendrils and leaf spines are the examples of simple leaves.
4. Insectivorous plants grow in a nutrient rich soil.
5. An irregular network of veins is found in banana leaves.

IV. Match the following.

Column A	**Column B**
1. Maize leaf	(a) Reticulate venation
2. Mango leaf	(b) Parallel venation
3. Onion bulb	(c) Kitchen of the plant
4. Leaf	(d) Stomata
5. Gaseous exchange in plants	(e) Scale leaves

V. State the functions of the following.

1. Leaf tendrils _____
2. Leaf spines _____

Understanding Ideas

I. Give one word for the following.

1. The point of attachment of the leaf to the stem. _____
2. A bud present in the axil of leaf. _____
3. A process by which plants make their own food _____
4. A process of leaves that keeps cool the plant. _____
5. The tiny pores through which air enters the leaves. _____
6. A space between the two nodes. _____
7. The wide, thin, flat part of a leaf. _____
8. The plants that feed on the insects. _____

II. Answer the following questions in short.

1. Give one example of leaf modification.

_____

_____

_____

2. Name a plant that has reticulate venation in its leaves.

_____

_____

_____

3. Which type of leaf venation is found in the leaves of banana plant?

_____

_____

_____

4. Give two important functions of the leaf.

_____

_____

_____

5. What is meant by the term photosynthesis?

_____

_____

_____

6. Give examples of two plants in which leaves are modified into leaf tendrils.

_____

_____

_____

7. What are leaf spines? Give example.

_____

_____

_____

8. Give two examples of insectivorous plants.

_____

_____

_____

9. Which part of the cactus plant gets modified into spines?

_____

_____

_____

III. Answer the following questions in detail.

1. Why the leaves in cactus plants are reduced to spines?

_____

_____

_____

_____

_____

2. How is green colour of leaves helpful to the plants?

_____

_____

_____

_____

_____

3. Mention three functions of leaves.

_____

_____

_____

_____

_____

4. Which types of plants are known as insectivorous plants? Which part of the plant body is modified in these plants?

_____

_____

_____

_____

_____

5. Give two examples of the following:

(a) Scale leaves _____

_____

(b) Leaf tendrils _____

_____

6. What is meant by the venation of leaves? Write its types with examples.

_____

_____

_____

_____

_____

7. What are the main parts of a leaf?

_____

_____

_____

_____

_____

8. What is a leaf? mention its types.

_____

_____

_____

_____

_____

9. Define the following terms:

(a) Photosynthesis _____

_____

(b) Stomata _____

_____

10. Write a short note on vegetative propagation in leaves.

_____

_____

_____

_____

_____

IV. Differentiate between the following.

1. Parallel venation and reticulate venation

_____

_____

_____

2. Leaf tendril and leaf spine

_____

_____

_____

3. Simple leaf and compound leaf

_____

_____

_____

Think Critically

1. Why are the leaves of cactus plant reduced to as spines?
2. Why does the insectivorous plants feed on insects?

Diagram-based Question

1. The picture of spur cactus is shown below. Observe the picture and label the leaves on it. Also mention the function of cactus leaves.

Function of cactus leaves is: _____

_____

_____

_____

_____

Project Ideas

1. Prepare a project on the topic 'Different Types of Leaves'. For this, collect different types of leaves from the nearby garden or a park. With the help of strong glue, stick them on a chart paper. Below each leaf, mention its name, structure, and type of venation. Display your project in the class.
2. Choose any one kind of plant with simple leaves such as mango, neem, guava and peepal. Pluck at least 10 leaves from it. Use a thread to measure the length from the start of the tip of the leaf to its end and note down the measurement. Now add up all the measures and divide them with the number of leaves you have measured. This is average length of the leaf.
3. Collect different types of leaves. Press them and dry them carefully. Now cut the leaves in a designer pattern and paste them by giving a beautiful look. Here an example is given for you.

Chapter - 2

Plant Life—The Flower

Learning Objectives

Let's learn about

- The Flower
- Parts of a Flower
- Types of Flowers
- Functions of a Flower
- Pollination
- Types of Pollination
- Fertilisation
- The Fruit
- Dry and Fleshy Fruits
- Functions of a Fruit
- The Seed
- Types of Seeds
- Germination of a Seed
- Types of Germination

You have already been familiarised with the different parts of a plant body such as roots, leaves, flowers, buds and fruits. Now, you will study more about the flower, the most attractive and beautiful part of the plants. The flower develops from a **floral bud** present on the stem.

THE FLOWER

A **flower** is the reproductive part of a plant. It may or may not be attached to the stem by means of a long stalk called **pedicel**. The tip of pedicel is slightly flattened and is called **thalamus**. All the other parts of a flower arise from the thalamus.

PARTS OF A FLOWER

A typical flower has four main parts—**calyx**, **corolla**, **androecium** and **gynoecium**. All the four main parts of a flower arranged in four whorls.

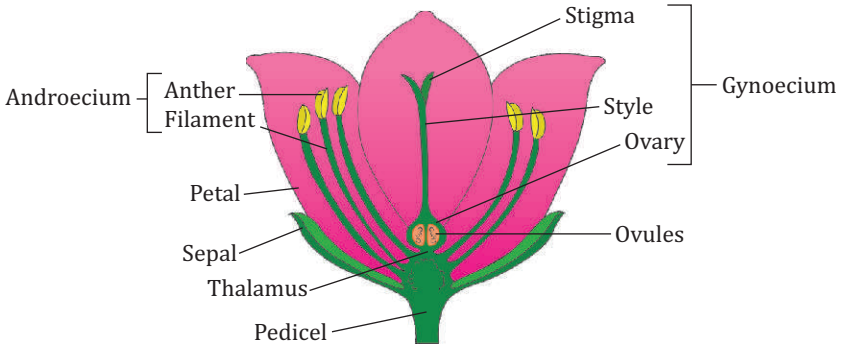


Fig. 2.1 Parts of a flower

Calyx

It is the outermost first whorl of a flower. It is usually green in colour. It consists of green, leaf-like structures called **sepals**. The sepals enclose and protect the flower in the bud stage.

Corolla

It is the second inner whorl of a flower. It consists of brightly coloured, large and scented structures called **petals**. They protect the other essential whorls of a flower and help in pollination.

More to Know

- A flower which has all the four floral whorls is called a **complete flower**.
- A flower which lacks any one of the floral whorls is called an **incomplete flower**.
- The largest flower in the world is **Rafflesia**, found in the rainforests of Indonesia. It can grow 3 feet long.

FACT ZONE

Interesting Facts about Flowers

- Flowers of the bamboo plants are rarely seen. Some bamboo plants develop after 65 to 120 years. Interesting fact about flowering is that in a single bamboo plant, all flowers bloom at the same time.
- A sunflower is not a single flower but it is made of many tiny flowers called **florets**.
- In the agave plant a single flower blooms after many years and dies.

ENRICHMENT

- Flowers are used for extraction of perfumes and in the manufacture of cosmetics.
- Cloves, which are the dried flowers, are used as a spice and also have some medicinal value.

ROUGH WORK

_____

_____

_____

_____

_____

_____

_____

_____

Androecium

It is the third whorl of a flower. It is the **male reproductive part** of a flower. It consists of filament-like structures called **stamens**. The number of stamens in different flowers may vary from a few to more. Each stamen has two main parts:

- a thin, long and narrow stalk called **filament** which supports the anther, and
- a small, bilobed structure called **anther**.

The anther bears yellow, powdery substances called **pollen grains**. The pollen grains take part in reproduction of flowers.

Gynoecium

It forms the fourth innermost whorl of a flower. It is the **female reproductive part** of a flower. It is composed of one or more **carpels** or **pistils**. Each carpel or pistil is composed of **stigma**, **style** and **ovary**.

- **Stigma** is the sticky, disc-like terminal part of the ovary on which the pollen grains land.
- **Style** is the long, narrow, thread-like tube extending from the ovary. It holds the stigma.
- **Ovary** is the swollen part which contains small round-shaped eggs called **ovules**.

ACTIVITY 1

Aim To study the different parts of a flower

Materials Required A china rose (hibiscus) flower, forceps, glass slide, brush, blade and microscope

Procedure

1. Take a china rose flower and observe all the four whorls carefully.
2. Gently peel off all the four green sepals from the outermost whorl with the help of forceps; you will see a large red coloured whorl of petals that are joined at the base.
3. After removing the petals, you will see a thin, long, tube-like structure which is swollen at the base and has a sticky, bilobed tip. This is the pistil. Its swollen part is called ovary, its tube is called style and the sticky tip is called stigma.
4. At the tip of the pistil, you will see numerous, small hair-like structures with orange coloured tips. These are the stamens. With the help of a brush, put some stamens on the glass slide and observe them under the microscope. You will see that the stamens are bilobed. When you carefully slit the stamen with the help of a blade, you will find minute pollen grains present inside the stamens.

   On the basis of your observations complete the following:

   - Number of whorls present _____
   - Number of petals present _____
   - The stamens consist of _____
   - Number of sepals present _____
   - The gynoecium consist of _____

Note: You can study other flowers such as petunia and mustard flower in the same manner.

Table 2.1 Parts of a flower and their functions

Flower part	Function
Sepals	Sepals protect the inner parts of a flower at its bud stage.
Petals	Petals protect the essential whorls of a flower and attract butterflies, bees and insects for pollination. They may also secrete scent and nectar.
Stigma	It has a sticky substance for trapping the pollen grains.
Style	Style holds the stigma high to catch the pollen grains. It varies in length.
Ovary	It protects the ovule and grows into the fruit.
Ovule	The ovules develop into seeds.
Filament	It holds the anther high up.
Anther	It contains pollen grains.

TYPES OF FLOWERS

Based on the presence and absence of male or female reproductive parts, flowers are of mainly two types:

1. **Bisexual flower** which possesses both the male part (androecium) and female part (gynoecium). Rose and hibiscus are the examples of bisexual flower.
2. **Unisexual flower** which possesses either male part (androecium) or female part (gynoecium). Papaya flower is an example of unisexual flower.

FUNCTIONS OF A FLOWER

A flower serves an important function in plants. As a reproductive part, it insures the continuation of a species by the process called **reproduction**. The first step for achieving this is **pollination** and the second step is **fertilisation**.

POLLINATION

For the formation of seeds, the pollen grains produced in the anther must be transferred to the stigma of the pistil. The process of transfer of pollen grains from the anther to the stigma of the same flower or another flower of same type of plant is known as **pollination**. It occurs naturally or by means of some external agents such as wind, water and insects.

TYPES OF POLLINATION

There are two types of pollination—**self-pollination** and **cross-pollination**.

ENRICHMENT

Pollinator

A pollinator is a living organism or an animal that helps in pollination. These animals may not be aware that they are helping in pollination, they visit the plant attracted by its smell, sugary nectar and colour. Animals that help plants in pollination include insects such as bees, butterflies, moths, beetles and certain other animals such as birds and bats. Usually, insects visit the plant to get sweet nectar. For this, they sit on the base of the petals and rub themselves onto the stamens of the flower. The sticky pollen grains get attached on their body. When they move to another flower for food, some of the pollens fall on the stigma of that flower, thus, leading to pollination.

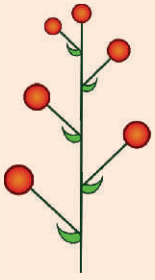
ACTIVITY 2

Take a flower and pinch off the anthers from it. Crush the anthers between your fingers. You will find a yellow, powdery substance coming out in your fingers. These are the **pollen grains**. If you rub your fingers on a white sheet of paper, the pollen grains will be transferred to the paper. In the same way, the process of cross-pollination takes place.

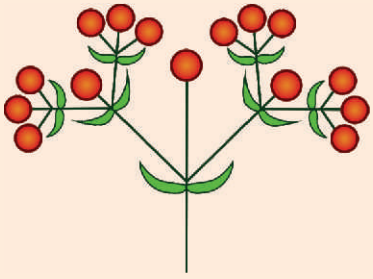
More to Know

Inflorescence

An **inflorescence** is a group or cluster of flowers on a branch of a plant. It refers to the arrangement of flowers on the floral axis (flower stalk). The flower arranged singly or in clusters on the floral stalk.



(a) Flowers borne singly

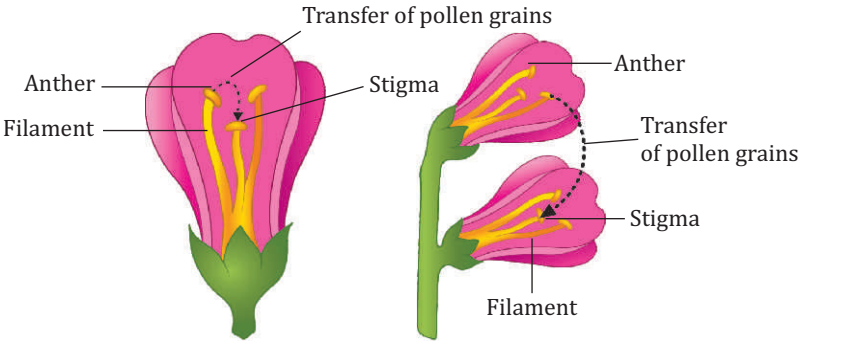


(b) Flowers borne in clusters

Fig. 2.4 Arrangements of flowers on the floral stalk

Self-pollination

When the pollen grains from an anther of a flower are transferred to the stigma of same flower or another flower of the same plant, it is termed as **self-pollination**. The self-pollination occurs naturally.



(a) Transfer of pollen grains from anther to the stigma of the same flower

(b) Transfer of pollen grains from anther of one flower to the stigma of another flower of the same plant

Fig. 2.2 Self-pollination

Cross-pollination

When the pollen grains are transferred from the anther of one flower to the stigma of another flower of the same type, it is termed as **cross-pollination**. It occurs through external agents.

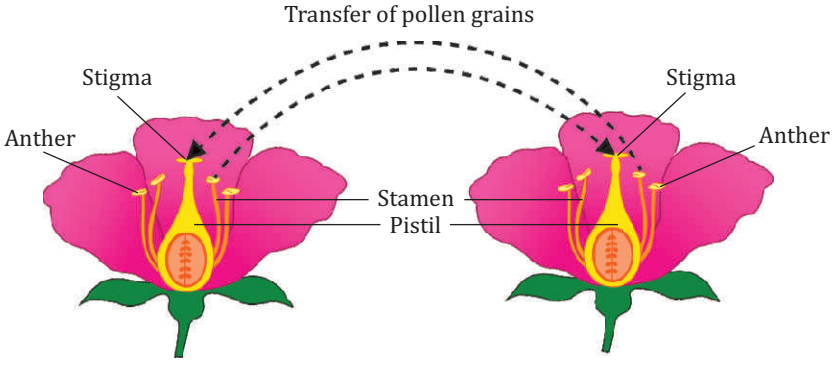


Fig. 2.3 Cross-pollination

Agents of Cross-pollination

Cross-pollination takes place by various external agents like, wind, water and insects.

Pollination by Wind Some plants like maize and wheat have dry and light pollen grains produced in a large quantity. As the flowers of these plants get matured, pollen grains are blown away by the wind. Some of these pollen grains fall on the stigma of a flower of the same type, thus, resulting in pollination.

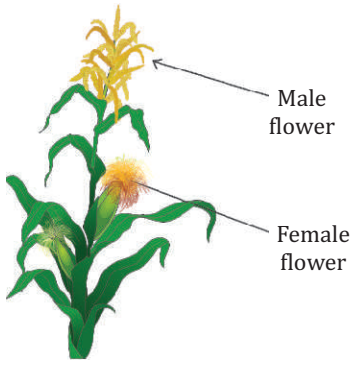


Fig. 2.5 Pollination by wind in maize plant

Pollination by Water In some aquatic plants like *hydrilla* and *vallisneria*, the male flowers are completely submerged in water. On maturity, they get detached and float on the surface of water. The female flower that has a long stalk also floats on the surface of water. When a male flower moving with the water current comes in contact with the female flower, the pollen grains fall on the stigma, thus, leading to pollination.

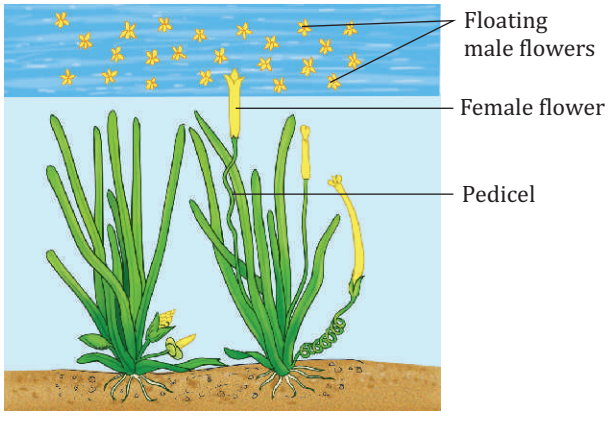


Fig. 2.6 Pollination by water in *vallisneria*

Pollination by Insects Insects, like bee and butterfly, collect nectar from flowers. When these insects alight on a flower, the pollen grains stick to their bodies. When they visit another flower, the pollen grains are transferred to the stigma, thus, leading to pollination.

Examples: Orchids, *harsingar* and *salvia.*

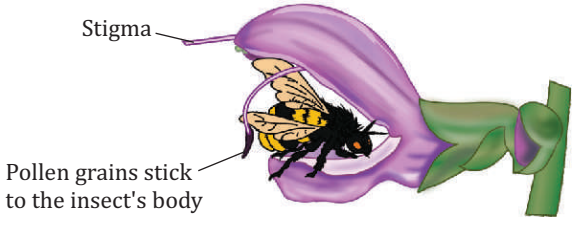


Fig. 2.7 Pollination by insects in *salvia*

More to Know

The Maize Plant

In the maize plant, the lower leaves are broad and long. Under these leaves and close to the stem grow the ears. The ears are the female reproductive parts of the corn cob, tightly covered with many layers of leaves. The pale yellow silky hairs emerge from the ear are the elongated stigmas.

ENRICHMENT

Flowers that are pollinated by insects show the following features:

- They have brightly-coloured petals to attract insects.
- They produce nectar.
- They are sweet smelling.
- Pollen grains and stigmas of such flowers are sticky.

FACT ZONE

The flowers of Trapa (*Singhara*) are exposed to air and get pollinated by insects.

THINK ZONE

1. Wind pollinated flowers are usually small in size. Why are they so?
2. Why are petals brightly coloured specially in insect-pollinated flowers?

ASSESS YOURSELF

Fill in the blanks.

1. A typical flower has four whorls, namely _____, _____, _____ and _____.
2. The _____ encloses and protect the flower.
3. _____ are brightly coloured parts of the flower.
4. The pollen grains land on the _____.
5. The _____ contains round shaped eggs called _____.
6. A flower which has all the four whorls is called _____ flower.
7. After fertilisation, the ovary changes into a _____.
8. *Vallisnaria* is a _____ pollinated plant.

ROUGH WORK

_____

_____

_____

_____

_____

_____

_____

Table 2.2 Differences between self-pollination and cross-pollination

Self-pollination	Cross-pollination
1. The transfer of pollen grains takes place from the anther to the stigma of the same flower or another flower of the same plant.	1. The transfer of pollen grains takes place from the anther of one flower to the stigma of another flower of the same type.
2. In this type of pollination external pollinating agents are not required.	2. In this type of pollination external pollinating agents such as water, wind and insects are required.
3. The flowers need not be large, showy and scented.	3. Flowers should be large, showy and scented.

FERTILISATION

After reaching the stigma, the pollen grains develop a pollen tube which carries a **male cell** on its tip. The pollen tube travel through the style and reach the ovule inside the ovary. The ovule contains a female cell (an egg). When the male cell through the pollen tube reaches the ovary, it unites with the female cell. As a result, a single cell called **zygote** is produced, which later develops into a new plant. The process of fusion of the male cell with the female cell is known as **fertilisation**.

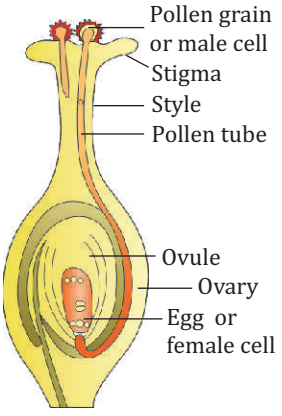


Fig. 2.8 Process of fertilisation

Post-fertilisation Changes

After fertilisation, the changes that take place in each part of the flower are shown in Table 2.3.

Table 2.3 After fertilisation fate of each part of a flower

Part of a flower	Change takes place
1. Petals, stigma and anthers	Dry up and fall off
2. Sepals	Often dries up and stay attached
3. Ovary	Develops into fruit
4. Ovary wall	Develops into fruit wall
5. Ovule	Develops into seed

THE FRUIT

A fruit is the mature and ripened ovary, developed after the completion of two processes—pollination and fertilisation. A fruit contains an outer fruit wall or **pericarp** and the **seeds**. The structure and thickness of pericarp may vary from fruit to fruit.

DRY AND FLESHY FRUITS

When the pericarp of a fruit is dry, it is known as **dry fruit**. All the nuts are the examples of dry fruits. When the entire pericarp or its part becomes juicy and fleshy on ripening, the fruit is called the **fleshy fruit**, e.g. mango and papaya.

(a) Almond (dry fruit) (b) Walnut (dry fruit) (c) Banana (fleshy fruit)

Fig. 2.9 Examples of dry and fleshy fruits

In the fleshy fruits, the pericarp is further divided into three parts:

1. **Epicarp** is the outer, thin and leathery part which forms the tough, outer skin of the fruit. Initially, it is green in colour but when ripen, it becomes coloured other than green.
2. **Mesocarp** is the sweet, fleshy and edible part of the fruit.
3. **Endocarp** is the inner hard and woody part of the fruit that usually contains seeds.

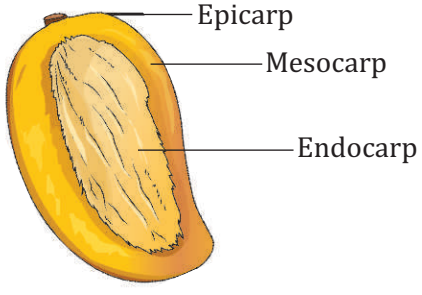


Fig. 2.10 Parts of a fruit (mango)

FUNCTIONS OF A FRUIT

- It protects the seeds from extreme environmental conditions.
- It stores food materials.

More to Know

Types of Fruits

- Fruits can be classified as follows:
- **Simple fruits** are those which develop from a single ovary, e.g. cherry, mango, peach, pear, apple, tomato, peanut and walnut.
- **Aggregate fruits** develop from a single flower which has many ovaries and each ovary gets fertilised separately, e.g. strawberry and blackberry.
- **Multiple fruits** develop from a cluster of separate flowers borne on a single structure, e.g. pineapple and fig.

FACT ZONE

Actually, most of the dry fruits are green in their initial stage. They become dry at maturity.

ENRICHMENT

True Fruit and False Fruit

A **true fruit** is develops from a mature and ripen ovary. The **false fruit** develops from the other parts of the flower rather than ovary. Apple is an example of false fruit because it does not develop from the flower but develops from the thalamus (a part on which the flower grows). Gourd, cucumber, pine apple and jack fruit are also the examples of false fruits.

More to Know

- Mango, orange, melon, gourd and apple are the examples of **fleshy fruits**. They have seeds in their fleshy parts.
- Plums, peaches and cherries are the examples of **stone fruits**. They contain pits or stones in them.
- Different types of nuts, grains, legumes such as beans are the examples of **dry fruits**.
- Peas are the examples of **pods**.

ACTIVITY 3

Aim To identify the given seeds as monocot and dicot

Take some seeds of rajma bean, gram, maize and wheat. Soak them in a glass bowl containing water for six hours. Now remove their seed coats and open up all the seeds. If the seed has two exactly the same parts (they are cotyledons), it is called a dicot seed. The seed which cannot be opened into two equal halves is a monocot seed. Now, list out the two types of seeds.

ROUGH WORK

- It attracts birds and animals for dispersal of its seeds to far away places where in suitable climatic conditions, these seeds grow into the new plants.

THE SEED

After fertilisation, the ovule present in the ovary develops into the **seeds**. The seed has an outer protective cover, called the **seed coat**. There is a small scar on the seed coat. This is known as **hilum**. It is a point from where the seed breaks from the stalk. At the pointed end of a seed, **micropyle** is situated very close to helium. The micropyle marks the point through which the pollen tube had entered the ovule. On removing the seed coat, the fleshy parts called **cotyledons** are seen. The cotyledons store food for the baby plant called **embryo**. An embryo has two parts—**radicle** and **plumule**. The radicle develops into roots while the plumule develops into shoot. Under favourable conditions of air, water and temperature, the seed germinates to produce a new plant.

TYPES OF SEEDS

On the basis of the number of cotyledons present, seeds are of two types:

1. **Monocot** This type of seeds have only one cotyledon, e.g. maize and rice.
2. **Dicot** This type of seeds have two cotyledons, e.g. gram and beans.

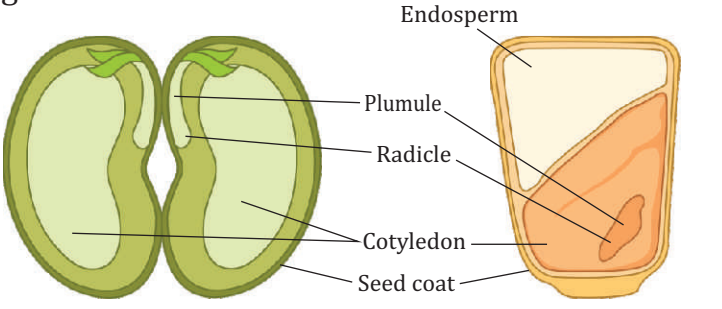


Fig. 2.11 Structures of dicot and monocot seeds

GERMINATION OF A SEED

The embryo lies dormant in the seed. But when the embryo is supplied with moisture, it becomes active and tends to grow into a small seedling. The process by which the dormant embryo becomes active, grows and establishes itself as a seedling is called **germination**.

ACTIVITY 4

Aim To observe germination in a bean seed

Procedure

1. Take a small amount of water around the jar.
2. Fold your napkin or kitchen roll and place it in the jar. (We make the kitchen roll very slightly damp also.)
3. Place the bean seed in the jar resting on the napkin.
4. Spray some water on the bean seed every few days.
5. The bean seed should start to grow roots after a few days, this is called germination.
6. Draw the germinated seed. Remove the seed coat and open up the seed. Observe the baby plant using a hand lens. Draw correctly what you observe.

Repeat the same activity but keep the setup inside the refrigerator. Did the seed germinate inside the refrigerator? What do you conclude?

So, we can conclude that the most important external factors required for germination include right temperature, water, oxygen or air and sometimes light or darkness.

Conditions Necessary for Germination of Seeds

Seeds have ability to germinate when the conditions are favourable. The conditions necessary for germination of seeds are the sufficient amount of **water**, **air** and a **suitable temperature**.

Water

For the germination of seeds, water is one of the most important factors due to following reasons:

- It softens the seed coat due to which the seed bursts open. When the seed coat bursts, the radicle elongates and grows to form the primary root. The plumule comes out and grows upward to form the shoot.
- In dormant seeds, food material is stored in concentrated form. Water dissolves the concentrated food into the soluble form which is used by the growing embryo. Water also activates enzymes (the chemicals that accelerate absorption of soluble food by the growing embryo).

Air

Like any other organisms a plant also respires, *i.e.* takes in air (oxygen). Seeds require energy for their proper growth. This energy comes from the respiration of seeds.

Temperature

Seeds require an optimum temperature to grow properly. The favourable temperature for the germination of most of the seeds is 35°C to 40°C. Below 0°C and above 40°C, seeds fail to germinate.

ACTIVITY 5

Aim To compare the rate of germination in different types of seeds

You can compare the rate of germination of different types of seeds. For this, soak bean, mustard, maize, wheat, and gram seed, leave them in a tray of soil to germinate. Observe germination in each seed. Compare the rate in which the seeds germinate. Write the observation in a tabulated form.

ROUGH WORK

EXPERIMENT 1

Aim To study the condition necessary for the germination of seeds

Materials Required Three bean seeds, glass slide and a beaker

Procedure Tie three bean seeds to a glass slide with the help of a cotton thread. Take a beaker and fill it three-fourths with water. Dip the slide into the water in such a way that the lower seed is completely soaked in water, the upper seed is exposed to air and the middle seed is half-immersed in water and half exposed to air. Keep the beaker in a warm place for a week.

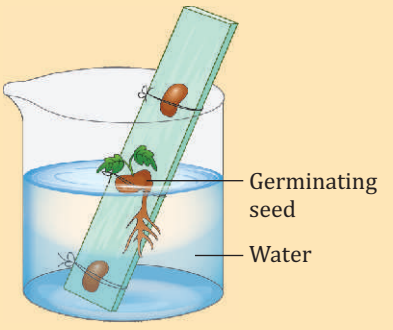


Fig. 2.12 To study the conditions necessary for germination of a seed

Observation After a week, you will observe that:

- The middle seed germinates well because it gets the sufficient amounts of heat, air and water.
- The upper seed does not germinate because it had sufficient amounts of air and heat but no water.
- The lower seed does not germinate because it had sufficient amount of water but no heat and air.

ASSESS YOURSELF

Choose the correct option.

1. The fruit is a ripened ovary/ovule.
2. The outer, thin and leathery part of a fruit is called pericarp/epicarp.
3. The protective cover of a seed is called helium/seed coat.
4. Dicotyledonous plants have two/three cotyledons.
5. A process by which seeds establish themselves as seedlings is called germination/fertilisation.
6. The necessary conditions for seed germination are water, air and a suitable temperature/only air and water.
7. In epigeal/hypogeal germination, cotyledons are carried above the soil.
8. In epigeal/hypogeal germination, cotyledons are remain underground.

TYPES OF GERMINATION

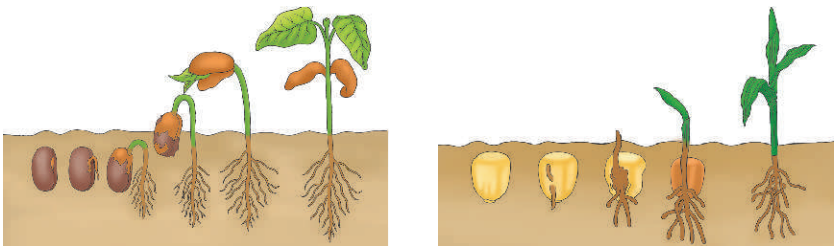
A seed can be germinate by two types—**epigeal germination** and **hypogeal germination**.

Epigeal Germination

In dicot seeds, the cotyledons, thick with stored nutrients, emerge above the ground during germination, and then transport the stored nutrients to the developing seedling. This type of germination is known as **epigeal germination**. Bean, cotton, papaya and caster are the seeds that show epigeal germination.

Hypogeal Germination

The monocot seeds contain only one cotyledon. When these seeds germinate, the cotyledon remains below the ground. The cotyledon transports the nutrients in them to the developing seedling. This type of germination is called **hypogeal germination**. Seeds of maize, groundnut and mango show the hypogeal germination.



(a) Bean seed is carried above the ground with the developing shoot **(Epigeal germination)**

(b) Maize seed remains underground **(Hypogeal germination)**

Fig. 2.13 Types of germination of seeds

Let's Recapitulate

- **Flower** is the most beautiful and colourful part of a plant. It develops from the floral bud present on the stem.
- A typical flower performs the reproduction in plants. It has four whorls—**calyx**, **corolla**, **androecium** and **gynoecium**.
- **Calyx** or **petals** are green colour structures which form the outermost whorl while **corolla** or **petals** are coloured other then green structures, form second inner whorl of a flower.
- **Androecium** and **gynoecium** are the third and fourth whorls of a flower which are known as male and female parts of a flower, respectively.
- The main function of the flowers is to produce fruits and seed. For achieving this, they perform two processes—pollination and fertilisation.
- The process of transfer of pollen grains from the anther to the stigma of the same flower or another flower of same type is known as **pollination**. It is of two types—**self-pollination** and **cross-pollination**.
- Cross-pollination of plants takes place by various external agents like wind, water, birds and insects.
- The process of fusion of the male cell with the female cell is known as **fertilisation**. After fertilisation, the petals and sepals wither away, the ovule changes into a seed and the ovary develops into a fruit.
- The **fruit** is a matured ripened ovary.
- On the basis of the number of cotyledons present, seeds are of two types—**monocots** and **dicots**.
- **Germination** of seed is a process in which a dormant embryo becomes active and establishes itself as a seedling.
- Sufficient amount of water, air and a suitable temperature are the conditions necessary for the germination of seeds.
- A **seed** can be germinated either by **epigeal germination** or by **hypogeal germination**.

Evaluate Your Understanding

Recalling Ideas

I. Select the correct option.

1. Flowers enhance the process of
   (a) pollination in plants ☐ (b) fertilisation in plants ☐
   (c) both of them ☐ (d) none of them ☐
2. Pollen grains are produced in the
   (a) ovary ☐ (b) anther ☐
   (c) stigma ☐ (d) style ☐
3. The gynoecium consists of
   (a) style, stigma, ovary ☐ (b) anther, filament, style ☐
   (c) stigma, style, anther ☐ (d) stigma, filament, ovule ☐

4. Calyx consists of the
   (a) stamens ☐ (b) anthers ☐
   (c) sepals ☐ (d) petals ☐
5. Transfer of pollen grains from anther to stigma is termed as
   (a) reproduction ☐ (b) fertilisation ☐
   (c) pollination ☐ (d) fusion ☐
6. A dicot seed has
   (a) one cotyledon ☐ (b) two cotyledons ☐
   (c) three cotyledons ☐ (d) four cotyledons ☐
7. A dicot seed germinates by
   (a) epigeal germination ☐ (b) hypogeal germination ☐
   (c) germination does not take place ☐ (d) none of them ☐
8. The fusion of male cell with the female cell in the ovary is called
   (a) pollination ☐ (b) fertilisation ☐
   (c) germination ☐ (d) vegetation ☐

II. Fill in the blanks with the correct option.

1. Pollen grains are produced in the _____. (anther/stigma)
2. All fruits are formed by the _____. (ovaries/ovules)
3. The gynoecium consists of _____. (stigma and style/stigma and anther)
4. The brightly coloured flowers are usually pollinated by _____. (insects/wind)
5. The part of a flower that gives rise to a seed is called _____. (ovule/stigma)

III. State if the following statements are True or False. Correct the False statement.

1. The flower is transformed into a fruit.
2. Zygote is the result of fusion of male cell with the female cell.
3. Most flowers have colourful sepals.
4. Wind-pollinated flowers produce pollen grains in large quantity.
5. A stamen has long stalk called style.

IV. Match the following.

Column A		**Column B**
1. Style	(a)	Androecium
2. Stamen	(b)	Gynoecium
3. Fruit	(c)	Outer skin of the fruit
4. Seed	(d)	Ripen ovary
5. Epicarp	(e)	Ovule

V. Choose the odd one out and give scientific reasons.

1. Style, stigma, ovary, anther
2. Calyx, corolla, androecium, stem
3. Self-pollination, insect pollination, wind pollination, water pollination
4. Leaf, style, ovary, stigma
5. Sepals, petals, stigma, roots

Understanding Ideas

I. Give one word for the following.

1. It is the most attractive and colourful part of the plant. _____
2. The female reproductive organ of a flower. _____
3. A process by which a dormant seed develops into a seedling in the favourable conditions of air, water and warmth. _____
4. The transfer of pollen grains from anther to stigma of a flower. _____
5. The male reproductive part of a flower. _____
6. A matured, ripen ovary. _____
7. The second whorl of a flower. _____
8. The sweet, juicy and edible part of the fruit. _____
9. A process of fusion of a male cell with a female cell in flowers. _____
10. The outer, thin and leathery part of a fruit. _____

II. Answer the following questions in short.

1. Name any four flowering plants. Also mention the colour of the flowers in these plants.

_____

_____

_____

2. Name a flower that has all the four whorls.

_____

_____

_____

3. In which part of the flower is the ovule found?

_____

_____

_____

4. What is pollination?

_____

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_____

5. Which is meant by the term 'fertilisation'?

_____

_____

_____

6. Give examples of two plants that show epigeal germination of seeds.

_____

_____

_____

7. What are the conditions necessary for the germination of seeds?

_____

_____

_____

8. Where does fertilisation occur in a flowering plant?

_____

_____

_____

III. Answer the following questions in detail.

1. What are the male and female parts of a flower? Mention the functions of each.

_____

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2. Explain the structure of a seed in detail.

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3. What are the two types of germination in plants? Give two examples of each.

_____

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4. Name three agents by which pollination takes place in plants. Also give two examples of plants in which pollination take place by these agents.

_____

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5. What part is played by stamens and carpel of a flower in reproduction?

_____

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6. Why do insect-pollinated flowers produce nectar?

7. What are pollen grains? Why are they produced in the flower?

8. Give a one point difference between calyx and corolla.

IV. Differentiate between the following.

1. Complete flower and incomplete flower

2. Self-pollination and cross-pollination

3. Epigeal germination and hypogeal germination

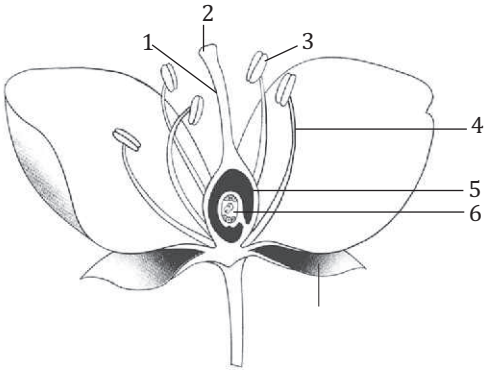
4. Androecium and gynoecium

Think Critically

1. Can fertilisation occur in flowering plants without pollination?
2. Tomato is a fruit but apple is not considered as a true fruit. Give reason.

Diagram-based Question

1. Given here is the diagrammatic sketch of the vertical cross-section of a flower.
   (a) Label the parts 1 to 6.
   (b) Name the reproductive whorls of a flower.



Project Ideas

1. (a) Work in a group. Collect 10 transparent plastic pots, 20 seeds each of bean and maize, water, soil, washed sand and sticky labels.
   (b) Prepare and label the transparent plastic pots in the following manner.

Pots 1a and 1b	Empty pots
Pots 2a and 2b	Put a very small amount of water in them.
Pots 3a and 3b	Keep both the pots half-filled with water.
Pots 4a and 4b	Put slightly wet soil in both the pots
Pots 5a and 5b	Put slightly wet-washed sand in both the pots

   In all the pots, put two seeds of beans and two seeds of maize.
   (c) Place the pots 1a, 2a, 3a, 4a and 5a in a warm place and pots 1b, 2b, 3b, 4b and 5b in a cold place such as a refrigerator.
   (d) Keep the soil moist by adding water to it.
   (e) Leave the set-up for two weeks. Observe them after every two days. Note the changes taking place in the seeds.
   (f) Record your observations as the seeds germinate and the seedlings begin to grow. Maintain a table in the given format. List the observations in your notebook.

Name of the pot	Date of observation	Changes taking place in maize seeds	Changes taking place in bean seeds

   (g) State your calculation based on the observations that you made while performing the experiment.
2. Make a PowerPoint presentation on different parts of the flower and present it in the class.

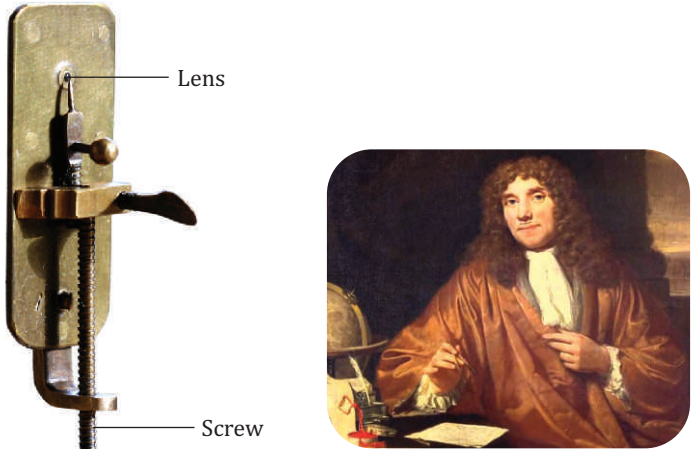
Chapter - 3

Cell—The Basic Unit of Life

Living world includes innumerable types of plants and animals which show a large variation in their external features. However, all of them resemble each other in one respect that their bodies are made of numerous building blocks called **cells**. In an organism, the cells are organised to perform different functions and work together with a common aim—to sustain life. Therefore, we define a cell as **a basic structural and functional unit of life.** In this chapter, we will study about the structure, composition and functions of a plant cell and an animal cell.

DISCOVERY OF THE CELL

Cells are very small and invisible to naked human eyes. Our knowledge of their structure was made possible only by the invention of the **microscope** and subsequent improvement in its technology. **Antonie van Leeuwenhoek** (1632–1723) developed the first simple microscope, which was made up of single lens. He was the first to observe tiny, single- celled living units in a drop of water. However, he did not name them as cells.



(a) Leeuwenhoek's simple microscope (b) Antonie van Leeuwenhoek

Fig. 3.1 Simple microscope developed by the Leeuwenhoek

Learning Objectives

Let's learn about

- Discovery of the Cell
- Microscopy and Biology
- Cell Diversity
- Basic Cell Structures of Plant and Animal Cells
- Cell Organelles
- Vacuoles
- Differences between Animal Cell and Plant Cell

FACT ZONE

All living organisms are made up of cells. The study of cell is called **cytology**.

More to Know

Historical Study of the Cells

- **Antonie van Leeuwenhoek** was first to recognise the **living units** of organisms.
- **Robert Hooke** discovered and named the living units as **cells**.
- In 1833, **Robert Brown**, a Scottish naturalist, noticed that each cell had a dark spot inside it. He named it **nucleus**.
- In 1838, **Matthias Jakob Schleiden**, a German botanist, proposed that all plants are composed of cells.
- A year later, **Theodor Schwann** came to the same conclusion about the animal cell.
  In 1858, **Rudolf Virchow** revealed that all cells grow from other cells by the division of cells.
  All these conclusions led to the formation of the **cell theory**, which states that:
  - All organisms are composed of cells.
  - The cell is the structural and functional unit of all living beings.
  - All cells are produced from pre-existing cells.

SCIENTIST ZONE

Antonie van Leeuwenhoek, studied the structure of microorganisms such as bacteria and protozoa by using his microscope. He made extensive observations on microorganisms and earned the title of **Father of Microbiology**.

FACT ZONE

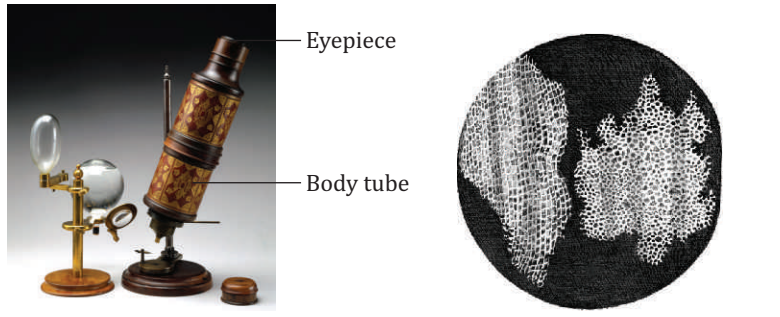
- The size of an organism depends on the total number of cells it has and not the size of the cells, which is found to be small in all organisms. For example, a bird has more cells in comparison to an insect.
- The cells present in the outer surface of the skin of animals are flat in shape which help to cover a large area. In plants, the cells which carry water and food are thin and long in their structures.

More to Know

Different Lifespans of Cells

- On the basis of their types and functions, the cells in human body have different lifespans. For example, certain cells of digestive tract live for only few days, the red blood cells live for 120 days and pancreatic cells can live for as long as a year while other specific types of cells can live for five to six weeks.

In 1663, **Robert Hooke**, an English scientist devised a compound microscope, which was made up of two lenses. He examined a thin slice of a cork under his microscope and observed that it was made of tiny honeycomb compartment like structures piled up together. He named these structures as **cells**. The term 'cell' is derived from a Latin word *'cellula'* meaning 'room' or 'small compartment'.



(a) Robert Hooke's compound microscope (b) Cork cells as seen by Robert Hooke

Fig. 3.2 Robert Hooke's compound microscope and the cells seen in a thin slice of cork

MICROSCOPY AND BIOLOGY

Of all the techniques used to study organisms, **microscopy** is probably the most important. The vast majority of living organisms are too small to be seen in any detail with the naked human eye. The cells and their organelles can only be seen with the aid of a microscope.

Some organisms are so small that they can be seen only by the magnification of 2000X or even more. Some of them cause diseases. Therefore, without the microscope many diseases would have never found a cure. In microscopy, **magnification** and **resolution** both are important, if you want to see the clear picture of something very tiny.

- **Magnification** It is a measure of how much larger a microscope (or set of lenses within a microscope) causes an object to appear. For instance, the light microscopes typically used to magnify up to about 400 times the actual size.
- **Resolution** The **resolution** of a microscope or lens is the smallest distance by which two points can be separated and still be distinguished as separate objects. The smaller the value, the better the clarity and detail of the image.

The units of measurements used to study the microscopic organisms are given in Table 3.1.

Table 3.1

millimetre	mm	$= 10^{-3}$ m
micrometre	µm	$= 10^{-6}$ m
nanometre	nm	$= 10^{-9}$ m
picometre	pm	$= 10^{-12}$ m
angstrom	A^0	$= 10^{-10}$ m

CELL DIVERSITY

All the cells are not alike. They show a great variation in their number, shape and size.

Cell Number

The number of cells in an organism depends upon the size of the organism. In comparison to large organisms, the small organisms have less number of cells. The organisms that are made up of a single cell, are called **unicellular organisms**, e.g. *amoeba* and *paramecium*. On the other hand, most of the plants and animals are made up of numerous cells. They are called **multicellular organisms**, e.g. human beings, insects, birds and plants like neem, rose and wheat.

Cell Size

Size of the cells varies from microscopic to large one. Bacterial cell is the smallest cell. Nerve cell is the longest and egg cell is the largest cell.

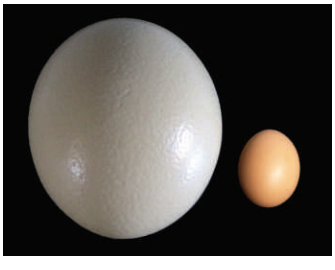
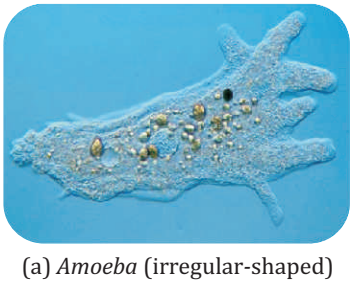


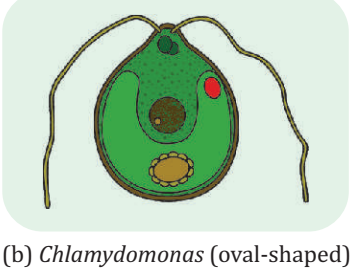
Fig. 3.3 Different sizes of the cells—an ostrich egg and a hen egg

Cell Shape

All living cells show a great variety in their shapes which is determined by the function that a particular cell performs. For example, the red blood cells are biconcave. The cell of



(a) *Amoeba* (irregular-shaped)



(b) *Chlamydomonas* (oval-shaped)

Fig. 3.4 Different shapes of the cells

ASSESS YOURSELF

Fill in the blanks.

1. A _____ is the basic structural and functional unit of life.
2. Robert Hooke designed the first _____ microscope.
3. The cell shows diversity in _____, _____ and _____.
4. The bacterial cell is the _____ and an egg cell is the _____ cell.
5. The study of cell is called _____.
6. The red blood cell is _____ in shape.
7. _____ is a technique used to study microscopic organisms.
8. The concepts of microscopy are _____ and _____.

ROUGH WORK

chlamydomonas is oval-shaped. *Spirogyra*, a multicellular alga (singular of algae) has a cylindrical-shaped body. *Amoeba* is in irregular shape and *paramecium* is in slipper shape.

BASIC CELL STRUCTURES OF PLANT AND ANIMAL CELLS

Except for a few differences, a plant cell and an animal cell are quite similar in their structures. Some basic structures, such as—**nucleus**, **cytoplasm** and **cell membrane** are common in plant cells as well as in animal cells.

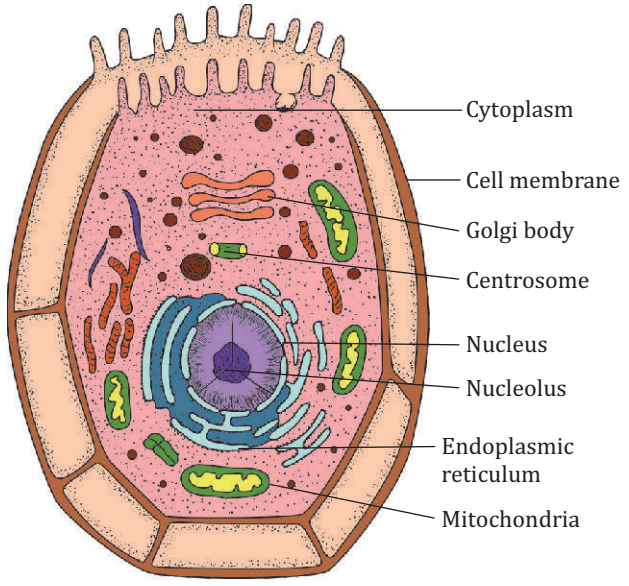


Fig. 3.5 An animal cell—internal structure

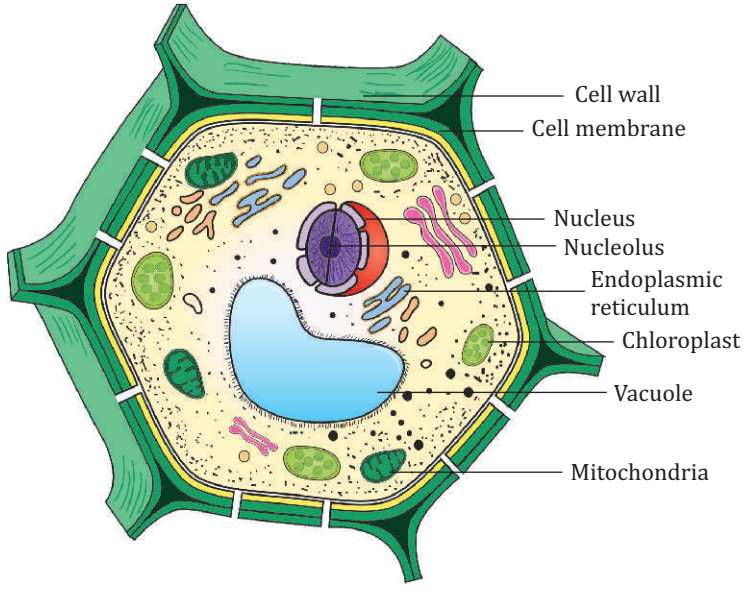


Fig. 3.6 A plant cell—internal structure

FACT ZONE

The plant cells are characterised by the presence of a rigid **cell wall** outside the cell membrane, **plastids** and a large, centrally located **vacuole** whereas animal cells do not posses the cell wall, vacuole and plastids.

ENRICHMENT

All living cells have three common structures. These are:

1. **Cell membrane** which encloses the living substances of the cell.
2. **Nucleus** controls the functions of the cell. Its liquid part is called nucleoplasm.
3. **Cytoplasm** contains all the living parts of the cell.

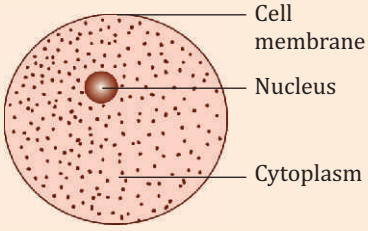


Fig. 3.7 Three common structures of all living cells

The cytoplasm together with nucleoplasm forms the **protoplasm**, a living matter of the cell.

Cell Membrane

Both the plant cell and animal cell are enclosed by a thin, delicate membrane called the **cell membrane** or **plasma membrane**. It is a living, elastic and selectively permeable membrane. It separates the outside environment of the cell from inside of the cell.

Functions

- It holds the protoplasm of the cell and provides mechanical support to the internal components of the cell.
- Being selectively permeable, it allows only selective substances to pass through it.
- It provides a definite shape to the cell.
- It helps in removal of waste products from inside the cell.

Cell Wall

In a plant cell, the **cell wall** provides an additional support to the cell membrane. It is made up of **cellulose**. It is a rigid, freely-permeable and non-living part of a plant cell which allows free passage of substances through it.

Functions

- It provides mechanical support to the plant cell.
- It provides a definite shape to the plant cell.

Table 3.2 Differences between a cell membrane and a cell wall

Cell membrane	Cell wall
1. It is an outermost, living membrane of the cell.	1. It is an outermost, non-living, thick, protective membrane of the plant cell.
2. It is selective permeable in nature.	2. It is highly permeable and allows free passage for substances pass through it.
3. It is found in animal cells as well as in plant cells.	3. It is found only in plant cells.

Nucleus

A **Nucleus** is the most important structure found in plant cell as well as in the animal cell. It is the largest known structure of a cell. It is a dense, spherical living body which lies inside the cytoplasm. The nucleus is enclosed by a double membrane called the **nuclear membrane**.

More to Know

Selective Permeable Membrane

- An egg shell is a **natural selective permeable membrane** that allows only oxygen to pass through but keeps the liquid content inside the cell.
- The candle of a water filter is acts as an **artificially selective permeable** that allows only the water molecules to pass through but keeps the harmful minerals inside the candle.

ENRICHMENT

Basic Parts of a Cell

- Cell membrane
- Cytoplasm
- Nucleus

Outermost Layer

- Living cell membrane (found in both the plant and animal cells).
- Non-living cell wall (found in the plant cell only).

Cytoplasm contains:

- Living cell organelles like mitochondria, endoplasmic reticulum, Golgi body, plastids, etc.
- Non-living cell inclusions like vacuoles, fat droplets and granules.

Nucleus contains:

- Nuclear membrane
- Nucleolus
- Nucleoplasm
- Chromatin fibres

FACT ZONE

- Nucleus is the largest cell organelle present in the cell.
- It was the first cell organelle to be discovered.
- The red blood cells of human beings do not have a nucleus.

More to Know

In each type of living organisms, the number of chromosomes is definite in each cell. For example, in the human body each cell has 46 chromosomes arranged in 23 pairs, an onion cell has 16 chromosomes, rice has 24 chromosomes and dogs have 60 chromosomes.

ENRICHMENT

Within the cell membrane, there are two major compartments—**cytoplasm** and the **nucleoplasm**. The cytoplasm contains cell organelles that consume and transform energy and perform the different metabolic functions of the cells. The nucleoplasm contains a prominent nucleus which controls the proper functioning of the cell.

ASSESS YOURSELF

Name them.

1. A non-living outer covering of the plant cell. _____
2. A selectively permeable living membrane of a cell. _____
3. The brain of each cell. _____
4. A homogeneous, colourless and semi-fluid substance that forms the main bulk of the cell. _____
5. The basic units of parental characteristics. _____

It separates the nucleus from the cytoplasm. The nuclear membrane surrounds the dense, semi-fluid substance called the **nucleoplasm**. The nucleoplasm contains one or more spherical bodies called **nucleolus** and a network of **chromatin fibres**. Each chromatin fibre contains thread-like structures called **chromosomes**. The chromosomes carry **genes** which are the carriers of parental characters passed on from the parents to their children.

Functions

- It controls and coordinates all the vital activities of the cell therefore, it is also called the **brain of a cell**.
- It contains chromosomes which carry the parental characters in the form of **genes**.
- It plays an important role in cell division.

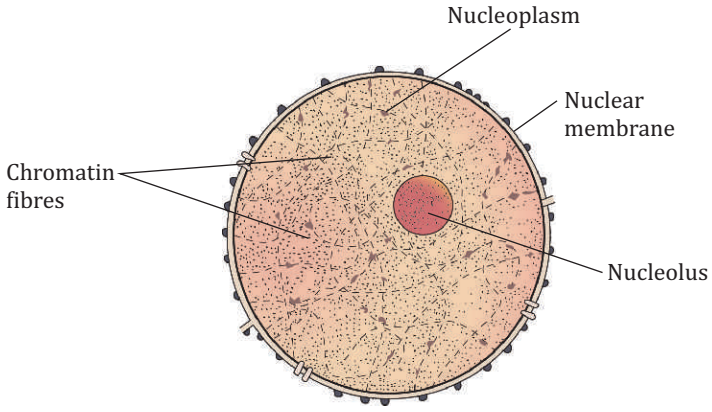


Fig. 3.8 Structure of a nucleus

Cytoplasm

It is a homogeneous and colourless liquid-like substance that lies between the nucleus and the plasma membrane of a cell. It is a translucent, granular, semi-fluid which forms the main bulk of the cell.

Functions

- It contains many living parts called **cell organelles** and some non-living parts called **cell inclusions**.
- Cytoplasm stores many chemicals that are essential for life.
- It supplies proper nutrition to the cell organelles and stores food in the form of starch grains.
- It is the site for most of the chemical reactions taking place within the cell.

ACTIVITY 1

Aim To observe and draw structures seen in permanent slides of the following:

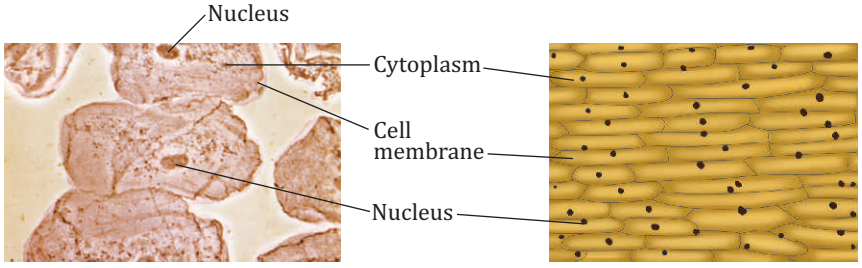
(a) Onion peel cells and human cheek cells (b) Different types of blood cells (c) *Amoeba* (d) *Chlamydomonas*

Procedure

Ask your teacher to help you observing the above mentioned permanent slides under a low power and high power of the microscope.

(a) Observation of onion peel cells and human cheek cells under a microscope

Observe the permanent slides of onion peel and human cheek cells under low and high power microscope. Draw exactly what you observe and label the parts that you seen under the microscope. Draw your observation neatly.



(a) Human cheek cells (b) Onion peel cells

Fig. 3.9 Permanent slides of human cheek cells and onion peel cells

(b) Observation of different types of blood cells

While observing the permanent slide of blood under a microscope, the structures shows as follows:

- Some red colour structures look like the jelly donut with its centre pushed in. These are the red blood cells.
- Some irregular-shaped structures containing nucleus within them. These are fewest and largest of all structures present in the blood. These are the white blood cells.

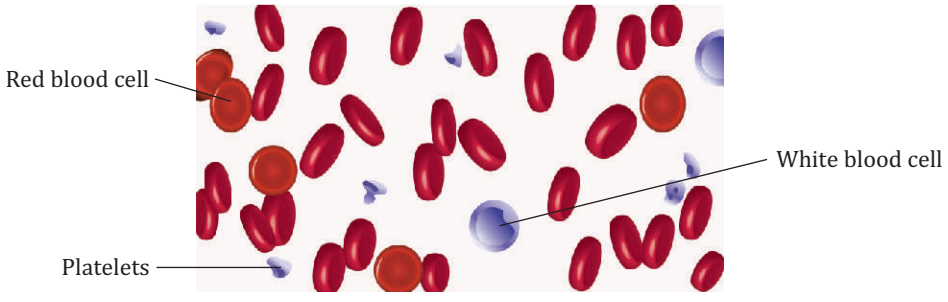


Fig. 3.10 Permanent slide of blood cells

Note: Platelets are very minute structures so it is not possible to see the platelets under the compound microscope.

(c) To observe permanent slide of *Amoeba*

Under the high power compound microscope, *amoeba* looks like an irregular drop of water with some finger-like projections.

(d) To observe permanent slide of *Chlamydomonas*

While observing the permanent slide of chlamydomonas under the high power microscope, numerous single-celled, green coloured organisms are seen. (Refer to Fig. 3.4)

ROUGH WORK

More to Know

Cell Inclusions

Apart from the living cell organelles, a cell also contains some non-living substances called **cell inclusions**. These are either found in the cytoplasm or in a vacuole of the cell. In plant cells, they are present in the form of starch, proteins and waste materials like gum, mucilage and tannin. In the animal cells, they are present in the form of fat droplets, pigments and granules.

ENRICHMENT

Ribosomes

- Ribosomes are very small, dense granular structures either scattered freely in the cytoplasm or attached to the endoplasmic reticulum.
- They synthesise proteins and are called the **protein factories of the cells.**
- Ribosomes are found both in animal cells as well as in plant cells.
- They are not bound by any membrane.

CELL ORGANELLES

All the living cells contain many membrane bound living structures scattered in the cytoplasm called **cell organelles**. They have a definite shape and structure. They perform definite functions within the cell. Some important cell organelles of plant cell and animal cell with their functions are discussed below:

Mitochondria (Singular: Mitochondrion)

Mitochondria are tiny bodies of varying shapes (rod, round, oval), distributed uniformly in the cytoplasm of plant cells as well as in animal cells. Each mitochondrion (singular of mitochondria) is enclosed by a double membrane. The inner membrane is folded into finger-like projections called **cristae**. A fluid filled in the inner membrane of the mitochondria is called the **matrix**. A single cell has a few hundred to thousands of mitochondria.

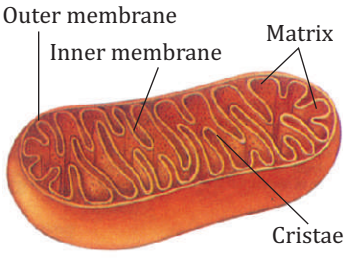


Fig. 3.11 Structure of a mitochondrion

Functions

- They perform the respiration within the cells.
- Mitochondria convert the chemical energy contained in the food into a form of energy that a cell can use to perform its functions. Thus, they are also known as **powerhouse of the cell**.

Endoplasmic Reticulum (ER)

It is an irregular network of tube-like structures distributed throughout the cytoplasm. At some places, it connects the plasma membrane with the nuclear membrane and transports useful substances within the cell. The endoplasmic reticulum is of two types—the **smooth endoplasmic reticulum** and the **rough endoplasmic reticulum**. Rough endoplasmic reticulum has many fine granules called **ribosomes**.

Functions

- They form the supporting skeletal framework of the cell.
- They provide a pathway for transport of nuclear material from one cell to the other and within the cell.

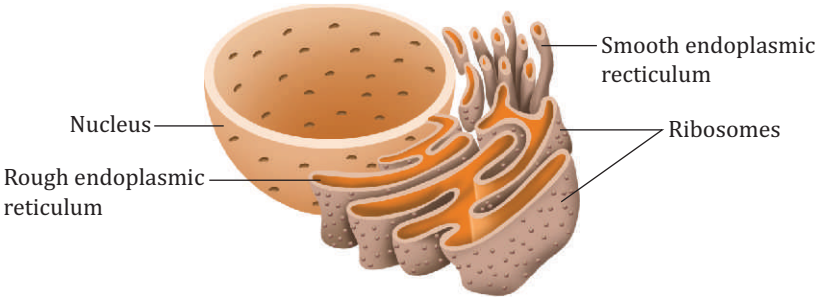


Fig. 3.12 Endoplasmic reticulum

Golgi Bodies

Golgi bodies are the stacks of flat, membranous sacs, usually found near the nucleus of most of the animal cells. They are bounded by a smooth double membrane. The main components of the Golgi body are—**cisternae** and **vesicles**. The cisternae are stacked one over the other and the vesicles are the budded outgrowths of cisternae.

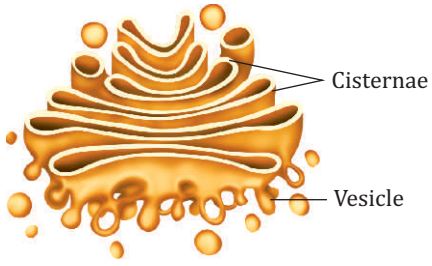


Fig. 3.13 Golgi bodies

Function

- Golgi bodies are the secretory cell organelles. They secrete proteins, hormones (chemicals) and enzymes.

Lysosomes

The **lysosomes** are sac-like cell organelles, mainly found in the animal cells and some specific plant cells.

Function

- It protects the cell from harmful foreign bodies (like bacteria) by engulfing them.

Centrosome

The **centrosome** is a minute, non-membranous body found near the nucleus of animal cells only. Plant cell do not contain centrosomes.

Function

- Centrosome initiates the cell division in the cells.

Plastids

The **plastids** are disc-shaped living cell organelles found in plant cells only. They are bounded by a double membrane and store pigments. There are three types of plastids present in the plant cells, namely—**leucoplasts**, **chromoplasts** and **chloroplasts**.

More to Know

- Golgi body was identified in 1897, by the Italian physician, **Camillo Golgi** and named after him in 1898.
- In plant cells, Golgi bodies are smaller, unconnected and more in number and usually called **dictyosomes**.

FACT ZONE

Lysosomes digest the worn-out cell organelles and then die themselves. Hence, they are called the **suicidal bags of the cell**.

ROUGH WORK

FACT ZONE

Chloroplasts

Chloroplasts are the sites of photosynthesis, a process of food making in plant. Therefore, they are known as the **kitchen of the plant cell**.

THINK ZONE

Which types of plastids are found in the petals of a sunflower?

ENRICHMENT

In lower organisms, like the *amoeba* and the *paramecium*, the **contractile vacuole** helps in throwing out excess water and waste products through the surface of the cells. In these organisms, food is digested by the enzymes present in **food vacuoles**.

ROUGH WORK

Leucoplasts

These are colourless plastids present in the cells of underground storage parts like roots and some modified stems of the plant. The leucoplasts store food prepared by the plant in the form of starch. Some leucoplasts also store fats and proteins.

Chromoplasts

These are the coloured plastids other than the green coloured ones. They are mostly present in the petals of flowers and pericarp of the fruits and impart colour to them.

Chloroplasts

These are the green coloured plastids, which contain green colour pigments called the **chlorophylls**. Chloroplasts trap the energy of the sun to perform the process of photosynthesis. The green colour of leaves and soft stems is due to the presence of chloroplasts in them. A chloroplast has two parts—**granum**, a pile of flat-green solid bodies and **stroma**, a liquid matrix.

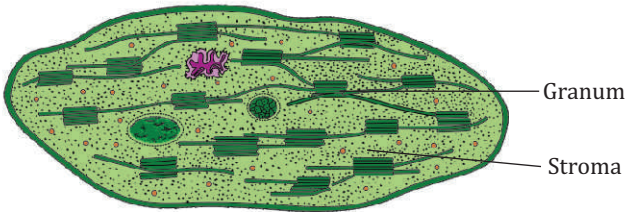


Fig. 3.14 Chloroplast

VACUOLES

They are membrane-bound, non-living, fluid-filled spaces present in the cytoplasm of the cells. The membrane that binds a vacuole is called the **tonoplast**. A large vacuole is generally found in the plant cell. If vacuoles are present in an animal cell, they are very small and temporary.

Functions

- Vacuoles store excess of water, pigments and waste products.
- Vacuoles maintain the turgidity of cells and keep them in shape.
- They store dissolved substances such as sugar, minerals.

In animal cells, vacuoles are absent and if present they are very small and numerous in number.

ACTIVITY 2

Aim To make a model of plant cell using a shoe box

Procedure You can make the following cell organelles as follows:

- **Cell wall** Take a shoe box and cover it up with green paper from both the sides.
- **Cell membrane** Roll the green colour clay into a long rope and place it along the base of the box.
- **Cytoplasm** Spread the white cotton and fills the space within the green boundary.
- **Chloroplast** Using green clay make out flat oval discs and put some green beads or buttons on it. Now place these chloroplasts evenly on the white cotton base.
- **Vacuole** Take some cotton and colour it with light yellow colour. After making it dry, roll the yellow coloured cotton into the size of small egg. Place it at one corner of the box within the clay cell membrane.

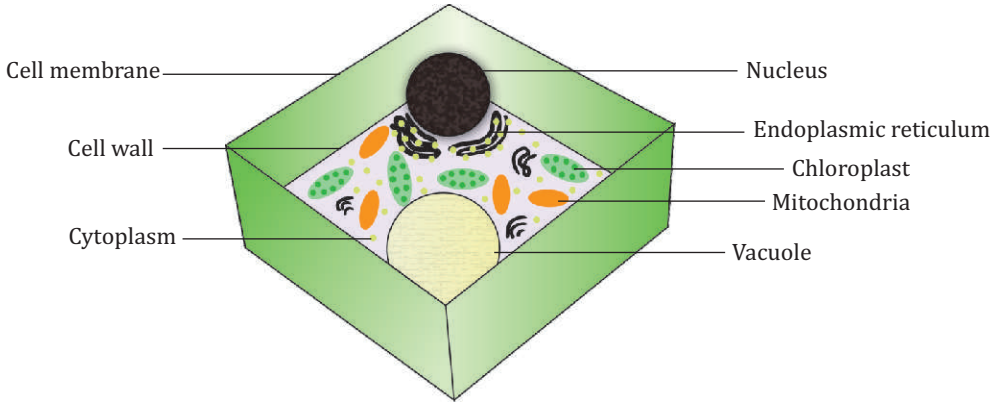
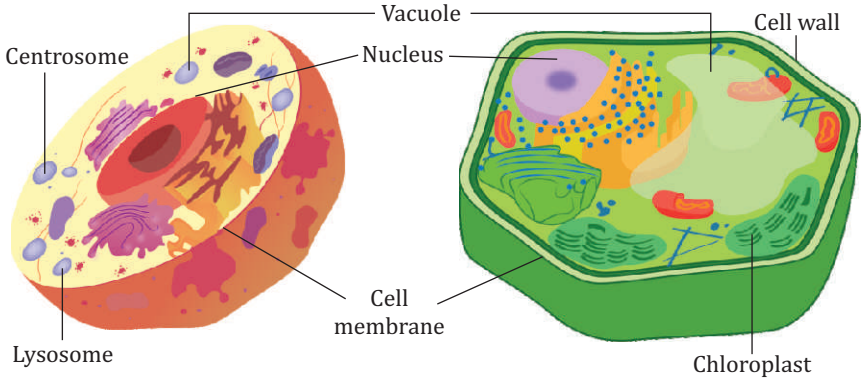


Fig. 3.15 A model of plant cell

- **Nucleus** All of you are familiar with paper mashing. Mash some old newspapers and make an irregular-shaped ball. Let the ball becomes dry. Now, colour the paper ball with black colour. Put this black ball in the centre of the box.
- **Endoplasmic reticulum** Take some black colour yarn and attach them with the nucleus to resemble endoplasmic reticulum.
- **Mitochondria** Take some orange colour clay and make 2 or 3 oval-shaped balls from it. Place these orange balls on the white cotton base of the box.

DIFFERENCES BETWEEN ANIMAL AND PLANT CELLS



(a) Animal cell (b) Plant cell

Fig. 3.16 Differences between an animal cell and a plant cell

ROUGH WORK

Assess Yourself

1. **Name them.**
   (a) Finger-like projections of mitochondria. _____
   (b) Suicidal bags of the cell. _____
   (c) Kitchen of the cell. _____
   (d) A network of tube-like structures comprises the supporting skeletal framework of the cell. _____
   (e) The dense, granular substance responsible for protein synthesis within the cells. _____
2. **Fill in the blanks.**
   (a) The leucoplasts are _____ plastids.
   (b) The _____ impart colour to fruits and flowers.
   (c) The _____ initiates the cell division.
   (d) The membrane that surrounds a vacuole is called _____.
   (e) Mitochondria are also called as _____ of the cell.

Rough Work

_____

_____

_____

_____

_____

_____

_____

_____

Table 3.3 Differences between a plant cell and an animal cell

Features	Plant cell	Animal cell
Size	Larger in size	Smaller in size
Cell membrane	Present along with non-living, rigid cell wall	Present without a cell wall
Plastids	Plastids are present in the form of chloroplasts, chromoplasts and leucoplasts	Plastids are absent
Vacuole	A large vacuole is present	Vacuoles are usually absent. If present, they are very small in size
Lysosome	Lysosomes are absent	Lysosomes are present
Centrosome	Centrosome is absent	Centrosome is present

Plant cells have some cell organelles such as **plastids**, large permanent **vacuole** and **cell wall** that are not found in an animal cell.

Table 3.4 Cell organelles that common in both animal and plant cells

Cell organelles	Functions
Cell membrane	• Allows selective substances pass through it
Cytoplasm	• Helps in exchange of materials between different cell organelles
Endoplasmic reticulum	• Provide framework to the cell and also form pathway for transfer of molecules
Ribosomes	• Help in protein synthesis
Mitochondria	• Provide energy to the cell
Golgi body	• Helps in synthesis of cell membrane
Lysosomes	• Protect the cell from harmful foreign bodies like bacteria
Nucleus	• Controls the cell activities

Let's Recapitulate

- All living organisms are made of cells. **Cell** is the structural and functional unit of life.
- Cells are of different shapes and sizes. The shape of a cell depends on the function that it performs.
- **Nucleus**, **cytoplasm** and **cell membrane** are the basic structures present in a plant cell as well as in an animal cell.
- Cell membrane is selectively permeable. It allows only certain substances in and out from the cell.
- Plant cell has a **cell wall** which gives strength and rigidity to the cell. It is a non-living structure made of cellulose.
- **Nucleus** is the most important structure that controls all the vital activities of the cells.
- Nucleus contains **chromosomes** which carry parental characters in the form of **genes**. It also contains one or more dense bodies called the **nucleoli** and a network of thread-like structures called **chromatin fibres**.
- **Cytoplasm** is a homogeneous and colourless liquid that lies between the nucleus and the cell membrane. It consists of two parts—living **cell organelles** and non-living **cell inclusions**.
- **Endoplasmic reticulum** is a network of tube-like structures which form a supporting skeletal framework of the cell.
- **Golgi bodies** are the secretory organs. They secrete proteins, hormones and enzymes.
- **Mitochondria** are the sites of cell respiration and called the powerhouse of the cell.
- **Lysosomes** are tiny spherical sac-like structures evenly distributed in the cytoplasm. They destroy foreign materials which enter the cell and also called the suicidal bags of the cell.
- **Centrosome** just lies outside the nucleus of the animal cell only and initiates cell division.
- **Plastids** occur only in plant cells. They are of three types—**chloroplasts**, **chromoplasts** and **leucoplasts**.
- Chloroplasts perform the process of photosynthesis; chromoplasts impart colour to the fruits and flowers and the colourless leucoplasts store the food prepared by the plant.
- **Vacuoles** are the membrane-bound, fluid-filled spaces present in the cytoplasm of the cell.

Evaluate Your Understanding

Recalling Ideas

I. Select the correct option.

1. The cell is a _____ unit of life.
   (a) functional ☐ (b) structural ☐
   (c) functional and structural ☐ (d) neither structural nor functional ☐
2. The term 'cell' was coined by
   (a) Robert Hooke ☐ (b) Leeuwenhoek ☐
   (c) Richard Altman ☐ (d) Carl Benda ☐
3. A plant cell is different from an animal cell because it has
   (a) nucleus ☐ (b) cytoplasm ☐
   (c) cell membrane ☐ (d) cell wall ☐

4. A cell organelle which controls all the activities of the cell is known as
   (a) nucleus ☐ (b) mitochondrion ☐
   (c) lysosome ☐ (d) golgi complex ☐
5. Each cell has a
   (a) cell wall ☐ (b) chloroplast ☐
   (c) nucleus ☐ (d) all the above ☐
6. Cells are surrounded by a living membrane called
   (a) cell membrane ☐ (b) nuclear membrane ☐
   (c) cell wall ☐ (d) cover of the cell ☐

II. Fill in the blanks with the correct option.

1. Lysosomes are called the _____ of the cell. (suicidal bags/food factories)
2. The cell wall is made up of _____. (cellulose/proteins)
3. A plastid responsible for the storage of starch is _____. (leucoplast/chloroplast)
4. The _____ pigments perform the process of photosynthesis. (chlorophyll/chromosome)
5. A membrane surrounds the vacuole is known as _____. (cell wall/tonoplast)

III. State if the following statements are True or False. Correct the False statement.

1. Cells must have a prominent nucleus to live.
2. An outer covering of an animal cell is called the cell wall.
3. Presence of a large central vacuole is the characteristic feature of an animal cell.
4. Mitochondria are bound by a double membrane structure.
5. All the animal cells have a large vacuole.

IV. Match the following.

Column A	**Column B**
1. Plasma membrane	(a) Powerhouse of the cell
2. Lysosomes	(b) Kitchen of the plant cell
3. Chloroplast	(c) Unit of a living body
4. Cell	(d) Suicidal bags
5. Mitochondria	(e) Selectively permeable

V. Give the location and function of the following parts of the cell.

1. Plasma membrane
   _____
2. Cell wall
   _____
3. Nucleus
   _____
4. Chloroplast
   _____
5. Mitochondria
   _____

Understanding Ideas

I. Give one word for the following.

1. Honeycomb-shaped compartments discovered by the Robert Brown. _____
2. A non-living membrane which provides rigidity and strength to the plant cell. _____
3. A cell organelle which provides the skeletal framework to the cell. _____
4. The controlling centre of the cell. _____
5. An instrument which helps in the study of cells. _____

II. Answer the following questions in short.

1. Define a cell.

_____

_____

_____

2. What are cell organelles? Name any four of them.

_____

_____

_____

3. What is the main function of chloroplast?

_____

_____

_____

4. Name the three basic structures found in both the plant cell as well as in the animal cell.

_____

_____

_____

5. Why is a cell called the structural and functional unit of life?

_____

_____

_____

6. What is the importance of a nucleus in a cell?

_____

_____

_____

7. What is protoplasm? What are its constituents?

_____

_____

_____

8. What are the features possessed by a plant cell only?

_____

_____

_____

III. Answer the following questions in detail.

1. Why is mitochondria called the powerhouse of a cell?

_____

_____

_____

_____

_____

2. Why is the cell membrane called a selectively permeable membrane?

_____

_____

_____

_____

_____

3. What are the three basic structures of most of the cells? Explain each of them briefly.

_____

_____

_____

_____

_____

4. Give one main function of each of the following:

(a) Cell membrane

_____

_____

(b) Cell wall

_____

_____

(c) Chromosomes

_____

_____

(d) Lysosome

_____

_____

5. What is the function of a nuclear membrane?

6. Where does the nucleus lie in a cell? Give its composition. Also mention its function.

7. What are plastids? Mention the functions of each type of plastids.

IV. Differentiate between the following.

1. Plant cell and animal cell

2. Cytoplasm and nucleoplasm

3. Chromoplast and chloroplast

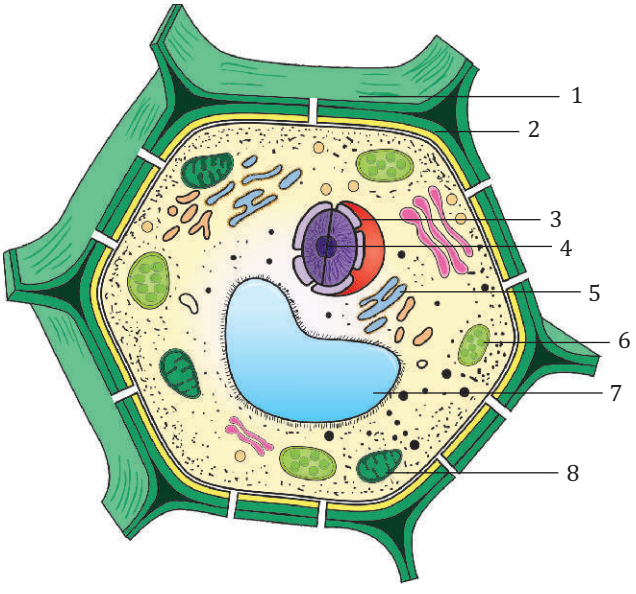
4. Cell membrane and cell wall

Think Critically

1. Unicellular organisms perform all the vital functions in a single cell. Explain it scientifically.
2. Name the plastids found in the cells of yellow coloured petals of a flower.
3. 'Lysosomes are the suicidal bags of a living cell.' Justify the statement.

Diagram-based Question

1. Look at the diagram and answer the following questions:



(a) Label the parts numbered 1 to 8.

(b) Does the given diagram represent a plant cell or an animal cell? Justify your answer.

(c) Describe the functions of parts labelled1, 6 and 7.

Project Ideas

1. The cells are invisible to human eyes. Our knowledge of their structure was made possible only by the invention of a microscope. Collect information on the contribution of scientists during the invention from simple microscope to compound microscope. Your findings should include:
   - Name of the scientists
   - Types of the microscope
   - Year of inventions
   - Magnification of the microscopes
2. Make a PowerPoint presentation on a plant cell. Discuss how it is different from an animal cell.

Chapter - 4

Human Body— Digestive System

Learning Objectives

Let's learn about

- Process of Nutrition
- Human Digestive System
- Alimentary Canal
- Associated Digestive Glands
- Process of Digestion
- Assimilation of Digested Food
- What is Indigestion?
- Unhealthy Eating Habits

The human body consists of a number of organ systems. Some major organ systems are—the digestive system, respiratory system, circulatory system, excretory system, nervous system and skeletal system. Each of these systems consists of different organs that help them to perform some specific functions of the body. In this chapter, we are going to learn about **digestive system** of the human body. Before we study the human digestive system, it is necessary to understand the process of nutrition.

PROCESS OF NUTRITION

Food is the fuel that keeps the body alive. Different organisms have adopted various physical and chemical processes of handling food. By these processes the organism converts the food into useful form that can be utilised by the cells for growth of the body. This process is called **nutrition**. It comprises of **ingestion**, **digestion**, **absorption**, **assimilation** and **egestion**.

- **Ingestion** Taking in of food into the mouth and chewing it
- **Digestion** Breaking of complex food into simpler substances by the action of enzymes
- **Absorption** Absorption of digested food into the blood stream
- **Assimilation** The absorbed food is consumed by the body for growth and repair of the body cells. A part of absorbed food is stored as a reserve food.
- **Egestion** Elimination of undigested food from the body in the form of faeces.

The type of nutrition which comprises ingestion, digestion, absorption, assimilation and egestion is called the **holozoic nutrition**. This type of nutrition is found in unicellular organisms, such as *amoeba* as well as in multicellular organisms, such as human beings.

More to Know

Organ System

An **organ system** refers to a group of organs that work together to perform a specific function. The main organ systems of human body are the **digestive system** (for digestion of food), **circulatory system** (for transportation of blood and nutrients throughout the body), **respiratory system** (for exchange of gases within the body), **excretory system** (for elimination of excretory products) and **reproductive system** (for producing young ones). Collectively, these systems are also called the **life processes**.

FACT ZONE

Cell is the functional unit of the body, similarly, an **organ** is the functional unit of an organ system.

ENRICHMENT

Enzymes are the biochemicals that speed up the chemical reactions in the organisms without undergoing a change themselves.

More to Know

Care of Teeth

- Use a toothbrush to clean your teeth regularly, particularly after taking a meal and before going to bed at night.
- If possible, finish your meal with a raw vegetable such as carrot, then rinse your mouth with water.
- Do not eat sweets or drink sugary drinks between meals, and above all do not keep the sweet in your mouth for a long time.

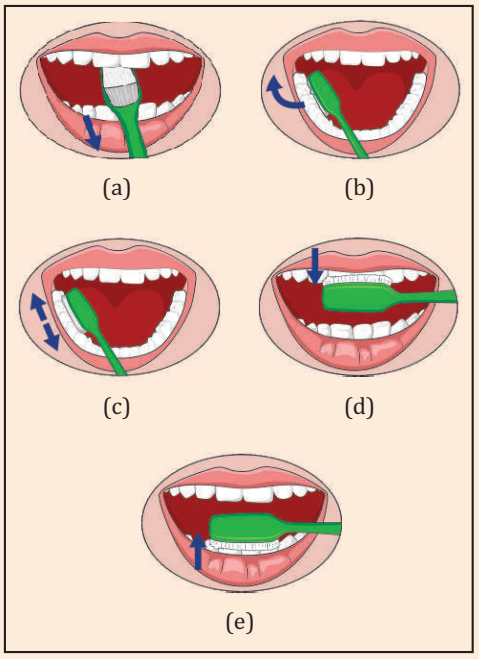


Fig. 4.2 Proper ways of brushing the teeth

THINK ZONE

1. What would happen to your teeth if you do not take care of them?
2. What is bad breath?

HUMAN DIGESTIVE SYSTEM

The **human digestive system** consists of two parts—**alimentary canal** and **associated digestive glands** such as the salivary glands, liver and pancreas.

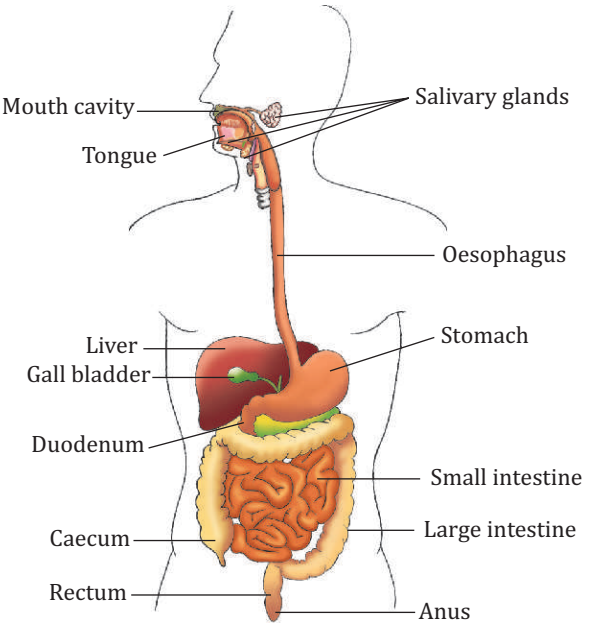


Fig. 4.1 Human digestive system

ALIMENTARY CANAL

The alimentary canal is a long, muscular tube extending from mouth to the anus. It consists of the mouth, pharynx, oesophagus, stomach, small intestine, large intestine, rectum and anus.

Mouth

Mouth is the beginning of alimentary canal. It is covered by the upper and lower lips. The lips help in closing the mouth while swallowing the food. There are four types of teeth present in the mouth cavity that help in digestion of ingested food.

Functions

- In the mouth, ingested food is chewed and mixed with saliva.
- Different types of teeth help in mastication and grinding of ingested food.
- The tongue mixes the chewed food with saliva secreted by the salivary glands and change into a ball-like mass called **bolus**.

Types of Teeth

Human beings have four types of teeth—**incisors**, **canines**, **premolars** and **molars**.

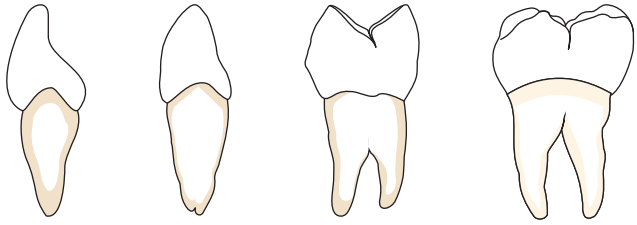


Fig. 4.3 Types of teeth in the mouth cavity of human beings

The functions of the four types of teeth are:

- **Incisors** are the front teeth with sharp, flattened edges. They serve to **cut** and **bite** the food.
- **Canines** are the sharpest teeth and have a pointed edge. They are used for **tearing** or **shredding** the food especially, meat.
- **Premolars** are the small teeth with two cusps on their crown. They are used for **crushing** and **grinding** the food.
- **Molars** are the large back teeth with four cusps. They serve to **chew** the food.

FACT ZONE

- **Enamel** of the tooth is the hardest known substance present in the human body. It is tougher and stronger than a bone.
- The nerves present in the pulp cavity transmit the sensation of pain to the brain. The blood vessels supply the nutrients to the teeth.

ENRICHMENT

Wisdom Tooth

The last molar in each jaw is known as the **wisdom tooth**. It generally emerges when the individual is in the age of 17 to 25. This is the age of wisdom, therefore the tooth is named as wisdom tooth. In reality, it has no use.

ACTIVITY 1

Aim To identify the number and types of teeth

Material Required A mirror

Procedure Open your mouth and observe your teeth in the mirror. Count your teeth and note down in the table given below.

Types of teeth	Number of each type of teeth
1.	
2.	
3.	
4.	

Pharynx

Pharynx is a common passage for food and air from the mouth and nose to the throat. It is a white muscular tube which has three parts:

- The upper part used as the passage of air only
- The middle part used as the passage for both air and food
- The lower part is used as the passage for food only

Assess Yourself

Name them.

1. Teeth serve to chew the food. _____ .
2. Teeth used for crushing and grinding the food. _____
3. A hardest known part of the tooth. _____
4. The front teeth with sharp, flattened edges. _____
5. The sharpest tooth which has pointed edges. _____

Rough Work

Function

- It passes the bolus into the oesophagus.

Oesophagus

The pharynx leads to the oesophagus. It is about 25 cm long tube extending from pharynx to the stomach. The wall of oesophagus is lined with circular muscles which contract and expand rhythmically. This rhythmic movement of muscles is called **peristalsis**. Due to the peristalsis movement, the food moves forward in the digestive tract. The lining of oesophagus secretes mucus that lubricates the bolus so that the bolus slips down easily into the stomach.

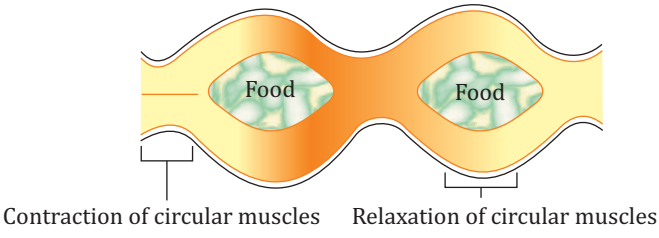


Fig. 4.4 Diagrammatic representation of peristalsis movement

Function

- Oesophagus provides the passage for bolus into the stomach. There is no digestion that takes place in the oesophagus.

Stomach

Stomach is a J-shaped muscular, bag-like structure situated on the left side of the abdomen. When empty, it is of the same size as a large sausage, but it can stretch to the size of a melon. The upper end of the stomach is attached to the oesophagus and the lower end opens up in the small intestine.

Functions

- The stomach churns the food and mixes it with digestive juices. After then, it passes the food on to the small intestine for further digestion.
- It also provides acid and digestive juice to the churned food.

Small Intestine

Small intestine is a coiled tube about 6 metres long and about 2.5 cm wide. It lies in a coiled form in the abdomen. It consists of mainly three parts—the anterior part called **duodenum**, the middle part called **jejunum** and the

posterior part called **ileum**. The inner wall of small intestine has millions of finger-like projections called **villi**. These are supplied with blood vessels and capillaries.

Function

- The main function of small intestine is the absorption of nutrients from the digested food. The viili of small intestine increase the surface area for maximum absorption of digested food.

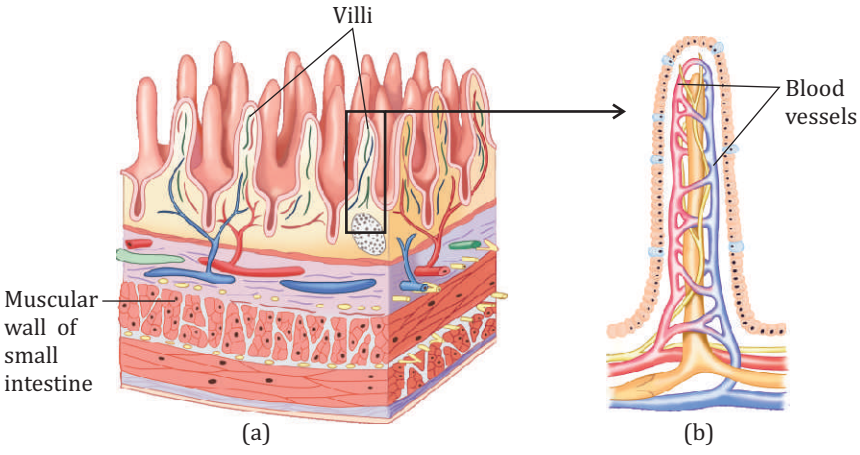


Fig. 4.5 (a) The finger-like villi projecting into the wall of small intestine (b) A single villi containing blood vessels

Large Intestine, Rectum and Anus

Large intestine is 1.5 metres long. It extends from ileum to the anus. It also has four parts—**caecum** or **blind pouch** into which ileum of small intestine opens. The cecum leads to **colon**. The colon leads to a small tube called **rectum**. At the end of rectum is a small opening called **anus**. The anus has two sphincters. The pressure of the faeces on sphincters causes the urge to defecate.

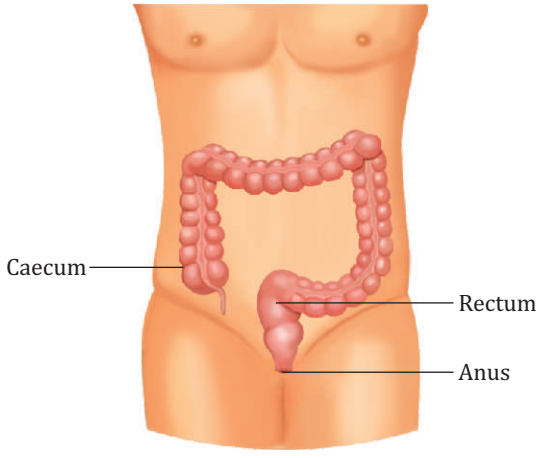


Fig. 4.6 Large intestine of the human beings

FACT ZONE

In the pharynx and oesophagus, no digestion of food takes place. The food is simply swallowed by the pharynx and then passes into the oesophagus. In the oesophagus, peristalsis movement of muscles pushes the bolus into the stomach.

ENRICHMENT

Digestive System

Almost all animals have a tube-like digestive system in which the food enters the mouth, passes through a long tube and gets digested. The undigested part moves out as faeces through the anus. The smooth muscle in the walls of the tube rhythmically and efficiently moves the food through the system, where it is broken down or digested into a simple absorbable form.

ROUGH WORK

ENRICHMENT

Path of Food in Alimentary Canal

Mouth
- Digestion of carbohydrates starts
- Tongue mixes food with saliva
- Teeth masticate the food

↓

Pharynx
- Provides connection of mouth with the oesophagus. No digestion of food takes place here.

↓

Oesophagus
- Passes the food to the stomach. No digestion of food takes place here.

↓

Stomach
- Gastric juices makes the medium of food acidic
- Digestion of protein starts

↓

Small Intestine
- Digestion of proteins starts
- Digestion of carbohydrates, fats and proteins are completed here

↓

Large intestine
- Absorption of water takes place and undigested food thrown away through the anus

Functions

- The main function of large intestine is to absorb water from the remaining undigested food.
- It throws the solid wastes from the body through the anus.

ASSOCIATED DIGESTIVE GLANDS

The human digestive system consists of the following digestive glands—**salivary glands, liver** and **pancreas**. All the three types of digestive glands are present outside the alimentary canal while numerous **gastric glands** are present inside, on the wall of the alimentary canal.

The functions of these associated digestive glands are as follows:

Salivary Glands

There are three **salivary glands** present in the mouth cavity. They are called as sublingual, parotid and submandibular. They secrete **saliva** which helps in moistening of ingested food. The saliva also helps in digestion of carbohydrates. This is the reason when we chew a small piece of bread for some time, it becomes sweet in taste.

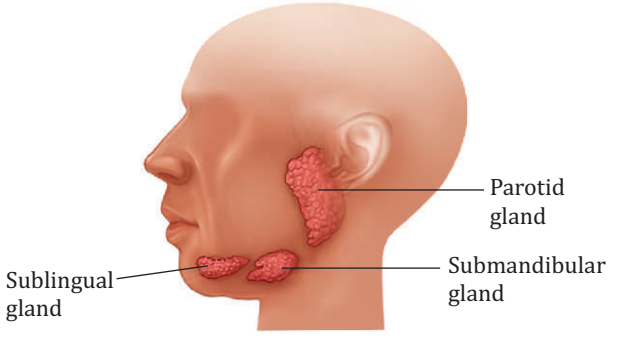


Fig. 4.7 Salivary glands present in the mouth cavity

Liver

It is the largest gland of the human body situated on the right side of the abdominal cavity. It is reddish-brown in colour. The liver produces a greenish-yellow liquid called **bile**. The bile helps in breaking down of large fat molecules into small fat droplets for easy digestion of fats. The liver also regulates blood sugar level and controls the storage of carbohydrates in our body.

Gall bladder is a pear-shaped organ located under the liver. It stores bile until the body needs it for digestion. It is connected to the liver and the duodenum portion of small intestine by a **bile duct**.

Pancreas

It is the second largest, whitish coloured digestive gland situated behind the stomach. The pancreas secretes **pancreatic juice** which contains a number of enzymes such as, **amylase** (starch digesting enzyme), **trypsin** (protein digesting enzyme) and **lipase** (fat digesting enzyme).

Gastric Glands

These are numerous in number situated inside on the wall of the stomach. These glands secreted gastric juice which contains **hydrochloric acid** and the two enzymes—**pepsin** and **rennin**. Both the enzymes help in the digestion of proteins.

DEMONSTRATION 1

Aim To study the digestive system of human beings

Material Required A model of human digestive system

Procedure: Ask your teacher to show a model of human digestive system. With the help of your teacher, identify the various parts of the human alimentary canal and find out their functions.

If possible, study the chart of the digestive system of a cow and compare it with that of the human digestive system. Observe the differences, if any.

PROCESS OF DIGESTION

Digestion

The physical chemical, and physiological processes of converting food into simple soluble chemical compounds that can be absorbed by the living cells of the body is collectively called **digestion**. As a result of the digestion of food, the body is supplied with nutrients that are used in growth, development and repair of the organisms.

Digestion of Food in Mouth

As the food is taken into the mouth, the incisors bite it into pieces and the molars and premolars grind them into a fine paste. The tongue mixes the chewed food with saliva, secreted by the salivary glands and the food turns into a spherical mass called **bolus**. Saliva contains an enzyme

THINK ZONE

When a piece of bread is chewed, it becomes sweet in taste after some time. Why do you think this happens?

ENRICHMENT

Bile

Bile is a yellow-green, watery liquid which does not contain any enzymes. The colour of bile is due to the presence of bile pigments produced by the breakdown of dead and worn-out red blood cells of the liver. The bile also contains salt of sodium bicarbonate that makes the medium of food alkaline in the stomach.

FACT ZONE

The liver has an amazing quality. It can regenerate itself. Only 25 per cent of the liver is sufficient for regeneration into a complete liver.

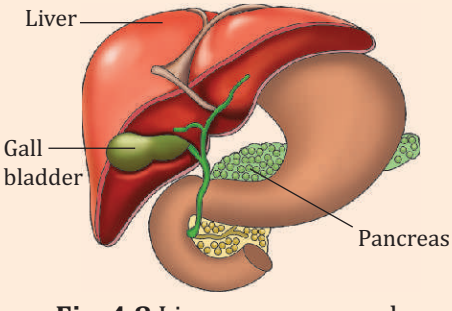


Fig. 4.8 Liver, pancreas and gall bladder

called **salivary amylase**, which starts digesting the starch and converts it into maltose (sugar). The salvia also moists the food so that it easily passed into the oesophagus.

- The digestion of **carbohydrates** starts in the mouth.
- The enzyme **salivary amylase** converts starch (a type of carbohydrate) into maltose (a type of sugar), an end product of digestion process takes place in the mouth.

$$\text{Starch} \xrightarrow{\text{Salivary amylase}} \text{Maltose}$$

Digestion of Food in Stomach

The food remains in the stomach for about 30 minutes to 4 hours, depending on the type of meal that we take. Fatty meals stay here for a long time. In the wall of the stomach, millions of gastric glands are present which secrete about 400–800 mL of **gastric juice** during each meal. The gastric juice is rich in **hydrochloric acid** which makes the environment acidic inside the stomach to kill the harmful bacteria that come along with the food. The gastric juice helps in the digestion of proteins only. It does not support the digestion of starch, sugar and fats.

The gastric juice contains two enzymes—**pepsin** and **rennin**. The enzyme pepsin converts large molecules of protein into smaller molecules called **peptones** and **proteoses**. The enzyme rennin changes the milk protein **casein** into **paracasein** which is the insoluble curd. The muscles of the stomach walls contract and relax to churn the food and mix it thoroughly with the enzymes. Now, the bolus changes into a semi-solid paste called **chyme**. The chyme passes into the duodenum, the first part of the small intestine.

- The digestion of **proteins** starts in the stomach.
- The enzymes **pepsin** and **rennin** take part in the digestion of proteins present in the stomach.
- The **rennin** converts the milk protein casein into paracasin.
- The end products of digestion of protein in the stomach are **proteoses**, **peptones** and **paracasein**.

$$\text{Proteins} \xrightarrow{\text{Pepsin}} \text{Proteoses and peptones}$$

$$\text{Casein} \xrightarrow{\text{Rennin}} \text{Paracasein}$$

More to Know

Carbohydrates

Carbohydrates provides energy for proper functioning of the body. There are two types of carbohydrates—**simple carbohydrates** and **complex carbohydrates**. Glucose, fructose, and sucrose are the simple carbohydrates present in fruits, sugarcane and milk. The complex carbohydrates include starch present in the staple diets like wheat, rice and potato.

THINK ZONE

Why the fatty meals stay for a long time in the stomach?

ROUGH WORK

Digestion of Food in Small Intestine

Small intestine completes the digestion of starch, proteins and fats. It transports food from the stomach to the large intestine.

- The digestion of chyme takes place in the duodenum. The duodenum receives the secretion called **bile** from the liver. It is a yellow-greenish fluid which breaks down the fat into tiny droplets.
- The duodenum also receives a secretion called the **pancreatic juice** from the pancreas. It contains some digestive enzymes namely the **amylase**, **trypsin** and **lipase**.
  - **Amylase** is a starch-digesting enzyme. It changes starch into maltose and other sugars.
  - **Trypsin** is a protein-digesting enzyme. It acts on the proteins and changes them into peptones.
  - **Lipase** is a fat-digesting enzyme. It changes the fats into fatty acids and glycerol.

Starch $\xrightarrow{\text{Amylase}}$ Maltose and other sugars

Proteins $\xrightarrow{\text{Trypsin}}$ Peptones

Fats $\xrightarrow{\text{Lipase}}$ Glycerol and fatty acids

From the duodenum, food enters the jejunum. No digestion of food takes place here and the food then moves to the ileum, which is the last part of the small intestine. The inner lining of the ileum contains intestinal glands which secrete the enzymes like erepsin, maltase, sucrase and lactase.

- **Erypsin** converts proteoses and peptides into amino acids.
- **Maltase** coverts maltose and other sugars into glucose.
- **Sucrase** converts sucrose into glucose and fructose.
- **Lactase** converts lactose into glucose and galactose.

Proteoses and peptide $\xrightarrow{\text{Erypsin}}$ Amino acids

Maltose $\xrightarrow{\text{Maltase}}$ Glucose

Sucrose $\xrightarrow{\text{Sucrase}}$ Glucose and fructose

Lactose $\xrightarrow{\text{Lactase}}$ Glucose and galactose

More to Know

Proteins

Proteins are the body-building food. They are the large chemical molecules that contain amino acids. The foods rich in proteins are meat, fish, eggs, milk, cheese, nuts, beans and peas. Proteins help in the building of worn-out cells. It also makes antibodies that help in fighting harmful bacteria and viruses.

FACT ZONE

The villi of the small intestine have a large surface area of about 2760 square feet, which is enough to cover a tennis court.

ENRICHMENT

Absorption of Food

Every morsel of food that we eat, has to be broken down into simple nutrients that can be absorbed by the body. That is why it takes hours to digest food. Protein must be broken down into amino acids, starch into simple sugars, and fats into fatty acids and glycerol. The water in our food is also absorbed into the bloodstream to provide the body with the nutrients it needs.

More to Know

Fats

Fats are the energy banks for the living organisms. They are stored in almost all parts of the body except in the brain. Fatty acids and glycerol are the simplest forms of the fats. The fat acts as insulation to the body.

FACT ZONE

The process of breaking down of large fat molecules into tiny fat droplets is called **emulsification** of fats.

ACTIVITY 2

Interview your friends about their eating habits. Ask the questions below. You could add more of your own and tabulate the results.

1. What do you eat for breakfast each day?
2. How many meals a day do you eat?
3. Do you pay attention to chewing your food well or you just gulp it down?
4. Do you snack in between the meals?
5. Do you focus on food while eating or watch TV or read a book?
6. Do you eat your food with your family or eat alone?
7. How often do you eat out?
8. How often do you eat fast food/ soft drinks/chips?
9. How many servings of fruits and vegetables do you eat each day?

In the small intestine, the soluble food is absorbed by the villi and transported to the blood. The blood distributes it to all parts of the body. Some food remains undigested in small intestine and enters the large intestine where absorption of water takes place and undigested food thrown out from the body through the anus.

ASSIMILATION OF DIGESTED FOOD

The utilisation of digested and absorbed nutrients when required by the body is called **assimilation**.

- In the liver, glucose is stored in the form of insoluble glycogen. When the body require it, the liver converts it into soluble glucose. Excess of glucose is converted into the fat which is stored in the special types of cells present under the skin.
- Amino acids are used for the production of proteins. These proteins are used for growth and repair of the body cells. Excess of amino acids are broken down into urea. Inside the kidney, this urea is filtered out from the blood and then it passes out in the form of urine.

WHAT IS INDIGESTION?

Indigestion is just another name for an upset stomach. It usually happens when people eat too much, too fast, or foods that is too oily and loaded with fat.

The symptoms of indigestion include:

- Burning in the stomach or oesophagus
- Abdominal pain
- Bloating (full feeling)
- Belching and gas
- Nausea and vomiting
- Acid taste in the mouth.

If indigestion continues for a long time, then a doctor must be consulted. Smoking and drinking can also be the cause of indigestion.

UNHEALTHY EATING HABITS

Unhealthy eating habits lead to many health problems. Good eating habits are cultivated early in life and they go a long way in helping you lead a happy and healthy life.

1. **Skipping meals** It is a very bad habit. It makes you eat excessive later. Body needs healthy diet at regular interval. A healthy breakfast according to your age and lifestyle is a healthy way to start the day.
2. **Eating out and junk food** Stuffing yourself full of chips, sodas and candy will make a big chunk of your calorie intake unhealthy. Eating healthy snacks such as nuts, fruits, salads and seeds will add nutrients, fibre and a good source of energy to your diet. Food in restaurants and fast-food joints are low on nutrients and high on calories. This kind of diet taken very frequently leads to obesity. Obesity is the cause for heart diseases and diabetes.
3. **Not reading a nutrition label** Nutrition labels are filled with accurate and valuable information that you can use before buying a food product. The nutrition label can give you information on calories, fat, salt levels, ingredients and nutrient content. Reading labels correctly is important. One must not go by what the advertisements say.

   Other important things to keep in mind for a healthy life is that one must:

   - Drink a lot of water
   - Eat healthy food with lots of fruits and vegetables
   - Exercise everyday
   - Sleep well and avoid stress.

Assess Yourself

Answer the following questions.

1. What is bolus?
2. Name the organs that constitute the alimentary canal.
3. What is the secretion of liver called?
4. What are the three parts of the small intestine?
5. In which part of the small intestine does the maximum digestion of food takes place?
6. What is the role of large intestine in humans?

Think Zone

Rahul loves to eat food like pizza, potato wafers and chocolates daily. Do you think it is a good eating habit?

Let's Recapitulate

- The process of **nutrition** comprises of **ingestion**, **digestion**, **absorption**, **assimilation** and **egestion**.
- Human digestive system consists of the **alimentary canal** and the **associated digestive glands** such as the salivary glands, liver and pancreas.
- Along with these glands there are numerous **gastric glands** present on the wall of the stomach.
- Alimentary canal is a long tube that extends from the mouth to the anus.
- The muscles of the alimentary canal move the food forward by the movement called **peristalsis** and push the food down into the alimentary canal.
- Digested food is absorbed by the **villi** of small intestine and then sent to the blood for its distribution throughout the body.
- Water is absorbed by the large intestine and the faeces is expelled from the body through the anus.

- **Indigestion** is just another name for an upset stomach. It usually happens when people eat too much, too fast, or foods that are too oily and loaded with fat.
- Unhealthy eating habits such as skipping meals, eating out and exercise junk food lead to many health problems.

EVALUATE YOUR UNDERSTANDING

Recalling Ideas

I. Select the correct option.

1. Digestion of starch, proteins and fats is completed in
   (a) small intestine ☐ (b) large intestine ☐
   (c) stomach ☐ (d) oesophagus ☐
2. Gastric juice is mixed with food in the
   (a) stomach ☐ (b) oesophagus ☐
   (c) mouth ☐ (d) intestine ☐
3. Bile is produced by this organ.
   (a) Pancreas ☐ (b) Stomach ☐
   (c) Large intestine ☐ (d) Liver ☐
4. Amylase is an enzyme responsible for the digestion of
   (a) starch ☐ (b) fat ☐
   (c) protein ☐ (d) none of these ☐
5. Pepsin, a protein digesting enzyme is present in the
   (a) mouth ☐ (b) oesophagus ☐
   (c) stomach ☐ (d) duodenum ☐

II. Fill in the blanks with the correct option.

1. _____ is the process which involves the removal of undigested food from the body. (Assimilation/Egestion)
2. The largest digestive gland of human digestive system is the _____. (liver/pancreas)
3. The enzyme present in saliva is _____. (salivary amylase/pepsin)
4. Duodenum, jejunum and ileum are the parts of the _____ intestine. (small/large)
5. The water present in the digested food is absorbed by the _____ intestine. (small/large)
6. Burning sensation in the stomach is caused due to _____ of food. (indigestion/digestion)

III. State if the following statements are True or False. Correct the False statement.

1. Pancreatic juice does not contain any enzymes.
2. Most of the ingested food can be digested in the mouth.
3. Absorption and assimilation are the similar processes of digestion.
4. The bile contains no enzymes, except salts to emulsify the fat present in the food.
5. Saliva contains lipase which digests carbohydrates.
6. Eating junk food is a good eating habit.

IV. Match the following.

Column A		Column B
1. Amylase	(a)	Gastric juice
2. Lipase	(b)	Starch
3. Stomach	(c)	Fats
4. Small intestine	(d)	Egestion
5. Anus	(e)	Protein
6. Pepsin	(f)	Villi

V. Give reasons for the following.

1. When we chew a chappati for some time it tastes sweet.

   _____

2. The small intestine has a large number of villi.

   _____

Understanding Ideas

I. Give one word for the following.

1. A rhythmic movement that propels food from the pharynx to the stomach. _____
2. An acid present in the stomach for killing of unwanted bacteria come along with food. _____
3. The finger-like projections which absorb soluble food in the small intestine. _____
4. An organ where the bile juice is stored temporarily. _____
5. An organ where the digestion of proteins starts. _____

II. Put the following processes in their correct sequence of occurrence during digestion.

Tongue pushes the food, peristalsis, grinding and mixing saliva, cutting and tearing of food.

III. Answer the following questions in short.

1. Name the secretion of salivary glands.

   _____

   _____

   _____

2. What is the main function of bile juice?

   _____

   _____

   _____

3. What is peristalsis? Where does it occur?

   _____

   _____

   _____

5. What is meant by the digestion?

_____

_____

_____

6. What is chyme? Where is it formed and how?

_____

_____

_____

7. What is the indigestion of food? What are its symptoms?

_____

_____

_____

IV. Answer the following questions in detail.

1. How does the presence of villi help in absorption of digested food?

_____

_____

_____

_____

_____

2. State two functions of the pancreas.

_____

_____

_____

_____

_____

3. What happens to the food when it reaches to the stomach? Name the digestive juice secreted by the wall of stomach.

_____

_____

_____

_____

_____

4. What is the fate of excess glucose in our body?

_____

_____

_____

_____

_____

5. Give the functions of the large intestine.

_____

_____

_____

_____

_____

6. Describe the functions of the following:
   (a) Oesophagus

   _____

   (b) Tongue

   _____

7. What are the unhealthy food habits? State its effects on a person's health.

_____

_____

_____

_____

_____

V. Differentiate between the following.

1. Liver and pancreas

_____

_____

_____

2. Bolus and chyme

_____

_____

_____

3. Egestion and ingestion

_____

_____

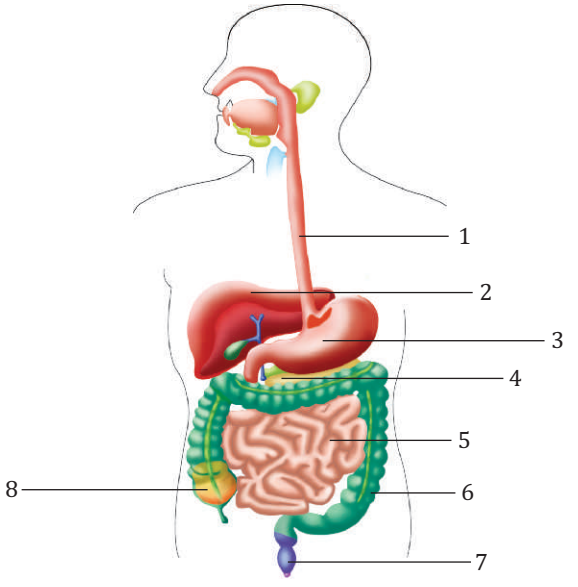
_____

Think Critically

1. How is digestive system is different from the alimentary canal?
2. Why it is advisable to eat lots of fruits and vegetables?
3. Why it is necessary to digest food?
4. If a person eats food while standing, would it reach his stomach?

Diagram-based Question

1. Given below is a diagram of the human digestive system:
   (a) Label the parts 1 to 8.
   (b) State the functions of parts numbered 2, 3, 4 and 6.



Project Ideas

1. Visit a nearby hospital. Talk to any five patients that have some problems related to digestion of food such as acidity, indigestion, etc. With the help of the doctor mention the type of medication they have been advised.

	Name of the patient	Problem they have	Medication advised
1.			
2.			
3.			
4.			
5.			

2. Interview any three neighbours of your locality and find out about their food habits. Make a list of the food items they had at breakfast, lunch and dinner last week. Group the dishes according to the components of food, namely carbohydrates, proteins, fats, vitamins and minerals. Are their food habit is good or bad? Are they eating a balanced diet or not? Make a project report based on your findings.

Chapter - 5

Human Body—Respiratory System

Learning Objectives

Let's learn about

- Respiration
- Phases of Respiration
- Breathing
- Human Respiratory System
- Mechanism of Breathing
- Phases of Respiration in Human Beings

  Common Respiratory Diseases
- Ways to Prevent Respiratory Diseases

In this chapter, we will learn about the respiratory system, which is one of the most important organ systems of the living body. We have learnt that the muscles of digestive tract continuously contract and relax, due to which the ingested food gets digested and provides nutrients to our body. The fact is that the muscles of our digestive tract need oxygen to work properly. This oxygen comes from the process of **respiration**. So before studying about the human respiratory system, we have to learn that what the respiration is?

RESPIRATION

Respiration is the process of release of energy (ATP) by the breaking down of glucose (an organic substance) present in the digested food of the living body. All organisms including human beings obtain oxygen from the air. When the glucose present in digested food combines with oxygen, it completely breaks down and a large amount of energy is released with the liberation of carbon dioxide and some amounts of water vapours. In the absence of oxygen, the incomplete breakdown of glucose releases less amount of energy. In respiration, the energy released in the form of **ATP** (adenosine triphosphate) molecules. It is a **chemical process**.

Glucose + Oxygen $\longrightarrow$ Carbon dioxide + Water + Energy (ATP)

Though, the process of respiration looks simple, but it involves a series of reactions that are controlled by the enzymes.

PHASES OF RESPIRATION

The process of respiration has two stages—**breathing** and **cellular respiration**.

Breathing or External Respiration

It is a **physical process** which involves inhaling air rich in oxygen and exhaling air rich in carbon dioxide.

ENRICHMENT

Gaseous Exchange

All living things need energy to carry out various life processes. Most organisms obtain their energy from the oxidation of food by the process called **respiration**. To keep the process going, a living organism takes in oxygen and gives out carbon dioxide. This process is known as **gaseous exchange**.

FACT ZONE

- **ATP** molecules act as energy packets in our body. These energy packets can release instant energy whenever it is needed.
- Respiration releases energy that comes from the breakdown of large food particles into simpler one. Hence, digestion and respiration both the life processes are inter-related.

  In fact, we will see that all life-processes are inter-related.

ENRICHMENT

Single-celled Animals Need Less Energy

Single-cell organisms, such as *amoeba* have a relatively smaller oxygen requirement. All the oxygen they need diffuses through their body surface. They give out carbon dioxide in the same way through their body surface.

ASSESS YOURSELF

Answer the following questions.

1. What is respiration?
2. Why the respiration is called a chemical process?
3. Why the breathing is called a physical process?
4. Name the energy packets of our body.
5. Which part of the body of an amoeba takes part in gaseous exchange?

FACT ZONE

The rate of breathing is regulated by the nerves present in the respiratory centre of the brain.

ACTIVITY 1

Aim To check breathing in and breathing out

Put your one hand on your chest and the other one just below the ribcage. Breathe in deeply. What do you feel? Now breathe out. What happens?

Cellular or Internal Respiration

It is a **biochemical process** in which glucose is oxidised to release energy. As a result of cellular respiration carbon dioxide and water are formed as by-products.

On the basis of their mode of respiration, the process of external respiration or breathing is different in different organisms. However, the cellular respiration is similar in both plants and animals. Both of them take in oxygen and release carbon dioxide, water and some amounts of energy.

BREATHING

In breathing, an organism takes in (inhales) oxygen from the environment and releases (exhales) carbon dioxide. It takes place outside the cell and does not liberate energy. Different organisms carry out the breathing process in various ways, depending on their size and environment. For example, *amoeba* exchanges oxygen and carbon dioxide directly with the environment through its cell membrane.

Table 5.1 Differences between respiration and breathing

Respiration	Breathing
1. It is a biochemical process.	1. It is a physical process.
2. It occurs in every living cells of the body.	2. It involves mainly the lungs of the body.
3. It involves the breakdown of glucose into carbon dioxide, water and energy.	3. It involves the exchange of oxygen and carbon dioxide through the body organs.
4. It liberates energy.	4. It does not liberate energy.
5. It takes place inside the cell.	5. It takes place outside the cell.

HUMAN RESPIRATORY SYSTEM

Human beings have a well-developed respiratory system that comprises of the nose, nasal cavity, pharynx, larynx, trachea, bronchi and alveoli. In human respiratory system, lungs are the main respiratory organs where exchange of gases takes place.

Nose and Nasal cavity

Air enters the body through the **nose**. Externally, the nose consists of two nostrils. The inner wall of **nasal cavity** is lined with hair and mucus. The hairs trap dust particles

and germs that enter along the inhaled air. The mucus makes air passage moist and sticky. The membrane of the inner lining of the nose has cilia. The dust particles falling on the sticky surface are swept out by the cilia towards the throat, where they are either swallowed or coughed up to remove large foreign particles from the lungs. In this way, the inhaled air is cleaned before entering the lungs.

Pharynx

Nasal cavity leads into a short tube called the **pharynx**. It is situated behind the nose and the mouth. It leads to an air tube called trachea or wind pipe and a food tube called oesophagus. The lower portion of the pharynx leads to the larynx or voice box.

Larynx

Larynx or **voice box,** is located in the trachea, a short distance from the throat. It contains folds of muscular tissues called **vocal cord** that vibrates with the passage of air and produces sound. The larynx leads to the trachea.

Trachea (Wind Pipe)

Trachea is a long, muscular tube extending from the larynx in the neck to bronchi in the thoracic cavity. The front opening of trachea called **glottis** is guarded by a muscular flap called **epiglottis**. The epiglottis closes the trachea at the time of swallowing of food. The walls of the trachea have C-shaped cartilagenous rings that prevent the trachea from collapsing. The cells lining the trachea also have cilia which move dust particles away from the lungs.

Bronchi and Bronchioles

Trachea runs in the middle of the chest up to a short distance between the two lungs where it divides into two **bronchi** (singular: bronchus)—the **left bronchus** and the **right bronchus**. After passing through the trachea, the air enters each bronchus and finally enters the lungs. In the lungs, air is pulled into fine branches of the bronchi and eventually enters microscopic branches called **bronchioles**. The bronchioles are slightly thicker than the bronchi. The cilia lining the bronchi and bronchioles also help to remove the small foreign particles.

More to Know

Respiratory Organs of Other Animals

- **Fish** Respiratory organ of fish is the **gills**. Each gill has a pair of **gill filaments** and covered by the **gill cover** or **operculum**.
- **Frog** It can breathe through its **skin** and **lungs** both.
- **Insects** They can breathe through **tracheae**.

ROUGH WORK

FACT ZONE

- You can feel the cartilage of your larynx in your neck.
- A new born baby breathes faster than an adult.
- An adult breathes 12 to 18 times in a minute whereas a new born baby breathes about 60 times in a minute.

ENRICHMENT

Exchange of Gases in Lungs

Exchange of gases takes place in the alveoli. The alveoli have a thin, moist wall through which the gases pass through very easily. The alveoli are surrounded by numerous fine blood capillaries, which contain oxygenated blood. The oxygen in the alveoli diffuses into the blood cells (RBCs) and is carried to different parts of the body. At the same time, carbon dioxide from the blood cells diffuses into the alveoli. From the alveoli, carbon dioxide travels upward through bronchioles, bronchi, trachea and then larynx, and is exhaled through nostrils into the atmosphere.

Lungs

The **lungs** are a pair of spongy, elastic organs. They lie in the thoracic cavity, protected by the ribcage and rest on a muscular sheet called the **diaphragm**. The lungs are protected outside by two membranes called **outer pleura** and **inner pleura**. The space between the two membranes is filled with a fluid called **pleural fluid**. It keeps the lung's surface moist for easy diffusion of gases. The plural fluid also provides lubrication for expanding and contracting the lungs, so that the lungs are protected from any damage due to friction. Both the lungs occupy the maximum space of thoracic cavity. They are located close to the thoracic wall and their lower parts rest on the diaphragm. The left lung is slightly smaller and has two lobes whereas the right lung has three lobes.

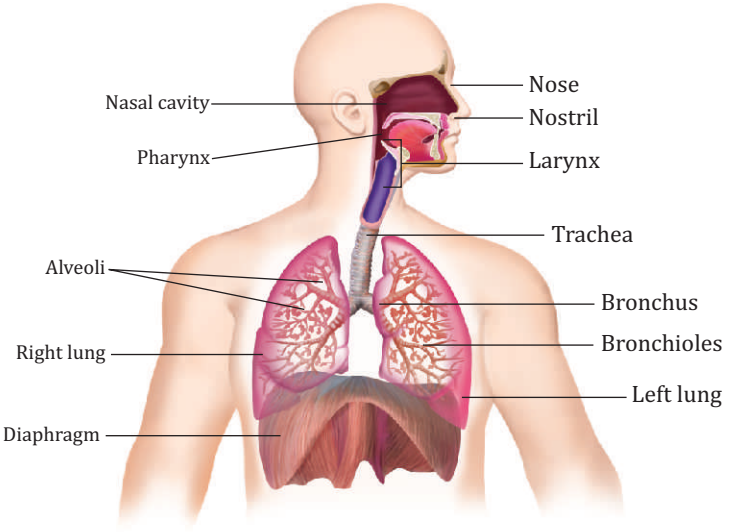


Fig. 5.1 Human respiratory system

DEMONSTRATION 1

Aim To demonstrate the model of human respiratory system

Materials Required A model of human respiratory system and a pointer

Procedure Demonstrate the model of human respiratory system. Now explain the function of lungs. The following questions may be asked:

1. Which is the main respiratory organ of the human respiratory system?
2. Why it is so spongy in touch?
3. Why the inner lining of nose has small hairs?

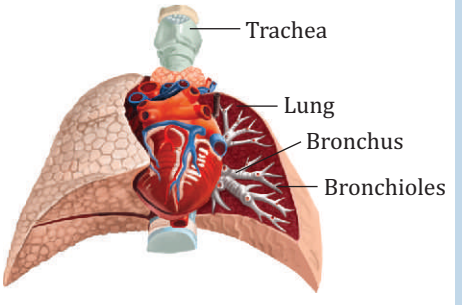


Fig. 5.2 A model of human respiratory system

Alveoli

The bronchioles connect to tiny ducts that lead into the air-sacs called **alveolar sacs**. Each air sac has a group of **alveoli** which are usually surrounded by the blood capillaries. The gaseous exchange occurs in the alveoli of the lungs. Blood present in the capillaries contains more carbon dioxide than alveolar air. Since the alveoli contain inhaled oxygen-rich air, there is more oxygen in the alveoli than in the blood. Thus, oxygen diffuses into the capillaries from the alveoli. In the similar manner, carbon dioxide diffuses into the alveoli from the capillaries.

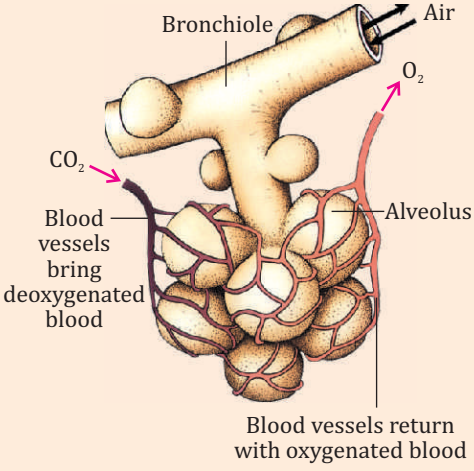
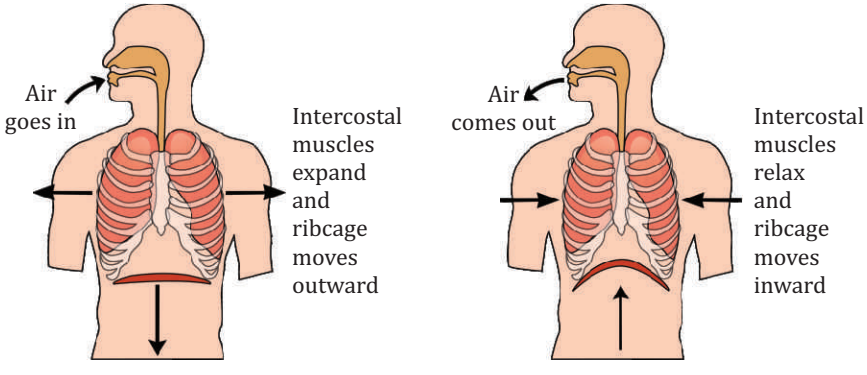


Fig. 5.3 Structure of alveoli

MECHANISM OF BREATHING

The mechanism of breathing comprises of two steps—**inspiration** or **inhalation** in which air through the nostrils is drawn into the lungs and **expiration** or **exhalation** in which the impure air from the lungs is expelled out through the nostrils.

During **inspiration**, the intercostal muscles expand, the ribcage moves up and outward, so the volume of the chest increases and the diaphragm expands which make it flatten out. As a result, the chest cavity expands and the air moves down the windpipe and is drawn into the lungs.



(a) Diaphragm contracting during **inhalation**

(b) Diaphragm relaxing during **exhalation**

Fig. 5.4 Mechanism of breathing

During **expiration**, the intercostal muscles relax and ribcage moves down and inward, so, the volume of the chest decreases. The diaphragm relax and returns to its domb-shape and the chest cavity becomes smaller. As a result, the air is forced out to the lungs.

ACTIVITY 2

Aim To prove that exhaled air is warmer than inhaled air

Take a thermometer and hold it for two minutes to measure the temperature of the air. Note down the temperature. Now, place the thermometer below your nostrils and exhale on it. Do this for two minutes and note the temperature of exhaled air.

Is there any difference between the temperature of the inhaled air and exhaled air?

ROUGH WORK

ACTIVITY 3

Aim To show that water is lost during the breathing process

Procedure Take a dry glass tumbler. Gently breathe over its surface. Note that the surface becomes wet with water droplets. They have condensed from water vapours present in the exhaled air, best seen in winters.

ROUGH WORK

The temperature of inhaled air is much lesser than the body temperature. The blood vessels present in the nasal cavity makes the inhaled air warm. The temperature of exhaled air is higher than that of inhaled air. It is very close to the body temperature. The exhaled air also contains a higher percentage of carbon dioxide and moisture than the inhaled air.

Table 5.2 Composition of air during inhalation and exhalation

Component	Inspired air	Expired air	Reason
Oxygen	21%	16%	Oxygen is used by the cells in respiration.
Carbon dioxide	0.03%	4%	Carbon dioxide is produced by the cells as a waste product of respiration.
Nitrogen	79%	79%	Nitrogen gas is not used by cells.
Water vapours	Variable	Always high	Some of the water evaporates and is lost along with breathed out air.

DEMONSTRATION 2

Aim To demonstrate the action of diaphragm in breathing

Materials Required A Y-shaped tube, two small balloons, a rubber sheet and a cork

Procedure Take a Y-shaped tube. Tie two small balloons over the two ends of this tube. Suspend the tube in a bell-jar by means of a cork. Close the broader end of the bell-jar by means of a rubber sheet. The rubber sheet is like a diaphragm and the bell-jar like the chest cavity. The Y-shaped tube is like the trachea and balloons are the two lungs. Now pull the rubber sheet downwards. What do you observe?

Observation You will observe that when you pull the rubber sheet downward, the balloons are expanded by the air through the Y-shaped tube from outside. When you push the rubber sheet inward, the balloons collapse again due to the air rushing out of them.

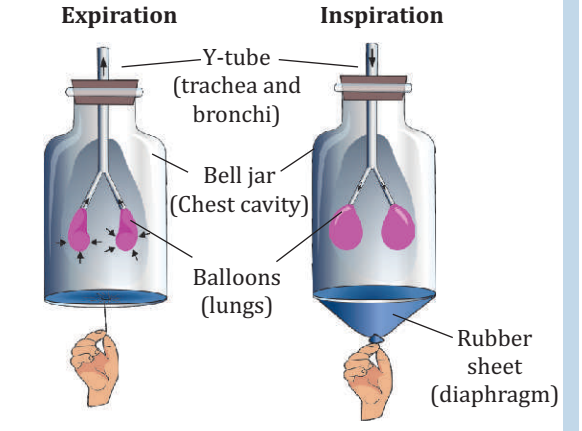


Fig. 5.5 Demonstration of the action of diaphragm in breathing

PHASES OF RESPIRATION IN HUMAN BEINGS

In human beings, respiration occurs in following three phases:

1. Breathing or External Respiration

It is the inhaling of oxygen from the air into the lungs and exhaling carbon dioxide back to the air through nostrils. The air enters through the nostrils into the nasal cavity and finally reaches into the lungs where the gaseous exchange takes place.

2. Gaseous Transport

It involves the absorption of inhaled oxygen into the blood present in the lungs. This oxygenated blood from the lungs is transported throughout the body and reaches all the cells where the gaseous exchange takes place. During the gaseous exchange, the blood transports oxygen to the cells and collects the carbon dioxide from the cells (deoxygenated blood). This deoxygenated blood transports back to the lungs for the removal of carbon dioxide.

3. Cellular or Internal Respiration

It is a process by which cells oxidise sugar (glucose) into carbon dioxide and water to release energy in the form of adenosine triphosphate (ATP). ATP molecules are the **energy currencies** of the cells. They are used to perform the functions necessary for life.

The reaction involves in cellular respiration is as follows:

$$\text{Glucose} + \text{Oxygen} \longrightarrow \text{Carbon dioxide} + \text{Water} + \text{Energy (38 ATP)}$$

COMMON RESPIRATORY DISEASES

Respiratory illness is a common problem in our country. Most often, smoking, pollution or infections are to blame. Respiratory tract, lungs or both are affected in the diseases of the respiratory tract.

Asthma

In a simple language, asthma narrows the tubes present in the lungs during an acute attack, which makes it more difficult for the sufferer to breathe. Coughing, wheezing and shortness of breath are the symptoms asthma patients are used to. This disease can run in families or may develop because of pollution. Others prone to asthma may include those who smoke and those who are overweight.

More to Know

Respiration vs Burning

- The process of respiration may be compared to the process of burning. For example, when wood is burned, it produces heat, carbon dioxide and water vapour. Similarly when organisms respire, they burn energy (sugar) and produce carbon dioxide and water.
- Athletes burn energy (sugars) as they exercise. The harder they exercise, more sugar is burned, therefore, more oxygen is needed.
- Respiration is a kind of burning of food, to get energy to grow and to do work. It is very important to understand that both plants and animals (including microorganisms) need oxygen for respiration. That is why very wet or saturated soils are detrimental to the growth of root as well as for the decomposition processes carried out by the microorganisms in the soil.

ENRICHMENT

It is not advisable to breathe through the mouth, as in the mouth there is no hairy and sticky lining present to trap the dust and germs come along the inhaled air. Therefore, dust and germ particles can easily get into the lungs and cause infection.

ENRICHMENT

Cough and Hiccup

- **Cough** The epiglottis shut the windpipe while swallowing the food. Sometimes when you talk while eating, the food particles can go into the windpipe and causing you o choke. The cough sets up a blast of exhaled air and thus clears the air passage.
- **Hiccup** It is caused due to muscular spasm in the diaphragm. Due to the sudden constriction of diaphragm, the air rushes in with a 'hic' sound. To stop air rushing into the epiglottis, it snaps shut causing a 'cup' sound. This action stops the flow suddenly and gives the body a jolt.

ASSESS YOURSELF

Answer the following questions.

1. What are the three phases of respiration in human beings?
2. Name the organ that is called as voice box.
3. What are the alveoli?
4. Where does the gaseous exchange take place in human respiratory system?
5. Name the gases present in inhaled and exhaled air.
6. What do you meant by respiratory diseases? Give some examples.

Bronchitis

When a person has bronchitis, it is harder for air to pass in and out of the lungs, the tissues become irritated and more mucus is produced in the respiratory tract. The most common symptom of bronchitis is a cough.

Pneumonia

Pneumonia is a general term for lung infections that can be caused by a variety of germs.

Symptoms of pneumonia vary, depending on the age and what caused the disease, but can include:

- Fever
- Shivering chills
- Cough
- Stuffy nose
- Very fast breathing or breathing with wheezing sound

Tuberculosis (T.B.)

Tuberculosis generally affects the lungs, but can also affect other parts of the body. Tuberculosis is a disease caused by the bacteria (bacteria is a type of germ). This germ spreads through the air from the person suffering from T.B.

Acute cough, fever and weight loss are the symptoms of T.B.

WAYS TO PREVENT RESPIRATORY DISEASES

- Wash your hands often, especially when you are around people with colds as the germs spread through contact.
- Keep your hands away from your nose, eyes and mouth. These are the places from where germs are most likely to enter your body.
- Do not smoke or use other tobacco products. Smoking makes lungs and respiratory tract more susceptible to infections. If you live in an area that has problems with air pollution wear a mask when you step out.
- Exercise regularly. This will make you strong and strengthen your immunity and protect you from diseases.
- Get a flu shot (influenza vaccine) each year.
- Lastly, remember nothing replaces a 'healthy diet'. A balanced diet gives you resistance against diseases.

Let's Recapitulate

- Process of taking in oxygen to release energy and giving out carbon dioxide and water is called **respiration**. It is a chemical process which involves the breakdown of glucose (carbohydrates) to form carbon dioxide and water with the release of energy.
- When the respiration takes place in the presence of oxygen, a large amount of energy is released. In the absence of oxygen, there are less energy released.
- **Breathing** or external respiration is the exchange of gases (oxygen and carbon dioxide) between an organism and its environment. Energy is not released during breathing. It is a physical process.
- In internal respiration, also called cellular respiration, oxygen is used to oxidise the food to release energy.
- Mechanism of breathing includes—**inhalation** and **exhalation**.
- The process of taking in air is called **inhaling** and expelling air from the lungs is called **exhaling**.
- Human respiratory system consists of the nose, pharynx, larynx, windpipe, bronchi and brochioles, alveoli and lungs.
- Gaseous exchange takes place in **alveoli**. Alveoli are richly supplied with blood vessels.
- Respiratory tract, lungs or both are affected in the diseases of respiratory tract.
- Asthma, bronchitis, pneumonia, tuberculosis are the examples of respiratory diseases.

Evaluate Your Understanding

Recalling Ideas

I. Select the correct option.

1. The by-products of respiration are
   (a) carbon dioxide, water and energy ☐ (b) water and oxygen ☐
   (c) sugar and oxygen ☐ (d) oxygen and carbon dioxide ☐
2. A process in which energy is released on oxidation of glucose is called
   (a) respiration ☐ (b) excretion ☐
   (c) digestion ☐ (d) transpiration ☐
3. The chief respiratory organ of human beings is the
   (a) lungs ☐ (b) skin ☐
   (c) gills ☐ (d) spiracles ☐
4. Alveoli are the structures present in the
   (a) bronchi ☐ (b) lungs ☐
   (c) gills ☐ (d) bronchioles ☐
5. Oxygen carrying blood cells are the
   (a) blood platelets ☐ (b) red blood cells ☐
   (c) white blood cells ☐ (d) lymph ☐

II. Fill in the blanks with the correct option.

1. Breathing is a _____ process. (physical/chemical)
2. The taking in of air is called _____. (exhalation/inhalation)
3. Bronchi divided into smaller tubes called _____. (alveoli/bronchioles)
4. A muscular membrane present below the lungs is called the _____. (diaphragm/pleura)
5. Tuberculosis is a _____ disease. (respiratory/circulatory)

III. State if the following statements are True or False. Correct the False statement.

1. Gaseous exchange takes place in the alveoli of the lungs.
2. In the process of respiration, oxygen is given out while the carbon dioxide is taken in.
3. The trachea branches into two brochioles.
4. The oxidation of food to release energy and water is called breathing.
5. Breathing is a chemical process while respiration is a physical process.

IV. Match the following.

Column A		**Column B**
1. Diaphragm	(a)	Cartilagenous rings
2. Trachea	(b)	Breathing
3. Alveoli	(c)	Voice box
4. Larynx	(d)	Large surface area
5. Epiglottis	(e)	Swallowing

V. Arrange the following in a correct order to show the passage of air:

Bronchioles, bronchi, nose, larynx, alveoli, pharynx, lungs, trachea

Understanding Ideas

I. Give one word for the following.

1. The chief respiratory organ of human beings. _____
2. A large flat muscle found in the chest cavity. _____
3. A membrane enveloping the lungs. _____
4. A form of energy released by the oxidation of food. _____
5. A muscular flap which guards the opening of wind pipe. _____

II. Answer the following questions in short.

1. Define respiration.

_____

_____

_____

2. What changes take place as the air passes through the nasal cavity?

_____

_____

_____

3. What is the role of red blood cells in respiration?

_____

_____

_____

4. Where is the blood enriched with oxygen in human beings?

_____

_____

_____

5. Why one should not talk while eating?

_____

_____

_____

6. What is the function of voice box?

_____

_____

_____

III. Answer the following questions in detail.

1. Name the three phases of respiration in human beings.

_____

_____

_____

_____

_____

2. Name the various parts of the human respiratory system. Also mention their functions.

_____

_____

_____

_____

_____

3. What is the role of diaphragm?

_____

_____

_____

_____

_____

4. Describe briefly the functions of the following:

   (a) Pleural fluid

   _____

   _____

   (b) Epiglottis

   _____

   _____

5. How is food prevented from entering the trachea?

   _____

   _____

   _____

   _____

   _____

6. What are the features of alveolar wall that make it an excellent respiratory surface?

   _____

   _____

   _____

   _____

   _____

7. What is the function of hairs present in the lining of nasal cavity?

   _____

   _____

   _____

   _____

   _____

8. What are the respiratory diseases? How they are prevented?

   _____

   _____

   _____

   _____

   _____

IV. Differentiate between the following.

1. Respiration and breathing

   _____

   _____

   _____

2. Inhalation and exhalation

_____

_____

_____

3. Bronchi and bronchioles

_____

_____

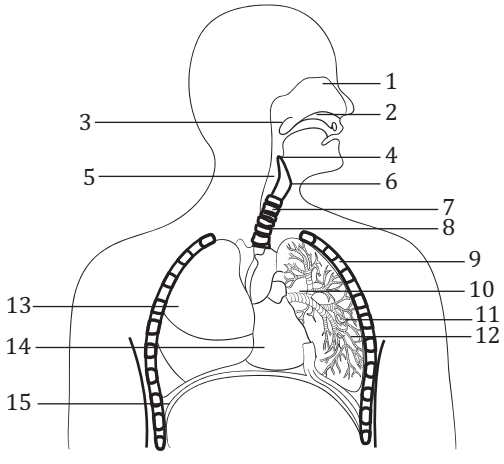
_____

Think Critically

1. Why do body cells require oxygen?
2. Why is respiration important for organisms?
3. What happen to lime water when exhaled air is passed through it?
4. Breathing through nose is said to be healthier than through the mouth. Justify the statement.

Diagram-based Question

1. The figure given below shows the respiratory system of human beings.
   (a) Label the parts 1 to 15.
   (b) What is the function of part 12?
   (c) Why is the trachea lined with C-shaped cartilaginous rings?



Project Ideas

1. Find out the names of some respiratory diseases like asthma, bronchitis, tuberculosis, etc. Invite a doctor to discuss health issues related to these diseases. Make a project report on the basis of information collected. Also find out the ways for prevention of these diseases.
2. Make a PowerPoint Presentation on the topic, 'air pollution is a necessary evil in a modern society'.

Learning Objectives

Let's learn about

- Circulatory System
- Blood
- Blood Groups
- Blood Donation and Blood Bank
- Blood Vessels
- Heart
- Circulation of Blood
- Heartbeat and Pulse rate
- Blood Pressure
- Exercise and Healthy Diet for Heart

ENRICHMENT

Transport System

The transport system brings oxygen and digested food materials to the cells from specific organs. It also takes away the wastes from the cells to the excretory organs. This provides a rapid movement of materials in and out of the body. In an adult human body, there is about 5 litres of blood forming an amazing transport system within the body.

FACT ZONE

- More than two hundred million red blood cells get destroyed and immediately replaced in every second.
- The taste of blood is salty due to the presence of dissolved mineral salts like sodium chloride.

Chapter - 6

Human Body— Circulatory System

We have already learnt that the food we eat gets digested. As a result, the nutrients absorbed in the intestine go into the bloodstream as does oxygen from the lungs. Both the nutrients and the oxygen have to be delivered to each and every cell in the body. In addition to this, all the wastes produced such as carbon dioxide, etc. from these cells have to be carried to specialised organs from which they are eliminated. The body, therefore, needs an effective transport system. This transport system is known as the **circulatory system**. It is responsible for the transportation of nutrients, minerals, essential chemicals and respiratory gases to all parts of the body.

CIRCULATORY SYSTEM

The circulatory system comprises three main components:

- A **fluid**, *i.e.* **blood** that transport the substances to and from the cells of the body.
- A **network of transporting vessels**, comprising of **arteries**, **veins** and **capillaries** that distribute and collect the blood to and from the body.
- A **pump**, *i.e.* **heart** that pumps the blood throughout the body.

BLOOD

Blood is the life giver of the body. It is a red coloured liquid that connects the different body parts and also maintains continuity within the body. It comprises of a complex mixture of **plasma** and **blood cells**.

- **Plasma** constitutes 55 to 60 % of total blood.
- **Blood cells** are the solid parts of blood comprise 40 to 45 % of total blood. They are of three types—red blood cells (RBCs), white blood cells (WBCs) and platelets.

Components of Blood

Plasma

The plasma is the straw-coloured liquid part of the blood. About 90 per cent of plasma is water and the remaining 10 per cent constitutes dissolved substances such as digested food, salts (sodium, potassium, calcium chloride and bicarbonates), hormones and waste products (urea and carbon dioxide) and antibodies.

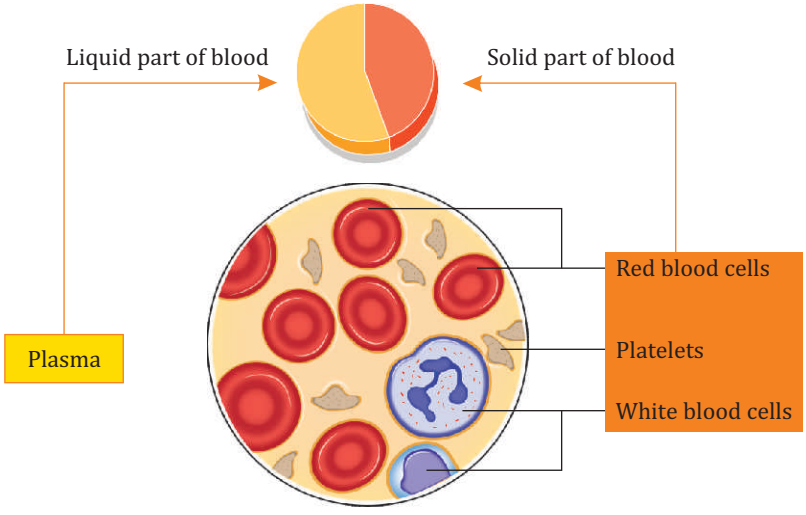


Fig. 6.1 Components of blood

Red Blood Cells (RBCs)

Red blood cells are also known as **erythrocytes**. They are made in the bone marrow of long bones and broken down in the liver. They have the lifespan of about 120 days. These are the most abundant component of the blood. These are present in large number (about 4.5–5 million per cubic millimetre) in the blood. The red blood cells contain a protein called **haemoglobin** in which the haem part is iron, responsible for the dark red colour of the blood. The haemoglobin is a very important compound of blood because it can attract and carry oxygen molecules and distribute them to each cell of the body.

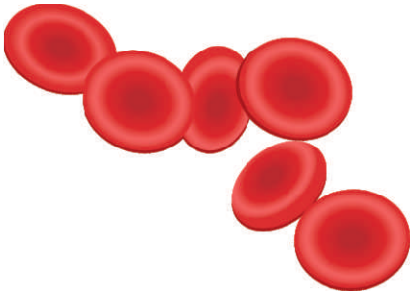


Fig. 6.2 Red blood cells filled with haemoglobin

A red blood cell has a disc-shaped structure. Unlike other cells, a mature red blood cell does not have a nucleus.

More to Know

- **Anaemia** is a disease caused due to deficiency of RBCs in the blood. The deficiency of RBCs is caused by the loss of blood, iron deficiency and the diseases which show down the formation of blood.
- Increasing amount of WBCs in the blood indicates that there is some infection in the body.
- Plasma helps to regulate body temperature.

Enrichment

Haemoglobin present in the red blood cells carries oxygen to different body cells in the form of a compound called **oxyhaemoglobin**. When the blood reaches the cell that needs oxygen, the oxyhaemoglobin again splits into the oxygen and haemoglobin. The oxygen is retained by the cell and the haemoglobin carries carbon dioxide from the cell to the lungs in the form of **carbamino haemoglobin**.

Think Zone

What would happen to a person whose red blood cells have less amount of haemoglobin?

ENRICHMENT

On the site of wound, some white blood cells surround the germs and dead cells of the wound and digest them while some other white cells make a special type of chemicals named **antibodies**. The antibodies help the body to fight with diseases.

ROUGH WORK

White Blood Cells (WBCs)

The white blood cells are also known as **leucocytes**. They are colourless and circulate throughout the body. They are irregular in shape. Unlike RBCs, they have a nucleus and are less in number (5000–8000 per cubic millimetre of the blood). They have an average lifespan of only a couple of days.

On the basis of their appearances, origins and functions, the white blood cells are of various types. They have ability to change their shapes. So they can easily reach the site of infection where they fight against infection and harmful substances that invade the body by engulfing them.

Platelets

Platelets, also known as **thrombocytes** are colourless blood cells. They are disc-shaped cells without nuclei. They are made in the red bone marrow. They have lifespan of about 5 to 10 days.

They are the smallest formed elements of the blood. A cubic millimetre of blood normally contains about 1,50,000 to 2,50,000 platelets. Platelets help in clotting of blood and thus, prevent loss of blood.

Table 6.2 Comparative study of different types of blood cells

Feature	Red blood cells (Erythrocytes)	White blood cells (Leucocytes)	Platelets (Thrombocytes)
Formation	They are formed in the bone marrow of long bones.	They are formed in the bone marrow and lymph nodes.	They are formed in the red bone marrow.
Colour	They are red in colour.	They are colourless.	They are colourless.
Structure	They are disc-shaped structures.	They are irregular in shape.	They are disc-shaped structures.
Lifespan	120 days	Only a couple of days	5 to 10 days
Nucleus	In mature red blood cells the nucleus is absent.	In white blood cells the nucleus is present.	In platelets the nucleus is absent.
Function	They transport nutrients and oxygen throughout the cells of the body.	They protect the body from disease-causing germs.	They help in blood clotting.

Functions of Blood

Blood is a very important liquid part of the body because it performs the functions such as transportation, regulation and protection within the body.

- **Transport of nutrients** The major function of blood is to transport nutrients absorbed from the intestine to each cells of the body.
- **Transport of respiratory gases** The blood carries oxygen from the lungs to the cells and carbon dioxide from the cells to the lungs. Hence, plays an important role in transportation of respiratory gases.
- **Drainage of waste products** The blood carries metabolic waste products like urea, uric acid and bile pigments to the kidney which filters the wastes and excrete them from the body as urine.
- **Maintenance of body temperature** It controls the body temperature at 37°C and equally distributes heat from one part of the body to other part of the body.
- **Maintenance of water balance** It maintains water balance to a constant level and distributes it uniformly over the body. It provides water to the cells when they required and takes excess water from the cells. Along with water, blood also controls the levels of minerals such as sodium and potassium in the body.
- **Defensive action** It kills the disease-causing bacteria and other harmful organisms by transporting the disease-fighting white blood cells to the site of injury.

ASSESS YOURSELF

Name them.

1. A transport system of our body. _____
2. The fluid part of the blood. _____
3. A type of blood cells which carry oxygen with them. _____
4. The disease-fighting cells present in the blood. _____
5. A component of blood responsible for blood clotting. _____

ROUGH WORK

ACTIVITY 1

Aim To examine the prepared slides of the red blood cells and white blood cells

Place a prepared slide of the human blood under a microscope. Try to focus on the red blood cells and the white blood cells under low power of magnification. Request your teacher to help you to focus the slide under high power of magnification. Now you will observe the red blood cells and white blood cells more clearly.

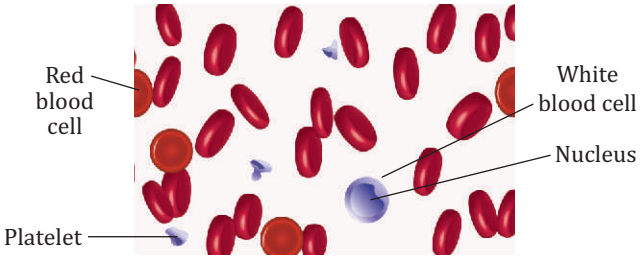


Fig. 6.3 Different types of blood cells

You will observe that the red blood cells are comparatively small, disc-shaped structures which do not have a nucleus. The white blood cells are irregular-shaped structures with a prominent nucleus.

Note: Platelets are too small to be seen at this magnification of the microscope.

More to Know

Rh-factor

In 1940 **Karl Landsteiner** and **Alexander Wiener** discovered another important factor of blood called Rh factor in RBCs of human beings. It is a type of antigen, first found in RBC of Rhesus monkey and so was named as **Rh-factor**. People, who have Rh-factor are called **Rh-positive**. More than 85% of people are Rh-positive. People without the Rhesus factor in their blood are called **Rh-negative**.

SCIENTIST ZONE

Karl Landsteiner, an Australian biologist in the year 1900, developed the ABO system of classification of blood. This classification is based on the presence and absence of antigens and antibodies on the surface of red blood cells and the Rh-factor. He was awarded the Nobel Prize in medicine in the year 1930 for this great contribution.

Karl Landsteiner (1868–1943)

FACT ZONE

A person having blood group AB is called **universal acceptor** and the person who have the blood group O is called **universal donor**.

BLOOD GROUPS

On the basis of absence and presence of proteins called **antigens** and **antibodies** on the surface of red blood cells, the human blood divided into four groups—**A, B, AB** and **O**. This system of division of blood cells is known as **ABO system**. According to this system, there are two antigens A and B associated with their two antibodies a and b.

The four possible blood groups of ABO system are shown in Table 6.3.

Table 6.3 Blood groups with their antigens and antibodies

Blood group	Antigen	Antibody
A	A	b
B	B	a
AB	A and B	None
O	None	a and b

Antigens are the proteins present on the surface of RBCs while **antibodies** are present in the plasma. Both antigens and antibodies work against each other. An antigen never works with its corresponding antibody. This is because when their similar types are working together, the red blood cells clump and burst.

Blood Transfusion

Sometimes, severe blood losses occur due to some injury, accident or certain illness. In such cases, blood from a healthy person is transferred to the needy person. The transfer of blood from one person to another is known as **blood transfusion**. The person who receives the blood is called **recipient** and the person who donates the blood is called **donor**. Transfusion of blood is done only after cross-checking the blood groups of the patient and the donor. Wrong blood transfusion may cause death of the recipient, due to clumping of the RBCs.

Table 6.4 Blood transfusion compatibility in ABO system

Blood group	Can donate blood to	Can receive blood from
A	A and AB	A and O
B	B and AB	B and O
AB	AB	All groups
O	All groups	O

ACTIVITY 2

Aim To find out more about blood groups.

Procedure Select two more families along with your family and collect information about the blood groups of the family members. Make a chart for recording their blood groups.

Family	Blood group			
	A	B	AB	O
Your family				
Family I				
Family II				

BLOOD DONATION AND BLOOD BANK

Blood Donation

Blood donation is one of the most significant contributions that a person makes towards the society. Worldwide, many people need blood for various reasons. They may be attacked by severe anaemia, have undergone an operation or met with an accident. But, such patients may die as blood is not available very easily. Blood donation is our human duty. It is not harmful to donate blood. The body of the donor can regenerate the blood within a few days.

Nowadays, public awareness is noticed to donate blood. Many clubs, colleges and societies organise blood donation camps on different occasions.

Who are the blood donors?

The person who donates the blood must pass the following conditions:

- Must be above the age of 15–17 years and under the age of 55–60 years
- Must be in good health
- Must pass the physical and health test given prior to donating the blood.

Before donating the blood, certain tests of the donor must be performed. These are:

- Blood type based on the ABO system
- Rh-factor (positive or negative)
- Test for HIV
- Test for any disease

FACT ZONE

A steady supply of donors is needed to ensure a continuous source of blood in blood banks. Because certain blood components last for only a short period of time. For example, platelets must be used within days of being banked. In contrast, haemoglobin can last for several years.

ROUGH WORK

More to Know

In the hospitals there is an exclusive department that takes care of blood related issues. It is called the **blood Bank**. Nowadays, blood banks collect blood and carefully test for its type. Infected blood can also cause serious complications in the human body, not only infecting the patient to whom the blood is given, but also destroying the healthy blood cells in the body.

ACTIVITY 3

Aim To observe the different types of blood vessels

Material Required A mirror with handle

Procedure

1. Gently pull down your lower eyelid by using your fingers. Now, look into the mirror. You may see many red coloured fine lines. These are the blood capillaries.
2. Look at the under portion of your tongue with the help of a mirror. You should able to see that thick blue coloured veins, red coloured arteries and the fine red ones are capillaries.

ROUGH WORK

Fig. 6.4 Blood donation camp

Blood Bank

To store the donated blood properly, blood banks have been established worldwide. The **blood banks** are specialised medical centres where donated human blood is stored for blood transfusion. Here, the blood has been collected and then separated into its various components (red blood cells, white blood cells, platelets and plasma) so they can be used most effectively according to the needs of the patient. Red blood cells carry oxygen, platelets help the blood clot and plasma has specific important proteins that help in many important functions.

BLOOD VESSELS

Blood vessels are the transport network of our body system. In a general sense, a vessel is defined as a hollow tube for carrying liquids. In the human body, there is a network of blood vessels that carries substances to and from various parts of the body. This system of blood vessels comprises **arteries**, **veins** and **capillaries**.

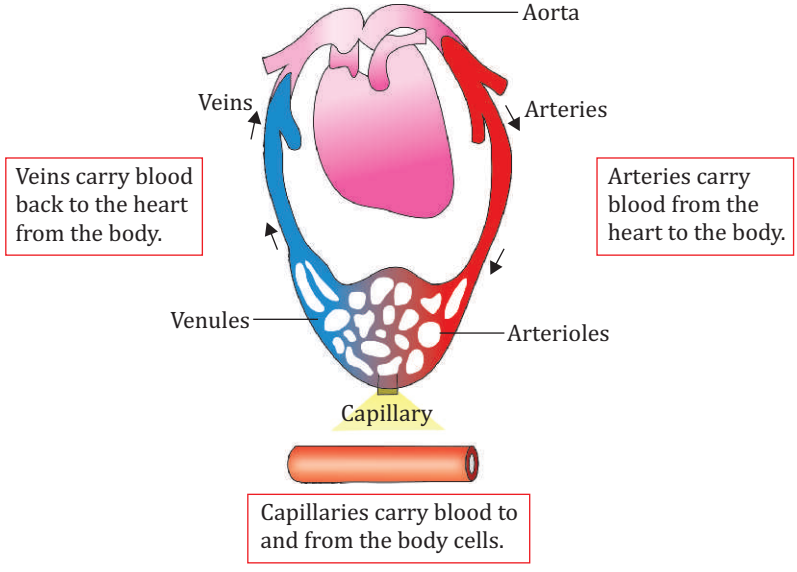


Fig. 6.5 Different types of blood vessels and their distribution in the circulatory system

The heart pumps blood into these vessels which then carry to all parts of the body. The structure of each type of blood vessel is closely related to its function. During blood circulation:

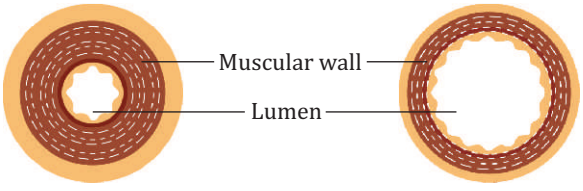
- The arteries carry blood **away** from the heart.
- The capillaries connect the arteries to the veins.
- The veins carry blood back **to** the heart.

Arteries

Arteries are the thick-walled, elastic and muscular vessels with a narrow lumen in which the blood flows with jerks. They carry pure (oxygenated) blood away from heart to various parts of the body. Only the **pulmonary artery** carries impure (deoxygenated) blood to the lungs.

Veins

Veins are the thin-walled and less muscular vessels with valves. They have wider lumen in which the blood flows smoothly. They carry impure (deoxygenated) blood back to the heart from different parts of the body. Only the **pulmonary vein** carries pure (oxygenated) blood from the lungs.



(a) Artery (b) Vein

Fig. 6.6 Transverse sections of the artery and the vein

Table 6.5 Differences between arteries and veins

Arteries	Veins
1. They are located deep beneath the skin.	1. They are located close to skin.
2. They carry blood away from heart to various organs and tissues.	2. They bring blood from various organs and tissues to the heart.
3. They have thick muscular walls.	3. They have thin muscular walls.
4. They have a narrow lumen in which the blood flows with jerks.	4. They have a wide lumen. in which the blood flows smoothly.
5. They do not have any valve.	5. They have valves which control the unidirectional flow of blood.

FACT ZONE

- In the arteries blood flows with jerks because of the force exerted by the pumping action of heart.
- The blood flowing in arteries is red in colour because it contains oxygen.
- In the veins blood flows smoothly.
- The blood flowing in the veins is dark in colour because it is deoxygenated or without oxygen.

THINK ZONE

1. Why do arteries have thick walls and veins have thin walls?
2. In which blood vessel does the blood flows with jerks?

ENRICHMENT

Importance of Blood Vessels

Besides circulating blood, the blood vessels provide two important means of measuring vital health statics, *i.e.* **pulse** and **blood pressure**. We measure the pulse by touching the radial artery. The best place to take the pulse are at wrist, inside the elbow, at the side of neck and the top of the foot. Since the radial artery is near to the surface of the skin, we can easily touch the artery and get an accurate measure of the pulse rate.

Assess Yourself

Complete the following passage.

Blood vessels are _____ structures which transport _____ throughout the body. There are _____ types of blood vessels in our body. The _____ carry oxygenated blood whereas, _____ carry deoxygenated blood. The _____ connect the arteries with the veins.

Capillaries

Capillaries are the fine blood vessels connecting the arteries with the veins. The wall of the capillary is very thin. It is only one cell thick through which oxygen, nutrients and carbon dioxide dissolved in the blood are diffused out into the cells of the body.

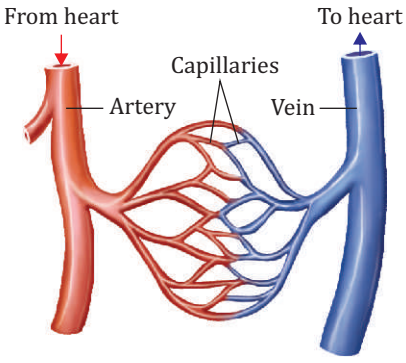


Fig. 6.7 Different types of blood vessels

Table 6.6 A comparison of arteries, veins and capillaries

Feature	Artery	Vein	Capillary
Direction of flow of blood	Away from the heart (except in pulmonary artery)	Back to the heart (except in pulmonary vein)	Through organs; to and from the cells
Pressure	High	Low	Medium
Oxygen content	High (except in pulmonary artery)	Low (except in pulmonary vein)	Oxygen diffuses out through wall
Size of lumen	Relatively small	Relatively large	Small, about the diameter of a red blood cell
Properties of wall	Tough and elastic	Thin and distended easily	One cell thick and easily permeable

Enrichment

The left side of the heart comprising left atrium and left ventricle has pure or oxygenated blood. The right side of the heart comprising right atrium and right ventricle has impure or deoxygenated blood.

HEART

Heart is roughly a cone-shaped muscular organ about the size of your fist. It weighs about 300 g. It is located behind the alimentary canal and in between the two lungs. It is protected by the ribcage. The heart is made up of special type of muscles called the **cardiac muscles**. These muscles work throughout the life without getting tired. The heart is enclosed by a double-layered membrane called **pericardium**. The space between the membranes is filled with a fluid called **pericardial fluid**. It protects the heart from jerks during contraction. The heart is internally divided by a muscular wall called **septum**. On each side, there are two chambers connected by a **valve**. The upper chamber is called **auricle** and the lower chamber is called **ventricle**. Thus, the heart has four chambers—the right auricle, the right ventricle. the left auricle and the left ventricle.

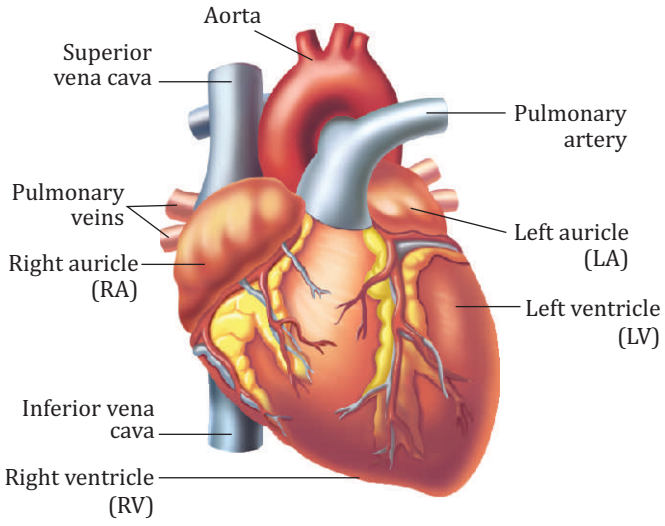


Fig. 6.8 Structure of the human heart

CIRCULATION OF BLOOD

In the heart, due to presence of valves the blood flows unidirectionally. Due to continuous contraction and relaxation of the heart, the blood circulates within the heart as well as throughout the body. The right auricle receives impure or deoxygenated blood (rich in carbon dioxide) through two large veins—**superior vena cava** from the anterior part of the body and through **inferior vena cava** from the posterior part of the body. Then the blood is forced by arterial contraction through the valve into the right ventricle. The right ventricle pumps the blood into the pulmonary artery and then the two lungs. In the lungs, carbon dioxide is exchanged with the oxygen and the blood becomes oxygenated (rich in oxygen). This oxygenated blood is brought to the left auricle by the pulmonary vein. From there, it passes to the left ventricle and then due to ventricular contraction, the oxygenated blood pumped into the **aorta**, the largest blood vessel of the body. From the aorta blood flows through arteries to all parts of the body, except lungs. When the blood passes through the capillaries, oxygen and nutrients are supplied to the cells and carbon dioxide and other wastes are collected by the blood. This deoxygenated blood comes back to the right auricle and then completing one round of blood circulation.

SCIENTIST ZONE

William Harvey was the first person to correctly explain the circulation of blood in the body. He showed that arteries and veins form a complete circuit. The circuit starts at the heart and leads back to the heart. The heart's regular contractions drive the flow of blood around the whole body.

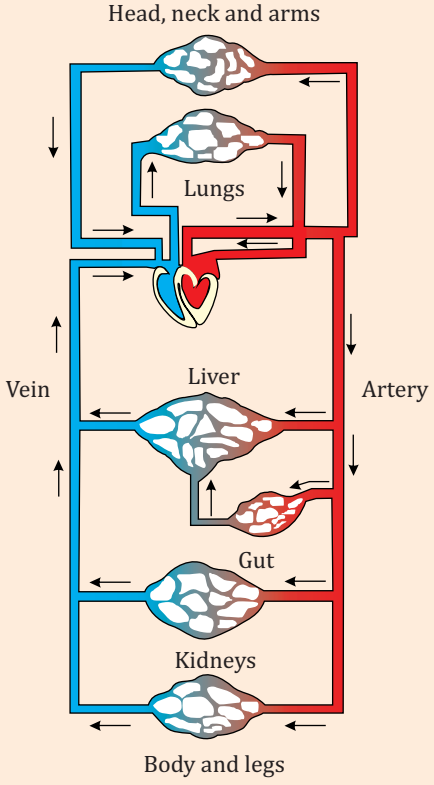


Fig. 6.9 Circulation of blood in the body

ENRICHMENT

Why do we feel sleepy after a heavy meal?

A heavy meal makes one feel sleepy. It is because, in order to pick up nutrients, the blood flows towards our digestive system very fast. Therefore, the brain and muscles get less amounts of oxygen and the person feel like having a snooze.

ENRICHMENT

How to keep your heart strong?
Remember, that your heart is a made up of special type of muscles called cardiac muscles that work throughout the life tirelessly. If you want it to be strong, you need to exercise it. Try to be active every day for at least 30 minutes! An hour would be even better for your heart! Eat a variety of healthy foods and avoid foods high in unhealthy fats, such as saturated fats or animal fats.

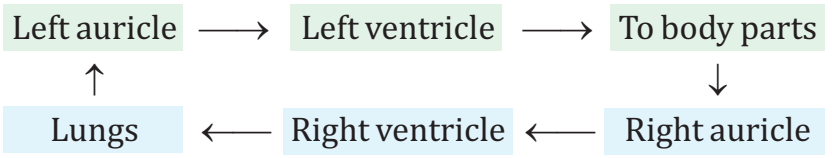
FACT ZONE

During the lifetime, the heart beats on an average about 60–80 times per minute. This means our heart beats about 100000 times a day or 36 million times per year.

More to Know

- When the heart beats faster than normal, it indicates condition of **hypertension** or **fever**.
- The very low pulse rate indicates poor functioning of the heart.
- A **stethoscope** is an instrument that the doctors use to hear the heartbeats.
- The blood in arteries flows in jerks, which can be felt in the **pulse**.
- The blood exerts pressure against the walls as it moves through the arteries. This pressure is called **blood pressure**.

The path of blood circulation within the heart is as follows:



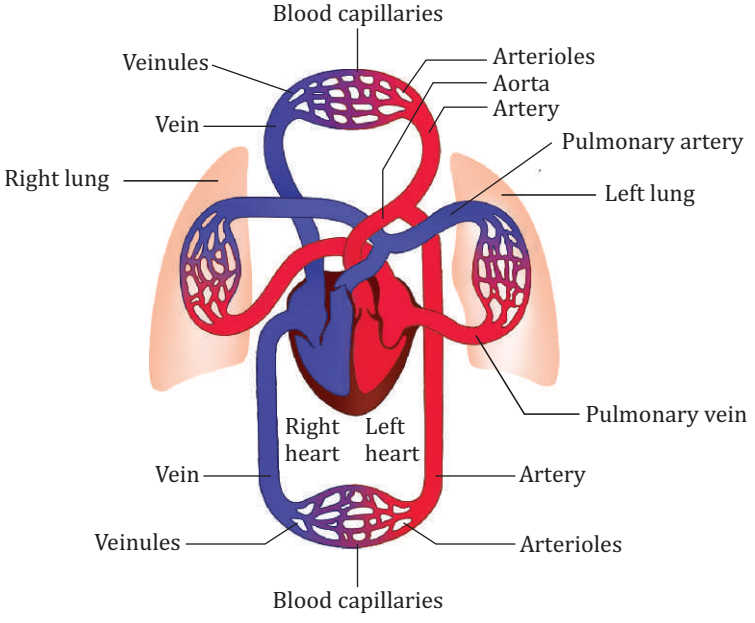


Fig. 6.10 Path of blood flow within the heart

HEARTBEAT AND PULSE RATE

Heartbeat

All the muscles of the heart do not contract or relax at the same time. The contraction of the heart muscles starts in the auricles first and pushes the blood into the ventricles. After a fraction of a second, the wall of the ventricles squeezes and force the blood out into the arteries—the aorta to the body and pulmonary artery to the lungs. This

Fig. 6.11 A doctor listen to heartbeats with a stethoscope

contraction phase of the heart is called **systole**. Afterwards, the heart muscles relax and allowing blood to flow in from the veins and fill the aorta again. This relaxation phase of the heart is called **diastole**. One complete contraction and relaxation of heart muscles make up one **heartbeat**. It lasts for about 0.8 seconds.

One complete heartbeat lasts for about 0.8 seconds. Each heartbeat is heard as two sounds—**lub** and **dubb**. Lub sound is a weak sound which is produced when the valves connect the auricle to the ventricle. Dubb sound is a stronger sound produced when the valves in the artery close. An instrument used for listening to the heart sound is known as **stethoscope**.

More to Know

High Blood Pressure

High blood pressure increases the chance for getting heart disease or kidney disease, and for having a heart or brain stroke. It is especially dangerous because it often has no warning signs or symptoms. Regardless of race, age or gender, anyone can develop high blood pressure. It is estimated that one in every four adults has high blood pressure. Once high blood pressure develops, it usually lasts a lifetime. One can prevent and control high blood pressure by taking necessary precautions.

ACTIVITY 4

Aim To measure your pulse rate

Place your middle and index fingers on the inner side of your wrist while you are sitting on the chair calmly. You can feel the regular thumping. This is your pulse. Note down the numbers of pulse per minute. Repeat this for five times and then calculate the average pulse rate. Now, starts jogging or skipping a rope for five minutes and take your pulse count again. How many pulses do you count? Compare the readings.

It is concluded that the average pulse rate of human beings at rest is about 72 times per minute. After doing any strenuous exercise, the pulse rate increases and may reach up to 120 or more per minute.

Fig. 6.12 Feeling pulse at the wrist

Pulse Rate

The number of times a heart beats in a unit time is called **pulse rate**. An adult heart beats on an average 75 beats per minute. By counting the pulse, we can find how fast our heart is beating. The easiest place to find the pulse is on the underside of our wrist or neck. If you can place your fingers correctly on these places, you can easily count how many times your heart beats.

Why the heart beats faster on exercising?

When we do any exercises or other physical activities, the cells of our body need more glucose and oxygen to provide energy. To meet this demand, more blood has to be pumped by the heart, and hence, the heart beats faster. As a result of which the pulse rate increases.

ROUGH WORK

ACTIVITY 5

Invite a cardiologist to your school for a talk on healthy heart. Ask him most common reason of cardiac diseases in India.

ENRICHMENT

Effect of Exercise on Breathing

During exercise, the muscle cells respire more than they do at rest. This means:

- Oxygen and glucose must be delivered to them more quickly.
- Waste carbon dioxide must be removed more quickly.
- This is achieved by increasing the breathing rate and heart rate. The increase in heart rate can be detected by measuring the pulse rate.
- During hard exercise, the oxygen supply may not be enough for the needs of the muscle cells. When this happens, the person starts breathing fast.

ASSESS YOURSELF

Answer the following questions.

1. What is the function of the heart?
2. Name the different types of blood vessels associated with the heart.
3. What is a heartbeat?
4. What is the function of valves present in the heart?
5. What is the relationship between the rate of heartbeats and the rate of pulses?

BLOOD PRESSURE

While flowing through the artery, the blood exerts a pressure on its wall. This pressure is called **blood pressure**.

It is measured with the help of an instrument called **sphygmomanometer**. There are two numbers in a blood pressure reading. The standard blood pressure reading is 120/80 (say, 120 over 80). The person whose blood pressure is being measured should be calm and rested. If there is an increase or decrease in the pressure, it indicates that there may be some underlaying health problems.

Fig. 6.13 A sphygmomanometer

EXERCISE AND HEALTHY DIET FOR HEART

Like all muscles, the heart becomes stronger as a result of exercise, so it can pump more blood through the body with every beat and continue working at maximum level.

Regular exercise for at least 30 minutes a day is advised by the doctors to keep the heart healthy and in a good working condition. Exercise has a number of effects that benefit the heart and circulation (blood flow throughout the body). These benefits include improving cholesterol, helping weight loss programs and helping to keep blood vessels flexible and open. Studies continue to show that physical activity and avoiding high-fat foods are the two most beneficial ways of reaching and maintaining healthy levels of fitness.

- The food we eat every day plays a very important role in keeping the heart healthy.
- Eat wholesome food. Limit your intake of processed food and high-fat diet.
- Limit the intake of aerated drinks and junk food.
- Include seasonal fruits, berries and nuts in your diet.
- Some foods like nuts, fish, flax seed are very good for your heart.
- Avoid bad habits like smoking and drinking.

Let's Recapitulate

- Higher organisms like human beings need a **circulatory system** to connect all living cells to the organs that exchange vital materials such as nutrients, respiratory gases and metabolic wastes.
- Circulatory system in human beings consists of **blood**, **blood vessels** and **heart**.
- The blood is a complex mixture of **plasma** and **blood cells**.
- Blood cells are of three types—**red blood cells**, **white blood cells** and **platelets**.
- On the basis of presence and absence of antigens and antibodies, blood is classified into four groups—**A**, **B**, **AB** and **O**.
- **Rh-factor** makes the blood either Rh-positive or Rh-negative.
- **Arteries** are the thick-walled, elastic and muscular vessels that carry oxygenated blood and distribute it to all parts of the body. Only **pulmonary artery** carries deoxygenated blood.
- **Veins** are the thin-walled and less muscular vessels with valves. They collect deoxygenated blood from the body. Only **pulmonary vein** carries oxygenated blood.
- **Capillaries** are fine blood vessels connecting the arteries with the veins.
- **Heart** is a hollow, muscular organ located in the chest and protected by the ribcage. It is made up of cardiac muscles which work continuously and never get tired.
- The human heart has four chambers—left auricle and left ventricle and right auricle and right ventricle.
- In the heart, the blood flows from left auricle → left ventricle → to body parts → right auricle → right ventricle → lungs to complete a cycle.
- One complete contraction and relaxation of heart muscles make up one **heartbeat**. By doing any hard physical activity, the rate of heartbeat increases.
- The number of times a heart beats in a unit time is called **pulse rate**. An adult heart beats on an average 75 beats per minute.
- While flowing through the artery, the blood exerted a pressure on its wall. This pressure is called **blood pressure**. It is measured with the help of an instrument called **sphygmomanometer**.
- Regular exercise and low-fat food keep our heart healthy and in a good working condition.

Evaluate Your Understanding

Recalling Ideas

I. Select the correct option.

1. Which of the following is not a component of the human circulatory system?
   (a) Blood ☐ (b) Heart ☐
   (c) Lung ☐ (d) Capillary ☐
2. A muscular structure that divides the heart into two equal halves is called
   (a) ventricle ☐ (b) septum ☐
   (c) atrium ☐ (d) pericardium ☐

3. Blood cells which are the carriers of oxygen are
   (a) red blood cells ☐ (b) white blood cells ☐
   (c) platelets ☐ (d) all of them ☐
4. Human heart is divided into
   (a) one auricle and one ventricle ☐ (b) two auricles and one ventricle ☐
   (c) two auricles and two ventricles ☐ (d) one auricle and two ventricles ☐
5. An instrument used to measure blood pressure is called the
   (a) barometer ☐ (b) thermometer ☐
   (c) ammeter ☐ (d) sphygmomanometer ☐
6. The four blood groups of human beings are
   (a) A, B, AB, and C ☐ (b) A, B, AB, and O ☐
   (c) AA, AB, B, and O ☐ (d) A, B, AB, and C ☐
7. Arteries are the blood vessels which carry blood
   (a) away from the heart ☐ (b) towards the heart ☐
   (c) none of them ☐ (d) both of them ☐

II. Fill in the blanks with the correct option.

1. Blood in the pulmonary artery has _____ oxygen than in the pulmonary vein. (more/less)
2. The blood cells that protect the body from diseases are the _____.
   (white blood cells/red blood cells)
3. An artery carries deoxygenated blood is called _____ . (pulmonary artery/aorta)
4. _____ allows exchange of materials between blood and the nearby cells. (Venules/Capillaries)
5. The fluid part of the blood is called _____. (plasma/lymph)
6. Pulmonary vein carries _____ blood. (deoxygenated/oxygenated)

III. State if the following statements are True or False. Correct the False statement.

1. The solid part of the blood is called plasma.
2. Blood is composed of RBCs, WBCs and platelets.
3. The left and right side of the heart is separated by a septum.
4. Capillaries have thick, elastic walls.
5. The pressure exerted on the wall of ventricle by the blood is called blood pressure.

IV. Match the following.

Column A	Column B
1. Veins	(a) Carry blood from heart to various body parts
2. Blood	(b) Four chamberd
3. Red blood cells	(c) Controls the body temperature
4. Heart	(d) Haemoglobin
5. Arteries	(e) Return blood back to the heart

V. Define the following terms.

1. Heartbeat _____
2. Pulse _____
3. Blood pressure _____
4. Blood transfusion _____

Understanding Ideas

I. Give one word for the following.

1. An iron containing protein present on the surface of red blood cells. _____
2. A liquid that serves as an exchange medium between the internal parts of an organism and its external environment. _____
3. A system consisting of the heart, blood and blood vessels. _____
4. A muscular pumping organ which pumps the blood to all the body organs. _____
5. Blood minus blood cells. _____

II. Answer the following questions in short.

1. What do you meant by the circulatory system?

_____

_____

_____

2. Name the main parts of the circulatory system.

_____

_____

_____

3. Name the types of blood groups present in the blood of human beings.

_____

_____

_____

4. Name the four chambers of the human heart.

_____

_____

_____

5. Why the white blood cells called soldiers of the body?

_____

_____

_____

6. Which types of blood cells help in clotting of the blood?

_____

_____

_____

7. What are the different blood groups identified by the ABO blood group system?

_____

_____

_____

III. Answer the following questions in detail.

1. What are the functions of blood?

2. What is the function of heart in our body? How many chambers does the human heart have?

3. After a brisk walking our heartbeats become faster, why?

4. What is meant by the blood pressure? Which instrument is used to measure the blood pressure?

5. Describe the different components of the blood.

IV. Differentiate between the following.

1. Heartbeat and pulse rate

2. Arteries and veins

_____

_____

_____

3. Red blood cells and white blood cells

_____

_____

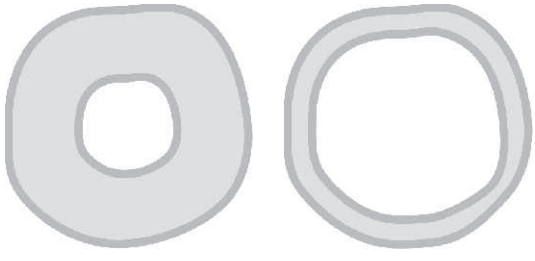
_____

Think Critically

1. Why do we feel sleepy after having a heavy meal?
2. Why do we need blood banks?

Diagram-based Question

1. The given figure shows cross-section of three different types of blood vessels.
   (a) Identify the blood vessels A and B.
   (b) State two ways in which vessel A is adapted for its functions.
   (c) Mention any two differences between A and B.



A B

_____

_____

_____

_____

_____

Project Ideas

1. Visit a nearby hospital with an elderly person. Meet the doctor over there and request him to demonstrate the procedure of measuring blood pressures of any five patients. Note down the blood pressure of all the five patients in the table given below.

   Find out the blood pressure of how many patients is in increasing side? Discuss with the doctor that how can we make our heart healthy?

	Patient -1	Patient -2	Patient -3	Patient -4	Patient -5
Blood pressure					

2. Using a funnel, three small pieces of thin rubber tubing and a Y-tube, you can make your own stethoscope. Try to listen to heartbeats of your friends. Now count their pulse. Is the pulse beat the same as the heartbeat? Also find out how the heartbeats increase or decrease with exercise?

Learning Objectives

Let's learn about

- Disease
- Types of Diseases
- Communicable Diseases
- Common Examples of Communicable Diseases
- Modes of Transmission of Diseases
- Ways to Prevent Communicable Diseases
- Non-communicable Diseases
- How to Prevent Non-communicable Diseases?
- Hygiene
- Segregation of Wastes

Chapter - 7

Health and Hygiene

Good health involves more than just the absence of diseases. A truly healthy person not only feels physically good but, also has a realistic outlook on life and gets along well with other people. According to World Health Organisation (WHO), 'health is a state of complete physical, mental and social well being and not merely an absence of disease or infirmity.'

The factors that keep us in good health are:

- Balanced diet
- Adequate exercise and rest
- Personal and social hygiene
- Protection from communicable diseases

A healthy body is the first step towards a happy life. Good health does not only imply a healthy or disease-free body, but it also covers physical, mental and social health.

- **Physical health** means a good body, which is healthy because of regular physical activity, good nutrition, and adequate rest. Physical health relates to anything concerning our body as a physical entity.
- **Mental and social health** refer to a state of well-being in which a person realises his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community.

DISEASE

The word disease is made up of two words—*dis* + *ease* means disturb the comfort. An abnormal condition of an organism which interrupts the normal body functions is called a **disease**. It often leads to feeling of pain and weakness, and is usually associated with certain symptoms and signs. A disease may affect different people in different ways.

More to Know

- A healthy body is the first step towards happy life. It is truly said that *'health is the real wealth'*.
- Physical pain and mental stress are linked together, that is why, the mental tension leads to restlessness.
- Cleanliness, balanced diet and adequate exercises are essential for good health.

ENRICHMENT

Regular exercise makes our muscles strong and keeps us healthy. When we exercise regularly, the blood circulation in our body becomes faster and we feel more energetic. In spite of that, rest and sleep are equally important to restore energy in the body. People of different age groups need different amount of sleep. Adults sleep 7 to 8 hours, but children need more sleep in comparison to adults. An infant needs more than 20 hours of sleep.

Any physical or functional change from a normal health condition that causes discomfort or affects the health is called a **disease**.

A disease can develop due to any of the following reasons:

- Lack of balanced diet
- Infection caused by the pathogens
- Malfunctioning of any one of the body parts
- Consumption of tobacco, narcotic drugs or alcohol

TYPES OF DISEASES

Diseases can be broadly divided into two categories:

- **Congenital diseases** Diseases which are present right from birth, e.g. haemophilia, colour blindness, etc.
- **Acquired diseases** Diseases which are develop after birth. These diseases further classified into **communicable diseases** and **non-communicable diseases**.

In this chapter, we will discuss about communicable and non-communicable diseases.

COMMUNICABLE DISEASES

Diseases that can spread from an infected person to a healthy person are called **communicable diseases** or **infectious diseases**. These diseases are caused by **germs** or **pathogens** which are mostly microorganisms. Communicable diseases can be grouped according to the types of pathogens that cause them. They can be bacteria, viruses, protozoa or worms. Some communicable diseases are tabulated in Table 7.1.

Pathogens of Communicable Diseases

Bacteria

They are microscopic, single-celled organisms widely spread almost everywhere. They multiply rapidly in the living cells and cause diseases.

Viruses

These are the non-living microorganisms that become living only when they invade a living cell. In a living cell, a virus can reproduce and destroy the body cells. A viral disease results if the number of cells gets infected.

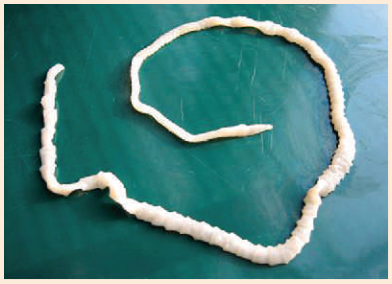
FACT ZONE

Here are some lesser known interesting facts for improving health:

- It has been proved that by reducing plaque on teeth, you can improve your health.
- The more you smile, the longer you live. Smiling and laughing release chemicals into the bloodstream, which have an analgesic effect, helping you relax.
- From the age of 30, human beings begin to shrink in size. Diet and nutrition are essential to slow down this process and stay young and strong.
- Our body produces about 2 litres of sweat each day. This volume of lost water emphasises our need to stay hydrated for good health and vitality. We should drink 2–3 litres of water each day just to replace the water lost due to perspiration.

ENRICHMENT

The disease-causing pathogens thrive in the body cells and destroy them and thus cause diseases.



(a) Tapeworm

(b) Roundworm

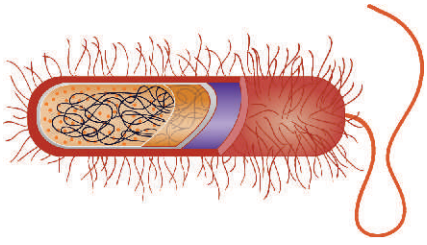
Fig. 7.1 Some disease-causing worms

Protozoa

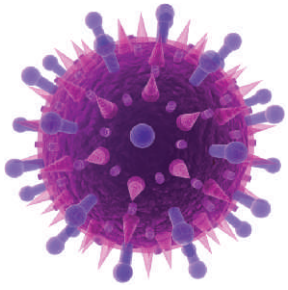
These are the single-celled microorganisms. When they invade a human cell, they can multiply very easily and cause infection.

Worms

Certain worms like flatworms and roundworms are the parasites that cause disease in human beings. Some other worms like flukes enter the blood, intestine, liver and lungs and tapeworms live in the intestine cause infection.



(a) A bacteria



(b) An influenza virus

Fig. 7.2 Some common pathogens

Table 7.1 Some common communicable diseases and their pathogens

Pathogens	Diseases
Bacteria	Tuberculosis, cholera, whooping cough, tetanus, diphtheria, pneumonia, food poisoning, typhoid, leprosy
Viruses	Influenza, chickenpox, common cold, mumps, encephalitis, dengue, AIDS, poliomyelitis
Protozoa	Malaria, sleeping sickness, amoebic dysentery, kala azar
Worms	Elephantiasis, taeniasis, ascariasis

COMMON EXAMPLES OF COMMUNICABLE DISEASES

Some common communicable diseases caused by different types of pathogens can be explained as follows:

Diseases Caused by Bacteria

Cholera

It is an infection of the small intestine. The main symptoms of cholera are watery diarrhoea and vomiting. It is primarily transmitted by consuming contaminated water or food. It spreads through flies and by eating uncovered food sold by the roadside vendors.

ENRICHMENT

Fever is caused due to inhibiting the growth of bacteria, viruses and other pathogens by the body but not by the germs themselves.

FACT ZONE

Our physical health should be strong to prevent us from communicable diseases. People get infected if they are not physically healthy. A balanced diet, enough rest, regular exercise and personal hygiene will go a long way to help you ward off communicable diseases.

Tuberculosis (T.B.)

It is a common disease. Tuberculosis first attacks the lungs and then affects other parts of the body. It spreads through the air when an infected person coughs or sneezes, and thus transmits the water droplets into the air. A person needs only to inhale a small quantity of these germs to get infected.

Diseases Caused by Virus

Influenza

It is commonly called **flu**. The most common symptoms of the disease are chill, fever, sore throat, muscle pains, severe headache and coughing.

Common Cold

It is a viral infection of the upper respiratory tract. Its common symptoms include cough, sore throat, running nose and fever. Common cold is the most frequent infectious disease found in human beings. It spreads through water droplets from sneezing and coughing being inhaled by other people.

Diseases Caused by Protozoa

Malaria

It is transmitted to human beings when an infected female *Anopheles* mosquito bites a healthy person and injects the malarial parasites into the blood. Symptoms of malaria include high fever coupled with shivering.

Amoebic Dysentery

It is a type of dysentery caused by a species of *amoeba*. It is transmitted through contaminated food and water. Its symptoms are loose motion with gripping abdominal pain along with discharge of mucus and sometimes blood.

MODES OF TRANSMISSION OF DISEASES

Knowing the methods by which a disease is transmitted is important in infection control and in attempting to decrease infections. Communicable diseases can be spread by the following means:

Through Air—Air-borne Diseases

When an infected person sneezes, a mist of droplets full of germs are thrown out with great force into the air. They float on the dust particles and remain suspended in the air.

More to Know

Tuberculosis (T.B.)

Since 2014, 1.5 million T.B. related deaths have occurred worldwide. The burden of this disease may increase further with the emergence of the HIV epidemic. Due to improvement in medical facilities, now the success rate of treatment has more than doubled and the death rates have decreased by 75 per cent in India.

ENRICHMENT

Rabies is a disease caused by the bite of animals infected by the rabies virus. Dogs and monkeys are the animals most affected by the rabies virus.

ROUGH WORK

Fig. 7.3 A sneeze contains millions of germs

THINK ZONE

Floods cause a lot of damage to human lives. After flood, the people living in the affected area face many diseases. Think about the reasons.

Fig. 7.4 Contaminated water causes illness

ROUGH WORK

When a healthy person inhales this infected air, he or she becomes ill. People can contact such infections in crowded places like buses, trains, malls, etc.

Diseases like cold, influenza, measles, tuberculosis, etc. are spread through air.

Through Contaminated Water—Water-borne Diseases

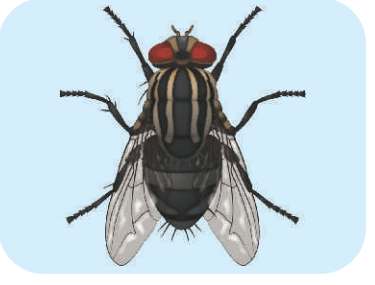
These diseases spread through contaminated water and cause gastrointestinal infections. When an infected person bathes or defecates near the source of water, the water becomes infected and this infected water when consumed by a healthy person causes infection.

Typhoid and cholera are diseases that spread through contaminated water.

By Insects—Vector-borne Diseases

Insects like mosquitoes and houseflies carry disease-causing germs and are called **vectors**. When they visit the source of infection such as heaps of garbage and stagnant water, the disease-causing germs get stuck to their bodies. When these insects sit on the uncovered foods, they transfer the disease-causing germs. When we eat such infected food, we fall ill. Germs are also transferred when these insects sit on open wounds or bite a healthy person.

Malaria, dengue and typhoid are the examples of vector-borne diseases.



(a) Housefly contaminates the food kept in the open

(b) Mosquito spreads malaria

Fig. 7.5 Vectors of communicable diseases

Through Direct Contact—Contagious Diseases

Some diseases can be spread through direct contact of a diseased person with a healthy person. Conjunctivitis and scabies are the examples of such type of diseases. Sharing of things like towels and combs used by affected persons can also spread the infection. In a hospital environment, medical equipment, clothing, bedding, dressings and sinks can transmit infection.

Through Contaminated Food

Contaminated food also transmits the infectious diseases. People working in food shops and food processing factories must be careful about their personal cleanliness. If they are careless, they can infect other people too. Regular hand-washing is one of the most effective defences against the spread of diseases caused by contaminated food. Diarrhoea is the most common disease that results from infection through food and water.

WAYS TO PREVENT COMMUNICABLE DISEASES

Proper sanitation and hygienic conditions are a must to prevent the spread of communicable diseases. Following are some of the precautionary measures used to prevent the spread of communicable diseases:

- Drinking water should be boiled and filtered. Nowadays, Reverse Osmosis (RO) system is the best option for purifying water.
- While sneezing and coughing, always cover your mouth and nose with a handkerchief.
- Do not spit in public places.
- Vegetables and fruits must be properly washed before they are eaten.
- Do not eat uncovered food.
- Make sure that there is no stagnant water near your house because mosquitoes breed quickly in this water.
- When a person is infected by a highly contagious disease, do not share clothes, towel or bedsheet with them.
- Eat properly cooked food.
- There are preventive vaccines available for some of the infectious diseases like tuberculosis, cholera and polio. It is advisable to get these vaccinations done. You will learn more about vaccination in the next class.

NON-COMMUNICABLE DISEASES

Non-communicable diseases are not caused by pathogens and therefore cannot be spread by one person to another. These diseases are caused by:

- Improper diet
- Metabolic malfunctioning of the body
- Inherited diseases

More to Know

Preventing Mosquito-Borne Diseases

- Use a mosquito repellent to drive mosquito away.
- Use a net/screen in windows to keep mosquitoes out.
- Empty any standing water from flowerpots, pots, buckets and other containers because these are the breeding grounds for mosquitoes.
- Keep children indoors at dusk and at dawn. Mosquitoes are most active at these times.

ACTIVITY 1

Consult a doctor and get information about some communicable diseases, their causative agents and their precaution. Tabulate the information.

FACT ZONE

Controlling the breeding and multiplication of vectors and maintaining hygiene and sanitation are the important steps in control of communicable diseases. Unplanned constructions, open sewers, lack of proper garbage disposal, waste management and climate change is having a significant impact on disease transmission in recent years.

Assess Yourself

Answer the following questions.

1. What is a disease? What are its types?
2. Name the pathogens responsible for communicable diseases.
3. Which type of pathogen is responsible for influenza?
4. Why is it not advisable to eat food sold by the roadside vendors?
5. What are the different modes of transmission of communicable diseases?

Enrichment

Healthy and Disease-free

Disease (Dis+ease) literally means disturbed ease or discomfort. In other words, the term **disease** simply refers to an uncomfortable feeling. However, one must understand that being disease-free is not the same as being healthy. **A person can be disease-free yet be in a state of poor health.** For example, a person might be suffering from diarrhoea due to nervousness before appearing for an interview. In this case, if he gets himself tested, there may not be any infectious agent present. This implies that he does not have any disease since the disease causing agent is not detected, yet he is not said to be healthy.

- Diseases caused by ageing
- Mental illness

On the basis of their cause, non-communicable diseases are classified into the following types:

Degenerative Diseases

They are caused due to the malfunctioning of vital organs like heart, lungs, pancreas and kidneys. Diabetes mellitus, heart attack, uremia, arthritis and cancer are some examples of the degenerative diseases. Degenerative diseases are long-term diseases and affect adults more than the children.

Diabetes Mellitus

In diabetes mellitus, a person has a high level of sugar in the blood, because the pancreas does not produce enough insulin, a chemical (hormone) secreted by pancreas to control the sugar level in the blood. This high blood sugar level produces the symptoms of frequent urination, increased thirst and hunger and loss of body weight. Depending on the conditions, diabetic patients are either administered insulin injection or given some medications. This diseases can exist in families or can develop at any age.

Heart Attack

In a heart attack the blood supply to the heart muscles gets obstructed and the heart muscles do not work properly. A sedentary lifestyle, fat-rich food and stress are the major causes of malfunctioning of the heart.

Uremia

Uremia is the disease caused due to the malfunctioning of kidneys in which kidneys fail to function properly and the waste gets accumulated in the blood and causes the disease.

Cancer

Cancer is caused by the uncontrolled growth of certain cells of the body. The cancer cells eventually destroy the surrounding normal cells and then spread to other organs in different parts of the body. If cancer is detected in early stage, it can be treated. If left untreated, it will lead to death.

Abnormal growth of cells at any part of the body, unexplained fever, night sweating and unintentional weight loss are the symptoms of the cancer.

Inherited Diseases

These diseases are passed on within the families from one generation to another. Hemophilia, thalassemia and sickle-cell anaemia are the examples of inherited disease.

Allergies

The defence system of our body provides protection against many types of infections. Some times, due to some reasons, the defence system of our body becomes weak and does not work properly. In this case, it causes abnormal responses which are called **allergies**. Common allergic reactions include asthma, hay fever, food allergy, etc.

Dietary Deficiency Diseases

Diseases which are caused by the deficiency of essential proteins, vitamins and minerals in a diet for a prolonged period of time are called **dietary deficiency diseases.**

Protein Deficiency Diseases

Kwashiorkor and **marasmus** are the examples of protein deficiency diseases.

Fig. 7.6 A child suffering from kwashiorkor

Fig. 7.7 A child suffering from marasmus

Vitamin Deficiency Diseases

This type of diseases include scurvy, pellagra, night blindness and beri-beri.

(a) Pellagra

(b) Scurvy

(c) Rickets

Fig. 7.8 Examples of some vitamin deficiency diseases

FACT ZONE

The parts of the body that are prone to react to allergies include the eyes, nose, lungs, skin and stomach. Although the various allergic diseases may appear different, but they all result from a reaction to an **allergen**.

More to Know

Lack of nutrients in the diet is called **malnutrition**. The diseases caused due to lack of one or more nutrients in the diet are called **deficiency diseases**.

ENRICHMENT

Importance of Vitamins

Vitamins are the organic compounds which are very essential for the growth and development of the defence system in our body. They are required in very little quantities. The absence of certain vitamins in our body is likely to develop vitamin deficiency diseases that can contribute to an overall state of physical decline and inability to fight particular illness.

Table 7.2 Some common vitamin deficiency diseases

Vitamin	Deficiency disease	Source	Function
Vitamin A (Retinol)	Nightblindness, drying of cornea	Milk, butter, eggs, liver, leafy green and yellow vegetables	Normal growth in children, good vision, healthy skin and hair
Vitamin B_1 (Thiamine)	Beri-beri	Whole grains, fish, lean meat, liver, milk, poultry, green vegetables	Normal functioning of of heart and nervous system
Vitamin B_3 (Niacin)	Pellagra, dermatitis (skin inflammation)	Lean meat, liver, dried yeast, cereals, bread eggs, green vegetables	Prevents appetite loss, aids nervous system and food conversion to get energy
Vitamin C (Ascorbic acid)	Scurvy (bleeding gums)	Citrus fruits, berries, tomatoes, cabbage, green vegetables	Builds strong body cells and blood vessels
Vitamin D (Calciferol)	Rickets (in childhood) bones turn soft	Fortified milk, cod liver oil, salmon, tuna, egg yolk	Builds strong bones

Mineral Deficiency Diseases

The deficiency of minerals give rise to many diseases like anaemia and goitre.

Table 7.3 Some common minerals deficiency diseases

Mineral	Disease	Source	Function
Calcium	Weak and brittle bones and teeth	Milk and milk products, leafy green vegetables, cheese, peanuts, dried beans	Formation of strong bones and teeth; important for blood clotting
Iodine	Goitre	Iodised table salt, seafood	Used to make thyroxine hormone; promotes growth
Iron	Anaemia	Liver, lean meat, raisins, beans and peas, whole grain products, egg yolk	Formation of haemoglobin in red blood cells and promotes resistance to disease
Potassium and sodium	Dehydration, external weakness and pain in muscle contraction	Banana, orange, juicy and leafy vegetables, carrot, table salt, cheese	Helps in maintaining fluid levels in cells; needed for conduction of nerve impulses; aids in elimination of waste from the body

ACTIVITY 2

Aim Match the deficiency diseases with the deficient nutrient and its natural sources.

On a chart paper, make three columns and write down the names of the diseases in the first column, the deficient nutrient in the second and the natural sources of the nutrients in the last column (please check table given below). Ask the class to make a similar table in their notebook. In an interactive session, the teacher will quiz the students and simultaneously fill in the chart.

Disease	Deficient nutrient	Natural source
Anaemia	Iron	Liver and lean meat
Rickets		
Scurvy		
Goitre		
Nightblindness		

(*The first one has been done to explain the purpose of this activity*)

HOW TO PREVENT NON-COMMUNICABLE DISEASES?

Non-communicable diseases are a consequence of improper body function. They are not communicable from person to person. If we follow all the preventive measures given below, we can effectively defend our body against these types of diseases.

- We should do at least 30 minutes exercise every day, because physical activity removes disease-causing germs through the sweat and makes our body strong.
- We should do yoga every day. Yoga strengthens the mind and body. It prevents lifestyle diseases, especially diabetes, heart diseases and respiratory diseases.
- Daily bath keeps the skin free from disease-causing germs.
- We should wear clean clothes to avoid any kind of infection.
- We should wash our hands frequently.
- We should eat healthy and balanced diet that will keep us fit.
- We should eat fresh fruits and vegetables that provide sufficient minerals and vitamins to keep us healthy and strong.

FACT ZONE

Symptoms of a Healthy Person

- **Pink nails** The nails of a healthy person has a pink colour and appear strong. Changes that occur within the nails are often an indication of health issues, like respiratory disorders or iron deficiency.
- **Pale yellow urine** The standard colour of the urine of a healthy person is pale yellow. If the urine turns thick, it means the person is experiencing dehydration.
- **Heart rate** A healthy heart beats at 70–75 times per minute. If the heart rate increases or decreases, there is a chance of occurrence of some heart diseases.
- **Elastic skin** If fluid intake is adequate, then the skin retains its elasticity. To check it, simply pinch the skin of the hand, if the skin comes back into its original form slowly then it indicates dehydration.

Assess Yourself

Name them.

1. A disease caused due to insufficient amount of iodine in the diet. _____
2. Any one example of inherited disease. _____
3. A protein deficiency disease. _____
4. A disease caused by the defficiency of vitamin C in the diet. _____
5. A degenerative disease caused due to malfunctioning of pancreas. _____
6. A disease caused due to deficiency of iodine. _____
7. A disease caused due to uncontrollable growth of body cells which invade and destroying other healthy body cells. _____
8. A disease caused by the malfunctioning of the kidneys. _____

Rough Work

_____

_____

_____

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Table 7.4 Differences between communicable and noncommunicable diseases

Communicable diseases	Noncommunicable diseases
1. These diseases are transmitted from one person to another through various agents.	1. These diseases are not transmitted from one person to another. There are no agents involved.
2. These diseases are caused by pathogens like bacteria, viruses, protozoans, etc.	2. These diseases are caused due to deficiency of certain elements, improper diet allergic reaction or aging.

HYGIENE

Hygiene is a practice of good healthy habits. It involves keeping clean, eating a well-balanced diet, sufficient exercise and sleep. It also involves regular medical check-up. Apart from maintaining personal hygiene, we must keep our surroundings clean. Various programmes and activities aimed at improving public health come under **social hygiene**. Some common social hygiene programmes include:

- Provision of safe drinking water
- Safe disposal of garbage

Provision for Safe Drinking Water

Safe-drinking water is one of the basic requirements for good health. Water is made safe for drinking by some of the following methods:

Chlorination

In this method, chlorine tablets are added to water to kill the germs.

Sedimentation

It is an age-old method for purification of water. Impure water is stored in a pot and allowed to stand for some time. In this way, the suspended impurities (sediment) settles at the bottom of the pot and clear water is decanted out.

Alum Crystals

In villages and some cities, drinking water is simply pumped out from underground aquifers that contain lots of mud. A crystal of alum is used to settle down the mud particles and the clear water is filtered out later.

Boiling

Boiling of water kills the germs present in the water. We should boil water for at least 15 minutes to kill the germs.

Water Purifiers

Water purifiers also make water safe for drinking. Nowadays, water purifiers work on the techniques such as by passing ultraviolet rays through the water, using activated carbon, ceramic candles and Reverse Osmosis (RO) systems that enable us to get germ-free water.

Boiling Chlorination RO system

Fig. 7.9 Methods of purification of water

Safe Disposal of Garbage

Community health is also concerned with the proper disposal and treatment of sewage and industrial wastes. The methods for proper disposal of wastes and their treatment are as follows:

Sewage Disposal and Treatment

Sewage is a water-containing waste matter that comes from kitchens and toilets and from other places through underground water pipes. Most cities and towns have sewage treatment plants. Here, the solid waste is converted into manure and the remaining water is released after removing the impurities from them.

Solid Waste Disposal

The solid waste, also called **refuse**, consists of wastes from cities and towns, animal carcasses from farms, saw dust and scrap metal from factories. In cities, civic bodies make proper arrangements for collection of solid wastes and their disposal.

More to Know

Social Services

The population of India is rising very rapidly and has become a main cause of increasing congestion. The congested living affects mental and physical health. It also brings down cleanliness and increases the chances of spread of diseases. There are some important social services provided by the municipal corporation in a city:

- Gardens and parks
- Medical centers and vaccination booths
- Family planning and child health care centres
- Health services for school children
- Environment control centres.

ACTIVITY 3

Visit your surroundings and survey the status of cleanliness, sewage disposal system, open drains, public garbage bins, etc. Do you find that they all are in perfect condition? If not, then report to your local municipal authority by taking the help of your parents. Also, find out what should you do personally to keep your surroundings clean.

ROUGH WORK

Enrichment

Importance of Three R's

The three R's stand for **Reducing**, **Reusing** and **Recycling** wastes. We should reduce the consumption of things because more consumption leads to more production of wastes. We should try to reuse the waste. For example, before discarding the plastic boxes, we should use them as containers to store things. The waste papers, plastic bottles should be recycled by converting them into new items.

Fig. 7.12 Symbol of three R's

More to Know

Vermicompost

In the fields, the earthworms eat cow dung or farmyard manure along with other farm wastes and pass it through their body in the form of excreta. In this way, the earth-worms are used to prepare compost. This prepared compost is called **vermicompost**.

Once the waste is collected, it is deposited in a pit in a low-lying area away from human habitation. The waste in the pit is covered with sand or soil completely once it gets filled up. If it is not covered with soil or sand, it will smell unpleasant and may also emit foul smell. It may also get scattered by animals and enhances the spreading of diseases.

Composting

For the disposal of wastes like rotten vegetables, garden waste and cow dung, we use the method of composting. In this method, a pit is dug and the waste is dumped in it. Here, the waste is decomposed by the microorganisms and within a few months, it gets converted into manure rich soil or **compost**.

Fig. 7.10 Waste water disposal

Fig. 7.11 A compost pit

The important measures of social hygiene are as follows:

- A proper disposal of city garbage
- A proper system for disposal of human and animal wastes, e.g. sewage, compost pits, gobar gas plants, etc.
- Covering of drains
- Use of smokeless chullahs
- Compulsory protection of food articles from dust, pollutants and disease-carriers such as flies and cockroaches
- A provision of safe drinking water
- Keeping public places clean, e.g. schools, offices, cinema halls, malls, etc.
- A provision of clean public lavatories and bathrooms
- Checking of dhabas, restaurants, hotels and other eating places for general sanitation, cleaning of utensils and kitchens and covering of eatables
- Occasional spray of disinfectants and insecticides for killing germs and germ carriers

- A provision of health education, efficient health services and immunisation.

SEGREGATION OF WASTES

Almost six billion people live on our earth. Every person creates waste such as food packages made of cardboard and plastic, aluminum and plastic cans, worn out toothbrushes, used paper, broken down cars, etc. If the waste, we generate is not sorted and disposed of properly there would be a mountain of waste in the places we live. This would cause diseases to spread. So, the waste disposal is an important part of sanitation.

Sorting out waste or segregating it is very important before disposing it. This helps in proper disposal with minimum damage to the environment.

Methods of Segregation of Wastes

Wastes can be segregated as **biodegradable wastes** and **non-biodegradable wastes**.

Biodegradable Wastes

Wastes that can be decomposing by the action of microorganisms are called **biodegradable wastes**. These include organic wastes, *i.e.* kitchen wastes such as peels of vegetables and fruits, used flowers and leaves from the garden and waste papers. The microorganisms in the soil breakdown the biodegradable waste and decompose it. This type of waste does not harm the environment.

Non-biodegradable Wastes

Wastes that cannot be decomposed by the action of microorganisms are called **non-biodegradable wastes**. The non-biodegradables wastes can be further segregated into the following types:

- **Recyclable wastes** such as plastics, paper, glass and metals.
- **Toxic wastes** such as old medicines, paints, chemicals, bulbs, spray cans, fertilisers and pesticide containers, batteries and shoe polish.
- **Biomedical wastes** such as hospital wastes that include cloth soiled with blood and other body fluids. The toxic and soiled wastes must be disposed of with utmost care as it can cause deadly infections.

FACT ZONE

We can use different colour containers for proper segregation of wastes. For example, blue colour container for waste papers, red colour container for waste plastics and metal scraps and green colour container for waste glass materials. The properly segregated wastes can easily be disposed of.

Fig. 7.13 Proper segregation of wastes

ASSESS YOURSELF

Answer the following questions.

1. Why is it called that hygiene is a practice of good healthy habits?
2. What are the methods used in providing safe drinking water?
3. Name some important social services provided by the local municipal corporation.
4. What do you understand by vermicompost?
5. Why it is necessary to segregate wastes?
6. Recyclable wastes fall under which category of wastes?

ROUGH WORK

The collection, transport, treatment and disposal of waste in a correct scientific manner is important for the safety and health of a community. "Reduce, Recycle, Reuse" means using the material after its initial use. For example, using a box for storing food after its content has been used. Reducing the use of non-biodegradable material by using things wisely is also an important step.

LET'S RECAPITULATE

- **Health** is a state of complete physical, mental and social well being and not merely an absence of disease or infirmity.
- Balance diet, adequate exercise and rest, personal and social hygiene influence good health.
- An abnormal condition of an organism which interrupts the normal body functions is called a **disease**.
- Diseases can broadly divide into congenital diseases that are present right from birth and acquired diseases that develop after the birth of an organism.
- **Communicable diseases** and **non-communicable** diseases are the types of acquired diseases.
- Communicable diseases are caused by the pathogens such as bacteria, viruses, protozoa and worms.
- Malaria, diphtheria, influenza, AIDS, cholera, whooping cough are some examples of communicable diseases.
- Air, water, food and insects are the different modes of transmission of the communicable diseases.
- Non-communicable diseases are caused either due to the deficiency of nutrients or malfunctioning of an body organ. Diabetes, heart attack, cancer and allergy are some non-communicable diseases.
- **Hygiene** is a practice of good healthy habits. Apart from maintaining personal hygiene, we must keep our surroundings clean. Various programmes and activities aimed at improving public health come under social hygiene.
- Wastes should be properly segregated into biodegradable and non-biodegradable substances before disposing off.

EVALUATE YOUR UNDERSTANDING

Recalling Ideas

I. Select the correct option.

1. Cholera and typhoid are the examples of
   (a) air-borne disease ☐ (b) water-borne diseases ☐
   (c) inherited disease ☐ (d) deficiency diseases ☐
2. Communicable diseases are caused due to
   (a) viruses ☐ (b) bacteria ☐
   (c) protozoa ☐ (d) all of them ☐

3. How can you remain healthy?
   (a) By taking care of personal hygiene. ☐
   (b) By eating balanced diet. ☐
   (c) By maintaining cleanliness of our surroundings. ☐
   (d) All of them. ☐
4. Which of the following is spread by a droplet infection?
   (a) Malaria ☐ (b) Common cold ☐
   (c) Typhoid ☐ (d) Cholera ☐
5. The responsibilities of local municipal authority include
   (a) general health and cleanliness ☐ (b) building roads ☐
   (c) maintaining proper water supply ☐ (d) all of these ☐

II. Fill in the blanks with the correct option.

1. Solid waste is called _____. (sewage/refuse)
2. An healthy person always feels _____. (lethargic/energetic)
3. Kwashiorkor and marasmus are the _____ deficiency diseases. (protein/vitamin)
4. _____ is a communicable disease. (Malaria/Asthma)
5. Hygiene is the practice of _____ habits. (healthy/unhealthy)

III. State if the following statements are True or False. Correct the False statement.

1. Regular exercise makes us healthy and strong.
2. Water-borne diseases can also be called as communicable diseases.
3. Kwashiorkor is caused due to deficiency of protein in the diet.
4. To stay mentally alert, we should sleep as less as possible.
5. Washing of hands can prevent the spread of deficiency diseases.

IV. Match the following.

Column A		Column B
1. Vitamin D	(a)	Carries oxygen as a part of haemoglobin in blood
2. Vitamin C	(b)	Produces thyroxine hormone
3. Iron	(c)	Prevents rickets
4. Iodine	(d)	Needed for nerve impulses
5. Potassium	(e)	Prevents scurvy

V. Choose the odd one out and give scientific reasons.

1. Diabetes, Arthritis, Uremia, Obesity
2. Night blindness, Scurvy, Beri-Beri, Kwashiorkor
3. Cholera, Measles, Pneumonia, Leprosy
4. Vitamin D, Calcium, Iron, Magnesium

Understanding Ideas

I. Give reason for the following.

1. We should cover our mouth and nose while coughing and sneezing.

   _____

2. We must wash our hand thoroughly before eating.

   _____

II. Answer the following questions in short.

1. How can we maintain good health?

_____

_____

_____

2. Define the term 'disease'.

_____

_____

_____

3. Name two examples of non-communicable diseases.

_____

_____

_____

4. List two diseases spread by insects.

_____

_____

_____

5. Name any two diseases caused by bacteria and protozoa.

_____

_____

_____

6. What is a deficiency disease?

_____

_____

_____

III. Answer the following questions in detail.

1. What is meant by the term 'health'? What are the characteristics of a healthy person?

_____

_____

_____

_____

_____

2. Name the minerals required for healthy bones and teeth. Mention the disease caused by the deficiency of these minerals.

_____

_____

_____

_____

_____

3. Name the diseases caused by the deficiency of following vitamins.
   (a) Vitamin A

   _____

   _____

   (b) Vitamin B

   _____

   _____

4. How does tuberculosis spread? What are the symptoms of this disease?

   _____

   _____

   _____

   _____

   _____

5. Social hygiene is equally important as personal hygiene. Give reason.

   _____

   _____

   _____

   _____

   _____

6. List the various steps involved in prevention of diseases.

   _____

   _____

   _____

   _____

   _____

IV. Differentiate between the following.

1. Communicable and non-communicable diseases

   _____

   _____

   _____

2. Biodegradable wastes and non-biodegradable wastes

   _____

   _____

   _____

Think Critically

1. Identify the deficiency disease by reading the following clues.
   (a) Sanjay is suffering from dryness of cornea. The doctor has asked him to eat food rich in Vitamin A. Which deficiency disease is he suffering from?
   (b) Rizwan is suffering from bleeding gums. The doctor has asked him to eat citrus fruits and tomatoes. Which deficiency disease is he suffering from?

Diagram-based Question

1. Study the images given below. Identify the name of the disease. Also identify the name of deficient vitamin or mineral along with its importance in human body.

Name of the disease: _____

Vitamin/mineral that is deficient: _____

Importance of that vitamin/mineral in human body:

_____

_____

Name of the disease: _____

Vitamin/mineral that is deficient: _____

Importance of that vitamin/mineral in human body:

_____

_____

Project Ideas

1. Organise a fitness day in your school. You can ask for help from your teachers. Prepare posters on various deficiency diseases such as rickets, marasmus, and kwashiorkor. Try and create awareness about these diseases, how we can avoid them and how we can adopt a healthy lifestyle to prevent such diseases.
2. Find out how many children often consume foods from outside vendors. Select at least 20 children of your class and ask them how often they consume food from outside vendors. Note down the information that you get from them in the table given below.

Name	**How many times they take food from outside vendors?**				
	Daily	Once in a week	Rarely	Never	Have they suffered from any kind of illness?

You will see that the children consume food more often from outside vendors fall ill frequently. You may find out the reasons for it.

Chapter - 8
Adaptation

Learning Objectives

Let's learn about

- Habitat
- Habitat and Adaptation
- Types of Habitat
- Adaptation in Aquatic Habitat
- Adaptation in Desert Habitat
- Adaptation In Mountain Habitat
- Air Adaptations of Birds for Flight
- Adaptation in Aerial Plants

All living beings live in a particular surrounding that includes plants, animals, land, air, water, sky and many other living and non-living things. All these things affect the life of a living being and constitute its environment. Thus, anything that surrounds and affects the life of an organism is called its **environment**. The non-living components of the environment are called **abiotic components**, e.g. air, water, light, soil and temperature. The living components such as plants and animals are called **biotic components**.

Both abiotic and biotic components are cycled in nature. For example, the abiotic components supply nutrients to the plants. Plants prepare food for the animals. When the plants and animals die, they are decomposed by the microorganisms and mixed with the soil. Thus, nutrients are put back into the soil. These nutrients are again absorbed by the plants and the cycle is again repeated.

HABITAT

Living things are found almost everywhere in the world; on land and in air, water and underground. The natural environment in which a living organism lives is called its **habitat**. Every organism is survives best in its own habitat because its body is adapted to live in that particular habitat.

(a) Ducks live in water and on land.

(b) Zebras live on land.

(c) Fish live in water.

Fig. 8.1 Living things are adapted to their particular habitat

ENRICHMENT

An adjustment in an organism for short changes over a short period of time is called **acclimatisation**. For example, on going to mountains, some people feel difficulty in breathing but when they return to the plain area this difficulty of breathing does not exist.

FACT ZONE

The study of interaction and relationship between living things and their environment is called **ecology**.

ACTIVITY 1

Aim To identify biotic and abiotic components in your environment

Procedure Look around you. Observe your environment closely and make a chart of various biotic and abiotic components. Identify at least five things of each category.

ASSESS YOURSELF

Answer the following questions.

1. What is a habitat?
2. What is the relation between habitat and adaptation?
3. Give two examples of biotic components and abiotic components.
4. How are biotic and abiotic components interdependent to each other?

ACTIVITY 2

Find out the habitats of the following living beings.

Organisms	Habitats
Parrot	
Monkey	
Money plant	
Cactus	

ROUGH WORK

A habitat provides the living things with food, water and right kind of environment to live. For example, the wild ass needs warm weather, it feeds upon desert plants and can live with less amount of water. Therefore, we can say that the warm, sandy desert is its habitat.

The abiotic components such as temperature, duration of light and rainfall vary from habitat to habitat. Each habitat has different kinds of environment, so that it has various types of living things. All living things are adapted to grow in a particular environment. Plants and animals which grow well in a forest will not grow on mountains.

In our country, different types of habitats are available for all the living things. These include the hot sandy deserts of Rajasthan and Kutch of Gujarat, the cold mountainous Himalayan regions and the lush green Western Ghats in which a rich variety of plants and animals can survive.

HABITAT AND ADAPTATION

Immediate surroundings of an organism are called its **habitat** while the favourable environmental conditions that help the organism to survive in that particular habitat are called **adaptation**. For example, the body of a polar bear is adapted to live in the cold mountainous regions.

Fig. 8.2 Adaptation in polar bear

TYPES OF HABITAT

Biosphere is the place where all the living things can live. There are different types of habitats present in the biosphere for all living things. Habitats located on the land are called **terrestrial habitats**. Sandy deserts and mountain regions are the examples of terrestrial habitats. Habitats of different water bodies such as lakes, rivers, ponds and oceans are come under **aquatic habitats**.



Cow—terrestrial habitat Monkey—terrestrial habitat Whale—aquatic habitat

Fig. 8.3 Animals with different habitat

Let us discuss the adaptation of plants and animals living in different habitats.

ADAPTATION IN AQUATIC HABITAT

Aquatic habitats include ponds, lakes, rivers, etc. These are the examples of **freshwater habitats** while the coral reefs and oceans are the examples of **salt water habitats**.

Aquatic Habitat for Plants

Plants that grow in water are called aquatic plants. They are also known as **hydrophytes**. They have some special adaptation in their body parts that help them to grow in water. The adaptive features of aquatic plants are as follows:

- Roots help the plants to hold them in place.
- Their stem is long, hollow and thin that helps the plant to float with water.
- Their leaves either float on the surface of water or are fully submerged in the water.

There are three types of aquatic plants. They are—**floating plants, fixed plants** and **submerged plants**.

Floating Plants

Some plants such as duckweed, green-algae, water-hyacinth (also called the terror of Bengal) and pistia float freely on the top of the water and are called as **floating plants**.

The floating plants show following adaptations:

- They have flat, floating leaves to collect maximum sunlight.
- The leaves have waxy coating to make them waterproof.
- They have air spaces in their stems and leaves that make the plant light enough to float.

More to Know

Biosphere

The different parts of the earth, *i.e.* lithosphere, hydrosphere and atmosphere that support life are collectively called **biosphere**. It supports all the life-forms present on the earth. It extends 11 km deep into the sea and 10 km up into the air from the earth's surface.

ENRICHMENT

Plants in the Ocean

Kelp is the longest known aquatic plant that grows up to a length of 60 metres. It grows around rock coastlines. It is a surface plant that lives in shallow water. Lots of aquatic animals feed upon them.

Fig. 8.4 Kelp—the longest known aquatic plant

ACTIVITY 3

By using the internet or other sources like science magazines, find out why the water hyacinth called the Terror of Bengal and discuss it with the class.

FACT ZONE

One of the largest aquatic plants in the world is the Amazon water lily.

ACTIVITY 4

Aim To study the aquatic habitat

Visit a nearby pond and make a list of different plants and animals found in the pond water. Ask your teacher to help you in finding out different types of plants and animals of this aquatic habitat. Also, find out in what ways animals and plants adapted themselves to the pond habitat.

ROUGH WORK

(a) Pistia

(b) Water hyacinth

Fig. 8.5 Examples of floating plants

Fixed Aquatic Plants

Some plants like water-lily and lotus have roots that fix the plants in the mud at the bottom of the pond. They are known as **fixed aquatic plants**.

The fixed aquatic plants show following adaptations:

- Roots of such plants are fixed in the soil at the bottom of a pond.
- They have plate-like leaves that float over the surface of water.
- The stomata in the leaves are on the upper side.
- The leaves have waxy coating to make them waterproof.
- The stems are hollow and very light which helps the leaves to float.
- The stems are very flexible. They bend with the flow of water so that they do not get damaged by strong water currents.

(a) Water lily

(b) Lotus

Fig. 8.6 Examples of fixed aquatic plants

Submerged Plants

Plants like pondweed, tape-grass, hydrilla, etc. live and grow under the water (completely) and hence, are called **underwater** or **submerged plants**. Most of the plants used in aquariums are submerged plants.

The submerged plants show following adaptations:

- They have thin, ribbon-like leaves that can easily bend with the flowing water without getting damaged.
- Leaves of some submerged plants are divided which allow water to flow without causing any damage to them.
- The stems are flexible and have air spaces.

(a) Hydrilla (b) Pond weeds

Fig. 8.7 Examples of submerged plants

Aquatic Habitat for Animals

Like the variety of aquatic plants, there is a large variety of animals like fish and frogs that are also adaptive to live in the aquatic habitat. Here, we will discuss about the adaptive features of fish for aquatic habitat.

Fishes are found in freshwater habitats such as ponds and lakes as well as in the salt water habitat such as oceans. Both the freshwater fish and salt water fish show similar adaptive features for aquatic life. They show the following adaptations:

- They have streamlined body which allows them to penetrate easily through the water.
- They have an air bladder that helps them to float in the water.
- They have gills for exchange of gases. They use oxygen dissolved in water for breathing.

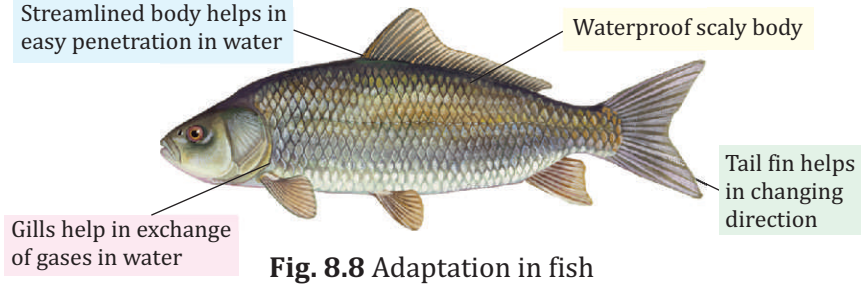


Fig. 8.8 Adaptation in fish

ENRICHMENT

Submerged water plants are also known as **oxygenating pond plants** because they actually filter the pond water. Plants that grow completely under water provide food and shelter for fish, oxygen to the water and filter out pollutants. Submerged plants grow fully immersed in water and get their nutrients from the water through their leaves, not their roots like the other plants.

FACT ZONE

Interesting Facts about Fishes

- Whales and dolphins are not fish, they are mammals. They do not have gills to breathe like any other fish. Instead they have lungs and hence they have to rise to the surface of the water to breathe.
- Fish are often coloured to match their background, and some can actually change colour to blend in with their surroundings.
- Large spots on the rear parts of some fishes fool predators. The spots look like eyes and the fish appear to be moving in the opposite direction.
- Some marine fish have the ability to produce light through chemical reaction in their bodies. Most light-producing fish live in mid-water or are the bottom-dwelling deep sea species.

More to Know

Adaptation in Acacia

- **Acacia** or **Babool** is a drought resistant tree which shows some adaptations for living in deserts. Their leaves fall when it confronted with severe drought. The loss of leaves prevents transpiration and slows plant growth. This conserves moisture and plant energy until rains come and then the plant can resume growth. The tap root system is very extensive. The acacia tree has thorns which are a useful adaptation to prevent grazing.

ENRICHMENT

The stem of cactus plant has a thick, waxy coating which reduces the loss of water from the body of plant. The plant that holds water inside their body is called **succulent plant**. Cactus is an example of succulent plant.

THINK ZONE

Though the water table in deserts is found very deep inside the earth. How can the roots of the desert plants absorb water from the soil?

- Their body is covered with scales. A layer of mucous covers the scaly body of the fishes and makes them waterproof.

ADAPTATION IN DESERT HABITAT

Desert habitat is a type of terrestrial habitat. In deserts, days are very hot while the nights are very cool. A desert receives no rainfall or scanty rainfall throughout the year. Plants and animals living in the deserts receive water from dew drops formed during the cool nights.

Desert Habitat for Plants

Cactus is the plant that grows in deserts. It shows some adaptive features which enable them to survive in such a hot and dry condition.

- It stores water in their thick stems.
- Their leaves are reduced to spines that help in checking the loss of water from the plant.
- Their roots grow deeply into the soil to absorb water and minerals.
- Their stems are green and make food for the plant by the process of photosynthesis.

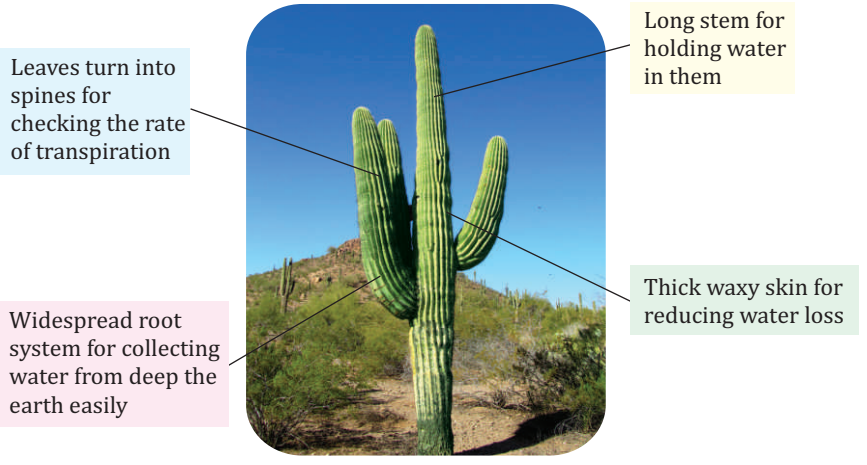


Fig. 8.9 Adaptation in cactus

Desert Habitat for Animals

Animals such as camels, mice, kangaroo rats, lizards and snakes are found in deserts. These animals are adapted to live with less amount of water. They obtain water from the food they eat. During the day time, most of the desert animals remain in the shade.

The camel shows the following adaptive features:

- The long legs of camels keep their body away from the hot sand and help to keep cool.
- They can store excess food in their **hump** for future use.
- They have long eyelashes which protect their eyes from sand.
- They can keep their nostrils closed for avoiding the entrance of sand and dust particles.
- They have long neck so that they can easily reach the ground for grazing.
- The long fur coat of skin reduces the loss of water from the body.
- They do not sweat. They excrete very little urine.
- Their padded feet are flat and wide so that they can walk very easily in the loose and dry sand.

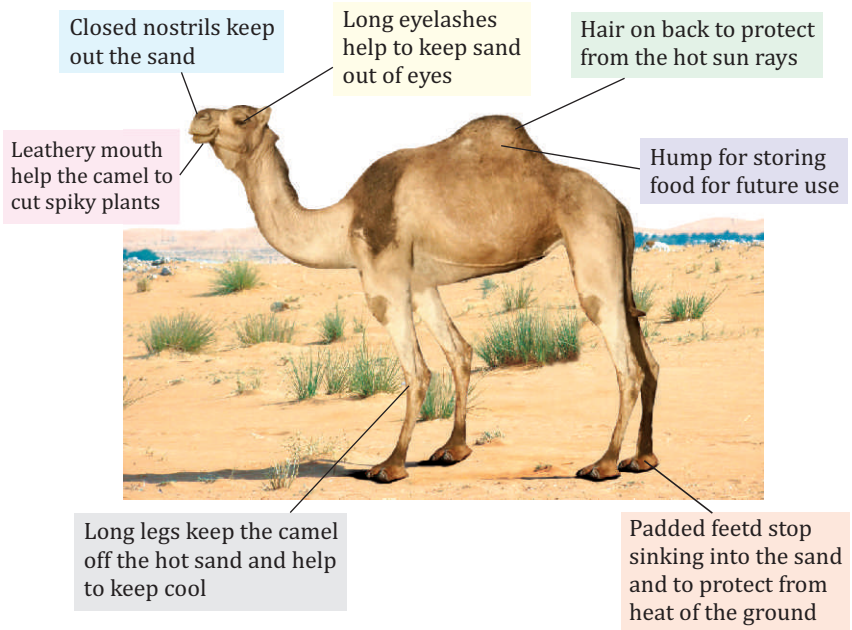


Fig. 8.10 Adaptation in camel

ADAPTATION IN MOUNTAIN HABITAT

Mountains are very cold and windy. In most of the months of a year, the mountain ranges are covered with snow. This makes it difficult for plants and animals to survive there. In the mountain regions the temperature decreases with increase in altitude. The regions of lower altitude are warmer in comparison to the regions of higher altitude. Due to such environmental differences, there is a large variety of plants and animals found in this type of habitat.

FACT ZONE

The camels change their body temperature throughout the day from 34°C to 42°C. This enables the camel to reduce the loss of water from their bodies.

ASSESS YOURSELF

Fill in the Blanks

1. The habitat located on land is called the _____ habitat.
2. Rivers and lakes are the examples of _____ habitat.
3. Plants that grow in water are also called _____.
4. Floating plants have _____, floating leaves to collect maximum _____.
5. Hydrilla is the example of _____ plants.
6. The _____ body of fish helps them to penetrate easily through the water current.
7. The stem of cactus becomes _____ and holds _____ in them.
8. The camel excretes very _____ urine.

ROUGH WORK

More to Know

Food, Moisture and Energy Storage

Spring and summer in the mountains is a very short period, between late May and September. In most of the other months, mountain ranges are covered with snow. For this reason, plants have adapted to store food, moisture and energy. Plants at higher altitudes have stems which extend deep beneath the surface of the soil. These stems allow food storage so plants can begin immediate growth in the spring, without having to wait for the soil to thaw to provide water and minerals. Other plants have formed a waxy substance on their leaves that seals the moisture in, due to the fact that thin soil in the mountains cannot retain moisture. The mountains are home to many evergreen trees and plants which keep their leaves throughout the winter; therefore, they don't require energy and nutrients to develop new leaves during the short growing season.

(a) Pine tree (b) Fir tree

Fig. 8.11 Trees adapted for mountain habitat

The dense forests of trees like bamboo and oak are found in lower and warmer regions of mountains. As we go on to higher altitudes, the temperature drops and the region gets covered with coniferous forests and evergreen trees such as firs, pines and cedars.

Adaptation in Pine and Fir Trees

The adaptive features of pine and fir trees are as follows:

- Both the trees are in triangular and pointed in shape so that they can easily shed heavy snow fall on them.
- They have the thick bark for the protection against extreme cold.
- Their leaves are green throughout the year so that they can photosynthesise whenever there is sufficient sunlight available.
- The leaves of pine tree are needle-like so that they conserve water.
- The waxy coating of leaves reduce the water loss by transpiration.

Adaptation in Mountain Goat

The adaptive features of a mountain goat are as follows:

- It has specialised hooves, composed of a hard outer edge and a soft center that allow them to grip rocks and climb steep hills and rocks.
- It also has developed a thick coat of fur that protects them from the cold temperatures and biting mountain winds.
- Its dazzling white coat of fur provides good camouflage on the snowy heights.

Fig. 8.12 Mountain goat adapted for mountain habitat

AIR ADAPTATIONS OF BIRDS FOR FLIGHT

The bodies of birds are adapted for flying. Some adaptive features of birds for flight are as follows:

- Their bones are light and hollow which makes the body of birds lightweight.
- Flying birds have strong flight muscles attached to an enlarged breastbone called **sternum**. The flight muscles help birds to move their wings for flying.
- Birds also have smooth feathers that reduce the force of their body weight.
- The long flight feathers on the wings and tail help birds balance and steer in the direction it wants to fly. Birds have a system of air sacs in their body that connect to the lungs. The air sacs enable birds to extract much more oxygen from each breath of air than other animals can.
- Birds need extra oxygen to release large amounts of energy to power their flight. Their four-chambered heart also helps a bird to get more oxygen.

Birds show two types of flight—**flapping flight** and **gliding flight**.

- In **flapping flight**, the wings move up and down. The downstroke and upstroke movements of bird's feathers are brought about by the strong breast muscles of the bird.

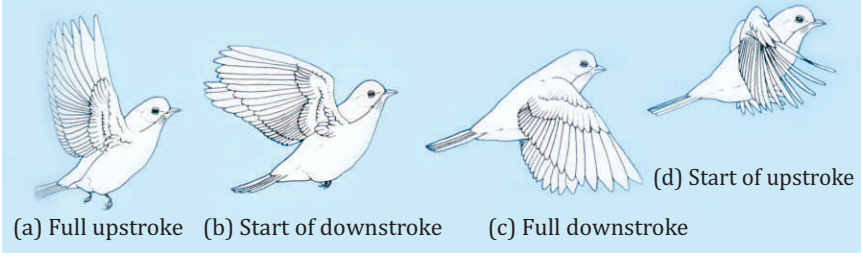


Fig. 8.13 Flapping flight in a bird

- **Gliding flight** In gliding flight, the birds stretch their wings and do not flap them. Soaring birds like vultures and kites, use air currents to gain heights. While landing, they glide down with a high speed.

ADAPTATION IN AERIAL PLANTS

Aerial plants are the plants that normally grow on rainforest trees and take nutrients from the surrounding atmosphere. They do not have their root system grow in the soil. Instead of this, their roots grow above the soil and

More to Know

- **Light bones** which are basically hollow with air sacs. This type of bone reduces the force of body weight.
- A **rigid skeleton** that provides a firm attachment for powerful flight muscles.
- A **streamlined body** that helps to reduce the force of drag (an air resistance or friction).

ENRICHMENT

Aerodynamics

Birds can fly using the motion of air, according to a branch of science called **aerodynamics**. They fly on the principle of indirect movement. It moves the air, which by its displacement, moves the bird. The air displaced by the beating of wings, sets up currents that keep the bird aloft and move forward, resulting in flight.

Fig. 8.14 Gliding flight of kite

More to Know

Wings

The shape of a bird's wing is important for producing lift so that the bird can takeoff. Birds also glide and change the direction of their flight using their wings.

ENRICHMENT

Generally roots grow from the radicle of a seed. But in some plants they arise from other parts such as stems or leaves. Such types of roots are called **adventitious roots**.

FACT ZONE

Some epiphytes (plants that grow on other plants but are not parasites), like certain orchids, have roots that can absorb moisture from the air.

ROUGH WORK

are called as **aerial roots**. These aerial roots serve different purposes, such as for support, for breathing, for getting nutrients and for propagation. These roots are of following types:

Supportive Roots

In some plants, the roots get modified to give additional support to the plants. The supportive roots are of the following types:

- **Prop Roots** These roots arise from the horizontal branches of the stem. They grow vertically downwards and penetrate deep into the soil. They become thick, pillar-like and provide a mechanical support to the plant. The hanging roots of the banyan tree are the examples of prop roots.
- **Stilt Roots** In some plants, the aerial adventitious roots grow from the lower part of the stem and fix the plant firmly in the soil. These are called **stilt roots**. Examples: Stilt roots of maize and sugarcane
- **Climbing Roots** Some weak and green stems, such as the money plant, develop clusters of aerial roots from the nodes or internodes to support the plant to climb upward. Such roots are called **climbing roots**.

Prop roots (Banyan tree) | Stilt roots (Sugarcane) | Climbing roots (Money plant)

Fig. 8.15 Examples of supportive roots

Breathing Roots

Some plants like mangroves grow in marshy or waterlogged lands, where the roots do not get enough oxygen for respiration. In such plants, cone shaped roots come above the ground. They have small pores through which they can take oxygen from the atmosphere. Such roots are also called **pneumatophores**.

Fig. 8.16 Breathing roots of mangrove plant

Parasitic Plants

The plants that live on other plants to get nutrients are called **parasitic plants**. Plant that provides nutrient is called the host and the plant that gets nutrient is called the parasite. The parasitic plants penetrate into the host body to get nutrients. One example of this is the dodder.

Dodder—a parasitic plant

Fig. 8.17 An example of parasitic plant

Assess Yourself

Answer the following questions.

1. In what ways the hooves of mountain goat are adapted for climbing on steep hills and rocks?
2. Why the birds have light weight bones?
3. How can parasitic plants get their nutrients?
4. What are the mangroves?

Let's Recapitulate

- Anything that surrounds and affects the life of an organism is called its **environment**.
- The natural environment in which a living organism lives is called its **habitat**.
- The favourable conditions that help the organism to survive in a particular habitat are called **adaptation**.
- Habitats located on land are called **terrestrial habitats** while the habitats of different water bodies are called **aquatic habitats**.
- Both the plants and animals show some adaptive features for aquatic habitat, desert habitat, mountain habitat and air habitat.

Evaluate Your Understanding

Recalling Ideas

I. Select the correct option.

1. Air, water and soil are the examples of
   (a) biotic component ☐ (b) abiotic component ☐
   (c) cultural component ☐ (d) none of them ☐
2. Duckweed is the example of
   (a) submerged plant ☐ (b) floating plant ☐
   (c) fixed plant ☐ (d) green plant ☐
3. The leaves of cactus plants reduce to
   (a) thorns ☐ (b) spines ☐
   (c) tendrils ☐ (d) none of them ☐

4. Habitats located on land are called

(a) aquatic habitats ☐ (b) terrestrial habitats ☐

(c) mountain habitats ☐ (d) desert habitats ☐

II. Fill in the blanks with the correct option.

1. The waxy coating of leaves reduces the rate of _____. (transpiration/photosynthesis)
2. The thick coat of fur protects the mountain goat from _____. (cold/rain)
3. _____ of birds help them to change the direction of their flight. (Wings/Beaks)
4. Mangroves are the plants that grow in _____ area. (marshy/desert)

III. State if the following statements are True or False. Correct the False statement.

1. The survival of all living organisms is dependent on one another.
2. The interaction of living organisms with the abiotic components constitutes the ecosystem.
3. Habitat is an artificial environment in which living organisms can live.
4. Submerged plants have leaves that float to collect maximum sunlight.

IV. Match the following.

Column A	**Column B**
1. Terrestrial habitat	(a) Floating plant
2. Pistia	(b) Sandy desert
3. Gills	(c) Breathing roots
4. Long legs	(d) Exchange of gases
5. Pneumatophores	(e) Camel

Understanding Ideas

I. Give one word for the following.

1. The living components of the environment. _____
2. The natural environment of a living organism. _____
3. The favourable conditions that help an organism to survive in a particular habitat. _____
4. A body part of fish used for exchange of gases in water. _____
5. An elevated portion of camel's back. _____

II. Answer the following questions in short.

1. Give two examples each of terrestrial and aquatic habitats.

_____

_____

_____

2. Give any three adaptive features of a mountain goat.

_____

_____

_____

3. How do desert animals obtain water?

_____

_____

_____

4. Name the roots of plants that grow in marshy areas.

_____

_____

_____

III. Answer the following questions in detail.

1. What is habitat? What are the benefits of it for the living organisms?

_____

_____

_____

_____

_____

2. How is the body of a bird adapted for flight?

_____

_____

_____

_____

_____

3. Why the leaves of submerged plants are thin and ribbon-shaped?

_____

_____

_____

_____

_____

4. State the adaptive features of a fish for aquatic habitat.

_____

_____

_____

_____

_____

5. In what ways, is the desert habitat suitable for a camel?

_____

_____

_____

_____

_____

IV. Differentiate between the following.

1. Floating plants and submerged plants

_____

_____

_____

2. Desert habitat and mountain habitat

_____

_____

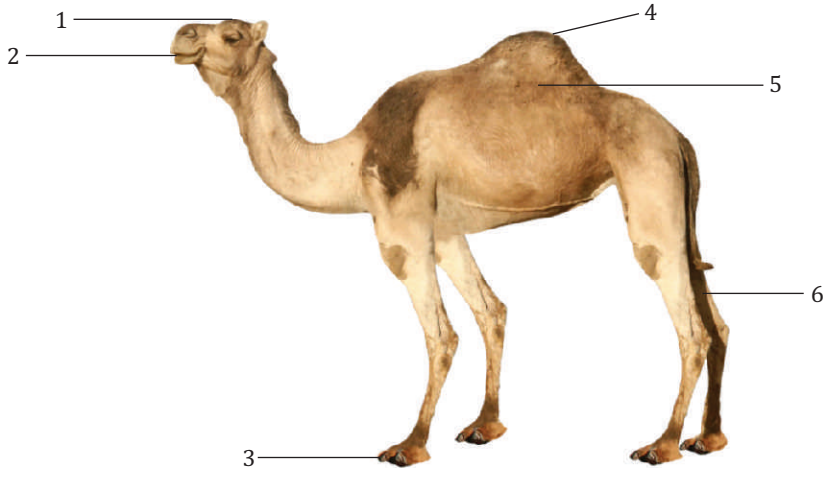
_____

Think Critically

1. Why the dense forests of bamboo trees are found in lower regions of the mountains?
2. Why the leaves of cactus plants are reduced to spines?
3. The mountain goats have white, shiny fur. Give reason for it.

Diagram-based Question

1. Study the given diagram and mention the adaptive features 1 to 6 of a camel for desert habitat.



Project Idea

1. Collect information about some aquatic animals. Find out how they can survive in different water levels of an ocean. In what ways, aquatic green plants are beneficial to aquatic animals? On the basis of the above-mentioned information makes a project and give the title 'Aquatic Habitats for Plant and Animals' to your project. Do not forget to paste the colourful pictures of different plants and animals of an aquatic habitat.

Keywords

1. Plant Life—The Leaf

Lamina	:	The flat, expanded and thin part of a leaf
Leaf tendrils	:	The thread-like modification of leaves that provide support in climbing of weak stems
Leaflets	:	The clearly divided distinct parts of a compound leaf
Photosynthesis	:	A process of food making in green plants
Stomata	:	The tiny pores present on the lower surface of a leaf that help the leaf to release excess water absorbed by the roots
Transpiration	:	A process of releasing excess water by the plants through the stomata

2. Plant Life—The Flower

Anther	:	A bilobed structure of stamen which contains yellow, powdery pollen grains
Hilum	:	A point from where the seeds breaks from the stalk
Pedicel	:	A long stalk by which a flower is attached to the stem
Pericarp	:	The outermost fruit wall
Thalamus	:	A slightly flattened part of pedicel through which all the flower parts arise
Zygote	:	A single cell produced by the fusion of male cell with the female cell

3. Cell—The basic Unit of life

Cell wall	:	An outermost non-living membrane of a plant cell, made up of cellulose
Cells	:	The structural and functional units of life
Chlorophyll	:	The green colour pigments responsible for photosynthesis
Granum	:	A pile of green, solid bodies in chloroplasts
Microscope	:	An instrument used to study the objects which are very small or invisible to naked human eyes
Plastids	:	The disc-shaped colourful cell organelles that are present in the plant cells only
Stroma	:	The liquid part of chloroplasts
Tonoplast	:	The membrane that binds a vacuole
Vacuole	:	A non-living, fluid-filled space present in the cytoplasm of the plant cells

4. Human Body—Digestive System

ATP (Adenosine Triphosphate)	:	An energy currency of the cell
Bile	:	A greenish-yellow colour liquid secreted by the liver
Bolus	:	A form of the ingested food chewed and mixed with saliva in the mouth
Chyme	:	A semi-solid paste of digested food present in the small intestine
Enamel	:	The hardest, outer, non-living shining layer of the crown of the teeth

Enzymes	:	The biochemicals present in the living cells that speed up the chemical reactions in the organisms without undergoing a change themselves
Nutrition	:	The process of conversion of ingested food into a useful form that can be utilised by the cells for the growth of the body
Villi	:	Numerous, finger-like projections in the small intestine meant for absorption of digested food

5. Human Body—Respiratory System

Breathing	:	A physical process of inhaling and exhaling of air. It does not involve any enzymes
Bronchi	:	The two branching tubes of the trachea
Lungs	:	The main respiratory organs where exchange of gases take place
Respiration	:	A process of oxidation of glucose into carbon dioxide, water and ATP (energy)
Vocal cord	:	The folds of muscular tissues that vibrates with the passage of air and produce sound

6. Human Body—Circulatory System

Antibodies	:	The proteins present in the plasma
Antigens	:	The proteins present on the surface of red blood cells
Haeamoglobin	:	An iron-containing protein of red blood cells
Pulmonary artery	:	An artery that carries impure blood to the lungs
Pulmonary vein	:	A vein that carries pure blood from the lungs
Plasma	:	The liquid part of the blood which contains different types of blood cells

7. Health and Hygiene

Disease	:	An abnormal condition of an organism which interrupts the normal body functions
Hygiene	:	It is a practice of good healthy habits that involves keeping clean, eating well, balanced diet, sufficient exercise and sleep
Pathogens	:	The disease-causing microorganisms such as bacteria, viruses, protozoa and worms
Sewage	:	A water-containing waste matter comes from the homes

8. Adaptation

Adaptation	:	The favourable environmental conditions that help the organism to survive in its habitat
Camouflage	:	It is an adaptation that allows animals to blend with certain aspects of their environment
Environment	:	Anything that surrounds and affects the life of an organism
Habitat	:	The natural environment of an organism
Hydrophytes	:	The plants that live in the water
Succulent plants	:	The plants that hold water inside their body and grow in desert areas