Concise

BIOLOGY

— Middle School

7

By

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PREFACE

Concise Biology Middle School meant for Class VII students is a part of "Integrated Science" with Physics and Chemistry books being brought out separately. The book has been written strictly in accordance with the latest curriculum prescribed by the Council for the ISC Examinations, New Delhi.

In the modern context, science education deals with concepts, processes, applications, attitudes, creativity and world view.

Biology, often described as life science is perhaps the most fascinating of all the sciences and is very relevant in the lives of pupils — in terms of knowledge about plants and animals, nutrition, diseases, health and hygiene. The author has taken great pains to prepare this book keeping these facts in mind.

Great effort has been made to deal with the different topics of the subject in a clear and interesting manner so that it may elicit among the students a spirit of enquiry and scientific temper, strengthening their power of observation and ability to draw appropriate conclusions from the experiments they perform. Above all, it has been his effort throughout the book that the students develop an appreciation of nature and its mysteries.

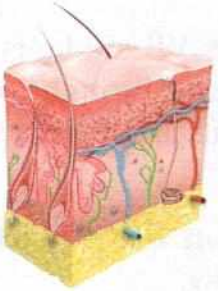
The language of the book has been kept simple. Some scientific terms are unavoidable; still they have been kept at a minimum level. Each chapter has been greatly enriched with lots of activities to perform, tables to fill up and sketches to draw. Further, important questions related to the chapters have been given at the end of each chapter.

We hope that both the teachers and the students will enjoy learning about science through this series of biology books. Inspite of our best efforts, some shortcomings might have escaped our notice. We shall feel obliged if the same are brought to our attention. Also, we will gratefully acknowledge suggestions and criticisms for improvement of the book.

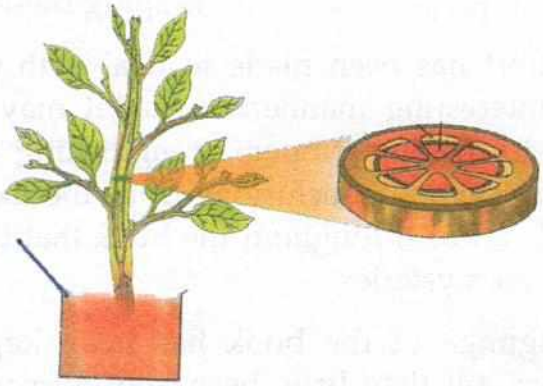
—Author

CONTENT

UNIT 1 : Tissue

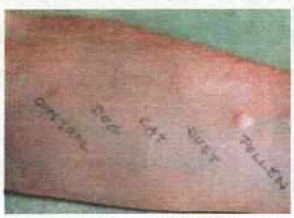


UNIT 2 : Plant Life

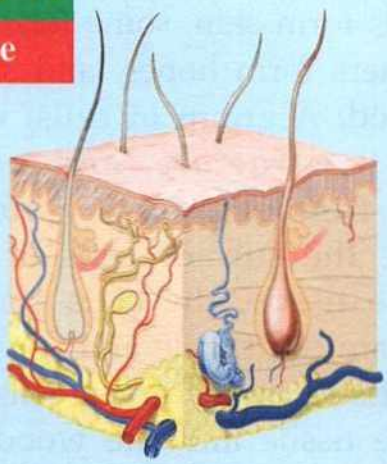


UNIT 3 : Human Body





UNIT : 1
Tissue



1

PLANT AND ANIMAL TISSUES

SYLLABUS

Plant tissues

- Definition of tissue.
- Classification of plant tissues: Meristematic and permanent (simple and complex);
- Meristematic tissues: characteristics (any two), simple structure, location, function, examples;
- Simple permanent tissues: parenchyma, collenchyma, sclerenchyma (simple structure, location and functions of each), examples;
- Complex permanent tissues: xylem, pholem (only nature of cells and function. Elements of xylem and pholem not to be mentioned).

Animal tissues

- Epithelial tissue: simple location, and function (types of epithelial tissues not to be mentioned);
- Connective tissue: location and functions of areolar, adipose, bone, cartilage, blood, ligament, tendon;
- Muscular tissue: location and one function of :
  - striated (voluntary or skeletal muscle)
  - unstriated (involuntary/smooth muscle)
  - cardiac (specialized muscle)
- Nerve tissue : parts of neuron (cell body, dendron, axon).

Note : Only basic structure and basic functions of the above mentioned tissues to be done.

You have studied that "cell" is the structural and functional unit of life. All living organisms, plants and animals are made up of tiny microscopic cells.

The cell, whether that of a unicellular organism or a multicellular organism, consists of **protoplasm** — the living substance. You have also learnt that there

are various organelles present inside the cell. These organelles are arranged in a highly organised manner to perform specific functions. Cells organise to form tissues. Tissues organise to form **organs** and organs further form **organ systems**. The organ systems are present in both plants and animals of higher groups. [Thus, one can say that the bodies of plants and animals are organised structures and hence they are called **organisms**.]

TISSUES (Fig. 1.1)

All multicellular organisms (animals and plants) start their life as a single cell (the fertilised egg or zygote). The fertilised egg divides repeatedly to produce thousands, millions or billions of cells (trillions in human body). Some of these cells form skin, some form muscles, some others form bones, and still others form blood. **A group of cells, which are similar in structure, and perform a specific function, form a tissue.** For example, the surface cells of the skin form one tissue, the cells constituting muscles are contractile and constitute the muscle tissue, or the green cells of a leaf form one tissue and the wood forming cells of the stem constitute another tissue.

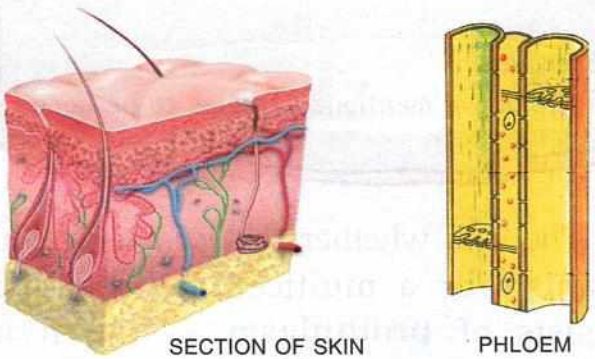


Fig. 1.1 Examples of some tissues

Kinds of Tissues

The bodies of plants and animals consist of different types of tissues, each of which performs a specific function.

PLANT TISSUES

Plant tissues are basically of *two* kinds — meristematic and permanent tissues.

1. Meristematic tissues are made up of **actively dividing cells**. Their only function is to produce more cells leading to the growth of the plant body.

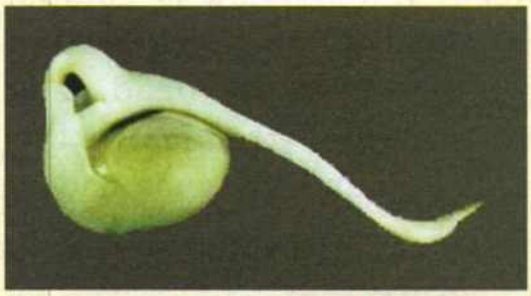
Meristematic tissues are found *at all* **growing points** in a plant, like the tip of roots, stems and branches, where growth in length occurs. The growth in the thickness of stem is also due to meristematic tissues.

Activity 1

To study the activity of meristematic tissue in a plant.

Soak some green gram (*moong*) seeds overnight in water and then keep them on soaked cotton in a petridish. After two or three days, you will see white

sprouts coming out of the seeds. Observe these daily; they grow very fast. Their root tip consists of meristematic tissues which help in their growth.



Sprout of seed

The main characteristics of meristematic tissues are as follows :

(i) The cells are **small.**

(ii) The **cell-walls are thin.**

(iii) The **nuclei are large** and conspicuous.

(iv) The cells are almost **without vacuoles.**

(v) The cells **actively divide to add new cells.**

2. Permanent (Non–dividing) tissues : The permanent tissues form the bulk of the plant body. These tissues **do not divide.** They become specialised and remain **same throughout their life.**

New cells are formed when the meristematic cells divide. These newly formed cells grow, mature and get differentiated into various types of permanent tissues. Permanent tissues do not divide further. **A permanent tissue is a group of cells in which growth has either stopped completely or for the time being.**

The permanent tissues can be classified into *two* main types.

- Simple permanent tissue (provides support and protection).
- Complex permanent tissue (conducts nutrients and water).

Simple permanent tissues

According to the function, the simple permanent tissues are of two types :

(i) Protective tissue and

(ii) Supportive tissue.

(i) Protective Tissue

Protective tissue consists of cells with thick walls. These are found on the surface of roots, stems and leaves.

Example : **Epidermis** of leaves, which secretes a waxy water-proof substance. (You might have observed that water drops falling on a leaf, do not stick on it).

(ii) Supporting Tissue

Supporting tissue has mainly *three* categories : parenchyma, collenchyma and sclerenchyma.

(a) Parenchyma is composed of large **thin walled** cells, usually with **intercellular spaces** (Fig. 1.2). These are the living cells and are found in the soft parts of the plant.

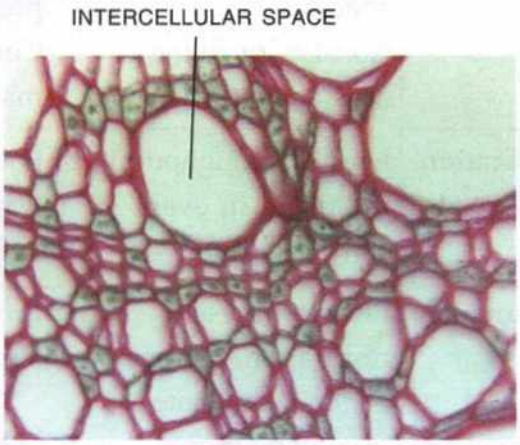


Fig. 1.2 Parenchyma cells

They store food material and also provide temporary support to the plant.

Potatoes are mainly composed of parenchyma cells (storing starch). Some parenchyma cells contain chlorophyll (as in leaf) for the manufacture of food.

(b) Collenchyma is made up of living cells which are **elongated** and are **thick at the corners or edges** (Fig. 1.3). This tissue is found in the leaf stalks and below the epidermis of stems. This tissue helps to **support** the plant parts.

(c) Sclerenchyma is composed of **long, narrow** and **thick-walled cells** (Fig. 1.4). These are dead cells. This tissue provides **strength** to the plant parts. It is found in stems and veins of the leaves mostly as fibres.

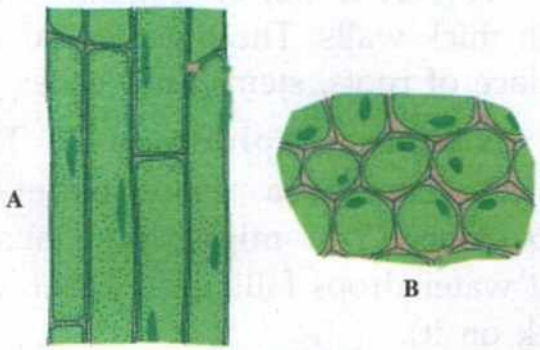


Fig. 1.3 Collenchyma
A - Longitudinal section, B - Cross section

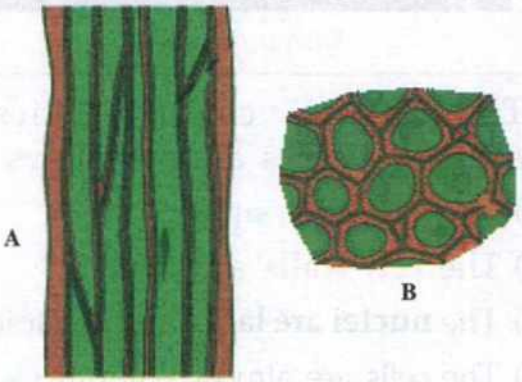


Fig. 1.4 Sclerenchyma
A - Longitudinal section, B - Cross section

Table 1.1 : Comparison between parenchyma, collenchyma and sclerenchyma at a glance.

	Parenchyma	Collenchyma	Sclerenchyma
1. Characteristics	Spherical, thin-walled cells with large intercellular spaces. Consists of living cells at maturity.	1. Elongated cells with unevenly thickened cell walls at the edges. Little intercellular spaces are present between the cells. Consists of living cells at maturity.	1. Long, narrow, thick-walled cells. Intercellular spaces are absent. Consists of dead cells at maturity.
2. Location	Found throughout the plant, in every soft part.	2. Found in petioles, veins of the leaves and young stems.	2. Found in mature parts of the plant like in wood, bark, etc.
3. Function	Photosynthesis, respiration, storage of food, buoyancy in aquatic plants.	3. Provide a flexible mechanical support to plant parts.	3. Provide a rigid mechanical and structural support to the plant.

Complex permanent tissues

Complex permanent tissue or conducting tissue is also called the **vascular tissue**. It provides a passage for the transport of materials in the plant. Xylem and phloem (Fig. 1.5) are the two types of conducting tissues.

(i) Xylem is formed of thick-walled, tubular and often dead cells.

- These cells are placed end-to-end.
- The partitions between the cells dissolve to form long channels for the transport of water and minerals.

The xylem tissue consists of (i) tracheids, (ii) vessels, (iii) xylem parenchyma and (iv) xylem fibres.

Xylem cells transport water and minerals absorbed by the roots from the soil, upward to the leaves. The water is used in preparing glucose during photosynthesis or lost as water vapour in transpiration.

Old xylem forms the **wood** and does not participate in the transport of food.

(ii) Phloem is formed of living tubular cells which provide a passage for the downward and upward movement of the food, manufactured in the leaves, to various parts of the plant.

The phloem consists of (i) sieve tubes, (ii) companion cells, (iii) phloem parenchyma, and (iv) phloem fibres.

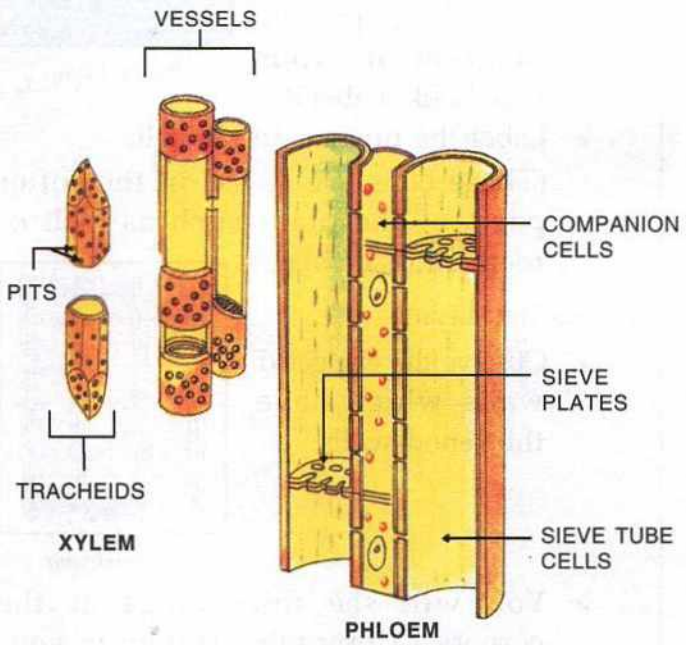


Fig. 1.5 Xylem and phloem

Table 1.2 : Differences between xylem and phloem.

Xylem	Phloem
1. Transports water and minerals absorbed by the roots to other plant parts.	1. Conducts food manufactured in the leaves to other plant parts.
2. Consists mainly of dead cells.	2. Consists mainly of living cells.
3. Conduction is unidirectional *i.e.* only upwards from the roots.	3. Bidirectional conduction *i.e.* both upwards and downwards from the leaves.

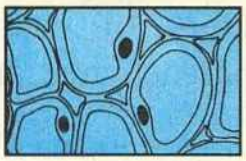
Activity 2

To study different types of plant tissues.

Request your teacher to provide prepared slides of various plant tissues. Take the slides one by one and place them on the microscope. Ask your teacher to properly focus the slide, and then study it.

1. Parenchyma

- Look at the large thin-walled cells. You will see a large vacuole. Copy this diagram in your note book. Label it.



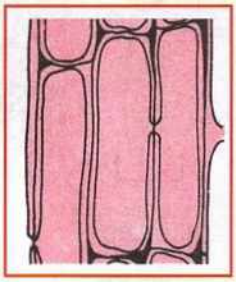
Parenchyma

- Label the nucleus in the cell.

(These cells are found in the softer parts of the plant such as pith of roots and stems).

2. Collenchyma

- Observe the elongated walls which have thickened walls.



Collenchyma

- You will see thickenings at the corners ? Copy this diagram in your note book. Label the thickenings.

(These cells are found in the leaf stalks and below the epidermis of stems).

3. Sclerenchyma

- Look at the long and narrow cells such as cotton fibre.
- Are they thin-walled or thick-walled ?
- Copy this diagram in your note book. Label the nuclei in the cells.

Sclerenchyma

(They are found in stem and veins of the leaves).

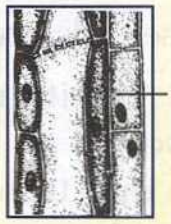
4. Xylem

- Look at the thick-walled tubular cells.
- These cells are placed end to end like a drain pipe.

Xylem

5. Phloem

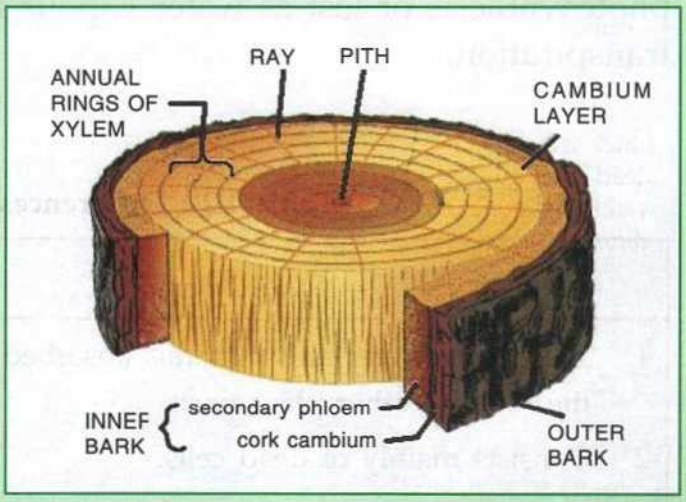
- Look at the tubular structure lined with cells having distinct nuclei.
- Copy this diagram in your note book. Label the nuclei.



Phloem

Tissues in woody stem

Xylem rings indicate the age of the stem. Here is a diagrammatic sketch of the cross section of a 3 year old woody stem. The cambium (meristematic tissues) gives rise to new xylem ring every year.



Diagrammatic sketch of the cross section of a 3 year old woody stem. Note the three concentric rings of xylem indicating its age

Activity 3

To study the conduction of water by xylem. Cut the lower end of a fresh carrot and you will see a central yellowish circle. Leave the carrot with its cut end dipped in a solution of red ink in a beaker for a few hours. Now cut this carrot lengthwise. You will see that the central cylinder in the carrot has become red in colour. This shows that the ink has been absorbed and transported upwards.

PLANT TISSUES

- **Meristematic Tissues** (actively dividing cells; produce more cells)
- **Permanent Tissues** (specialised cells to perform a particular function; do not divide)
  - **Protective tissue** (on the surface of roots, stems and leaves)
  - **Supporting tissue**
    - **Parenchyma** (large, thin-walled cells)
    - **Collenchyma** (elongated cells thickened at the corners)
    - **Sclerenchyma** (long, narrow and dead thick-walled cells)
  - **Conducting tissue**
    - **Xylem** (thick-walled, tubular dead cells; transports water and minerals to different parts of the plant)
    - **Phloem** (tubular living cells; provide passage for the upward and downward movement of food prepared by the green leaves)

ANIMAL TISSUES

The animal tissues may be classified into four major groups :

1. Epithelial (covering) tissue.
2. Connective (supportive) tissue.
3. Muscular (contractile) tissue.
4. Nervous (message conveying) tissue.

1. Epithelial Tissue (Fig. 1.6)

Epithelial tissue forms a thin protective layer of cells. It covers the surface of the body and forms the lining of various body cavities and internal organs. Epithelial cells may be flat, cuboidal or columnar in shape.

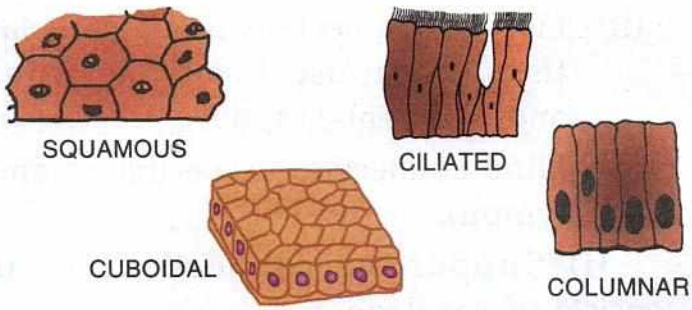


Fig. 1.6 Kinds of epithelial tissue

On the basis of the shape of the cells, the epithelial tissues are of four types :

(i) Squamous epithelium : They are composed of thin, flattened and polygonal cells. *Example :* Cells of the outer layer of skin. These cells are usually ***protective.***

(ii) Cuboidal epithelium : They are composed of cube-like cells. *Example :* Inner wall lining of kidney tubules. These cells are usually concerned with **absorption.**

(iii) Columnar epithelium : They are composed of vertically arranged, tall, cylindrical or column-like cells. *Example :* Inner lining of stomach and intestine. These cells are usually **secretory.**

(iv) At some places in the body, for example in the lining of the wind pipe and oviduct, the columnar epithelium has developed cilia. Such an epithelium is called **ciliated epithelium.** The cilia keeps lashing and move the substances in its contact.

2. Connective Tissue

Connective tissue connects various other tissues and organs, as well as it provides support to different organs to keep them in proper position. Connective tissues are of three kinds :

(i) Supportive connective tissue (bone and cartilage),

(ii) Fibrous connective tissue (areolar tissue, adipose tissue, tendons and ligaments), and

(iii) Fluid connective tissue (blood and lymph).

(i) Supportive connective tissue consists of **cartilage** and **bone.**

(a) Cartilage covers the ends of bones, and gives support to certain organs such as tip of the nose, external projection of the ear, and wind pipe. Press, fold or twist your external ear and leave it. It reverts to its normal shape. You can feel the supporting cartilage in your ears. Similarly, there is a cartilage between your two nostrils at the tip of the nose. The cartilage consists of a clear ground substance (matrix) (Fig. 1.7), which contains a large number of spaces, each occupied by one or more cells.

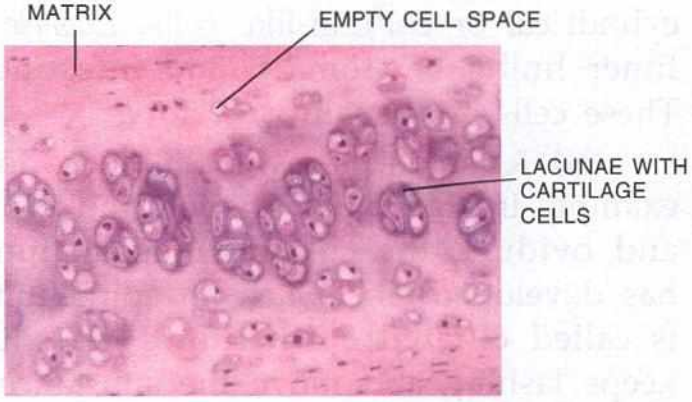


Fig. 1.7 Section of cartilage

(b) Bone is the main supportiv structure of vertebrates. The bone cells ar embedded in a **hard** matrix of calciun and phosphorus salts. The matrix i deposited in the form of concentric layer (Fig. 1.8) around a central canal. The bon cells occupy small spaces.

Fig. 1.8 Section of human bone

(ii) Fibrous connective tissue serv for packing and binding of most of th organs.

(a) **Areolar tissue** binds our skin t the underlying tissue.

(b) **Adipose tissue** contains cell filled with fat globules.

(c) **Tendons** connect muscles t bones at joints.

(d) **Ligaments** connect a bone t another bone at joints.

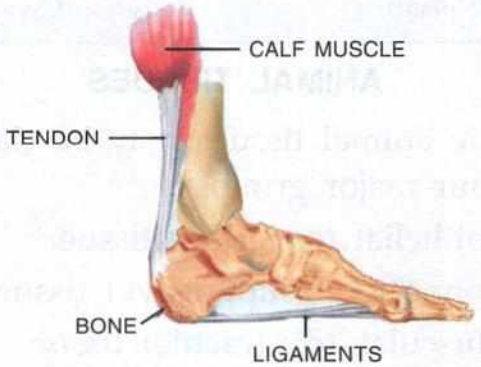


Fig. 1.9 Tendon and ligament

(iii) Fluid connective tissue consists of **blood** and **lymph** (Fig. 1.10).

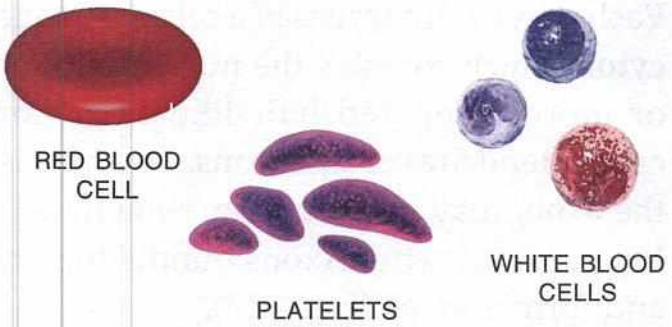


Fig. 1.10 Magnified Human blood cells

(a) Blood : It is composed of both liquid and cellular parts. The liquid part in the blood is the **plasma,** and the cellular part includes the **red blood corpuscles, white blood corpuscles** and **platelets.**

(b) Lymph is the fluid surrounding the body cells. It is essentially the plasma with some leukocytes or white blood cells that have oozed out of the blood capillaries. It lacks red blood cells and blood platelets.

Fluid connective tissue is mainly concerned with the transportation of substances, like glucose, amino acids, oxygen, etc.

3. Muscular Tissue (Fig. 1.11)

Muscular tissue forms the muscles of the body. The muscles can contract and relax. Thus, they help the body in all its movements and locomotion.

Three distinct kinds of muscles are :

(i) **Striated** (skeletal, striped, or voluntary) muscles,

(ii) **Unstriated** (smooth, unstriped, or involuntary) muscles, and

(iii) **Cardiac** or heart muscles.

(i) Striated Muscles

Striated muscles found attached to bones are under the control of the will of an individual. The muscles in your arm move only when you want. For example, when you want to throw a ball, you move your arm. Such muscles constitute about 40% of the body weight. Common places to find such muscles are arms and legs, face, neck, etc.

(ii) Unstriated Muscles

Unstriated muscles are not under control of one's will. Movements like passage of food in the alimentary canal, for example, are caused by the contraction of the unstriated muscles in the intestinal walls. Such muscles are composed of slender, tapering cells. Muscles of the iris in the eye and those in the urinary bladder wall are also unstriated or smooth muscles.

(iii) Cardiac Muscles

Cardiac muscles are also involuntary, but of a different kind. The cells here are striated and comparatively short. Unlike

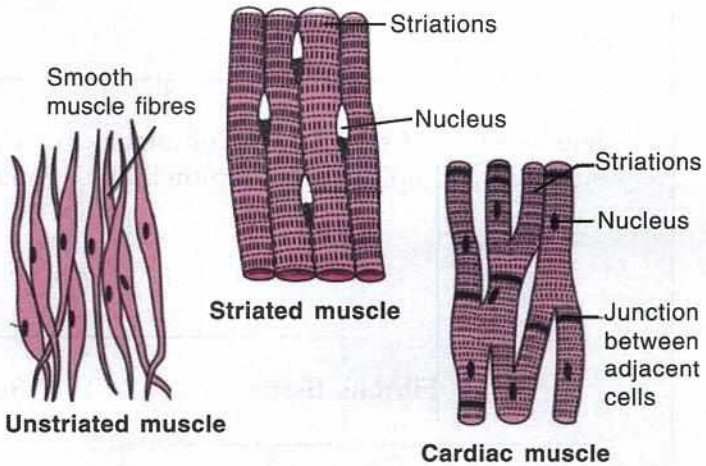


Fig. 1.11 Three different kinds of muscles

the others, **cardiac muscles are branched.** These muscles are found only in the walls of the heart. They can contract without outside stimulation and never get tired in a person's lifetime.

4. Nervous Tissue

Nervous tissue constitutes the nervous system. This tissue is made up of elongated cells, called *neurons*. Figure 1.12 given here shows a typical neuron or nerve cell. Each nerve cell consists of a cell body called **cyton** which contains the nucleus and one or more elongated hair-like extensions called **dendrites** or **dendrons**. One of these, the **axon**, may be very long, sometimes as long as one metre. Axons bundle together and form a *nerve* (Fig. 1.13).

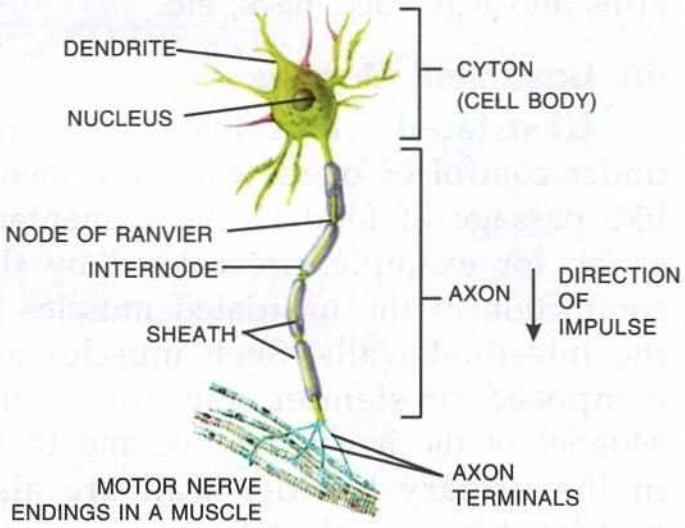


Fig. 1.12 A nerve cell (neuron)

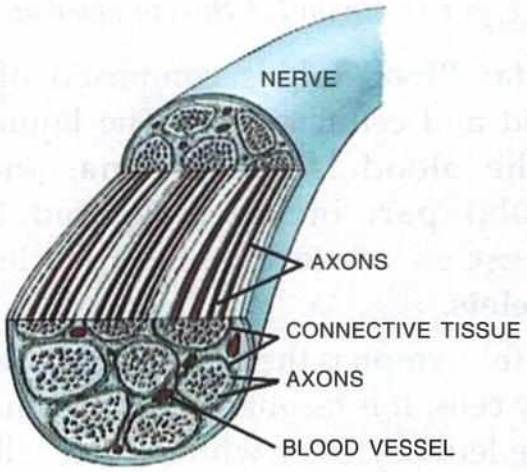
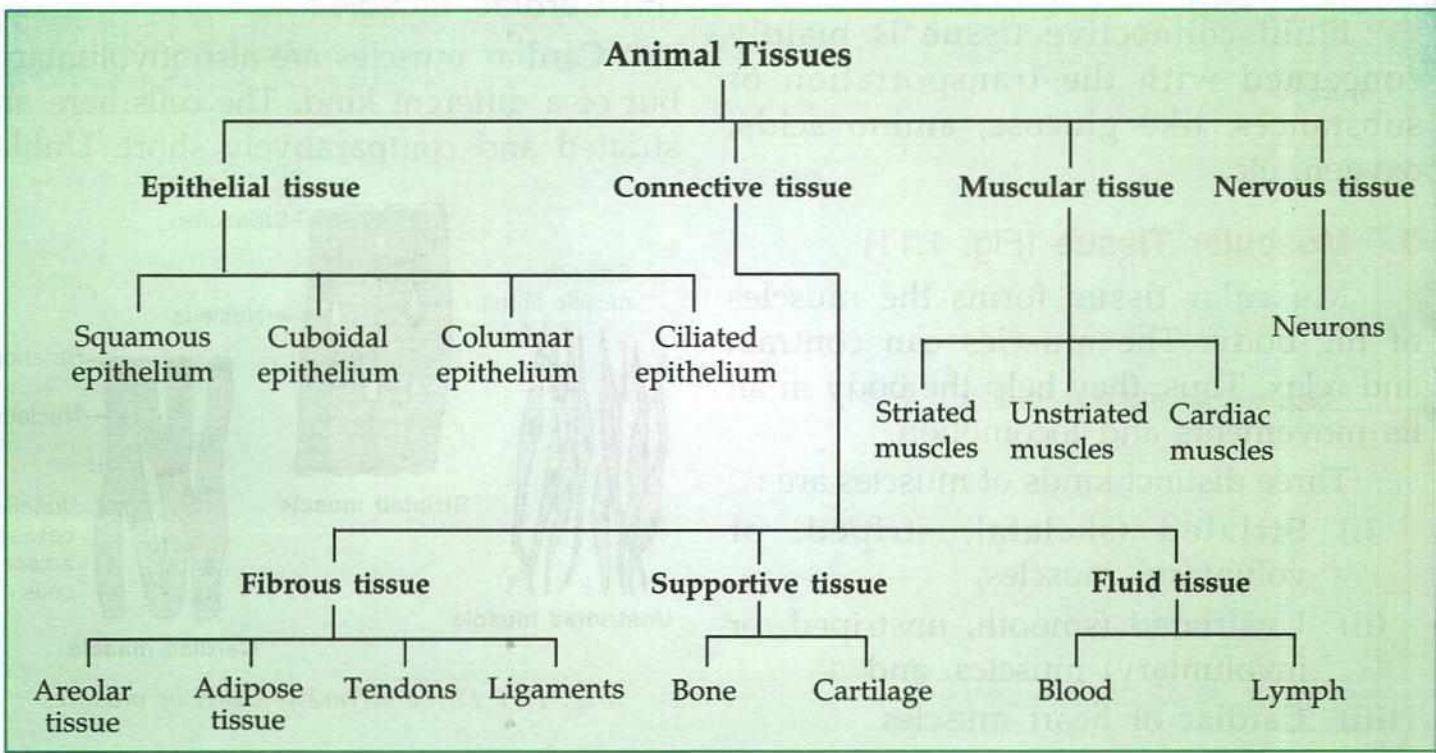


Fig. 1.13 Nerve is a bundle of axons



Activity 4

To study different types of animal tissues.

Request your teacher to provide prepared slides of different animal tissues.

➢ Focus the slides one by one under the microscope and view them carefully.

Space for drawing Squamous epithelium

Space for drawing Cuboidal epithelium

Space for drawing Columnar epithelium

Space for drawing striated muscle

Space for drawing nerve cell

1. Epithelial tissue :

- The epithelial tissues are mainly of three types — squamous, cuboidal, and columnar epithelium.
- The three types of epithelial tissues can be easily identified on the basis of the shape of the cell.
- Observe the shape of the cells in the three slides and give your observations in the table given below.

Observations :

Type of epithelial tissue	Shape of the cells
1. Squamous	.....
2. Cuboidal	.....
3. Columnar	.....

- Draw neat and labelled diagrams of different epithelial cells in the spaces provided alongside.

2. Striated muscle :

- Examine the long fibres.
- Do the fibres show any cross striations throughout the length ? Yes/No
- Draw the diagram in the space provided alongside.

3. Nerve cell :

- Do you see a single cell in your slide or several cells ?
- Observe the main cell part and the fibre extending out from it.
- Do you see a nucleus in the cell body ? Yes/No.
- Draw a neat and labelled diagram in the space provided alongside.

Note : Draw neat diagrams of the tissues you have observed, in the spaces provided.

REVIEW QUESTIONS

MULTIPLE CHOICE QUESTIONS

1. Put a tick (√) against the most appropriate alternative in the following statements.

   (i) A group of similar cells to perform a specific function forms a

   (a) organ ☐ *(b)* species ☐

   (c) organ system ☐ *(d)* tissue ☐

   (ii) The small fine branches given out from the cell body of a nerve cell are

   (a) dendrites ☐ *(b)* cyton ☐

   (c) axon ☐ *(d)* neurons ☐

   (iii) Fluid connective tissue of humans is

   (a) blood and cartilage ☐ *(b)* lymph and plasma ☐

   (c) blood and lymph ☐ *(d)* stroma and matrix ☐

SHORT ANSWER QUESTIONS

1. Define the following terms :

   (i) Tissue : .....

   (ii) Organ : .....

2. Answer the following :

   (i) What is a meristematic tissue ? How is it different from permanent tissues ?

   .....

   .....

   .....

   (ii) Which living material would you take to demonstrate meristematic tissue ?

   .....

.....

.....

(iii) What is the function of meristematic tissue ?

.....

.....

.....

3. State whether the following statements are *True* or *False*.

(i) A tissue is formed of only one type of cells.

(ii) Only one type of tissue forms an organ.

(iii) Permanent tissue is made up of undifferentiated and dividing cells.

(iv) Meristematic tissue is found at the growing tips of a plant.

(v) Phloem is formed of dead tubular cells.

4. Fill in the blanks by selecting suitable words from the list given below :

thin-walled, collenchyma, vascular, tissues, conducting

(i) A group of different ..... working together to perform a function is called an organ.

(ii) Xylem and phloem form the ..... tissue.

(iii) Conducting tissue is also called ..... tissue.

(iv) Cells are elongated and thick at the corners in ..... tissue.

(v) Parenchyma is composed of large ..... cells.

5. Match the items given in Column A with those given in Column B :

Column A	Column B
(i) Fibrous connective tissue	*(a)* blood
(ii) Fluid connective tissue	*(b)* cartilage
(iii) Supportive connective tissue	*(c)* connects a bone to another bone.
(iv) Ligament	*(d)* areolar tissue
(v) Tendon	*(e)* connects a muscle with a bone.

6. How do you rank the following with respect to a cell, tissue, organ, or organism ?

(*i*) Amoeba : .....

(*ii*) Euglena : .....

(*iii*) Skin : .....

(*iv*) Lungs : .....

(*v*) Neuron : .....

(*vi*) Cardiac muscles : .....

7. Each of the tissues listed in **Column A** is related to one of the functions given in **Column B**. Match the correct pairs by drawing lines.

Column A (Tissue)	Column B (Function)
(i) Epithelial tissue	(a) movement
(ii) Connective tissue	(b) protection
(iii) Vascular tissue	(c) messages
(iv) Nervous tissue	(d) support
(v) Muscular tissue	(e) transport

8. Name the kind of tissue that

(i) Carries oxygen around your body .....

(ii) Brings about movement in animals .....

(iii) Transports food to different parts of a plant .....

(iv) Transports water in plants .....

(v) Supports an animal's body .....

(vi) Binds different tissues together .....

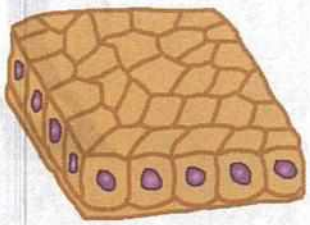
(vii) Conducts messages from one part of the body to another .....

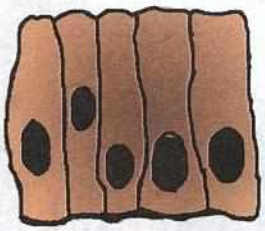
9. Based on the following information, identify the three types of epithelial tissue in the figure given below :

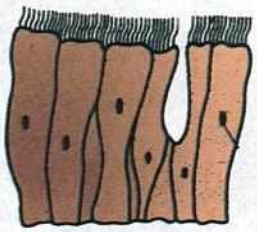
(i) **Cuboidal epithelium :** It consists of a single layer of cuboidal cells.

(ii) **Columnar epithelium :** It is composed of tall, cylindrical cells with oval nuclei usuall placed at the base of the cells.

(iii) **Ciliated epithelium :** It consists of cells bearing hair-like cilia on their free surface.







(a) ..... (b) ..... (c) .....

10. Write *three* differences between the two principal vascular tissues found in plants.
11. Mention the main characteristic features of meristematic tissues, and state where we find such tissues in plants. Give the function of the meristematic tissue.
12. Name the plant tissue which helps in the movement of water and minerals in the body. What are the various types of cells present in this tissue ?
13. Which plant tissue is responsible for the distribution of food prepared in the leaves ? Name the four component parts of this tissue.
14. Name the various types of animal tissues and state their functions.
15. Give the structure and function of different types of epithelial tissues.
16. Draw the diagram of a neuron and label the following parts in it.

    Cyton, axon, node of Ranvier, internode.
17. Name the three main kinds of muscular tissues. Give the exact location of each kind in an animal body.

PROJECT

- Make a colourful chart showing different types of animal tissues.

2 CLASSIFICATION OF PLANTS

SYLLABUS

- Meaning and concept of classification.
- Need and advantages of classification
- Characteristics of each kingdom with suitable examples :
  - Monera: bacteria - shape; useful bacteria, harmful bacteria (applications related to daily life to be discussed);
  - Protista: *Amoeba* - basic structure and life processes (nutrition, locomotion, respiration, excretion and reproduction — by binary and multiple fission);
  - Fungi: basic structure of mould, nutrition and respiration in mould, useful fungi, harmful fungi (applications related to daily life to be discussed);
  - Plantae: characteristics and examples (classification of plantae not to be discussed);

INTRODUCTION

We know that the subject Biology deals with the study of living things — the plants and animals. Biologists have identified, named and grouped more than a million types of plants and animals living on this earth. In order to facilitate the study of this vast variety of plants and animals, they have been classified into different groups.

CLASSIFICATION AND ITS NEED

All living things are broadly classified into two main groups — **plants** and **animals**. Based on their similar characterstics, both plants and animals are further divided into various divisions or classes. On the basis of this grouping, the living organisms can be studied systematically. Thus, ***classification means grouping organisms together on the basis***

of certain common features. It is a system of putting organisms with similar characterstics into one group.

In biology, classification is a system of arranging living organisms into groups based on their similarities and differences.

Advantages of classification

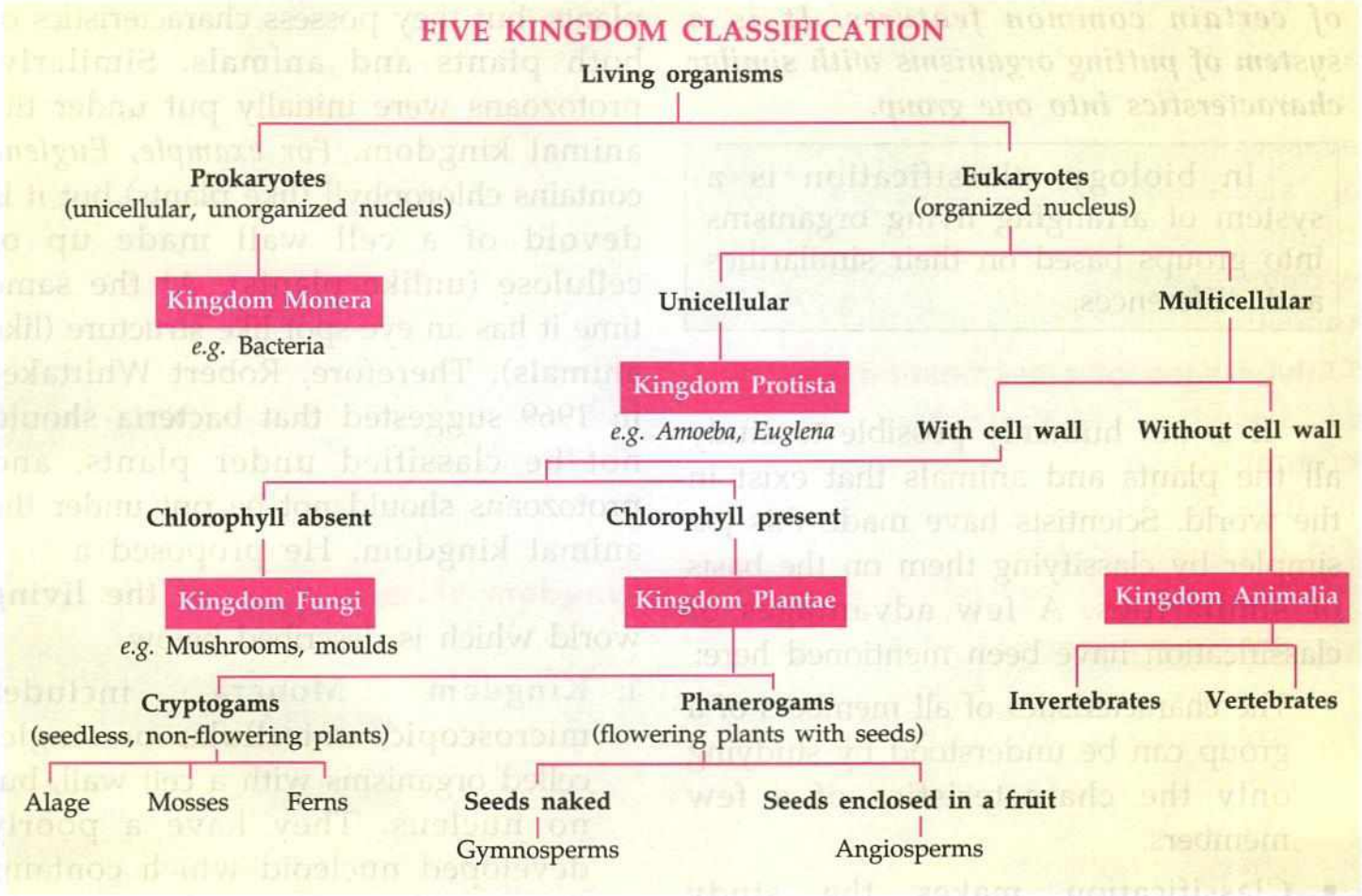
It is not humanly possible to study all the plants and animals that exist in the world. Scientists have made this job simpler by classifying them on the basis of similarities. A few advantages of classification have been mentioned here:

- The characteristics of all members of a group can be understood by studying only the characteristics of a few members.
- Classification makes the study systematic. It highlights the relationship between different organisms.
- It helps in identifying different organisms and placing them into particular groups.
- It also gives us an idea about the evolution of organisms from simpler to more complex forms.

CLASSIFICATION OF LIVING WORLD

Originally the living world was broadly classified into two main kingdoms — Kingdom Plantae (plants) and Kingdom Animalia (animals). But this classification presented certain anomalies. Bacteria in the original classification were classfied along with plants, but they possess characteristics of both plants and animals. Similarly, protozoans were initially put under the animal kingdom. *For example, Euglena* contains chlorophyll (like plants) but it is devoid of a cell wall made up of cellulose (unlike plants). At the same time it has an eye-spot like structure (like animals). Therefore, Robert Whittaker in 1969 suggested that bacteria should not be classified under plants, and protozoans should not be put under the animal kingdom. He proposed a **five kingdom classification** of the living world which is described below.

1. **Kingdom Monera** includes microscopic, unicellular or single-celled organisms with a cell wall, but no nucleus. They have a poorly developed nucleoid which contains the genetic material. *For example,* bacteria.
2. **Kingdom Protista** includes single-celled organims with a well-developed nucleus. *For example, Amoeba, Paramecium, Chlamydomonas, Euglena.*
3. **Kingdom Fungi** includes mostly multicellular or many-celled organisms. This group of organisms is characterised by the absence of chlorophyll. They can not synthesise their own food and depend on dead or decaying matter for their food. So, they are called saprotrophs. *For example,* mushrooms, yeasts, bread moulds.
4. **Kingdom Plantae** includes multicellular eukaryotes with cellulose



cell wall, and chlorophyll present in their cells. They are autotrophs and conduct photosynthesis.

5. **Kingdom Animalia** includes all multicellular animals with hetrotrophic mode of nutrition. They depend on plants or other animals for food. They possess a nervous system with sense organs and unlike plants, can move from one place to another.

Animals are classified into two groups, that is, invertebrates and vertebrates, based on the presence or absence of a backbone. Animals without a backbone are called **invertebrates**. Animals with backbone are called **vertebrates**. You will learn more about the classification of animals in the next chapter.

KINGDOM MONERA

This kingdom mainly contains bacteria. They are composed of a single cell but differ from other single-celled organisms because their nuclear material is not enclosed in a nuclear membrane but is organized in a region called a **nucleoid**. Since the nuclear membrane is absent, bacteria are called prokaryotes. Their cell-wall, although not made of cellulose, is a rigid structure. Many bacteria feed by absorption of externally digested food. Hence, they are called **heterotrophs**. Many others live on other living organisms and are called **parasites**.

Bacteria (*sing.* bacterium) (Fig. 2.1) are one of the smallest and structurally the simplest organisms. They are found everywhere — air, water and soil. They are also found in the bodies of humans, plants and animals. They can survive in extreme temperatures too. Bacteria, being unicellular organisms, are visible only under a high powered light microscope.

Based on the shape, there are four common forms of bacteria — coccus, bacillus, spirillum and vibrio.

(A) **Coccus** form (Gk. *kokkos* : a berry). These bacteria are spherical or ovoid in shape.

(B) **Bacillus** form (**bacillus** : rod). These are rod-shaped. These may also occur singly or in groups of two or three, joined end to end in long chains.

(C) **Spirillum** form. These are spiral-shaped.

(D) **Vibrio form.** These are comma-shaped. For example, *Vibrio cholerae* (responsible for causing cholera).

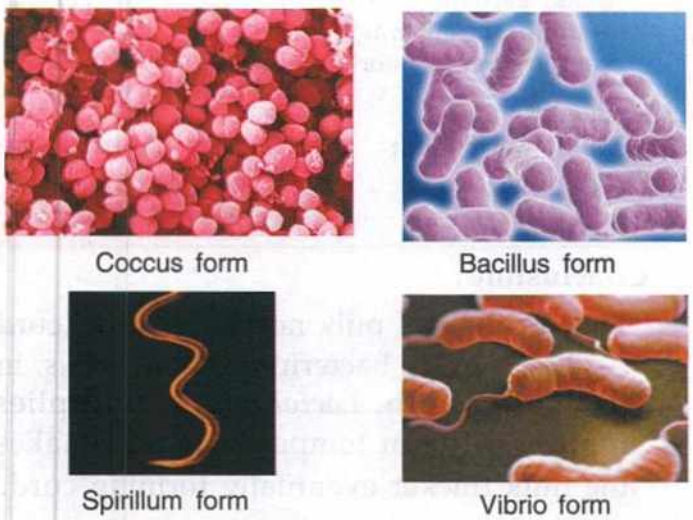


Fig. 2.1 Different shapes of bacteria

Structure of a Bacterium Cell

A bacterium cell has the most primitive nucleus not bound by nuclear membrane and has only chromatin material in the centre. Outermost cell wall is made up of largely protein-like material. The cell wall is surrounded by a gelatinous or proteinaceous **'capsule'**. Nucleolus, mitochondria and plastids are absent. **Reserve** food is 'glycogen' (Fig. 2.2).

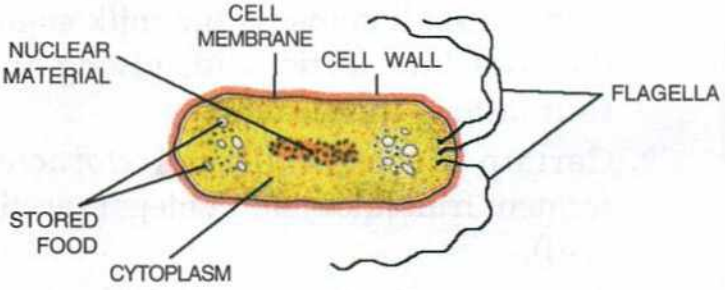
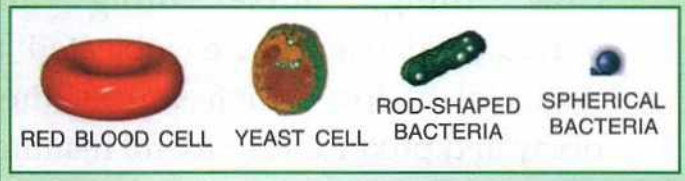


Fig. 2.2 Generalised diagram of a bacterium

How big are the bacteria ?

The sketches below compare the sizes of our red blood cell (extreme left), a yeast cell and two kinds of bacteria — a rod–shaped and a spherical (extreme right).



You know that red blood cells are microscopic, so compare its size with the bacteria given above.

USEFUL BACTERIA

1. **Medicines :** Antibiotics are medicines that can destroy disease causing germs in the body. Certain types of

bacteria are used in the manufacture of antibiotics such as Streptomycin to treat various human diseases. These antibiotics are used in treating many plant and animal diseases also. Killed or weakened disease-causing bacteria are used in the preparation of vaccines. Vaccines are used in preventing diseases such as polio, tuberculosis, small pox, etc.

2. ***Lactobacillus* bacteria** is used for curdling of milk (formation of curd from milk). It converts the milk sugar (lactose) into lactic acid, giving the sour taste to the curd.
3. Certain bacteria like *Acetobacter* ferment fruit juices into vinegar (acetic acid).
4. **Tanning of leather :** Certain bacteria are used in curing of animal hides and skin.
5. **Retting of fibres :** Jute fibres are separated and made softer by the use of bacteria.
6. **Formation of compost and manure :** Cow dung, horse dung and agricultural wastes are subjected to bacterial action which causes their decay and produce very useful manure.
7. **Biogas and "gobar gas" :** There are sewage plants in big cities (Delhi has one such unit) where the collected human excreta is decomposed by sewage bacteria. The inflammable gas produced in the process is collected for cooking, and the liquid and solid products are used as manure.

Activity 1

To study the conditions necessary for curdling of milk.

- Take three bowls, label them 'A', 'B' and 'C'.
- Pour some luke warm milk in bowl 'A', *add a spoonful curd* (starter) in it and stir it well. Put a suitable cover over it, and keep it in the lab *at room temperature.*
- Similarly, take bowl 'B', pour luke warm milk in it, *add starter*, cover it, and put it in a *refrigerator.*
- In the same way, take bowl 'C', pour lukewarm milk in it, but **do not add any starter**. Keep this bowl in the lab *at room temperature.*
- Leave all the three bowls for 4–5 hours. Open each bowl and give your observations in the table given below.

Observations :

Samples	Observations	Inference
1. Bowl 'A' (milk, starter and warmth)	.....	.....
	.....	.....
2. Bowl 'B' (milk, starter but no warmth, since it was kept in a refrigerator)	.....	.....
	.....	.....
3. Bowl 'C' (milk, warmth but no starter)	.....	.....
	.....	.....

Conclusion :

The curdling of milk needs a starter (curd — which has a bacterium, *Lactobacillus*, in it) and warmth. *Lactobacillus* multiplies rapidly at room temperature and makes the milk thicker eventually forming curd.

8. Some bacteria live in the large intestine of human beings (*E. coli*) and produce vitamins such as Vitamin B and K that are needed by the body.

9. Bacteria present in the intestines of herbivores, like cow and buffalo, help in the digestion of cellulose.

10. Certain types of the *Rhizobium* bacteria are found living in the root nodules (small swollen structures on roots) of leguminous plants like the pea, bean etc. These bacteria trap the nitrogen from the atmosphere and convert it into nitrates (mineral salts) which can be easily absorbed by the plants from the soil along with the water. It is observed here that the bacteria provide food to the host plant and the host plant in turn provides shelter to the bacteria. This kind of relationship wherein two organisms live in harmony, each benefitting from such a relationship is called **symbiosis**. The organisms are called **symbionts**.

Fig. 2.3 Roots of leguminous plants showing root nodules

11. Certain bacteria which are saprophytic, feed on dead organic remains. They act like scavengers, help in converting complex food material into agriculturally useful nutrients like nitrates, sulphates and phosphates. This way they increase the soil fertility, e.g. nitrifying bacteria.

HARMFUL BACTERIA

1. **Spoilage of food.** Food items such as milk, meat, fish and vegetables get spoiled quickly due to the presence of bacteria. Tinned and packaged foods should not be consumed after their expiry date as it can be infected by bacteria.

2. **Diseases.** Bacteria are responsible for a number of diseases, some of which are typhoid, leprosy, TB, pneumonia, cholera, etc.

Table 2.1 Some disease-causing bacteria

Sl. No.	Name of disease	Name of disease causing bacteria
1.	Typhoid	*Salmonella typhi*
2.	Tuberculosis (TB)	*Mycobacterium tuberculosis*
3.	Pneumonia	*Streptococcus pneumoniae.*
4.	Cholera	*Vibrio cholerae*
5.	Diphtheria	*Corynebacterium diphtheriae*

KINGDOM PROTISTA

This kingdom also consists of unicellular organisms. The nucleus here is bound by a nuclear membrane and

hence, the organisms are called as eukaryotes. Some are animal-like since they do not make their own food. Example, *Amoeba* and *Paramecium*. Some are plant-like since they have one or more chloroplasts and can make their own food using solar energy. Example, *Euglena* and diatoms.

Amoeba is one of the simplest animals. It is made up of just one single cell. Being so small, it can be seen only under a microscope.

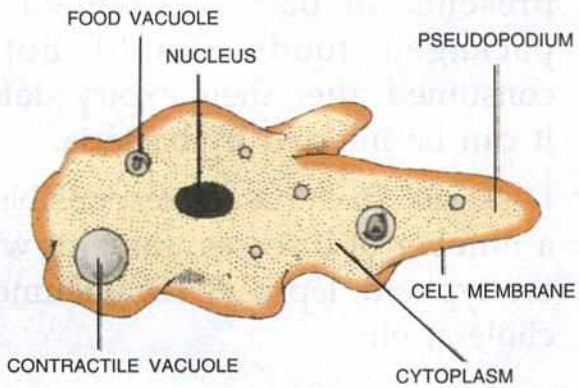


Fig. 2.4 Amoeba

Amoeba is found in ponds, ditches and other places with stagnating water. When seen under the microscope, it looks like as shown in the Fig. 2.4.

The body of *Amoeba* is irregular in shape. The outer covering of the body is the **cell membrane**. A prominent **nucleus** lies in the centre surrounded by **cytoplasm**.

HOW AN AMOEBA MOVES

The organ of locomotion in an *amoeba* is the pseudopodium (meaning false foot, plural : pseudopodia). It is a finger-like projection formed temporarily by the extension of cytoplasm along with the cell membrane in a particular direction. Many pseudopodia may be seen projecting out from the body of an amoeba at a time. But only one of them extends longer than the others towards the direction it wants to move in. This type of movement is often termed as the "amoeboid movement".

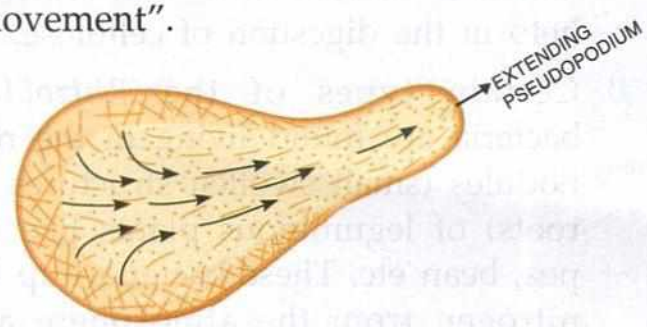


Fig. 2.5 Movement of an Amoeba

Movement of *amoeba* by extending a pseudopodium, is shown in Fig. 2.5.

HOW AN AMOEBA FEEDS

When the amoeba senses food in its immediate surroundings, it quickly puts out its pseudopodia and moves towards it. On reaching the food particle, it extends two of its pseudopodia and surrounds the food particle. The tips of the two pseudopodia fuse together to form a small space with the food inside it. A **food vacuole** is thus formed (Fig. 2.6).

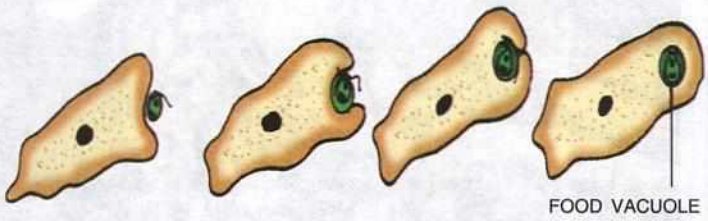


Fig. 2.6 Amoeba : Formation of a food vacuole

The cytoplasm secretes digestive juices into the food vacuole. These act on

the food and help in breaking it down into a simple soluble form. This soluble food is absorbed into the cytoplasm, where it is stored or utilized for growth and release of energy.

The undigested food is expelled from the body through the cell membrane. Digestion occurs only inside a food vacuole to prevent the digestive juices mixing with the cytoplasm.

HOW AN AMOEBA "EXCRETES"

Ammonia is the main waste product that is formed in the body of an amoeba.

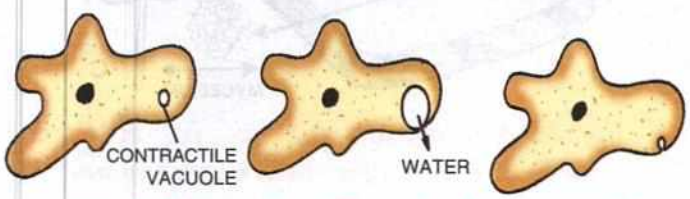


Fig. 2.7 Amoeba : Excreting by means of contractile vacuole

This is eliminated from the body through the general body surface by the simple process of diffusion.

Excess of water from the body of the amoeba is collected in the contractile vacuole. Ammonia is soluble in water. Hence, sometimes ammonia is expelled out along with the water from the **contractile vacuole**.

The contractile vacuole expands when there is water in it and shrinks when the water is released into the surrounding.

The nitrogenous wastes are also given out directly through the **cell surface** (Fig. 2.7).

HOW AN AMOEBA RESPIRES

In amoeba, exchange of gases occurs through the **cell membrane**. Oxygen from the surrounding water diffuses into the cytoplasm and carbon dioxide from the body of the amoeba diffuses out into the surrounding water.

HOW AN AMOEBA REPRODUCES

Amoeba reproduces by splitting into two. In a full-grown *Amoeba*, first the nucleus divides into two, and then the rest of the cell divides in a way that each half gets one daughter nucleus. This process is called **binary fission** (*binary* = two; *fission* = division). The two daughter amoebae live independently, grow to full size and divide again (Fig. 2.8).

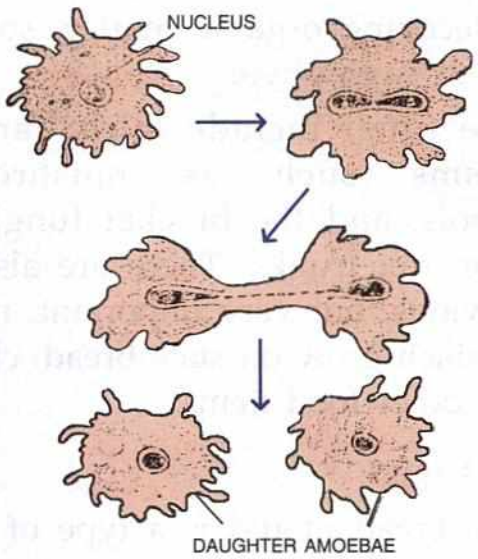


Fig. 2.8 Amoeba reproducing by binary fission

Sometimes, when the environmental conditions are unfavourable, ponds go dry, or it is too cold or too hot, *Amoeba* withdraws its pseudopodia and turns into a small rounded speck. At this time, the amoeba secretes a thick wall around itself, and is now called a cyst. Reproduction occurs in the cyst by

multiple fission. Inside this cyst, the nucleus divides several times to form many daughter nuclei. Each daughter nucleus is surrounded by some cytoplasm to form amoebulae. When favourable conditions return, the cyst breaks open to release the amoebulae. Each amoebula then develops into a young amoeba.

KINGDOM FUNGI

The fungi may be unicellular (e.g. *Yeast*), multicellular or filamentous. Their nuclei are distributed throughout the cytoplasm. Since, they do not have chlorophyll, as such they can not prepare their own food. They mostly live on dead decaying organic matter, so they are called **saprophytes**.

The fungi include fairly familiar organisms such as mushrooms, toadstools, and the bracket fungi that grow on tree-trunks. There are also the less obvious, but very important, mould fungi which grow on stale bread, cheese, fruit or other food items.

Bread Mould

The bread mould is a type of fungi commonly seen growing on stale bread. Its body is made of thread like structures called **hyphae** (*sing* : hypha). A network of hyphae is called **mycelium**. Mature, erect structures bearing rounded bodies at its tip start developing from the hyphae. The erect hyphae are called the **sporangiophores** and the rounded bodies are the **sporangium**. These are the spore containing bodies. When the sporangium bursts open, the spores are dispersed int the air. When they land on a suitabl substratum, each can grow to form new mycelium (Fig. 2.9).

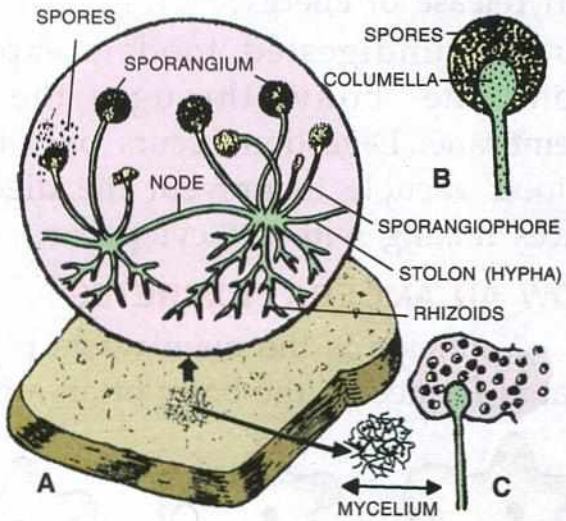


Fig. 2.9 A — Bread mould growing on bread, B — Structure of a mature sporangium, C — A sporangium bursting to release spores

Respiration in the bread mould mainly aerobic. They respire in th presence of oxygen, that is why they ar seen growing on the top layer of th bread, and not in the lower layer.

Saprophytic mode of **nutrition** i seen in the bread mould. Saprophyte obtain their nourishment from dead an decaying organic matter.

The hyphae of the bread moul secrete digestive juices into the bread These enzymes convert the starch presen in the bread into a simple sugar glucose. This is then absorbed through th body surface and stored as glycogen Thus we see that digestion occur outside the body of the mould and th nutrients are absorbed directly into th hyphae.

Activity 2

Take a few slices of bread and moisten them by sprinkling some water. Keep them for 2-3 days in open and observe. You will see bluish fur-like outgrowth on these bread pieces. This is a fungus called *Rhizopus*, commonly known as bread mould.

Useful Fungi :

1. Fungi are an important source of food. Some mushrooms such as *Morchella* and *Agaricus* are edible.
2. Yeast, a unicellular fungus, is important in bakeries as it is used in the making of bread. It is also important in the breweries for making alcohol.
3. Yeast also produces vitamin B.
4. Fungi, like bacteria, are also good decomposers. They decompose dead organic matter and return the nutrients back into the soil.
5. Penicillin an important antibiotic is obtained from a fungus called *Penicillium notatum*.
6. Some species of *Mucor* and *Penicillium* are used in the ripening of cheese.

Harmful fungi :

1. Some moulds are responsible for the spoilage of food, leather goods and textiles.
2. Many of the crops are susceptible to fungal attacks. This causes huge losses to farmers.
3. Fungi cause serious skin and lung infection in human beings. Athlete's foot and ringworm are some common fungal infections that are seen in humans.

KINGDOM PLANTAE

It is the second largest kingdom of organisms after the animal kingdom. There are over 250,000 species that make up this kingdom. The constituent organisms of this kingdom are multicellular and eukaryotic. They are characterized by the presence of a green pigment called chlorophyll. Because of this pigment, plants are capable of producing their own food via photosynthesis. Hence, plants are autotrophic organisms which provide food and oxygen to other living organisms for their survial. Life on earth, in other words, is possible because of plants. The plant kingdom can further be divided into algae, mosses, ferns and flowering plants.

Algae (sing. Alga) : Algae are aquatic in habitat. These may be unicellular or multicellular. They are usually green, having chlorophyll. e.g. *Spirogyra* (Fig. 2.10). Some algae, however, have colours like red and brown also.

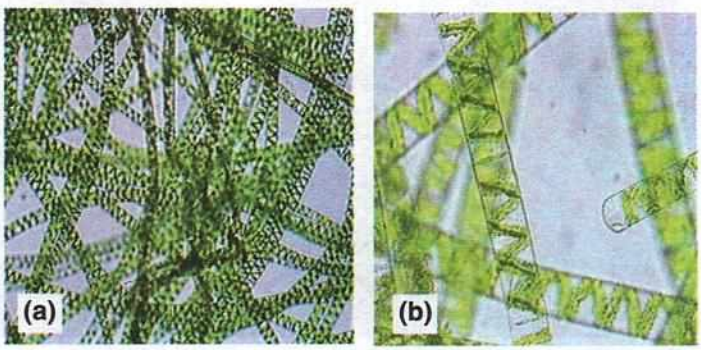


Fig. 2.10 (a) Spirogyra filaments
(b) A single filament as seen under a microscope

Table 2.2 : Differences betwen algae and fungi.

Algae	Fungi
1. Chlorophyll present.	1. Chlorophyll absent.
2. Photosynthetic organisms synthesizing their own food.	2. Heterotrophic organisms usually living on dead and decaying organic matter and are called saprotrophs.
3. Are mostly aquatic, found in fresh as well as marine water.	3. Are mostly terrestrial *i.e.* growing on land.
4. Body not differentiated into root, stem and leaves, and is known as a thallus. Example : *Spirogyra, Ulothrix,* etc.	4. Body is composed of thread-like structures called hyphae, and is known as a mycelium. Example : *Aguricus, Penicillium,* etc.

Mosses (Bryophyta) (Fig. 2.11)

Mosses grow as green, velvety layers in moist places such as damp soil, on the bark of trees, and on damp walls. These plants have stems and leaves, but no roots. Instead, they have thread–like structures called *rhizoids* which stick to the surface and absorb water. They are also called **'amphibians of the plant group'** as they need water to reproduce

Fig. 2.11 Moss

Ferns (Pteridophyta) (Fig. 2.12)

Ferns are grown in most of th gardens for their beautiful leaves. The bear well-formed leaves, stems and root but do not produce flowers and see

Fig. 2.12 Fern

Their leaves produce small rounded bodies on their undersurface. These bodies contain tiny **spores** which get scattered to produce new plants.

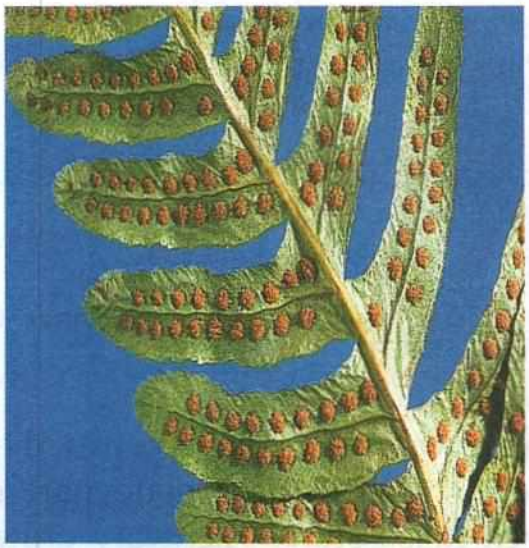


Fig. 2.13 A single leaf of a fern showing the spore-containing bodies on its lower surface

FLOWERING PLANTS [PHANEROGAMS]

The flowering plants are further grouped into two categories :

(i) Gymnosperms (ii) Angiosperms

Fig. 2.14 Pine cones

Gymnosperms

The group of plants that bear seeds but no fruits are called **gymnosperms**. Their seeds are thin and naked, not enclosed in fruits (*gymno* means naked; *sperm* means seed).

Most gymnosperms are evergreen *i.e.* they do not shed all their leaves at one time. Some examples are pine, fir, cedar (Fig. 2.14) and spruce trees that grow in mountainous areas. Pine and fir

Pine

Fir

Cedar

Fig. 2.15 Some gymnosperms

Table 2.3 : Differences between gymnosperms and angiosperms.

Gymnosperms	Angiosperms
1. Are mostly woody trees.	1. Can be herbs, shrubs and trees.
2. Flowers and fruits are absent.	2. Flowers and fruits are present.
3. Bear naked seeds which are not enclosed in a fruit.	3. Bear seeds enclosed in a fruit.
4. Reproductive structures are unisexual cones (male or female) that bear the seeds. *Example : Pine, cedar,* etc.	4. Reproductive structures are unisexual or bisexual flowers. *Example :* Grass sugarcane, mango tree, etc.

are usually big trees. They do not bear true flowers, but they bear seeds inside the **cones** (Fig. 2.14). Some cones are male while others are female.

Angiosperms

The group of plants which bear flowers, fruits and seeds are known as **angiosperms** (*"angios"* means 'case' referring to the fruit, and *"sperm"* means 'seed'). Their seeds are enclosed in a fruit. Some common examples are cashewnut, mango, peas, etc. In angiosperms, the seeds develop within the female part of the flower, called *ovary*. The ovary grows into a *fruit* containing the seeds inside.

Sugarcane

Mint

Fig. 2.16 Examples of some angiosperms

Types of Angiosperms

Angiosperms are characterised by the presence of "seed-leaves" or cotyledons that store food and form the bulk of the seed (Fig. 2.17). On the basis of their number, angiosperms are divided into the following two categories :

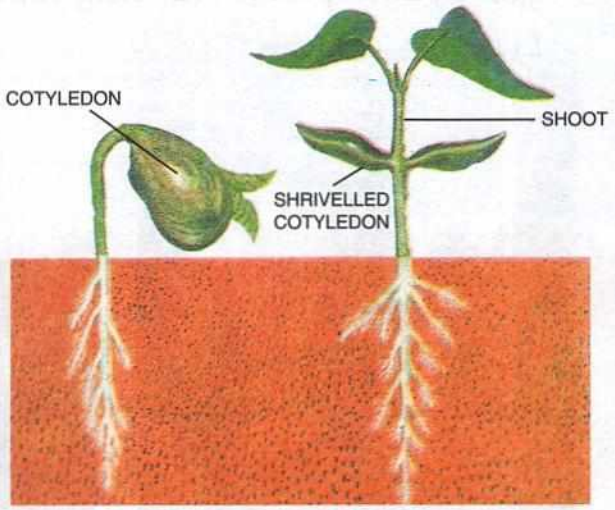


Fig. 2.17 Two cotyledons in pea seed

(1) **Monocotyledons :** Plants containing only one cotyledon or one seed leaf in their seeds. ***Examples :*** rice, grass, maize, etc. (Fig. 2.18).

Fig. 2.18 Maize : a monocotyledon plant

(2) **Dicotyledons :** Plants containing two cotyledons or two seed leaves in their seeds. ***Examples :*** rose, balsam, mango, sunflower, pea, brinjal, etc. (Fig. 2.19).

Fig. 2.19 Brinjal : a dicotyledon plant

Table 2.4 : Differences between monoctyledonous and dicotyledonous plants.

Monocotyledonous plant	Dicotyledonous plant
1. Seeds have a single cotyledon.	1. Seeds contain two cotyledons.
2. Leaves have parallel venation.	2. Leaves with reticulate venation.
3. Fibrous root system is present.	3. Tap root system is present.
4. Stem usually hollow.	4. Stem mostly solid.
Example : Rice, grass, etc.	Example : Pea, rose, etc.

Activity 3

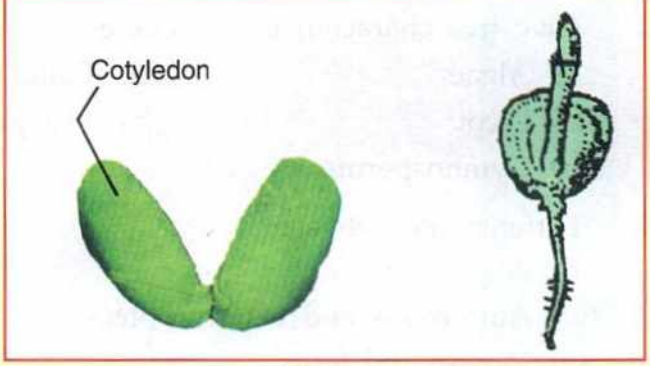
To compare a monocot and dicot seed.

Take a few gram and maize seeds. Soak them in water for about 5-6 hours. Take out a swollen seed of both gram and maize and gently remove their seed coats.

You will see two parts in the gram seed. Each part of the seed is called cotyledon. In maize seed, you will see only one cotyledon. Can you tell which seed among them is monocotyledon and which is dicotyledon ?

Monocot : .....

Dicot : .....



Cotyledons of gram and maize seeds

REVIEW QUESTIONS

MULTIPLE CHOICE QUESTIONS

1. Tick (√) the appropriate answer :

   (i) The two main categories of plants recognised on the basis of whether they produce fruits or not are :

   (a) Biennials and annuals ☐ *(b)* Angiosperms and gymnosperms ☐

   (c) Herbs and shrubs ☐ *(d)* Bryophyta and pteridophyta ☐

   (ii) Unicellular organisms with a proper nucleus are included in the group :

   (a) Protista ☐ *(b)* Monera ☐

   (c) Fungi ☐ *(d)* Algae ☐

   (iii) Amoeba belongs to :

   (a) Monera ☐ *(b)* Protista ☐

   (c) Fungi ☐ *(d)* Algae ☐

SHORT ANSWER QUESTIONS

1. Name the categories of the following :

   (i) Plants which do not have roots, stems, and leaves : .....

   (ii) Plants with no roots, but have stems and leaves : .....

   (iii) Plants with roots, stems, and leaves, and which bear spore-producing bodies : .....

   (iv) The amphibians of the plant kingdom .....

2. Give *two* characterists and one example for each of the following :

   (i) Algae *(ii)* Fungi *(iii)* Monocot

   (iv) Dicot *(v)* Bryophyta *(vi)* Pteridophyta

   (vii) Gymnosperms

3. Differentiate between :

   (i) Algae and fungi. *(ii)* Monocot and dicot plants.

   (iii) Autotrophs and heterotrophs. *(iv)* Bacteria and amoeba.

   (v) Mosses and ferns. *(vi)* Angiosperms and gymnosperms.

4. Match the items given under **column I** with those given under **column II** :

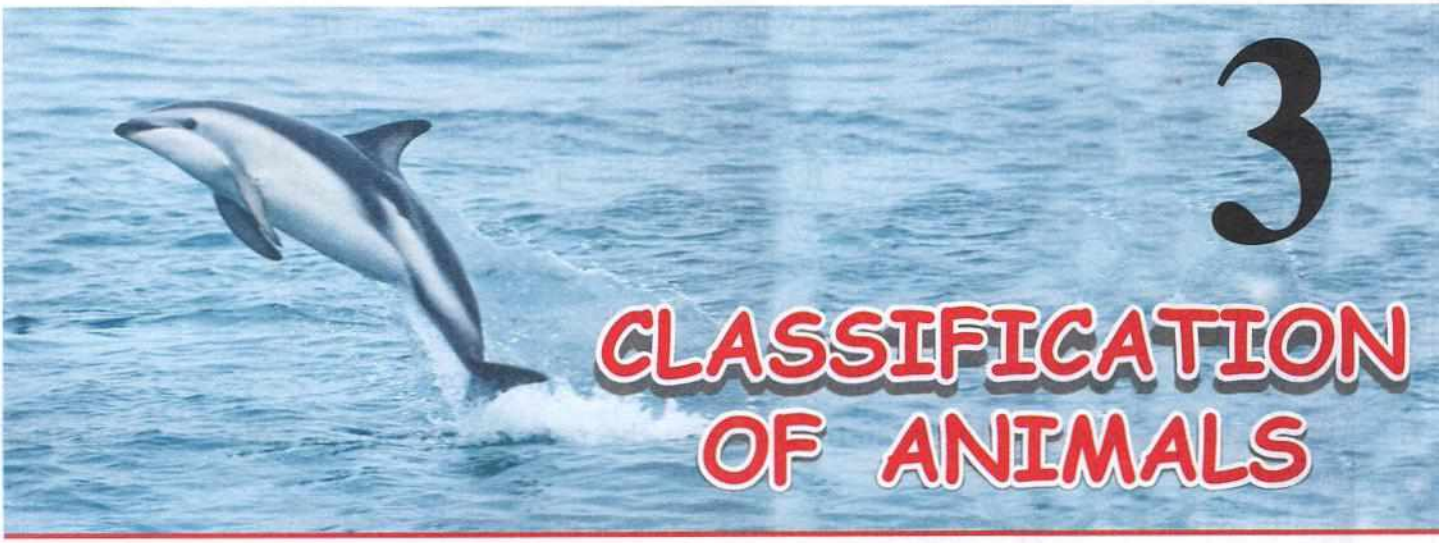
Column I	Column II
(i) Bread mould	*(a)* Has chlorophyll
(ii) *Spirogyra*	*(b)* Leaves with spores
(iii) Moss	*(c)* Naked seeds
(iv) Fern	*(d)* Saprophyte
(v) Gymnosperm	*(e)* Has rhizoids

LONG ANSWER QUESTIONS (Write the answers in your note book)

1. What name is given to the bacteria found in the root nodules of pea plants ? State their importance.
2. Briefly explain *four* types of bacteria on the basis of their shape.
3. Give reasons for the following :
   (i) Bryophytes are called amphibians of plant kingdom.
   (ii) Amoeba does not have any regular shape.
4. What is a contractile vacoule ? State its function in amoeba.
5. List out *five* uses each of bacteria and fungi in our lives.
6. "Bacteria are harmful to human beings." Briefly explain this statement.
7. With reference to number of seeds, venation in the leaves and type of roots, differentiate between monocotyledonous and dicotyledonous plants.
8. Briefly describe the binary fission in *Amoeba*.

PROJECT

Collect a small monocotyledonous plant and a dicotyledonous plant. Dry each of them by pressing in between folds of a newspaper. Observe and record the differences in their structures.



3 CLASSIFICATION OF ANIMALS

SYLLABUS

Animalia

- Invertebrates: 8 major phyla : Porifera, Cnidaria (Coelenterata), Platyhelminthes, Nematoda, Annelida, Arthropoda, Mollusca, Echinodermata (Two characteristics and two examples of each phylum).
- Vertebrates : 5 classes : Pisces, Amphibia, Reptilia, Aves and Mammalia (with their characteristics and examples).

There are thousands and thousands of different kinds of animals found on earth. These animals live in different environments and places. They are of various shapes and sizes. Their sizes range from the tiny ant to giant-sized elephants, whales and sharks.

Although different animals have unique features yet they show certain common features as well. *For example,* animals cannot prepare their food by themselves and they feed either on plants or on other animals for nutrition. They are **heterotrophic** in nature.

Most animals move from one place to another mainly in search of food or shelter. Such a movement is called **locomotion**.

Depending on the presence o absence of backbone, animals are broadly classified into two categories :

(A) Invertebrates

(B) Vertebrates

A. INVERTEBRATES (*Animals without backbone*)

The animals that do not have a bac bone are called invertebrates. Based on their different characteristics, th invertebrates are further divided int eight groups (phyla).

(i) Porifera (*Pore-bearing animals*)

- Mostly found in sea, very few occ in fresh water.

- Fixed to some object or to the bottom of the pond or ocean.
- Body is porous, *i.e.* bear many tiny pores to draw water into the body cavity, and one large pore to pass it out.

Common example : Sponge (Fig. 3.1).

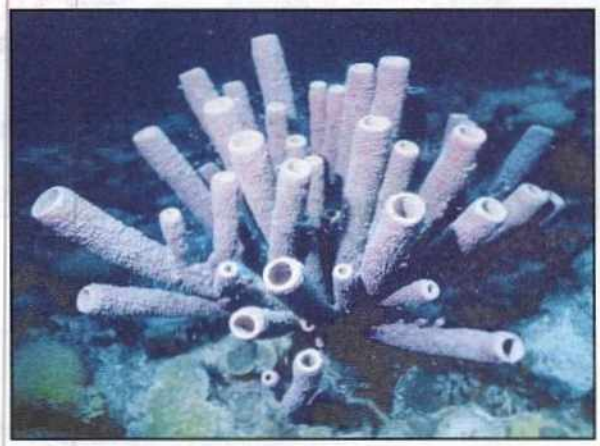
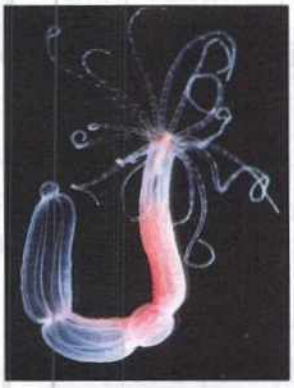


Fig. 3.1 Sponge

(ii) Cnidaria or Coelenterata (*Hollow sac-like animals*)

- Aquatic animals.
- Sac-like body with only one opening *i.e.* mouth.
- Mouth surrounded by finger-like projections called tentacles for catching food and swimming.



HYDRA

SEA ANEMONE

Fig. 3.2 Two coelenterates

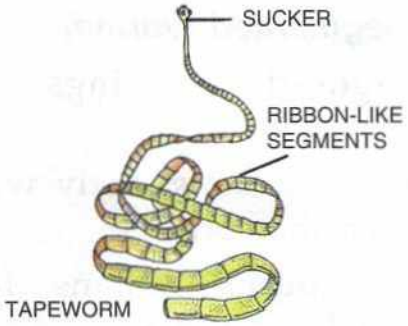
- The body is radially symmetrical, that is, the body can be divided into two identical halves along any plane.

Common examples : Jellyfish, hydra, sea-anemone (Fig. 3.2).

(iii) Platyhelminthes (*Flatworms*)

- Body thin and flattened.
- Mostly live as parasites in the bodies of other animals (hosts).

Common example : Tapeworm and liver fluke (Fig. 3.3).



LIVER FLUKE

Fig. 3.3 Two flatworms

The tapeworm occurs in the human intestine and may gain a length of about six metres. It looks like a long ribbon with a small head-like part at the front. It absorbs the already digested food from the human intestine.

(iv) Nematoda (*Roundworms*)

- Body is rounded and unsegmented.
- Except for a few, most of them are minute organisms.
- Mostly live as parasites in the body of animals including humans.

Common examples : The roundworm in humans (*Ascaris*) (Fig. 3.4) lives in the small intestine of humans, commonly in children who eat with unwashed hands or eat unwashed fruits and vegetables.

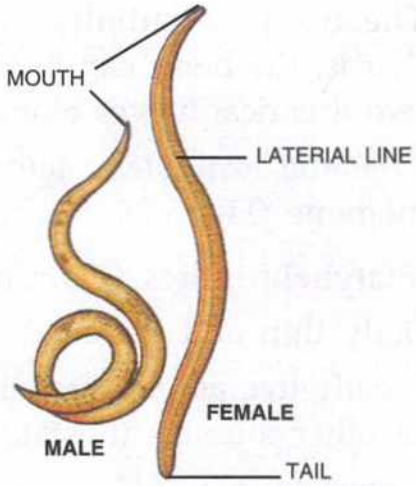


Fig. 3.4 Ascaris (roundworm in humans)

(v) Annelida (*Segmented worms*)

- Body composed of rings or segments.
- They have a soft, moist body wall through which they breathe.
- They have special organs for excretion called **nephridia**.

Common examples : Earthworm, leech (Fig. 3.5).

Fig. 3.5 Some annelids

(vi) Arthropoda (*Animals with jointed legs*) (Fig. 3.6)

- Body is divided into three regions– head, thorax and abdomen. In most cases, the body is covered by a tough covering of chitin.
- Body has jointed legs.

Fig. 3.6 Arthropods

They are further divided into four classes.

(a) Crustacea – Head and thorax (middle part) are fused, have many jointed legs. Mainly live in water.

Examples – Crab, shrimps, lobsters, prawn, etc.

(b) Myriapoda – Body is divided into many segments, one or two pairs of legs on each segment.

Common examples – Centipede, millipede.

(c) Insecta – Body is divided into three regions – head, thorax and abdomen.

- Have three pairs of jointed legs.
- Head bears a pair of antennae or feelers and mouth parts.

Common examples – Ant, housefly, butterfly.

(d) Arachnida – Head and thorax fused.

- Have four pairs of jointed legs.
- Have no antennae.

Common examples – Spider, ticks, scorpion.

(vii) Mollusca (*Soft-bodied shelled animals*)

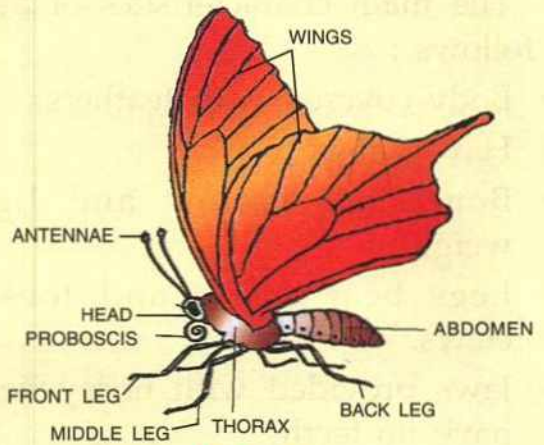
- Soft body which is not segmented.
- Body enclosed in a hard shell.
- Move with the help of a muscular foot.

Common examples : Snail, slug, pearl oyster, octopus (Fig. 3.7).

Fig. 3.7 Octopus

Activity 1

Ask your teacher to place before you the preserved specimens of some common animals. Observe these animals and identify them. Note their important features and draw them in your Practical Note Book. A diagram of a butterfly is given here for your guidance. Draw, identify and label the body parts of other animals in the same manner.

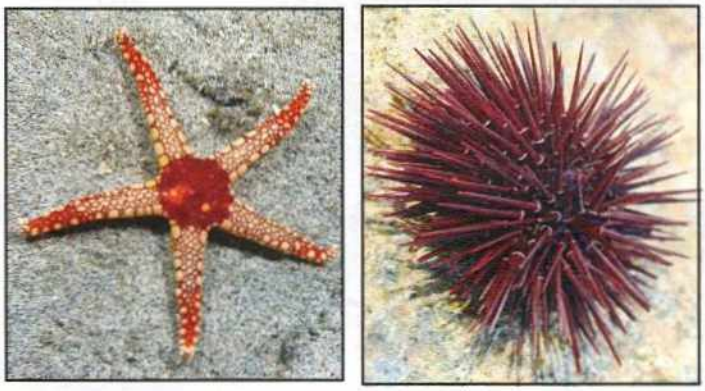


Butterfly

(viii) Echinodermata (*Spiny-skinned animals*)

- Body is rough and spiny.
- Mainly marine.
- Move with the help of tube feet.
- Radially symmetrical bodies.

Common examples : Starfish, sea urchin (Fig. 3.8).



STARFISH SEA URCHIN

Fig. 3.8 Some echinodermata

B. VERTEBRATES (or Phylum Chordata)

Animals with a backbone (vertebral column) are called vertebrates. They are classified into five groups (classes) :

(i) Class PISCES (*Fishes*)

The main features/characteristics of pisces are as follows :

- Aquatic animals with a streamlined body (narrow at both ends).
- Swim with the help of fins.
- Body covered with scales.
- Breathe through gills.

Common examples : Almost all fishes (Fig. 3.9) and to name a few — Rohu, Catla, Mahasheer, Electric ray fish, Dogfish.

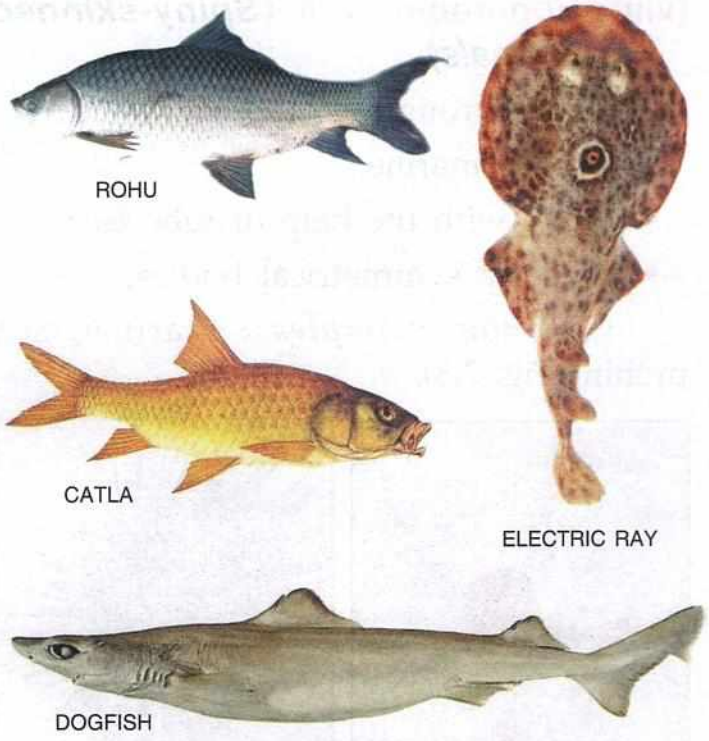


Fig. 3.9 Some fishes

(ii) Class AMPHIBIA (*Frogs and Toads*)

The main characteristics of amphibians are as follows :

- Can live in water as well as on land.
- Lay their eggs in water.
- Body covered by a slimy and slippery skin.
- Breathe through lungs and skin.

Common examples : Frog and toad (Fig. 3.10 and 3.11).

Fig. 3.10 Frog

Fig. 3.11 Toad

(iii) Class REPTILIA (*Lizards and Snakes*)

The main characteristics of reptiles are as follows :

- Mostly live on land. Some live in water too.
- Skin is dry and scaly.
- Breathe through lungs.
- Females lay soft shelled eggs on land.
- Have four short legs for crawling on land.

Common examples : Lizards, snakes, etc. Turtles, tortoises, crocodiles, etc. live in water (Fig. 3.12).

Fig. 3.12 Some reptiles

(iv) Class AVES (*Birds*)

The main characteristics of aves are as follows :

- Body covered with feathers.
- Have wings to fly.
- Bones are hollow and light in weight.
- Legs bear scales and toes have claws.
- Jaws provided with horny beak but have no teeth.
- Females lay hard-shelled eggs.

Common examples : Peacock, parrot, pigeon, bulbul, sparrow, etc.

BULBUL

SPARROW

Fig. 3.13 Two common birds

However, there are some birds that cannot fly such as ostrich (largest bird), penguin, kiwi, etc.

(v) Class MAMMALIA (*Milk-nourishing animals*)

The main characteristics of mammals are as follows :

- Body covered with hair.
- Possess projecting external ears.
- Give birth to young ones (babies).
- Young ones suckle milk from mammary glands present in mothers.

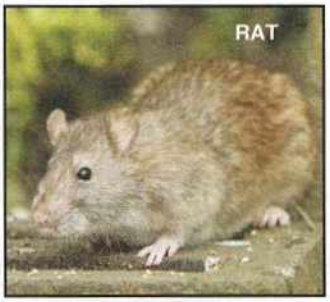


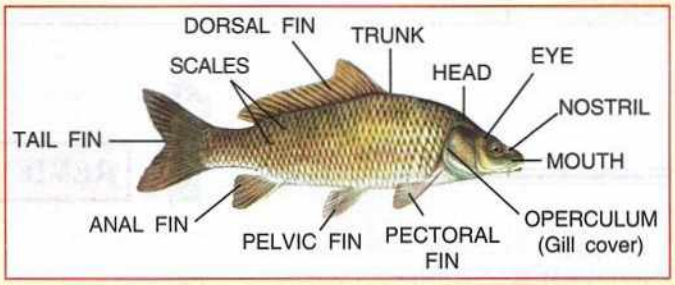
Fig. 3.14 Some mammals

- Usually, have a tail (except humans) and four limbs.

Common examples : Cow, dog, deer, camel, lion, tiger, elephant, rat, and humans (Fig. 3.14).

Activity 2

Ask your teacher to place before you a preserved specimen of a fish. Observe the fish and note its important features. Draw the diagram of the fish in your Practical Note Book, and label its various parts. While labelling the parts, you can take the help of the figure given below.



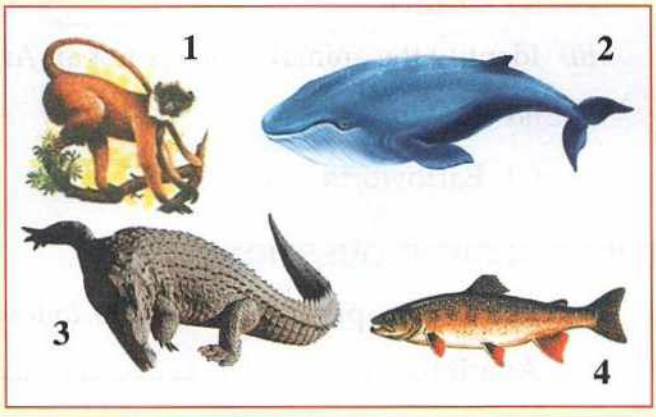
Activity 3

Look at the four animals shown below.

Which four classes of vertebrates are represented by them ? Name these classes.

1. _____ 2. _____

3. _____ 4. _____



CLASSIFICATION OF INVERTEBRATES AND VERTBRATES AT A GLANCE

		Category	Common Examples
ANIMAL KINGDOM	INVERTEBRATES (animals without a backbone)	1. Animals with pores for water intake (Poriferans).	Sponges
		2. Hollow sac-like animals (Cnidarians or Coelenterates).	Hydra
		3. Flatworms (Platyhelminthes).	Tapeworm, liverfluke
		4. Round (cylindrical) worms (Nematodes).	*Ascaris*
		5. Segmented worms (Annelids).	Earthworm, leech
		6. Soft-bodied shelled animals (Molluscs).	Snail, slug
		7. Animals with jointed legs (Arthropods).	Ant, bees, prawn, butterfly, scorpion, millipede, centipede
		8. Spiny skinned animals (Echinoderms).	Starfish
	VERTEBRATES (animals with a backbone)	CLASSES	
		Fishes : Body covered with scales, fins for swimming.	Rohu, catla, mahasheer
		Amphibians : Can live in water as well as on land, but must go to water for laying eggs.	Frog, toad
		Reptiles : Mostly land vertebrates with dry and scaly skin.	Lizard, snake
		Birds : Body covered with feathers and wings for flying.	Pigeon, parrot, peacock, crow
		Mammals : Body covered with hair and their young ones suckle milk from the mother.	Cow, rat, cat, elephant, camel, lion, tiger, Man

REVIEW QUESTIONS

MULTIPLE CHOICE QUESTIONS

1. Tick (√) the appropriate answer :

(i) Identify the aquatic animal with scaly skin which breathe with gills —

(a) Rohu ☐ *(b)* Tortoise ☐

(c) Sparrow ☐ *(d)* Rat ☐

(ii) Identify the bird which cannot fly —

(a) Peacock ☐ *(b)* House sparrow ☐

(c) Ostrich ☐ *(d)* Penguin ☐

(iii) Identify the animal which is not an Arthropod —

(a) Prawn ☐ *(b)* Butterfly ☐

(c) Earthworm ☐ *(d)* Spider ☐

SHORT ANSWER QUESTIONS

1. Give *two* examples of each of the following :

(i) Amphibians : ....

(ii) Segmented worms : ....

(iii) Reptiles : ....

(iv) Coelenterates : ....

(v) Arthropods : ....

(vi) Flatworms : ....

2. Give names of *two* animals which are found as parasites inside the human intestine.

.....

3. Name *one* example each of an animal which shows the following characteristics :

(i) Fixed animals with a pore-bearing body : .....

(ii) Star-shaped body : .....

(iii) Can live in water as well as on land : .....

(iv) Has a flattened ribbon-like body : .....

4. Write *one* difference each between the following pairs :

(i) Porifera and Coelenterata.

(ii) Arthropoda and Mollusca.

(iii) Invertebrates and Vertebrates.

(iv) Platyhelminthes and Nematoda.

5. Match the animals given under **column A** with their respective classification group given under **column B** :

Column A	Column B
(i) Sponge	(a) Amphibia
(ii) Snail	(b) Reptilia
(iii) Butterfly	(c) Echinodermata
(iv) Toad	(d) Mollusca
(v) Lizard	(e) Arthropoda
(vi) Starfish	(f) Porifera

6. Write the characteristics of class Aves with reference to their body covering and jaws.

7. Categorise the following animals under their appropriate columns of classfication :

ANIMALS :

Dog	Grasshopper	Rat	Scorpion	Toad
Butterfly	Lizard	Turtle	Frog	Bat
Snail	Honey bee	Pigeon	Liverfluke	Leech
Cattle	Snake	Rohu	Parrot	Ascaris
Earthworm	Cow	Rabbit	Monkey	Elephant

CLASSIFICATION :

WORMS	MOLLUSCS	FISHES	AMPHIBIANS	REPTILES	BIRDS	MAMMALS
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....

8. Give *three* characteristic features of Amphibians which help to differentiate them from fishes.
9. Why fishes are said to have a streamlined body ? Name their respiratory organs.
10. Why Arthropods have been given this name ? Name the *four* classes of phylum Arthropods giving *one* example each of the *four* classes.
11. Give *two* characteristic features of birds which enable them to fly. Name any *two* birds which cannot fly.
12. Differentiate between flatworms and roundworms.
13. Animals cannot prepare their own food. What scientific name is given to such organisms.

PROJECT

Collect pictures of some common animals and plants from various sources. Display them on the "Display Board" of your school. Write the name of each animal and plant below it. Similarly, paste pictures of different plants and animals in your note book and write not only the names of each below them, but also their characteristics alongwith other examples of the same kind.

UNIT : 2
Plant Life

4

PHOTOSYNTHESIS AND RESPIRATION

SYLLABUS

Photosynthesis :

- Definition, basic process, factors affecting photosynthesis: (light, carbon dioxide, water, chlorophyll), significance of photosynthesis, setup.
- Experiment to demonstrate photosynthesis process.

Respiration :

- Basic process, word equation; respiration as a process which releases energy; respiration in plants; two types (aerobic and anaerobic: basic concept, word equations for both, examples)
- Respiration and photosynthesis in plants, differences in both processes.

All organisms need food for growth and energy. Green plants can prepare their own food, hence they are called **autotrophs** (*auto* = self; *trophs* = nourishment), and this type of nutrition is known as **autotrophic nutrition**.

These plants first form simple soluble carbohydrates (glucose), and later, form complex insoluble carbohydrates (starch) in the presence of sunlight and chlorophyll, with the help of water and carbon dioxide. As this process is carried out in the presence of sunlight, it is known as **photosynthesis**.

Therefore, photosynthesis is the process by which green plants capture solar energy and use it to convert carbon dioxide and water into simple sugars.

For preparing food, the plants require the following :

1. Water (from soil).
2. Carbon dioxide (from air).
3. Chlorophyll (contained in the leaf).
4. Energy (from sunlight).

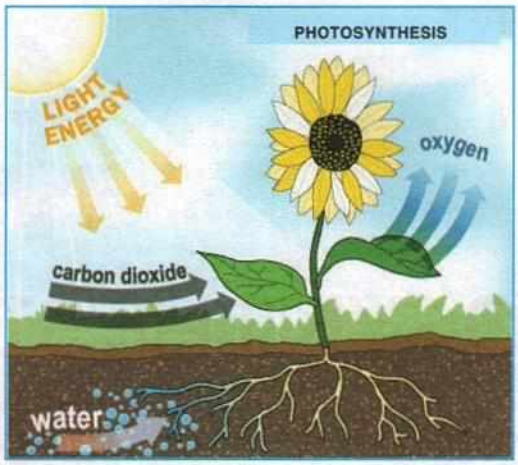


Fig. 4.1 Leaf : The site for photosynthesis

PHOTOSYNTHESIS

The term photosynthesis means combining by light (*photo* = light; *synthesis* = combining). During photosynthesis, water is combined with carbon dioxide in the presence of light and chlorophyll to produce glucose and oxygen.

Photosynthesis is represented as follows :

$$\text{carbon dioxide + water} \xrightarrow[\text{sunlight}]{\text{chlorophyll}} \text{glucose + oxygen}$$

This entire process gets completed in a series of complex chemical reactions.

Photosynthesis occurs in the mesophyll cells of the leaf (Fig. 4.2). These cells contain numerous plastids called **chloroplasts**. These chloroplasts contain the green pigment called the **chlorophyll**. This pigment is of utmost importance as it absorbs the sunlight which provides energy for the process of photosynthesis. The entire process of photosynthesis occurs inside the chloroplast of the leaf. These cells are more abundant on the upper side of the leaf where they can receive more sunlight (Fig. 4.2). On the lower surface of the leaf are numerous pores called **stomata** (singular : stoma), which open into small air cavities inside the leaf. Carbon dioxide from the air diffuses into the leaf through these stomata and reaches the chlorophyll-containing cells or chloroplasts.

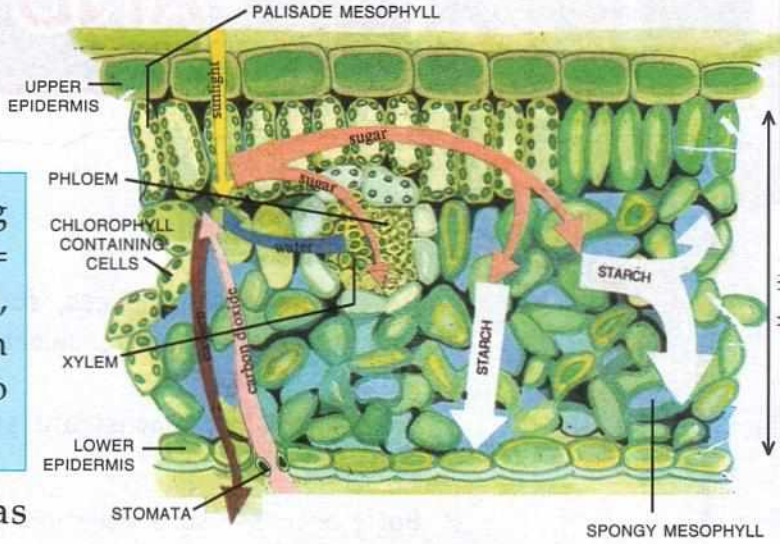


Fig. 4.2 Section of a leaf

STOMATA

Stomata [*singular* – stoma] are tiny openings found mainly on the lower surface of the leaves. These openings are surrounded by a pair of bean-shaped cells called **guard cells**.

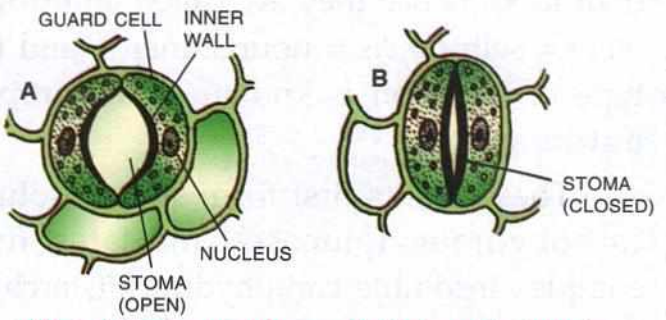


Fig. 4.3 The opening and closing of stomata
A – Guard cells turgid, the stoma opens,
B – Guard cells flaccid, the stoma closes

The main function of the stomata is to let in carbon dioxide from the atmosphere for photosynthesis and release oxygen. During the day, the guard cells absorb water and the stomata remain open. At night, the water is drawn out of the guard cells and the stomata remain closed.

The leaves are adapted to carry out the process of photosynthesis because :

- They have broad, wide and flat surfaces to absorb light.
- Leaves bear minute pores known as *stomata* on both surfaces to facilitate exchange of gases between the leaf and the atmosphere.
- Carbon dioxide from the atmosphere also enters into the palisade mesophyll through the stomata. The diffusion of carbon dioxide becomes very easy in each and every cell because of the presence of large intercellular spaces among the cells of the leaf.
- Palisade mesophyll absorbs maximum sunlight as it is situated just below the upper epidermis. Each cell of the palisade mesophyll contains numerous chloroplasts and the chlorophyll pigments found inside these chloroplasts absorb sunlight.
- There is a continuous supply of water and minerals in every cell through the extensive network of veins within the leaf lamina. Water coming from the veins enters the cells by osmosis. Veins also help in the translocation of prepared food to other parts of the plant.
- The oxygen produced at the end of photosynthesis is released into the atmosphere through stomata.

How does Photosynthesis Occur ?

All plants have a transport system called **vascular system**. The vascular system is composed of two types of tissues called **xylem** and **phloem**. The xylem transports water and minerals upwards from roots to the leaves.

The sunlight falling on the leaf is absorbed by the chlorophyll to provide energy. This energy is used to split water molecule (H_2O) into hydrogen ions (H^+) and hydroxyl ions (OH^-). Subsequently, a series of chemical reactions occur :

(1) Oxygen from the hydroxyl (OH^-) ion is released into the air.

(2) Hydrogen ions (H+) combine with carbon dioxide to form glucose ($C_6H_{12}O_6$).

The phloem transports glucose made in the leaves to the other parts of the plant in the form of sucrose.

Factors Affecting Photosynthesis

Many factors affect photosynthesis, but the three factors that are most important are **carbon dioxide, light** and **suitable temperature** (but not higher than 40°C because it slows down and can even stop the enzyme action). All the three factors are interdependent and each of these factors limits the other. *For example,*

if CO_2 is less and the other two are more, there will be less photosynthesis. Similarly, less light will slow down the process even if there is lot of CO_2 and suitable temperature. Similarly, if the temperature is low, there will be less photosynthesis even if sufficient amount of CO_2 and sunlight are present.

Too much light beyond a certain limit destroys chlorophyll and the process of photosynthesis is adversely affected.

The End Products of Photosynthesis

There are two end-products of photosynthesis :

1. Glucose ($C_6 H_{12} O_6$) and
2. Oxygen.

Glucose : The **sugar** (glucose) is either immediately utilised by the cells or stored in the form of insoluble **starch**.

Oxygen : Some of the oxygen released may be used in respiration in the leaf cells, but the major portion of it is not required, hence **diffuses out** into the atmosphere through the stomata. In a way, even this oxygen is not a waste, because it is a vital gas as all organisms need oxygen for respiration.

Utilisation of Synthesised Food and Its Transportation

Food manufactured in the leaf is required for use by all other parts of the plant. Glucose is formed in the leaf very rapidly during photosynthesis and it cannot be transported to other parts with the same rapidity. So, several molecule of glucose join together to form **insoluble starch for temporary storage** in the leaf At night, this starch is reconverted int soluble sugar. This sugar in the form o sucrose is transported in solution throug the veins of the leaf and down throug the phloem of the stem. In this way, it get transported to different parts of the plan where it may be reconverted into starc for storage (in most stems and fruits) o it is utilised to produce energy for variou functions in the plant.

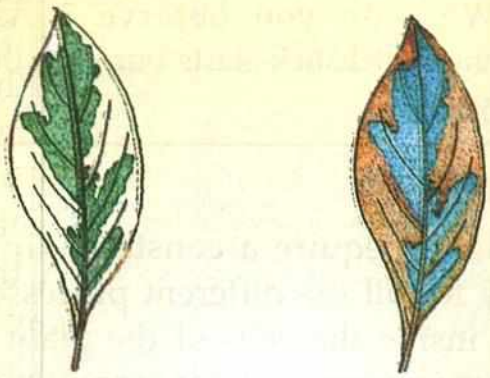
Significance of Photosynthesis

1. **Food for all :** Plants prepare thei own food by photosynthesis, an the plants in turn are eaten by th animals.
2. **Oxygen for respiration :** All th free oxygen in the atmospheric ai is the result of photosynthesis. N animal can survive without oxyge as it is needed for respiration. Eve the plants use the same oxygen i the dark for their own respiration

Activity 1

To show that chlorophyll is necessary for photosynthesis.

The green colour of a leaf is due to the presence of chlorophyll. Although most leaves are green, some have white or yellow patches on them, for example, the leaves of Coleus. Such leaves are described as *variegated* leaves.



(i) Variegated leaf (b) After testing for starch

Chlorophyll is neccessary for photosynthesis

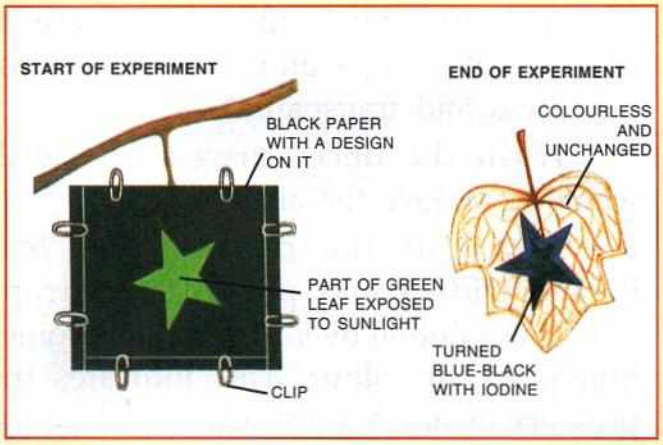
Only the green part of a leaf shows production of starch. Carry out a starch test on a variegated leaf of a plant that has been kept in sunlight. Only those parts of the leaf will turn blue-black which were green, while the white or yellow patches remain unchanged.

This shows that photosynthesis occurs only in chlorophyll-containing parts.

Activity 2

To show that light is necessary for photosynthesis.

Take a potted plant which has been destarched by keeping in a dark room overnight. Cover its one leaf on the upper surface by black paper which has a design cut out on it. Clip the paper firmly as shown in the figure. Thus, the parts of the leaf adjacent to the cut-out design are exposed to light, while the covered parts are not. Keep this set-up in sunlight for 6-8 hours. Next, pluck this leaf from the plant and remove the black paper. Perform the starch test on the leaf as suggested in Activity 3.



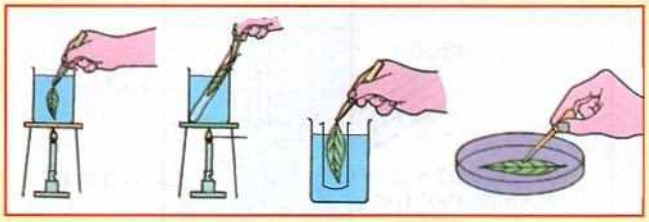
Only the part of the leaf exposed to sunlight performs photosynthesis

The parts of the leaf left uncovered and exposed to sunlight will turn blue-black showing that photosynthesis occurs only in those parts that received light.

Activity 3

To show that starch is produced in green leaves during photosynthesis.

Pluck a green leaf from a plant which has been growing in bright sunlight. Put this leaf in a beaker with boiling water for about 2-3 minutes so as to kill the cells, denature the enzymes and make the leaf more permeable to iodine solution. Take the leaf out of the beaker and place it inside a tube containing boiling methylated alcohol. Put the tube of alcohol in a beaker of boiling water. [Do not heat the tube of alcohol directly over a flame, but put it in a beaker of boiling water].



Preparing a leaf for iodine test

After 10 minutes, the leaf will lose its chlorophyll entirely and will turn almost colourless and transparent.

Wash the decolourised leaf with water to remove the alcohol.

Now put the decolourised leaf in a petridish and pour a few drops of iodine solution over it. Soon, it becomes blue-black in colour. This indicates the presence of starch in the leaf.

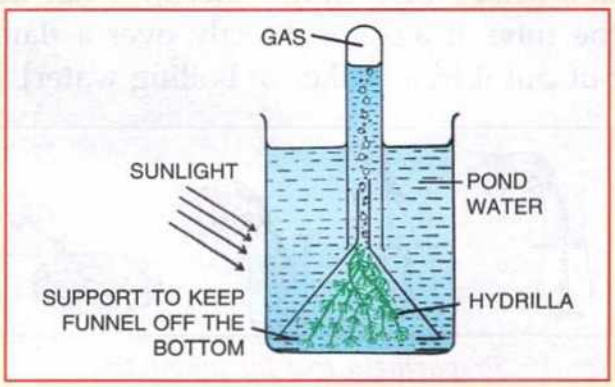
Activity 4

To show that oxygen is given out during photosynthesis.

Take a beaker and fill three quarters of it with water. Place 'Hydrilla' plants in it. The stems of the plant should be placed upwards. Cover the plants with a glass funnel. Completely fill a test tube with water. Place your thumb on the opening of the test tube and slowly invert this over the stem of the funnel. Place this arrangment in sunlight for a while.

What will you observe ? Bubbles of a gas are seen escaping into the test tube. As the gas rises up, it displaces the water.

Remove the test tube with the gas carefully. Insert a glowing matchstick or splinter.



What do you observe ? As the glowing matchstick starts burning, the gas is oxygen.

RESPIRATION

Plants require a constant supply of energy for all the different processes that go on inside the cells of the plant body. Energy is required for growth of the plant, for root cells to penetrate the soil and absorb water and minerals and so many other such activities. Where does the plant get this energy from ? As you have learnt earlier, energy is obtained by all living things through a process called **respiration**.

WHAT IS RESPIRATION ?

Respiration is the process in which glucose is broken down to release energy.

Some of the energy liberated during the breakdown of the glucose molecule, is in the form of heat, but a large part of it is converted into chemical energy called **Adenosine Triphosphate** (ATP). Any activity inside the cell is carried out by the energy released by these ATP molecules.

Types of Respiration

There are *two* types of respiration :

(i) Aerobic respiration that utilizes oxygen.

(ii) Anaerobic respiration that does not utilize oxygen.

(i) Aerobic Respiration

Usually, all cells throughout life

perform aerobic respiration by utilizing oxygen to breakdown the food and get energy. In aerobic respiration, glucose is completely oxidised into carbon dioxide, water and energy. The excess energy gets stored in the cell in the form of ATP.

Aerobic respiration follows the following equation :

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

(ii) Anaerobic Respiration

Anaerobic respiration occurs in the absence of oxygen. It is usually seen in intestinal parasites, yeast and most bacteria.

In anaerobic respiration glucose is partially broken down.

$$\text{Glucose} \xrightarrow{\text{Enzymes}} \text{Ethanol} + \underset{\text{dioxide}}{\text{Carbon}} + \underset{\text{(2 ATP)}}{\text{Energy}}$$

In anaerobic respiration the food (glucose) is broken down into ethanol (in plants) and carbon dioxide, but the energy given out is less (only 2 ATP). Differences between aerobic and anaerobic respiration are given in table 4.2.

Table 4.2 : Differences between aerobic and anaerobic respiration

Aerobic Respiration	Anaerobic Respiration
1. It utilizes oxygen.	1. It does not utilize oxygen.
2. Food molecules (glucose) completely break down.	2. Food molecules (glucose) partially break down.
3. Carbon dioxide and water are formed.	3. Ethanol along with carbon dioxide (in plants) and lactic acid (in animals) are formed.
4. More energy is released (38 ATP molecules).	4. Less energy is released (2 ATP molecules).

RESPIRATION IN PLANTS

The process of respiration in plants includes the following steps :

- Absorption of oxygen from the atmosphere.
- Oxidation of stored food (glucose) by absorbed oxygen.
- Release of energy as a result of oxidation.
- Carbon dioxide and water are the end products which go out of the plant.

RESPIRATION AND PHOTOSYNTHESIS

Plants get the required energy for the oxidation of glucose during the process of respiration.

$$\text{Glucose} + \text{Oxygen} \xrightarrow{\text{enzymes}} \underset{\text{dioxide}}{\text{Carbon}} + \text{Water} + \text{Energy}$$

You have already learnt that plants synthesize their own food by photosynthesis. Glucose is synthesized when carbon dioxide and water combine together in the presence of sunlight and chlorophyll.

$$\underset{\text{dioxide}}{\text{Carbon}} + \text{Water} \xrightarrow[\text{chlorophyll}]{\text{sunlight}} \text{Glucose} + \text{Oxygen} + \text{Water}$$

At the first sight, it appears that respiration and photosynthesis in plants are two "OPPOSITE" processes. In some ways, it is correct. During photosynthesis,

glucose is produced, and during respiration, glucose is broken down. During photosynthesis, the energy is obtained from sunlight, while in respiration, energy is produced in the form of ATP.

Table 4.3 : Differences between photosynthesis and respiration

Photosynthesis	Respiration
1. Food is synthesized.	1. Food is broken down.
2. Oxygen is released as a by-product.	2. CO_2 is released as a by-product.
3. Occurs in plant cells containing chlorophyll.	3. Occurs in all cells of both plants and animals.
4. Occurs only during the day.	4. Occurs both during the day and the night.

During night too, respiration continues. Plants take in oxygen and give out carbon dioxide. Hence, **there is some truth in the belief that one should not sleep under the trees at night**. But sleeping under the tree during hot mid-day is good as one gets both the oxygen due to photosynthesis and coolness due to transpiration.

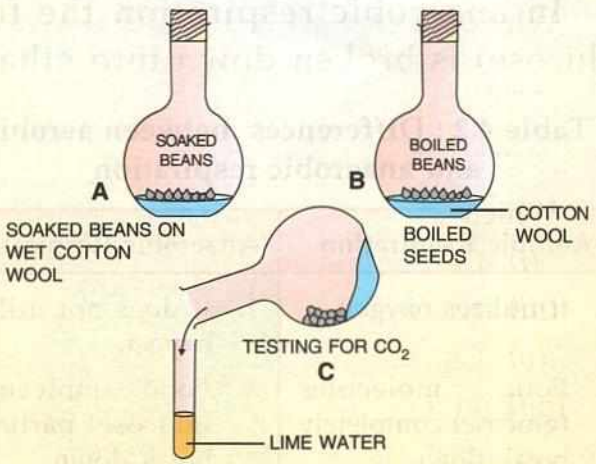
Activity 5

To prove that carbon dioxide is produced during respiration in germinating seeds.

Take two flasks A and B. Place some wet cotton-wool at the bottom of each flask. Soaked seeds (such as pea or gram) are placed in flask (A) and an equal number of boiled (dead) seeds are placed in flask (B).

A little antiseptic (such as carbolic acid) is added to flask (B) to prevent bacterial growth on dead seeds, which would otherwise in turn respire and release carbon dioxide. The flasks are tightly corked and left in similar conditions of light and temperature.

A few days later, the seeds in flask (A) will germinate and those in flask (B) will show no signs of any germination (as they are dead). The gases in each flask are then tested by removing the cork and tilting the flask over a test-tube containing lime water and then shaking up the test-tube. The expected gas carbon dioxide being heavier than air would "flow down" into the test tube. The gas from flask (A) would turn the lime water milky, showing the presence of carbon dioxide in it, while the gas in flask (B) will show no effect. Therefore, the conclusion is that the germinating (respiring) seeds give out carbon dioxide.



Experiment to show the production of carbon dioxide in germinating seeds
A-Soaked bean seeds
B-Dead bean seeds
C-Testing for the presence of carbon dioxide

REVIEW QUESTIONS

MULTIPLE CHOICE QUESTIONS

1. Put a tick (√) against the most appropriate alternative in the following statements.

   (i) Carbohydrates are stored by plants in the form of :

   (a) Starch ☐ *(b)* Proteins ☐

   (c) Fats ☐ *(d)* Glucose ☐

   (ii) Stomata are present on the surface of :

   (a) Leaves ☐ *(b)* Roots ☐

   (c) Stem ☐ *(d)* Flower petals ☐

   (iii) Which one of the following is the immediate end-product of photosynthesis ?

   (a) Fructose ☐ *(b)* Glucose ☐

   (c) Cellulose ☐ *(d)* Lactose ☐

SHORT ANSWER QUESTIONS

1. Why do leaves generally look green ?

   .....

   .....

2. Which *four* of the following are needed for photosynthesis in a leaf ?

   (i) Carbon dioxide *(ii)* Oxygen

   (iii) Nitrates *(iv)* Water

   (v) Chlorophyll *(vi)* Soil

   (vii) Light

3. What is the source of energy for photosynthesis ?

   .....

4. Which gas is taken in and which one is given out by a green leaf in bright sunlight ?

   (i) Taken in : .....

   (ii) Given out : .....

5. Suppose we compare the leaf with a factory, match the items in *Column* A with those in *Column* B.

Column A LEAF	*Column* B FACTORY
(i) Cells in the leaf	*(a)* Raw materials
(ii) Chloroplast	*(b)* Power
(iii) Sunlight	*(c)* Machinery
(iv) Oxygen and water	*(d)* End product
(v) Carbon dioxide and water	*(e)* By product
(vi) Glucose	*(f)* Work room

6. State whether the following statements are *True* or *False* :

(i) Green plants prepare their food by using two raw materials, oxygen and water.

(ii) The chlorophyll enables the plants to use light energy.

(iii) The free oxygen in the atmospheric air is the result of photosynthesis.

(iv) Photosynthesis occurs only in chlorophyll-containing parts of the plant.

7. Differentiate between aerobic and anaerobic respiration. Write the overall chemical equations o the two kinds of respiration in plants.

(i) Aerobic : .....

(ii) Anaerobic : .....

8. Explain how photosynthesis is different from respiration.

9. Do the plants respire all day and night or only during the day ? Give reasons.

10. What happens to the energy liberated during respiration ?

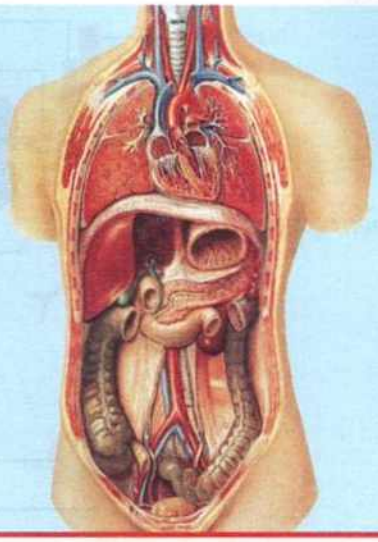
LONG ANSWER QUESTIONS (Write the answers in your note book)

1. In order to carry out photosynthesis, what are the substances that a plant must take in ? Als mention their sources.

2. What is the role of chlorophyll in photosynthesis ?

3. Do plants need oxygen ? If so, what is its source ?

UNIT : 3
Human Body



5 EXCRETION IN HUMANS

SYLLABUS

Exretion : Definition

- Excretory organs and their excretory products (kidneys, sweat glands, lungs);
- Renal Excretory System — kidneys, ureter, urinary bladder, urethra (location and functions to be explained along with diagram);
- Role of kidneys in filtration of blood through millions of nephrons (details not required, structure of nephron not to be discussed); common disorders of the urinary system: Urinary Tract Infection, kidney stone.

WHAT IS EXCRETION ?

During different metabolic activities taking place in our body, the body produces many substances of which some are useful while the others are useless (not required by the body). If retained in the body, the useless unwanted substances may become poisonous and cause much harm and in severe cases, even death. The organs which remove these unwanted and toxic substances from the body are called **excretory organs**. The process of removal of unwanted and harmful metabolic waste substances is called **excretion**.

Substances to be Excreted

1. **Urea and uric acid** (nitrogenous wastes). These are produced as a result of the breakdown of excessive amino acids in the liver. If allowed to accumulate in the body, these are harmful.
2. **Bile pigments.** These are formed in the liver. They give a yellowish tinge to the urine. Excess of bile pigments become harmful, hence they are removed from the body.
3. **Water.** Water is taken in with food and beverages in large quantities. Plenty of

water in the body is essential for "washing out" of the nitrogenous wastes. The body retains some water required as a normal constituent while the excess water is removed from the body in different ways.

4. **Extra Salts.** Such as the common salt (NaCl). Sodium and chloride ions or any other ions are needed in the body only in certain proportions. Any extra quantity must be removed. Extra salts are expelled alongwith the urine.
5. **Extra Vitamins.** The vitamins absorbed from the food may be in excess. The fat-soluble ones are stored in the body to some extent, but the extra water-soluble ones such as vitamins B and C are passed out in urine. Similarly, certain medicines including antibiotics, if taken in extra quantity are passed out along with urine.

Excretion is the removal of all toxic and unwanted metabolic waste products from the body.

THE EXCRETORY SYSTEM

The renal excretory system or simply excretory system in humans consists of a pair of kidneys, two ureters, a urinary bladder and a urethra.

1. **Kidneys.** The two reddish-brown bean-shaped **kidneys** are situated towards the back of the abdomen, one on either side of the backbone at the level of the last two ribs. The right kidney is located slightly lower than the left one (Fig. 5.1).

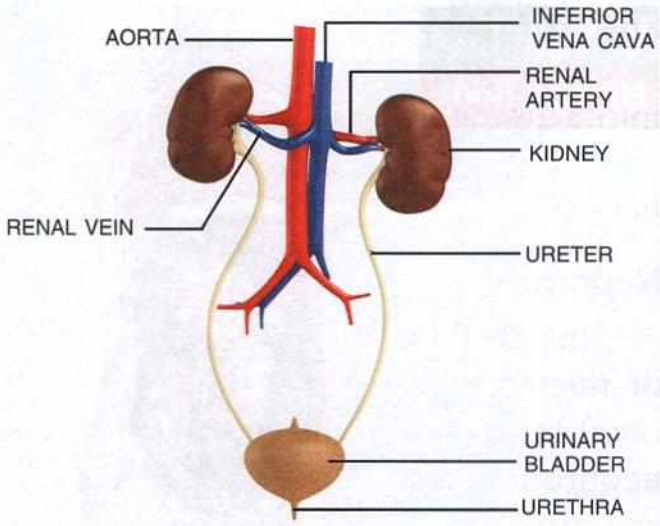


Fig. 5.1 The human excretory system (front view)

2. **Ureters.** A narrow tube called the **ureter** runs from the inner side of each kidney up to the **urinary bladder.**
3. **Urinary bladder.** It is a muscular bag situated in the lower abdomen.
4. **Urethra.** Leading from the urinary bladder is a single median tube called the **urethra** opening to the outside. It is longer in the males and shorter in the females.

Structure of the Kidney

Internally, each kidney is composed of an outer darker region called *cortex*

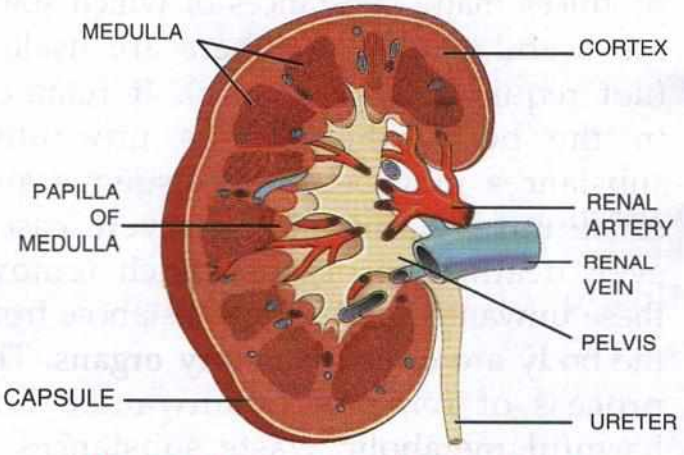


Fig. 5.2 Section through the kidney to show different regions

and an inner lighter region called *medulla*. The medulla drains the urine into a funnel-shaped structure called the *renal pelvis*. The ureters orginate from here (Fig. 5.2).

Nephrons

Inside the kidney, there are millions of microscopic tubular structures called *renal tubules* or nephrons (Fig. 5.3). Each nephron starts as a cup-like **Bowman's capsule** which continues behind as a narrow **tubule**. The tubule is convoluted (twisted) and opens into a collecting duct. All the collecting ducts then open into the renal pelvis which leads into the ureter.

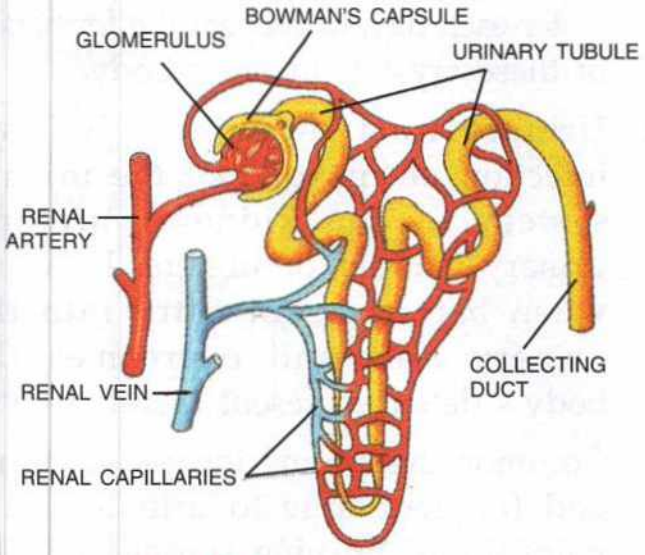


Fig. 5.3 Structure of a nephron

Nephron is the structural and functional unit of kidney.

Role of Kidneys in Urine Formation

- The kidneys are made up of millions of the microscopic units called nephrons. They are surrounded by a network of blood capillaries.
- The main function of the nephrons is to filter the blood, purify it and to produce urine.
- Blood which enters the kidney through the renal artery contains unwanted waste substances as well as some useful substances.
- The nephrons remove the waste substances such as excess water, mineral salts and urea from the blood and convert it into urine.
- They also re-absorb certain useful substances like glucose, sodium and potassium ions that are needed by the body and put it back into the blood.
- The blood that finally leaves the kidney is pure, devoid of all wastes and contains the right amount of water and other useful substances required by the body.
- The urine that is formed in the kidneys is sent to the ureters for its further temporary collection in the urinary bladder.
- When the bladder is full, the urine is expelled to the outside through the urethra.
- This process of expulsion of the urine to the outside is called **urination**.

The normal human urine mainly consists of **water, urea, uric acid** and some amount of **mineral salts**.

Accessory Excretory Organs (Skin, Lung, Liver, Salivary glands)

Besides kidneys, some other organs also help in the removal of waste products.

They are called **accessory excretory organs**. In human beings, the skin, lungs and liver are such organs.

Excretory role of skin : The major excretory function of the skin is production of sweat which on evaporation from the surface of the skin, cause cooling. Sweat is secreted by **sweat glands** which are located underneath the skin. These glands have ducts which open on the surface of the skin. Through these ducts, sweat comes out of the body. Sweat is composed of excess water, salts and traces of urea and uric acid.

Excretory role of lungs : You have learnt that the carbon dioxide is produced during breakdown of glucose during respiration. This passes from the blood into the lungs and exhaled through the nose.

Excretory role of liver : Breakdown of amino acids in liver produce urea. Urea is then carried to the kidneys from where it is excreted out in the urine.

Liver also helps in the elimination of bile pigments, extra vitamins and many drugs which get accumulated there.

OSMOREGULATION

Besides removing urea and uric acid from the blood, the kidneys also help in maintaining the water and salt concentration in it. This process is called **osmoregulation** (regulation of water and salt content).

During summer, we urinate fewer times than in winter and the urine passed is usually more concentrated. The reason being that in summers, we lose much water through sweat.

Common Disorders of the Urinary System

1. **Kidney stones :** They are formed when crystal forming substances such as calcium oxalate, calcium phosphat and uric acid are more than the flui in the urine. When these chemical start sticking together, they form crystals, commonly called **kidney stones**. They may be formed in any area of the excretory system and caus severe pain. They block the flow o urine if they are present in the ureters urinary bladder or urethra. Very often they have to be removed surgically.

   It is very important to drink sufficien water each day, to prevent the formatio of these crystals in one's body.

2. **Urinary tract infection :** It is an infection of any part of the urinar system — the kidneys, urethra urinary bladder or ureters. It occur when bacteria gain entry into the urinary tract and overcomes th body's defence present there.

   Common symptoms include a stron and frequent urge to urinate and painful and burning sensation whil urinating. It is treated with antibiotic and can be cured within 2-3 days o treatment in case of mild infections.

3. **Diabetes :** Presence of glucose in th urine, indicates that the person i suffering from diabetes mellitus. Thi is a disease in which the sugar leve in the blood is much higher than th normal level. The excess sugar i excreted out through the urine.

4. Presence of blood cells in the urine may indicate an infection, tumor, internal bleeding or damage to the kidneys.

WHAT HAPPENS IF KIDNEYS FAIL ?

Sometimes, one or both the kidneys may stop working properly. This may happen if they become infected, seriously injured, or damaged due to some reason.

A person can well manage with just one kidney, but if both fail, the blood soon becomes loaded with urea and other waste substances. If nothing is done in such situations, the person may die.

One of the treatments for such a person is to use a machine which filters and cleans the blood. The process is known as **dialysis** (Fig. 5.4).

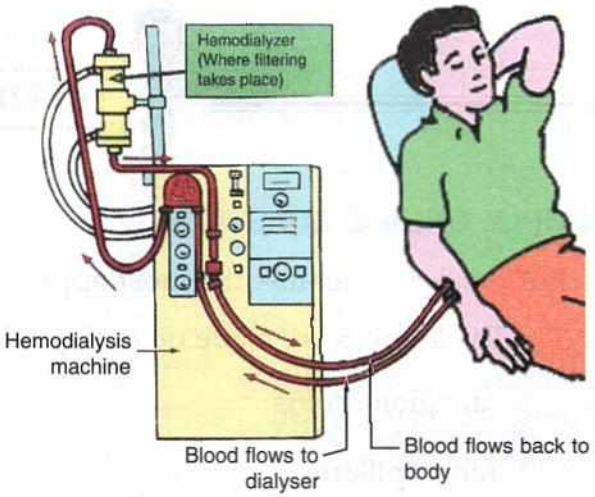


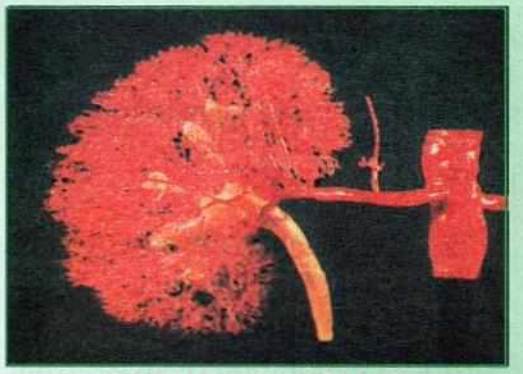
Fig. 5.4 Dialysis

A person with complete kidney failure needs regular dialysis done in a hospital to lead a normal life. As an alternative, a patient with both kidneys damaged can undergo kidney transplant from a suitable donor. The donor can live normally with one single kidney and the recipient gets a lease of life.

RENAL TUBULES

Tiny, so many and for so much!

- Total number in both kidneys : approximately 2 million.
- Each single tubule : 4-5 cm long.
- Total length of all tubules together : more than 16 kilometres.
- Blood flowing through kidneys per minute : 1 litre.
- Primary urine produced in 24 hours : 180 litres, but 179 litres is reabsorbed back into the system.
- Final urine produced from the primary urine after reabsorption per day : 1·2 litre.



Blood vessels in kidney

A preparation of the kidney. All tissues except the main blood vessels have been dissolved away. The two kidneys contain about 16 km of tubules and 160 km of blood vessels.

REVIEW QUESTIONS

MULTIPLE CHOICE QUESTIONS

1. Put a tick (√) against the most appropriate alternative in the following statements.

(i) The kidneys are made up of tiny tubular units called :

(a) glomerulus ☐ *(b)* nephrons ☐

(c) capillaries ☐ *(d)* neurons ☐

(ii) In human beings, urea is produced in :

(a) liver ☐ *(b)* kidney ☐

(c) spleen ☐ *(d)* urinary bladder ☐

(iii) Besides water, the urine mainly contains :

(a) urea ☐ *(b)* nitric acid ☐

(c) glucose ☐ *(d)* bile pigments ☐

(iv) Filtration of excretory wastes from the blood occurs in :

(a) collecting tubule ☐ *(b)* ureter ☐

(c) urinary bladder ☐ *(d)* nephrons ☐

SHORT ANSWER QUESTIONS

1. Fill in the blanks :

(i) Nitrogenous wastes in urine are in the form of .....and .....

(ii) The unit of human kidney is called .....

(iii) Evaporation of sweat from skin surface has ..... effect.

2. Define the following :

(i) Excretion : .....

(ii) Excretory organs : .....

(iii) Dialysis : .....

(iv) Nephron : .....

3. Write *True* (T) or *False* (F) for the following statements in the spaces provided. Rewrite the false statements in correct form .

   (i) Removal of solid undigested food is excretion.

   (ii) Medulla of kidney passes urine into urinary bladder.

   (iii) Excess sugar in blood is a symptom of diabetes.

   (iv) Urine is devoid of blood cells.

4. Name the blood vessel that brings blood to the kidneys. ..... .

5. Where in the urinary system do the following processes take place ?

   (i) Urine formation : ..... .

   (ii) Transport of urine away from kidney : ..... .

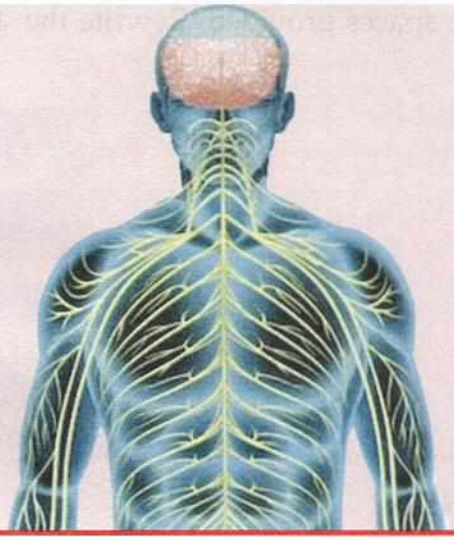
   (iii) Temporary storage of urine : ..... .

LONG ANSWER QUESTIONS (Write the answers in your notebook)

1. Define excretion. Write the *four* organs of human urinary system in their correct sequence.
2. Why is excretion necessary in living beings ?
3. What is meant by osmoregulation ?
4. Describe the structure of kidney with the help of a labelled diagram.
5. What are the two ways by which a person can get relief in case of kidney failure ?
6. Draw a diagram of human excretory system and label the following parts :
   Kidney, ureter, urinary bladder and urethra.
7. How are kidney stones formed ?
8. What are the symptoms of a urinary tract infection ?

PROJECT

Research and find out at least three factors which affect the nature of urine excreted from the pair of kidneys.



6

NERVOUS SYSTEM

SYLLABUS

- Main parts: brain, spinal cord, nerves.
- Brain : cerebrum, cerebellum, medulla oblongata (location and function).
- Spinal cord: location and function.
- Nerves: what are nerves; their general function.

COORDINATION

All living beings are dependent on a number of processes going on in their body, like digestion, respiration, movement, *etc*. These processes do not function independently but they are inter-related to fulfill the general needs of the body. The interaction of these activities of a living being as per the needs of the body internally or externally is called **coordination**.

There are two types of coordination *viz*, (i) nervous coordination and (ii) chemical coordination.

(i) **Nervous coordination :** This coordination is brought about by the **nervous system** which is made up of the brain, spinal cord, nerves and the sense organs. Some examples of this category are given below :

- When you feel hungry, you eat food. The act of eating food involves a number of coordinated activities. Your eyes look at the food placed on the table. Your brain records this information and the action starts. The arms get the message and they are raised and the hands hold the plate in which the food is kept. The fingers pick up the food and push it into the mouth. The food goes down through the alimentary canal and after a series of processes in the

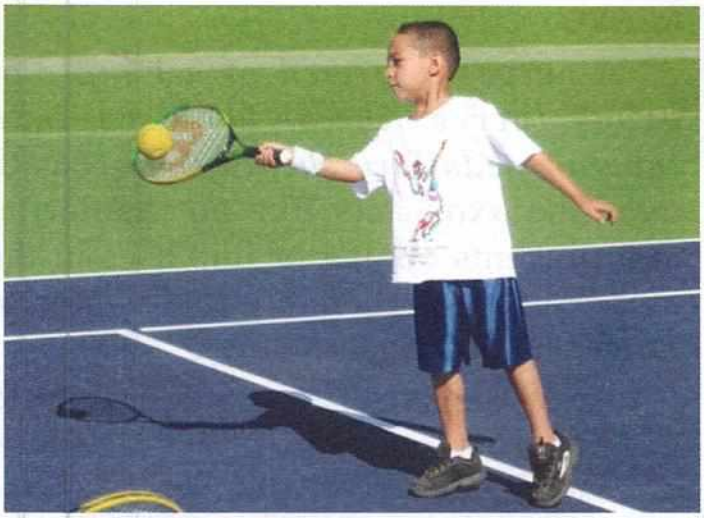


Fig. 6.1 Playing tennis — an example of muscle and brain coordination

body, reaches the blood stream to fulfil the requirement that had arisen when you felt hungry.

- Playing a fast game like tennis requires a lot of coordination by the muscles, judgement by the brain and observation by the eyes.
- Pain in a sprained ankle signals not to move the affected part, otherwise, it may not recover fast.

(ii) **Chemical coordination :** This coordination is brought about by chemical messengers called hormones. An example of this category is given below :

- In an emergency situation, if you are suddenly attacked by a bull in the street, you try to run away from it. In such a situation, certain chemicals are released into the blood to provide you extra energy and strength to run.

STRUCTURAL AND FUNCTIONAL UNIT OF NERVOUS SYSTEM — THE NEURON

The nervous system is made up of special cells called **nerve cells** or **neurons.**

A neuron is made up of two main parts — (1) a main cell body called **cyton**, which gives out a number of fine processes (dendrites). (2) a long process called **axon**.

The cell body contains a nucleus. The dendrites are cytoplasmic extensions of the cell body. They receive messages (impulses) from the organs and transmit them through the cell body into the axon, which transmits the message. The end of the axon terminates in a number of branches called **terminal branches.**

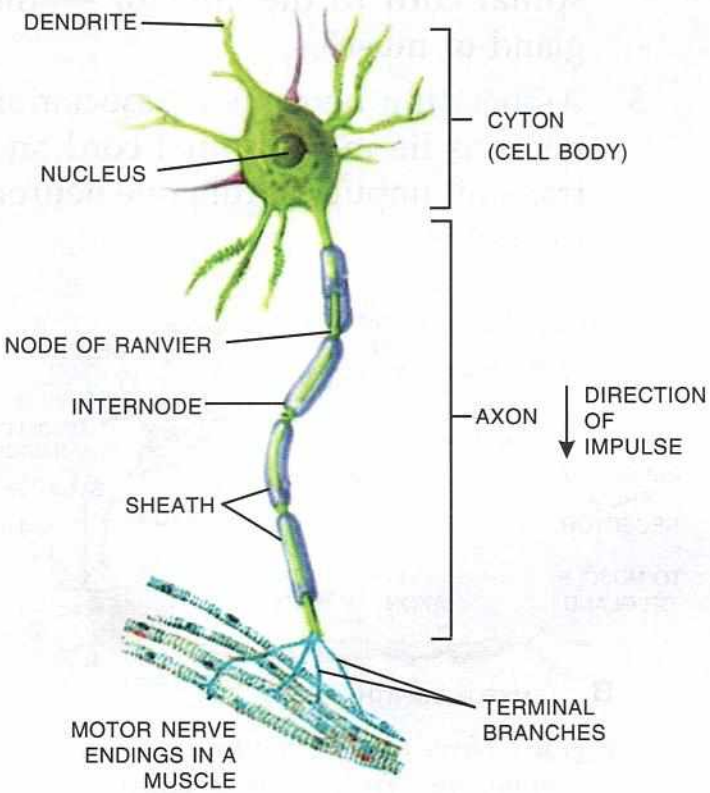


Fig. 6.2 A nerve cell

The individual neurons make contact through these processes. The terminal branches of the axon of one neuron lie very close to the dendrites of another neuron. This point of contact is called a **synapse**. It is at the synapse, that the message is transmitted from the axon of one neuron to the dendrites of the next neuron. Messages are relayed in this manner from one neuron to the next.

Types of neurons

There are *three* types of neurons :

1. **Sensory neurons :** Sensory neurons carry impulses from the sensory cells or sense organs to the spinal cord or brain.
2. **Motor neurons :** Motor neurons carry messages from the brain or spinal cord to the effector — the gland or muscles.
3. **Association neurons :** Association neurons lie in the spinal cord and transmit impulses from one neuron to another.

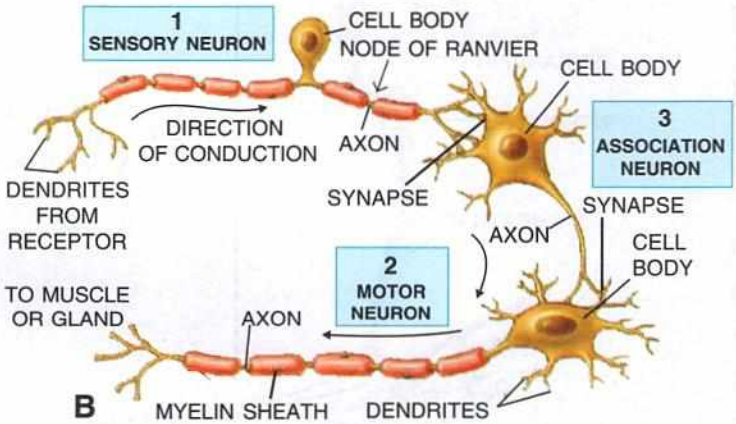


Fig. 6.3 Three types of neurons (sensory, motor and association), synapse between them and the direction of transmission of nerve impulse

NERVE

A nerve is formed of a bundle of axons (nerve fibres) enclosed in a tubular medullary sheath. This sheath over the axon acts like an insulation and prevents mixing of impulses in th adjacent fibres. There are three kinds o nerves as described below :

1. **Sensory nerve** contains onl sensory neurons, *e.g.* optic nerv of the eye.

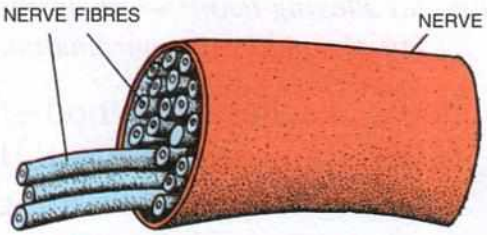


Fig. 6.4 Nerve fibres grouped into a nerve

2. **Motor nerve** contains only moto neurons, *e.g.* nerves of the muscle of the eyeball.
3. **Mixed nerve** is the one whicl carries both sensory and moto neurons, *e.g.* the nerve which goe to the tongue.

HUMAN NERVOUS SYSTEM

The nervous system of human beings consists of the following *tw* systems :

1. **The central nervous system :** I consists of the brain and the spinal cord. The brain lies within the skull, and the spinal cord lies within th vertebral column.
2. **The peripheral nervous system :** It consists of the nerves passing to and from the central nervous

system, reaching out to all parts of the body. The peripheral nervous system further consists of two subdivisions : Somatic nervous system and autonomic nervous system.

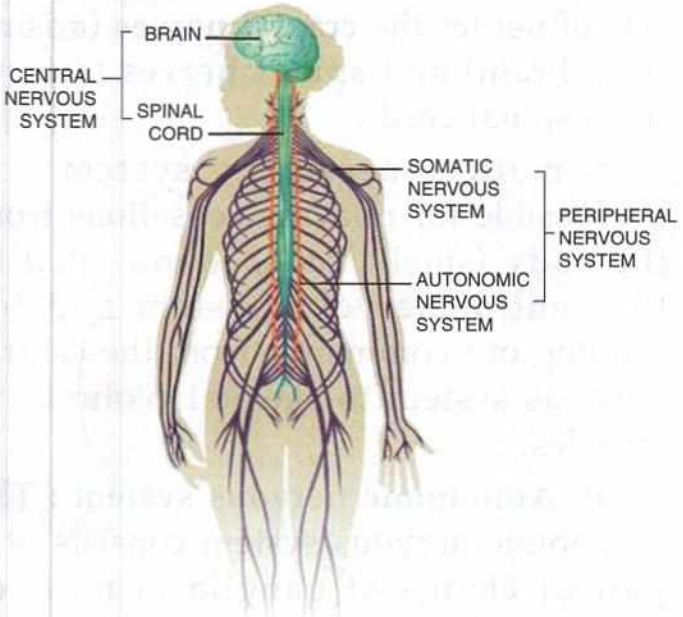


Fig. 6.5 The human nervous system

THE BRAIN

The human brain is the most complex and important organ of our body. The brain along with the spinal cord forms our central nervous system. On average, an adult human brain weighs about 1·5 kg. It is contained in, and protected by, a bony structure called the **skull** or the **cranium**. The brain is further enclosed in three protective membranes, collectively called as **meninges**, which are separated by cerebrospinal fluid.

The brain has three main parts :

(i) Cerebrum, (ii) Cerebellum

(iii) Medulla oblongata.

Cerebrum is the largest portion of the brain. It is divided into two (right and left) halves called the **cerebral hemispheres.** Each hemisphere is internally hollow. The outer surface of the hemispheres is folded with ridges and grooves which increase the surface of the brain so as to accommodate a large number of neurons.

The human cerebrum contains about 9 billion neurons.

The cerebrum is the seat of **intelligence, consciousness** and **will power.** It controls all the voluntary activities.

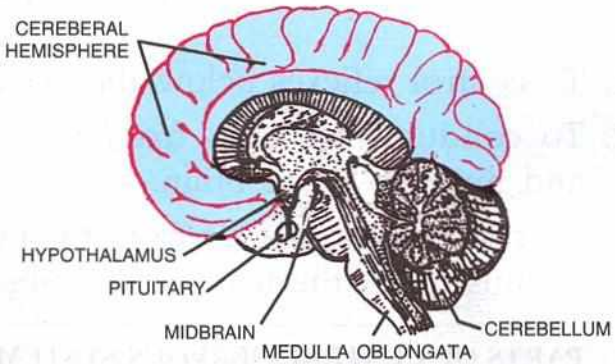


Fig. 6.6 Brain in median section

Cerebellum is much smaller and is located under the cerebrum. Its main function is to **balance the body** and **coordinate muscular activities.** The cerebrum decides an action, whereas the cerebellum implements the action. *For example*, if you get an idea to stand up and walk, it arises in the cerebrum, but the muscles involved in this process to contract or relax lies under the control of cerebellum.

Cerebellum gets affected by alcohol. That is why, an alcoholic is unable to coordinate his muscular movements properly.

Medulla oblongata is the lowest part of the brain and continues down to the

spinal cord. Its function is to control the activities of the internal organs. *For example*, beating of the heart, breathing, swallowing, digestion, sneezing, *etc.* Injury to the medulla may result in immediate death of a person.

THE SPINAL CORD

The spinal cord extends from the medulla of the brain and runs down almost through the whole length of the backbone.

The main functions of the spinal cord are :

1. To control reflexes below the neck.
2. To conduct messages from the skin and muscles to the brain.
3. To conduct commands from the brain to muscles of the trunk and limbs.

PARTS OF CENTRAL NERVOUS SYSTEM AND THEIR MAIN FUNCTIONS

BRAIN

Cerebrum — Intelligence, consciousness, memory and will power.

Cerebellum — Muscular coordination, body balance.

Medulla oblongata — Breathing, digestion, beating of the heart, etc.

SPINAL CORD

— Controls reflexes below the neck.

— Conducts messages from skin and muscles to the brain.

— Conducts commands from brain to muscles of trunk and limbs.

PERIPHERAL NERVOUS SYSTEM

The peripheral nervous system consists of nerves which connect the central nervous system to all parts of the body.

It is divided into **somatic nervous system** and **autonomic nervous system**.

A. Somatic nervous system : Somatic nervous system consists of two sets of nerves the **cranial nerves** (arising from brain) and **spinal nerves** (arising from spinal cord).

Somatic nervous system is responsible for relaying sensations from the body (smell, taste, sound, etc.) to the central nervous system and for sending out commands from the central nervous system to skeletal (voluntary) muscles.

B. Autonomic nervous system : The autonomic nervous system consists of a pair of chains of ganglia (a mass of cytons of nerve cells) and nerves found on either side of the spinal cord. This system acts largely unconsciouly and regulates the involuntary activities of ou internal organs like the heart rate, blood pressure, respiratory rate, pupillary response, etc.

Autonomic nervous system operate through two systems – the **sympathetic** and **parasympathetic** systems, which ar opposite in their actions. Sympatheti nervous system produces immediat fight or flight responses agains abnormal conditions, while th parasympathetic nervous system re establishes the normal conditions. Fo exmaple, if sympathetic nervous syste increases the heart rate, parasympatheti nervous system relaxes it.

REVIEW QUESTIONS

MULTIPLE CHOICE QUESTIONS

1. Put a tick mark (✓) against the correct alternative in the following statements :

(a) Medulla oblongata controls

(i) Smelling ☐

(ii) Beating of heart and respiratory movement ☐

(iii) Intelligence and will power ☐

(iv) Balancing of the body ☐

(b) Spinal cord is an extention of :

(i) Cerebellum ☐ *(ii)* Cerebrum ☐

(iii) Vertebral column ☐ *(iv)* Medulla oblongata ☐

(c) Body posture is mantained by :

(i) Cerebrum ☐ *(ii)* Cerebellum ☐

(iii) Medulla oblongata ☐ *(iv)* Spinal cord ☐

SHORT ANSWER QUESTIONS :

1. Write one word in the space provided to complete the second pair of the related words pertaining to nervous system :

Memory : cerebrum : : breathing : .....

Balance : cerebellum : : reasoning : .....

2. *(a)* Name the *two* major divisions of the human nervous system.

(i) .....

(ii) .....

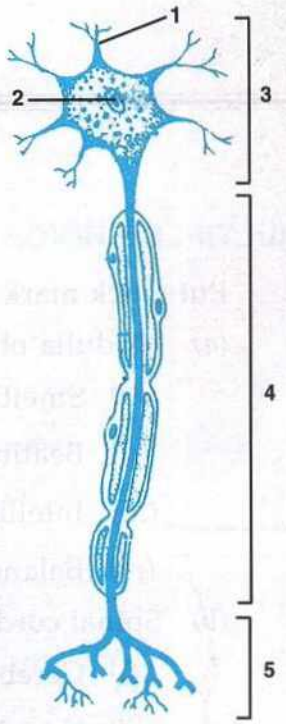
(b) Name the *three* main parts of the human brain.

(i) .....

(ii) .....

(iii) .....

3. Given alongside is the diagram of a neuron. Name the parts numbered 1 – 5.



1. .....

2. .....

3. .....

4. .....

5. .....

LONG ANSWER QUESTIONS (Write the answers in your notebook)

1. With the help of a suitable diagram describe the structure of a neuron .
2. Briefly describe the structure of the cerebrum in human brain and mention its functions.
3. Mention the *three* functions of spinal cord.
4. Describe *three* kinds of nerves, giving example of each.
5. What are voluntary and involuntary actions ? Which part of the nervous system controls them ?

PROJECT

Locate the body part where you do not feel the pricking of a pin. What is special about this part ? Discuss with your friends and teachers.

Research : Try to find out what happens to a body part when it undergoes paralysis ? Why ?

7 ALLERGY

SYLLABUS

- Concept of allergy.
- What is an allergen ? Common allergens like dust, pollen grains, mites, strong sunlight, particular food items.
- Entry routes of allergens: mouth, nose, skin.
- Symptoms of allergic reaction.
- Types of allergies: seasonal and perennial with examples.
- Precautions and care to be taken by a person who is prone to allergies.

ALLERGY

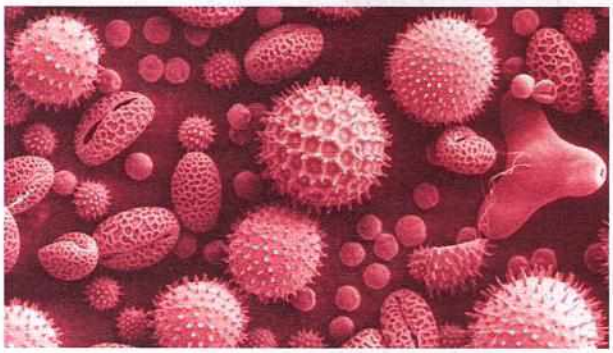
The concept of "allergy" was orginally introduced in 1906 by the Viennese pediatrician Clemens Von Pirquet, after he noticed that some of his patients were hypersensitive to normally harmless substances such as dust, pollen or some foods. Pirquet called this phenomenon "allergy" which in Greek means "other work". All forms of hypersensitivity were classified as allergies, and all were thought to be caused by an improper activation of the immune system.

Allergies, also known as allergic diseases, are a number of conditions caused by hypersensitivity of one's immune system to something in the environment that usually causes no adverse effects to most other people. These diseases include hay fever, dermatitis, asthma, food allergies, etc.

The substances that cause allergies are called **allergens**. People show allergic reactions to different allergens. A few common allergens are dust, spores, pollen, insect stings, certain types of

clothes, food, etc. In an attempt to protect our body from these allergens, our immune system produces immunoglobulin proteins that are specific to the allergen. These proteins first bind to the allergen and then to the white blood cells present in our body. This binding triggers the release of an inflammatory chemical called **histamine**. It is the histamine which shows allergic symptoms like inflammation, skin rash and constriction of the bronchioles (as in asthma).

(a) Dust mites



(b) Pollen

(c) Peanuts

Fig. 7.1 Common allergens

Allergies are common throughout the world, but more common in the developed nations; above 20% of people are affected by allergic rhinitis (running nose), above 6% of people have atleast one food allergy, and above 20% have allergic dermatitis at some point in life. Depending on the country, about 1-18% of people have asthma. Rates of many allergic diseases appear to be increasing with increasing number of fast foods, synthetic fabrics, pollutants in the environment, etc.

ENTRY ROUTES OF ALLERGIES

1. **Skin** — Substances that come in contact with the skin, such as latex, certain types of clothes, insect bites, etc. are common causes of allergic reactions.
2. **Mouth** — A wide variety of foods can cause allergic reactions, but 90% of allergic responses to foods are caused by cow's milk, soya, eggs, wheat, peanuts, fish and shellfish. Other food allergies, affecting less than 1 person per 10,000 population, may be considered "rare". The occurrence rate of allergies differ between adults and children.

Milk-protein allergies are most common in children. Some people are unable to tolerate milk from goats or sheeps and even cows, and many are also unable to tolerate dairy products such as cheese. Roughly 10% of children with milk allergy will have a reaction to beef. Beef contains a small amount of protein that is present in cow's milk.

3. **Nose** — Pollen, spores, dust particles and certain chemicals find entry through the nose. This can trigger coughing, sneezing, running nose, itching and watering in the eyes.

SIGNS AND SYMPTOMS OF ALLERGIES

Some allergens such as dust or pollen are airborne particles. In these cases, symptoms arise in areas in contact with air, such as eyes, nose, and lungs. General symptoms of inhaled allergens include :

Irritation of nose, sneezing, coughing and wheezing, red and watery eyes, increased production of mucus in the lungs, shortness of breath, etc.

(a) Red and watery eyes

(b) Sneezing

Fig. 7.2 Some symptoms of inhaled allergens

Apart from these allergens, allergic reactions can result from foods, insect bites, and reactions to medications like aspirin and antibiotics such as penicillin.

Symptoms of food allergy include abdominal pain, bloating, vomiting, diarrhoea, itchy skin, and swelling of the skin. Food allergies rarely cause respiratory (asthmatic) reactions.

Insect bites and reactions to antibiotics (like penicillin), and certain medicines (like aspirin) produce a systemic allergic response that is also called **anaphylaxis**. Therefore, before administering these medications, a doctor or a nurse asks the patient if he/she is allergic to any of them.

(a) Reddened skin

(b) Skin rash

(c) Swelling

Fig. 7.3 Symptoms of an insect bite

Types of allergies, allergens and symptoms

Type of allergy	Name of allergen	Symptoms
1. Food allergy	(a) Milk	Vomiting, hives.
	(b) Wheat	Stomach upset, eczema, asthma like symptoms (bronchospasms)
	(c) Sea-food	Vomiting, anaphylaxis (in severe cases)
	(d) Nuts	Vomiting, red rashes on skin, itching.
2. Seasonal allergy		
(a) Spring	Pollen (as flowers begin to blossom)	Sneezing and sniffling.
(b) Summer	Pollen	Very often people are sensitive to pollen, allergic reaction persists in summer too.
(c) Winter	Pollutants like sulphur dioxide, nitrogen dioxide (present in the smog common in the northern cities of India)	Coughing, itchy eyes and nose, sneezing, running nose and watery eyes.
3. Dust allergy	Dust particles	Asthma
4. Drugs	Penicillin	Diarrhoea, nausea, hives

During anaphylaxis, multiple organ systems can be affected, including the digestive system, the respiratory system, and the circulatory system. Depending on the rate of severity, anaphylaxis can cause local skin reactions (an area of skin redness greater than 10 cm in size), rashes, or swelling and inflammation within the skin, broncho-constriction, low blood pressure, etc. This type of reaction can be triggered suddenly, or the onset can be delayed.

SOME COMMON ALLERGIC REACTIONS

1. **Hay fever** is usually caused by a reaction to pollen, and is therefore particularly common when flowers are open. Many people suffer from it. The lining of the nasal cavity becomes sensitive and inflamed and produces a large amount of mucus, so the affected person suffers from running nose and sneezing. The eyes may be affected in the same way, becoming itchy, sore and weepy. When a person reacts adversely to a substance in this way, we say he is **allergic** to it.
2. **Asthma** is more serious. The muscles in the walls of the bronchioles contract, so the tubes get narrower. This makes it difficult for a person to breathe because of which he/she wheezes. The attacks are often brought on by pollen or dust, or occasionally by some kind of food to which the person is allergic.

In some people, the attacks become worse because of their nervousness or worry. Asthma can be treated with drugs which make the bronchial muscles relax, so the tubes widen allowing air to be breathed in and out of the lungs more easily.

3. **Hives** is an outbreak of swollen, pale red bumps or patches on the skin that appear suddenly due to an allergic reaction to certain allergens like medicines or food.

Fig. 7.4 Hives

4. **Anaphylaxis** is a sudden allergic reaction resulting in decreased blood pressure and shortness of breath. The nature of anaphylaxis is such that the reaction can seem to be subsiding, but may recur throughout a period of time.

PRECAUTIONS TO AVOID ALLERGIC REACTIONS

There is no permanent cure for an allergy. Medication for allergies do give relief. Those people prone to allergic reactions should be aware of the allergens that trigger these responses in their bodies and avoid them completely, especially food and medicines. Anti-allergy shots are helpful to those with seasonal allergies like those caused by pollen.

Doctors specialised in treating allergies should be consulted when the allergy is severe.

DIAGNOSIS OF ALLERGY

Effective management of an allergic disease relies on the ability to make an accurate diagnosis. Allergy testing can help confirm or rule out allergies. Correct diagnosis, counselling, and avoidance advice based on valid allergy test results reduces the incidence of symptoms and need for medications, and improves quality of life. To assess the presence of allergen-specific antibodies, two different methods can be used : a skin prick test, or an **allergy blood test**. Both methods are equally valid and are recommended for diagnosis.

SKIN PRICK TEST

Skin prick test is also known as "puncture testing" or "prick testing" due to the series of tiny punctures or pricks made into the patients skin. A small plastic or metal device is used to puncture or prick the skin. Sometimes, the allergens are injected intradermally into the patients skin, with a needle and syringe. Small amounts of suspended allergens or their extracts (e.g., pollen grain, insect sting proteins, peanut extracts) are introduced to sites on the skin marked with pen or dye. Common

areas for testing include the inside of forearm and the back.

If the patient is allergic to the substance, then a visible inflammatory reaction will usually occur in about 30 minutes. This response will range from slight reddening of the skin to a full-blown hive in more sensitive patients similar to a mosquito bite. Some patients may believe they have determined their own allergic sensitivity from observation, but a skin test is always better.

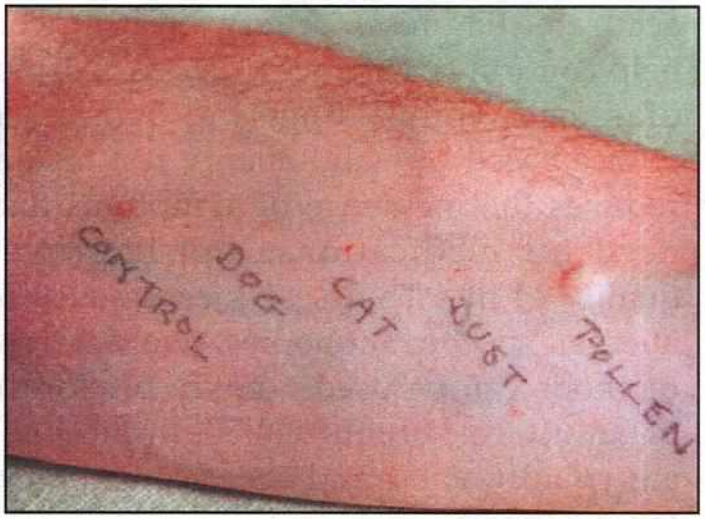


Fig. 7.4 Skin prick test

A drop of fluid containing the substance to be tested is placed on the skin, then the skin is pricked through the drop. If the person is allergic to the substance, a 'blister' develops. This particular person was found to be allergic to certain kinds of pollen. What do you think the control drop consists of, and why is it included in the test ?

BLOOD TESTING

An allergy blood test is quick and simple, and can be ordered by a licensed health care provider (e.g., an allergy specialist). Unlike skin-prick testing, a blood test can be performed irrespective of age, skin condition, medication, symptom, disease activity, and pregnancy.

An allergy blood test is available through most laboratories. A sample of the patient's blood is sent to a laboratory for analysis. Multiple allergens can be detected with a single blood sample. Allergy blood tests are very safe, since the person is not exposed to any allergens during the testing procedure.

The test measures the concentration of specific antibodies in the blood. The quantitative allergy blood result can help determine what a patient is allergic to, help predict and follow the disease development, estimate the risk of a severe reaction, and explain cross-reactivity.

REVIEW QUESTIONS

1. Define the term "allergy".
2. Name the inflammatory chemical released by the basophils causing skin reaction and constriction of the bronchioles.
3. How the allergy causing chemical is naturally removed from the body ?

4. Match the items given under column I with those given under column II :

Column I	Column II
(i) Dust allergy	*(a)* Nuts
(ii) Food alergy	*(b)* Pollen
(iii) Seasonal allergy	*(c)* Asthma

5. Name any *three* routes by which allergens normally enter in our body.
6. What are allergens ? Name any *three* allergens.
7. Name the two tests generally used to diagnose allergy and describe any one of them.
8. Which test is mostly favoured for testing allergy, prick test or blood test ? Why ?

PROJECT

When a person goes to areas of higher altitudes, he/she suffers form shortness of breath. Will you consider it as an allergic reaction or not ? Why ? Discuss in the class.

SCIENTIFIC TERMS TO REMEMBER

AEROBIC	:	In the presence of oxygen.
AEROBIC RESPIRATION	:	Respiration in which oxygen is used for the complete oxidation of glucose with the formation of CO_2, water and a good amount of energy.
ANAEROBIC	:	Absence of oxygen.
ANAEROBIC RESPIRATION	:	Respiration in the absence of oxygen, is the incomplete break-down of glucose into ethanol and CO_2, and releases only small quantities of energy.
ANGIOSPERMS	:	Flowering plants bearing seeds inside fruit.
ANNELIDS	:	Animals having segmented bodies.
ARBOREAL	:	Animals which live on trees.
ARTHROPODS	:	Animals having many joints in their bodies. *For example* – insects.
ANTAGONISTIC	:	Opposite in the function.
AUTOTROPHS	:	All green plants which are capable of preparing their own food with the help of CO_2 and H_2O, in the presence of sunlight.
BALANCED DIET	:	A diet supplying all the nutrients in the right quantity according to the needs of the body.
BRYOPHYTA	:	A word used for mosses (*bryon* = moss, *phyton* = plant). They have stems and leaves but no roots.
CEREBELLUM	:	Located at the base and under the cerebrum, and concerned with the muscular coordination and balance of the body.
CEREBRUM	:	The largest portion of the brain concerned with intelligence and consciousness.
CILIA	:	Tiny, delicate, hair-like outgrowths over the entire body of Paramecium for swimming.
COLLENCHYMA	:	It is made up of parenchymatous cells which are elongated and are thick at the corners.
COMMUNITY	:	It is the population of different species found in a particular place.
CONNECTIVE TISSUE	:	It connects various other tissues and organs, providing support to different organs to keep them in proper position.
CORTEX	:	The dark coloured outer area of the kidney.
CRUSTACEA	:	A subdivision of arthropods that have head and thorax fused, *e.g.*, crabs, prawns, etc.
CRYPTOGAMS	:	Flowerless plants like thallophytes, mosses, ferns that reproduce by means of spores rather than seeds.
CYTOPLASM	:	Semi-liquid, colourless and translucent fluid filled in the entire cell.
DEFICIENCY DISEASE	:	A disease caused due to insufficient supply of one or more nutrients in the diet.
EPITHELIAL TISSUE	:	It is a thin protective layer of cells, which covers the surface of the body and forms the lining of various body cavities and internal organs.
EXCRETION	:	Removal of harmful or unwanted substances (metabolic waste products) from the body.

EXPIRATION	:	Expelling air out of the lungs.
FERMENTATION	:	Process by which yeast converts sugary solution into ethanol and carbon dioxide with the help of enzymes.
FLAGELLUM	:	Long, thread-like structure that extends out through the anterior part of the cell as in Euglena for swimming.
GLOMERULUS	:	Mass of blood capillaries lying within the Bowman's capsule of a nephron.
HERBIVORE	:	An animal feeding on plants.
HETEROTROPHS	:	All animals which depend on plants indirectly for nutrition.
IMPULSE	:	A wave of electrical disturbance that runs through the nerves.
INSPIRATION	:	Drawing air into the lungs.
INVERTEBRATES	:	Animals without backbone.
LIGAMENT	:	A connective tissue which connects a bone to another bone.
LOCOMOTION	:	Movement of the entire body of the animal from one place to another for water, food and shelter.
MEDULLA	:	The light coloured inner area of the kidney.
MERISTEMATIC TISSUE	:	It consists of actively dividing cells to produce more cells leading to growth.
MOLLUSCS	:	Animals having soft bodies, enclosed in a hard shell, such as snail, pearl, octopus, etc.
MULTICELLULAR	:	Many – celled organism.
NEPHRON	:	The structural and functional unit of kidney.
NEURON	:	The structural and functional unit of the nervous system.
ORGANISATION	:	It is the manner in which small units of any structure or system are arranged into larger ones and the larger ones into still larger ones in hierarchy, where the units of each level coordinate with one another towards a particular goal.
PARASITE	:	An organism which lives in or on the body of another organism for its food and shelter.
PARENCHYMA	:	It is composed of large thin-walled cells, usually with a small vacuole.
PERMANENT TISSUE	:	It consists of differentiated or specialised cells which have lost their ability to divide, and perform a particular function.
PHANEROGAMAS	:	Flowering plants which bear seeds and fruits.
PHLOEM	:	It is formed of living tubular cells which provide a passage for the downward movement of food manufactured in the leaves to various parts of the plant.
PHOTOSYNTHESIS	:	A process by which plants prepare their food (starch) by using water and carbon dioxide in the presence of chlorophyll utilising sunlight as a source of energy.
PORIFERANS	:	Animals (sponges) having pores on their bodies.
PROTOPLASM	:	The colourless living substance contained in the cell, *i.e.* cytoplasm along with nucleus and other cell organelles.
PSEUDOPODIUM	:	Finger-like projection of the body of amoeba for locomotion.
PTERIDOPHYTA	:	A word used for ferns (*pteron* = feather, *phyton* = plant). The leaves of ferns are often large and look like feathers.

SCLERENCHYMA	:	Plant tissue composed of long, narrow and thick cells. These are dead cells, providing strength to plant parts.
SETAE	:	Tiny, curved bristles projecting out of the earthworm's skin, which help in providing grip while crawling.
STOMATA	:	Minute pores in the leaf through which air enters into the leaf, and water gets evaporated from it in the form of water vapour.
STIMULUS	:	Any agent or change in the environment that usually results in some activity of the body.
SYNOVIAL FLUID	:	The lubricating fluid found between the two bones at a movable joint.
TENDON	:	A connective tissue which connects muscles to bones.
THALLOPHYTA	:	Organisms which possess undivided bodies named as thalli, *e.g.*, bacteria, fungi and algae.
TISSUE	:	It is a group of cells which are similar in structure and perform the same particular function.
TUBE FEET	:	Tiny, tubular retractile structures, ending in a sucker. These are the locomotory organs of starfish.
UNICELLULAR	:	Single — celled organism.
URETER	:	The duct connecting the kidney with the urinary bladder.
URETHRA	:	The duct which takes the urine out from the urinary bladder to the outside of the body.
VERTEBRATES	:	Animals having backbone.
XYLEM	:	It is formed of thick-walled, tubular and often dead cells which are placed end to end like drain pipes, and transport water and minerals absorbed by the roots from the soil.