PREFACE

Concise Biology Middle School meant for Class VIII 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.

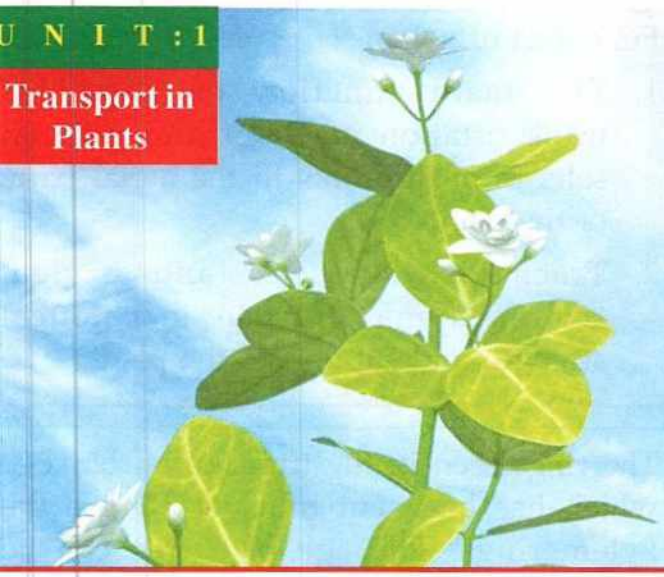
The language of the book has been kept simple. Some scientific terms are unavoidable; still they have been kept at a minimum level. Each chapter has been greatly enriched with lots of activities to perform, tables to fill up and sketches to draw. Further, important questions related to the chapters have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



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TRANSPORT IN PLANTS

SYLLABUS

- Diffusion — definition;
- Osmosis — definition, example semipermeable membrane, root pressure; active transport.
- Transpiration — definition, importance and factors affecting transpiration.
- Structure and function of Xylem and Phloem in detail.
- Importance of minerals: macro and micro-nutrients; three deficiency diseases caused by lack of these essential nutrients.

TRANSPORT IN PLANTS

You have already learnt that plants can prepare their own food by a process called photosynthesis. For this process, plants require carbon dioxide and water. The leaves take in carbon dioxide from the atmosphere. The water along with minerals is absorbed from the soil through the roots. It is then transported upwards to the leaves of the plant.

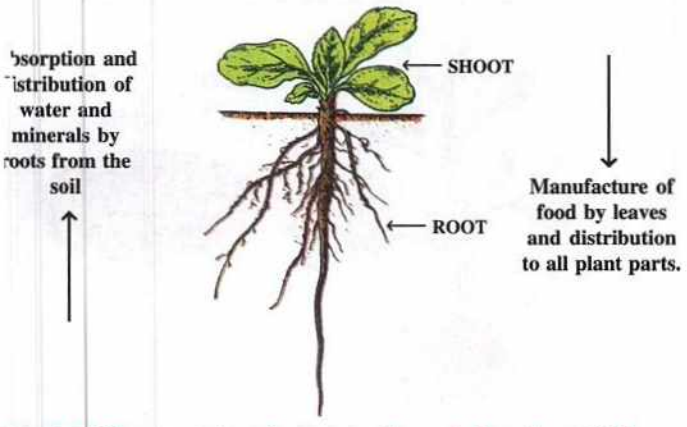


Fig 1.1 The root (underground) and the shoot (above ground) are the conducting systems of a plant

The food prepared by the leaves is transported to all parts of the plant including roots.

Transportation in plants is the process in which substances absorbed or synthesized in one part of the plant are moved to other parts of the plant.

Transportation of water and food in plants is carried out by a **conducting system** consisting of two main tissues — **xylem** and **phloem**. Together, they form the vascular bundle.

THE CONDUCTING OR TRANSPORTING TISSUES

Xylem : This tissue forms a tubular passage to **transport water and mineral salts** from the roots to the aerial parts of the plant.

The xylem tissue consists of *four* types of cells : xylem tracheids, xylem vessels, xylem fibres and xylem parenchyma.

- **Tracheids** are elongated dead cells with tapering ends. Their walls have thickenings with lateral pores. They provide mechanical strength and support to the plant in addition to conducting water upwards.
- **Vessels.** They are tube-like structures open at both ends. They are placed one above the other, to form long channels. Just like tracheids, they provide mechanical support to the plant and conduct water upwards.
- **Xylem or wood parenchyma.** They are small, thick walled, living cells. They store food and also help to conduct water and mineral salts.

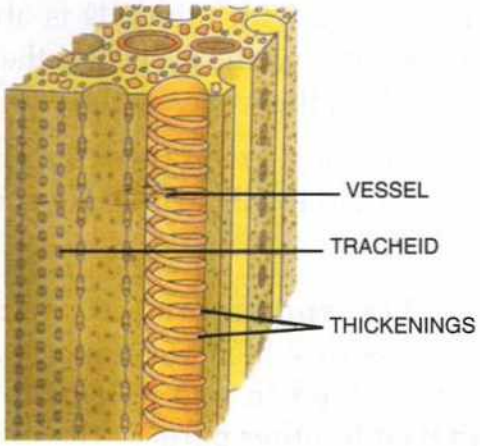


Fig 1.2 L.S. of Xylem

- **Xylem sclerenchyma or wood fibres.** They are thick walled, long, narrow cells with tapering ends. They provide only mechanical support to the plant.

Functions of xylem

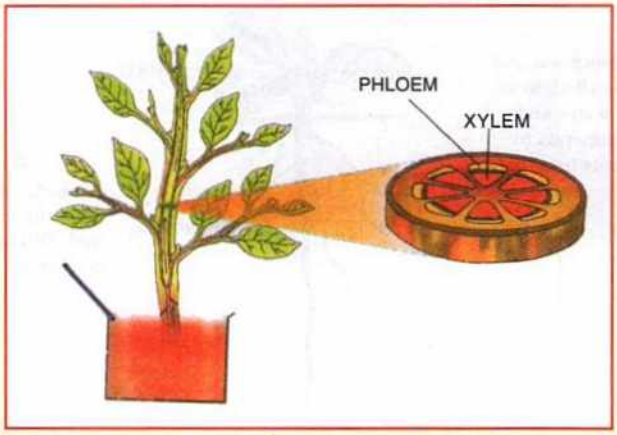
1. The main function of xylem is transportation of water and mineral salts from the roots to the aerial parts of the plant.
2. Tracheids, vessels and xylem sclerenchyma provide mechanical strength and support to the plant.

The rings seen in the trunk of an old tree which has been cut transversely are the xylem rings. The age of a tree can be determined by counting the number of rings.

Activity 1

To study xylem as the water conducting tissue.

Take a soft twig of a flowering plant and put it in a beaker containing water. Add a few drops of red ink to the water. Leave the twig in this water for half an hour. Cut a thin slice of the stem of the twig. Keep this slice of the stem on a glass slide. Put a few drops of water on the slide. Observe the slide under a microscope. You will observe that only the xylem gets stained as water is transported up through xylem.



Xylem conducts water in plants

Phloem : It **transports food** manufactured by leaves to various parts of the plant. It is a part of vascular bundle and along with xylem, phloem also extends along the length of the plant body, in the root, stem, branches and leaves.

The phloem tissue consists of the following *four* types of cells : sieve tubes, companion cells, phloem parenchyma and phloem fibres.

- **Sieve tubes** are formed of cylindrical cells that are devoid of nucleus. They are found arranged in vertical rows, placed end to end. Their end walls are perforated and are called **sieve plates**. Through these sieve plates, food material passes from cell to cell. Thus, sieve tubes play an important role in transporting food.
- **Companion cells** are living, thin walled, elongated cells found attached to the sides of the sieve tubes. These cells help the sieve tubes in the conduction of food.
- **Phloem parenchyma** is formed of thin-walled parenchymatous cells. These cells store food.
- **Phloem fibres** are dead sclerenchyma fibres formed of elongated cells. These fibres provide mechanical strength and support to the plant.

Functions of phloem

1. Phloem transports food prepared by the leaves to all parts of the plant.
2. Phloem parenchyma helps in the storage of food. The phloem sclerenchyma (phloem fibres) provides mechanical support to the plant.

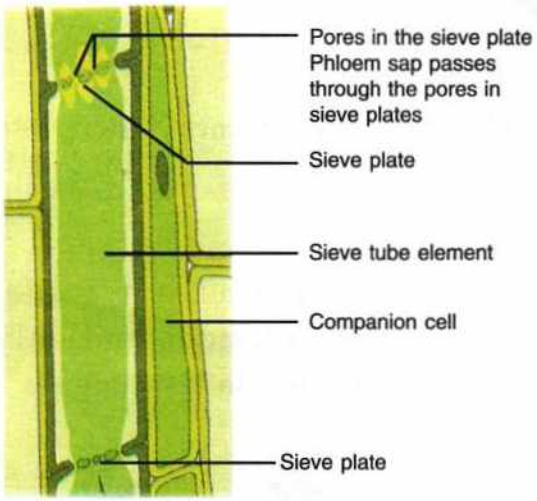


Fig 1.3 L.S. of phloem

Differences between xylem and phloem

Xylem	Phloem
1. Conducts water and mineral salts from the roots to the aerial parts of the plant.	1. Translocates food from the leaves to the storage organs and growing parts of the plant.
2. Made up of tracheids, vessels, xylem prenchyma and xylem fibres.	2. Made up of sieve tubes, companion cells, phloem parenchyma and phloem fibres.
3. Conducting cells (vessels and tracheids) are dead.	3. Conducting cells (sieve tubes) are living.
4. Conduction is unidirectional.	4. Conduction is bidirectional.
5. Conduction does not require any expenditure of energy.	5. Conduction requires expenditure of energy.

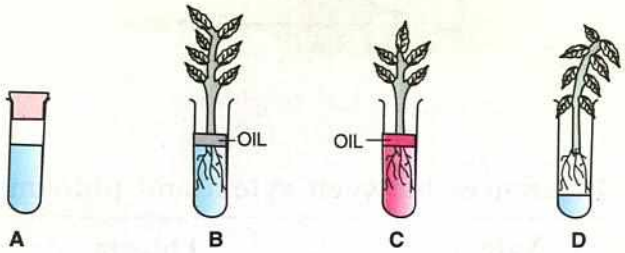
The roots alone can absorb water, whereas the leaves or the stem cannot. This property of the roots can be demonstrated by a simple activity given ahead.

Activity 2

Only the roots absorb water.

Take four test tubes and mark them A, B, C and D.

Fill water in test tubes A, B and C up to about three-quarters, and only a little amount of water in test tube D.



Start of the experiment

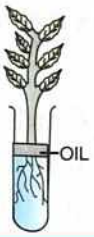
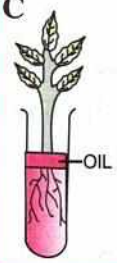
Fix a cork firmly over the mouth of test tube A and leave it.

Take three young small-sized plants such as balsam with their roots intact. Wash their roots under tapwater and insert them in the test tubes B, C and D in a manner that the roots get fully dipped in water in test tubes B and C but remain well above the water level in test tube D.

In C, add a dye (such as pink-coloured carmine) to water. Pour a few drops of oil (like mustard oil) in B and C which will float on the surface and prevent any loss of water by evaporation.

Mark the levels of water in the four test tubes with a marker. Leave this set-up for about 24 hours and look for any change in their water levels.

Result of the experiment

Test Tube	*Observation*	*Conclusion*
A 	Water level remains unchanged.	No loss of water.
B 	Water level falls [not by evaporation from the water surface due to the presence of oil].	Water was absorbed by the plant through its roots dipped in water.
C 	Water level falls just as in tube B, but here, the veins in the leaves have taken up the red colour of water.	Water got into the plant through the roots, and reached the leaves.
D 	The leaves shrivelled up.	The leaves lost water by evaporation, that could not be replaced by absorption through the roots.

Transport of Food

During photosynthesis, the plants produce their food as glucose which is stored in the form of starch. This starch is transported in the form of a sucrose solution through the phloem upwards and downwards to all parts of the plant including its roots. This is also called **translocation of solutes** (food).

WATER ABSORPTION BY THE ROOTS

We are familiar with the absorption of water by blotting paper or by cotton dipped in water. In both cases, water is absorbed by the property of capillarity (attraction of water molecules towards narrow spaces) and surface tension. But the absorption of water by the roots is quite different. To understand it, let us first consider the structure of the roots.

The root system of plants consists of a ***main root***, which gives out ***lateral (branch) roots***. The lateral roots bear a large number of fine outgrowths called ***root-hairs*** (Fig. 1.4).

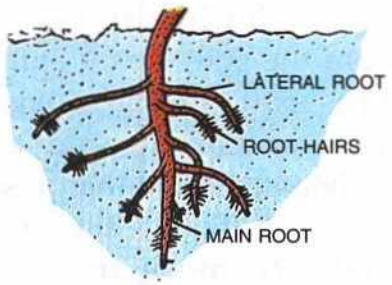


Fig 1.4 Root system of a plant

ROOT HAIR : Given below is a magnified view of a root hair (Fig. 1.5). It is a long protuberance (extension) of an epidermal cell of the root. This cell being a plant cell, has an outer cell wall and an inner cell membrane. The outer cell wall is rigid and the inner cell membrane encloses the nucleus, cytoplasm and its contents.

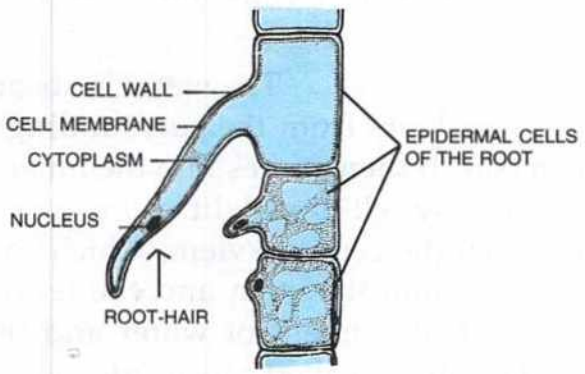


Fig. 1.5 A root hair (highly magnified)

The cell wall is said to be **freely permeable** as it allows all substances to pass through it. The cell membrane is **semi-permeable**. It allows the water molecules to pass through it, but prevents the entry of any larger molecules. This feature of the cell membrane facilitates the movement of water molecules from the soil into the root cells.

The cell sap in the root hair cell is said to be of a high concentration as it contains more solutes compared to the surrounding soil water. This promotes water absorption.

Speciality of root hairs

The root hairs are well-suited for absorbing water from the soil in three ways :

1. The numerous root hairs provide a **large surface area**. More the surface area, greater is the absorption.
2. Root hairs contain cell sap which is of a **higher concentration** than the surrounding soil water.
3. The cell wall is freely permeable, *i.e.*, permits movements of all types of substances. But the cell membrane is semi-permeable. It allows only some substances to pass through it.

The nature of a semi-permeable membrane can be illustrated by the following diagram (Fig. 1.6).

The semi-permeable membrane lies between water on one side (A) and a strong sugar solution on the other side (B). While the sugar solution has a higher

concentration of sugar molecules, there are no sugar molecules in water.

In other words, side A, containing only water molecules is a **dilute solution**, whereas side B, containing sugar solution is a **concentrated solution** as here the water molecules are comparatively less and sugar molecules are more.

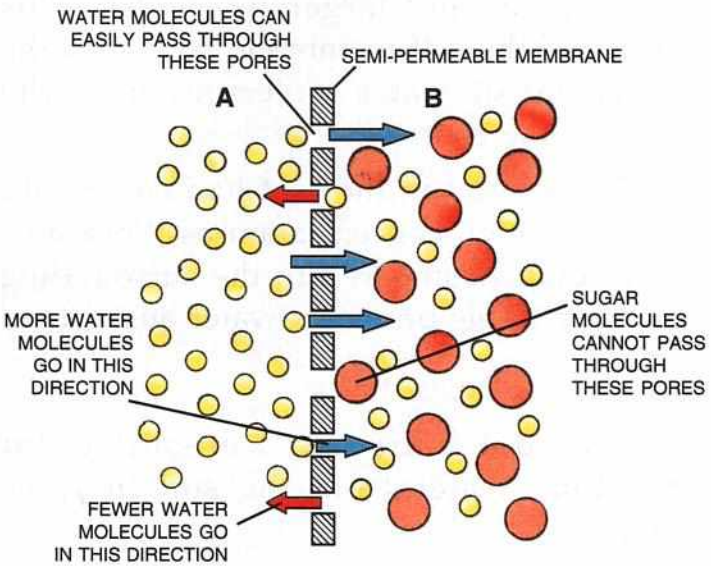


Fig. 1.6 Diagrammatic representation of the nature of a semi-permeable membrane

After a while it will be observed that the level of water on side A decreases, and the level of sugar solution on side B increases. This occurs because water molecules which are more on side A, have moved across to side B, where they are less in number.

The movement of water molecules from a dilute solution to a concentrated solution across a semi-permeable membrane is known as OSMOSIS.

Three types of movements of molecules are seen in plants.

1. **Diffusion** : Soil water and minerals move into the root hair cell by the simple process of **diffusion**. In da time, carbon dioxide diffuses fror the atmosphere into the leaf cell and oxygen diffuses out from th leaf cells into the atmospher during photosynthesis.

   This **movement of molecules — gas, liquid or solid from highe concentration to lower concentratio is called diffusion.**

2. **Osmosis** : It is the **movement o water molecules** from its region o higher concentration *through a semi permeable membrane* to the region o its lower concentration.

3. **Active transport** : The root hair absorb both water and mineral from the soil. Water enters the roo hair cell by osmosis, becaus concentration of water molecules i higher in the soil than inside the roc hairs. But in case of mineral they are more in **concentratio** inside the root hairs than in th soil. These minerals have to b absorbed from a level of lowe concentration (soil) to a level o higher concentration (cell). Thi *movement of molecules from their lowe concentration to a higher concentratio requires energy and is called activ transport*.

Ascent of sap : The water is absorbed b the root hairs from the surrounding soil b osmosis. It then moves into the inner cells o the root by cell-to-cell diffusion and osmosi to reach the central xylem, which continue upward into the stem and the leaves. Thi upward movement of water and mineral (called sap) is called **ascent of sap**.

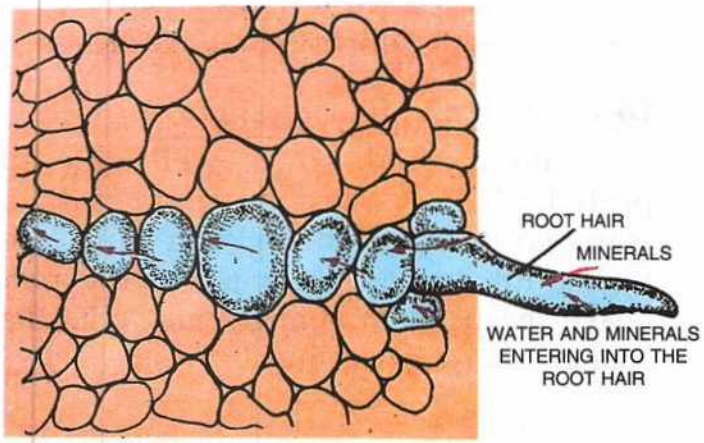


Fig. 1.7 Movement of water along with minerals in a plant

Root pressure : It is the pressure developed in the root due to the continuous inflow of water because of cell-to-cell osmosis. As a result of this pressure, water enters the xylem vessels and helps in pushing the plant sap upwards. Thus, root pressure is one of the forces which contributes to the ascent of sap through the stem into the leaves upto a certain height.

TRANSPIRATION

You have learnt that plants continuously absorb water through their roots. This water is distributed through the stem to all parts of the plant, including the leaves. Only a little amount of water is either retained in the plant or utilised by it during photosynthesis. The rest of it gets evaporated into the atmosphere as water vapour through the stomata present in the epidermis of the leaves by a process called **transpiration**.

Transpiration is the loss of water in the form of water vapour from the aerial parts of a plant.

As a result of transpiration, a suction force is created in the xylem vessel. This force causes the water to be pulled up from the xylem in the roots to the stem and then to the leaves. This pulling force is called the **transpirational pull**. This is very important in tall trees where an upward conduction of water takes place upto a height of 100 m or more.

Xylem tissues are in the form of capillary tubes, where narrower the diameter, greater is the force of movement of water molecules upwards. Whenever the xylem vessels lie empty, such as during the loss of water by transpiration, the water from below rises into them by a **capillary force**. Water molecules are pulled up due to their tendency of remaining joined together (cohesion) and stick to the sides of the xylem vessels (adhesion).

Factors affecting the rate of transpiration

The following main factors affect the rate of transpiration :

1. **Sunlight :** During daytime, the rate of transpiration is faster. This is because the stomata remain open to allow the inward diffusion of carbon dioxide for photosynthesis. During night time, the stomata remain closed and hence transpiration hardly occurs.
2. **Temperature :** Transpiration is faster on hot summer days due to faster evaporation of water.
3. **Wind :** Transpiration is more when the wind is blowing faster as water vapour moves away faster from the surface of leaves.
4. **Humidity :** Transpiration is reduced if the air is humid. Air cannot hold any water molecules when it is already laden with moisture (humidity).

Importance of transpiration in plants

1. **Cooling effect :** In transpiration, water gets evaporated from the plant. The heat required for this evaporation is obtained from the plant itself (latent heat) and thus the plant is able to cool itself, when it is hot outside.
2. **Transpiration helps in maintaining the concentration of the sap inside the plant body :** The roots continue to absorb water from the soil. If excess water is not evaporated out, the sap would then become dilute, preventing further absorption of water along with the minerals required by the plant.

Uses of water in the plant

The water absorbed by the roots is important for the plant in three main ways — Transportation, food production and cooling.

1. **Transportation.** The water in the plant body, both in xylem and phloem, transports substances in a solution form from one part to another.
2. **Food production.** Water is required for photosynthesis. It combines with carbon dioxide from the air in the presence of sunlight and chlorophyll to produce glucose and oxygen.
3. **Cooling.** The heat utilized when water is transpired from the surface of leaves in the form of water vapour induces a cooling effect.

You must have experienced that standing under a tree during a hot summer midday, gives you a cooling effect. This cooling is not entirely due to shade, but also due to the loss of water from the surface of the leaves by evaporation. Since evaporation produces coolness, it makes the air cool. The cool air being heavier, tends to settle down and makes the surroundings pleasant.

Activity 3

To demonstrate transpiration.

Take a small-sized, well-watered potted plant. Cover the plant with a transparent polythene bag and tie its mouth around the base of the pot. Leave the plant in sunlight and note the change after a few hours.

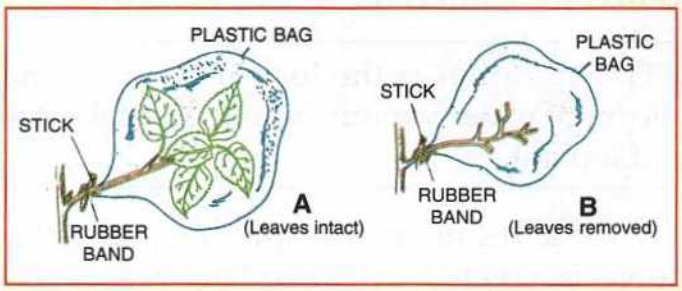
Release of water vapour by the plant

You will see drops of water on the inside surface of the bag, which have appeared due to the condensation of water vapour given out by the plant. The experiment gives better results when it is hot and sunny outside.

Activity 4

To demonstrate that the plants lose water through leaves.

Take one small-sized, well-watered potted plant having a few branches. Place a polythene bag over its one branch as shown in Fig. (A) and tie it with a rubber band.



The plant loses water by the leaves

Remove all the leaves from another branch Fig. (B) of the same plant, cover this too with a polythene bag and tie it with a rubber band.

Place the plant in sunlight, and observe it after 4-6 hours. You will notice that drops have appeared on the inner surface of the polythene bag over branch A, while no water drop appears on branch B.

Conclusion : This experiment indicates that most water gets evaporated from the plant through its leaves.

IMPORTANCE OF MINERALS

Nutrient elements (minerals) are essential for the plants to grow well and complete their life-cycle properly.

The nutrient elements are divided into two broad categories – **macronutrients** (*macro* : large) required in larger concentrations, and **micronutrients** (*micro* : small) required in very small amounts. All of the nutrient elements are obtained from the soil.

Activity 5

To study factors affecting the rate of transpiration.

Take two small potted plants of same type having equal number of leaves. Leave one plant undisturbed. In another plant, apply vaseline on either surface of all leaves. Leave both the plants at same place in sunlight. Observe and compare the plants after 4-5 hours and record your observations.

Plant with vaseline applied on its leaves appeared wilting because transpiration which is necessary for gaseous exchange and water transport in the plant could not take place.

Some of the macro- and micro-nutrients, their occurrence in the plants and their deficiency symptoms are given in table 1.1 below. There are several other deficiency diseases under each category which are beyond the scope of the syllabus.

Table 1.1 : Macro-nutrients and micro-nutrients for the plants

Nutrients	*Role in the Plant*	*Major Deficiency Symptoms*
Macro-nutrients		
1. Nitrogen (N)	Major constituent of all proteins.	Yellowing of leaves, wrinkling of cereal grains.
2. Phosphorus (P)	Constituent of cell membrane and certain proteins.	Purple and red spots on leaves, delay in seed germination.
3. Potassium (K)	More abundant in growing tissues, involved in the opening and closing of stomata.	Poor growth with reduced rate of transpiration.
Micro-nutrients		
1. Iron (Fe)	Constituent of some proteins.	Yellowing of leaves.
2. Manganese (Mn)	Constituent of some enzymes.	Yellowing of leaves, with grey spots.
3. Zinc (Zn)	Constituent of plant hormones, activates enzymes.	Deshaped leaves, yellowing of leaves, stunted plant growth.

REVIEW QUESTIONS

Multiple Choice Questions :

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

(a) Diffusion occurs when molecules move :

- *(i)* from lower concentration to higher concentration. ☐
- *(ii)* from higher concentration to lower concentration through a membrane. ☐
- *(iii)* from higher concentration to lower concentration. ☐
- *(iv)* when energy is used. ☐

(b) Ascent of sap in plants takes place through :

- *(i)* Cortex ☐ *(ii)* Epidermis ☐
- *(iii)* Xylem ☐ *(iv)* Phloem ☐

(c) If the xylem vessels of a plant are plugged :

- *(i)* The leaves will turn yellow ☐ *(ii)* No food will be made ☐
- *(iii)* The plant will wilt (shrivel) ☐ *(iv)* The plant will continue to grow ☐

(d) Force responsible for the ascent of sap is :

- *(i)* Capillary force ☐ *(ii)* Root pressure ☐
- *(iii)* Transpirational pull ☐ *(iv)* All the three ☐

(e) Raisins swell when put in :

- *(i)* Rain water ☐ *(ii)* Saline water ☐
- *(iii)* Mustard oil ☐ *(iv)* Saturated sugar solution ☐

(f) The root hairs are suited for absorbing water from the soil because :

- *(i)* They have a large surface area. ☐
- *(ii)* They have a semi-permeable membrane. ☐
- *(iii)* They contain a solution of higher concentration than the surrounding water. ☐
- *(iv)* All the three. ☐

(g) Transpiration is defined as

- *(i)* the rise of water up to the stem of a plant. ☐
- *(ii)* the elimination of water with dissolved water products. ☐
- *(iii)* the loss of water as water vapour from the aerial parts of a plant. ☐
- *(iv)* the loss of water as water vapour from the roots as well as the leaves of the plant. ☐

(h) Which one of the following favours the fastest transpiration rate ?

(i) A cool, humid, windy day ☐ (ii) A hot, humid, windy day ☐

(iii) A hot, humid, still day ☐ (iv) A hot, dry, windy day ☐

Short Answer Questions :

1. An experiment was set up as shown in the figure below. After some time, the water level in test tube A fell down but not in test tube B.

Why was there a fall in the water level of test tube A and not in that of test-tube B ?

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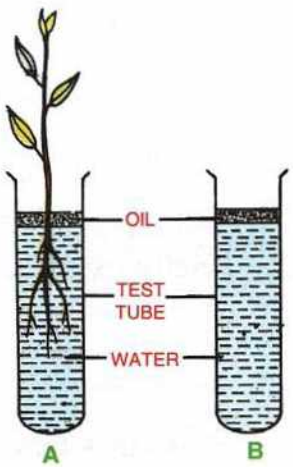

2. How are roots useful to the plants ? Give any *two* points.

(i) .....

(ii) .....

3. What do xylem vessels carry ?

.....

4. Name the plant tissue which helps in carrying the food to different parts of a plant.

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5. Define the terms : *(a)* semi-permeable membrane *(b)* osmosis.

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6. Under what conditions do a plant transpire *(a)* more quickly and *(b)* most slowly ?

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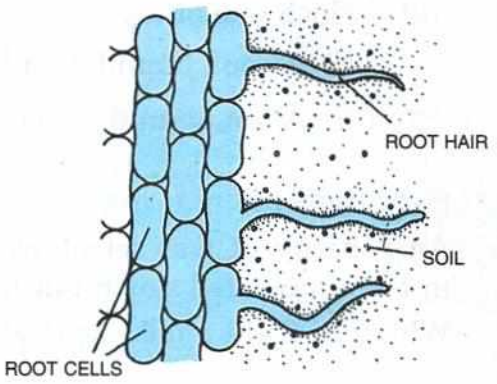
7. Given alongside is an enlarged diagram of a part of the root. Draw arrows on the diagram to show the movement of water passing through different parts.



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8. Why is the structure of a root hair considered suitable for absorbing water from the soil ?

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9. Briefly explain, how transpiration helps in the upward conduction of water in plants ?

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10. How does temperature, light intensity and wind affect transpiration ?

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11. The set up shown alongside was kept in sunlight for an hour. It was observed that drops of water appeared on the inside surface of the polythene bag.

(a) Name the process which is being demonstrated.

.....

(b) Why was the pot with its soil left uncovered by the polythene bag ?

.....

(c) Why was the pot left in sunlight ?

.....

(d) Suppose that the pot in this experiment was placed inside a dark room instead of placin it in sunlight for some time. What difference would be noticed ?

.....

12. State whether the following statements are *True* or *False*. Rewrite the false statements correctly

(a) Water absorption mainly occurs through the root-hair.

(b) Water enters the root-hair by osmosis.

(c) Water absorbed by the roots reaches the leaves and is used in producing food for the entire plant.

(d) A semi-permeable membrane allows larger molecules to pass through, but prevents the smaller ones.

(e) Transpiration is the loss of water from the roots of the plant.

(f) Transpiration cools the plant when it is hot outside.

13. Fill in the blanks with suitable terms given below :

(fast, leaves, conducting, ascent, humid)

(a) Transportation in plants is carried out by a ..... system.

(b) The upward movment of sap that contains water and minerals is called ..... of sap.

(c) Transpiration is more when the wind is blowing ..... .

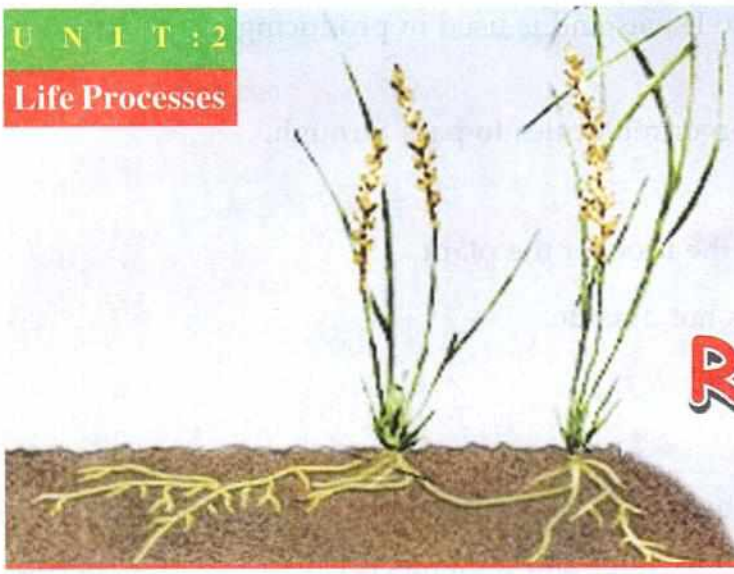
(d) Most water gets evaporated from the plant from its ..... .

(e) Transpiration is reduced if the air is ..... .

Long Answer Questions (Write the answers in your notebook) :

1. Draw a magnified view of the root hair, and describe how it helps in the absorption of water from the soil ?
2. How does transpiration help the roots absorb water and minerals from the soil ?
3. Define the three processes by which plants absorb water and minerals from the soil.
4. How the water absorbed by the roots is important for the plants ?
5. Name the factors that affect the rate of transpiration. State their role in each case.
6. Mention the *two* ways in which transpiration helps the plants.
7. Describe an experiment to show that the plant loses water through its leaves.
8. Name any *three* minerals whose deficiency causes diseases in plants. Give the symptoms of each deficiency.
9. List out the differences between xylem and phloem.

UNIT : 2
Life Processes



2 REPRODUCTION IN PLANTS

SYLLABUS

Types of Asexual reproduction :

- Binary fission, budding, fragmentation, spore formation, vegetative propagation, artificial propagation by tissue culture (basic process along with a suitable example of each)

Sexual reproduction in Plants :

- Review of parts of a typical flower (4 whorls and their structure and function),
- Pollination : self and cross.
- Agents of pollination : three characteristics of plants pollinated by insects, water and wind (with examples). Characteristics of flowers of each kind.
- Fertilization process in brief by flow chart.
- Mention of artificial pollination.

REPRODUCTION

All living organisms produce individuals of their own kind for the survival of their species. This is called **reproduction**.

> Reproduction means producing young ones of the same kind.

Modes of reproduction in plants

They are broadly grouped into *two* types —

(i) Asexual reproduction

(ii) Sexual reproduction

In **asexual reproduction**, only one parent is involved and there is no formation or fusion of the male and female sex cells (gametes).

In **sexual reproduction**, two parents are involved and there is formation and fusion of the male and female gametes.

Asexual reproduction in plants

Lower organisms like bacteria and plants like algae, fungi reproduce asexually by fission, fragmentation or by the formation of spores. In some higher plants, the vegetative parts of the plant like the root, stem or leaf

lso help in producing new plants. This is alled **vegetative propagation**.

1. **Binary fission :** Lower organisms like bacteria, reproduce asexually by the method of binary fission (binary means 'two' and fission means 'splitting'). In this method, the nucleus splits or divides into two and then the cell splits across the middle, forming two small identical cells called the **daughter cells**. (Fig. 2.1).

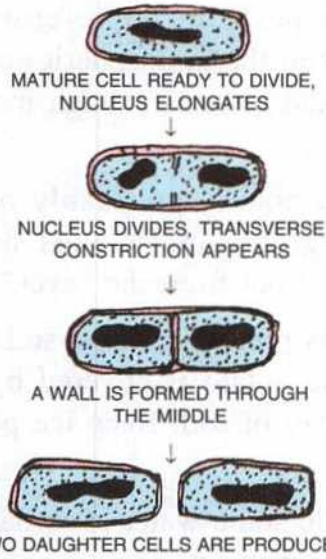


Fig. 2.1 Binary fission in bacteria

In some organisms, like *Chlorella* and *Chlamydomonas*, one cell divides into four daughter cells. This process is called **multiple fission**.

2. **Budding :** This method is common in yeast. Here, the parent cell produces an outgrowth called a bud. The bud grows, and then gets detached (along with its daughter nuclei) from the parent body to lead an independent life.

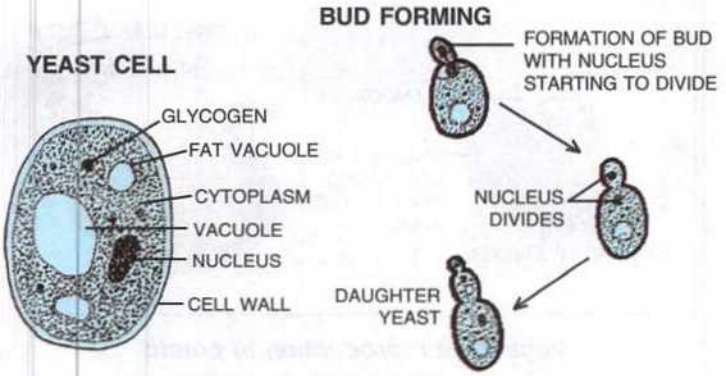


Fig. 2.2 Stages of budding in yeast

3. **Fragmentation :** In organisms such as *Spirogyra* which are made of long, ribbon-like filaments, one filament grows and breaks off into two or more parts called **fragments**. Each fragment then regrows into an individual. This type of reproduction is called fragmentation.
4. **Spore formation :** Spore formation is common in plants like mosses and ferns. These are ornamental plants and bear spores on the underside of their leaves. The spores are light and can be carried away by wind or insects to different places. On reaching suitable conditions for growth, spores germinate giving rise to new plants.
5. **Vegetative reproduction :** New plants can be produced by certain parts of a plant such as the leaf, stem and root. These vegetative parts of a plant that are capable of giving rise to new plants are called **propagules** and the process is known as vegetative propagation. Vegetative propagation can either be natural or artificial.

NATURAL VEGETATIVE PROPAGATION

1. Reproduction by Stem

The stems of common grass and mint grow horizontally parallel to the ground. New roots and shoots develop at their nodes. These roots grow downward into the soil and the shoot upward to form new plants.

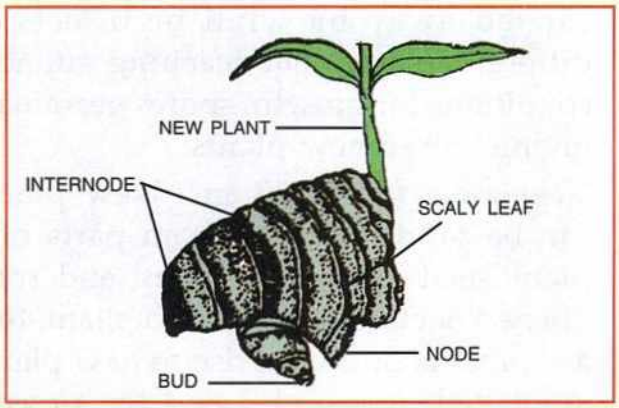
Ginger is a modified stem. It has nodes and internodes. It also has scaly leaves. You can also see some axillary buds growing out from the nodes. The farmers grow ginger from small pieces of ginger containing these axillary buds.

Activity 1

To grow ginger by vegetative reproduction.

- Take a healthy piece of ginger. Remove one small piece from it. Place the piece in moist soil in a flower pot.
- Watch this set-up for 8–10 days; sprinkle some water everyday over the soil to keep it moist.
- In due course of time, the axillary buds grow into aerial shoots to form new plants.

  (Perform this activity in warm humid season).



Vegetative reproduction in ginger

Conclusion :

- Ginger has nodes and internodes, and the nodes carry thin, dry, brown papery scaly leaves.
- Axillary buds grow out from the nodes to produce new plants.

Similarly, potato is another example of a modified stem. Potato bears vegetative buds called the "eyes". Cut a piece of potato with an "eye". Put this piece in moist soil. New plants grow from these buds within a few days. Potatoes kept in humid warm months may grow out shoots. If placed in soil, they form complete plants.

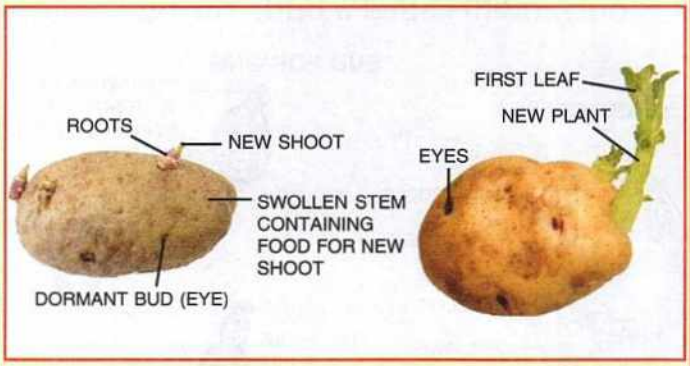
Ginger, potato and onion are called modified stems because they perform additonal functions of food storage and vegetative propagation.

Activity 2

To grow potato by vegetative reproduction.

[Growing of potato by the vegetative method should be performed preferably in those months when the atmospheric temperature is moderate and there is enough moisture in the atmosphere].

- Take a potato, preferably one in which some green, leafy buds have already sprouted out from the "eyes".
- Put this potato in moist soil in a manner that the potato is covered by just a very thin layer of soil. Keep the pot in a shady place.
- Sprinkle some water everyday on the soil to keep it moist.
- Observe the set up for 7-8 days.
- Each green leafy bud grows into a new plant.
- Each new individual plant together with some tuber parts, can be separated from the rest and grown separately.



Vegetative reproduction in potato

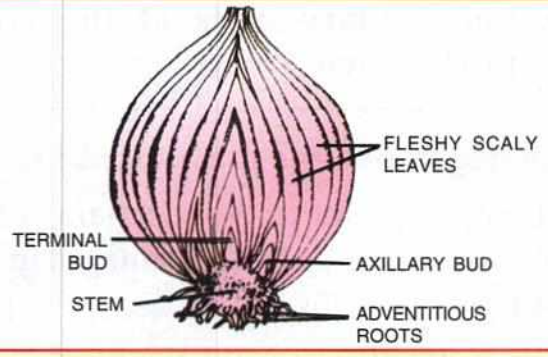
Activity 3

To grow onion by vegetative reproduction.

- Take a healthy onion bulb and put it in moist soil in a flower pot.
- Sprinkle some water everyday over the soil to keep it moist; watch for 8–10 days
- In due course of time, the axillary buds (protected by fleshy scaly leaves) grow into aerial shoots to form new plants.

Conclusion :

- Onion bulb has a thick, short, stem in the form of a condensed disc (visible in a vertical section).
- The disc bears fleshy overlapping scaly leaves for storing food material.
- The disc-like stem bears terminal and axillary buds.
- The axillary buds grow into new green aerial shoots under favourable environmental conditions.



An onion bulb has been shown in vertical section

2. Reproduction by Leaf

Leaves of some plants, such as *Bryophyllum*, produce buds in the notches in their margins. When such leaves fall in moist soil, their buds in the margins begin to grow as young tiny plants.

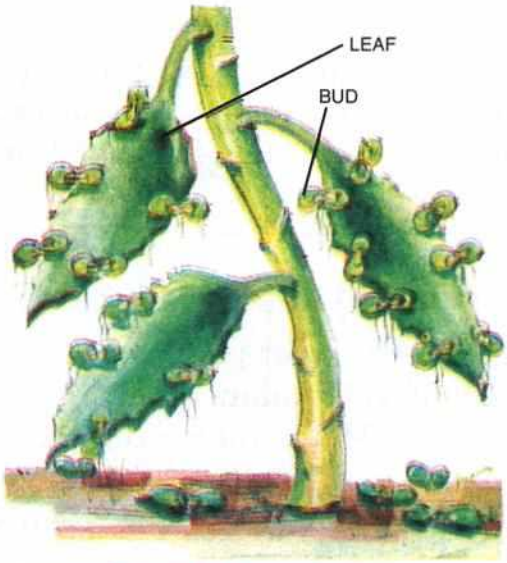
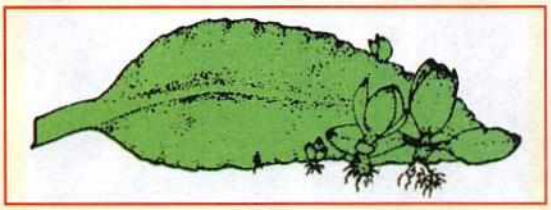


Fig. 2.3 Bryophyllum

Activity 4

To grow bryophyllum by vegetative reproduction.

- Take a full grown leaf of ***bryophyllum*** with some adventitious buds growing out from its margin.
- Cut the leaf into bits, each containing a growing adventitious bud.
- Put these bits in a flower pot and cover them under moist soil keeping the emerging buds just projecting out from the surface.
- Observe after 10–12 days.
- Tiny plants grow out from the buds.



A Bryophyllum leaf with growing axillary buds

Conclusion :

- **Bryophyllum** is a plant whose leaves produce adventitious buds in their margin.
- The adventitious buds grow into new plants under favourable conditions when the leaf with buds falls off from the parent plant.

3. Reproduction by Root

Plants like sweet potato (Fig. 2.4) and asparagus develop numerous large swollen fleshy roots. These roots contain a large quantity of food inside them. Each such single root is capable of giving rise to a new plant.

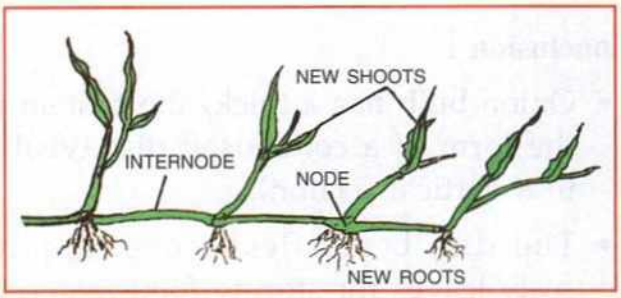
Carrot, a taproot, is a biennial plant. Its roots grow vegetatively in the first year and store food. In the following year, its stem produces flowers and seeds which die by the end of the second year. Buds produced at the base of the old stem just above the tap root are meant for vegetative propagation.

Fig. 2.4 Sweet potato

Activity 5

To grow grass by vegetative reproduction.

- Put a piece of lawn grass in a pot and cover some of its portion with moist soil.
- Leave it for 10–12 days.
- Sprinkle some water everyday over the soil so as to keep it moist.
- After a few days, new grass shoots grow out from the buds at the nodes.



Vegetative propagation in grass.

Conclusion :

- Lawn grass has long internodes between successive nodes, creeping on the surface of the ground.
- From each node, roots are given out.
- The axillary buds at the nodes produce new shoots.

Advantages of vegetative reproduction

Farmers prefer to grow certain crops by vegetative method. The advantages in doing so are the following :

1. Reproduction by vegetative parts takes place in a shorter time.
2. New plants, thus produced, sprea very fast in a small area.
3. It is a surer method of propagation.

4. All the good characters of the mother plant are retained by the daughter plants.

Disadvantages of Vegetative Reproduction

1. As all plants developed by vegetative reproduction are genetically identical, they are all likely to be affected simultaneously if a disease spreads in the farm.
2. Dispersal of plants does not take place on its own. Daughter plants, so developed, tend to remain nearby and are restricted to a particular area leading to competition for resources.

ARTIFICIAL VEGETATIVE PROPAGATION

These days, farmers and horticulturists have developed certain artificial methods of vegetative propagation, such as cutting, layering, grafting and tissue culture.

1. **Cutting :** In this method, the stem is cut into small pieces with each bearing an axillary bud. The cut ends are planted in moist soil. After a few days, they strike roots, and grow into new plants. This method is normally employed for propagating plants like sugarcane, rose, china rose, lemon, *etc.*
2. **Layering :** In this method, a portion of one of the lower branches of the plant with an axillary bud at the node is bent down to the ground so that it touches the soil. A ring of bark is removed from this portion, which is then covered with soil. Some heavy object, such as a small piece of stone or a brick, is kept on the branch so that it does not come out of the soil. In a few days, when the branch gives out roots, it is cut off from the main plant. It then continues to grow out as an independent plant. This method is used for the propagation of plants like mint, rose, jasmine, *etc.*

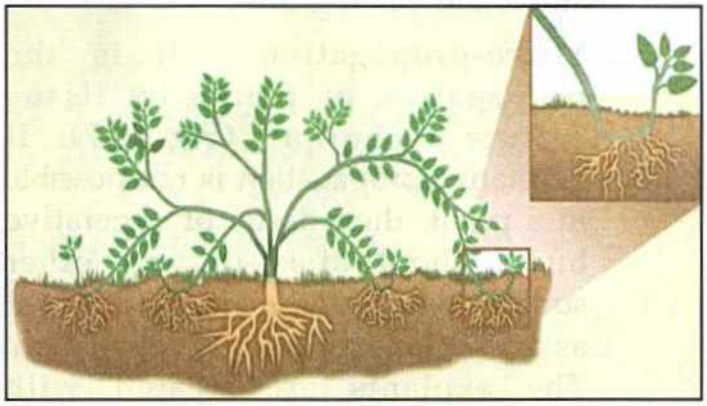


Fig. 2.5 Layering

3. **Grafting :** In some cases, such as rose, mango, guava, *etc.*, a small shoot or bud of a desired variety of plant is intimately fixed on the stem of another plant of the same or related species. The plant receiving the bud or the shoot is called the **stock** and the shoot fixed on it is called the **scion**. For a successful graft, it is important that the cambium layers of the stock and the scion must come into very close contact so that growth may continue. The grafted points are then bound together with tape and the joint is covered with

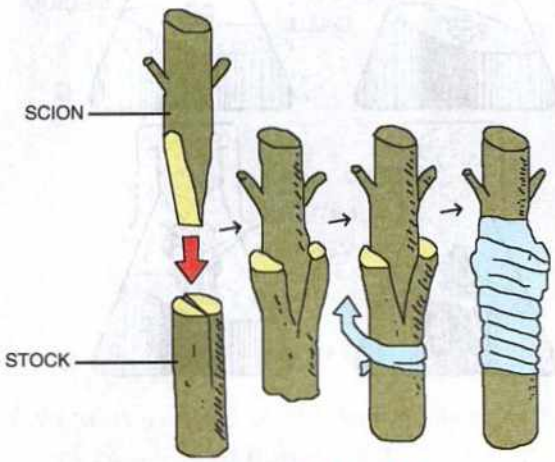


Fig. 2.6 Grafting

wax to prevent dehydration and is protected from any bacterial infection. In a few days, the new cells develop and a new plant grows.

4. **Micro-propagation : It is the propagation of plants by tissue culture technique** (Fig. 2.7). If vegetative propagation is not possible in a plant, then tissue of vegetative buds, shoot apex or any other suitable part of the plant can be used as an **explant** for micro-propagation. The explants are treated with sterilisation chemicals to prevent microbial growth, and then cultured in a particular nutrient medium. Cells grow and divide to form a cell mass called **callus**. Some growth regulators (plant hormones) are added. The callus differentiates into plant parts looking like a tiny plant, called **plantlet**. After 4-6 weeks, the plantlets are transferred to the soil. This can be used to develop and multiply disease-free stock. This technique is being used to grow orchids, *Gladiolus*, *Chrysanthemum*, etc.

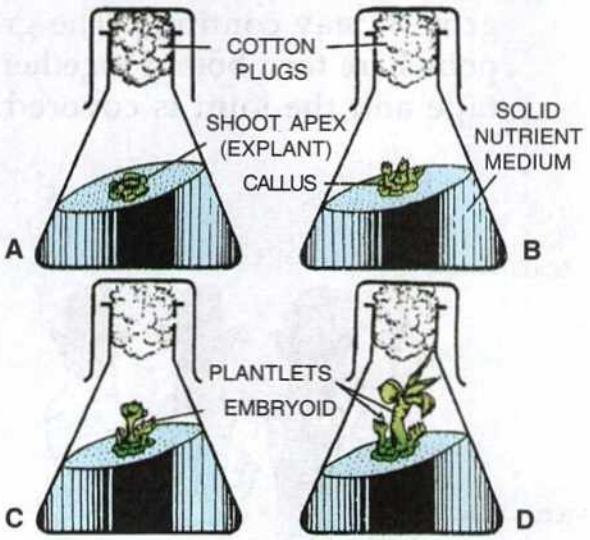


Fig. 2.7 Micropropagation: A. Culture tube with explant; B & C. Differentiation of callus into embryoids; D. Development of plantlets.

Benefits of plant tissue culture technique

- It provides rapid propagation of identical individuals. This technique is very productive for superior varieties.
- It is very useful in cases where seeds are dormant. The embryo in these seeds can be cultured and micropropagated.

Limitations of tissue culture

- It requires a lot of scientific expertise.
- It cannot be applied to all cases.
- It is not easily applicable in remote agricultural areas.

SEXUAL REPRODUCTION IN PLANTS

Most of the plants that you see around bear flowers. These flowers are borne on shoots and serve as the reproductive parts of a plant. They bear male and female reproductive cells, which on fusion produce seeds. The seeds germinate to produce new plants.

The flower is the reproductive part of a plant. To understand how a flower helps in the sexual reproduction in plants, let us study a typical flower.

Examine a fully opened flower and note its different parts. The diagram (Fig. 2.8) shows a general representation of the floral parts of most plants.

Stalk : The flower is attached to the shoot by means of a **stalk** or **pedicel**. The tip of the stalk is enlarged and slightly flattened, from where, the petals and other parts arise. This flattened part of the stalk is called the **thalamus**.

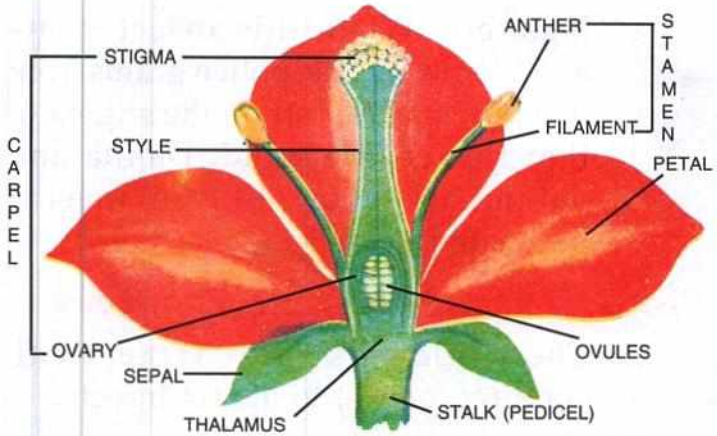


Fig. 2.8 A typical flower with its internal parts

The four whorls of the flower are —

1. **Calyx** : This is the outermost part of the flower forming a whorl of tiny green leaf–like structures called **sepals**. In the bud condition, they enclose the inner parts of the flower providing them necessary protection.

Sepals are the green, outermost part of the flower.

2. **Corolla** : Made up of **petals**, it forms the second inner whorl arranged next to the sepals. Usually, petals are white or coloured but rarely green. The petals make the flower attractive.

Petals are the large, fragrant and brightly coloured parts of the flower.

3. **Androecium** (The male part) : It is the next (third) whorl, inner to the petals, consisting of delicate, thread–like structures called the **stamens**. Each stamen is formed of a long, narrow, thin **filament** and a broad sac–like bilobed **anther** found at its tip. Each anther contains four pollen sacs in which the pollen grains develop. The pollen grains contain the male gametes.

Stamens are the male reproductive parts of the flower.

4. **Gynoecium** (The female part) : It consists of carpels, the fourth innermost part of the flower. It is also called a **pistil**. Each carpel is formed of three parts — a swollen **ovary** at the base, a narrow thread–like **style** in the middle and a terminal expanded **stigma** at the top.

Carpels are the female reproductive parts of the flower.

Ovules : These are the small, rounded bodies present inside the ovary. Each ovule contains an egg cell which later develops into a seed after successful fertilisation.

Flowers bearing both male and female parts are called **bisexual flowers**, while those bearing only male (staminate) or female parts (pistilate) are called **unisexual flowers**.

Function of a flower : It is the reproductive organ of the plant. A flower contains the male parts (stamens) and the female parts (carpels). The pollen grains from the male part are transfered (by air or insects) to the female part of the flower. This transfer of pollen from anther to stigma is called **pollination**.

POLLINATION

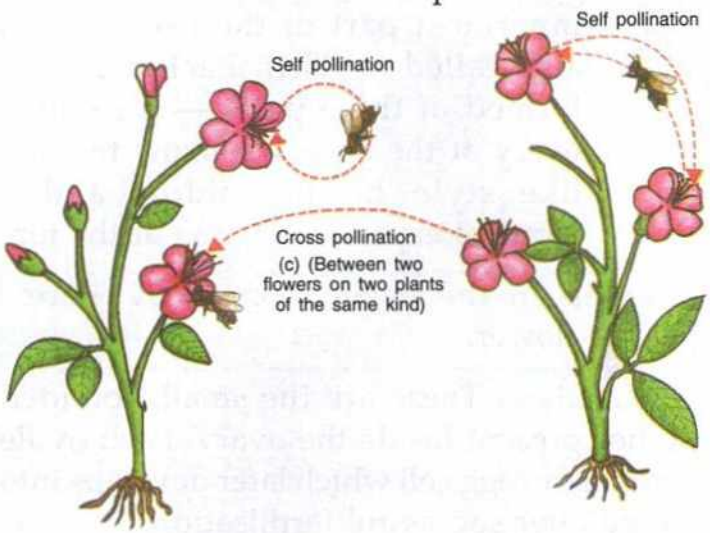
Pollination is the process in which the pollen grains from the anthers are transferred to the stigma of a flower of the same species.

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

1. **Self–pollination** is one that occurs either WITHIN THE SAME FLOWER OR BETWEEN TWO FLOWERS ON THE SAME PLANT.

   Here, the pollen grains from the anthers may fall on the stigma of the

same flower or the stigma of another flower on the same plant.



2. **Cross-pollination** occurs between TWO FLOWERS ON DIFFERENT PLANTS of the same species.

Agents of cross pollination

For cross pollination to take place, an agent has to be available. These agents can be insects, wind or water.

1. **Insects :** When insects help in pollination, such a transfer of pollen grains is called **insect pollination**. Butterflies, bees and other insects visit flowers for nectar (honey). When an insect alights on a flower, the pollen grains stick to its mouth parts, wings, legs, etc. When this insect visits another flower, the pollen grains from its body may fall off on the stigma of that flower. Marigold, Dahlia and Salvia are some of the insect–pollinated flowers.

Fig. 2.9 A nectar–sucking insect is pollinating a Salvia flower

Characteristics of insect-pollinated flowers :

(1) These flowers are **large** with **coloured petals**, to attract insects.

(2) These are **scented** so that insects locate the flowers by smell.

(3) These contain **nectar** as food for insects.

(4) These produce **sticky pollen grains** so that they may stick to the body parts of the insect.

Activity 6

Visit a garden, especially in the season when flowers of various plants are blossoming. Try to locate insect-pollinated plants, such as marigold, mustard, balsam, dahlia, snapdragon, *etc*. and appreciate the variety of colours of the petals of their flowers. You would see a large number of butterflies, bees, *etc*. hovering over the flowers. Insects get attracted towards these flowers because of their bright colours and the sweet fragrance that they produce.

Given here is the picture of a honey bee.

Honey bee with its body covered with pollens

In the picture, you can see its entire body covered with pollen grains. We therefore presume that this bee has returned after visiting and alighting over the flowers in a mustard field. When this bee visits other flowers of the same kind, there is every chance that pollen from its body may fall on their stigma. This is exactly what happens in case of insect pollinated flowers.

Apart from the colour, there are other features of the flowers too which attract the insects and ensure pollination. You will study more about pollination in higher classes.

Certain animals like birds, squirrels, bats, etc., also bring about cross-pollination in flowers of certain plants.

2. **Wind :** When wind is the agent of cross pollination, it is called **wind pollination**. Some plants like maize, palm, pine, *etc.*, produce dry pollen grains in large quantity. When these flowers mature, the pollen grains get blown away by the wind. These pollen grains may fall in all sorts of places and some may even get wasted. But if they happen to fall on the stigma of a flower of the same type, then pollination occurs.

Characteristics of wind-pollinated flowers :

(1) They are usually **small** and are of dull colours.

(2) They generally have **long anthers** protruding out of the flower so that pollen grains may get blown off easily.

(3) They produce a **large quantity of pollen**.

(4) The pollen grains are light so that they are easily carried away.

3. **Water :** Pollination where water acts as an agent of cross pollination is known as **water pollination**. *Vallisneria* is one good example of a water–pollinated flower. These are aquatic plants whose male flowers are submerged in water to start with, get detached when mature, and float on the surface of water. When these floating male flowers happen to come in contact with a female flower, the pollen grains are transferred to its stigma.

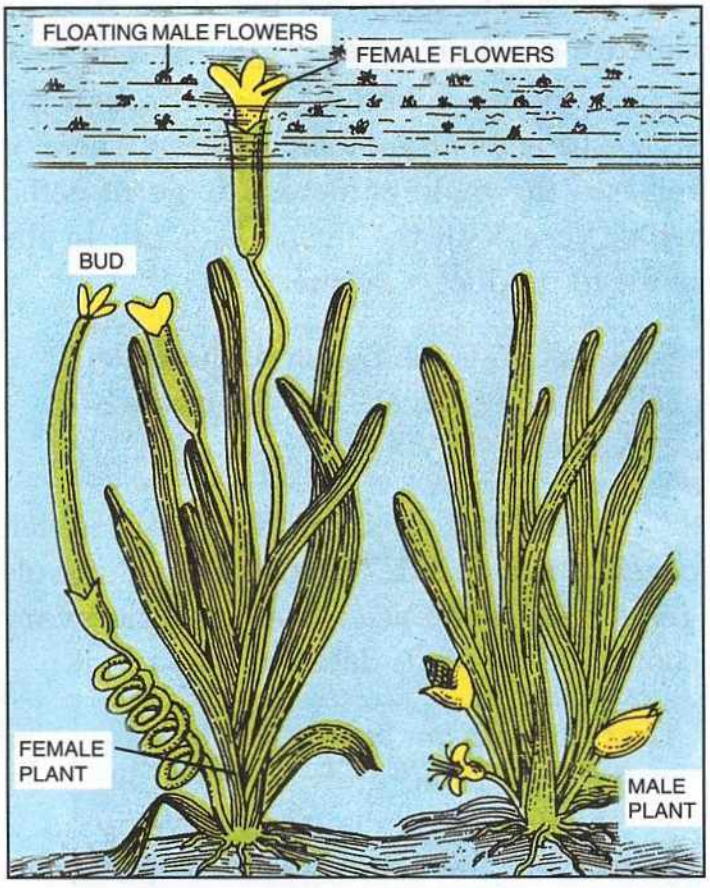


Fig. 2.10 Pollination in Vallisneria
of the pollen grain

LOTUS and TRAPA (Singhara) are aquatic plants, but their flowers are exposed to air and are pollinated by insects.

Characteristics of water-pollinated flowers

- Flowers are small and light so that they can easily float on water.
- Male and female flowers are borne on separate plants.
- Pollen grains are produced in large numbers.

FERTILISATION

(Fusion of male and female sex cells) : After reaching the stigma of the flower of the same kind of plant, the pollen grain absorbs moisture from the stigma's surface and begins to grow a tube. This tube is called the **pollen tube**.

The pollen tube lengthens through the style and enters the ovule in ovary. There, it releases the male gametes (or germ cells) which fuse with the female egg cell in the ovule to produce a **zygote**.

Fertilization is the fusion of the male cell with the female cell to produce a zygote.

The ovule containing the fertilised cell develops into a seed. The covering of the ovule gives rise to the seed coat and the ovary containing the seeds develops into a fruit.

The ovary remains attached to the stalk of the flower and grows into a fruit. The ovules inside the ovary develop into seeds. Other parts, like the sepals and petals fall off.

Fertilisation in flowering plants (flow-chart)

Pollination ↓ *Germination* ↓ *Penetration of the ovule* ↓ *Double fertilisation*

A pollen grain, containing the male gametes, lands on the surface of stigma.

Upon absorbing moisture, the pollen grain begins to grow a pollen tube which starts lengthening in the direction of ovule towards the egg cell.

The pollen tube penetrates the female gametophyte and enter into the ovule.

The two male gametes carried in the pollen tube fertilize the egg nucleus and the polar nuclei in the ovule resulting in the formation of the zygote and endosperm respectively.

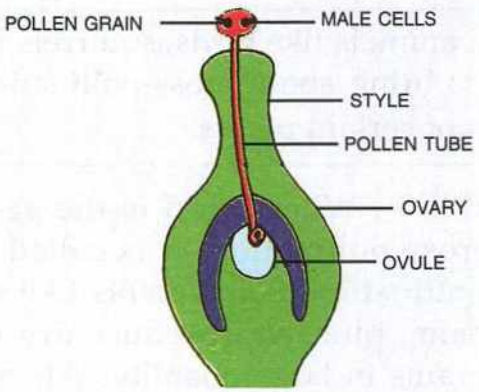


Fig. 2.11 Pollen tube entering the ovule

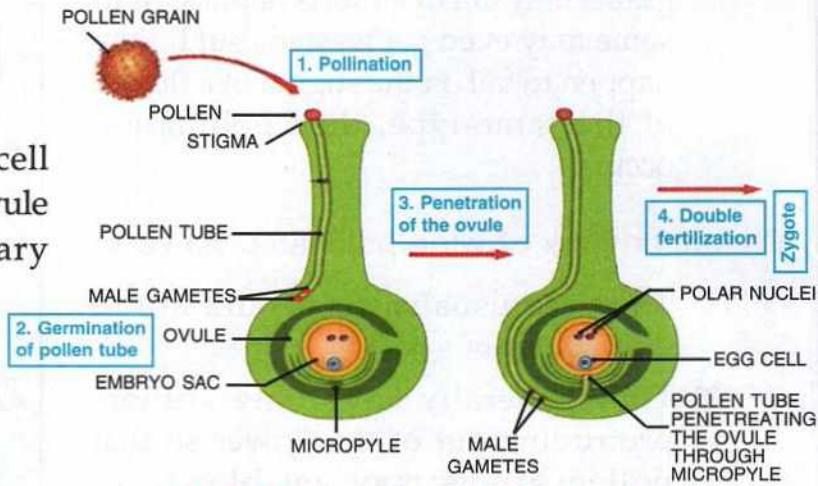


Fig. 2.12 Flow chart showing fertilization

Artificial pollination : Artificial pollination means transfer of pollen grains to the stigma manually. Nowadays, artificial pollination is practised by plant breeders for developing new varieties. The breeders select two different varieties of a crop plant with desired characteristics. *For example*, one variety may be high-yielding and the other may be disease-resistant. Cross breeding between them is done by artifical pollination. After selecting the male and female plants out of the two, the anthers from the flowers of the female plant are removed. These female flowers are then pollinated with the pollen grains taken from the flowers of the male plant. Many high-yielding varieties of rice, wheat, maize, etc. have been produced by this process.

REVIEW QUESTIONS

Multiple Choice Questions :

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

   (a) Pollen is produced in the :

   (i) Filament ☐ *(ii)* Style ☐

   (iii) Pistil ☐ *(iv)* Anther ☐

   (b) Reproductive whorls of a flower are :

   (i) Stamens and carpels ☐ *(ii)* Sepals and petals ☐

   (iii) Sepals and stamens ☐ *(iv)* Petals and carpels ☐

   (c) Grafting is a method of :

   (i) Artificial vegetative propagation ☐

   (ii) Sexual reproduction ☐

   (iii) Artificial pollination ☐

   (iv) Cross-pollination ☐

Short Answer Questions :

1. Write *two* ways in which pollination may occur in plants.

   (a) .....

   (b) .....

2. Name the *three* agents of pollination.

   (a) .....

   (b) .....

   (c) .....

3. Give *two* features of flowers which favour pollination by insects.

   (a) .....

   (b) .....

4. Name *two* characteristics of flowers in which pollination occurs by wind.

   (a) .....

   (b) .....

5. Fill in the blanks by selecting suitable words :

(unisexual, fertilisation, fruit, stamen, anther, bisexual, pollination, seed, ovary)

(a) A flower that bears both the male and the female parts is known as ..... flower.

(b) A flower bearing only male or female parts is known as ..... flower.

(c) Transfer of pollen grains from the anther to the stigma is known as ..... .

(d) Fusion of male cell with the female cell is called ..... .

(e) The ovule develops into a ..... .

(f) The ovary of the flower develops into a ..... .

Long Answer Questions (Write the answers in your note book) :

1. What is vegetative reproduction ?
2. Briefly explain why a gardener prefers to grow certain plants vegetatively ?
3. Why is it disadvantageous to grow plants vegetatively ?
4. What is meant by pollination ? Explain the structure of a germinating pollen grain with the help of a labelled diagram.
5. Imagine all the seeds produced by a plant happen to fall under the same plant and sprout into new plants. Mention any *two* problems that will be faced by the new plants.
6. What is a flower ? Draw a neat labelled diagram showing the L.S. of a typical flower.
7. Write short notes on the following :

   (a) Micropropagation (b) *Bryophyllum*

   (c) Vegetative reproduction (d) Grafting
8. How is artificial pollination useful to plant breeders ? Discuss briefly.
9. With the help of suitable diagrams, describe :

   (a) Binary fission in plants (b) Budding in Yeast cell

PROJECT

- Visit a garden or a park and pluck a flower. Separate and study its different floral parts.

3

REPRODUCTION IN HUMANS

SYLLABUS

- Sexual reproduction in humans.
- Main organs of male and female reproductive system.

Reproduction is the process in which organisms give rise to new individuals of their own kind. Reproduction also helps in the continuance of the species. Different organisms reproduce in different ways.

You have already studied that some single-celled organisms, like amoeba, reproduce simply by dividing into two. Some multicellular animals, like *Hydra*, produce small buds which grow in size, get separated and lead an independent life. These are the **asexual methods** of reproduction (not involving eggs or sperms).

However, most animals reproduce **sexually**. In this process of reproduction, two sexes, *i.e.*, males and females produce special types of reproductive cells, *i.e.* **sperms** and **eggs** respectively, collectively known as **gametes**. The sperm and the egg fuse to form a **zygote**, which develops into an individual resembling its parents.

ASEXUAL REPRODUCTION IN ANIMALS

1. **Fission (Binary fission or multiple fission) :** This is the most common method of reproduction in single-celled organisms, *e.g.*, *Amoeba*, *Paramecium*, *etc.* In amoeba, it results in the division of the parent amoeba into two daughter amoebae (Fig. 3.1). First, the nucleus divides into two, followed by the division of the cytoplasm and then, the two offsprings separate and live as new individuals.

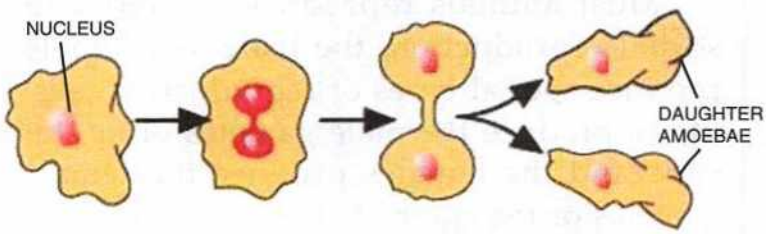


Fig. 3.1 Binary fission in Amoeba

2. **Budding :** Budding is a process in which buds grow on the outside of the parent body (Fig. 3.2). These buds detach themselves when they are big enough for independent existence. Budding is a common method of reproduction in *Hydra*.

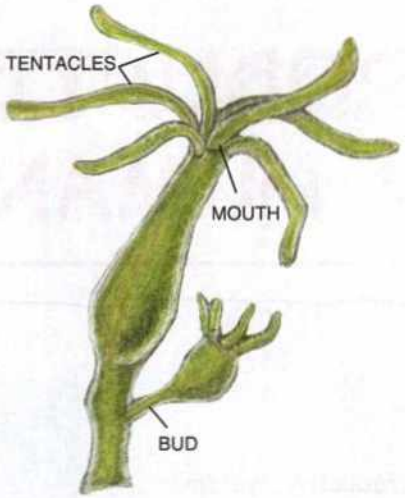


Fig. 3.2 Hydra

3. **Regeneration :** Animals like *Hydra* and starfish have a great power to regrow the missing or lost parts of their body. This process of generating lost parts is called regeneration. Regeneration can also take place for reproductive purposes. *For example*, if we cut *Hydra* transversely into 2-3 pieces, each piece will regenerate and give rise to a new individual. Same is the case with the flatworm *Planaria*. If it is cut into 5-6 pieces, then each piece will develop into a young worm.

SEXUAL REPRODUCTION IN ANIMALS

Most animals reproduce **sexually**. In sexual reproduction, the male and female produce special types of reproductive cells. Males produce the male gametes or **sperm cells** and the females produce the female gametes or the **egg cells (ova)**.

When the sperm fuses with the ovum, fertilization occurs.

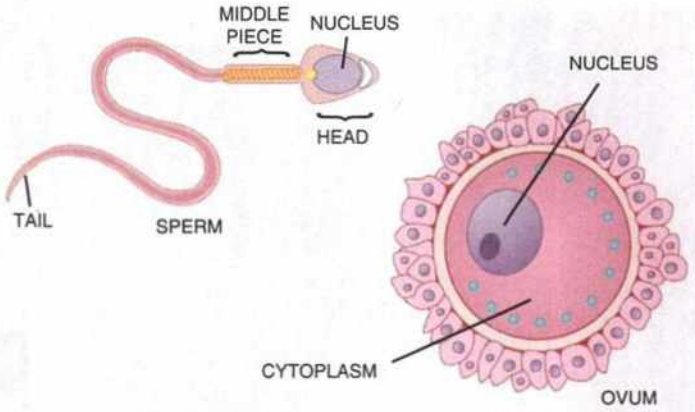


Fig. 3.3 Human sperm and egg

After the fertilisation of an ovum by a sperm, a cell called the **zygote** is formed. The zygote grows by cell division and produces an **embryo**. The embryo finally grows to become a new individual.

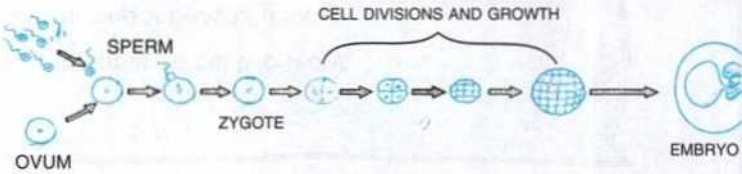


Fig. 3.4 Fertilisation and development

HUMAN REPRODUCTIVE SYSTEM

Female : The eggs are produced in the **ovaries**. The ovaries are two whitish oval bodies, lying within the lower half of the abdomen, one on either side of the **uterus**. The function of the ovary is to produce eggs. Only one egg is produced by an ovary alternatively

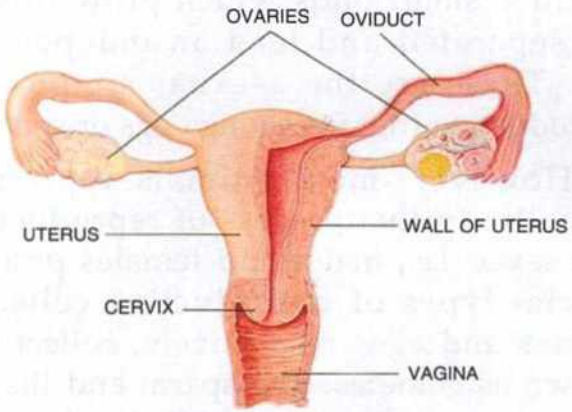


Fig. 3.5 The female reproductive system

every month. A pair of narrow, muscular, long ducts extend from each ovary to the upper part of the uterus. These are called the **oviducts** or **fallopian tubes**. The mouth of these oviducts is expanded to form a funnel-shaped structure. It is through this that the egg enters the uterus when it is released by the ovary.

The **uterus** is a hollow, inverted pear-shaped muscular organ found in the pelvic cavity between the urinary bladder and the rectum. The embryo grows and develops in the uterus.

The uterus opens to the outside through a long, muscular tube called the **vagina**, situated between the rectum and the urethra. The vagina receives the male's penis during copulation and also serves as the birth canal. The urethral opening is seen above the vaginal opening in the region of the vulva.

Male : Sperms are produced in the **testes.** A pair of testes lie outside the abdominal cavity in a sac called the **scrotum.** In such an arrangement, the testes are at a temperature which is 2–3°C lower than that of the body. This is the most suitable temperature for sperm production and development.

The testes consist of a mass of sperm–producing tubes. These tubes join to form ducts leading to the highly coiled **epididymis** found on the upper side of the testes. This in turn leads into a muscular **sperm duct**. The two sperm ducts, one from each testis, open into the urethra, (Fig. 3.6) just below the urinary bladder.

The **seminal vesicles** are a pair of lobulated glands, each opening into the corresponding sperm duct just before they unite with the urethra. The seminal vesicles produce a secretion which serves as a medium for the transportation of the sperms. The mixture of this fluid and the sperms produce a milky fluid, called the **semen**.

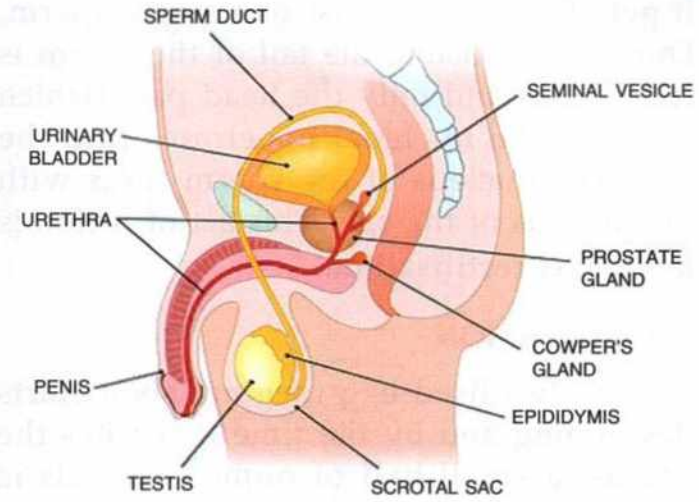


Fig. 3.6 The male reproductive system

At the base of the urinary bladder, encircling the urethra is the **prostate gland**. This pours an alkaline secretion into the semen as it passes through the urethra.

Cowper's glands are two small ovoid glands found below the prostate gland. The secretion of these glands serves as a lubricant.

The urethra passes through the **penis** and carries either urine or semen.

Semen is a mixture of sperms and secretions from seminal vesicles, prostate and Cowper's glands. It is a milky white fluid. Its average amount is 2 – 3 mL in a single ejaculation, and contains 20,000,000 – 40,000,000 sperms.

FERTILISATION

During sexual intercourse, the sperms (present in the semen) are released in the vagina from where they actively swim upwards with the help of their tail. Out of the millions of sperms released into the vagina, only a few of them are able to reach up to the upper parts of the oviducts. The rest die on the way and are absorbed. If there happens to be an egg in the oviduct,

it gets fertilised by just one single sperm. During this fusion, the tail of the sperm is left behind and only the head part (which contains the nucleus) penetrates into the egg. The nucleus of the sperm fuses with the nucleus of the egg. This act of fusion is known as **fertilisation**.

IMPLANTATION

The fertilised egg (zygote) soon starts developing and by the time it reaches the uterus, a small ball of numerous cells is already formed. The embryo forms a pit in the wall of the uterus and gets fixed in it. This natural way of fixing of the embryo in the wall of the uterus is called ***implantation***. This produces the state of pregnancy.

GROWTH

Growth means any type of irreversible increase in the size and weight of an individual during the process of development.

In the growth process, a single-celled fertilised egg *i.e.*, a **zygote** divides and redivides to form a cluster of cells. This division is accompanied by another process *i.e.*, specialisation of cells. The specialisation of cells leads to formation of different parts of the body. This whole process is called **differentiation**. This process also gives rise to various tissues, and further, various organs and organ systems. Thus, the zygote grows into an **embryo**. The embryo soon develops into a baby (foetus).

By the end of five weeks of pregnancy, the embryo is in quite an advanced stage. During this period, the heart and the circulatory system are formed. After two months, limbs are also formed.

BIRTH

The full term of the development of an embryo in the uterus is called **gestation.** In humans, it lasts for about 280 days. At the time of birth, the baby is pushed out with the head oozing out first by the powerful contractions of the muscles of the uterus through the vagina.

REVIEW QUESTIONS

Multiple Choice Questions :

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

(*a*) The testes are located within the :

(*i*) Penis ☐ (*ii*) Scrotum ☐

(*iii*) Ureter ☐ (*iv*) Urinary bladder ☐

(*b*) Amoeba most commonly reproduces by :

(*i*) Budding ☐ (*ii*) Regeneration ☐

(*iii*) Binary fission ☐ (*iv*) Multiple fission ☐

(c) Identify the stage which is formed after the fertilisation of the egg by the sperm ?

(i) Ovule ☐ (ii) Foetus ☐

(iii) Embryo ☐ (iv) Zygote ☐

(d) Internally, the uterus opens into :

(i) Urethra ☐ (ii) Vagina ☐

(iii) Oviduct ☐ (iv) Vulva ☐

Short Answer Questions :

1. Distinguish between the following pairs of terms :

(a) Egg and sperm : .....

(b) Sexual reproduction and asexual reproduction : .....

(c) Budding and regeneration : .....

2. Define the following terms :

(a) Fertilization : .....

(b) Implantation : .....

3. State the reason why testes lie outside the abdomen in a scrotum ?

.....

.....

4. Why is it important that a very large number of sperms should be present in the semen ?

.....

.....

5. List the structures, in their correct sequence, through which the sperms must pass from the time they are produced in the testes to the time they leave the urethra.

.....

.....

6. State the functions of the following :

(a) Ovary : .....

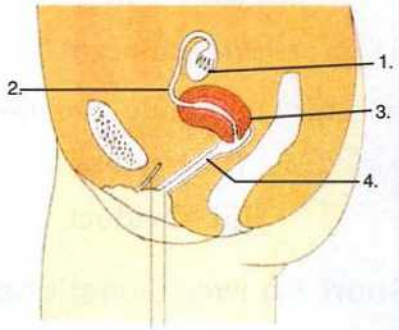
(b) Testes : .....

(c) Fallopian tubes : .....

(d) Seminal vesicles : .....

(e) Uterus : .....

7. Given here is a section of the female reproductive system in humans.



(a) Name the parts labelled 1 to 4

.....

.....

.....

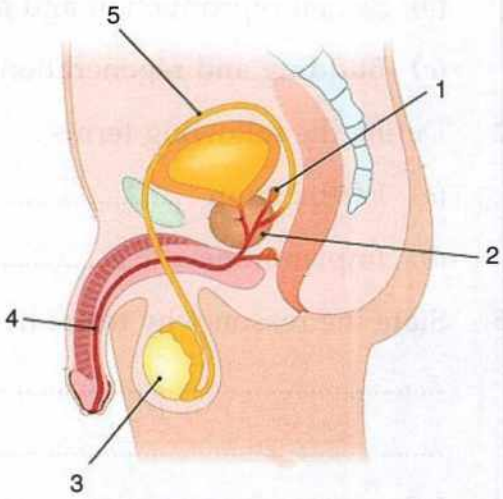
.....

.....

(b) Name the part where fertilisation occurs in the female reproductive system.

.....

8. Given alongside is a diagram of the male reproductive system in humans. Label the parts indicated by numbers 1 to 5, and state their functions.



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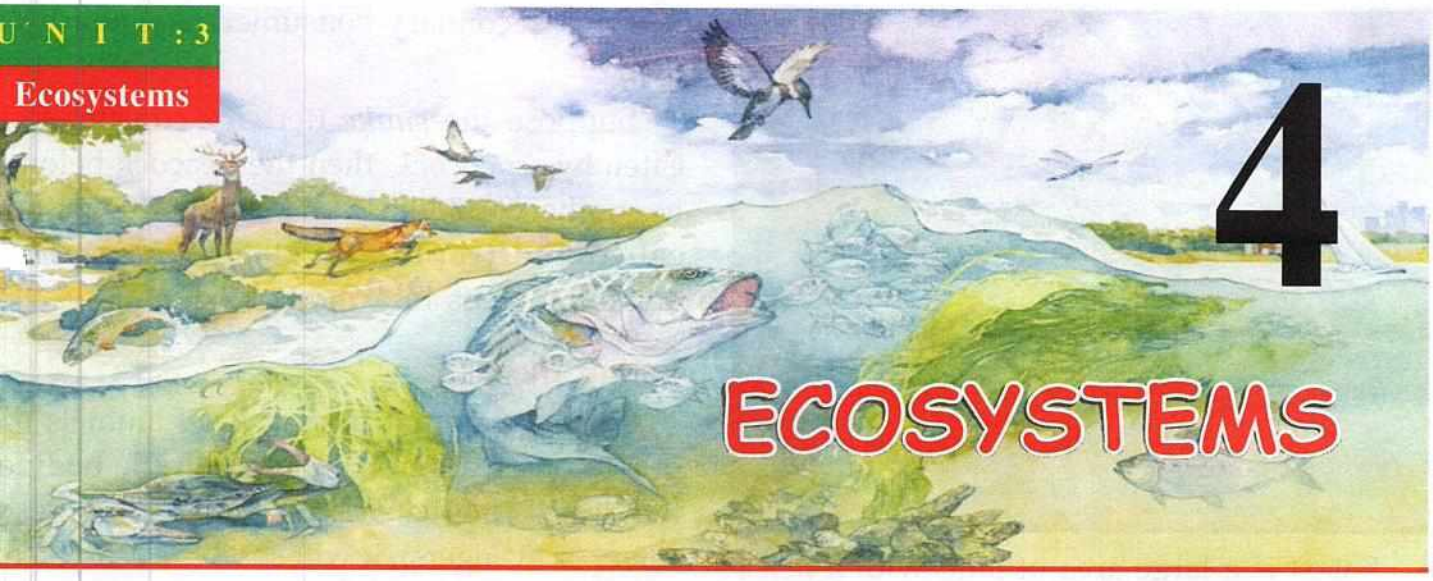
Long Answer Questions (Write the answer in your notebook)

1. How does a single-celled fertilized egg grow into an adult human body ?
2. Describe the human female reproductive system with a labelled diagram.

PROJECT

Try to find the gestation period of different animals. Do all animals have the same gestation period ? If not, think of a reason for the same.



4 ECOSYSTEMS

SYLLABUS

- Understanding ecosystems: definition, interaction between biotic and abiotic factors;
- Biotic components consisting of producers, consumers, decomposers. Meaning of food chain, food web, and pyramid of numbers.
- Interdependence between organisms: symbiosis, parasitism and predation,
- Brief account of abiotic or non-living components such as air, soil, water and climatic factors such as sunlight, temperaure, humidity and wind;
- Only forest ecosystem with its flora and fauna to be taught.

We see around us a vast variety of organisms ving in various types of conditions on land nd in water. There are large agricultural fields, g orchards, forests, ponds, lakes, rivers, seas, eans, etc. And, there are hot deserts and snow-lad cold mountains. All such areas have their istinctive characteristics of life. All the plants nd animals are adapted to live only in their pective type of geographical areas.

WHAT IS AN ECOSYSTEM?

An ecosystem is a self-contained area composed of all the *different organisms* living in it, interacting with each other, as well as interacting with the physical conditions *i.e.* sunlight, air, water, soil, climatic factors, etc. prevailing in the area.

Literally, the term *"ecosystem"* is derived from the Greek word *"Oikos"* which means a *"house"*, a dwelling place with the inhabitants living together and interacting with each other and also with their physical environment in some definite ways. This interaction is primarily for food, *i.e.*, **"eat"** and **"be eaten"**. To understand it better, let us take the example of a forest.

FOREST ECOSYSTEM

In a forest, like any other ecosystem, the general chain of relationship among the organisms is same *i.e.* the **food producers** (plants) and the **food consumers** (animals) depending on each other.

Forest is a large area of land with a *dense growth of trees* and a large variety of shrubs, bushes, grasses, *etc.*

All these plants produce their own food through photosynthesis and are, therefore, categorised as self-food producers, more technically called the *autotrophs* (*auto* : self, *troph* : food).

Next, there are plant-eating animals (herbivores) such as deer, rabbits, pigeons, parrots, or even insects like grasshoppers, crickets, butterflies, bees, etc. They all eat the plants directly or eat their fruits, flowers etc., or even suck the plant juices. All such animals are ranked as *primary consumers* (meaning direct plant eaters).

Next to the primary consumers, there are animals like tiger, lion, wolf, lizards, snakes, some birds which capture the herbivores and eat their flesh. Such animals are categorised simply as **carnivores**, or technically the *secondary consumers*.

Consider another possibility in a forest involving one more stage of food level.

Grass (producer) eaten by *Grasshopper*.

Grasshopper (primary consumer) eaten by a *Frog*.

Frog (secondary consumer) is eaten by *Snake*.

Suppose the *snake* (tertiary consumer) i eaten by a *peacock*, then the peacock belong to another food level. All such food levels a called the **trophic levels** meaning food obtaining steps in a food chain.

Eating the dead :

All the different trophic level animals di due to one reason or the other. If the body the dead is not eaten by the putrefying flesh eaters (scavengers), it will spoil the ecosyster The dead material is further broken down b bacteria and fungi in the soil, thus helping i the return of nutrients back to the soil for th plants to grow.

Thus in a forest, or in any other ecosyste the chain of the types of food obtainers wi be as follows :

Producers →	**Primary consumers** →	**Secondary consumers** →	**Tertiary consumers**
(Green plants)	(Herbivores)	(Primary carnivores	(Secondary carnivores

COMPONENTS OF AN ECOSYSTEM

In an ecosystem there are two categorie of components : the **living components** (a kinds of plants, animals, and microorganism called the **BIOTIC** component, and severa **non-living components** like sunlight, ai water, warmth, etc. collectively called th **ABIOTIC** component.

A. The **BIOTIC** (living) components of a ecosystem consist of the followin sequence of **trophic (food) levels** :

1. **Trophic level 1 (Green plants)** : Thes consist of the trees, bushes and grasse These are the *starting point* of th

nourishment chain for all life in an ecosystem. They produce the food through photosynthesis, thus categorised as self-food *producers* (autotrophs).

All the different food levels next to autotrophs are covered under a common category — *heterotrophs* meaning "differently nourished".

2. **Trophic level 2 (Plant-eating animals — the herbivores) :** These are the vast varieties of animals such as deer, rabbits, rats, pigeons, parrots, grasshoppers, bees, etc. They directly eat the plants or their parts such as fruits, seeds, flowers, etc. or suck the plant sap from their leaves or stems.

[***Producers vs consumers :*** As described earlier, the green plants are ranked as producers, the plant-eating animals are ranked as *consumers* (they consume the food produced by the plants) or even more technically as primary consumers because they are the first direct plant eaters.]

3. **Trophic level 3 (Flesh-eating animals — carnivores) :** These are the animals which capture their prey (some herbivore) and eat it. *Examples :* Tigers, wolves, snakes, lizards, certain birds, etc. These are also described as *secondary consumers* (eating the primary consumers).

4. **Trophic level 4 (Second rank flesh-eaters) :** Peacock can be a good example of this third rank of consumers. Its food chain sequence can be as follows :

Plants	→	**Rat**	→	**Snake**	→	**Peacock**
Producer		Consumer (Primary)		Consumer (Secondary)		Consumer (Tertiary)

Besides the above mentioned four chain-wise levels, there is yet another category of

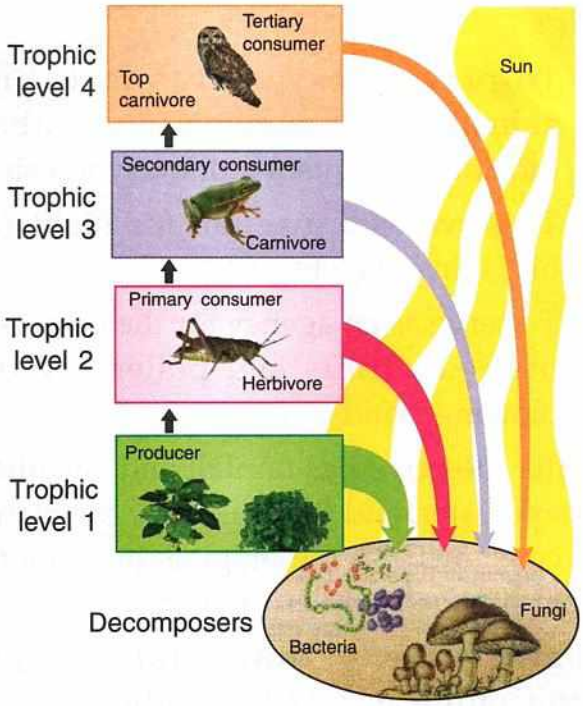


Fig. 4.1 Trophic levels within a food chain

organisms that feed on the dead material of the organisms occupying the above four trophic levels. These can be further divided into scavengers, detritivores and decomposers. **Scavengers** feed on dead animal and plant material. *Example :* Vultures, kites, crows, some insects, etc. Detritivores and decomposers consume the remains left by the scavengers. **Detritivores** such as earthworms, millipedes, slugs, etc. feed on detritus or decomposing plant and animal parts as well as faeces while **decomposers** obtain nutrition by absorbing nutrients that result from the breaking down of the dead organic matter. Bacteria, fungi and protists fall under the category of decomposers as they are unable to ingest dead matter directly.

B. The **ABIOTIC** (non-living) components in an ecosystem constitute the following :

1. **Sunlight :** For the production of food in green plants by photosynthesis.

2. **Air :**
   - To provide oxygen to plants and animals for respiration, and carbon dioxide to plants for photosynthesis.
   - To serve as a medium for flight for birds, insects, etc.
   - To serve as an agency for the dispersal of seeds, fruits and pollen, by the blowing winds.
3. **Water :** Received as rainfall and absorbed as soil water, and then taken by the plants or consumed by the animals in drinking from drains, puddles or rivers.
4. **Temperature :** Hot, mild or cold temperature of a region influences the body functions of the plants and animals living in that region.
5. **Soil :** Soil in a way is the foremost component of the forests and for that matter even for all other ecosystems. The trees, grasses and bushes grow in soil. Soil contains water and mineral nutrients (sodium, potassium, *etc.*) required by the plants. Soil also contains microorganisms (bacteria, *etc.*). It also provides a dwelling place for burrowing animals like rats, snakes as well as for earthworms which even swallow the mud containing dead organic matter.

   The soil types are different in plains, on hills, mountains, *etc.* In deserts the soil provides support to prickly pear and date palms.

   Even ponds, rivers and lakes have some kind of soil at their bottom, which is required by the organisms living there.

FOOD CHAINS AND FOOD WEBS

Food chain is the linear sequence of organisms in which each organism eats the lower member and is itself eaten by the next higher member.

Food web is a network of several interconnecting food chains.

FOOD CHAINS

The diagram given below depicts a food chain involving five organisms representing five trophic levels starting from a green plant at the bottom.

Eagle
— Top carnivore, Trophic level V (Quaternary consumer)

Snake
— Carnivore, Trophic level IV (Tertiary consumer)

Frog
— Carnivore, Trophic level III (Secondary consumer)

Grasshopper
— Herbivore, Trophic level II (Primary consumer)

Green Plant
— Producer, Trophic level I

(Start)

Fig. 4.2 given below depicts another food chain. Here again, the green plant is the **producer**, the caterpillar which is eating the leaf is the **primary consumer**, a small bird

-ating the **caterpillar** is the **secondary onsumer** and the hawk at the end is the **ertiary consumer** that eats up the small bird.

Fig. 4.2 A food chain. The caterpillar eats the leaf, the small bird eats the caterpillar and itself may fall prey to the hawk.

The number of steps in different food hains may vary from 2 to 5 and very rarely :hese can be 6 but never 7.

Some of the food chains could be as ollows:

(i) Rice → Man (Two steps)
(ii) Grass → Rabbit → Fox (Three steps)
(iii) Maize → Goat → Man (Three steps)
(iv) Maize → Goat → Lion (Three steps)
(v) Grass → Grasshopper → Lizard → Crow (Four steps)
(vi) Grass → Buffalo → Leech (parasite) (Three steps)

FOOD WEBS

The food chains are not so simple as described above. There are various alternative interconnections at different points. Such interconnections (inter-connected food chains) develop a network of food chains called **food webs**.

Food webs are very complex, and even biologists are yet to understand all the dynamics and interactions in food webs. A simplified version of a food web would function like this : plants grow, an animal eats plant, another animal eats the animal who ate plants, both animals and plants die, and are in turn eaten by smaller organisms (micro-organisms), who convert this organic material back into organic compounds in soil that can be taken up again by plants.

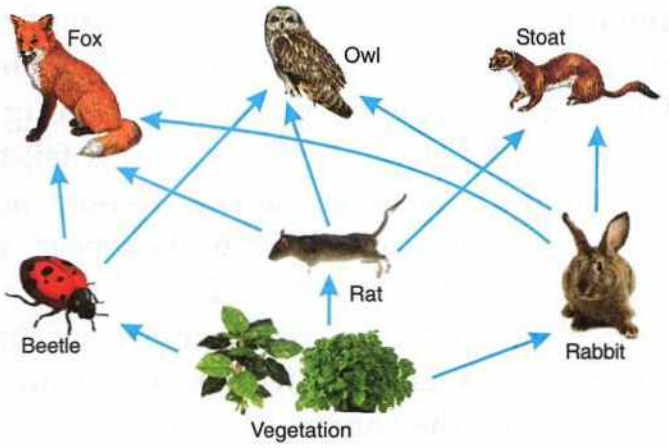


Fig. 4.3 A food web.

Food web is a network of interconnecting food chains in a natural community of different organisms.

Fig. 4.3 represents some of the food relationships in a forest. In this food web consider one food chain consisting of :

Vegetation → rat → fox

- Here, rat can be a food for an owl, or for a stoat (a kind of otter – Hindi *oodbilao*).
- The owl could be a consumer of the beetle as well as of the rat or of the rabbit.
- Rabbit could be a link towards the stoat, the owl or the fox.

Thus, altogether it is a network of interconnecting food chains. This is what is meant by a food web.

The existence of plant life is integral to the continuity and development of most **ecosystems**. The term "plant" may include everything from small blades of grass to the biggest and oldest trees in the forest. The **environment** is made up of two kinds of matter : organic and inorganic, and plants are the only link in the **food chain**, that are capable of transferring inorganic chemicals

into organic compounds for the consumption of other living things in the ecosystem. These nutrients are passed on through **trophic levels** in **food webs**. If plants fail to transfer these materials, animals would not be able to gain the nutrients they need to survive. Plants do this by extracting nutrients from the ground — nutrients that other organisms are not able to consume directly from the source, *i.e.*, soil.

Advantages of Food Webs

The food webs permit alternative foods. These ensure a better chance of survival of an organism, in case, any one of its food source happens to be scarce. It simply means that food web provides more stability to an ecosystem than a food chain.

FOOD PYRAMIDS

You know what a pyramid means. It means any figure or shape that has a large base, which continues narrowing at each level upwards, finally ending as a small point. Same thing generally happens in a food chain. For example, let us take a food chain with tiger at the top.

Grass → Deer → Tiger

A grown up tiger must have eaten several deer in its life-time and each one of these deer must have eaten hundreds and thousands of grass twigs. This was in terms of **number of individuals** consumed at each level. Similarly, weightwise or more appropriately **mass-wise, relationship** can be indicated in a food chain. Largest mass is consumed at the first level (grass → deer), which does not lead to the same mass of flesh of the deer. Next, again the total mass of flesh of deer eaten by the

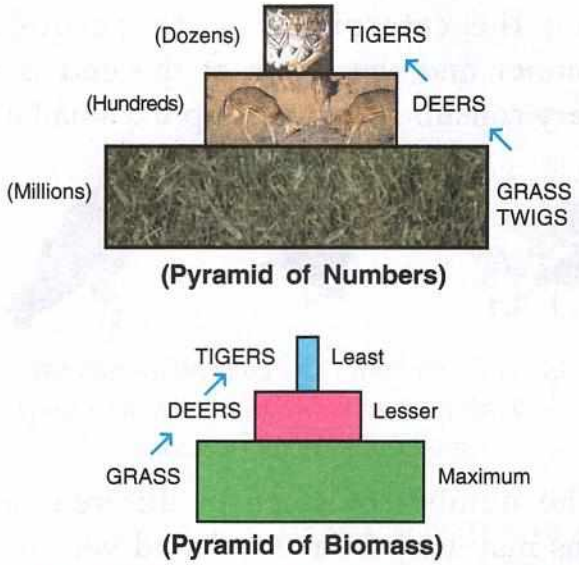


Fig. 4.4 Two examples of food pyramids.

tiger in its life time, must have been several times that of its own body mass. Thus, these two types of pyramids (**of numbers** and **of biomass**) in a certain forest can be supposedly as represented in Fig. 4.4.

Interdependence between organisms

In the beginning of this chapter, you have learnt that biotic components (plants, animals and microbes) of every ecosystem, be it pond, forest or ocean can not live independently. They are interdependent on each other in one way or the other.

Possibly you can not think of any population on earth that is inhabited just by its own. For any species, the minimal requirement is more species on which it can feed. Even a plant which produces its own food, can not survive alone; it needs soil microbes to break down the organic matter in soil and return the inorganic nutrients for absorption. Not only this, the plants need an animal agent for pollination. Thus, it is obvious that in nature animals, plants and microbes can not live independently but they

are interdependent on each other in many ways to form a biological community.

Interdependence between organisms arise from the interaction of populations of two different species. These interactions could be beneficial, harmful or neutral to one species or both. The three such relationships are : *Symbiosis, parasitism* and *predation.*

Symbiosis : In this interaction, both the interacting species are benefitted. The most fascinating example is found in plant-animal relationship. Plants need the help of animals for pollinating their flowers and dispersing their seeds. Animals are paid "fees" by the plants in the form of juicy and nutritious fruits. *Lichens* provide another good example of symbiosis in which a fungus and a photosynthetic alga live in a symbiotic relationship.

Parasitism : In this interaction, one partner (the parasite) receives advantage while the other (the host) is at a loss. In fact parasite enjoys free lodging and meals at the cost of the host. The life-cycles of parasites are often complex, involving one or more intermediate hosts. The malarial parasite, *Plasmodium* needs an intermediate host (vector) — a mosquito to spread to other hosts. Human liver fluke (a nematode parasite) depends on two intermediate hosts (a snail and a fish) to complete its life-cycle. The parasites harm the host — they may reduce the revival, growth and reproduction of the host.

Predation : A predator catches and kills other organisms for food. Predation is nature's way of transferring energy. Although animals eating fruits are categorised as 'herbivores', they are, in broad ecological context, not very different from predators.

The tiger and the deer provide a good example of predation, but a house sparrow eating any seed is no less a predator.

FLORA AND FAUNA OF FOREST ECOSYSTEM

Flora means the plants *naturally occurring* in a particular area, and similarly ***fauna*** means the animals *naturally living* in that area.

Flora and Fauna of a forest can never be same throughout the world. Forests of very cold regions, of moderately warm regions and those of hot regions will have their own particular types of plants and animals. So, a single description cannot serve the purpose.

There are different kinds of forests of India each with its characteristic life forms, *for example :*

1. **Tropical rain forests** such as those on western coast of India and North East Himalayas.

   Flora : Evergreen trees, bamboos, ferns, shrubs.

   Fauna : Jungle cats, leopards, monkeys, flying squirrels, snakes, centipedes, millipedes, many insects, snails, *etc.*

2. **Temperate Deciduous forests** such as those found on the eastern coast of India.

   Flora : Teak, sandalwood, sal, etc.

   Fauna : Moths, beetles, deer, wolves, foxes, *etc.*

3. **Coniferous forests** such as those found in the Himalayas at an altitude above 1700 to 3000 metres.

   Flora : Fir and pine trees.

   Fauna : Very few animals such as squirrel, deer, goat, wolves, some birds like robin, sparrow.

Now, let us study some particular forests of India :

- **Gir Forests (Gujrat)**

  Flora : Various kinds of large shady trees such as peepal, acacia, neem, *etc.* Some wild bushes, and grasses.

  Fauna : Animals like bears, dogs, cats, rats, rabbits, crows, kites, vultures, and the most significant animal, the *Lion*.

- **Jim Corbett National Park (Uttarakhand)**

  Flora : Various kinds of trees including the pine trees, shrubs and grasses.

  Fauna : Various types of animals, especially the *tiger*.

- **Jaladpara Sanctuary (West Bengal)**

  Flora : Various kinds of trees, including banyan trees.

  Fauna : Various kinds of animals and birds, especially the *rhinoceros*.

Risks to ecosystem

With the increased industrialisation and scientific approach to our life, the natural resources and rich natural heritage which were being preserved for centuries, have begun dwindling greatly. Any kind of imbalance in nature results into severe danger to our ecosystem. Its treatment with nature has posed many serious challenges and problems like climate change, vector-borne diseases, decay in wildlife and its resources and food and water shortage today. Exploitation of natural resources prevalent all over the world, has erupted into severe ecological degradation, which is definitely the biggest threat to proper functioning of our ecosystem.

Need to restore and conserve the ecosystems

Restoring an ecosystem by establishing the finer balance between organisms and environment is the best that, being responsible humans, we can do. Until and unless the steps to preserve the decaying charm of our ecosystem are not initiated, our ecosystem is not going to support us in having a better and healthy environment.

Nowadays, it is imperative that we assist nature by not disturbing its integrity, and help in restoring its lost balance. By protecting our native natural resources like wildlife, rivers, forests, etc., one can contribute greatly towards the preservation of our ecosystem. Radical changes have to be made in our thoughts to save and accumulate the natural resources — the very root of our life.

REVIEW QUESTIONS

Multiple Choice Questions :

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

   (a) The term "ecosystem" is derived from the Greek word "Oikos" meaning.

   (i) Body weight ☐ *(ii)* Food ☐

   (iii) House ☐ *(iv)* Size ☐

(b) Rat in any food chain would occupy the position of

(i) Tertiary consumer ☐ (ii) Secondary consumer ☐

(iii) Primary consumer ☐ (iv) Producer ☐

(c) Evergreen broad-leaved trees are characteristic of

(i) Tropical rain forests ☐ (ii) Temperate deciduous forests ☐

(iii) Coniferous forests ☐ (iv) All of the above types of forests. ☐

(d) The number of steps in a food chain can never be more than

(i) Four ☐ (ii) Five ☐

(iii) Six ☐ (iv) Seven ☐

Short Answer Questions :

1. Mention if the following statements are **true** (T) or **false** (F)

(a) Snakes are primary consumers.

(b) Some humans are strictly primary consumers while others are secondary or tertiary consumers as well.

(c) No ecosystem can survive without light.

2. Match the following :

(a) Grass	(i) Carnivore
(b) Deer	(ii) Decomposers
(c) Cobra	(iii) Primary consumer
(d) Vulture	(iv) Autotroph
(e) Microbes	(v) Scavenger

3. Rewrite the following in their correct sequence in a food chain :

(a) Snake → Grasshopper → Grass → Frog

(b) Grass → Tiger → Deer

(c) Snake → Peacock → Rat → Wheat

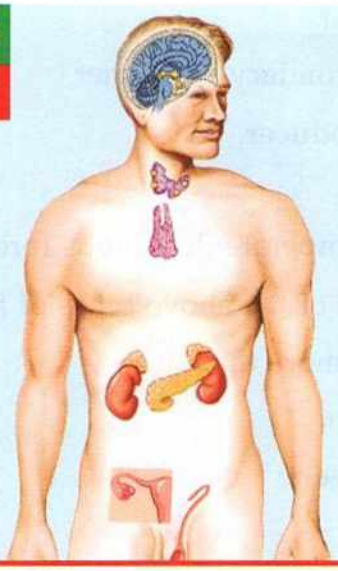
Long Answer Questions (Write the answer in your notebook)

1. Differentiate among primary, secondary and tertiary consumers. Give one example of each in a food chain.
2. Define the terms (a) flora and (b) fauna.
3. List any there members each of the flora and fauna of tropical rain forests.
4. Define the following terms and give two examples in each case.

(a) Autotrophs (b) Consumers (c) Food chain

(d) Symbiosis (e) Parasitism (f) Predation

UNIT : 4
Human Body



5 ENDOCRINE SYSTEM AND ADOLESCENCE

SYLLABUS

Endocrine system :

- Two types of glands — exocrine, endocrine (basic concept and difference).
- Hormone (definition);
- Hormonal glands — (thyroid, adrenal, pancreas, pituitary); location and function of each;
- Following points to be studied in tabular form; name of gland, location in body, secretion, function;

Adolescence and accompanying changes :

- Physical and emotional changes in the body during adolescence;
- Importance of personal hygiene.
- Stress management (meaning of stress : ways to tackle stress : yoga, meditation, time management, sports, hobbies, rational thinking, etc.).

Our body has two types of glands — the exocrine glands and the endocrine glands. The exocrine glands send their secretions (enzymes) through ducts to the target organs. *For example*, salivary glands, pancreas, etc. On the other hand, the endocrine glands are ductless glands. Their secretions are called **hormones**, which are poured directly into the blood and are then carried by blood to the target organs.

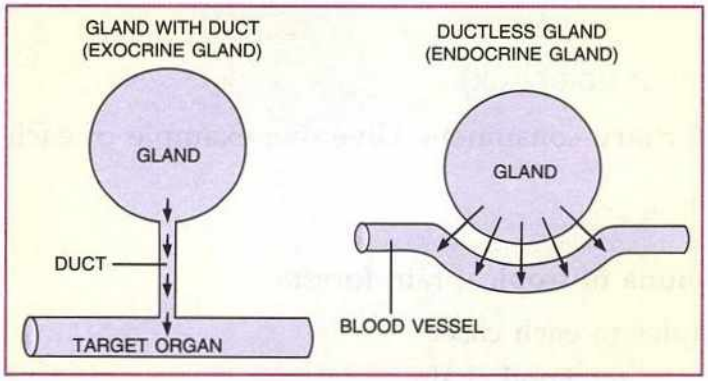


Fig. 5.1 Difference between the glands with ducts and ductless glands

ENDOCRINE GLANDS

The hormone-producing glands are called **endocrine glands**. These glands have no ducts and they pour their secretions directly into the blood (Fig 5.1). Therefore, they are also called **ductless glands**. The secretions of these glands, *i.e.*, hormones, are secreted in very small quantities, yet they are vital and carried to all parts of the body. Each hormone has a specific function

nd its effect is produced in one or more pecific parts only.

Hormone is a chemical substance secreted by an endocrine gland, which is directly poured into the blood stream and acts on a target organ or cell.

In this chapter, we will discuss only he important endocrine glands, namely hyroid, adrenal, pancreas and pituitary lands.

THYROID GLAND

The thyroid is a bilobed gland situated n either side of the wind pipe, just below he larynx. It secretes the hormone **hyroxine** which is an iodine-containing rotein. This hormone speeds up the rate of ost of the activities of the body. It timulates growth in infants. The insufficent ecretion or over-secretion of this gland has armful effects on the body.

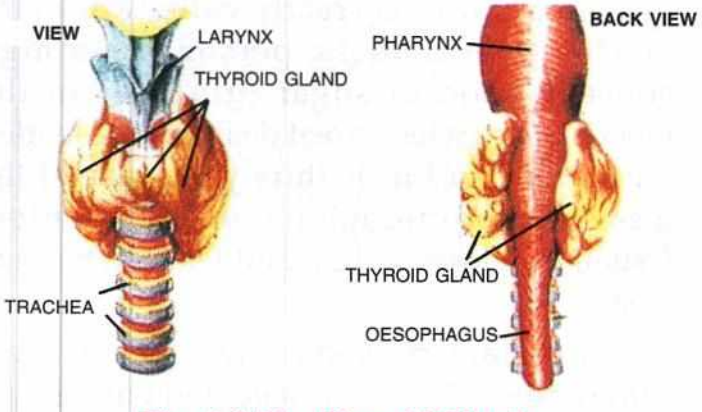


Fig. 5.2 The Thyroid Gland

A. Insufficient secretion of thyroxine auses three ailments :

1. **Simple goitre :** It is an ailment caused due to the enlargement of the thyroid gland. It appears as a swelling in the neck. It occurs due to insufficient iodine in our daily food.

Fig. 5.3 Simple goitre

Thyroid deficiencies are common in many parts of India. The use of iodised (iodine–added) salt in the food is recommended because iodine is required in the production of thyroxine.

2. **Cretinism :** It is an ailment which brings about abnormal development in an infant. This results in both physical and mental retardation.
3. **Myxoedema :** It is a condition seen in an adult when insufficient amount of thyroxine is produced. It shows general sluggishness, with swelling on the face and hands.

B. Oversecretion of thyroxine causes an increased metabolic rate, increased heart beat, weight loss and general restlessness.

ADRENAL GLANDS

The adrenal glands are like caps over the kidneys (Fig. 5.4). Each adrenal gland consists of two parts — a central **medulla** and a peripheral **cortex.**

Medulla secretes **adrenaline** (also called **epinephrine** or **emergency hormone**). This hormone is secreted when a person is under

severe stress (physical or emotional), fearful or angry. This hormone prepares the body to meet any emergency situation *i.e.*, to face the danger, or flee from a situation. Hence, adrenaline is called the **"fight or flight hormone"**. This hormone provides extra energy and strength to the body in any adverse situation. It increases the heart beat and the rate of respiration, accompanied with a rise in blood pressure, increase in blood supply to the muscles and release of more glucose into the blood by the liver (like putting more fuel into the engine).

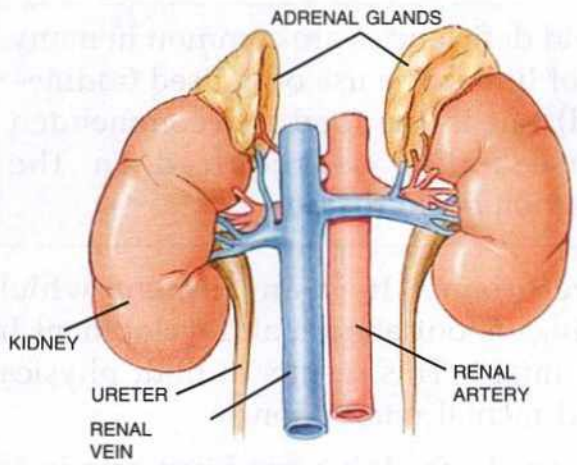


Fig. 5.4 The adrenal gland

The adrenal **cortex** secretes many hormones, but the well-known hormone is **cortisone**. In general, the cortical hormones influence carbohydrate, fat, and protein metabolism. Also, they regulate the salt and water balance in the body. They adapt the body to "stresses" such as extreme heat, cold, infections, *etc.*

PANCREAS

The pancreas is situated behind the stomach. Although it is mainly a digestive gland, it has a cluster of hormone-secreting cells called **Islets of Langerhans**. They secrete two principal hormones – **insulin** and **glucagon**.

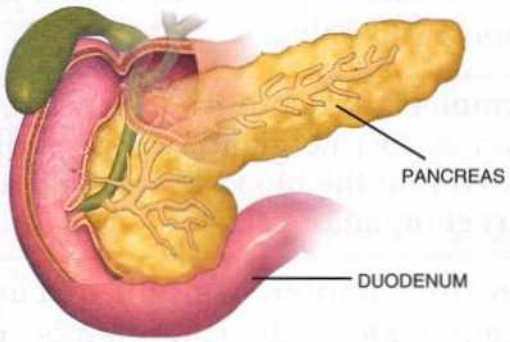


Fig. 5.5 The Pancreas Gland

Insulin lowers glucose from the bloo stream in three ways :

(i) Converts extra glucose to glycoge which is ultimately stored in the live and muscles.

(ii) Induces the cells to burn extr glucose to produce heat and energy for the body.

(iii) Causes the cells to convert extr glucose into fat.

Insufficient secretion of insulin cause **diabetes** (more correctly called **diabetes mellitus**). A diabetic person has a hig concentration of sugar (glucose) in th blood. He excretes a great deal of urine loade with sugar and feels thirsty because of th loss of water through too much urination Usually, he loses weight and tends to becom weak.

In certain persons, the glucose leve comes down due to oversecretion of insulin This is very harmful and may have seriou consequences.

Glucagon stimulates the breakdown o glycogen in the liver to glucose. Thus, it raise the sugar level in the blood.

PITUITARY GLAND

Pituitary gland is a pea-sized gland located below the brain. It secretes severa

.ormones, some of which regulate the ctivity of other endocrine glands. So, the)ituitary gland is also called the **"master ;land"**.

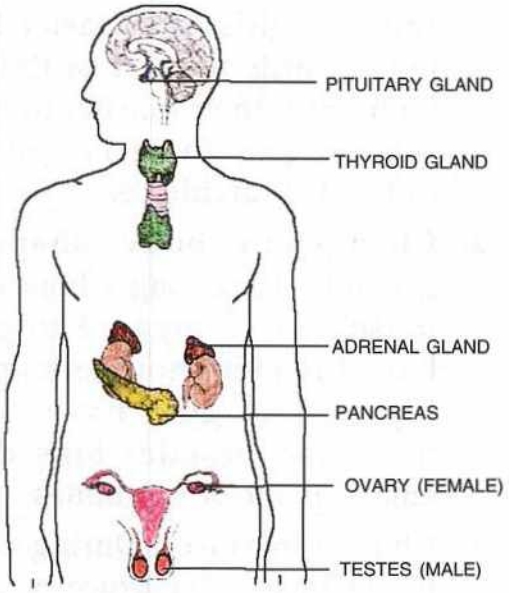


Fig. 5.6 Some major hormone – producing glands in humans

Some of the functions of major hormones produced by the pituitary are :

— **Growth hormone** regulates growth especially in the adolescent years. Insufficient amount of growth hormone causes dwarfism and excess secretion results in gigantism.

— **Thyroid-stimulating hormone** stimulates the thyroid gland to produce thyroxine.

— **Follicle-stimulating hormone** influences the production of sperms in males and the ova or eggs in females.

— The pituitary gland plays an important role in the birth process as it produces hormones which cause the contraction of the muscles of the uterus during child birth.

— **Prolactin** stimulates the breasts to produce milk after child birth.

Table 5.1 : Some of the main hormone-producing glands and their secretions in the human body

Gland	Location	Hormone	Function
Thyroid	On either side of the wind pipe, just below the larynx.	Thyroxine	Controls the metabolic rate.
Adrenal	Like a cap over the kidneys.	Adrenaline	Prepares the body for any emergency situation.
Pancreas	Behind the stomach.	• Insulin • Glucagon	Regulates the amount of sugar in the blood. Releases sugar from the liver.
Pituitary	Below the brain.	(i) Growth hormone (GH) (ii) Thyroid-stimulating hormone (TSH) (iii) Follicle-stimulating hormone (FSH)	Speeds up growth. Stimulates the thyroid gland to secrete thyroxine. Stimulates the production of sex cells (gametes) in males and females.

ADOLESCENCE

Growth begins from the day an individual is born. A new-born baby has a complete set of sex organs. However, the testes of a baby boy are not yet able to make sperms, and the ovaries of a baby girl can't produce eggs even though hundreds of *immature* eggs are already present in them.

Growing up is a natural process. The period of life when the body undergoes development leading to reproductive maturity is called "**adolescence**". Adolescence is a transitional stage of physical and mental human development that occurs between childhood and adulthood. The term "adolescence" is derived from a Latin word *adolescere* which means "to grow into maturity". It is a time of rapid development of growing towards physical and sexual maturity. An adolescent is neither a child nor an adult.

The period between 10-19 years of age in an individual's life is called adolescence. It normally begins around the age of 12 and lasts upto 18 or 19 years of age. However, this period may vary from person to person. In girls, adolescence may begin a year or two earlier than in boys.

Physical changes during adolescence

Upon crossing the age of 10 or 11, there is a sudden spurt in growth which is quite noticeable. These changes taking place in the body, under the influence of hormones, are part of growing up. The following physical changes occur during adolescence :

1. **Increase in height** : The most visible and conspicuous change during adolescence is the sudden increase i height. During this period, the bone of the arms and legs elongate. Th weight of the body also increases Initially, girls grow faster than boys but towards the end of their teenage both reach their maximum height. Th rate of growth in height varies i different individuals.
2. **Change in body shape** : Boy generally have longer bones and mc muscles as compared to girls. Boy have broader shoulders and narrov hips, while girls have curvaceou body and broader hips due to th enlargement of hip bones.
3. **Change in voice** : During adolescenc the **larynx** or the voice box begins t grow. Boys develop larger voic boxes. This can be seen in boys as protruding part of the throat whicl has been called ***Adam's apple***. In girls the voice box is smaller in size Generally, girls have a high pitche voice, whereas boys have a dee hoarse voice.

   You must have observed that some o your classmates develop a hoars voice. This is due to the muscles of thei growing voice box that develop to larger extent changing their voice. Thi situation remains for a brief period may be for a few months, after whic the voice becomes normal.
4. **Increased activity of sweat and sebaceous glands** : Durin adolescence, the secretion of swea glands and sebaceous glands (oi glands) increases. Many young peopl get acne and pimples on the face at thi time because of the increased activity of these glands in the skin.

Development of sexual and secondary sexual characters during adolescence

During the adolescent period, the sex organs become active — the testes start producing sperms, and the ovaries start producing eggs. This indicates that the individual is becoming capable of producing children. This is the stage of **puberty**.

> Puberty is the period during which the reproductive systems of boys and girls mature. In girls, it starts at the age of about twelve and the first sign of puberty is the development of breasts. In boys, it starts at about thirteen years of age and the enlargement of the testes is its first sign.

Puberty is brought on by **sex hormones** which start getting produced by the testes and the ovaries. The male sex hormones are called **androgens** (the main one is called **testosterone**), and the female ones are called **oestrogens**. These hormones are activated by the Follicle-stimulating hormone (FSH) produced by the pituitary gland.

The sex hormones bring about other changes as well. *For example*, in boys the voice breaks and hair starts growing on the legs, chest and face. A boy who has been through puberty soon finds himself having to shave. In girls, breasts start developing, and fat is laid down in the thighs, giving the characteristic curves of the female body.

The various changes which have just been described constitute the person's **secondary sexual characteristics**. At this stage, boys and girls both become more interested in the opposite sex.

The table given below shows the important physical changes in boys and girls that take place during puberty.

Boys	Girls
1. Enlargement of testes.	1. Ovaries mature, the release of eggs starts.
2. Penis and scrotal sac grow.	2. Uterus and vagina grow in size. Menstruation cycle starts.
3. Sudden spurt in growth, shoulder girdle grows more than the hip girdle.	3. Sudden spurt in growth for a short time, hip girdle becomes trough-shaped and bigger than the shoulder girdle, breasts grow.
4. Beard, moustache, pubic and chest hair grow.	4. No hair on chest or abdomen.
5. Voice becomes deep and hoarse, low pitched voice.	5. High pitched voice.

The changes that occur at puberty are perfectly normal, but adolescents who are worried about them should ask for help from their parents or a counsellor at school. The changes in the hormones sometimes cause depression and emotional swings during adolescence.

Adolescence and the related psychological changes

Adolescence is a very critical period. During this period, boys and girls not only experience a spurt of physical growth, but also rapid emotional or psychological changes. Some of these changes are highlighted below :

- Boys and girls become too conscious and start worrying about the growth in various parts of their body. They start feeling shy and feel hesitant in sharing their problems with others. Most of the time, they go on finding

faults with themselves and develop a complex. Also, they spend a lot of their time in grooming.

- They become worried about their future although it is a juvenile stage to think about the future. Since they have no set goals, they start fearing, which develops a stage of depression in them. Scientifically, the cause of depression is the dramatic increase in the hormone level in the body. The hormones affect the brain that control emotions and moods. Normally, it is a temporary phase that goes away as one grows up.
- Boys and girls like to remain with their group of friends (also called peers) most of the time, since they feel safe in groups. They also try to imitate what others do in their peer group.
- This is a crucial age, as adolescence brings with it emotional and psychological changes. In the eagerness to be like their peers, boys and girls may get into wrong company, develop habits like smoking and drinking, or become addicted to certain types of drugs. This may cause harm to them in the long run.

Adulthood : The stage that follows adolescence is adulthood. An individual attains full physical growth and a great amount of emotional stability. By this time, the values learnt during childhood and adolescence are grounded and a strong vision for the future dominates. Stable relationships, intellectual and career pursuits and shouldering responsibilities take priority.

IMPORTANCE OF PERSONAL HYGIENE

Personal hygiene plays a very important role in maintaining one's own health during adolescence. Hence, individuals are advised to observe the following practices :

1. **Proper and safe food :**
   - Adolescence is a stage of rapid growth and development. Hence, an adolescent should take care of his/her diet. They should take a balanced diet that includes proteins, carbohydrates, fats, vitamins and minerals. Milk is good for our bones. Fruits and fresh vegetables also provide nourishment.
   - Take freshly prepared food, and avoid stale food.
   - Cooked food and milk, butter, fish, meat and other perishable food items should be stored properly in a refrigerator.
   - Avoid excessive consumption of fast foods.
2. **Proper life style :** Sleep and regular exercise are necessary for maintaining good health.
   - Avoid long hours of continuous table work.
   - Avoid watching television or playing games on computer for long hours.
   - Avoid smoking and consumption of alcohol and drugs.
3. **Cleanliness :** Certain basic precautions are necessary for maintaining personal hygiene, like —
   - Always wash your hands with soap before and after taking meals.
   - Clean your teeth after each meal and before going to bed.
   - Take bath regularly with clean water and good soap.

- Clothes, especially undergarments, should be changed daily. Wearing very tight clothes must be avoided.
- Regular toilet habits must be adopted for maintaining good health. After defecation, hands should be cleaned with water and soap.
- The feet should be cleaned everyday and kept well protected.
- Hair should be washed regularly. Combing removes the dirt sticking to hair. Always use a clean comb.
- Eyes should be washed daily with clean and cold water. Rubbing of eyes with hands should be avoided to prevent the entry of germs into the eyes.
- If cleanliness is not mantained, there are chances of catching bacterial infection. Girls should take special care of cleanliness during the time of their menstrual cycle.

4. **Physical exercise :** To keep the body fit and healthy, all young boys and girls should walk, exercise and play outdoor games regularly. Physical activity is also important to combat the stress and strain of adolescence.

STRESS

Stress is a state of mental or emotional strain and in very simple terms it can be called **tension**.

Stress is body's way of responding to any kind of demand. It can be caused by both good and bad experiences. When people feel stressed by something going on around them, their bodies react by releasing certain hormones into the blood.

Stress is what you feel when you have to handle more than what you are used to. You may feel there's nothing you can do about the things going on in your life. This results in alteration in attention, thought processes and body functions resulting in various physiological and psychological disorders. When you are **stressed**, your body responds as if you are in danger. It makes hormones that speed up your heart beat, make you breathe faster, and give you a burst of energy.

Stress produces numerous physical and mental symptoms which vary according to every individual's situational factors. This can include a decline in both physical and mental health. The skill of stress management is regarded as one of the key skills to a happy and successful life in modern society.

How to manage stress

Stress management is all about taking charge of your lifestyle, thoughts, emotions, and the way you deal with problems. No matter how stressful your life seems, there are steps you can follow to relieve the pressure and regain control. Although life provides numerous demands that can prove difficult to handle, stress management provides a number of ways to manage anxiety and maintain overall well-being. A number of self-help approaches to prevent stress have been developed.

Yoga : It is a mind-body practice that combines physical poses, controlled breathing and meditation or relaxation. Yoga may help reduce stress with :

- Increased flexibility.
- Increased muscle strength and tone.
- Improved respiration, energy and vitality.

- Weight reduction.
- Improved athletic performance.

Exercise : Just 30 to 45 minutes of exercise at least three times a week can make you feel much healthier and in control of your own life. You may take up running/jogging, swimming, playing a team sport like cricket, football, hockey, etc.

Proper sleep schedule : Improving your sleep schedule will go a long way in helping you to reduce stress.

Reading : It is a great way to calm your mind and to gain knowledge.

Thinking positively : Become a positive thinker and take more pleasure in your everyday interactions.

Laughing : It improves your mood and makes you feel happier.

Deep breathing : It is another way to invoke the relaxation response to stress.

Meditation : For meditation, sit in a quiet place for about 15-20 minutes every day, with your hands in a comfortable position, eyes closed, and focus on your breathing. Work on clearing your mind of negative or stressful thoughts and simultaneously concentrate on your inhaled and exhaled breath.

Time management : Getting organized will help you to plan your work and have a better sense of what you need to do and how.

Hobbies : Do something that you enjoy every day, whether it is reading, writing, music, playing a musical instrument, or doing a puzzle as it helps in diverting your mind from all the negative or stressful thoughts.

REVIEW QUESTIONS

Multiple Choice Questions :

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

(*a*) Cortisone hormone is secreted by :

(*i*) Medulla of adrenal ☐ (*ii*) Cortex of adrenal ☐

(*iii*) Pancreas ☐ (*iv*) Thyroid ☐

(*b*) Which one of the following hormones stimulates the breakdown of glycogen in the liver into glucose ?

(*i*) Insulin ☐ (*ii*) Adrenaline ☐

(*iii*) Glucagon ☐ (*iv*) Thyroxine ☐

(*c*) Which one of the following hormones converts excess of glucose into glycogen ?

(*i*) Glucagon ☐ (*ii*) Thyroxine ☐

(*iii*) Insulin ☐ (*iv*) Adrenaline ☐

(d) Which one of the following glands is also called the master gland ?

(i) Pituitary gland ☐ (ii) Adrenal gland ☐

(iii) Thyroid gland ☐ (iv) Ovary ☐

(e) The emergency hormone to face the danger or to fight is secreted by :

(i) Islets of Langerhans ☐ (ii) Adrenal cortex ☐

(iii) Pituitary ☐ (iv) Adrenal medulla ☐

(f) Which one of the following endocrine glands produces its hormone in large quantities as a result of emotional stimulation ?

(i) Thyroid ☐ (ii) Islets of Langerhans ☐

(iii) Adrenal medulla ☐ (iv) Adrenal cortex ☐

(g) In humans, increased thyroxine production results in :

(i) Increased metabolism ☐ (ii) Decreased metabolism ☐

(iii) Dwarfism ☐ (iv) Cretinism ☐

Short Answer Questions :

1. What is a hormone ?

.....

.....

2. Match the items in Column A with those in Column B.

Column A	Column B
(a) Cretinism	(i) Pituitary gland
(b) Diabetes mellitus	(ii) Abnormal development of infant
(c) Increased metabolic rate	(iii) Oversecretion of thyroxine
(d) Simple goitre	(iv) Insufficient iodine in food
(e) Growth hormone	(v) Insufficient insulin in blood.

3. In table given below, fill in the blanks by naming endocrine glands, the hormones they secrete, and the function they perform in a normal person.

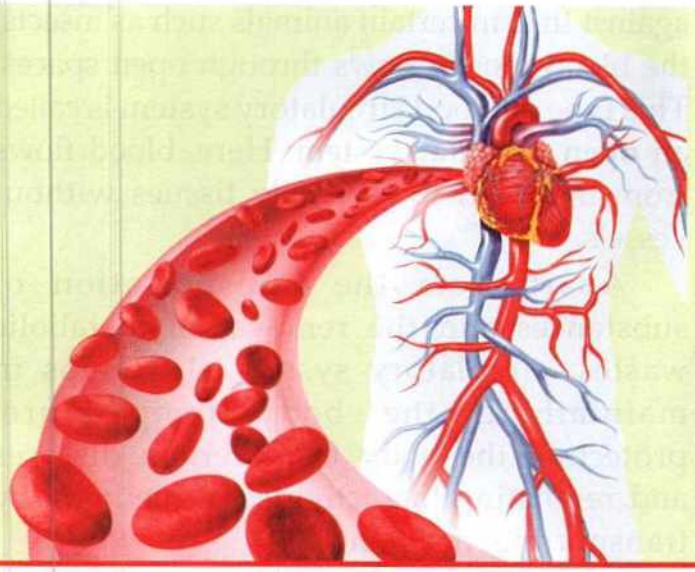
S. No	Name of the gland	Hormone produced	Function
1.	Thyroid	.....	.....
2.	.....	Insulin	.....
3.	.....	.....	Prepares the body for action
4.	.....	Growth hormone	.....

4. Name the source and the function of each of the following hormones :

	Hormone	Source	Function
(a)	Glucagon	.....	.....
(b)	Thyroxine	.....	.....
(c)	Adrenaline	.....	.....
(d)	Insulin	.....	.....
(e)	Cortisone	.....	.....

Long Answer Questions (Write the answers in your notebook)

5. What is the difference between an exocrine gland and an endocrine gland ?
6. Why is pituitary gland called the "master gland" ?
7. Briefly write about the importance of physical hygiene during adolescence.
8. Briefly dicuss any four activities which can be practised to overcome stress.



6 THE CIRCULATORY SYSTEM

SYLLABUS

1. Internal structure of heart in detail (including valves, septum, pacemaker).
2. Schematic diagram of the heart.
3. Blood vessels — aorta, pulmonary trunk, coronary artery and vein, vena cava.
4. Circulation of blood as double circulation.
5. Blood Groups (A, B, AB and O): universal donor and universal acceptor.
6. Conditions related to the functioning of the heart : palpitations, cardiac arrest and hypertension.
7. Introduction of lymphatic system as a parallel circulatory system

HUMAN CIRCULATORY SYSTEM

Both human beings and animals need food and oxygen to keep themselves alive. Simultaneously, their bodies produce certain harmful substances like carbon dioxide and metabolic wastes. The transport of nutrients and oxygen, and the removal of the above mentioned wastes is carried out through blood by a transport system called **circulatory system.**

The circulatory system comprises of the heart, blood and blood vessels which circulates blood throughout the body, thereby helping in the transport of nutrients, oxygen and carbon dioxide.

Transportation is mainly carried out by the blood and the lymph. The blood is transported to all parts of the body by a pumping organ, *i.e.* the heart, through the blood vessels. Lymph is transported by the lymph vessels which run alongside the blood vessels of the circulatory system.

FLUIDS IN OUR BODY

There are three principal fluids in our body :

(i) **Blood** : It is contained in the heart and the blood vessels (arteries, veins and capillaries) of the circulatory system.

(ii) **Tissue fluid :** It occupies the spaces between the individual cells of the body and is also known as the interstitial fluid.

(iii) **Lymph :** It is contained within the lymph vessels and lymphatic organs.

Fig. 6.1 shows a diagrammatic representation of the relationship between blood, tissue fluid and lymph as they circulate in their respective vessels or spaces between the cells in different organs.

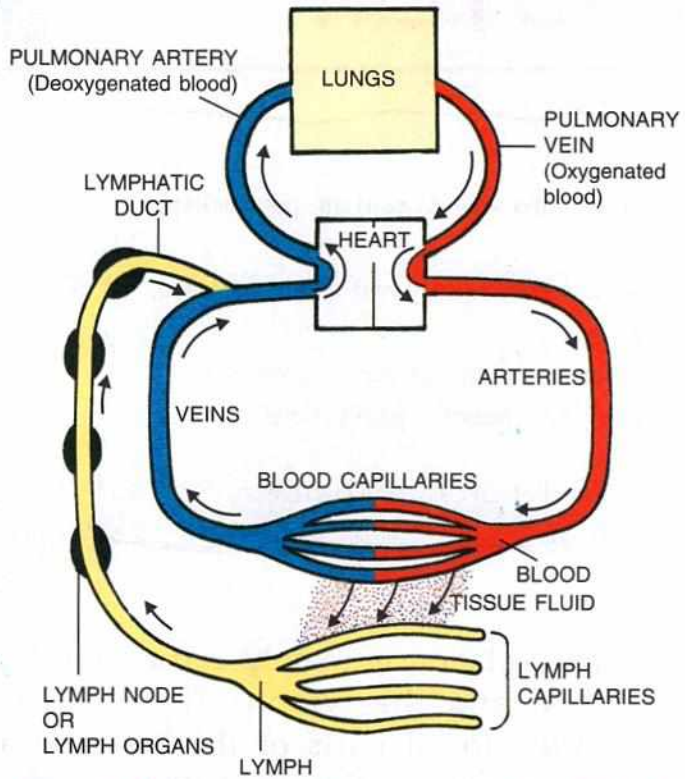


Fig. 6.1 Diagrammatic representation of blood and lymph circulation (Red-oxygenated blood, Blue-deoxygenated blood).

It is clear from the diagram that blood in our body circulates in a closed manner *i.e.* all the time through blood vessels. The blood flows through blood vessels and its flow is regulated by the heart. The heart, acting as a pump, pushes and receives the blood to and from the whole body through the blood vessels. Such a type of blood circulatory system is called a **closed vascular system**. As against this, in certain animals such as insects, the blood mostly flows through open spaces. This type of blood circulatory system is called an **open vascular system**. Here, blood flows from the heart to the body tissues without vessels.

Apart from the transportation of substances and the removal of metabolic wastes, circulatory system also helps in maintaining the body temperature, protecting the body from certain diseases and regulating the activities of the body by transporting hormones.

HEART — THE PUMPING ORGAN

The heart has the size of one's folded fist and weighs about 225-340 grams. It is located in the centre of the chest cavity, with its tip slightly tilted to the left side. It is enclosed within a protective double-layered membrane called **pericardium**. The space between the two membranes is filled with a fluid called **pericardial fluid** which protects the heart from shocks, jerks or any mechanical stress.

The main function of the heart is to receive and pump blood and to keep it circulating in the body through blood vessels.

Internally, the heart is divided vertically into a left and a right portion by a membrane or a **septum**. Each half is further divided horizontally into two chambers — an upper chamber called **auricle** and a lower chamber called **ventricle**. Therefore, heart has four chambers in all — *two* auricles and two ventricles.

The auricles are the "receiving chambers" as they receive blood from different body parts. They are smaller and have thin walls. The ventricles, on the other hand, are the "distributing chambers" as they pump blood into lungs and blood vessels that distribute

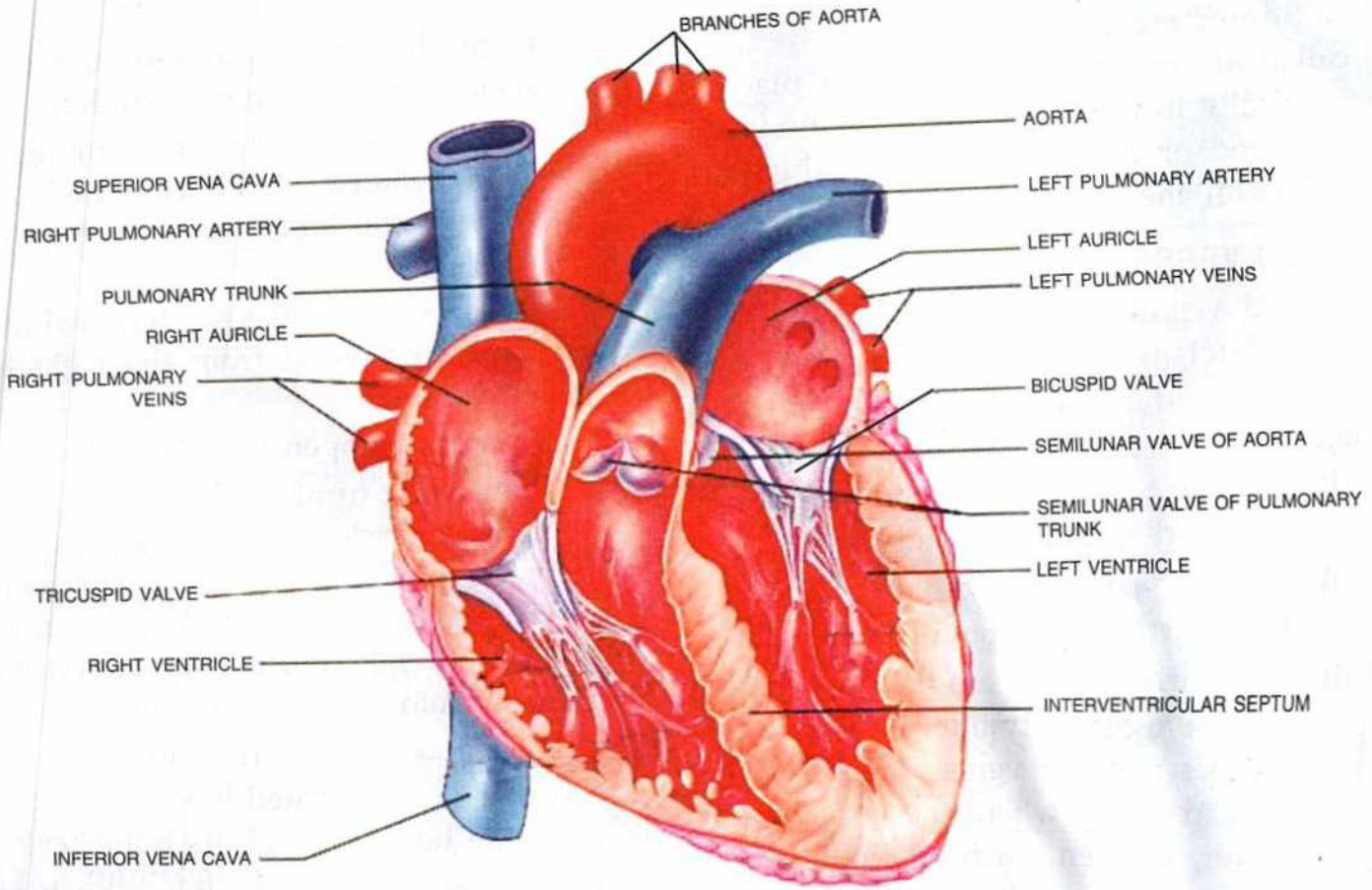


Fig. 6.2 Internal structure of the human heart (Diagrammatic)

the blood to all parts of the body. Ventricles are bigger in size and their walls are thicker, elastic and muscular so as to efficiently pump blood to different parts of the body.

The right auricle opens into the right ventricle, this opening is guarded by the **tricuspid valve** (having three cusps or flaps). Similarly, the opening between the left auricle and the left ventricle is guarded by the **bicuspid valve** (having two cusps or flaps). These valves regulate the flow of blood in one direction *i.e.*, from auricles into the ventricles.

The blood flows from the right ventricle into the pulmonary artery and from the left ventricle into the aorta (the largest artery). The flow of blood from the ventricles into these two arteries is also regulated by valves. These valves resemble a half moon, hence they are called **semi-lunar valves**. These valves are present at the opening where the pulmonary artery and aorta leave the right and left ventricles respectively. They ensure that the blood does not flow back into the ventricles.

Pacemaker

The heart is a muscular organ made up of specialised muscles called **cardiac muscles**. These muscles show continuous contraction and relaxation, without any rest throughout the lifetime of a person. This contraction (and simultaneous relaxation) is a result of an electrical impulse which originates in a node called the **sinoatrial o SA node**. This node is located in the uppe right corner of the right auricle and i responsible for setting a rhythm for th contractions and relaxations of the heart simply the **heart beat**. Hence, it is also calle as the **"natural pacemaker of the heart"**.

Sometimes, a mechanical device called an **artificial pacemaker** is placed surgically in humans if their SA node is damaged or if the electrical conduction system of the heart has problems.

BLOOD VESSELS

Blood vessels form a complex network of conducting tubes that carry blood throughout the body. They are of three major types :

(i) **Arteries** : They carry blood away from the heart to different body parts.

(ii) **Veins** : They carry blood towards the heart from different body parts.

(iii) **Capillaries** : These are the finest blood vessels in the body interconnecting the arteries and the veins. These are the principal sites where the exchange of water, oxgyen, carbon dioxide and many other nutrients and waste substances between the blood and body tissues takes place.

Blood vessels of the heart

- **Vena cavae** — These are the two large veins bringing deoxygenated blood to the right auricle. The **superior vena cava** brings in deoxygenated blood from the upper parts of the body such as the head and shoulders.

  The **inferior vena cava** brings in deoxygenated blood from the lower parts of the body, such as the trunk and legs.
- **Pulmonary veins** — They bring in oxygenated blood from the right and left lungs.

  These veins open into the **left auricle**.
- **Pulmonary trunk** — It arises from the right ventricle carrying deoxygenated blood to the lungs for oxygenation. (The pulmonary trunk branches into a left and right **pulmonary artery**, each going into the respective lung.)
- **Aorta** — Leaves the **left ventricle** carrying oxygenated blood to all parts of the body through its branches.
- **Coronary artery** — It is the blood vessel that distributes oxygenated blood to the walls of the heart. It is a branch that arises from the aorta.
- **Coronary veins** — They bring back deoxygenated blood from the walls of the heart and pour it into an opening in the right auricle.

Differences between arteries and veins

Characteristics	Arteries	Veins
1. Direction of blood flow.	Carry blood from the heart to various parts of the body.	Carry blood from different parts of the body to the heart.
2. Nature of blood	Carry oxygenated blood (except the pulmonary artery).	Carry deoxygenated blood (except the pulmonary vein).
3. Flow of blood	Blood flows with high speed and under high pressure.	Blood flows with low speed and under low pressure.
4. Valves	Valves are absent.	Valves are present.
5. Position in the body	Arteries are deep-seated.	Veins are comparatively superficial.

BLOOD CIRCULATION

- The deoxygenated blood from different parts of the body is received in the right auricle. Simultaneously, the oxygen-rich blood returning from the lungs is received in the left auricle (Fig. 6.3).
- The right auricle contracts and pumps deoxygenated blood into the right ventricle. Simultaneously, the left auricle contracts and pours oxygented blood into the left ventricle.
- The atrio-ventricular valves close with a sound when the ventricles are full (end of an auricular contraction). At the same time the semi-lunar valves open.
- The right ventricle begins to contract. The deoxygenated blood is pushed into the pulmonary artery, which transports this blood to the lungs for oxygenation. Similarly, the left ventricle contracts and oxygenated blood is pumped into the aorta with great pressure because the blood has to reach all parts of the body.
- The semi-lunar valves close with a sound when the blood in the ventricles has been pushed into the arteries (end of a ventricular contraction).

It should be remembered that when the heart chambers relax — they are filled with blood and when they contract — blood is pushed out of them. Both auricles relax and contract together. Similarly, both ventricles too, relax and contract together. The contraction of the auricles is quickly followed by the contraction of the ventricles. This goes on in a rhythmic manner, about 72 times per minute. Also remember that the right half of the heart (*i.e.* the right auricle and the right ventricle) receives deoxygenated blood, while the left half (*i.e.* the left auricle and the left ventricle) receives oxygenated blood. The blood on the right side of the heart never mixes with that on the left side.

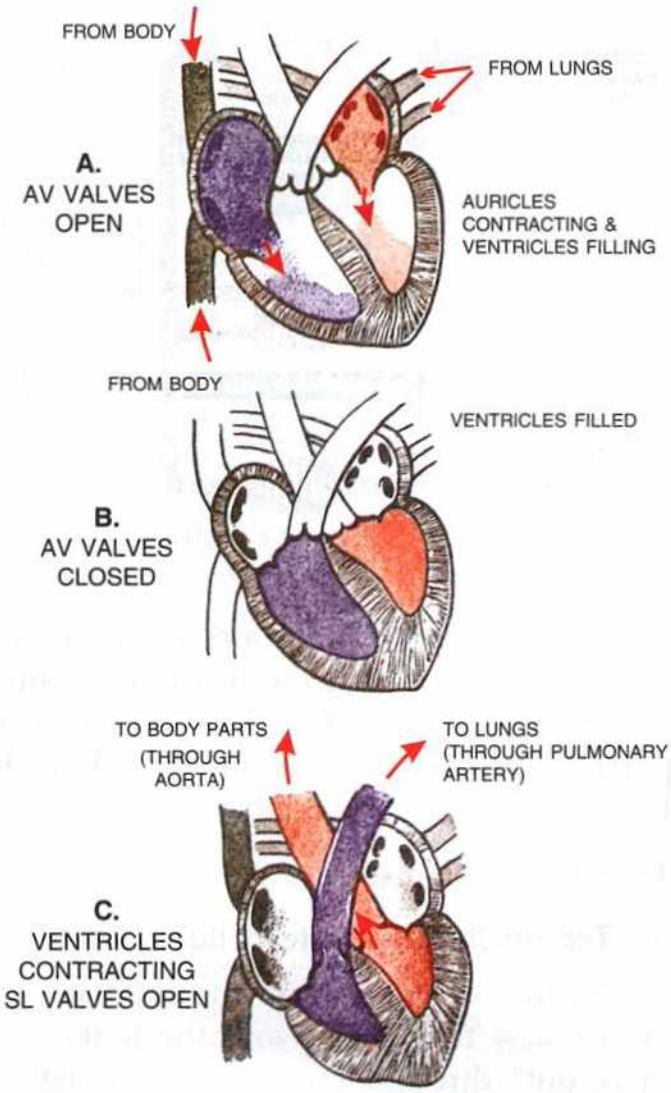


Fig. 6.3 Working of the heart

Double circulation

The blood flows through the heart twice to complete one full circulation throughout the body.

- At first, blood flows from the right side of the heart to the **lungs** and then returns to the left side of the heart (Pulmonary circulation).
- The second time, the blood flows from the left side of the heart to all parts of the **body** and then returns to the right side of the heart (Systemic circulation).

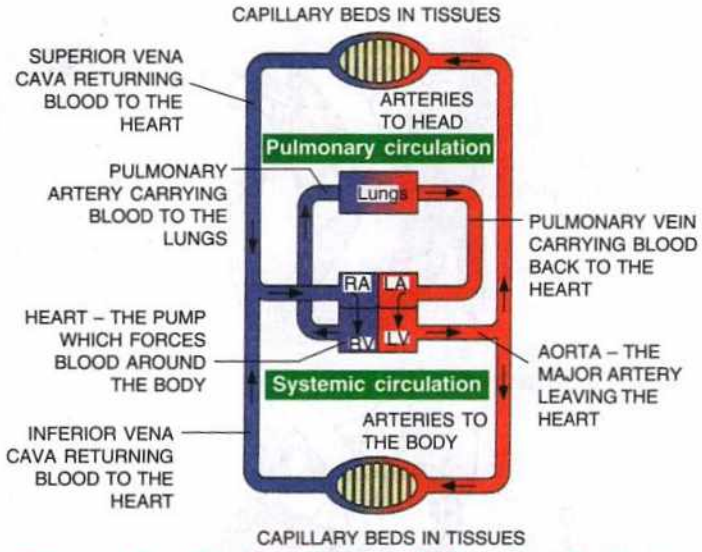


Fig. 6.4 Double circulation of blood in the body

From the above diagram it is clear that blood passes through the heart twice, once when it is deoxygenated and then after getting oxygenated. This is called the **double circulation** of blood.

TISSUE FLUID AND LYMPH

1. Tissue fluid (or intercellular fluid)

As the blood flows in the capillaries of the tissues, the plasma and the leukocytes "leak out" through their walls and bathes the cells. This fluid is called the **tissue fluid** or the intercellular or extracellular fluid. It is from this fluid that the cells absorb oxygen and other required substances, and in turn, give out carbon dioxide and other wastes back into it.

2. Lymph and lymphatic system

Some of the tissue fluid may be reabsorbed into the blood vessels, but most of it enters into another set of minute channels named lymph vessels and is then called **lymph**.

The lymph flows in these vessels due to contraction of the surrounding muscles. The lymph vessels on the way drain lymph into lymph nodes from where fresh lymph channels arise. These channels ultimately pour th lymph into the major anterior veins close : their entry into the right auricle, and it is th in circulation again.

The lymphatic system consists of lymphatic organs, such as the spleen and the tonsils, a conducting network of lymph vessels and the circulating lymph (Fig. 6.5).

Composition of Lymph :

Lymph consists of a cellular part an a non-cellular part.

- **Cellular part :** It contains only leukocytes (mostly lymphocytes). Blood platelets or red blood cells are absent.
- **Non-cellular part :** It is made up o. mostly water (about 94%) and th. rest is made up of proteins, fats, carbohydrates, enzymes, antibodies, etc. (about 6%).

Functions of Lymph :

(i) **Nutritive :** It supplies nutrition and oxygen to those parts where blood cannot reach.

(ii) **Drainage :** It drains away excess tissue fluid and **metabolites** and returns proteins to the blood from tissue spaces.

(iii) **Absorption :** Fats in the intestine are absorbed through lymph vessels (or lymphatics).

(iv) **Defence :** Lymphocytes and monocytes of the lymph function to protect the body. The lymphatics also remove bacteria from the tissues. We often experience painful swellings in our groins or in the axils of our arms when we get a boil or injury in the limbs. This is a protective sign. The lymph nodes present in these regions tend to localize the infection

Differences between lymph and blood

Lymph	Blood
1. Lymph is a part of open circulatory system.	1. Blood is a part of closed circulatory system.
2. It circulates through lymph capillaries, lymph nodes and lymph vessels.	2. It circulates through arteries, veins, blood capillaries and the heart.
3. It is pale yellow in colour and does not contain RBCs and haemoglobin.	3. It is red in colour due to the presence of RBCs and their haemoglobin content.
4. It contains WBCs (mostly lymphocytes) and blood plasma without blood platelets and proteins.	4. It contains WBCs and blood plasma with blood platelets and proteins.
5. It is a part of the immune system as it protects our body and helps to build immunity.	5. It is primarily responsible for transporting respiratory gases, nutrients and hormones throughout the body.

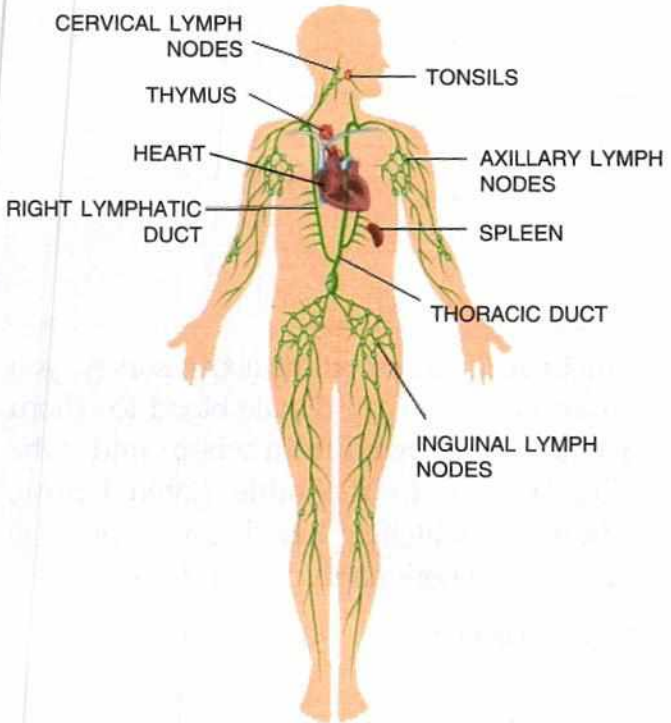


Fig. 6.5 Distribution of main lymph vessels in the human body.

and prevent it from spreading to the body as a whole.

BLOOD GROUPS

Karl Landsteiner in 1900 identified different types of blood groups in humans. These blood groups are differentiated on the basis of proteins (antigens) found on the surface of the RBCs. There are two types of antigens — A and B.

A person's blood group is 'A' if the antigen present on his RBCs is 'A', and 'B' if the antigen is 'B'. The persons whose RBCs have both types of antigens belong to the 'AB' blood group and those with no antigens *i.e.* neither A nor B have the 'O' blood group.

MATCHING OF BLOOD GROUPS

Matching of blood groups (compatibility) under the ABO system for donation is done as follows (√ = Yes, × = NO) :

Blood group of donor	Blood group of recipient			
	A	B	AB Universal recipient	O
A	√	×	√	×
B	×	√	√	×
AB	×	×	√	×
O Universal donor	√	√	√	√

What do you conclude from the above matchings ?

1. The blood of A group can be given to a person with A and AB groups.

2. The blood of B group can be given to a person with B and AB groups.
3. The blood of AB group can only be given to AB group, but a person with AB type of blood can receive blood from all types, and is therefore called a **universal recipient.**
4. The blood of O group can be given to all the groups. Hence, a person with O blood group is called a **universal donor.**

Activity 1

To collect information about the blood group of persons around you, and to know about blood transfusion.

The activity is based upon the information you have to collect from your own family members as well as from some of your friends.

Write the type of blood groups in the columns provided in the table. In case, the person does not know his/her blood group, place a "dash" (–) in the column.

You should also ask the blood donors if they have ever given blood to other persons or received it from others. Also, ask whether any matching of the blood groups of the donor and the recipient was earlier done or not. The matching of blood groups is also called ***blood group compatibility***.

A child is being given a blood transfusion

Chart For Recording Blood Groups

Serial No. of family	Member of the family	Blood group			
		A	B	AB	O
Family No. 1 (Own family)	Father				
	Mother				
	Brother (Anyone)				
	Sister (Anyone)				
Family No. 2	Father				
	Mother				
	Brother (Anyone)				
	Sister (Anyone)				
Family No. 3	Father				
	Mother				
	Brother (Anyone)				
	Sister (Anyone)				

Conclusion : Based on the above survey, you can find out who can donate blood to whom or who can receive it from whom under the ABO system. In the table given below, indicate the matching blood groups by a (√) and a (×) for non-matching blood groups.

Blood group of donor	**Blood group of recipient**			
	A	B	AB	O
A				
B				
AB				
O				

[Sometimes, people may respond by saying "B (+)" (B-positive) or "B (–)" (B-negative). In such cases, "positive" or "negative" refers to another blood group system called "Rh" system. You will learn about it in your higher classes.

BLOOD DONATION AND BLOOD BANKS

Blood donation is a voluntary procedure where blood is drawn from a healthy person called a 'donor', so that it can be given to someone who needs it during a surgery or medical treatment. Normally a pint of blood (420 mL) is withdrawn from a donor at a given time.

Blood bank is a place where blood collected from donors, is stored and preserved to be later given to a recipient as and when needed.

HEART-RELATED CONDITIONS

1. Palpitations

Sometimes, one may experience the heart beating too hard or too fast or sometimes even skipping a beat.

This can be frightening, but not serious or harmful and often this condition goes away on its own. Most of the time it is caused by stress or anxiety. Sometimes certain types of food may also cause palpitations.

In rare cases, palpitations may be an indication of a more serious heart condition, specially if it is accompanied by shortness of breath, dizziness or chest pain.

2. Hypertension

This is a condition that occurs in a person when blood flows through the blood vessels with a force greater than normal. This is also called **High Blood Pressure**. Hypertension can strain the heart, damage blood vessels and increase the risk of a heart attack or stroke.

3. Heart attack

A heart attack is a sudden interruption of blood supply to the heart. It usually occurs due to a blood clot that prevents the flow of oxygen-rich blood to the cardiac muscle. As a result, a part of the cardiac muscle dies and causes a permanent damage to the heart. However, the heart still functions and sends blood around the body. Some common symptoms of a heart attack include uncomfortable pressure, tightness or squeezing pain in the centre of the chest; discomfort or pain spreading beyond the chest to the shoulders, neck, jaw, teeth or one or both arms; shortness of breath; dizziness; sweating and nausea.

4. Cardiac arrest

A cardiac arrest occurs when the heart suddenly stops pumping blood around the body. Someone who is having a cardiac arrest will suddenly lose consciousness and will stop breathing or have abnormal breathing. Some people may have chest pain, shortness of breath, or nausea before a cardiac arrest occurs. If not treated within minutes, it usually results in death.

The most common cause of cardiac arrest is coronary artery disease wherein the walls of the arteries thicken as a result of fat or plaque deposition. Less common causes include major blood loss, lack of oxygen, low potassium levels, heart failure, and intense physical exercise.

If proper "First Aid" is provided to the patient, and he/she gets the right treatment quickly, chances of recovery from a cardiac arrest are quite high.

Difference between a cardiac arrest and a heart attack.

Normally people consider a cardiac arrest and heart attack to be the same but they are quite different. During a heart attack, the flow of blood to the heart is interrupted; while in a cardiac arrest, the heart stops pumping blood to other parts of the body. A person having a heart attack is at a high risk of experiencing a cardiac arrest.

Both a heart attack and a cardiac arrest are life-threatening medical emergencies and require

immediate medical help/treatment. If you witness a person showing the symptoms of heart attack or cardiac arrest, you can increase the person's chances of survival by taking certain immediate emergency steps like —

- calling an ambulance/doctor immediately.
- helping the person to sit or lie down in a comfortable position so as to reduce the pressure on the heart.
- performing chest compression (pumping the heart by external cardiac massage). This massage will improve the blood circulation until the ambulance/doctor arrives.
- using mouth-to-mouth resuscitation so that the lungs get filled with fresh air. The person will get more oxygen for the heart muscles to start functioning.

Keeping the heart healthy

- It is important to take care of one's health to protect one from heart diseases. Eating healthy food and regular exercise should become healthy habits that one should develop early in life.
- Avoid too much of oily and fried foods. They contain fat.
- Excessive eating of fast foods deprives the body of the required nutrients. Eating lots of vegetables and fruits is recommended.
- Eat plenty of fibre-containing foods such as whole grain cereals, oats, etc.
- Avoid eating excessive amounts of sweet foods. Too much of sugar in the body is a major cause for obesity.
- Obesity or excessive weight is a very common problem now-a-days and the cause of many diseases, especially heart diseases.
- Playing outdoor games is a good form of exercise. It keeps us active and happy.
- Regular walking, jogging, cycling, etc. help to keep our body fit and healthy.

REVIEW QUESTIONS

Multiple Choice Questions:

1. Put a tick mark (√) against the correct alternative in the following statements :
   (a) The vein which brings oxygenated blood to the heart from the lungs :
   (i) Renal vein ☐ (ii) Superior vena cava ☐
   (iii) Pulmonary vein ☐ (iv) Coronary vein ☐
   (b) The path which the blood flows through during pulmonary circulation is :
   (i) RA → RV → Pulmonary arteries → Lungs → Pulmonary veins → LA ☐
   (ii) LA → LV → Pulmonary veins → Lungs → Pulmonary arteries → RA ☐
   (iii) LA → LV → Aorta → Body → Vena Cavae → RA ☐
   (iv) RA → RV → Vena Cavae → Body → Aorta → LA ☐

Short Answer Questions :

1. In which organ of our body does blood get oxygenated ? .....
2. Which side of the heart (left or right) contains oxygenated blood ? .....
3. Name the following :
   (a) Three kinds of blood vessels. .....
   (b) Two types of blood circulation in the human body. .....

(c) The membranous structure which divides the heart into a right and a left portion. .....

(d) The structure responsible for starting electrical impulses that cause the heart to contract and relax in order to keep pumping blood. .....

(e) The scientist who identified different types of blood groups. .....

4. Define the terms :

(a) Circulatory system : .....

(b) Blood : .....

(c) Lymph : .....

(d) Artificial pacemaker : .....

Long Answer Questions (Write the answers in your notebook) :

1. Differentiate between the following pairs on the basis of what is indicated within the brackets:

(a) Pulmonary artery and pulmonary vein (kind of blood)

(b) Artery and vein (direction of blood flow)

(c) Closed and open vascular system (definition)

(d) Bicuspid and tricuspid valve (location)

(e) Blood and lymph (composition)

2. Write important role/roles of each :

(a) Pericardial fluid (b) Aorta (c) Vena cavae

3. Name any *four* heart-related conditions that occur commonly in humans. Briefly explain the cause and symptoms of each of them.

4. Give the functions of lymph.

5. Explain : (a) Universal donor (b) Universal recipient

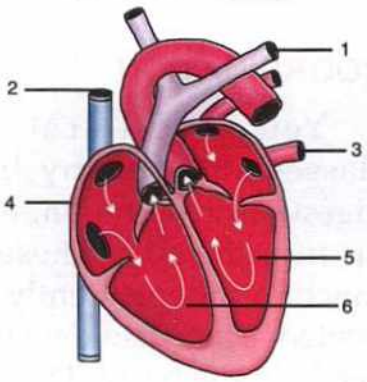
6. During surgical operations or during accidents, the patient may be given blood from outside to save his life. What is the technical name of this process ? Briefly explain the precautions to be observed and taken in this process.

7. Given alongside is a diagram of the human heart showing its internal structure. Label the parts marked 1 to 6, and answer the following questions.

(a) Which type of blood is carried by the blood vessel marked 2 ?

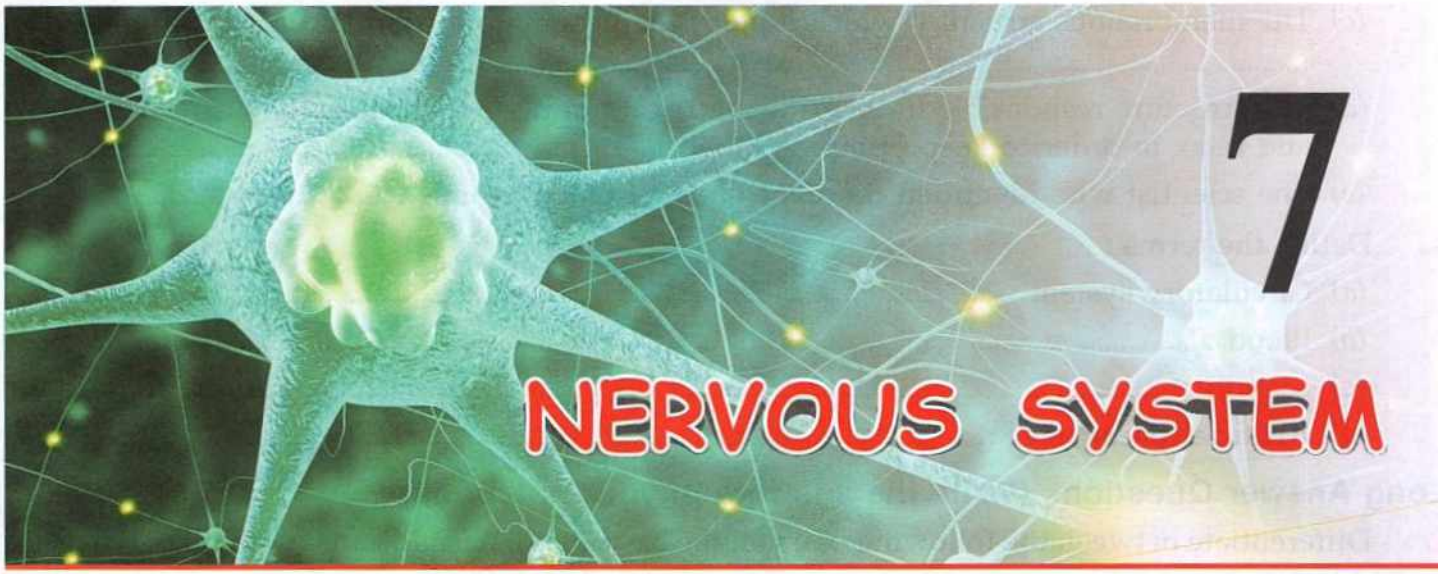
(b) Name the main artery which takes the blood from heart to different parts of the body.

(c) Which chamber of the heart receives deoxygenated blood from the body ?



PROJECT

- Using coloured 'Red' and 'Blue' tubes, develop a model of pulmonary circulation and systemic circulation with heart in the middle.



7 NERVOUS SYSTEM

SYLLABUS

Revisit learning of earlier classes

- Types of nerves : sensory, motor, mixed (function only). Cranial and spinal nerves (only definition and number).
- Structure of a motor neuron.
- Central nervous system (CNS) in detail with its parts and their functions.
- Reflex action : definition and basic terms used to describe reflex action (stimulus, response, impulse, receptor, effector), common examples of reflex action.

COORDINATION

You have learnt in your previous classes about many life processes, like digestion, respiration, excretion, etc. going on in our body. These processes do not function independently but they are inter-related. They also depend upon the general needs of the body. The interlinking 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** : Thi coordination is brought about by th **nervous system**. It consists of th brain, spinal cord, nerves and th sense organs. How does nervou system operate in our body ? Let u take an example :

When you feel hungry, you eat food The act of eating food involves number of coordinated activitie Your eyes look at the food placed o the table. Your brain records thi information and the action starts. Th

arms get the message and they are raised. 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 body, reaches the blood stream to fulfil the requirements that had arisen when you felt hungry.

If someone suddenly happens to come in front of a running car, the driver instantaneously applies the brakes. In this situation, in a fraction of a second, the eyes watch and the message goes to the brain, as well as an order is sent to the leg muscles to press the brakes.

(ii) **Chemical coordination** : This coordination is brought about through 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 *i.e.* hormones are released into the blood to provide you extra energy and strength to run.

FUNCTIONS OF THE NERVOUS SYSTEM

The nervous system in our body performs the following major functions :

1. **Keeps us informed** about the outside world through the five sense organs.
2. Enables us to **remember, think and reason**.
3. **Controls and harmonises all voluntary muscular activities**, e.g., running or even holding this book in your hand while you are reading it.
4. **Regulates involuntary activities** such as breathing or the beating of the heart, without our thinking about them.

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**,
(2) a long process called **axon**.

The cell body contains a nucleus. The dendrites are cytoplasmic extensions of the cell body. From the cell body arises one long process called the axon. Its length may vary from a few millimetres to 1 metre. The end of the axon terminates in a number of branched filaments called **terminal branches**.

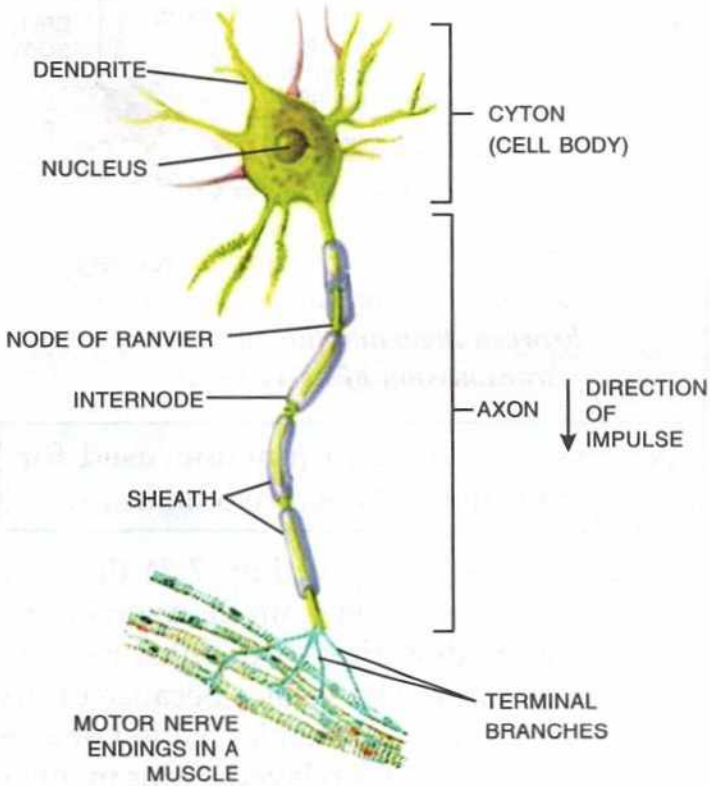


Fig. 7.1 A nerve cell or a neuron

There are *three* kinds of neurons.

1. **Sensory neurons** : These carry impulses from the sense organs to the spinal cord or brain.
2. **Motor neurons** : These carry impulses from the brain and spinal cord to the muscles and glands.
3. **Association neurons** : These transmit impulses from one neuron to another.

The neurons do not actually touch each other. They communicate with one another via **synapses** where the axon terminal of one cell impinges on the dendrite of another (Fig. 7.2).

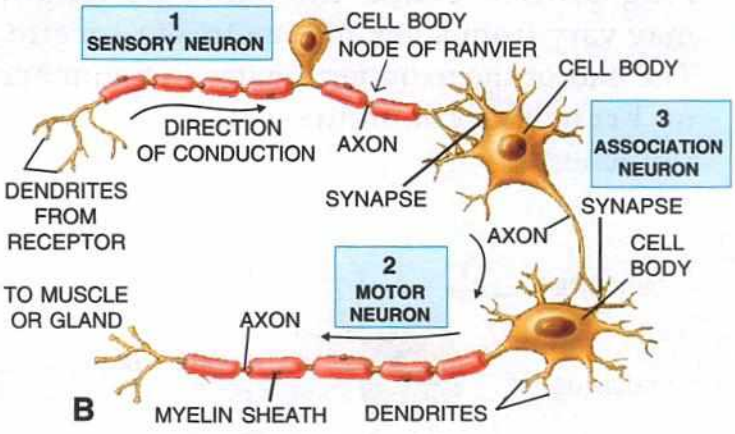


Fig. 7.2 Three types of neurons (sensory, motor and association), synapse between them and the direction of transmission of nerve impulse

A synapse is a small junction used for communication between two neurons.

It is at the synapse (Fig. 7.3) that the message is transmitted from the axon of one neuron to the dendrites of the next neuron. This transmission takes place because of the secretion of a specific chemical called **neuro-transmitter**. Messages relayed in this manner from one neuron to the next allow the unidirectional flow of impulses.

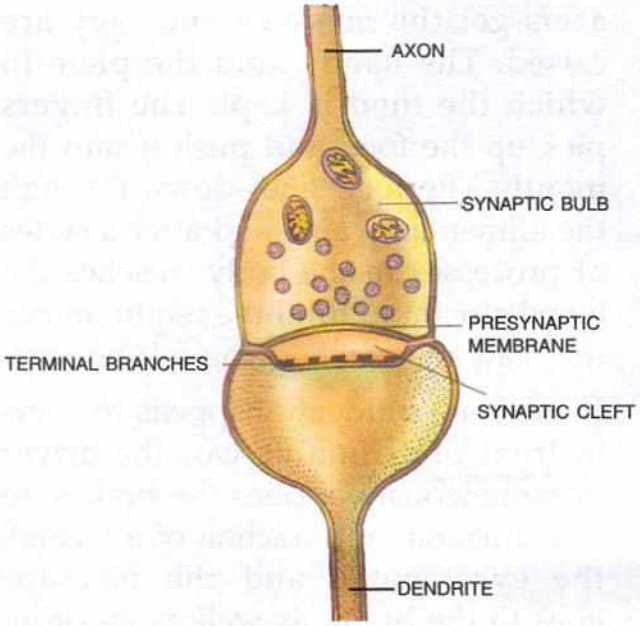


Fig. 7.3 Structure of the synapse

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 the adjacent fibres. There are three kinds of nerves as described below :

1. **Sensory nerve** : It contains only sensory neurons, *e.g.* optic nerve of the eye.

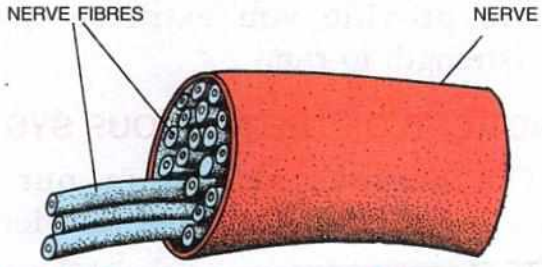


Fig. 7.4 Nerve fibres grouped into a nerve

2. **Motor nerve** : It contains only motor neurons, *e.g.* nerves going to the muscles of the eyeball.
3. **Mixed nerve** : It is the one which carries both sensory and motor neurons, *e.g.* the nerve which goes to the tongue.

HUMAN NERVOUS SYSTEM

The following *two* divisions make up the human nervous system :

1. **The central nervous system or CNS :** It consists of the brain and the spinal cord. The brain lies protected within the skull, and the spinal cord lies well-protected within the vertebral column.
2. **The peripheral nervous system or PNS :** It consists of the nerves arising from or going to the central nervous system. These nerves are spread throughout the body.

The peripheral nervous system has two subdivisions : Somatic nervous system and autonomic nervous system. Somatic nervous system connects the CNS to the organs, muscles and skin. It carries motor and sensory information both to and from the CNS.

Autonomic nervous system acts largely unconsciously and controls involuntary bodily activities such as heart rate, dilation and constriction of blood vessels, etc.

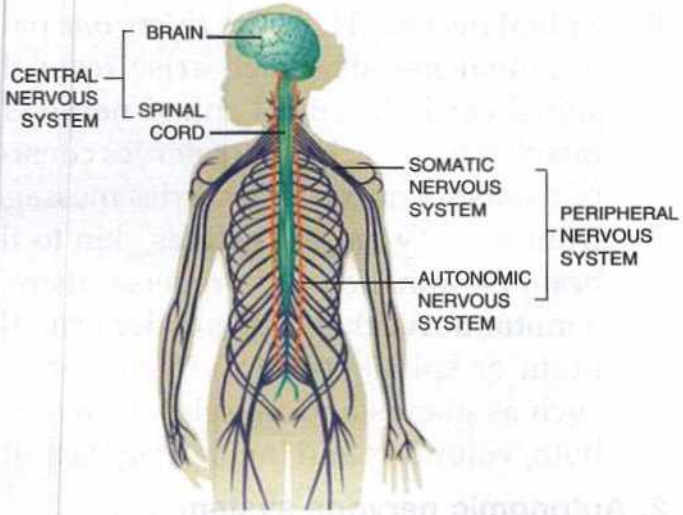


Fig. 7.5 The human nervous system

CENTRAL NERVOUS SYSTEM

1. THE BRAIN

The brain has three main parts :

(i) The cerebrum, (ii) The cerebellum, and (iii) The medulla oblongata.

Cerebrum is the largest portion of the brain. It is divided into two (right and left) halves called the **cerebral hemispheres.** Their outer surface is folded with ridges and grooves. Each hemisphere is internally hollow. Their walls have an outer and an inner portion. The **outer** portion contains cell bodies of the neurons and is called **grey matter**. It accommodates a large number of neurons (human cerebrum contains about 9 billion neurons). The **inner** portion of the cerebrum mainly consists of axons and is called **white matter.**

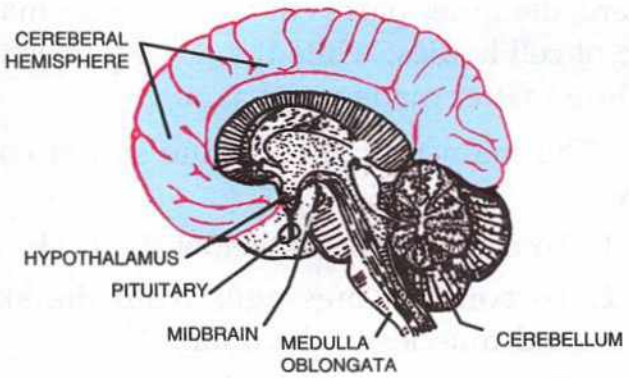


Fig. 7.6 Brain in median section

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

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 contract or relax under the control of the 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 upto the spinal cord. Its function is to control the activities of the internal organs. *For example*, beating of the heart, breathing, peristalsis of the alimentary canal, *etc*. Injury to the medulla may result in the death of a person.

2. THE SPINAL CORD

The spinal cord extends from the medulla of the brain and runs down almost through the whole length of the backbone. In the spinal cord, the arrangement of white and grey matter is reversed from that in the brain. Here, the **inner** part is the **grey matter** made up of cell bodies, while the **outer** part is the **white matter** made up of axons.

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 (or torso) 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.

The peripheral nervous system is divided into **somatic nervous system** and **autonomic nervous system**.

1. Somatic nervous system

It consists of two sets of nerves :

(A) **Cranial nerves** and

(B) **Spinal nerves**

A. Cranial nerves emerge from the brain. There are ***twelve*** pairs of cranial nerves, some of which are :

— sensory like the **olfactory** (for nose), **optic** (for eyes) and **auditory** (for ears),

— motor nerves like the ones going **to the eye muscles**, and

— mixed nerves like those going to and **coming from the face and tongue**.

B. Spinal nerves : There are ***thirty one*** pairs of spinal nerves which arise from the spinal cord. A typical spinal nerve is a mixed nerve. Each pair of nerves consists of a **sensory nerve**, that carries messages from sensory organs such as skin to the brain or spinal cord. In reverse, there is a **motor nerve** that brings order from the brain or spinal cord to **effector organs** such as glands and muscles. It involves both, voluntary and involuntary activity.

2. Autonomic nervous system

The autonomic nervous system consists of a pair of chain of nerves and ganglia (a mass of cytons of nerve cells) found on either side of the backbone. This system controls the involuntary activities of the internal organs. It operates through two

ystems — the **sympathetic** and **parasympathetic** systems, which are antagonistic opposite) in their actions. *For example*, in imes of fear, the sympathetic nervous system ilates the pupil of the eyes, constricts the essels of the skin and accelerates the heart ate. The parasympathetic nervous system is esponsible for the constriction of the pupil f the eyes, dilation of blood vessels and lowing down of the heart rate.

Now, the nervous system acts in two ways, the actions or responses being : **Voluntary** (performed consciously) and **Involuntary** (performed unconsciously).

1. **Voluntary actions** (occuring knowingly) : *For example*, you wish to watch some programme on TV and you switch it on and press the remote for a particular channel. Similarly, you pick up an apple and eat it.
2. **Involuntary actions** (occurring unknowingly, also called **Reflexes**) : *For example*, some particle falls into your eye and there is immediate **flushing of tears** to wash out the particle (glandular secretion). **Instantaneous withdrawal of hand** when it accidentally touches a hot iron (muscular movement).

REFLEX ACTION

The peripheral nervous system and pinal cord together control certain actions here brain is not involved, e.g. if you touch hot object or get pricked by a pointed object, ou instantly remove your hand, without hinking about it. Such an action is called a **reflex action**.

Reflex action is the quick, immediate and automatic response to a stimulus without the involvement of the brain.

The shortest pathway of the nerve impulse from a receptor to the effector which makes a reflex action possible is called a **reflex arc**.

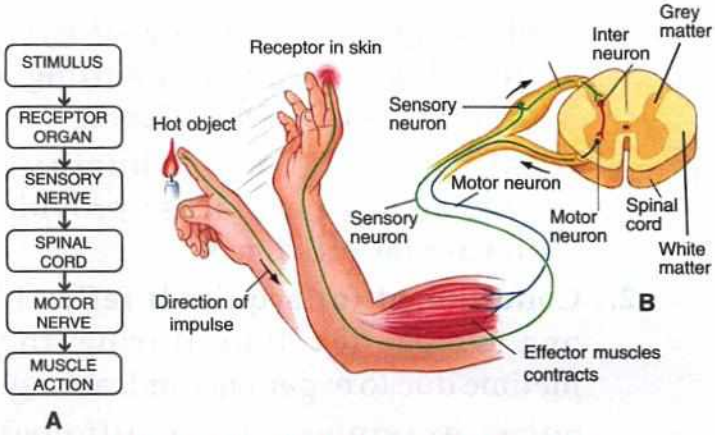


Fig. 7.7 A. Pathway of a reflex arc
B. Diagram of a reflex arc

Stimulus received by the sensory receptors (in the finger)
↓
Impulse is generated and carried along by sensory neurons towards the spinal cord
↓
Impulse travels through spinal nerves towards the spinal cord
↓
Impulse arrives at the nerve endings of sensory neurons
↓
The impulse passes across the relay neuron (or interneuron, present between a sensory and motor neuron) to the motor neuron
↓
Impulse travels along the motor neuron away from the spinal cord
↓
The nerve endings of motor neuron connect effector organ or muscle
↓
Response is produced by effector organ or muscle

TYPES OF REFLEXES WITH EXAMPLES

Reflexes are of *two* types — (1) Natural (inborn) reflexes and (2) Conditioned (acquired) reflexes.

1. **Natural (inborn) reflex** is one in which no previous experience or learning is required. These reflexes are inborn, *i.e.* inherited from the parents. *Example :*
   - Blinking and watering of eyes coughing, sneezing, vomitting : these are **protective reflexes**.
   - Salivation (when hungry), swallowing, peristalsis : provide **functional efficiency**.
2. **Conditioned (or acquired) reflex** is one which develops during the lifetime due to experience or learning.

   Some examples of conditioned reflexes are :
   - Watering of mouth (salivation) at the sight of a favourite or tasty food. Here, as an acquired reflex, salivation occurs because our brain remembers the taste of the food due to a previous experience.
   - Typing on the keyboard of a computer.
   - Playing a musical instrument.

SOME BASIC TERMS IN THE FUNCTIONING OF NERVOUS SYSTEM

To understand the functioning of th nervous system, you should be familiar wit the following basic terms :

1. **Stimulus** : Any change in th environment that usually results i change in the activity of the body.
2. **Response** : The activity of the bod due to the stimulus.
3. **Impulse** : A wave of electrical disturbanc that runs through the nerves.
4. **Receptors** : The sense organs whic receive the stimulus.
5. **Effector** : Any muscle or gland whe the response occurs.

The above terms can be understood b taking an example of sudden removal o hand on touching a hot object.

— Heat is the **stimulus.**

— The nerve cell in the skin tha receives the stimulus is the **receptor**

— The 'sensation' travelling through th nerve is the **impulse.**

— The muscle of the hand receiving th command from the "brain" is the **effecto**

— The contraction of the muscle fo withdrawing the hand is the **response**

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) Balance of body is controlled by

(i) Spinal cord ☐ (ii) Cerebellum ☐

(iii) Cerebrum ☐ (iv) Medulla ☐

(c) The smell of good food causes watering of your mouth. It is

(i) Natural reflex ☐ (ii) Acquired reflex ☐

(iii) Inborn reflex ☐ (iv) Ordinary reflex ☐

(d) The structural and functional unit of nervous system is

(i) Axon ☐ (ii) Nephron ☐

(iii) Neuron ☐ (iv) Dendron ☐

Short Answer Questions :

1. You are driving your bicycle at a fast speed. Suddenly, a small boy comes in front of your cycle and without wasting any time in thinking, you immediately apply the brakes and the accident is avoided. What name is given to such an action ? .....

2. Name the following :

(a) The long, extended process of a neuron : .....

(b) The point of contact between two neurons : .....

(c) The kind of nerve which carries both sensory and motor neurons : .....

(d) The nerve which connects the eyes to the brain : .....

(e) The nerve which connects the nose to the brain : .....

(f) The nerve which connects the ears to the brain : .....

(g) Two sub-divisions of the peripheral nervous system : .....

(h) Two parts of the autonomic nervous system : .....

3. Define the terms :

(a) Coordination : .....

(b) Synapse : .....

(c) Impulse : .....

(d) Reflex action : .....

(e) Reflex arc : .....

Long Answer Questions (Write the answers in your notebook)

1. Differentiate between the following pairs of terms on the basis of what is indicated within the brackets :
   (*a*) Stimulus and response (definition)
   (*b*) Receptor and effector (examples)
   (*c*) Motor nerve and sensory nerve (function)
   (*d*) Cranial and spinal nerves (number in pairs)
   (*e*) Cerebrum and medulla oblongata (function)
   (*f*) Cerebrum and spinal cord (arrangement of white and grey matter)
2. With the help of a suitable diagram, describe the structure and function of a neuron.
3. Briefly describe the structure of the cerebellum in human brain and mention its functions.
4. Mention the *three* functions of spinal cord.
5. With the help of a suitable example, describe reflex action.
6. Briefly differentiate between the following by giving examples :
   (*a*) Voluntary and involuntary action
   (*b*) Inborn and acquired reflexes.

UNIT : 5
Health and Hygiene

8

DISEASES AND FIRST AID

SYLLABUS

Diseases :

- A brief idea of communicable diseases (influenza, measles, malaria, dengue, chikungunya, HIV) — causative agents, symptoms and prevention to be **dealt within a tabular form.**
- The meaning of vector.
- Method of preventing diseases in general; use of vaccines to be mentioned, vaccination and immunization, the concepts and differences between the two.
- Harmful effects of consuming tabacco, drinking alcohol, taking drugs.

First aid :

- First aid - meaning.
- First aid given in the following cases : burns, bleeding, fracture, objects in the eye, unconsciousness, swallowing poison, snake bite and stings.

HEALTH

Normally, a person is said to be healthy, if he or she is not suffering from any disease. When a person can work hard, interact well with people, enjoy leisure and can adapt to the changes and stresses of life, then he or she is in good health.

Health is defined as a state of complete physical, mental and social well-being, and not merely an absence of disease or infirmity.

Physical health and mental health are inter-related. "A sound mind in a sound body" is an old and appropriate saying for good health.

Disease is a departure from normal health through structural or functional disorders of the body.

CATEGORIES OF DISEASES

There are *two* major categories of diseases :

1. **Communicable or infectious diseases.** These diseases are spread from an infected person to a healthy one. These diseases are caused by the germs known as pathogens. When pathogens reach a healthy person through certain agencies, like insect-bite, contaminated water or food, etc., he or she is infected with the disease. Some examples of communicable diseases are cholera, viral fever, chicken pox, malaria, typhoid, *etc.*
2. **Non-communicable or non-infectious diseases.** These diseases are not caused by any germ, therefore these diseases cannot spread from an infected person to a healthy person (*i.e.*, they are non transmissible). These may be caused due to improper functioning of the body organs. *Examples*: diabetes, heart attack, *etc.*

COMMUNICABLE OR INFECTIOUS DISEASES

Communicable or infectious diseases are those diseases which spread from an infected person to a healthy person by the entry of microorganisms/pathogens.

These diseases are caused due to microorganisms such as viruses, bacteria, fungi, worms and protozoa. The disease-causing germs are called **pathogens**. We get such infections through air, water, food, physical contact, cuts, sexual contact and from insects like mosquitoes, flies, *etc.*

Spread of communicable diseases

To continue their race, the pathogens try to come out of the body of an infected person and reach out to more hosts for their survival. These pathogens transfer from a patient to a healthy person, generally, in the following ways :

• Direct method, or • Indirect method

Direct method —

Direct contact : Diseases like measles, chicken pox and fungal infections are spread through direct contact with an infected person.

Indirect method — This includes the following :

- **Touching and sharing items used by the infected person :** The use of same towel, handkerchief or same bed, or sharing the same utensils which were handled by the patient may spread the disease to a healthy person.
- **Contaminated food and water or drink :** Many intestinal diseases are spread by the intake of vegetables and fruits that are not washed properly or are washed with contaminated water. The germs on infected vegetables and fruits on reaching our alimentary canal, multiply and cause the disease.
- **Vectors :** Vectors are those organisms (*e.g.* house flies, mosquitoes, *etc.*) which carry germs from a source of infection but themselves do not get the infection. *For example*, mosquitoes while feeding on the blood of a malaria patient, gain the germs in their bodies, and get them transferred

Fig. 8.1 A fly feeding on a lump of food and contaminating it

in the blood stream of a healthy person whom they bite next.

Houseflies carry germs from garbage or sewage and deposit them on food. A person will get the disease if he eats such contaminated food.

Fig. 8.2 A mosquito (vector) sucking blood from a person's arm

Droplet infection : Many viral and bacterial diseases of the respiratory tract are transmitted through droplets. *For example*, the germs of tuberculosis pass into the air during sneezing or coughing of the patient. These fine droplets remain suspended in the air for quite sometime. The healthy person gets the infection by inhaling the same air containing these suspended droplets. Tuberculosis, common cold, measles, diphtheria, etc. spread in this way.

Some communicable diseases in brief

1. Diseases caused by viruses

Influenza is a common disease. The symptoms of this disease are cold, fever and chill. It spreads through droplet infection.

Measles is a highly contagious viral infection of the respiratory system, usually of children spread by contact. Its symptoms are nasal discharge, redness of the eyes, coughing, fever and eruption of red **papules**.

AIDS (Acquired Immuno Deficiency Syndrome) is caused due to a virus called HIV (Human Immunodeficiency Virus). It weakens the immunity or self-defence mechanism of the human body. AIDS makes the infected person prone to many other infectious diseases. It spreads through sexual contact, blood transfusion and infected syringes (injection needles). Children may get this disease through the blood of their infected mother during pregnancy and breast feeding.

2. Diseases caused by vectors

Malaria is caused by a protozoan *Plasmodium* which enters the human body through the bite of a female *Anopheles* mosquito. It shows the symptoms of chills and intermittent high fever. Prevention of malaria can be done by protection against mosquito bites and taking antimalarial drugs.

Dengue is a mosquito-borne disease caused by the dengue virus. It is spread by a mosquito called ***Aedes aegypti***. Symptoms typically begin 3-14 days after infection. These may include high fever, headache, muscle and joint pains, and characterstic skin rashes. In extreme cases, it can lead to excessive bleeding (haemorrhage) and death.

Dengue can be prevented by the use of mosquito repellants and ensuring that there is no stagnant water to act as a breeding ground in or around homes.

Chikungunya is also a mosquito-borne disease caused by a virus which is spread by the bite of the *Aedes* mosquito. The virus in this case, is different from the dengue virus. The symptoms occur 2-12 days after exposure and include fever, joint pain, muscle pain, headache, etc. Most people feel better within a week following the treatment, however sometimes the joint pain may last for months. The preventive measures include mosquito control and not visiting areas where the disease is common.

Communicable diseases — Viral diseases

S.No.	Name of disease	Causative agent	Symptoms	Prevention/treatment
1.	Influenza	Virus	Cold, fever and chills.	Rest and isolation of the patient.
2.	Measles	Virus	Nasal discharge, red watery eyes, fever, eruption of papules on the skin.	Vaccine
3.	Malaria	Protozoan called *Plasmodium* (transmitted by the bite of a female *Anopheles* mosquito)	Intermittent high fever, followed with profuse sweating, headache and violent shivering.	Prevent breeding of mosquitoes. Avoid being bitten by mosquitoes by wearing clothes that fully cover the body.
4.	Dengue	Virus (spread through the bite of the *Aedes* mosquito)	Fever, headache, muscle and joint pain, skin rash.	Prevent breeding of mosquitoes. Do not allow water to stagnate in or around homes. Use of mosquito repellants.
5.	Chikungunya	Virus (spread by the bite of the *Aedes* mosquito)	Fever, headache and acute pain in the joints.	Prevent breeding of mosquitoes and avoid getting bitten by them. Use mosquito repellants.
6.	AIDS (acquired immunodeficiency syndrome)	HIV (human immunodeficiency virus)	Loss of weight, body's normal defense against infection breaks down.	Avoid sexual contact with infected person, always use disposable syringes.

PREVENTIVE MEASURES FOR DISEASES

As is rightly said "prevention is better than cure," we must observe the following preventive measures for our good health.

1. Public Hygiene

Public hygiene is as important as personal hygiene. It involves proper disposal of human excreta and domestic wastes.

- Sewage and chemical wastes should not be released into the water bodies. Sewage should be chemically treated first before being released into the water bodies to avoid water-borne diseases.
- There should be proper sewer lines connected to sewage treatment plants.

2. Healthy Environment

- Maintain a healthy environment to prevent the spreading of diseases due to the breeding of mosquitoes, house flies and microorganisms.
- Garbage should be kept in covered bins so that flies do not breed on them.
- Do not allow water to stagnate outside your house and in your neighbourhood. All the drains should also be covered. This will prevent breeding of mosquitoes.
- Contamination of drinking water with faeces (animal or human excreta) causes a number of diseases.

VACCINATION

The idea of vaccination was conceived by Edward Jenner (1749-1823). He observed that milkmaids who were in contact with cows suffering from cowpox never got small pox. He tested his theory on an eight year old boy. He got the material taken from a cow pox pustule and introduced it into the boy's body. The boy's body developed pustules which later on formed a scab and healed leaving only a scar.

To further test his idea, he injected the boy with small pox virus after two months, and found no sign of small pox on the boy. In this way, Jenner's vaccination experiment was successful. He used the term "*Vaccine*" for immunity-inducing preparation (*vacca* in Latin means cow) and the process was called **Vaccination**. Jenner's findings were later confirmed by Louis Pasteur, and he developed vaccines for anthrax, chickenpox, cholera, etc.

Vaccination is the practice of artificially introducing germs or germ substances into the body for developing resistance to particular diseases. Scientifically, this practice is called **prophylaxis** and the material introduced into the body is called the **vaccine.**

Fig. 8.3 A doctor is inoculating a child against measles

Usually, the vaccine or germ substance is introduced into the body by injection (*e.g.* TAB vaccine) and sometimes orally (*e.g.* polio drops). When the vaccine is injected in the body, it stimulates the WBCs to produce antibodies against germs for that particular disease.

The terms "vaccine and vaccination" were originally used only for vaccination against small pox, but now these are used in a general sense.

A vaccine can be prepared by any one of the following four methods :

(1) **Using killed germs.** *e.g.* TAB vaccine for **typhoid**, Salk's vaccine for **poliomyelitis**, and the vaccine for **rabies** (dog-bite).

(2) **Using living weakened germs.** The living germs are treated in such a way that they become very weak and as such, they cannot cause the disease. They can induce antibody formation in the body, *e.g.* the vaccine for **measles**, and the freeze-dried BCG vaccine for **tuberculosis.**

(3) **Using fully virulent living germs.** *e.g.* the vaccine for smallpox. In this vaccination, a person is inoculated with cowpox virus which is very similar to smallpox virus.

Small pox vaccinations are no more given, because the disease has almost been eradicated from India as per the latest data.

(4) **Using Toxoids.** They are vaccines used for diphtheria and tetanus. The toxoids are extracts of toxins secreted by bacteria, and these poisons are made harmless by the addition of formalin, to retain the capacity to produce antibodies (antitoxins).

Attempts are being made to develop a vaccine against AIDS also.

IMMUNIZATION

Immunization is an artificial way of achieving protection from infections by the introduction of dead or weakened germs into one's body.

When exposed to vaccines, the body makes antibodies, and more-or-less permanent protection from infection is achieved.

Thus, immunization is a process by which the body of an individual is made resistant to a specific disease by vaccination. Immunization has decreased the number of people susceptible to various diseases in the world. In our country, immunization programme is under way to immunize infants against tetanus, diphtheria, whooping cough, mumps, measles, tuberculosis and polio. The Pulse Polio programme is still going on in full swing, you all must be quite familiar with it. It is being done to eradicate polio from our country.

FIRST AID

As the name suggests, it is the immediate care or help given to a patient at the time of medical emergency before he or she is taken to a doctor. *e.g.*, during accidents, heart attacks, snake bites, burns, *etc.*

- **Burns :** First aid for burns depend on the degree of burns. One should not pull away clothes stuck to burnt areas and don't cut blisters. Apply any oily substance (ointment, butter, vaseline, *etc.*) to the burnt skin surface.
  - — In the case of superficial burns, pour cold water over the burnt area. Then dry that portion and cover with sterile dressing.
  - — In the case of deep burns, never use water, and cover the injured part with dressing.
  - — In the case of chemical burns (due to acid and other chemicals), wash with running water for 10 minutes and then cover with dressing.
- **Bleeding :** In the case of bleeding, raise the affected body part to minimise the gravitational flow of the blood. Wash the cut surface with clean water, press the area with a piece of clean cotton wool, and if possible, apply some mild antiseptic.
- **Fractures :** In the case of fractures, lay the victim comfortably, and loosen or remove the clothes from the affected part. Do not move the fractured part/parts. If the fractured part is an arm, tie a sling to rest the arm on it.
- **Eye :** If anything falls in the eyes, do not rub them. Wash them gently with clean water.
- **Unconsciousness :** If someone falls unconscious, immediately lay the person comfortably on the bed. Loosen the clothes. Let fresh air come into the room.
- **Swallowing poison :** In case some poisonous substance has been swallowed, make the patient drink as much salt water as possible, and try to induce vomiting.
- **Snake bite :** In the case of a snake bite, immediately squeeze out some blood from the wound, and tie it tightly with a tourniquet above that spot to prevent spreading of venom (poison) into the blood stream.
- **Sting :** In the case of a sting by a bee or a wasp, pull out the sting if still in the wound, and squeeze out some blood to force out the venom. Apply some alkali, like baking soda on that spot.

- **Fever :** When you feel bodyache, cold and your body temperature is more than 98·6°F, it indicates that you are suffering from fever. Fever is not a disease but it is a symptom of some disease. In case of high fever, you can immediately apply an ice pack or a piece of cloth dipped in ice-cold water on the forehead of the patient to bring down the body temperature. If the fever persists for more time, consult a doctor immediately.

Bad habits to be avoided

(1) **Harmful effects of consuming tobacco.** Smoking and chewing tobacco or tobacco products increase the risk of mouth and lung cancer, high blood pressure and heart attack. Cough and irritation in the throat is also common among smokers. Even non-smokers sitting with active smokers may suffer from such diseases. This is known as passive smoking.

(2) **Harmful effects of drinking alcohol.** Alcohol is a slow poison, which affects the mental and physical processes of the body. Alcohol may cause damage to the nervous system, blood vessels, the kidneys and the stomach. Excess alcohol causes damage to the liver and gets stored in the form of fat. Alcohol drinking impairs judgement and reduces self-control. It also affects muscular coordination of the body resulting in accidents.

(3) **Harmful effects of drugs.** Drugs which cause an insensible condition in human beings are called narcotic drugs or psychotropic drugs, *e.g.*, morphine, cocaine, heroin and opium. Such drugs cause serious damage to the nervous system and other organs of the body. They also cause respiratory diseases and heart problems. Due to the habitual use of drugs, addicts find it hard to give up on drugs easily and suffer from a variety of health problems and even early death.

REVIEW QUESTIONS

Multiple Choice Questions :

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

(*a*) A mosquito is a vector for :

(*i*) Typhoid ☐ (*ii*) Cholera ☐

(*iii*) Malaria ☐ (*iv*) Jaundice ☐

(*b*) Dengue is caused by a

(*i*) Protozoan ☐ (*ii*) Virus ☐

(*iii*) Worm ☐ (*iv*) Fungus ☐

(*c*) The idea of vaccination was conceived by

(*i*) Charles Darwin ☐ (*ii*) Alexander Flemming ☐

(*iii*) Issac Newton ☐ (*iv*) Edward Jenner ☐

(d) Which one of the following is not a psychotropic drug ?

(i) Morphine ☐ (ii) Cocaine ☐

(iii) Heroin ☐ (iv) Penicillin ☐

(e) Which one of the following is a communicable disease ?

(i) Measles ☐ (ii) Cancer ☐

(iii) Heart attack ☐ (iv) Allergy ☐

Short Answer Questions :

1. (a) What is a non-communicable disease ?

.....

(b) What are communicable diseases ?

.....

(c) How can we control spreading of diseases by mosquitoes and houseflies ?

.....

(d) Public hygiene is equally important as personal hygiene. Give reasons.

.....

2. Name the following :

(a) A viral disease caused due to sexual contact with an infected person .....

.....

(b) A disease caused due to *Plasmodium* .....

(c) A disease caused by the bite of female *Anopheles* mosquito .....

(d) *Two* viral diseases caused by mosquito bites. ....., ...

(e) Any droplet — borne disease. .....

3. Write short notes (2-3 sentences) on the following :

Disease, immunization, pathogen, AIDS, vaccination, vector.

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Long Answer Questions (Write the answers in your note-book)

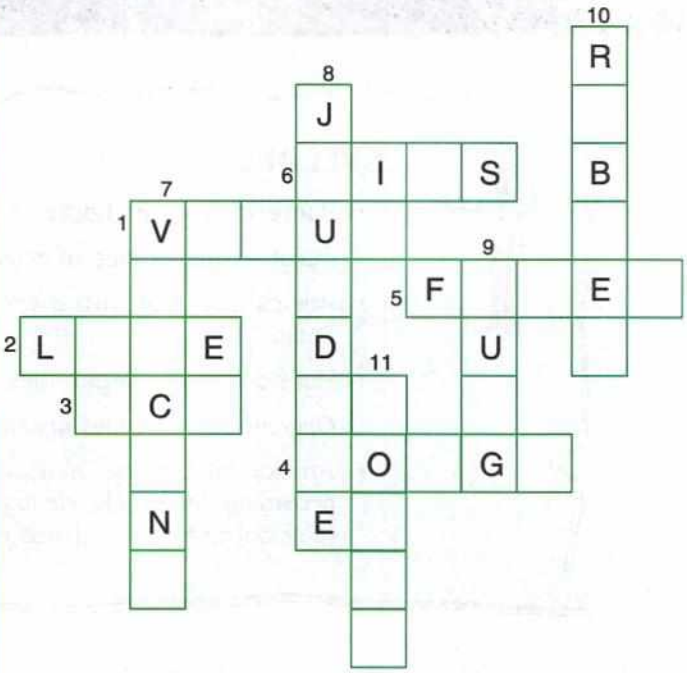
1. What is vaccination ? Mention the four ways in which vaccines are prepared, giving the name of one disease for which each type of vaccine is used.
2. Burns can be superficial burns, deep burns or chemical burns. What emergency care would you suggest in each case.
3. Describe *four* ways in which communicable diseases are transmitted through various indirect methods.
4. Given below is a crossword puzzle. Read the clues across and clues downward, and fill up the blank squares. Check up your answers with the correct solution given at the end.

CLUES ACROSS (1–6)

1. The kind of pathogen which causes diseases like common cold and mumps.
2. These may readily grow in your hair, if you do not wash it regularly.
3. This is the vaccine for preventing tuberculosis.
4. The disease pertussis is popularly known as whooping .....
5. One of the most common insects that visit our exposed foods and contaminate them.
6. A disease that weakens body's defence system against infections.

CLUES DOWN (7–11)

7. Germ or germ substances introduced into the body to prevent occurrence of an infectious disease.
8. A disease in which the eyes, the skin and the urine turn yellow.
9. An organ usually affected by tuberculosis.
10. A disease caused by the bite of an infected dog, and which affects the central nervous system.
11. Cover this part of your body by a handkerchief while sneezing to prevent droplet infection to others.



Answers :

Clues across : 1. Virus 2. Lice 3. BCG 4. Cough 5. Flies 6. AIDS

Clues down : 7. Vaccine 8. Jaundice 9. Lung 10. Rabies 11. Mouth

PROJECT

Visit a clinic and enquire about the vaccinations that are given to a child from birth to upto 3 years of age. Prepare a chart for the same.

UNIT : 6
Food Production

9 FOOD PRODUCTION

SYLLABUS

- Bacteria: uses of bacteria in food industry.
- Fungi — importance of mushrooms and yeast in food industry.
- Agriculture: cultivated crops (food-crops and cash crops), crops grown in India.
- Horticulture — vegetables, fruits, decorative plants and flowers.
- Organic farming and green revolution in brief (awareness level).
- Animal husbandry; milk yielding (milch) animals; white revolution; meat providing livestock; draught animals (heavy work); poultry; fish farming (pisciculture); sericulture and apiculture (awareness level).

Food is the prime need of all living beings. Animals, including human beings eat either plants and plant products or feed on the flesh of animals and other animal products.

Originally, human beings lived in jungles and led a nomadic life. They knew nothing about agriculture or animal keeping. They used to hunt wild animals and ate them raw, but gradually they started roasting them on fire before eating. They also ate roots, leaves or fruits of different plants.

With the passage of time, humans changed from food-gatherers to food cultivators. Besides growing crops, they also started breeding animals. Today, we get food from several sources.

In this chapter, you will learn how microorganisms, plants and animals are being utilised for getting food and other useful things.

MICROORGANISMS

Microorganisms are those organisms which cannot be observed by the naked eye. They are extremely small in size and can be seen only under a microscope. They are also called *microbes*. The science which deals with

the study of such organisms is called **microbiology**. Most of these organisms are unicellular, *e.g.* viruses, bacteria, algae, fungi and protozoans. Microorganisms are found everywhere — in air, water, soil, food (milk, curd, vegetables, fruits), *etc.* Generally, microbes are harmful as they cause different diseases like cholera, malaria, dysentery, tetanus, anthrax, *etc.*, but some of the microbes are useful to us in many ways.

Do You Know ?

Microbes were the first living organisms to appear on the earth. Leeuwenhoek, the father of microbiology, was the first to describe the shapes of bacteria found in pond water and the saliva of mouth.

BACTERIA

You have already learnt in earlier classes that bacteria (*sing.* : bacterium) are very small in size. They are of various shapes — round (*coccus*), rod-shaped (*bacillus*), helical (*spirillum*) and comma-shaped (*vibrio*). A bacterial cell is very simple in structure. It is surrounded by a wall and has a primitive nuclear material (chromatin fibres) without a nuclear membrane. A bacterial cell has an outermost slimy, gelatinous, protective layer in the form of a capsule. There is a thin cell membrane, below the cell wall, within which the cytoplasm along with some granules is present. Certain bacteria move with the help of a thread-like structure called flagellum.

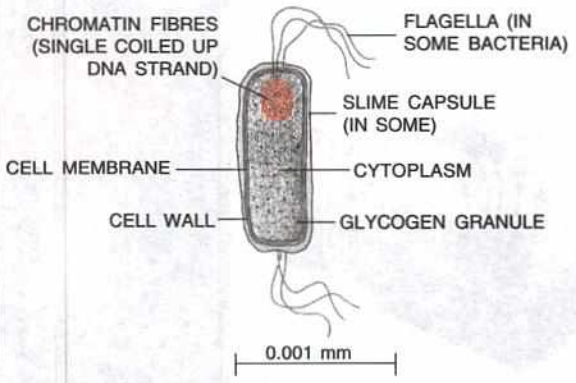


Fig. 9.1 Bacterium (highly magnified)

Bacterial growth is dependent upon the availability of adequate water and an appropriate food supply. In addition, external conditions such as suitable temperature and air are required. Some bacteria require oxygen to survive whereas others do not.

Uses of bacteria in food industry

Biotechnology or using microorganisms to make end products that are useful to mankind, is an ever-growing area of industrial development. The range of materials that can be produced in this way is getting bigger all the time. Some of these processes have been part of human culture for thousands of years.

1. Curd : Traditionally, curd is fermented whole milk. It is formed by the action of bacteria on the lactose (milk sugar), present in the milk. The most commonly used bacteria in this process are *Lactobacillus bulgaricus* and *Lactobacillus acidophilus*.

Eating curd is becoming increasingly popular. Curd is one of the fastest growing food products of the dairy industry, and even the food industry as a whole. Curd is now being flavoured with the help of an enormous range of fruits, making it very pleasant to eat. It is also a convenient food for both adults and children. It is considered as being a "healthy" food, high in calcium which is important for bone growth in children and for the prevention of osteoporosis (weak and brittle bones) in adults.

Curd can be made from the milk of any dairy animal, but buffalo's and cow's milk are the most common sources. When curd is made traditionally, a small amount of the previous batch of curd is mixed as a "starter" with a new batch of milk to start the fermentation process.

2. Cheese : Cheese is a valuable food with high quantities of protein, some fat, together with calcium and phosphorus along with different types of vitamins.

People have been eating cheese for centuries. It is also made from milk.

The manufacturing of cheese includes the following major steps :

(i) **Curdling of milk** by the addition of lactic acid bacteria (*Lactobacillus accidophilus*). Curd produced is separated from whey (liquid remained after curdling).

(ii) **Curd is processed** to remove moisture. At this stage it is called **cottage cheese**.

(iii) **Salting** — This further removes moisture and prevents growth of undesirable microorganisms.

(iv) **Ripening** — The curd is kept at a suitable temperature and humidity. The microorganisms added along with lactic acid bacteria at step 1, impart a particular flavour to the cheese.

3. Tea : Curing of tea is done with the help of bacteria. By this process, the bitterness of the tea leaves is removed and a specific flavour and aroma are obtained. [Tobacco leaves are also cured by bacteria].

4. Alochol and vinegar : The activity of specific types of bacteria results in the production of alcohol and vinegar from sugar solution.

5. Vitamins : Certain types of bacteria live in our intestine where they synthesise certain 'B' vitamins. In the intestine of herbivorous animals like a cow and a buffalo, bacteria help in the digestion of cellulose.

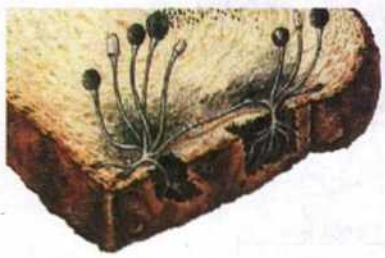
6. Agriculture : Bacteria also play an important role in agriculture by enriching the soil with nitrates. *Rhizobium* bacteria, found in the root nodules of legumes, like pea plant, etc., fix atmospheric nitrogen (N_2) into simpler, more readily absorbable forms of nitrogen. Similarly, bacteria like *Nitrosomonas, Nitrobacter*, etc. also enrich the soil with nitrogen.

FUNGI

Fungi may be unicellular or multicellular. They do not have chlorophyll and thus cannot prepare their own food. Most fungi live on dead and decaying organic matter. That is why, along with bacteria they are also called **saprophytes** (*sapro* : rotten), the natural cleaners of environment.

Some common examples of fungi

The blackish cottony growth on a stale bread is a type of fungus called **bread mould**. Another common fungus is the white umbrella-like **mushroom**, that generally grows on decaying wood or moist soil (Fig. 9.2). Yeast is a unicellular **fungi**.



Bread mould (*Rhizopus*)

Mushroom

Fig. 9.2 Bread mould and Mushroom

Mushrooms : Certain varieties of mushrooms (button mushrooms) are eaten as food. They are highly nutritive being rich sources of proteins and minerals. Some wild mushrooms of wild nature are not to be eaten, because they may be poisonous. Therefore, always buy mushrooms from a reliable shop (Fig. 9.3).

Fig. 9.3 A poisonous mushroom

Yeasts : Yeasts are found freely in the atmosphere. They readily grow in all kinds of sugary solutions and in any plant exudations containing sugar. They grow readily on grapes, in the nectar of flowers, in sugar cane juice, *etc.* The yeast cell (Fig. 9.4) is ovoid in shape, has a distinct cell wall and a nucleus. There may be one or more vacuoles in the cytoplasm.

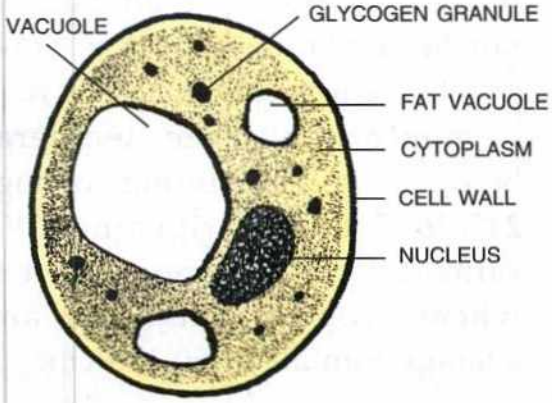


Fig. 9.4 A single cell of yeast

Economic importance of yeast

1. **As food** : Yeasts contain vitamins of B group, E group and 15% protein.
2. **In breweries** : Yeasts undergo fermentation in the presence of sugar solution (glucose) to produce **ethyl alcohol** and **carbon dioxide (CO_2)**. Alcohol is the main component in beverages such as wine, whiskey, beer, etc. The quality of alcohol varies not only with the material fermented but also the type of yeast used.

   The carbon dioxide (CO_2) so obtained is collected, solidified and sold as dry ice.
3. **In bakeries** : Softness in bread and other such baked products is due to the presence of the numerous air spaces in them. These air spaces are formed when CO_2 rises through the dough as a result of fermentation by the yeast mixed in it.
4. Yeasts also play an important role in the manufacture of vitamins and proteins.

Making bread

Imagine you are a baker. You mix some flour and water with a small amount of sugar and yeast. This makes **dough**. You then leave the dough for an hour or so in a warm place. During this

Fig. 9.5 Dough before and after rising

period, the living yeast cells multiply and ferment sugar to form alcohol and carbon dioxide gas. The gas so produced makes the dough rise, more or less doubling its size (Fig. 9.5). Then when you bake the dough in a hot oven: the heat kills the yeast and evaporates the alcohol. Result? A crisp golden loaf if you're lucky— or a brick if you're not.

AGRICULTURE – PRIMARY FOOD SOURCE

Agriculture is the backbone of human existence. **Agriculture** is defined as the science of growing plants and other crops as well as the rearing of animals for food and for other human needs.

Crop plants : These are the plants of the same kind which are grown on a larger scale in a field for food or other useful products and are harvested, annually or seasonally. The edible parts obtained from them may be in the form of grains, roots, vegetables and fruits.

Crops grown in India

Cereal crops	–	Rice, wheat, barley, maize
Pulses	–	Beans, gram, chickpea
Oil seed crops	–	Groundnut, mustard, sunflower
Root crops	–	Sweet potato, turnip, carrot, radish
Tuber crops	–	Potato, tapioca
Sugar crops	–	Sugarcane, beet root
Plantation crops	–	Coffee, tea, rubber, coconut
Fibre crops	–	Cotton, jute

The cultivated crops can be classified under two categories :

1. **Food crops :** Crops cultivated for the production of food are called food crops, such as cereals, pulses, oil-seeds, *etc.*
2. **Cash crops :** Crops cultivated for commercial purposes are called cash crops, such as rubber, tea, coffee, spices, *etc.*

Based on the season in which crops are cultivated, they have been put into two categories.

A. Kharif crops (means "autumn crops") : Kharif crops are raised in the rainy season (June to October). Rice is the most important kharif crop of India which is grown in rain fed areas with hot and humid climate, usually eastern and southern parts of India. Rice requires a temperature of 16°-20°C during the growing season and 18°–32°C during ripening. It needs a rainfall of 150–200 cm and a flooded field during the growing period.

B. Rabi crops (means "winter crops") : Wheat is an important rabi crop of India. It is grown in alluvial soils of northern plains. Wheat is sown in October/early November. It requires a monthly average temperature between 10°-15°C during sowing and 21°-26°C during ripening. Winter rains are very important for the wheat crop. It needs an annual average rainfall of 50-100 cm.

Nutrients in crops

- Cereals are rich in carbohydrates and starch.
- Pulses are rich in proteins.
- Nuts, coconut and mustard are rich in oils.
- Fruits and vegetables provide minerals and vitamins in particular.

Horticulture : It is the branch of agriculture which deals with the cultivation of fruits, vegetables, flowers, mushrooms, algae and medicinal plants. It also includes growing of non-food crops such as ornamental plants, trees and grasses too. Horticulturists carry out research to produce better varieties of fruits, flowers and vegetables in large quantities.

Horticulture crops

Vegetables – Cabbage, cauliflower, spinach, potato, onion, *etc.*

Fruits – Mango, grapes, apple, banana, *etc.*

Ornamental plants – *Croton*, coleus, ferns, *Bougainvillea*.

Flowers – Rose, gladiolus, chrysanthemum, jasmine, *etc.*

Fig. 9.6 Some flowering plants

Organic farming : Farmers are now becoming more aware of the harmful effects of using chemical fertilisers, pesticides and weedicides. As such, many farmers and horticulturists are now shifting to organic farming. *Organic farming is the practice of raising crops without using synthetic fertilisers and pesticides.* Farmers use organic manure that has been prepared scientifically from organic wastes of crops, animal and farm wastes, aquatic wastes and other biological materials. The main aim of organic farming is to enhance soil fertility, grow crops in an ecofriendly environment free from chemical pollution (pesticides) and thus produce crops with high nutritional value.

GREEN REVOLUTION

The **green revolution** was a period when agricultural productivity increased greatly due to the introduction of agronomic technology. New chemical fertilizers, synthetic herbicides and pesticides were developed. Use of chemical fertilizers for crops resulted in a produce with extra nutrients and an increased yield. Application of the herbicides controlled the growth of weeds and the pesticides destroyed insects and prevented diseases of crops. This resulted in a sharp increase in the production of crops.

In addition to the application of chemicals for a higher yield, specific types of crops were also developed and introduced. These crops were referred to as the **High Yielding Varieties** (HYV) which were specifically designed to produce a high overall yield.

As a result of green revolution, the agriculture industry was able to produce much larger quantities of food grains. This increase in productivity made it possible to feed the growing human population.

The green revolution, started in India in the early 1960's, led to an increase in food grain production, especially in Punjab, Haryana and Uttar Pradesh initially.

An Indian scientist M.S. Swaminathan played a very important role in implementing and developing the green revolution in India. It has made our country self-sufficient in wheat production and improved the economic condition of farmers. Now, agriculture has become an industry which gives employment to a large section of India's population and also in various related industries producing agricultural implements.

ANIMAL HUSBANDRY

The branch of biology which deals with feeding, shelter, caring and breeding of domesticated animals is called **animal husbandry.**

> Animals domesticated for home companionship are called **pets**, while those domesticated for food or work are called **livestock**.

Animals which provide food are of two types :

A. **Milk-yielding** or **Milch** animals, like cows, buffaloes and goats.

B. **Meat and egg-yielding** animals, like hen, sheep, goat, fish, pig, *etc.*

Draught animals are those animals which are reared for doing heavy work such as bullocks, camels, elephants, horses, donkeys and mules.

Some animals like sheep, goat, deer, silkworm and honey bee provide us with wool, skin, horns, silk and honey respectively.

MILK-YIELDING OR MILCH ANIMALS

Milk-producing animals of India are mainly cows, buffaloes and goats. The **milk from goats** is nutritious and is sometimes preferred over cow milk. But the production of goat milk is much less than that of cows and buffaloes. **Cow milk** is quite nourishing and easy to digest, but as compared to buffaloes, cows produce less quantity of milk. Buffaloes are the major source of milk in our country. Milk from camels is also consumed in some parts of India.

Breeds of Cows

There are about thirty different breeds of cows in our country. Considering the males and females together, these breeds are classified into *three* categories :

(i) draught, (ii) dual purpose and (iii) dairy.

(i) **Draught breeds** are those whose males are primarily used for drawing bullock carts, ploughing land and transporting materials from one place to another. The females of this breed yield less milk.

(ii) **Dual purpose breeds** are quite good milk-yielders (cows), and their bullocks (castrated bulls) are good for draught purposes. The breeds **Haryana** (Fig. 9.7), **Dangi** and **Tharparkar** serve dual purposes. Their females are good milk-yielders, while males are good for draught work.

(iii) **Dairy breeds** are high milk-yielders (cows) and their bullocks are poor for draught purposes.

Fig. 9.7 "Haryana" bull

In India, we have three types of breeds of dairy cows:

(a) *Indigenous* (Indian) breeds. *For example,* Red Sindhi, Sahiwal and Gir.

(b) *Exotic* (Foreign) breeds. *For example,* Jersey, Holstein-Friesian, and Brown Swiss.

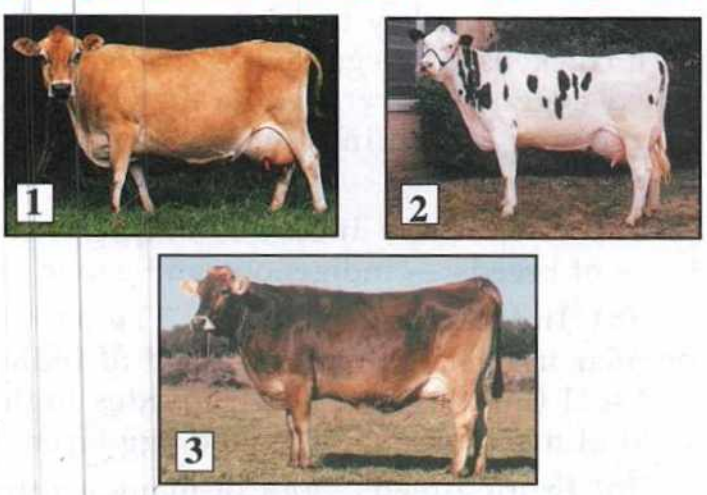


Fig. 9.8 Three exotic breeds of Cows
(1) Jersey, (2) Holstein-Friesian, (3) Brown Swiss

(c) *Cross* breeds (developed by mating bulls of exotic breeds with the cows of the indigenous ones). For example, Karan-Fries and Frieswal.

The yield of milk from these improved breeds of cows is 2-3 times more than the indigenous ones.

Breeds of Buffaloes

(i) **Murrah :** This is the original breed of Haryana and Punjab (Fig. 9.9). Its average annual yield of milk is 1800 to 2500 litres with the fat content upto 7 percent.

Fig. 9.9 Murrah buffalo

(ii) **Mehsana :** This is a breed common in Gujarat. Its average milk yield is about 1200-2500 litres.

(iii) **Surti :** This breed is a native of Kaira and Vadodara districts of Gujarat. Its average milk-yield is 1600-1800 litres. The fat content of the milk is about 8-10 percent.

White revolution

After the huge success of the Green Revolution in India that resulted in a tremenduous increase in the production of wheat and rice, the Indian Government started a programme in 1970 called **"operation flood"** with the motive to increase milk production. This programme resulted in India becoming the largest producer of milk and milk products in the world and hence it is called as the **"White Revolution"** of India. "Anand Milk Union Limited" popularly known as "Amul", a Gujarat based milk co-operative, was the engine that drove this mission to such a successful height. The main architect of India's white revolution was Mr. Verghese Kurien. He has been the driving force in making India one of the largest producers of milk in the world.

The purpose of this programme was to link the rural producer (dairy farmer) with the urban consumer. Rural farmer co-operatives were organized at the village level and connected to the urban consumer. This ensured that the dairy farmer got a major share of the price of milk which consumers pay.

In brief, the "operation flood" ensured three objectives :

(i) increased milk production

(ii) strengthened the dairy farmer's income

(iii) easy availability of milk at a fair price to all.

MEAT PROVIDING LIVESTOCK

In India, goat, sheep and pig are the main sources of meat supply besides poultry and fish.

Goats are mainly used for meat though they also provide milk which is good, especially for children, the sick and the old. Important breeds of goats are *Gaddi, Kashmiri Pashmina, Marwari, etc* (Fig. 9.10).

Fig. 9.10 Two Indian breeds of goat: A. Gaddi, and B. Kashmiri Pashmina

Sheep provide mutton, wool and skin. Goat and sheep breeding is cheaper and therefore, it is a major occupation of many landless labourers in India. Important breeds of sheep are *Nali, Deccani, etc.*

Pig contributes only 5% of the total meat production in India and is a rich source of protein and that too, at a low cost.

In pig farming (piggery), pigs are reared for meat (pork) and animal fat (lard). Pork is known differently according to the part of the body; bacon (back and sides), ham (back of the thigh), and sausages (minced pork). Lard (fat) is used as a cooking medium and in the manufacture of soaps, lubricants, candles and grease. Stiff body hair of pigs are used for making painting brushes.

The indigenous breeds of pigs are **Desi** and **Ghori**. Some **exotic breeds** are **Berkshire** and **Large White Yorkshire**.

POULTRY

Poultry farming is the process of raising domesticated birds such as chickens, ducks, turkeys and geese for the purpose of obtaining meat or eggs for food.

Poultry farming can be profitable. With a small investment, with the requirement of a small area and ease to look after the birds, the returns can be quick.

In India, poultry farming mainly deals with chickens. The egg-laying chickens are called **eggers** or **layers**, while the chickens reared for obtaining meat are called **broilers**.

Indian poultry includes mainly *two* types of breeds — indigenous and exotic.

(a) Indigenous breeds : The most popular indigenous poultry breed of India is **Aseel** (Fig. 9.11A). This provides high yield of meat, but is not a good egg-layer.

(b) Exotic breeds : Out of many exotic breeds of fowl, the following two breeds are most popular in India :

(i) **White Leghorn** (Fig. 9.11B) which produces oval white eggs. It is more popular because of its small size and requires less feed for its maintenance. Thus, its farming is more economical.

(ii) **Rhode Island Red** was developed on a farm in Rhode Island, U.S.A. This is a dual type of breed, as it is a fairly good egg-layer and also a good meat provider.

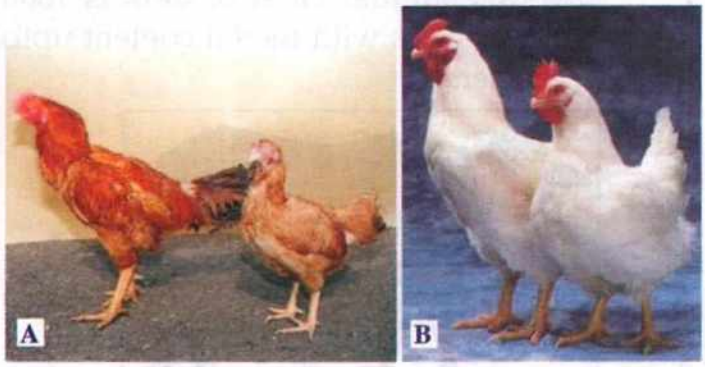


Fig. 9.11 Two poultry breeds: A-The indigenous (Indian) breed Aseel, and B-An exotic breed (White Leghorn)

Poultry birds are kept in wire cages or in the poultry sheds. The birds should not be kept in the open because they can be attacked and killed by predators like dogs and cats.

The feed given to poultry birds consists of mashed cereals like *bajra, maize, wheat, jowar, ragi, rice bran* and *groundnut cakes*. The 'fish meal' (prepared from the wastes of meat processing industry) is also used to feed poultry birds.

FISH FARMING

Fish is an important source of food. A large population, especially those living in coastal areas, eat fish as their staple food. Fish and other variety of sea-food (for example, oysters, prawns, lobsters, shrimps, *etc.*) are rich in proteins. Sea food is highly nutritious and easily digestible. Fish liver oil is rich in vitamins A and D. In India, edible fishes are abundantly available in seas, rivers, lakes and ponds.

The term **"aquaculture"** is used for the production or farming of useful aquatic animals like fish, prawns, lobsters, molluscs, *etc.*, in various types of water bodies. The term **"pisciculture"** is used for the production and management of fishes only (Fig. 9.12). It involves breeding and raising fish commercially in tanks or enclosures mainly for food.

Fig. 9.12 Fish (Pisciculture)

In fresh water fish culture or fish farm, fish eggs (known as fish seeds) are put in nurseries called **hatcheries.** The young ones of fishes hatched from these eggs are fed, tended and nursed, and finally harvested, when fully grown.

Mariculture is another specialized branch of aquaculture which involves the rearing of marine organisms in an enclosed section of the ocean, or in tanks or ponds which are filled with sea water. These marine organisms are cultivated mainly for food and other products.

Some edible fishes of India :

Marine water fishes are *Bombay duck, eel, hilsa, pomphret, salmon, sardine, etc.*

Fresh water fishes are *rohu, calbasu, catla, singhara, magur* and *singhi*. These are found in rivers, ponds, lakes, canals, *etc.*

SERICULTURE

The artificial rearing of silkworm and production of silk from them is called **sericulture**. Four varieties of silk — *mulberry, tassar, eri* and *mugga*–are produced in India.

To obtain commercial silk, cocoons of silk moth are treated with boiling water to kill

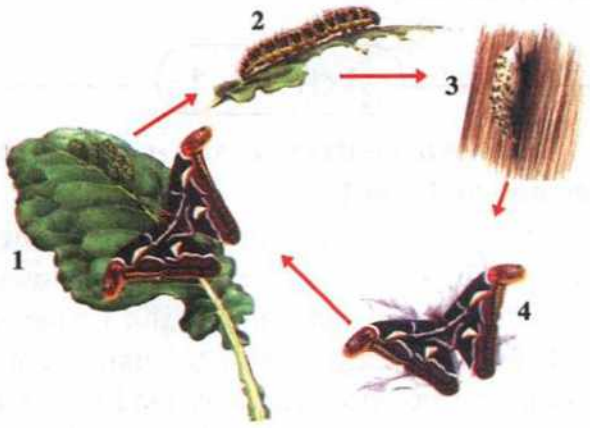


Fig. 9.13 Life cycle of silk moth: 1- Female lays eggs on a leaf; 2- Caterpillar (larva); 3- Chrysalis (pupa); 4- An adult moth

the living pupa inside. Thread is recovered from the killed cocoons. This process is called **reeling**. However, the process of getting silk fibre by killing the pupae has been criticised by the environmentalists.

APICULTURE

The rearing of honey bees to obtain honey and other commercially important products is known as **apiculture**. Bee keeping or apiculture is the maintenance of honey bee colonies, commonly in man-made hives. A bee keeper or an apiarist keeps or rears bees in order to collect their honey as well as other hive products like bees wax, pollen and royal jelly. All these have great commercial value. The place where bees are kept is called an 'apiary'.

The common species of the Indian variety of honey bee is *Apis indica*. In their natural environment, honey bees build their own hives. There are 40–50 thousand bees in one hive including one queen (egg-laying female), some drones (males) and mostly all the workers (sterile females, which means, incapable of laying eggs). Hexagonal cells of the hive are made up of wax to store honey and pollen grains in the upper part. Honey is rich in carbohydrates (sugar, dextrose and levulose). Beeswax is used in the manufacture of candles, polishes, cosmetics, *etc.*

Activity 1

To visit centres of silk-rearing, bee-keeping and poultry.

Ask your school authorities if any one or more of these industries exist in your town or elsewhere. You can contact the officers of such places to allow you to visit them for educational purpose. You may read your books beforehand to be familiar with some information about them. These may be verified when you visit these places.

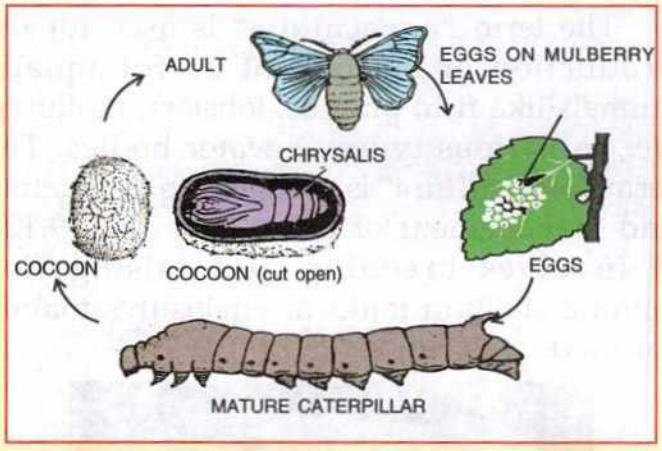
What you should try to observe ?

(a) Sericulture :

- The adult moths.
- Eggs laid on the mulberry leaves.
- Various growth stages of the larvae that feed on the leaves.
- Silken cocoons.
- Treatment of cocoons with boiling water, and reeling of the thread.

(b) Apiculture :

- A complete modern bee-hive with the vertical sequence of different box chambers.
- Watch the honey bees entering and leaving the hive.
- Ask the bee-keeper to demonstrate how the bee swarm is collected and introduced into the hive.
- Observe the manner in which honey is extracted.



(c) Poultry :

- Observe the various types of cages and the birds kept inside them.
- Enquire about the feeds given to the birds.
- Ask about the names of some of the local and foreign poultry breeds and their speciality.

REVIEW QUESTIONS

Multiple Choice Questions :

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

(a) Which *one* of the following is an indigenous breed of dairy cows ?

(i) Jersey ☐ *(ii)* Frieswal ☐

(iii) Sahiwal ☐ *(iv)* Dangi ☐

(b) Which *one* of the following is the common breed of buffalo found in Gujarat ?

(i) Surti ☐ *(ii)* Murrah ☐

(iii) Gir ☐ *(iv)* Mehsana ☐

(c) Identify the indigenous breed of poultry of India.

(i) White Leghorn ☐ *(ii)* HH-260 ☐

(iii) Aseel ☐ *(iv)* B-77 ☐

(d) Which one of the following is a rabi crop ?

(i) Mustard ☐ *(ii)* Pea ☐

(iii) Rice ☐ *(iv)* Wheat ☐

(e) Identify the Kharif crop.

(i) Barley ☐ *(ii)* Mustard ☐

(iii) Rice ☐ *(iv)* Wheat ☐

Short Answer Questions :

1. Fill in the blanks :

(a) Cattle feed made from cereals and wheat is called .....

(b) Rearing of birds for egg and meat is called .....

(c) Animal food is rich in .....

2. Name the following :

(a) The popular indigenous breed of poultry in India. .....

(b) Rearing of honey bees .....

(c) Architect of white revolution in India .....

(d) A kashmiri goat which gives expensive wool .....

(e) Scientist responsible for green revolution in India .....

3. Match the columns

Column A	Column B
(a) Rabi crop	(i) Transplantation
(b) Rice crop	(ii) Winter crop
(c) Orchards	(iii) Kharif crop

4. Answer the following questions :

(a) Name any *four* animals which provide us food.

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(b) Name any *two* dual purpose breeds of cattle.

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(c) Give *two* examples of milch animals.

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(d) Name any *two* high-yielding indigenous breeds of cows.

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(e) Name *four* varieties of edible fishes in India.

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(f) Name *two* breeds of buffaloes.

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5. Briefly explain the following terms :

Animal husbandry : .....

Sericulture : .....

Aquaculture : .....

Hatcheries : .....

Pisciculture : .....

6. What is organic farming ?

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Long Answer Questions (*Write the answers in your note-book*) :

1. Differentiate between an egger and a broiler.
2. Name any *two* exotic breeds of fowl in India, and mention their usefulness.
3. What are "milch animals"? Give *two* examples each of exotic and cross breeds of cows.
4. What is the meaning of the term "aquaculture"? Name any *three* animals which can be cultured by this method.
5. Differentiate between food crops and cash crops. Give *two* examples of each.
6. What are kharif crops ? Name the most important cereal plant of such crops.
7. Name the *two* main crop seasons of India. Give *three* examples of the crops grown during each season.
8. List the uses of bacteria in the food industry.
9. Name any *one* variety of edible mushrooms.
10. Mention the benefits of "Green Revolution" in our country.
11. List out the benefits of "White Revolution" in our country.

PROJECT

- Discuss and find out the methods to check the quality of :
  — Milk — Eggs — Honey

SCIENTIFIC TERMS TO REMEMBER

ANIMAL HUSBANDRY	:	Branch of biology which deals with breeding, feeding, shelter and caring of domestic animals.
APICULTURE	:	Rearing of honey bee for obtaining honey and other useful products.
AQUACULTURE	:	Farming of useful aquatic animals.
ARTERY	:	A blood vessel that carries the blood away from the heart.
BISEXUAL FLOWER	:	A flower bearing both male and female parts.
BROILERS	:	Meat providing chickens.
CARNIVORE	:	An animal feeding on other animals.
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.
CONCENTRATE	:	Feed which is rich in protein with very little fibrous matter given to cattle.
CONSUMER	:	An animal which depends on plants and plant-products for its food.
COWPER'S GLAND	:	A male gland whose secretion serves as a lubricant for the sperms.
CRETINISM	:	Defective development of a child showing dwarfism and mental retardation.
DECOMPOSER	:	Microorganism which breaks down the dead remains of animals and plants.
DICOTYLEDONOUS SEED	:	A seed with two cotyledons.
DISEASE	:	Departure from normal health through structural or functional disorder of the body.
DOMESTICATION	:	Breeding of animals for specific purpose.
ECOSYSTEM	:	Plants and animals along with the non-living world form a system called ecosystem.
EGGERS	:	Egg-laying chickens.
EPIDIDYMIS	:	The duct leading from testis to sperms duct.
FALLOPIAN TUBE	:	A duct leading from the ovary into the uterus.
FIRST-AID	:	First-aid is an immediate care given to the victim at the time of emergency before he/she is taken to the doctor.
GESTATION	:	The period of development of the embryo within the uterus.
HEALTH	:	State of complete phyical, mental and social well-being, and not merely an absence of disease or infirmity.
HERBIVORE	:	An animal feeding on plants.
HORMONE	:	A substance produced by ductless glands and poured directly into the blood.
HORTICULTURE	:	Branch of agriculture which deals with the growing of vegetables, fruits and decorative plants.

IMMUNISATION	:	Generalised term used for introducing any kind of dead or weakened germs into the body of a living being for developing resistance (immunity) against the disease.
IMPLANTATION	:	The embedding of the fertilised ovum in the uterus wall.
IMPULSE	:	A wave of electrical energy that runs through the nerves.
ISLETS OF LANGERHANS	:	Hormone–secreting cells of the pancreas.
LIVESTOCK	:	All domestic animals which are used to produce food and other valuable products for human beings.
MACRONUTRIENTS	:	Nutrients like C, H, N, P, etc., which are required by plants in large quantity.
MEDULLA OBLONGATA	:	Lower part of the brain, joining it with the spinal cord, and controls the heart beat, respiration and peristalsis.
MICROBIOLOGY	:	Branch of science which deals with the study of micro-organisms.
MICRONUTRIENTS	:	Nutrients like Cu, Zn, Cl, Fe, etc., which are required by plants in small quantity.
MONOCOTYLEDONOUS SEED	:	A seed with only one cotyledon.
MYXOEDEMA	:	A condition affecting an adult due to his thyroid gland functioning properly. It causes general sluggishness of metabolism.
NEURON	:	The structural and functional unit of the nervous system.
OSMOSIS	:	Movement of water molecules through a semi–permeable membrane from the region of their higher concentration to the region of their lower concentration.
OVARY	:	The female reproductive organ that produces the eggs.
PISCICULTURE	:	Production and management of fishes.
PLASMA	:	The pale liquid which contains the blood cells.
PLUMULE	:	The upper part of the plant embryo, which develops into shoot.
POLLUTANT	:	Substance added in the air, water or land which causes the degradation of the environment.
POLLUTION	:	Contamination of the environmental air, water and land with wastes from human activity.
POULTRY	:	Keeping birds, such as chickens, for meat and eggs.
PROPHYLAXIS	:	Preventive measure to prevent suffering from a disease.
SAPROPHYTES	:	Organisms which feed on dead and decaying organic matter such as fungi.
SCAVENGER	:	Animal that feeds on dead flesh.
RADICLE	:	The lower part of the plant embryo which develops into root.
SEMEN	:	A mixture of sperms and secretion from seminal vesicle, prostate gland, and Cowper's gland.
SEMINAL VESICLE	:	A gland in the male that produces a secretion which serves as a medium for the transportation of sperms.
SEMIPERMEABLE MEMBRANE	:	A membrane which allows smaller molecules to pass through, but prevents the larger ones.

SERICULTURE	:	Rearing of silkworm and production of silk.
SERUM	:	A yellow liquid consisting of the part of the blood left after clotting.
SEXUAL REPRODUCTION IN PLANTS	:	Reproduction through flowers and seeds.
STIMULUS	:	Any agent or change in the environment that usually results in some activity of the body.
STOMATA	:	Minute pores in a leaf through which air enters the leaf, and water gets evaporated through it.
TESTIS	:	The male reproductive organ that produces sperms.
TRANSPIRATION	:	Loss of water as water vapour from the aerial parts of the plant.
UNISEXUAL FLOWER	:	A flower having either the male parts or the female parts.
URETHRA	:	A duct taking the urine out of the body from the bladder, and in males also conveying semen.
UTERUS	:	The female organ where the embryo develops.
VACCINATION	:	Practice of artificially introducing germs or germ substance into the body for developing resistance to a particular disease.
VAGINA	:	A canal leading from uterus to the external genital opening in the female.
VEGETATIVE REPRODUCTION	:	Reproduction through vegetative parts such as leaf, stem and root.
VEIN	:	A blood vessel that brings the blood towards the heart.