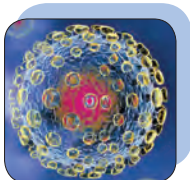
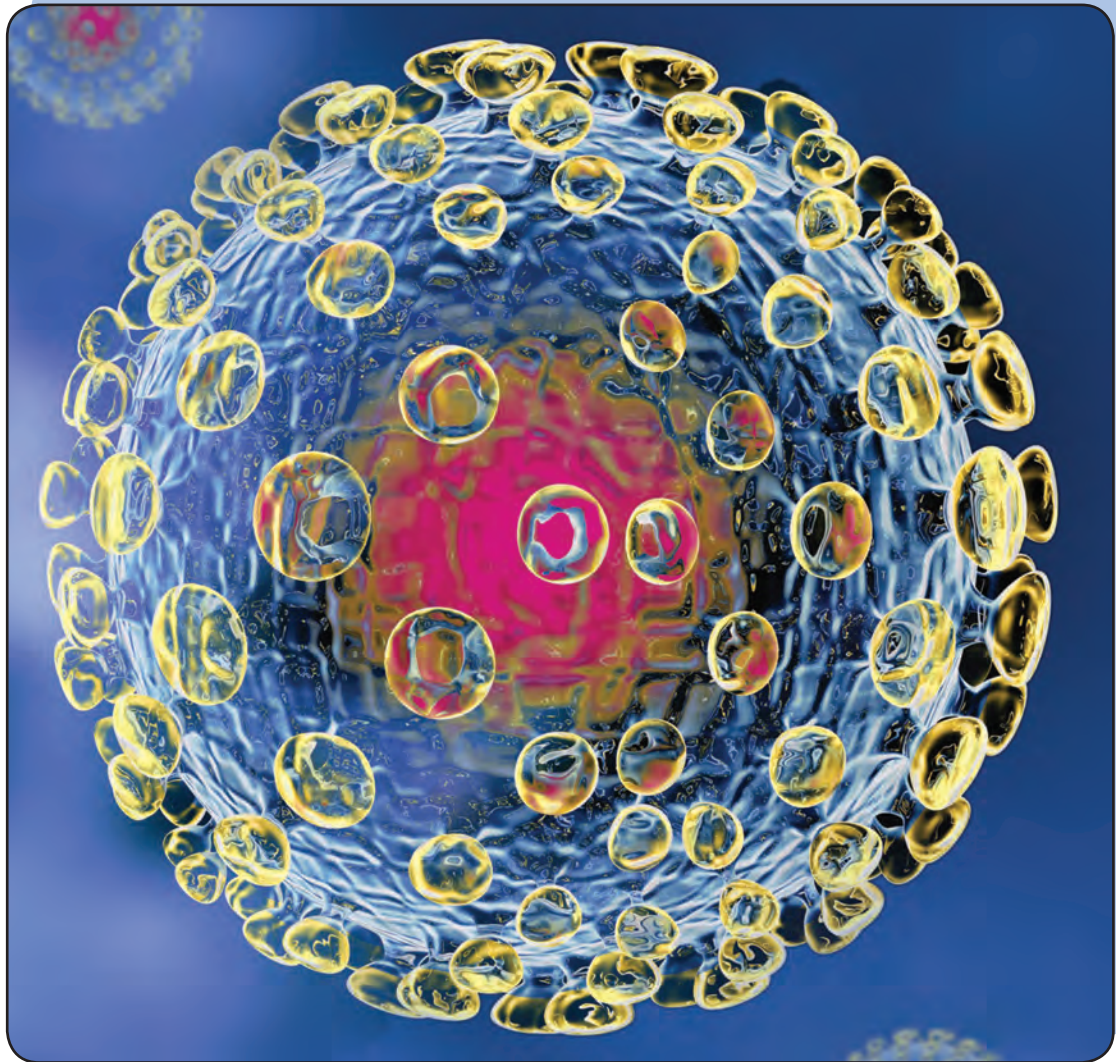


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# HEREDITY AND EVOLUTION

# 1. HEREDITY AND EVOLUTION

## HEREDITY AND VARIATION

A cow gives birth to a calf. Both the mother cow and calf share common characteristics like body design, physiological function etc., that are specific to their species. However on a very close observation of the mother cow and the calf and the bull which is the calf's other parent, we will come across a number of differences among them, like colour pattern in the skin. By virtue of being

parents, in body design, function etc., The rules of heredity determine the process by which the traits and the characteristics are relatively inherited.

***"The inheritance of characteristics through generation is called heredity"***

The inheritable characteristics may be morphological/anatomical/physiological/reproductive and are also known as traits.

If we take a very close look at the rules of inheritance, both father and mother contribute equal amount of genetic material to the child. This means that each trait can be influenced by both paternal and maternal genetic material – i.e, DNA.

Gregor Johann Mendel (1822-1884) worked out the first ever scientific experimental study on heredity.

Mendel, an Austrian Augustinian monk observed variations in the characteristics of garden pea plant (*Pisum sativum*) which he had cultivated in his monastery garden. Mendel was curious to find out the results of crossing of pea plants with the variation in traits. The visible contrasting characters that Mendel observed in the garden pea plants were

- Seed shape - Round/Wrinkled
- Seed colour - Yellow/Green
- Flower colour - Violet / White

### ACTIVITY 1.1

- Ask your classmates to roll their tongues. Observe how many can and how many are not able to roll their tongues. Record your findings.
- Similarly record the variation in the eye colour noticed among your classmates.

the progeny of the parent, the progeny individual, need not just be the replica of what its parents are. (Inheritance of characters from the parents to the progeny ( i.e. , Heredity) ensures the passing of the parental characters to the progeny). The difference or change in the characteristics between the individuals is called Variation. Human population shows a great deal of variation.

## 1.1. HEREDITY

The progeny produced through the reproductive process is similar to its

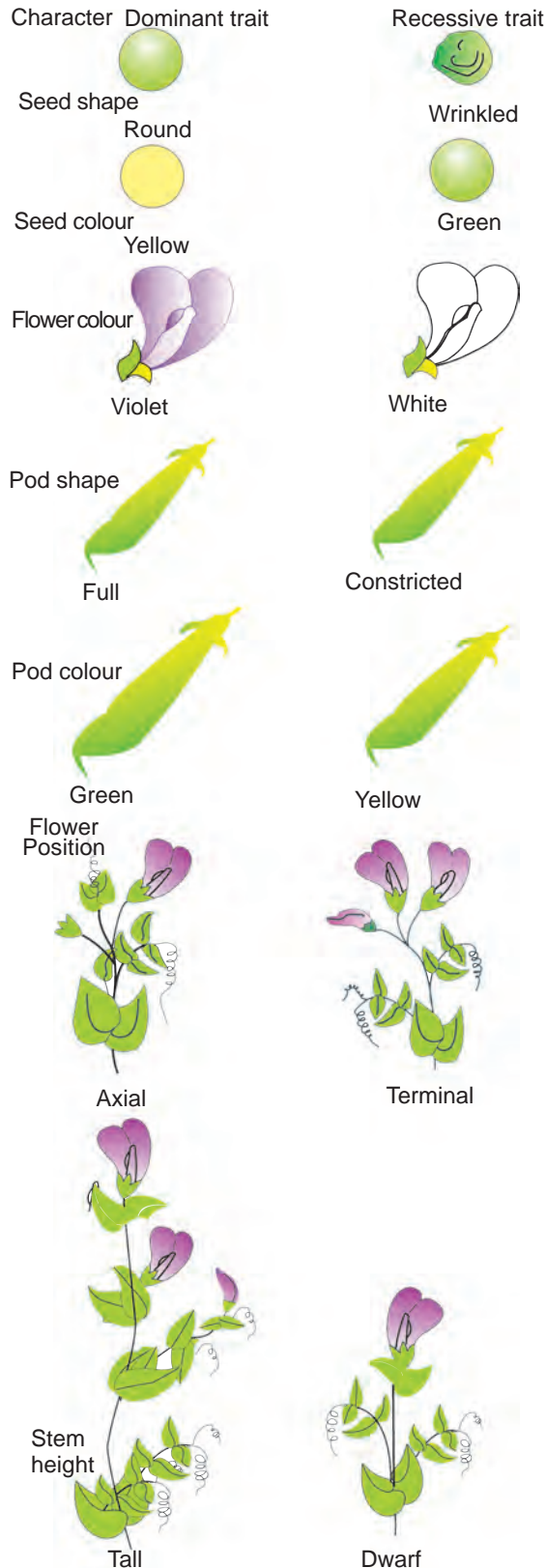


Fig. 1.1 Seven pairs of contrasting traits in Pea plant studied by Mendel.

- Pod shape - Full / Constricted
- Pod colour - Green / Yellow
- Flower position - Axillary / Terminal
- Stem height - Tall / Dwarf

### 1.1.1. Mendel's monohybrid cross

Mendel selected the garden pea plant, *Pisum sativum* for his experiments. He selected tall and dwarf plants and allowed them to grow naturally. As pea plants produce seeds only by self pollination, he observed that tall plants produced always

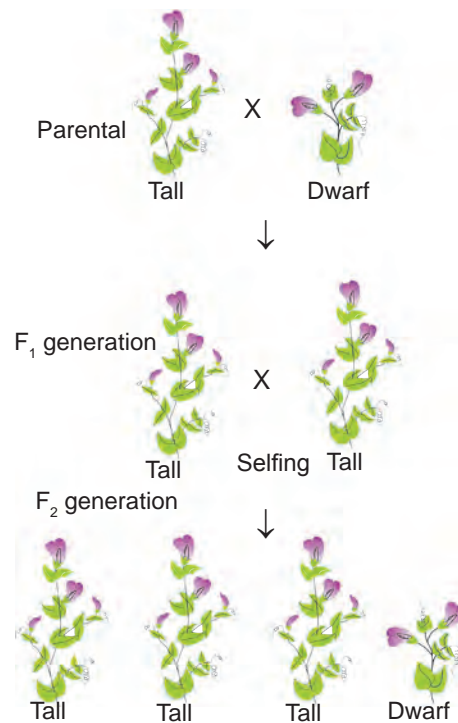


Fig. 1.2 Diagrammatic representation of Monohybrid cross

tall plants generation after generation under natural condition. Similarly, dwarf plants produced always dwarf plants generation after generation. Hence, he termed the tall and dwarf plants as wild types or pure breeding varieties.



Then he crossed a tall plant with a dwarf plant, produced progeny and calculated the percentage of tallness and dwarfness in subsequent generations.

When a pure breeding tall plant was crossed with a pure breeding dwarf plant, all plants were tall in the first filial generation (F1) i.e., there was not any

### Gregor Johann Mendel(1822-1884)

Mendel was educated in a monastery and went on to study science and mathematics at the university of Vienna. Failure in the examinations for a teaching certificate did not suppress his zeal for scientific quest. He went back to his monastery and started growing peas. Many others had studied the inheritance of traits in peas and other organisms earlier, but Mendel blended his knowledge of Science and Mathematics and was the first one to keep count of individuals exhibiting a particular trait in each generation. This helped him to arrive at the laws of inheritance that we have discussed in the main text.



### ACTIVITY 1.2

Observe in your locality for plants which show different characters for the following traits. Count them and record your findings. Examples:

Coconut	Tall	Dwarf
Bean	Violet Flower	White Flower
Sugar Cane	White Stem	Purple Stem
Clitoria	Blue Flowers	White Flowers

medium height plants or dwarf plants. This means that only one of the parental traits were seen and not the mixture of the two. When such a F1 tall plant was allowed to have self pollination, both the tall and dwarf plants appeared in second filial generation (F2). in the ratio of 3:1. This indicates that both tallness and dwarfness were inherited in the F1 plants but only tallness trait was expressed.

The first experiment of Mendel considering the inheritance of a single trait (Height of the plant Tall/Dwarf) is called Monohybrid Cross.

Expression of morphological characters as tall or dwarf plant, violet or white flower is called Phenotype.

The expression of gene (or Chromosomal make up) of an individual for a particular trait is called Genotype.

### 1.1.2. Physical basis of heredity

The genotype of a character is influenced by factors, called Genes. The genes are the factors which form the physical basis for inheritance of Characters. The alternate expressions of the same gene are called alleles. The contrasting pair of alleles make up an allelomorph. Examples : Tall and

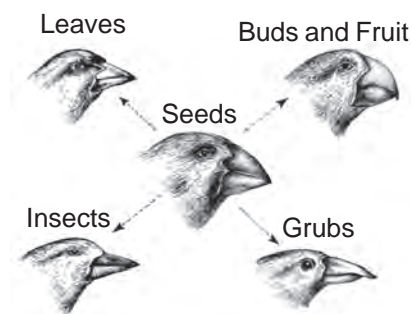


Fig. 1.3 Variations in the beaks of finches to suit their eating habits.

**ACTIVITY 1.3**

Find out identical / Non-identical twins in your school and locality. Find the minute variations between them.

dwarf plants, wrinkled and smooth seed coat, white and violet coloured flower. Organisms differ or vary in expressing phenotype which leads to variation.

**1.2. VARIATION**

All around us, we see different organisms belonging to different species, differing from one another. Variation may be defined as the differences in the characteristics among the individuals of the same species (intra specific variation) or among the different genera



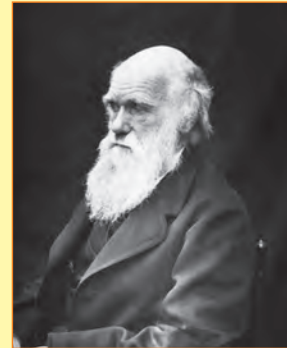
Fig. 1.4 Identical twins

(intergeneric variation) or different species (Inter specific Variation). No two individuals are identical to each other. Asexual reproduction produces, very closely resembling offsprings. Asexual reproduction thus results in offsprings with minor variations. Sexually reproducing organisms produce offsprings with marked, significant and visible variations.

**1.2.1. Types of variations**

a. **Somatic Variation** - It pertains to body cells and it is not inherited.

**Charles Darwin:** (1809-1882) Charles Darwin set out on a voyage when he was 22 years old. The 5 year voyage took him to South America and the islands, off its coast. Interestingly, after he got back to England, he never left to the shores again. He stayed at home and conducted various experiments that led him to formulate his hypothesis



from which evolution took place due to natural selection. He did not know the mechanism from where the variations arose in the species. Had he been enlightened by Mendel's experiments, he would have contributed more. But these two great men did not know of each other or of their works!

We often associate Darwin solely with the theory of evolution. But he was an accomplished naturalist, and one of the studies he conducted was, to do with the role of earthworms in soil fertility.

b. **Germinal Variation** - It pertains to germ cells or gametes and it is inheritable. It leads to speciation and evolution.

**Significance of Variation**

- ◆ It is the source of raw material for evolution.
- ◆ Animals are able to adapt themselves to the changing environment.

### Lamarckian View on organic evolution:

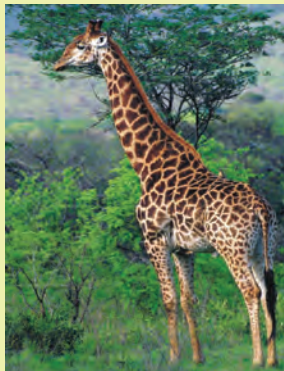


Fig. 1.5 Giraffe

Jean Baptise Lamarck (1744-1829) postulated the Use and Disuse Theory. According to Lamarck, use of a part / organ efficiently by a species, for generations over a long period of time, results in that part / organ being well developed in the subsequent generations and disuse of part/organ for a long period would make that part / organ diminished or degenerated.

Lamarck quotes the example of development of long neck of Giraffe. Giraffes were forced to extend their neck and stretch their legs to reach the leaves of tall trees. Over a long period of time, this resulted in long neck and legs in giraffe. Lamarck remarks that the “will or want” for a character makes the organisms to possess it at a later time.

- ◆ Organisms are better suited to face the struggle for existence
- ◆ Variations give the organisms an individuality of their own.
- ◆ Without variation, there would be no science of heredity as all individuals

of a race, would be identical in all aspects.

### 1.2.2. Theory Of Natural Selection

Charles Darwin made a number of observations in many parts of the world and put forth the law of natural selection involving struggle for existence and survival of the fittest.

Variation leads to genetic diversity, which is the key for evolution.

### 1.3. EVOLUTION

Evolution may be defined as a gradual development of more complex species from pre-existing simpler forms.

It is an extremely slow process and has occurred over millions of years, as revealed by fossil evidences.

Evolution has thus resulted in the diversity of organisms, influenced by environmental selection.

### 1.4. SPECIATION

Mankind in India and all other parts of the world, form a single species called *Homo sapiens*. As in India, morphological features of people living in different geographical areas like South India, North India, North Eastern region, Kashmir and Andaman are not the same as the people living in different continents are different in morphological features.

Men, with these differences in their bodily features, differentiate more and more, if there is no chance of interbreeding among them.

Imagine a situation, where this would result in the impossibility of



breeding between two such individuals of geographically isolated populations. Then they would be ready to become two different species.

When two populations are isolated by geographical barriers, or reproductive barriers, there is a chance for a change to develop in their gene flow (Genetic drift), leading to formation of a new species. Genetic drift with changes in the gene flow imposed by isolation mechanism acts as an agent of speciation.

Thus speciation is arising of a new species from a sub-population of a species which is geographically or reproductively isolated over a long period of time from the other population of the same species.

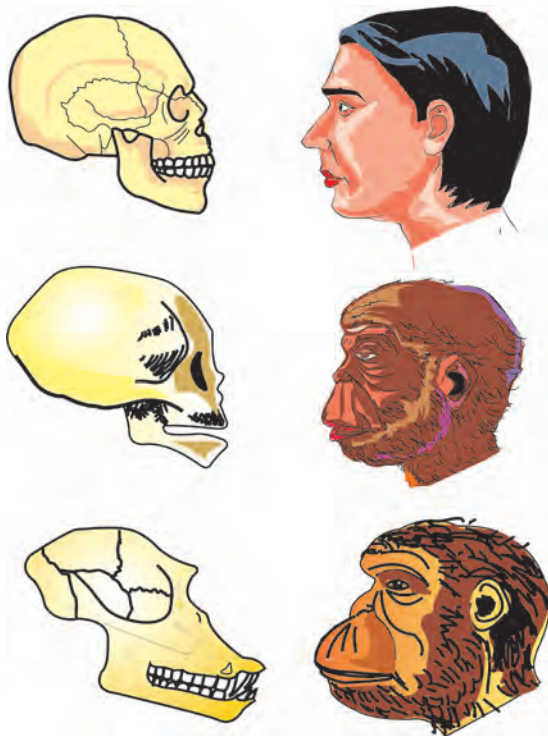


Fig. 1.6 A comparison of the skulls of adult modern human being, baby chimpanzee and adult chimpanzee. The skull of baby chimpanzee is more like adult human skull than adult chimpanzee skull.

## 1.5. HUMAN EVOLUTION

Fifteen million years ago, in Africa existed hairy bodied Gorilla and Chimpanzees like Hominids. After that 3-4 million years ago, men like hominids, walked into Eastern Africa. Evidence shows that they hunted with stone weapons but were mostly fruit eaters. They were probably not taller than four feet but, walked upright in the grass lands of East Africa. These creatures were called the First human like being – the hominid. The hominid was called *Homo habilis*.

The next stage of human evolution came into existence 1.5 million years ago with the rise of *Homo erectus* who were meat eaters

The Neanderthal man who lived in East and Central Asia 1 million years

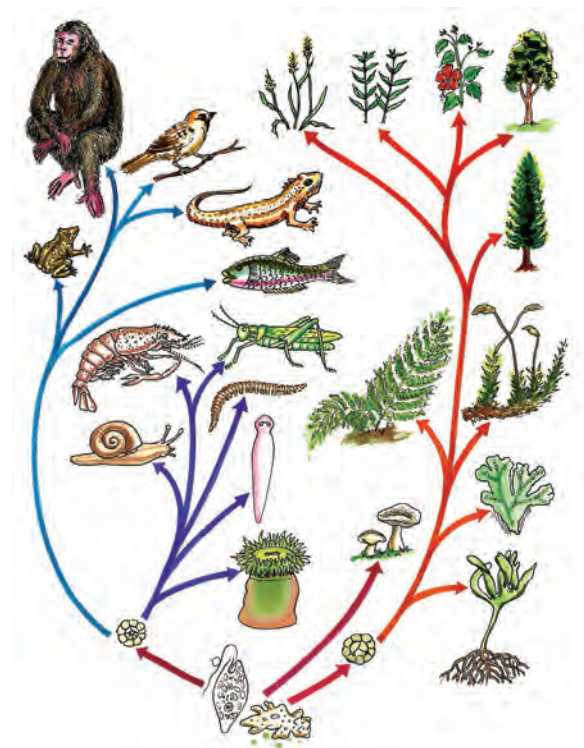


Fig. 1.7 Evolutionary tree

ago, used to hide to protect them and buried their dead.

Archaic Homo sapiens arose in South Africa and moved across continents and developed into distinct races during the ice age. Between 75,000 – 10,000 years, the modern Homo sapiens arose. Pre-historic caves were developed about 18,000 years ago, agriculture came around 10,000 years back and human settlements started.

## 1.6. EVOLUTION TREE

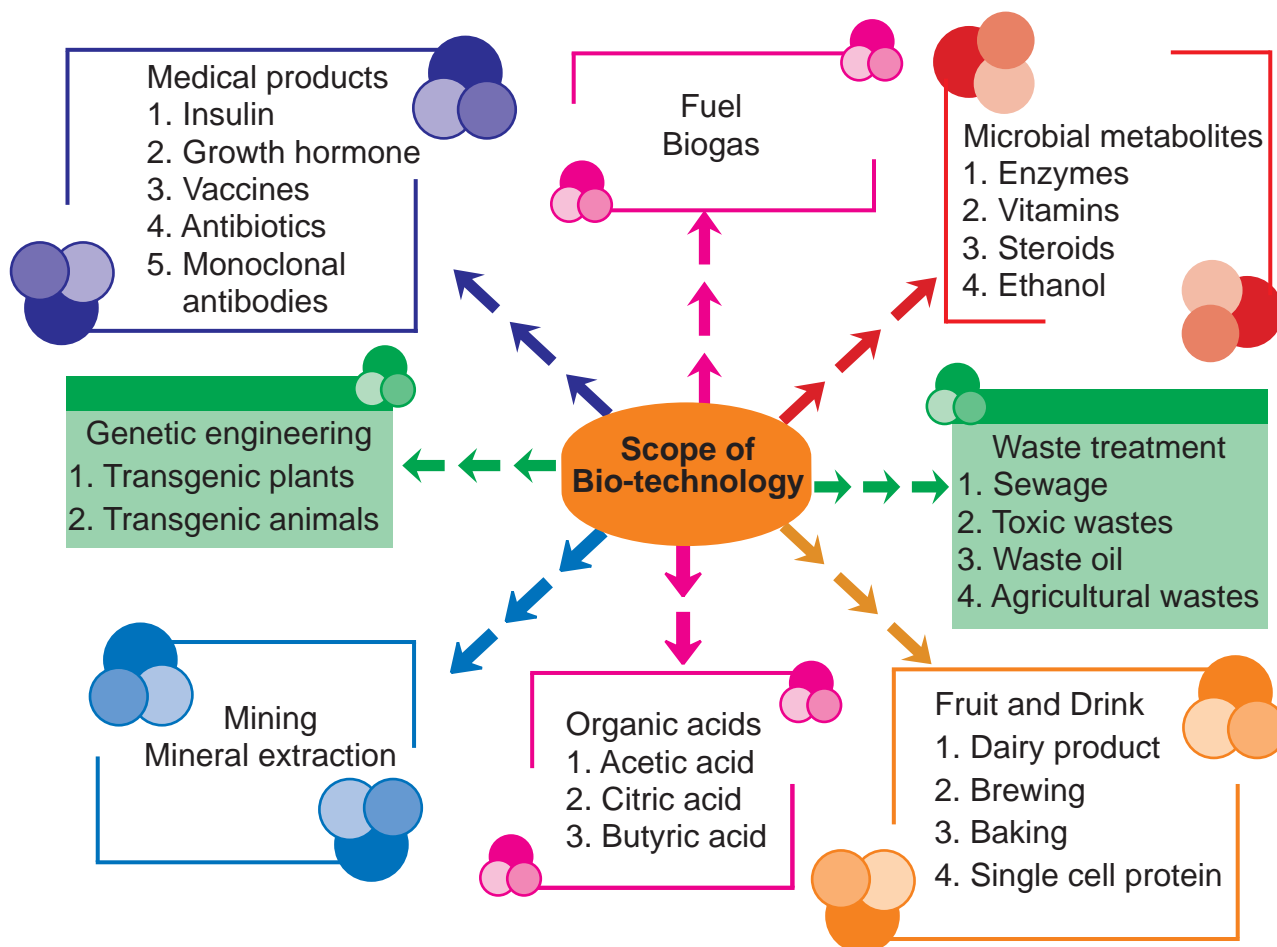
To understand evolution, a branching diagram or “Tree” is used to show the inferred evolution, relationships, among various biological species or other entities

based upon similarities and differences in their physical and genetical characters.

## 1.7. GENETIC ENGINEERING

Genetic engineering is the modification of the genetic information of living organisms by manipulation of DNA by adding, removing or repairing part of genetic material (DNA) and changing the phenotype of the organism. It is also known as gene manipulation or recombinant DNA Technology (r-DNA Technology)

Recent advances made in Genetics, Molecular Biology and Bio-Chemistry have resulted in the origin of this new branch of science. The benefits derived through the Genetic Engineering include:



- ◆ Understanding of the gene structure and function through basic research.
- ◆ Production of large quantities of insulin, interferon (Anti-Viral Protein produced by Virus infected cells) human growth hormones, proteins (Polypeptides) and vaccines for foot and mouth disease of cattle (komari – in Tamil) etc.,
- ◆ This technique is also employed in the transfer of genes involved in Nitrogen fixation (NF–genes). This will help the cultivator to increase productivity.

### 1.7.1. Basic techniques in Genetic Engineering

Genetic Engineering has developed after the discovery of two enzymes. The enzymes which can cut DNA into fragments, and enzymes which can join such fragments.

Restriction enzymes or Restriction endonucleases are molecular scissors which cut DNA at specific sites. DNA ligases are the paste enzyme which helps to join the broken DNA fragments.

## 1.8. BIO-TECHNOLOGY AND CLONING

Bio-technology has contributed towards exploitation of biological organisms or biological processes through modern techniques which could be profitably used in medicine, agriculture, animal husbandry and environmental cleaning. There are several applications of Bio-technology such as brewing Industry, enzyme technology, manufacturing of

It was Edward Jenner (1749-1823) in 1791 who coined the term vaccine and the term vaccination for protective inoculation.



*Edward Jenner*

Vaccines produced by Bio-technology differ from others. In that, they do not contain weakened or killed agents. Instead they are so refined as to consist only the reactive material i.e., the antigen protein only. The first such vaccine was used against Hepatitis B Virus (HBV)

anti-biotics, organic acids, vitamins, vaccines, steroids and monoclonal anti-bodies.

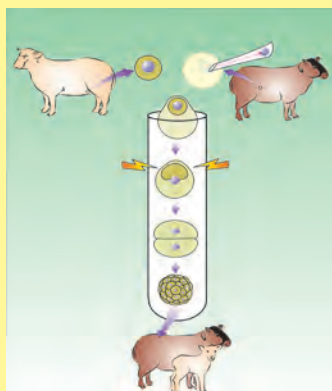
**Brewing Industry:** Fermentation in alcoholic beverages like beer, wine etc.,

**Enzyme Technology :** Enzymes are bio-catalysts that speed up reaction in cells. They can be used to catalyze the industrially important reactions and are more efficient than inorganic catalysts. Many enzymes are utilized in the pharmaceutical industry.

**Anti-Biotics :** These are substances produced by some microbes that help in increasing the immunity to human beings which are toxic to other micro-organisms.

**Organic Acids:** Acetic acid is used for the production of vinegar.

### Development of Dolly



Cloning

Dolly was a cloned sheep, developed by Dr. Ian Wilmut and his colleagues in Roselind Institute in Scotland in July 1996.

The scientists used nucleus of udder cell (somatic cell taken from mammary gland) from a six year old Finn Dorset white sheep.

The nucleus of the udder cell contains, diploid number ( $2n$ ) of chromosomes with all the genes. They preserved the diploid nucleus in a suitable preservative. Then they took an ovum from the ovary of another sheep. The haploid nucleus ( $n$ ) in the ovum was removed.

The diploid nucleus of the udder cell was injected into the cytoplasm of the enucleated ovum. Then the ovum with the diploid nucleus, was implanted into the uterus of the surrogate mother sheep. Since the ovum had the diploid nucleus, it developed into a young clone. It was named "Dolly" by Dr. Ian Wilmut.

**Vitamins:** These are chemical compounds present in variable minute quantities in natural food stuffs. They do



Fig. 1.10 Dr. Ian Wilmut with dolly

not furnish energy but are very essential for energy transformation and regulation of metabolism.

**Vaccines:** Vaccines are substances that confer immunity against specific disease. They act as antigens and stimulate the body to manufacture antibody.

**Steroids:** They are a type of derived lipids. Ex: Cholesterol, containing steroid drugs like prednisolone is produced from fungus *Rhizopus*.

**Monoclonal anti-bodies :** These are the anti bodies produced by cloned cells. Monoclonal anti -bodies, are now used for treatment of cancer.

**Cloning:** Cloning is an experimental technique wherein a group of morphologically and genetically identical organisms are produced. The "Clone" is an organism derived from a single parent by asexual method. A clone may be defined as an exact carbon copy or copies of a single parent.

The word clone refers only to living species.

If the cloning technique is to be applied to veterinary science, valuable



animals could be cloned from desirable adult cells.

### 1.8.1 Types of Clones

**Natural clones:** The natural clones include identical twins.

**Induced clones:** The induced (artificial) clones are developed by nuclear transfer into the host cell

### 1.9. STEM CELL (ORGAN) CULTURE:

One of the most fascinating branches in applied embryology is stem cell culture. The stem cells are the most unspecialized mass of cells. They are derived from animals and plants. They have two important characteristic features. They are:

1. Unspecialized cells which have the potentiality of growing and multiplying into enormous number of same type of cells by repeated mitosis.
2. They can be introduced to become any other type of tissues with specific functions i.e., they can be induced to become a cardiac muscle, beta cells of pancreas (which produce insulin), special neurons in brain etc.,

#### 1.9.1. Types of Stem Cells

**There are two kinds of stem cells**

**1. Embryonic Stem Cells:** The embryonic stem cells can be derived from early embryo which is developed by "invitro fertilization" (fertilisation made artificially in the laboratory).

After fertilization the zygote develops into a hollow blastula by cell division.

The inner mass of undifferentiated cells are isolated and they are considered as embryonic stem cells.

#### 2. Adult or Somatic Stem Cells:

The body of higher animals and human beings have many well differentiated tissues like epithelial, connective, muscular, vascular, supporting, nervous and reproductive tissues. In these tissues, there are some undifferentiated cells and are considered as the adult or somatic stem cells. They can grow, multiply and can be differentiated into same type of tissues into which they are implanted. The mechanism of adult or somatic stem cell culture is similar to that of embryonic stem cell culture. The somatic stem cells are derived from sources such as bone marrow, embryos, amniotic fluid and umbilical cord.

### 1.10. MICROBIAL PRODUCTION

As we discussed earlier, the field of Bio-technology is so vast and has great scope for different fields like agriculture, medicine, food industry etc.,

The microbial products of every day use are:

**Vaccines :** Killed or live germs suspension which is employed to induce the production of antibodies and bring forth immunity.

**Antibiotics :** Antibiotics are chemical substances derived from microbes like fungi, bacteria etc., employed to kill the infectious germs and cure a disease.

**Vitamin B<sub>12</sub> :** Bio technologically synthesized vitamin B<sub>12</sub> is used, to cure pernicious anaemia.



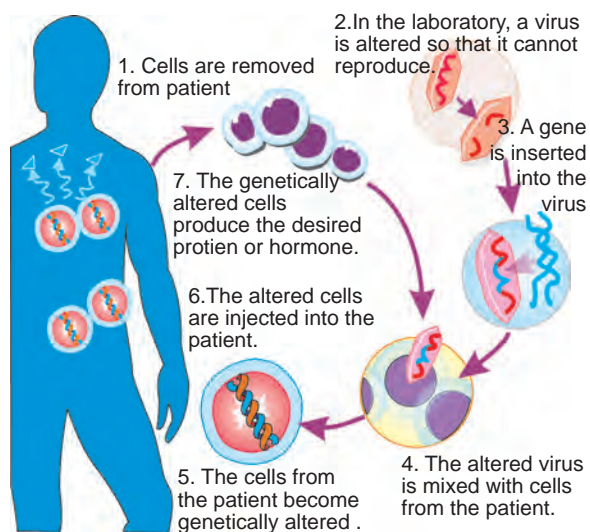


Fig 1.11 Gene therapy

**Enzymes :** Bio-Chemically significant enzymes are derived from microbes \ Ex. Amylase is derived from amyloproteins of bacteria.

**Insulin :** Diabetes is treated by the biotechnologically produced insulin.

### 1.11. BIO-SENSOR AND BIO-CHIPS

**Bio sensor:** It is a device consisting of immobilized layer of biological material such as enzyme, antibody, hormone, nucleic acids, organelles or whole cells and its contact with a sensor. The sensor converts biological signals into an electrical signal. It is used in medicines and industry.

1. Blood glucose level can be detected.
2. Production of any toxin in the body due to infection can be detected.
3. Pollution in drinking water can be monitored.
4. Odour, freshness and taste of food can be measured.

### Bio-Chips

Bio-Chips are microchips which are developed by employing techniques of Bio-technology. In future, biological computers will be developed using bio-chips. Bio-Chips will be useful in defence, medicine etc.,

### 1.12 SCIENCE TODAY - GENE THERAPY

Insulin dependent diabetes is treated with insulin injection. Insulin dependent diabetes is caused by the degeneration of beta cells due to a defective gene. Applying the principle of Bio-technology, it is possible to correct the defective gene. When the defective gene is corrected with a new gene, the genetic defect developed is, rectified and cured.

Gene Therapy is the means to treat or even cure genetic and acquired diseases like cancer and Aids by using normal gene to supplement or replace the defective gene.

It can be used to treat defects in Somatic i.e., (body) or Gametic (sperm or eggs) Cell.

#### Types of Gene Therapy

1. **Somatic gene therapy:-** The genome (gene set) of the recipient is changed. But this change is not passed along to the next generation.
2. **Germ line gene therapy:-** Egg and sperm of the parents are changed, for the purpose of passing the changes to the next generation.

## EVALUATION

### PART A

- Mendel observed 7 pairs of contrasting characters in *Pisum sativum*. One of the following is not a part of that. Find out.
  - Tall and dwarf,
  - Yellow and green seed colour,
  - Terminal and axial Flower,
  - Smooth and rough stem
- Primitive man evolved in – (Africa, America, Australia, India)
- Which of the following is inheritable (an altered gene in sperm, an altered gene in testes, an altered gene in zygote, an altered gene in udder cell)
- Theory of natural selection was proposed by - (Charles Darwin, Hugo de Vries, Gregor Johann Mendel, Jean Baptise Lamarck)
- Somatic gene therapy (affects sperm, affects egg, affects progeny, affects body cell)

### PART B

- Mendel has observed Tallness as dominant character in Garden pea plant. Similarly tongue rolling is a dominant character in man. In a group of 60 students, 45 can roll their tongue and 15 are non rollers.
  - In the above context, calculate the percentage of dominant and recessive characters.
  - In Garden pea plant, draw the diagrammatic representation of mono hybrid cross as explained by Mendel.
- The heritable characters are varying in different species and within the same species.
 

Name the variation in the following cases.

The eye colour among the human beings are varied as blue, black, brown, green, etc.,

  - This is called as \_\_\_\_\_ variation. The dentition in rabbit and elephant are not the same.
  - This is called as \_\_\_\_\_ variation.
- Sexually reproducing organisms produce offsprings with marked, significant and visible variation.
 

Asexually reproducing offsprings show minor variations.

  - Do you agree with the above statements?
  - Among the following organisms list out the asexually reproducing organisms.  
(Paramecium, Euglena, Earthworm and Bird).
- Here is a certain important hereditary jargons, fix a suitable one from the list given below.
  - \_\_\_\_\_ are the factors which form the physical basis of inheritance.
  - \_\_\_\_\_ is alternate expression of same gene.
  - \_\_\_\_\_ are contrasting pairs of alleles. (alleles, variation, speciation, gene, allelomorph)

10. A change that affects the body cell is not inherited. However, a change in the gamete is inherited. Radiation effects of Hiroshima has been affecting generations. Analyzing the above statements, give your interpretation.

11. Sequentially arrange the different species of man from primitive to modern man. (Neanderthal man, Homo habilis, Homo erectus, Homo sapiens)

12. Bio-technology, the modern science in biology, has helped in producing different types of products.

One of the following group does not have a product of bio-technology. Pick out and give reasons.

- a) Enzymes, Organic acids, Steroids, Vaccines
  - b) Vaccines, Enzymes, Antibiotics, Organic acids
  - c) Antibiotics, Hormones, Steroids, Vaccines
  - d) Steroids, Enzymes, Antibodies, Vaccines.
13. Identical twins are syngenic with similar chromosomal contents. Natural clones are those who possess identical chromosomes. Fill up with the suitable word given in the bracket.

a) Identical twins are \_\_\_\_\_  
(Natural clones / Induced clones)

b) Identical twins are \_\_\_\_\_  
(dissimilar to each other / similar to each other).

14. The ancestor of particular type of frog found in India and Srilanka were the same,



a) With reference to the above map, identify the factor that has resulted in the formation of a new species.

b) State a few other factors that help in the formation of new species.

### PART C

15. Human evolution has a record of changes for the past of 15 million years.

a) Name the different species of mankind in chronological order from primitive to modern man.

b) When were the primitive caves developed?

c) Narrate the life led by early man like hominids.

### FURTHER REFERENCE

**Books:** 1. Biology - A Modern Introduction B.S.Beckett, Second Edition, Oxford University Press



# IMMUNE SYSTEM

## 2. IMMUNE SYSTEM

### IMMUNE SYSTEM

“Health is Wealth” is an apt proverb. There can be no wealth greater than the good health that a person enjoys. In a healthy state, a person keeps himself physically, mentally and socially, fit. Our body has a complex defense mechanism to keep itself fit and work against various agents which disturb our well being. Being exposed to diseases, we develop resistance towards diseases and gain immunity.

### 2.1. HEALTH AND ITS SIGNIFICANCE

“Health is a state of physical, mental and social well being of an individual and not merely absence of a disease or infirmity”.

When a person is in good health, the different organ systems, not only function well discharging their duties, but the body as a whole is also able to adjust itself and strike a balance with the physical, mental and social environments.

The varying environmental factors such as temperature, humidity, wind, pressure, sun, rain, pollution caused by man, atomic radiation, malnutrition, the millions of microbes that surround our bodies, the inter-personal conflicts are all other factors affect our lives and are challenges to our health.

#### Dimensions of Health

1. **Physical dimension** : A person who is free from disease, is bright with his skin shining enjoying normal metabolism, has a good lustrous hair

and has no black rings around his eyes.

2. **Mental dimension** : A mentally healthy person who knows his capacities, does not overestimate or underestimate himself and can judge his shortcomings and weaknesses.

3. **Social dimension** : A person

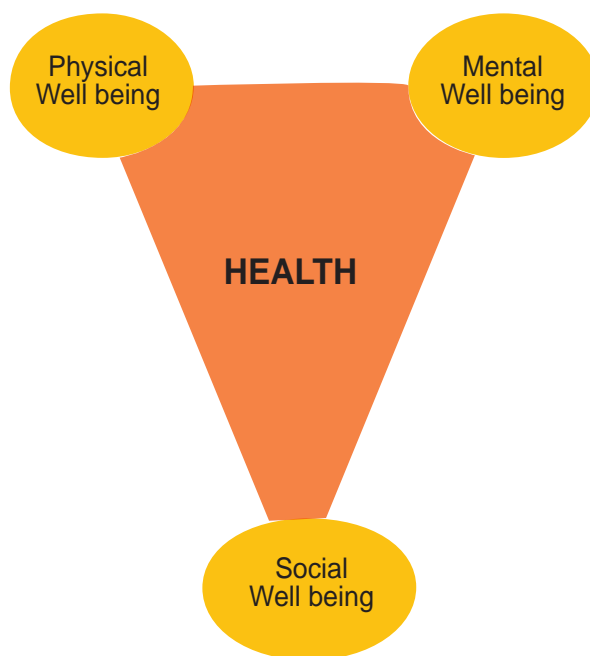


Fig. 2.1 Dimensions of health

adjusting himself in society, does not find fault with others. He maintains interpersonal relationships with his family members and colleagues at workspot and is free from interpersonal conflicts and will not quarrel.



## ACTIVITY 2.1

Following the above criteria, make a survey of your classmates/people in your neighbourhood and record your finding

- Number of students/neighbours who are healthy.
- Number of students/neighbours who do not have good interpersonal relationship and do not enjoy social well being.
- Number of students/neighbours who have diseases affecting their metabolism.
- List out positive qualities that you admire in your friend.

## 2.2. DISEASES AND CAUSES

The word disease means, “without ease or not at ease” and it is opposite to health. The condition of malfunctioning of the organ system or systems is called **disease**. There are numerous diseases that damage our health.

### Causes of the diseases

Diseases are caused due to various factors such as pathogens, environmental factors, nutritional factors, genetic factors, metabolic factors, etc.

Based on the causative agent, diseases are classified into:

1. Diseases not caused by organisms
2. Diseases caused by organisms

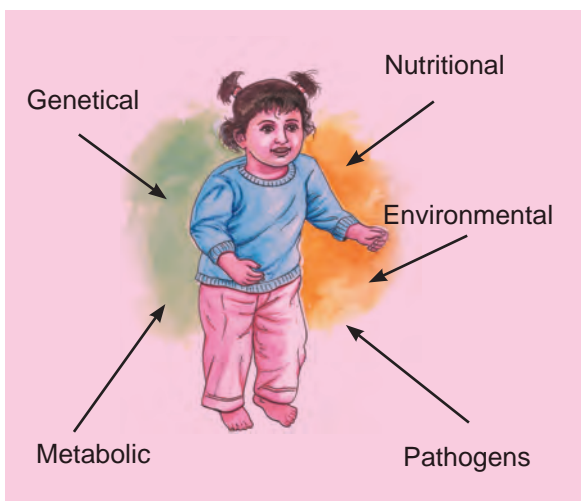


Fig. 2.2 Causes of diseases

### Diseases not caused by organisms – Non communicable diseases

**1. Organic diseases or Metabolic disorders:** Healthy body maintains a constant blood sugar level which is normally 80-120 mg / 100 ml of blood under, fasting conditions. When large quantities of glucose enter the blood stream, as it happens after a meal, the excess glucose is converted into insoluble glycogen and stored in liver and muscles for future use. Later when required, glycogen is reconverted into glucose and reintroduced into blood stream. All these processes are controlled by the hormone, Insulin, secreted by beta cells of Islets of Langerhans of Pancreas. If Insulin is not produced in sufficient quantity, excess of sugar cannot be stored and utilized. As a result, sugar continues to get accumulated in the blood, till it is lost through urine. This leads to other complications and results in diabetes mellitus. Diabetes mellitus is a state of expulsion of excess unused glucose in the urine due to less production of insulin.

Similarly, Diabetes Insipidus, Coronary heart diseases, Renal failure, Hypertension,

Obesity, Alzheimer's disease, Stroke affecting the functions of the brain, etc, are all caused due to metabolic disorders.

**2. Hereditary diseases or Genetical disorders:** The genetical disorders are caused due to defective or mutated genes. Albinism is an inherited disorder of melanin metabolism, characterized by the absence of melanin in the skin, hairs and eyes. The recessive mutant genes cause this disorder. The clinical symptoms of Albinism are milky white coloured skin and marked photophobia (high sensitivity to light). Haemophilia, sickle cell anaemia, Thalassaemia, Down's syndrome, Bubble boy syndrome, etc., are a few other genetical disorders.

**3. Nutritional Deficiency Diseases:** A diet which contains all essential nutrients in correct proportion, is indispensable for maintaining good health. Deficiency in certain food constituents, causes various kinds of diseases. Protein deficiency causes Marasmus and Kwashiorkor. In Marasmus, the child loses weight and suffers severe diarrhoea and it will appear as though bones are covered by the skin. In Kwashiorkor the child develops an enlarged belly with swelling in the face and feet.



Fig. 2.3 An albino

#### 4. Diseases caused by Organisms:

Robert Koch and Louis Pasteur were the first to establish the Germ theory of diseases. A germ or microbe gains entry into the host, such as man, multiplies so fast that it can increase in large numbers, produce poisonous substance called Toxins and interfere with the host metabolism and produce a characteristic set of symptoms by which the disease can be diagnosed.

#### Disease producing organism



Fig. 2.4 Kwashiorkor



Fig. 2.5 Marasmus

SOME IMPORTANT VITAMIN DEFICIENCY DISEASES ARE TABULATED BELOW:

Vitamin	Deficiency disease	Symptoms
Vitamin A	Nyctalopia	Night blindness
Vitamin B <sub>1</sub>	Beri-Beri	Nervous disorder
Vitamin B <sub>5</sub>	Pellagra	Dementia, dermatitis, diarrhoea
Vitamin B <sub>12</sub>	Pernicious anaemia	Destruction of RBC
Vitamin C	Scurvy	Bleeding gums and loosening of teeth
Vitamin D	Rickets	Defective calcification of bones
Vitamin E	Sterility	Inability to reproduce
Vitamin K	Haemorrhage	Profuse loss of blood

**1. Parasitic Micro-organism:** The causative organism of a large number of diseases in man, are micro-organisms belonging to different groups. They are viruses, bacteria, fungi and protozoans.

**2. Viruses and viral diseases in man:** Viruses are living substances inside the host cell and behave as dead particles outside the host cell. The Viral body consists of a nucleic acid, DNA or RNA and a protein cover. All the known viruses are parasitic and some of them cause deadly diseases such as. polio, rabies, hepatitis, meningitis, encephalitis (brain fever), etc.

**3. Bacteria and Bacterial Diseases:**

Bacteria are unicellular prokaryotes and visible under Compound Microscope. Though many bacteria are harmless, some are parasitic and produce diseases. Bacteria can enter the host body through the mouth, nostrils or cuts and bruises on the skin. They multiply rapidly, producing toxins in high concentration to affect health. Some bacterial diseases in man are Tuberculosis, Leprosy, Cholera, Typhoid, Diphtheria, Tetanus, Plague, Pneumonia, Syphilis, Gonorrhoea, etc.

**Fungi and Fungal Diseases:** Fungi are non green saprophytic or parasitic plants living on dead and decaying organic matter or living organisms. Certain species



of fungi are parasitic on man and cause Ringworm attacking the keratinized layer of skin, destroying it in circular patches.



**Fig. 2.6 Bacilli**

Dandruff, Athletes' foot are some other fungal diseases in man.

### Protozoan and Protozoan Diseases:

Protozoans are unicellular animalcules, some parasitize man and cause diseases such as malaria, amoebic dysentery, sleeping sickness, etc.

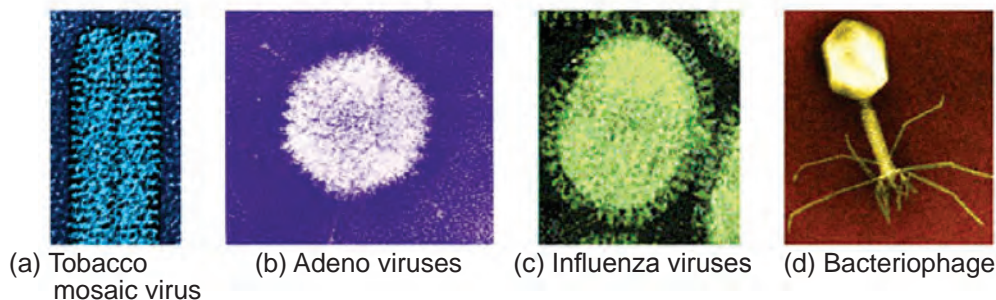
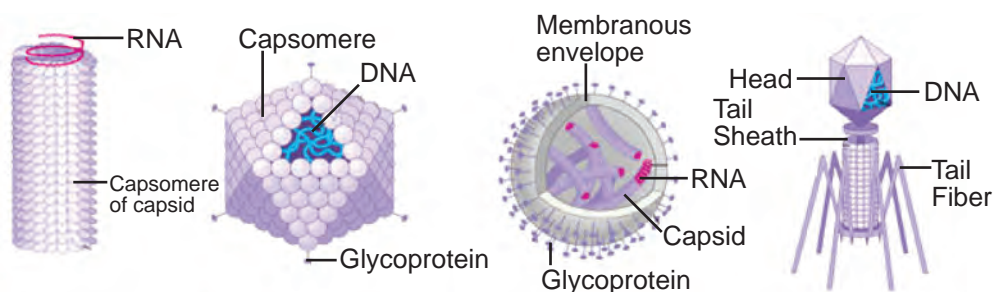
### Parasitic macro-organisms:

Infestations of the body with tapeworm, liver fluke, round worm, filarial worm, etc., cause diseases in man like Taeniasis, Ascariasis, Filariasis, etc.,

## 2.3. DISEASES CAUSED BY MICROBES AND PREVENTION

A disease caused by a parasitic organism and transmitted from one person to another by the transfer of the parasite is known as **infectious disease**.

We shall study the cause, spread and prevention of a few selected infectious diseases prevalent in our country so that we will know how to guard ourselves against them and other similar diseases.



**Fig. 2.7 Types of Viruses**

## 2.3.1. Viral diseases

### 2.3.1.1. Common Cold

More than hundred strains of viruses are responsible, for causing common cold in man. Children are more susceptible to common cold than adults.

#### Symptoms

1. Inflammation of upper respiratory passage – nasal epithelium.
2. Flow of mucous.
3. Headache, slight rise in temperature, etc.,

It lowers the resistance of the body, leading to a number of secondary infections like pneumonia, bronchitis, etc.,

#### Transmission

- i) It spreads mostly through the droplets discharged from the nose and the mouth of the patient in the process of talking, laughing, sneezing, etc.,
- ii) It may also spread through close inanimate objects like handkerchief,

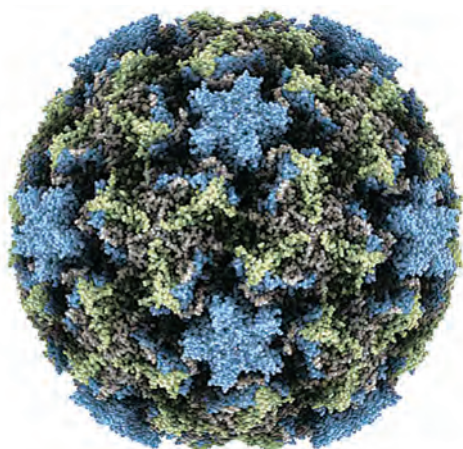


Fig. 2.8 Human rhino virus

bedding, clothes, utensils, toilet articles, etc., (called **fomites**)

**Control and prevention:** There are no effective measures to control common cold. However, a good nourishing food, avoiding contact with patients and wearing suitable clothing are suggested, to keep away from common cold.

### 2.3.1.2. Influenza

It was a dreadful disease once and worldwide in distribution (pandemic) in 1970s.

**Causative agent :** A(H<sub>1</sub>N<sub>1</sub>) Virus , is



Fig. 2.9 H1N1 Virus

spherical in shape and highly contagious, causing influenza.

#### Symptoms

Sudden onset of fever accompanied by aches and pains in the back and limbs.

#### Transmission

It spreads through nasal and mouth droplets of patients and enters into the respiratory tract of normal man. It also spreads through fomites.

#### Prevention

- i. Avoid contact with the patients.
- ii. Avoid crowding.



### 2.3.2. Bacterial diseases

Bacteria are prokaryotic organisms. Some of the bacteria are parasitic in man, causing diseases like TB, Cholera, Typhoid, dysentery etc.,

#### 2.3.2.1. Tuberculosis

It is an airborne disease affecting the lungs and also parts of our body such as bones, joints, lymph glands, alimentary tract, liver, kidney, etc.,

**Causative agent:** *Mycobacterium tuberculosis*, a rod shaped bacterium causes tuberculosis (TB).

#### Symptoms

- i) The affected parts develop lesions in the form of small nodules called tubercles from which the disease gets its name.
- ii) Persistent cough
- iii) Loss of body weight

#### Transmission

Tuberculosis is transmitted through air. Large number of bacteria leave the patients through the droplets of sputum expelled by the patients while eating, sneezing, talking, laughing and so on by the patients. The droplets may remain suspended in the air for a long time. The dust arising from the sputum may also contain



Fig. 2.10 Tuberculosis bacteria

viable germs. The waxy cell wall of the tuberculosis bacillus prevents it from drying up and so it can remain viable outside the body for a long period. The germs suspended in the air may be inhaled by a healthy person.

#### Prevention

- i) Keeping oneself healthy and avoiding insanitary conditions, overcrowding and poor ventilation.
- ii) Sunlight and fresh air are important agents, as they act as natural disinfectants readily destroying the germs.
- iii) Isolation of the patients and frequent sterilization of articles used by them are also important.
- iv) Incineration (burning) of the droplets, the sputum from the patients to prevent its occurrence in the air.
- v) Immunization with BCG vaccine is an effective measure to prevent this disease.

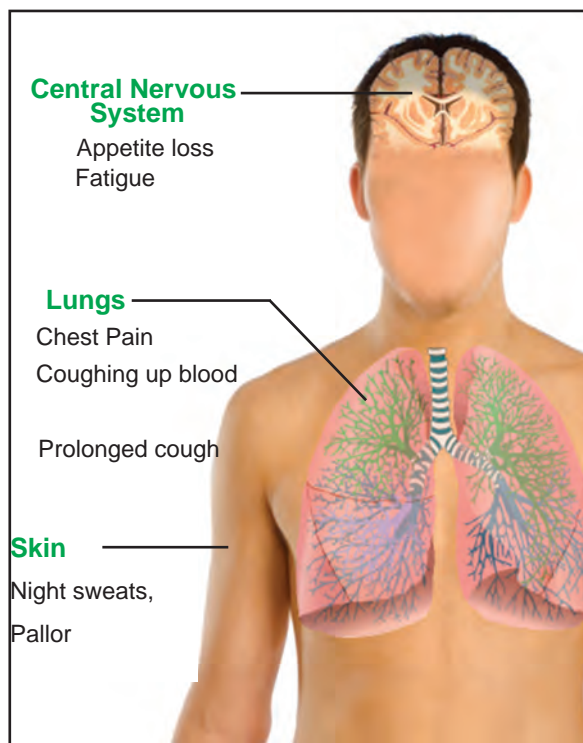
### ACTIVITY 2.2

#### Making a culture of live bacteria

Boil a few grams of chopped meat, carrot and potatoes in water for 15 minutes, then filter off the solid matter to obtain a fairly clear broth.

Leave the broth in open test tubes for a few hours. Plug the tubes with cotton wool and leave them in a warm place (approximately 25°C) until the broth has “gone bad” owing to the growth of bacteria.

What you have produced, is a bacteria culture.



**Fig. 2.11 Symptoms of tuberculosis**

- vi) The patient should cover his mouth and nose while coughing.

### 2.3.2.2. Typhoid

**Causative agent:** A short rod shaped bacterium with numerous flagella – ***Salmonella typhi*** causes typhoid.

#### Symptoms

- i) Continuous fever.
- ii) Inflammation and ulceration of intestine.
- iii) Enlargement of spleen and a characteristic red spot eruption on the abdomen.

#### Transmission

Transmission of typhoid is through food and water contaminated with the germ, the personal contact with patients and carriers. Flies are also important transmitting agents of this disease.

**Prevention and control:** Isolation of the patient, control of flies, hygienic food habits, proper public sanitary measures are effective means of prevention of this disease. Artificial immunization with typhoid vaccine is advised. A recovery from typhoid usually confers a permanent immunity.

### 2.3.3 Protozoan diseases:

Some of the unicellular protozoans are parasitic pathogens and cause diseases in man.

#### 2.3.3.1 Malaria

**Causative agent:** A tiny protozoan – Plasmodium is responsible for causing malaria. Four different species of Plasmodium namely, *P.vivax*, *P.malariae*, *P.falciparum* and *P.ovale* occur in India causing malaria. Of these, the malignant and fatal malaria, caused by Plasmodium falciparum is the most serious one.

#### Transmission

Through the vector - the female ***Anopheles*** mosquito.

#### Symptoms

- i) Malaria is characterized by chillness and rise in temperature. This is followed by perspiration and lowered body temperature. The person feels normal for some time but the fever recurs at regular intervals.
- ii) Successive attacks of malaria result in the distension of spleen and destruction of liver tissues.

#### Prevention and control:

- i) Sanitary measures include ground fogging with disinfectants.
- ii) Closure of stagnant pools of water and covering ditches is suggested.

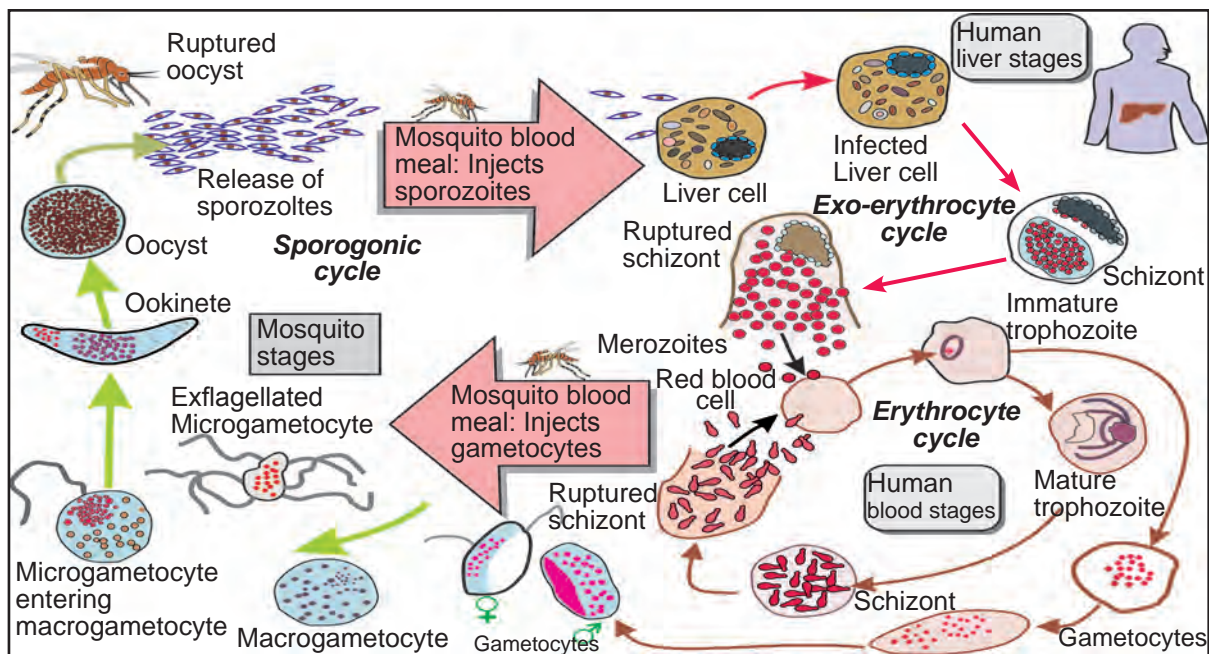


Fig. 2.12 Life cycle of malarial parasite

**Life cycle of malarial parasite – Plasmodium:** The sexual stage of Plasmodium takes place in female Anopheles mosquito whereas the vegetative stage occurs in man. When a female Anopheles mosquito bites an infected person, these parasites enter the mosquito and undergo further development in the mosquito body. The parasites multiply within the body of the mosquito to form sporozoites that are stored in the salivary glands of mosquito. When these mosquitoes bite a person, the sporozoites (the infectious stage) are introduced into his body; they multiply within the liver cells first and enter the RBC of man, resulting in the rupture of RBC. This results in the release of toxic substance called haemozoin which is responsible for the chill and high fever, recurring three to four days.

### Sir. Ronald Ross

Sir. Ronald Ross (1857-1932), a British-Indian physician was born in Almora, India. He had his school education and higher studies in medicine in England. Later he was posted at the Presidency General Hospital, Calcutta. Ross studied about malaria between 1882 and 1899. As he was working in Bangalore, he noticed the connection between water as breeding ground of mosquitoes and the spread of malaria. He discovered the presence of malarial parasites in the female Anopheles mosquito when he was working on malaria at Secunderabad. He demonstrated that malaria is transmitted from infected individual to a healthy person by the bite of mosquito. In 1902, he was awarded the Nobel prize for his work on malaria.





- iii) Using mosquito nets and repellants also, will grossly lower the chance for infection.

### 2.3.3.2. Amoebic dysentery (Amoebiasis)

**Causative agent:** *Entamoeba histolytica* – a protozoan parasite in the large intestine of man causes **Amoebiasis**.

#### Symptoms

- i) Fever.
- ii) Constipation and abdominal pain and cramps.
- iii) Stools with excess mucous and blood clot.

#### Transmission

It is a water and food borne disease. House flies act as mechanical carrier and serve to transmit the parasite from the faeces of infected persons to the food – thereby contaminating the food and water.

**Prevention and control:** Precaution may be taken by providing germ free clean water; clean food habits. Good sanitary facilities will control the flies.

### 2.3.4. Fungal diseases in man

Some of the fungi are parasitic on man and cause diseases



Fig. 2.14 Ringworm

#### 2.3.4.1. Ringworm

Three different genera of fungi namely, Epidermophyton, Microsporum and Trichophyton cause ringworm.

#### Symptoms

The above fungi live on the dead cells of outer layer of skin in man and cause superficial infections in skin, hair, nail, etc; and form patches and itching

#### Transmission

By direct contact or through fomites such as towels, combs, etc.,

**Control and prevention:** Avoid contact with infected person and articles used by them.

### 2.4. MODES OF TRANSMISSION



Fig. 2.13 Clean habits

## OF INFECTIOUS GERMS

The transfer of a disease causing germ from an infected person to a normal healthy person through certain agents or direct contact is called transmission of the disease. The transmission can take place in one of the following ways;

**Direct Transmission :** By direct transfer of germs from the patient to normal healthy person through close contact, the diseases like diphtheria, pneumonia, cholera, typhoid, measles, mumps, etc., are transmitted.

During sneezing, coughing and talking, the droplets from the patients are discharged from the mouth and the nose and enter the air. While a normal person is inhaling such air, laden with the droplets,



**Fig. 2.15** Cover face while coughing and sneezing

he gets infected.

Through the umbilical cord, the germs are transferred from the infected mother to the child at the time of childbirth by the direct contact method.

**Indirect transmission through fomites:** Some germs may remain viable outside the body of the hosts and may be transferred indirectly through close inanimate objects used by the patients like clothing, bedding, handkerchief, toilet articles, utensils, drinking cups and glasses that are freshly soiled with the germs present in the discharges of the patients. Such contaminated objects are called **fomites**.

**Transmission by animals:** Various animals such as ticks, mites, birds, insects and mammals transmit diseases like cholera, malaria, rabies, etc;

## 2.5. IMMUNIZATION

**Immunity:** Immunity is part of a complex system of defence reaction in the body. It means the defence against or specific resistance exhibited towards the infectious organisms and their products.

The infectious organisms that invade the body and the toxins produced by them and any foreign protein entering the body are called **antigens**.

The immune system which includes blood plasma, lymph and lymphocytes analyze the chemical nature of the antigens and produce the suitable proteinaceous substances called **antibodies** to detoxify the antigens.



### 2.5.1. Types of Immunity

**Natural or Innate Immunity:** The **natural or innate immunity** that enables an individual to resist the disease, to which the particular species is immuned. E.g. Plant diseases do not affect animals.

**Acquired or Specific Immunity:** The resistance against some infectious diseases developed by an individual during lifetime on exposure to the infections is called **acquired or specific** immunity.

The acquired or specific immunity is of two kinds – active acquired immunity and passive acquired immunity.

**Active acquired immunity:** This kind of immunity is developed by our body,

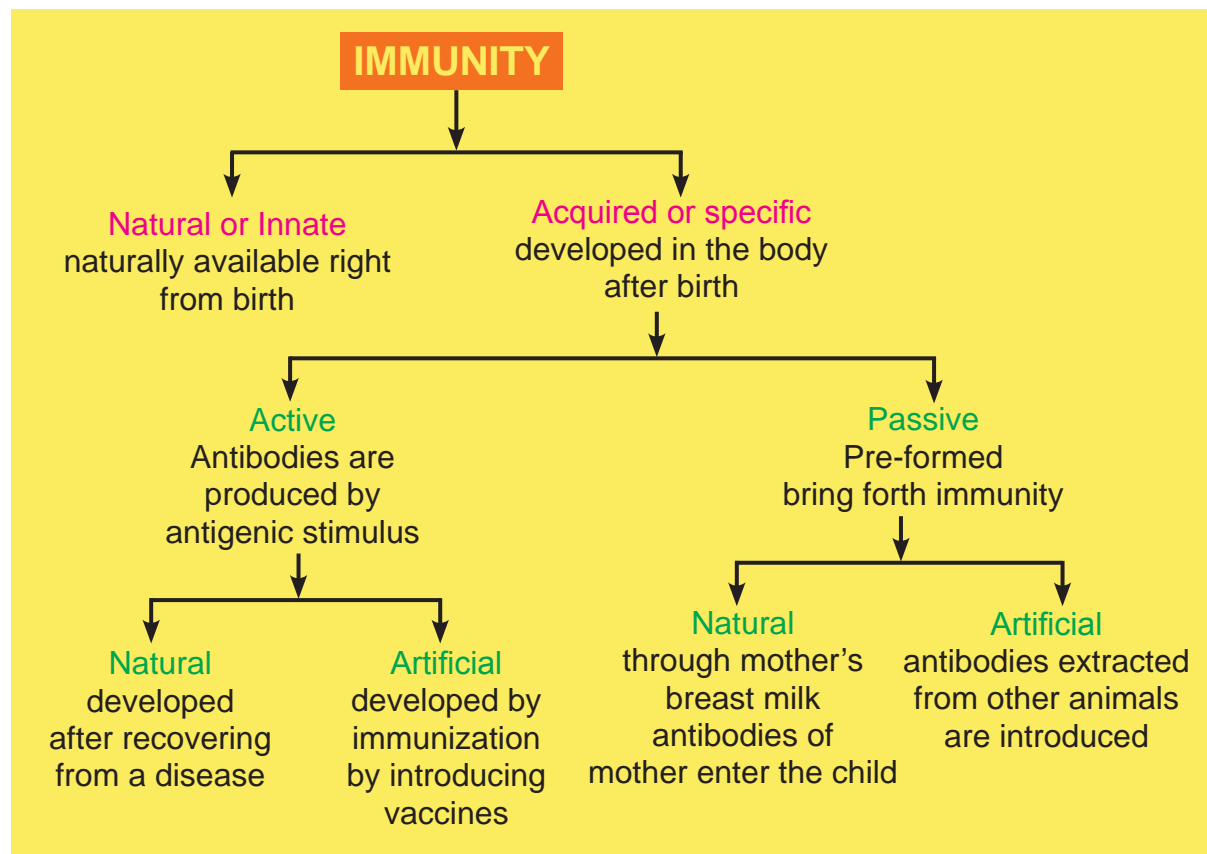
during the first infection of any pathogen. The antibodies produced in the blood stays for a long period and kills the similar pathogens whenever they enter the body.

If the antibody production is stimulated naturally, after recovery from a disease, it is called Natural Active Acquired Immunity.

If the antibody synthesis is stimulated by application of vaccines or any other man made methods, the immunity gained is called Artificial Active Acquired Immunity. E.g. The polio drops and triple antigen injected into the child in the immunisation programme.

**Passive Acquired Immunity:** In this type of immunity, a readymade antibody is introduced from outside instead of

## TYPES OF IMMUNITY



stimulating the body to produce antibody with antigenic stimulus.

If the readymade antibody is taken from the mother's blood into the foetus, it is called Natural Passive Acquired Immunity. If the readymade antibody is given to an individual artificially, (produced in some other animal and extracted) it is called Artificial Passive Acquired

### MORE TO KNOW

What kind of Immunity does a child get when it is breast fed ? **BREAST FEED IS THE BEST FOOD.** Antibodies or Immunoglobins are found in breast milk. Through breast milk antibodies are passed on to the nursing baby. Bottle fed infants do not have the advantage of fighting the ingested pathogens on their own until the antibodies are produced in them. An infant should be breast fed for a minimum of six months.

Medical establishment knows that infants who are breastfed contract fewer infections than bottle fed infants. Breast milk protects the child, against bacteria like Escherichia coli, Salmonella, Shigella, Streptococci, Staphylococci, Pneumococci and viruses like Polioviruses and Rotaviruses.

### IMMUNIZATION SCHEDULE

The immunization schedule indicates the stages at which the vaccinations and inoculations have to be given to safeguard children against different diseases. The table given below lists the names of vaccines, their dosages and the stage at which they have to be administered.

Immunization schedule followed in India			
S.No	Age	Vaccine	Dosage
1	New born	BCG	1 <sup>st</sup> dose
2	15 days	Oral polio	1 <sup>st</sup> dose
3	6 <sup>th</sup> week	DPT & Polio	1 <sup>st</sup> dose
4	10 <sup>th</sup> week	DPT & Polio	2 <sup>nd</sup> dose
5	14 <sup>th</sup> week	DPT & Polio	3 <sup>rd</sup> dose
6	9-12 months	Measles	1 <sup>st</sup> dose
7	18-24 months	DPT & Polio	1 <sup>st</sup> booster
8	15 months - 2 years	MMR vaccine	1 <sup>st</sup> dose
9	2 – 3 years	Typhoid vaccine	2 doses at 1 month gap
10	4 – 6 years	DT & Polio	2 <sup>nd</sup> booster
11	10 <sup>th</sup> year	TT & Typhoid	1 <sup>st</sup> dose
12	16 <sup>th</sup> year	TT & Typhoid	2 <sup>nd</sup> booster



Fig. 2.16 Oral Polio immunization

Immunity. This immunity is not permanent.

**Immunization:** Administering vaccines to prevent the disease is called immunization. This process of Immunisation develops Artificial Active Acquired Immunity.

Immunisation through inoculation is a mass means of protecting a greater number of people against the spread of diseases.

BCG Tuberculosis Vaccine

DPT Diphtheria, Pertussis,  
Tetanus Vaccine (Triple antigen)

MMR Mumps , Measles, Rubella

DT Diphtheria, Tetanus (Dual antigen)  
TT Tetanus toxoid

## 2.6. TREATMENT AND PREVENTION OF THE DISEASES

Treatment means medical management of the symptom of the disease.

Medical management includes:

- i) Treatment involving medicine.
- ii) treatment not involving medicine.

### **Treatment involving medicine:**

Medicines are generally used to treat infectious diseases. These medicines either reduce the effect of the disease or kill the cause of the disease. The antibiotics are used as blocks to the

pathways of the disease without affecting ourselves.

### **Treatment not involving medicine:**

As a person is recovering from the effect of fracture or neurotic problem, yoga and physiotherapy do a great deal of help to do normal activities. People addicted to

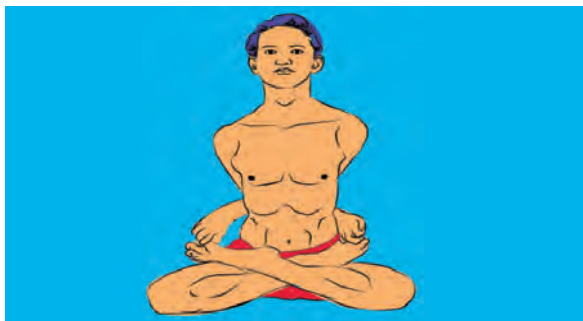


Fig. 2.17 Yoga practice

alcohol and drugs are given counselling to overcome the habit.

**Prevention:** Getting rid of a disease causing germs, is a means of prevention of the disease.

Prevention can be achieved in two ways:

- i. General – preventing the infectious germs by keeping away from the exposure to the germs. Hygienic life style, avoiding overcrowding, fresh air, safe drinking water and good sanitary measures are all ways to prevent a disease causing germ, coming into contact with us.
- ii. Specific – This relates to a peculiar property of the immune system that usually fights the microbial infections. e.g. Immunisation programme.

## 2.7. BIO-TECHNOLOGY IN MEDICINE

A detailed account of the role of Biotechnology in healthcare, has been dealt with in chapter 1.

Biotechnologically synthesized insulin has been effectively used replacing the defective insulin to treat diabetes mellitus in the field of medicine.

## 2.8. HIV AND PREVENTION

Acquired Immune Deficiency Syndrome (AIDS) is a dreadful disease transmitted through sexual contact or through blood and blood products. Robert Gallo at National Institute of Health, USA and Luc Montagnier at Pasteur Institute, Paris isolated the virus, Human Immuno Deficiency Virus (HIV) which causes AIDS.

HIV is a retro virus with glycoprotein envelope and the genetic material – RNA. HIV causes profound Immuno suppression in humans. It is due to the depletion of one type of WBC, which is involved in the formation of antibodies called CD4 plus T-helper cells (lymphocytes).

**Symptoms:** Significant weight loss, chronic diarrhoea, prolonged fever, opportunistic infections such as tuberculosis, candidiasis and recurrent herpes zoster (viral) infection.

### Test for Virus:

1. Enzyme Linked Immuno Sorbent Assay (ELISA)
2. Western Blot – a confirmatory test.

### Prevention:

1. Protected sexual behaviour.
2. Safe sex practices.
3. Screening the blood for HIV before blood transfusion.
4. Usage of disposable syringes in the hospitals.
5. Not sharing the razors / blades in the saloon.
6. Avoid tattooing using common needle.

## EVALUATION

### PART A

1. Pick out a case of healthy state of an individual.

Mr. X is recovering from an infectious disease,

Mr. Y is taking insulin injection everyday,

Mrs. Z is very much depressed,

Mr. K is attending to his duty and spends time joyfully,

2. Which one of the following is a state of a disease in which a person is not socially balanced.

He enjoys a birthday party,

He behaves rudely even for menial matters,

He is adjusting to the surrounding situation,

He is attending to his ailing mother at the hospital.



3. Pick out the bacterial disease.  
Meningitis, Rabies, Tetanus, Small pox.
4. One of the following is transmitted through air. Find out.  
Tuberculosis, Meningitis, Typhoid, Cholera.
5. The most serious form of malaria is caused by Plasmodium \_\_\_\_\_.  
P. ovale, P. malariae, P. falciparum, P. vivax.
6. An example for protozoan infecting our intestine is \_\_\_\_\_.  
Plasmodium vivax, Entamoeba histolytica, Trypanosoma gambiense, Taenia solium.
7. One of the means of indirect transmission of a disease is \_\_\_\_\_.  
Sneezing, Droplet from mouth, Placenta, Utensils of patients.
8. When antibodies, extracted from some other animal is injected into your body, what kind of immunity do you gain?  
Artificial active acquired immunity,  
Artificial passive acquired immunity,  
Natural active acquired immunity,  
Natural passive acquired immunity.
9. The first vaccine injected into a just born baby is \_\_\_\_\_.  
Oral polio, DPT,  
DPT and Oral polio, BCG.
10. Pick out a non-antigen. Entry of \_\_\_\_\_.  
(Germ, Toxins of germs, New forms of protein, Mother's Milk.

## PART B

11. In order to lead a healthy life a person should enjoy physical, mental and social well being. If a person lacks any one of them, then that person is suffering from \_\_\_\_\_.
12. Tamil selvan has inherited colour blindness from his father. Name the causative factor responsible for this defect \_\_\_\_\_.
13. Marasmus and Kwashiorkor are both protein deficiency defects. Marasmus differs from Kwashiorkor in enlarged belly and swelling in the face. Are these symptoms for the above diseases correct? If not, correct it.
14. A list of disorders are given below. Pick out the odd one out and give reasons. (colour blindness, haemophilia, night blindness, albinism, sickle cell anaemia)
15. Ramya is suffering from bleeding gum and loosening teeth. On a diagnosis, it was found to have been caused by vitamin deficiency.  
  
Suggest Ramya the kind of vitamin that is lacking in her food and tell your friend the name of deficiency disease that she suffers from.  
(A) Vitamins  
(B) Deficiency diseases and  
(C) Symptoms are given.

Match B, C with A.

A	B	C
Vitamins	Deficiency diseases	Symptoms
e.g. Vitamin A	Nyctalopia	Night Blindness
Vitamin B1	Scurvy	Nervous disorder
Vitamin C	Rickets	Bleeding Gum
Vitamin D	Haemorrhage	Defective calcification of bones
Vitamin K	Beri-beri	Profuse loss of blood

16. Kavitha is suffering from common cold. What are the questions you will put forth to Kavitha to confirm the disease?

- \_\_\_\_\_
- \_\_\_\_\_

18. There is a widespread outbreak of malaria in your area.

- Suggest some controlling measures to the local authorities concerned.
- Pick out the right symptom for malaria. (chill and shiver and a rise in temperature / diarrhoea )

## PART C

17. Kala has delivered a baby,

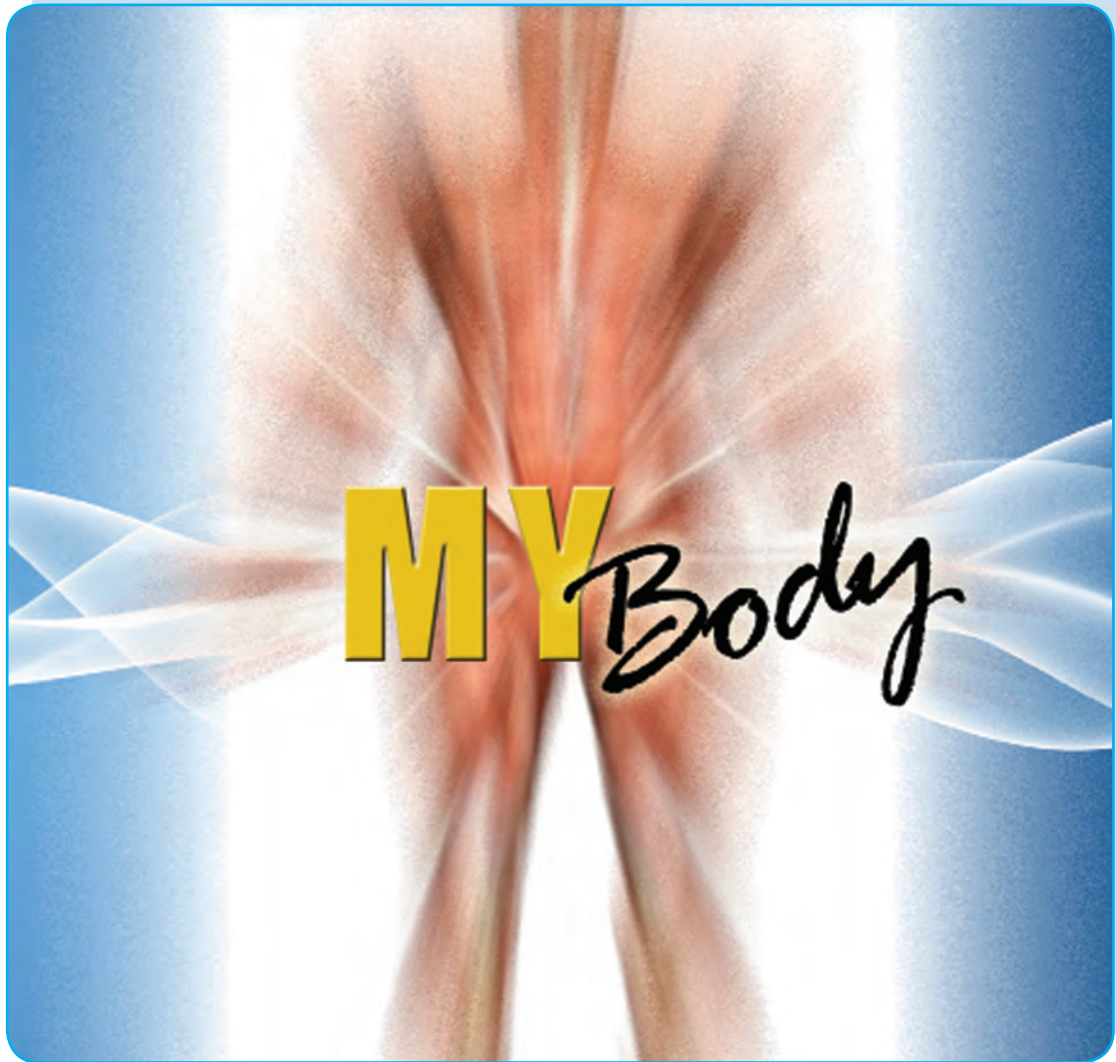
- Suggest the immunization schedule for the baby, in the first six months
- What are all the diseases that can be cured as per the schedule?

19. 15th October is observed as 'Handwashing Day'

- Tell your friend the effects of hand washing.
- In a day what are the occasions in which you wash your hand?

## FURTHER REFERENCE

**Books:** 1. Biology - **RAVEN, Johnson** WCB Mc Graw - Hill  
2. Biology - A Modern Introduction, **B.S. Beckett**, Second Edition Oxform University Press.



## STRUCTURE AND FUNCTIONS OF HUMAN BODY-ORGAN SYSTEMS

### 3. STRUCTURE AND FUNCTIONS OF HUMAN BODY-ORGAN SYSTEMS

#### NERVOUS SYSTEM – INTRODUCTION

Two or more people when gather together, each one is set with an interest and aptitude and performs his works in his own way. But when it is the question of maintenance of an order, a systematic working among them, there is a need for someone to control and co-ordinate them so that a harmony prevails. Similarly the functions of organs and organ system is our body cannot go on in their own way but must be coordinated to maintain the harmonius steady state of body functioning called Homeostasis. Coordination is the process through which two or more organs interact and compliment the functions of one or the other. In our body the neural or nervous system and the endocrine system do the function of coordinating and integrating all the activities of the organs so that the body works efficiently by synchronizing the functions.

The nervous system provides an organized network of point to point connections for a quicker coordination. The endocrine system provides chemical integration

through hormones. In this chapter, we will learn the structure and functioning of the nervous system and the endocrine system in man.

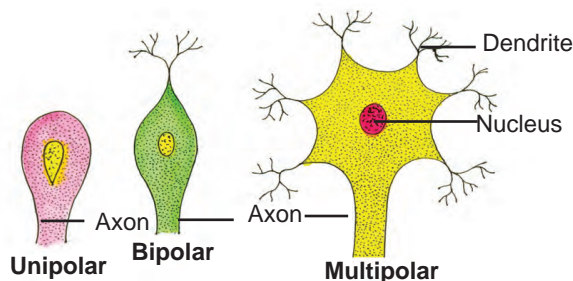
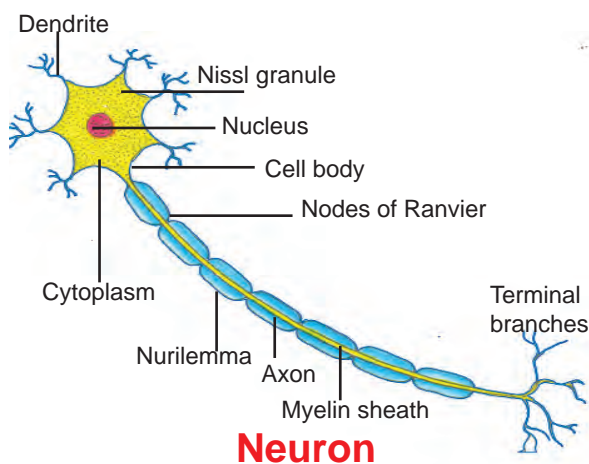


Fig. 3.1 structure of neuron and types



### 3.1 NERVOUS SYSTEM

The nervous system of an animal is composed of

- i) Specialized cells called neurons or nerve cells which can detect, receive and transmit different kinds of stimuli.
- ii) The nerve fibres which are certain bundles of extended processes of nerve cells.

#### 3.1.1 Nerve cells

Nerve cells or neurons are the structural and functional units of the nervous system.

Billions of nerve cells make up our brain. A nerve cell is a microscopic structure consisting of three major parts namely cell body, dendrites and axon.

##### Cell body

It is the cell structure irregular in shape or polyhedral structure, it is also called as cyton. Cell body contains cytoplasm with typical cell organelles and certain granular bodies are called Nissl granules .

##### Dendrites

Dendrites or Dendrons are shorter fibres which branch repeatedly and project out of the cell body. Dendrites transmit electrical impulses towards the cyton.

##### Axon

One of the fibres arising from the cell body is very long with a branched distal end and it is called as Axon.

The distal branches terminate as bulb like structures called synaptic knob filled with chemicals called neuro transmitters. Axon contains axoplasm inside and is covered by a membrane called neurilemma. Neurilemma encloses the axon except at the branched distal ends. In some neurons called myelinated neurons an additional white fatty fibre called myelin sheath covers the neurilemma. Myelin sheath is not continuous over the neurilemma. The gaps left by the myelin sheath on the axon are called Nodes of Ranvier. Over the myelin sheath are found certain cells called Schwann cells.

#### Types of nerve cells

- a) Myelinated or Medullated or White neurons:

When the axon is enclosed by the white fatty myelin cover it is called Myelinated or Medullated or White neurons. This forms the cerebral cortex of our brain.

- b) Non- Myelinated or Non-Medullated or Grey neurons:

This neuron is not enclosed by myelin sheath; so it appears greyish in colour. The axon is covered by only neurilemma and Schwann cells. This type of neuron is found in the white matter of cerebrum.

- c) Unipolar neurons:

The embryonic nervous tissue contains unipolar neurons. An unipolar neuron has a nerve cell body with a single process or fibre, which will act both as axon and Dendron.

d) Bipolar neurons:

The sensory hair cells of the sense organs like rods and cones of retina are made up of bipolar neurons. Each bipolar neuron has a cell body and two process at the ends, one acting as axon and the other acting as Dendron.

e) Multipolar neuron:

The cerebral cortex contains the multipolar neurons; each multipolar neuron has a cell body with many dendrites and an axon.

**Synapse:** The dendrites and the synaptic knobs of the axons of neighbouring

which convert the electrical impulse into chemical impulse and pass it to the neighbouring neuron.

### 3.1.3 Human nervous system

The human nervous system is divided into

- The Central Nervous System (CNS) and
- The Peripheral Nervous System (PNS)
- The Autonomic Nervous System (ANS)

The CNS includes the brain and spinal cord and it is the site of information processing and control.

The PNS comprises of the nerves of the body associated with the central nervous system.

#### 3.1.3.1 Central Nervous System

It is organized of two organs namely the brain and the spinal cord. The CNS is accommodated in the protective bony structures namely skull and vertebral column.

**MENINGES:** The central nervous system is covered by three protective coverings or envelops collectively called meninges. The outermost cover lying below the skull and vertebral column is doubly thick and is called **Duramater**. The middle covering is thin and vascularised and is called **Arachnoid membrane**. The innermost cover is a very thin delicate membrane and is closely applied on the outer surface of brain and spinal cord and it is called **Piamater**.

### ACTIVITY 3.1

Visit a hospital in your locality and study the principle behind the administration of anesthesia at the time of surgery. Find out if the fat soluble anesthetic substances like chloroform, ether etc, merge with medullary sheath and prevent conduction of nerve impulse.

neurons are in physical contact with one another without fusing. This point of contact between the neighbouring nerve cells is called synapse.

#### 3.1.2 Nerve impulse:

The conduction of stimuli by the nerve cells is called nerve impulse. The dendrites will receive the stimuli from the receptor (sense organ) and conduct the same as electrical impulse to the axon through the cyton. At the synapse, the synaptic knobs release out chemical substances called neuro transmitters

### 3.1.3.1.1 The Brain

Man is a vertebrate and a mammal belonging to the animal kingdom. But, he stands unique and supreme and this supremacy in the living world is reflected

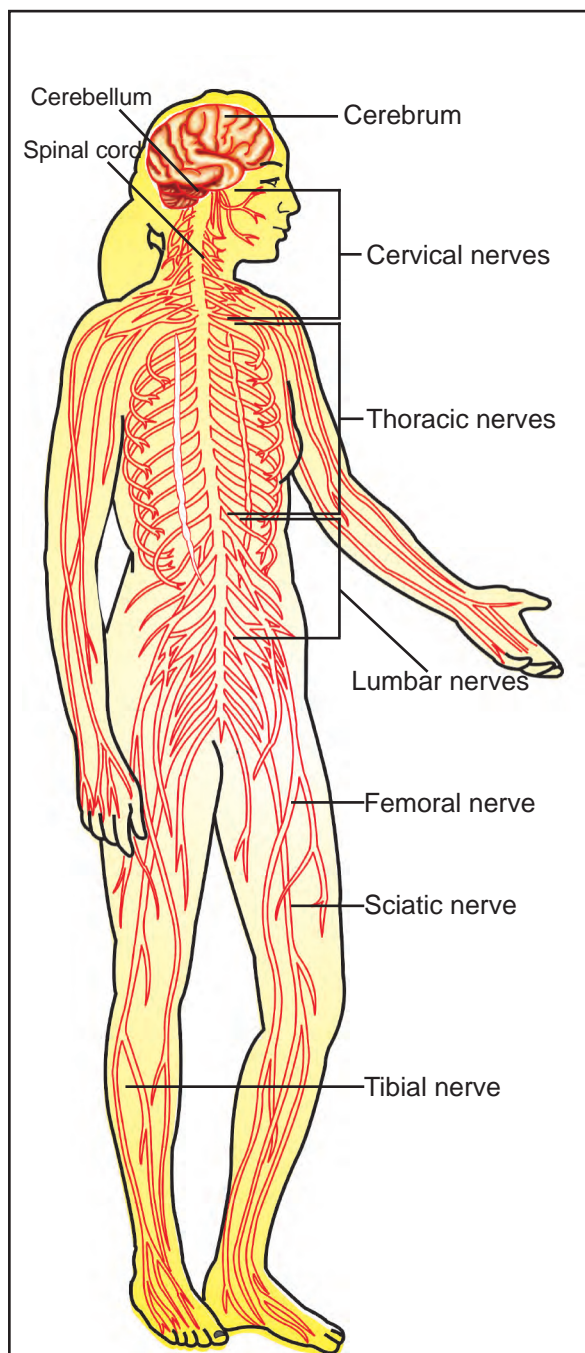


Fig. 3.2 Human Nervous System

in the organization of the brain. The brain is the central information processing organ and acts as the command and control system.

The human brain as in the case of other vertebrates, is divided into three major parts:

- a) Fore brain      b) Mid brain
- c) Hind brain

#### Fore brain

Fore brain consists of cerebrum, thalamus and hypothalamus.

#### Cerebrum

This forms the major part of the human brain (nearly two third of the brain is cerebrum). A deep cleft called **median cleft** divides the cerebrum longitudinally into two halves as right and left cerebral hemispheres, which are united at the base by a sheet of nervous tissue called **corpus callosum**. The outer region of the cerebrum is distinguished as, the grey matter or cerebral cortex and the inner region is called white matter.

#### Cerebral cortex

It consists of the nerve cell bodies of several layers of greyish nerve cells giving grey colour – so called as grey matter. The increased surface area of the cerebral cortex in man is folded and thrown into a pattern of convolutions consisting of ridges and furrows.

#### Cerebral cortex contains

- a) motor areas
- b) sensory areas and
- c) association areas (a region that is neither sensory nor motor).

## Motor areas

Motor areas are the sites of order or command of the cerebrum, from where the order arises to control the activities of the different organs of our body. Initiation of voluntary activities takes place here.

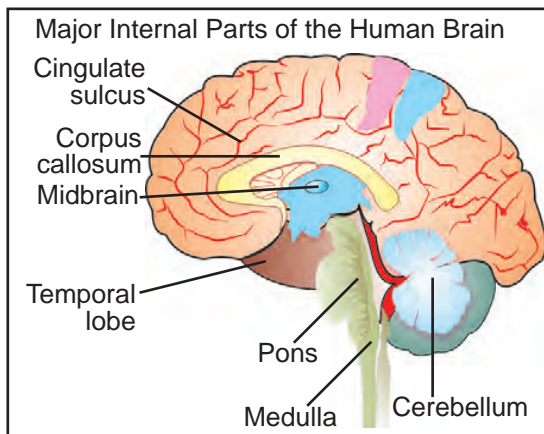


Fig. 3.3 Major internal parts of human brain.

## Sensory areas

These are the sites where the sensory functions of the various sense organs are received through the sensory nerves.

## Association areas

These are responsible for complex functions like intersensory associations, memory and communication.

**White matter of cerebrum:** The inner part of the cerebrum lying below the cerebral cortex is called white matter and it consists of bundles of nerve fibres with myelin sheath giving the white colour. Some of these bundles of nerve fibres connect the different parts of the cerebrum while others connect the cerebrum with the rest of the brain and spinal cord.

Within the cerebral hemispheres are present cavities called ventricles, filled with a nutritive fluid called cerebro spinal fluid.

**Functions of cerebrum:** Cerebrum is the seat of consciousness, intelligence, memory, imagination and reasoning. It receives impulses from different parts of the body and initiates voluntary activities. Specific areas of cerebrum are associated with specific functions. Thus there is a centre for hearing, another for seeing, another for tasting, another for smelling, another for speaking and so on. A damage in a specific centre of cerebrum will deprive the particular faculty from doing its functions.

## Thalamus

Cerebrum wraps around a structure called thalamus – a major conducting centre for sensory and motor signalling.

## Hypothalamus

It lies at the base of the thalamus. It controls body temperature, urge to

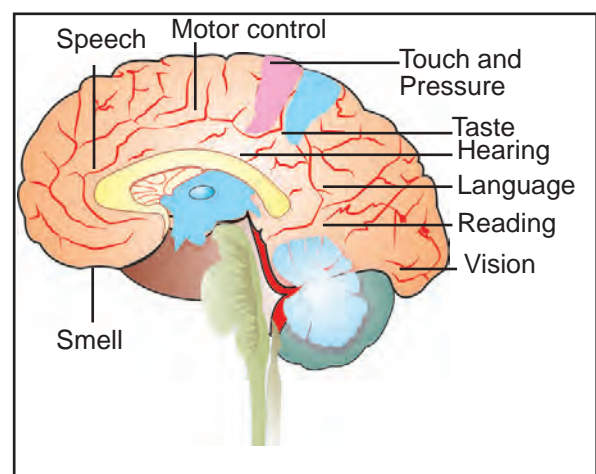


Fig. 3.4 Functional areas of human brain.



eat and drink, regulation of sexual behaviour, express emotional reactions like excitement, anger, fear, pleasure and motivation.

### Mid brain

The mid brain is located between the thalamus and the hind brain. A canal called **cerebral aqueduct** passes through the mid brain. The dorsal portion of the mid brain consists of four hemispherical bodies called **corpora quadrigemina** which controls and regulates the various visual reflexes and optical orientation.

Mid brain with hind brain together form the brain stem.

### Hind brain

Hind brain comprises of pons, cerebellum and medulla oblongata.

### Cerebellum

It lies below the cerebrum and consists of a median portion and two lateral lobes. Cerebellum regulates and coordinates the group movements of voluntary muscles as in walking or running.

### Pons

It is the bridge of nerve fibres that connects the lobes of cerebellum. It relays the information from the cerebrum to cerebellum. It also contains sleep centre and respiratory centre.

### Medulla oblongata

Medulla is the posterior most part of the brain where it merges with the spinal cord. It acts as a coordination pathway for both ascending and descending nerve tracts. Medulla is the centre for several reflexes

involved in the regulation of heartbeat, blood vessel contraction, breathing, etc.,.

The ventricle of the medulla remains connected with the ventricles of the cerebral hemisphere.

### 3.1.3.1.2 The Spinal cord

This is a tubular structure, a continuation of the brain lying in the neural canal of the vertebral column. The three meninges – Piamater, Arachnoid membrane and the Duramater cover the spinal cord as in the case of brain.

The spinal cord has two enlargements – one in the neck region of the body called **cervical plexus** and another in the lumbar region of the vertebral column called **lumbar plexus**.

The spinal nerves arise from these enlargements. The lower end of the spinal cord is filamentous and is called **Filum terminale**. On the mid dorsal side of the spinal cord is found a narrow depression called **dorsal fissure** and on the mid ventral side of the spinal cord is found a deep depression called **ventral fissure**. Running through the center of the spinal cord is the **central canal**, an extension of the ventricle filled with **cerebro spinal fluid**. Outer region of the spinal cord contains medullated white neurons and the inner region contains non-medullated grey neurons. The spinal cord conducts impulses to and from the brain and acts as a reflex centre.

### 3.1.3.2 Peripheral nervous system (PNS)

The nerves arising from the brain and spinal cord constitute the PNS.

a) Cranial nerves:

Twelve pairs of cranial nerves arise from the brain. Some of the cranial nerves are sensory nerves (taking impulse from the sense organ to the brain e.g., optic nerves from the eyes). Some of the cranial nerves are the motor nerves taking impulse from the brain to the effector organ. e.g. vagus nerve innervating the heart and some are mixed nerves with both sensory and motor functions. e.g facial nerve

b) Spinal nerves:

Thirty one pairs of spinal nerves arise from the spinal cord. Each spinal nerve has a sensory root and a motor root. Thus, all spinal nerves are mixed nerves.

### 3.1.3.3 The Autonomic Nervous System (ANS)

It controls the functions of the vital organs of the body through its two antagonistic divisions namely, sympathetic nerves and parasympathetic nerves.

## 3.2. ENDOCRINE SYSTEM IN MAN

The chemical coordination of physiological processes to maintain the homeostasis is the work of endocrine system. Endocrines control and coordinate the physical processes of growth, reproduction and sustenance of life.

Endocrine system consists of a number of endocrine glands and their hormones.

Endocrine glands are ductless glands (without ducts), secreting the chemical substances called hormones. The

hormones are carried by the blood from the site of production to the site of action.

Endocrine glands in man are distributed in the different regions of the body without interconnections. The various endocrine glands found in different regions in man are as follows:

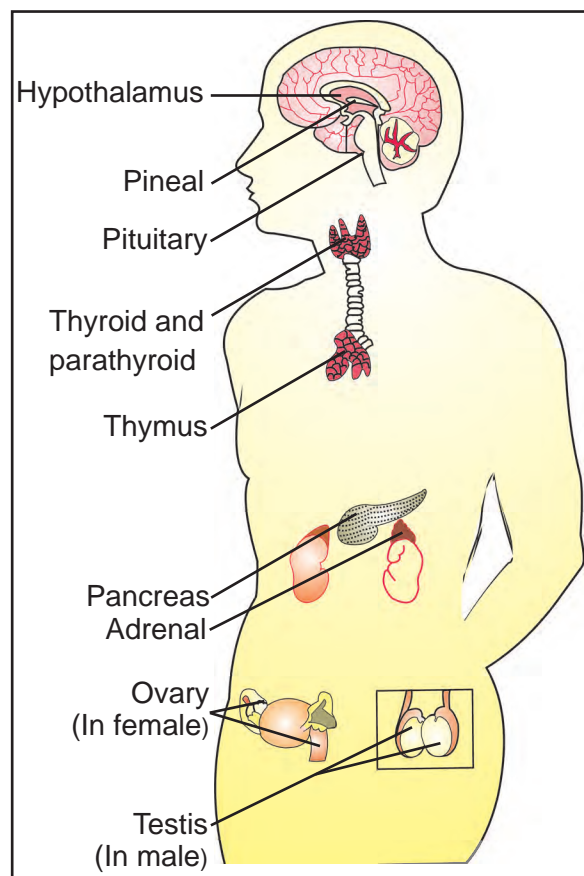


Fig. 3.5 Endocrine system in man

Head	– a) pituitary gland b) pineal gland
Neck	– a) thyroid gland b) parathyroid gland
Thorax	– thymus gland
Abdomen	– a) pancreas – Islets of Langerhans

- b) adrenal glands – adrenal cortex and adrenal medulla
- c) gonads – testes in man and ovaries in woman

### Hormones

Chemically hormones are proteins or amino acids or steroids. Though the hormones are secreted in small quantities, their performance is profound in action.

### Pituitary gland

It is a tiny gland of the size of a pea attached to the hypothalamus of the brain. Since some of the endocrine glands are regulated by the pituitary gland, it is called as the conductor of endocrine orchestra.

**Divisions of pituitary :** Pituitary gland is differentiated into an anterior lobe called **adenohypophysis** and a posterior lobe called **neurohypophysis**.

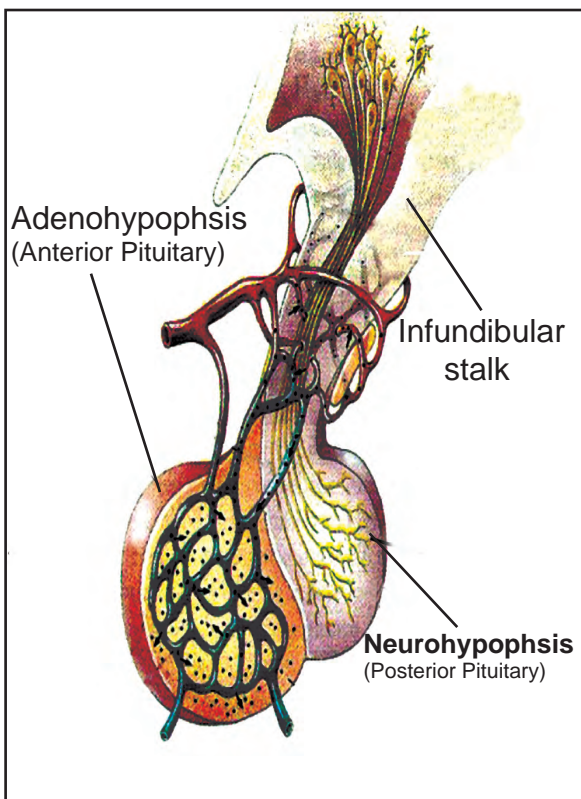


Fig. 3.6 Diagrammatic internal view of pituitary gland

Hormones of adenohypophysis	Functions and malfunctions
Somatotropic or Growth hormone (STH or GH)	<ul style="list-style-type: none"> <li>It brings forth growth in general</li> <li>Less production in children – <b>dwarfism</b> with retarded growth</li> <li>Excess production in children – <b>gigantism</b> with excess growth</li> <li>Excess production in adolescents – <b>acromegaly</b> with large limbs and lower jaw</li> </ul>
Thyrotropic or Thyroid stimulating hormone (TSH)	It stimulates the growth of thyroid gland and its production – the thyroxine
Adrenocorticotrophic or Adrenal cortex stimulating hormone (ACTH)	It stimulates the adrenal cortex to produce the hormones aldosterone and cortisone

Follicle stimulating hormone (FSH)	It stimulates the maturation of graafian follicles (in the ovary) in the female, to produce the eggs and sperm formation in the males.
Lutenizing hormone (LH) in female or interstitial cell stimulating hormone (ICSH) in male	LH in female causes discharge of egg from graafian follicle – a process, called ovulation and production of female sex hormone oestrogen and progesterone.  ICSH in male, induces the interstitial cells to produce male sex hormone – testosterone
Lactogenic hormone (LTH)	It stimulates the growth of mammary glands in female and milk production after child birth.

“

The hormones of neuro hypophysis namely, oxytocin and vasopressin are secreted by hypothalamus and are released on specific stimuli.

Thus the neurohypophysis hormones are secretions of a part of the nervous system and are chemically octapeptides and decapeptides

”

Hormones of Neuro hypophysis	Functions and malfunctions
Oxytocin	It speeds up the child birth process, by stimulating the contraction and relaxation of the uterus in the female.
Vasopressin or Antidiuretic hormone (ADH)	It helps in the reabsorption of water, producing concentrated urine in small quantity.  It constricts the blood vessels and raises up the blood pressure  Less production of ADH results in <b>diabetes insipidus</b> , leading to production of excess of dilute urine.



## Thyroid gland

The bilobed thyroid gland is located in the neck, one lobe on each side of

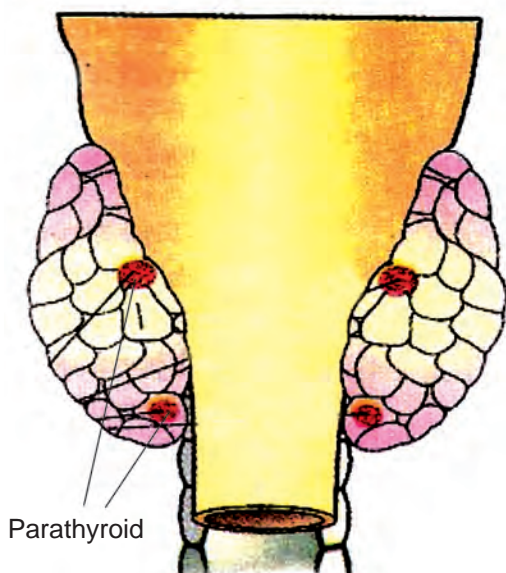
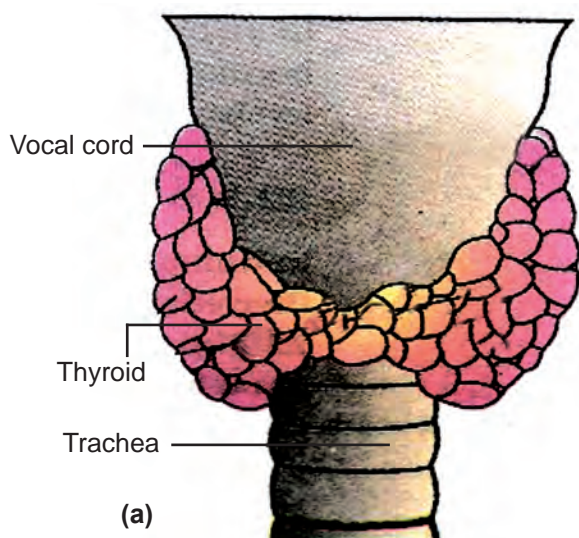


Fig. 3.7 Thyroid gland a) Dorsal view  
b) Ventral view

larynx, which secretes a hormone called **thyroxine**. Thyroxine is an iodinated protein, composed of the amino acid, tyrosine and iodine.

## Functions of thyroxine

- It increases the rate of metabolism.
- It stimulates a rise in the body temperature.
- It promotes growth and differentiation of tissues.
- Since it affects indirectly growth of the body, thyroxine is also called as **personality hormone**.
- it regulates iodine and sugar level in the blood.
- it controls working of kidneys and urine output.

## Thyroid disorders

- 1) Hypothyroidism – less secretion of thyroxine causes many abnormalities. like **simple goitre**, **myxoedema** and **cretinism**.
  - a) Simple goiter – It is due to the deficiency of iodine in our diet. Thyroid gland bulges as a swelling in the neck and it is called as **goiter**.
  - b) Myxoedema – It is caused in the adults, the symptoms are, low



Fig. 3.8 a person with goitre

metabolic rate, loss of mental and physical vigour, increase in weight, thickening of skin, lowered heartbeat, mental dullness, etc.,

- c) Cretinism – This is produced in children and the symptoms are stunted growth, retarded mental development, defective teeth, protrusion of tongue and loose skin.
- 2) Hyperthyroidism – The excess production of thyroxine causes exophthalmic goiter or Grave's disease. The symptoms are high metabolic rate, high blood pressure, high irritability, profuse sweating, loss of weight, fatigueness and protrusion of eyeballs.

### The islets of Langerhans

Pancreas is a dual role playing endocrine gland. The exocrine parts produce pancreatic juice. The endocrine portion is called **islets of Langerhans**. It consists of two type of cells namely, alpha

cells and beta cells. **Alpha cells** produce a hormone called glucagon and **Beta cells** produce insulin and amylin.

### Insulin

- It promotes the uptake of glucose by the cells for tissue oxidation.
- It favours conversion of glucose, into glycogen and its storage in the liver and the muscles.
- It prevents the formation of glucose from protein and fat.
- It maintains normal blood glucose level at 80 – 120 mg / 100 ml of blood.

### Diabetes mellitus

Less production of insulin causes Diabetes mellitus, in which the excess unused glucose is excreted in the urine.

### Glucagon

- It is secreted when glucose level in the blood is low.
- It influences conversion of glycogen into glucose, thus raising the blood glucose level.

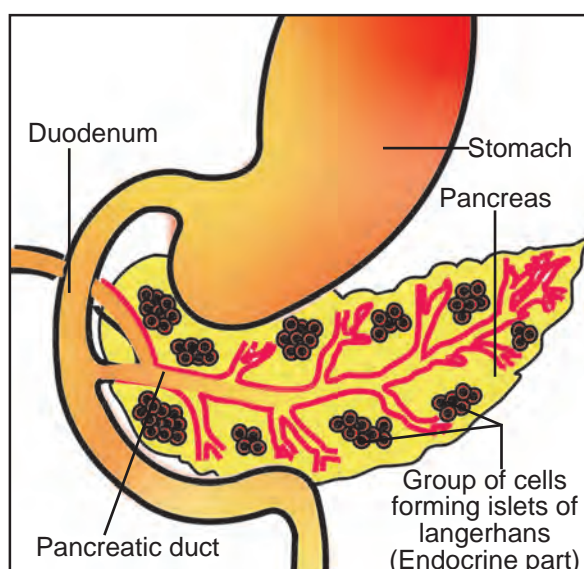


Fig. 3.9 Pancreas showing islets of Langerhans

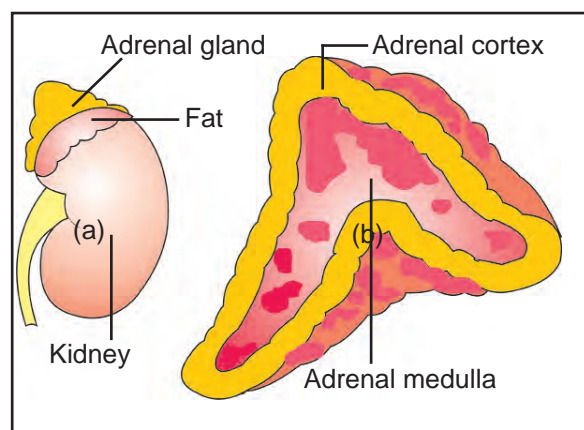


Fig. 3.10 a) Adrenal gland  
b) LS of Adrenal gland

### Adrenal gland (Supra renal gland)

On each kidney is found an adrenal gland. It is composed of two portions, an outer adrenal cortex and an inner adrenal medulla.

#### Adrenal cortex

It secretes two hormones namely, Aldosterone and Cortisone

#### Aldosterone (Mineralocorticoid)

It maintains mineral metabolism, by favouring reabsorption of sodium and water and excretion of potassium and phosphate ions.

It maintains electrolyte balance, body fluid volume, osmotic pressure and blood pressure.

#### Cortisone (glucocorticoid)

It stimulates the breakdown of glycogen into glucose raising the blood glucose, level.

It also produces an anti-inflammatory reaction and suppresses the immune response.

#### Adrenal medulla

It is made up of modified neuroectodermal cells. It secretes two hormones, namely **adrenaline (epinephrine)** and **noradrenaline (norepinephrine)**. They are together called **emergency hormones or hormones of flight and fight** as they rapidly mobilize the body to face a stress or emergency situation.

- They increase the heartbeat.
- They increase alertness.

- They increase the respiratory rate.
- They promote the conversion of glycogen into glucose.
- They cause dilation of pupil.
- They cause profuse sweating.
- They make the hair stand erect. (gooseflesh)
- In short noradrenaline and adrenaline mobilize the body, to face the emergency by fighting with it or running away from it.

### Testes

They are both cytogenic (producing sex cells) and endocrine (producing male sex hormones) in functioning.

The endocrine part secretes male sex hormone called **testosterones (androgen)**.

Testosterone stimulates the growth of reproductive organs and the production of male sex cell, the sperms.

Testosterone determines the secondary sexual characters in male, such as growth of facial hairs, hoarse voice, broadening of shoulder, etc.,

### Ovaries

Ovaries are both cytogenic (producing egg cells) and endocrine (producing reproductive hormones, such as oestrogen, progesterone and relaxin) in functioning.

**Oestrogen** is responsible for growth of female reproductive organs and the appearance of secondary sexual characters in female, such as growth of pubic hairs, soft voice, feminine body, etc.,

Progesterone maintains pregnancy and regulates menstrual cycle.

Relaxin relaxes the muscles of the pelvic region at the time of child birth.

### Parathyroid gland

These are found within thyroid and produce the hormones mainly **parathormone** and calcitonin which maintain the mineral metabolism.

### Thymus gland

It's a lymphoid mass, present above the heart. It secretes **thymosin** which stimulates the differentiation of "T" lymphocytes to resist infection.

### Pineal gland

It lies under the corpus callosum in the brain. It produces **melatonin**, causing concentration of pigments in some specific areas like areola, scrotal sacs, etc.,

## 3.3. CELL DIVISION

A matured cell divides into two daughter cells. Unicellular animalcules like amoeba, undergo binary fission – without any change in the chromatin reticulum by a type of cell division called Amitosis.

Body cells of all animals and plants undergo a cell division called **Mitosis**, involving changes in the structure of chromosomes, but without any change in the chromosomal number.

The germinal epithelial cells of animals undergo **Meiosis** cell division, involving changes in the structure and number of chromosomes.

You have studied the process of mitosis in the previous year. We will understand the various stages of meiosis and its significance in this unit.

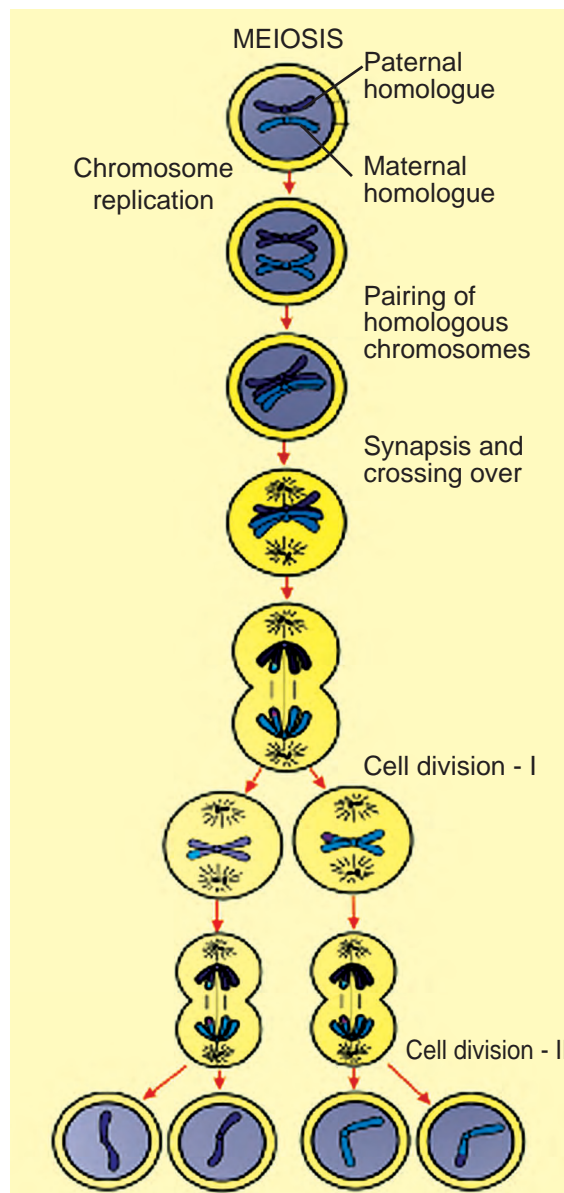


Fig. 3.11 Meiosis - stages

### Meiosis

Meiosis is a kind of cell division, which occurs in the germinal epithelial cells of the gonads to form the gametes. Meiosis takes place in the specialized



diploid cells of gonads and produces four haploid gametes, each having half the number of chromosomes as compared to the parent cell. Meiosis is completed in two successive divisions – Meiosis-I and Meiosis-II. In Meiosis-I, as the chromosomal number is reduced to half, it is called Reduction division. Meiosis-II is similar to Mitosis.

### Meiosis - I

The various events of Meiosis-I are studied under four substages namely Prophase-I, Metaphase-I, Anaphase-I and Telophase-I.

#### Prophase - I

The chromatin reticulum unwebs and individual chromosomes are liberated from one another. The nuclear membrane dissolves. The chromosomes undergo, marked differences in their shape and structure. Based on the shape of the chromosomes, this stage is studied under five sub-divisions as Leptotene, Zygotene, Pachytene, Diplotene and Diakinesis.

#### Leptotene

The chromosomes condense and appear like threads. Each chromosome splits up longitudinally, except at the centromere.

#### Zygotene

The homologous chromosomes come closer and start **pairing**. (a homologous pair of chromosomes consist of a paternal chromosome and maternal chromosome with similar genes). The pairing starts from the tip or from the middle and get attached laterally throughout the length. This pairing is called **Synapsis**, the paired chromosomes are called **Bivalents**.

#### Pachytene

The paired chromosomes become shorter and thicker. Each bivalent appears to have four strands called as, **tetrads** or **quadrivalents**. The point of contact between the homologous pair of chromosomes are called, **Chiasmata**. At the point of chiasmata, exchange of chromosomal segment takes place, between the chromatids of the homologous pairs. This exchange of segments of chromatids between homologous chromosomes, is called **crossing over**.

#### Diplotene

After the crossing over is completed, the homologous chromosomes separate and this separation is called **terminalization**. Terminalization may begin in chiasmata and move to the terminal end of the chromosomes.

#### Diakinesis

The nuclear membrane and the nucleolus disappear. The spindle apparatus is formed in the cytoplasm.

#### Metaphase - I

The chromosomes get condensed. Bivalents now appear on the equator of the spindle with their chromatids, pointing towards the equatorial plate and the centromere pointing towards the poles.

#### Anaphase - I

The spindle fibres contract pulling the chromosomes, towards the opposite poles. The entire chromosome, with the two chromatids move to the opposite poles. This involves, a reduction in the number

of chromosomes. Now two groups of chromosomes are produced, one at each pole with half the number of chromosomes.

### Telophase - I

At the poles, around the group of chromosomes, a nuclear membrane develops. Thus two daughter nuclei each with half the number of chromosomes, are formed at the poles. The spindle fibres disappear.

At the end of Meiosis-I at right angle to the position of the nuclei, the cytoplasmic constriction takes place leading to the division of the cell. The cytoplasmic division is called Cytokinesis.

### Meiosis - II

Meiosis-II is similar to Mitosis and so it is called Meiotic Mitosis. The events of Meiosis-II are studied in four sub-divisions as, Prophase-II, Metaphase-II, Anaphase-II and Telophase-II.

### Prophase - II

The bivalent chromosomes gets shortened. The centrioles form asters and move to the poles. The nucleolus and nuclear membrane disappear.

### Metaphase - II

Chromosomes, each consisting of two chromatids held together by a centromere are arranged at the equator of the spindle fibres. The centromeres are attached with the spindle fibres.

### Anaphase - II

The centromere divides into two and the two chromatids separate and now they are called as daughter chromosomes or new

chromosomes. The daughter chromosomes move towards the opposite poles.

### Telophase - II

The haploid set at the two poles coil to form chromatin material. The nuclear membrane and nucleolus reappear. Thus two daughter nuclei are formed.

### Cytokinesis

The cytoplasmic division takes place at right angles to the position of the nuclei resulting in the formation of four gametes.

### Significance of Meiosis

1. Haploid sex cells are produced, in order to maintain the constancy in the number of chromosomes of a species.
2. Crossing over results in variation of genetic traits in the offspring.
3. Variations form the raw material for evolution.

## 3.4. HEREDITY

The resemblance of son or daughter with his or her father or mother, is an interesting feature in nature. Inheritance of characters from the parents to the progeny, (i.e heredity) ensures the passing of the parental characters to the progeny. The inheritance of characteristics through generations is called heredity.

The inheritable characters may be morphological or physiological or anatomical or reproductive and are also known as traits. Both the mother and father contribute equal amount of genetic material to the child. This means, that each trait can be influenced, by both paternal and maternal genetic material i.e DNA.

## EVALUATION

### Part A

1. Unipolar neurons are found in \_\_\_\_\_.

Brain, Spinal Chord, Embryonic nervous tissue, Adult nervous tissue.

2. The sensory organs contain \_\_\_\_\_.

Unipolar neuron, Bipolar neuron, Multipolar neuron, Medullated neuron.

3. The part of brain which controls emotional reactions in our body is \_\_\_\_\_.

Cerebellum, Cerebrum, Thalamus, Hypothalamus.

4. One of the following is the part of the brain stem. Pick out.

Fore brain and mid brain, Mid brain and hind brain,

Fore brain and hind brain, Fore brain and spinal cord.

5. Spinal nerves are \_\_\_\_\_.

Sensory nerves, Motor nerves, Mixed nerves, Innervating the brain.

6. An endocrine gland found in neck is \_\_\_\_\_.

adrenal gland, pituitary gland, thyroid gland, pancreas.

7. An endocrine gland which is both exocrine and endocrine is \_\_\_\_\_.

(pancreas, pituitary, thyroid, adrenal).

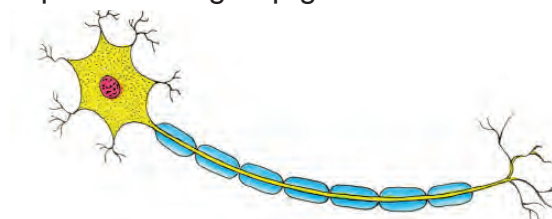
8. Normal blood glucose level in 100 ml of blood is \_\_\_\_\_.

9. The "T" lymphocytes are differentiated to resist infection in \_\_\_\_\_. (parathyroid gland, lymph gland, thymus gland, adrenal gland).

10. In Meiosis-I, the pairing of homologous chromosomes take place during \_\_\_\_\_ stage. (leptotene, zygotene, pachytene, diplotene)

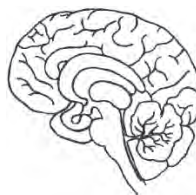
### Part B

11. Copy the diagram and label any two parts in the group given.



(cyton, axon, dendron, endplate)

12. This diagram is human brain, and the functions of different parts are given below.



A. Seat of smell

B. Seat of vision

Mark A and B in the parts of the brain, Corresponding with the function.

13. On the basis of the function performed, Pick out the right statements.

a. Pituitary gland secretes hormones and enzymes

b. Thyroid gland secretes thyroxine and insulin.

c. Testes produces sperms and the hormone androgen.

d. Pancreas produces enzymes and hormones.

14. Based on relationships fill in the blanks.

Thyroxine: personality hormone;  
adrenaline : \_\_\_\_\_.

15. Correct the statements if they are wrong.

a. alpha cells produce insulin and beta cells produce glucagon

b. cortisone suppresses the immune response

c. thymus gland is a lymphoid mass.

d. Ovary produces eggs and Androgen..

16. Reduction division is the process by which gametes are produced,. The cells in which reduction division take place are

(germinal epithelial cells, the sensory epithelial cells, cuboidal epithelial cells, columnar epithelial cells.)

17. In Amoeba, the cell division takes place \_\_\_\_\_

(involving changes in the chromatinreticulum,

without involving changes in the chromatin reticulum,

leading to reduction in the number of chromosomes, without dividing the nucleus. )

18. Pick out the item which has sequential arrangements

a. zygotene -> Leptotene -> Pachytene -> Diplotene -> Diakinesis

b. Diakinesis -> zygotene -> Leptotene -> Pachytene -> Diplotene

c. Leptotene -> zygotene -> Pachytene -> Diplotene -> Diakinesis

19. The important event of meiosis is the crossing over. It occurs during

(Leptotene, Pachytene, Diplotene, Zygotene. )

## FURTHER REFERENCE

**Books:** 1. Biology - **RAVEN, Johnson WCB** Mc Graw - Hill

2. Biology - A Modern Introduction, **B.S. Beckett**, Second Edition  
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# REPRODUCTION IN PLANTS

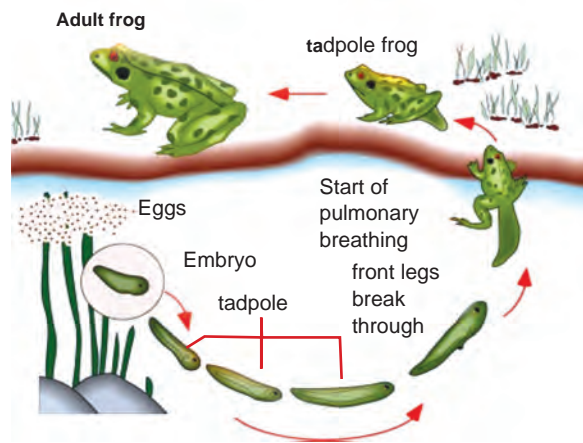
## 4. REPRODUCTION IN PLANTS



### REPRODUCTION IN PLANTS

Do you know that all living organisms reproduce (both plants and animals)? Reproduction is a special biological process, by which new individuals of the same species are produced. It is one of the biological processes like nutrition, respiration and excretion etc.

**What will happen if there is no reproduction?**



**Fig. 4.1 Life cycle of Frog**

Some of the methods of reproduction in organisms are:

Reproduction in animals	Reproduction in plants
Fission – Protozoan	Fission – Bacteria
Budding – Coelenterates	Budding - yeast
Fragmentation – Flatworms	Fragmentation – Algae
	Spores – Fungi
Sexual reproduction – Mammals	Pollination and Fertilization – Flowering plants



Fig. 4.2 Pollination and fertilization

### Questions

1. What is meant by reproduction?
2. Mention a few methods of reproduction in plants and animals.

South African fossil records show that the first formed organism in the Earth is a Bacterium, i.e, Eobacterium which came into existence approximately four billion years ago. In the past two billion years, life got diversified into multitude of varieties of organisms that exist today or existed and became extinct in the past, whereas bacteria continues to live as bacteria without much change.

## 4.1. MODES OF REPRODUCTION

### 4.1.1. Modes of reproduction in single cell organism

Let us examine how different organisms actually reproduce. The methods by which organisms reproduce depend upon the body shape and structure of organisms.

Unicellular organisms, like amoeba and bacteria, split into two equal halves and produce new ones which is called binary fission.

Some Bacteria, like Lactobacilli, Salmonella multiply rapidly, others like Mycobacterium tuberculosis, multiply slowly.

### ACTIVITY 4.1

- Wet a slice of bread and keep it in a cool, moist and dark place.
- Observe the surface of the slice with a magnifying glass.
- Observe for a week and record.

#### Beneficial activity to humans :

Conversion of milk into curd by Lactobacilli

#### Harmful activity to humans :

Bacteria like Mycobacterium tuberculosis cause tuberculosis.



## Reproduction in unicellular organisms :

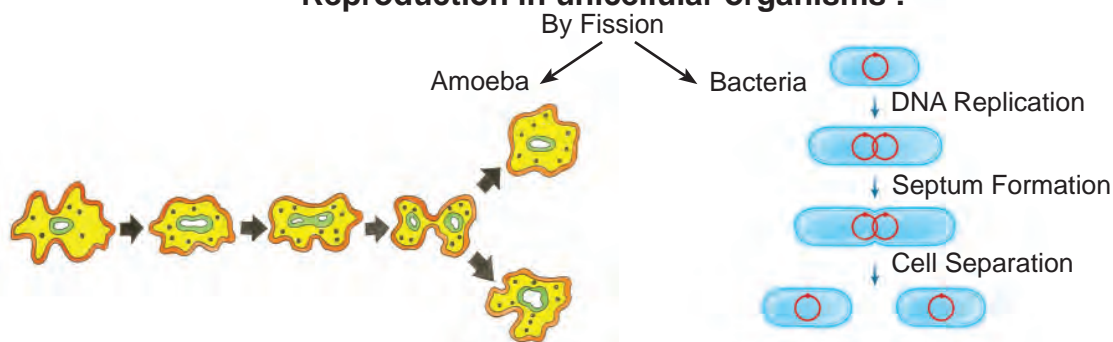


Fig. 4.3 Reproduction in unicellular organisms

Think, read and analyse,

why there are so many methods of reproduction?

Evolution may be defined as a gradual development of more complex species from pre-existing forms. On this basis, the reproduction in simpler forms, like Amoeba and Bacteria, is very primitive by means of Binary Fission, Fragmentation, etc., If, the complexity of the body design of organisms increases, the method of reproduction also gets complicated involving two organisms (male and female).

### 4.1.2. Modes of reproduction in multicellular organisms:



Depending upon the body organization of multicellular organisms, there are various methods of reproduction.

**Vegetative propagation:** is the ability of plants to reproduce by bringing forth new plants from existing vegetative structures without sexual reproduction.

#### Fragmentation

In multicellular organisms with simple body organization, simple reproductive methods have been noticed.

In Spirogyra algae, the plant body breaks up into smaller fragments. Each fragment grows into a new individual.

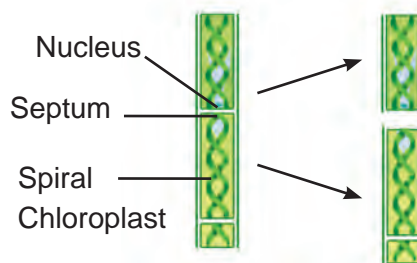


Fig. 4.4 Fragmentation in spirogyra

### ACTIVITY 4.2

- Observe a permanent slide of bacteria under a microscope.
- Similarly, observe another permanent slide of bacteria showing Binary Fission.
- Now compare the observations of both the slides.



### ACTIVITY 4.3

- Collect water from a lake or pond that appears dark green and contains filamentous structures.
- Put one or two filaments on a slide.
- Put a drop of glycerin on these filaments and cover it with a cover slip.
- Observe the slide under a microscope.

#### Budding

In Hydra, a bud develops as an outgrowth due to repeated cell division at one specific site. These buds develop into tiny individuals and, when fully mature,

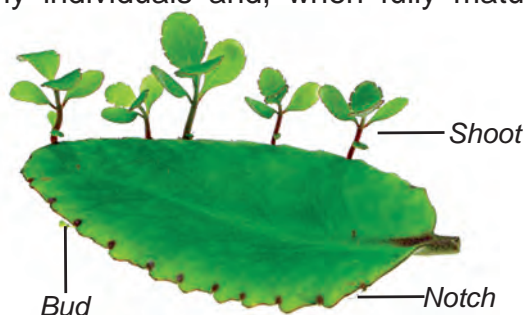


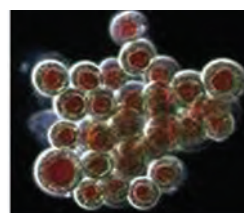
Fig. 4.5 Bryophyllum

get detached from the parent body to become new independent individuals.

Similarly, buds produced in the notches along the leaf margin of Bryophyllum fall on the soil and develop into new plants (in Tamil katti pottal kutti podum).

#### 4.1.3. Asexual reproduction

In lower group of plants, reproduction takes place by means of spores. The spores are covered by thick walls that protect them until they come into contact with another moist surface and can begin to grow.



Aplanospores



Zoospores



Akinetes



Conidia

Fig. 4.6 Different kinds of spores

Some of the spores in different algae and fungi are

APLANOSPORES	ZOOSPORES	AKINETES	CONIDIA
In algae, the protoplast of the vegetative cells contract and produce ovoid bodies surrounded by a thin wall. These thin walled non-motile spores are called Aplanospores. New filaments are formed by the germination of these spores.	A zoospore is a motile asexual spore that uses a flagellum for locomotion. These spores are created by some algae, bacteria and fungi to propagate themselves.	In algae, the vegetative cells secrete thick additional wall layers. During adverse conditions, food materials are filled up in cells. These structures are called akinetes. When the Zable, they develop into new filaments.	Conidia are uninucleate, non-motile, asexual spores produced by the fungus like penicillium, etc.

## Questions

1. Differentiate vegetative propagation and sexual reproduction.
2. Mention some of the spores of asexual reproduction.

### 4.1.4. Sexual reproduction in plants

What is sexual reproduction?

Sexual reproduction is the process in which two components ( male and female) are involved to produce offsprings of their own kind.

A bull alone cannot produce new calves. It needs a cow. Female sheep alone cannot produce new ones. It needs a male sheep.

Both the sexes, male and female, are needed to produce new offspring.

As you have already studied in your earlier classes, the flower is a reproductive organ of a flowering plant. To understand this we need to look first at the structure of a flower.

### Parts of a typical flower

A flower is a modified shoot with a limited growth. Flowers vary in size, shape, structure and colour.

The main parts of a flower are,

1. Calyx
2. Corolla
3. Androecium and
4. Gynoecium.

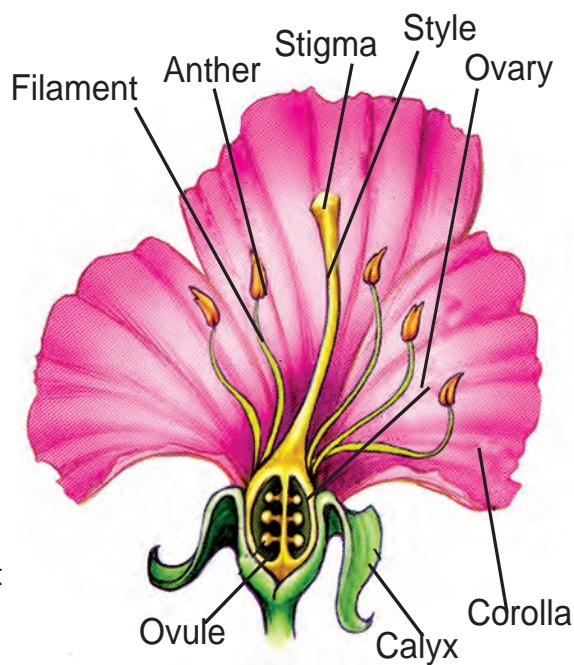
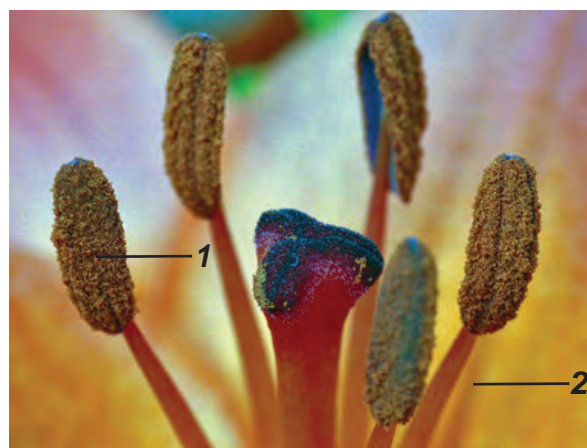


Fig. 4.7 Parts of a flower



1. Anther,

2. Filament

Fig 4.8 Androecium

Androecium is the male part of a flower, and Gynoecium is the female part.

**Androecium** is a group of stamens. Each Stamen consists of a stalk called the filament and a small bag like structure called the anther at the tip. The pollen grains are contained in the anther within the pollen sacs.

### Gynoecium

Gynoecium is the female part of the flower and consists of the carpels or ovary. Gynoecium has three parts 1) Stigma 2) Style and 3) Ovary.

The ovary contains the ovules and each ovule carries within it an embryo sac, within which lies the egg cell or the female gamete.

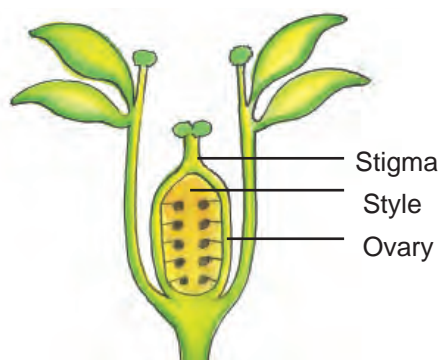


Fig. 4.9 Gynoecium

### ACTIVITY 4.4

- Take a shoe flower from a growing plant.
- Observe the floral parts Calyx, Corolla, Androecium and Gynoecium.
- Separate the stamens and carpels and observe the parts.
- Dust the pollen grains on a slide and observe under the microscope.

## 4.2. POLLINATION

How does sexual reproduction take place in flowering plants?

The sexual reproduction in flowering plants involves

1. Pollination
2. Fertilization

### 1. Pollination

Transfer of pollen grains from the anther to the stigma is called pollination. Pollen grains are transferred mainly by wind, water and insects. They are called as pollinating agents.

Pollination is the first and important event in the development of the fruit and seed. Pollination is followed by fertilization.

### Types of Pollination

Pollination is of two types. They are

1. Self pollination
2. Cross pollination

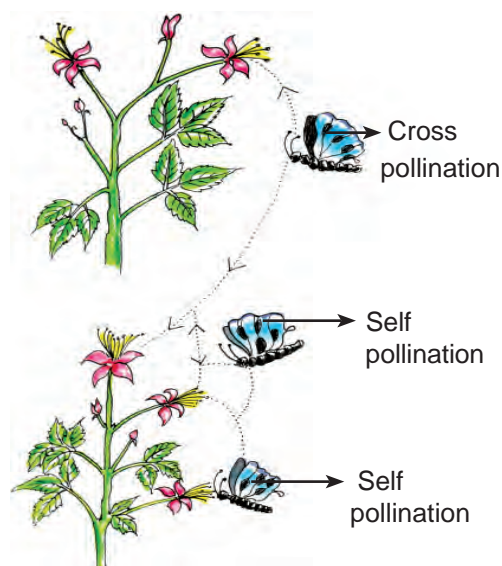


Fig. 4.10 Pollination

### 4.2.1. Self Pollination

Self pollination is also known as autogamy. The transfer of pollen grains from the anther of a flower to the stigma of the same flower or another flower of the same plant is known as self pollination.

#### Advantages of self pollination

1. Self pollination is certain in bisexual flowers.
2. Flowers need not depend on agents of pollination.
3. There is no wastage of pollen grains.

#### Disadvantages of self pollination

1. The seeds are less in number.
2. Endosperm is minute. Therefore, the seeds produce weak plants.
3. New varieties of plants cannot be produced resulting in the degradation of the plant.

### 4.2.2. Cross Pollination (Allogamy)

The transfer of pollen grains of a flower to the stigma of another flower of a different plant of the same species is called cross pollination or allogamy.

#### Advantages of cross pollination

1. The seeds produced as a result of cross pollination develop, germinate properly and grow into better plants, i.e., cross pollination leads to the production of new varieties.
2. More viable seeds are produced.

### 4.2.3. Agents of cross pollination

How is it possible for the transfer of pollen grains from one flower to another?

In order to bring about cross pollination, it is necessary that the pollen should be carried from one flower to another of a different plant. This takes place through agency of animals, insects, wind and water.

Pollination by birds (Ornithophily)

Pollination by insects and animals

#### ACTIVITY 4.5

Observe the flowers in a garden near to you. Identify the insects, and birds, that act as pollinating agents. Maintain a record detailing the pollinating agents and the plants they pollinate

#### Zoophily

Animals and insects – Birds, squirrels and insects are attracted to the bright petals of the flowers. These flowers are also large in size and have a sweet smell. Some of these flowers have nectar and a sweet scent. This is the most common of all methods of pollination. This kind of pollination is called Zoophily. (Pollination by animals and birds).

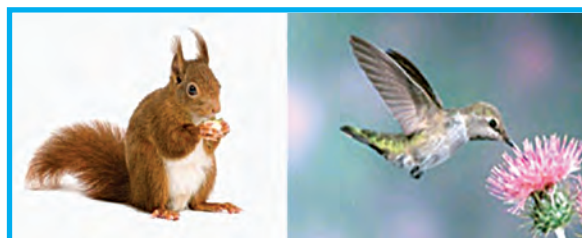


Fig. 4.11 Zoophily



### Anemophily (Pollination by wind)

The flowers pollinated by air are mostly small in size and without any attractive colour, smell and nectar. They produce a large number of pollen grains to make up for the wastage of pollen in times of transit.



Fig. 4.12 Anemophily

The pollen grains are dry and powdery, and hence are easily carried by the wind.

Some pollen grains even have wings. Stigmas are large and protruding, even branched and feathery. e.g. Maize.

Flowers pollinated by wind are called Anemophilous, e.g. Grass and pine.

### ACTIVITY 4.6

- Collect some of the zoophilous, anemophilous, hydrophilous flowers.
- Prepare a chart and make a note of their adaptations to suit the corresponding pollination.

### Pollination by Water (Hydrophily)

This pollination takes place in water plants or plants that are adapted to water habitat. e.g. Vallisneria. This pollination is known as hydrophily. The flowers are small and inconspicuous.



Fig. 4.13 Hydrophily

## 4.3. FERTILIZATION

Recall what you have studied about pollination.

Pollination is the transfer of pollen grains from the anther to the stigma. Each pollen grain has protective walls called exine and intine. The outer wall exine is thick and it has small pores called germination pores. The inner wall is thin and elastic.

### Germination of pollen grain

If pollen grain falls on a suitable stigma, it starts germinating. A mature pollen consists of two cells. The larger one is vegetative cell and the smaller one is generative cell. The vegetative cell starts growing and emerges through the germination pore. It develops through the style as a long tube known as pollen tube. The generative cell gets into the tube and divides into two male gametes (sperms).

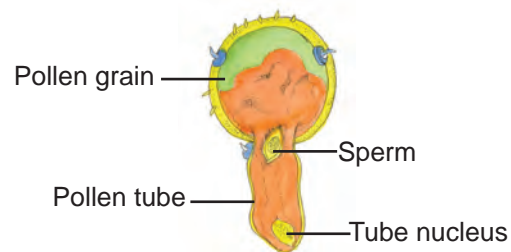


Fig. 4.14 Germination of pollen grain



### 4.3.1. Process of fertilization

The pollen tube enters into the embryo sac through micropyle. At this time, the pollen tube bursts open, gametes released from the pollen tube and enter into the embryo sac. One of the gametes fuses with the egg, and the other fuses with the secondary nucleus. The fusion of a male gamete with egg is known as fertilization. The fertilized egg is known as zygote which develops into embryo.

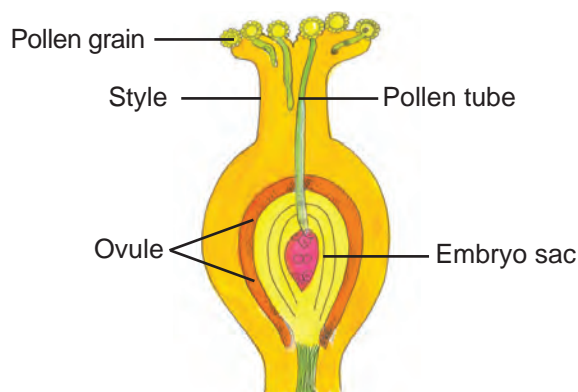


Fig. 4.15 Process of fertilization

### 4.3.2. Double fertilization

The other male gamete fuses with the secondary nucleus. The secondary nucleus is diploid in nature.

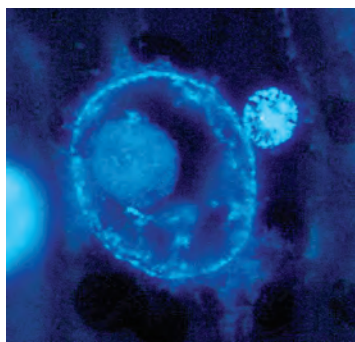


Fig. 4.16 Double fertilization

The fusion of this nucleus with the second male gamete is known as triple fusion. The triple fusion nucleus is called endosperm nucleus because it develops into endosperm.

Endosperm is a nutritive tissue meant for the development of the embryo. The process of fusion of a male gamete with egg and the other gamete with secondary nucleus is known as double fertilization.

### 4.3.3. Post fertilization changes :

- The ovule develops into seed.
- The integuments of the ovule develop into seed coats.
- The ovary enlarges and develops into fruit.

## 4.4. FRUIT FORMATION

You are all very familiar with fruits. They are inseparable with us in our day-to-day life. Fruits are rich in vitamin and give energy to us. Now let us discuss about the development of fruits and their types.

As we discussed earlier, fruits are the product of fertilization. The ovary will become fruit after fertilization. It has two parts namely pericarp (fruit wall) and seeds.

Some fruits develop without the act of fertilization. Such fruits are called Parthenocarpic fruits. e.g. seedless grapes, guava, mango etc.

### 4.4.1. Classification of fruits

The fruits are classified as follows:

#### Simple fleshy fruits

In simple fleshy fruits, the pericarp is succulent and juicy when fully ripe. The fleshy fruits are indehiscent in nature. The pericarp is distinguished into three parts, namely epicarp, mesocarp and endocarp. There are mainly two types of fleshy fruits – Baccate and Drupaceous. Baccate is further classified into berry, hesperidium, pome and pepo.

### Simple dry fruits

These fruits have a dry pericarp. They are classified based on mode of dehiscence as dry dehiscent, dry indehiscent and schizocarpic fruits.

#### 4.4.2. Dry dehiscent fruit

These fruits split open at maturity to liberate the seeds.

#### 4.4.3. Dry indehiscent fruit

These fruits do not split open at maturity and the seeds are liberated by the decay of pericarp

#### 4.4.4. Schizocarpic fruits

At maturity, these fruits break into many one seeded parts called mericarps. The mericarps containing the seeds remain indehiscent. Thus the schizocarpic fruits show characters of dehiscent and indehiscent fruits.

#### 4.4.5. Aggregate Fruit

It is developed from a single flower with multicarpellary, apocarpous, superior ovary. Each free carpel develops into a fruitlet. Hence, the aggregate fruit has a cluster of fruitlets attached to a common stalk (e.g) Polyalthia

In *Annona squamosa* (custard apple), the margin of the carpels are united and appears like a single fruit.



Fig. 4.17 Polyalthia



Fig. 4.18 Custard apple

#### 4.4.6. Composite or Multiple fruit

Multiple or composite fruit is formed by all the flowers of whole inflorescence and give a single fruit. There are two types of multiple fruits namely sorosis and syconus.

### ACTIVITY 4.7

Collect a variety of fruits. Identify what type of fruit they belong to and make a note on them.

Think, read and find out :

Why are there so many varieties of fruits?






#### 4.4.7. Seed Formation

Seed is a fertilized ovule. It possesses embryo, food materials and are protected by the seed coat. During favourable condition, the seed germinates and gives rise to a new seedling.

Seeds have great variations in the size, shape, colour and surface. In orchids, there are many seeds which are tiny dust like particles. In coconut, there is a large sized seed. The seed grows into a full plant.





On the basis of the number of cotyledons in the embryo (seed), the angiosperms have been divided into two groups.

### Simple fleshy fruits


Sl.No	Type	Diagram	Description
1.	Baccate - Berry	Tomato 	It is one or many seeded fruit. Epicarp is thin and the mesocarp is fleshy. They form a pulp which is edible and the seeds are embedded in it.
2.	Hesperidium	Orange 	It develops from multicarpellary, superior ovary with axile placentation. The epicarp is thick, leathery and contain oil glands. The whitish spongy layer lining the epicarp is called mesocarp. The endocarp forms distinct chambers. Juicy hairs produced from the endocarp is the edible part.
3.	Pome	Apple 	The fruit develops from pentacarpellary syncarpous inferior ovary with many seeds. The thalamus becomes fleshy and develops into a fruit which is edible. The true fruit containing seeds remain inside.
4.	Pepo	Cucumber 	It develops from a tricarpellary, syncarpous inferior ovary with parietal placentation. The pulp contains many seeds.
5.	Drupaceous Drupe	Mango 	It is a one seeded fleshy fruit and develops from monocarpellary, syncarpous ovary. The pericarp is differentiated into outer skinny epicarp, fleshy middle mesocarp and stony inner endocarp. Because of the presence of stony endocarp, the fruit is also known as stone fruit.

### Simple dry fruits




### Dry dehiscent fruits

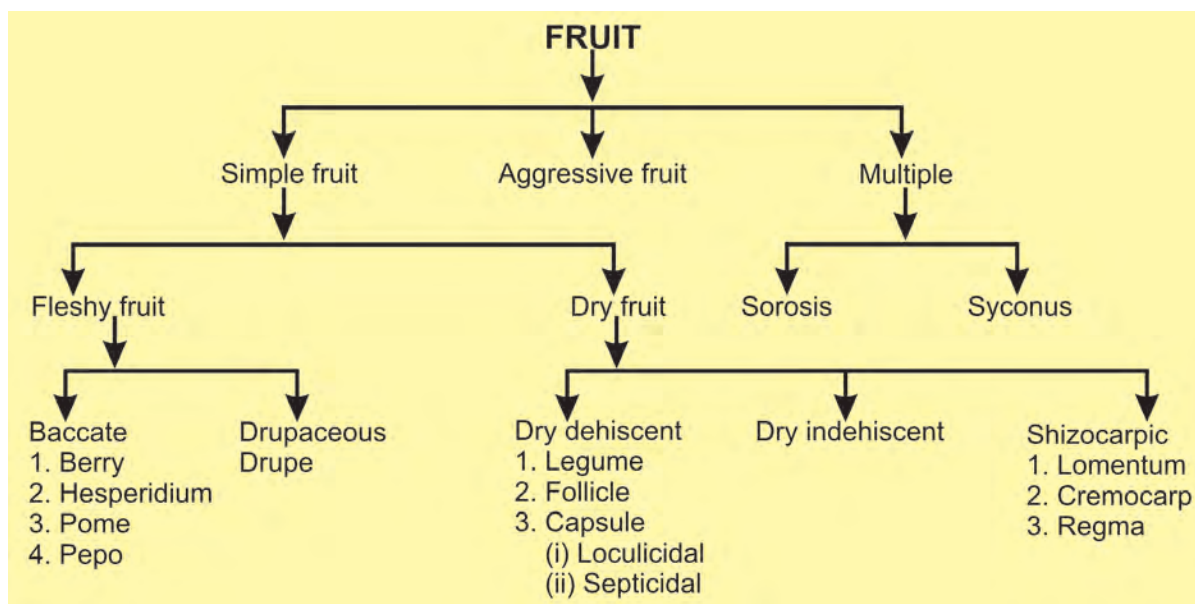
Sl.No	Type	Diagram	Description
1.	Legume	Beans 	It develops from monocarpellary, unilocular, superior ovary with marginal placentation. Pericarp dehisces along both dorsal and ventral sutures (e.g.) pea, bean, etc.
2.	Follicle	Calotropis 	It is like a legume fruit, but the pericarp dehisces along one suture only. (e.g.) Calotropis.
3.	Capsule (a) Septicidal capsule  (b) Loculicidal capsule	Cotton   Lady's finger 	This is a many seeded fruit developing from superior or inferior, syncarpous multicarpellary ovary. Capsules dehisce by various methods.

### Dry indehiscent fruits




Sl.No	Type	Diagram	Description
1	Achene	Clematis, Mirabilis 	This is a single seeded fruit which develops from monocarpellary, unilocular ovary. Pericarp is hard and leathery, remains free from the seed coat




2.	Caryopsis	Paddy	It is a one seeded fruit which develops from superior mono-carpellary ovary. Pericarp is fused with the seed coat (e.g paddy, wheat, maize).
			
3.	Cypsela	Tridax	This fruit develops from inferior, bicarpellary syncarpous ovary. The pericarp and the seed coat remains free (e.g Tridax).
			
4.	Nut	Cashew nut	It is a dry indehiscent, one seeded fruit with hard and woody pericarp. Nut is developed from superior, bi or multi-carpellary ovary (e.g. Cashew nut, Walnut etc).
			




### Schizocarpic Fruits

Sl.No	Type	Diagram	Description
1.	Lomentum	Acacia 	It resembles a legume and breaks transversely at constrictions between the seeds (e.g Acacia).
2.	Cremocarp	Coriandrum 	It is a two seeded fruit which develops from bicarpellary syncarpous, bilocular and inferior ovary. It dehisces longitudinally into two indehiscent mericarps (e.g) Coriandrum.
3.	Regma	Castor 	It develops from tricarpellary syncarpous superior ovary and breaks up into three one seeded cocci (e.g Castor).

### Composite Fruits

Sl.No	Type	Diagram	Description
1.	Sorosis	Jack fruit 	In jack fruit, the rachis (inflorescence axis) and other floral parts of the female inflorescence fuse together forming a composite fruit. It consists of a fleshy central axis. The edible part represents the perianth which is bag like and one seeded. There are numerous, elongated, whitish flat structures in between the edible flakes. They represent the sterile or unfertilized flowers. The pines on the tough rind represent the stigma of the carpels.

Sl.No	Type	Diagram	Description
2.	Syconus	Fig 	It is derived from a special type of inflorescence known as hypanthodium which has a fleshy receptacle. It has large number of minute unisexual flowers. On ripening, the receptacle becomes fleshy and juicy and forms the edible portion (e.g.) banyan, peepal, fig, etc.

**1. Dicotyledons:** Seeds with two cotyledons (e.g) pea, bean, gram and castor.

**2. Monocotyledons:** Embryo with one cotyledon (e.g) maize, rice, wheat and onion.

### 1. Structure of a dicot seed (bean)

The seed is bulky, oval and slightly indented on one side. On this side there is a short longitudinal, whitish ridge called the raphae. At one end of the raphae there is a minute opening known as germ pore or micropyle.

If a water soaked seed is pressed gently a small drop of water along with air bubbles will be found coming out through the micropyle.

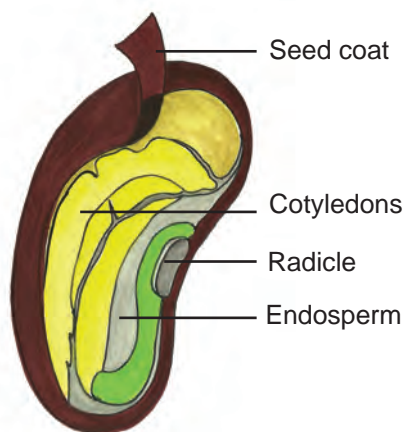


Fig. 4.19 Dicot Seed (Bean)

The embryo is enclosed by the seed coat. It consists of cotyledons attached to the primary axis which has rudimentary root portion called the radicle and a rudimentary stem portion known as plumule.

The tip of the radicle projects outside, and is nearer to the micropyle. The plumule is placed between the two cotyledons and consists of a short axis, and a small bud having two tiny little folded leaves.

### 2. Structure of monocot seed (paddy)

In paddy, the so called seed is actually a fruit. It is a simple indehiscent one seeded fruit known as caryopsis, (you have already studied about this in the lesson of fruits.). The seed coat is very thin. The fruit wall (pericarp) is thin and fused with the seed coat. The fruit is covered by generally yellowish bract and bracteoles which are commonly known as chaff. The embryo consists of single cotyledon called scutellum and a short axis. The lower part of the axis is the radicle, covered by a sheath called coleorrhiza (root sheath). The upper part is known as plumule which is covered by a sheath called coleoptile. In a day or two, after the seed is placed in a moist soil, the coleorrhiza pierces the base of the seed. The radicle comes out next after splitting the coleorrhiza.

The radicle does not form the root system. Meanwhile, roots are formed from the lower most nodes of the stem. These roots are called adventitious roots. These adventitious roots form fibrous root system of matured plant.

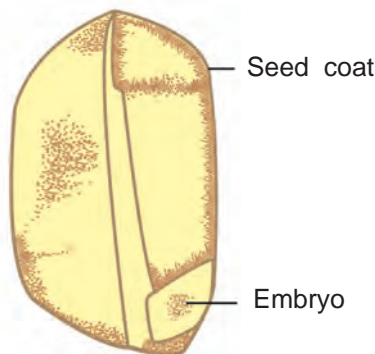


Fig. 4.20 Monocot seed (Paddy)

### MORE TO KNOW

Darwin used seeds of cress, cabbages, lettuces and onions. Darwin also studied longer periods in sea water, the effect of water temperature on germination and floating of seeds. His experiments overturned the idea that sea water kills seeds. Of the 87 species he used, Darwin found almost three-quarters of the seeds studied could tolerate salt water at least 28 days in salt water.

### ACTIVITY 4.8

Label jars, filled with sea water and seeds. After 7 days put the seeds in a sieve, rinse under a tap, and plant out in labeled pots.

### ACTIVITY 4.9

- Soak a few seeds of bengal gram (Channa) and keep them over night in a wet cloth.
- Take care that the bengal gram is not swollen absorbing excess of water. (The bengal gram should not be decayed with excess water.
- Drain the excess water and cover the seeds with the wet cloth and leave them for a day. Make sure that the seeds do not become dry.
- Cut and open the seed carefully and observe the different parts.
- Compare your observations with the diagram and see if you can identify all the parts.

### 4.5. Dispersal of seeds :

**The seeds fall off far away from the mother plant. Why?**

The reproductive capacity of plants is so tremendous that a very large number of seeds is produced by a single plant. If all these seeds fall directly below the parent plant, the seedlings would have to compete for space, water, oxygen, minerals and sunlight, leading to competition. When the seedlings are grouped together at one place, they could easily be destroyed by grazing animals. Such a situation would be detrimental to the species.

The fruits and seeds of plants have evolved various devices by which they can be distributed far and wide through various agencies.



This not only eliminates the unhealthy competitive struggle that would arise from over crowding, but also ensures the successful spreading and establishment of a species on the earth. Most fruits and seeds have evolved adaptations for dispersal.

### Agents for the dispersal of fruits and seeds:

Based on the agents involved in dispersal, there are various types of dispersal mechanisms of fruits and seeds in plants.

**Autochory:** Autochory is an active mechanism of self dispersal of fruits and seeds. Fruits like Balsam burst with a sudden jerk and disperse the seeds by an explosive mechanism.

**Anemochory** is the wind dispersal of fruits and seeds. Alternatively, the wind may blow them away, for which they have to be light, so that their buoyancy may enable them to float on air over long distances. Some of them are provided with hairs and membranous wing-like structures which enable them to be carried away easily (e.g. Seeds dispersed by the wind are Calotropis (Erukkum), Moringa (drum sticks) etc.,

Fruits of Tridax carry a persistent calyx modified into a pappus (a ring of fine, feathery hairs) which act like a parachute and aids in the dispersal by wind.

**Hydrochory:** Hydrochory is a mechanism in which dispersal of fruits and seeds is by water. Fruits which are dispersed by water have outer coats that are modified to enable them to float. The mesocarp of coconut is fibrous, which is easily carried away by water currents.

The spongy thalamus with air chamber of Lotus floats in water streams and after some time the fruits get separated, and the seeds germinate.

**Zoochory:** Zoochory is a mechanism in which dispersal of fruits and seeds is by animals. Some fruits are provided with hooks, spines, bristles, stiff hairs, etc., on their outer coat. With the aid of these out growths, these fruits stick to the furry coats of skins of some animals and get carried away from one place to another.

The fruits of Xanthium have sharp-pointed stiff hooks and the Achyranthus the perianth and bracts are pointed. Many fleshy fruits are eaten by animals and human beings and the seeds are thrown away.



Fig. 4.21 Autochory (Balsam)



Fig. 4.22 Anemochory (Tridax)



Fig. 4.23 Hydrochory(Lotus)



Fig. 4.24 Zoochory(Xanthium)



Fig. 4.25 Zoochory(Achyranthus)

In fruits like tomato and guava, the seeds are eaten along with the edible portion and later passed out by excreta. These types of seeds are protected from the digestive juices by their seed coat.

Man is responsible for the dispersal of many fruits and seeds. In the pursuit of more economy, useful plants like Cinchona, Rubber and Eucalyptus have been successfully introduced by man and they have acclimatised well to the new surroundings far away from their original mother land.

### ACTIVITY 4.10

- Collect a few fruit or seeds which have wings.
- Observe the fruit of Tridax and draw. Look at the pappus calyx.
- Why is the mesocarp of coconut fibrous?

Collect some of the plants around you. What are their local names?

Can you find out their botanical names?

## EVALUATION

### PART A

1. This is the one of the methods of reproduction in unicellular organisms like amoeba and bacteria in which they split into two equal halves and produce new ones is called.  
(fragmentation, binary fission, budding, spore formation)
2. In sexual reproduction of flowering plants, the first event involved in this is.  
(fertilization, germination, regeneration, pollination)
3. Which of the following statement is true.  
(Thin walled non mobile spores are called zoospores, A motile asexual spore produced by some algae bacteria and fungi are Akinetes,

Uninucleate non-motile asexual spores are produced by the fungus are called conidia,  
Thick walled vegetative cells produced by the algae during adverse conditions are called aplanospores.)

4. The fertilized ovary is a fruit. The fruit develops from a single flower with multi carpellary, apocarpous superior ovary is  
(Aggregate fruit, Composite fruit, Simple fruit, Multiple fruit)
5. If a water soaked seed is pressed, a small drop of water comes out through.  
(stomata, lenticel, micropyle, radicle)
6. The mango fruit is called as stone fruit. because it has.  
(skinny epicarp, stony mesocarp, fleshy endocarp, hard endocarp)
7. Pick out the wrong statement.  
(In a dicot seed there is a short longitudinal whitish ridge is called the raphe.  
There is a minute opening in dicot seed is known as micropyle.  
The rudimentary stem portion known as radicle.  
The rudimentary root portion is called radicle)
8. Consider the following statement regarding the dispersal of fruit by wind and select the correct answer.  
(Fruits and seeds dispersed with a sudden jerk by an explosive mechanism.

Fruits of tridax are carry a persistent calyx modified into pappus.

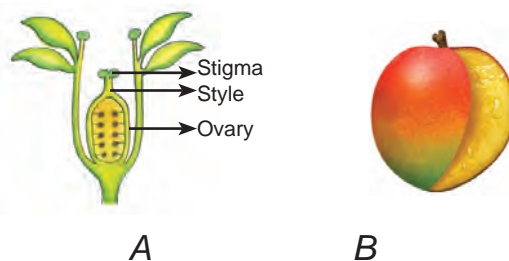
The fruits of xanthium have sharp pointed stiff hooks.

The mesocarp of coconut is fibres)

9. The product of triple fusion which acts as nutritive tissue for the development of embryo is  
(zygote, placenta, scutellum, endosperm)
10. The disadvantage of self pollination is  
(There is no wastage of pollen grains,  
The seeds are less in number  
Self pollination is sure in bisexual flowers  
Flowers need not depend on agents of pollination

## PART B

11. a. Identify the given fig. A and B.  
b. Which part of the A is modified in to B.



12. The methods of reproduction and the organisms are given below. Match the type of reproduction to the suitable organisms.

Fission	Spirogyra	Yeast
Budding	Protozoans	Flatworms
Fragmentation	Bryophyllum	Bacteria

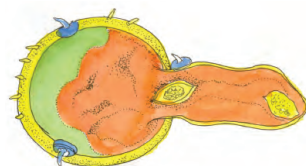
13. In balsam plant the seeds fall off far away from the mother plant.

- Is this statement correct or incorrect?
- Give reason.

14. Composite fruits is formed by all the flowers of -----, ----- fruit is developed from a single flower with multicarpellary apocarpous superior ovary.

15. Redraw the diagram and label the following parts.

- Exine
- Tube nucleus.



### PART C

16.a) Name the process by which the fruit is developed.

b) Give the development process in brief.

c) Draw a neat diagram of that process and label.

17.a) Write the two events involved in the sexual reproduction of flowering plant.

b) Discuss the first event and write the types

c) Give advantages and disadvantages of that event.

18. a) Fruit is the product of fertilization. Is there any fruit is formed with out the act of fertilization?

b) Represent the classification of fruits in a diagrammatic sketch

19. Compare aggregate fruit with multiple fruit with suitable examples.

20. Describe the structure of dicot seed.

### FURTHER REFERENCE

#### Books:

- Plant Reproduction - **S.R.Mishra** - Discovery Publishing House Pvt. Ltd.



## NAME OF THE PLANTS IN ENGLISH AND TAMIL

S.No	Botanical Name	Common Name in English	Tamil Name	How it is called locally
1	Abelmoscus esculentus	Lady's finger	வெண்டை	
2	Acacia coccina	Soap acacia	சிகைக்காய்	
3	Achyranthes aspera		நாயுருவி	
4	Anacardium occidentale	Cashew nut	முந்திரி	
5	Anona squamosa	Custard apple	சீதாப்பழம்	
6	Artocarpus integrifolia	Jack fruit	பலா	
7	Bryophyllum		கட்டிப் போட்டால் குட்டிப் போடும்	
8	Calotropis gigantea	Madar plant	எருக்கு	
9	Citrus sinensis	Sweet orange	சாத்துக்குடி	
10	Cocus nucifera	Coconut	தென்னை	
11	Coriandrum sativum	Coriandar	கொத்துமல்லி/தனியா	
12	Gossypium arboreum	Cotton	பருத்தி	
13	Cucumis sativus	Cucumber	வெள்ளரிக்காய்/ தோசைக்காய்	
14	Cucurbita maxima	Pumpkin	பூசணிக்காய்/ பரங்கிக்காய்/ அரசாணைக்காய்	
15	Ficus glomerata	Fig	அத்தி	
16	Impatiens balsamia	Balsam	பால்செண்டு/பால்சம்	
17	Lablab purpureus	Bean	அவரை	
18	Lycopersicon esculentum	Tomato	தக்காளி	
19	Mangifera Indica	Mango	மா	
20	Mimosa pudica	Touch me not plant	“தொட்டால்வாடி/ தொட்டால்சுருங்கி/ தொட்டால்சினுங்கி”	
21	Mirabilis jalapa	Four o clock plant	“அந்திமந்தாரை/ அந்திமல்லிகை”	
22	Nelumbo nucifera	Indian lotus	தாமரை	
23	Oryza sativa	Paddy/ rice	நெல்	
24	Pisum sativum	Pea	பட்டாணி	
25	Polyalthia longifolia	Mast tree	நெட்டிலிங்கம்	
26	Pyrus malus	Apple	ஆப்பிள்	
27	Ricinus communis	Castor	ஆமணக்கு/ முத்துக்கொட்டை	
28	Tridax		வெட்டுக்காய்ப் பூண்டுச் செடி	



## A REPRESENTATIVE STUDY OF MAMMALS

## 5. A REPRESENTATIVE STUDY OF MAMMALS

Mammals are the diverged group of animals, occupying different biomes of the environment, successfully fitting in their habitats. Mammals are found almost in all habitats like oceans, freshwater, hilly regions, forests, deserts, polar regions and swamps.

### 5.1. MORPHOLOGY

Mammalian morphology is so divergent, as they occupy different habitats. The sea living dolphins, whales etc., look like fish, by form and structure. A nocturnal bat gliding in the sky, looks like a bird. All the large land animals are mammals. The size of mammals sets them apart from all other kinds of land animals.

Mammals are distinguished from other vertebrates by two fundamental characteristics that all mammals possess and no other living vertebrate possess. They are

1. Epidermal Hairs
2. Milk producing glands.

#### Epidermal Hairs

All mammals have hairs, even apparently naked whales and dolphins grow sensitive bristles on their snouts. Mammalian hair is a new form of skin structure a derivative from the skin; the hair is an insulator against heat loss. The colouration and pattern of mammal's skin usually matches its background. Hairs also are sensory structure, as the

whiskers of cats and dogs are sensitive to touch. Hair is also defensive for porcupine and hedgehogs with long, sharp, stiff hairs called **quills** to protect them from predators.

### ACTIVITY 5.1

Observe the hair of dog, cat, cattle, man, horse and donkey. Look for the structural details like shape, texture and curly or straight condition and record your findings.

#### Milk producing glands

All female mammals possess mammary glands that secrete milk. New born mammals, born without teeth suckled by the mother. Milk producing glands are modified sweat glands.

### 5.2. HABITAT

The place of living of an organism is its habitat. Mammals exhibit a great degree of functional adaptation to fit in the habitats in which they live. We find mammals living in high mountains, plains and forests, tundra, grassland, deserts, fresh water and marine habitats. Some important mammals in their different habitats are listed below;

High mountains	- mountain goats, big horned sheep, grizzly bears, etc.,
Plains and forests	- porcupine, giant squirrel, deers,

elephants,  
tiger, leopard,  
rhinoceros,  
Hippopotamus,  
etc.,

Tundra - reindeer, muskdeer  
ox, rodents, etc.,

Desert - black buck, Indian wild  
ass etc.,

Fresh water - beavers, platypus,  
otters, etc.,

Marine - whales, dolphins,  
dugong, porpoise, seal,  
walrus, etc.,

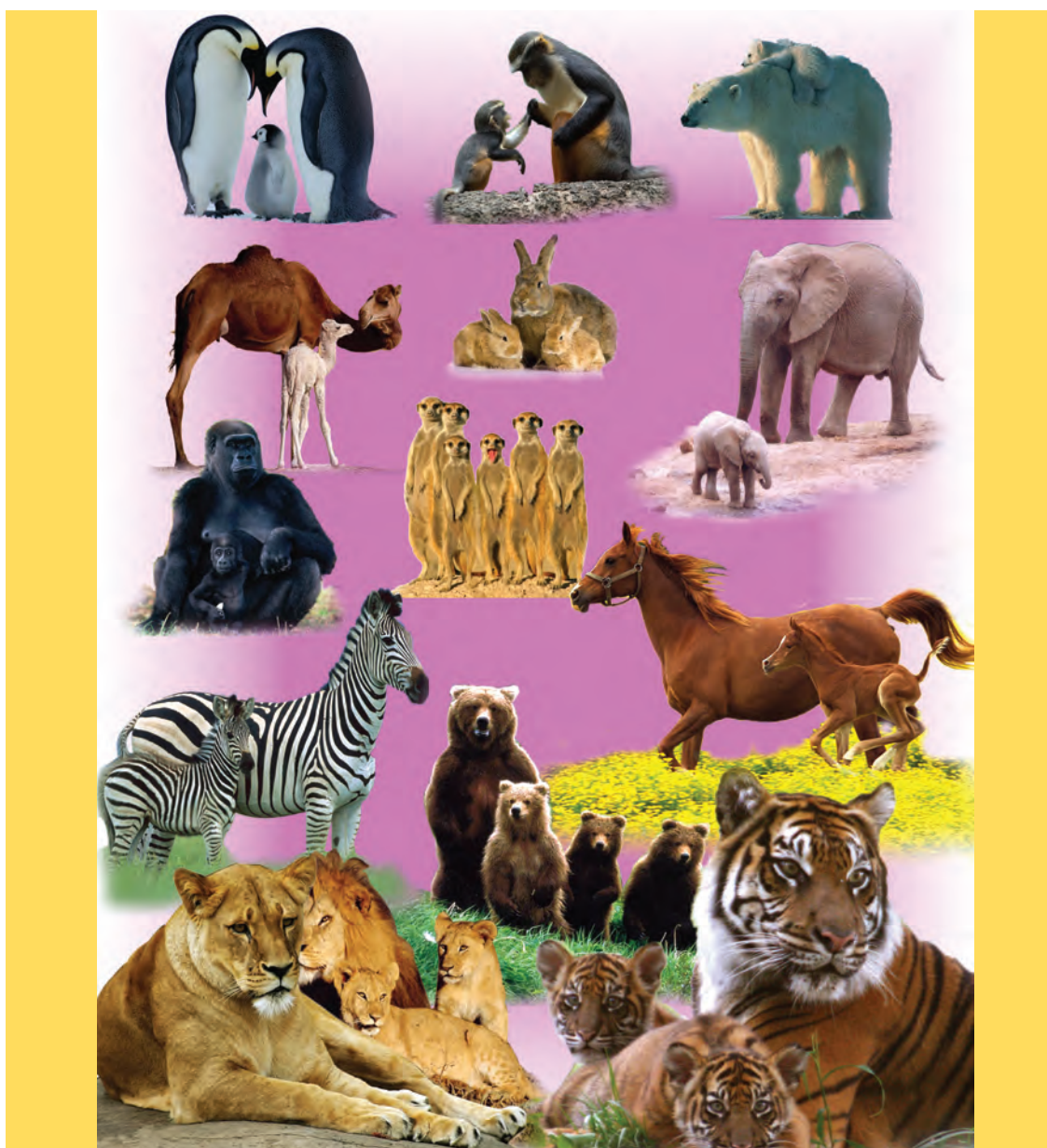


Fig. 5.1 Diverged group of mammals with their young ones



### 5.3. MAMMALIAN ADAPTATIONS

Mammalian group is the most successful animals adapted to different conditions of life.

- i) In the marine whales, dolphins, etc., the limbs are modified into flippers which are used as oars to swim in water. They also possess huge subcutaneous fat deposits to conserve heat. The jaws of the whales are modified into baleen plates to sieve the water and trap the minute planktonic organisms as their food called krill.
- ii) The skin of camels is doubly thick and contains water storing osmotic cells to conserve water, as they live in deserts. They have thick bushy eyebrows covering the eyes to protect the eyes from sandy wind. Their nasal hole can be closed during desert storms to prevent the entry of sand particles.
- iii) Most mammals are herbivores, eating mostly or only plants. To digest the cellulose rich food, they have developed a mutual partnership with bacteria that have cellulose splitting enzymes.
- iv) Mammals such as cows, buffaloes, antelopes, goats, deers, etc., have huge four chambered stomachs that function as storage and fermentation vats. The stomach of cattle also helps them to ruminate or cud the food.
- v) Mammals have heterodont dentition with different types of teeth that are highly specialized to match particular eating habits. For example, the carnivorous animals have tearing teeth - the canine. In elephant the incisors are modified into tusks as a specialized weapon.
- vi) Bats are the only mammals capable of powered flight. The forelimbs of bats are modified into wing like structure. The bat's wing is a leathery membrane of skin and the muscle is stretched over the bones of the four fingers. Bats prefer to hang upside down from their legs while resting. The nocturnal bats can fly without crashing into things and still capture insects by echo location. As a bat flies, it emits very rapid series of extremely high pitched clicking sounds. The sound waves bounce off objects or flying insects and the bat hears the echo.
- vii) The marsupials, kangaroo have developed abdominal pouches to bear the tender young ones.
- viii) The polar bears have thick skin coats and woolly fur to bear the biting cold of the polar regions.
- viii) The supreme mammal – man is highly adapted as an intellectual social animal. The fingers and toes are adapted for handling extremely fine movements in holding of fine objects, in writing and using very delicate instruments.



Fig. 5.2 Bat

## 5.4. BASIC PHYSIOLOGICAL FUNCTIONS

Mammals perform the physiological functions more efficiently compared to other vertebrates.

Mammals are warm blooded or homeotherms, maintaining a constant body temperature, irrespective of the temperature in the surroundings. The body temperature in man is maintained at 98.4° F to 98.6° F. The temperature regulation is done as a team work, by the sweat glands of skin, kidneys, lungs and blood.

In summer, we sweat more as a cooling up mechanism, to conduct the heat out in the sweating process. This is possible with increased blood supply to the sweat glands. The kidneys expel less urine since much of water is lost in the sweat.

In winter, we produce little sweat as a warming up mechanism to conserve heat. The sweat glands are supplied with less amount of blood, so that the amount

of heat lost is lowered. Now the kidneys excrete out more urine.

Mammalian respiration is more efficient in comparison to other vertebrates. Red blood cells of mammals are fully packed with the respiratory red blood pigment haemoglobin, to carry the maximum amount of oxygen. The mammalian RBCs are without nucleus, as the space occupied by the nucleus is taken up by the haemoglobin molecules.

### ACTIVITY 5.2

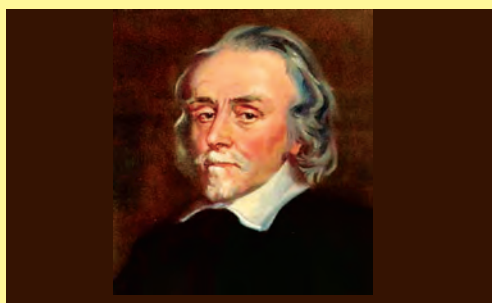
Note the body temperature of some of your classmates at 10 a.m, 1 p.m and 4 p.m. Record the same. Do you find any change in the temperature at different timings?

## 5.5. CIRCULATORY SYSTEM OF MAN

In order to transport substances from one part of the body to the other, the circulatory system has evolved. In man, the circulatory system is composed of

- i) the heart
- ii) the blood vessels namely arteries, veins and capillaries
- iii) the blood and
- iv) the lymph.

William Harvey in 1628 discovered the circulation of blood in man, until then it was thought that the body is a blood filled entity, and the blood is stagnant in it.



William Harvey 1578-1657 was an English physician. He was the first to give the details of blood circulation, the properties of blood and the pumping of blood by the heart.

### The heart

The human heart is a hollow fibro muscular organ. It is conical in shape. The heart is covered by a protective double walled sac called **pericardium** filled with **pericardial fluid**. The heart is made up of special type of muscles, called cardiac muscles. The partitions within the heart divide the heart into four chambers as auricles and ventricles. The right half of the heart receives and pumps off deoxygenated blood and the left half of the heart receives and pumps out oxygenated blood.

### Auricles

These are thin walled upper chambers. The auricles are divided into a right auricle and a left auricle, by a partition called inter auricular septum. Auricles are the receiving chambers of blood. Into the right auricle open the superior venacava and inferior venacava emptying the deoxygenated blood brought from different parts of

the body. Into the left auricle open the four pulmonary veins emptying the oxygenated blood brought from the two lungs.

### Ventricles

These are thick walled lower chambers of the heart. A partition called inter ventricular septum divides the ventricle into right and left ventricle. The ventricles pump the blood out from the heart. From the right ventricle the deoxygenated blood is pumped into pulmonary artery to supply the two lungs. From the left ventricle oxygenated blood is pumped into the aorta to supply the oxygenated blood to the different parts of the body through its branches.

### Apertures of the heart

Between the right auricle and right ventricle is found the right auriculo ventricular aperture and between the left auricle and left ventricle is found the left auriculo ventricular aperture.

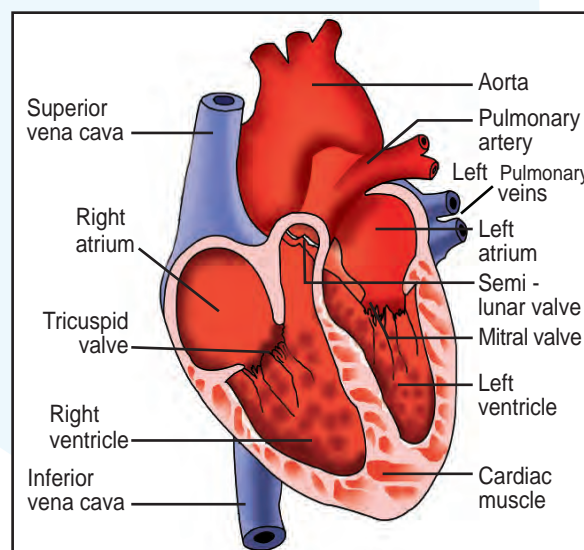


Fig. 5.3 Human heart

### Valves of the heart

A tricuspid valve with three flaps is found in the right auriculo ventricular aperture to regulate the flow of blood, from right auricle to right ventricle and not backwards.

A bicuspid valve or mitral valve with two flaps in the left auriculo ventricular aperture regulates the flow of blood, from left auricle to left ventricle and not backwards.

At the base of the pulmonary artery is present the semi-lunar valve, which regulate the blood to flow from the right ventricle to the pulmonary artery.

At the base of the aorta is present the aortic valve, to regulate the flow of blood from left ventricle into aorta.

### Working of heart

Human heart works by contraction and relaxation of the cardiac muscles. The contraction phase is called systole and relaxation phase is called diastole.

When the auricles are filled with blood they are in relaxation phase (auricular diastole). By now ventricles will push the blood into aorta and pulmonary artery by their contraction (ventricular systole).

When the auricles contract (auricular systole) the blood is pushed into the ventricles through the bicuspid and tricuspid valves, leading to ventricular relaxation (ventricular diastole).

### Heartbeat

The closure of the valves of the heart produce two different cardiac sounds

as “*lubb*” and “*dubb*”. The human heart beats 72 times in a minute at rest. Heartbeat is an inherent capacity of the heart, begun and conducted by the specialized muscle bundle in the heart.

### Blood vessels

There are three distinct types of blood vessels, namely, arteries, veins and capillaries.

#### Arteries

Arteries carry the blood from the heart to different parts of the body. They are the branches of aorta, supplying oxygenated blood to the different regions of the body (except pulmonary artery which carries deoxygenated blood). The aorta branches into arteries. Arteries branch into arterioles. Arterioles branch into fine tubes called meta arterioles. The meta arterioles end up in the tiny blood vessels called capillaries.

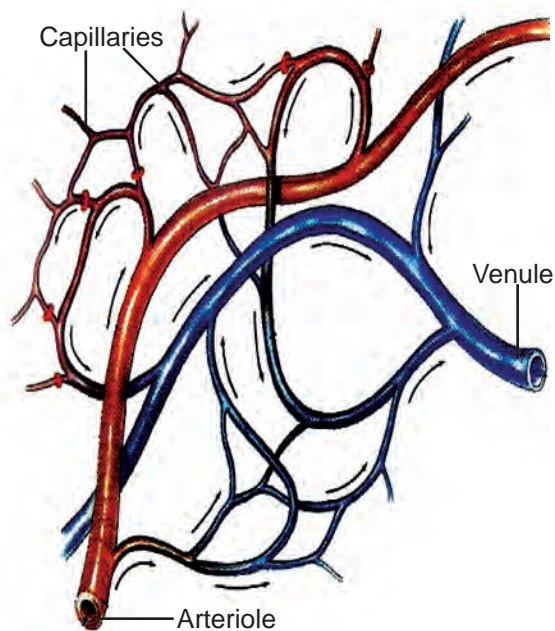


Fig. 5.4 Arteries, capillaries and veins



### Capillaries

These tiny blood vessels form a network, called capillary network around the tissues to enable the passage of substances from the blood into the tissues.

### Veins

The veins drain the blood from different parts of the body to the heart. The capillaries reunite to form venules, which drain the deoxygenated blood from the tissues. The small venules united with the big veins open into superior venacava and inferior venacava. Except the pulmonary veins all other veins carry deoxygenated blood.

### The blood

Blood is the river of life – providing the internal environment to the body. Blood is the connective tissue, consisting of the fluid part, the plasma and the solid components, the blood cells.

### Plasma

The liquid component of blood, the plasma is composed of water, organic substances, inorganics substances, etc.,. The important organic substances of plasma are the plasmaproteins namely globulin (for immunity), fibrinogen (for blood clotting) and albumin (for water balance).

### Blood cells

There are three types of blood cells namely Red Blood Cells, White Blood Cells and Blood Platelets freely floating in the plasma.

### Red Blood Cells –Erythrocytes

RBCs are circular, biconcave and disc shaped. While the young RBCs

have nuclei, the matured ones are without nuclei. The red blood pigment haemoglobin is fully packed in the RBCs. They are concerned with carriage of respiratory gases.

### White Blood Cells – Leucocytes

WBCs are amoeboid in shape with prominent nuclei. WBCs are concerned with phagocytosis of engulfing the germs and producing antibodies to resist the germs entering the body.

### Blood Platelets – Thrombocytes

Platelets are irregular broken up pieces of certain giant cells. They are concerned with blood clotting to prevent the loss of blood.

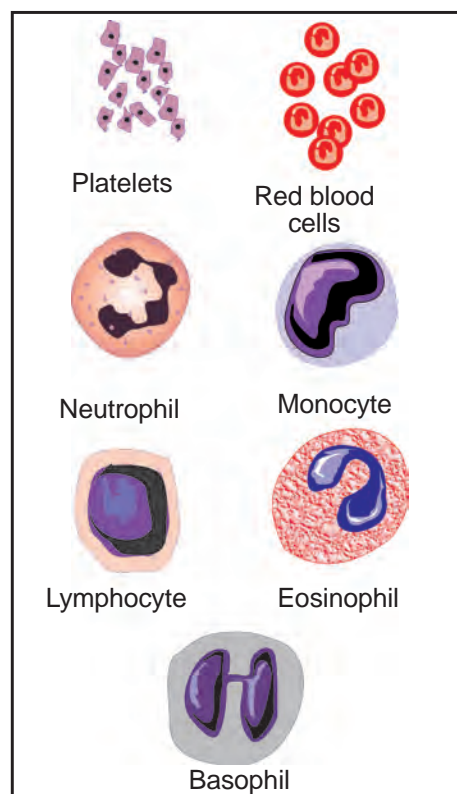


Fig. 5.5 Blood Cells

## 5.6. EXCRETORY SYSTEM IN MAN

Excretory organ	Excretory products	Sent out as
Kidneys	Nitrogenous waste products – urea, uric acid, creatinine, etc.,	Urine
Lungs	Carbondioxide and water vapour	Expired air
Skin	Excess water and salt	Sweat

Excretion is the removal of metabolic waste products called excreta. The important excreta and the excretory organs which remove them are shown in the above table.

The principal excretory organs of our body are the kidneys, which maintain the chemical composition of the blood and so are called as master chemist of our body.

### External structure of kidney

A pair of kidneys are present in the upper abdominal region, one on either side of the

vertebral column attached to the dorsal body wall. A thin transparent membrane called capsule covers the kidney. The kidneys are bean shaped with outer convex surface and inner concavity. The depression in the concavity is called renal hilus, from which arises the muscular tube called ureter. The two ureters open into the distensible muscular sacs called the urinary bladder which is the store house of urine. From the urinary bladder arises the urethra which delivers the urine out of the body.

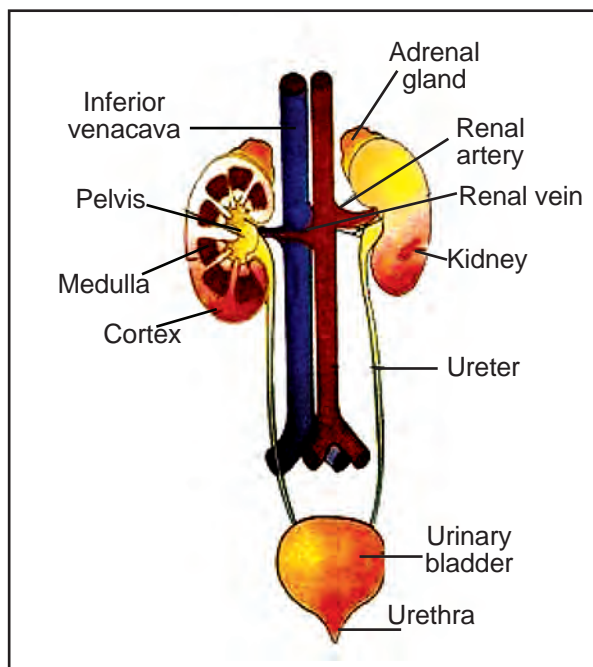


Fig. 5.6 Excretory system of man

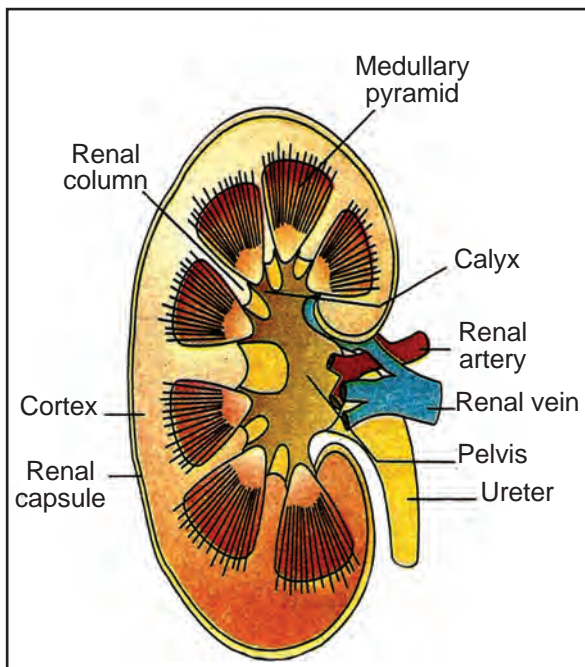


Fig. 5.7 LS of Kidney

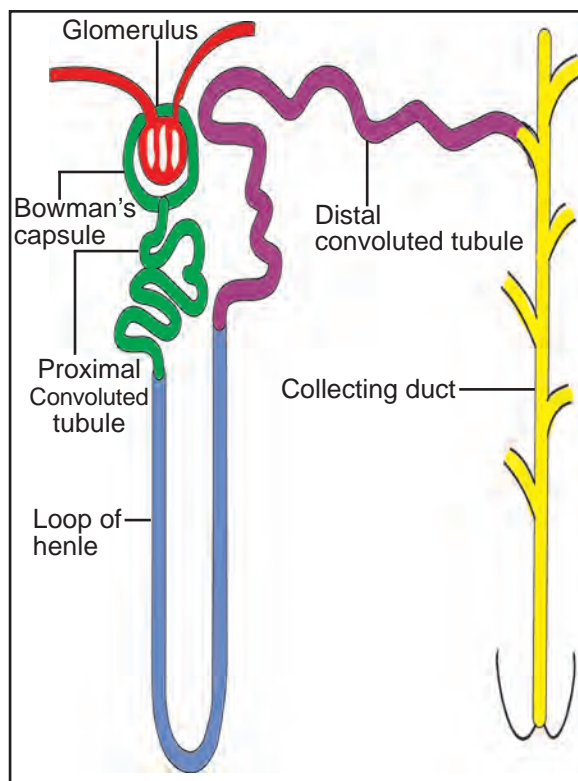
### Internal structure of kidney

The outer portion of the kidney is dark in colour and is called renal cortex and inner pale region of the kidney is called renal medulla. Renal medulla contains conical masses called renal pyramids. On the renal pyramids are found the openings called renal papillae, which open into the inner space of the kidney called renal pelvis. From the renal pelvis arises the ureter.

The kidneys are composed of millions of units called nephrons.

### Structure of a nephron

Nephrons are the structural and functional units of the kidney, each kidney is composed of millions of nephrons. A nephron has two structural components namely, Malpighian capsule and the uriniferous tubules.



**Fig. 5.8 Nephron**

### Malpighian capsule

This consists of a network of blood capillaries called glomerulus and a double walled cup called Bowman's cup. The glomerulus is a network of blood capillaries, formed by the branches of the wider afferent renal arteriole. From the glomerulus arises the narrow efferent renal arteriole, which branches over the rest of the nephron as network of capillaries. The Bowman's capsule accommodates the glomerulus.

### Uriniferous tubules

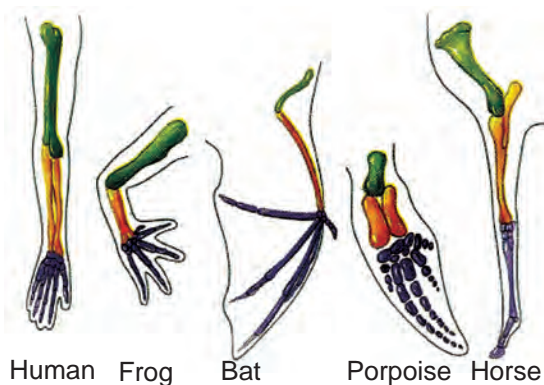
From the Bowman's capsule arises the Uriniferous tubules. It is divided into three portions as the initial coiled proximal convoluted tubule, the middle U-shaped Henle's loop and the later coiled distal convoluted tubule. The distal convoluted tubule straightens as the collecting ducts. The collecting ducts open on the renal pyramids as renal papillae. The nephrons filter the blood and form the urine.

## 5.7.RELATIONSHIP OF STRUCTURE AND FUNCTION

Based on the functional need a particular organ or part gets a suitable modification in its structure. Thus a structure is so adapted to perform a specific function. So structure and function go hand in hand. The fore limbs of different mammals are suitably modified to do different functions according to their environment. For example, all the vertebrate animals in general, and all mammals in particular, have their fore limbs sharing a common basic pattern of construction. The fore limbs of mammals consist of five parts namely upper arm, fore arm, wrist, palm

and phalanges, but they are differently used in different animals like

- i) Man uses his fore limb to hold an object, write, operate very fine musical instruments and delicate digital devices. The thumb is deviant from other four fingers, to enable man to do the above jobs.
- ii) A horse uses it's fore limb to gallop.
- iii) A rat or bandicoot uses it's fore limb to make holes in the ground to live.
- iv) A giraffe uses its pretty long and stout fore limbs to reach up the vegetations, at the height of the plants.
- v) A monkey leaps from one branch of the tree to another using it's fore limb to swing and leap.
- vi) A whale uses its fore-limbs as oars to swim.



**Fig. 5.9 Basic pattern of forelimbs of vertebrates**

## 5.8. ANIMAL BEHAVIOR

Behaviour can be defined as an organism's adaptive response to stimuli in its

environment. The stimuli may be as simple as the odour of the food. Nervous system perceives and passes the information concerning the environmental stimuli and trigger adaptive motor response which we see as the patterns of behaviour.

### 5.8.1. Social behavior

Behaviour is both an instinctive process (influenced by genes) and learned experience (gained by experience).

Social attachments between animals is called imprinting. The binding or attachment between the parents and the offspring is called filial imprinting. At times, we find an individual of a species is raised by a parent of another species (e.g the chick of cuckoo bird is fed by crow in its nest). This behavioural pattern is called cross fostering.

Many insects, fish, birds and mammals live in social groups in which information is communicated between group



**Fig. 5.10 Honey Bee**

members. For example some individuals in mammalian societies serve as guards.

In an elephant herd, it is always the oldest she elephant that leads the herd,



while the strong males will form the periphery of the herd and the young calves and other she elephants will be in the centre.

### Sexual behavior

The coming closer of the opposite sexes is both by instinctive process and sexual attraction exhibited by one or both the partners. The secondary sexual characters developed during the breeding season bring the two sexes together for sexual reproduction. For example, the bright and colourful plumage of male peacock is to draw the attention of the female.

### Sexual imprinting

Is a process in which an individual learns to direct its sexual behaviour at a member of its own species. During the courtship, animals produce signals to communicate with potential mates and with other members of their own sex. A character exhibited by one sex to attract the other sex is called courtship signalling. Many courtship signals are species-specific to help animals avoid making errors in mating.

### Parental care

Any investment or effort by the parent to take care of the young ones in order to increase the chance of survival of the offspring and hence increase the reproductive success is called parental care. The parents care for the young ones and provide high nutrition, protect the young ones from predators and enable the young ones to lead a successful life.

Providing the young one with the milk from its mammary gland and aggression exhibited against the predator are the best means of taking care of the young one. Even after the nutritional independency is



*Fig. 5.11 Parental care in elephants*

obtained by the young one i.e it takes care of its nutrition by itself, the parental care is extended in some species beyond this level.

## 5.9. A CASE STUDY BY A RESEARCHER

The behavioural patterns in different situations are investigated in the research projects taken up by leading universities in Tamilnadu.

The abstract of case study by Arun Venkatraman, Asian Elephant Conservation Centre, Centre for Ecological Science, Indian Institute of Science – Bangalore on Dholes is given below.

Courtesy to the researcher – Mr. Arun Venkatraman)

Asiatic wild dog (Chen Nai – in Tamil), commonly called Dholes – **Cuon**

**alpines** is an endangered species living in Mudumalai Wildlife Sanctuary at Nilgiris, Tamilnadu.

The Dholes live in packs which consist of old females, males, females and pups. The pack members co-ordinate while pulling down and killing large prey such as adult Sambar Deer. There is a tendency to share the meat among the members of the pack. However there prevails a squabbling among them to get the choicest meat. The young pups are allowed to take the meat first. The old males follow

them. The other young ones and old females usually lag behind.

The Dholes also exhibit a high degree of parental care by changing



Fig. 5.12 Dholes

### ACTIVITY 5.3

#### CASE STUDY

- Conduct a case study on the behavioural aspects of your pet dogs in reference to their territorial dominance when strangers or other dogs try to enter into your locality.

#### ACTIVITY

- Follow an ant line and try to break its route by drawing a line with your finger without killing any ant.
- Observe the behaviour of the ants as to whether they change the route or go in disarray.
- Try to observe for a few minutes for any change they resort in their route. Make a report of their behaviour and submit.

the den frequently so that the pups are safe from predators such as leopards and hyenas.

- functions efficiently.
- Behaviour is the adaptive response of an organism to the stimuli in the environment.
- Social behaviour is both instinctive and learned experience.
- Sexual behaviour involves courtship signalling which is species specific.
- The investment or effort by the parent on their offsprings to provide nutritive food and safeguard them from predators is called parental care.

## EVALUATION

### PART A

1. Sensitive whiskers are found in \_\_\_\_\_.  
Bat, Elephant, Deer, Cat.
2. The tusks of elephants are modified \_\_\_\_\_.  
Elephant, Dolphin, Deer, Kangaroo.
3. Pick out an animal which has four chambered stomach \_\_\_\_\_.  
Elephant, Dolphin, Deer, Kangaroo.
4. Normal body temperature of man is \_\_\_\_\_.  
98.4 – 98.6°F, 96.6 – 96.8°F, 94.4 – 98.6°F, 98.4 – 99.6°F.
5. Mitral valve is found between \_\_\_\_\_.  
Right auricle and right ventricle, Left auricle and left ventricle,  
Right ventricle and pulmonary artery, Left ventricle and aorta.
- c. antelope, deer, cow, buffalo, black buck  
d. dog, cat, crocodile, lion, tiger
7. The epidermis of mammals contains  
a. hair, bristle, quills  
b. hair, nail, claw  
c. hair, bristle, horn  
d. hair, nail, scale
8. Based on relationship, fill up:  
Whale: Baleen plates; Bat : \_\_\_\_\_
9. Fill in the blanks.  
Plasma : Fibrinogen ; RBC : Carrier of oxygen; WBC: \_\_\_\_\_
10. Master chemists of our body are kidneys. Justify.  
a. kidneys acquire all chemicals taken in the body  
b. maintain the chemical composition of blood  
c. kidneys send out all chemicals taken in the body  
d. kidneys store the various chemicals taken in the body

### PART B

6. One of the following groups contains a non mammalian animal. Pick up the group.  
a. dolphin, walrus, porcupine, rabbit, bat  
b. elephant, pig, horse, donkey, monkey
11. Based on modifications make the pairs:  
incisor: tusk of elephant;  
\_\_\_\_\_ : quills of porcupine.

### FURTHER REFERENCE :

#### Books:

1. Biology - **RAVEN, Johnson** WCB Mc Graw - Hill
2. Biology - A Modern Introduction, **B.S. Beckett**, Second Edition  
Oxford University Press.



## 6. LIFE PROCESSES

How do you differentiate the living things and non-living things?

If we see a dog running

(or)

a cow chewing cud

(or)

a man shouting loudly on the street,

We know that these are living beings.

What if the dog or the cow or the man were asleep?

We would still think that they were alive, but how did we know that? We see them breathing and we know that they are alive.

What about plants?

How do we know that they are alive?

We see their green leaves and some kind of movements like the folding and unfolding of leaves, stages of growth as common evidences for being alive.

### 6.1. WHAT ARE LIFE PROCESSES?

The maintenance of living organisms must go on even at the conditions, when they are not physically active. Even when we

sit idle and during sleeping, this maintenance job through cells functioning has to go on. The life process includes the activities performed by the different organs to maintain the body.

Some of the life processes in the living beings are described below:

#### Nutrition

The processes of obtaining energy through consumption of food.

#### Respiration

The process of acquiring oxygen through breathing and make it available to cells for the process of breaking down of organic substances into simpler compounds is called as respiration.

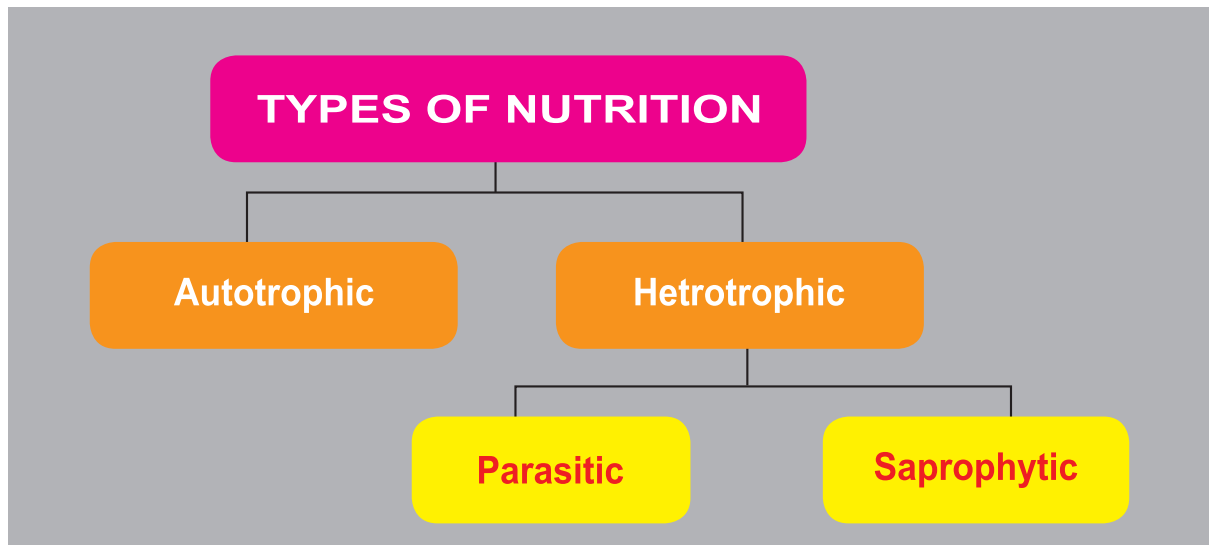
#### Transportation

Transportation is the process by which the food and oxygen is carried from one organ to other organs in the body.

#### Excretion

It is the process by which the metabolic waste by-products are removed from the different organs and released out from the body.





### Questions

1. How do we understand the living nature of organisms?
2. What are the materials available from external sources for the organism's consumption?
3. What processes are essential to maintain our body?

## 6.2. NUTRITION IN PLANTS

Do you know that we need energy for all activities?

When do we get that energy?

The source of energy is the food we eat.

### Types of Nutrition

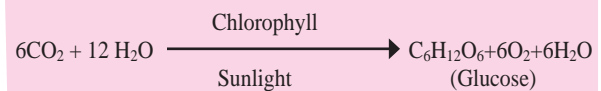
#### Autotrophic Nutrition

Most of the green plants are self-dependent, because they synthesize their own food materials by photosynthesis. Such mode of nutrition is described as autotrophic nutrition.

It is the process by which autotrophic plants consume substances from the external sources and convert them into

stored form of energy. The materials are taken in the form of carbon dioxide and water which are converted into carbohydrates in the presence of light and chlorophyll. Carbohydrates are utilized as energy rich sources to the plant., for their entire activity.

The process of photosynthesis is explained in the form of bio-chemical reaction shown below:



The raw materials and other necessary items required for photosynthesis are Sunlight, Water,  $\text{CO}_2$  and Chlorophyll.

- |               |   |
|---------------|---|
| Sunlight      | - energy from the sun   |
| Water         | - plant absorbs water from the soil through roots.                                      |
| $\text{CO}_2$ | - assimilated from the atmosphere through leaves containing small pores called stomata. |
| Chlorophyll   | - the green pigments in the chloroplasts, an organelle of the cells of leaf.            |

Let us do an activity which demonstrates that chlorophyll is essential for photosynthesis

### ACTIVITY 6.1

1. Take a potted plant with variegated leaves – for example, money plant or crotons.
2. Keep the plant in a dark room for three days so that all the starch gets used up.
3. Now keep the plant in sunlight for about six hours.
4. Pluck a leaf from the plant. Mark the green areas in it and trace them on a sheet of paper.
5. Dip the leaf in boiling water for a few minutes.
6. After this, immerse it in a beaker containing alcohol.
7. Carefully place the beaker in a water-bath till the alcohol begins to boil.
8. What happens to the colour of the leaf? What is the colour of the solution?
9. Now dip the leaf in a dilute solution of iodine for few minutes.
10. Take out the leaf and rinse off the iodine solution.
11. Observe the colour of the leaf and compare this with the tracing of the leaf done in the beginning.
12. What can you conclude about the presence of starch in various spots of the leaf?

### Heterotrophic nutrition

Fungal cells do not contain chloroplasts and they formed into saprophytes and parasites. Likewise all organisms, except the green plants do not possess chloroplasts as they do not carry out photosynthesis. They depend upon plants or other organisms for their nutrition.

#### Parasites

Some organisms live on other organisms for nourishments. They are called Parasites.

The plants or animals in which the parasites live for nourishments are called hosts. Parasitic plants have some special roots, which penetrate the host plants and absorb food from the phloem, water and minerals from xylem. These roots are called haustoria. (e.g.: *Cuscutta* and *Viscum*).

#### Saprophytes

Some plants obtain nutrients from non-living organic matter. They are called saprophytes. Many fungi and bacteria are

saprophytes. Certain angiosperms like *Monotropa* lack chlorophyll and have mycorrhizal roots. The plant absorbs nourishments from the humus through their mycorrhizal roots.

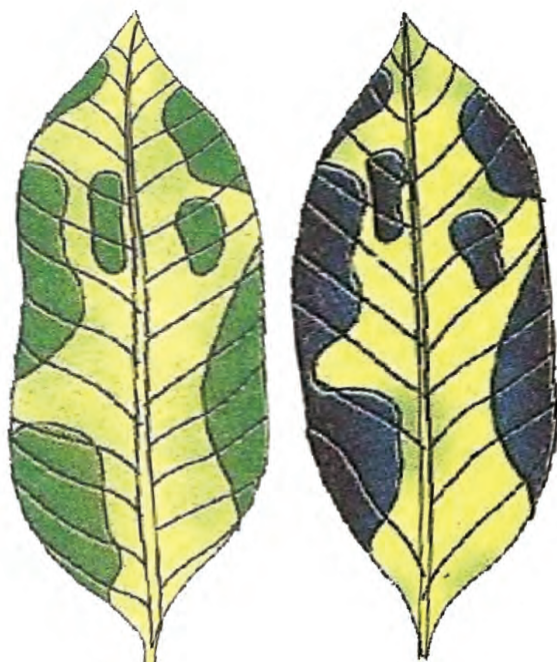


Fig. 6.1 Variegated Leaf

(a). Before starch test

(b). After starch test



Fig. 6.2 *Cuscutta* - a parasitic plant



Fig. 6.3 *Viscum* - a parasitic plant

## Questions

1. What are the differences between autotrophic nutrition and heterotrophic nutrition?
2. What are the sources of materials required by plants for photosynthesis?

## 6.2. HUMAN DIGESTIVE SYSTEM

### Intracellular digestion

White blood cells (leucocytes) in vertebrate animals are defensive in functioning and get rid of germs in the body of the animals. WBCs engulf the invading germs by producing pseudopodia around the germs and digest the germs inside them by phagocytosis.

The unicellular animalcules like *Amoeba* also produce pseudopodia to engulf the diatoms and other minute organisms and digest them within the cell. *Paramoecium*, another protozoan has a cytopharynx, a cytoplasmic depression to swallow the food (i.e. microorganisms).

in water) and digest the food within the cells. In the above mentioned examples the food is directly taken into the cells and is digested within the cell. This sort of digestion is called intracellular digestion. Intracellular digestion is a very primitive form of digestion and does not require an organized digestive system. Even in animals like sponges and coelenterates, the digestion is intracellular, though an alimentary canal like structure has developed in them.

### Extracellular digestion

As animal body becomes more complex, digestive system has evolved to digest the food taken into the body. The digestive system in higher animal and man consists of alimentary canal and digestive glands that are specialized to produce digestive juices. Food is taken into alimentary canal and in the regions of digestion like mouth, stomach and duodenum, digestive juice is secreted by the digestive glands and the complex food swallowed is broken down to simpler food molecules by the action of enzymes of the

digestive juices. Since digestion takes place in the space or lumen of alimentary canal i.e outside the cell it is called as extracellular digestion – an advanced form of digestion.

### Digestion in human beings

Food contains a number of nutrient molecules needed for building up of new body tissues, repairing damaged tissues and sustained chemical reactions.

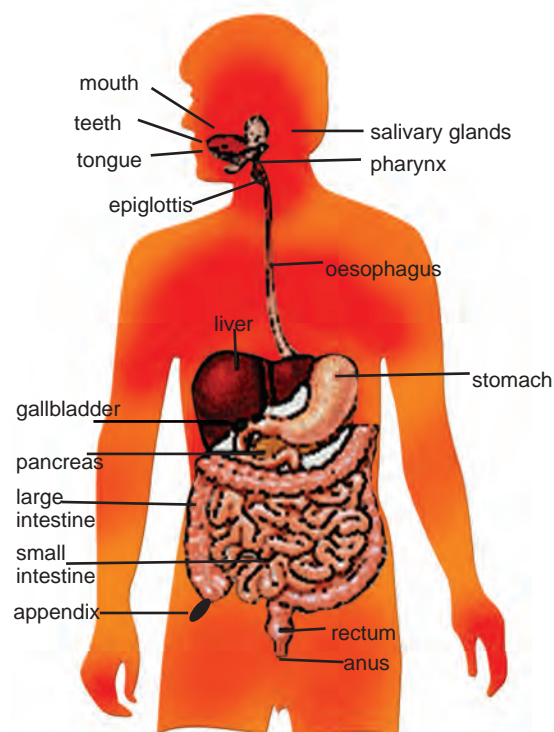


Fig. 6.4 Human Digestive System

### ACTIVITY 6.2

- Take 1 ml of starch solution (1%) into test tubes (A and B)
- Add 1 ml of saliva to test tube A and leave both the test tubes undisturbed for 20-30 minutes
- Now add a few drops of dilute iodine to the test tubes
- In which test tube do you observe a colour change?
- What does this indicate about the presence or absence of starch in the two test tubes?
- What does this tell us about the action of saliva on starch?
- Is there a difference? If yes, in which case more energy from external sources is consumed.



Food must be broken down to be used as a source of energy. The process of converting the complex food into a simple chemical substance, that can be absorbed and assimilated by the body is called digestion. The medical speciality that deals with the structure, function, diagnosis and treatment of diseases of stomach and intestine is called gastroenterology.

The digestive system is composed of two groups of organs. They are

- 1) The gastro intestinal tract
- 2) Accessory digestive glands

Digestion is brought about in a stepwise manner with the help of enzymes which are otherwise called bio-catalysts.

The gastro intestinal tract (alimentary canal) is a long muscular tube, about 9 mts in length and it commences from the mouth and ends in the anus. The mouth, buccal cavity, pharynx, oesophagus, stomach, small intestine, large intestine, rectum and anus are the parts of the alimentary canal.

### 6.3. RESPIRATION IN PLANTS

**Why should we eat?**

**Why should plants synthesize food?**

For the simple reason that all living organisms ranging from minute bacteria to large elephants, plants and humans, require energy for growth, movement and reproduction.

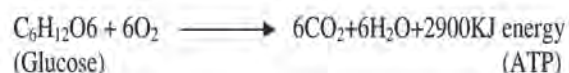
**Where does this energy come from?**

Food that we eat is the starch that is synthesized by plants and it is the source of energy.

In fact, energy is locked up in food materials. During respiration, the food materials are oxidized (degraded). During this reaction, energy is released from the food and it is stored in a special chemical (or) biological substance called ATP (Adenosine triphosphate).

The energy of ATP is utilized in various activities of cells.

Apart from ATP, two other substances are also formed during respiration. They are  $\text{CO}_2$  and  $\text{H}_2\text{O}$ .



Substance that is used in respiration is known as respiratory substrate. Respiratory substrates are of three kinds viz., carbohydrates, fats and proteins.

### Types of Respiration

Depending on whether oxygen is used or not, respiration is of two types:

1. Aerobic respiration.
2. Anaerobic respiration.

#### 1. Aerobic respiration

In majority of living organisms, oxygen is utilized during respiration. Respiration that uses oxygen is known as aerobic respiration.

Aerobic respiration takes place in four stages:

1. Glycolysis
2. Oxidative decarboxylation of pyruvic acid
3. Krebs's cycle
4. Electron transport chain.

In Glycolysis, glucose (a simple carbohydrate) is split into two molecules of pyruvic acid. This takes place in the cytoplasm, in a series of reactions and a number of enzymes are involved. With the formation of pyruvic acid, glycolysis comes to an end.

Further oxidation of pyruvic acid takes place in the second and third stages occurring in the mitochondria.

During the last stage i.e. electron transport chain, the energy associated with the liberated electrons is used to synthesize the ATP energy molecules at certain stages. Finally the hydrogen, an electron joins with oxygen to produce water as a by-product.

Complete oxidation of a glucose molecule in aerobic respiration produces 38 ATP molecules.

## 2. Anaerobic respiration

In some organisms, oxygen is not utilized for respiration. This type of respiration is known as anaerobic respiration. It is also known as fermentation.

[E.g. Conversion of milk into curd.]

## 6.3. RESPIRATION IN ANIMALS

Amoeba, Hydra, Sponge, etc., live in water. In these organisms, respiration takes place through their body surface. Dissolved oxygen in water diffuses through the cell membrane or body surface into

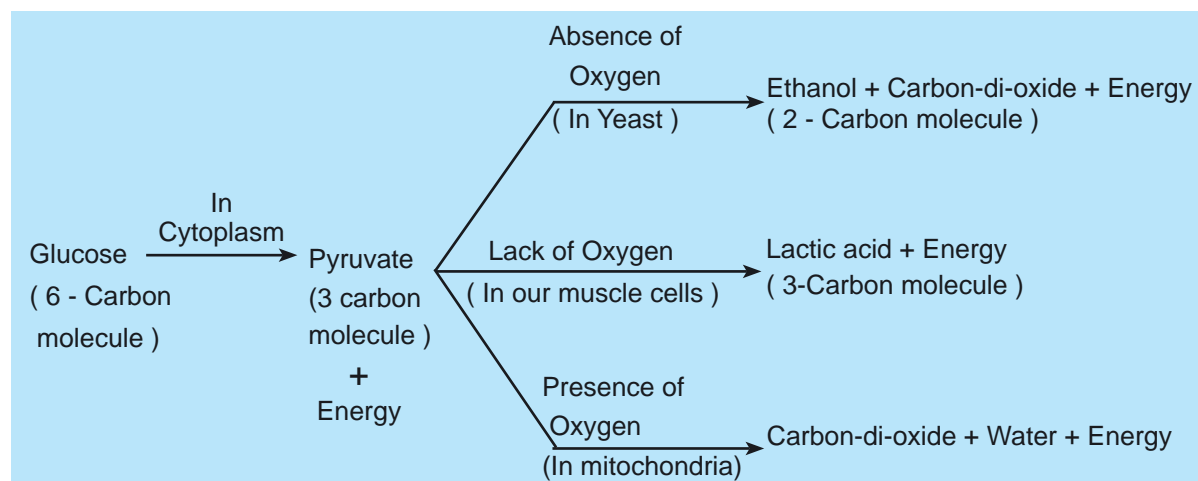
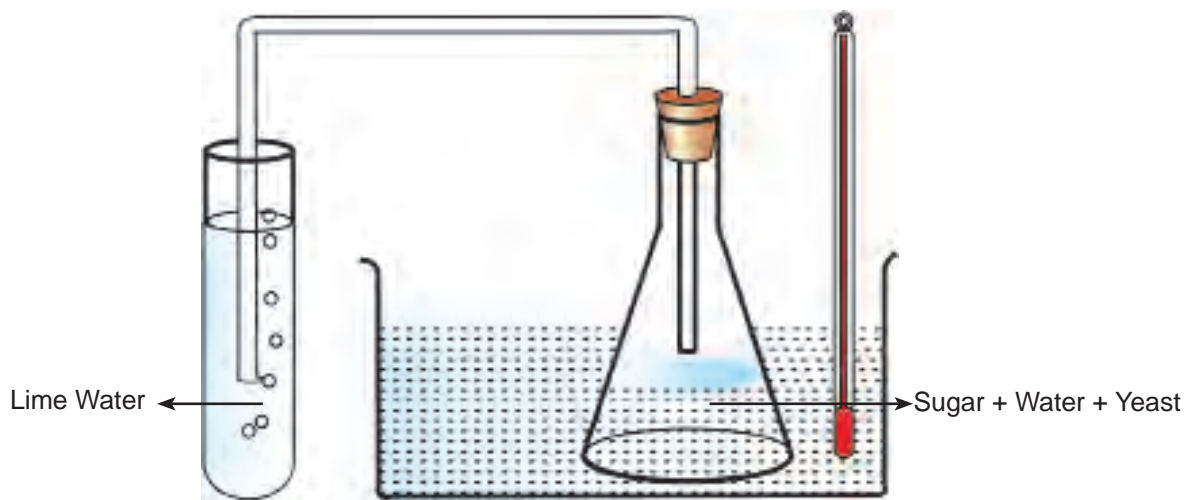


Fig. 6.5 Break down of glucose by various pathways

### ACTIVITY 6.3

- Take some fruit juice or sugar solution and add some yeast to this. Take this mixture in a test tube fitted with a one-holed cork.
- Fit the cork with a bent glass tube. Dip the free end of the glass tube into the test tube containing freshly prepared lime water.
- What change is observed in the lime water and how long does it take for this change to occur?
- What does this tell us about the products of fermentation



**Fig 6.6 Anaerobic respiration apparatus**

### ATP

- ATP is the energy currency for the most cellular processes. The energy released during the process of respiration is used to make an ATP molecule from ADP and inorganic phosphate.
- $\text{ADP} + \text{P}_i \xrightarrow{\text{Energy}} \text{ATP}$
- Think of how a battery can provide energy for many different kinds of uses. It can be used to obtain mechanical energy, light energy, electrical energy and so on. Similarly, ATP can be used in the cells for the contraction of muscles, protein synthesis, conduction of nervous impulses and many other activities.

the cell and after its usage, the carbon-dioxide produced is passively diffuses out into water.

Respiratory surface for a fish is gill; for a frog it is lungs and skin the lungs for land vertebrates.

Since the amount of dissolved oxygen is fairly low, compared to the amount of oxygen in the air, the rate of breathing in aquatic organisms is much faster than that seen in terrestrial organisms. Fishes take in water through their mouth and force it past the gills where the dissolved oxygen is taken up by the blood.

Terrestrial organisms use the oxygen in the atmosphere for respiration, Oxygen is absorbed by different respiratory organs in different animals. All these organs have a structure that has bigger surface area, which is in contact with the oxygen-rich atmosphere. The exchange of oxygen and carbon-di-oxide has to take place across this surface. But it is usually placed within the body. So there are air passages present, that will take atmospheric air to this area. In addition, there is a mechanism for blowing the air in and out of this area where oxygen is absorbed.

In human beings, air is taken into the body through the nostrils. The air passing through the nostrils is filtered by fine hairs that line the passage. This passage is also lined with mucous which helps in this process. From here, the air passes through the throat into the lungs. Rings of cartilage are present in the throat which keep the air passage open and prevent it from collapsing.

Within the lungs, the air passage branches repeatedly into smaller tubules

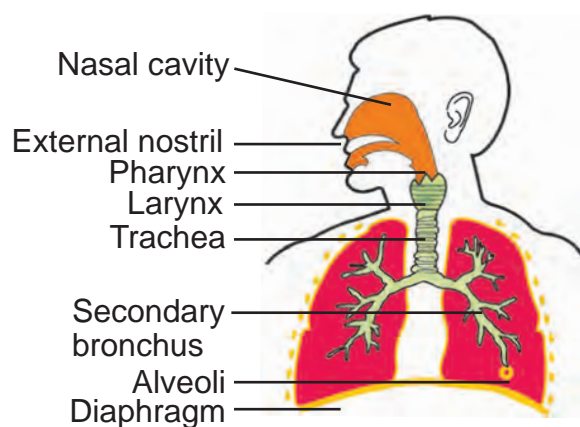


Fig. 6.7 Human respiratory system

### ACTIVITY 6.4

- Observe fishes in an aquarium, and their opening and closing of mouth and the gill slits (or the operculum which covers the gill slits) found behind their eyes also open and close. Is not the timing of the openings and closings of the mouth and gill slits co-ordinated?
- Count the number of times the fish opens and closes its mouth in a minute.
- Compare this into the number of times you breathe in and out in a minute.

which finally terminate in balloon like structure called alveoli. The alveoli surrounded by blood capillaries provide a surface, where the exchange of gases takes place.

### 6.4. TRANSPORTATION IN PLANTS

We have discussed earlier, how the plants prepare food by the process of photosynthesis using various raw materials, like water,  $\text{CO}_2$ , sunlight and chlorophyll.

We already know that the chlorophyll pigments are in the leaf. So the leaf is the site for photosynthesis. The food prepared from the leaf should be transported to all other parts.

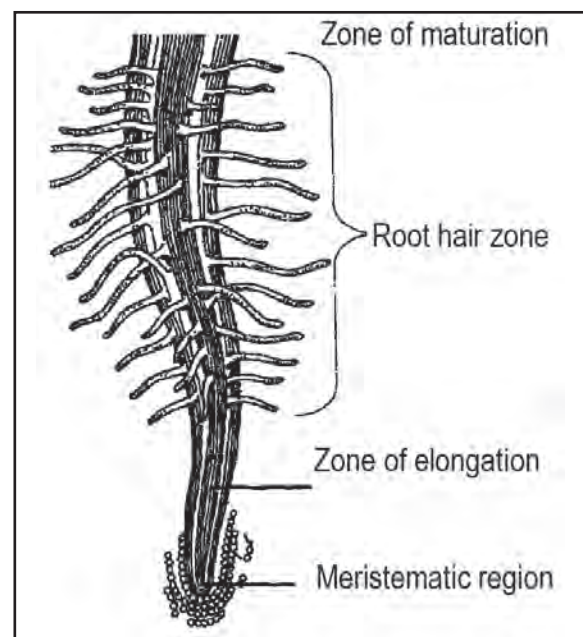


Fig. 6.8 Root hair region

In the same manner, water is essential for photosynthesis and all other biological activities in the plants. For plants, soil is the nearest and richest source of water and other raw materials like nitrogen, phosphorus and other minerals.



How do the absorbed water and minerals get transported from one place to all other parts of the plant body?

Which part of the plant is in contact with the soil?

For the above questions, you were getting answers already in your lower classes.

The roots are the absorbing organs of the plant.

Thus, plant transport systems will mobilize energy stores, (food) from leaves, and raw materials from roots. These two pathways are constructed as independently organized conducting tubes.

- i) Xylem transports water with dissolved minerals absorbed from the soil.
- ii) Phloem transports products of photosynthesis (food) from the leaves to the parts of the plant.

### Transport of water

In xylem, vessels and tracheids are the conducting elements of the roots, stems and leaves. They are inter-connected to form a continuous system of water conducting channels, reaching all parts of the plant. In roots, the root hair cells in contact with the soil, actively take up ions.

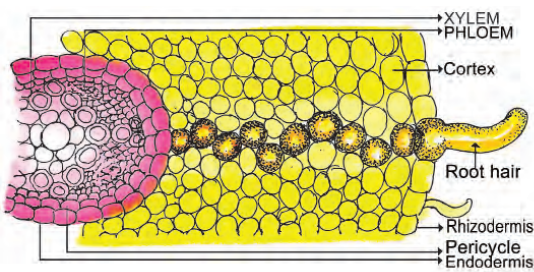


Fig. 6.9 Path of water across the root

This creates a difference in the concentration of these ions between the root and the soil. Water, therefore enters into the root from the soil to eliminate this difference.

This means that there is a steady movement of water into root xylem, creating a column of water that is steadily pushed upwards.

Is this pressure enough to conduct water over the heights in tall and huge trees?

Plants use another strategy to move water in the xylem upwards to the highest points of the plant body. This can be achieved by the process of transpiration, in which when the plant has an adequate supply of water. The water which is lost

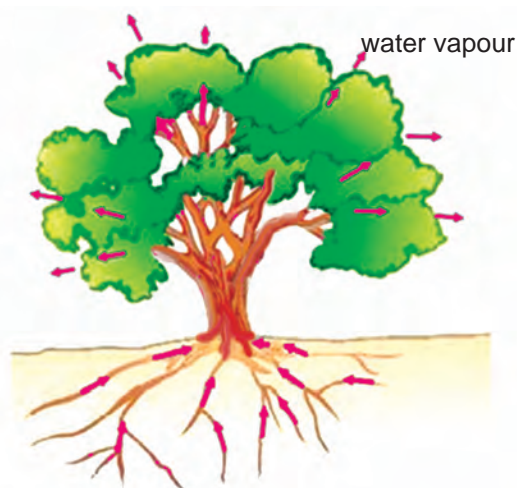


Fig. 6.10 Movement of water during transpiration in a tree

through the stomata is replaced by water from the xylem vessels in the leaf.

In fact, evaporation of water molecules from the cells of a leaf creates a suction which pulls water from the xylem cells of roots.

## ACTIVITY 6.5

- Place a potted plant into a clear glass bell jar. The pot is covered with plastic to prevent water evaporating from the soil.
- Set up a second bell jar with a potted plant with leaves removed.
- Keep the bell jars in bright light at room temperature (20°C) for 6 hours.
- No liquid condenses in the bell jar without leaves.
- The bell jar containing the leafy plant has much more condensed liquid.
- Test the liquid it turns dry blue cobalt chloride paper to pink colour. Therefore the liquid is water.
- Discuss with your classmates, and find the reason why water droplets are formed in the potted plants containing leaves.

The loss of water in the form of vapour from the aerial parts of the plant is known as transpiration.

Thus, transpiration helps in the absorption and upward movement of water and mineral dissolved in it from roots to the leaves. It also helps in temperature regulation. The effect of root pressure in transport of water is more important at night. During the day when the stomata are open, the transpiration pull becomes the major driving force in the movement of water in the xylem.

### Transport of food and other substances

How are the products of photosynthesis transported from leaves to other parts of the plant?

The transport of soluble products of photosynthesis is called translocation and it occurs in the part of the vascular tissue known as phloem. Besides the products of photosynthesis, the

phloem transports amino acids and other substances. These substances are especially delivered to the storage organs of roots, fruits, seeds and to growing organs. The translocation of food and other substances takes place in the sieve tubes (sieve tubes are one of the constituents of the phloem which act as pipe line from leaves to the other parts of the plant) with the help of companion cells both in upward and downward directions. The translocation by phloem is achieved by utilizing energy. Materials like sucrose is transferred into phloem tissue using energy from ATP. This increases the osmotic pressure in the tissue causing water movement. This pressure moves the material in the phloem to tissues which have less pressure. This allows the phloem to move material according to the plant's needs. For example, in the spring, sugar stored in root or stem tissue would be transported to the buds, which need energy to grow.

## Questions

1. What are the components of the transport system in highly organized plants?
2. How are water and minerals get transported in plants?
3. How is food transported in plants?

## Transportation in animals

In microscopic organisms such as Amoeba and Paramecium, the volume of body is so small that useful substances can be distributed by a process called diffusion. Oxygen for example, enters an amoeba through the cell membrane and spreads out i.e diffuses, in all directions at the rate approximately equal to the rate at which oxygen is consumed in respiration. Similarly, carbon-di-oxide diffuses out of an Amoeba with sufficient speed to prevent it accumulating to harmful levels within the cell.

In large multi-cellular organisms, however, the body volume is so great that diffusion alone is far too slow a process for adequate distribution of oxygen and food, and removal of waste.

The cells in the multi-cellular organisms relying on diffusion alone

would be a tightly packed crowd. Those in the middle region would not get enough oxygen. Hence, most large organisms do not rely on diffusion for their supply of food and oxygen. They have a transport system of some kind to carry these substances to all the cells in the body.

In human body, for example the transport system consists of a pump called heart which propels the fluid called blood around a complex system of tubes called blood vessels. As it passes through these blood vessels, the blood picks up oxygen from the lungs and transport it to every cell in the body. Blood also picks up waste product such as carbon-dioxide and many other substances like salts from the cells and excrete out from the body.

## Lymph

There is another type of fluid which is also involved in transportation. This is called lymph or tissue fluid. It is similar to the plasma of blood but it is colourless and contains less protein. Lymph drains into lymphatic capillaries from the intercellular spaces, which join to form large lymph vessels that finally open into veins. Lymph carries digested and absorbed fat, from intestine and drains excess fluid from extra cellular space back into the blood.

## ACTIVITY 6.6

1. Visit a health centre in your locality and find out what is the normal range of haemoglobin content in human beings.
2. Is it the same for children, women and men? Discuss why does the difference exist?

## 6.5. EXCRETION IN PLANTS

What is excretion?

How does the excretion take place in plants?

Excretion is the process by which the metabolic waste products are removed from the plant body.

In plants there are different ways for excretion.

1. Plant waste products are stored in cellular vacuoles.
2. Waste products may be stored in leaves that fall off.
3. Other waste products are stored as

resins and gums, especially in old xylem tissues.

4. Plants also excrete some waste substances into the soil around them.

### Excretion in animals

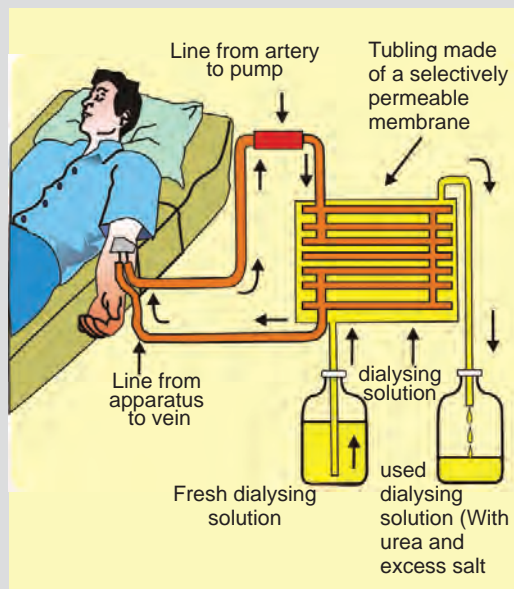
In unicellular protozoans, the excreta are discharged out through the contractile-vacuoles, which are formed by the absorption of water and other excreta.

In coelenterates and sponges, the excreta diffuse out through the cell membrane.

In flat worms and round worms, the excretory tubes develop for transporting

### Artificial kidney (Hemodialysis)

Kidneys are vital organs for survival. Several factors like infections, injury or restricted blood flow to kidneys reduce the activity of kidneys. This leads to accumulation of poisonous wastes in the body, which can even lead to death. In case of kidney failure, an artificial kidney can be used. An artificial kidney is a device to remove nitrogenous waste products from the blood through dialysis.



Artificial kidneys contain a number of tubes with a semipermeable lining, suspended in a tank filled with dialysing fluid. This fluid has the same osmotic pressure as blood, except that it is devoid of nitrogenous wastes. The patient's blood is passed through these tubes. During this passage, the waste products from the blood pass into dialysing fluid by diffusion. The purified blood is pumped back in to the patient. This is similar to the function of the kidney, but it is different since there is no re-absorption involved. Normally, in a healthy adult, the initial filtrate in the kidneys is about 180 L daily. However, the volume actually excreted is only a litre or two a day, because the remaining filtrate is re-absorbed in the kidney tubules.



the excreta to exterior. In annelids special kidneys called nephridia are evolved to collect excreta from the coelomic cavity.

In vertebrates, an elaborate well-defined excretory system has developed with kidneys and excretory tubes. The kidney of vertebrates consists of nephrons which filter the blood and form the urine and large amount of ammonia is found in fish excreta. They are called ammoniatelic animals. The birds are called uricotelic animals as their excretory substance is composed mostly of uric acids. In mammals urea is the main excretory products so they are called ureotelic animals.

### Nephron

Each Nephron consists of a filtering apparatus called glomerulus and uriniferous tubules. The glomerulus filters the plasma part of the blood to form urine. The uriniferous tubules reabsorb the substances required in the body from that filtrate and the final urine product contains mostly water and nitrogenous waste products.

## 6.6. NERVOUS SYSTEM

The millions of cells and the scores of different tissues and organs in the body of an animal do not work independently of each other. Their activities are co-ordinated. This means that they work together, performing the various functions at certain times and at certain rates according to the needs of the body as a whole.

One of the most familiar examples of co-ordination is the way in which muscles work together during movement. When a boy runs to catch a ball, for example, he uses hundreds of muscles to move the

joints in his arms, legs and back using informations from his sense organs. The boy's nervous system co-ordinates these muscles so that they contract in correct sequence with the correct degree of power, and for precisely the correct length of time needed to get him to the spot where he can catch the ball. Muscular activities like running to catch a ball, involves many other forms of co-ordination, such as those which increase the rate of breathing and heart beat to adjust blood pressure, remove extra heat from body and maintaining sugar and salt levels in the blood. Furthermore, all these co-ordinations occur as an unconscious process.

Worms have the simplest form of coordinating system where an earthworm has dual nerve cords. Two ganglia acts as brain and eye spots act as photo receptors.

In insects, ganglia are connected by a ventral nerve cord function as brain. Well-developed sensory organ for vision and antennae for olfactory function are present.

In mammals and other well-developed vertebrates this co-ordination is achieved by nervous system and endocrine system.

In simple, the nervous system consists of tissues which conducts "messages" called nerve impulses, at a high speed to and from all parts of the body.

## 6.7. CO-ORDINATION IN PLANTS

How do plants co-ordinate?

Unlike animals, plants have neither nervous systems nor muscles.



Fig. 6.11 Sensitive Plant (Touch-me-not plant)

So, how do they respond to stimuli?

When we touch the leaves of Touch-me-not plant, they begin to fold up and droop.

When a seed germinates, the roots go down, the stem comes up above the soil.

What happens during the above actions?

In the first instance, the leaves of sensitive

Plants show two different types of movements.

1. Movement independent of growth
2. Movement dependent on growth

### Movement- Independent of growth

#### Immediate response to stimulus

This movement is sensitive to plant. Here, no growth is involved but, the plant actually moves its leaves in response to touch. But there is neither nervous tissue nor muscle tissue.

How does the plant detect the touch and how do the leaves move in response?

In touch-me-not plant, if we touch at one point, all the leaflets show the folding movements. This indicates that the stimulus at one point is communicated. But unlike in animal, there is no specialized

tissue in plants for transmitting the information. Plant cells change the shape by changing the amount of water in them resulting in swelling or shrinking and therefore the leaves in touch-me-not plant shrinks.

### Movement dependent on growth:

More commonly, the plants respond to stimuli slowly by growing in a particular direction. Because this growth is directional, it appears as if the plant is moving.

Let us understand this type of movement with the help of some examples.

1. Response of the plant to the direction of light (Phototropism)
2. Response of the plant to the direction of gravitational force (Geotropism)

### ACTIVITY 6.7

1. Go to the field and find the touch-me-not plant.
2. Touch the plant at one point.
3. Observe what happens.

3. Response to the direction of water (Hydrotropism)
4. Response to the direction of chemicals (Chemotropism)

### Phototropism

It is the growth of the stem towards the direction of sunlight.

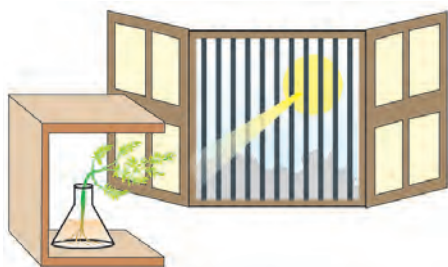


Fig. 6.12 Phototropism

### Geotropism

It is the growth of roots towards the direction of gravitational force.

Roots cannot grow towards sunlight and stem cannot grow towards gravitational force.

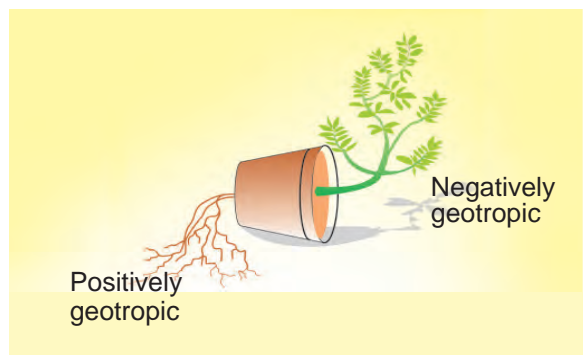


Fig 6.13 Geotropism

### Hydrotropism

The roots of very huge trees grow towards the availability of water source

(e.g) The roots of coconut tree are seen away from the plant for the want of water.

### Chemotropism

This is the movement of plant parts towards the direction of chemicals. (e.g) The pollen tubes grow towards ovule.

## ACTIVITY 6.8

- Fill a conical flask with water.
- Cover the neck of the flask with a wire mesh.
- Keep two or three freshly germinated bean seeds on the wire mesh.
- Take a cardboard box which is open from the side.
- Keep the flask in the box in such a manner that the open side of the box faces light, coming from a window.
- After two or three days, you will notice that the shoots bend towards light and roots away from light.
- Now turn the flask so that shoots are away from the light and roots towards light. Leave it undisturbed in this condition for a few days.
- Have the old parts of the shoot and root changed direction?
- Are there differences in the direction of the new growth?
- What do you understand from this activity?

## 6.9. HORMONES IN ANIMALS

The endocrine system consists of ductless glands and their secretions called hormones. Hormones are bio-chemical substances which act as bio catalysts speeding up the chemical

reactions. These are released into the blood stream and transported around the body. Hormones co-ordinate the physiological activities in our body. A detailed account on hormones is dealt in chapter 3.

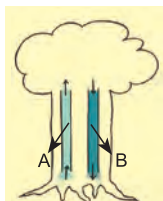
## EVALUATION

### PART A

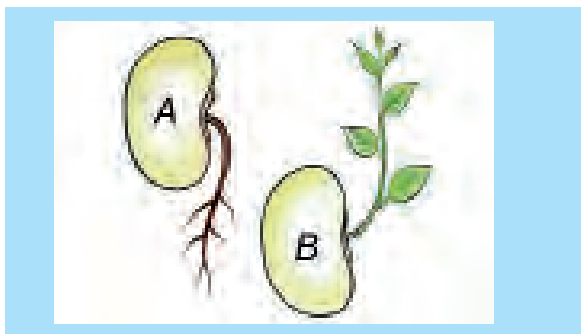
1. In monotropa the special type of root which absorbs nourishment is (Haustoria, Mycorrhizal root, Clinging root, Adventitious root)
2. The product obtained in the Anaerobic respiration of yeast is (Lactic acid, Pyruvic acid, Ethanol, Acetic acid)
3. The roots of coconut tree are seen away from the plant. Such kind of movement of root for want of water is (Phototropism, Geotropism, Chemo-tropism, Hydrotropism)
4. The xylem in the plants are responsible for (transport of water, transport of food, transport of amino acid, transport of oxygen)
5. The autotrophic nutrition requires ( $\text{CO}_2$  and water, chlorophyll, sunlight, all the above)

### PART B

6. Name the types of vascular tissues in the plant stem which are labelled as A and B



- a) Name A and B
- b) What are the materials transported through A?
- c) What are the materials transported through B?
- d) How do the materials in A move upwards to leaves?



7. Observe the above diagram
  - a) Mention the type of movements shown in fig, A and B.
  - b) How does the movement differ from the movement of mimosa
8. Match the methods of nutrition of special organs with suitable examples.

Autotrophs	Mycorrhiza	Cuscutta
Parasites	chlorophyll	Monotropa
Saprophytes	Haustoria	Hibiscus



9. In the process of respiration \_\_\_\_\_ is carbon compound, the lactic is \_\_\_\_\_ carbon compound. into the body through \_\_\_\_\_ and the dissolved oxygen of water diffuses into \_\_\_\_\_.

10. Sugar is converted into alcohol. From the above statement what kind of process takes place? Which micro organism is involved?

11. Pick out the odd one : The parts of the alimentary canal are ( Pharynx, mouth, buccal cavity, pancreas)

12. In human beings air enters into the body through \_\_\_\_\_ and moves into \_\_\_\_\_. In fishes water enters

### PART C

13. Compare the respiration in higher plants with the respiration in lower plants

14. Is the pressure created in xylem enough to conduct water in tall trees. Give reasons.

15. In touch me not plant the leaves show movements. What type of movement have you observed. Discuss.

### NAME OF THE PLANTS IN ENGLISH & TAMIL

SL. NO.	BOTANICAL NAME	NAME IN ENGLISH	TAMIL NAME	HOW IT IS CALLED LOCALLY
1	MONOTROPA UNIFLORA	INDIAN PIPE	மானோடி ரோபா	
2	VISCUM	PARASITIC PLANT	புல்லுருவி	
3	CUSCUTA REFLEXA	PODDERPLANT	அம்மையார் கூந்தல் / சடதாரி	

### FURTHER REFERENCE

- Books :**
1. Modern Plant Physiology **Sinha Narosa**
  2. Fundamentals of plant physiology **Jain .V.K.**



# CONSERVATION OF ENVIRONMENT

## 7. Conservation of Environment

Living organisms live in different surroundings. Some plants and animals completely live in water and some others live on land.

Man also leads life in different surroundings. Some live in cities, some in towns and some in villages. How do they adapt themselves to the place they live in?

Plants, animals, human beings survive with the interaction between them and the non-living things like air, water and land. Human beings depend on the resources of nature. These resources include soil, water, coal, electricity, oil, gas, etc. These resources improve the life style of human beings.

Environmental science can be defined as the study of organisms in relation to their surrounding.

In the course of development, unplanned and vast misuse of natural resources like water, forest produce, land and mineral resources have occurred. This has led to an imbalance in nature and release of many harmful substances in the atmosphere.

Mankind is greatly influenced by the surrounding in view of the problem of over Population, environmental pollution, human survival, pest control and conservation of natural resources.

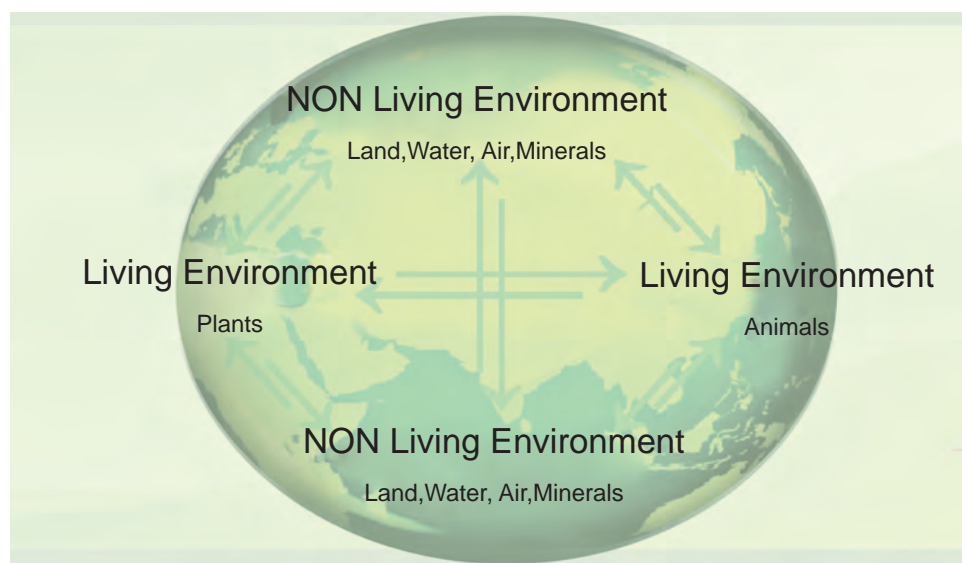


Fig. 7.1 Interaction between non-living and living components in the biosphere

In our daily activities, we generate a lot of materials that we throw away.

- What are some of these waste materials?
- What happens after we throw them away?

Human activities related to livelihood and welfare generate waste. All wastes are pollutants and they create pollution in one way or another. Air, land and water surroundings are affected due to improper disposal of wastes which create an imbalance in the environment.

- What is Pollution?
- What are Pollutants?

**Pollution:** Any undesirable change in the physical, chemical or biological characteristics of air, land and water that affect human life adversely is called pollution.

**Pollutant:** A substance released into the environment due to natural or human activity which affects adversely the environment is called pollutant. e.g. Sulphur-di-oxide, carbon-monoxide, lead, mercury, etc.

## 7.1.CLASSIFICATION OF WASTES

1. Bio–degradable wastes
2. Non–bio-degradable wastes

Substances that are broken down by biological process of biological or microbial action are called bio-degradable waste. e.g. wood, paper and leather.

Substances that are not broken down by biological or microbial action are called non-bio-degradable wastes. e.g. Plastic substances and mineral wastes.

**How to protect us from these hazardous wastes ?**

Why do the government and so many organizations conduct awareness

## ACTIVITY 7.1

- Find out what happens to the waste generated at home. Is there a system in place to collect this waste?
- Find out how the local body (panchayat, municipal corporation or resident welfare association) deals with the waste. Are there mechanisms in place to treat the bio-degradable and non-bio-degradable wastes separately? Calculate how much waste is generated at home in a day.
- How much of this waste is bio-degradable?
- Calculate how much waste is generated in the class room in a day.
- How much of this waste is non bio-degradable?
- Suggest ways of dealing with this waste

## THINK IT OVER

### Disposable cups in trains

If you ask your parents, they will probably remember a time when tea in trains was served in plastic tumblers which had to be returned to the vendor. The introduction of disposable cups was hailed as a step forward for reasons of hygiene. No one at that time probably thought about the impact caused by the disposal of millions of these cups on a daily basis. Some time back, Kulhads, that is, disposable cups made of clay, were suggested as an alternative. But a little thought showed that making these Kulhads on a large scale would result in the loss of the fertile top-soil. Now disposable paper-cups are being used. What do you think are the advantages of disposable paper-cups over disposable plastic cups?



Programmes against using plastics ?

The following methods are adopted for the disposal of harmful waste materials.

### 1. Land Fills

There are permanent storage facilities in secured lands for military related liquid and radioactive waste materials. High level radioactive wastes are stored in deep underground storage.

### 2. Deep well injection

It involves drilling a well into dry porous material below ground water. Hazardous waste liquids are pumped into the well. They are soaked into the porous material and made to remain isolated indefinitely.

### 3. Incineration

The burning of materials is called incineration.

Hazardous bio-medical wastes are usually disposed off by means of incineration. Human anatomical wastes, discarded medicines, toxic drugs, blood, pus, animal wastes, microbiological and bio-technological wastes etc., are called bio-medical wastes.

## Management of non-hazardous wastes – solid waste management

### Reuse and recycling technique

The separating out of materials such as rubber, glass, paper and scrap metal from refuse and reprocessing them for reuse is named as reclamation of waste or recycling.

### Paper

(54% recovery) Can be repulped and reprocessed into recycled paper, cardboard and other products.

### Glass

(20% recovery) Can be crushed, re-melted and made into new containers or crushes used as a substitute for gravel or sand in construction materials such as concrete and asphalt, Food waste and yard wastes (leaves, grass etc.,) can be composted to produce humus soil conditioner.

## 7.2. WATER MANAGEMENT

Due to increasing demands for water and reduced availability of fresh ground water resources, urgent measures have to be taken to conserve each and every drop of water that is available.

Clean and fresh water is essential for nearly every human activity. Perhaps more than any other environmental factors, the availability of water determines the location and activities of human beings.

### Can you list out the reasons for increasing demand of water?

#### 7.2.1. Sources of water

Water is a basic natural resource and valuable asset to all nations. Human beings depend on water for all their needs such as bathing, washing, cooking, transportation and power. Water in India is of two kinds. Salt water and fresh water. Fresh water is obtained from rain water, surface water and ground water.

The main sources of water are rain and snow which form a part of the hydrological cycle.

### Surface water

India is blessed with a number of rivers, lakes, streams and ponds.

### Ground water

Aquifers are under ground reserves of fresh water.

In the water table, water that percolates into the ground through porous rocks is ground water. These porous rocks are saturated with water to a certain level. The upper layer of water level is the watertable. The ground water is important for plant growth, man also taps this water through tube wells and bore wells. Scanty rainfall and unnecessary felling of trees affect the ground water level.

## 7.2.2. Fresh water management

To meet out the water scarcity we need several ways to increase the water supply.

### i) Seeding clouds

Seeding clouds with dry ice or potassium iodide particles sometimes can initiate rain if water laden clouds and conditions that favour precipitation are present.

### ii) Desalination: (Reverse osmosis)

Desalination of ocean water is a technology that has great potential for increasing fresh water. Desalination is more expensive than most other sources of fresh water. In desalination, the common methods of evaporation and re-condensation are involved.

### iii) Dams, reservoirs and canals

Dams and storage reservoirs tap run-off water in them and transfer the water

from of excess to areas of deficit using canals and underground pipes.

### iv) Water shed management

The management of rainfall and resultant run-off is called water shed management. Water shed is an area characterized by construction of small dams to hold back water which will provide useful wildlife habitat and stock watering facilities.

### v) Rain water harvesting

Rain water harvesting essentially means collecting rain water from the roof of building or courtyards and storing it under ground for later use. The main idea in harvesting rain water is to check the run-off water. The rain water that falls on the roofs of buildings or in courtyards is collected through pipes and stored in under ground tanks of the buildings fitted with motor for

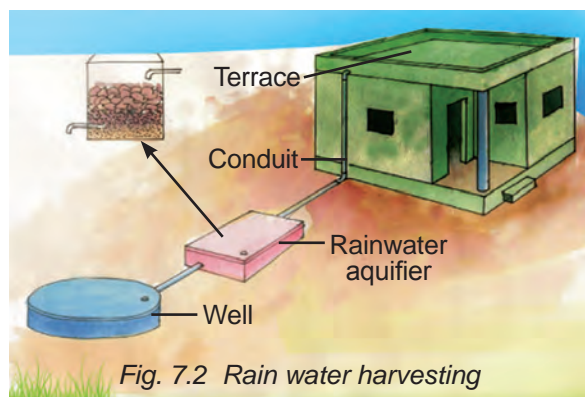


Fig. 7.2 Rain water harvesting

lifting water for use. The process of rain water harvesting is not only simple but also economically beneficial. It helps in meeting the increased demand for water, particularly in urban areas and prevent flooding of living areas.

### vi) Wetland conservation

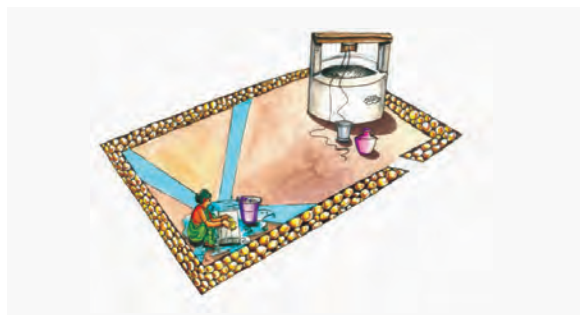
It preserves natural water storage and acts as aquifer recharge zones.

### vii) Domestic conservation

As an individual, every one can reduce the water loss by taking shower, using low-flow taps, using recycled water for lawns, home gardens, vehicle washing and using water conserving appliances.

### viii) Industrial conservation

Cooling water can be recharged and waste water can be treated and reused.



**Fig. 7.3 Domestic conservation method of water**

## 7.3. WILDLIFE SANCTUARIES

### Wildlife

All non-domesticated and non-cultivated biota found in natural habitat are termed 'wildlife'. It includes all the natural flora and fauna of a geographic region. Wildlife is an asset to be protected and preserved to our own advantage and to the benefit of future generations.

There are approximately 400 varieties of reptiles, 200 varieties of amphibians, 3000 varieties of fishes, 3000 species of birds, 20,000 species of flowering plants and 4100 species of mammals found in our country according to the latest census estimate.

It is essential to protect and conserve wildlife because they have aesthetic, ecological, educational, historical and scientific values, a good biotic diversity is essential for ecological balance. Large scale destruction of wildlife could lead to ecological imbalance. Wildlife also adds aesthetic value and from this, eco-tourism is being promoted in a big way by several countries. Wildlife and their products could be of great economic value if utilized properly. The invulnerable plants could yield products of immense medicinal value in future. Wildlife also forms a store of vast genetic diversity which could be properly used with advances in genetic engineering. Thus wildlife has been of great value in the past and will continue to be so in the future. Protection and conservation of wildlife, therefore, gains importance.

### SANCTUARIES

Wildlife sanctuary is an area constituted by competent authority in which hunting or capturing of animals is prohibited except by or under control of the highest authority responsible for management of the area.

Wildlife sanctuaries were established in India in the pursuit of conserving wildlife which was suffering due to ecological imbalance caused by human activities. There are 89 National parks, 500 wildlife sanctuaries, 27 Tiger reserves, 200 Zoos and 13 Biosphere reserves in the country covering an area of 1.6 lakh sq.km.

## 7.4. BALANCE IN ECOSYSTEM

### What is Ecosystem?

- Fish lives in Water.
- Tiger lives in Forest.

*Important sanctuaries in Tamilnadu*

Name	Location	Animals
Indira Gandhi Wildlife, Sanctuary	Western Ghats.	Tiger, leopard, porcupine, nilgiris tahr, civet cat, elephant, gaur, pangolin.
Kalakkadu Wildlife Sanctuary.	Tirunelveli District	Lion tailed macaque, sambhar, sloth bear, gaur, flying squirrel.
Srivilipathur Grizzled squirrel wildlife Sanctuary	Virudhunagar District	Grizzled squirrels, mouse deer, barking deer, tree shrew.
Vedathangal Bird's Sanctuaries	Kancheepuram District	Cormorants, egrets, grey heron, open-billed stork, white bears, shovellers, pintails, stets, sandpipers.
Mudumalai wildlife Sanctuary	The Nilgiris	Elephants, gaur, langur, tigers, leopards, sloth bear, sambhar, wildbear, jackal, porcupine, mongoose.
Viralimalai	Trichy District	Wild peacocks
Gulf of Mannar marine National Park.	Coast of Rammad and Tuticorin district.	Coral reefs, dugong, tuties, dolphins, balanoglossus,
Mundhanthurai wildlife Sanctuary.	Tirunelveli District	Tiger, bonnet macaque, langurs, sloth bear, wild dog.
Vallanadu Blackbuck Sanctuary.	Tuticorin District	Blackbuck, jungle cat, hare, mongoose.
Arignar Anna Zoological Park	Vandalur	Lion, elephant, tiger, monkeys.
Mukkurthi National Park	The Nilgiris	Tigers.
Point calimere wildlife Sanctuary	Nagapattinam district	Chital, wild bear, plovers, stilts, bonnet macaque.
Anamalai wildlife sanctuary	Slopes of western ghats.	Civet cat, porcupine, gaur, tiger leopard, nilgiri tahr.



### Important National Parks, wildlife sanctuaries and reserves.

Bandhipur National Park (It is a tiger reserve too)	Karnataka	Indian bison, chital, sloth bear, elephants.
Corbett National Park (India's first national park) (Tiger reserve too)	Uttaranchal	Tigers, chital, elephants, leopard, Jungle cat and sloth bear.
Gir National Park	Gujarat	Asiatic Lion
Kanha National Park (Tiger reserve)	Madhyapradesh	Deer Tiger, Wilddog, chital.
Bharathpur Bird sanctuary	Rajasthan	374 special of bird, e.g. Indian darters, spoonbills, painted stock, open billed stork, black necked stork etc.,
Manas wildlife sanctuary (Tiger reserve)	Assam	Hispid hare (rere), pygmy hog, golden langue
Sunderbans National Park (Tiger reserve)	West Bengal	Unique Royal Bengal Tigers.

### How can they lead their life in the above habitats? Pond Ecosystem

A community of organisms that interact with one another and with the environment is called an ecosystem.

The Ecosystem is of two types, namely aquatic and terrestrial.

### What are the major components in Ecosystem?

There are four major components, namely:

1. Abiotic factors
2. Producers
3. Consumers
4. Decomposers.

Producers, consumers and decomposers are biotic factors.

An example for aquatic ecosystem is a pond.

### Abiotic factors

It includes light, temperature, hydrogen ion concentration, inorganic substances like  $\text{CO}_2$ ,  $\text{H}_2$ ,  $\text{O}_2$ ,  $\text{N}$ ,  $\text{PO}_4$ ,  $\text{CO}_3$  and  $\text{S}$  and organic substances like carbohydrates, proteins and lipids.

### Biotic factors

It includes producers and consumers. Producers are the water living plants like *Hydrilla*, *Vallisneria* etc., and phytoplankton like *Chlamydomonas*, *Volvox* and *Spirogyra*.

### Primary consumers or herbivores

Zooplanktons like insects, larvae of Dragon-fly consume the phytoplanktons.

### Secondary Consumers

These are certain fishes, frogs, water beetles etc., which feed on the primary consumers in the pond.

### Tertiary Consumers

These are big fishes and kingfisher that feed on small fishes.

### Decomposers

Several bacteria and fungi form the decomposers in the pond.

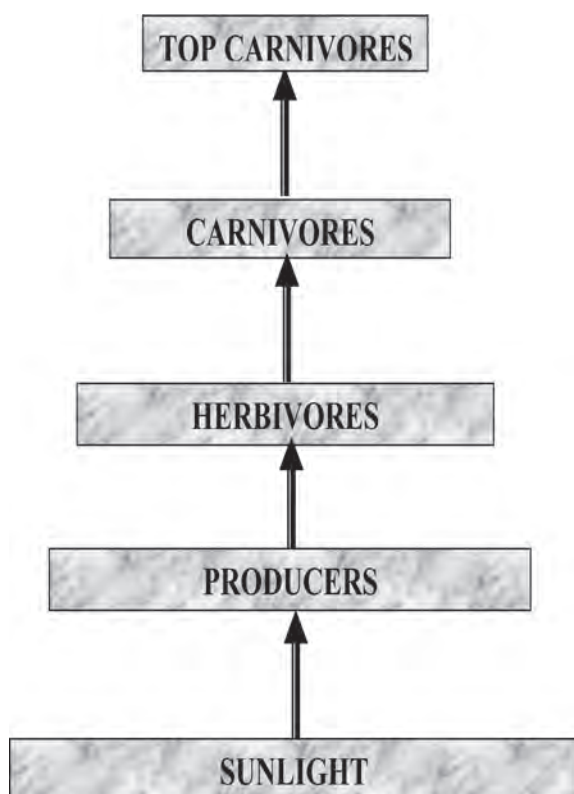


Fig. 7.4 Flow of energy in an ecosystem

### BALANCE IN ECO-SYSTEM

A balanced ecosystem is an ecological community together with its environment and functioning as a complex unit.

## ACTIVITY 7.2

- While creating an aquarium did you take care not to put an aquatic animal which would eat others? What would happen otherwise?
- Make groups and discuss how each of the above groups of organisms are dependent on each other.
- Write the aquatic organisms in order of who eats whom and form a chain of at least three steps.
- Would you consider any one group of organisms to be of primary importance? Why or why not?

An ecosystem is maintained by the balance in nature such as the balance between hawks and mice, if hawk population is larger than the mice population, then it is not balanced.

They are balanced between resources like a banana tree and monkeys. If the banana trees stop growing, the monkeys won't get bananas.

An ecosystem maintains the balance between the number of resources and the number of users or the balance between prey and predators.

### What is food chain and food web?

Various organisms are linked by food chains in which the food energy is passed from one organism to another in a linear fashion.

e.g. Food chain of a grassland ecosystem.



Grass → Grass hopper → Frog → Snake → Eagle  
 (Producers) (Herbivores) (Primary consumer) (Secondary consumer) (Tertiary consumer)

Fig. 7.5 Grassland ecosystem

### ACTIVITY 7.3

- Go to a pond and observe the organisms that live in the pond.
- List out the organisms.
- Prepare a chart of food chains

### Food Web

The food chains are interlinked to form food webs. So every component of the ecosystem is connected to one another.

### How is the ecosystem maintained?

There are many factors which maintain the harmony in an ecosystem naturally. Disturbing any one factor could have a drastic impact upon the living conditions of other organisms that will result in an imbalance. For example, removal of trees and vegetation would affect both land and water ecosystems as there will be no food for organisms. Killing animals and polluting land, air and water also disturb the balance in nature.

In order to maintain the eco-balance in an ecosystem, there should be recycling of nutrients, minerals, and water. Careful use of natural resources will maintain the eco-balance. Thus eco-balance or ecological balance is the maintenance of

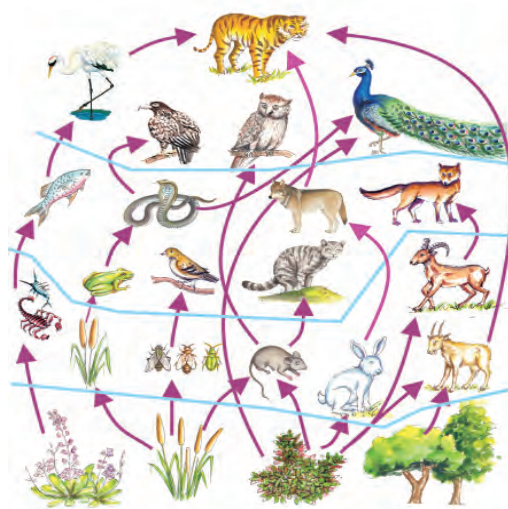


Fig. 7.6 Food web

balance between living components and its resources of an ecosystem, so that it remains a stable environment community for the better functioning of the organisms.

### Bio - Geo chemical cycles

In an ecosystem, the energy from the sun is fixed by the plants. Then it is transferred to herbivores and carnivores. i.e. the energy flows in one direction only. But the minerals required in the ecosystem are continuously absorbed by the plants and transferred to animals. As the minerals are removed from the soil, they have to be replaced or cycled. These minerals are returned to the soil by the decomposition of dead and decaying materials by saprophytic organisms such as bacteria and fungi (You have studied the cycles in earlier classes in detail.)

## 7.5. COAL AND PETROLEUM

### 7.5.1 Coal

Coal is a compost primarily of carbon along with variable quantities of other elements chiefly sulphur, hydrogen, oxygen and nitrogen.

Coal is a fossil fuel and is the largest source of energy for the generation of electricity world wide, as well as one of the largest worldwide sources of  $\text{CO}_2$  emissions. Gross  $\text{CO}_2$  emission from coal usage is high and more than those from petroleum and about double the amount from natural gas.



Fig. 7.7 Coal

Coal is obtained through mining or in open pits. Coal is primarily used as a solid fuel to produce electricity and heat through combustion. When coal is heated in air, coal burns and produces mainly carbon-di-oxide gas. Coal is processed in industry to get some useful products such as coke, coal tar and coal gas.

#### Environmental effects of coal burning

1. Generation of waste products which contain mercury, uranium, thorium, arsenic and other heavy metals, which are harmful to human health and environment.
2. Sulphur particles present in the coal will cause acid rain..
3. Interference with ground water and water table levels.
4. Contamination of land and water ways.
5. Dust nuisance.
6. Release of  $\text{CO}_2$ , a green house gas, which causes climate change and global warming.
7. Coal is the largest contributor to the man-made increase of  $\text{CO}_2$  in the air.

#### ACTIVITY 7.4

- Visit Neyveli lignite corporation.
- See how the coal is mined.
- Discuss with your classmates about the uses of coal.

#### 7.5.2 Petroleum

In modern life today, we are inseparable from petrol and petroleum products. Petroleum or crude oil is a naturally occurring, toxic, flammable liquid consisting of a complex mixture of hydrocarbons and other organic compounds that are found beneath the earth's surface.

#### Do you know how does petroleum form?

Petroleum was formed from organisms living in the sea. After the death of those organisms, their bodies settled at the bottom of the sea and were covered with layers of sand and clay. Over millions of



years, absence of air, high temperature and high pressure transformed the dead organisms into petroleum and natural gas.

Many useful substances are obtained from petroleum and natural gas. These are used in the manufacture of detergents, fibers (polyester, nylon, acrylic etc.), polythene and other plastic substances. Hydrogen gas, obtained from natural gas, is used in the production of fertilizers (urea). Due to its great commercial importance, petroleum is also called 'Black Gold'.

## Environmental effects

### Oil Spills

1. Crude oil (refined fuel) spills from tanker ship and accidents have damaged natural ecosystem.
2. Oil Spills at sea are generally causing more damage than those on land. This can kill sea birds, mammals, shellfish and other organisms, because of their lateral spreading on water surface.

### Tar Balls

A tar ball is a blob of oil which has been weathered after floating on the ocean. Tar balls are aquatic pollutants in most of the seas.



Fig 7.8 Petroleum Industry

## Alternatives to petroleum – based vehicle fuels

1. Internal combustion engines (Biofuel or combustion hydrogen)
2. Electricity (for e.g. all electric (or) hybrid vehicles), Compressed air or fuel cells (hydrogen fuel cells).
3. Compressed natural gas used by natural gas vehicles.

## 7.6 GREEN CHEMISTRY

Green chemistry is the design of chemical products and processes to reduce or eliminate the use and generation of hazardous substances.

The concept of green chemistry was introduced in 1995. The Green Chemistry Institute was recently created and the Presidential Green Chemistry challenge awards were established in 1999.

### MORE TO KNOW

Many countries are making commitments to lower green house gas emissions according to the Kyoto protocol.

### ACTIVITY 7.5

Coal is used in thermal power stations and petroleum products like petrol and diesel are used in means of transport like motor vehicles, ships and aeroplanes. We cannot really imagine life without a number of electrical appliances and constant use of transportation. So, can you think of ways in which consumption of coal and petroleum products can be reduced?

- Greener reaction conditions for an old synthesis e.g. replacement of an organic solvent with water or the use of no solvent at all)
- A greener synthesis for an old chemical (e.g. a synthesis which uses biomass rather than petrochemical feed stock or the use of catalytic rather than stoichiometric reagents).
- The synthesis of a new compound that is less toxic but has the same desirable properties as an existing compound. (e.g. a new pesticide that is toxic only to target organisms and bio-degrades to environmentally benign substances)

Green chemistry / technology has been developed in almost all branches of chemistry including organic, bio-chemistry, inorganic, polymer, toxicology, environmental, physical, industrial etc.

### The Principles of Green Chemistry

- It is better to prevent waste generation than to treat or clean up waste after it is generated.
- Wherever practicable, synthetic methodologies should be designed to use and generate substances that possess little or no toxicity to human health and the environment.
- Chemical products should be designed to preserve efficacy of function while reducing toxicity.



Fig. 7.9 Green chemistry

### List of some of the products produced by the process of green chemistry

- Lead free solders and other product alternatives to lead additives in paints and the development of cleaner batteries.
- **Bio-plastics:** Plastics made from plants including corn, potatoes or other agricultural products.
- Flame resistant materials.
- Halogen free flame retardants.

e.g. silicon based materials can be used.

### Future products

- A raw material feedstock should be renewable rather than depleting whenever technically and economically practical.
- Catalytic reagents are superior to stoichiometric reagents.
- Green Chemistry is applicable to all aspects of the product life cycle as well. Finally, the definition of green chemistry includes 'The term "hazardous". It is important to note that green chemistry is a way of dealing with risk reduction and pollution prevention.

### PVC and Lead

New lead free solders with lower heat requirements are being developed.

### Beware of Green washing

Green chemistry is not a panacea. We must be vigilant in making sure that what is called "Green Chemistry really pushes towards a more sustainable world and not simply green washing".

## 7.7. SCIENCE TODAY – TOWARDS A GLOBAL VILLAGE

### Global village

Global village is the term used to mean that world had shrunk into a village by means of different media types, most especially the world wide web, making it easy to pass across messages (like news) thereby making the world become a single village where people can easily contact each other quicker.

### What is global village?

A term that compares the world to a small village, where fast and modern communication allows news to reach quickly. The use of electronics for faster communication is a global village concept.

### What is the global electronic village?

Global electronic village (GEV) is a term used to refer to a village without borders; it refers to connecting people around the world technologically through Information Communication Technologies (ICTS).



*Fig. 7.10 Global village*

Global Village (GV) is located at a distance of 12 kms from Bangalore on the Bangalore - Mysore Expressway and easily accessible by road. Spread over 110 acres of greenery, the project will house a cluster of technology companies in a campus type setting. The Buildings nestle among the lush green of manicured lawns, coconut palms and an eclectic mix of old trees in a serene and dust free environment. The Technology Campus has been conceptualized and designed

by a team of reputed Indian and international architects and landscape designers. Ample residential facilities are in close proximity to the campus. The estimated driving time to GV from the heart of Bangalore city is approximately 20 minutes.

Kshema Technologies have the distinction of being the first of GTV's companies to move into the campus with an 80,000 sq ft facility to house 600 employees.

The term global village was coined by Marshall McLuhan. He emphasized that “this forces us to become more involved with one another from countries around the world and be more aware of our global responsibilities”. Similarly, web-connected computers enable people to link their web sites together. This new reality has implications for forming new sociological structures within the context of culture.

## EVALUATION

### PART A

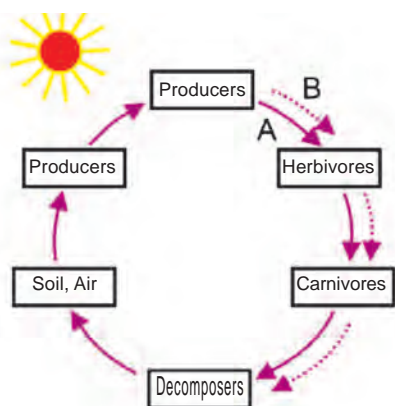
Multiple choice questions

- Which of the following groups contain only bio degradable items?  
(Grass, flowers and leather ; Grass, wood and plastic ; Fruit peels, cake and plastic ; Cake, wood and grass)
- Which of the following constitute a food chain?  
(Grass, wheat and mango ; Grass, goat and human ; Goat, cow and elephant ; Grass, fish and goat)
- Which of the following are environmental friendly practices?  
(carrying cloth bags to carry the purchase items during shopping, switching off light and fans when not in use, use the public transport, all the above)
- what is called as ‘black gold’?  
(hydrocarbons, coal, petroleum, ether)
- odd one out.  
(Plants, grasshopper, frog, tiger, snake)
- Example for product of green chemistry is  
(plastic, paper, bio plastics, halogen flame retardants)
- \_\_\_\_\_ green house gas which causes climate change and global warming.  
(hydrogen, oxygen, nitrogen, carbondioxide)
- The \_\_\_\_\_ forms decomposer in the pond ecosystem (plants, bacteria, frog, phytoplanktons)
- \_\_\_\_\_ chemical is used in seeding clouds (potassium iodide, calcium carbonate, sulphurdioxide, ammonium phosphate)
- Example for fossil fuel is  
(copper, iron, magnesium, coal)

### PART B

- Study the food chain below, correct it and convert into a pyramid of energy.  
Mulberry -> Sparrow -> Caterpillar -> Kite
- Study the illustration and answer the question.
  - which line (A or B) represent the flow of energy? Why do you say so?
  - Give an example of a decomposer.
- Study the food chain.  
Paddy -> Mouse -> Snake -> Kite  
If the producer has a STORED UP ENERGY OF 500 k CAL. How much of it goes to the organism at the third trophic level get from it?

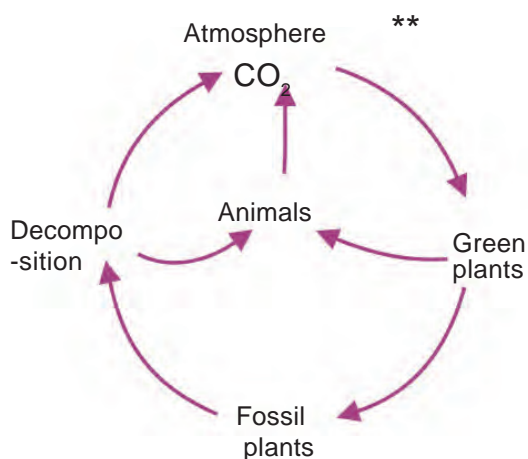




- 14.
- Name the processes noted as no. 1 and 3
  - Define the process 1
  - Name any one fossil fuel. (\*\*)

### PART C

- Classify the following substances – wood, paper, plastic and grasses.
  - Give detailed account on your classification.
16. In your area there is scarcity of water due to this the people are affected.



So what are the measures to be taken by you to meet out the scarcity of water.

17. Smoke, smoke everywhere smoke. Do you agree this situation is good for health. List out the harmful effects of coal burning.



Sholas and grasslands of western ghats are the sources of all our South Indian rivers. All the hillocks in the upper mountains have this unique ecosystem, which we cannot create.

### FURTHER REFERENCE

- Books:**
- Plant Ecology **Sheela.R.S** and **Chandel .P.S**
  - New development in green chemistry **V.K. Atlerwalia, M. Kidwai**

**Website:** [www.enviroliteracy.org/article.php/600.html](http://www.enviroliteracy.org/article.php/600.html)