COMPLETE NOTES

11TH BIOLOGY FULL BOOK NOTES

Chapter 1

INTRODUCTION

Q.1 (a) Define Biology.
(b) What are the general characteristics of life?

Ans. (a) BIOLOGY

"The study of living things is called Biology". It is the science which helps to understand the different living things in the environment. In an environment, living and non living things have inter-relationship. This branch of science explains structure, activity, chemical nature and transmission of characters from generation to generation.

"Bio" means life and "logy" means knowledge.

(b) LIFE

Life is not a subject of Biologist. The subject of biologist deals only with work of life. What is life? It is subject of philosophers and theologians.

Life, for Biologist:

The field of biologist is first of all to distinguish between living and non-living. Secondly, the life is the normal activity of protoplasm. In other words, *"protoplasm is second name of life"*.

An organism has certain characters like respiration, growth, movement, intake of water, excretion, development, self regulation etc. It has well developed organization. All these activities must have protoplasm. Actually, *protoplasm is the seat of life*.

Making and breaking of molecules provide energy to organisms. In case of reproduction, gene has important role. Volume or size depends on number of cells. Division of labour of cells is very important factor for organization in a complex organism. In unicellular cell, organelles are very important for regulations.

Q.2 What do you know about the major aspects of Biology? Define basic branches of Biology.

Ans. ASPECTS OF BIOLOGY

A living thing has many aspects. Each aspect requires specific consideration due to its particular function in the body. Thus Biology is divided into different divisions and branches on the basis of different aspects. *The simplest organism like Amoeba and most complex organism man,* both have different aspects of like locomotion, digestion, structure of cell and metabolic process. For example, disease, internal structure of any cell, tissue or organ, development of foetus or embryo, cell's organelles and cell's chemistry, function of different cells, tissue or organs etc. are different important considerations and aspects of every living body. These aspects are studied under certain field, branch or science:

SOME BASICS

BRANCHES OF BIOLOGY

The name of branches are mostly Greek and Latin words:

Ecology is the branch of biology which deals with interrelationship between organism and environment. Embryo means early developmental stage, so, "The study of early developmental stage is called ***Embryology".*** Study of function is called ***Physiology.*** *Physio* means function. Study of structure and form is known as ***Morphology***. Morpho means structure.

Anatomy is the study of internal structure of living things. The prefix "Palaeo" is for fossils. So, ***Palaeontology*** is the study of plant fossils and animal fossils. ***Palaeobotany*** and ***palaeozoology*** are further branches of ***Palaeontology***. Study of cell is ***Cytology*** and study of tissue is known as *Histology*.

Evolution is the gradual changes in organisms with the passage of time.

Biogeography: The study of organism distribution on the earth is called ***Biogeography. Zoogeography*** means animal distribution on the earth so phytogeography means plant distribution on the earth.

Genetics, the study of inheritance in which transmission of characters from generation to generation are considered.

Q.3 Define the branches of Biology of broad spectrum and field level.

Ans. **BRANCHES OF BIOLOGY AT FIELD LEVEL AND BROAD SPECTRUM LEVEL**

Molecular Biology:

The study of cell organelles, cells and organism on the basis of molecular level.

Example: Cell membrane is composed of *proteins* and *lipid* with specific arrangement.

Environmental Biology:

The study of the interrelationships between organisms and environment is called environmental biology. OR "The study of organisms in relation to inorganic and organic (abiotic) factors is called environmental biology or ecology".

A sum of effects of all external conditions on organism is environment.

Microbiology: (*micro means small*):

The study of microorganisms like *bacteria, virus, protozoa,* small algae and fungi is called microbiology.

Fresh Water Biology:

The biological study of the organisms which live in fresh water i.e. rivers, tanks, lakes etc.

Marine Biology:

The biological study of the organisms which live in seas and oceans on all aspects.

Parasitology:

The study of structure, transmission, life cycle and parasitism of a parasite is called parasitology.

Human Biology:

The study of man on structural, functional, cellular, histological, ecological, molecular and embryological basis is known as human biology.

Social Biology:

The study of social relationship or behavior of organisms in the community.

(OR)

The branch of biology which deals with the study of behavior of organisms on the basis of *physiological and psychological* factors is called social biology.

Biotechnology:

The branch of biology which deals with *manufacture of biological products* at industrial level. Antibiotics, enzymes, hormones and cheese from milk etc.

Q.4 What type of elements are present in a cell? Write the %age of common elements.

Ans. CHEMICAL REACTIONS AND BIOLOGY

Many chemical reactions take place in a cell of an organism. Even a simplest unicellular organism has many hundred chemical reactions. ***Almost 92 chemical elements are found in a cell***. Almost 16 elements are commonly used for preparation of different compounds. These elements are called Bioelements.

* **The percentage of six commonest bio-elements.**

(1)	Oxygen	65%	(2)	Carbon	18%
(3)	Hydrogen	10%	(4)	Nitrogen	10%
(5)	Calcium	02%	(6)	Phosphorus	01%

* **The elements below than 1%**

(7)	K	0.035%	(8)	S	0.25%

(9)	Cl	0.15%	(10)	Na	0.15%
(11)	Mg	0.05%	(12)	Fe	0.004%
(13)	Cu	trace	(14)	Mn	trace
(15)	Zn	trace	(16)	I_2	trace

Q.5 *What is biological organization? Discuss subatomic, atomic, molecular, organelles, cell and tissue level organizations.*

Ans. BIOLOGICAL ORGANIZATION:

Sixteen chemical elements are present in all cells. These sixteen elements have different properties in living, while in non-living play entirely different kind of role. Different type of processes in regular fashion are essential for living organism. Some very complex processes are routine of organism for structure and function. These reactions are also necessary for stability in environments.

Protoplasm is a living substance. Therefore, for the understanding of life the study of different steps, levels and phenomena is must.

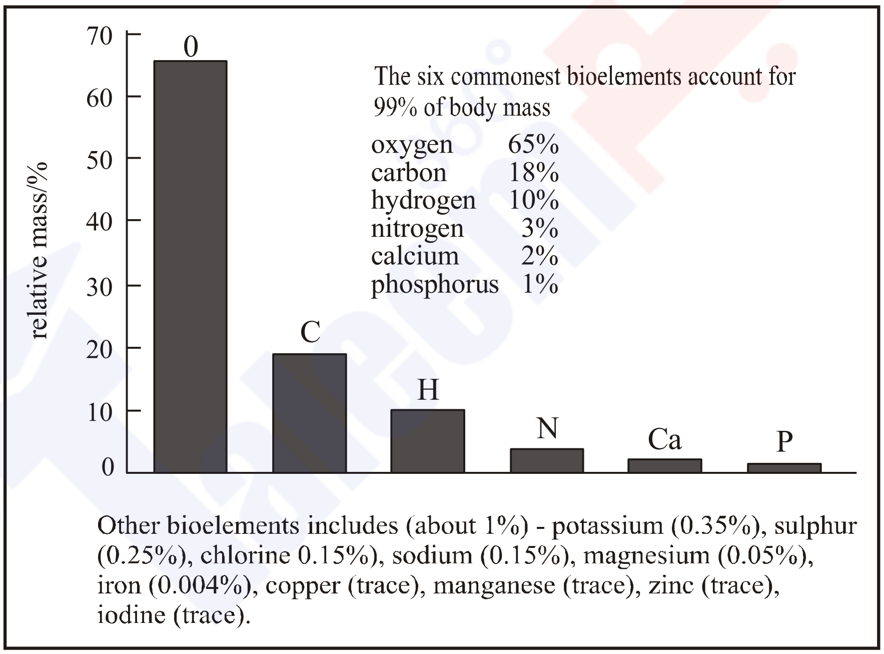


Fig. Percentage composition of bioelements by mass of a human being

(i) ATOMIC AND SUB-ATOMIC LEVEL:

Electrons, protons and neutrons are sub atomic particles. They form atoms. All living and non living things basically formed by atoms. *Atoms are basic simplest unit of living and non living matter.*

(ii) MOLECULAR LEVEL:

Different atoms combine and form molecules which are formed by ionic and covalent bonds. Molecule is a stable form in organism. There are great variety of molecules and complexity in organism. Two main kinds of molecules are micromolecules and macromolecules on the basis of molecular weight.

Micromolecules: The molecules with *low molecular weight* are called micromolecues i.e. CO_2, H_2O etc.

Macromolecules: The molecules with *high molecular weight* are called macromolecules i.e. starch, proteins etc.

Another division of molecules is organic molecules and inorganic molecules:

Organic Molecules: If a molecule contains C and H, it is considered as organic molecule e.g. CH_3OH, C_6, H_{12} O_6, H_2N-C-COOH etc.

Inorganic Molecule: When a molecules does not contain C and H together, it is inorganic molecule e.g. CO_2, H_2O, NaCl, HCl, H_2SO_4, NaOH etc.

(iii) ORGANELLES AND CELL LEVEL

Cells and cell organelles are formed by the particular arrangements of micro-molecules and macromolecules.

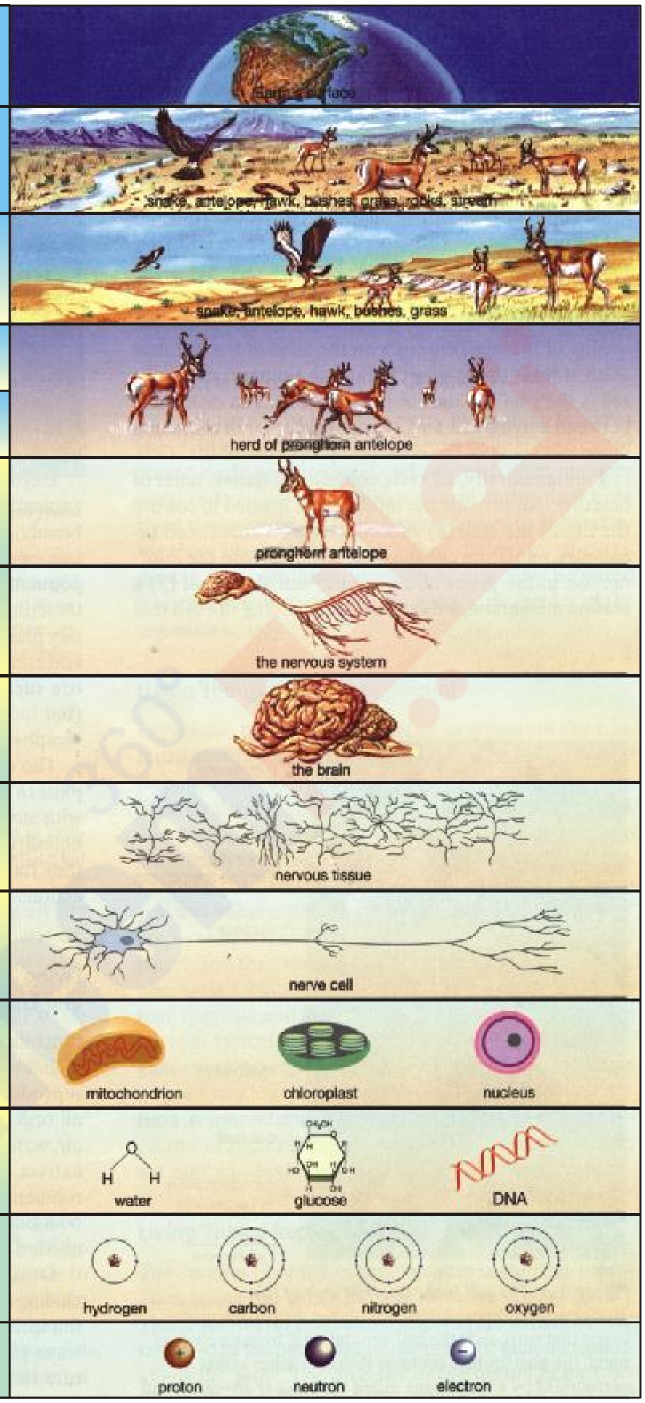
(a) Organelles or Subcellular Structures: The small bodies inside the cells which perform specific functions as subunits are called organelles or sub cellular structure e.g. mitochondria, ribosomes, golgi bodies, endoplasmic reticulum etc. The overall activity of cell depends upon cell organelles.

(b) Division of Labour of Organelles: Each organelle has special role in the cell. *Mitochondria is power house, ribosomes produce the proteins and cell membrane provides support, protection and shape etc.*

Cell is the basic structural and functional unit of organism. It may be divided into prokaryote and Eukaryote on the basis of absence and presence of nucleus:

Prokaryote: Cell *without nucleus* is called prokaryote. It has limited organelles. Mitochondria, golgi bodies etc. absent in prokaryotes.

Biosphere	That part of earth inhabited by living organisms; includes both the living and nonliving components
Ecosystem	A community together with its nonliving surroundings
Community	Two or more populations of different species living and interacting in the same area
Population	Members of one species inhabiting the same area
Species	Very similar, potentially interbreeding organisms
Multicellular Organism	An individual living thing composed of many cells
Organ System	Two of more organs working together in the execution of a specific body function
Organ	A structure normally composed of several tissue types that form a functional unit
Tissue	A group of similar cells that perform a specific function
Cell	The unit of life
Organelle	A structure within a cell that performs a specific function
Micro-molecules and Macro molecules	A combination of atoms
Atom	The smallest particle of an element that retains the properties of that element
Subatomic Particle	Particles that make up an atom



Eukartyote: Cell *with well defined nucleus* is called eukaryote. Eukaryotes have many membranous organelles.

The simplest organisms like Amoeba, paramecium, volvox and chlamydomonas are unicellular. On the other hand multicellular organisms like fungi, algae, invertebrates and man are complex with large number of cells and cell division respectively.

(iv) TISSUE LEVEL: "A group of similar cells which performs a specific function is called Tissue".

Examples:

Epidermis is a protective tissue.

Xylem is a water conducting tissue.

Phloem is a food transporting tissue.

Muscle is a contracting and relaxing tissue.

Gland is a secretory tissue.

In an organism, cells make tissue, and tissues construct organ.

Q.6 Define organ and system, OR explain organ and system.

Ans. ORGAN AND SYSTEM

ORGAN: ***"A specific structure of system which is formed by different tissues is called organ".***

Each organ of a system performs particular role. In other words, tissues have division of labour in organs and organs have division of labour in systems too.

Examples: ***Stomach*** is a organ of digestive system.

Heart is an organ of circulatory system.

Lung is a organ of respiratory system.

When stomach is considered as tissue level, there are secretory tissues (glands) and muscular tissues at different places in the stomach. Secretory tissues secrete enzymes and other chemicals for digestion. Muscular tissues help in contraction and relaxation for mechanical roles. Quality and quantity of organs depend upon efficiency of tissues. Thus performance of system depends upon the efficiency of organs.

Animals have well organized organs than plants. Any way, roots anchor the plants. Flower or cones are reproductive structures. Leaves manufacture food.

SYSTEM: ***"A system is established by the co-ordination of organs in an organism".***

For example, the sequence of buccal cavity, pharynx, oesophagus, stomach, small intestine and large intestine like organs form digestive system.

Higher animals (vertebrates) and higher plants (gymnosperm and angiosperms) have well developed systems than lower animals and lower plants. Complexity of organisms increase with increase of systems. Similar is the case of systems organs, the complexity of systems and organs depends upon number of organs and tissues respectively.

Q.7 *Write down the levels of individual, population, community and ecosystem.*

Ans. ORGANISM AND INDIVIDUAL

"A living thing with particular systems and specific characters is called individual or organism".

An organism has unity of systems in the body for normal activities. Each organisms in its company has special characteristics or individuality. *"The group of closely resembled organisms freely interbreed and reproduce fertile off spring is called Species".* So, the individuality of the organism of some species is VARIATION. It is due to gene's effect.

Coordination among different systems in an organism is surety of balance functions. When a man is busy in hard exercise, it needs a much energy because the muscular tissues get maximum business. The attains of energy depends upon respiration, so process of respiration increased. Process of respiration further depends upon oxidation reaction. On the other, supply of energy, food or oxygen depends upon circulatory system. In this way, chief organ of circulatory system i.e. HEART works according to demand of active muscle cells. Heart beat also increase. There is interdependence among different systems in an individual for proper function. Nervous system and endocrine system ensure the coordination among systems.

Neurons of nervous system and hormones of endocrine system coordinate the different systems of the body. The activities become regular, organized, balanced, united and timely by neurons and hormones. Some activities or changes occur by the interaction of environment.

POPULATION

"A group of the same species in an area is called population".

Example: Population means human beings in a city. Rats in the field of rice.

All human beings are a single species. The group of human beings will be population. In biological organization, population is a higher level.

Explanation: In a population the members of some species have specific characteristics like colors, height, eye color etc. These feature are considered as variation. *Variation* is related to gene. *Gene is a basic structural and functional unit of inheritance* (chemically, gene is a group of nucleotides of DNA in chromosome).

Gene frequency, gene flow age, population density and population pressure are factors involving in appearance and background of population in the habitat.

COMMUNITY

" A group of organisms of different species with interactions in a habitat is called community".

Community has different kinds of population. A variety of plants and animals may be present in a community. *In a community, associations and competitions may develop among different populations. Actually, this associations, dependence or competitions are inter relationships.* Sometimes, certain species live as dominant in community. Less number of species means simple community and high number means complex community.

Keep in minds, at this level, only living things are considered. For consideration of non living (abiotic) factors, we study ecosystem.

ECOSYSTEM

"The system which is established by the interactions between the physical factors (Abiotic) and living factor (Biotic) in an environment is called ecosystem."

Biotic factors means plants and animals and abiotic factors means H_2O, soil, air, temperature, gravity, light etc.

Q.8 What is biome? Discuss interactions of organisms in a biome.

Ans. BIOME

"The assemblage of plants and animals in a geographical area is called Biome."

Interactions among Organisms:

In an environment, organisms *associate* to each other for nutrition and shelter. They also *compete* to each other for facilities. They co-operate and fight for both biotic and abiotic factors. The relationships are commonly of two types:

Beneficial Relationship: Mutualism and commensalisms

Harmful Relationship: Predation, parasitism and other competitions.

Q.9 What is geological time chart? Describe the time of the origin of living things according to chart.

Ans. GEOLOGICAL TIME CHART

"A chart which represents the placement of organisms in the sequence of past time is called geological time chart".

Fossil Study:

The study of fossils helps biologists to arrange the organism in a time sequence.

Date/Age of Rocks:

Firstly, date/age of rocks is determined. The age of rocks is determined by specific radioactive isotopes. The isotopes are found in these rocks. The old sediment layers of rocks have less isotopes than young layers. The indication of age is found by the comparison of rocks. The age of the rocks shows the age of fossils which are preserved in it.

Era: Geological time scale is divided into four era. Era are major divisions i.e. (1). Cainozoic era (2). Mezozoic era (3). Palaeozoic era and (4). Proterozoic era.

Periods: Periods are sub division of era.

(1) Cainozoic Era:

It is most advanced era. About recent 70 million years are considered in it. It has two periods i.e. ***Quaternary and Tertiary***. Mammals and birds have peak in this era. Angiosperms are also on climax.

(2) Mesozoic Era:

It is the duration between 225-135 million years ago. ***Cretaceous (135 M)***, ***Jurrasic (180 M) and Triassic (225 M)*** are the periods of Mesozoic era. It was the ideal era for gymnosperms and reptiles. Birds and angiosperm were started in this era.

(3) Palaeozoic Era:

The time of this era was about 600-270 M years ago. (i). ***Permian (270 M)***. (ii) ***Carboniferous (350 M)***, (iii) ***Devonion (400 M),*** (iv). ***Silurian (440 M),*** (v) ***Ordovician (500 M) and*** (vi) ***Cambrian (600 M)*** are periods of palaeozoic era. It is the era of the beginning of gymnosperm (270 M), Ferns (400M), reptiles (350M), amphibian (400M) and Mammals (850M). Amphibia and Ferns were on climax. Fishes were originated almost 500M years ago. The duration of the beginning of invertebrates was also 500 M years ago.

Preterozoic Era:

It is the ***oldest era***. It was before 2000 million years (ago). Fungi and algae are belonging to this era. ***"First living organisms about 3000 M years ago"***.

In short, *fungi and algae are oldest organism. Angiosperm, mammals and birds are most advanced. Man is the latest, most complex, most organized and most advanced.*

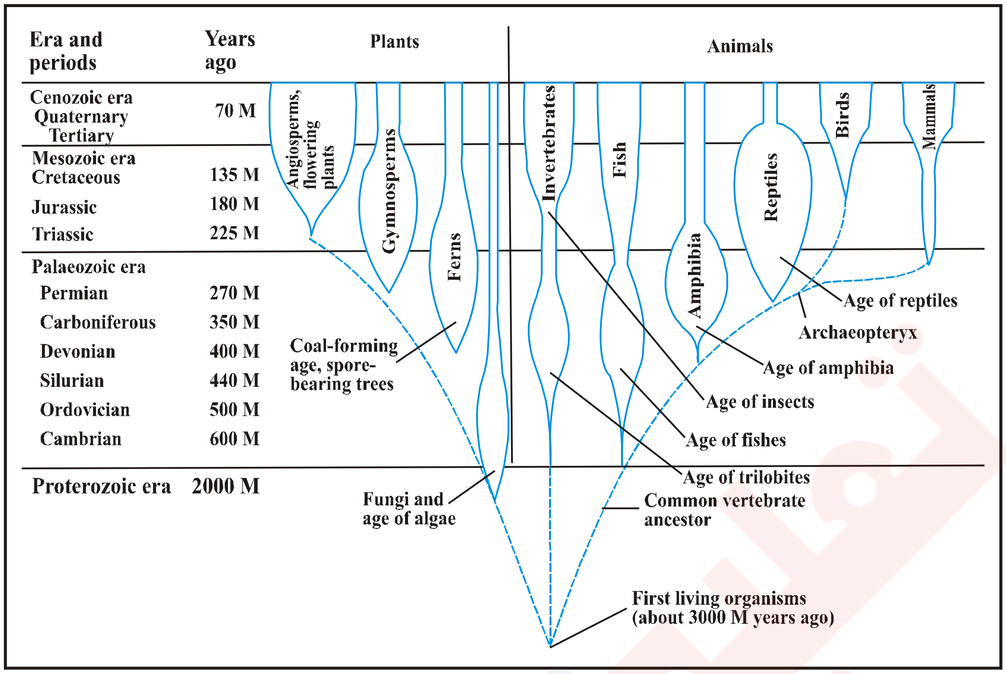


Fig. Fossil record of Plants and animals shown in a geological time chart

Q.10 What do you think about phyletic lineage?

Ans. **PHYLETIC LINEAGE:**

"The continuous sequence of evolution which shows that each species is evolved from the previous species or generation, known as phyletic lineage."

About 2.5 million species of organism are known. Among them ***53.1% species are insects***. Others animals except insects which are 19.9%. Known ***vascular plants are 17.6%*** on the earth. ***Fungi, algae, protozoa*** *and* ***prokaryotes*** *are* ***9.4%****.*

Still, all species are not identified. According to biologists, the total species in the coniverse are between 5 and 30 millions. About 2.5 million out of these are identified.

The number and variety of species in an area is called BIO DIVERSITY. Evolution becomes the reason of production of new species. Number of species and new species increase at back ground level. Different species show the same ancestors. The history of organisms show the common origin of life. The past provides the evidences of common origin of all early life.

A phyletic lineage ***is an unbroken series of species which is arranged in ancestor to descendent sequence, while each later species is evolved from the previous generations.***

Q.11 How are observations hypothesis, deductions, theory and law play role in biological methods?

Ans. **BIOLOGICAL METHODS**

All sciences are based on experimental inquiries. For study or research the work is planned stepwise. The first step of the research or study is observation.

Observation:

"The seeing and noting of the objects is called observation".

Observations depend upon five senses: Vision, Hearing, Smell, Taste and Touch. The utilizations of senses vary with the nature and function of object. Observations may be qualitative and quantitative.

Data Formations:

Observer arranges the data, then gives a statement as per experience and background knowledge of the event. So after observations the hypothesis step takes place.

Hypothesis:

"A statement on the basis of available information is called hypothesis"

Hypothesis is formulated by two ways i.e. (i) deductive reasons (ii) inductive reasons

Deduction:

"A logical consequence result on the basis of available information is known deduction.

"If … and "then …" are frequently used to make testable hypothesis. Deduction means specific conclusion from general principle or assumptions.

Example:

Wings and Birds:

If we accept that all birds have wings. It is hypothesis-I. so sparrows are birds, it is hypothesis-II. if we know sparrow is bird then we will say eagle, parrot, hawk and crow are also birds. Thus we induced that all birds have wings. Considerable thing is this, *firstly, we moved from general to specific. It is **deductive reasoning**. Secondly, we moved from specific to general, it is **inductive reasoning**.*

Theory:

"An opinion or idea supported by experimentations is called theory".

All hypothesis are not true. Sometimes, mistakes, personal interests or effects/cause the reasons of fault. At this stage further concentrations and study are required, so hypothesis are tested again and again. Tests are proceeded up to no chance of falsification. A theory is formulated on the basis of repeated experiments and conclusion. A theory has good predictiveness and power of explanation. Theory is a productive step of biological methodology.

Law:

"The uniform or constant fact of nature is called law".

Work on theory and points of theory discussed and criticized by scientists. If all aspects of theory are checked repeatedly and ultimately no challenged aspect is found in it. Theory is survived, experiments support to theory thus it becomes scientific law.

Law has general ways of description. It affords good and suitable answers of complicated questions than theory. Mendel's law of inheritance and Hardy-Weinberg law are good examples in biological fields.

IMPORTANT BASIC TERMS

Q.12 Define the following basic terms:

(i)	***Stimulus***	***(ii)***	***Response***
(iii)	***Organism***	***(iv)***	***Translocation***
(v)	***Organ***	***(vi)***	***Enzymes***
(vii)	***Hormones***	***(viii)***	***Gene***
(ix)	***Species***	***(x)***	***Evolution***
(xi)	***Phylogeny***	***(xii)***	***Ontogeny***
(xiii)	***Antibiotics***	***(xiv)***	***Vaccination***
(xv)	***Cancer***	***(xvi)***	***Carcinogenic***
(xvii)	***Disease***		

TERMS TO REMEMBER

Ans.

(i) **Stimulus:** Any external or internal change detected by body is called stimulus.

(ii) **Response:** The reaction to stimulus is called response.

(iii) **Organism:** A living thing with particular system and specific characters is known as organism.

(iv) **Translocation:** The transport of materials from one part to other body part is called translocation.

(v) **Organ:** The specific arrangement of tissues forms a particular structure of a system is called organ. e.g., stomach, heart etc.

(vi) **Enzyme:** A biochemical which speeds up chemical reaction without its own involvement is called enzyme. e.g. lipase, sucrase, maltase, pepsin etc.

(vii) **Hormone:** An organic compound which is secreted by glands and transported to target tissues for specific functions. e.g. Insulin, parathormone, gastrin etc.

(viii) **Gene:** The basic structural and functional unit of the inheritance is called gene.

(ix) **Species:** The closely resembled organisms which freely interbreed and reproduce fertile offspring is known as species.

(x) **Evolution:** The ***gradual changes*** of organisms with the passage of time is called evolution.

(xi) **Phylogeny:** The ***evolutionary history*** of a group of individual is known as phylogeny.

(xii) **Ontogeny:** The ***developmental history*** of an individual is called ontogeny.

(xiii) **Antibiotics:** The chemicals which are obtained from the organisms and used to kill the disease causing (pathogen) organism as a medicine called antibiotics.

(xiv) **Vaccination:** The supply of inactive pathogens into the body to create the immunity or antibodies for immediate defence against the disease causing organism is known as immunation or vaccination.

(xv) **Cancer:** The disease due to false mitosis, in which dividing cells are not similar to parental cell, thus structural and functional abnormalities occur in the body.

(xvi) **Carcinogenic:** The cancer causing substances or chemicals are called carcinogenic.

(xvii) **Disease:** Any deviation in normal structure or function of any tissue or body part is called disease.

Q.13 Enlist services of Biology.

Ans. **BIOLOGY AND THE SERVICES OF MANKIND**

Important Roles of Biology:

Biology is the science which facilitates to human beings in the fields of:

(1) Improvement of health.

(2) Cures of Diseases by:

- (i) Gene Therapy
- (ii) Chemotherapy
- (iii) Radiotherapy

(3) New varieties of plant and animals.

(4) Biological control.

(5) Addition of nutrients in the soil.

(6) Protection of food.

(7) Conservation of environment.

Q.14 (a) What is the role of Biology in plant production?
(b) What do you know about Biological control?

Ans. (a) Plant Production

Valuable plants are improved by scientists. In this way, ***new varieties*** *are formed and* ***resistance*** *and* ***yield*** *are increased by the biologists.* These projects depend on Genetics. Wheat, rice, corn, other fruits and crops etc. are improved by genetic engineering. "***Genetic Engineering*** is the manipulation of genes by man".

Valuable gene is selected and transferred from one plant to other for required results. The plant in which gene is incorporated is called Transgenic Plants.

Another method for the production of better variety is cloning. A type of asexual reproduction in which similar cells or organism are produced is called ***Cloning***. It is tissue culture technique.

(b) Biological Control

"The process by which harmful organisms are destroyed by other living organism is known as biocontrol".

It is an advanced way in which chemicals or toxic substances are not used. Because toxic substances are dangerous for human beings, become the source of pollution. *In biological control, pests etc are destroyed by competing or eating of other living bodies*. It is the way in which natural enemies used against to each other.

Some bacteria are also used as a biological control method. So these bacteria which decompose harmful organism are called *Bio Pesticides*. These modern ways are useful for plants.

Example: An ***aphid*** attacks walnut tree. So aphid is controlled by another organism i.e. ***wasp***.

These approaches to kill the disease causing organisms is called ***Integrated Disease Management***.

Q.15 (a) How soil fertility is increased?
(b) What is the role of biology in food protection?

Ans. (a) Improvement of Soil

Some nutrients are necessary for soil. Plants can not grow without the absorption of such nutrients. Nutrients requirements study is very difficult because soil is a complete medium. It is difficult to judge which nutrient is essential for plant and which is not essential.

Hydroponic Culture Technique is introduced by biologists to face such difficulties. Plants are cultivated in aerated water and then study which kinds of mineral nutrients or salts are essential. Hydroponic farming is yet impossible but some astronauts use it for growing vegetables.

(b) Food Protection:

Milk and milk products are protected by PASTEURIZATION. ***Pasteurization is a process by which a liquid is heated to certain temperature and then chilled it to kill harmful organisms.***

Many other methods are also used to preserve the spoilage of food like drying, use of preservative (chemicals) etc.

Q.16 Briefly discuss the cloning.

Ans. **Cloning**

- A clone is a population of genetically identical cells or organisms.
- Clones of plants are easily produced by vegetative propagation or by tissue culture methods.
- Cloning is a method of preservation of superior genotype in organisms.
- The technique of cloning is applied successfully for production of nitrogen fixating bacteria, synthesis of antibiotics, preparation of Insulin and human growth hormones through the E. coli (bacterium).

"The identical offspring from a single parent are referred to as a clone". The process of clone formation is cloning.

Q.17 In which disease chemotherapy and radiotherapy are used?

Ans. **CHEMOTHERAPY AND RADIOTHERAPY**

Chemotherapy and radiotherapy are used against the cancer. *Cancer is related to uncontrolled growth of tissues*. Generally, surgical methods, radiotherapy and chemotherapy are used for treatment of cancerous growth.

Radiotherapy involves burning and destroying the cancerous tissues by x-rays etc.

Chemotherapy includes drug treatments for cancer. Blood cancer is fatal i.e. not cureable. Both these methods have adverse effects on the body.

Q.18 What is the effective role of Gene Therapy?

Ans. **GENE THERAPY**

"Adding, removing or repairing a part of genetic material is gene therapy".

This method is the transfer of the purified genetic material from one organism to the other or from the test tube to the cell.

EFFECTIVE ROLES:

(i) Cures may be possible of inherited diseases.

(ii) Development of new forms of medicines may be possible.

(iii) Transfer of nitrogen fixing genes from bacteria or blue green algae to major crops may be possible.

Q.19 What is mutation?

Ans. **MUTATION**

"The sudden heritable change in the genetic material is known as mutation".

Mutation may be occurred in two ways:

(i) Gene Mutation:

The change in gene level i.e. sequence of nucleotide level.

Example: Haemophilia etc.

(ii) Chromosomal Mutation:

This type of mutation involves change in chromosome number. Example: Down syndrome etc.

Q.20 What do you know about AIDS? Brief it.

Ans. AIDS is a disease caused by Human Deficiency Virus (HIV) which affects the immune systems. The victims of the disease are unable to defend themselves against infections (pathogenic attack) and certain cancers. HIV is a latent and slow acting virus. It may be dormant for years.

Transmission Ways:

(i) HIV found in semen and vaginal fluids and transmitted *by intercourse*.

(ii) It may be spread *through blood*.

(iii) Transfusion of HIV may be due to shared *needles of syringes* etc.

Symptoms: *Headache, dizziness, loss of weight, purple patches on skin, whitish spots on tongue tip, difficulty in breathing.*

Q.21 How does law differ from theory?

Ans. Theory is an opinion or idea supported by experimental results. In other words, the generalizations supported by experiments with repeatable results. "Deductions are tested again and again and supported by experiments and then theory is formed".

Law is uniform and constant fact of nature. Actually, law is a brief statement which based on a large number of data.

Q.22 Define Predation, Parasitism, Commensalism, Mutualism, Competition and Biopesticides.

HELP LINES

Ans. PREDATION:

The phenomenon in which one animal capture and killed other organism for its food i.e. predator, while killed and eaten i.e. prey, it is collectively called predation.

Parasitism: A harmful association between organism of different species as a parasite and host in which parasite is benefited and host is harmed.

Commensalism: The symbiotic association in which one partner gains benefits without harming and benefiting to other is called commensalism.

Mutualism: The beneficial relationship between two organisms is called mutualism. e.g., Lichen and Mycorrhiza.

Competition: The fight or interactions among the organisms for food and shelter is called competition.

Biopesticides: The organisms have the abilities to kill the harmful pesticides are called biopesticides.

Q.23 What are the meanings of phyletic lineage?

Ans. **MEANINGS OF PHYLETIC LINEAGE**

Phyletic means *evolutionary history*, linkage from generation to generation successively.

Lineage means *"the way in which members of a family are descended from other members"*.

Q.24 What do you know about endangered species?

Ans. **ENDANGERED SPECIES**

"Those animals and plants species which are facing the problems and in dangers by other species or harmful environmental factors are called endangered species".

It is necessary to safe these species, otherwise these may be extinct. A biologist always busy in such try that each species must be live forever. Each existing species should be improved. In short, species with low population numbers that are in considerable danger of becoming extinct.

Q.25 How a disease can be controlled by preventive measures?

Ans. **PROTECTION FROM DISEASES**

Avoid Pathogens:

Preventions are better than cures. A healthy person must *avoid the pollutions* and infected persons or organisms. The contagious types of infectious disease are harmful because of transmission of pathogens from infected to healthy persons.

Vaccination:

Vaccination is a good method to prevent the health. A person must avoid to used the shared surgery tools, syringes and needles. We must be careful about transfusion of blood. HIV and H Virus may be transmit due to carelessness. Every body must be careful about food and places. DR. must be consulted immediately in case of any abnormality.

Q.26 What is vaccine? How Vaccination (immunization) control the disease?

Ans. **VACCINE**

"A suspension of killed microorganisms like viruses and bacteria for prevention against infectious disease is called vaccine".

VACCINATION:

Scientists are struggling to develop the vaccine against AIDS.

Vaccine prepared from live microorganisms or viruses cultured under adverse conditions leading to loss of their virulence but retention of their ability to induce protective immunity.

The introduction of vaccine into the body to produce immunity is called Vaccination. In 1795, Jenner developed the technique of vaccination. *Vacca means cow.* So, first time cowpox pus famous as vacca.

Disease, like whooping cough, measles, mumps, small pox can be easily controlled by vaccination. Small pox has been eliminated from world by vaccination. Some vaccines in early life are enough for all life. Inoculation of vaccines actives the defence mechanism of the body. As soon as the pathogen i.e. virus or bacteria attack the certain already stimulated antibiotics defeat the pathogens.

Q.27 Brief gene therapy as a disease controller.

Ans. **GENE THERAPY**

"The isolation of normal gene from a donor and insertion into host to replace defective gene is called GENE THERAPY".

Defective genes become the reason of different abnormalities like inherited diseases. In this case, defective gene may be replaced by genetic engineering. The production of medically valuable plant species by inserting the desirable gene is a tremendous drive of genetic engineering.

Q.28 Write an account on cloning.

Ans. **CLONING**

Cloning is a nuclear transplantation technique in which nuclei were taken from the cells of the same animal and production of genetically identical organism occur.

A group of genetically identical organism is called a *CLONE*. Cloning is a technique for developing large numbers of genetically identical cells or organisms. Any way, the normal reproductions by such method are not possible and regular. In some cases some insects and plants give somewhat positive results.

Cloning of Sheep in Scotland in 1997:

A success of cloning of sheep in 1997 became the history in cloning field. The scientists in Scotland applying the following methods:

(a) The nucleus from a fertilized egg is removed.

(b) The nucleus from a fully developed individual is inserted in its place.

(c) The altered zygote is then implanted in a suitable womb where it completes its development.

Result: The new formed individual was genetically identical clone of the individual whose nucleus was used. Thus multiple copies of desired genotypes are possible by cloning.

Creation of Identical Twins:

The division of single egg or embryo into one or more embryos is another type of cloning. By this process identical twins are created. These identicals or off spring have chromosome of two parents. In this way, farm animals or identical cattle are produced.

Creation of Valuable Animals:

On commercial basis, known pedigree of ***valuable animals like horses*** are projects of scientists. These animals may be cloned.

Q.29 Discuss protection and conservation of environment, write down industrial effect on environment?

Ans. PROTECTION AND CONSERVATION OF ENVIRONMENT

Industrialization is raising the standard of man. But on the other hand, it is creating the problems for man by pollution. *The environmental pollution has been increased by industrial wastes*. Toxic substances in the environmental have become carcinogenic.

Chromium from Tanneries and Lead from Automobiles creating the injurious problems for mankind. Solid, gas and liquid waste materials of industry are big source of environmental pollution.

Role of Biology to Solve the Environmental Problems: Biologists are searching the solution of environmental problems. They are working on the techniques by which removal or degradation of pollutants and toxic materials may be possible.

Bio remediation by several ways is under consideration. "The process in which unwanted and toxic materials are degraded by the organisms is called bioremediation.

Example: Algae may be used as bioremediation organism. It may reduce the heavy metals by Bioabsorption.

Endangered Species: These species of animals and plants may be extinct. So protection of endangered species is urgently needed. Biologists are working on this project.

Pollution as a National Problem: ***City sewage*** and ***industrial wastes*** mix as pollutants in rivers and canals. The living bodies of fresh H_2O are rapidly reducing. The population of fish is facing dangerous condition. While atmosphere is disturbed by ***exhaust*** and ***lead***, which is increased by ***automobiles***.

DIFFICULT WORD MEANINGS

Words	Meanings	Words	Meanings
Bio-	زندہ اشیاء کے لئے (سابقہ)	Relationship	تعلق
-logy	مطالعہ (لاحقہ)	Manufacture	تیار کرنا / بنانا
Certain aspect	خاص پہلو	Synthesize	تیار کرنا / تیار ہونا
Object	شے	Organization	ترتیب/تنظیم
Contain	میں ہونا / میں رکھنا	Included	مشتمل ہونا
Matter	مادہ	Population	ایک ہی قسم کے جاندار کا گروپ
Philospher	فلسفی	Community	مختلف قسم کے جاندار کا گروپ
Theologians	روحانی پیشوا	Ecosystem	ایک ہی جگہ پر مختلف قسم کے جاندار اور اُن کا ماحول
Acquire	حاصل کرنا	Biome	علاقہ جہاں زندگی ممکن ہو
Volume	حجم	Process	عمل
Division	تقسیم	Mechanism	عمل/کام/فعل
Ancestor	اباء	Interact	باہمی عمل
Heredity	توارث / وراثت	Bioelements	زندہ اشیاء کے عناصر
Environment	ماحول	Trace	بہت ہی کم
Structure	ساخت	Subatomic	ایٹموں کے ذرات
Function	فعل/کام	Micro-	چھوٹا
Parasite	زندہ اشیاء سے خوراک اور رہائش حاصل کرنے والا	Macro-	بڑا
Saprophyte	مردہ اشیاء پر رہ کر خوراک حاصل کرنے والا	Prokaryote	بغیر نیوکلیس کے سیل

Familiar	مشہور	Eukaryote	سیل بمعہ نیوکلیس
Respectively	بالترتیب	Various	مختلف
Evolution	ارتقاء	Secretory epithelium	رطوبتیں خارج کرنے والی تہہ
Social	معاشرتی	Distinguish	نمایاں/ممتاز
Convenience	سہولت	Observation	بغور جائزہ/مشاہدہ
Marine	سمندری	Hypothesis	مفروضہ
Distribution	تقسیم	Theory	تھیوری/نظریہ
Organism	کوئی بھی زندہ شے/جاندار	Frequency	پائے جانے کی شرح
Organelles	سیل کے چھوٹے چھوٹے حصے/سیل کے اندر پائی جانے والی ساختیں	Fossils	زمین کے اندر دبی ہوئی پرانی زندہ اشیاء کے حصے
Descendents	اباء کے بعد والے	Sequence	سلسلہ/ترتیب
Transmission	منتقلی	Nutrients	غذائی مادے
History	تاریخ	Species	نوع/انواع
Transplantation	ایک شے سے دوسری میں منتقلی	Womb	پیٹ کا وہ حصہ جہاں بچہ نشوونما پاتا ہے
Bioremediation	حیاتیاتی علاج/زندہ شے سے زندہ چیز (جراثیم) کا خاتمہ	Mutualism	باہمی مفاد دو جانداروں کے درمیان باہمی تعاون کا تعلق
City sewage	شہری نکاسئ آب	Toxic	زہریلے
Automobiles	گاڑیاں وغیرہ	Degradation	توڑ پھوڑ
Tanneries	چمڑہ سازی	Offspring	اولاد
Identical	ہم شکل	Lineage	ایک نوع سے آگے نئی نوع بننا
Abnormality	خراب/معمول کے مطابق نہ ہونا	Measles	خسرہ

Extinct	جو زمانے سے مٹ جائے	**Mumps**	کان پیڑے
Whooping cough	کالی کھانسی	**Small pox**	چیچک
Stimulus	گرمی، شعاع، آواز اور چھونے کا محسوس کرنا/محرک	**Descendents**	بعد از اباء
Deduction	قیاس/مفروضہ درست ماننے کے بعد اُس کا اندراج اور ریکارڈ/منطقی جواب اخذ کرنا	**Inductive reasoning**	خاص سے عام کی طرف قیاس آرائی کو عمل میں لانا
Deductive reasoning	عام سے خاص کی جانب قیاس آرائی	**Zoo**	**Animals**
Physio-	فنکشن/فعل	**Morpho-**	سٹرکچر/ساخت
Palaeo-	فاسلز	**Eco-**	ہوم/گرد و نواح/ماحول
Patho-	باعث بیماری/بیماری کے متعلق	**Botane**	گھاس پھوس
homo-	ایک جیسا	**hetero-**	مختلف
histo-	ٹشوز	**epi-**	اوپر
-dermis	تہہ	**-cutaneous**	اوپر والی تہہ/جلد کے متعلق
hypo-	نیچے	**Meso-**	درمیان/درمیان میں
Hydro-	پانی سے متعلق	**Pollution**	آلودگی
Biocontrol	زندہ چیز کو زندہ چیز سے کنٹرول کرنا	**Hydroponic**	پانی میں تجربات (پودے اگانے کے لئے زمین کے بجائے پانی میں کوشش)
Micro-	چھوٹا	**Macro-/Mega-**	بڑا
Scope of Biology	بائیالوجی کا دائرہ کار	**Endangered**	جن کی زندگی خطرہ میں ہو/جن کی نسل ختم ہونے کے قریب ہو

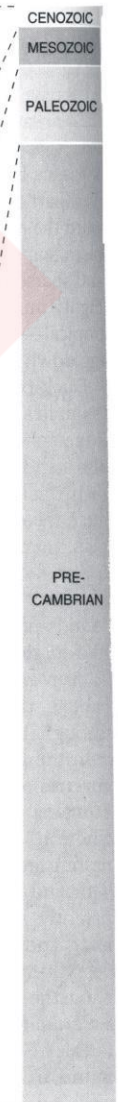
Remedy / cure / therapy	علاج	**Radiotherapy**	شعائی علاج
Chemotherapy	کیمیکل سے علاج	**Gene therapy**	علاج بذریعہ جین کی تبدیلی
Metabolism	پروٹوپلازم میں مالیکیولز کا بننا اور ٹوٹنا	**Catabolism**	بڑے مالیکیولز کا چھوٹے مالیکیولز میں ٹوٹ جانے کا عمل
Anabolism	ایسا عمل جس میں چھوٹے مالیکیولز مل کر بڑے مالیکیولز بنائیں	**Cloning**	غیر جنسی تولید/ ایسا غیر جنسی تولید کا عمل جس سے والدین کی طرح ہو بہو بچے پیدا کروائے جاسکیں
Phyletic-line-age	ایسا سلسلہ جس میں زندہ چیزوں میں ارتقاء ہوا اور اس کے نتیجہ میں نئی نسلیں وجود میں آنے کے ساتھ پہلی نسلیں بھی اپنے آپ کو برقرار رکھیں	**Evolution**	وقت گزرنے کے ساتھ درجہ بدرجہ تبدیلیاں جو نئی انواع بننے کا باعث بنیں/ ارتقاء
Phyl	**kind** / ارتقاء	**Lineage**	سلسلہ

HELP LINE

The Geological Time Scale

Era	Period	Epoch	Millions of Years Ago	Some Important Events in the History of Life
CENOZOIC	Quaternary	Recent		Historic time
			0.01	
		Pleistocene		Ice ages; humans appear
			1.8	
	Tertiary	Pliocene		Apelike ancestors of humans appear
			5	
		Miocene		Continued radiation of mammals and angiosperms
			24	
		Oligocene		Origins of many primate groups, including apes
			38	
		Eocene		Angiosperm dominance increases; origins of most modern mammalian orders
			54	
		Paleocene		Major radiation of mammals, birds, and pollinating insects
			65	
MESOZOIC	Cretaceous			Flowering plants (angiosperms) appear; dinosaurs become extinct at end of period
			144	
	Jurassic			Gymnosperms continue as dominant plants; dinosaurs dominant
			213	
	Triassic			Cone-bearing plants (gymnosperms) dominate landscape; first dinosaurs, mammals, and birds
			248	
PALEOZOIC	Permian			Radiation of reptiles; origins of mammal-like reptiles and most modern orders of insects; extinction of many marine invertebrates
			286	
	Carboniferous			Extensive forests of vascular plants; first seed plants; origin of reptiles; amphibians dominant
			360	
	Devonian			Diversification of bony fishes; first amphibians and insects
			408	
	Silurian			Diversity of jawless fishes; first jawed fishes; colonization of land by vascular plants and arthropods
			438	
	Ordovician			Marine algae abundant
			505	
	Cambrian			Origin of most invertebrate phyla; first vertebrates (jawless fishes); diverse algae
			590	
PRECAMBRIAN			670	Diverse invertebrate animals, mostly soft-bodied
			700	Origin of first animals
			1500	Oldest eukaryotic fossils
			2500	Oxygen begins accumulating in atmosphere
			3500	Oldest definite fossils known (prokaryotes)
			4600	Approximate time of origin of Earth

Relative Time Span of Eras



Q.1 Fill in blanks:

(i) —————— is the study of organisms in relation to their environment.

(ii) The Study of organisms living in fresh water bodies like rivers lakes etc is called ——————.

(iii) —————— is the branch of biology which deals with the study of social behaviour and communal life of human beings.

(iv) In the —————— body only six bio-elements accounts for 99% of the total mass.

(v) All living things and nonliving things are formed of simple units called ——————.

(vi) Various organs in plants and various organ systems in animals are assembled together to form an ——————.

(vii) A —————— is a group of organisms of the same species located in the same place at the same time.

(viii) A —————— is based upon observations.

(ix) A hypothesis is a result of deductive reasoning or it can be the consequence of —————— reasoning.

ANSWERS:

(i)	Ecology	(ii)	Fresh water biology	(iii)	Social Biology
(iv)	Human	(v)	Atoms	(vi)	Organism
(vii)	Population	(viii)	Hypothesis	(ix)	Inductive.

Q.2 Write whether the statement is 'true' or 'false' and write the correct statement if it is false:

	STATEMENT	T/F	CORRECT STATEMENT
(i)	Penicillin was discovered by Edward Jenner from a fungus Penicillium.	F	Penicillin was discovered by Alexander Fleming from a fungus Penicillium
(ii)	Many diseases such as polio, whooping cough measles, mumps etc. can by controlled by antibiotics	F	Many diseases such as polio whooping cough, measles, mumps etc. can by controlled by vaccination.

(iii)	Exposure to the small pox virus allows the body to develop immunity against cowpox virus.	F	Exposure to the small pox virus allows the body to develop immunity against small pox virus.
(iv)	AIDS is caused by HIV and it spreads through sexual contracts, blood transfusion by contaminated syringe or surgical instruments.	T	

Q.3 Each question has four options. Encircle the correct answer:

(i) Which one of the following is a correct sequence in biological methods:

(a) Observations – Hypothesis – Law – Theory

(b) Observations – Hypothesis – Deduction – Testing of deduction

(c) Hypothesis – Observations – Deduction – testing of deduction

(d) Law – Theory – Deduction – Observations

(ii) Which one of the following is employed in treatment of cancer:

(a) Antibiotics and vaccination (b) Radiotherapy and chemotherapy

(c) Chemotherapy and Antibodies (d) All of the above

(iii) Which one of the following is not a viral disease:

(a) Cowpox (b) Mumps

(c) Tetanus (d) Small pox

(iv) Which one of the following is not related to cloning:

(a) Replacement of the nucleus of zygote, by another nucleus of the same organism

(b) Separation of cells of embryo to form more embryos

(c) The individuals resulting have similar genetic make up

(d) Removal of piece of DNA or gene from the cell and incorporating another gene or piece of DNA in its place

ANSWER:

(i) (b) (ii) (b) (iii) (c) (iv) (d)

Q.4 Short questions:

(i) What do you mean by hypothesis?

Ans. By scientists observations are organized into date. Based on date a statement or hypothesis is made considering previous experience and knowledge of the event. The Hypothesis is tentative explanation of observation.

(ii) How does law differ from theory?

Ans. A series of hypothesis supported by the results of many tests is called a theory. If a theory survives this skeptical approach and continues to be supported by experimental evidence because a scientific law. A scientific law a uniform are constant fact of nature.

(iv) Define vaccination.

Ans. Vaccination is the method of developing immunity against germs.

HELP LINE

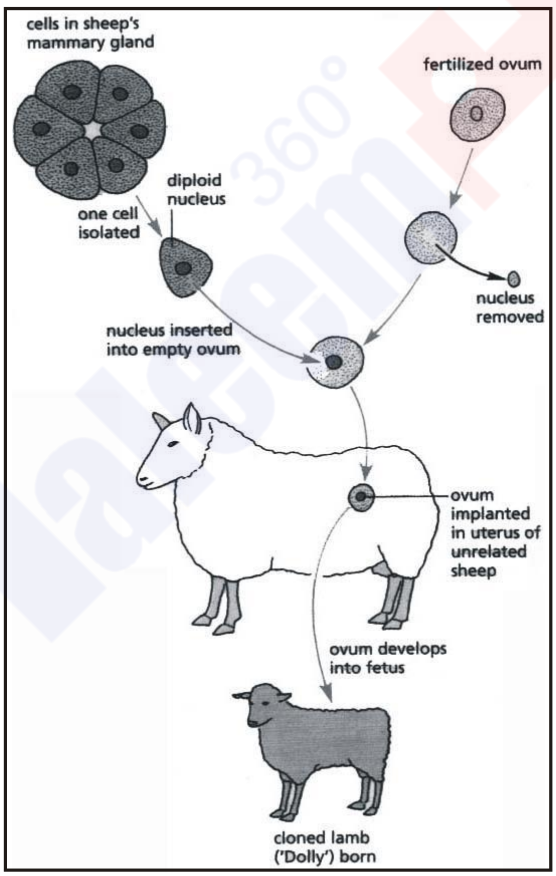


Fig. Cloning 'Dolly'. The technique varies in different laboratories

Chapter 2

BIOLOGICAL MOLECULES

Q.1a *Define the following basic terms:*

(i)	***Biochemistry***	*(ii)*	***Organic Compounds***
(iii)	***Inorganic Compounds***	*(iv)*	***Carbohydrates***
(v)	***Lipids***	*(vi)*	***Proteins***
(vii)	***Nucleic Acids***		

Ans. BASIC TERMS

(i) Biochemistry: The study of the chemicals of living organisms is called biochemistry.

(ii) Organic Compounds: Those compounds in which C and H atoms are necessary with other atoms and carbon is central and basic element.

(iii) Inorganic Compounds: H_2O, HCl, H_2SO_4, NaCl, NaOH, Na_2CO_3 like compounds in which both C and H in same molecules are not essential.

(iv) Carbohydrates: *Polyhydroxy aldehydes or ketones are called carbohydrates.*

(v) Lipids: The organic compounds which are heterogenous, hydrophobic and sparingly solube in water are called lipids.

(vi) Proteins: The organic molecules in which polypeptide chains are formed by the peptide linkages of amino acids are called proteins.

(vii) Nucleic Acids: The acids in which ***pentose sugar***, ***purine*** or ***pyrimidine*** and ***phosphoric acid*** are components. e.g. DNA and RNA.

Q.1b *Define the following key terms:*

(i)	***Metabolism***	*(iv)*	***Micromolecules***
(ii)	***Catabolism***	*(v)*	***Macromolecules***
(iii)	***Anabolism***	*(vi)*	***ATP***

Ans. KEY TERMS

(i) Metabolism: The *making and breaking* of molecules in *biochemical reactions* is called metabolism.

(ii) Catabolism: The breaking of large molecules into small molecules during metabolism is called catabolism.

(iii) Anabolism: The making of large molecules from small molecules in biochemical reactions is called anabolism.

(iv) Micromolecules: The small molecules which have lower molecular weight.

(v) Macromolecules: Large organic molecules which have polymeric chain structure. e.g. Proteins, polysaccharides.

(vi) ATP (Adenosine triphosphate) the energy currency in the organism which becomes the source of different activities.

Q.1 What is Biochemistry? Discuss the chemical composition of protoplasm.

Ans. **BIOCHEMISTRY**

"The branch of biology which deals with the chemical components and biochemical reactions in living organisms is known as biochemistry".

Relationship of Biochemistry: It is an important branch of biology and is directly related with some other branches of biology such as physiology, anatomy etc. All organisms are composed of either organic or inorganic molecules.

Organic Compounds: The living matter i.e. protoplasm consists of organic compounds such as proteins, lipids carbohydrates and nucleic acids.

Inorganic Compounds: Inorganic compounds may include water, CO_2, acids, bases and salts.

Comparison of Chemical Composition of a Bacterial and a Mammalian Cell:

Compounds	Total Cell Weight (%)	
	Bacterial cell	**Mammalian cell**
1. Water	70	70
2. Proteins	15	18
3. Carbohydrates	3	4
4. Lipids	2	3
5. DNA	1	0.25
6. Other organic molecules	2	2
7. Inorganic ions	1	1

Na+, K+, Ca++, Cl^-, SO^{-4}		
8. RNA	6	1.1

Q.2 What do you mean by metabolism? Briefly discuss its types.

Ans. METABOLISM

"The making and breaking of molecules during chemical reactions in living bodies are called metabolism".

The survival of any animal or plant depends upon its ability to take some chemical from the environment, to make its protoplasm. For this, the cells of every organism are constantly taking a new substances and using them to from new cellular materials and obtaining energy for their needs.

Categories of Metabolism:

The process of metabolism may be divided into two categories.

(a) Anabolism: "The type of metabolism in which simpler substances are combined to form ***complex substances*** is called metabolism".

(b) Catabolism: "The type of metabolism in which ***complex substances are broken down*** to simple and smaller molecules by the action of energy is called catabolism".

Example: ***Interconversion of organic molecules:*** Proteins, lipids and carbohydrates are commonly interconverted in living cells. These interconversions are example of metabolism.

Q.3 What is the role of carbon in biochemicals?

Ans. ROLE OF CARBON

(1) Valency of Carbon: Carbon has 4 valency. It makes covalent bonds. It is also known as ***tetravalent***.

(2) Skeleton of Organic Compounds: Carbon is skeleton of organic compounds. Carbon is basic element of organic compound. It is ***central element*** of organic compounds.

(3) Tetrahedron: The arrangement of carbon to ***four bonds*** symmetrically with four atoms is called tetrahedron.

(4) Stability: Carbon is suitable element for the synthesis of cellular structures due to having *stable configuration.*

(5) Rings and Branches: Ringed and branched structures are easily and comfortably formed by carbons.

(6) Combinations: C generally combines with H, O, N, P and S for the formations of different organic compounds.

(7) C-H Bonds: Carbon and hydrogen bonding is a *good source of energy* for cellular activity.

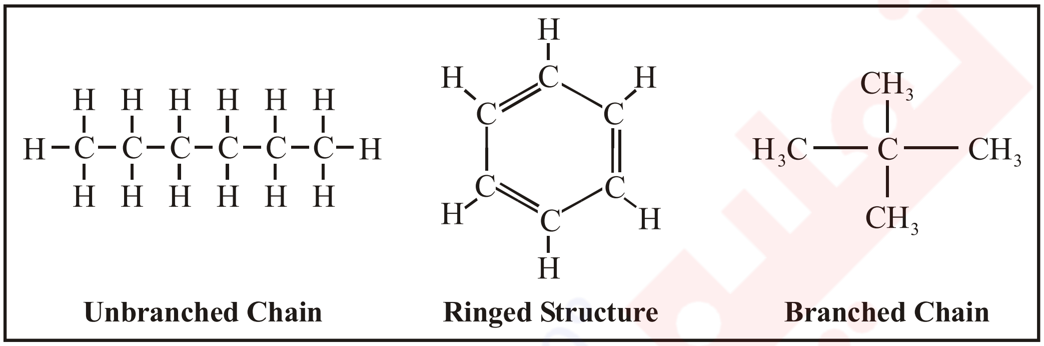


Fig. Unbranched and branched chains, and ring structures formed by C-C bonds.

(8) Glycosidic Linkage (*C-O association*): In carbohydrates, carbon and oxygen linkage provides stability to molecules. The C-O association in carbohydrates is called glycosidic linkage. When two monosaccharides combine, they linked by glcosidic bonding.

(9) Peptide Bonds: The linkage of C-N between the amino acids in protein is known as peptide linkage or peptide bonding.

(10) Macromolecules: ***Proteins, polysaccharides*** *and* ***fats*** *etc. are macromolecules.* They are generally insoluble in water. They form structure of cells. In these long and ring structures molecules carbon play an important role of skeleton stability.

(11) Small Molecules: ***Glucose, amino acids*** *and* ***fatty acids*** *are small molecules.* These are sub units of polysaccharides, proteins and lipids respectively. These are unstable. Due to immediately break down, they release energy i.e. ATP. So they provide immediate source of energy for metabolism.

Q.4 What is the importance of H_2O in metabolism? (OR) Describe the importance of H_2O in life. (OR) How is water effective for metabolic processes?

Ans. IMPORTANCE OF WATER

(1) Medium of Life: It is found 65 to 90% in different cells of different organisms. It is most abundant in all cells or organisms. All reactions take place in H_2O of cells.

It is 20% in bone cells of man and 85% in human brain cells. Active tissues have more water than inactive ones.

(2) Raw Material: It is raw material of photosynthesis.

(3) Best Solvent: Water acts as solvent for metabolic reactants. It is known as the best solvent. More substances dissolve in it than any other solvent.

Water is *polar*, so it dissociates the ionic substances into +ve and –ve ions. But non-polar organic molecules are insoluble in water. While in case of ionic substances, water molecules behave like dipoles. Water is oriented toward both +ve and –ve ions, this is the *property* ability of water to act as a solvent. Positive and negative ions in a crystal lattice can be approached by dipolar water molecules and brought into solution.

(4) Heat Capacity: Water absorbs heat. When it absorbs heat, very minute temperature of water is changed. So water provides stability to the temperature of an organism in its environment. Water *protects* living material against temperature change. ***H_2O keeps** the temperature of an organism relatively constant.*

Actually, water works as ***"Temperature Stablizer"*** for energy is used to break hydrogen bonds.

"The specific heat capacity of water is the number of calories required to raise the temperature of 1 g of water from 15 to 16°C 1.0". It is due to much of energy is used to break hydrogen bonds.

(5) Heat of Vaporization: Water absorbs much heat as it changes from liquid to gas.

Heat of vaporization is expressed as calories absorbed per gram vaporized. The specific heat of ***vaporization of water is 574 Kcal/kg***, which plays an important role in the regulation of heat produced by oxidation. It also provides ***cooling effect*** to plants when water is transpired, or to animals when water is respired.

Evaporation of only two ml out of one liter of water, lowers the temperature of the remaining 998 ml by 1°C.

(6) Ionization of Water: The water molecules ionize to form H^+ and OH^- ions.

$$H_2O \rightleftharpoons H^+ + OH^-$$

This reaction is reversible but an equilibrium is maintained. At 25°C the concentration of each of H^+ and OH^- ions in pure water is about 10^{-7} mole/litre. The H^+ and OH^- ions affect, and take part in many of the reactions that occur in cells.

(7) Protection: Water is effective ***lubricant*** that provides ***protection against damage*** resulting from friction. For example, tears protect the surface of eye from the rubbing of eyelids, water also forms a fluid cushion around organs that helps to protect them from trauma (shock).

Q.5 What are carbohydrates? Give their types in detail.

Ans. **CARBOHYDRATES**

Definition: "Carbohydrates are the organic compounds which are composed of carbon, hydrogen and oxygen".

Chemically: "Carbohydrates are defined as *polyhydroxy aldehydes or ketones which on hydrolysis produce* polyhydroxy aldehyde or ketone subunits."

General Formula: Their general formula is **$C_x(H_2O)_r$**, where x=3 to many thousands.

Presence: Carbohydrates are found abundantly in

CLASSIFICATION OF CARBOHYDRATES:

Carbohydrates are also known as "**saccharides**" (drived from Greek word "sakcharon" means "sugar".)

They are classified into following three groups:

(1) Monosaccharides
(2) Oligosaccharides
(3) Polysaccharides.

**mono means one.*
**oligo means few.*
**poly means many.*
**saccharide means sugars.*

(a) MONOSACCHARIDES

(1) These are *simplest sugars.*
(2) They are sweet in taste and soluble in water.
(3) They *cannot be hydrolysed* into *simpler sugars.*
(4) All carbon atoms in a monosaccharides except one have a *hydroxy group.*
(5) The sugar with aldehyde group is called aldo sugar and with the *keto group* is keto sugar.

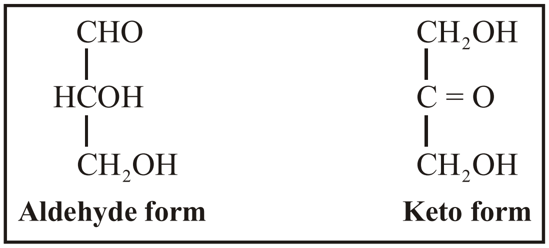


Fig. Structure of glyceraldehydes, a 3C Sugar ($C_3H_6O_3$). The aldehyde form is glyceraldehyde, whereas ketonic form is dihydroxyacetone.

(6) The aldehyde form is glyceraldehydes, whereas ketonic form is dihydroxyacetone.

(7) The number of carbon atom varies from “3” to “1 in monosaccharides. They are called trioses (3C), tetroses (4C), pentoses (5C), hexoses (6C) and heptoses (7C).

(8) They have the general formula (CH_2O)n. *Tetroses are rare in nature and occur in some bacteria. However, pentoses and hexoses are most common.*

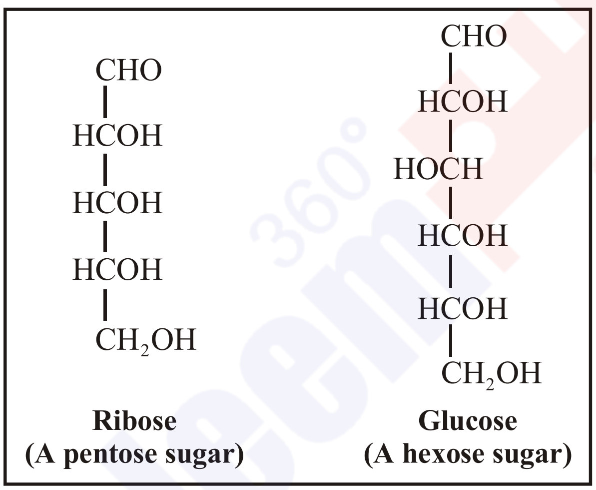
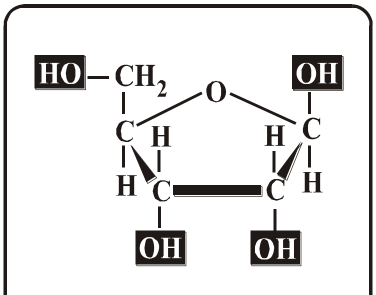


Fig. Structure of Ribose and Glucose

(9) Monosaccharides also form ringed structures e.g. ribose will form a five corner rings known as ***ribofuranose*** where as glucose will form six corner ring known as ***glycopyranose***.



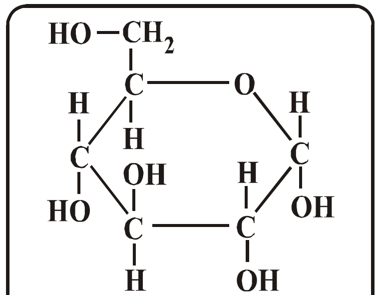


Fig. Ribose and glucose form ring shaped structures

(10) Glucose is present in all fruits e.g. grapes, figs and dates. Our blood normally contains 0.08% glucose. As a result of photosynthesis, glucose is synthesized in all green plants.

$$6CO_2 + 12H_2O \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} \underset{\text{(Glucose)}}{C_6H_{12}O_6} + 6O_2 + 6H_2O$$

(b) OLIGOSACCHARIDES

(1) The oligosaccharides *yiled 2-10 monosaccharides* on hydrolysis.

(2) These are ***less sweet*** in taste and less ***soluble in water***.

(3) The oligosaccharides, which yield two monosaccharides are known as *disaccharides,* those yielding three are known as *trisaccharides* and so on.

(4) The *covalent* bond between two monosaccharides is called ***"glycosidic bond"***. Maltose, sucrose and lactose are examples of disaccharides.

(5) The common table sugar i.e. sucrose on hydrolysis yield glucose and fructose.

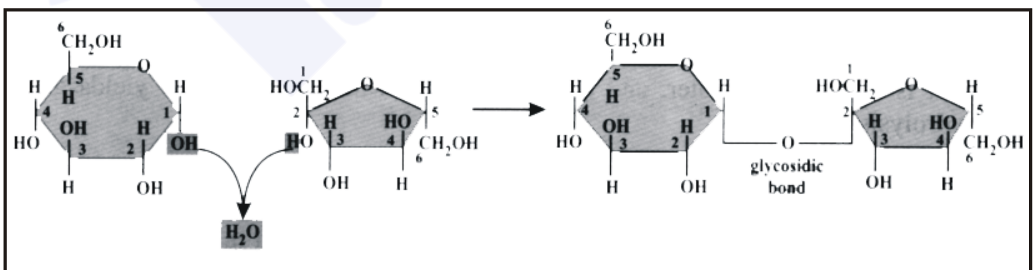


Fig. A disaccharide. Note carefully the between two monosaccharides glycosidic linkages

POLYSACCHARIDES

He carbohydrates which are *formed by* ***several monosaccharides*** units linked by glycosidic bonds are known as polysaccharides":

(1) They have higher molecular weights and are ***sparingly soluble in water*** e.g. starch, glycogen, cellulose, pectin and chitin.

(2) These are normally ***branched*** and ***tasteless***.

(a) STARCH

It is found in *seeds, grains tubers and fruits*. It is one of the main source of carbohydrates for animals. It yields glucose, molecules on hydrolysis. *It gives blue colour with iodine.*

Types of Starches: There are two types of starches:

(i) Amylose: They have ***unbranched chains*** of glucose and are ***soluble in hot water*** only.

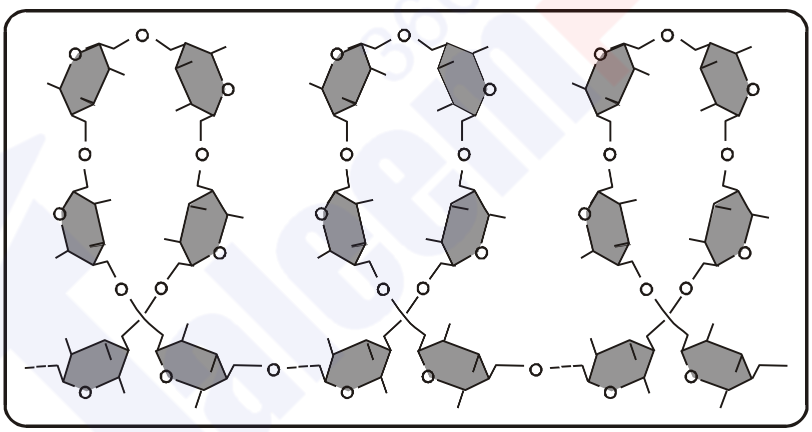


Fig. Polysaccharides are polymers of monosaccharides

(ii) Amylopectin: They have ***branched chains*** and are ***insoluble in water***.

(b) GLYCOGEN

(1) It is the chief form of carbohydrates stored in animal bodies and that is why it is also called ***animal starch***.

(2) Mostly it is found ***in liver and muscular cells***.

(3) It also ***yields glucose*** units on hydrolysis.

(4) It is ***insoluble*** in water.

(5) And gives ***red color with iodine***.

(c) CELLULOSE

(1) It is the most abundant carbohydrates in nature because it is the *major* ***constituent of cell walls*** in plants.

(2) On hydrolysis, it also yields glucose units e.g. cotton is insoluble in water.

(3) It is ***insoluble*** in water.

(4) It is *not digested in human* digestive tract.

(5) In herbivores it is digested because of microorganisms (bacteria, yeast and protozoa) and enzyme ***cellulase in*** their digestive tract.

(6) *Cellulose gives* ***no color with iodine***.

Q.6 Define lipids. Give the details its kinds with examples.

Ans. LIPIDS

"Lipids are hydrophobic compounds and are the basic components of cellular membranes". They store energy because of C-H linkage in them. *These are also related to fatty acids*. They are *insoluble* in water but *soluble in organic solvents* such as ether, alcohol, chloroform and benzene.

Examples: Examples of lipids are fats, oils, waxes etc.

CLASSIFICATION OF LIPIDS:

Lipids can be classified into following groups:

(i) Acylglycerol	(ii) Waxes	(iii) Sphingolipids
(iv) Phospholipids	(v) Glycolipids	(vi) Terpenoids

(i) Acylglycerol:

They are composed of glycerol and fatty acids. The most commonly used acylglycerol is "**triacylglycerol**". It is also known as neutral lipids or triglyceride. On chemical basis the acylglycerol can be defined as "**the esters of fatty acids and alcohols"**. An acid is produced by the action of acetic acid and ethanol i.e.

$$C_2H_5OH \quad + \quad CH_3COOH \longrightarrow C_2H_5COOCH_3 + H_2O$$

(ethyl alcohol) (acetic acid) (ethyl methyl ester)

The fatty acids are of the most important compounds of triglycerides. *They contain 4-30 carbon atoms in their straight chains.* They may contain *no double bond* (saturated fatty acids) or up to 6 double bonds (unsaturated fatty acids). *In animals the fatty acids may be unbranched while in plants these may be branched or ringed.*

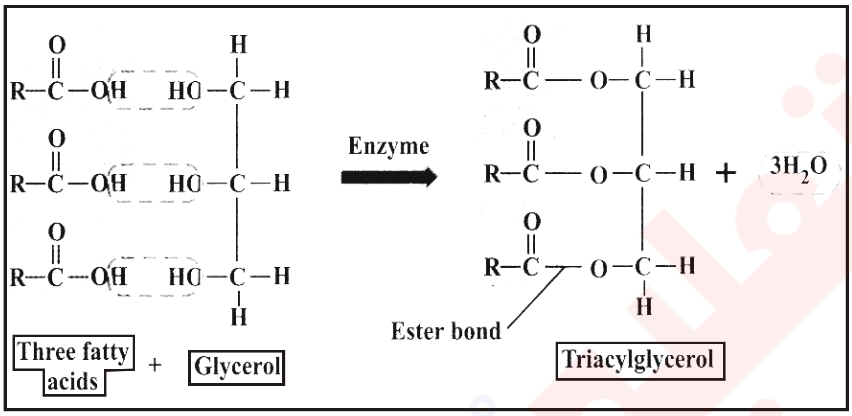


Fig. Triacylglycerol is composed of one glycerol and three fatty acids molecules

The solubility of fatty acids and their melting points in organic solvents increase with increasing number of carbon atoms in chain e.g. palmitic acid, C_{16}(63.1°C) is more soluble inorganic solvents than butyric acid, C_4(-8°C).

$\overset{2}{C}H_3.\overset{1}{C}OOH$	**Acetic Acid (C_2)**
$\overset{4}{C}H_3.\overset{3}{C}H_2.\overset{2}{C}H_2.\overset{1}{C}OOH$	**Butyric Acid (C_4)**
$\overset{16}{C}H_3.\overset{15}{C}H_2.\overset{14}{C}H_2.\overset{13}{C}H_2.\overset{12}{C}H_2.\overset{11}{C}H_2.\overset{10}{C}H_2.\overset{9}{C}H_2.\overset{8}{C}H_2.\overset{7}{C}H_2.$	
$\overset{6}{C}H_2.\overset{5}{C}H_2.\overset{4}{C}H_2.\overset{3}{C}H_2.\overset{2}{C}H_2.\overset{1}{C}OOH$	**Palmitic Acid (C_{16})**
$\overset{18}{C}H_3.\overset{17}{C}H_2.\overset{16}{C}H_2.\overset{15}{C}H_2.\overset{14}{C}H_2.\overset{13}{C}H_2.\overset{12}{C}H_2.\overset{11}{C}H_2.\overset{10}{C}H{=}\overset{9}{C}H.$	
$\overset{8}{C}H_2.\overset{7}{C}H_2.\overset{6}{C}H_2.\overset{5}{C}H_2.\overset{4}{C}H_2.\overset{3}{C}H_2.\overset{2}{C}H_2.\overset{1}{C}OOH$	**Oleic Acid (C_{18})**

Fig. Some fatty acids with carbon numbers 2-18 are shown. Oleic acid is an unsaturated fatty acid (note a double bond between C_9 and C_{10}) other fatty acids are saturated.

One thing is very important that higher fat contents causes slower movement of feces through the alimentary canal. Thus, the bacteria present in the food convert the fat into "**Cancer causing compounds".** There are two broad types of fatty acids i.e.

(a) Oils:

Fats containing unsaturated fatty acids are usually liquids at room temperature and are said to be oils.

(b) Solids:

Fats containing saturated fatty acids are solids. Animal fats are solid at room temperature whereas, most of the plant fats are liquids. They have specific gravity of about 0.8. Normally, they are not crystalline but can be made crystalline under specific conditions.

(ii) Waxes:

Waxes are mixtures of long chain alkanes and alcohols, ketones and esters of long chain fatty acids. The carbon atoms in the chain are always in odd number ranging from C_{25} to C_{35}.

Functions:

(1) They are wide spread as **protective coatings** on fruits and leaves. Some insects also secrete wax.

(2) They protect plants form water loss and abrasive damage.

(3) They also provide **water barrier** for insects, birds and animals like sheep.

(iii) Phospholipids:

These are composed of glycerol, fatty acids and phosphoric acid linked with nitrogenous bases such as ***choline, ethanolamine*** and ***serine***. In other words, the phospholipids are derivatives of phosphatidic acid. Phosphatidicholine is one of the common phospholipids. They are wide spread in bacteria, animal and plant cells.

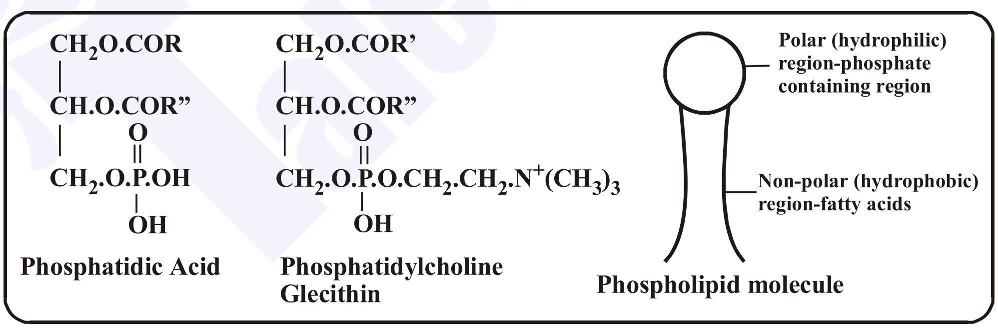


Fig. Phosphatidic acid is composed of glycerol, 2 fatty acids (on C1 and C2), and a phosphoric acid on C3 of glycerol. In phospholipids a nitrogenous base (e.g. choline) is attached to phosphoric acid in phosphatidic acid.

(v) Terpenoids:

They are important compounds and are wide spread. They are made up of simple repeating units called “**isoprenoid unit**”. ***Rubber, carotenoids, steroids*** and ***terpenes*** are examples of terpenoids.

HELP LINE

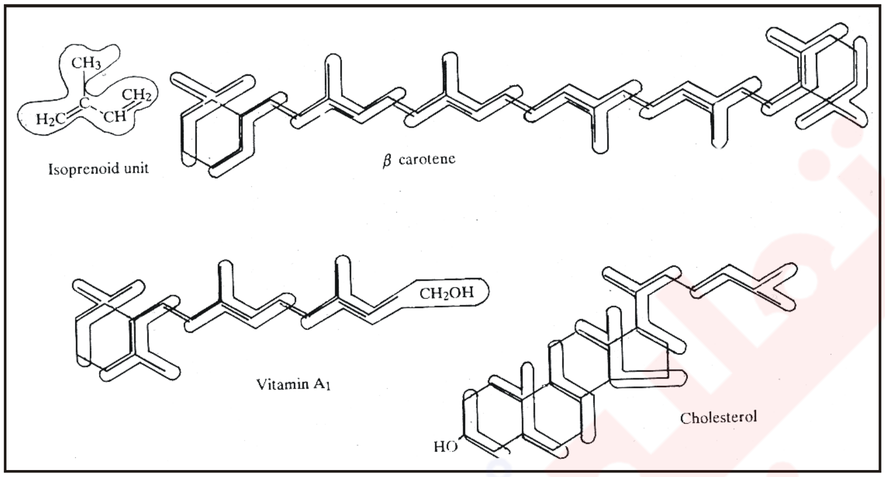


Fig. Some terpenoids formed by condensation of isoprenoid units

Q.7 What are proteins? Describe their important functions.

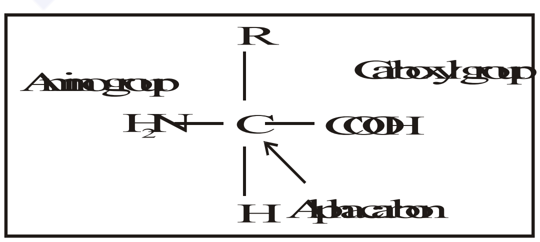
Ans. **PROTEINS** ***Consult Q.10.***

Q.8 What are the amino acids? Describe its general formula and its role in protein.

Ans. **AMINO ACIDS**

“Amino acid has an amino group (**-NH2**) and a carboxylic group (**-COOH**) attached to the same carbon, also known as alpha carbon”.

General Formula: Following is the general formula of an amino acid:



Where "R" may be a hydrogen atom as in glycine or CH_3 in alanine. The amino acid differ due to the R-group. (i.e., alkyl group).

Role of Amino Acid in Protein:

About 170 amino acids have been found to occur in cells and tissues of these, about 25 are constituents of proteins. However, most of the proteins are made up of 20 types of amino acids. The amino acids are linked to form polypeptide proteins by peptide bonds. The amino group of an amino acid may react with the carboxyl group of another releasing a molecule of water.

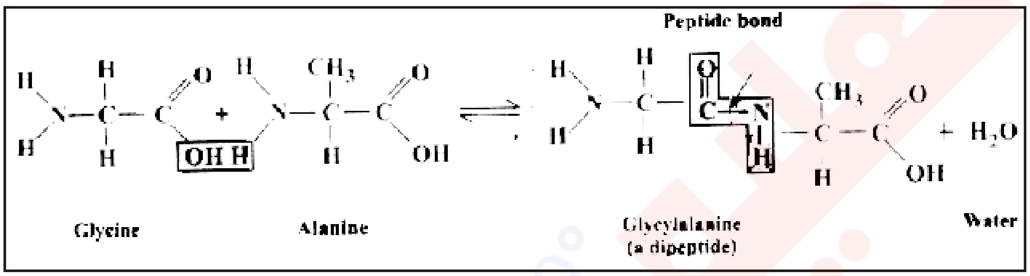


Fig. Peptide linkage-formation of peptide bond

Q.9 Classify p`roteins into major categories. (GRW-06)

Ans. **CLASSIFICATION OF PROTEIN**

Protein classification is rather difficult due to complexity in structure. However, following 2 categories can be diversified:

(a) FIBROUS PROTEINS:

They show following characters.

(i) Polypeptide Chains: They consists of polypeptide chains in the form of fibrils.

(ii) Insoluble: They are insoluble in aqueous media.

(iii) Non-Crystalline: They are non crystalline and are elastic in nature.

(iv) Structural Roles: They play structural roles in cells and organisms. For example, the secondary structure of protein, silk fibers, ***myocin, fibrin*** and ***keratin*** etc.

(b) GLOBULAR PROTEINS:

They have following main characters:

(i) ***Folding of Polypeptide:*** They are spherical or ellipsoidal due to multiple folding of polypeptide chains.

(ii) ***Soluble:*** They are soluble in aqueous media such as salt solution, acids, bases or alcohols.

(iii) ***Crystallized:*** They can be crystallized and disorganized in the physical environment.

For Example: Protein tertiary structures, enzymes, antibodies, hormones, haemoglobin etc.

Q.10 (a) Define protein, amino acid.

(b) What types of elements are found in proteins?

(c) Discuss function of proteins.

(d) Describe structural kinds of proteins.

Ans. (a) (i) PROTEIN

"The organic compound in which polypeptide chains are formed by the peptide linkage among the amino acids is called protein".

(ii) AMINO ACID

Amino Acids are the basic units of protein in which **carboxyl group** and **amino group** are essential components.

(b) ELEMENTS OF PROTEINS

All proteins contain *carbon, hydrogen, oxygen, nitrogen,* and usually sulfur and some have *phosphorus*. Proteins are made up of chain of amino acids. They amino acids of a protein are united to one another by their respective amino carboxyl groups, forming peptide bonds.

(c) FUNCTIONS OF PROTEIN

"Protein is the structural and functional unit of the cell".

(i) As Enzyme: All enzymes are proteins. Enzymes speed up the chemical reactions. e.g. ***Pepsin, lipase, amylase*** etc.

(ii) As Hormones: Those proteins which regular and control the metabolic process are considered as hormone. e.g. ***Insulin*** etc.

(iii) O_2 Carrier: ***Haemoglobin*** is the protein which transports oxygen.

(iv) **Antibodies:** These are proteins which defend against the disease causing organisms.

(v) **Blood Clotting:** ***Fibrinogen*** is a blood clotting protein. It prevents the loss of blood in case of injury.

(vi) **Contraction and Relaxation:** Muscles have ***Myosin*** and ***actin*** which are contracting and relaxing bonds

(vii) **Structure of Chromosome:** ***Histone*** protein forms the structure of chromosome.

(viii) **Structure of Cell Membranes:** The membranes of cells and organelles are formed by (lipid and) proteins.

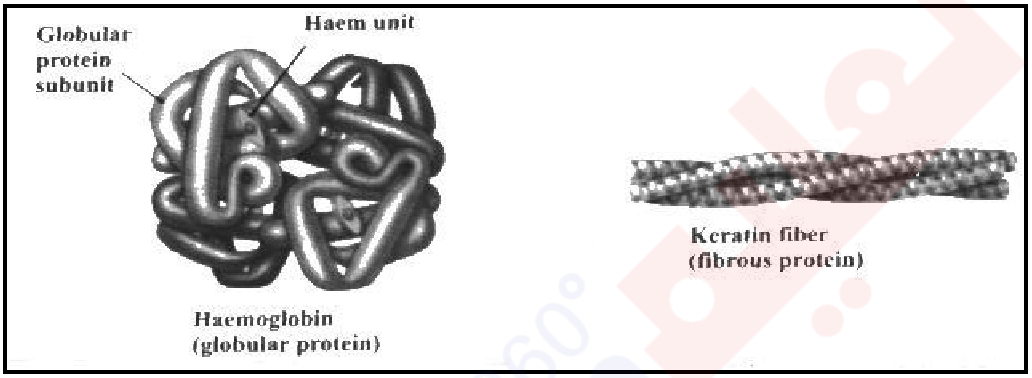


Fig. Polypeptide chains in keratin (fibrous protein) and in hemoglobia (globular protein) are held together to form respective functional proteins.

Q.11 Differentiate between Glycosidic linkage and peptide bonding.

Ans. **Glycosidic Linkage** takes place among the monosaccharides for the *preparation of oligosaccharides and polysaccharides of carbohydrates*. Glycosidic linkage (bonding) has two kinds E.g. *(1-4) glycosidic linkage and (1-6) glycosidic linkage.*

In case of 1-4 glycosidic linkage unbranched chains of carbohydrates are formed. While 1-6 glycosidic linkage form a branch on linear chain.

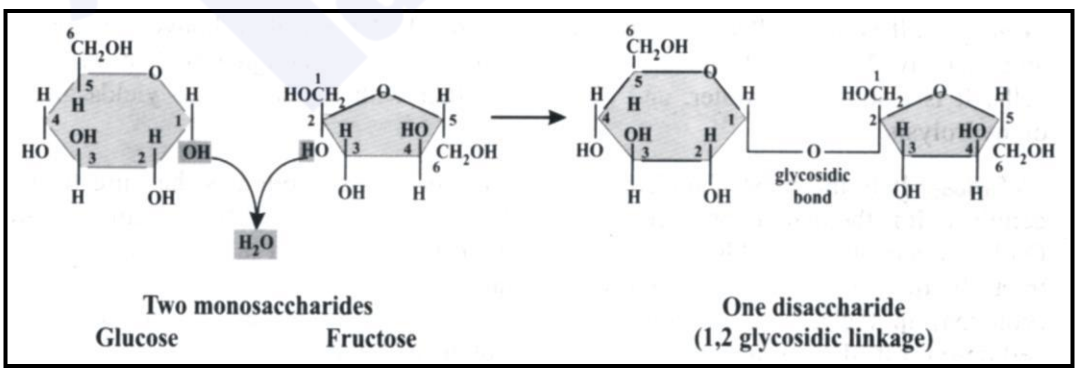


Fig. A disaccharide. Note carefully the glycosidic linkages between the two monosaccharides.

PEPTIDE LINKAGE: The bond which is formed ***between amino group and carboxyl group*** of two amino acids is called peptide linkage or peptide bonding. In this case, bond is formed between C and N of carboxyl group and amino group. Peptide linkages form the ***polypeptide chains*** of proteins.

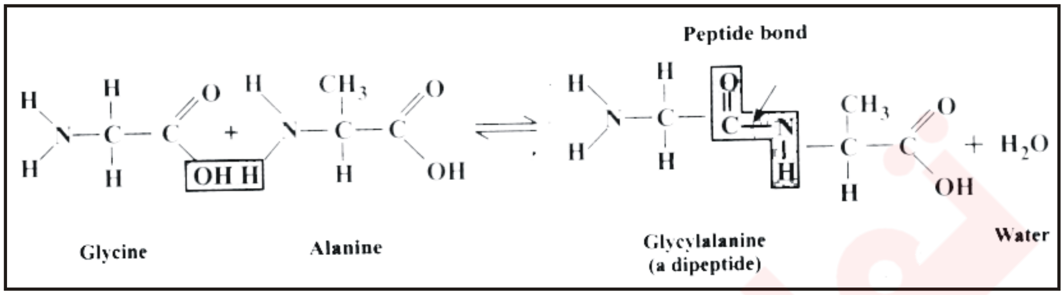


Fig. Peptide linkage-formation of peptide bond

Q.12 Define the followings

Ans.

(a) **Fatty Acids:** The organic compounds with *monocarboxylic acid* and straight chain of 4 to 30 carbons are called fatty acids.

Fatty acid = Monocarboxylic acid + 4 to 30 carbon chain

(b) **Waxes:** The organic compound in which *C_{25} to C_{35} long chain alkanes* with odd carbon numbers have oxygenated derivatives such as secondary alcohols and ketones, are called waxes.

(c) **Phospholipid:** The kind of lipids in which key components i.e. ***glycerols, fatty acids and nitrogenous base*** also have phosphorus atom is called phospholipid.

(d) **Glycolipids:** The association of lipids with carbohydrates is called glycolipids.

(e) **Sphingolipids:** The kind of lipid in which *central compound is 4-sphingenine,* these lipids are closely associated with animal membranes and nerve tissues.

(f) **Terpenoids:** The organic compounds of lipid company which *have repeating isoprenoid units.*

CONCEPTIONAL VIEW

Q.13 What do you know about bonding of amino acids in proteins?

Ans. BONDS INVOLVE IN PROTEINS:

(1) Covalent Bond:

Each amino acid has central carbon which is attached to $–NH_2$, -COOH and –H with three sides by covalent bond. These (atoms or) molecules have covalent linkage to each other or itself. In amino acid, the only fourth position is variable. It is R group. R group of amino acid is called variable group.

(2) Peptide Bond:

A covalent bond between $–NH_2$ and –COOH of two different amino acid is called peptide bond. The elimination of H_2O by the bonding of $–NH_2$ and -COOH is called condensation.

(3) Ionic Bond:

Acidic and basic (R) groups exist in an charged state at different pH. Acidic R is +vely charged while basic R is –vely charged. When acidic R and basic R meets the ionic bonding occurs. In aqueous environment, ionic bonds are weaker due to this reason they may be broken by pH changes.

(4) Disulfide:

These bonds make the molecules fold into a particular shape. These are strong. Disulphide forms between different chains or in the same chain. In this case, R group has –SH (sulphidryl) group. So two molecules of –SH group line up (oxidized) and form disulphide bond.

(5) Hydrogen Bonding:

Hydrogen bonding is weaker. But H bonding present frequently. It produces helix structure in polypeptide chain. In it, hydrogen is attracted towards a neighboring electronegative O or N. H bonding provides stability to structure.

---O---H……………O

---O---H……………N

---O---H……………O

---O---H……………N

H-bonds

(6) Hydrophobic Interactions:

Some R group of amino acids are non polar, so they are hydrophobics. Hydrophobics means water hating. In chain, the hydrophobic groups tend to point inwards towards the center of molecule in aqueous medium. While hydrophilic groups

(H_2O loving) face outwards into the aqueous medium.

(d) KINDS OF STRUCTURE OF PROTEINS

Primary Structure:

"The sequence of amino acids in a polypeptide chain is called primary structure".

F. Sanger was first worker who described the sequence of amino acids in protein. proteins have ***specific arrangements*** of amino acids along its chains. today, one hundred thousand protein primary structures are known.

There are thousands of different proteins in the human body. These proteins have different arrangements of 20 amino acids. Total kinds of amino acids are 20 which form proteins. But each protein has specific kinds, particular arrangement and certain number of amino acids. Alteration of a single amino acid from its specific position becomes the reason of abnormal function.

For example, ***haemoglobin*** protein has ***574 amino acids***. If a single amino acid is replaced from its normal place the function of hemoglobin is disturbed. Hemoglobin carries oxygen. So ***sickle cell anaemia*** occurs if only one amino acid is replaced from its proper place in hemoglobin.

Concept of Primary Structure:

(i) "It is defined as the linear sequence of amino acids in the polypeptide chain".

(ii) "No other forces or bonds are indicated by the term "primary structure".

Secondary Structure:

The term "secondary structure" refers to ***regular folding patterns of contiguous portions of polypeptide chain***. This structure includes coil into helix. In other words α-helix and the β-pleated sheets are formed and bonds occur.

α-helix means chain rotates clock wise.

α-helix has 3.6 amino acids per turn.

β-pleated sheets represent hydrogen bonding.

So β-pleated sheets structure, like the α-helix, allow to maximum amount of H-bonding.

In this consideration, ***H-bonding*** occur between $-\overset{O}{\overset{\|}{C}}-$ and NH–. So the stable and rigid structure is called β-pleated sheet.

Tertiary Structure:

This term refers to ***three dimensional structure***. The bonds between the amino acids are distant from each other in polypeptide chain.

Usually the chain bends and folds extensively, forming a compact globular shape.

This structure is maintained by four types of bonds, ***ionic, hydrogen, disulphide bonds and hydrophobic interactions***. In aqueous surrounding ***hydrophilic*** amino acids side chain exposes, while hydrophobic amino acids side chain buried inside.

This is the proteins Tertiary Conformation. The term "conformation" refers to the secondary and tertiary structure jointly.

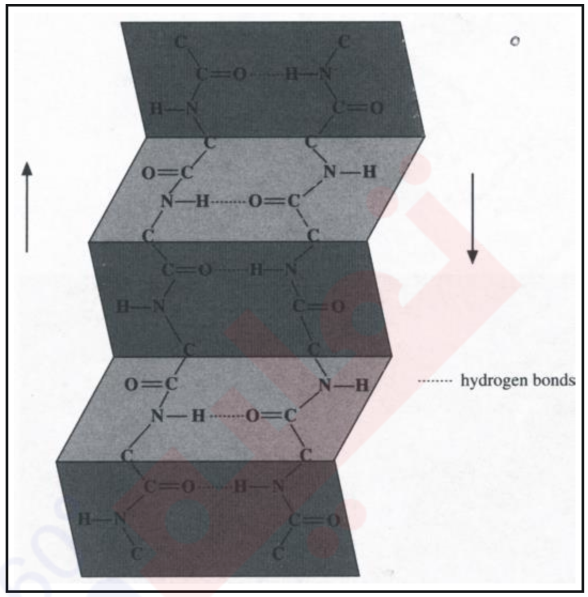


Fig. β-pleated sheet. The chains are held parallel to each other by the hydrogen bonds that form between the NH and CO groups. The side groups (R) are not shown but would project above and below the plane of the sheet.

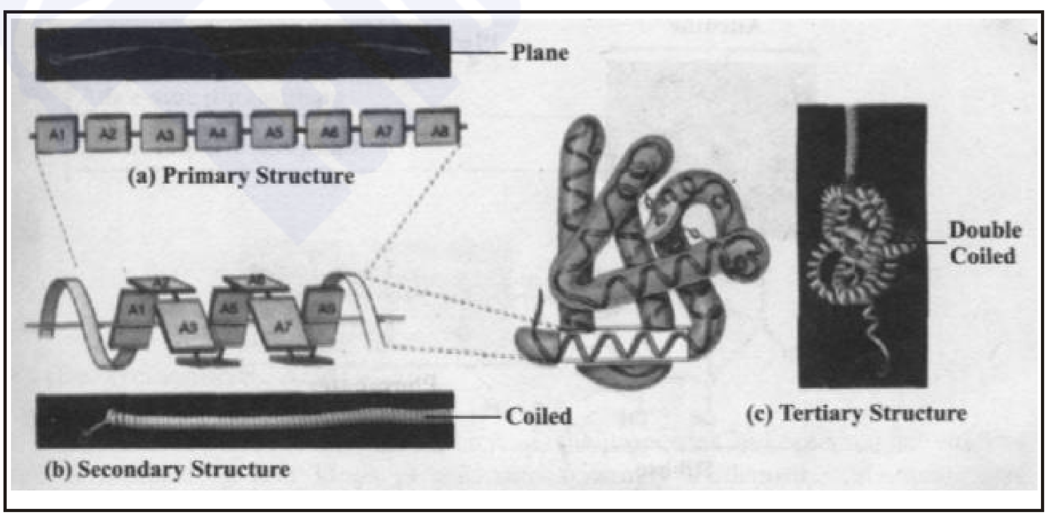


Fig. Three levels of protein structures compared with a telephone wire.

ITEMS FOR SPECIAL ATTENTION

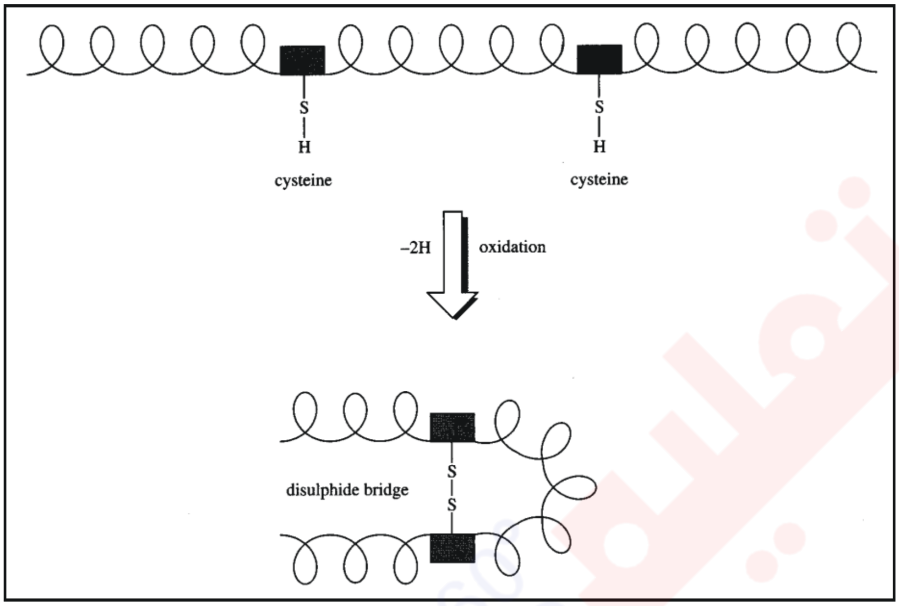
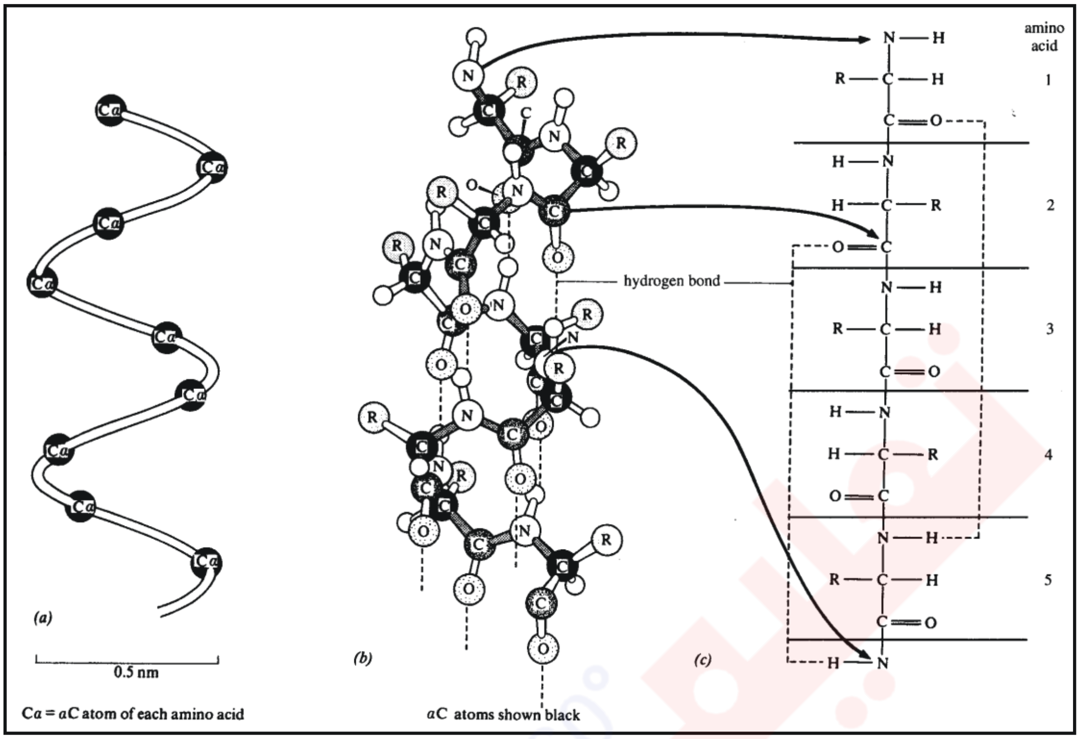


Fig. Formation of a disulphide bond between the sulphydryl groups of two cysteines.



Quarternary Structure:

"The separate chains are held together by hydrophobic interactions, ionic ***bonds and hydrogen bonds*** is known as quarternary structure".

Hemoglobin having quarternary structure, consisting of two identical and chains and two identical β chains.

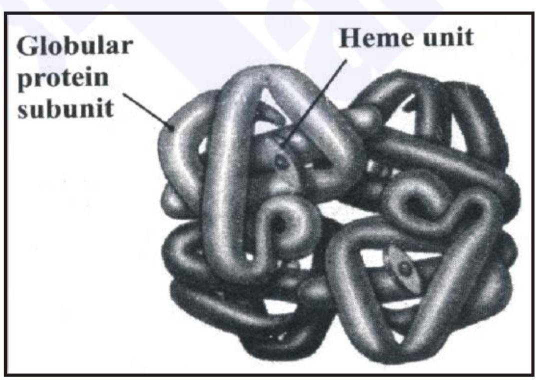


Fig. Tertiary structure of lysozyme. The arrows represent a region of β sheet. α helices are shown as regular coils. The rest of the molecule is represented as a ribbon and the four disulphide bridges as black zig-zags (compare fig.)

Carbohydrates:

(1) The skeleton carbons of carbohydrates have (H-C-OH) polyhydroxy groups. OR-All contain several hydroxyl groups.

(2). All carbohydrates are (C=O) aldehyde H or (C=O) ketones |

(3) It contains C, H and O. General formula is CnH2On.

Lipids:

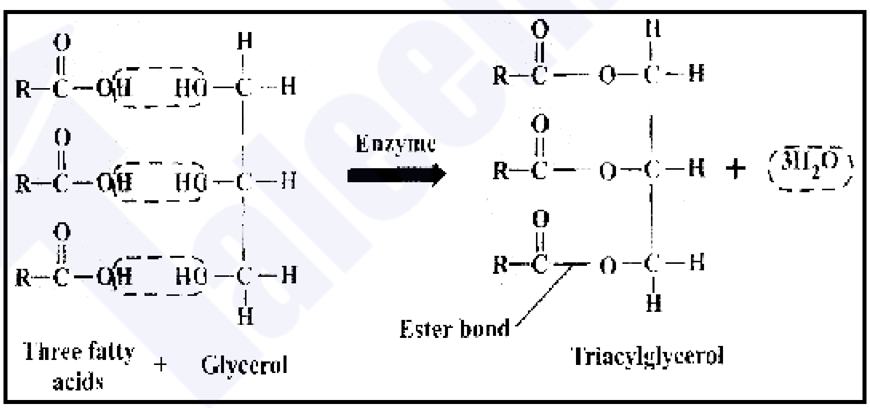
(1) True lipids are formed by condensation reactions between fatty acids and alcohols.

Structure of a haemoglobin. The molecule consists of four chains and two b chains. Each chain carries a haem to which one molecule of oxygen binds. The assembly of a protein from separate polypeptide chains is an example of quaternary structure.

(2) Carbohydrates, phosphate group, alkanes, alkenes etc may be additional component.

Q.15 What are the key components of lipids?

Ans. ***Fatty acids, glycerols*** and ***estrification*** are key components of lipids.



Q.16 What are the key components of carbohydrates and proteins?

Ans. The key components of carbohydrates are ***polyhydroxy, aldehydes*** or ***ketones***.

The key components of proteins are ***amino acids*** while amino acids have carboxyl group. ***Amino group*** and H with ***alpha carbon*** are as key component.

Q.17 Define the Followings: HELP LINE

Ans. Amino Acids:

The basic units of proteins in which alpha carbon (central) is always attached to _COOH carboxyl group, Amino ($-NH_2$) group and hydrogen (-H) are called amino acids.

Condensation:

Elimination of water between amino group and carboxyl group of amino acids is called condensation.

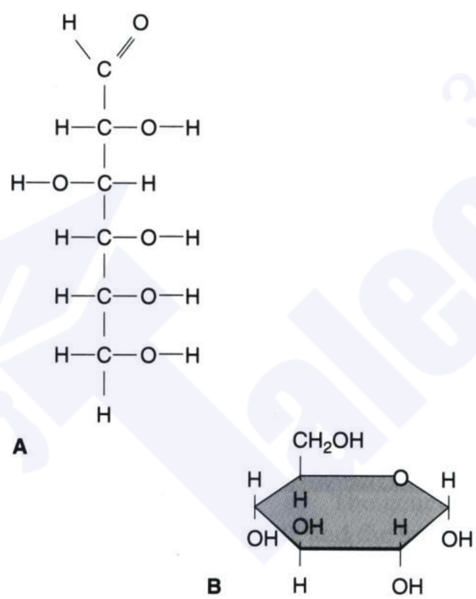
Peptide Bond:

The covalent bond between amino group ($-NH_2$) of one amino acid and carboxyl (-COOH) of another amino acid is called peptide bond or peptide linkage.

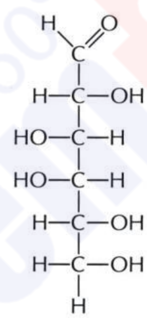
FOR CONCEPT ONLY

Q.18 Write any five examples of carbohydrates with structural formulae:

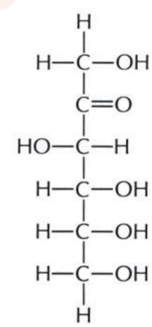
Ans. Structural formula shows the actual places of atoms and arrangement of molecule.



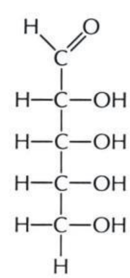
Two ways of depicting the structural formula of the simple sugar glucose. In **A,** the carbon atoms are shown in open-chain form. When dissolved in water, glucose tends to assume a ring form as in **B.** In this ring model the carbon atoms located at each turn in the ring are usually not shown.



Galactose

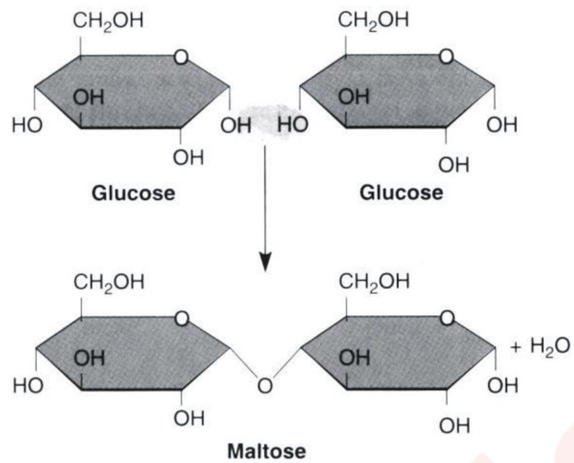


Fructose



Ribose

These two hexoses and a pentose are common monosaccharides. Galactose and ribose are aldehyde sugars; fructose is a ketone sugar.



Formation of a double sugar (disaccharide maltose) from two glucose molecules with the removal of one molecule of water. This type of reaction is a condensation reaction. The reverse reaction, adding a molecule of water to maltose and forming two glucose molecules, is a hydrolytic reaction.

Q.19 What are nucleic acids? Differentiate between RNA and DNA.

Ans. **NUCLEIC ACID (DNA & RNA)**

"The macromolecules which are essential contributors in reproduction, genetic control, biosynthesis are called nucleic acid".

F.Miecher in 1870 discovered "nucleic acid" from the nuclei of PUS cells, for the first time in history. Due to their isolation from nuclei and other acidic nature, they were named as 'Nucleic Acids'.

Types of Nucleic Acids:

There are following two types of Nucleic acids"

(i) DNA (ii) RNA

(i) DNA stands for (Deoxyrido Nucleic Acid).

(ii) RNA stands for (Ribonucleic Acid).

DNA	RNA
(1) DNA occurs ***in chromosomes***, in the nuclei of cells, in ***mitochondria*** and ***chloroplasts***.	(1) RNA is present in the *nucleolus*, in the ***ribosomes***, in the ***cytosol*** and in smaller in other parts of cell.
(2) It is made up of deoxyribo nucleotides.	(2) It is composed of *ribonucleotides*.

(3) It contains ***deoxyribose sugar***.	(3) It contains ***ribose sugar***.
(4) DNA has ***double helical chain*** of nucleotides.	(4) RNA has ***single chain*** of nucleotides.
(5) It contains adenine, guanine, cytosine and ***thymine*** as nitrogen bases.	(5) It has ***uracil*** in place of thymine.

Q.20 Describe chemical composition of nucleic acids.

Ans. ***Nucleic acids*** are complex substances. They are polymers of nucleotides. Each nucleotide is made up of following three sub units:

(1) 5-Carbon monosaccharides (a "pentose" sugar).

(2) A 'nitrogen' base.

(i) ***Adenine*** [A]
(ii) ***Guanine*** [G] Larger units (purines)
(iii) ***Cytocine*** [C]
(iv) ***Thymine*** [T] or ***Uracil***) Smaller units (pyrimidines)

(3) Phosphoric Acid:

Phosphoric acid (H_3PO_4) has the ability to develop ***ester linkage with OH group*** of pentose sugar.

In a typical nucleotide, the nitrogen base is attached to position '1' of pentose sugar, while phosphoric acid is attached to carbon ***at position 3 of pentose*** sugar.

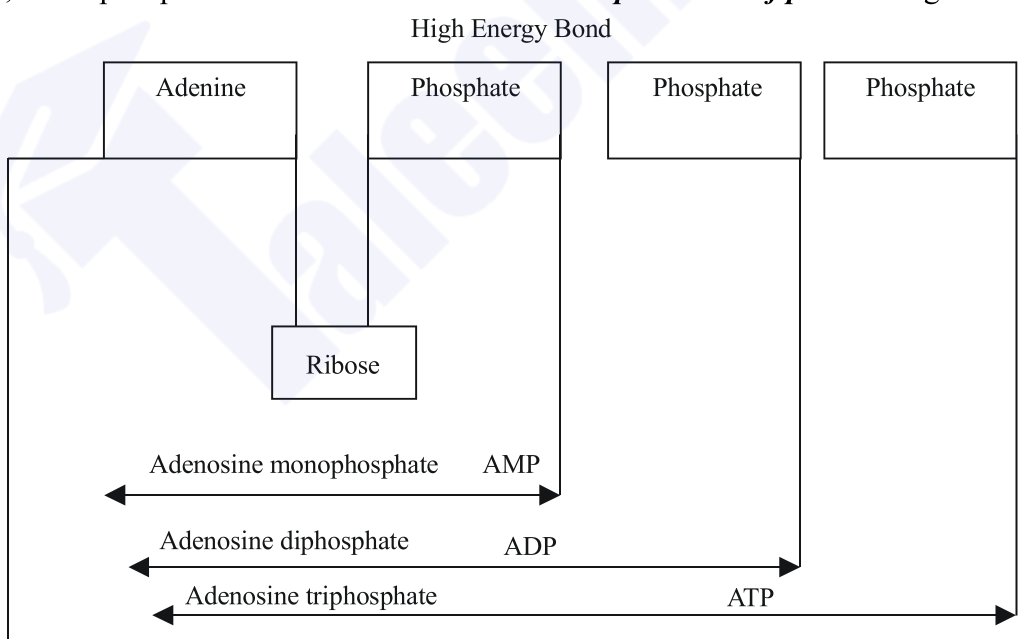


Fig. Showing Components of "ATP"

Nucleoside and Nucleotide:

The compound formed by a base and a pentose sugar is called ***nucleoside***.

A nucleoside and phosphoric acid combine to form a ***'nucleotide'***.

There are following four nucleotides, depending on the nitrogen bases:

Adenine + Sugar + Phospheric acid $\longrightarrow$ Adenine nucleotide
Guanine + Sugar + Phosphoric acid $\longrightarrow$ Guanine nucleotide
Cytosine + Sugar + Phosphoric acid $\longrightarrow$ Cytosine nucleotide
Thymine + Sugar + Phosphoric acid $\longrightarrow$ Thymine nucleotide

ATP is also an important nucleotide used as energy currency by cell.

Q.21 Write note on DNA. Also discuss various molecules of its structure.

Ans. **DNA (DEOXYRIBONUCLEIC ACID)**

DNA is the hereditary material and is transferred from parents to off springs.

It controls the activities of a cell.

DNA is made of following four nucleotides:

(i) d-adenosine monophosphate (d-AMP)

(ii) d-guanosine monophosphate (d-GMP)

(iii) d-cytidine monophosphate (d-CMP)

(iv) d-thymidine monophosphate (d-TMP)

Phosphodi-ester Linkages:

These nucleotides are united with one another through phosphodiester linkages.

NAD (Nicotinamide adenine dinucleotide) is an excellent example of ***dinucleotide***.

This is an important coenzyme in several oxidation-radiation reactions in the cell.

MODELS OF DNA STRUCTURES

(a) Chargaff's DATA: (*Ratio of Bases*)

Erwin chargaff in 1951 provided data about the ratios of different bases present in DNA molecule. The data suggested that adenine and thymine are equal in ratio and so are guanine and cytosine.

(b) Wilkins and Franklin's Technique: (*Structure*)

In 1995, Maurice Wilkins and Rosalind Franklin used the ***technique of 'x-rays diffraction'*** to determine the structure of DNA.

List of ribonucleotides and deoxyribonucleotides

	RNA		DNA	
Nitrogenous base	Nucleosides (ribose + nitrogenous base)	Nucleotides (ribose + nitrogenous base + phosphoric acid)	Nucleosides (deoxyribose + nitrogenous base)	Nucleotides (deoxyribose + nitrogenous base + phosphoric acid)
Adenine	***Adenosine***	AMP, ADP, ATP	***d-Adenosine***	dAMP, dADP, dATP
Uracil	***Uridine***	UMP, UDP, UTP		
Guanine	***Guanosine***	GMP, GDP, DTP	***d-Guanosine***	dGMP, dGDP, dGTP
Cytosine	***Cytidine***	CMP, CDP, CTP	***d-Cytidine***	dCMP, dCDP, dCTP
Thymine			***d-Thymidine***	dTMP, dTDP, dTTP

Relative amounts of bases in DNA from various organisms (on percentage basis).

Source of DNA	Adenine	Guanine	Thymine	Cytosine
Man	30.9	19.9	29.4	19.8
Sheep	29.3	21.4	28.3	21.0
Wheat	27.3	22.7	27.1	22.8
Yeast	31.3	18.7	32.9	17.1

WATSON AND CRICK'S MODEL

In 1956, James D. Watson and Francis Crick built the scale model of DNA. Following are the important points of their model:

(1) 2-Polynucleotide Chains: DNA is made up of two polynucleotide chains or ***strands***.

(2) Antiparallel Coiling: The two strands are coiled round each other in the form of ***double helix***. This ***coiling is antiparallel***.

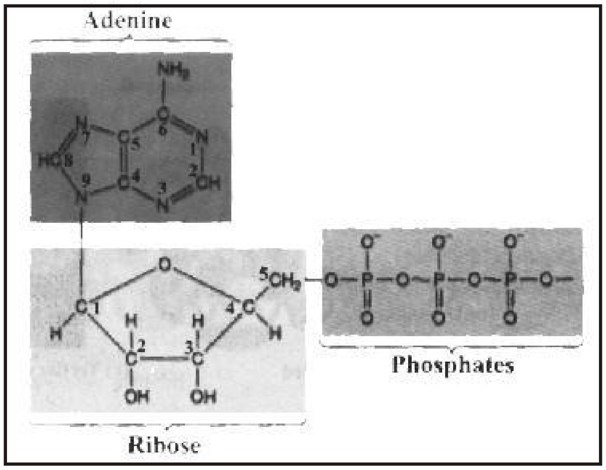


Fig. Structural formula of ATP (a nucleotide)

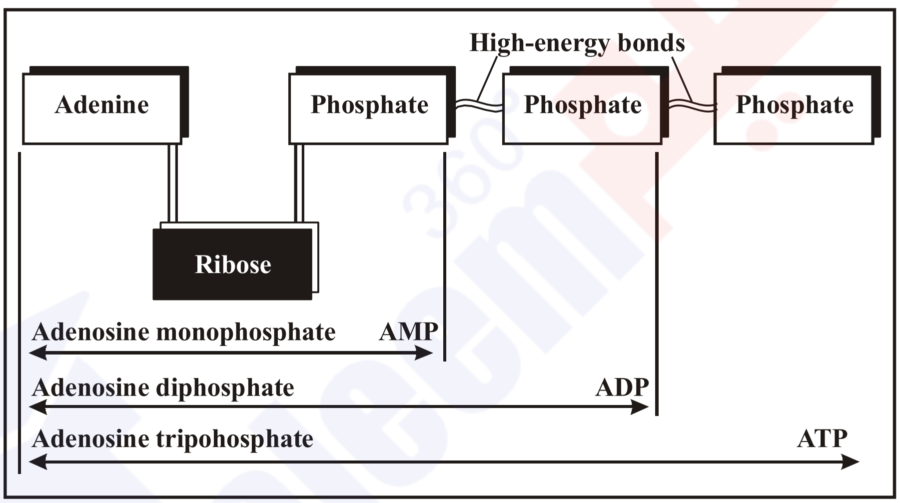


Fig. Components of ATP, nucleotide

(3) Hydrogen Bonding: The two chains are held together by weak bonds i.e. hydrogen bonds.

(4) Complements: Adenine (A) is always opposite to thymine (T), guanine (G) and cytosine (C) are opposite to each other.

(5) Specific H-bonding: There are two hydrogen bonds between 'A' and 'T' pair **A = T** and three hydrogen bonds between 'G' and 'C' pair **G ≡ C**.

(6) 10 Base Pairs in Each Turn: The two strands are coiled around each other so that there are 10 base pairs in each turn of about 34 Angstrom units (A°). One A° = one 100 millionth of a centimeter.

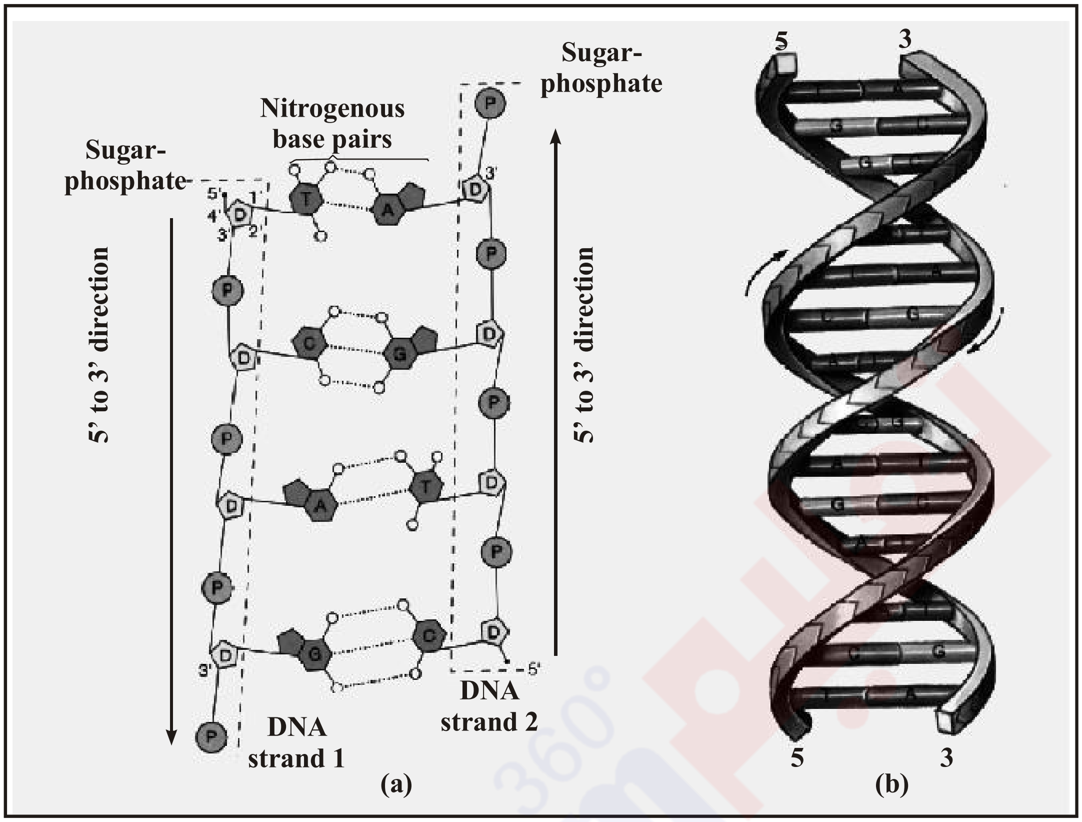


Fig. Model of DNA. Double helical structure of DNA proposed by Watson and Crick (b). A hypothetical sequence of nucleotides (on the left side) shows hydrogen bonding between the complementary bases. Note a double bond between. A and T, and triple bond between C and G (a)

Q.22 (a) What are the basic types of RNA and their role in protein synthesis?

Ans. **RNA (RIBONUCLEIC ACID)**

The molecules of RNA occur as single strand. This can be folded to give double helical characters. RNA is synthesized by DNA in a process known as "**transcription**".

Types of RNA:

Following are three different types of RNA:

(i) Messenger RNA (mRNA)

(ii) Transfer RNA (tRNA)

(iii) Ribosomal RNA (rRNA)

(i) mRNA (3-4%):

It takes the genetic message from the nucleus to the ribosomes in the cytoplasm to form particular proteins. This type of RNA consists of a single strand of variable length. Its length depends upon the size of the gene as well as the protein for which it is taking the message.

For Example:

For a protein molecule of 1,000 amino acids, mRNA will have the length of 3,000 nucleolides. mRNA is the most important type of RNA and is *about* ***3-4%*** of the total RNA in the cell.

(ii) tRNA (10-20%):

It transfers amino acid molecules to the site where peptide chains are being synthesized. The 'tRNA' *comprises about* ***10-20%*** of the cellular RNA. Its molecules are small, each with a chain length of 75-90 length nucleotides. Its main function is to pick up amino acids from cytoplasm and to transfer them to ribosomes.

(iii) rRNA (80%):

It is about ***80%*** of the total cellular RNA. It is mainly associated with the ***ribosomal protein***. It acts as ***bio-machinery*** for the synthesis of proteins.

Q.22 (b) Describe the conjugating molecules.

Ans. **CONJUGATING MOLECULES**

Two different molecules, belonging to different categories, usually combine together to form conjugating molecules:

(i) **Carbohydrates:** Carbohydrates may combine with proteins to form glycoprotein or with lipids to form glycolipids.

(ii) Most of the cellular secretions are ***glycoprotein*** in nature.

(iii) Both ***glycoprotein*** and ***glycolipids*** are integral structural components of ***plasma membrane***.

(iv) Lipoprotein formed by combination of lipids and proteins are basic ***structural frame work*** of all types of membrane in the cell.

NUCLEIC ACID:

(i) Nucleic acids have special affinity for basic proteins.

(ii) They are combined together to form ***nucleoprotein***.

(iii) The nucleohistones are present in chromosomes.

(iv) These conjugated proteins are not only of ***structural*** but also are of functional significance. They play an important role in ***regulation of gene expression.***

SHORT QUESTIONS

Q.1 *What are the amphoteric molecules? Give an example.*

Ans. **Amphoteric Molecules**

A molecule which *contains both an acid and a basic part* are described as amphoteric molecule.

Example: Amino acid.

Q.2 *How many bonds are used in protein structure?*

Ans. **Bonds in Proteins**

Generally five types of bonds are used in the structure of proteins:

- Amino acids combine to form proteins.
- Amino acids are joined together by a type of bond known as Peptide Bond.
- After peptide bonding, the protein folds into a particular shape due to four other types bonds, namely:
  - (i) Ionic bonds
  - (ii) Disulphide bonds
  - (iii) Hydrogen bonds
  - (iv) Hydrophobic interactions.

Q.3 *What are amino acids? How many amino acids are known?*

Ans. **Amino Acids**

Amino acids are the basic units from which proteins are made by ***peptide linkages***.

Over ***170 amino acids are known*** in cells or tissue.

Only ***20 are commonly found in proteins***.

Q.4 *Write the names of any five amino acids. (for concept only)*

Ans. **Names of Amino Acids**

(i)	Glycine	(ii)	Alanine	(iii)	Phenyl alanine
(iv)	Arginine	(v)	Lysine	(vi)	Leucine
(vii)	Tyrosine	(viii)	Serine	(ix)	Valine

Q.5 What is quaternary protein?

Ans. More than one polypeptide chains held together by hydrophobic interactions and hydrogen and ionic bonds a complex protein form is called quaternary protein.

Q.6 What do you know about β-pleated sheet?

Ans. **β-Pleated Sheet:** All NH_2 and C=O groups are involved in hydrogen bonding, so the structure is very stable and rigid. The whole structure is known as **β-pleated sheet.**

Q.7 Define tertiary structure of protein.

Ans. Bending and folding of polypeptide chains into compact globular shape, which is maintained by bonds like ***ionic, hydrogen*** and ***disulphide*** bonds as well as ***hydrophobic*** interactions known as tertiary structure.

Q.8 How can you briefly describe about secondary structure of protein.

Ans. Spiral spring like structure which is maintained by hydrogen bonding between C=O and NH_2 called as secondary structure.

Q.9 Shortly describe about structural protein with few examples.

Ans. **Structural Proteins**

Keratin is structural protein, it is found in skin, feathers, nails, hairs and horn.

Elastic is also structural protein found in elastic connective tissues (ligament).

Collagen is structural protein which is component of bones, cartilage and tendons.

Q.10 What are reducing sugars? Give an example of non-reducing sugar.

Ans. **Reducing Sugars**

"Those sugars which carry out ***reduction reactions*** are called reducing sugars".

(i) ***All monosacchardies are reducing sugars.***

(ii) Some disaccharides i.e. ***maltose*** and ***lactose*** are reducing sugars.

(iii) Bendict test and Fehling test are common test for reducing sugars.

Sucrose is the only common non reducing sugar.

TERMS TO REMEMBER

Q.11 Define Oxidation, Reduction, Oxidation-reduction reaction, ATP, Fermentation, Respiration.

Ans. Oxidation: Oxidation means accept of O_2 or donate electrons.

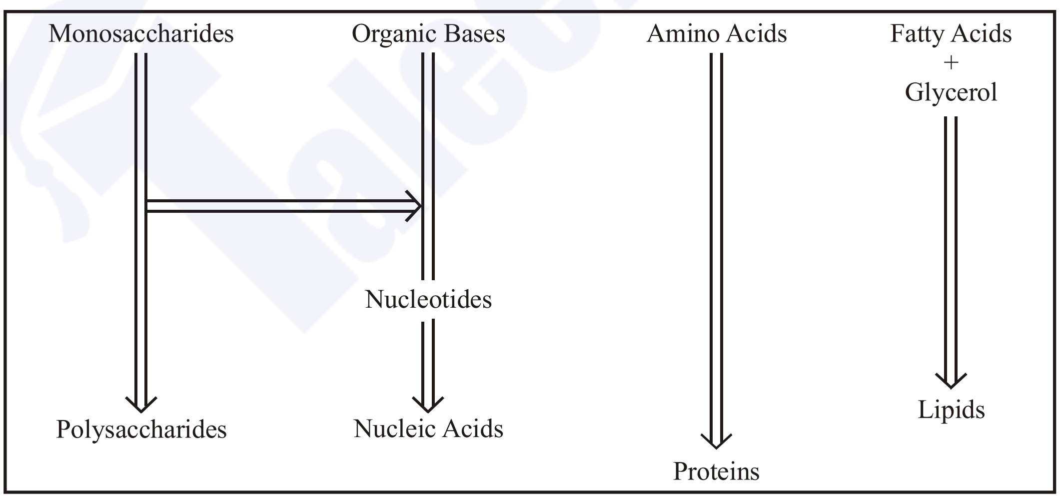
Reduction: Reduction means donate O_2 or accept electrons.

Oxidation-Reduction Reaction: A process in which electrons are transferred from an electron donor (oxidizing agent) to an electron acceptor (reducing agent), it is major energy supplying reaction in animals and plants.

Adenosine Triphosphate (ATP): A major energy transferring molecule in biological reactions in which adenosine is linked with three phosphates is called ATP.

Fermentation: The process or reaction in which energy is obtained from glucose in the absence of free oxygen.

Respiration: The oxidative breakdown of food substances within the cells of an organism and energy is likerated for processes of life or activities.



MAKE SHORTS QUESTIONS & ANSWERS

Table Organic Compounds Associated with Living Things

Macromolecule	Monomer	Function
Proteins	Amino acids	Enzymes speed up chemical reactions; structural components (e.g., muscle proteins)
Carbohydrates		
Starch	Glucose	Energy storage in plants
Glycogen	Glucose	Energy storage in animals
Cellulose	Glucose	Plant cell walls
Lipids		
Fats and Oils	Glycerol, 3 fatty acids	Long-term energy storage
Phospholipids	Glycerol, 2 fatty acids, phosphate group	Plasma membrane structure
Nucleic Acids		
DNA	Nucleotides with deoxyribose sugar	Genetic material
RNA	Nucleotides with ribose sugar	Protein synthesis

DIFFICULT WORD MEANINGS

Words	Meanings	Words	Meanings
Specific	مخصوص	Lipids	چکنائیاں
Describe	بیان کرنا	Mono	ایک
Arrangement	ترتیب	Di	دو
Kinds (types)	قسمیں	Tri	تین
Alternation	تبدیلی	Poly	کئی / بے شمار
Abnormal	صحیح نہ ہونا	Oligo	چند
Sequence	ترتیب	Soluble	حل پذیر
Linear	ایک لائن میں	Insoluble	ناحل پذیر
Sickle cell Anaemia	آکسیجن کی کمی کی وجہ سے سیل کی شکل خراب ہونا	Peptide bond	امائنو ایسڈز کے درمیان تعلق کیمیائی داری
Haemoglobin	آکسیجن سپلائی کرنے والی پروٹین	Saturated	بغیر ڈبل بانڈ
Helix	بل کھانا (رسی کی طرح)	Unsaturated	ڈبل بانڈ کے ساتھ
Bond (linkage)	کیمیائی جوڑ	Fibres	دھاگہ نما
Glycosidic	کاربوہائیڈریٹس کے درمیان کے بانڈ	Globular	گلوب / بلرز کی
Tetrahedron	چار کونے / جوڑ	Crystallised	قلمی شکل کی
Association	تعلق	Contraction	سکڑنا
Stability	استحکام	Relaxation	پھیلنا
Respectively	بالترتیب	Hydrophobic	پانی سے نفرت کرنے والے
Dipolar	دوپول / اور + چارج	Hydrophilic	پانی سے محبت کرنے والا
Product	تیار کردہ مال / شے		

Q.1 Fill in blanks:

(i) The sum of all the chemical reactions taking place within a cell is called __________.

(ii) __________ is the basic element of organic compounds.

(iii) All the amino acids have an amino group and carboxyl group attached to the same __________ atom.

(iv) __________ is the most abundant carbohydrate in nature.

(v) Adenine and guanine are double ringed bases and are called __________.

ANSWERS:

(i) Metabolism (ii) Carbon (iii) Carbon

(iv) Cellulose (v) Purines

Q.2 Write whether the statement is 'true' or 'false' and write the correct statement if it is false:

	STATEMENT	T/F	CORRECT STATEMENT
(i)	A small proportion of water molecules are in ionized form	T	
(ii)	The covalent bond among two monosaccharides is called a peptide bond	F	The covalent bond among two monosaccharides is called a glycosidic.
(iii)	Glycogen is also called plant starch.	F	Glycogen is also called animal's stored poly saccharide
(iv)	Adenine is always opposite to guanine cytosine and thymine or opposite to each other in DNA molecule.	F	Adenine is always opposite to thymine, cytosine and guanine are opposite to each other in DNA molecule.
(v)	DNA molecule is made of two polynucleotide strands.	T	

Q.3 Each question has four options. Encircle the correct answer:

(i) Animals obtain carbohydrates mainly from:

(a) Glucose (b) Starch

(c) Sucrose (d) Glycogen

(ii) Peptide bond is a:

(a) C – N link (b) C – O link

(c) C – H link (d) C – H link

(iii) Globular proteins differ from fibrous proteins in:

(a) Having amino acids

(b) Their repeating units joined by peptide bond

(c) Being soluble in aqueous medium

(d) Being non-crystalline

(iv) Which of the following amounts of bases are more likely to be found in an organism?

(a) Adenine 30.9% and Cytosine 30.7%

(b) Guanine 27.5% and Adenine 27.8%

(c) Cytosine 19.8% and thymine 20.0%

(d) Adenine 32% and Thymine 31.9%

(vi) Amino acids are arranged in proper sequence during protein systhesis according to the instructions transcribed on:

ANSWERS:

(i) (d) (ii) (a) (iii) (c) (iv) (d) (v) (c)

Q.4 Short Questions:

(i) Name the carbohydrates suitable as food for man.

Ans. Glucose, fructose, sucrose, lactose and starch.

(ii) Why are fats considered as high energy compounds?

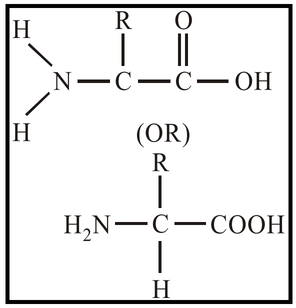
Ans. Because fats contain high proportion of C – H bonds and low proportion of oxygen 50 energy stored in fats is twice as compared to carbohydrates.

(iii) What is the function of mRNA?

Ans. It carries the genetic message from nucleus to ribosome in cytoplasm to form a particular type or protein.

(iv) What is the general formula for amino acid?

Ans. Formula of amino acid.

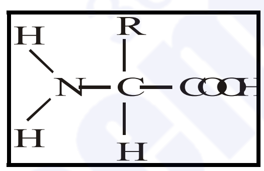


R group is different in different amino acids.

(v) Write a short note on amino acids.

Ans. **Amino Acids:** About 170 types of amino acids have been found to occur in cells and tissues. Of these, about 25 are constituents of proteins. Most of the proteins are however, made of 20 types of amino acids.

Structure of an Amino Acid: All the amino acids have an amino group (- NH_2) and a carboxyl group (- COOH) attached to the same carbon atom, also known as ***alpha carbon***. They have the general formula as:



R may be a hydrogen atom as in glycine, or CH_3 of as in alanine, or any other group. So amino acids mainly differ due to the type or nature R group.

(vi) How many bonds are found in quaternary structure of protein which hold the chains?

Ans. (i) Hydrophobic interactions (ii) Hydrogen bonding

(iii) Ionic bonds

Chapter 3

ENZYMES

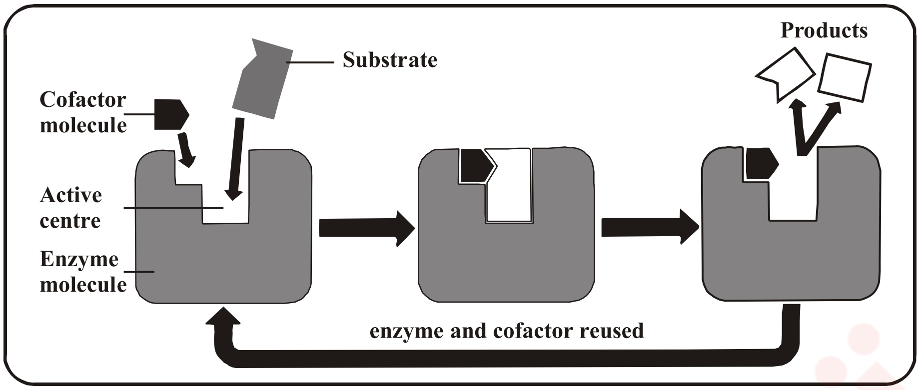
Q.1 Define enzyme, and write an account on enzymes.

Ans. **ENZYME**

"A protein which ***speeds up biochemical reaction*** without its used up is called enzyme".

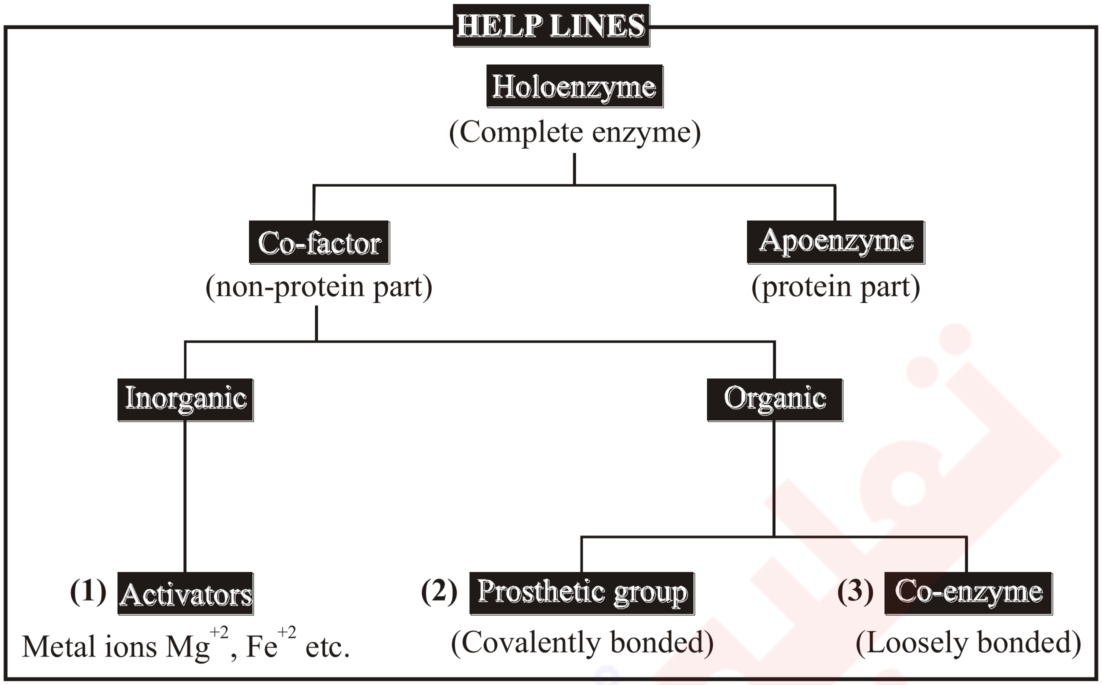
- Enzymes have very important role in life. It is that substance which is *not used up* in biochemical reaction.

  It is essential for proper activities of life, because without enzymes the reactions proceed very slow. *Proper speed* of reactions is essential for proper functions.
- The study of enzymes is called ***enzymology.***
- General process of life like digestion, respiration, excretion etc. depend upon enzymes.
- Particular enzyme acts on a specific reactant or substrate. ***"Substrate is that substance on which enzyme acts".***
- There is a ***lock and key relationship*** between substrate and enzyme.
- Enzymes never become the part of product.
- Commonly the "suffix" of the enzyme is ***"__ase"***, in few case ***"__IN"*** is also ending of enzyme. *e.g., sucrase, maltase, lipase, catalase, amylase, orginase, enterokinase etc. and pepsin, trypsin, erepsin etc.*
- All enzymes are ***globular proteins.***



- **Co-Factors** and ***Coenzymes*** are necessary for catalytic activities of enzymes. Mg++, Fe++, Cu++ and Zn++ etc act as cofactors, but these are inorganic ions and termed as activators.
- **Coenzymes** organic molecules i.e. vitamins (NAD, Biotin) which also essential for reactions. The tightly bounded coenzyme situation is prosthetic group.
- ***Inactive Protein Portion of Enzyme:*** The remaining protein portion after removal of cofactor or prosthetic group is known as *apoenzyme*.

  Active Complex: Enzyme plus cofactor become the active complex, which is termed as holoenzymes.
- **Active Sites:** The site at which the substrate of an enzyme is bound during catalysis. Once bound, the substrate reacts to form a product or products, which are then released from the active site.
- ***Specific Enzymes and Specific Sites:*** Specific enzymes are produced on specific site, according to requirement. The enzymes for cellular respiration are found in *mitochondria*. *Ribosomes* and *chloroplast* have those enzymes which involved in protein synthesis and photosynthesis respectively.



Q.2 Define Catalysis, Substrate, Products.

Ans. **Catalysis** The process by which a chemical reaction is enhanced by a biocatalyst or enzyme without its own involvement in the product.

Substrate The molecule or molecules on which an enzyme exerts its catalytic action.

Products The formations occurred by the chemical reactions as a result are called products.

Q.3 Define activator and prosthetic group.

Ans. **Activator** The inorganic part of an enzyme is called activator. These are Mg^{++}, Fe^{++}, Zn^{++} and Cu^{++} etc.

It is that substance which makes another substance active. (See coenzyme for prosthetic group).

Q.4 Brief about cofactors and coenzymes.

Ans. $\boxed{\text{COFACTOR}}$ The non-protein component of some enzymes that is necessary for catalytic activity which may be metal ions or coenzymes: (i) activators (ii) prosthetic group (iii) co-enzymes.

Function of Cofactor:

Cofactors play the role of bridge between enzymes and substrate. They provide a source of chemical energy. Mg^{2+}, Fe^{2+}, Zn^{2+} etc are used as cofactor. The detachable cofactor is called as an activator if it is an inorganic ion.

$\boxed{\text{COENZYME}}$ An organic molecule i.e. vitamin that acts as an enzyme cofactor.

Example: NAD, NADP, Biotin and coenzyme A etc.

Function of Coenzyme:

Coenzymes function as intermediate carrier molecules, which transfer or remove functional groups, atoms or electrons. When coenzyme is tightly bound to enzyme, in this case it is known as ***Prosthetic Group***. If it may be only loosely arranged then acts like a secondary substrate of the enzyme.

Q.5 What do you know about apoenzyme and Haloenzyme?

Ans. $\boxed{\text{Apoenzyme}}$ The inactive protein portion of an enzyme that remains when the prosthetic group or cofactor has been removed.

OR

"The remaining protein of an enzyme after removal of cofactor or prosthetic group is called aponzyme". (Kinases requires Mg and Mn ions).

$\boxed{\text{Holoenzyme}}$ The active complex, which has *enzyme plus cofactor*. In other words, sum of enzyme and cofactor is holoenzyme. Thus apoenzyme may become active by addition of cofactors.

Q.6 Where are enzymes found commonly?

Ans. $\boxed{\text{Sites of Enzymes}}$

Enzymes are present in *cytoplasm* and also found near the site of productions. They are also tightly bounded to cell organelles.

Respiratory enzymes are present in *Mitochondria*. *Chloroplasts* have that enzyme which is involved in photosynthesis. Enzymes help in protein synthesis are found in *ribosomes*.

All enzymes are produced within cells. Some enzymes speed up the reactions inside the own cell while some are produced inside its cells but play its role out side the cells, in a particular environment. On these basis enzymes are divided into two categories Endoenzymes and Exoenzymes.

FOR CONCEPT

Q. Define exoenzymes and endoenzymes.

Exoenzyme:

"Enzymes which come out of cell and catalyze the useful reactions in their environment are known as exoenzymes".

Example: Pepsin is secreted by chief cells and works in stomach's environment.

Endoenzymes:

"Enzymes which are formed within a cell and also act within the same cell is called endoenzymes".

Q.7 What is the difference between enzyme and proenzyme?

Ans. Enzymes like pepsin are not produced in such form, these are produced in inactive form i.e. pepsinogen. The inactive form of enzyme is called *Proenzyme*. This proenzyme is changed into active form by HCl.

$$\underset{(Proenzyme)}{\text{Pepsinogen}} \xrightarrow{\text{HCl}} \underset{(Enzyme)}{\text{Pepsin}}$$

Q.8 Write down the characteristics of enzymes.

Ans. CHARACTERISTICS OF ENZYMES

(1) Globular Proteins: All enzymes are globular proteins.

(2) Speed up the Reactions: Enzymes speed up or enhance the chemical reaction without being used up.

(3) No Effect on End Product: When the reactant or substrate change into product the enzyme does not effect on the nature of end product.

(4) Minute Amount: Very minute amount is very much effective for reactions.

(5) Specific in Action: A particular enzyme acts on a specific substrate or a special group of substrates.

(6) Sensitive to Temperature: All enzymes perform its function at a specific temperature called as ***optimum temperature***. Human enzymes have 37°C optimum temperature.

(7) Sensitive to pH: Different enzymes properly work at its optimum pH. e.g. Pepsin works on 2.00 pH and catalase on 7.60 pH.

(8) Sensitive to Substrate Concentration: Up to a certain limit, the rate of enzyme reaction increases with increasing substrate concentration.

(9) Requirement of Co-factors: Co-factors are essential for proper performance.

(10) Lower the Activation Energy: Enzymes lower the activation energy for reactions.

(11) Enzyme Larger than Substrate: Most enzymes are larger than substrates.

Some enzymes are potentially damaging if they are manufactured in their active form. For example, **pepsin** is a powerful protein-digesting enzyme and is quite capable of destroying cell's internal structure and thus is produced in inactive **pepsinogen** form by the cell. It is converted in its active form only in the digestive tract where it is required to be active.

Q.9 Write an account on the mechanism of enzymes or catalysis.

Ans. **MECHANISM OF ENZYME ACTION OR CATALYSIS**

(i) Lock and Key Hypothesis:

Enzymes are specific, they have particular shape. ***Three-dimensional globular proteins*** give specific structure and specific chemical composition. Actually, enzyme has a particular shape into which the substrate fit exactly. This is lock and key hypothesis.

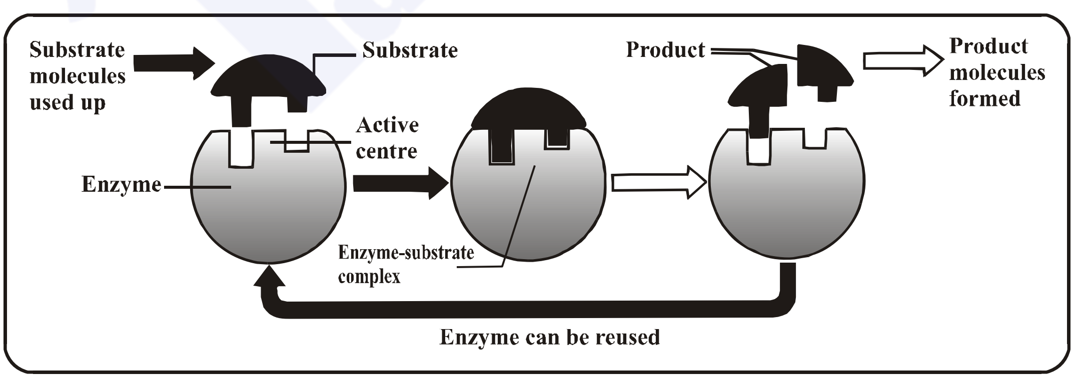


Fig. Diagrammatic representation of an enzyme-substrate reaction (Lock and Key Model)

(ii) Enzyme not Changed During Reaction:

Enzyme reacts with substrate and changes the substrate into products but enzyme itself not changed. It remains unaltered. After the formation of products, it goes toward a new reaction and again performs its function.

E	**+ S**	**------------(ES)-------------------**	**Product + E**
Enzyme	**Substrate**	**Enzyme Substrate Complex**	**(E ready for new work)**

(iii) Active Site:

The site where the substrate binds in enzyme is known as active site.

Active site has specific shape. The enzyme is larger than substrate. The active site of the enzyme is smaller than its other body bulk. Only three 3 to twelve 12 amino acids may be arranged in active site portion. These amino acids have specific coiling and folding which becomes the reason of special symmetry or geometry.

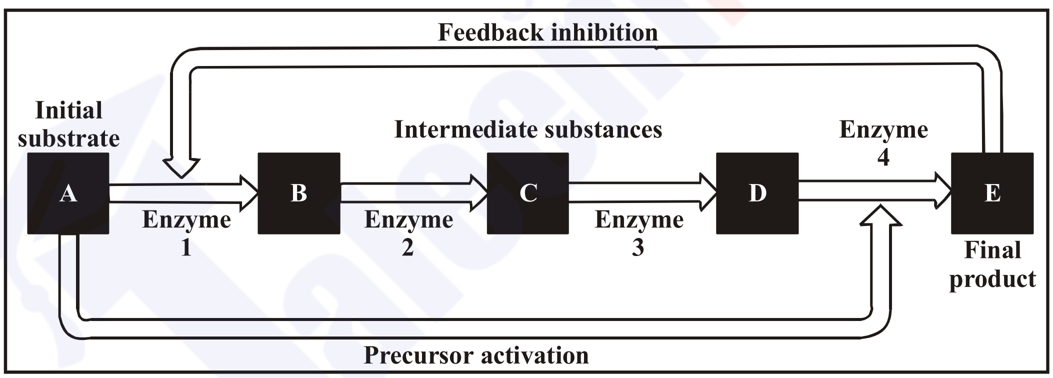


Fig. Enzyme to enzyme chain (association)

(iv) Binding and Catalytic Places of Active Site:

Active site of enzyme is divided into two further sites. One is binding site and other catalytic site.

Binding site holds proper substrate and fit it as ES-complex.

Catalytic site transforms the substrate into product or products.

(v) "Induced Fit" Hypothesis:

According to ***E. Fischer*** (1890), there is no modification or flexibility in the active site so lock and key rule is applied here. But in 1959 another hypothesis came about the active site. ***Mr. Koshland*** proposed that active site could be modified as the substrate interacts with the enzyme.

In other words, the slightly change may be occurred in active site and enables the enzyme to perform its catalytic activity more effectively.

EXAMINE YOURSELF

Q. Define Binding site, catalytic site, active site, apoenzyme, holoenzyme.

Q. What is "Lock and Key" hypothesis?

Q. Discuss induced fit hypothesis.

Q. What is enzyme substrate complex? Give an example.

Q.10 Which factors do affect the activity of enzymes?

Ans. **FACTORS AFFECTING THE RATE OF ENZYME ACTION**

Enzyme concentration, substrate concentration temperature and pH value are major factors, which affect the rate of enzyme action. Some factors should be constant and few should be at optimum level for proper rate of enzyme action. The work of an enzyme is disturbed by any factor which change the shape, chemistry or specificity of its.

(1) Enzyme Concentration:

The rate of reaction is proportional to enzyme concentration if temperature and pH remain constant. Increase the enzyme means number of active sites is increased. Substrate is converted into products actively due to available of extra active sites. These are all have a limit, after a certain limit there will be no increase in rate of reaction even increasing of enzymes.

(2) Substrate Concentration:

At constant enzyme concentration, the rate of an enzyme reaction increases with increasing substrate concentration. Ultimately, a point comes when any further increase in substrate concentration produces no significant change in reaction rate.

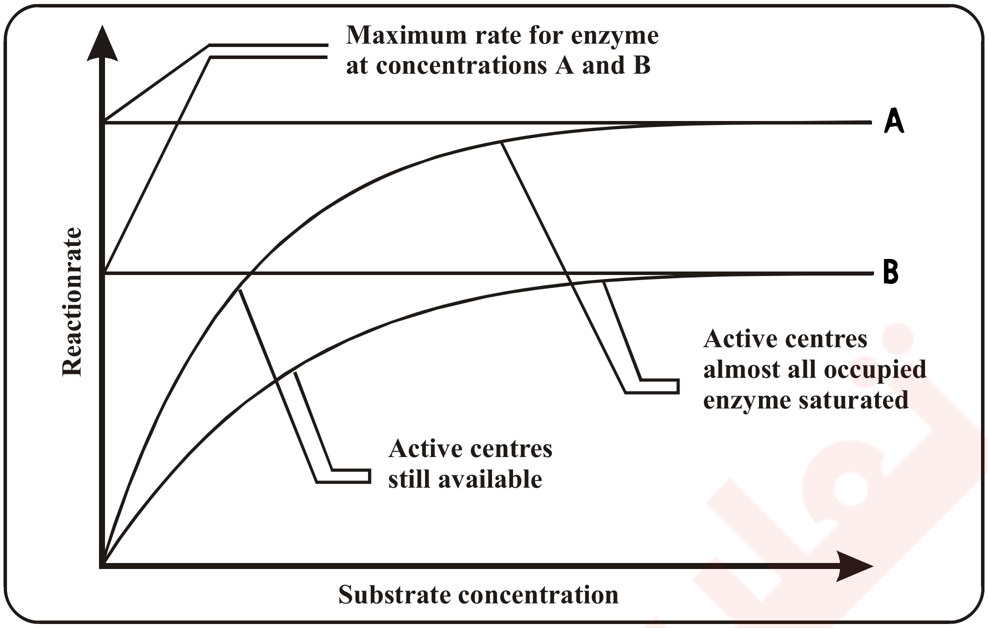


Fig. Effect of enzyme concentration and substrate concentration on the rate of an enzyme catalyzed reaction

(3) Temperature:

A suitable temperature is necessary for work of enzyme. An enzyme has maximum activity at a particular temperature this is optimum temperature. The enzymes of human body play a effective role at 37°C because it is optimum temperature for human enzymes.

In case of more than enough temperature, the rate of reaction is decreased. At this stage, the frequency of collisions is increased, in this way, the structure of an enzyme is disrupted and enzyme becomes denatured. In other word, due to extra collisions the structure of enzyme is disturbed and globular protein de-shaped thus inactive enzyme is called denatured.

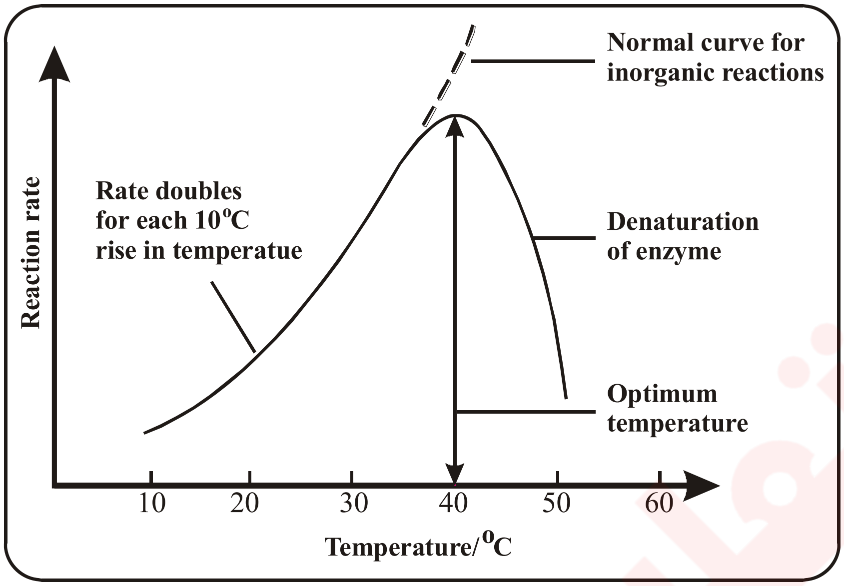


Fig. Effect of temperature on the rate of an enzyme catalyzed reaction

(4) Effect of pH Value:

Every enzyme functions efficiently over a particular pH range, at constant temperature. When the pH value is changed above or below the rate of enzyme activity diminishes.

Example: Pepsin catalyses protein at acidic medium i.e. pH 2.00 while trypsin also catalyses the protein but in alkaline medium i.e. pH.

pH change leads to an alteration of enzyme shape. Enzyme may become denatured in non-suitable pH. pH change also alters the ionization of amino acids.

Examples:

Enzymes	Optimum pH
Pepsin	2.00
Sucrase	4.50
Enterokinase	5.50
Salivary amylase	6.80
Catalase	7.60
Chymotrypsin	7.00 to 8.00
Pancreatic lipase	9.00
Arginase	9.70

Q. ***What type of role is played by enzyme concentration during catalysis?***
(Ans. See Q. 10 (1).

Q. ***What do you know about three kinds of co-factors? [Consult helpline of Q.1)***

Q. ***Describe the effect of substrate cone during catalysis. [(Ans. See Q.10 (2)]***

Q. ***Write the effect of temperature on enzyme action. [See Q.10 (3)]***

Q. ***What is the effect of pH on enzyme activity? [See Q.10 (4)]***

Q. ***What are optimum pH values of pepsin, sucrase, catalase and arginase?***
[(Consult Q.10 (table)]

Q.11 Define Inhibitor, Inhibition and Explain Inhibitors.

Ans. **ENZYME INHIBITORS**

"The small molecules which fit into active sites or on the other parts of enzymes and reduce the rate of enzyme controlled reactions are called enzyme inhibitors".

Enzyme Inhibition:

"The reduction in rate of enzyme controlled reactions by poisons or drugs (chemicals) is called enzyme inhibition".

Enzyme inhibitors
- (1) Irrversible
- (2) Reversible
  - (a) Competitive
  - (b) Non-competitive

Explanation:

Active site is only for substrates. If active site of enzyme is occupied by other chemical like poison or drugs then the reaction rate is so much disturbed because of wrong thing on sensitive place. It is the reason of inhibition. And poisons or drugs are termed as inhibitors. Inhibitors are divided into two types:

(1) Irreversible Inhibitors

(2) Reversible Inhibitors

(1) Irreversible Inhibitors:

Those inhibitors which check the rate of reaction by occupying the active sites and destroying the structure of globulin (or protein or amino acids) are called irreversible inhibitors. I.I. form covalent bonds on active sites and block the site.

(2) Reversible Inhibitors:

In this case, weak linkages are found between enzyme and inhibitor. So, reversible inhibitors can be neutralized by increase of substrate concentration.

(a) Competitive Inhibitors:

Some times a compound has same structure to that of the normal substrate. This similar compound fits at active site. In this way, the active site owner i.e. substrate loose its site. Even a inhibitor after fitting no increasing the rate but place is occupied. Due to this reason a competition is occurred between inhibitor and substrate, so inhibitor is called competitive inhibitor.

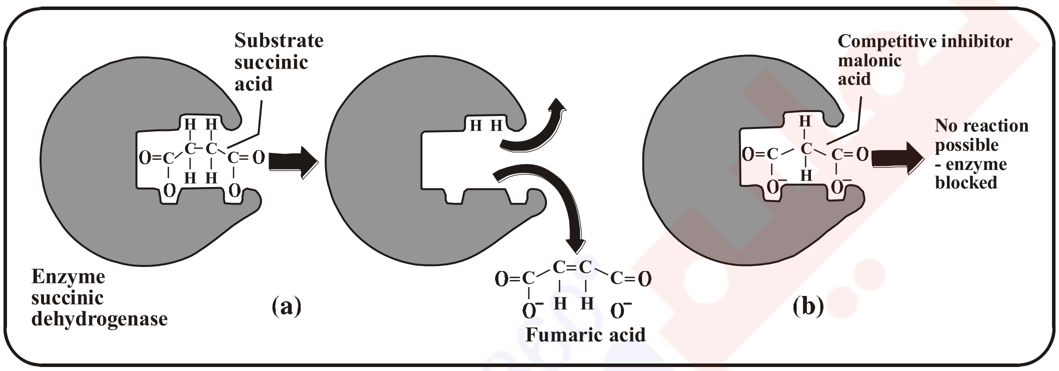


Fig. Mechanism of competitive inhibition. (a) Formation of enzyme-substrate complex resulting in the formation of product. (b) Inhibitor malonic acid does not fit the active site, hence no product is formed.

(b) Non-competitive Inhibitors:

In this type, inhibitor has no structural similarity to the substrate. So inhibitor does not fit at active site but attach to other part of enzyme. In this case substrate fits its own active site even then reaction rate is not increased.

DIFFICULT WORD MEANINGS

Words	Meanings	Words	Meanings
Enzyme	نامیاتی کیمیکل جو زندہ اشیاء کے ایکشن تیز کرنے	Complex	پیچیدہ/مرکب/بڑا
Active	متحرک	Lock and key role	انزائم اور سبٹریٹ کا مخصوص تعلق
Specific	مخصوص	Proposed	بیان کردہ
Proceed	چلانا	Visualize	دکھائی دینا/اظہار
Coiled	بل کھاتا ہوا	Modification	بدلنا/تبدیلی
Substrate	ایسا کیمکل جس پر انزائم عمل کرے	Concenteration	مقدار
Active site	انزائم کی وہ جگہ جہاں پر substrate سیٹ ہو	Available	پایا جانا/موجود
Contribute	حصہ ڈالے	Activity	سرگرمی/عمل/کام
Bridge	پُل	Vibration	تھرتھراہٹ
Activator	متحرک کرنے والا	Denatured	اصل ساخت خراب ہونا/فطرت بدلنا
Essential	ضرور	Cause	وجہ
Raw material	خام مال	Narrow range	کم مقدار
Represent	اظہار	Antimetabolite	جو کیمیائی عملی کرنے والوں کے خلاف ہو
Consist of	پر مشتمل ہونا	Occupy	قبضہ کرنا/جگہ گھیرنا
Dissolved	حل ہوا	Drug	دوائی/میڈیسن
Globular	گول	Genuine	اصلی/خالص
Sensitive	حساس	Catalysis	ایکشن کو تیز کرنے کا عمل
Recognize	شناخت/نمائندگی	Inhibition	رکاوٹ
Contain	میں ہونا/میں رکھنا/میں پایا جانا	Inhibitor	رکاوٹ ڈالنے والا
Definite	مستقل	pH	تیزابیت یا اساسیت کے متعلق
Binding	بندھے ہونا	Optimum	مناسب مقدار

Q.1 Fill in the blank:

(i) Enzymes are composed of hundreds of ————.

(ii) If the non-protein part is covalent bonded it is known as ————.

(iii) Many enzymes require non-protein component called ———— for their proper functioning.

(iv) Enzyme are highly ———— in nature.

(v) The enzymes which carry out the synthesis of ———— are integral parts of ribosomes.

ANSWERS:

(i) Amino acids (ii) Prosthetic group (iii) Co-factor

(iv) Specific (v) Proteins

Q.2 Write whether the statement is 'true' or 'false' and write the correct statement if it is false:

STATEMENT		T/F	CORRECT STATEMENT
(i)	Ligases catalyze the breakdown of complex substances into simple ones but water is not used as in hydrolytic reactions.	F	Oxidases catalyse the break of complex substances into simple ones but the water is used in hydrolytic reactions.
(ii)	Oxidases catalyze the transfer of hydrogen atoms to oxygen.	T	
(iii)	Calvin Malvin proposed Lock and Key model for enzyme action.	F	Emil Fischer proposed lock and key model for enzyme action.
(iv)	The active site of an enzyme is composed of four regions.	F	Active site of an enzyme is composed of one region or two regions.
(v)	Structure of an enzyme has no specific importance.	F	Structure of an enzyme has specific importance.

Q.3 Each question has four options. Encircle the correct answer:

(i) If more substrate to an already occurring enzymatic reaction is added, more enzyme activity is seen because:

(a) Then is probably more substrate present than there is enzyme.

(b) Then is probably more enzyme available than there is substrate.

(c) Then is probably more product present than their in either substrate or enzyme.

(d) The enzyme substrate complex is probably failing to form during the reaction.

(ii) What if you add more substrate to already occurring enzymatic reaction and it has no effect on the rate of reaction? What is the form given for this situation?

(a) Saturation (b) Denaturation

(c) Composition (d) Inhibition

(iii) The rate of enzyme – catalyzed reaction:

(a) Is constant under all conditions

(b) Decrease as substrate concentration increase

(c) Cannot be measured

(d) Can be reduced by inhibitors

(iv) The active site of an enzyme:

(a) Never changes

(b) Forms no chemical bond with substrate

(c) Determines, by its structure, the specificity of the enzyme

(d) Looks live a lump projecting from the surface of an enzyme

(v) Which statement about enzyme is not true?

(a) They consist of proteins, with or without a non-protein part

(b) They change the rate of catalyzed reaction

(c) They are sensitive to heat

(d) They are non-specific in their action

ANSWERS:

(i) (b) (ii) (a) (iii) (d) (iv) (c) (v) (d)

Q.4 Short Questions:

(i) List two conditions that destroy enzymatic activity by disrupting bonds between the atoms in an enzyme.

Ans. (a) Temperature (b) pH value

(ii) How do low and high temperature, respectively effect an enzyme activity?

Ans. Very high and low temperature reduce the activity of enzyme, Enzyme activity is at its best at optimum temperature.

(iii) What is a prosthetic group?

Ans. The non-portenious part attached with enzyme by covalent bond is called prosthetic group.

(iv) Define inhibitors of enzyme.

Ans. Inhibitors are chemical substance which block the active site of enzyme.

(v) How does an enzyme accelerate a metabolic reaction?

Ans. An enzyme accelerates a metabolic reaction because:

(a) It acts as a catalyst.

(b) It remains unchanged and can at in a reaction again and again.

(c) It works at very fast speed.

(vi) What is the importance of enzymes in life?

Ans. Importance of enzymes are major:

(a) It controls all the metabolic activities in a cell like respiration, photosynthesis.

(b) Enzymes being about synthesis of all complex molecules of life such as nucleic acid, protein, starch, glycogen, lipid etc.

(c) Each and every particular reaction in a cell is controlled by particular enzyme. If there is no enzyme, the reactions are slow down.

Chapter 4

THE CELL

Q.1 Define: Cell, Cytology, Tissue and histology.

Ans. CELL: *The basic structural and functional unit of the living body is known as cell.*

Cytology: The study of structure and function of cell is known as cytology.

Tissue: A group of physically linked cells and associated intercellular substances for particular function is known as tissue.

Histology: The study of tissue is known as histology.

Q.2 What is Cell?

Ans. ***"Cell is the basic structural and functional unit of the living body"***. Each cell has different cell organelles which perform specific functions. In different parts of the body, different kinds of cells are present.

Cells play their role according to necessity and demand. The activities of a cell depend upon cell organelles, so in different situations and places particular organelle is active. For example, in photosynthetic cells, plastids or chloroplasts play important role. In case of secretory cells, golgi bodies and lysosomes are active. *"A distinct part of a cell which has a particular structure and function is called* ***organelle****".*

Cell is the unit which ***builds up*** the body, and cell is also that unit which is basis of every function. Union of cells forms tissue, assembly of tissue forms organ. Different organs make system when they are arranged in particular arrangement. *Thus body is formed by the specific sequence and combination of systems.*

In other words, the healthy body or organism depends upon normal functions of the systems. The performance of the system depends upon organs. The regulation of organ depends upon tissue. If tissue will be normal so cells are normal in it. Cell plays its normal role if organelles are normal and active in their duties.

KEEP IN MIND

"The basic structural and functional unit of the cell is Protein". Protein is builder of organelles in the cell, while all enzymes and most hormones are proteins. Immunity, contraction and relaxation, wound healing, and carrying of O_2 etc. depend upon protein.

"Cell is a bag of chemicals. Actually, making and breaking of chemicals occur in it".

Q.3 (a) What is cell theory and also describe its salient features?

(b) Describe the emergence and implication of cell theory?

(OR) Describe the history of cell theory.

Ans. (a) CELL THEORY

Final or concluding description about the cell is known as cell theory". It is described by a German Zoologist Theodar Schwann in 1838 and a German botanist M.J. Schleiden in 1839.

Salient Features:

(i) All organisms (living body) are ***composed of one or more cells.***

(ii) All cell arise ***from pre-existing cells.***

(iii) Cell is the basic ***structural as well as functional unit for all organisms.***

(b) HISTORY OF CELL THEORY

"Is there a fundamental unit of structure shared by all organisms?" This was the scientific question of the history.

Invention of Microscope (1610):

The invention of microscope helped the scientists to find out the answers of this type of question. Crude microscope seen to has been made for the first time in Holland shortly before 1600. By about 1610, the Italian Astronomer and Physicist.

Galilio and Observation of Microorganism:

Galilio had made a microscope and used it to observe very small organisms animals.

Discovery of Microscopic Life:

He was followed by many others among them. *Leeuwenhoek* who discovered microscopic life.

Magnified images revealed a hidden world and answered questions that could not have been answered before.

Robert Hooke and Cork (1665):

Robert Hooke in 1665 was reported first of all his observations, sensational at that time in this book. *"Microgrpahia"*, that the apparently uniform and firm matter of bottle corks (outer bark of the oak) was in reality composed of innumerable ***"tiny boxes"*** *or 'cells'.*

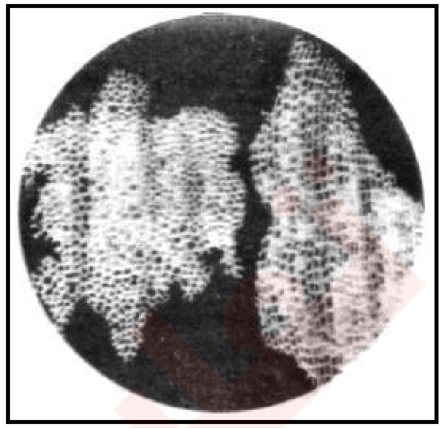


Fig. The microscopic structure of a piece of cork

Conclusion of Hooke:

According to *Hooke* cells were empty space bounded by thick walls or filled with air or water, because he saw only non-living or dead frame work of cell walls.

Oken and Vesicles (1805):

The work was again started in 19th century. In 1805, Lorzen Oken, a German scientist believed that all living beings originated from or consist of vesicles or cells.

Dutrochet and Box Like Structures (1824):

In 1824, French botanist Henri Dutrochet were seen same box like units similar to those as Hooke.

Robert Brown and Nucleus (1831):

In 1831, Robert Brown discard the nucleus in the cell. Due to which the Hooke's idea of empty space changed.

Cell Theory by Schwann and Schleiden (1838 – 39):

In 1838 and 1839, J. Schwann and Schleiden respectively give cell theory. After the cell theory, many details of cell were studied and as a result cell theory was extended.

Rudolph Virchow and Division (1855):

Rudolph Virchow (1855), a German physician made hypothesis that new cells were formed only by division of already existing cells (in Virchow's words) ***"omnis cellula-e-cellula"*** i.e. all cells from cells".) It was contrary to the idea of abiogenesis (living things arise spontaneously from non-living beings).

Prove of Virchow by Louis Pasteur (1862):

Louis Pasteur (1862) supplied experimental proof for Virchow's hypothesis by demonstrating that microorganisms (bacteria) could be formed only from existing bacteria. "Original cell theory and Virchow's hypothesis give us the basis for working definition of living things i.e. *living things are chemical organization, composed of cells which capable of reproducing themselves.*

Weismann and Report of Common Origin (1880):

August Weismann (1880) said that all presently living cells have a common origin because they have basic similarities in structure and molecules etc. It was shown that there are fundamental similarities in the chemical composition metabolic activities and structure, although they differ in many respects. Cell are basically similar but extraordinary versatile. Cell is not only the structural but also a functional unit of living organisms so cell theory is a very important unifying concept.

Q.4 What do you know about division of labour of cells?

OR

Describe cell as a structural and functional unit.

Ans. **CELL AS A STRUCTURAL & FUNCTIONAL UNIT**

A cell is a unit of structure and function but cells also act as sites of growth and development. In multicellular organisms, there is a division of labour.

Division of Labour in Animal Cells:

(i) ***Contraction Relaxation:*** Muscle cells contract and relax.

(ii) ***Transmission of Impulse:*** Nerve cells transmit impulses.

(iii) ***Secretions:*** Gland secretes hormones.

(iv) ***O_2 Carrier:*** *Red blood cells* carry oxygen.

(v) ***Juices:*** Some stomach cells secrete gastric juice.

Division of Labour in Plant Cells:

(i) **Conduction:** Xylem cells conduct water and minerals salts from soil to aerial parts of plants.

(ii) **Food Transport:** Phloem cells transport food.

(iii) **Support:** Sclerenchymatous cells give support to the plants.

(iv) **Photosynthesis:** Chlorenchymatous cell carry out photosynthesis.

(v) **Store:** Parenchymatous cells store surplus food.

As these cells perform different functions, they show great variation in shapes and sizes. Despite the structural and functional diversity, the plant cells have a common plan of organization.

Q.5 Describe the techniques to study the cell and parts of cell.

OR

What are fixation staining, cell fraction and centrifugation?

Ans. Cell can be studied under the light microscope as well as electron microscope. To observe the cell under microscope preparation have to do:

(i) Chemical Treatment:

The cells are fixed. This means that they are *treated with chemical agents* that *solidify* the normal jelly like parts. Thus the cells are killed by this fixation process.

(ii) Formation of Thin Slices:

Secondly, if the cell are in thick masses, they have to spread out in this sheath or necessary to make any thin slices of the material.

SPECIAL ATTENTION

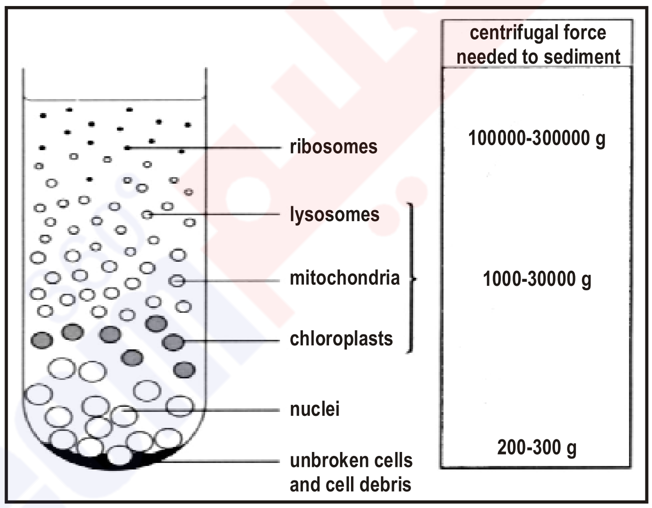


Fig. Fractionation of cell components by centrifugation centrifugal forces are measured in a (number of times gravity)

(iii) Staining:

Thirdly the cells are stained with one or more of a variety of dyes. *Hamatoxylin* dye stain the nucleus.

The modern technology enables us to isolate various components of cell including its organelles by cell fractionation and centrifugation.

Cell Fractionation:

The technique by which the *tissues are homogenized or disrupted* by special instruments is called cell fractionation.

Centrifugation:

Separation of different organelles by density gradient centrifugation. This is due to spinning the homogenized in a special medium in a centrifuge machine at specific speed. Different parts separate out in different layers depending upon their size and weight, related to the density of the medium. High speed for separation achieved by ultra centrifugation.

Q.6 What are resolution and magnification power?

Ans. **RESOLUTION (INSTRUMENT'S ABILITY)**

The ability of an observational instrument. Such as human eye or microscope to differentiate between two adjacent points.

Magnification (Size Increasing):

Magnification is the increase in size of a optical image over the size of the object being viewed with the help of lenses.

Explanation:

The unaided human eye or naked human eye under optimal conditions can differentiate between two points which at least apart 1.0 mm apart (Human eye sensitive in 555 mm wavelength of light). This resolution can be increased with the aid of lenses. In typical compound microscope the resolution is 2.0 um. Which 5000 x that of naked eye. The magnification power of a microscope is determined by multiplying x values of ocular lense and x value of objective lenses. Ocular lens may be 5x, 10x or 125x etc. Objective lens may be 5x, 10x, 40x or 100x. The resolution of this microscope remain the same at every magnification power if the same visible light is used as a source of illumination. Resolution increase with decrease in wavelength of light used as illumination sources. The resolution in electron microscope become highest (2-4 A°) because here a beam of electron is used as illumination source which is 500 x and 250,000 x greater than compound microscope and naked eye respectively.

Limit of resolution R= λ/n sin a

Lamda (λ) = wavelength of light/illumination source

n = Refractive index of the material b/w specimen and the objective lens.

Sina = sin a is sin of angle of the cone of light used to illuminate the specimen which is equal to one. Refractive index of immersion oil is about 1.6.

Q.7 *What kind of division of organism are found on the basis of cell numbers and structure?*

Ans. Organism are divided into two categories on the basis of number. of cell.

(1) Unicellular (2) Multicellular

(1) Unicellular

The organism who consists of only one cell e.g. Euglena, bacteria, protozoans etc.

(2) Multicellular

If the body of organism consist of two or more than two cells. They are called as multicellular e.g. all higher animals and plants.

Organism are divided in two following categories on the basis of structure of cell e.g.

(i) Plant and animal

(ii) Prokaryotes and Eukaryotes

(1) Plants:

Those organism who have cell wall as an outermost covering and also contain plastids for photosynthesis e.g: chlamydomonas, higher plants.

According to true sense plants also have embryo.
• ***Plastids* + *cell wall* means plants like organism e.g., Algae.** • ***Plastids* + *cell wall* + embryo means plants i.e., bryophytes, pteridioptytes, gymnosperms and angiosperms.**

(ii) Animal:

Those organisms who have cell membranes as outermost layer and lack cell walls and plastids in cells e.g. amoeba, plasmodium are animal like.

(iii) Prokaryotes (without nuclear membrane)

Primitive type of cells in which chromatin material is not bounded by a membrane e.g. bacterial cell or bacteria and cyanobacteria.

(iv) Eukaryotes:

Those organism in which cells have chromatin material bounded in a definite membrane called nuclear membrane e.g. all higher animals and plants.

KEEP IN MIND

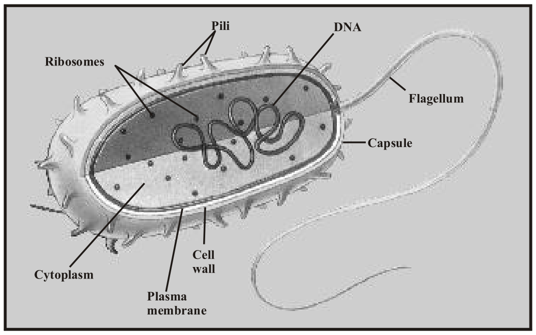
"Plants like" animals and "fungi like" organisms are members of kingdom protista,. These are not member of kingdom animalia and plantae.

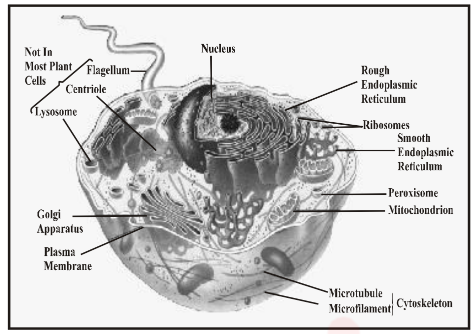
Q.8 Differentiate between prokaryotes and Eukaryotes.

Ans.

	Prokaryotes	Eukaryotes
1.	***Nucleus Absent:*** Organism possessing cells without nucleus are called prokaryotes e.g. *bacteria* and *blue green algae.*	***Nucleus Present:*** Organisms possessing eukaryotic cells are called eukaryotes e.g. cells of plants animals, fungi and protists.
2.	***No Membrane Organelles:*** They lack many of membrane bounded structures e.g. mitochondria, endoplasmic reticulum, golgi bodies and chloroplast etc.	***Membranous Organelles:*** They have membrane bounded structure
3.	***No Nuclear Membrane:*** Nuclear membrane is absent therefore prokaryotic cell has no distinct nucleus. **DNA** molecule is directly suspend in cytoplasm.	***Nuclear Membrane:*** A double nuclear membrane is present. They have a well defined nucleus. Chromosomes or **DNA** are enclosed in double nuclear membrane.
4.	***70s ribosome:*** Prokaryotes have small sized ribosomes i.e. 70s.	***80s ribosome:*** Eukaryotes have 80s ribosomes
5.	***Murein cell wall:*** The cell wall of prokaryotic cell is composed of polysaccharides chains bounded covalently to shorter chains of amino acids forming ***peptidoglycan*** or murein. The entire cell wall is often regarded as single huge molecule or molecular complex called murein.	***Cellulosic cell wall:*** Cell wall (if present) of eukaryotes is composed of **cellulose**.
6.	Mitosis is absent. They are divided by **binary fission**.	Mitosis and mitotic apparatus present.

7.





Q.9 Draw and labeled the diagram of typical cell?

Ans.

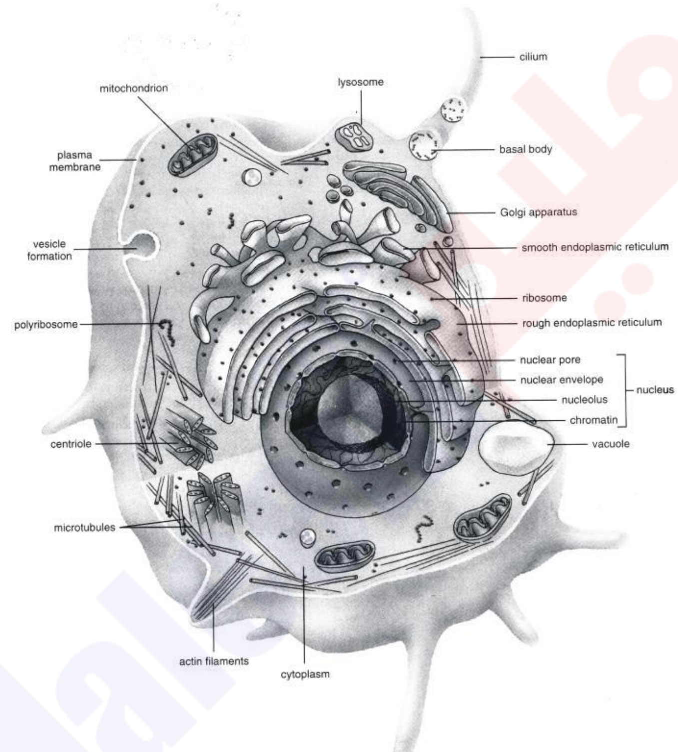


Fig. Animal cell.

EASY TO DRAW

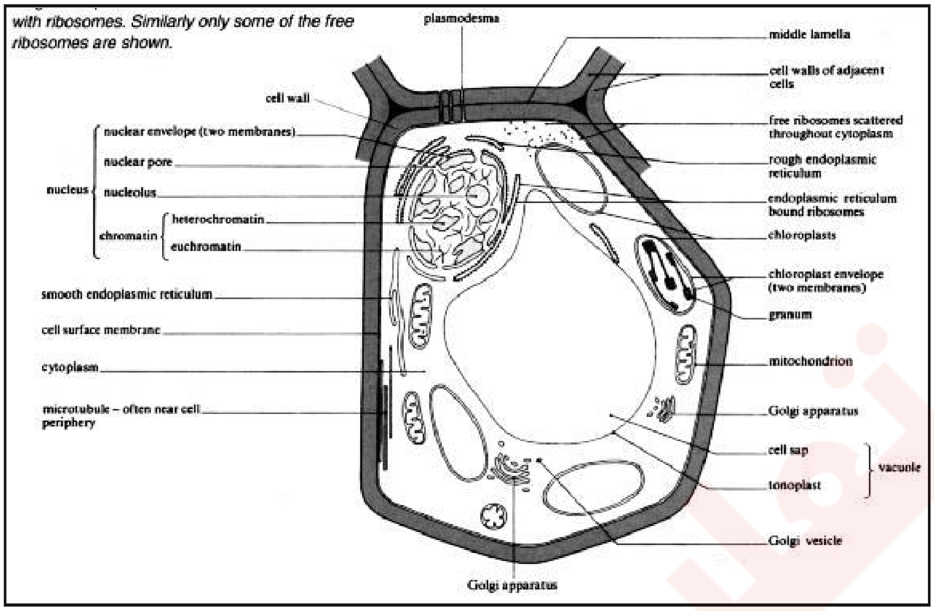


Fig. Ultrastructre of a generalized plant cell as seen with the electron microscope

Q.10 Describe the structure and function of cell membrane or plasma membrane?

Ans. **CELL MEMBRANE** (*Plasma Membrane*)

"The outermost permeable boundary of cell made up of protein and lipid is called cell membrane".

Chemical Composition:

Chemically, it is composed of ***lipids*** and ***proteins.***

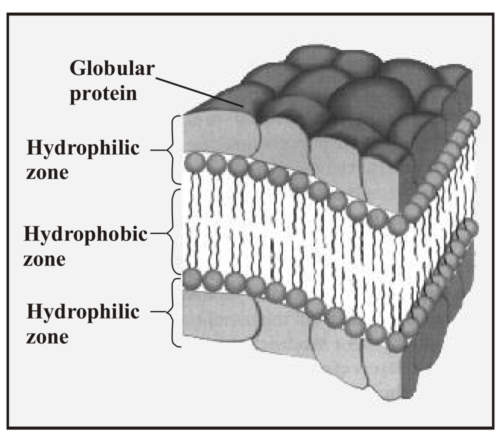
Proteins are 60-80% while Lipids are 20-40%:

In addition there is a small quantity of carbohydrates.

MODEL OF PLASMA MEMBRANE

(a) Three Layers:

In 1935 Danielli and Davson proposed that cell membrane consists of three layers.



(b) Unit Membrane:

It was suggested by Harvey and Danielli in 1838 that plasma membrane is composed of lipid bilayer sandwiched between two protein layers. This basic structure is found in all the membrane such as those of mitochondria, chloroplast etc., and is called unit membrane.

Fig. Unit membrane

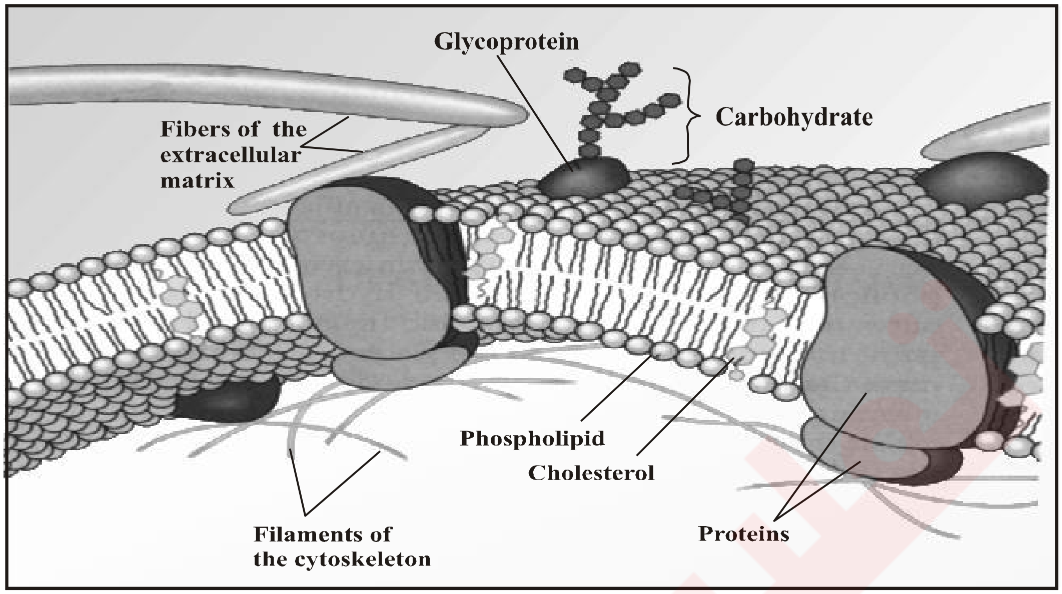


Fig. Fluid Mosaic Model

Fluid Mosaic Model

Singer and Nicolson (1972) reported that lipid bilayer is not sandwiched between two protein layers. Instead proteins are embedded in the lipid bilayer in a mosaic manner. This discovery led to the proposal of "Fluid Mosaic Model". *This model is most acceptable model*. Cell membrane contains *pores* through which movement of materials take place both by active and passive transport.

Intrinsic Proteins or Permeases (*Completely Embedded* in Double Lipid Layer):

Some protein are called intrinsic proteins or permeases. There are completely embedded in the double layer of lipids i.e. they extend from one side of lipid layers to the other.

Extrinsic or Surface Proteins (*Partly Embedded* in Double Layer Lipid):

Some other proteins called extrinsic or surface proteins partly embedded in the lipid bilayer i.e. they may be attached one side of lipid bilayer or the other.

In addition to the proteins and lipids, carbohydrates also participate in the structure building of membrane in the form of glycolipids and glycoproteins.

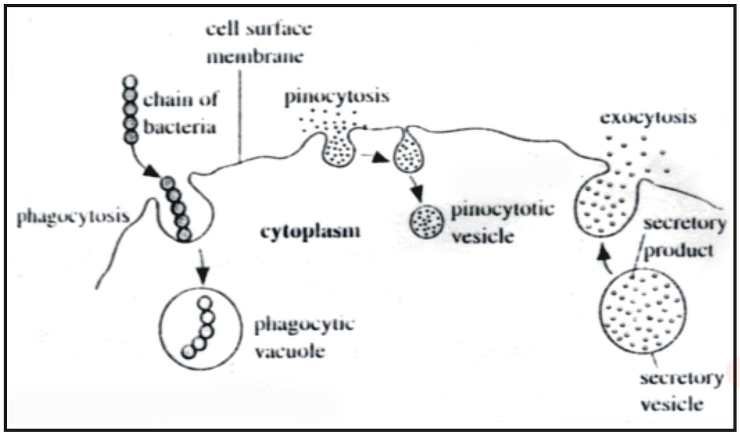


Fig. Endocytosis and exocytosis

FUNCTIONS

(1) Mechanical Support:

Plasma membrane provides mechanical support and external form to protoplasm.

(2) Differentiately Permeable:

Cell membrane is differentiately permeable or selectively permeable membrane because it allows some kind of molecule to pass through it and not others. Lipid bilayer and membrane proteins make the plasma membrane differentiately permeable barrier.

(3) Kinds of Transports:

Cell membrane plays an important role in the movement of materials from and to the cell. These two main processes which are involved in the transport of materials:

(a) Non Facilitated Transport:

Non-polar molecule like ***oil droplets, phospholipids, fatty acids*** *etc*. move across the membrane freely through the lipid bilayer. This is non facilitated transport.

(b) Facilitated Transport:

The movement of ionic materials like *water molecules* O_2, CO_2, *ions* of radicals is carried out across the cell membrane only ***with the help of proteins***. So it is called facilitated transport. There are two types of facilitated transport:

(i) Active Transport (Transport Against Concentration Gradient):

The transport of molecules across the membrane against concentration gradients (from higher to lower concentration) with the expenditure of energy is called active transport.

(ii) Passive Transport (Transport Along Concentration Gradients):

The transport of molecules across the membrane along concentration gradients (from higher to lower concentration) without utilizing energy is called passive transport. There are two types of passive transport.

(a) Diffusion:

The movement of soluble materials (solutes) from an area of higher concentration to an area of lower concentration across the membrane is called diffusion.

Osmosis:

The movement of water molecule from an area of its higher concentration to an area of lower concentration through differentiately permeable membrane is called osmosis.

(4) Exocytosis:

The process in which transportation occur from cell to the exterior or the other cells is called exocytosis. By exocytosis either the waste products or secretion move across the membrane.

ENDOCYTOSIS:

The process of inward movement of materials by infolding of cell membrane in the form of vacuole or vesicle is known as endocytosis. There are two types of endocytosis.

(i) ***Phagocytosis:*** The intake of *solid particles* into the cell is called phagocytosis.

(ii) ***Pinocytosis:*** The ingestion or intake of *liquid material* into the cell is termed as pinocytosis.

(5) Homeostatsis:

The maintain of balance of chemical and water etc. is called homeostatsis.

EXAMINE YOURSELF

Q.11 Define: Cell, Nerve Cell, Parenchyma, Sclerenchyma.

Q. Write 3 points of cell theory.

Q. What are the roles of Robert Brown and Robert Hooke in Cell discoveries?

Q. Define prokaryote and Eukaryote.

Q. How much proteins and lipids are found in plasma membrane?

Q. Differentiate between unit membrane and fluid mosaic model.

Q. Differentiate between the following:

(i) Intrinsic proteins and extrinsic proteins.

(ii) Non facilitated and facilitated transport.

(iii) Active and passive transports.

(iv) Osmosis and diffusion.

(v) Phagocytosis and pinocytosis.

Q.11 Describe the structure and function of cell wall.

Ans. **CELL WALL**

The non living outermost boundary of plant cells which contain three layers and provides shape and protection is called cell wall.

- Cell wall is the **outermost boundary of the plant cell**.
- It is not found in animal cell.
- Cell wall of plant is different from that of prokaryotes both in structure and chemical composition.
- It is **secreted by the protoplasm** of the cell.
- Cell wall can be separated from the cell without killing it.
- When the cell dies, the cell wall persists which shows that cell wall is **nonliving**.
- Cell wall of woody plants is very thick.

Structure and Chemical Composition:

Thickness of cell wall varies in different cells of plants. It is composed of three main layers:

(i) Primary wall (ii) Secondary wall (iii) Middle lamella.

Middle Lamella:

The middle lamella is first to be formed in between primary walls of neighbouring cells.

* *It **holds** adjacent cells together.*

Primary Wall (Outer):

The primary wall is composed of many layers formed of ***cellulose*** with some deposition of ***pectin and lignin***. * (PC-L).

- In each layer the cellulose fibers run parallel to one another but at same angle to those in the first layer.
- Thus cellulose molecule show a crisscross (zigzag) arrangement.

- The primary wall is a true wall and developed in newly growing cells.

Secondary Cell Wall (Inner):

The secondary cell wall is formed on its inner surface and is comparatively *thick and rigid.*

* Chemically, it is composed of ***inorganic salts*, *silica*, *waxes*** and **cutin** etc.

FUNCTION

(1) Protection: Cell wall provides protection from drying environment.

(2) Stiffness: It gives stiffness to the cell.

(3) Definite Shape: It gives a definite shape.

(4) Prevent from Swelling: It prevents plant cell from swelling and bursting as a result of osmosis when it is in a medium of higher potential.

(5) Not a Barrier (Freely Permeable): It does not act as a barrier to the materials passing through it. Water various ions and small molecules can pass freely through ***tiny pores*** in cell wall.

(6) Antigenic Properties: The cell wall (in bacteria) also has a antigenic properties caused by both proteins and polysaccharides.

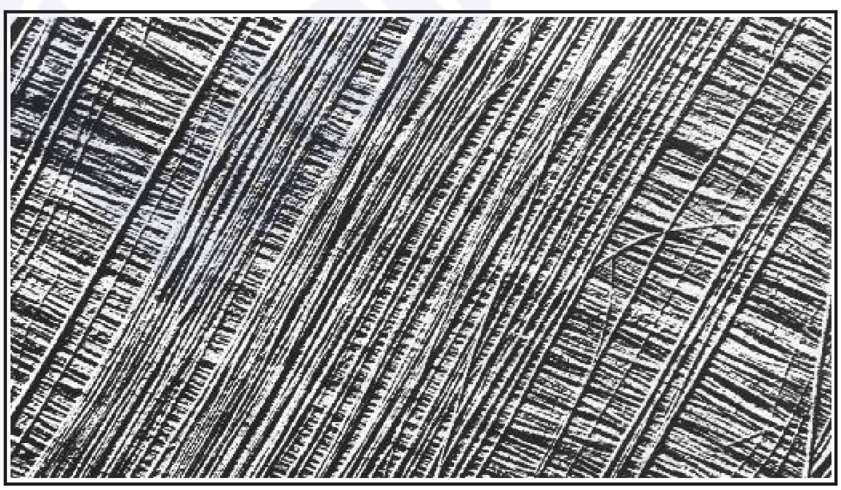


Fig. Secret of the strength of plant structure is revealed by electron microscope photographs of the cell walls. The cellulose fibers are arranged in layers, with the fibres of each layer at right angle to those of other layers.

Q.12 Describe the structure and function of cytoplasm.

Ans. **CYTOPLASM**

The word *cytoplasm literally means living gel (plasm)* "of the cell" (cyto). *It is a fluid portion of the cell lying outside the nucleus and inside the cell membrane.*

The living contents of eukaryotic cells are divided into nucleus and cytoplasm, the two collectively form protoplasm.

MAJOR COMPONENTS:

The **major components** of ***cytoplasm are:***

(i) **A gel like fluid**

(ii) **Storage substances**

(iii) **A network** of interconnected filaments (microfilamets and microtubules) and fibers (intermediate fibers), collectively called *cytoskeleton.*

(iv) **Cell organelles** e.g., mitochondria, plastids golgi bodies, lysosomes, vacuoles etc.

(v) The free floating cell organelles like mitochondria move about in cytoplasm due to cytoplasmic ***streaming movements***. This is an active mass movement of cytoplasm.

CYTOSOL

Cytoplasm has an aqueous ground substance called cytosol. Chemically it is about 90% of water and *forms a solution* having all the fundamental molecules of life. In the ***cytosol***, small molecules and ions form *true solutions* and larger molecules from *colloidal solutions*. Colloidal solutions may be in the form of a ***sol (non viscous)*** or ***a gel (viscous)***.

Peripheral parts of the cells are often like a gel.

FUNCTION OF CYTOPLASM:

(i) ***Store House:*** Cytoplasm serves as store house of vital materials/chemicals e.g. glycogen in the liver cell.

(ii) ***Metabolic Pathway:*** It is a site of certain metabolic pathways (e.g. glycolysis). [Glycolysis means breakdown of glucose into pyruvic acid]

(iii) ***Maintains the Shape:*** The cytoskeleton present in the cytoplasm not only *maintains the shape* of the cell but also helps in the *movement of cell organelles.*

Q.13 Describe the structure and function of endoplasmic reticulum.

Ans. **ENDOPLASMIC RETICULUM**

"The network of channels or tubules extending between nuclear membrane and cell membrane which performs the functions like detoxification, transport and protein synthesis".

The channels seems to be in contact with plasma membrane as well as nuclear membrane. The entire system or channels is the endoplasmic reticulum. These membranes vary widely in appearance from cell to cell. The materials present in these channels is separated from cytoplasmic materials by the spherical or tubular membranes, called cisternae.

Types of Endoplasmic Reticulum:

There are two types of endoplasmic reticulum on the basis of their appearance:

(i) Rough endoplasmic reticulum (**RER**) having ribosome at its surface.

(ii) Smooth endoplasmic reticulum (**SER**) *without ribosomes.*

FUNCTIONS:

(1) **Mechanical Support:** Due to flexible nature of plasma membrane and ability to extend into the cytoplasm, it has connections with nuclear envelope, golgi apparatus etc. which helps to provides mechanical support to the cell.

(2) **Transportation of Materials:** *Smooth endoplasmic reticulum* also plays an important role in the transport of materials from one part of the cell to the other.

(3) **Synthesis and Transportation of Proteins:** The *rough E.R.* is involved in the synthesis and transportation of cellular proteins.

(4) **Detoxification:** *Smooth endoplasmic reticulum* due to its own enzyme system metabolizes or destroys the toxic substances like steroids, carcinogenic etc.

(5) **Synthesis of Lipids:** The *smooth endoplasmic reticulum* synthesizes different types of lipids which are used for the formation of plasma membrane and steroid hormones like testosterone and estrogens. Glycogen and glycolipids are also synthesized here.

(6) **Site of New Membrane:** Endoplasmic reticulum being the site for synthesis of proteins and lipids are also considered to be primary site of new membranes.

(7) **Transmission of Nerve Impulse:** The *smooth endoplasmic reticulum* of the muscle cells is developed and is involved in the transmission nerve impulse which initiates muscle contraction.

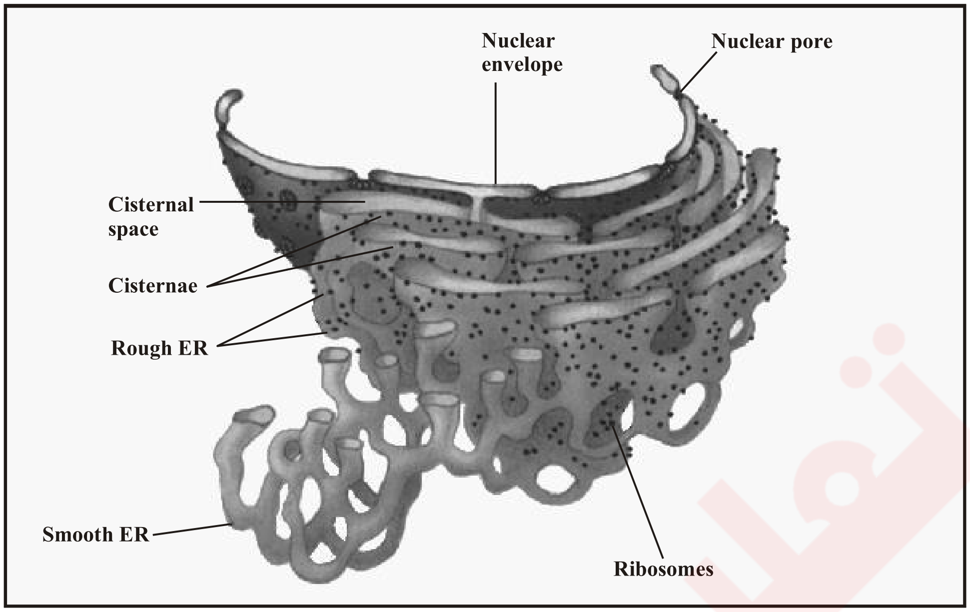


Fig. Rough endoplasmic reticulum is marked by he presence of ribosomes attached to the membranes of endoplasmic reticulum. Proteins synthesized on ribosomes are pushed into channels of endoplasmic reticulum, from where they are transported to Golgi Apparatus, on their way out of the cell

Q.14 Describe the structure and function of Ribosomes.

Ans. **RIBOSOMES**

"The non membraneous cell organelles with two sub units and involve in proteins synthesis are called ribosomes".

Composition:

These are tiny granules first studied by Palade in 1955. They are composed of about 60% RNA and 40% protein (i.e. ribonucleoprotein). This RNA is of ribosomal type.

Location:

The ribosomes exist in two forms:

(i) Freely scattered in cytoplasm (ii) Attached with rough endoplasmic reticulum.

New ribosomes are assembled in the nucleolous of the nucleus from where they are transported to the cytoplasm via the pores in nuclear membrane:

The factory of ribosome is the nucleolous.

While the factory of protein synthesis is the ribosome.

Size:

Their size is always about the same; from 150 to 2000 A° in diameter.

PARTICLES OF RIBOSOMES:

Eukaryotic Ribosomes:

Each eukaryotic ribosomes is composed of two sub units. The larger sub unit sediments at 60S (S=swedbarg unit which specifies sedimentation rate of specific particles or molecule in medium during ultracentrifugation) with smaller sub unit sediments at 40S. Two sub units on attachment with each other form ***80S*** particles. This attachment is controlled by the presence of Mg++ ions.

Prokaryotic Ribosomes:

Bacterial ribosomes exist in the cell as 70S particles, but they can be broken down to smaller 50S and 30S.

"If several ribosomes are to the same stretch of mRNA the resulting structure is called ***polysome***"

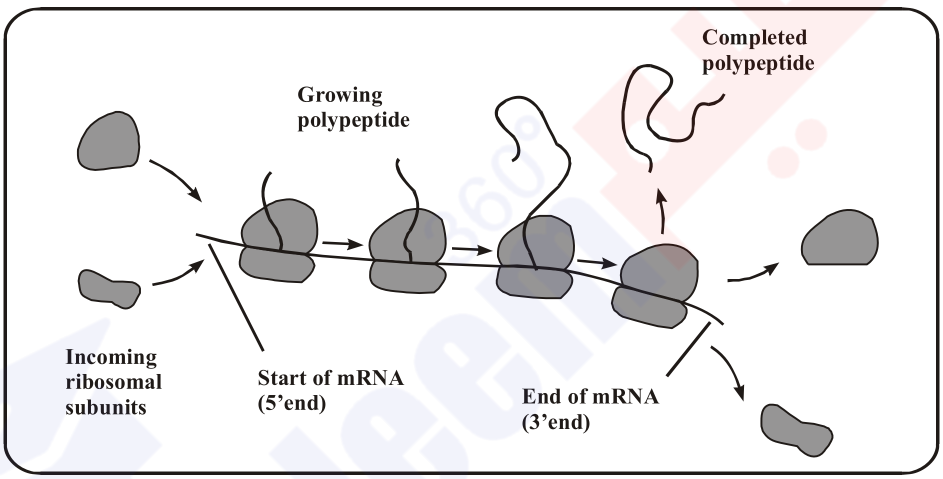


Fig. mRNA attached to ribosomes forming polysomes

Function:

The ribosomes are concerned with the synthesis of protein.

Q.15 Describe the structure and function of Golgi Apparatus.

Ans. GOLGI APPARATUS

Structure:

They were discovered by **Camillo Golgi** in 1898, so called golgi complex or apparatus.

The term golgi apparatus refers to a set of smooth membranes that are stacked into flattend, fluid filled sacs called cisternae, **containing proteins, carbohydrates, glycoprotein and specific enzymes.**

In plant they are also known as dictyosomes.

Most of the Golgi apparatus is formed of *flattened sac or cisternae* but some tubules and vesicles may also participate in the formation of Golgi complex. The number of fluid filled flattened sacs may range from 3-7 in most of the animals but the lower organisms may have up to 30 flattened sacs.

These flattened sacs are arranged in a concentric fashion, the convex sac lie closer to the nuclear membrane and are termed as *cis-golgi or forming face.* The farthest concave sacs are named as *trans-golgi or maturing face.*

Functions:

(1) Secretion:

The main function of the golgi complex is cell secretion. Secretions are produced within the cell on ribosomes and then passed to the outside through endoplasmic reticulum and golgi apparatus. The *secretions are converted in to* ***finished products*** and are packed inside membrane, before export.

(2) Storage of Proteins:

The exportable proteins synthesized by the ribosomes are passed to endoplasmic reticulum and stored in the golgi apparatus.

(3) Formation of Glycolipid and Glycoprotein:

The carbohydrates, lipids and proteins synthesized by the endoplasmic reticulum are modified as glycolipid and glycoprotein within golgi complex.

(4) Cell Wall Formation:

Golgi bodies are involved in the formation of new cell wall.

(5) Formation of Digestive Granules:

In mammals the golgi bodies have a role of in the formation of ***certain granules secreted by pancreas****. These granules have enzymes that help in digestion.*

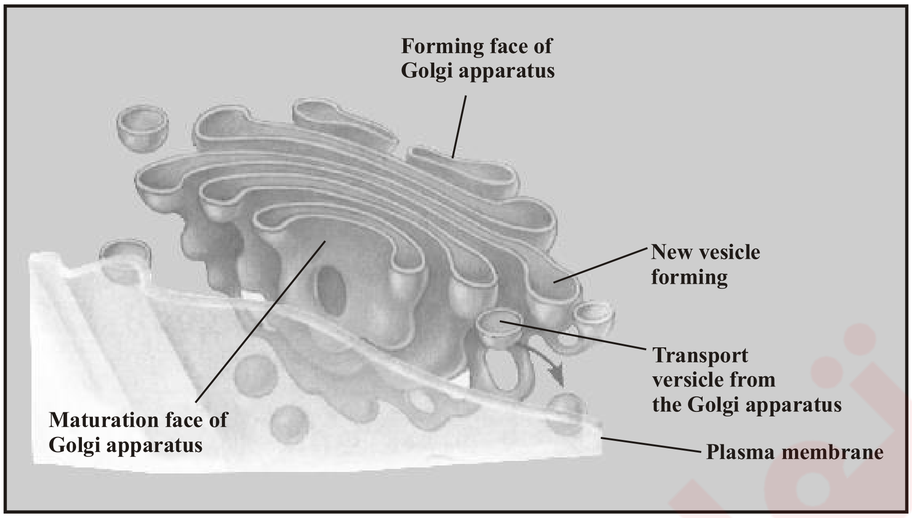


Fig. This figure shows relationship of endoplasmic reticulum with Golgi Apparatus, lysosome and plasma membrane, golgi Apparatus has two ends, forming face and Maturation Face. Blebs from tips of SER fuse with Golgi Apparatus cisternae at Forming Face, whereas secretory granules (transport vesicles) are pinchedoff at the Maturation Face of Golgi Apparatus. The arrows show the direction of flow of protein product synthesized on ribosomes. These proteins are converted into glycoproteins in the Golgi apparatus.

Q.16 Describe the structure and function of Lysosomes.

Ans. **LYSOSOMES**

A. STRUCTURE: ***"The cytoplasmic organelles bounded by single membrane and are simple sacs".*** Lysosomes (***lyso=splitting, soma=body***) were first discovered by De Duve in 1949. They are found in most of eukaryotic cells. They are rich in acid phosphatases and hydrolytic enzymes such as *proteases, nucleases and lipases.*

Size:

In animal cell lysosomes are commonly 0.1-0.5 um in diameter. Their no. varies from 15 to 20 per cell.

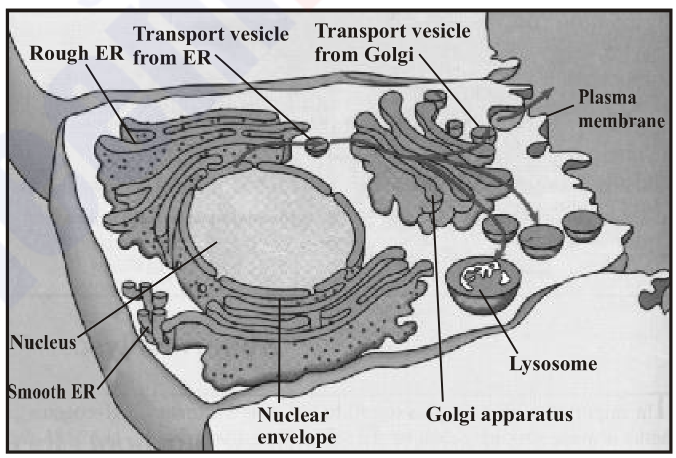


Fig. This figure shows relationship of endoplasmic reticulum with golgi apparatus, lysosome and plasma membrane golgi apparatus has two ends, forming face and maturation face. blebs from tips of SER fuse with golgi apparatus cisternae at forming face, whereas secretory granules (transport vesicles) are pinched off at the maturation face of golgi apparatus. The arrows show the direction of flow of protein product systesized on ribsomes. These proteins are converted into glycoproteins in the golgi apparatus.

Origin From Vesicles of Golgi Complex:

(1) *Lysosomes are often derived from vesicles of golgi apparatus.*

(2) Acid phosphatases and other hydrolytic enzymes are taken to golgi apparatus where they are further processed and budded off as golgi vesicles. These vesicles are called *Primary lysosomes.*

(3) When primary lysosomes fuse with food vacuole, they digest the food particles and become residual body secondary lysosomes (autophagosome).

B. FUNCTIONS

(1) Phagocytosis:

Any foreign object that gains entry into the cell, immediately engulfed by the lysosomes and is completely broken into simple digestable pieces. This process is called phagocytosis.

(2) Intra-Cellular Digestion:

They are involved in intracellular digestion since they have enzymes to digest the phagocytosed food particles present in food vacuoles.

(3) Extra-Cellular Digestion:

They also help in extra cellular digestion by releasing enzymes.

(4) Exocytosis: (Cell Egestion / Excretion)

Sometimes enzymes of primary lysosomes are released from the cell. *This occurs during the replacement of cartilage by bone during development.* Similarly the matrix of bone may be broken down during the remodeling of bone that can occur in response to injury, new stresses and so on.

(5) Autophagy: (Self Eating)

It is a process by which unwanted structures e.g. damaged mitochondria etc. within the cell are removed. Unwanted structures are first enclosed by a single membrane, usually derived from smooth endoplasmic reticulum. Then this structure fuses the unwanted materials and digests.

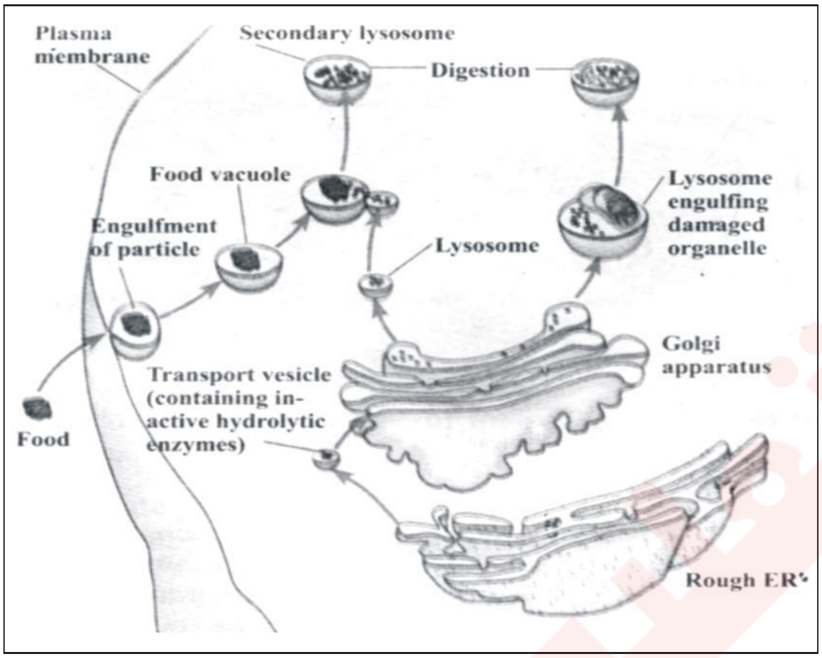


Fig. Lysosomes protect the cells from invading organisms or any other foreign object, (food) which are engulfed in the cell as phagocytic vacuoles. These fuse with primary lysosomes to form digestive vacuole (secondary lysosome in which various lysosomal enzymes digest various componenets of the vacuole. Some time under abnormal circumstances, e.g. starvation, or as normal physiological process the parts of the cell are engulfed by primary lysosomes and digested to generate energy. The lysosomes which eat parts of its own cell are known as autophagosomes. The digestive vacuoles and autophagosomes are also known as secondary lysosomes.

Q.17 Write a note on storage disease or congenital diseases produced by a mutation that effect of the lysosomal enzymes.

Ans. **AS STORAGE DISEASES OR CONGENITAL DISEASES**

Several congenital diseases, have been found to be *due to accumulation within the cell* of substances such as *glycogen* or various *glycolipids*. These are also called ***storage diseases,*** and are produced by a mutation that affect one of the lysosomal enzymes involved in the catabolism of a certain substances. About twenty such diseases are known these days. Which are because of absence of a particular enzyme.

(ii) Glycogenosis Type-II Disease (*Due to absence of D- Glucosidase*):

In this disease liver and muscle appear filled with glycogen with in membrane bound organelles. *D-glucosidase* the enzyme that *degrades glycogen to glucose is absent.*

(iii) Tay-Sach's Disease (*Lipid storage in brain cells*)

Tay-Sach's disease is due to ***absence of hexaseamidase*** *that* is involved in the *catabolism of lipids*. Accumulation of lipids in brain cells lead to mental retardation, and even death.

Q.18 Write a note on Peroxisomes.

Ans. **PEROXISOMES**

"Single membraned cell organelle in which large amount of oxidative enzymes are found".

De-Duve and co-workers isolated in 1965 *particles from liver cells* and other tissues which were enriched with some oxidative enzyme, such as *peroxidase, catalase D-amino acid oxidase, glycolic acid oxidase* and *orate oxidase.* They have also been found in protozoa, yeast and many cells of higher plants. These are single membrane enclosed cytoplasmic organelles found *both in animal and plant cells.*

Diameter and Number:

They are approximately 0.5 um in diameter. The average diameter of peroxisome in liver is 0.6-0.7 um. There number varies between 70-100 per cell.

FUNCTION (Formation and Decomposition of H_2O_2):

(i) The name peroxisome was applied because this organelle is specifically involved in the formation and decomposition of hydrogen peroxide (H_2O_2) in the cell.

(ii) Catabolic and Anabolic Pathway:

In plants, peroxisomes play important role in both catabolic and anabolic paths.

(iii) Producing Oxidases and Catalase:

These are characterized by containing H_2O_2-producing oxidases and catalases.

(iv) Contain β oxidation:

Liver peroxisomes also contain *β oxidation system for oxidizing long chain fatty acid.*

The short chain fatty acids are oxidized in mitochondria.

Q.19 Write a short note on glyoxisomes.

Ans. **GLYOXISOME**

"Plant cell organelle which contain enzymes like glycolic acid oxidase and catalase etc. are called glyoxisome".

Abundant in Plant Seedling:

This organelle is present in plants, which in addition to glycolic acid oxidase, and catalase, also posses a number of enzymes that are not found in animal cells.

This organelles, called glyoxisome is most abundant in plant seedling which rely upon stored fatty acids to provide them with the energy and materials to begin the formation of a new plant.

Primary Activities:

One of the primary activities in these germinating seeding is the conversion of stored fatty acids to carbohydrates. This is achieved through a cycle, glyoxylate cycle, the enzymes of which are located in the glyoxisome.

$$\boxed{\text{Fatty Acids} \longrightarrow \text{Carbohydrates}}$$

In Seed:

In seed, rich in lipids such as *castor bean* and *soybean*, glyoxisomes are the site for *break down of fatty acid to succinate.*

$$\boxed{\text{Fatty Acids} \longrightarrow \text{Succinate}}$$

Short Period in the Germination:

This organelle is present only during short period in the germination of the ***lipid rich seed***, Glyoxisomes are ***absent in lipid poor seed*** such as ***pea***.

Q.20 Describe the structure and function of vacuoles.

Ans. **VACUOLES**

"The single membranous nonliving cell organelles involve in storage to rigidity and support etc. are called vacuoles".

In Animal and Plant Cell:

Vacuoles are present both in animal and plant cells, but they are particularly large and abundant to plant cells often occupying a major portion of the cell volume and forcing the remaining interacellular structures into a thick peripheral layer.

Single Membrane:

These vacuoles are bounded by a single membrane and are formed by coalescence of small vacuole during the plants growth and development.

FUNCTIONS

To Expand: Vacuoles serve to expand the plant cell without diluting its cytoplasm.

Site for Storage: Vacuole performs function as sties of storage of water and cell products or metabolic intermediates.

Provides Support: The plant vacuole is the major contributor to the turgor pressure that provides support for the individual plant cell and also contributes the rigidity to leaves and younger parts of the plants.

Q.21 Write a short note on cytoskeleton.

Ans. **CYTOSKELETON**

Unbranched cylindrical structures which are made by protein and involves in internal structures and movement contraction and relaxation etc.

Cytosol is made up cytoskeletal fabric formed of microtubules, microfilaments and intermediate filaments. The main proteins that are present in cytoskeleton are *tubulin actin, myosin, tropomyosin* and others which are also found in muscles.

(i) Microtubules: Microtubules are long unbranched cylindrical structures.

It has an average ***diameter of about 0.25 nm***.

The structures are made primarily by the self assembling of tubulin protein.

Constituents of Cilia, Flagella, Basal Bodies and Centrioles:

Several cell organelles are derived from special assembled of microtubules, for example cilia, flagella, basal bodies and centrioles. One very important function of microtubules is their role in the assembly and disassembly of the spindle structures during mitosis. They also provide internal structures.

(ii) Microfilaments:

Microfilaments are considerably more *slender cylinders* made up of *contractile protein* ***actin*** and linked to the inner face of the plasma membrane (***they are narrower than microtubules***). They are involved in internal cell motion e.g. movement of ***cyclosis*** and amoeboid movements are because of microfilaments.

(iii) Intermediates Filaments:

They are ***8-10 nm in diameter***. Intermediate filaments are involved in determination of cell shape and integration of cellular compartments.

Q.22 Describe structure and function of centriole.

Ans. **CENTRIOLE**

Location: Animal cells and cells of some microorganisms are lower plants contain two centrioles located near the exterior surface of the nucleus. *They are absent in higher plants.*

Structure: In cross section each centriole consists of a cylindrical *array of nine microtubules*. However, each of the nine microtubules is future composed of three tubules. The two centrioles are usually placed at right angle to each other.

Fig. Centrioles are made up of nine microtubule triplets

Functions:

Help in Cell Division: Just before a cell divides, its centrioles duplicate is one pair migrates to the opposite side of the nucleus. The spindles then form then centioles play important role in the location of furrowing during cell division is in the formation of cilia.

Q.23 Describe structure and function of mitochondria.

Ans. MITOCHONDRIA (Power House)

Double membranous cell organelle which acts as power house due to metabolic processes is called mitochondria.

They are involved in the *manufacture and supply of energy to cells*.

Location: Mitochondria are found in the cytoplasm of all the eukaryotic cells. Except in mature RBC of multicultural organisms.

Shape: Mitochondria may be spiral or spherical , elongate , cup-shaped and even branched . They are usually larger in active cells than in less active ones.

Size: Their length ranges from 1.5- lum and width 0.25-1.00 um, but their diameter does not exceed 1um.

Number: The no of mitochondria per cell varies considerably and depends on they type of organism and nature of the cell.

Structure:

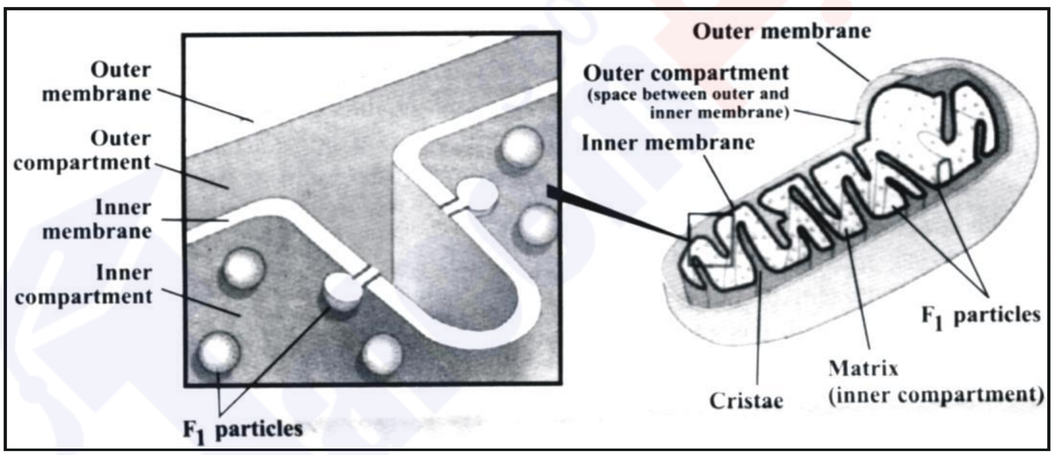
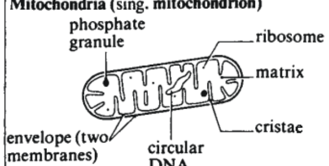


Fig. Diagrammatic representation of a mitochondrion cut longitudinally. The main features are shown. A cristae is made of lipoprotein membrane containing different enzymes as well as F1 Particles embedded in it. After a special processing the inner mitochondrial membrane is ruptured and the F1 particles come out on the surface.

mitochondria	**Mitochondria** (sing. **mitochondrion**) 	Surrounded by an envelope of two membranes, the inner being folded to form **cristae**. Contains a **matrix** with a few ribosomes, a circular DNA molecule and phosphate granules.	In aerobic respiration cristae are the sites of oxidative phosphorylation and electron transport, and the matrix is the site of Krebs cycle enzymes.

Double Membranous: A mitochondrion is bound by two membranes the outer membrane is smooth while the inner membrane form infolding into the inner chamber called ***Cristae***.

The mitochondrial membranes are similar in structure to other cell membranes.

DNA: Detailed studies have shown that mitochondria also contains DNA indicate that some proteins are synthesized in them. It is a self replicating organelle.

F1 Particle: The inner surface of cristae in the mitochondrial matrix has small ***knob like*** structures known as F1 particles . Mitochondrial matrix contain in it a large number of enzyme. Coenzyme and organic and inorganic salts which help in several vital metabolic processes like *Kreb's cycle, aerobic respiration, fatty aid metabolism etc.*

FUNCTIONS

As Power House: As a result of metabolic processes occurring in mitochondria . The energy extracted from the organic food is transformed into energy rich compound ATP(adenosine triphosphate) and the ATP then provides energy to the cell on demand. This energy is used for various cellular activities . *The spent energy, which is in the form of ADP is regenerated by mitochondria into ATP.* Mitochondria is therefore described as power house of the cell.

Q.24 What are Plastids? Describe different types of Plastids or explain the structure and function of different types of plastids.

Ans. PLASTIDS

Double membranous pigment containing organelle which involves in photosynthesis is called plastids.

Plastids are present *only in plant cell.* There are three main types of plastids

(1) CHLOROPLAST

The *green pigment containing plastid* in plant cell is called chloroplast . The green pigment is an organic compound called chlorophyll, which helps the cell to absorb light energy and utilized it to manufacture food. Chloroplast are ***self replicating organelles***.

Chlorophyll:

Chlorophyll molecule resembles the haem group of haemoglobin, a protein used in the transport of oxygen. The main difference between these two molecules is that chlorophyll has Mg++ while haem has Fe++ as a central atom.

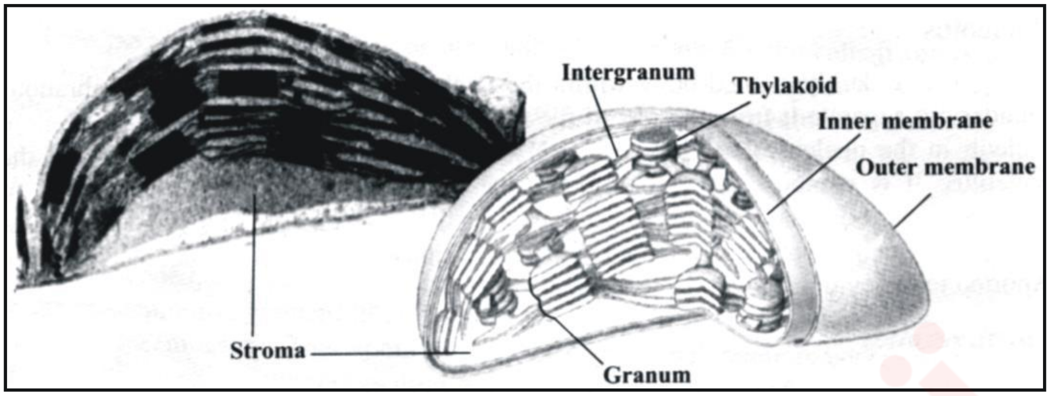


Fig. Diagram of chloroplast showing the main structural components

Shape and Size: Chloroplast vary in their shape and size with a decimeter or out 4-6 um.

Grana: In the mature chloroplast heterogeneous structures with small granules known as grana. Chloroplast shows three

(i) The envelope (ii) Stroma (iii) Thylakoid

(i) **Envelope:** The envelope is formed by *double membrane* while stroma covers most of the colume of the chloroplast.

(ii) **Stroma:** *The fluid which surrounds the thylakoid in the chloroplast is called stroma.* It contains proteins some ribosome and small circular DNA. It is in this part of the chloroplast where CO_2 is fixed to manufacture sugar. Some proteins are also synthesized in this part.

(iii) **Thylakoids:** The flattened vesicles which arrange themselves to form grana ***and intergrana*** in the chloroplast. A granum appears to be a pile of thylakoid stacked on each other like coins. On the average, there are 50 or more thylakoids piled to form one ***granum***. On the layers of thylakoids chlorophyll molecules are arranged is that is why granum appears to be green .Each granum is interconnected with other by the non green part called *intergranum.*

Membranes of grana are the sites where sunlight energy is trapped and ATP is formed.

(2) CHROMOPLAST

The colourful kind of plastids in the coloured parts of plants is called chromoplast. They colours to the plants other than green. They are present in the **petals** of flower and in the **ripened fruit**. They help in pollination and dispersal of seeds.

(3) LEUCOPLASTS

The *colourless* kind of plastids is known as leucoplast. They are **triangular tubular** or of some other shape. They are found in the **underground parts** of the plants and store food.

THINKING ROOM

Table Eukaryotic Cell Components

Category	Name	Composition	Function
Nucleus	Nucleus	Nuclear envelope surrounding the nucleoplasm, chromosomes, and nucleoli	Cellular reproduction and control of protein synthesis
	Nucleolus	Concentrated area of chromatin, rRNA, and proteins	Ribosome formation
Granule-like particle	Ribosome	Protein and rNA in two subnits	Protein synthesis
Membranous canals and vacuoles	Endoplasmic reticulum (ER)	Membranous flattened channels and and tubular canals	Synthesis of macromolecules and transport by vesicle formation
	Rough	Studded with ribosomes	Protein synthesis
	Smooth	No ribosomes	Various, lipid synthesis in some cells
	Golgi apparatus	Stack of membranous saccules	Processing, packaging, and secretion of proteins
	Vacuole and vesicle	Membranous sacs	Storage of substances
	Lysosome	Membranous vesicle containing digestive enzymes	Intracellular digestion
Energy-related organelles	Mitochondrion	Inner membrane (cristae) within outer membrane	Aerobic cellular respiration
	Chloroplast*	Grana within inner and outer membranes	Photosynthesis
Cytoskeleton	Microtubule Intermediate filament Actin filament	Network of protein tubules and filaments	Cell shape and movement
Centrioles and related structures	Centriole**	9 + 0 pattern of microtubules	Microtubule organization, forms basal bodies
	Cilium and flagellum	9 + 2 pattern of microtubules	Movement of the cell

Q.25 Describe the structure and function of nucleus.

Ans.

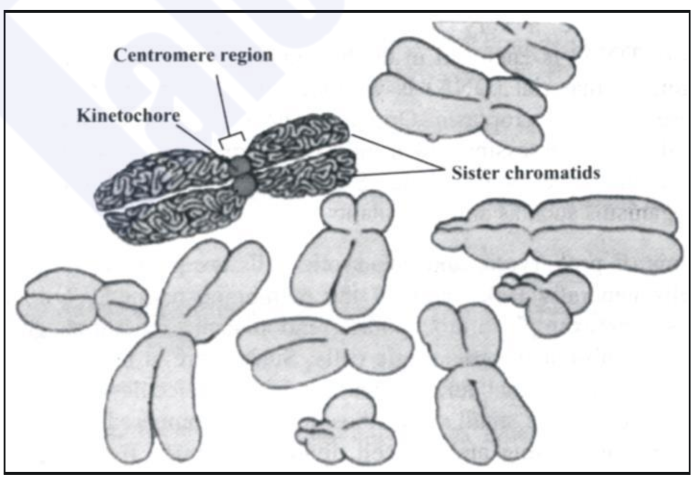


Fig. Structure of chromosome and its shape

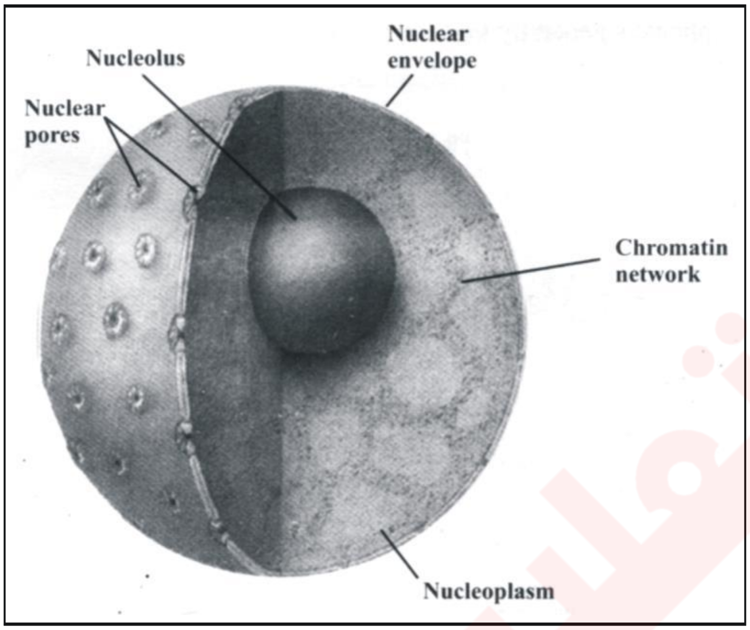


Fig. Structure of nucleus

Ans. $\boxed{\text{NUCLEUS}}$ ***"The organelle which controls the activities of life and genetics etc. is called nucleus."***

Nucleus was discovered in **1831** by ***Robert Brown***.

- It controls the life activities of cell in cell, It is generally **occupies the central space**.
- In case of plant cells it is pushed towards periphery due to the presence of a large vacuole.
- Nucleus may be **irregular or spherical** in **shape**.
- Generally the cells with one nucleus are called uninucleate.
- The *cell with two nuclei are* ***binucleatie***.
- The cell with more than two as ***multinucleated***.
- Nucleus is only visible when the cell is in non dividing stage.
- In dividing cells the nucleus disappears and the chromatin material is replaced by chromosomes
- Nucleus consists of ***nuclear membrane, nucleoli, nucleoplasm*** and ***chromosomes***.

Nuclear Membrane:

- Nucleus is surrounded by a nuclear membrane which *separates the nuclear materials* from the cytoplasm.
- The nuclear membrane is actually *a nuclear envelope composed of two membranes.*
- The outer membrane is at places continuous with the endoplasmic reticulum, while the inner membrane is at places continuous with the endoplasmic reticulum while inner membrane encloses the nuclear content.
- The outer and the inner membranes are continuous at certaing points resulting in the formation of pore the *nucleus and the cytoplasm.*
- The no of nuclear pores is highly variable. The undifferentiated cells (such as eggs) have numerous pores (about 30,000 per nucleus),whereas differentiated cell such as erythrocytes have only 3 or 4 pores/***nuclears***. Each pore has a definite structure which controls the traffic of substances passing through them.

Nucleoplasm:

The *soluble sap and chromatin network in the nucleus,* and is without any membraneous boundary to separate it form the rest of nuclear material. There may be one or more nucleoli in nucleus.

Synthesis of rRNA:

The ribosomal RNA (rRNA) is synthesized and stored in the nucleolous. It is composed of two regions, the peripheral granular area composed of precursors of ribosomal sub-unit and the central fibril consisting of large molecular weight RNA and rDNA . It is the nucleolus where ribosome are assembled and are then exported to cytoplasm via nuclear pores.

Chromosomes ***"The thread like structures which contain DNA and histone protein, act as hereditary bodies are known as chromosomes."***

Nucleus is often deeply stained with basic dyes because of chromatin material is converted into darkly stained thread like structures.

Chromosomes appear to be made of chromatids (arms) and centromeres.

2, Chromatids + 1, centromere = 1 chromosomes

Centromere:

Centromere is the place on the chromosomes where spindle fibers are attached during cell division. Each chromosome attacks with spindle fibre by centromere. Each chromosome consists of two identical chromatids at the begning of cell division (*chromatid is exact replica of the chromosomes*) Which are held together at contromere.

Composition and Function

A chromosome is composed of DNA and proteins.All the information necessary to control the activities of the cell is located on the chromosomes in the form of genes which are transferred from one generation to the other.

Number of Chromosomes:

All the organism of same species have same or equal no of chromosomes and remain constant generation after generation. The no of chromosomes in the normal body cells are diploid (2n), where in germ cells chromosomes are haploid.

Organism	In Somatic cells	In sex cells
	(2n)	(n)
Man	46	23
Frog	26	13
Chimpanzee	48	24
Fruitfly	8	4
Onion	16	8
Potato	48	24
Garden Pea	14	7

Q.26 Describe the differences similarities between Prokaryotic and Eukaryotic cells.

Ans. **PROKARYOTIC AND EUKARYOTIC CELL**

Biologists have divided cells into two types:

Prokaryotic and eukaryotic.

The differences between these two types of cells are mainly based upon the structure of their nuclei.

DNA of Eukaryotic and Prokaryotic:

Eukaryotes have a very well defined nucleus, in which nuclear material (chromosomes or DNA) is enclosed in double nuclear membrane. In prokaryotic cells, however the genetic material (DNA) is without any nuclear membrane covering and is directly submerged in the cytoplasm.

Prokaryote and Eukaryotes:

Organisms possessing prokaryotic cells are called Prokaryotes and those possessing eukaryotic cells are called Eukaryotes.

Examples: Prokaryotes include bacteria and blue green algae. Eukaryotes include all other unicellular or multicellular organisms such as animals, plants, fungi and protista.

Organelles:

Prokaryotic cells generally lack many of the membrane bounded structures found in eukaryotic cells. For example, mitochondria, endoplasmic reticulum, chloroplasts and Glogi apparatus are absent in prokaryotic cells. Since there is no nuclear membrane, a prokaryotic cell has no distinct nucleus and its DNA molecule is directly suspend in cytoplasm.

Sizes of Ribosomes:

Prokaryotes have small sized ribosomes 70S while eukaryotes has 80S.

Cell Division:

In prokaryotes mitosis is missing and the cell divides by binary fission. Because of their simpler structure, it was widely accepted for a long time that prokaryotic cells represent a more primitive stage of evolution than eukaryotic cells.

Cell Wall:

The most distinctive feature of the prokaryotic cell is its cell wall, composed of polysaccharide chains bound covalently to shorter chains of amino acids forming peptidogly can or murein. The entire cell wall is often regarded as a single huge molecular complex called **sacculus**. The cell wall of plants is generally made up of cellulose and is differently structured than that of a bacterium.

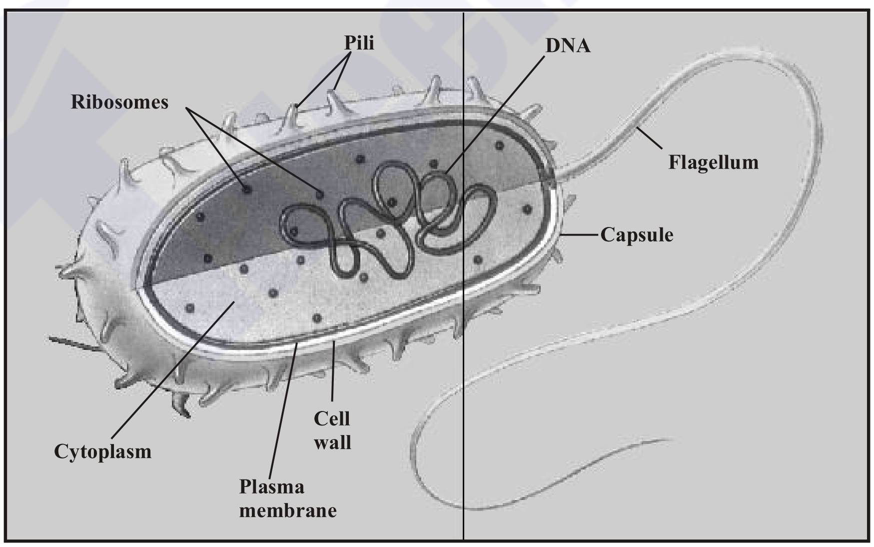


Fig. Generalized Prokaryotic cell

SHORT QUESTIONS

SPECIAL ATTENTION

Q.1 Write any four cells in which mitochondria are absent:

Ans. The cells of *green algae*, *blue green algae, red algae* and *brown algae* are without mitochondria.

Q.2 Which of the cell organelle is considered as rich in oxidative enzymes?

Ans. Mitochondria contains oxidative enzymes.

Q.3 Does the size of cell affect on role of metabolism?

Ans. Generally, the smaller cell are metabolically active than larger cells.

Q.4 Write any one non-living part of cell?

Ans. Vacuole is a non-living part of cell.

Q.5 Which is the outer most layer of cell wall?

Ans. Middle lamella is the outer most layer of the cell wall while primary wall is the inner most layer?

Q.6 Which nuclei are without nucleolus ?

Ans. The nuclei of sperms and muscle fibres are without nucleolus.

Q.7 What do you know about organelles of RBCs and WBCs?

Ans. *Red blood cells are without nucleus in the mammals. RBCs are also without cell organelles. They contain mainly the oxygen carrying pigment i.e. Hemoglobin.*

- The white blood cells of vertebrates and invertebrates have nuclei and other cell organelles.

Q.8 Which cell organelle is responsible for autodigestion?

Ans. ***lysosome*** is that cell organelle which is responsible for auto digestion. Lysosmes contain hydrolytic enzmes (about 36 types) they can digest proteins, carbohydrates and lipids etc. lysosomes are also called "suicide bad"

Q.9 Which cell organelle is single membranous and which one is non-membranous?

Ans. ***Lysosomes*** are single membranous while ***ribosomes*** *are non membranous*.

Q.10 What is the main function of centriole?

Ans. **Formation of spindle fibres** during the cell division is the main function of centriole.

Q.11 Which common proteins are not present in prokaryotes?

Ans. Histones, Fibrinogen, Myosin and Keratin are not present in prokaryotes.

Q.12 Does water amount affect on activity of cell?

Ans. Active cells or active tissues have more H_2O than less active cells or tissues.

Q.13 Write any three cell organelles which are locomotory?

Ans. Cilia, flagella and pseudopods are locomotory organelles.

Q.14 What is the alternative of cell wall in animal cell?

Ans. Animal cell do not poseess well-designed cell wall but have a ***cell coat.*** That plays important roles in the interaction with adjacent cells. Coat contians following molecules.

(i) Glycoproteins

(ii) Glycolipids

(iii) Mucopolysaccharides.

Q.15 What is kreb cycle?

Ans. A cycle in which a series of chemical changes takes place by which pyruvic acid (changed into) or completely degraded into CO_2 and H_2O, in this way O_2 upto taken and energy released and stored as ATP, is known as kreb cyele.

Q.16 In which organelles protein is synthesized other than ribosomes?

Ans. The following organelles also involved in protein synthesis:

(i) In packages of ER and Golgi bodies.

(ii) In nucleus.

(iii) In mitochondria

(iv) In chloroplasts

Q.17 Which parts of the cells are Hydrophobic and Hydrophilic?

Ans. **Hydrophobic (water hating):** All membranes of cell and cell organelles are hydrophobic.

Hydrophilic (water loving). The cytoplasmic matrix between the membrane system is water loving i.e. hydrophilic.

Q.18 what do you know about network of endoplasmic reticulum?

Ans. Endoplasmic reticulum is a structure of a network of their membrane-bounded cavities.

These cavities have two different shapes.

(i) In some cases fine tubules.

(ii) And in some cases flattened sacs which called cisternae.

Q.19 What is structural similarity between Endoplasmic reticulum and Glogi bodies?

Ans. Both have extensions of canal like system with ***stacked sacs***.

(But ***canal*** system of golgi body is smooth and devoid of ribosomes.)

Q.20 What is polysome?

Ans. "The association of the number of ribosomes with messenger RNA is called polysome"

RNA to form a polysome in both prokaryotic and eukaryotic cells.

Q.21 What do you know about the origin of lysosomes?

Ans. Lysomes may originate either from the endoplasmic reticulum or the golgi complex or both.

Q.22 Why is large vacuole important in plant cells?

Ans. Vacuole occupies 50 to 90% of cell volume in plants, plant cell depends upon vacuole for diffusion, supply of raw material of photosynthesis and O_2 for respiration.

Q.23 Which cells have numerous ribosomes?

Ans. Ribosomes are especially numerous in active cells and fewer in less active and starved cells. They are also numerous in cancer cells

"The particles, composed of ribonucleic acid and proteins, were named ribosomes."

Q.24 What is the basic structural and functional unit/substance of cell?

Ans. The basic structural and functional unit/substance of cell is PROTEIN.

DIFFICULT WORD MEANINGS

Words	Meanings	Words	Meanings
Structural	ساختی/جسمانی	Confined	میں بند/تنگ محدود
Functional	کام کرنے والے/فعلی	Endocytosis	کسی شے کا سیل میں جانا
Emergence	نمودار/نکلے ہوئے	Phagocytosis	ٹھوس چیز کا سیل میں داخلہ
Implication	استعمال	Pinocytosis	مائع چیز کا سیل میں داخلہ
Vesicles	دانے دار جسامت	Lamella	تہہ
Surrounding	اردگرد	Primary	بنیادی
Demonstrate	سمجھانا/بتانا/پڑھانا	Soluble	حل پذیر
Metabolic activities	نئے مالیکیول شے اور ٹوٹنے کے عمل	Criss cross	ایک دوسرے کے اوپر کراس کرتی ہوئی لائنیں
Bleb		Concentric	
Versatile	ورائٹی رکھنے والا/مختلف پہلوؤں والا	-some	باڈی/جسامت
Extraordinary	غیر معمولی	Colloidal solution	گاڑھا/لیسدار محلول
Tissues	سیل کا مجموعہ/بافت ایک سے زیادہ	Streaming movement	سیدھی حرکت/ندی کی طرح
Organ	ٹشو کا مجموعہ/عضو	Transmission	انتقال/منتقلی
System	آرگن کا مجموعہ/نظام	Mechanical	جسمانی/مکینیکل
Component	حصہ	Dispense	پھیلے/بکھرے
Matrix	مائٹوکونڈریا کا سیال حصہ/مائع حصہ	Stacks	تہہ در تہہ
Stroma	کلوروپلاسٹ کا سیال حصہ	Fusion	ملاپ

Organelles	سیل کے اندرونی حصے	**Tubule**	ٹیوب سے بھی باریک/یعنی یک خلوی تہہ والی دیوار والی نالی
Chromatin	دھاگہ نما/کروموسومز کا حصہ	**Secrete**	رطوبت خارج کرنا
Distinguished	نمایاں	**Engulf**	نگلنا
Submerged	ڈوبے ہوئے/چھپے ہوئے	**Germinate**	اُگنا
Seedling	پودوں کی پنیری	**Identical**	ایک جیسے
Autophagy	سیل کا اپنے ہی چھوٹے چھوٹے حصے کھانا	**Via**	بذریعہ/براستہ
Degenerate	توڑنا/ٹکڑے نما	**Binary fission**	دو میں تقسیم
Abundunt	کثرت سے	**Primitive**	قدیمی
Turgor	سیل کی ممبرین پر اندر کی طرف سے دباؤ	**Distinct**	واضح
Rigidity	سختی	**Possess**	رکھنا/پاس ہونا
Filamentous slender	دھاگہ نما	**ATP**	توانائی جو فیول کے طور پر جاندار کے کام آتی ہے
Exterior surface	بیرونی سطح	**Glycolysis**	سائیٹو پلاسم میں گلوکوز ٹوٹ کر کاربن والے دو پروِوک ایسڈ کا بننا
Infolding	اندر کی طرف تہہ	**Kreb cycle**	عملِ تنفس (ریپریشن) کا وہ عمل جو مائٹوکونڈریا میں ہوتا ہے
Replicate	کاپی بننا/کاپی ہونا	**Endocytosis**	سیل کے اندر داخلہ
Utilize	استعمال	**Pinocytosis**	سیل کے اندر مائع کا داخلہ
Dispersal	بکھرنا	**Phagocytosis**	سیل کے اندر ٹھوس کا داخلہ

Q.1 Fill in the blanks:

(i) In eukaryotic cell chromatin material is bounded by ————.

(ii) A micrometer is a unit of ————.

(iii) Chromosomes having equal arms on either side of the centromere are called ————.

(iv) The endoplasmic reticulum with attached ribosomes is known as ————.

(v) The soluble part of the cytoplasm is called ————.

ANSWERS:

(i) Nuclear membrance (ii) Measurements (iii) Metacentric

(iv) Rough (v) Cytosol

Q.2 Write whether the statement is 'true' or 'false' and write the correct statement if it is false:

STATEMENT		T/F	CORRECT STATEMENT
(i)	Cell membrane is present in all eukaryotic cells.	T	
(ii)	Chloroplast and mitochondria do not have hereditary material	F	Chloroplast and mitochondria have hereditary material.
(iii)	Centriole is involved in cell secretions.	F	Centrole is involved in cell division.
(iv)	Sometimes many ribosomes get attached to the same stretch of mRNA forming a structure called the cytosome.	F	Sometimes many ribosomes get attached to the same stretch of mRNA forming a structure called polysomes
(v)	Mitochondria are very important organelles of the eukaryoatic cells.	T	

Q.3 Each question has four options. Encircle the correct answer:

(i) Which statement about the nuclear envelope is not true?

(a) It has pores

(b) It is double membrane structure

(c) Its inner membrane bears ribosomes

(d) RNA and some proteins pass through it

(ii) Which statement about plastids is true?

(a) They are surrounded by a single membrane

(b) They are the powerhouse of cell

(c) They are found in all organisms

(d) They contain DNA and ribosomes

(iii) Which type of cell would probably be most appropriate to study lysosomes?

(a) Phagocytic white blood cells

(b) Nerve cell

(c) Mesophyll cell of leaf

(d) Muscle cell

(iv) Which of following pairs of structure – function is mis-matched?

(a) Ribosomes, protein synthesis

(b) Nucleolus; ribosome production

(c) Golgi; muscle contraction

(d) Lysosome; intracellular digestion

(v) Which of following statements about ribosomes is correct?

(a) They are structurally different from free ribosomes

(b) They are enclosed in their own membrane

(c) They are concentrated in the cisternal space of rough ER

(d) They are attached to cisternal surface

ANSWERS:

(i) (c) (ii) (d) (iii) (a) (iv) (c) (v) (d)

Q.4 Short Questions:

(i) Describe various movements involved in the transport of materials across the cell membrane.

Ans. Diffusion, Osmosis and active transport are involved in the transport of materials across the cell membrane.

(ii) State various structural modifications in a cell involved in secretions.

Ans. Golgi bodies and lysosomes.

(iii) List the process blocked by mitochondirial failure in a cell.

Ans. Respiratory processes like Krebs cycle and electron transport chain.

(iv) What will happen if a chromosome losses its centromere?

Ans. The chromosome will not be able to attached with spindle fibre.

(v) How does autophagy help in converting a tadpole larvae into an adult amphibian?

Ans. Disappearance of tail and gills of a tadpole larval is due to autophagy.

(vi) Is there any similarity between bacterial and plant cell wall?

Ans. (a) It is present on the outside of the cell.

(b) It is composed of dead material.

Chapter 5

VARIETY OF LIFE

Q.1 *Define classification and taxonomy. What are the basis of classification? Give various units of classification.*

Ans. CLASSIFICATION

Arrangement of organisms into groups and subgroups on the basis of similarities among them is known as classification.

Taxonomy:

The branch of biology which deals with naming and classification of organisms is known as taxonomy.

Basis of Classification:

Classification is based on relationship among the individuals. This relationship is in the shape of similarities in form and structure of an organism. The similarities among the organism can be measured by following:

- Homologies
- Comparative Biochemistry (protein, Carbohydrates, fats etc.)
- Cytology (cells and tissues)
- Genetics (genes and chromosomes)

Units of Classification:

The organisms are divided into various units of classification in species and heist is kingdom.

Following are various units of classification.

Kingdom: It is ***large unit*** of classification. The similarities among the organism in this group based on some general characteristics e.g. ***absence or presence of chlorophyll*** in animals and plants respectively.

Phylum: Each kingdom contain smaller groups known as phyla (phylum).

Class: Each phylum is further divided into smaller units called as classes.

Order: Classes are grouped into orders.

Family: An order constitutes many families of organisms. A family is a unit of classification that have many genera (sing:- genus).

Genus: A group of closely related species are placed in a unit of classification that is known as genus.

Species: The basic unit of classification is known as species. The species can be defined as:

"A group of closely resembled organisms which can interbreed freely and produce fertile off springs is known as species."

Interbreeding cannot be used a criterion for species definition for asexually reproducing organisms.

- Each species has its own prominent structure, ecological status and behavioural characteristics.
- Species is independent evolutionary units.
- The unit of classification is also called as taxa by some biologist.

Q.2 Give Biological Classification of Corn.

Ans. Following is hierarchic description of Zea mays (corn).

Classification of Corn:

Kingdom	Plantae
Division (Phylum)	Anthophyta (Tracheophyta)
Class	Monocotyledonae
Order	Poales
Family	Poaceae
Genus	***Zea***
Species	***mays***

- *The name of genus and species must be underlined or in italic.*

Q.3 Describe various classification system of living organism.

Ans. Different classification system have been introduced from the time of human civilization. Most famous system of classification are:

- Two kingdom classification.
- Five kingdom classification.

Two Kingdom Classification System

It is the **most primitive** system of classification. By this system living organism have been classified into two groups i.e. two kingdom.

(a) Plants (b) Animals.

(a) Plants:

This kingdom includes the **autotrophic organism**. The organism that can prepare their own food from simple inorganic material and store energy are known as autotrophic. Bacteria were placed with plants.

(b) Animals:

This is the kingdom of **heterotrophic organisms**. Heterotrophic organism are those which cannot synthesize their own food from simple inorganic material. These organism depend for their food on autotrophs or decaying organic matter

Many biologist think that two kingdom classification is satisfactory while other groups of biologist raised some objection on two kingdom classification system.

OBJECTION ON TWO KINGDOM CLASSIFICATION:

The biologist raised objection on some organism that are not fit in two kindgom classification system. Some of the organisms are listed below.

(1) Euglena:

The Euglena is an organism that shows properties of both plants and animals.

Animal Like Characters of Euglena:

- Absence of cell wall.
- Motile locomotion takes place by flagella.
- Loose chlorophyll when placed in dark for a long period of time.
- Autotrophic i.e., due to presence of chlorophyll they can synthesiz their own food.

Due to dual nature of Euglena Ernst Hackel (1866) placed Euglena, Euglena like organism and bacteria in a separate kingdom known as protista.

(2) Bacteria and Blue Green Algae:

In 1937 **E. Chatton** introduced two terms by raising objection on bacteria and blue green algae.

(i) ***Procariotique*** (ii) ***Eu-Cariotique***

Procariotique:

It is derived from two Greek words *pro means before* and *karyon means nucleus*. The organism made up of cells that has not prominent nucleus were placed in group pro-cariotique. i.e. Bacteria and Blue green algae.

Eu-cariotique:

It is also derived from two Greek words *Eu-meaning true and karyon meaning nucleus*. The organism that are made up f well developed nucleated cells were placed in group en-cariotique.

(3) Fungi:

A group of biologist also disagree with the classification of fungi due to following reasons.

- Fungi resemble to plants (algae) but are not autotrophic.
- The cell wall is mainly composed of chitin.
- Special heterotrophic (decomposers) that obtained energy by the break down of substances.

FIVE KINGDOM CLASSIFICATION

It is relatively recent system of classification and was proposed by *Robert Whittekar in 1969*.

This system of classification based on three levels of cellular organization associate with three main mode of nutrition viz.

- Photosynthesis.
- Absorption.
- Ingestion.

The five kingdom proposed by Robert Whittekar are as follows.

(1) Kingdom Monera

It includes:

(i) Prokaryote: *They have **no nucleus**.*

(ii) Unicellular: *They are unicellular.*

(iii) Heterotroph and Autotroph: They are heterotrophic (non-photosynthetic) or autotrophic (photosynthetic).

Examples: *Bacteria and blue green algae (cyanobacteria).*

(2) Kingdom Protista

(i) Eukaryote and Unicellular: They consist of eukaryotic predominantly unicellular organisms.

(ii) ***Colony:*** Some of them forms colonies.

(iii) ***Hetrotroph and Autotrophs:*** (a) They are heterotrophic or autotrophic.

Examples: *Euglena and Amoeba.*

(3) Kingdom Plantae

(i) ***Eukaryotes:*** The organism of this kingdom includes eukaryotic organisms.

(ii) ***Multicellular:*** They are multicellular organisms.

(iii) ***Autotrophs:*** Plants are photosynthetic. They can produce their food from CO_2 and H_2O.

Examples: *Liverworts, Mosses, Gymnosperms and Angiosperms.*

(4) Kingdom of Fungi

(i) ***Eukaryotes:*** Organisms of this groups are composed of eukaryotic cells.

(ii) ***Heterotrophic:*** They are non photosynthetic and non chlorophyllous.

(iii) ***Absorptive mode:*** Having absorptive mode of nutrition.

(iv) ***Decomposers:*** Decomposers that live on organic material.

(v) ***Enzymatic:*** Having well developed enzyme system by which they digest organic food into small molecules. These small molecules are then absorbed.

(5) Kingdom Animalia

This kingdom includes:

Eukaryotes and Multicellular:

Organisms composed of eukaryotic multicellular body.

(i) ***Heterotrophs:*** Gain food by ingestion which is digested in special cavities. Animals are Heterotrophs.

(ii) ***Locomotory:*** Organisms that move from place to place.

(iii) ***No Cellulose:*** Cellulose does not take part in cellular organization. e.g; Fish, amphibians, reptile, birds and mammals.

In five kingdom classification all eukaryotes that are not fit in the definition of plants fungi or animalia were included in protista. Most protists are unicellular but some are simple multicellular which are believed to be direct descendants of unicellular protista.

MODIFICAITON OF FIVE KINGDOM CLASSIFICATION SYSTEM

Lynn Margulis and Karlene Schwartz in 1988 modified five kingdom classification of Whittakar by considering.

- Cellular Organizaton.
- Mode of Nutrition.
- Cytology.
- Genetics.
- Organelles of symbiotic origin (Mitochondria and chloroplast).

These five kingdoms of Lynn and Schawtz are:

(i) Prokaryotae (Monera).

(ii) Protoctista (Protists)

(iii) Plantae.

(iv) Animalia.

(v) Fungi.

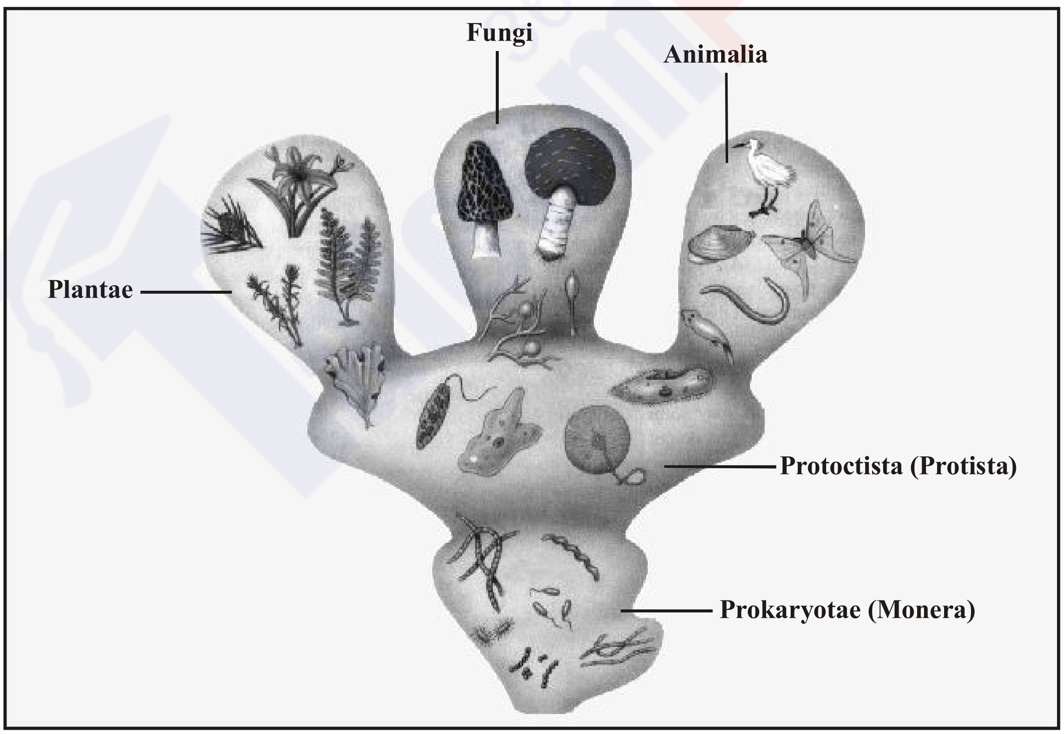


Fig. Relationship of five kingdom

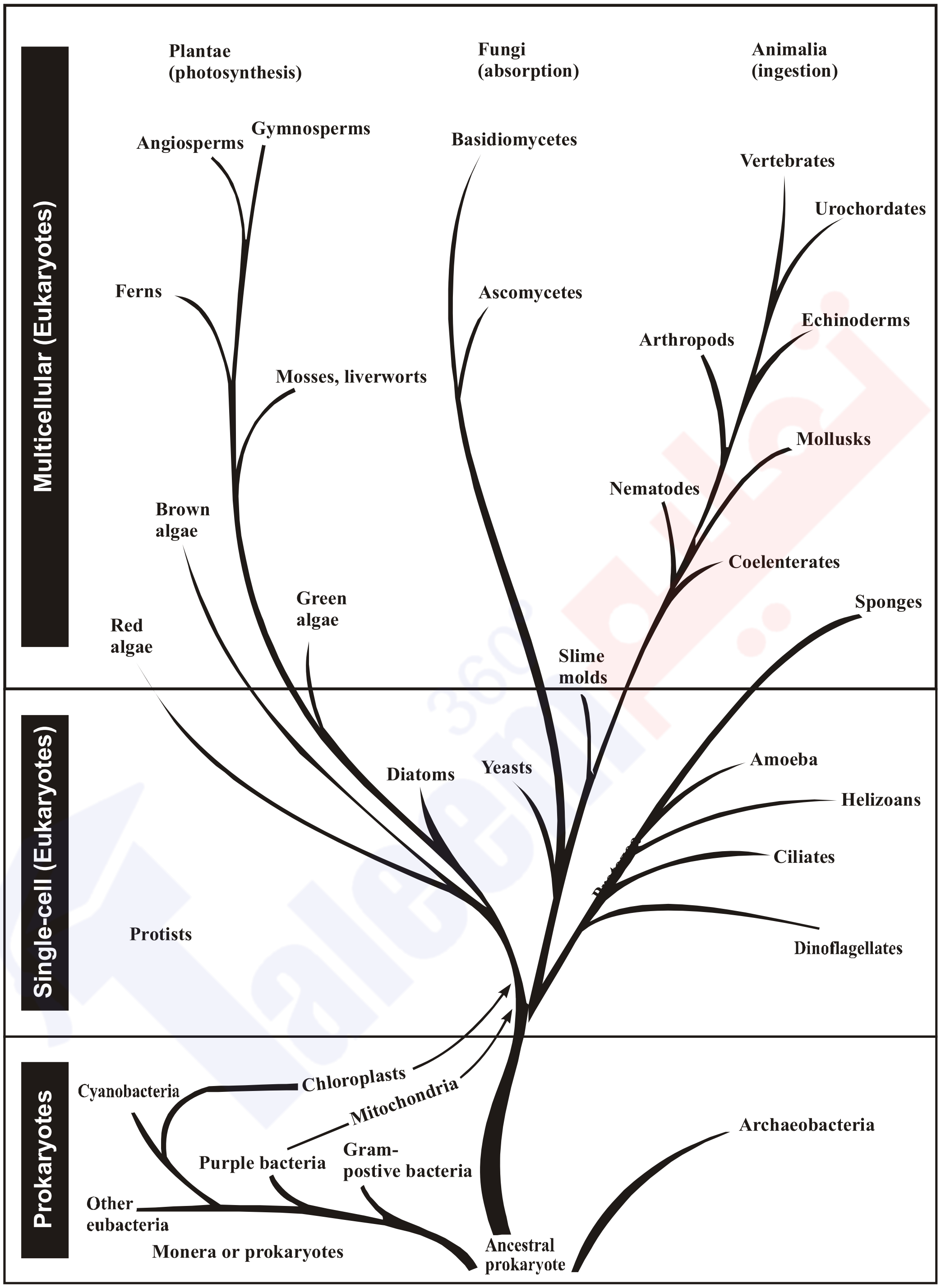


Fig. Five kingdom classification by Whittekar

Q.4 What do you mean by nomenclature? Write a note on Binomial nomenclature. Why is there need of binomial nomenclature?

Ans. **NOMENCLATURE**

The art of naming to any object in nature is called as nomenclature.

From the ancient times plants and animals have been given common names by people. Since no system was introduced in choosing (giving) common names to the organisms. Due to lack of a definite system in many cases various regions had their own name for plants and animal. e.g., onion has different common name in different region of Pakistan.

COMMON NAMES OF ONION:

Piaz in *urdu* language

Ganda in *Punjabi* language

Basal or ***vassal*** in *saraiki* language.

Similarly ammaltas, orgvad, gurmala golden shower and purging eassia are different common names of the same plant.

In some cases, different plants or animals have single name in different region. e.g., All plants with bell shape flower are known by the name of blue bells. Similarly the name "black bird" is given to a crow as well as to a raven.

"Fish" as a common name

Common name have no scientific basis e.g. Fish in the view of biologist is a vertebrate animal with back bone, fin and gills. But silver fish is insect (anathropod) cray fish also an arthropod. Jelly fish is a coelenterate. Star fish is an echinoderm. All these do not fit into definition of a fish.

Binomial Nomenclature:

During 18th century, a Swedish botanist "Carlous Linnaeus." (1707 – 1778) introduced a system for naming and classification of all organism known to him. He took the scientific name from Latin word. The scientific name of each organism had two parts. So the Linnaeu, system of giving name of species is known as binomial nomenclature.

Genus

First name is the name of genus and is called generic name which always ***begins with capital letter***.

Species

Second name is species name and ***begin with small letter***. The scientific name referred to some characteristics of organism or the person who collect the plant or animal.

LINNAEUS SYSTEM

The Linnaeus System is used today internationally. Following are some scientific names of plants and animal according to this system:

Some Scientific Names	
Onion:	*Allium cepa.*
Amaltas:	*Cassia fistula.*
Potato:	*Solanum tuberosum*
Tomato:	*Solanum esculentum.*
Human:	*Homo sapiens*
Cat:	*Felis domesticus.*

Some genus of tomato and potato, cat and lion shows a close relationship between these two species of plants and animals.

NEED OF BINOMIAL NOMENCLATURE:

Binomial nomenclature is necessary for species exactness. Common name had long caused confusion. When they came under discussion among the scientists of all over the world. So binomial nomenclature provides single name of an organism to avoid this confusion of scientists (biologists). A specific name has the advantage for a single kind of an organism through out the world.

Linnaeus Publications:

Linnaeus published the list of names of plant since 1953 his system become so popular that re-published a list of names of animals in 1958.

Many names of plants and animals are in use today.

INITIAL CATAGORY WAS BASED ON MORPHOLOGY:

Initially the classification was based on morphology of plants and animals. But with the advancement in field of cytology, physiology, genetics and molecular biology the classification of organism has been modified.

Q.5 Define virology, give history of discovery of virus.

Ans. **VIROLOGY**

"The branch of biology which deals with the study of virus is known as virology."

History of Virus Discovery:

About a century ago at the time of **Louis Pasteur** (1822 – 1895) and **Robert Brown** (1843 – 1910) the word virus was generally referred to as ***'poison'*** associated with disease and death of living organism.

In 1884 $\boxed{\text{Charles Chamberland}}$ (one of the Pasteur's associates) found that bacteria cannot pass through porecelain filters while agents responsible for rabies can pass through filters.

The filterable agents are known as filterable viruses.

$\boxed{\text{Ivanowski in 1892}}$ discovered that the agent which caused tobacco mosaic disease was filterable. He obtained bacteria free filterable from infected plants and applied it on healthy leaves of tobacco the healthy plant got disease.

Similarly ultramicroscopic agents which can pass from filter were seen in the victims of mainly diseases like foot and mouth disease (1898) and yellow fever (1901).

Finally the secret of filterable agent was disclose by *W.M. Stanley in 1935*. Stanley was successful in crystallizing "TOBACCO MOSAIC VIRUS" (TMV) for the first time in the history of virology.

The chemical analysis of crystallized particles showed that they consist of only nucleic acid protein. This suggest that viruses that have simple organization, are nucleoprotein in nature.

Q.6 Define virus. What are the important features of virus?

Ans. $\boxed{\textbf{VIRUSES}}$

Definition:

The word virus is derived from Latin language and means a *"poisonous liquid or poison"*.

Viruses as *"infectious nucleoprotein"*. Viruses may be generalized to define as:

"Such very small-sized disease that are capable of passing through filters that retain even bacteria, increase only in the presence of living cell, and give rise to new stains by mutation."

IMPORTANT DISTINGUISHING FEATURES:

(1) **Non Cellular:** Viruses do not fall into catagory of unicellular organisms (bacteria mycoplasm etc.) because they do not posses a cellular organization.

(2) **One Type of Nucleic Acid:** Viruses contains only one type of nucleus, either DNA or RNA but never both. However all other microorganism (bacteria, fungi mycoplasms etc.) contain both DNA as well as RNA.

(3) **Obligate Intracellular Parasite:** They are obligate intracellular parasites and show their extreme dependence upon living organism for their existence and multiplication.

(4) **Lack Enzyme:** Viruses lack the enzyme necessary for protein and nucleic acid synthesis. For replication, they depend on the synthetic machinery of host cell.

(5) **Virion:** The structural unit of a virus particle is called virion.

(6) **Size:** In size they range between ***10nm*** (foot and mouth disease viruses) ***to 250 nm*** (poxviruses). They are therefore submicroscopic and can be seen only with the help of electron microscope.

(7) **No binary Fission:** Viruses do not multiply by binary fission.

(8) **Resistant to Antibodies:** Antimicrobial antibodies do not show any affect on viruses.

(9) **Crystal:** Viruses can be crystallized like chemicals.

(10) **High Molecular Weight:** Viruses consist of high molecular weight ***nucleoprotein***.

Q.7 Give the name of some human viral diseases.

Ans. **SOME HUMAN VIRAL DISEASES**

In human beings the viral disease are very common, ranging from minor ailments such as ***common cold*** to highly fatal such as ***small pox***. They may be sporadic (***mumps***) epidemic (***measles***) endemic (***rabies***) or panedemic (***influenza***). Some of the viral diseases are world wide e.g., **Herpes**. Some of the viruses may even be the cause of many dreadful disease. Such as cancer in animals, birds as well human beings.

AIDS and *hepatitis* are also important viral diseases.

Q.8 (a) Define virus and give structure of typical viruses.

(b) Classify viruses on structural basis.

Ans. **(a)** **VIRUSES**

"Infectious agents which have no independent metabolism and replicate only within living cell are called viruses."

Structure of Typical Viruses:

The complete, mature and infectious particle is known as virion. A typical virion is composed of following parts.

(a) Genome (b) Capsid (c) Envelope

(a) ***Genome:*** The virion is composed of a central core made up of ***nucleic acid*** (DNA or RNA) known as genome.

(b) ***Capsid:*** The genome is surrounded by a ***protein coat*** called as capsid.

Capsid gives definite shape to virus.

The capsid is made up of protein subunits known as ***capsomers***. Capsomers is characteristics of a particular viruses e.g.

- 162 capsomers are present in the capsid of herpes viruses.
- 252 capsomers are present in adenovirus which cause some types of common cold.

(c) ***Envelope:*** In some animal viruses the ***nucleocapsid*** (genome and capsid) is covered by another membrane known as envelope. The envelope is derived from the host cell.

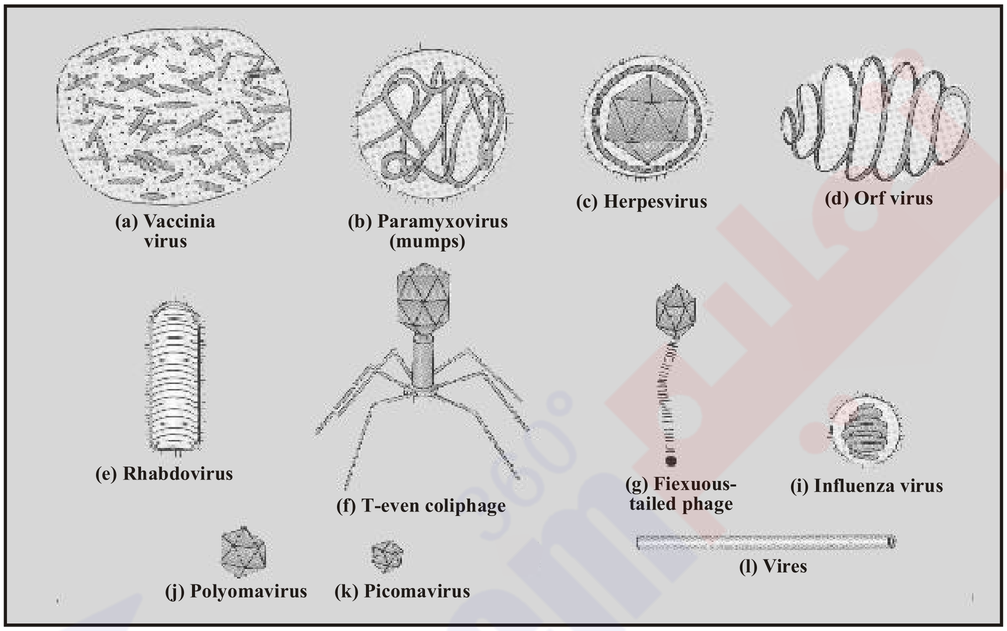


Fig. Different types of viruses

(b) CLASSIFICATION OF VIRUSES

On the basis of morphology **viruses can be classified as under:**

(i) ***Rod Shaped:*** Animals and plant viruses.

(ii) ***Polyhedron:*** The virus having many sides are known as polyhedron.

(iii) ***Helical:*** The viruses having spiral morphology.

(iv) ***Tadpole Like:*** Mostly bacteriophage that infects bacteria. Bacteriophage occur in structural forms having cubical or helical symmetry.

(v) ***Cubical Phage:*** These phages are regular solid or Icosahedral (having 20 sides).

(vi) ***Helical Phage:*** These are rod shaped viruses found in nature.

(vii) ***Phages with head and Tail:*** Many phages consist of head and tail in these cases heads or polyhedron but tails are rod shaped.

Q.9 Why viruses are considered as living and non-living?

ONLY FOR SPECIAL ATTENTION

Ans. DISPUTE OF LIVING AND NON-LIVING:

Nature and Origin:

The nature and origin of virus is still not clear because it is not easy to define. Then within excepted framework of living on non-living organism. Thereby biological status is still not crystal clear. Some virologist regard viruses as animate object whereas, other consider them inanimate.

Viruses are Living Because:

(1) They show ***growth***.

(2) They show ***mutation***.

(3) They can be ***transmitted*** from the diseased host to healthy once.

(4) They ***react to heat*** chemicals and radiations.

(5) They have ***genetic material*** i.e., DNA or RNA.

(6) They are capable to ***multiply*** in no of same genetic type.

(7) Viruses show ***irritability***. A character of only living organism.

(8) The are capable to bring about ***enzymatic change in vitro***.

(9) They have the ability to ***infect***.

Viruses are non-living because:

(1) They can be ***crystallized***.

(2) They are ***inert outside*** the host.

(3) A cell wall or cell membrane of any type absent in viruses.

(4) *They do not show functional anatomy*.

(5) *They do* ***not respire*** *or excrete*.

(6) Their sedimentation according to their molecular weight is like that of non-living.

(7) They are dependant upon living organism.

(8) They lack any energy producing enzyme system.

Specific Characters of Viruses Neither in Living Nor in Non-living

(1) Presence of *only one type of nucleic acid* either DNA or RNA.

(2) Capacity to reproduce from their sole nucleic acid.

(3) Viruses do not undergo binary fission.

(4) They make use of ribosome of their host cell.

Because of such characters some virologist consider viruses as a transition stage between living and non-living world. They are living organism with some non-living characters.

Q.10 What are viriods?

Ans. VIRIODS

The term viriod has been introduced by the ***Diener (1971)*** for a new class of subvial plant pathogens. They contain a genome much smaller than that of known viruses. They are also characterized by the apparent absence of an extracellular dormant phase (virion). The viriods consist solely of a protein free low-molecular weight (75,000, 125,000 dottons) double standard RNA. Such a RNA is resistant to heat and organic solvents. But sensitive to nucleus. The viriods were first indentified in potato spindle tuber disease (PSTV).

In short, *"the viriods are protein free plant pathogens with low molecular weight RNA.*

Q.11 Define: (i) Adenovirus (ii) Virion (iii) Herpes.

Ans. ADENOVIRUSES

The viruses causing ***diseases of upper respiratory tracts*** or common colds are called adenoviruses.

Virion: The complete viral particle which can infect a living cell and found in crystal form without cells is called Virion.

Herpes: The ***inflammatory skin disease*** marked by the formations of small viruses in cluster in human as herpes.

Herpes Virus: A group of viruses causing diseases like chicken pox and herpes is called herpesvirus.

Q.12 Define the followings:

(i) Hepatitis (ii) Hepatitis A (iii) Hepatitis B (iv) Hepatitis C
(v) AIDS (vi) Retrovirus (vii) Provirus (viii) HIV

Ans.

(i) **Hepatitis** The viral disease of *liver inflammation* in which *abdominal pain*, *jaundice, liver enlargement* and *fever* like symptoms appeared is known as hepatitis.

(ii) **Hepatitis A:** The *short terms* and less severe hepatitis due to attack of RNA type virus. HAV is called hepatitis A.

(iii) **Hepatitis B:** The recoverable DNA viral hepatitis with symptoms like jaundice and fatigue in which *patient ultimately immuned* is called hepatitis "B".

(iv) **Hepatitis C:** The chronic liver abnormality due to attack of RNA virus (HCV) is called hepatitis "C".

(v) **AIDS** The viral disease which *decreases immunity* with symptoms like loss of weight, swollen of lymphs and pneumonia etc. is called A.I.D.S.

(vi) **Retrovirus** Those specific viruses which cause disease like AIDS and Cancer etc. are called retroviruses or **oncovirus**.

(vii) **Provirus** The single stranded virus which is converted into double stranded DNA and infect host cell and also incorporate into host genome may cause cancer is called provirus.

(viii) **HIV** The *"Human Immunodeficiency virus"* which causes AIDS is called HIV.

Q.13 What are meanings of syndrome?

Ans. **SYNDROME**

A set of symptoms occurring together in an organism due to physiological and morphological abnormalities is called syndrome.

Examples:

- *Acquired immune deficiency syndrome (AIDS)*
- *Kilinefelter syndrome*
- *Down's syndrome*
- *Turner syndrome*

Q.14 What do you know about TMV?

Ans. The filterable virus which causes *Tobacco Mosaic Disease* is called *Tobacco Mosiac Virus* (TMV).

"(Mosiac means organism with more than one kind (lines) of cells with differed genes from the same zygote)

Q.15 Define Genome.

Ans. The complete set of hereditary factors contained in the haploid set of chromosome is known as genome.

Q.16 What do you know about capsid and capsomeres?

Ans. The coat of virus which is made up of protein is called **capsid**. This coat of capsid gives the definite shape to virus. The morphological units of capsid are known as **capsomeres**. Chemically, these are proteins.

HELP LINE

Q.17 Write a brief note on viral nucleic acids. (Just Concept)

Ans: Nucleic Acid (DNA and RNA):

The nucleic acid is only of one type in a virus, i.e. either DNA or RNA. Both the types of nucleic acids are not present in any virus. The single major character separates them from all known living organisms, all of which contain both DNA and RNA. The viruses possessing DNA are called DNA viruses (*Deoxyviruses*), whereas those possessing RNA are called RNA viruses (*Riboviruses*). There may be only a single strand or double strand of nucleic acid. Four categories of viruses may be recognized on the basis of single double stranded nature of nucleic acid.

(1) Viruses with *single stranded* DNA . e.g; colliphage viruses.
(2) Viruses with *double stranded* DNA e.g; Herpes simples and vaccinia.
(3) Viruses with *single stranded* RNA e.g; TMV and poliviruses.
(4) Viruses with *doubled stranded* RNA e.g; Retrovirus.

ATTENTION

Majority of the animals and bacterial viruses are DNA, whereas a majority of plant viruses are RNA viruses. However few plants viruses are also known to posses DNA (cauliflower mosaic virus) and a few animal and bacterial viruses posses RNA.

Generally more amount of nucleic acid is present in larger sized viruses. The nucleic acid molecule is linear in a majority of the viruses. However a few viruses posses circular molecule of nucleic acid.

Q.18 What are some minor components of viruses? (For concept only)

Ans. **Minor Components of Viruses**

Some viruses remain enveloped by a limiting membrane derived from cell or nuclear membrane of host cell. This membrane contain lipids or lipoproteins, and these viruses are called *"Lipoviruses"*. A few animal viruses (influenza virus) are also known to contain carbohydrates.

Q.19 What are shapes of viruses?

Ans. **Shape**

The shape of the viruses is highly variable in different groups of viruses. They may be *rod shaped bullet shaped*, *brick shaped*, *oval*, *irregular* and *pleomorphic* or even like a piece of *coil rope*. A majority of the aninal viruses are roughly *spherical*.

Virions fall in two major groups with respect to shape i.e. (i) Polyhedral forms e.g; Adenovirus. and (ii) Helical forms e.g.; TMV. However, in tailed or J. Bacteriophage the viron is made up of complex head region showing a polyhedral form, and an attached tail that is helical e.g. bacteriophage T. Rabies or Rhabdovirus are bullet shaped whereas poxiviruses are brick shaped.

Q.20 Give life Cycle of Bacterio phage (Phage virus)?

Ans. **LIFE CYCLE OF PHAGE VIRUS**

Bacteriophage replicates only in the bacterial cell the life cycle is completed in following steps. Two types of life cycles are found in bacteriophage.

(i) Attachment or Absorption:

In first step bacteriophage attached to cell wall of bacterium at a specific site known as receptor site. During attachment a weak chemical union developed between virion and receptor site takes place.

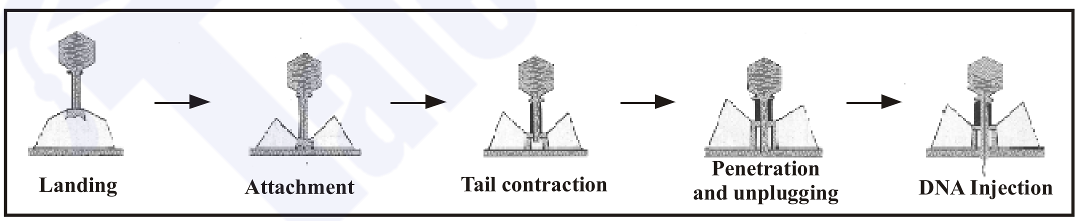


Fig. A phage injecting its DNA in to host

(ii) Penetration:

The tail of virion release enzyme known as *Lysozyme* which dissolve a small portion of bacterial cell wall. Now the tail sheath contract and inject DNA into the cell. The protein coat of virion remains out side the cell. However many animal virus enters as a whole in the cell.

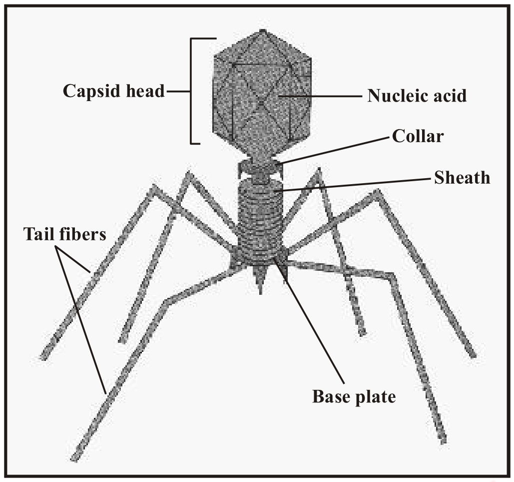


Fig. A Bacteriophage

(iii) Multiplication of Virion:

After entering host cell the *virion DNA takes over the control of biosynthetic machinery of host cells* and forces the host cell to synthesize necessary viral component (DNA and protein). In this way virus start multiplying. After 25 minutes of initial infection 200 new bacteriophages are found in bacterial cell.

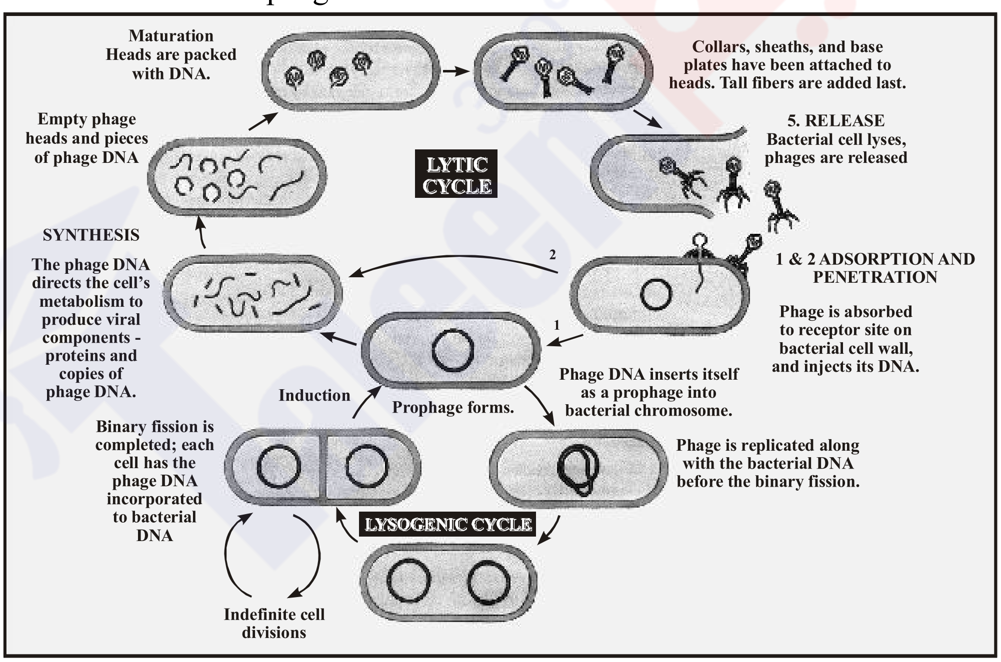


Fig. Replication of a bacteriophage. After adosprtion and penetration, the virus undergoes prophage formation (1) In the Lysogenic cycle, phages can exist harmlessly as a prophage with in the host cell for long periods of time. Each time the bacterial chromosome is replicated, the prophage also is replicated, all daughter bacterial cell are "infected" with the prophage. Induction involves either a spontaneous or environmentally induced excision of the prophage from the bacterial chromosome. (2) A typical lytic cycle, involves synthesis and maturation of phage and new phages are released. **(Note: Read it Compulsory)**

(iv) Lysis:

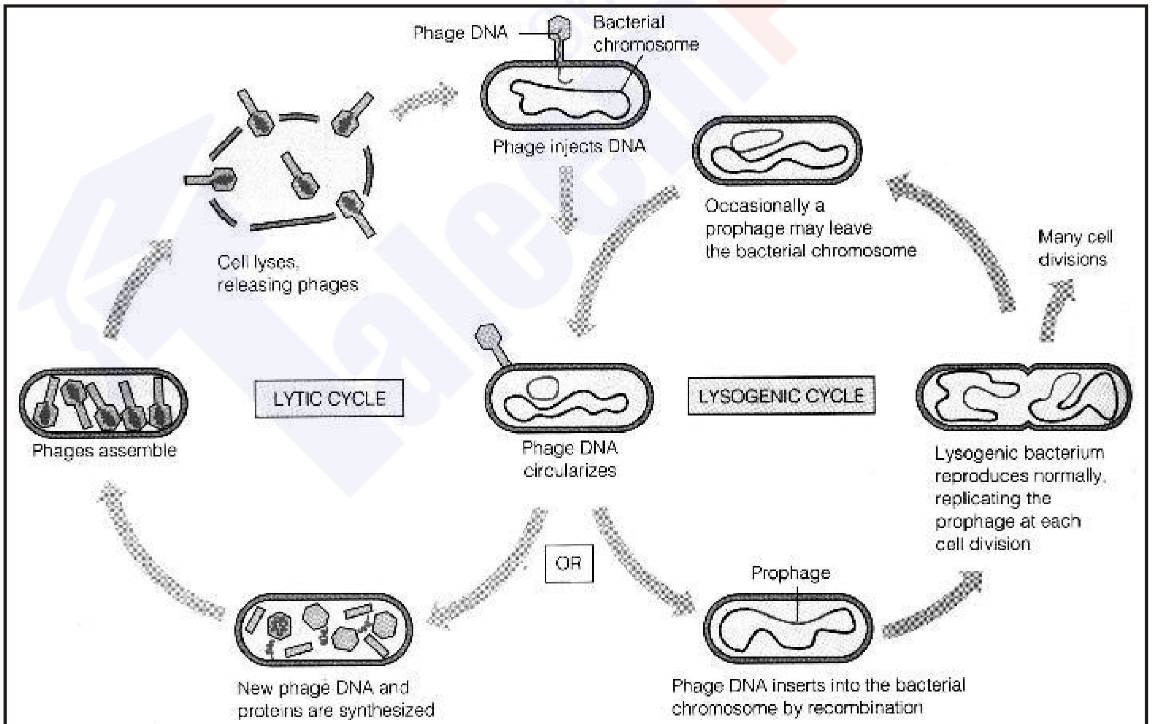
In the final step the bacterial cell burst. This process in called as lysis of bacterium. Newly formed phages are released to infect another bacterium to start the life cycle again.

This cycle which causes lysis of bacterium is known as lytic cycle and the phage is known as lytic or virulent phage.

(v) Lysogenic cycle:

All bacteriophage do not cause lysis of bacterium. Such phages are known as temperate (lysogenic) phages and show another kind of life cycle. The steps of attachment and penetration of phages are some as in lytic cycle. In this cycle instead of taking over the control of biosynthetic machinery of host DNA of phage ***incorporated into the bacterial chromosomes***. Now the DNA of phage is called *prophage* and this process is known as *lysogeny*. In this condition bacterium do not lyse, live and reproduce normally. The virus DNA remains attached to bacterial chromosomes for many generations until the process of induction takes place. In this process viral DNA gets detached from the bacterial chromosomes and start lytic cycle again.

HELP LINE



Two types of phage reproductive cycles

Q.21 What are prions?

Ans. **Prions**

These are most recently discovered in 1983 and least understood microorganism. **These are defined as infectious proteins**. The chemical nature of prions is very controversial. They contain only protein that contain information which codes for their own replication, prions were first introduced in 1983 and are responsible for mad cow infection and mysterious brain infection in man.

- (Like prions only infectious DNA particles are present which are known as viriods.)

Q.22 Write note on following:

(i) Bacteriophage	***(ii) Viral Diseases***	***(iii) Retrovirus***
(iv) AIDS	***(v) Hepatitis.***	

Ans. **Bacteriophage**

Bacteriophages are viruses *which infect bacteria*.

They were discovered independently, by "T wort" in "1915" and D. Herelle in 1917. Twort observed that bacterial colonies, some time undergo lysis i.e. dissolve and disappear. This process of lysis can be transferred from one colony to other. If a very diluted material from lysed colony applied to the bacterial colony, it has enough power of transferring the lytic effect. However, if the filtrate is heated it losses the lytic properly from all above mentioned observation. Twort conclude that lytic agent might be a viruses. ***D' Herette*** rediscovered this process and define the bactriophage as bacteria eater.

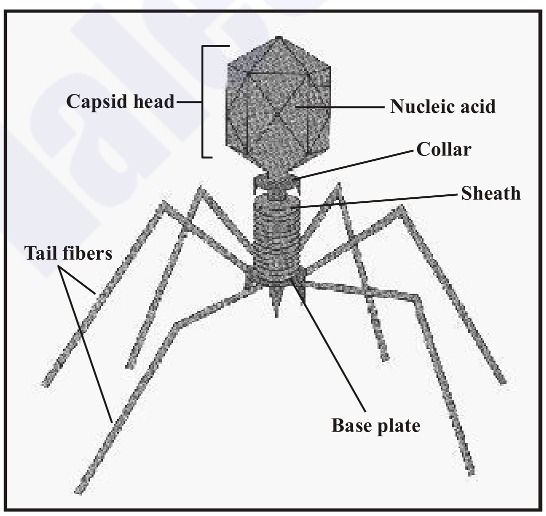


Fig. A Bacteriophage

The most popular phages that *Escherichia coli* (E. Coli) are known as J phage e.g (T.Type) Teven i.e. T_2T_4 are mainly use din molecular studies. Electron microscopic structures of T_4 shows following parts.

(i) **Head:** The head is elongated pyramidal (having two triangular structures with common base) hexagonal and prism shaped structures within the head double stranded DNA molecule is present.

(ii) **Tail:** A straight rod like structure attached to the head is known as tail. The structures of phage tail is more complex than head. It has following parts.

(a) ***Core:*** A layer of protein form the inner most tube known as core.

(b) ***Sheath:*** The core is enclosed in sheath made up of another type of protein.

(c) ***Collar:*** On the upper side near the head the sheath has a structure known as collar.

(d) ***Base plate:*** The lower most end of sheath has a plate like structures known as base plate or end plate.

(e) ***Tail fibres:*** Six tail fibres are attached to the end plate. Tail fibres structures of attachment.

- The volume of phage is about 1/1000 of the host.

Viral Diseases:

There are many diseases which are caused by viruses. Following are most common in Pakistan.

(i) Small Pox

Small pox is caused by pox virus. Pox virus is DNA enveloped virus. Small pox is ancient disease that occurred as *epidemic* in China in twelfth century B.C. Until early 20th century small pox was a common disease through out the world by 1950. Immunization and other prevention decrease the danger but it is still present in third world countries.

Symptoms:

- First of all raised *fluid filled vesicles* (ویزیکل) are formed on the patient's body.
- Lastly they are converted into *pitted scars* known as *pocks*.

Herpes Simplex

Herps virus is DNA viruses. It is a naturally occurring disease of mankind. In this disease *vascular lesions in the epithelial layers of ectodermal tissues* are formed. Most commonly this disease occur in mouth, *on lips* and at other *skin sites*.

Influenza

These are enveloped RNA viruses that cause influenza. It is a wide spread disease in man and occur in epidemic forms.

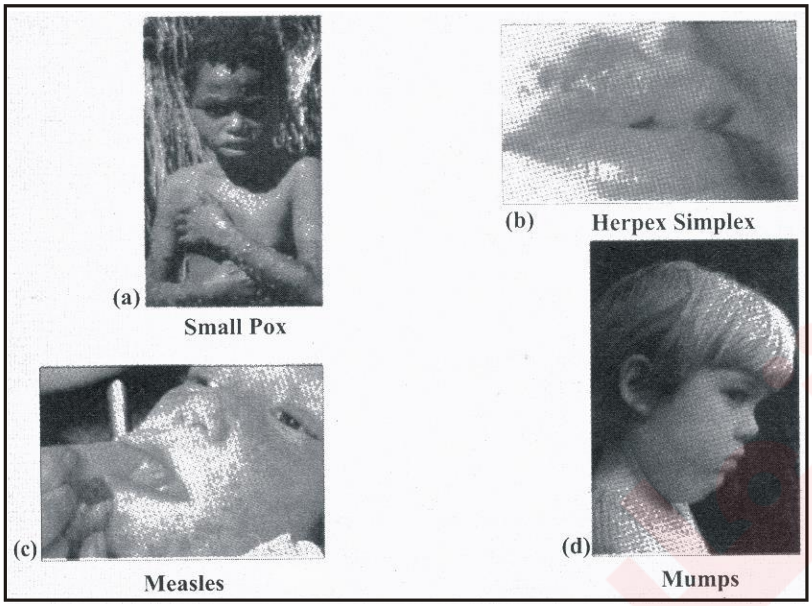


Fig. Some common human viral diseases

Mumps and Measles

The group of mumps and measles virus is known as ***para myxoviruses***. They are large enveloped RNA viruses. Mumps is highly contagious, wide spread but seldom fatal. About 60% adults are immune to it. Measles is the one of the commonest disease of the childhood and adult human population is equally susceptible. This disease develops immunity in its victim.

Polio

Poliomyelitis is caused by polio virus. It is found all over the world. This disease occur in *childhood*. The age at which primary infection depends on social and economic factors. The polio viruses are *smallest* known viruses that contain RNA in a *spherical capsid*.

Q.23 Why a virus is called retroviruses?

Ans. **Retroviruses**

The viruses which have a special enzyme known as ***reverse transcriptase***. Due to presence of this enzyme viruses have ability to convert single stranded RNA genome in to double stranded viral DNA. This process of conversion is known as *reverse transcription* hence the viruses are called as retroviruses.

$$\text{Single stranded RNA} \xrightarrow{\text{Reverse transcriptase}} \text{Double stranded DNA}$$

Infections:

The double stranded viral DNA not only infect the host cell but also incorporated into genome of the host as **poxvirus**. In this way a normal cells converted into cancerous cells. The viruses that have ability to convert normal, cell into cancer cells are known as ***"oncoviruses"***.

Spherical Structure:

Retroviruses are spherical in form, ***100 nm*** in diameter and enveloped by a host plasma membrane. Few retroviruses are nonspecific that is they can infect any cell most of them infect only those host cell which have required receptors. Human immuno deficiency ***virus (HIV)*** which cause acquired Immune deficiency syndrome (AIDS) and many echoviruses are

EXAMPLE OF RETROVIRUSES:

Using Receptors:

- ***AIDS virus enters the host*** cell by using a receptor which is meant for penetration of many kinds of leukocytes and tissue cells.
- ***Leukocytes are WBC***. (white blood cells).

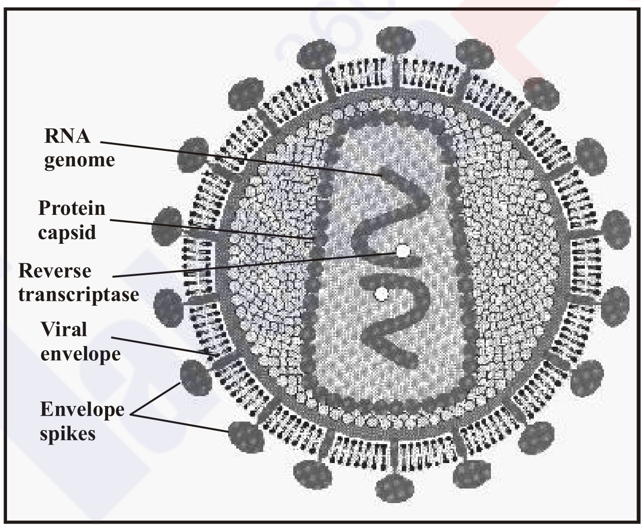


Fig. Human immunodeficiency virus (HIV)

Q.24 Write an account on AIDS.

Ans. **AIDS**

AIDS was first reported by physicians in early 1980's in young male having one or more complex symptons.

Symptoms:

- *Severe pneumonia.*
- *Rare vascular cancer.*
- *Sudden weight loss.*
- *Swollen lymph nodes.*
- *General loss of Immune function.*

Primarily one thing that was common in all patients is that all they are involve in homosexual habit but soon it was noticed that disease was present in those persons who were not involve in this habits but got transfusion from males fond of homosexuality.

Discovery of Causative Agent:

In 1984 the agent that cause AIDS was identified by research teams from Pasteur Institute in France and National Institute of Health (NIH) in USA. In 1986 viruses were named as “human Immuno deficiency virus” (HIV). One of the characteristics of HIV is that it is host specific because recent studies tells us that HIV infect and multiply in monkey but do no cause disease in monkey.

Major Target Cells and Systems of HIV:

The major cells of human which are infected by the HIV are helper T-lymphocyte Helper T-Lymphocyte is major component of immune system. The cells of nervous system are also infected by HIV.

Progonsis of AIDS:

As a result of infection in host cells the number of helper T-lymphocytes decrease in the body of patients. ***Infection continues at last a failure of immune system*** take splace. The infected person become susceptible to other disease.

Epidemiology of AIDS: HIV is transmitted by:

- *Sexual contact.*
- *Blood contact (transfusion).*
- *Breast feeding.*

Preventive Measures:

Following preventive measure should be adopted by every human to avoids AIDS.

Restricted to one sexual pariner. Do not use common syringes for intravenous drugs administration used stecile needles and surgical instruments.

Vaccination:

A vaccine against HIV has been synthesized and its experimental administration in human started in early 2001 in South Africa.

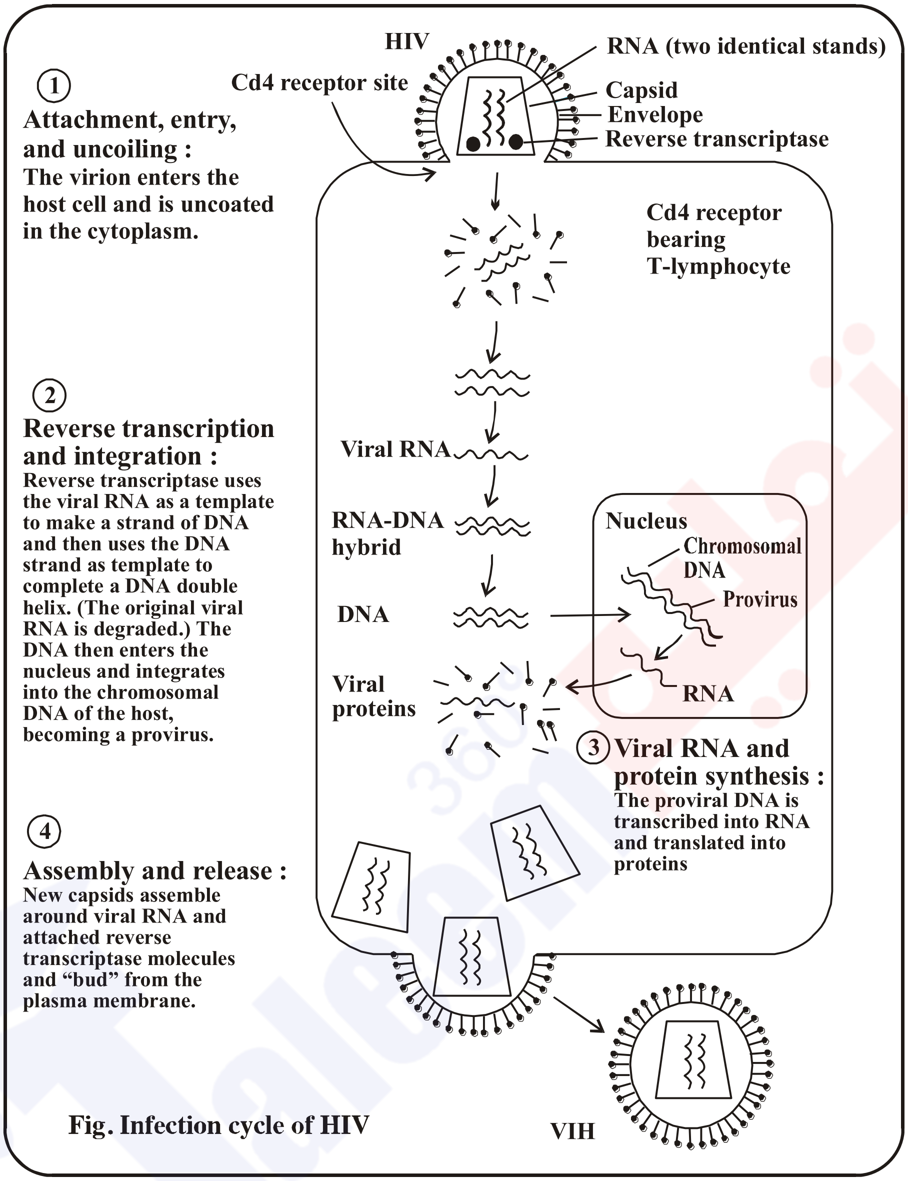


Fig. Infection cycle of HIV

Fig. Infection cycle of HIV

Q.25 Write an account on Hepatitis.

Ans. **HEPATITIS**

"The viral disease of Liver inflammation in which abdominal pain, jaundice and liver enlargement occur, is known as hepatitis."

(OR)

"Hepatitis is an inflammation of liver. It is usually a viral infection but toxic substance or drug can initiate the infection."

Symptoms:

- Jaundice.
- Abdominal pain.
- Liver enlargement.
- Muscle fatigue.
- Fever.

Hepatitis may be mild or acute, that can lead to lever cancer.

KIND OF VIRUSES INDUCE HEPATITIS

Following are some of hepatitis that are caused by viruses:

(i) Hepatitis A:

"The short term and less severe hepatitis due to attack of RNA type HAV is called Hepatitis A". (OR) "Formerly it was known as infectious hepatitis that is transmitted by contact with faces from injected individuals."

The hepatitis "A" virus (HAV) is RNA, non-enveloped virus. The hepatitis A is mild short term and less virulent disease.

(ii) Hepatitis B:

"The recoverable DNA viral hepatitis with symptoms like jaundice and fatigue in which patient ultimately immuned is called hepatitis "B"

It is also virus (HBV) induce disease and second major form of hepatitis. HBV is DNA virus which is very common in Asia, China, Philippines, Africa and the Middle East. Hepatitis B is transmitted by the exchange of body fluid e.g; blood serum, breast milk and saliva. It is also transmitted from mother to child during birth. Sexual contact also leads to the transmission of hepatitis B.

During acute attack of Hepatitis B following Symptom appear.

- Muscle fatigue.
- Loss of appetite and Jaundice.

People with chronic hepatitis infection are at risk of liver damage. Hepatitis can be controlled by adopting hygienic measures, vaccination and Screening of blood/organ/tissue of the donor.

(iii) Hepatitis C:

"The chronic liver abnormality due to attack of RNA virus (HCV) is called hepatitis C". (OR) Hepatitis C virus (HCV) is also RNA, enveloped virus. It is less severe than hepatitis "A" and "B" Hepatitis C leads to chronic liver disease.

DIFFICULT WORD MEANINGS

Words	Meanings	Words	Meanings
Bacteriophage	بیکٹیریا پر حملہ کرنے والا وائرس	Venome	زہریلا
Dissimilar	مختلف	Vacca	گائے
Homologies	ایک ہی انداز سے نکلے	Discovery	ایجاد
Taxonomic	شناختی	Virion	مکمل اور حملہ آور ہونے والا
Emergent	نکلنا/ابھار/سے نکلنا	Envelope	خول
Onion	پیاز	Adsoption	ساتھ لگنا/جڑنا
Latin	لاطینی زبان	Capsid	بیرونی تہہ
Binomial nomenclature	دُہرے نام کا انداز	Helical	رسی کی طرح
Hepatitis	یرقان	Decomposing	توڑنا
Polyhedral	کئی سطحیں رکھنے والی شے	Ingestion	خوراک لینا
Phages	فیز/کیفیت/حالت	Protista	ایسے جاندار جن میں ایمبریو نہ بنے
Prism shaped	ھیرے کی طرح	Rabies	کتے یا کسی جانور کا کاٹا
Monera	ایسے جاندار جن میں نیوکلیس نہ ہو	Core	بیرونی تہہ
Fungi	ایسے جاندار جن میں سیل وال ہو مگر ضیائی تالیف نہ ہو	Sheath	تہہ
Plantae	ایسے جاندار جن میں سیل وال ہو اور فوٹوسنتھسز بھی ہو	Collar	کالر
Animialia	ایسے جاندار جن میں ایمبریو بنے سیل کے گرد سیل ممبرین ہی ہو	Penetration	داخل ہونا

Q.1 Fill in the blanks:

(i) C. Linneaus divided all known forms of life into tow kingdoms; __________ and __________ Bacteria were placed in the kingdom __________ because they have cell walls, and protozoa were placed in the kingdom __________ because they move form place to place and ingest food.

(ii) The most common system of classification used today, developed in 1969 by Robert Whittekar of Cornel University, uses five kingdoms __________, __________, __________, __________ and __________.

(iii) Whittekar's five kingdom system of classification recognizes two basic types of cells __________ and __________.

(iv) In five kingdom system of classification proposed by Margulis and Schwartz organelles of symbiotic origin such as __________ and __________ were also considered.

(v) A bacteriophage reproduces by using the metabolic machinery of __________ and __________ of bacterial cell.

(vi) The protein coat that encloses the viral genome is called __________. It is made up of __________.

(vii) Retroviruses are __________ viruses which have specific enzymes __________ by which they convert RNA to DNA.

(viii) HIV infect __________ and the defects in these cells lead to failure in __________ system.

(ix) Hepatitis is caused by __________.

x. Viral Hepatitis is of __________ types. Hepatitis A and C are caused by __________ virus whereas __________ virus is the causative agent of Hepatitis B.

ANSWERS:

(i) Plantae, Animalia, Plantae, Animalia

(ii) Monera, Protista, Fungi, Plantae, Animalia

(iii) Prokaryotic, Eukaryotic

(iv) Mitochondria, Chloroplast

(v) Host, Enzyme System

(vi) Capsid, Protein

(vii) Oncovirses, Reverse Transcriptase

(viii) Helper T – Cell , Immune

(ix) Viruses, Toxic agents, drugs

(x) Seven, HAV HCV, DNA

Q.2 Each question has five/six option. Encircle the correct answer:

(i) The enzyme involved in viral replication are synthesized:
- (a) On the viral ribosomes
- (b) On the interior surface of viral embrane
- (c) By the host cell
- (d) On the interior surface of viral coat

(ii) A virion is a:
- (a) Virus (b) Viral protein
- (c) Viral lysozyme (d) Viral gene

(iii) An isolated virus is not considered living, since it:
- (a) Separates into two inert parts.
- (b) Can not metabolize.
- (c) Rapidly looses its genome chemically inert.
- (d) is coated with an air tight shield?

(iv) In the lytic cycle of a bacteriophage, the host DNA is:
- (a) Replicated
- (b) Turned off by a protein coat
- (c) Digested into its nucleotides
- (d) Turned on by removal of a protein coat

(v) In the lysogenic cycle, the DNA of a bacteriophage:
- (a) Joins the bacterial chromosome
- (b) Attaches to the inner surface of the host membrane
- (c) Is immediately degraded when it enters the host
- (d) Goes directly to the host's ribosome for translation

(vi) Temperature phage may exist as:

(a) Prophage (b) Caspid

(c) Viriod (d) Retrovirus

(vii) Phylogeny describes a species:

(a) Morphological similarities with other species

(b) Evolutionary history

(c) Reproductive compatibilities with other species

(d) Geographic distribution

(viii) In the binomial system of taxonomy, developed during the 18^{th} century by C. Linnaeus, the first word of an organism's name (e.g. Homo sapiens) is its:

(a) Species (b) Genus

(c) Race (d) Family

(ix) In the five kingdom system of classification develop dby Robert. Whittaker, member of the kingdom Plantae are autotrophic, eukaryotic, and

(a) Multicellular

(b) Motile

(c) Either unicellular or multicellular

(d) Have sexual reproduction

(x) Five kingdom system of classificaiotn propose dby Margulis and Schewartz is not based on:

(a) Genetics (b) Cellular organization.

(c) Nucleic acid (d) Mode of nutrition

(xi) The common name of Allium cepa is:

(a) Piyaz (b) Bathu

(c) Amaltas (d) Chana

(xii) Arrange the following in order of increasing group size, beginning wit the smallest: family, kingdom, species phylum (or divison) , genus, order, and class:

(a) ________________________ (b) ________________________

(c) ________________________ (d) ________________________

(e) ________________________ (f) ________________________

(g) ________________________

(xiii) Pigs are reservoirs to:

(a) Hepatitis A (b) Hepatitis B

(c) Hepatitis C (d) Hepatitis D

(e) Hepatitis E

(xiv) Which one of the following is false about AIDS:

(a) HIV

(b) Auto-immune deficiency syndrome

(c) T-lymphocytes

(d) DAV

(e) Host specific

ANSWERS:

(i)	(c)	(ii)	(a)	(iii)	(b)	(iv)	(c)	(v)	(a)
(vi)	(a)	(vii)	(b)	(viii)	(b)	(ix)	(a)	(x)	(c)
(xi)	(a)	(xii)		(xiii)	(e)	(xiv)	(d)		

Chapter 6

KINGDOM PROKARYOTAE (MONERA)

Q.1 (a) Define: Kingdom prokaryotae, Eubacteria & archaeobacteria.

(b) Write a note on the discovery of bacteria.

Ans. (a) PROKARYOATE

PRO means before, ***KARYON*** means nucleus.

A group of organisms which have prokaryotic cell (non nucleated cells). E.g. Bacteria and Blue green algae.

(1) Eubacteria (Eu means true):

The bacteria with typical cell wall (i.e., murein) are called cubacteria.

(2) Archaeo bacteria (Archaeo means ancient):

The bacteria without murein cell wall are known as archaeo bacteria.

(b) DISCOVERY OF BACTERIA

(1) Animalcules and Leeuwenhoek:

Firstly, bacteria were discovered by ***Leeuwenhoek*** in 1673. He observed bacteria, protozoans and red blood cells (RBCs). Bacteria were microorganism, thus, they named as *animalcules*. First time these tiny creatures were discovered from rain water, after it, bacteria were confirmed in saliva, vinegar, infusions and other substances.

(2) Louis Pasteur's Contributions:

The progress in the field of bacteria was very slow. After two centuries, the work of Leeuwenhoek was recognized in field of biology and medicine.

(a) Fermentation:

In 1867, ***Louis Pasteur*** demonstrated the role of bacteria in fermentation and decay. Pasteur evolved many basic techniques of bacteriology. He described that bacteria cause diseases.

(b) Vaccine Formation:

It is a great contribution of Pasteur. He developed vaccine against the disease like Anthrax, Fowl Cholera and Rabies.

(c) Pasteurization:

It is also a great development of Pasteur. ***Pasteurization is a process in which milk or other liquids are heated at certain temperature (60°C) in particular time (30 minutes) to kill the bacteria***.

(3) Robert Koch and Germ Theory:

In 1876, almost at the same period of Pasteur, Robert KOCH (German) made valuable contribution in bacteriological techniques. He proved that bacteria can cause diseases such as anthrax; tuberculosis and cholera. He isolated rod shaped bacteria i.e. Bacilli from the blood of anthrax infected sheep.

Koch formulated very **important postulates** to understand the disease and disease causing agents:

(i) A specific pathogen or organism can always be found in ***association with a disease***.

(ii) The organism can be isolated and ***grown in pure culture*** in laboratory.

(iii) The pure culture can produce the disease when inoculated into animal (or susceptible animal).

(iv) ***Recovery is possible*** of that organism which is infected in pure culture as experimental basis.

Koch and his co-workers formed many methods of isolation, inoculation, media preparations, specimen preparation, culturing and microscopic examinations.

Q.2 What do you know about occurrence of bacteria?

Ans. **OCCURRENCE AND DISTRIBUTION**

Bacteria found ***everywhere***. So the occurrence of bacteria is very wide.

They are in air, land, water, oil deposits, food and organic matter, on milk, on meat and eggs, pathogenic to man and plants.

They are also found in acidic soil, alkaline soil, saline soil, and in hot springs.

Q.3 Describe name of some common bacteria with reference to their environments (distribution).

HELP LINE

Ans. DISTRIBUTION OF BACTERIA:

In Soil: *Nitrosomans, Nitrobacters, Rhizobium, Azobacter*

In H_2O: *Salmonella typhosa, Vibrio comma.*

In AIR: *Sarcina sp. Clostridium.*

On Meat & Egg: *Escharichia proteus*

In Milk: *Streptococcus, Lactobacillus, E.coli.*

On Man: *Salmonella, Diplococcus pneumoniae, E.coli, Mycobacterium tuberculosis, Clostridium tetani, etc.*

On Plants: *Xanthomonas, Rhizobium, Erwinia, etc.*

Q.4 Briefly discuss the size of bacteria.

Ans. SIZE OF BACTERIA:

There is a variety of size and shape in bacteria. The range is from 0.1 to 600 um over a single dimension. ***Mycoplasma is considered as smallest bacterium***. Mycoplasma are 100 to 200 nm in diameter.

Some Spirochetes may reach up to 500 micron in length. In case of diameter, Staphylococci and Streptococci have 0.75 to 1.25 u diameter.

Q.5 Discuss the shape of bacteria.

Ans. SHAPE OF BACTERIA

Generally, the bacteria are divided into three types on the basis of shape:

(i) Cocci = ***OVAL*** shaped bacteria.

(ii) Bacilli = ***ROD*** shaped bacteria.

(iii) Spiral = ***CURVED*** shaped bacteria.

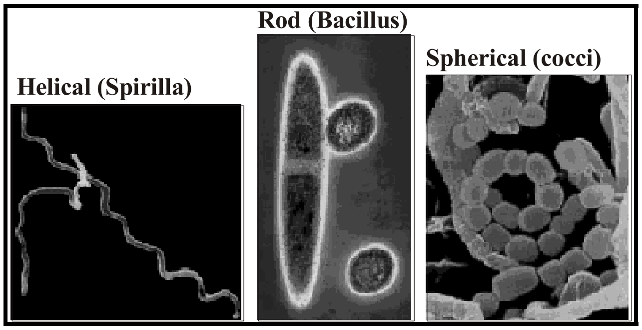


Fig. Shapes of Bacteria

Most of the bacteria have specific and definite shape wile few have different shapes. Those bacteria which have variety of shapes are called pleomorphic.

(1) Spherical or Oval Shaped Bacteria (*COCCI*)

These are spherical or oval shaped, and also called cocci, (sing: coccus). Almost all spherical bacteria lack flagella. These have different planes of division:

(i) One Plane:

The existence of cocci in pair and single plane is called diplococci.

(ii) Chain Plane:

The existence of cocci in a chain with single plane is called streptococci.

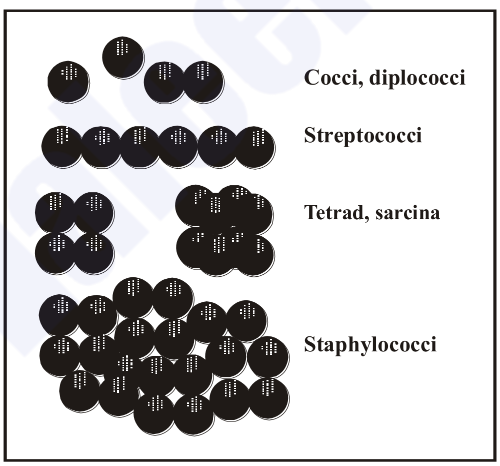
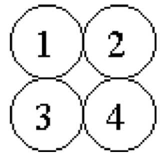


Fig. Cocci

(iii) Two Plane:

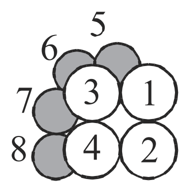
The existence of 4 cocci in two planes is known as ***tetrad*** or ***tetracoccus***.



Tetrad formation

(iv) Three Planes:

The arrangement of eight cocci in three planes (three dimensional structure or cube) is known as **Sarcina**.



Sarcina formation

(v) Irregular Cluster:

The arrangement of cocci in irregular grape like structure (cluster) is called Staphylococcus.

Examples: *Diplococcus pneumonia*, Cocci, *Staphylococcus aureus*.

(2) Rod Shaped (or) Bacilli

This is the **commonest bacterial shape**. The cells appear like tiny rods (or hyphens (–) under microscope. The rods are straight, cylindrical and always have rounded ends. Some bacilli have flagella.

(i) Chain Plane (Diplobacillus):

The arrangement of two bacilli in one plane is called Diplobacillus.

(ii) Chian Plane (Streptobacillus):

The arrangement of two bacilli in chain with one plane is streptobacilllus.

Examples: *Escherichia coli*

BACILLI:

Bacillus subtilis

Pseudomonas

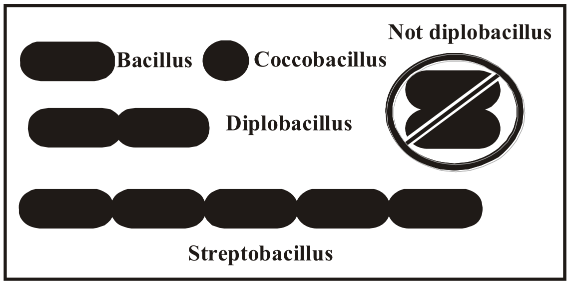


Fig. Spirilla

(3) Spiral Bacteria

These are least common bacteria. The cells of bacteria are wavy, spirally curved. These have three basic forms:

(i) Comma-Like Appearance (Vibrio):

Bacteria having slight curve and comma like appearance e.g *Vibrio comma*.

(ii) Twisted or Cork Screw Like:

Bacteria have many spirals and twisted like a cork screw. Spiral is thick and rigid. e.g., ***Spirillum***.

(iii) Flexible:

These bacteria have flexible spiral body. They have pointed ends e.g., ***Spirochete***.

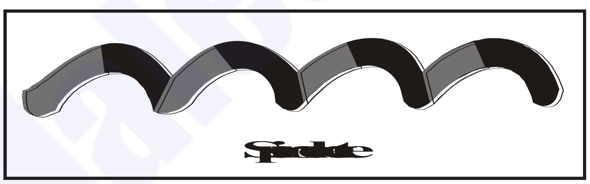


Fig. Spirilla

Q.6 Write a brief note on locomotion of bacteria.

Ans. LOCOMOTION

Bacteria have **flagella** as a locomotory appendages. **"**Flagella are hair like, long and fine appendages which come out through the cell wall and originates from basal body**"**. A structure just beneath the cell membrane.

- Each flagellum has three parts i.e. filament, hook and basal body.

- Bacterial filaments are made up of a protein called Flagellin.
- Flagella are commonly found in Rod Shaped & Spiral Bacteria. **"**The bacteria without flagella i.e. Atrichous**".**
- There are two types of arrangement of flagella, (i) Polars (ii) Peritrichous. When flagella are situated at one or both ends of bacterium, they are called *Polar*:

(i) **Polar:** Polar is divided into followings types.

(a) ***Monotrichous:*** **Single flagellum** at one e.g. end. e.g., *Vibrio comma*.

(b) ***Lophotrichous:*** A **cluster of flagella** on one end e.g., ***Spirillum***.

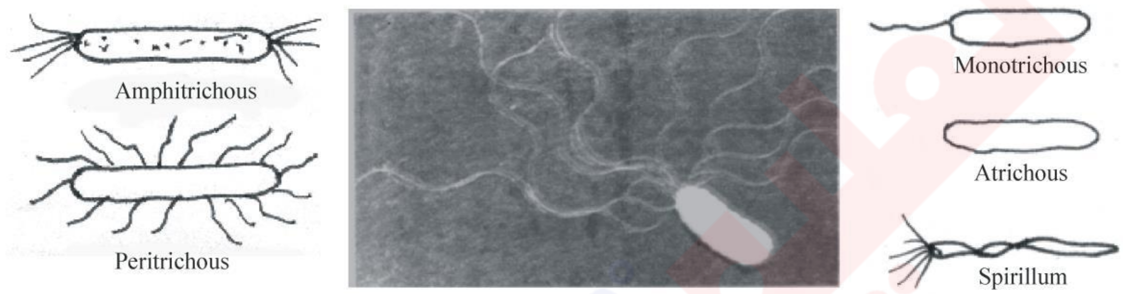
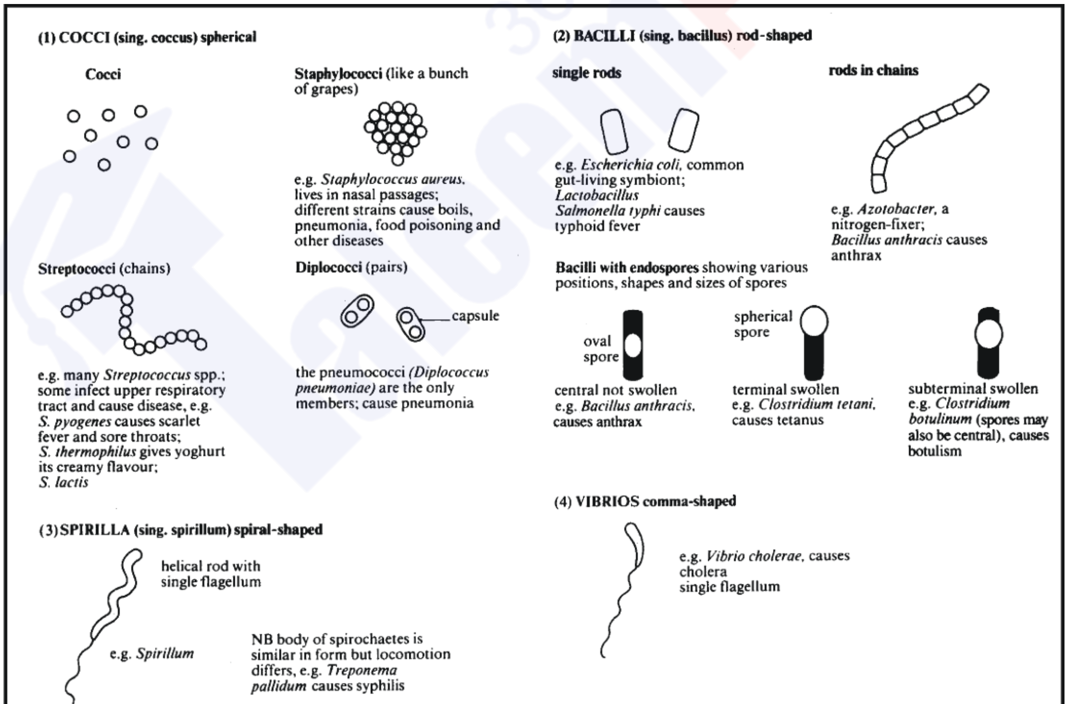


Fig. Lophotrichious



Forms of bacteria, illustrated by some common useful and harmful types.

(c) ***Amphitrichous:*** A cluster of flagella at both ends e.g.

(ii) Peritrichous: Flagella are arranged all over the cell e.g. *Typhoid bacilli*.

Cocci generally are without flagella, so they are called as ***Atrichous***. But very rarely have flagella.

Chemotaxis: Those bacteria which move away from chemicals, respond to chemicals are called chemotaxis. It is a type of behavior.

Q.7 Define pili & discuss functions of pilli.

Ans. **PILI**

Definition: *Small, hollow, non-helical filamentous appendages involved in attachment of bacteria are called pili.*

Characters:

(i) Chemically, pili are made by ***Pilin protein***.

(ii) Pili are smaller and thinner than flagella.

(iii) True pili are only present on *gram-negative* bacteria (bacilli).

(iv) Pili are present on motile and non-motile bacteria.

Functions:

(i) Their function is *to adhere* (attachment) of bacteria to different things or surfaces.

(ii) An important function of pili of some bacteria involved *in conjugation* or *mating* process. These pili are called ***"Sex Pili"***.

Q.8 Define cell envelope, what are its basic structures.

Ans. **ENVELOPE**

"The outer layer of typical bacterial cell which consists of capsule, slime and cell wall is known as cell envelope".

Cell envelope is external to cell membrane (protoplasm). It is outer wrapping of bacteria.

COMPONENTS OF CELL ENVELOPE

(i) Capsule:

Some bacteria secrete materials (viscous) around the cell surface. This material is organized into specific structure i.e. capsule. It may contain units of Polysaccharides and Proteins. These may be separate or together in a capsule. Capsule is bound tightly.

Capsule is sticky in nature due to presence of gummy material. In some cases, lipid are also found.

(ii) Slime:

The loose and soluble shield of macromolecules which covers the bacteria is called as slime.

Functions:

- Slime becomes the reason of disease causing ability (i.e. pathogenicity).
- It protects the bacteria against engulfing i.e. phagocytosis.

(iii) Cell Wall

Cell wall is present beneath the extracellular substances. It is external to cell membrane or plasma membrane.

(a) Functions of Bacterial Cell Wall:

- Cell wall gives definite *shape* to cell.
- It ***protects*** the cells.
- It provides ***rigidity***.
- It is 20 to 30% of dry weight of the cells.
- ***Cell wall is absent in mycoplasmas.***

(b) Chemicals of Bacterial Cell Wall:

Peptidoglycan (Murein) is a unique macromolecule of cell walls of most bacteria. Different kinds have different amount of peptidoglycan. In peptidoglycan, Glycan is a long chain framework, which is cross linked with peptidefragments.

The intact cell wall also has additional chemicals like sugar, teichoic acid, lipo-proteins, lipo polysaccharides. These chemicals are linked with peptidoglycan.

(c) Cell Wall of Archaobacteria

They do **not have peptidoglycan**. Bacteria contain protein, glycoprotein and polysaccharides.

(d) Cell Wall of Eubacteria

They have typical cell wall i.e. **peptidoglycan**.

(e) Cell Wall of Gram Positive Bacteria

The cell wall contains 50% **peptidoglycan** (of dry weight), **Techoic acid** and **Lipotechoic acid**. Thickness is 20 to 80 nm. No outer membrane present. Lipids are 1-4%. It is more permeable.

The cell wall of gram positive **retains the primary dye**. It retains the crystal violet stain. It is stained purple.

(f) Cell Wall of Gram Negative Bacteria

The cell wall contains only 10% peptidoglycan. **Lipoprotein** and **liposaccharides** are much present. It is thinner than gram positive cell wall. The gram negative wall is more complex. Between peptidoglycan region and outer membrane is present a periplasmic region. It is **less permeable**.

It **retains secondary dye**.

Q. Differentiate between the cell walls of Eubacteria and Archaebacteria.

(See c and d of Q.8)

Q. Differentiate between the cell walls of Gram +ve and Gram –ve bacteria.

(See e and f of Q.8)

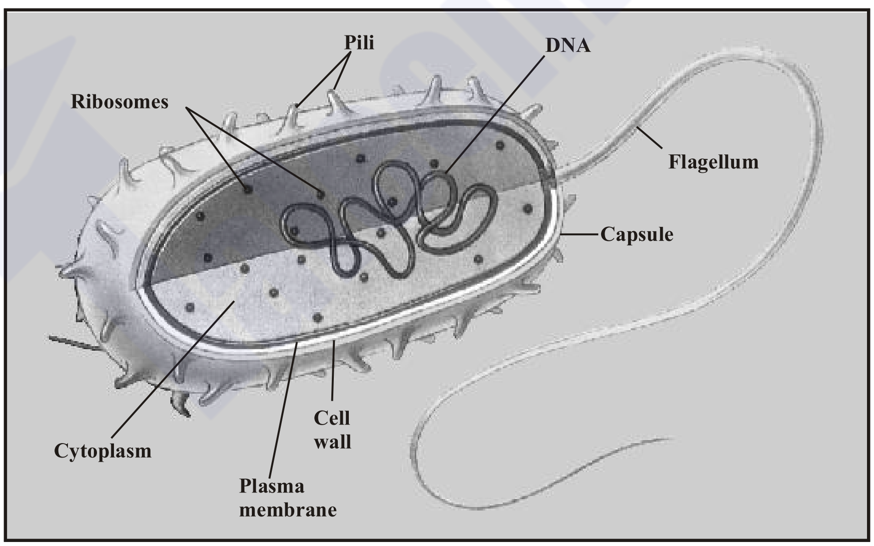


Fig. Typical cell of bacterium

Q.9 Differentiate between Gram +ve and Gram-ve Bacteria. (GRWOG)

Ans.

Gram positive	Gram negative
(i) Thicker (20-80 nm).	(i) Thinner
(ii) *Lipids* are commonly absent – less (1–4%).	(ii) Lipids are present (11 – 12%).
(iii) Few *amino acid* are present.	(iii) Several amino acid present.
(iv) 50 to 90% *peptidoglycan*.	(iv) 10% peptidoglycan.
(v) *Techoic* acid present.	(v) Techoid acid absent.
(vi) *Periplasmic* region absent (in few).	(vi) Periplasmic region present
(vii)	(vii) Lipopolysaccharide linked with peptidoglycan.
(viii) *Mesosome* more prominent.	(viii) Mesosome less prominent.
(ix) No true *pili*, commonly.	(ix) True pili present.
(x) Gram positive bacteria *retain crystal violet* stain, even treated with alcohol and acetone.	(x) Gram negative bacteria's stain decolorized, when treated with alcohol or acetone.
(xi) More permeable.	(xi) Less permeable.

Q.10 (a) Define cytoplasmic matrix and describe it.
(b) What do you know about nucleoid?

Ans. (a) Cytoplasmic Matrix

Bacterium is a prokaryote, so membrane bounded cell organelles and ***microtubules*** (cytoskeleton) are absent in it.

"The substance between cell membrane and nucloid is called ***cytoplasmic matrix***". It is present in the form colloidal system. Several inorganic and organic solutes are present in a viscous watery solution.

It has no protoplasmic streaming. Endoplasmic reticulum, mitochondria and golgi bodies are also absent in bacteria.

Nuclear body, ribosomes, mesosomes, granules and nucleoid are present in cytoplasm or cytoplasmic matrix or 'cell pool'.

The plasma membrane and cytoplasmic matrix are collectively called ***chloroplast***. Thus cytoplasmic matrix (***cytoplasm***) is an important and major part of ***protoplast***.

(b) Nucleoid

There are ***no nuclear membrane and nucleoli*** in bacterial cell. ***Discrete chromosomes*** are also absent. But densely packaged DNA present. "Nucloid is an irregular shaped dense structure which is made up of DNA in the cytoplasm or bacterium". Generally, nucloid has a single, circular and double stranded DNA molecule. ***Nucleoid is a chromatin body***.

A long molecule of DNA is folded and fit inside the cell component as a 'nuclear body'. Due to single chromosomal structure they are haploid.

(b) PLASMIDS (Self-replicating circular DNA)

"Some ***extra genetic elements*** made up of DNA in the cytoplasm in free state and reproduce (autonomously) are called plasmis". (OR) The self replicating, circular DNA molecules with addition to chromosomes are called plasmids.

Characteristics:

- These are ***self-replicating***.
- Plasmids are not essential ***for bacterial growth*** and ***matabolism***.
- They have ***drug resistant*** ability.
- They have ***heavy metals***.
- Plasmids also have ***insect resistant genes***.

Q.11 Discuss Ribosomes, Mesosomes, Storage Bodies, Spores and Cyst.

Ans. (a) RIBOSOMES

Tiny granules ***composed of DNA and proteins*** and act as proteins factories are called ribosomes.

Ribosomes of bacteria are 70S. These are found in cytoplasm in thousands. These are smaller than ribosomes of eukaryotes. In many cases, ribosomes are attached to plasma membrane.

Ribosomes are Protein Factories:

(b) MESOSOMES

(i) Structure: It may be in the forms of vesicles, tubules or lamella.

(ii) Definition: *"The vesicular and pocket like structures formed as **invaginations** of the **cytoplasmic membranes** in cytoplasm are called mesosomes".*

(iii) Functions:

- They help in ***DNA replication*** and cell division.

- ***Export exoenzymes*** (exo cellular eneyzmes).
- They have ***respiratory enezymes*** so act as respiratory site.
- They are ***analogous to mitochondria*** of eukaryotes.

(c) GRANULES AND STORAGE BODIES

(i) Storage Molecules:

Sometime, bacteria face unfavourable conditions, in this case, nutrients are short. Due to short supply of nutrients bacteria have storage bodies in the matrix. They store glycogen, sulphur, fats, and phosphates. In unfavorable conditions these storage molecules are used.

(ii) Waste Products:

Alcohol, lactic acid and acetic acid are waste materials of bacteria. Extra and unwanted are considered as waste products which are formed during metabolism.

(d) SPORES:

An ***asexual reproductive cell*** which germinates into new body is called spore.

Some species of bacteria produce spores. These are exospores and endospores.

(i) Endospores:

The spores ***inside the vegetative cells*** are called endospores.

(ii) Exospores:

The spores ***external to vegetative cells*** are called exospores.

DORMANCY OF SPORES:

Spores become dormant in unfavorable condition. It means spores have resistant ability to environment. As soon as, favourable condition is achieved then they grow. They resist to light, temperature and desiccation. Some endospores resist even to boiling.

(e) Cyst:

The ***peptidoglycan wall*** remains surrounded by multilayers ***exine*** around bacteria is called cyst. ***Multilayers structure*** is formed by lipo-polysaccharides and lipo-proteins. During cyst formation, a vegetative cell ***become deflagellated, sphere shaped*** and get ***surrounded by a coat***. It is not resistant to heat.

Q.12 What do you know about nutrition of bacteria?

Ans. NUTRITION

Energy is essential for growth and reproduction of bacteria, like other cells.

Bacteria are classified into two types on the basis of nutrition.

(a) Heterotrophic Bacteria:

Those bacteria which are ***unable to synthesize their own food*** and depend on host are called heterotrophic bacteria (or) heterotrophs. Heterotrophs are also of two types:

Parasites and Saprophytes

(i) Parasitic Bacteria (On Living Organism)

Bacteria which grow ***on or within living organisms*** are called parasitic bacteria. Most of them are disease causing (pathogen).

(ii) Saprophytic Bacteria (On Dead Materials)

Bacteria which grow ***on dead organic*** materials are called saprophytic bacteria.

SAPROPHYTIC BACTERIA AND HUMUS

"The organic material which is found by the partial decay of animals and plant is called humus". Soil is full of such humus. The soil bacteria commonly exist as a saprophytic bacteria. They decompose dead animals, plants and plant parts into humus. Saprophytic bacteria get simple substance as a food for energy. They have specific enzymes by which they decompose (break down) large complex molecules into simple and small molecules.

(b) Autotrophic Bacteria (Can make their food)

The bacteria that can synthesize their own organic compounds are called autotrophic bacteria. They have ability to utilize atmosphere (CO_2) and Nitrogen (N_2). They have independent existence in water and soil. Photosynthetic and chemosynthetic are two types of autotrophic bacteria.

(i) Photosynthetic Bacteria:

The bacteria in which **"bacteriochlorophyll"** is dispersed in cytoplasm and derive their energy from sunlight. So they have ability of photosynthesis.

But photosynthesis of such bacteria is different to plants. In bacterial photosynthesis, H_2S is raw material in place of H_2O and Chlorophyll is dispersed in cytoplasm, not in chloroplast. While sulphur is as a product instead of O_2. (e.g. Rhodospirillum), green sulphur bacteria, purple sulphur and purple non sulphur.

$$\boxed{CO_2 + 2H_2S \longrightarrow (CH_2O)_n + H_2O + 2S}$$

(ii) Chemosynthetic Bacteria:

Those bacteria which obtain energy from chemical reactions are known as chemosynthetic bacteria.

They oxidize ammonia, nitrate, nitrite, sulphur and ferrous iron and trap energy.

Nitrifying bacteria, iron bacteria, sulphur bacteria and ***hydrogen bacteria*** are examples of chemosynthetic bacteria. They are important in agriculture and soil fertility.

RESPIRATION IN BACTERIA

There are two kinds of respiration in bacteria. Aerobic respiration involves O_2 and in anaerobic respiration O_2 is not involved.

(i) Aerobic Bacteria:

The bacteria which ***respire in free oxygen*** are called aerobic bacteria. In other words, those bacteria which grow in the presence of O_2 are called aerobic bacteria.

(ii) Anaerobic Bacteria:

Those bacteria which can ***grow without O_2*** are called anaerobic bacteria.

(iii) Facultative Bacteria:

Those bacteria which ***can grow with or without O_2*** are called facultative bacteria. It means they can grow in the presence as well as in the absence of O_2.

(iv) Micro-Aero-Philic Bacteria:

Those bacteria which require very ***low amount of O_2*** for growth and reproduction are called microaerophilic bacteria.

Q.13 Discuss growth and reproduction of bacteria.

Ans. **GROWTH AND REPRODUCTION**

Growth means increase in number of cells, increase of volume and increase of weight of protoplasm. While in case of bacterial cell, it is increased in number of bacteria. It may be reproduction, because reproduction means multiplication of cells. The common type of reproduction is binary fission type asexual reproduction.

Binary Fission:

A type of asexual reproduction in which a cell is divided into two daughter cells is called binary fission:

Firstly, cell is enlarged.

Secondly, chromosome is duplicated and thirdly, plasma membrane is pinched inward at the center of the cell. At last, after equal distribution of nuclear material the cell wall (cross wall) is formed inward and separates into two cells (daughter cells).

Binary fission is found in all bacteria. Each daughter cell repeats the steps of: elongation, chromosomal duplication and cross wall formation.

Generation Time:

"The time interval between two cell divisions of a bacterium is called generation time. (It is also called population doubling time). For example, E.coli has 20 minutes generation time.

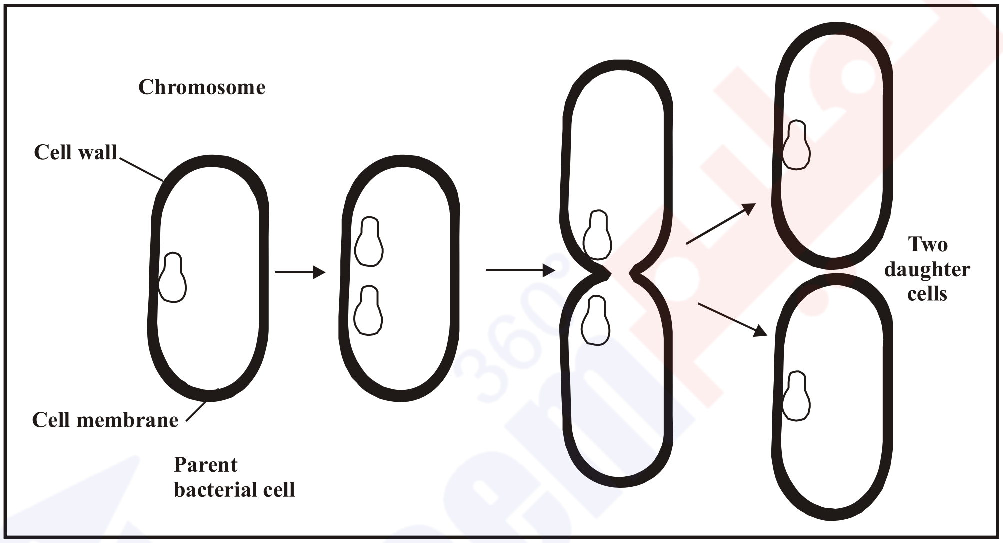


Fig. Binary Fission

GROWTH PHASES

(1) **Lag Phases (*No Growth*):** Bacterium prepare himself for division. No growth occurs.

(2) **Log Phase (*Rapid Growth*):** Fast growth occurs at this phase.

(3) **Stationery Phase (*Equal Death and Birth*):** In this phase rates of reproduction and death are equal.

(4) **Decline Phase (*Extra Death*):** Death rate increases and reproduction rate decreases.

There are no typical sexual reproduction and mitosis in bacteria. ***In some bacteria, the genetic material i.e. chromosomal material is transferred from one bacterium (donor) to another (recipient) bacterium through conjugating tube is called conjugation***.

In some cases Sex Pili or PILI are involved in conjugation.

So many ***recombinants are formed*** by conjugation. Thus recombinants having the ability to survive in different conditions.

Q.14 Write an account on the ecological and economic importance of bacteria.

Ans. **IMPORTANCE OF BACTERIA**

Ecological Importance

Bacteria live everywhere because they have ability to survive in all conditions. They can adjust itself according to environment.

(i) Gas Production:

Bacteria form CO_2 during aerobic and anaerobic respiration. H_2 is formed during fermentation of carbohydrates and amino acids. N_2 is formed during decomposition of nitrates and nitrites. *Bacteria form H_2S during decomposition of proteins*.

(ii) Role in Cycles:

Carbon and oxygen cycles are controlled by bacteria because of decomposition of remains of dead plants and animals. Denitrifying bacteria play role in *nitrogen fixations* and sulphur bacteria in *sulphur*.

Economic Importance

(i) In Industry: Butter, cheese or ghee manufacturing is based on bacterial activity.

(ii) In Drug Production: About 2220 antibiotics are produced from various bacteria.

(iii) In Food Technology: Bacteria produce vaccines, enzymes, vitamins, alcohols, acids.

(iv) In Biotechnology: Bacteria are used in production of vaccines, enzymes, vitamins, alcohols, acids etc.

(v) In Botulism/Food Spoilage: Food poisoning is occurred by bacteria. Food spoiling and pollution are also occurred by bacteria.

(vi) As Plant Pathogen: Bacteria cause many serious diseases in all groups of plants, e.g. Ear rot of wheat, stalk rot of maize etc.

(vii) As Human Pathogen: Typhoid, diphtheria, tuberculosis, cholera, plague, anthrax etc. are bacterial diseases.

(viii) As Animal Pathogen: Bacteria are fearful disease causing organisms of several animals.

Q.15 Write an account of different methods used for controlling microbes.

Ans. CONTROL OF BACTERIA

Control of bacteria is essential at home and industry levels. At medicine or drug level microorganism control is also very important. In case of disease controls, prevent the spoilage of food and protection of industrial products from bacterial attack are essential control for human beings.

Following methods are used for control:

(1) PHYSICAL METHODS:

Steam, dry heat, gas, *filtration* and *radiation* are used to control bacteria.

(a) **Sterilization:** All physical methods by which microorganisms are controlled, are known as sterilization.

(b) ***High Temperature:*** High temperature treatment is commonly used in labs. *High temperature becomes the reason of coagulations of proteins* of microorganism. Thus microorganisms are killed.

(c) ***Dry Heat:*** In case of dry heat, the *oxidation of chemical constituents* of microbes is occurred. It kills microorganisms.

(d) ***Moist Heat:*** *Coagulation of proteins* causes killing the microorganisms.

(e) ***Radiations:*** The radiations below 300 nm are useful to killing microorganisms. *Gamma Rays* are effective for sterilization. These are generally used.

(f) ***Membrane Filters:*** Membrane filters are also used for sterilization of sensitive compounds like antibiotics, seras and hormones. Mycoplasmos are filterable bacteria.

(2) CHEMICAL METHODS

The growth of bacteria or microorganisms may be controlled by the treatment of different chemicals. These chemicals may be *used to inhibit the growth* of bacteria on dead materials and living materials, in other words to kill the saprophytes and parasites. There are three types of treatment (i) antiseptic (ii) disinfectants (iii) chemotherapeutic.

(i) Antiseptics: (On living tissues)

A substance that inhibits the growth and development of microorganisms. These substances are used on living tissues.

(ii) Disinfectants: (On non-living tissues)

These chemicals are *used on non-living materials and vegetative cells* (no sexual cells or parts) for killing and inhibition of the growth of microorganisms. *Halogens, phenols, hydrogen peroxides, potassium permaganates, alcohols* and *formaldehydes* etc. are used as disinfectants.

(iii) Chemotherapeutic Agents and Antibiotics

"Treatment of diseases by chemical agents is known as chemotherapy". To control the diseases, different kinds of chemicals are used. It may be *anti-allergic* and antibiotic etc.

Antibiotics are used at broad spectrum level to control the diseases. *Antibiotics are those chemicals which are obtained from living organisms and used to kill the harmful organisms*.

Examples: Penicillin, tetra-cycline, sulfonamides.

Some famous drugs which are used as antibiotics	⟶ Septran, Amoxil, Ampiclox, Lincocin, Kanamycin, Penicillin etc.

Q.16 Write down the contributions of Pasteur in the progress of Immunization and Vaccination.

Ans. **IMMUNIZATION & VACCINATION**

Vaccines play important role ***to increase the immunity in organisms***. Vaccines in injection or drops form stimulate, and in case of response ***antibodies are formed***. ***Antibodies resist to pathogens or antigens***. Antibodies are source of resistant in body. Resistant is created by vaccines. This resistant power acts as immunity.

Pasteur introduced many methods of cause and preventions of infectious diseases.

Isolation of Chicken Cholera Bacteria:

Firstly, Pasteur isolated the bacteria which cause the chicken cholera.

Secondly, Pasteur grew chicken cholera in a pure culture in lab.

He used the basic techniques of MR. KOCH. He proved his work and repeated his experiments.

Inoculation:

Pasteur ***inoculated healthy chickens*** with his pure culture. But chicken remained healthy. It was surprising. No disease was appeared after inoculation.

Conclusions:

In some cases, only fresh culture of bacteria becomes the reason of disease. Old ***culture of bacteria lost its virulence***.

Achievements:

The less virulent bacteria became the reason of the production of antibodies. Antibodies are produced in response to stimulate of antigens. So less virulent stimulate to produce the antibodies.

Antibodies are source of resistant of an individual against the diseases.

It protect the host against infection.

Application of Inoculation Principle:

He used inoculation method with attenuated or less virulent to prevention of anthrax. He worked again and again to achieve the effective results. Ultimately, this attenuated culture is called bacterial vaccine.

KEEP IN MIND

"Vaccine is a suspension of attenuated or killed microorganisms for prevention of infectious disease".

"A vaccine prepared from live material cultured under adverse conditions for loss of their virulence but retention of their ability of induce".

Vaccine term is derived from ***"Vacca"***. Vacca is a ***Latin word***, and ***vacca means cow***. Thus immunization with attenuated culture of bacteria is known as Vaccination.

Pasteur also made a vaccine for ***hydrophobia*** or ***rabies***.

Rabies is caused when rabid dogs or cats etc. bite to a person.

Q.17 Define Immunity, Immunization, Vaccination and Antibiotics.

Ans.

(i) **Immunity (Resistant):** The resistant power against antigens or bacteria and viruses is known as immunity.

(ii) **Immunization (Creation of resistance):** The creation of immunity i.e. production of antibodies in the individual in response to vaccine is known as immunization.

(iii) Vaccination (Dead pathogen): Supply of ***suspension of inactive or dead pathogens to create the immunity*** in the living body is called vaccination.

(iv) Antibiotics (Obtained from living bodies): The chemical substances ***which are obtained from living bodies*** and used to kill the other disease causing organisms are called antibiotics.

Q.18 (a) What are characteristics of antibiotics?

(b) What problem can arise due to misuse of antibiotic?

Ans. USE AND MISUSE OF ANTIBIOTICS

(a) Charactersistics:

A chemical substance produced by a microorganism, which has the capacity to inhibit the growth of (or kill) other microorganisms is called antibiotic.

- Anti-biotic is a Greek word. So ***anti*** *means* ***against*** and ***bios*** *means* ***life***.
- Antibiotics are ***chemotherapeutic chemicals***.
- These are used for the ***treatment of infectious diseases***.
- Actually antibiotics are ***formed from living cells***.
- These are ***effective against the wide range of pathogens i.e. bacteria***.
- Certain ***bacteria, Actinomycetes and fungi are major source of antibiotics***.
- Some antibiotics are ***artificially prepared*** in the labs.

(b) Side Effects of Antibiotics:

- Antibiotics must be used according to the advice of Doctor. Coarse and regular intervals must be prescribed by Doctor.
- Everybody must avoid self medication and over dose. Self medication and over dose may be dangerous for health.
- Misuse may be the ***reason of extra resistance of pathogens***.
- Interact with human metabolism.
- Antibiotics like ***penicillin cause allergy; streptomycin cause deafness*** and can affect on auditory nerve. Tetracycline cause decolorization of teeth in children.

Q.19 Describe the general characteristics of cyanobacteria.

Ans. **CHARACTERISTICS OF CYANOBACTERIA**

Cyanobacteria are also called *cyanophyta* and blue green algae.

(i) **Habit:** Cyanobacteria have variety of shapes i.e., ***unicellular, colonial,*** and ***filamentous***.

(ii) **Cytology:** These are ***prokaryotes***. ***Cell wall is formed*** by ***lipo-polysaccharides***, lipo-proteins and peptidoglycan like Gram –ve bacteria.

(iii) **Habitat:** They may be ***terrestrial***, ***subaerial***, alkaline soil, moist rocks.

(iv) **Size:** 1 to 10 μm range of diameter is found.

(v) **Structure/Form:** Unicellular, colonial, filamentous and trichomous structures are common. Chain of cells (trichome) is surrounded by *mucilage layer*.

(vi) **Locomotion:** Movement is occurred by ***Gas Vesicles***.

(vii) **Gliding:** Gliding movement present in filamentous form and gas vesicle movement occurs in water.

No flagella are found.

(viii) **Nutrition:** These are ***autotrophs*** because photosynthesis occurs in it. Photosystem-II and chlorophyll a present in cyanobacteria. Photolysis of H_2O (water as donor) in the process of photosynthesis. O_2 is formed as a product of reaction. Photosynthetic pigments and electron transport chain like components are located in thylakoids membranes linked with Phyco-bili-somes.

(ix) **Pigmentation:** ***Phycobillins*** act as accessory pigments while blue pigment is *phycocyanin*. CO_2 is assimilated through calvin cycle.

(x) **Reclamation of Food Material:** Glycogen (polysaccharide) is reserve food material in blue green algae.

(xi) **Reproduction:** Asexual reproduction takes place by (i) ***Binary Fission*** (ii) ***Multiple Fission*** (iii) Fragmentations (iv) ***Budding*** (v) ***Akinete*** (vi) ***Heterocysts*** and (vii) ***Harmogonia***.

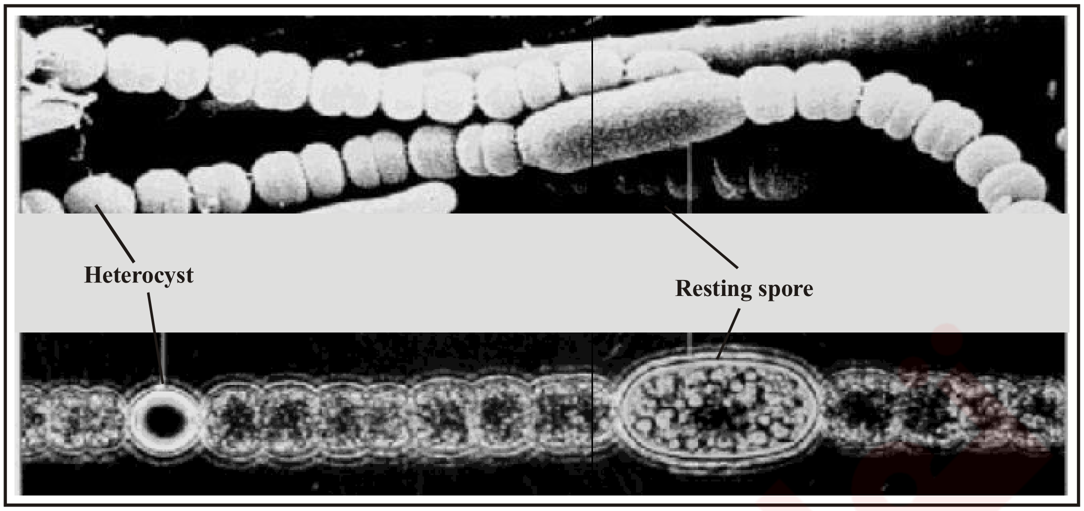


Fig. Cyanobacterium Anabaena

Q.20 Discuss useful and harmful aspects of cyanobacteria. (OR)
What do you know about economic importance of cyanobacteria?

Ans. (a) ECONOMIC IMPORTANCE OR BENEFITS

Replacement of Alkaline Soil: Cyanobacteria help in the reclamation of alkaline soil. Thus soil becomes useful.

Nitrogen Fixation: Structure like heterocyst play important role in the fixation of atmospheric nitrogen.

Oxygen Releaser: During photosynthesis oxygen is released into environment.

Pollution Indicator: Certain cyanobacteria i.e. oscillatoria act as pollution indicators.

As Symbiont (Symbiosis): Cyanobacteria become partner in symbiosis. *"Symbiosis is the mutual beneficial relationship between different groups of organisms"*. ***Symbiont means beneficial partner***. Cyanobacteria have association with protozoa, fungi angiosperms and gymnosperms.

In case of fungi and cyanobacteria, both partners make a compound plant i.e. ***Lichen***. Lichen are formed by symbiosis between fungi and algae. In it, Cyanobacteria is photosynthetic, it provides food while fungi provides protection *Cycas* and *Cyanobacteria* have association.

(b) HARMFUL EFFECTS OF CYANOBACTERIA

Formation of Water Blooms: In aquatic habitat, they form water blooms. They become the reason of unpleasant smell. Pollution takes place in this environment.

Extra Suspended Matter: Extra amount of organic matter is suspended in water medium. The consumption ability of water is decreased.

Toxic Effects: Cyanobacteria release toxic materials. Living bodies of environment are disturbed and cause morality.

Killing Effect: When water is drank, the drinking of water of cyanobacterial habitat becomes the reason of death of other animals. Water has toxins which are secreted by cyanobacteria.

Q.21 Write an account on NOSTOC.

Ans. **NOSTOC**

Habitat: Nostoc is found in ***terrestrial*** and subaerial habitat. It is also found on moist rocks and cliffs. It is widely distributed in the universe.

Filaments/Trichomes: Bead like masses are arranged in filaments and trichomes.

Filaments/trichomes are unbranched.

Cell Structure: Nostoc has spherical and sometime cylindrical and barrel shaped cells in filament.

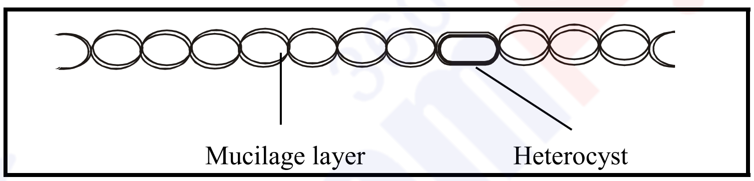


Fig. Trichome of Nostoc

BODY/TRICHOME'S SPECIAL FEATURES

Heterocyst:

(***Hetero*** means ***different; cyst*** means ***deposits*** on wall).

The thick walled yellowish cells, dissimilar to other cells, and help in nitrogen fixation plus asexual reproduction are known as heterocysts.

These are found in intervals in the trichome.

Harmogonia:

They help in fragmentation. Trichome breaks near heterocyst and form hormogonia.

REPRODUCTION:

Nostoc has ***no sexual reproduction***. Asexual reproduction takes place by means of hormogonia and akinete.

(i) Harmogonia:

When a filament break at different points then a small filament is formed or germinated form ***akinete*** is called harmogonium. In fact, ***breaking occurs due to decay*** of cells of trichome or filament, then new filaments are found as ***hormogonia from akinete. Ultimately, hormogonia develop into filament.***

(ii) Akinete:

"A ***thick walled spore*** which has ***ability to dormant*** (rest) in unfavourable condition and grow into new organism in favourable condition is called Akinete". Akinete has also the ***ability to store the food*** which it used in unfavourable conditions during resting phase.

Cyanobacteria are produced asexually by akinetes too.

Q.22 Write short notes on the followings:

(i) Heterocyst ***(ii) Harmogonia***

Ans. (i) Heterocyst

Any of the large cells that occur at intervals in the filaments of certain species of blue green algae.

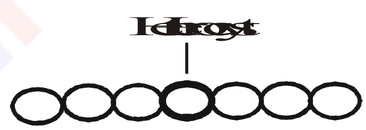


Fig. Trichome showing heteroyst

- They do not contain chlorophyll.
- They have ***much DNA***.
- Narrow pores are present on poles.
- Heterocysts are involved in ***nitrogen fixation***.
- They may be ***asexual reproductive*** cells.

(ii) Harmogonia

A short filaments of more or less spherical cells that may formed on germination of akinete in certain cyanobacteria.

- They move by the streaming of mucilage along the surface.
- When hormogonia reach on suitable place of favourable conditions then germinate into filament.

DIFFICULT WORD MEANINGS

Words	Meanings	Words	Meanings
Antiseptic	جراثیم کش	Pleomorphic	مختلف شکلیں رکھنے والا
Pro	قدیمی/ پرانے	Flexible	لچکدار
Eu	واضح	Peri	اردگرد
Typical creatures	مثالی، ماڈل کے طور پر	Beneath	نیچے۔تلے
Fermentation	آکسیجن کے بغیر عمل	Pili	چھوٹے چھوٹے۔دھاگہ نما
Micro	بہت ہی چھوٹا	Envelope (Cover)	خول
Saliva	لعاب	Slime (Sheath)	بیرونی تہہ
Decay	گلنا۔سڑنا	Several	کئی
Disease	بیماری	Dye (Staining)	رنگ چڑھانا
Resistant	مدافعت	Protective	حفاظتی
Cholera	ہیضہ	Discrete	علیحدہ علیحدہ
Tuberculosis	ٹی بی	Vesicular analogous	گول جسامت یا انڈا نما
Rabies	کتے کا کاٹنا	Spore	غیر تولیدی خلی(پل) جوزندہ اشیا اگائے
Vaccine	حفاظتی ٹیکہ	Dormant	خوابیدہ
Antibiotic	ایسی دوائی جو زندہ اشیاء سے نکالی جائے اور بہت بیماریوں کے خلاف ہو	Vegetative	غیر تولیدی/ غیر جنسی
Isolation	علیحدگی	Exospore	بیرونی سپور
Inoculation	میں داخل کرنا	Endospore	اندرونی سپور بیکٹیریا میں
Culture	تجرباتی طور پر ٹیسٹ ٹیوب یا پٹری ڈش میں اگانا یا زندہ رکھنا	Nutrition	غذائی حصول
Pathogenic	بیماری لگانے والا	Autotrophic	اپنی خوراک آپ تیار کرنے والے
Occurrence	پایا جانا	Heterotrophic	خوراک کے لئے دوسروں پر یا انحصار کرنے والے

Distribution	تقسیم	Parasite	جس کا host زندہ چیز ہو
Saprophyte	جس کا host مردہ ہو	Binary fission	دو میں تقسیم
Humus	وہ مٹریل جو اپنی شکل کھو کر نامیاتی مرکبات میں منتقل ہو جائے	Botulism	زہریلا کھانا کھانے کے بعد کی بیماری
Obligative	میزبان (ہوسٹ) کے بغیر نہ رہ سکنے والا	Diptheria	خناق
Facultative	میزبان (ہوسٹ) کے بغیر رہ سکنے والا	Plague	طاعون
Enlargement	بڑا کرنا یا ہونا	Typhoid	ٹائیفائیڈ، انتڑیوں میں انفکشن والا بخار
Lysis	توڑنا / توڑ پھوڑ	Acquired	حاصل کرنا / لینا
Lytic cycle	تباہ کرنے والا	Retroviruses	وائرس کی وہ قسم جو ناک کی بیماریاں پھیلاتی ہے
Lysogeny	توڑنے والا عمل	Prevention	بحث / دفاع
Temperate stage	عارضی سٹیج	Utensils	آلات / برتن
Naked	بغیر پردے کے / ننگے / دکھائی دینے والے	Syringes	سرنج / ٹیکہ لگانے والا آلہ
Pitted	سوراخ والے	Sterile	جراثیم کے بغیر
Pocks	پھنسی نما / دانے نما جلد پر ابھار	Intimate	قریب / معروف
Epidemic	وبائی	Inflammation	درد اور سوجن
Influenza	زکام و بخار	Fatigue	تھکاوٹ
Contagious	زہریلی / انفکشن والی	Hygienic	سینٹری
Susceptible	حساس	Routine	عموماً
Spherical capsid	بیضوی کیپسول	Donor	دینے والا
Tumor	گلٹی	Toxic agents	زہریلا / زہر پھیلانے والا
Immunodeficiency	قوتِ مدافعت کی کمی	Reclamation	
Appandages			

Q.1 Fill in the blanks:

(i) A bacterial arrangement in packets of eight cells is described as a ——————.

(ii) The shape and arrangement of —————— is diplococci.

(iii) Pili are tubular shafts in bacteria that serve as a means of ——————.

(iv) —————— are unusual type of bacteria that live in extreme habitats.

(v) —————— is a bacterium that is photosynthetic.

(vi) —————— is a cyanobacterium.

(vii) —————— called as bloom forming organism.

(viii) Use of antibiotics is one of the means of controlling —————— infectious.

ANSWERS:

(i)	Sarcina	(ii)	Cocci in pairs	(iii)	Conjugating process
(iv)	Archaeobacteria	(v)	Green sulphur bacterium	(vi)	Nostoc
(vii)	Nostoc	(vii)	Bacterial	(viii)	Infectious

Q.2 Each question has four options. Encircle the correct answer:

(i) Which of the following is not found in all bacterial cells:

(a) Cell Membrane (b) Ribosomes
(c) A nucleoid (d) Capsule

(ii) The major locomotors structures in bacteria are:

(a) Flagella (b) Fimbriae
(c) Pilli (d) Cilia

(iii) Which of the following is a primary bacterial cell wall function?

(a) Transport (b) Support
(c) Motility (d) Adhesion

(iv) Which of the following is present in both gram-positive and gram-negative cell walls?

(a) An outer membrane (b) Peptidoglycan
(c) Techoic acid (d) Lipopolysaccharides.

(v) Mesosomes are internal extensions of the:

(a) Cell wall (b) Cell membrane

(c) Chromatin body (d) Capsule

(vi) Bacterial endospores function in:

(a) Reproduction (b) Protein synthesis

(c) Survival (d) Storage

ANSWERS:

(i) (d) (ii) (a) (iii) (b) (iv) (b) (v) (b) (vi) (c)

Q.3 Short Question:

(i) (a) Name general characteristics that could be used to define the prokaryotes.

Ans. (i) Unicellular, lack membrane bound organelle e.g. Mitochondria.

(ii) Simpler organization as compared to eukaryotes.

(iii) Lack distinct nucleus, have small sized ribosomes.

(b) Do any other microbial groups besides bacteria have prokaryotic cells?

(c) In what habitats are bacteria found? Give some general means by which bacteria derive nutrients.

Ans. Cosmopditan in distribution, found everywhere.

(ii) (a) List functions that the cell membrane performs in bacteria?

Ans. (i) Regulates the transport of nutrients.

(ii) Contain enzymes for respiratory metabolism.

(iii) Responsible for the relationship of cell with outside world.

(b) What are mesosomes and some of their possible functions?

Ans. In bacteria, Mesosomes are invaginations of cell membrane into the cytoplasm and are involved in DNA replication cell division and export of extra-cellular enzyme.

(iii) What is unique about the structure of bacterial ribosomes?

Ans. Their ribosomes are small sized i.e. 80s.

(iv) Draw the three bacterial shapes.

Ans.

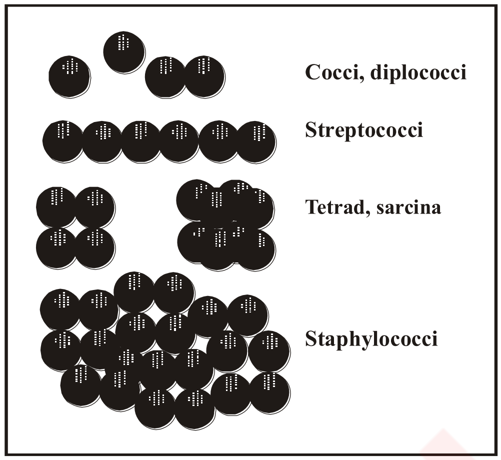


Fig. Cocci

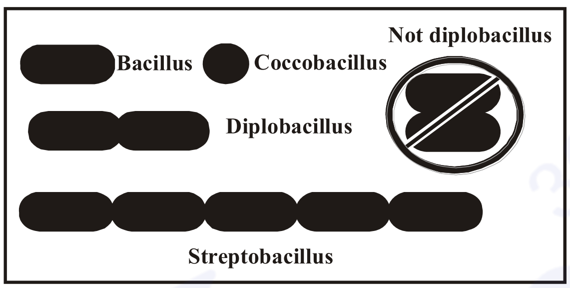


Fig. Bacilli

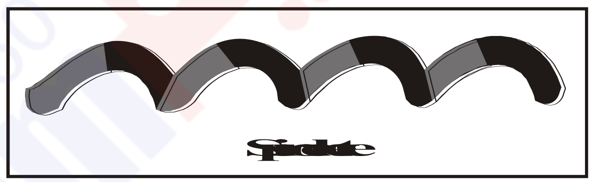


Fig. Spirilla

(v) Name a bacterium that has no cell wall.

Ans. Mycoplasmas.

(vi) A gram stain discharge from an abcess shows cocci in irregular, grape-like clusters. What is the most likely genus of this bacterium?

Ans. Staphylococcus.

(vii) Draw an outline and label (i) Streptobacillus (ii) Diplococcic (iii) Staphylococci.

Ans. Streptobacillius diplococci, Staphylococci.

(viii) You observe a culture of predominatly round (presumably spherical) bacteria that through apparently fully divided, nevertheless have failed to separate, thus resulting in long chains of cells. What, generally, might you call such an arrangement?

Ans. Streptococci

(ix) Match the following descriptions with the best answer.

(a)	Division in one plane: cocci arranged in pairs	(a)	Bacillus
(b)	Division in one plane: cocci arranged in chains	(b)	Streptobacillus
(c)	Division in two planes; cocci arranged in a square of four.	(c)	C.spirochete
(d)	Division in one plane; rods completely separate after division.	(d)	Spirillum
(e)	Division in one plane; rods arranged in chains.	(e)	Vibrio
(f)	A comma shaped bacterium.	(f)	F. streptococcus
(g)	A thin, flexible spiral.	(g)	G. staphylococcus
(h)	A thick, right spiral.	(h)	Diplococcus tetrad Sarcina

ANSWERS:

(a)	(h)	(b)	(f)	(c)	(i)	(d)	(a)	(e)	(b)
(f)	(e)	(g)	(c)	(h)	(d)				

Chapter 7

THE KINGDOM PROTISTA (OR PROTOCTISTA)

BASIC TERMS OF CHAPTER

Aquatic Eukarytoic Organisms: Those nucleated organisms which live in water.

Prokaryote: The non nucleated organisms.

Kingdom: The highest level in taxonomic ranks.

Protozoans: Unicellular eukaryotic organisms usually in aquatic habitat.

Algae: The eukaryotic aquatic plant like organisms in which sex organs are unicellular, commonly.

Slime Moulds: Slime moulds is a class of myxomycota, containing fungus like organisms which have naked protoplasm.

Evolutionary History: The history of genetic changes in populations over millions of years.

Endocytosis: The entry of particles or fluid into cells by diffusion or active transport across the membrane.

Symbiont: A partner of mutual beneficial association (i.e. in symbiosis).

Parasites: The organism which obtains food and shelter from another organism (host). (OR) "Organism living in (endoparasito) or on (ectoparasite) another organism".

Pellicle: A membrane surrounding the protoplast in some unicellular algae with cellulose cell wall (e.g. Euglena)

Conjugation: A form of sexual reproduction in which conjugating tube is developed between organism for exchange of genetic material.

Thallus: Leafless, rootless and stemless plant body.

Xanthophyll: The photosynthetic pigment acts as a primary light absorber in brown algae.

Hyphae: The basic, structural and functional unit of Fungi.

Blooms: A visible increase in the number of species in the plankton.

Malaria: A protozoan disease in which temperature rise up, headache, chilling & nausea occur.

African Sleeping Sickness: The disease, caused by *Trypanosoma*.

Amoebic Dysentery: The disease of intestinal disorder due to attack of *Entamoeba histolytica*.

Habitat: The area in which an organism lives. (OR) An address of an organism is called habitat.

Entangles prey: Means trapping of prey.

Zygote: Fertilized egg.

Phycoerythrin: ***Red pigment*** in red algae which absorbs dim blue – green light

Carotenoids: The accessory pigments in most photosynthetic cells. These are ***yellow***, ***orange*** or ***red*** and ***fat soluble***.

Autotrophs: Organisms which can synthesize their food from CO_2 & H_2O.

Heterotrophs: Organisms which cannot synthesize their food and depend on ready made food.

Hold Fast: A structure found on the base of algae for attachment.

Coral Animals: The members (polyps) of phylum coelenterata which secrete limestone.

Chitin: A polymer of cell wall of fungi which is contains ***acetyl glucose – amine***.

Spore: An asexual unicellular reproductive unit.

Sporangium: A structure in which spores are formed.

Cytoskeleton: The thread like skeletons of micro filaments & microtubules in cytoplasm.

Chlorophyll: The Photosynthetic pigment which ***absorbs red & blue*** – ***violet*** light and ***reflects green light***.

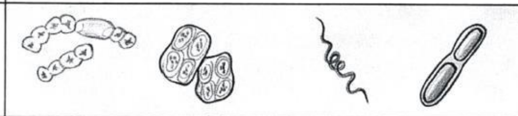
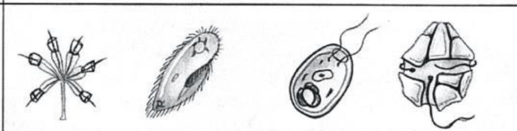
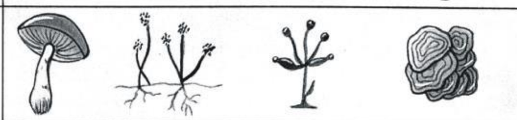
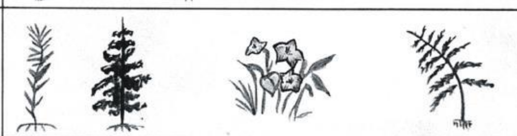
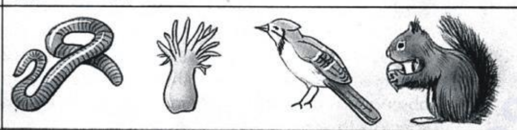
Kingdoms of Life	Representative Organisms	Organization	Type of Nutrition	Representative Organisms
Monera		Small, simple, single cell (sometimes chains or mats)	Absorb food (some photosynthesize)	Bacteria including cyanobacteria
Protista		Complex single cell (sometimes chains or colonies)	Absorb, photosynthesize, or ingest food	Protozoans, algae, water molds
Fungi		Multicellular filamentous form with specialized complex cells	Absorb food	Molds and mushrooms
Plantae		Multicellular form with specialized complex cells	Photosynthesize food	Mosses, ferns, pine trees, woody and non-woody flowering plants
Animalia		Multicellular form with specialized complex cells	Ingest food	Worms, sponges, insects, fish, reptiles, amphibians, birds, and mammals

Fig. Classification of organisms.

Q.1 (a) *What are protists?*

(b) Write down the important features of kingdom protista.

(c) What are the reasons for grouping simple eukaryotes into separate kingdom protista?

Ans. (a) PROTISTS

A vast variety of aquatic eukaryotes which has different structures, body forms, reproductive systems, type of nutrition and life styles, and evolved from prokaryotes are known as Protists:

Protozoans, Unicellular, Multicellular algae, Slime molds, Oomycetes.

(b) FEATURES OF KINGDOM PROTISTA:

(i) The members of kingdom protista are *Unicellular, colonial* and simple *multicellular*.

(ii) Eukaryotic cell organization is found.

(iii) There is *No Embryo* or *Blastula* stages in protists.

(iv) Protists are *evolved from prokaryotes*.

(v) The Fungi, Plantae & Animalia kingdoms are evolved from protista.

(vi) The Kingdom protista contains following major groups:

(a)	*Unicellular Protozoans*	(Animals Like Protists)
(b)	*Unicellular algae*	(Plant Like Protists)
(c)	*Multicellular algae*	(Plant like protists)
(d)	*Slime Moulds* and *Oomycetes*	(Fungus Like Protists)

(c) REASONS OF SEPARATE KINGDOM:

(i) Vast Variety:

These are primarily *aquatic eukaryotic* organisms. In case of reproduction, nutrition, body forms and life style the protists are so much different to fungi, plants & animals. This vast variation becomes the reasons of an independent kingdom.

(ii) Evolution:

According to evolutionary point of view *all protists are evolved from prokaryotes*. Prokaryotes are placed in kingdom Monera. So protists are evolved from members of monera and other members of kingdom fungi; kingdom plantae and kingdom animalia are evolved from protists. ***Prokaryotes are ancestor of protists while protists are ancestors of plantae, Fungi and animalia.***

(a) **(b)** **(c)**

Fig. The kingdom protista includes such diverse species as (a) single celled eiliated protozoan, (b) glant brown algae (kelps) and (c) slime molds.

(iii) Twin Character of Euglena:

Some organisms like Euglena have strange characters. They have characters of plants and animals, (because presence of Chlorophyll and absence of cell wall). Is organism like Euglena has merit in plantae, animalia or fungi? Due to this reason a new kingdom was formed for the accommodation of these dual characteristics organisms.

Q.2 Write a note on historical perspective of protists.

Ans. **HISTORICAL PERSPECTIVE**

(i) Proposal of J.Hogg: (1861):

J. Hogg had proposed that kingdom protista is for Microscopic Organisms.

(ii) Proposal of E.Haeckel (1866):

He suggested the bacteria and other microorganism i.e. Euglena in kingdom protista. Beasue bacteria & Euglena etc. were not accommodated in plant or animal kingdom. However, Haeckel placed prokaryote i.e. bacteria & cyanobacteria in separate group as Monera. But he kept group monera within kingdom protista.

(iii) Proposal of H.Copeland (1938):

H. Copeland gave a separate kingdom status to prokaryotes.

(iv) Five Kingdom System of R.Whittkar (1969):

Whittkar was the person who introduced five kingdom system. *Monera, protista, Fungi, Plantae & animalia*. But he placed only Eukaryotes in kingdom protista.

(v) Margulis & Shwartz's Modifications (1982):

They modified the five kingdom system. Margulis & Schwart, added simple multicellular & colonial eukaryotes (with unicellular) in kingdom protista.

Q.3 (a) Why are protists polyphyletic?

(b) What type of diversity is found in protists?

Ans. (a) **DIFFERENT BASIS OF EVOLUTIONARY HISTORY**

(a) Polyphyletic:

A great diversity is found in the members of kingdom protista. According to narrow and deep point of view, all groups do not share a single common ancestor. Biologists believe protists are polyphyletic (Polyphyletic means based on different evolutionary history. Due to great variety, *Margulis & Schwartz classified the protists into 27 phyla* for the accommodation or adjustments of different organisms.

(b) Diversity Among Protists:

Protists show following diversity during the course of evolutionary history (Polyphyletic) in organisms:

(i) Difference in ***size & structure*** (ii) Different ***means of locomotion***

(iii) Different types of ***nutrition*** (iv) ***Interactions*** with other organism

(v) ***Habitat*** are different (vi) Different kinds of **Reproduction**.

Animal – Like Protists:

Sr. No.	Common Name	Form	Locomotion	Examples
1.	**Zooflagellates**	Unicellular some Colonial	One or more Flagella	*Trypanosoma* *Euglena*
2.	**Amoebas**	Unicellular, no definite shape	Pseudopods	*Amoeba* *Entamoeba*
3.	**Actinopods**	Unicellular	Pseudopods	*Radiolarians*
4.	**Foraminifera**	Unicellular	Pseudopods	*Forams*
5.	**Apicomplexans**	Unicellular	None	*Plasmodium*
6.	**Ciliates**	Unicellular	Cilia	*Paramecium* *Vorticella,* *Stentor.*

Q.4 (a) What do you know about animal like protists?

(b) What are salient features of amoebas?

Ans. (a) PROTOZOA (*ANIMAL LIKE PROTISTS*):

Protozoans are unicellular organisms. *"Proto" means first Zoo means animals"*. Organisms are surrounded by cell membrane/*plasma membrane*. In case of animals, cell membrane is outer most boundary of the cells. Ingestion (intake of food) occurs by endocytosis. Endocytosis means entry of solid or liquid particles into cell by diffusion or active transport across the membrane. Various types of locomotion occur in protozoa. They have 50,000 species. Animal like protists are divided into following 6 groups:

(i) Zooflagellates (ii) Amoebas (iii) Actinopods.

(iv) Foramnifera (v) Apicomplexans (vi) Ciliatas

(b) (i) Amoebas

- These protozoans are ***free living.***
- Body is ***irregular***
- They reproduce by binary fission and multiple fission.

- These are *Fresh Water*, Marine & Soil living.
- Movement occurs by ***Pseudopodia***. (*"Pseudo"* means false and *"POD"* means foot.)

As Parasites: *Entamoeba histolytica* is human pathogen in intestine. It causes **human dysentery**.

Pseudopodia: These are irregular cytoplasmic projections by which Amoeba moves.

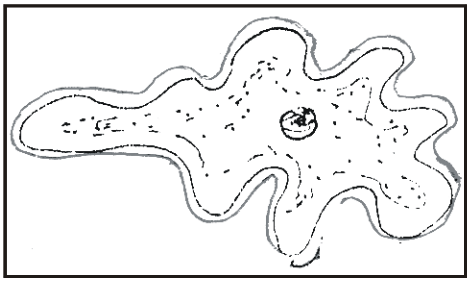


Fig. Amoeba proteus

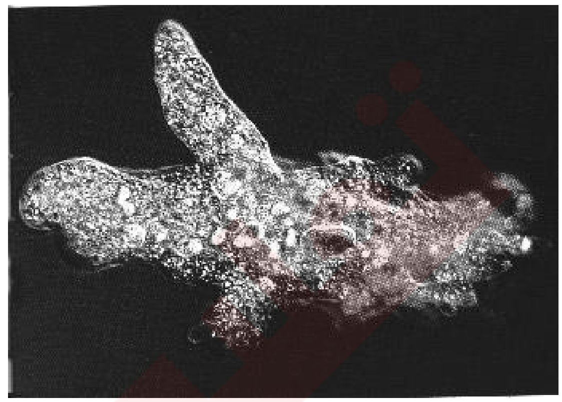


Fig. The flowing pseudopods of Amoeba constantly change shape as the organism moves and feeds.

Examples of Amoebas:

Amoeba proteus, Entamoeba histolytica, pelomyxa palustris.

Q.5 What do you know about Zooflagellates? Explain.

Ans. **ZOOFLAGELLATES**

- These are mostly ***unicellular*** and ***few colonial***.
- Zooflagellates are ***spherical or elongated***.
- They have single ***central nucleus***.
- ***Whip – like*** Flagella may be one or many.
- Rapid movement is occurred by ***flagella***.

Flagella are located on anterior end.

Ingestion: They obtain food from living organisms and/or dead organisms. They also absorb the nutrients from humus.

As Parasites: Different species of Trypanosomes are parasites of human being and animals. These are blood parasites. Trypanosoma gambiense causing ***African Sleeping Sickness***. The biting of tsetse flies transmits pathogenic stage of ***Trypanosoma***.

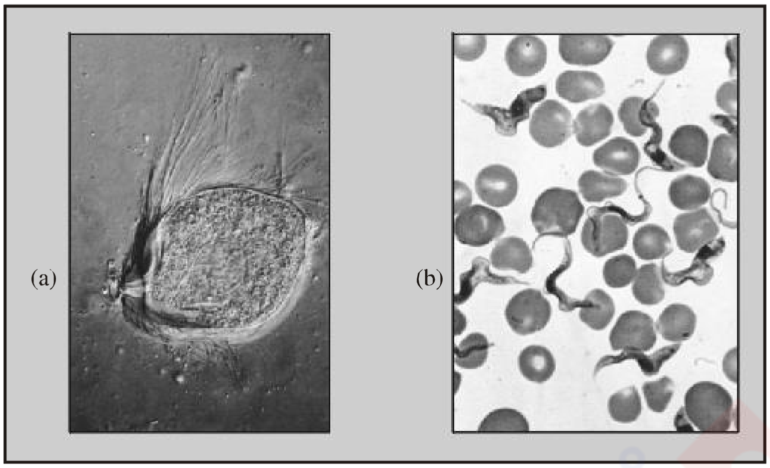


Fig. Zooflagellates (a) Trichonympha has hundreds of flagella (b) Trypanosoma causes sleeping sickness

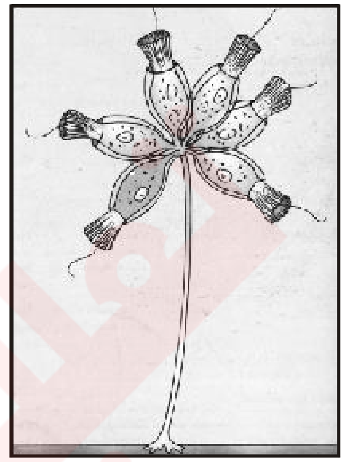


Fig. A colonial choanoflagellate

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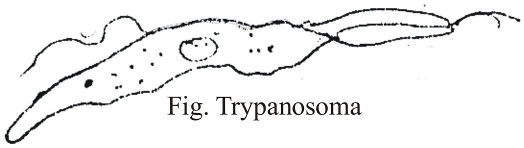

Fig. Trypanosoma

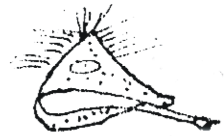

Fig. Trichonypha

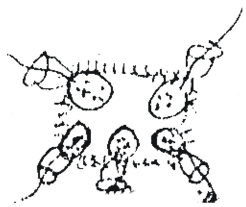

Fig. Proterospongia

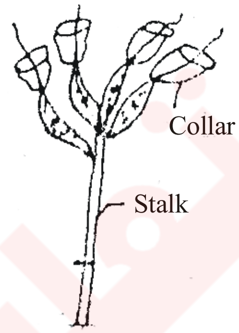

Fig. Choanoflagellate

As Symbiont: Many flagellated organisms like *Trichonympha* acts as symbiont in the guts of termites. They digest cellulose of termites & obtain food from hosts.

As Sessile: (Choanoflagellates) are non-motile. These are fresh water and marine attached. Flagellates with single flagella with collar are called choanaflagellates. They feed bacteria.

Q.6 Give the Salient Features of Ciliates.

Ans. **CILIATES**

Ciliates type protozoans have following characters:

- They are ***unicellular***, ***heterotrophs***.
- They posses ***Cilia***. "The fine hair like structures which beat and help in locomotion and feeding".
- ***Pellicle*** is present as outercovering of ciliates. "A flexible & thin covering which surrounds the protoplast and gives the definite shape"
- ***Micro & Macronucleus*** are present with complex cell structure:

  Macronucleus is polyploid. It controls ***metabolic activities***.

  Micronucleus is diploid. It controls ***reproduction and formation of new macro nuclei during nuclear division***.
- **Contractile vacuoles** regulate the water in fresh water ciliates.
- ***Ingestion of bacteria*** & other protists takes place in the ciliates.

- *Sessile ciliated are attached to rock surface. The cilia are used for feeding & drawing of water currents. e.g. Stentor.*
- ***Sexual*** reproduction takes place by **Conjugation**.
- ***Asexual*** reproduction is occurred by **Binary** Fission.

Example: Paramecium and Stentor are common ciliates.

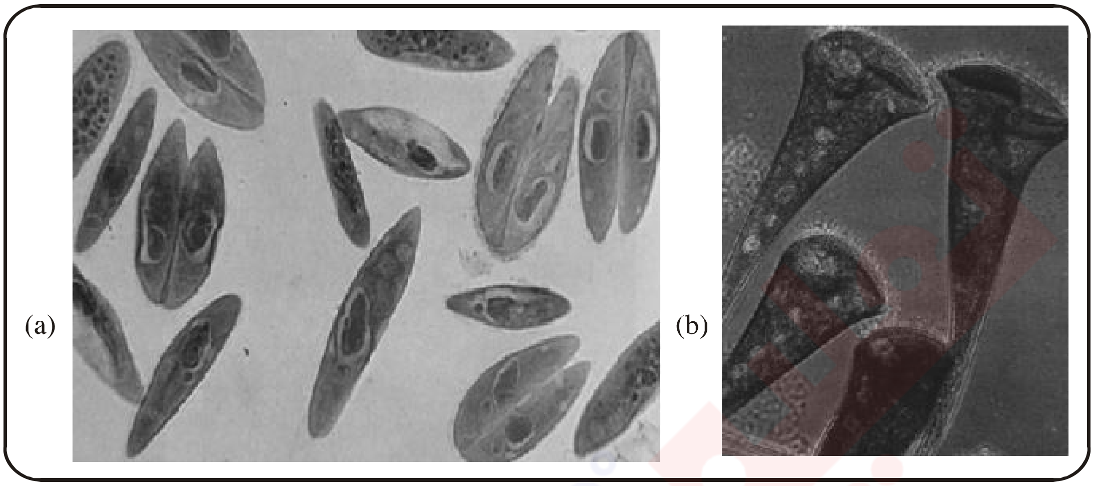

Fig. (a) Paramecium, conjugating individuals (b) Stentor, a sessile ciliate.

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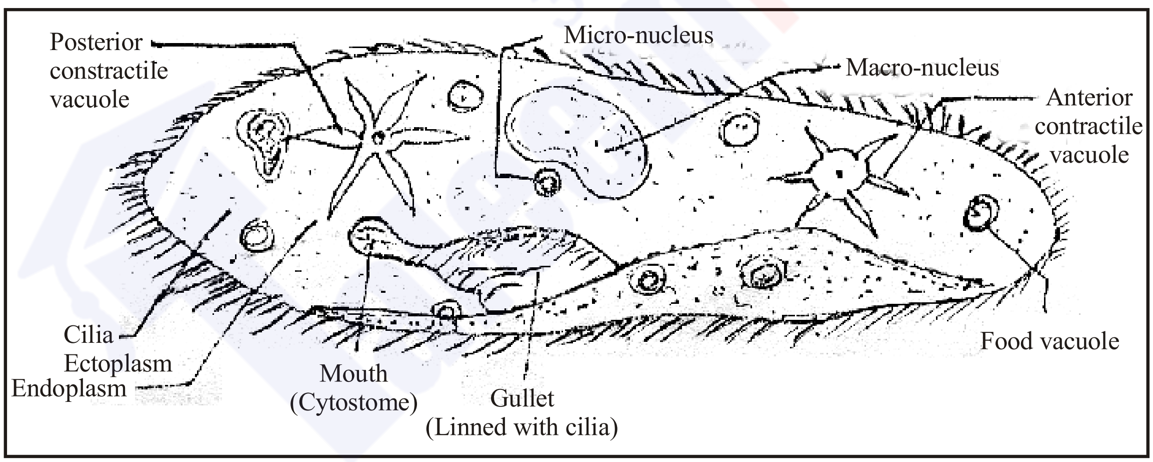

Fig. Paramecium

Q.7 Discuss Foraminiferans & Actinopods:

Ans. **FORAMINIFERANS & ACTINOPODS:**

- ***Marine*** Protozoans
- ***Shells*** (Tests) are – produced by foraminifera & Actinopods
  Calcium shell is present in foraminifera cases.

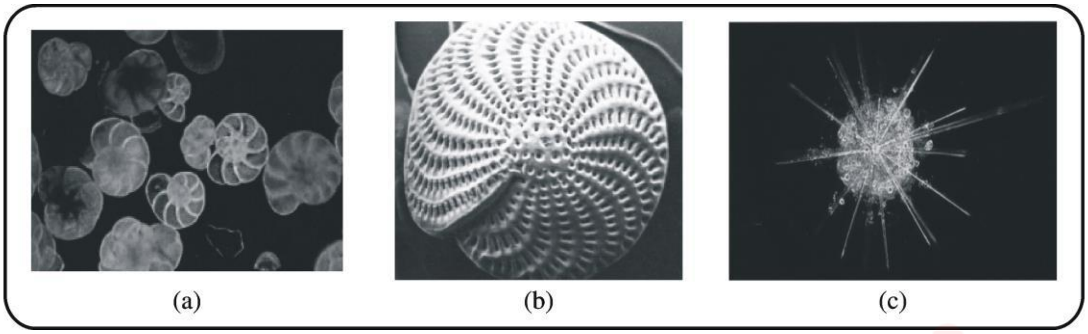

Fig. (a) Foraminiferan tests have (a) beautiful geometric patterns and (b) pores through which cytoplasmic projections are extended (c) Radiolarians are Actinopods with glassy shells.

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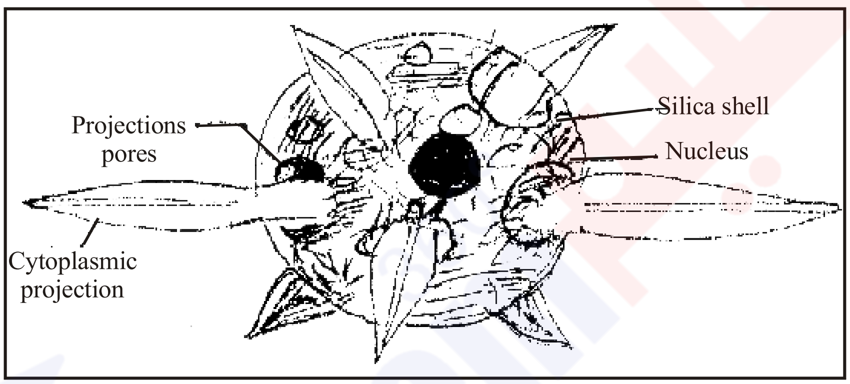

Fig. Radiolaria (Actinopod)

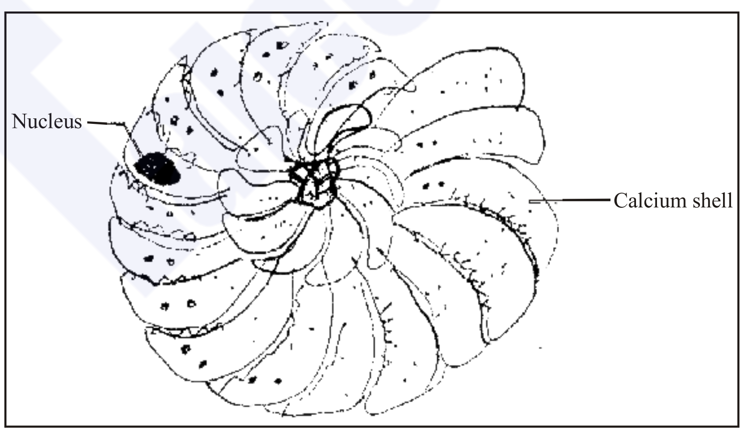

Fig. Foram

- **Pores** are present in shells through which cytoplasmic extensions or projections come out.

- **Entangling of prey** i.e. trapping of prey takes place by cytoplasmic projection.
- These **cytoplasmic projections** form a sticky, interconnected net which grip or entagles prey.
- **Limestone deposits** are created by foraminiferous in the past.
- Grey mud formation is gradually changed into chalk. This is formed by the sinking of dead foraminiferous in bottom of oceans.

Examples: Radiolarians & Actinopods.

Q.8 Write a note on apicomplexans of protozoans & discuss malarial parasite.

Ans. APICOMPLEXANS ***PARASITIC GROUP:***

- There are parasitic protozoans.
- **Malaria** is caused by apicomplexans in man.
- No special locomotory structures are found in ***apicomplexans***. They move by flexing. They have limited movement.
- ***Spore production*** *is a salient feature of apicomplexans.*

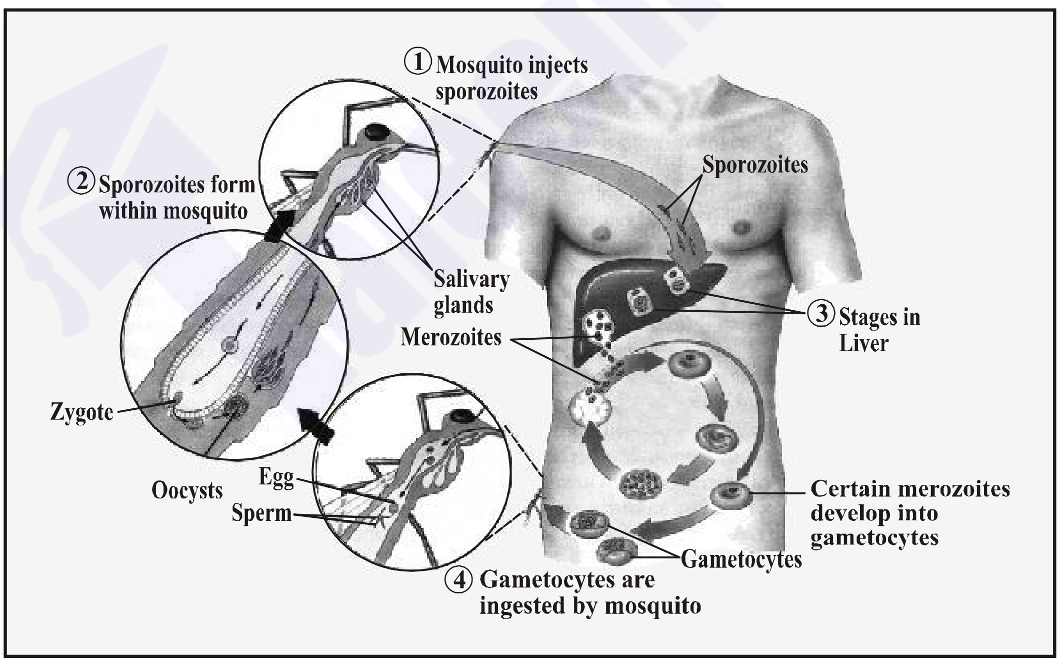

Fig. Life cycle of plasmodium

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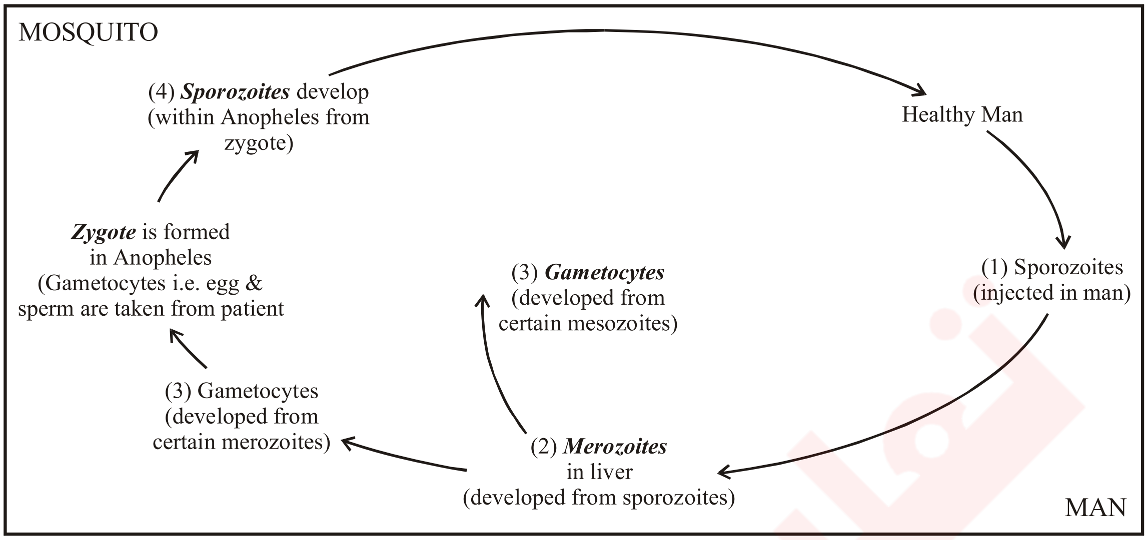


Fig. The life cycle of the malarial parasite (Plasmodium)

Plasmodium flaciparum is most widely distributed malarial parasite infecting man.

Female Anopheles (Mosquito) is a vector.

Spot is an immature form of plasmodium which is injected into the BLOOD of humans by mosquito.

Merozoites are formed in liver. From blood **sporozoites** enter into **liver**, stay unit in it & multiplied into large number of merozoites. After it, they enter into RBCs.

RBCs burst by the attack of ***merozoites***.

Q.9 Write down general characters of plant like protists.

Ans. ALGAE (PLANT LIKE PROTISTS):

"The Eukaryotic unicellular, colonial and filamentous aquatic plants in which unicellular sex organs found are called algae". The study of algae is called Phycology.

DISTRIBUTION

Fresh water: Algae are found in ponds, lakes, streams and hot springs.

Marine: Brown algae common in oceans.

Moist Soil/rocks/damp Places: Epiphytes, Endophytes etc.

SHAPE / STRUCTURE.FORM: Algae are unicellular; it is colonial. Multicellular forms are unbranched filamentous (Spirogyra), branched filaments (stigeoclonium), sheath like (Ulva). It may be in the form of leaf like extensions. These are uninucleated multinucleated etc.

SEX ORGANS:

Unicellular sex organs are found in algae. *No multicellular sex organs* are present like other plants.

PIGMENTS:

Chloropphyll a is found in all types of algae. *Chlorophyll b, c, & d is present in algae*. ***Carotenes, fucoxanthin, phycoerythrin, phycocyanin*** & ***Xanthophylls*** are common pigments.

CHLOROPLASTS: Ribbon & girdle shaped chloroplasts are found. These are also cup shaped, rod shaped & oval shaped chloroplast.

LOCOMOTION: Locomotion is generally found by falagella. Biflagellated & quadroflagellated cells are present. Some types are sesile too.

REPRODUCTION: Sexual reproduction is *isogamous*, *anisogamous* and *oogamous* is found. Asexual reproduction by spore & fragmentation is common.

LIFE CYCLES: *Isomorphic alternation of generation* is found (i.e. ULVA). There are separate sexual life cycles & asexual life cycles too.

COMMON NAMES: Green algae, brown algae, red algae, blue green algae, diatoms, dino-flagellates and euglenoides are common names.

PHYLA:

(i) Chlorophyta
(ii) Rhodophyta
(iii) Phaeophyta
(iv) Chrysophyta
(v) Pyrophyta
(vi) Euglenophyta
are common phyla

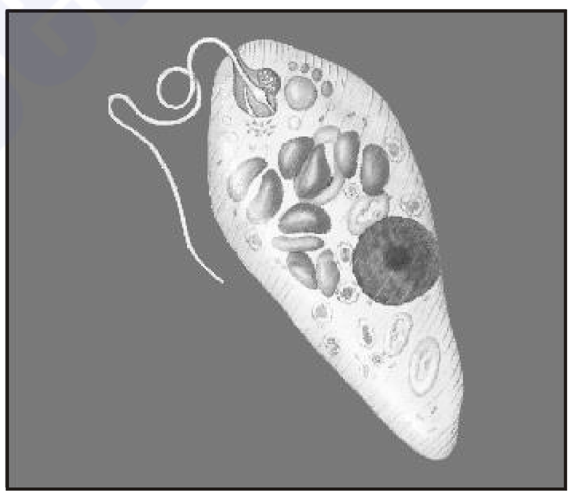
THINKING & ROOM

EXAMPLES:

Spirogyra, (filamentous)
Ulva, (sheath like)
Acetabularia (unicellular)
Chlorella (non-motile unicellular)
Stigeoclonium (branched filamentous)
Polysiphonia (filamentous)
Chondrus
Fucus (Thalloid)
Macrocystis (Thalloid)
Pinnularia
Firequilaria
Diatoms (unicellular)
Ceratium
Gonyaula
Euglena (unicellular)
Chlamydomonas (motile unicellular)
Laminaria (Thalloid)

Phylum	Common name	Form	Locomotion	Pigments	Examples
Euglenophyta	Euglenoids	Unicellular	*Two flagella* one long one short	Chl.a, Chl.b Carotenoids	*Euglena*
Phyrrophyta	Dinoflagellats	Unicellular	*Two flagella*	Chl.a, Chl.c Carotenes including Fucoxanthin	*Gonyaulax Ceratium*
Chrysophyta	Diatoms	Usually unicellular	Usually none	Chl.a, Chl.c Carotenes including Fucoxanthin	*Diatoma, Frequiaria Pinnularia*
Phaeophyta	Brown Algae	Multicellular	*Two flagella* on reproductive cells	Chl.a, Chl.c Carotenes including Fucoxanthin.	*Fucus, macrocystis*
Rhodophyta	Red algae	Multicellular or unicellular	None	Chl.a, carotenes Phycoerythrin	*Chondrus Polysiphonia*
Chlorophyta	Green algae	Unicellular, Colonial multicellular	Most have *flagella*	Chl. A, Chl.b, Carotenes	*Chlorella, Ulva, Acetabularia Spirogyra.*

Euglenoids



Euglenoids have been classified as a algae in plant kindom & as a protozoans of animal kindom.

Euglenoids are thought to be closely related to zooflagellates on the basis of molecular data.

Due to present of pigments, they resemble with plants. They behave like Autotrophs.

Like Autotroph:

Some Euglenoids lose their chlorophyll in dark condition. Then, they obtain their food like heterotrophs.

Like Heterotroph (Chl.a, b):

Some species of Egulenoids are always heterotrophs and colourless.

Euglenoids are very special (Autotroph) & animal (heterotroph). Due to this doubling, they have specific evolutionary importance.

EASY TO DRAW

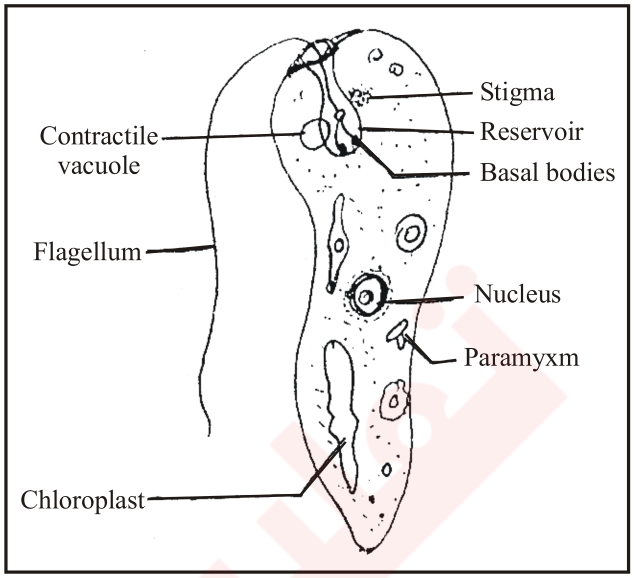


Fig. Euglenoids have special evolntionary significance as they resemble with plants and green algae in having similar pigments and, on the other hand, are also related to zooflagellates.

Dinoflagellates Chl.a, c) (GRWO1)

Dinoflagellatesa are mostly ***unicellular*** & unusual protists. The cell are covered by ***shells***. ***Shells have interlocking*** of ***cellulose plate***. Cellulose plate have silicates in it.

In ***marine*** ecosystem, Dinoflagellates are ***important*** as ***producers***. e.g., ***Ceratium***.

Ecosystem means environment with living & non-living links. Producer means autophic i.e., food providing)

Dinoflagellates 'blooms' which may cause the water to became yellowish, redish or orange.

Some Dinoflagellates produce toxins in marine and become the reason of pollution as blooms.

Examples: *Gonyaulax* and *Ceratium* are common.

(ii) Diatoms (*Chrysophyta*) (Chl. a) (GRWO1)

"A group of non-flagellated algae in which unicellular & colonial members having silica shells (silica cell wall) divided into two overlapping.

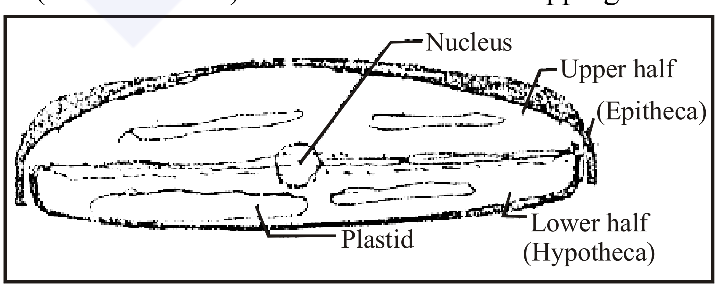


Fig. Pinnularia

General Characters:

- Diatoms are major producers (autotrophs) in ***fresh water*** and ***marine*** ecosystem.
- They are very important is food chain of aquatic ecosystem.
- They may be ***radially symmetrical*** (centro diatom) and ***bilaterally symmetrical*** (pinnate diatoms).
- Each diatom consists of two ***silica under shells***. Two shells fit together like ***petridish***. It is glass like material.

Fig. Centric diatoms

Examples: *Diatoms, Frequilaria, Pinnumeia etc.*

Inshort, Euglenoids, Dinoflagellates & Diatoms are plants like protists, but these are unicellular. While other multicellular algae are Brown algae, Red algae & Green algae etc. *(see next question)

Q.10	***Write an account on multicellular algae.***	***(OR)***
	Discuss multicellular plant like protists.	***(OR)***
	What are phaeophyta, Rhodophyta & Chlorophyta?	***(OR)***
	Write notes on the multicellular algae like rhodophyta phaeophyta and chlorophyta.	

Ans. (i) **BROWN ALGAE** — ***PHAEOPHYTA*:**

"The marine alage including sea weeds and kelps with parenchymatous thallus, have chlorophyll a & c, carotene, xanthophylls & fucoxanthin pigments, are called brown algae".

GENERAL FEATURES:

- ***Habitat:***

  They are commonly in cool marine water along rocky coastline in the intertidal zone.

- ***Shape/form/structure:***

  Brown algae is *multicellular*.

  They have length upto **75 meters**.

  They are largest brown algae is called **kelp**.

They tough & leathery.

They have **parenchymatous** body:

Leaf like ——— BLADES

Stem like ——— STIPES

Root like ——— HOLD FASTS

Examples: *Ectocarpus* (Branching filamentous), *Laminaria* (Kelp like) and *Fucus Macrocystis etc.*

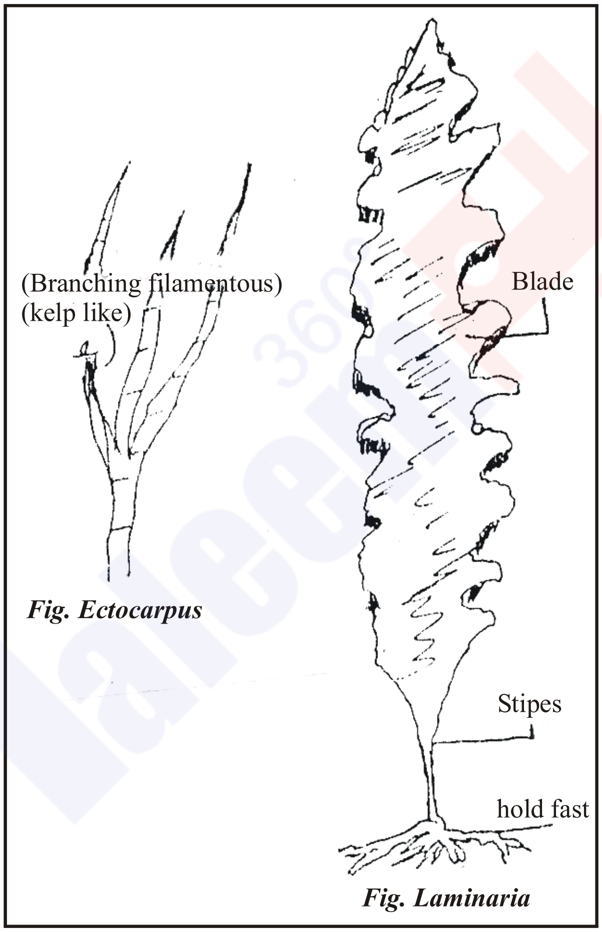


Fig. Ectocarpus

Fig. Laminaria

RED ALGAE (RHODOPHYTA):

"The non flagellate usually thalloid algae contain phycocyanin and phycoeryhrin pigments and have red colour called red algae".

General Characteristics

- They are ***multicellular***. Body commonly composed of ***interwoven filaments***.
- They are mostly marine organisms.
- Many red algae precipitate (secrete) ***calcium carbonates*** on their walls. So they become calcae.
- They are important in ***reef formations***.
- Marine red algae are beautiful with delicate and ***feathery structures***.

Examples:

Chondrus

Polysiphonia

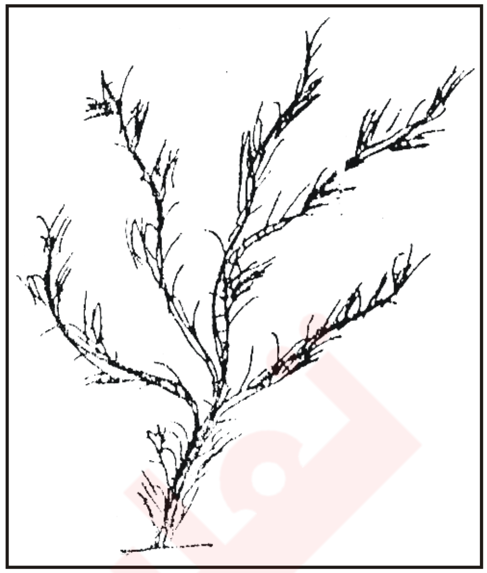


Fig. Polysiphonia

GREEN ALGAE (CHLOROPHYTA):

"They commonly fresh water & moist terrestrial group in which reserve – food material is starch & cell wall is formed by cellulose and chlorophyll –a chlorophyll –b are present, it is green algae".

DISTINGUISH FEATURES

* ***Plant like Characteristics:*** They resemble the plants (more than other algae) due to presence of cellulose cell wall & starch as a reserve food material.
* ***Pigments:*** They contain chlorophyll a & b, xanthophylls & carotenes.
* ***Reproduction:*** Algae have wide range of sexual & asexual reproductions methods.
* ***Habit:*** They have unicellular, multicellular, branched filament, un-branched filaments forms.
* ***Habitat:*** This green pigmented algae commonly found is fresh water & moist terrestrial habitats.
* ***Evolutionary Importance:***
  (i) Green algae is considered as ***ancestors of plants***.
  (ii) The sequence of RNA shows ***monophyletic lineage*** of green algae & plants.

Examples:

Chlorella ———— (Unicellular)

Ulva ———— (Sheat like)

Spirogyra ———————— (Unbranched filament)

Stigeoclonium ———————— (Branched filament

Acetabularia ———————— (Unicellular macroscopic)

EASY TO DRAW

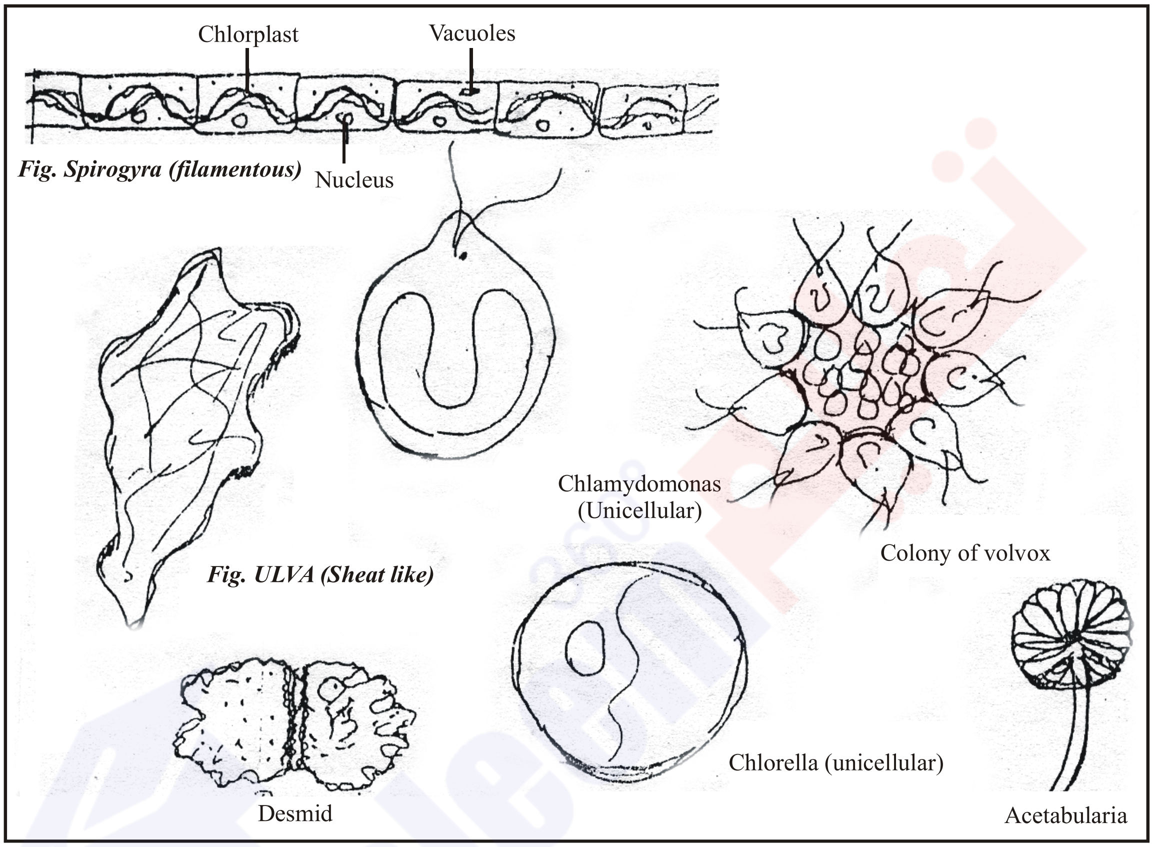


Fig. Spirogyra (filamentous)

Fig. ULVA (Sheat like)

Q.11 What are specific characters of green algae which show it as ancestor of green plants? (OR)

Green Algae considered ancestral organisms of green land plants, discuss.

Ans. Following characters of green algae show evidences of evolutionary traces of green plants:

(i) Similar pigmentation

(ii) Starch as a reserve food material.

(iii) Cellulose forms cell wall.

(iv) RNA shows same sequences.

ECONOMIC IMPORTANCE OF ALGAE

Useful Aspects:

Human Food: Laminaria is use das food. In Japan & China, it is commonly used, vitamins A, C, D, & E are obtained from algae.

Cattle Food: Sea weed are used for animals. In past sea weeds were used for cow & horses. Macrocystis is used for poultry.

Producer in Ecosystems: In aquatic ecosystem, algae provide food to aquatic animals. It behaves as producer in food chain. It is considered as basic food

Examples: Diatoms & Euglena etc.

Role in O_2 Supply: Algae is autotroph. During photosynthesis O_2 is released from algae. This O_2 is used for aquatic animal.

Antiseptic Role: Algae is used in medicines. Chlorella is used for synthesis of antibiotic *chlorellin*. Agar is useful for stomach diseases.

Source of Algin, Agar & Carageenan: Fucus sp., Laminaria & Macrocystis etc., are source of algin, agar & carra – geenan. Gelidum is a big source of agar.

Experimental Organisms: These are used for study of gentics and other physiological processes.

HARMFUL EFFECTS:

In some places it acts as *pollutants*. Sometimes it becomes the reason of closing of pipes.

Q.12 (a) Write down the salient features of Fungus – like – protists.

(b) Discuss characters of slime moulds & water moulds:

Ans. **FUNGUS LIKE PROTISTS**

"Those organisms which are not photosynthetic and have thread like hyphae but posses centroiles and cell wall of cellulose are called fungus like protists".

These Protists are divided into:

(i) Myxomycota – or ***slime moulds***.

(ii) Oomycotes – or ***water moulds***.

GENERAL CHARACTERS OF FUNGUS LIKE PROTISTS:

They are *non photosynthetic*, and having *hyphae* as a basic structural and functional units,. "Hyphae are thread like structures which are basic structural & functional units of fungi". So these heterotrophic & hyphal character similar to fungi.

Non-Fungal Features:

Centroiles are present in these protists.

Cell wall is made up of *cellulose*.

While true fungi lack centroiles & cell wall is made up of chitin.

Ans. (a) Slime Moulds or Myxomycete:

- These protests are also called *Plasmiodial Slime*.
- The vegetative phase (feeding stage) of these organisms is known as the *Plasmodium*.
- Plasmodium is multinucleated & free living *mass of protoplasm*.
- They can grow to 30cm or 1 ft in diameter.
- Plasmodial stage is frequently overlooked. It occurs on grass, decaying leaves (litter), wood & soil in moist, dark situations.
- Visible mass forms *channel network* which cover surface area.
- The protoplasm ingests (intake of food) bacteria, yeasts, spores & decaying organic matter.
- After prolonged vegetative phase the plasmodium enters the reproductive phase and it occurs in unfavourbale condition.
- *Resistant haploid spores* are formed by meiosis in sporangia. *Sporangia* are sac like spore box which have stalks.
- Again, in favourable condition, spores germinate into biflagellated or amoeboid reproductive swarm cells.
- These cells are irregular, uninucleated & motile they form diploid zygote after fusion. Then zygote produces multinucleate plasmodium by mitoisis. Each nucleus is diploid.
- Physarium polycephalum is a plasomodial slime mold.

It is a model organism for the study of processes as experimental level. It provides knowledge of growth, cytoskeleton, differentiation and cytoplasmic streaming.

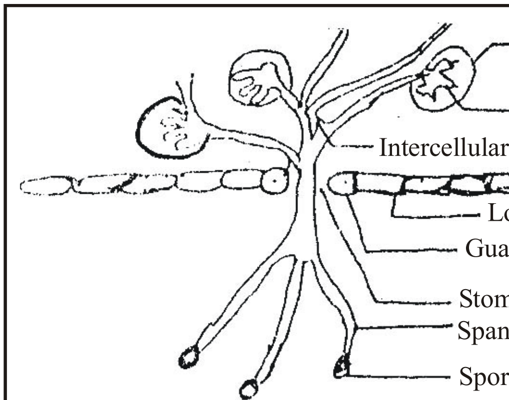
(b) Water moulds or Oomycotes:

Water moulds are closely *resemble to fungi due to presence of hyphae*. Hyphae are *aseptate*. Aseptate means no cross walls.

A group of hyphae is called **mycelium**. They are commonly ***pathogens***.

No chitin is found in cell walls but cellulose is present.

Example: Phytophthora infestan is disease causing organism of potatoes. They diseases of potato is called late blight.



In Ireland, the multiplication of water H_2O molds was increased during 1840. This was due to several rain, cool summer. The increase of water molds became the reasons of ***blight of potatoes***. ***Rotting of potatoes*** was due to attack of ***late blight disease***.

Starvation took place, and more than 1 million people died. Due to shortage of diet, they migrated to south countries as USA.

HELP LINE

FILAMENT means row of cells.

FROND means leaf like structure.

CELL WALL means external layer of protoplast of plant cells.

PIGMENTS means light absorber molecules.

CHLOROPHYLL is photosynthetic pigment.

PROTIST means organism without multi-cellular sex organ.

ALGAE means autotrophs without multi-cellular sex organs.

ANIMAL means heterotroph with multi-cellular sex organ.

FUNGI means heterotrophs with cell walls of chitin.

SPORANGIUM means spore box.

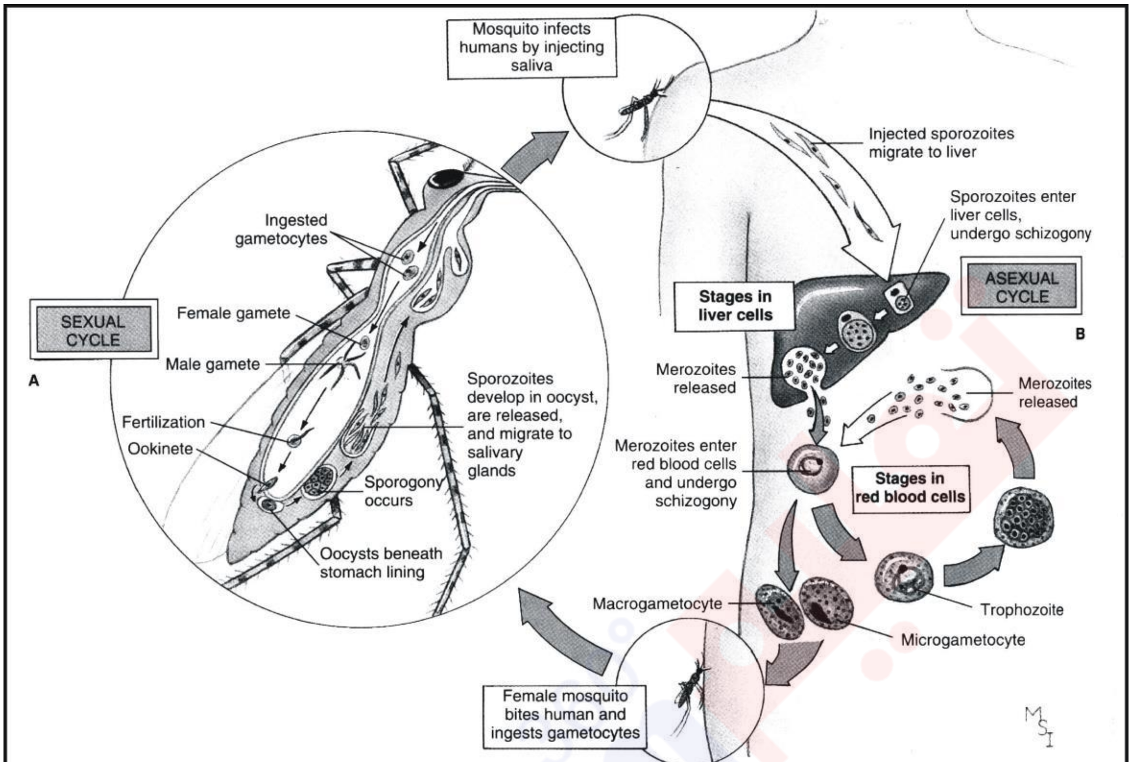
SPORE means unicellular asexual reproductive unit.

SKELETION means frame work of body.

HABIT means form and structure.

HABITAT means living area.

ITEMS FOR SPECIAL ATTENTION



Life cycle of *Plasmodium vivax,* one of the protozoa (class Sporozoea) that causes malaria in humans. **A,** Sexual cycle produces sporozoites in the body of the mosquito. **B,** Sporozoites infect humans and reproduce asexually, first in liver cells, then in red blood cells. Malaria is spread by the *Anopheles* mosquito, which sucks up gametocytes along with human blood, then, when biting another victim, leaves sporozoites in the new wound

DIFFICULT WORD MEANINGS

Words	Meanings	Words	Meanings
Clonial	اکٹھے رہنا/کالونی بنا کر رہنا	Intricate	پیچیدہ
Modified	متغیر/تبدیل شدہ	Kelps	چادر کی طرح پھیلے الجی
Elongated	لمبوترے	Stipes	الجی کا تنا نما حصہ
Conjugation	دو جانداروں کے درمیان بذریعہ ٹیوب جنسی تعلق	Hold fast	سرخ الجی کا جڑ نما حصہ
Parental	والدین سے/نسل سے	Coral Reefs	سمندر میں جزیرہ نما جگہیں جو سیلن ٹریسٹا سے $CaCO_3$ کے اخراج کے باعث بنتے ہیں
Coenocytes	ایسے سیل جن میں کئی نیوکلیس ہوں	Carotenoids	روشنی جذب کرنے والے مخصوص کیمیکل
Intricately	having many details/ complete	Antisepties	جراثیم کش
Summarizes	مختصر/اختصار کے ساتھ	Slime	چکنا چکنا
Explosions	دھماکہ/بکھرنا	Creeps	رینگتے ہوئے/زمین پر پچھے بچھے
Blooms	پھول/ پھیلے ہوئے	Infestation	پیراسائیٹ کا سطحی حملہ
Overlap	ایک دوسرے کے اوپر	Blight	آلوؤں پر لگنے والی ایک بیماری
Patterns	نمونہ/انداز	Shell	خول
Hetero	مختلف	Vector	وہ جاندار جو ایک سے دوسرے پر جراثیم پہنچائے
Prostista-	ایسے آبی جانور جن میں ایمبریو نہیں بنتا	Distribution	مختلف جگہوں پر پایا جانا/تقسیم

Peri	اردگرد	Endophyte	پودے کے اندر
Calcarious	کیلشیم کا بنا ہوا	-Phyte	پودوں سے متعلق
Pseudo-(False)	غلط	Epiphyte	پودے کے اوپر
Pods	پاؤں	oo-	انڈے سے متعلقہ
Habitat	رہنے کی جگہ/مسکن	-gamous	گیمیٹ سے متعلقہ
Flexible	لچکدار	Food chain	غذائی زنجیر
Poly-(many)	کئی	Over lapping	اوپر بچھنا
Macro (large)	بڑا	Skeleton	ڈھانچہ
Kelps	شیٹ کی طرح بڑی اور پھیلی ہوئی الجی	Starvation	قحط سالی
Silica			

Q.1 *Each question has five options. Encircle the correct answer.*

(i) Amoebas move and obtain food by means of:

(a) Plasmodium (b) Flagella
(c) Cilia (d) Pseudopodia
(e) Gametangia

(ii) The sexual process exhibited by most ciliates is called:

(a) Oogamy (b) Binary Fission
(c) Conjugation (d) Fertilization
(e) Zygote

(iii) Parasitic protozoans that form spores at some stage in their life belong to which group:

(a) Ciliates (b) Actinopods
(c) Diatoms (d) Apicomplexans
(e) Zooflagellates

(iv) Algae which have shells composed of two halves that fit together like petri dish belong to:

(a) Brown algae (b) Diatoms
(c) Euglenoids (d) Green algae
(e) Red algae

(v) Algae in which body is differentiate into blades, stipes and holdfast belong to:

(a) Golden (b) Diatoms
(c) Kelps (d) Euglenoids
(e) Green algae

(vi) Chl a, Chl b, and carotenoids are found in:

(a) Brown algae, golden, algae, and diatoms
(b) Green algae, golden algae, and euglenoids
(c) green algae, euglendoids, and plants
(d) Red algae, golden algae, and plants

(vii) The feeding stage of a sline mold is called:

(a) Mycelium (b) Pseudopodium

(c) Hyphae (d) Plasmodium

(e) Rhizoids

(viii) Cell wall in Oomycetes is chemically composed of:

(a) Cellulose (b) Chitin

(c) Proteins (d) Lignin

(e) Proteins and some carbohydrates

ANSWERS:

(i)	(d)	(ii)	(c)	(iii)	(d)	(iv)	(b)	(v)	(c)
(vi)	(c)	(vii)	(d)	(viii)	(a)				

Q.2 Short Questions:

(i) Write two characteristics of each of the following groups.

Ans. (a) Protozoa (b) Dinoflagellates

(c) Diatoms (d) Slime molds

(e) Oomycetes

(ii) Protozoa.

Ans. (a) All protozoa are microscopic, unicellular.

(b) Mode of nutrition is by endocytosis.

(iii) DNA Dinoflagellates.

Ans. (a) Unicellular

(b) Body covered our by shells of interlocking cellulose plates impregnated with silicates.

(iv) Diatoms.

Ans. (a) Usually unicellular.

(b) Cell wall consists of two shells that overlap and fit to like petridishes.

(v) Slime moulds.

Ans. (a) A multinucleate man of cytoplasm.

(b) The feeding stage of slime mode is a Plasmodium.

(vi) Oomycetes.

Ans. (a) Cell wall contain cellulose, not-chitin.

(b) Their may hyphae are aseptete (without cross walls).

Chapter 8

FUNGI
THE KINGDOM OF RECYCLERS

"The study of fungi is called mycology".

Q.1	***(a)***	***Define fungi. What is a hypha?***
	(b)	***What do you know about mycelium? Differentiate between septate and aseptate mycelia.***
	(c)	***What is the composition of cell wall of fungus? How is this composition beneficial for fungi?***

Ans. (a) DEFINITION:

"Fungi are heterotrophic, eukaryotic organisms which have spore bearing structure and cell wall of chitin". **(OR)**

"The achlorophyllous spore bearing organisms with cell wall of chitin which live as parasite, saporophyte and symbiont are called fungi".

HYPHAE

The long, fine and branched filament as a structural and functional unit of the fungus is called hypha. (Hyphae: Plural).

A hypha may be septate or aseptate, and uninucleated or multinucleated:

A multinucleated or uninucleated cells with cross walls are called ***Septate Hyphae***. The hyphae without cross walls are called ***Aseptate Hyphae***.

Rhizopus and *Mucor* are examples of aseptate hyphae while penicillium has septate hyphae.

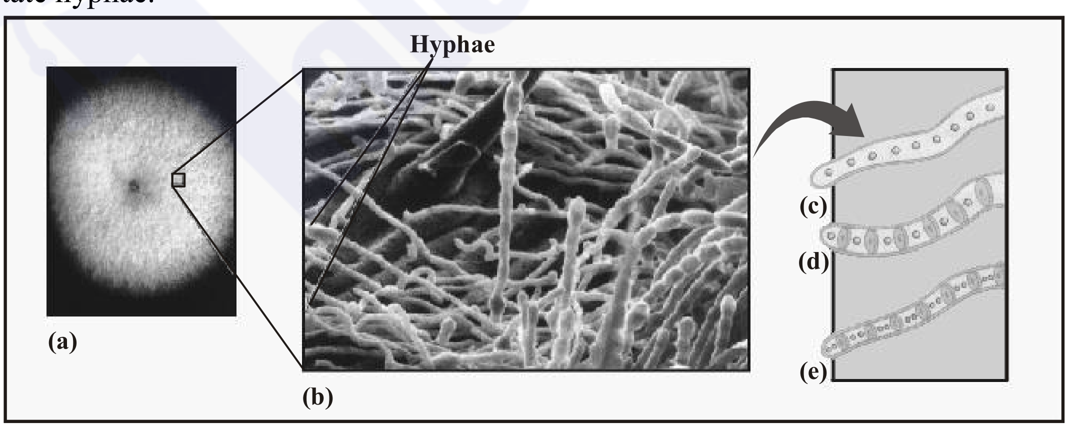


Fig. The fungus body plan: (a) Fungus mycelium growing on agar plate (b) Hyphae of mycelium (c) A coenocytic hypha (d) A septate hypha with porous speta and monokaryotic cells (e) A septate hypha with dikaryotic cell

(b) Mycelium

A group of hyphae is collectively called mycelium.

(OR)

"The interwoven hyphae in the form of fungus body is called mycelium".

The mycelium grows in between the host cells is called **intercellular mycelium**. And the mycelium grows into the cells is called **intracellular mycelium**.

The mycelium having cross walls is known as septate mycelium and mycelium without cross walls is called aseptate mycelium.

(c) Composition of Cell Wall (CHITIN)

Fungi have rigid cell wall. The cell wall is made up of CHITIN. In the cell wall chitin is present in fibrillar form. It surrounds the cells.

Chitin is N_2-containing polysaccharide.

Chemically, chitin is a *nitrogen-containing polysaccharide*.

Role of Chitin:

Chitin has tensile strength like cellulose.

It gives shape to the hyphae and prevents osmotic bursting of cells.

Chitin is a "fungal cellulose".

Due to presence of chitin, cell wall is more resistant to decay.

The cell wall is followed by **Plasmalemma**. It regulates the movement of soluble substances into and out of hypha.

Chitin facilitates the skeleton like structure, as external character of arthropods.

Q.2 (a) Write down characteristics of fungi.

(b) Discuss taxonomic status of fungi.

Ans. (a) CHARACTERISTICS OF FUNGI:

Hyphae: Hyphae are basic *structural* and *functional* units. Hyphae unite and *form mycelium* or body.

Non Photosynthetic: Fungi are *lack of chlorophyll*, so they are non photosynthetic.

Pathogens: They are pathogens of human beings, crops, animals etc.

Moisture Loving: They are moisture and dark loving.

Nutrition: Fungi can be *parasites*, *saprophytes* and *symbionts*.

No Digestion: Digestion does not take place inside the body unlike animals.

Reserve Food: Reserve food material is *glycogen*.

Decomposer: They act as decomposer like bacteria.

Non-Motile: They are non-motile and centrioles are absent.

Chitin: The presence of cell wall is a plant like character, but cell wall is made up of chitin. Chitin containing cell wall is a specific character.

Exoskeleton: Lack of cellulose and presence of chitin show resemblance to animals, specially arthropods have exoskeleton of chitin.

Different Kinds of Spores:

DNA study describes, fungi are different to animals and plants.

- **Zygospores, basidiospores, ascospores** and **conidia** are present in it.
- Fungi have **nuclear mitosis** in which nuclear envelope does not break.
- Fungi **reproduce asexually** as well as **sexually**. Fusion of gametes takes place in sexual reproduction. Asexual reproduction occurs by *spores fission*, *fragmentation* and *budding*.

(b) TAXONOMIC STATEUS

+ Plant Like Characteristics of Fungi

In the past, the fungi were included in the kingdom of plants due to following characters:

Cell Wall: Cell wall is a specific feature of plants, so fungi also have cell wall.

Lack Centrioles: No centrioles are present in plant cells, thus centrioles are also absent in fungi.

Non-Motile: They are non motile/non locomatory like plants.

+ Animal Like Characteristics

Fungi have the following features which are similar to animals:

Lack Chlorophyll: Due to absence of chlorophyll, fungi are heterotrophs. (fungi are not autotrophs).

Lack Cellulose: Absence of cellulose in cell wall, they may be considered as animal.

Presence of Chitin: Chitin is that chemical which is found as an external skeleton (exoskeleton) of arthropods.

Not Starch: Reserve food material is glycogen, not starch.

+ **Neither Plants Nor Animals**

Fungi are not plants because their cell wall is without cellulose and photosynthesis is absent. So all plants have photosynthesis and live as autotroph. While fungi live like heterotroph.

They are also not animals because cell is surrounded by cell wall and they are also non-motile while animals are always motile.

According evolutionary view, some mycologists think that fungi and animal have common ancestor.

DNA's evidence shows, fungi are different from all other organisms.

Specific mitosis is a salient feature of fungi. This is called nuclear mitosis.

"It is the mitosis in which nuclear membrane does not break. At the time of mitosis a pair of spindle pole bodies develop on opposite sides". This intranuclear spindle is made up of microtubules. The spindle pole bodies separate, move towards opposite poles and develop into two daughter nuclei. The entire nuclear mass remains still surround by nuclear envelope.

Q.3 What do you know about yeasts?

Ans. **YEASTS**

Unicellular Fungi (OR) *Non-mycelial Fungi*.

"Those fungi which have single cell stage in its life cycle and reproduced by budding or fission are called yeasts".

Characteristics of Yeast:

- They exist in ***parasite*** and ***saprophyte*** forms.
- The thallus (body) is ***non mycelial***.
- Yeasts are ***unicellular*** & *microscopic*.
- ***Chitinous cell wall*** surrounds protoplast.

- Cell wall is thin and delicate.
- Yeasts are ***heterotrophic***.
- Yeast protoplasm secretes ***zymase*** enzymes.
- Zymases change starch into simple sugars.
- During alcoholic ***fermentation***, *glucose* is broken down by yeast into *ethyl alcohol* (C_2H_5OH) and carbon dioxide (CO_2) in the absence of oxygen.
- Asexual reproduction takes place by ***budding*** and ***fission***.
- In case of sexual reproduction, ***no definite sex organs*** are found but they can reproduce by the union of two somatic cells.

Q.4 Define the following:

(i) Mushrooms	***(ii) Puff Balls***	***(iii) Yeast***
(iv) Coenocytic Hyphae	***(v) Lignin***	***(vi) Parasite***
(vii) Saprotroph	***(viii) Predator***	***(ix) Lichen***
(x) Mycorrhizae		

Ans.

(i) **Mushrooms:** The macroscopic fungi of basidiomycetes which have *umbrella like* ***pileus*** with ***gills*** and ***stipe*** are called mushrooms.

(ii) **Puff Balls:** The *macroscopic* fungi belonging to *basidiomycetes* group with *oval or ball shaped* vision are called puff balls.

(iii) **Yeasts:** Those fungi which are generally *unicellular* of *ascomycetes* and having ability to convert the glucose into alcohol and CO_2 are called yeasts.

(iv) **Coenocytic Hyphae:** (سینوسٹک ہائفی) The basic units of fungi which have *more than one nuclei*.

(v) **Lignin:** A *polymeric* substance formed from the certain *alcohlic molecules* found in cell wall.

(vi) **Parasites:** Those organisms which exist on other living bodies for food and shelter are known as parasites. (They may be *ectoparasites*, *endoparasites*, *obligate parasites* and *facultative parasites* etc.)

(vii) **Saprotroph:** (مردہ خور) An organism which obtains the food from dead materials (or dead organic materials) is known as saprotroph.

(viii) **Predation:** An interaction in which an organism destroys or ingests to other organism is called predation. An organism which ingest, destroy or kill the to other organism is called *Predator*.

(ix) **Lichen:** (لائیکن) A thallus like structure which is formed by symbiotic association between algae and fungi is called lichen. (You can say, it is a ***compound organism***).

(x) **Mycorrhizae:** (مائیکورائزا) A symbiotic association between fungi and roots of plants is known as mycorrhizae.

Q.5 Which fungus may be the largest in the world?

Ans. **LARGEST FUNGS**

Armillaria may be considered as the largest organism. It is also grown/produced rapidly. A single mycelium may produce one kilometer hypha in one day. It is a pathogenic fungus which is belonging to basidiomycetes group.

It has been measured up to 15 hectares. One hectare means 10,000 m^2.

Note: "Leafless, rootless and stemless plant body is called thallus"

Q.6 (a) What do you know about nutrition of fungi?

(b) Write notes on fungi as (i). Saprophyte, (ii). Parasite, (iii). Predators (iv). Symbiont.

Ans. **NUTRITION**

Nutrition *means feeding or being fed.*

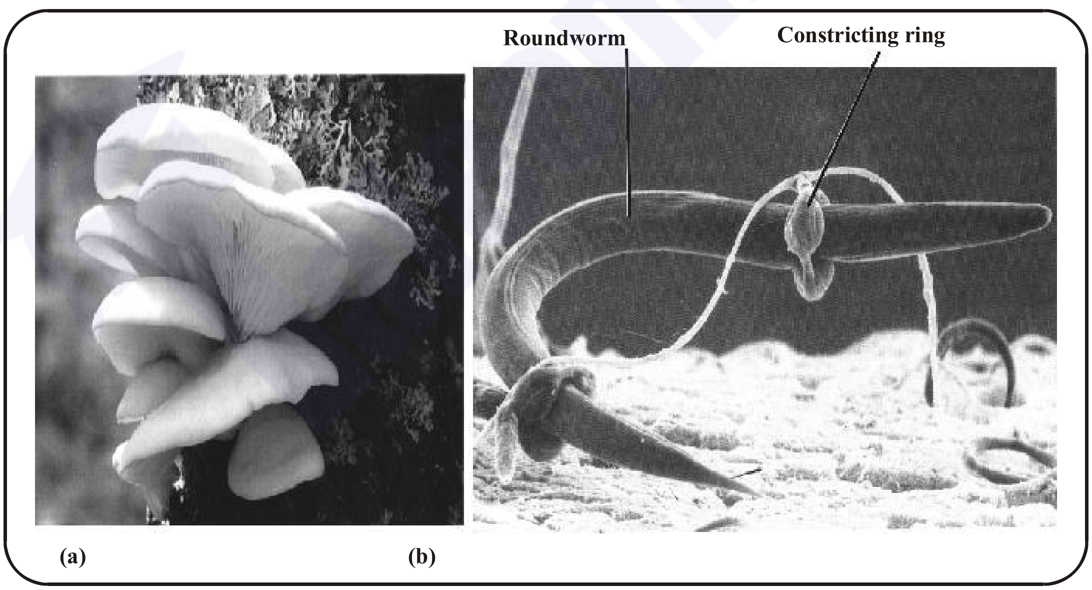


Fig. Carnivorous fungi (a) The oyster mushroom decomposes wood, and also uses nematodes as a source of nitrogen (b) A nematode is trapped in constricting ring of a soil-dwelling carnivorous fungus (Arthrobotrys sp.)

FUNGI:

Fungi are unable to manufacture their own food because of absence of chlorophyll. Absence of chlorophyll means "no photosynthesis". There is no photosynthesis means ***"organism is heterotroph"****.*

The two major kinds of heterotrophs are parasites and saprophytes while fungi heterotrophs are found in ***predators*** *form. Fungi may also survive as a partner of mutual beneficial relationship i.e.* ***symbiont****.*

(1) SAPROPHYTES (OR) SAPROTROPH

An organism which obtains the food from dead materials is known as saprotroph or saptrophyte. Saprotrophs are divided into two kinds i.e. *obligative saprotrophs* and *facultative saprotrophs*.

(i) ***Obligative saprophytes*** are those saprophytes which cannot survive without dead materials.

(ii) ***Facultative saprophytes*** are those saprophytes which can survive without dead materials. Most fungi are saprotrophs. Sometimes, saprotrophs are also called saprobes. Energy, carbon, nitrogen and food of saprotrophs is obtained from dead organic matter.

Saprotrophs as Decomposer:

Fungi are the decomposers of cellulose and lignin. Both cellulose and lignin are the main components of plant cell wall.

Keep in mind, bacteria cannot break cellulose and lignin, mostly. Saprobic fungi are the major decomposers of the biosphere.

Recycling of the elements like N, C, P, O, H etc. is occurred by fungi and bacteria. These elements are reused by living things.

Fungi secrete enzymes**,** these enzymes digest dead organic matter. So organic molecules are formed from organic matter by digestion. Then these organic molecules are absorbed back into the fungus.

Fungi anchor their hyphae into the substrate. Those hyphae which anchored into substratum are termed as *rhizoids*.

(2) AS PARASITES

"Those organisms which live on other living organisms for food and shelter are called parasites".

The fungi are found as *obligative parasites* and *facultative parasites*.

Obligative Parasites are those fungi which can grow only on their living host and cannot grow on available defined growth culture medium.

Facultative Parasites are those organisms which can grow other then specific host. In other words, these fungi have capabilities to grow on artificial growth media.

(3) AS PREDATORS

"Those organisms which ingest, destroy or kill the other living bodies, generally for nutrition are called predators".

The Oyster mushroom (*Pleurotus ostreatus*) is a predator, its preys are *nematodes*. Oyster mushrooms are *carnivores*. They may be *wood eater*. Another fungus Arthrobotrys is that predator which trap soil nematodes by constricting rings. Constricting rings are modifications of hyphae, these hyphae invade and digest the victim. Some predator secrete sticky substance which holds the prey. *The need of predators is nitrogen and glucose. They absorb the nitrogen from nematodes etc. and glucose from wood. In both cases, predators break and destroy the host*.

EASY TO DRAW

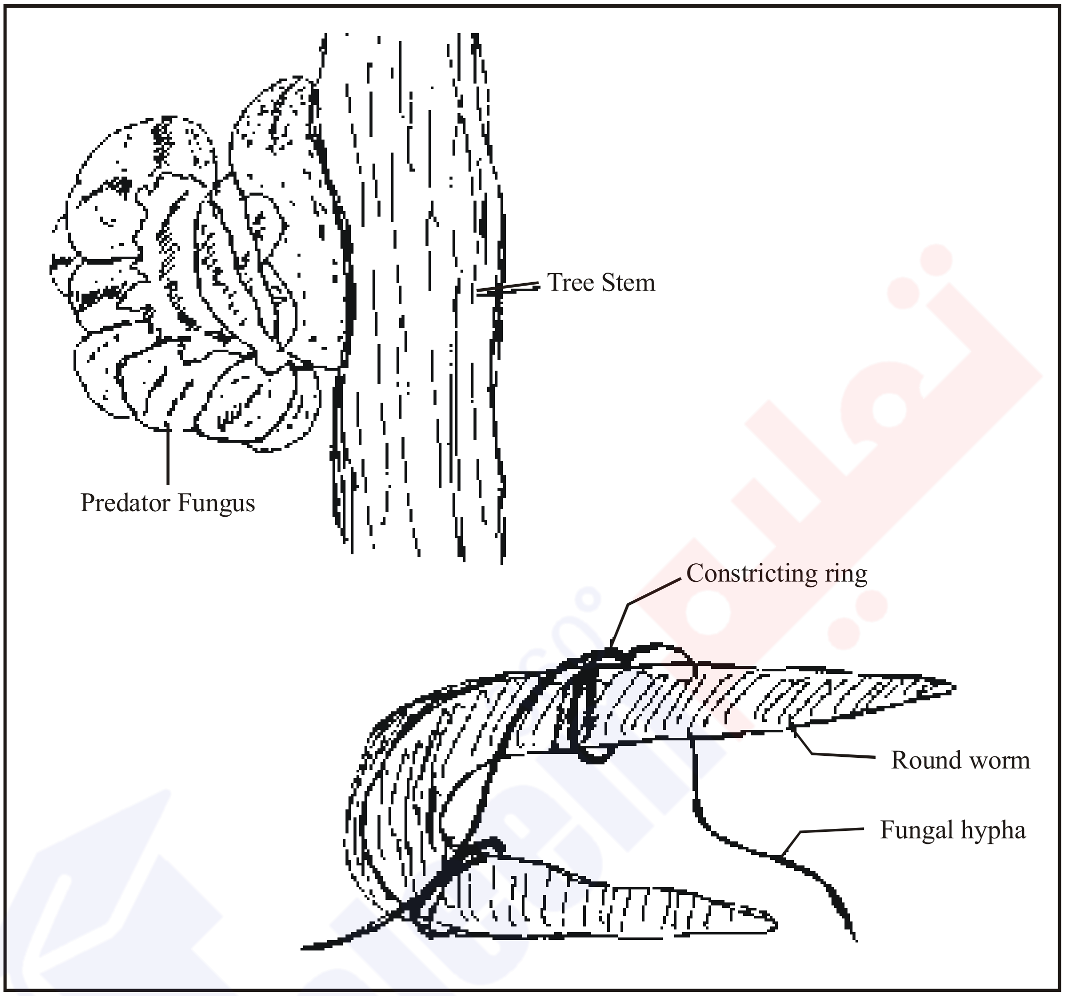


Fig. Fungi as Predator

(4) FUNGI AS A SYMBIONT (OR) SYMBIOTIC ASSOCIATION OF FUNGI:

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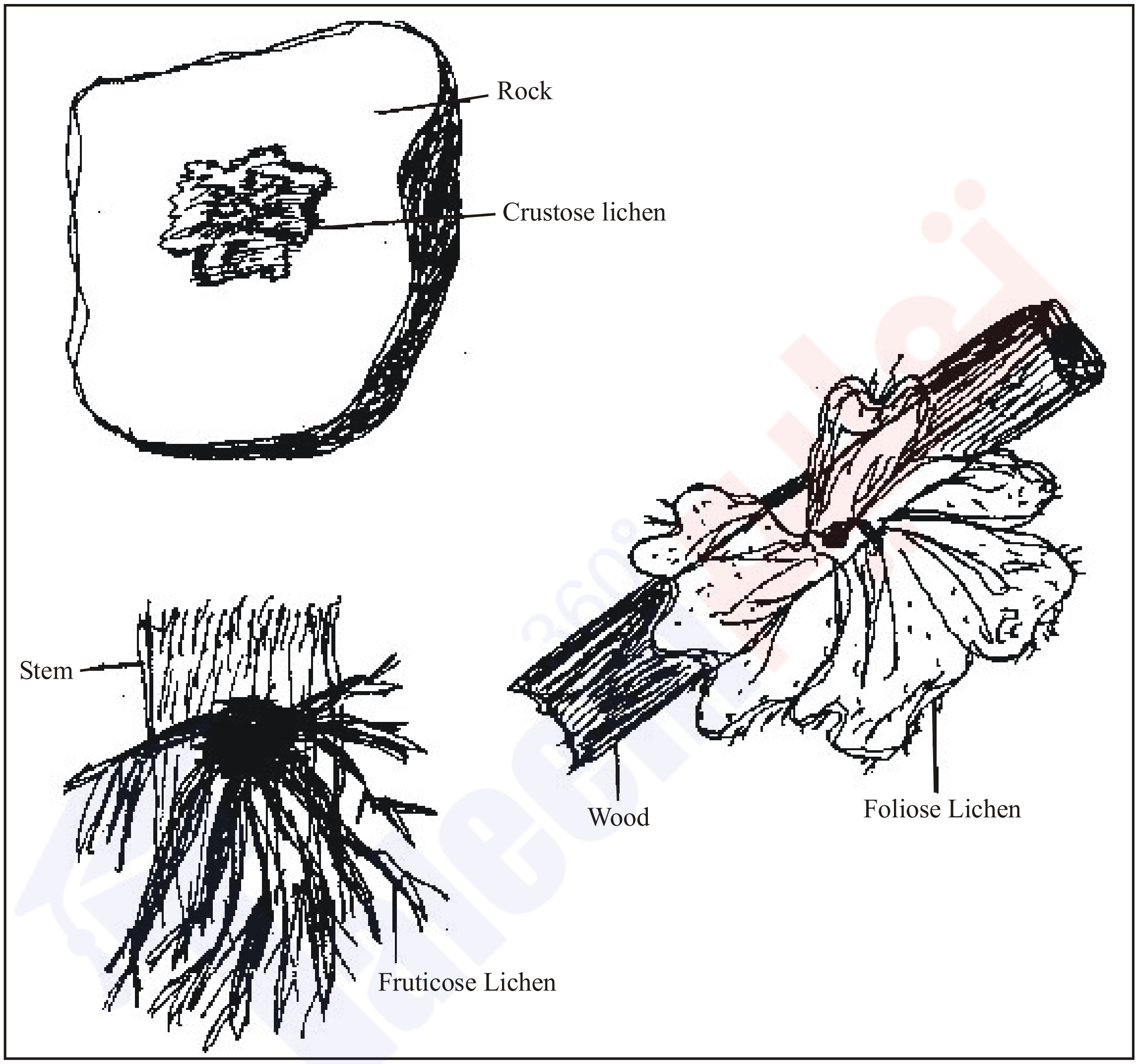

Fig. Lichens

LICHENS

These are "compound organism" of fungi and algae. They have thallus body structure.

"A thallus structure which is formed by symbiotic association between algae and fungi is called lichen".

(OR)

"A thallus which is formed by mutual beneficial relationship between algae and fungi is known as lichen".

Fungal Partner of Lichen:

Mostly *ascomycetes*, and *imperfect fungi* and *few basidiomycetes* are component of lichens.

Algal Partner of Lichen:

Chlorophyta (green algae) and *cyanobacteria* (blue green algae) are photosynthetic component of lichen.

Role of Fungi in Lichen:

In partnership, *fungi provide protection* to algal cells from strong light and desiccation. Algal cells are present within the fungal hyphae. Generally, visible part is fungi.

Role of Algae in Lichen:

Algae *give ready made food* to fungi in lichen. Actually, algae is photosynthetic or autotroph partner of fungi in lichen.

KINDS OF LICHENS

The association of algae and fungi in the lichens results in the formation of thallus type plant body. Lichens are divided into following kinds on the basis of structure or morphology.

Crustose Lichen is a crust like thallus closely adhered to substratum.

Foliose Lichen is a flat thallus like a leaf which is attached to substratum by rhizines.

Fruticose Lichen is branch like thallus.

Occurrence of Lichen:

They are found *on rocks*. Lichens grow on *bark of trees*. Some are found on soil.

Colours of Lichens:

Grey, yellow, red and ***brown*** colours are common. ***In Murree***, these are easily found.

Economic Importance:

These are *bio-indicators* of air pollution. *Drugs, food, perfumes, dyes* and *poison* are produced from lichens. *Biological weathering* also occurred by lichens.

(iv) MYCORRHIZAE

"A mutual beneficial relationship (symbiosis) between fungi and roots of plants is termed as mycorrhizae".

About 95% vascular plants have mycorrhizae (according to recent study mycorrhizae is 99% in angiosperms).

Role of Fungi in Mycorrhizal Associations:

Fungal hyphae are spread in large area of soil. *Hyphae collect phosphorus, zinc, copper and other nutrients from soil and supply to the roots of plants*. Due to this function fungal symbionts are called bio-fertilizers. This symbiotic relationship provides good facility for better growth.

Role of Roots in Mycorrhizal Association:

Plants are autotrophs while fungi are heterotrophs, so *plant roots donate food to fungi*. Plants supply organic carbon to fungi too.

Kinds of Mycorrhizae:

Generally, mycorrhizae are divided into two kinds:

(a) Endomycorrhizae (b) Ectomycorrhizae

(According to the latest research mycorrhizae have almost nine kinds)

(a) Endomycorrhizae:

Endomycorrhizae are that kind of mycorrhizae in which ***hyphae enter in the root cells*** and modified into branches, coils (arbuscules) and swellings (vesicles).

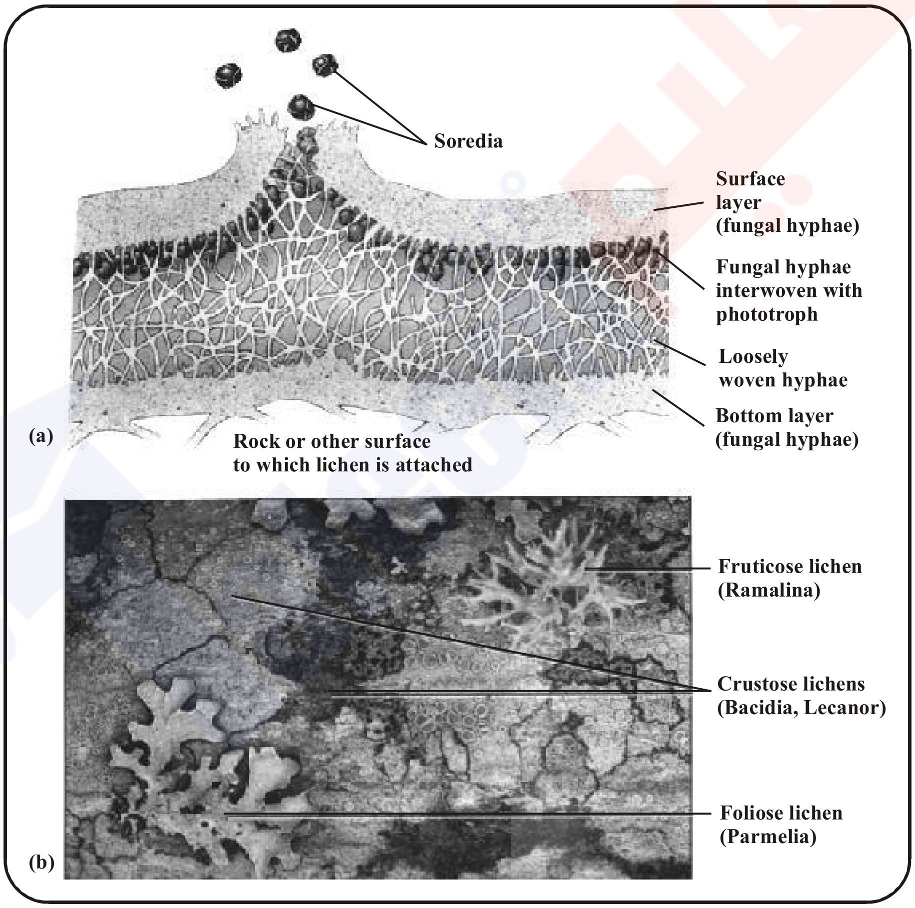

Fig. Lichens (a) Cross section of a typical lichen showing different layers. (b) Different types of lichens varying in size, colour and appearance. Three growth forms – crustose grow tightly attached to rocks, tree tranks etc; foliose are leaf – like, fruticose are branching.

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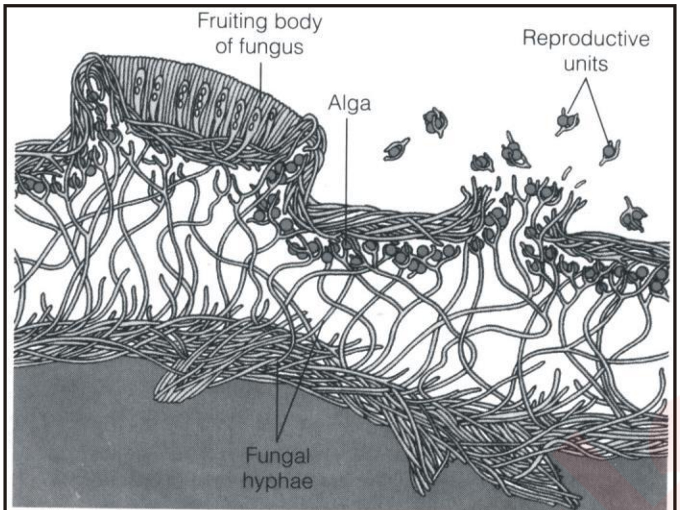


Asexual reproduction of a lichen

(b) Ectomycorrhizae:

Ectomycorrhizae is that mycorrhizae in which ***fungal hyphae surround the outer cells of roots but do not enter*** in the cells". It is common in pines and firs etc. The extended hyphae or mycelia are found all around the soil for collection of nutrients.

Importance of Mycorrhizae:

Endomycorrhizae ***enhance the growth*** of plants. They act as ***bio-fertilizers***.

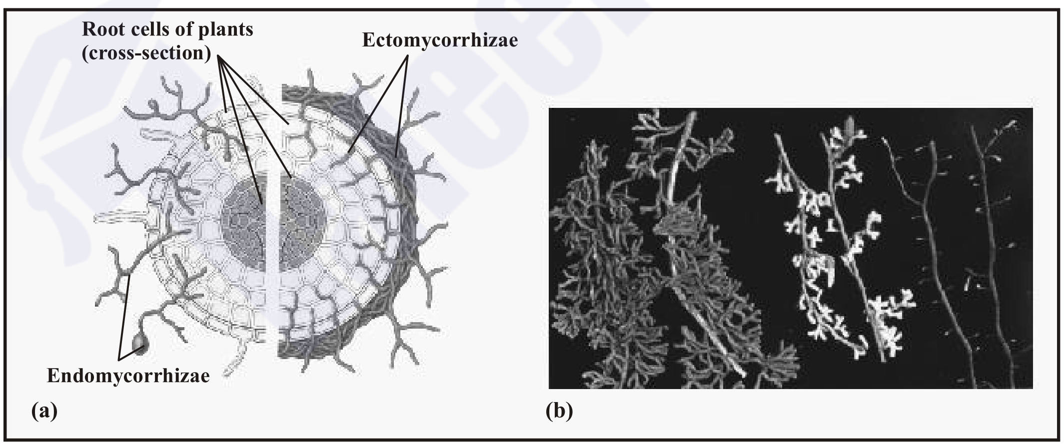
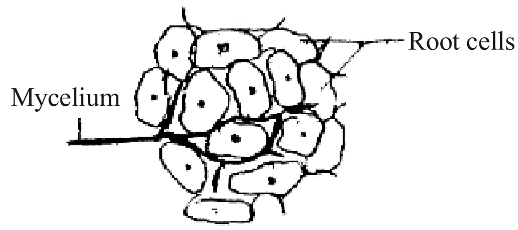


Fig. Endomycorhizae and ectomycorrhizae. (a) endomycorrhiza (left side of figure), fungal hypae penetrate and branch out in a root cells. In ectomycorrhiza (right side of figure), fungal haphae simply grow around but do not penetrate the root cell (b) Ectomycorrhizae on roots of pines.

EASY TO DRAW

(a) Interacellular Mycelium



(b) Inter-cellular Mycelium

Q.7 (a) Discuss the parasitism of fungi.

(b) What do you know about saprotroph?

(c) Write a note on lichen.

(d) What is mycorrhizae? Describe its kinds.

Ans. Consult relevant topics and prepare assignment.

Q.8 Where fungi grow? Discuss briefly.

Ans. **HABITATS OF FUNGI**

- Generally, fungi are ***moist*** *and* ***dark loving***.
- They grow in ***organic matter*** *habitats*.
- They have wide temperature range.
- They tolerate from 2-9 pH.
- In sugar or salt (in jam/jelly), they have high osmotic-pressure.
- They can grow *as* ***parasites*** of man, plants and animals.
- They are also found as ***saprophytes*** and ***symbionts***. Fungi also have land adaptations.
- ***Glycogen*** and ***oil droplets*** are reserve food materials in fungi.

EXAMINE YOURSELF

Q.9 Differentiate between followings:

(i) Septate and aseptate mycelium

(ii) Ectomycorrhizae and endomycorrhizae

(iii) Parasites and saprotrophs

(iv) Mushrooms and puff balls.

(v) Lichen and mycorrhizae

(vi) Obligate and facultative parasites.

(vii) Foliose and fruticose lichens.

(viii) Ascomycetes and Basidiomycetes

(ix) Zygomycetes and Deutromycetes

Ans. Consult different topics of this chapter and prepare this assignment.

Q.10 (a) Discuss asexual reproduction in fungi.

(b) What do you know about sexual rep. in fungi?

Ans. **ASEXUAL REPRODUCTION**

All group of fungi reproduce asexually. Sexual rep. is found in three groups while imperfect fungi (deutromycetes) have no sexual reproduction.

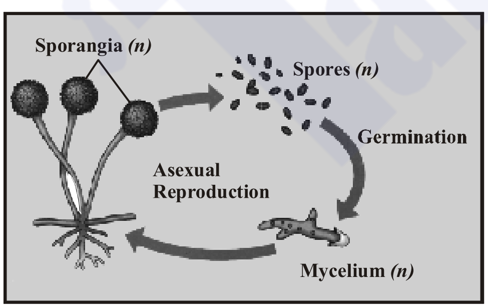


Fig. Spores are released from sporangia and germinate to produce new hypae

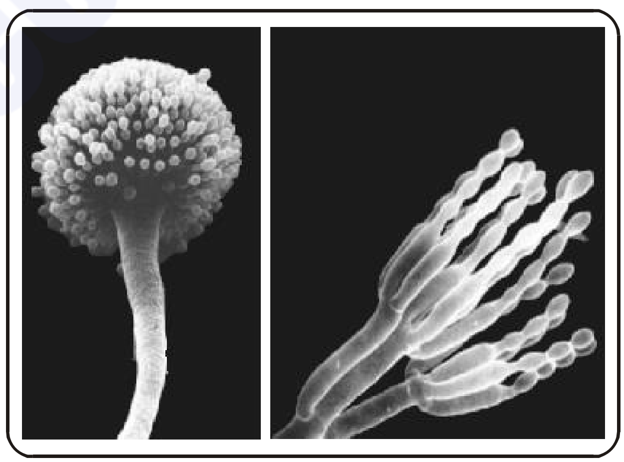


Fig. Conidia cut off at the tip of conidiophores in clusters chains

Asexual reproduction takes place by *spores, conidia, fragmentation* and *budding*.

(i) By Spores:

Spores are asexual reproductive cells which may grow into new body. They are formed in asexual reproductive structures i.e. *sporangia*.

The formation of spores occur by sexual and asexual process in reproductive structures i.e. sporangia. Sporangia are present on hyphae with complete septa. The sporangia are saclike structures.

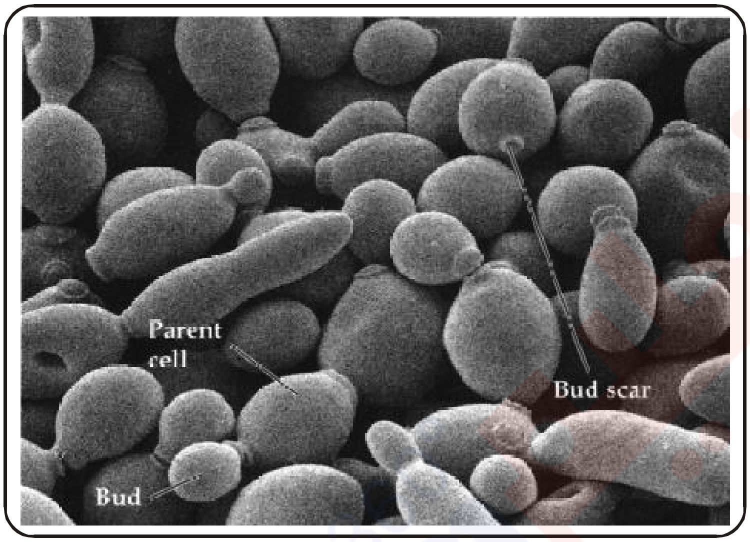


Fig. Micrograph shows yeast (Saccharomyces cerevisiae) in various stages of budding

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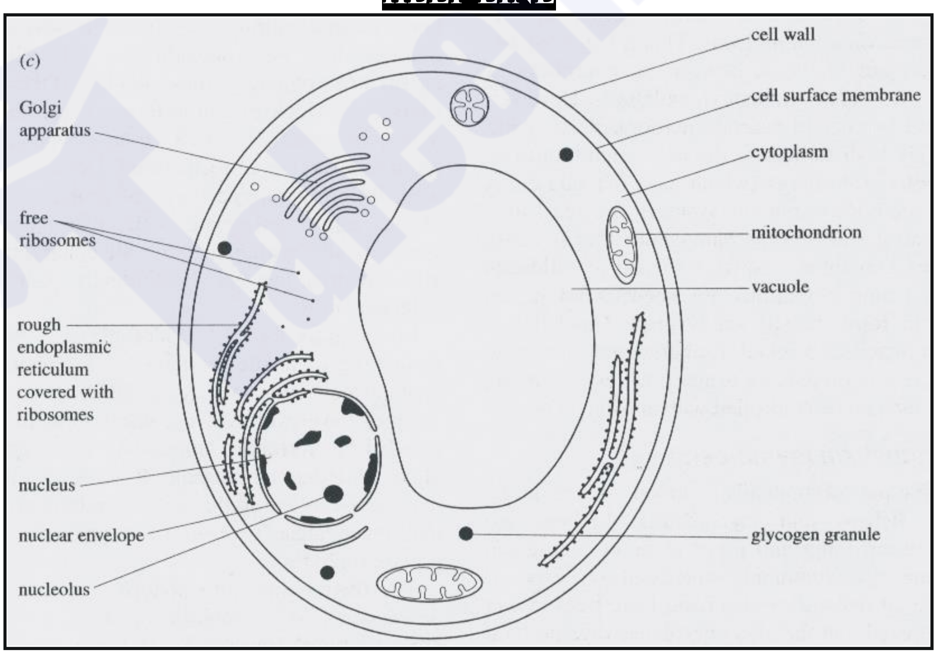

Fig. Slowing yeast

Spores may be uninucleate, multinucleate and non-motile. Non motile spores are also called Aplanospores.

Spores are formed from vegetative body of various processes other than sexual process. Sometimes, these are called *asexual spores*.

When spores fall on suitable place, they grow. It is the general mean for reproduction of fungi. It is the rapid method. Spores of fungi not required water for dispersal. They are dispersed by wind, animals, insects and rain etc.

CONCEPTUAL CHART

Certain spores are produced by sexual methods:

(i) Zygospores

(ii) Ascospores

(iii) Basidiospores

These are called sexual spores.

CONIDIA: *"The non-motile, asexual spores which are not formed in sporangium but develop singly or in chain on hypha are called conidia".*

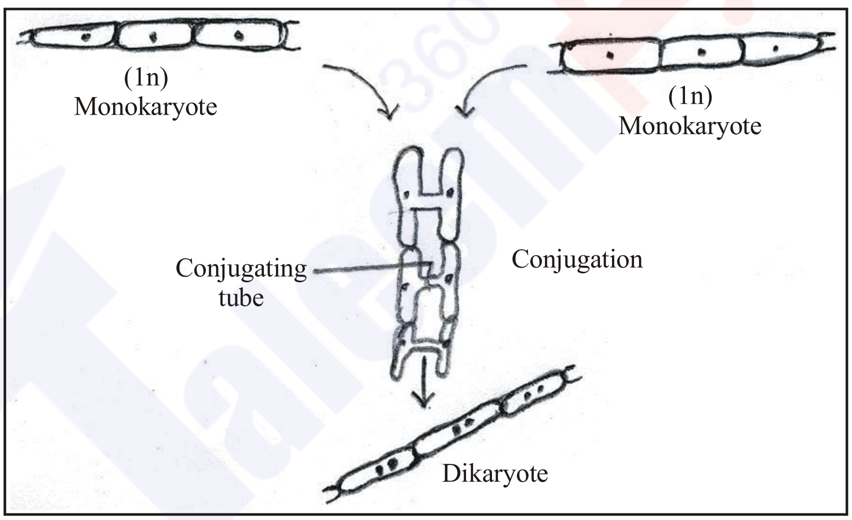

Fig. Showing dikaryotization

Conidia are different to spores, because conidia are not produced in sporangium. The specific hypha on which single conidium or cluster or chain of conidia developed is called Conidiophore. Conidia may be produced in large number. They can survive many days.

By Fragmentation: The kind of asexual reproduction in which certain hyphae break from mycelium and develop into new mycelium or individual is called fragmentation.

In other words, the division of a vegetative body into one or more fragments each of which grows into a new individual.

By Budding: The kind of asexual reproduction in which development of small outgrowth is occurred as a bud from vegetative body. This bud is separated and grows into new individual.

* (Vegetative means asexual or body)

Sexual Reproduction: Sexual reproduction in fungi involves the union of two nuclei of different genetics. This process has particular sequence.

(i) ***Plasmogamy:*** Union between the two protoplasts is called plasmogamy. During plasmogamy two nuclei come close to each other for mating.

(ii) ***Karyogamy:*** Union or fusion of two nuclei is called karyogamy.

In zygomycetes fusion of cytoplasm (plasmogamy) and fusion of nuclei (karyogamy) occur immediately. But in case of basidiomycetes and ascomycetes, karyagamy is delayed after plasmogamy. In this way, two nuclei of different parent cells and genetic constitution co-exist in same hypha. When two nuclei of different genetic type co-exist is called dikaryon. The hypha which contains two nuclei is called dikaryotic hypha. Two nucleated (dikaryotic) hypha is also called ***heterokaryotic*** hypha. This condition is found long time in the life, generally. Haploid cell or hypha becomes diploid by karyogamy.

MEIOSIS: After karyogamy, meiosis takes place. Thus diploid condition is changed into haploid by meiosis. In this way, sexual spores are formed. Ascospores & Basidiospores are formed in specific structures. A sac like structure in which 8 ***ascospore*** are formed i.e. Ascus. A group of ***ASCI*** in a special body is called ***ASCO CARP***. This is the specific character of ascomycetes (sac fungi).

Basidiospores are sexual spores of group ***Basidiomycetes***. "Those sexual spores which are formed is ***basidium*** are called ***basidiospores***. Basidium is a particular structure on which 4 basidiospores are formed. A group of ***basidia*** is known as basidiocarp.

Phylum	Typical examples	Sexual reproduction	Asexual reproduction	Hyphae
Zygomycota (zygomycetes)	Rhizopus (black bread mould) Pilobolus (splitting fungus)	***Zygospores***	Non-motile spores form in sporangia	Aseptate (non septate) multinucleate
Ascomycota (ascomycetes or sac-fungi)	Yeasts, Morels, truffles, powdery mildews, moulds.	***Ascospores*** inside sac-like asci	Conidia cut off from tips of conidiophores.	Septate, lengthy dikaryotic phase

Basidiomycota (basidiomycetes or club fungi)	Mushroom, rusts, smuts, puff balls, bracket fungi.	***Basidiospores*** borne on club shaped basidia	Uncommon	Septate, lengthy dikaryotic phase
Deuteromycota *(deuteromycetes imperfect fungi)*	*Aspergillus, Penicillium, Alternaria*	*Sexual phase has not been observed*	*Conidia*	

Q.11 Write a note on zygomycetes (or) conjugating fungi.

(OR)

Which type of fungi are included in zygomycetes OR zygomycota?

(OR)

What are the characteristics of zygomycetes?

Ans. ZYGOMYCETES

"A kind of fungus in which zygospores are formed is called zygomycetes".

Examples: Rhizopus (black mold) and ***Mucor***.

NUTRITION: They are *saprob* generally.

SUBSTRATUM: Mostly grow ***on decaying animals*** *and* ***plants***. They are also grown *on bread*, cooked food and dung.

MYCELIUM: Mycelium is ***aseptate*** and ***branched*** generally. There are grey and white *coeocytic* hyphae.

ASEXUAL REPRODUCTION: In zygomycetes, asexual reproduction takes place by non motile spores i.e. ***aplanospores***. Spores are produced in sporangium. Asexual spores germinates into new mycelium.

SEXUAL REPRODUCTION:

Sexual reproduction occurs due to presence of *zygospores*.

These are sexual spores. Zygospores are formed by conjugation process.

When strain or hypha strain or gametes or hyphal fuse together then zygospore is formed.

This *zygote* is modified into *zygospore*.

Meiosis takes place when zygospore germinates and haploid spores are formed.

"Due to presence of conjugation and zygospore formation, they are called conjugating fungi or zygomycetes".

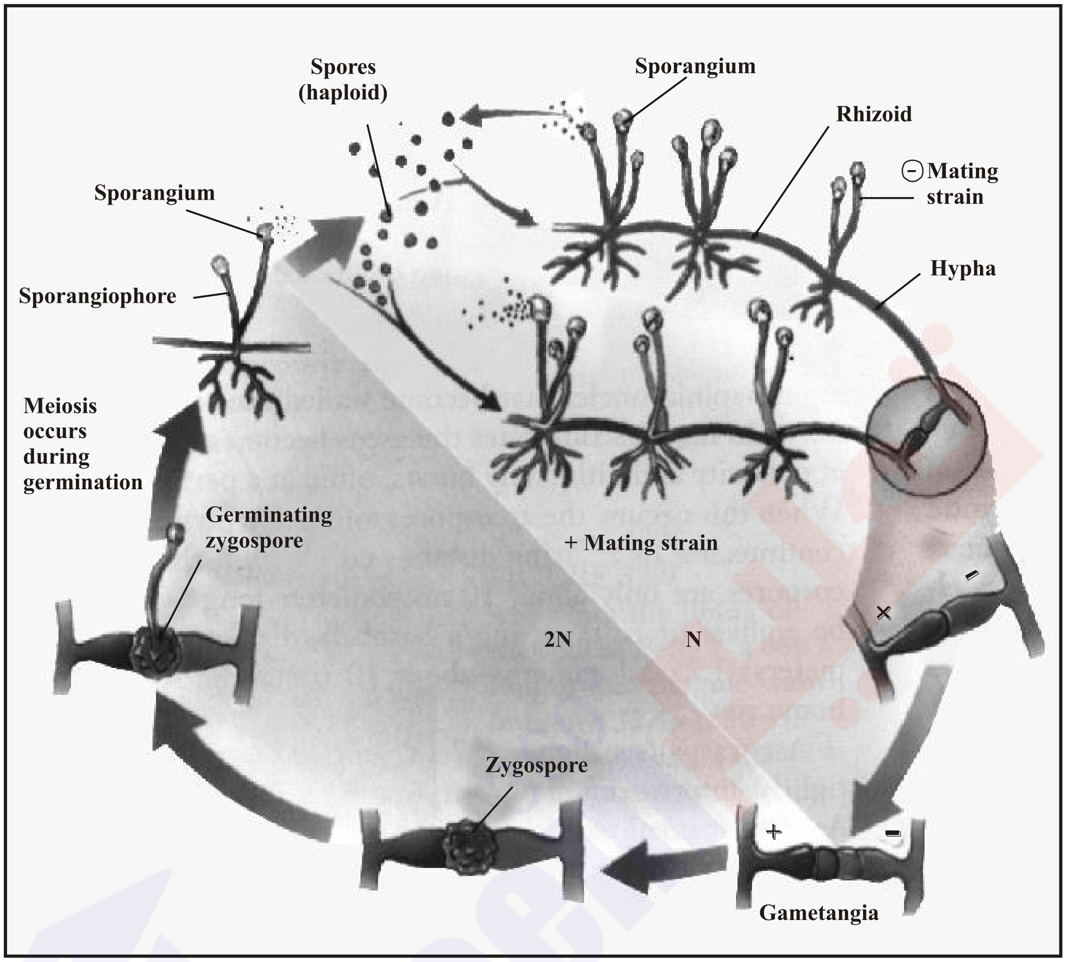

Fig. Life cycle of Rhizopus (black bread mould), a Zygomycete. Zygote formed by fusion of gametangia directly develops into a resulting zygospore.

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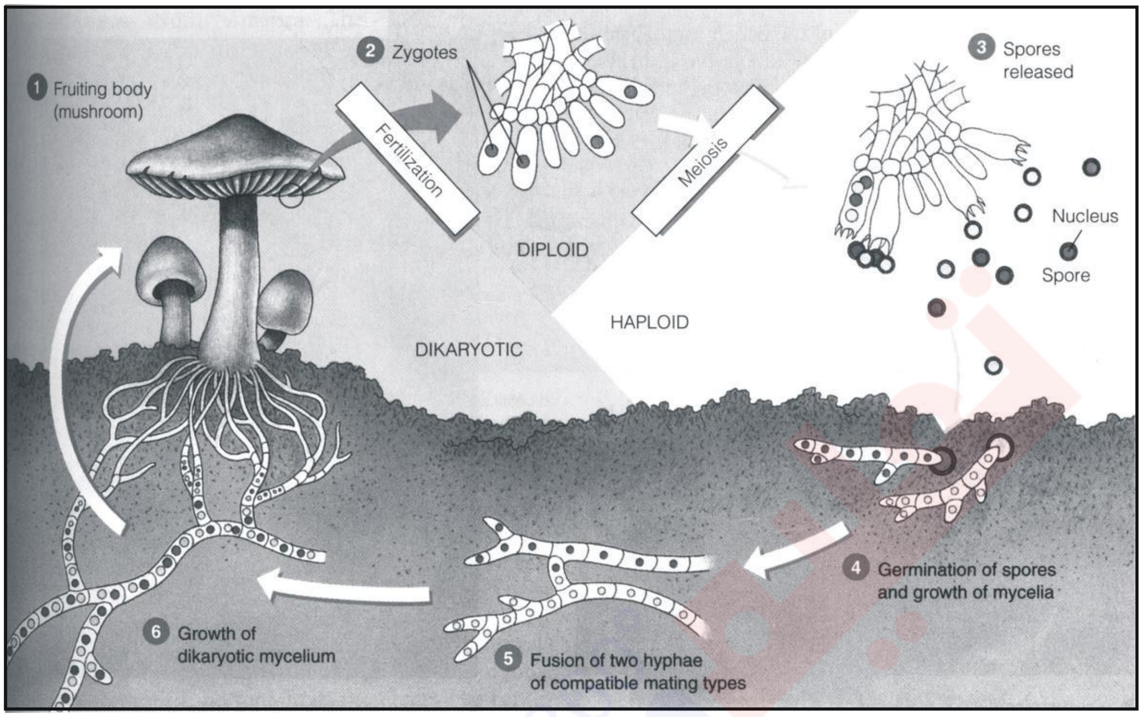

Q.12 (a) Define Ascomycetes, Ascus and Ascocarp.

(b) Give the salient features of ascomycetes.

Ans. (a) ASCOMYCETES

"Those fungi in which ascospores are found in asci (ascus) called ascomycota".

The most important feature of the ib (ascomycetes) is *saclike ascus* in which ***8 ascospores*** are present.

A group of asci in the form of fruiting body is called ascocarp.

(b) GENERAL FEATURES:

Largest Group: It is the largest group of fungi with 60,000 species.

50% Symbionts: About 50% are partners of lichen, *symbiont* in mycorrhizae and morels.

Terrestrial and Aquatic: Ascomycetes are terrestrial mostly but few are in marine and fresh water.

Unicellular and Multicellular: They are unicellular (yeast) to multicellular.

Parasites: Mostly parasites within host, only powdery mildews show ectoparasite condition (upon the surface).

Septate Mycelia: Branched mycelia with cross walls i.e. septate. They have *lengthy dikaryotic phase*.

Ascospores, Ascus, Ascocarp: *Eight ascospores* (sexual spores) are formed in ascus. A fruiting body with a group of asci is called ascocarp. Ascocarps may be cup or flask shaped and spherical shaped.

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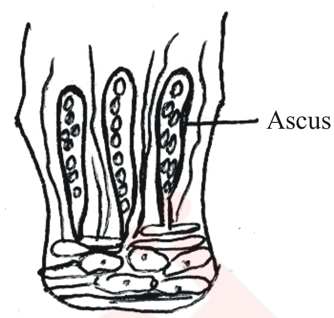


Fig. Ascocarp

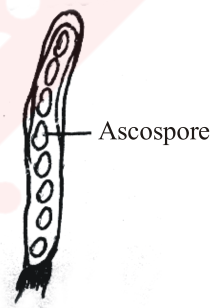


Fig. Ascus

Ascospores are haploid (IN), because they are formed by meiosis.

Asexual Reproduction by Conidia and Budding

Asexual reproduction takes place by non motile conidia. Conidia are naked spore which produced conidiophore.

Unicellular yeast are also members of ascomycetes. Yeast are asexually reproduced by budding.

Sexual Reproduction by Ascospores

Sexual reproduction occurs by ascospores in both multicellular and unicellular (yeasts).

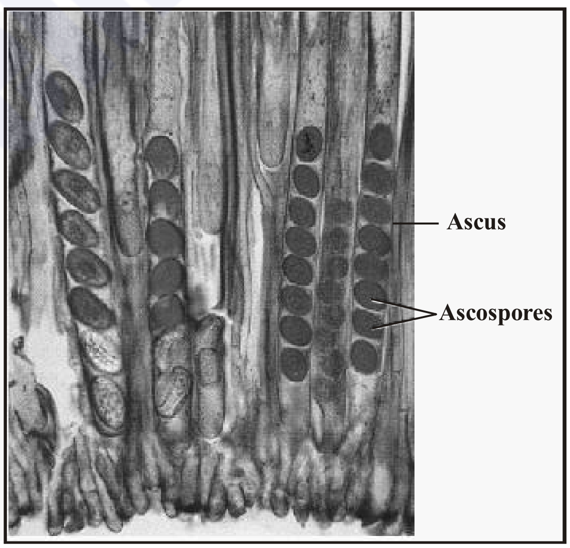


Fig. Asci and Ascospores. Each ascus contains eight haploid ascospores.

Q.13	***(a)***	***What is Basidium? What is Basidiocarp?***
	(b)	***What are basidiospores and how do they form?***
	(c)	***What are particular characters of basidiomycetes?***

Ans. (a) BASIDIUM

"A sexual reproductive structure in which sexual spores i.e. basidiospores are formed, called basidium".

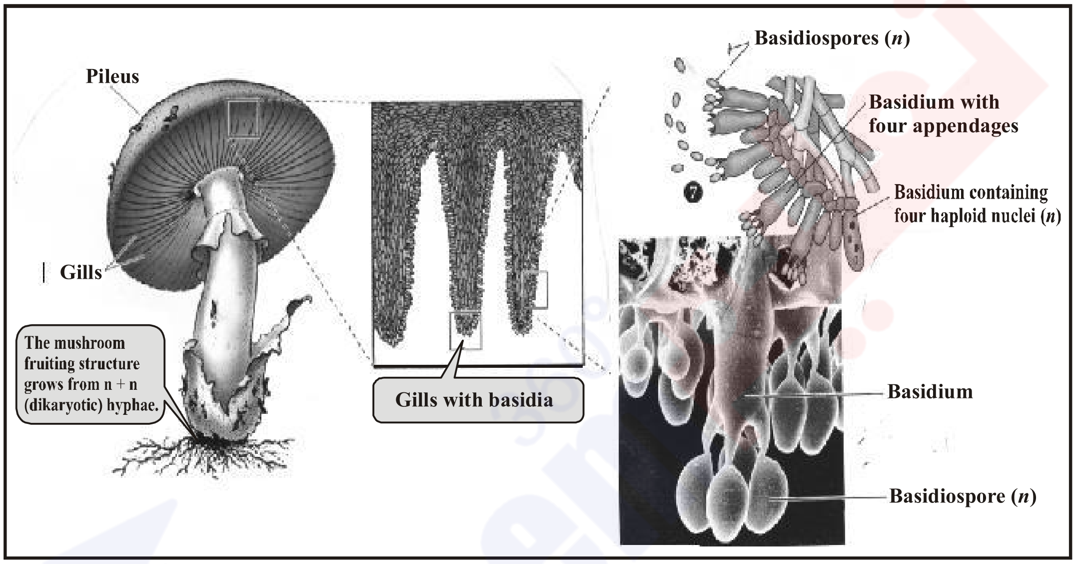


Fig. Basidiomycetes. A mushroom's fruiting structures. The gills on underside of mushroom's cap are lined with basidia, on which basidiospores are produced.

EASY TO DRAW

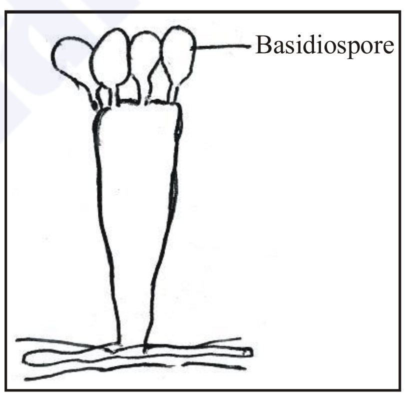


Fig. Basidiocarp

(b) BASIDIOSPORES:

"The haploid sexual spores which formed by basidium after meiosis are called basidiospores".

(c) GENERAL CHARACTERS OF BASIDIOMYCETES

Common Examples:

Mushrooms, (Edible)

Puff Balls

Bracket/club fungi

Rust and *smut* are the common and familiar names of basidiomycetes.

Basidiospores: Basidiospores are chief distinguished features. Four haploid spores are found in each basidium. Basidiospores are those sexual spores which are reason of the name of "Basidiomycetes".

Basidium: Sexual reproductive structure is called basidium.

Septate Mycelium: Septate branched mycelia are found in this fungi.

Primary Mycelium: Primary myecleim which develops from basidiospore is uninucleated cells. Basidia never develop on uninucleate mycelium.

Dikaryotization: When two hyphae of uninucleated cells fuse then dikaryotic mycelium or secondary mycelium is formed. It is the long phase of life cycle.

The conversion of primary mycelium into secondary mycelium is called Dikaryotization.

Fruiting body remains dikaryotic while whole body of mushroom is dikaryotic.

Q.14 What are rust and smut and how smut attack on wheat?

Ans. RUST AND SMUT:

Puccinia sp. is most common member of basidiomycetes which causes rust disease in different plants.

Ustilago tritici is most common smut fungus. It causes smut disease i.e. loose smut in wheat.

The ***teliospore*** of *Ustilago tritici* carried by wind.

Teliospore attacks on healthy flowers of wheat.

It *germinates on flower* and *mycelium penetrates in the ovary* of flower.

Mycelium grows inside ovary and then becomes dormant in seed.

As soon as, seed germinates the mycelium also start germination, plant and mycelium germinate together.

At last, smut spores are **formed in the kernal** (kernel). These spores destroys the kernel completely.

The covering of the wheat grains breaks exposing the black spores i.e. smut spores which may attack again.

(*Generally, rust and smut have not basidiocarp*).

Q.15 (a) What do you know about rusts and smuts?

(b) What is dikaryotization?

(c) What are teliospores?

Ans. (a) Rust and Smut (See answer in previous Q.)

(b) Dikaryotization

*It is **binucleated condition of hypha of basidiomycetes***. It is ***lengthy phase*** of life cycle. The whole mushroom body contains dikaryotization.

In beginning, primary mycelia with uninucleated hyphae fuse and form dikaryotic hyphae or mycelia.

(c) Teliospores

"The thick walled resting spores which are found in rusts and smuts are called Teliospores".

Teliospores are carried by wind.

They attack on healthy flower from infected plant.

Mycelium enters in ovary then teliospore remains dormant (resting) within seed.

In next season, when seed of wheat is sown, it grow within plant, and ultimately attack on kernel.

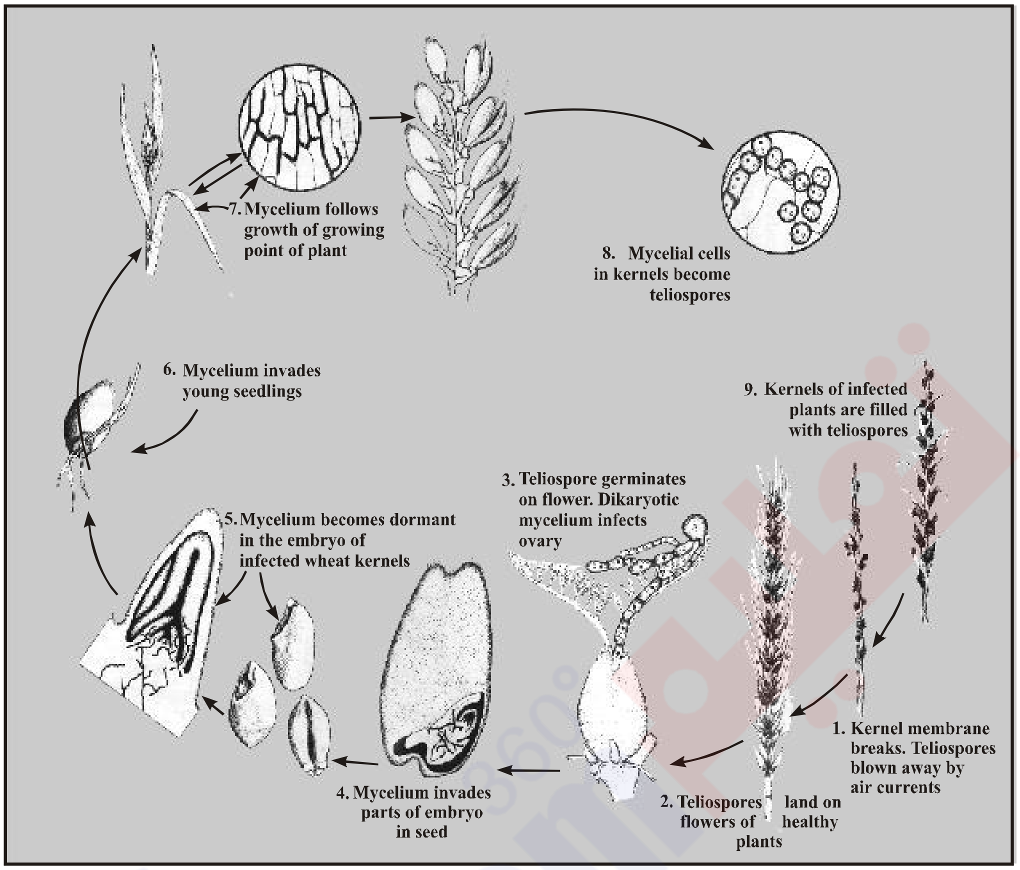


Fig. Disease cycle of loose smut of wheat caused by a club – fungus (Ustilago tritici)

Q.16 What is cell wall? Which kinds of cells are found in different organisms?

(OR)

Q. What do you know about cell wall? What are different chemical compositions in bacterial cell wall, fungal cell wall and plant cell wall?

Ans. **CELL WALL**

"Cell wall is the outer covering of a plant cells, fungal cells, algal cells and bacterial cells".

This external covering contains different chemicals in different kingdoms. Four kingdoms (Monera, protista, fungi and plantae) have cell wall as external covering. *Only protozoa group of protista is without cell wall in these four kingdoms. Kingdom animalia is only one kingdom in which cell wall is absent.* "The cell wall is secreted by protoplasm".

General chemicals of different kinds of cell walls are:

Cellulose (polysaccharides)	Lipids,Liposaccharide
Lignin	Proteins, lipoprotein
Suberin	Murein (*peptidoglycan*)
Cutin	Chitin (*N_2 containing proteins*)
Silica	Techoic acid
Inorganic salts	

CONCEPTUAL KEY

Cell Walls
- Cellulosie ⇨ (In Plants)
- Murein ⇨ (In Bacteria)
- Chitin ⇨ (In Fungi)

PLANT CELL WALL

Cellulose is the major chemical of plants cell wall.

- Cellulose is polysaccharide of carbohydrates.
- *Lignin, suberin, silica, cutin* and *inorganic salts* are additional chemicals of cell wall.

BACTERIAL WALL

Murein:

(*Peptidoglycan*) is the major chemical of bacterial wall.

- Murein is a compound of ***proteins plus carbohydrates***.
- Lipopolysaccharides, lipoproteins, techoic acid and lipotechoic acids are also in different cases.

FUNGAL CELL WALL

Chitin is the major chemical of fungal cell wall.

- Chitin is nitrogen containing proteins.
- Insoluble glucan element is additional one.

SHORT QUESTIONS

Q.1 *Why do some fungi are called "Rust Fungi"?*

Ans. **RUST FUNGI**

Members of fungi (teliomycetes) belonging to basidiomycota have reddish brown spores.

Due to these reddish brown spores these fungi are popularly called Rust Fungi-Brown pustules on the stems and leaves provide rusty appearance.

Q.2 *What are differences between spore and conidium?*

Ans.

SPORE	CONIDIUM
(i) Spore is an asexual, reproductive cell, formed in sporangium.	(i) Conidium is an asexual reproductive cell which formed on mycelium *without sporangium*.
(ii) It may be motile and non motile.	(ii) It is always non motile.
(iii) Spores are found in all types of plants, algae and fungi.	(iii) Conidia are found in fungi.

Q.3 *Why do deuteromycetes are famous as imperfect fungi?*

Ans. *Because of the absence any sexual phase*, these fungi are commonly called "Imperfect Fungi".

These are imperfect, because sexual spores like ascospores, basidiospores and zygospore are absent in it. But, they can reproduce asexually by conidia.

Q.4 *What are the differences between Rust and Smut?*

Ans.

RUST	SMUT
(i) Attack on stems and leaves.	(i) Attack on grains of inflorescence.
(ii) *Rusty appearance* may be red, yellow, orange and black etc.	(ii) Grains transform into *black powdery mass* or black dusty masses.
(iii) Caused by *Puccinia* spp.	(iii) Caused by *Ustilago* spp.

Q.5 Key out the summary of fungal classification.

Ans.

CONCEPTUAL KEY

Kingdom Fungi

(1) Zygomycota
Zoospores absent and Zygospores present

(2) Ascomycota
Zoopores & Zygospores absent, Ascospores present

(3) Basidiomycota
Biosidomycospores present (Basidiospores)

(4) Deuteromycota
Zygospores, Ascospores & Basidiospores are absent

Q.6 Which fungi have teliospores and where they rest/dormant?

Ans. TELIOSPORES AND DORMANCY OF TELIOSPORES

The member of basidiomycetes which causes rust and smut in different plants have teliospores. The rust and smut are belonging to teliomycetes class of basidiomycetes.

In case of smut fungi (Ustilago sp.), teliospores attack on flower (inflorescence) and penetrates its mycelium into ovary. They remain resting/dormant in ovary of seed upto next growing.

Q.7 Why myoxomycetes (slime molds) and oomycetes (water molds) have been excluded from true fungi?

Ans. REASON OF EXCLUSION OF SLIME MOLOS AND WATER MOLDS FROM FUNGI

(i) Myxomycetes and oomycetes are *without chitin* in cell wall. For the membership of fungi or true fungi chitin is essential in cell wall.

(ii) Slime molds and water molds *have centrioles* but centrioles are absent in fungi. Thus these two major features are the reason to expulsion of myxomycetes and oomycetes from fungi. Now, these are included in kingdom protista i.e. fungi like protists.

Q.8 (a) Write general features of deuteromycetes.

(b) What do you know about penicillium?

Ans. ***"Fungi without perfect stage or without sexual phase are included in Deuteromycota or imperfect fungi".***

DEUTEROMYCETES:

- ***Imperfect fungi*** means *fungi without zygospores, ascospores and basidiospores*.
- Fungi placed temporary in deuteromycetes, after discovery of sexual phase, organisms are shifted to their proper group.
- Mycelium consisting of well developed, branch and ***septate hyphae***.

Reproduction:

- ***Sexual reproduction absent***. Asexual reproduction occurs by asexual spores i.e. conidia.
- ***Conidia*** are non-motile asexual spores. They may be elongated, spherical or curved. They are not produced in sporangia. Conidia are directly produced on ***conidiophores***.
- Classification of Deuteromycetes also depends upon the basis of DNA sequence.

Examples:

Penicillium	*Fusarium*
Aspergillus	*Helminthosporium*
Alternaria	

(b) PENICILLIUM

Penicillium sp. is also called ***blue or green molds***. It is saprotrophic. Pencillium is ***found on bread and decaying food***.

Branched and Septate: It has septate hyphae which are branched.

Distribution of Conidia: Its conidia are present almost everywhere in the air.

Vegetative Reproduction: Vegetative mycelium breaks up into two or more fragments, each develops into a new mycelium.

Asexual Reproduction: Conidia developing on conidiophores are the means of asexual reproduction. Conidiophores are branched. Conidiophore branches terminate into clusters. Cluster is brush like structure.

Color (Blue or Green): The color of fungal colony is due to conidia.

Economic Importance: ***Penicillium notatum*** is used for production of ***antibiotic penicillin***.

EASY TO DRAW

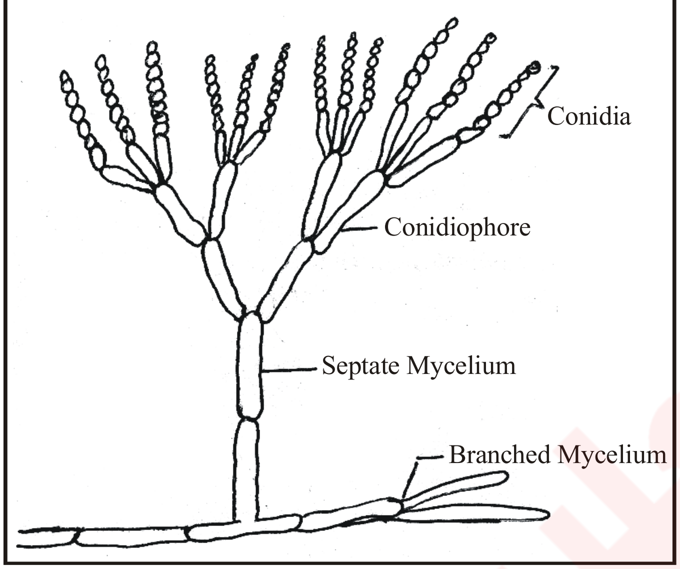


Fig. Penicilium

BENEFICIAL FUNGI

Q.9 What are ecological benefits of fungi?

OR

Give ecological importance of fungi.

Ans. Fungi are very important as **decomposers** and ***symbionts***, so they have great ecological importance.

In following three ways, fungi may be economically important.

(i) Mycorrhizae:

The mycorrhizal fungi improve the growth of plants with which they are associated. The vascular plants (95%) have such a kind of association.

(ii) Lichens:

The lichens growing on rocks break them during the course of ecological succession. They are very good biondicators of air pollution as they are highly sensitive to pollution.

(iii) Bioremediation:

Some fungi are also used for bioremediation. They degrade and thus remove poison and pollutants of organisms, from the environment.

Q.10 What are the commercial benefits of fungi? (OR)
Write down commercial importance of fungi.

Ans. **COMMERCIAL IMPORTANCE**

Following are the commercial benefits of fungi to human beings.

(i) As Edibles:

(a) Certain fungi are edible. About 200 species of mushrooms such as *Agaricus* sp., *morels* e.g., *Morchella esculenta*, truffles like tuber sp. are among the most common fungi.

(b) Some mushrooms are poisonous such as toads tools like *Amanita* (may also be called as death cap or death angel) and jack-O lantern mushrooms.

(c) The reindeer moss (actually a lichen) is used as food for reindeer and some large animals in arctic, sub-arctic and boreal regions of world.

(ii) Use in Food Industry:

Certain fungi are used in food industry:

(a) Because of the **fermentation ability**, yeasts like Saccharomyces cerevisiae are used in the production of bread and liquor.

(b) Penicillium spp. are used for giving **flavour**, aroma and particular colour to cheese.

(c) Aspergillus spp. are used for giving *citric acid, soy sauce* and *soy paste*.

(iii) Use in Antibiotics and Drugs:

Fungi may also be a source of antibiotics and drugs e.g:

(a) "*Penicillin*" is obtained from penicillium notatum. It was first discovered by Alexander Fleming in 1928.

(b) "*Lovastrin*" is used for lowering blood cholesterol.

(c) "*Cyclosporine*" is used for organ transplantation.

(d) "*Griseofulvin*" is used to inhibit fungal growth.

(e) "*Ergotine*" is used to relieve headache migraine.

(iv) As Natural Dyes:

Some important natural dyes are obtained from lichens and they are used in the fertile industry.

(v) Use in Genetics and Molecular Biological Research:

Fungi are widely used in genetic and molecular biological research because fungi have rapid growth and reproduction e.g., yeasts were the first eukaryotes to be used by genetic engineers. Fungi show visible and clear appearing characters. In 1983, a functional artificial chromosome was made in saccharomyces cerevisiae. The same yeast was completely studied in 1996. Yeasts are also being investigated for production of hormones. Pink bread, mold i.e. Neurospora erassa has also been used for genetic research.

HARMFUL FUNGI

Q.11 Discuss the economic losses due to attack of fungi. (OR) What do you know about harmfulness of fungi?

Ans. **ECONOMIC LOSSES DUE TO FUNGI**

Following are some of the economic losses caused by fungi:

(i) Plant Diseases:

Fungi are responsible for many serious plant diseases because they can breakdown cellulose, legnin and even cutin by producing several enzymes e.g.

(a) **Rusts** and **smuts of wheat, corn** and rice cause extensive damages and also starvation to death of many people.

(b) Some other diseases like **powdery mildews** of grapes, rose and wheat etc. Ergot of eye, **red rot** of sugarcane, **potato wilt, apple's scab** and **brown rot of peaches**, plums, apricots and cherries are also very important.

(ii) Animal Diseases:

Fungi cause many animal diseases:

(a) ***"Ringworm"*** and ***"Athlete's foot"*** are superficial fungal infections of skin caused by certain imperfect fungi e.g., condidi albicans and a yeast causes oral and vaginal infections too.

(b) ***"Histoplasmolysis"*** is caused by inhaling spores of a fungus. It is a serious infection of lungs.

(c) ***"Aspergillosis"*** is caused by inhaling spores of Aspergillosis Spp. which is very serious disorder.

(d) ***"AIDS"*** may also be caused in the persons having "Aspergillosis" but defective immune system.

(e) ***"Aflatoxins"*** is a type of cancer caused by carcinogenic fungus i.e. Aspergillus flavus.

(f) ***"Ergotism"*** is caused by eating bread made from purple ergot-contaminated rye flour. Nervous **tensions**, **psychontic delusion** and gangrene may also be occurred. Ergot also causes nervous spasm and convulsions.

(iii) Damage to Food, Wood, Fiber and Leather:

Fungi also cause serious damage to **food, wood,** fiber and leather.

(i) About 15-50% of world's fruit is lost each year due to fungal attack.

(ii) Wood rotting fungi destroy not only living trees but also structural timber.

(iii) Bracket/shelf fungi cause a lot of damage to stored out lumber as well as stands of timber of living trees.

Q.12 What do you know about benefits of fungi? Discuss in details. (OR) Discuss harmfulness of fungi. (OR) How animals are effected by fungi? (OR) Discuss the plant destroy by fungi. (OR) Write down wood and timber destroy by fungi.

Ans. Consult previous questions.

DIFFICULT WORD MEANINGS

Words	Meanings	Words	Meanings
Extensive	پھیلا ہوا	Dermant	خوابیدہ
Expand	پھیلنا	Morels	فنجائی کی ایک قسم
Puffballs	فنجائی کی ایک گیند نما قسم	Septate	جس میں جدا کرنے کی وال ہو
Rhizoids	وہ ساخت جو زمین میں یا ہوسٹ میں جائے	Edible	قابل خوراک
Saprobic	مردہ خور/گندخور	Mushroom	کھمبی
Facultative	خودمختار	Penetrate	دھنسا/اندرداخل ہونا
Mutualistic	باہمی مفاد پرمبنی	Ferrestrial mode	زمینی رہائش کا طریقہ
Symbiotic	مشترکہ فائدہ، باہمی مفاد	Succession	انواع کا مسلسل ترقی کرنا
Biondicators	زندہ اشیاء جو بیرونی اثرات ظاہر کرے	Termenting	آہستہ آہستہ تبدیلی/آکسیجن کے بغیر عمل تنفس
Resistant	مدافعت/رکاوٹ	Aflatoxins	
Tolerate	برداشت کرنا/گزارا کرنا	Ergotism	فنجائی سے لگنے والی ایک بیماری
Septa	علیحدگی/الگ/جدا	Curtains	پردے
Mycorrhizae	پودے کی جڑ اور فنجائی میں باہمی مفاد کا تعلق	Timber	لکڑی/عمارتی لکڑی
Lichen	ایسا مرکب جاندار جس میں الجی اور فنجائی میں باہمی مفاد کا تعلق ہے	Spore	غیر جنسی تولید کا باعث بننے والا یک خلوی یونٹ
Hypha	فنجائی کا سیل	Heterotroph	حیوانی/جس میں ضیائی تالیف نہ ہو
Mycelium	فنجائی کا ٹشو	Autotroph	خود پروردہ/ہمہ نباتی/جن جانداروں میں فوٹوسنتھز ہو
Decomposer	توڑنے والا/تحلیل کنندہ	Pathogen	باعث بیماری/مرض آور
Symbiont	رفیق/مفاد لینے اور دینے والا/ہم باش		

Q.1 Each question has four options. Encircle the correct answer:

(i) Which statement about fungal nutrition is not true:
- (a) Some fungi are active predators
- (b) Some fungi are mutualists
- (c) Facultative parasitic fungi can grow only on their specific host
- (d) All fungi require mineral nutrients

(ii) The absorptive nutrition of fungi is aided by:
- (a) Spore formation
- (b) Their large surface area-volume ratio
- (c) They are all parasites
- (d) They form fruiting bodies

(iii) They Zygomycetes:
- (a) Have hyphae without regularly occurring cross walls
- (b) Produce motile gametes
- (c) Are haploid throughout their life
- (d) Answers a and c are both correct

(iv) Which of the following cells/structures are associated with asexual reproduction in fungi:
- (a) Ascospores
- (b) Conidia
- (c) Zygospores
- (d) Basidiospores

(v) The closest relatives of fungi are probably:
- (a) Animals
- (b) Slime moulds
- (c) Brown algae
- (d) Vascular plants

(vi) E.coli of fungi are the:
- (a) Rusts
- (b) Brown mould
- (c) Green mold
- (d) Yeasts

(vii) An ascus is to ascomycetes as is a ———— to basidiomycetes:
- (a) Basidiospore
- (b) Basidiocarp
- (c) Basidium
- (d) Haustorium

(viii) Which statement is not true about Deuteromycetes:
- (a) They are also called imperfect fungi.
- (b) Their asexual spores are called conidia.
- (c) It is a heterogenous polyphyletic group.
- (d) They have both sexual and asexual reproduction.

ANSWERS:

(i)	(c)	(ii)	(b)	(iii)	(a)	(iv)	(b)	(v)	(b)
(vi)	(d)	(vii)	(c)	(viii)	(d)				

Q.2 Short Questions:

(i) What is a hyphae? What is the advantage of having incomplete septa?

Ans. Hyphae is a long, slender, branched tubular, thread like filaments of fungi, are of two types sepatate and non-sepatate. In complete septa in a hyphae is helpful for the transportation of materials.

(ii) What is the composition of fungal cell wall and how is this composition advantageous of fungi?

Ans. Cell wall of fungi is composed of **chitin**, this composition has advantage because it is more **resistant** to decay than are cellulose lignin which make up plant cell wall.

(iii) To which phyla do the yeasts belong? How they differ from other fungi.

Ans. Yeasts belong to phylum asomycetes and it differs from other fungi in having one celled body.

(iv) Name sexual and asexual spores of Ascomycetes.

Ans. Sexual spores of ascomycetes are called assospores and asxexual spores are called conidia.

(v) What are mycorrhizae?

Ans. Mutual association between fungi and roots of higher plants.

(vi) By what means can individuals in imperfect fungi be classified?

Ans. Individuals in imperfect fungi are classified of DNA sequencing.

(vii) Give a single characteristic that differentiates Zygomycota from Basidiomycota.

Ans. Zygospores are formed in zygomycota while basidiospores are the sexual by reproducing spores in basidiomycota. Basidiomycota have septate hyphae while, zygomycote have non septate hyphae.

(viii) Why is green mould likely to contaminate an orange kept in a refrigerator than are bacteria?

Ans. Because fungi can tolerate temperature extremes 5 – 6^{o} C below freezing.

(ix) What is fungus?

Ans. A fungus is eukaryotic heterotrophic, spore bearing filamentous organism.

(x) State two parallel characteristics of Ascomycetes and Basidiomycetes.

Ans. (a) Both have septate hyphae.

(b) Both produce haploid sexual spores.

Chapter 9

KINGDOM PLANTAE

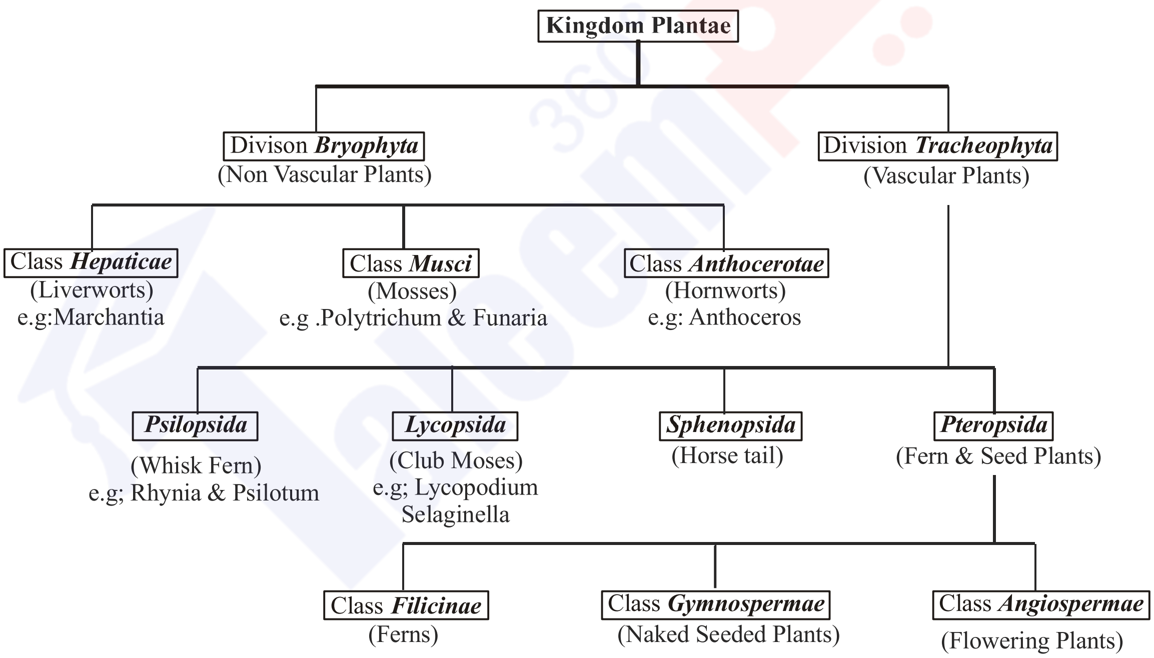
PHYLOGENETIC SYSTEM OF CLASSIFICATION:

Classification of animals and plants based on similarities and dissimilarities of relationship among living things and their organ is called phylogenetic system of classification.

Kingdom of Plantae:

The members of kingdom plantae are, ***eukaryotic***, ***autotrophic***, ***multicellular non-motile*** organisms that develop from ***embryo*** and has ***cellulose cell wall***. About 3,60,000 species of plants are known.

Outline of Classification of Kingdom Plantae:



Q.1 Give Characters of division Bryophyta.

Ans. $\boxed{\textbf{BRYOPHYTA}}$ **(*Non-vascular*)**

These are the ***first land green plants*** that ***evolved from algae***. These have following characters:

(1) **Shade Loving (Amphibian Plants):** These live on moist, damp, shady places and are thus called ***amphibians plants*** as **they cannot live away from water and require water for fertilization**.

(2) **Without Xylem and Phloem (*Non-vascular*):** Conducting tissue and supporting tissue are absent i.e., no xylem and phloem. Absorption of H_2O and mineral salts are occurred by diffusion. Transportation of food also takes place by diffusion.

(3) **Cuticle:** Plant body may be covered with cuticle to reduce transpiration or cuticle may be thin or absent.

(4) **Alternation of Generation:** These have ***hetromorphic*** alternation of generation i.e., gametophyte and sporophyte generation alternate with each other and both generations are morphologically distinct from each other.

(5) **Gametophyte Dominant:** Dominant generation is gametophyte (i.e., ***plant body is gametophyte***) which may be ***thalloid*** (no distinction between root stem and leaves) as in liverworts (***Marchantia*** مارکینٹیا) or differentiated into stem, leave and water absorbing and anchoring organs ***Rhizoids*** (as in Mosses like ***Funaria***).

(6) **Reduced Sporophyte:** The sporophyte is reduced which partly or totally *dependent on gametophyte* for its food and water absorption and anchoring organs Rhizoids.

(7) **Homosporous:** The sporophyte stage is diploid and produces *haploid (n) spores* by meiosis. All spores are of one kind and thus these plants are homosporous.

(8) **Spores Develop into Gametophyte:** The haploid spores develop into haploid gametophyte generation.

(9) **Antheridia and Archegonia:** *Sex organs* are multicellular and are of two types, male sex organs are called Antheridia while female sex organs are called archegonia. The antheridia or archegonia may develop either in same gametophyte or different gametophyte.

(10) **Sterile Covering:** Sex organs are protected by sterile (non fertile) covering of cells.

(11) **Antherozoids and Egg:** In antheridium male gametes (antherozoids) (n) are produced which are motile and produced in large number, while in archegonium a single female gamete (egg) develops (n).

(12) **Water for Fertilization:** They require water for fertilization. Fertilization takes place with in archegonium to form diploid zygote. The zygote develops with in archegonium by mitosis to form diploid embryo. The diploid embryo develops into diploid sporophyte.

(13) **Attachment of Sporophyte:** The sporophyte remain attached at the top of gametophyte.

Q.2 Give Characters of Bryophyte by which they adapted on Land.

Ans. **CHARACTERISTICS OF BRYOPHYTE**

Following are the characters of bryophytes by which they adapted on land.

(1) **Compact Body:** A multicellular compact plant body to ***conserve water*** and reduce surface exposed to dry conditions. Moreover a layer of cuticle developed to further reduce evaporation of water from surface.

(2) **Photosynthetic Tissue:** Development of photosynthetic tissue in special chamber for absorption of CO_2.

(3) **Rhizoids:** Development of hair like Rhizoids for absorption of water and to anchor the plant.

(4) **Heterogamy:** Development of heterogamy i.e. fusion of different types of gametes, motile sperm and non-motile egg with large amount of stored food.

(5) **Archegonia and Antheridia:** Gametes are protected and develop in multicellular sex organs i.e., archegonia and antheridia.

(6) **Embryo Formation:** Embryo is formed and protected in archegonium.

(7) **Alternation of Generation:** Alternation of generation which unables the plant to produce ***better genetic combination*** for survival in changing environment.

Q.3 Classify the Bryophytes. (OR)

(a/1) Write down the features of hepaticeae (ہی پیٹی سی) / Liverworts.

(b/2) Describe the characteristics of Musci / Mosses.

(c/3) Discuss Anthocerotae (اینتھوسرائی) / Hornworts.

Ans. Division bryophyte is divided into three classes:

(1) *Hepaticeae* (Liverworts)

(2) *Musci* (Mosses)

(3) *Anthocerotae* (Horn worts)

(1) Class Hepaticeae (Liverworts) (i.e., Marchantia Class):

It includes 900 species.

CHARACTERS:

(i) **Habitat:** These are found on ***damp rocks*** and ***wet soil***.

(ii) **Thallus:** The plant body is gametophyte and is thalloid, ***dichotomously branched*** (divides into two branches then each branch divides in the same manner)

(iii) **Rhizoids:** On lower surface of thallus are hair like rhizoids by which plant is attached to soil as in Marchantia or plant body may grow upright and differentiated into false stem and leaves as in porella.

(iv) **Sex organs on Upper Side:** Sex organs (Antheridia and Archegonia) develop on upper side of thallus near the tips of branches. Sometime sex organs develop on special branches on gametophyte. The branching bearing antheridia are called ***antheridiophores*** and branches bearing archegonia 1are called ***archegoniophore*** as in Marchantia.

(v) **Gametophyte *Dominant*:** Alternation of generation takes place with gametophyte generation dominant.

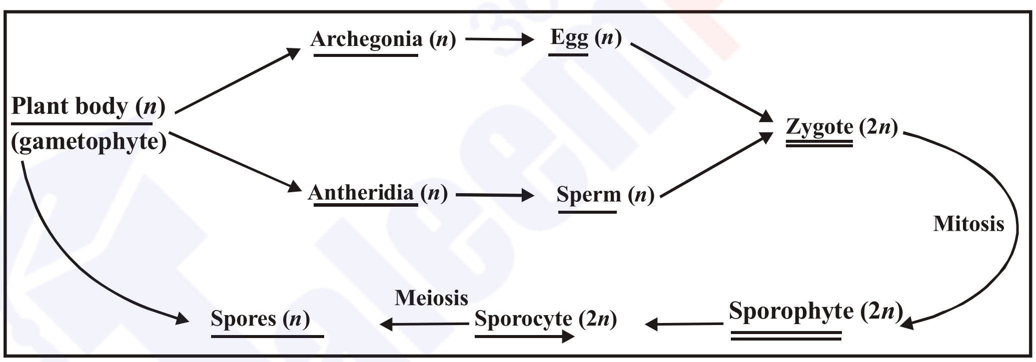


Fig. A generalized life cycle of liverworts showing alternation of generation

(2) Class Musci OR Moses (*Funaria Class)*:

These grow on damp places as well as on dry places. Water is necessary for fertilization.

CHARACTERS:

(i) ***Stem Like and Leaf Like Structure:*** Plant body is gametophyte and differentiated into stem and leaves, true roots are absent while ***rhizoids*** are present to anchor the plant and to absorb water.

(ii) ***Sex Organs on the Tip of Branches:*** *Antheridia* and *Archegonia* develop on the tip of different branches on the same plant as in Funaria or on different plants as in *Polytrichum*.

(iii) ***Paraphyses:*** Archegonia and antheridia develop in clusters and are protected by ***sterile hairs*** called ***paraphyses***.

(iv) ***Spores Develop into Protonema:*** Alternation of generation is similar to Marchantia but unlike Marchantia the spores develop into ***protonema*** or alga like stage in moss plant.

(v) ***Protonema Develops into Gametophyte:*** Gametophyte develops from bud developed on protonema stage.

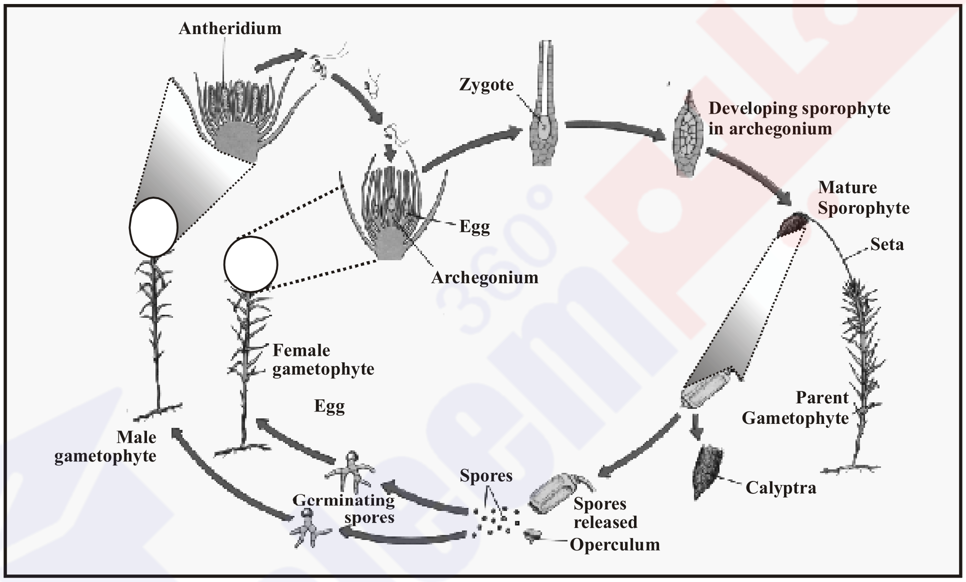


Fig. Moss life cycle

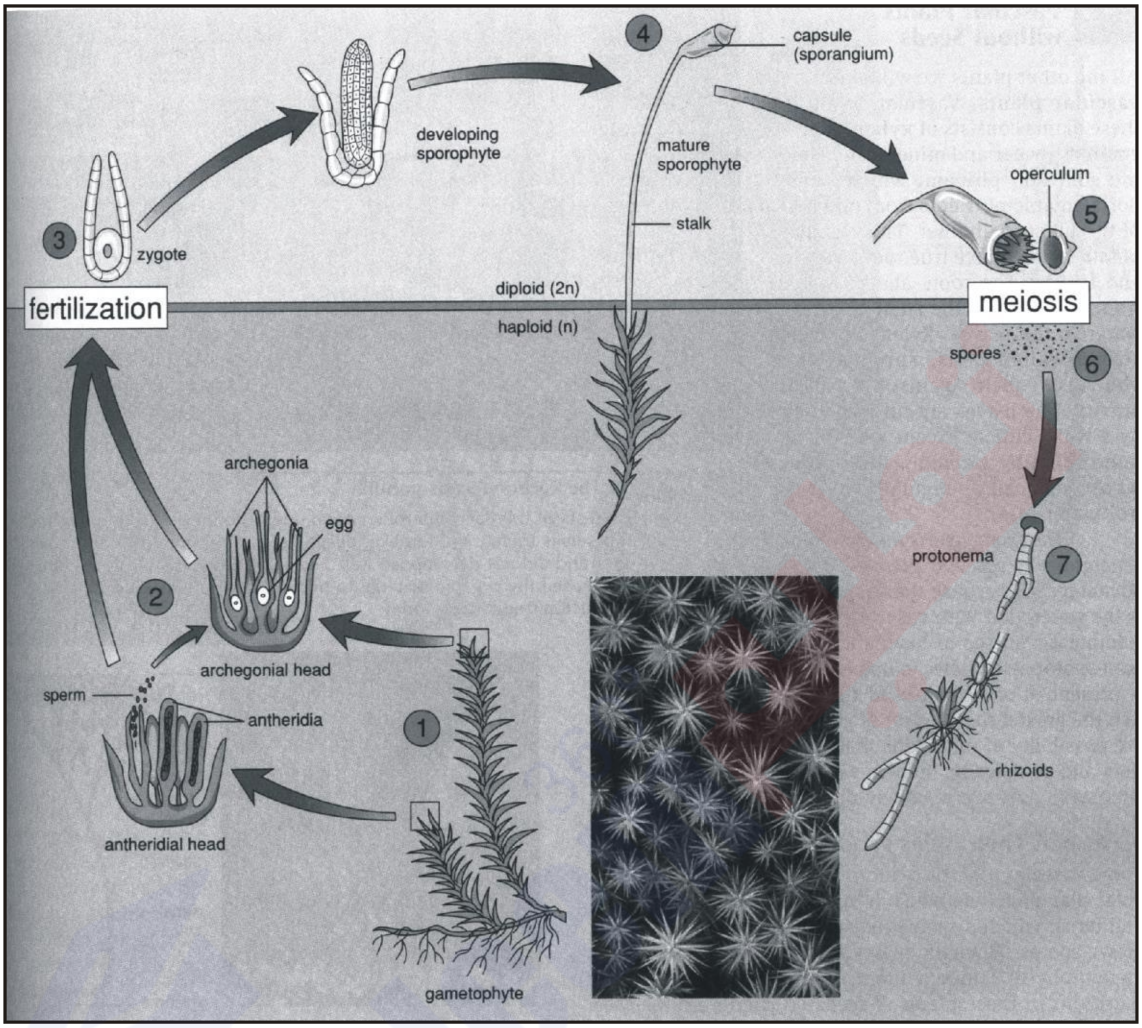


Fig: A moss bug, lacking rigid supporting tissue, bryophytes are low-profile plants they are most common in damp habitat

(3) Class Anthocerotae (*Hornworts – Anthoceros Class*):

It is *advance group* of bryophytes. The representative of this group is Anthoceros found *in hilly areas of Pakistan*.

Characteristics:

(i) ***Lobed Body:*** Gametophyte is highly lobed and ***irregular*** in outline.

(ii) ***Independent Sporophyte:*** Sporophyte (except early stage) is not dependent on gametophyte for protection and nourishment.

(iii) ***Sunken Sex Organs:*** Antheridia and archegonia are deeply sunk in gametophyte tissue.

ADVANCE CHARACTER IN SPOROPHYTE:

(iv) ***Stomata and Chloroplast in Epidermis:*** Sporophyte has stomata and chloroplast in epidermal cells and thus synthesize its own food and is independent of gametophyte.

(v) ***Waxy Cuticle:*** Sporophyte has waxy cuticle layer to reduce loss of water.

(vi) ***Meristematic Tissue:*** At the junction of foot and spore producing region there is a band of ***meristematic tissue (Power of division) that adds new cells towards spores producing region. This results increase in length of sporophyte and sporophyte continues to survive even after the death and decay of gametophyte***.

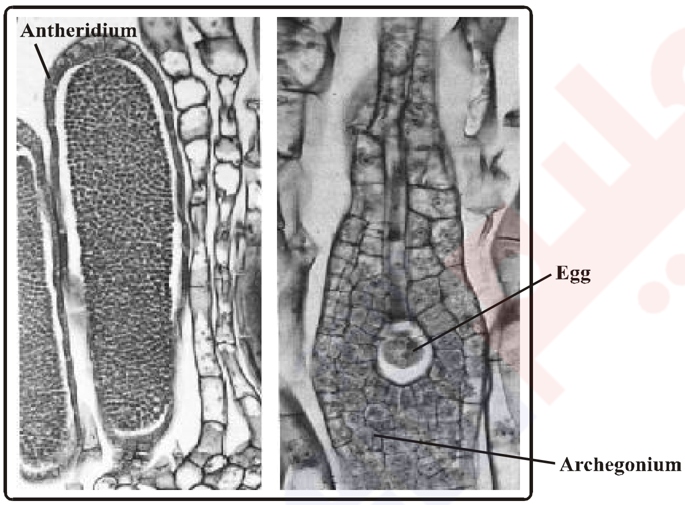


Fig. Sex Organs of Bryophytes

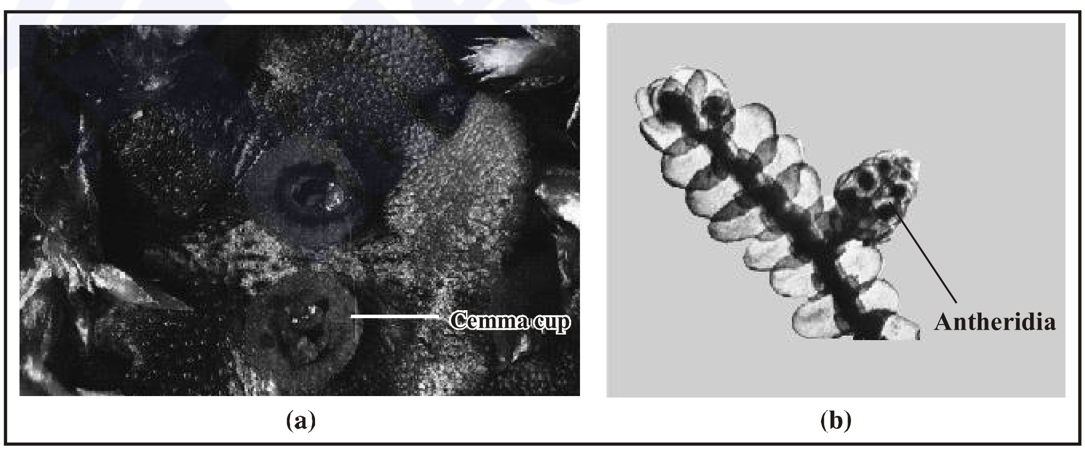


Fig. Marchantia. A typical liverwort, the gemma cups function in asexual reproduction (b) Porella, a leafy liverwort showing lateral antheridia bearing branch.

Fig. A liverworst, Marchantia bearing sex organs antheridia and archegonia on special branches called antheridiophores and archegoniaphores

Q.4 *Explain alternation of generation in Bryophytes give its importance.*

Ans. ALTERNATION OF GENERATIONS

In life history of plants there are two generations i.e., **Gametophyte** (gamete producing) generations and **sporophyte** (***spore producing***) generation, these two alternate with each other the phenomenon is called alternation of generation.

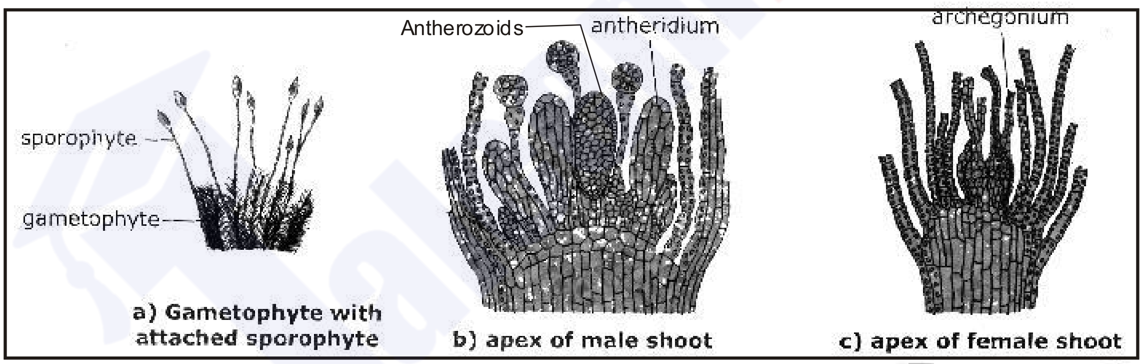


Fig. Funaria (Moss)

In bryophytes, *the dominant generation is haploid (n) i.e., plant body*. It produces gametes in sex organs.

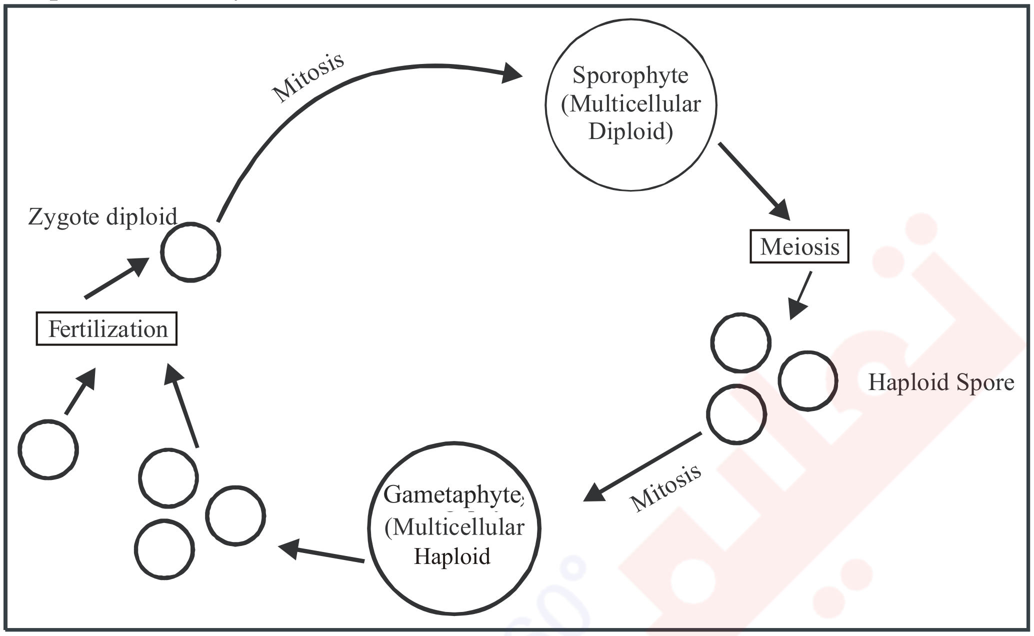
The spermatozoids or sperms are produced in **Antheridia** and eggs are produced in **archegonia**.

A haploid spermatozoid fuses with haploid egg to form diploid ***zygote or oospore***. The oospore does not develop into gametophyte but into embryo and then diploid sporophyte generation.

The sporophyte is reduced generation and consists of **foot**, **seta** (stalk) and **capsule** (sporangium).

The sporophyte produces haploid spores as a result of meosis.

The spores do not develop into sporophyte but into gametophyte stage by mitosis and complete the life cycle.



Importance of Alternation of Generation

***Spores** are formed as a result of **meiosis**.*

- ✓ *Due to **genetic recombination** variety of spores with different genetic make up are produced.*
- ✓ The spores develop into gametophytes which also have *variation in their genetic material*.
- ✓ The gametophyte with better genetic material have better chances of survival may die.
- ✓ The gametophyte with better genetic make up pass their better genes into sperms and eggs as gametes are produced by ***mitosis***.
- ✓ ***At fertilization*** there is genetic recombination of genes in oospore. From oospore or zygote sporophyte develops that produces spores by meiosis and results in variation of genetic material among spores.

Fig. Polytrichum, A hair cup moss plant

Thus alternation of generation have a survival value for bryophytes.

Q.5	***Give Classification of division Tracheophytes. (OR)***	
	(a)	***Write the important features of tracheophytes.***
	(b)	***What do you know about psilopsida?***
	(c)	***Give the characteristics of Lycopsida.***
	(d)	***Explain specific points of sphenopsida.***
	(e)	***Describe the important features of pteropsida.***

Ans. (a) TRACHEOPHYTES

Tracheophytes are also called *green land plant* with *vascular tissue* i.e. ***xylem for conduction* of *water*** *and salts* and ***phloem for conduction of food***.

All vascular plants have *tracheids* in their xylem and thus called *tracheophytes*.

These are ***successful land plants*** with following characters. In tracheophyte plant body is *sporophyte*.

Characteristics:

(1) These have *root*, *stem* and *true leaves*.

(2) ***Vascular system*** i.e. xylem and phloem in root, stem and leaves for conduction and support.

(3) ***Sporangia*** are protected that lead to evolution of seed.

(4) These do not require water for fertilization as sperm is transported to egg by **pollen tube**.

(5) Formation of **flowers and fruits** in angiosperms (flowering plants) for pollination and protection and dispersal of seeds.

(6) ***Heteromorphic alternation of generations*** i.e. gametophyte and sporophyte are distinct morphologically.

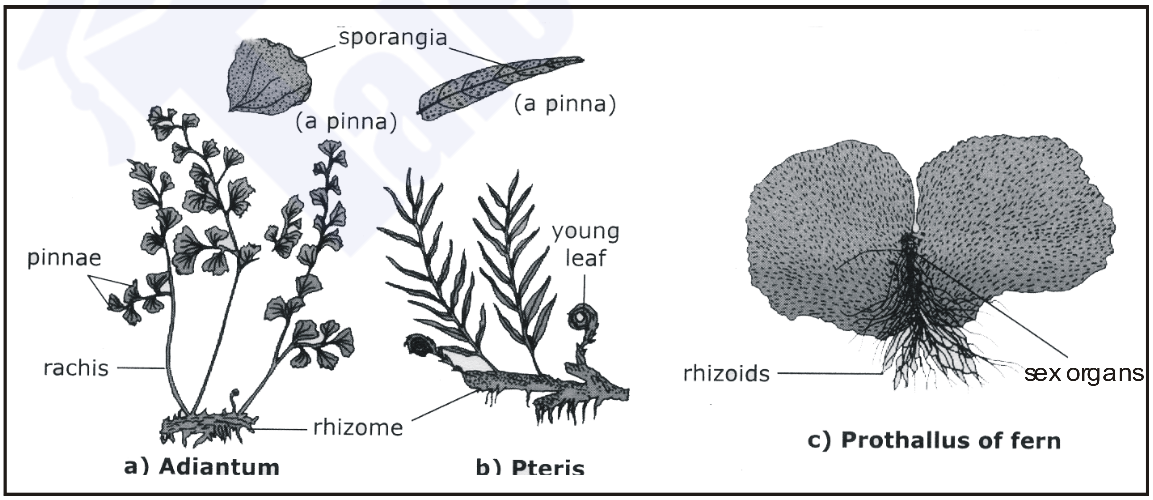


Fig. Pteridophytes

SUB-DIVISION OF TRACHEOPHYTES:

(1)	Sub division	Psilopsida	(سائی لوپ سِڈا)
(2)	Sub division	Lycopsida	(لائی کوپ سِڈا)
(3)	Sub division	Sphenopsida	(سفی ناپ سِڈا)
(4)	Sub division	Pteropsida	(ٹی راپ سِڈا)

(b/1) Sub Division Psilophyta

Psilopsida are the ***earliest primitive vascular plants***. Most of them become, extinct e.g., *Rhynia. Horneophyton, Psilophyton* and *Cooksonia*. There are only two living genera psilotum and tmesipeteris.

These have the following characters:

(i) The **sporophyte** is *rootless*.

(ii) **Stem** is differentiated into an underground stem called ***Rhizome*** and aerial stem.

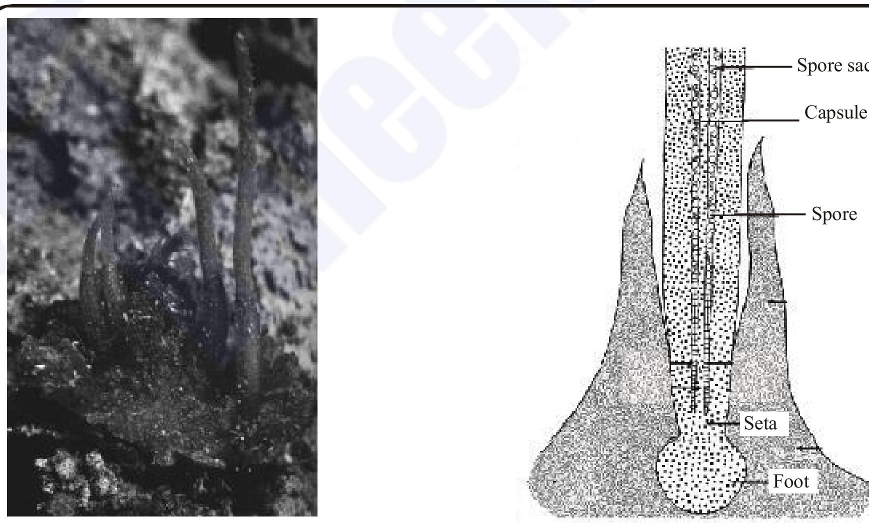
(iii) The stem is ***dichotomously branched*** i.e. repeatedly divides into two branches in Y-shaped manner.

(iv) The **Rhizome** (underground stem) bears *rhizoids* for absorption of water.

(v) The **aerial branches** were leafless bear small veinless outgrowth. The branches were green to carry out photosynthesis and thus worked as leaves.

(vi) The **sporangia** developed at the tip of branches or on lateral side of branches. Thus plant body was sporophyte.

(vii) In stem **xylem and phloem** were present in the centre in the form of solid cylinder without pith. Vascular tissue was surrounded by ***wide cortex*** around which ***epidermis*** was present.



(a) (b)

Fig. Anthoceros, a hornwort (a) gametophyte with attached horn-shaped sporophyte (b) V.S. of sporophyte.

(viii) **Gametophyte** is *thalloid*, *colourless* and *underground*. Its cells contain fungi, which provide gametophyte with food, and fungi get protection by gametophyte. This association is called mycorrhizal association e.g. in ***psilotum*** *and* ***Tmesipeteris*** (سلاٹم اور ٹمیسی پیٹرس).

Q.6 How did Evolution of Leaf occur?

Ans. **EVOLUTION OF LEAF**

The psilopsida were leafless but have very small outgrowth on branches which were veinless and not regarded as leaves. *Lycopsida were the first plants that formed true leaves*. There are two types of leaves.

(i) **Microphylls:** These are small and have a ***single vein***. These are found in Lycopods (Lycopodium).

(ii) **Megaphylls:** These leaves have ***large blade*** or ***lamina***. ***With large number of divided veins***, these are found in fern and seed forming plants.

EVOLUTION OF MEGAPHYLLS

These leaves developed from dichotomous branching system. In primitive fern like plant about 350 million years ago. Evolution of megaphylls took place in following steps:

(a) **Over Topping:**

It is unequal development of various branches. In primitive fern like plant the dischotomously branched aerial portions of stem showed ***unequal branching***, i.e. some branches were small while other were long and grew ***in different planes***.

(b) **Planation:**

The unequal dischotomous branches became arranged in one plane. It is called planation.

(c) **Fusion and Webbing:**

The space between overtopped dichotomous branches were occupied by photosynthetic tissues that connected these branches. Thus a flat leaf blade or lamina was formed with dichotomously branched veins.

Further evolution resulted in ***reticulate venation (network)***. The process of evolution of leaf was very slow and gradual and took about 15 – 20 million years.

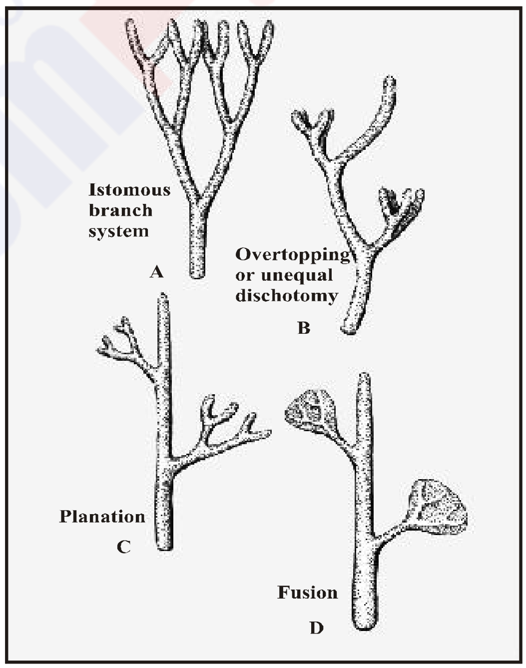


Fig. Successive evolutionary steps in the evolution of leaf

(b/2) Sub-Division Lycopsida

It includes *plant like* to *Lycopodium* and *Selaginella*.

These plants are also called club mosses or ***spike mosses*** due to their club/spike shaped cone or stobili and small moss like leaves. These plants are called ground as the resemble to ever green plants. These have following characters:

(i) The plant body is **sporophyte** differentiated into true root, stem and is true leaves. The leaves are single **microphylls**.

(ii) The ***leaves*** may be *spirally arranged* or opposite.

(iii) **Sporongia** develop *singly on upper side* of leaf, such leaf is called sporophyll.

(iv) The **sporophyll** may be grouped together to form cone or strobili.

(v) On the upper surface of leaf an outgrowth called **ligule** may be absent as in *Lycopodium* or present as in Selaginella.

(vi) The sporophyte may have sporangia of one kind as in *Lycopodium*. Such sporophytes are called **Homosporous** or sporangia may be of two kinds, microsporangia or male sporangia and mega sporangia or female sporangia. Such sporophytes having two types of sporangia are called **Heterosporous** as in *Selaginella*. This condition is called Homospory and Hetrospory respectively. *Heterospory is characteristics of seed forming plants*.

(vii) Gametophyte of Lycopsida is underground and has fungal association called mycorrhiza.

(c/3) Sub Division Sphenopsida OR (Horse Tail) (*Equisetum*):

The plants included in this group are called **Arthrophytes** because whole plant body consists of large number of joints.

These have following characters:

(i) ***The plant body is sporophyte*** differentiated into root, stem and leaves.

(ii) ***Leaves*** may be *broad or scale* like and are always arranged in whorls.

(iii) ***Main stem*** is not smooth but jointed (***Arthrophytes***) and had ***ridges*** *and* ***furrows***.

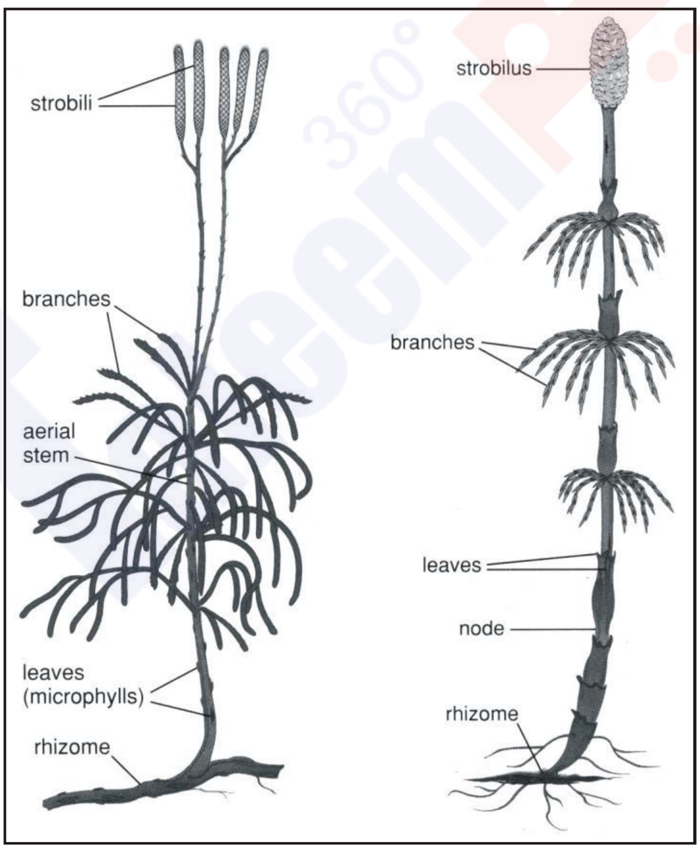
(iv) From each node there is given out whorl of branches.

(v) ***The sporangia*** develop on sporangiophore, the **sporangiophores** group together to form **cones**.

(vi) The sporangiophore has stalk and expanded disc. On the underside of disc sporangia develop.

(vii) ***Gametophyte*** is thalloid and grows on clay soil or mud e.g. Equisetum.

Fig. Representative of three of the subdivisions of vascular plants (a) club moss Lycopodium (b) horsetail, Equisetum (c) A tree fern



(d/4) Sub Division Pteropsida

It is divided into three classes.

(i) Class Filicinae (Ferns):

1. An important character of this group is that sporangia are attached on underside of **frond** or leaves. The immature or young frond has coiled pattern of development like watch spring and it is called **circinate vernation**.
2. Ferns are mostly shade and moisture loving plants. These grow on hills and plains.
3. Some are *epiphytes*, i.e. grow on bark of tree.
4. World wide distribution, abundant in tropics.

Fig. A frond bearing sporingia attached to the underside of the leaf.

Fig. Ferns. A ostrich fern growing on a froest floor. See the coiled immature and young frondsready to uncoil.

Examples: *Dryopteris, Pteridium, Adiantum and Pteris.*

ADIANTUM (*MAIDEN HAIR FERN*):

Structure:

It grows on moist walls. Watercourse and drains. It is small herb.

Stem is short underground, called rhizome which grow horizontally in soil covered by brownish scales leaves called ramenta and persistant leaf bases. From underside of ***Rhizome*** are given out ***Fibrous adventitious*** roots. From upper side of rhizome are given out large pinnately divided leaves called **fronds**. The young leaves are in ***circinate vernation*** i.e. ***coiled form***. The ***stalk or rachis*** of leaves is black smooth and shiny hence maiden hair fern. The leaflets show ***dichotomous venation***. The groups of sporangia or ***sori*** develop on under side of bent margin of leaflets.

Life Cycle

These have *heteromorphic alternation* of generations i.e. morphologically two distinct generations.

Sporophyte:

The plant body is **diploid sporophyte** bearing groups of ***sporangia or sori*** on under side of margin of leaflets. Mature sori become black. The leaves bearing sporangia are called **sporophylls**.

Each sporangium is multicellular having stalk bearing biconvex capsule. The capsule is made of single layer of thin walled flat cells. The edge of capsule is made of ***annulus*** which occupies 3/4 of edge and made of cells with radial and inner wall thick. The second part **stomium** is made of thin walled cells. Inside the **capsule** haploid spores are formed by meiotic division of haploid spores are formed by meiotic division of diploid spore mother cells. During dry weather cells of annulus contract and stomium cells rupture to release spores. The spores fall on moist soil and germinate to form gametophyte.

Gametophyte (Prothallus):

Prothallus is small ***heart shaped*** structure. It is ***notched at anterior*** and in which lies growing point. From posterior under surface are given out ***rhizoids*** which fix the prothallus and absorb water. It is made of thin walled of many layers of cells but at the margin it is of single layer.

*The **prothallus is monoecious*** i.e. sex organs develop on the same prothallus. *Archegonia* occur near the notch and *antheridia* are scattered among Rhizoids.

Antheridium: In each antheridium large number of ***coiled; multiciliated spermetozoids*** are produced.

Archegonium: These are ***flask shaped*** having broader part **venter** and elongated part ***neck***. Venter contains egg or *oosphere*.

Fertilization: The spermatozoids (Sperms) reach the neck of archegonium by water pass through neck, unite with egg to form **zygote** or **oospore**.

Formation of Sporophyte: The diploid oospore divides by ***mitosis*** to form young sporophyte which is attached to gametophyte but later on becomes independent.

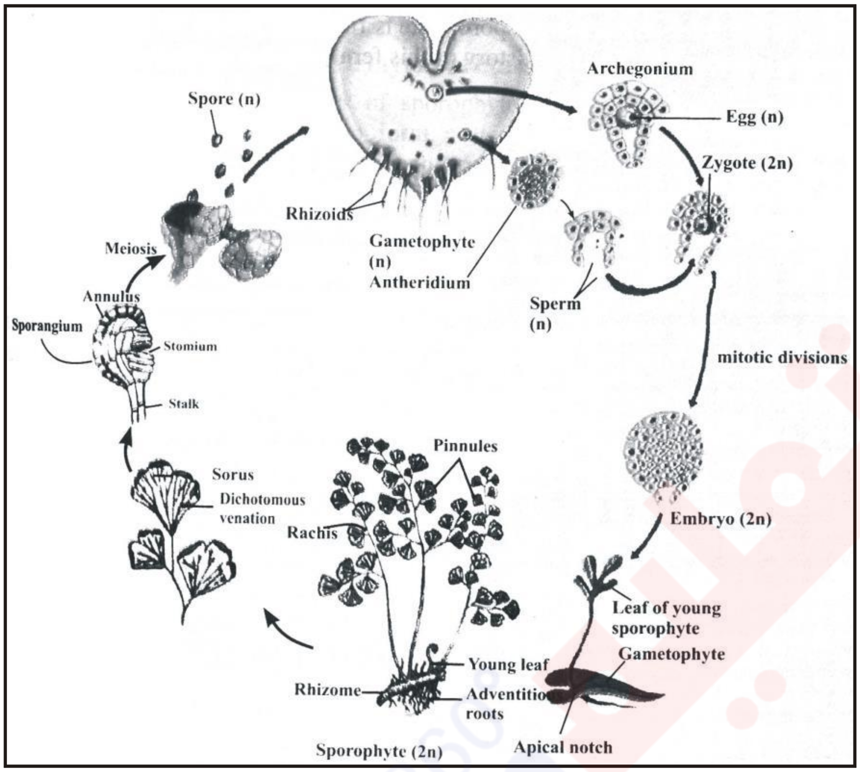


Fig. Life history of Adiantum

Q.7 How did evolution of seed occur in plants?

OR

Enumerate the evolutionary steps of seed.

Ans. **EVOLUTION OF SEED**

Seed forming plants are spermatophytes.

Among vascular plants the spermatophytes (seed forming plants) are predominant over non-seed forming plants.

The development of seed habit occurred approximately 390 million years ago but the complete seed forming plants appeared in late Devonian period about 365 million years ago.

Seed can be defined as fertilized ovule, integumented in indehisscent megasporangium. Integument is specialized protective covering around megasporangium.

Following were the steps in evolution of seed:

(i) Evolution of **heterospory**.

(ii) Retention and germination of **megaspore within Megasporangium**.

(iii) Development of **integument**, a protective layers around megasporangium.

(iv) Reduciton to a **single functional megaspore** per megasporangium.

(v) Development of **embryo sac** within megasporangium.

(vi) Modification of distal end of megasporangium for **pollen Capture**.

(i) Evolution of Hetrospory:

Bryophytes and pteridophytes (non seed vascular plants) are homosporous (except Selaginella and some other) i.e. produce one kind of spores. During evolution some plants like selaginella produced two kinds of spores and these are called Heterosporous. The smaller spores are male spores or microspores and larger spores are female spores or megaspores. Microspores developed in microsporangium while megaspore developed in megasporangium. Male spore or microspore germinates into male gametophyte or microgametophyte while female spore or megaspore develops into female gametophyte or megagametophyte.

(ii) Retention and Germination of Megaspore within Megasporangium.

In Selaginella the ***megaspore does not shed*** from megasporangium but megaspore develops into megagametophyte inside the megasporangium. In the megagametophyte egg develops.

(iii) Development of Protective layer around Megasporangium:

The branches from sporophyte surround the megasporangium containing megagametophyte. These branches fused to form a protective covering called integument around the megasporangium. This change led to ***formation of ovule***. "An ovule is an integumented indehiscent megasporangium containing megagametophyte" in other words ***ovule is an immature seed***.

(iv) Reduction of a Single Functional Megaspore per Megasporangium;

In pteridophytes normally single megaspore mother cell divides by meiosis to produce *four* ***functional megaspores*** which germinate to give rise four megagametophytes. In seed forming plants ***only one megaspore germinates*** to megagametophyte to avoid competition among four gametophytes. Remaining *three megaspore degenerate*.

(v) Development of Embryo Sac within Megasporangium:

A single megaspore retained in megasporangium germinates to form megagametophyte or embryo sac that contains egg.

(vi) Modification of Distal End of Megasporangium for Pollen Capture:

When development and evolution of seed completed then the distal end of megasporangium become modified for capturing pollen – containing sperms. It was

necessary for fertilization. The pollen after catching by tip of megasporangium develops pollen tube that contains sperm. ***The pollen tube transports the sperms to egg in embryo sac***. The ovule after fertilization change into seed and its integuments form seed coat or testa.

Advantages of Seed

(1) **Seed provides protection of developing embryo** against drying and injuries.

(2) **Seed stores food** for early developmental stages of embryo.

(3) Development of seed habit enabled in plant to live **on land** and dry environment permanently.

Q.8 Write down particular features of gymnospermae.

Ans. **CLASS GYMNOSPERMAE**

(i) **Naked Seeded:** These plants produce naked seed i.e. seed is not enclosed in fruit (Gymno = naked, spermae – seed).

(ii) **1/3 of World:** Wide spread and consists of 1/3rd of world's forest.

(iii) **Naked Ovule:** The naked ovules are born on megasporophyll.

(iv) **Heteromorphic alternation generation:** These show heteromorphic alternation of generations with independent dominant sporophyte and dependent reduced gametophyte.

(v) **Retainment of Ovule:** Female gametophyte is retained in ovule permanantly.

(vi) **Megaspore develop on megasporophyll:** The microspores develop on microsporophyll and megaspores develop on megasporophyll. The megasporophyll did not form ovary.

Example: Important genera are:

(i) *Cycas* (Sago Palm)

(ii) *Pinus* (Pines)

(iii) *Taxus* (Yew)

(iv) *Picea* (Hemlock)

(v) *Cedrus* (Deodar)

(vi) *Ginkgo*

Fig. (a) Cycas tree-habit and general organography

Fig. (b) Ginkgo biloba

Q.9 Discuss life cycle of Pinus / a gymnosperm.

Ans. **LIFE CYCLE OF PINUS (PINE)**

Alternation of Generation:

In Pinus the dominant diploid sporphyte (tree) generation alternates haploid inconspicuous (reduced) gametophyte generation.

Sporophyte: Pinus tree is sporophyte that produces ***microspores in microsporangia*** present on underside of ***microsporophyll***. The microsporophyll grouped together to form ***male cone***. The megaspores or ***female spores develop in megasporangium*** present on ***megasporophylls***. The megasporophyll also grouped together to form ***female cone***. The male and female cones are developed on same plant in different seasons. Due to formation of cones these plants are called ***conifers***.

MALE CONE

It consists of central axis on which microsporophylls are arranged.

Microsporophylls: On underside each microsporophyll, there are two microsporangia that contain haploid microspores.

Microspores: Each microspore has ***double wall*** containing ***nucleus*** and ***cytoplasm***. It has ***two wings*** to its lateral sides which aid in ***fertilization by wind***.

Two Sperm: The microspore's nucleus divides to form two sperms or male gametes. Microspore containing ***male gamete is called pollen grain***.

FEMALE CONE

(1) ***Central Axis:*** The female cone consists of central axis on which megasporophylls are arranged, which are ***woody***.

(2) ***Ovule:*** On the surface of each megasporophyll is a pair of ovule. In each ovule, integumented megasporangium contains single diploid megaspore mother cell. The diploid megaspore mother cell is divided by meiosis to form four haploid megaspores.

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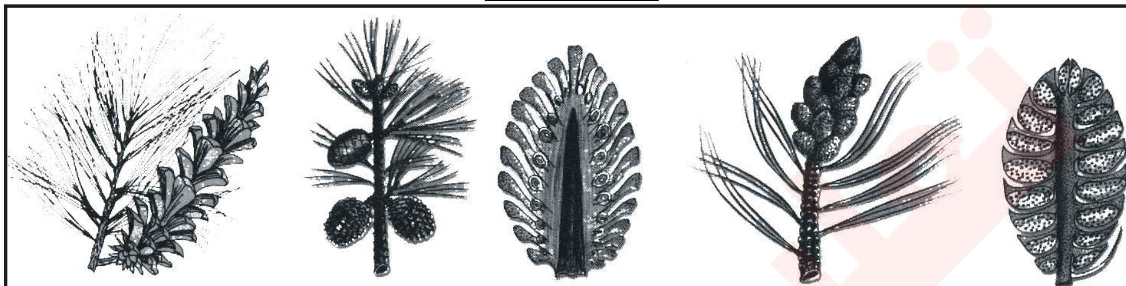

(a) Shoot with female cone | PINUS (b) Female cone | (c) Male cones (PINUS) | (D) L.S. Male cone

Megagametophyte: One out of four megaspore is functional and divideD by mitosis to form megagametophyte or ***female gametophyte*** or ***embryo sac***.

Embryo Sac: The embryo sac contains ***one to several archegonia*** that contain ***egg***.

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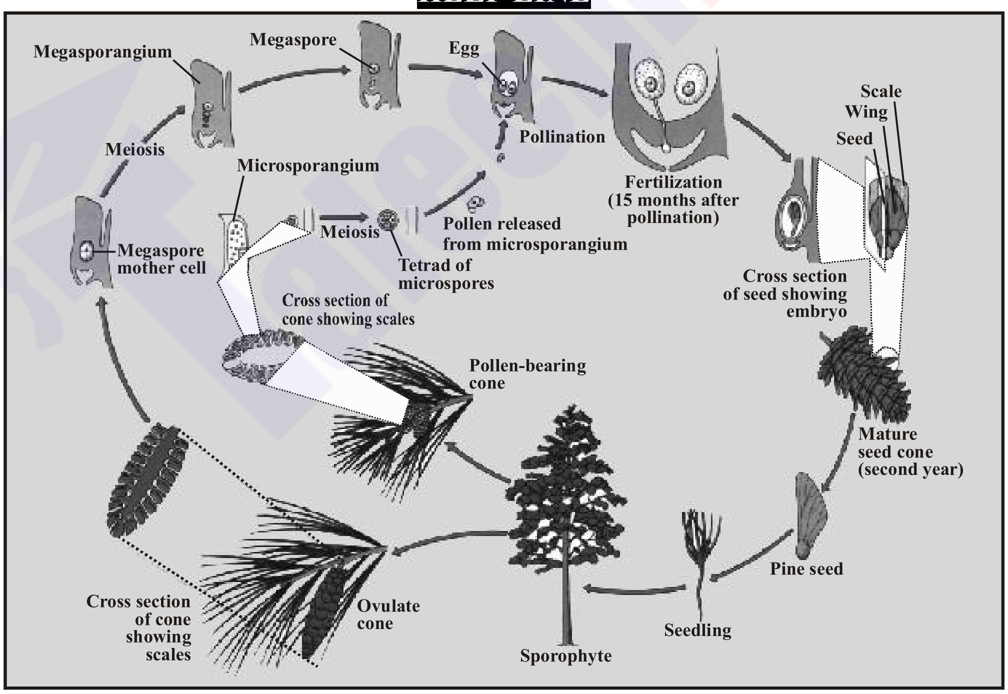


Fig. Life cycle of Pinus

Pollination by Wind: The transfer of pollen grains to ovule is called pollination and it takes place by wind. With the help of two wings the pollen grains containing sperm (male gametophyte) is carried by wind to female cone. The ***pollen grain develops pollen tube*** that passes through integumented megasporangium and reach the embryo sac.

Fertilization: The tip of the pollen tube dissolves and releases ***two sperms*** in embryo sac. One of the two sperms unites with egg to form zygote.

Zygote Formation: Many zygotes are formed in an ovule but ***only one zygote survives***.

Seed and Embryo Formation: Zygote develops into embryo. The ovules matures to form seed. On germination of seed the embryo forms a new sporophyte plant.

Q.10 (a) Give specific characteristics of angiospermae.
(b) Explain life cycle of an angiosperm.

Ans. (a) CLASS ANGIOSPERMAE (*FLOWERING PLANTS*)

These have following characters:

(i) Enclosed Seeded: In these plants the seed is enclosed in fruit. ***The fruit develops from wall of ovary***. The ovary is fertile leaf bearing ovule that become folded and its margins completely fused to form ovary. These are also called closed seeded plants (***Angio = Close, spermae = seed***).

(ii) No. of Species: Angiosperm constitute 2,35,000 species out of 3,60,000 known species of all plants.

(iii) Flowers and Fruits: Plant produces flowers, seed within the fruit.

(iv) Heterosporous: These are heterosporous and highly evolved.

(b) LIFE CYCLE OF ANGIOSPERMIC PLANT

(1) Sporophyte Generation:

(i) Diploid Body: The adult flowering plant is diploid sporophyte consisting of root, stem, leaves and flowers.

(ii) Flower: Flower is a reproductive part and is ***modified shoot***. Each flower consist of pedicel, thalamus or torus and floral leaves (***sepals, petals stamens*** and ***carpels***).

Modification: ***Thalamus*** *is a modified stem while stamens and carpels are modified floral leaves*. Sepals and petals are non-essential parts, as they do not take part in reproduction while stamens and carpels are essential parts of flower as they take part in reproduction.

Protective Parts of Flowers: The ***sepals*** and ***petals*** protect the essential parts of flower and also ***attract insects for pollination***.

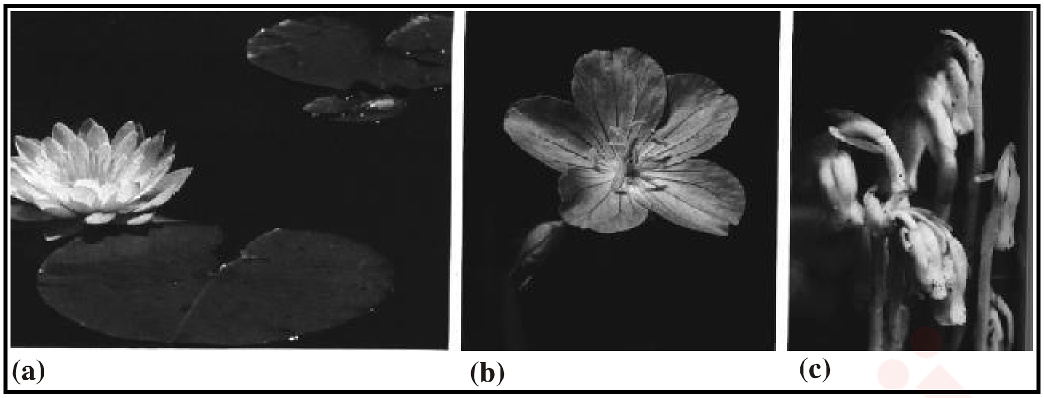


Fig. Some of the remarkable diversity of angiosperms is shown in these photographs. The species shown her eare Dicots (a) Fragrant water lily, (b) wild geranium, (c) Indian pipe (a parasite) an angiosperm that lacks chlorophyll.

(c) Reproductive Parts of Flower

(i) ***Stamen:*** It is a ***male reproductive part*** of flower and consists of ***long filament*** having bilobed ***anther*** at its tip. In anther haploid microspores are produced by ***meiosis*** inside pollen sacs.

(ii) ***Carpel:*** It is a ***female reproductive part*** of flower. The basal broader part of flower is ovary, elongated part is style and terminal broad part is ***stigma***. Inside ovary, one or more ovules are present. Ovule contains megasporangium covered by integument. In megasporangium embryo sac is surrounded by a tissue called ***nucellus***.

(d) Pollination: Pollen grain is transferred to stigma by insects, wind or water. It is called pollination.

(e) Male Gametophyte: On the stigma the pollen grain germinates to form ***pollen tube***. The nucleus of microspore first divides by mitosis to form ***two nuclei***, the tube nucleus and generative nucleus. The generative nucleus further divides by mitosis to form ***two sperms***. This germinated pollen grain containing ***two sperm is called male gametophyte***.

(f) Female Gametophyte: Inside the ovule a ***single functional megaspore*** divides by mitosis to form female gametophyte or ***embryo sac***. Embryo sac consists of ***seven cells*** out of which one cell is the ***egg or oosphere***.

(g) Double Fertilization: ***"Double fertilization a specific fertilization in angiosperms, in which two sperms are found, so sperm I fuses with egg to form zygote and sperm II fuses with a diploid nucleus to form endosperm".***

After pollination the pollen tube of male gametophyte passes through stigma style and enters ovule and reaches embryo sac.

In embryo sac two sperms are released. ***Sperm one*** unites with egg (n) to form diploid zygote. ***The zygotes divides by mitosis to form diploid embryo*** which on germination of seed develop into diploid sporophyte. In the meantime the two haploid nuclei present in embryo sac unites to form diploid fusion nucleus.

Sperm second (n) with haploid nucleus unites with diploid fusion nucleus to form triploid ***endosperm cell (3n)***. This triploid endosperm cell divides by mitosis to form a tissue called endosperm that stores food for developing embryo. ***This fusion of one sperm with egg and second sperm with diploid fusion nucleus is called double fertilization***.

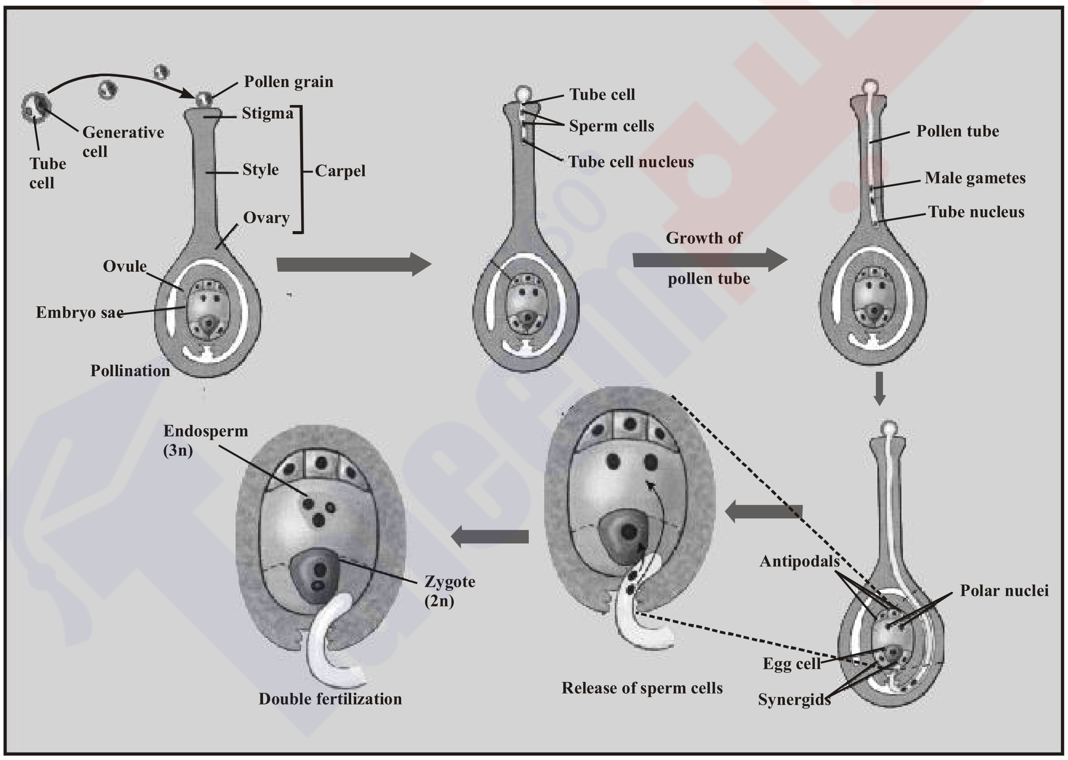


Fig. Life Cycle of on angiospermic plants

(h) **Formation of Seed and Fruit:** After formation of endosperm and embryo the ***ovule increases in size to form seed***. Its Integumen to become hard and dry to form seed coat or testa and tegmen.

The wall of ***ovary grows*** rapidly around the seeds and matures to form ***fruit***.

EXAMINE YOURSELF

Q. ***Brief sporophyte of angiosperm. (See A)***

Q. ***What are protective parts of flower? (See B)***

Q. ***Which are reproductive parts of flower? (See C)***

Q. ***What is pollination? (See D)***

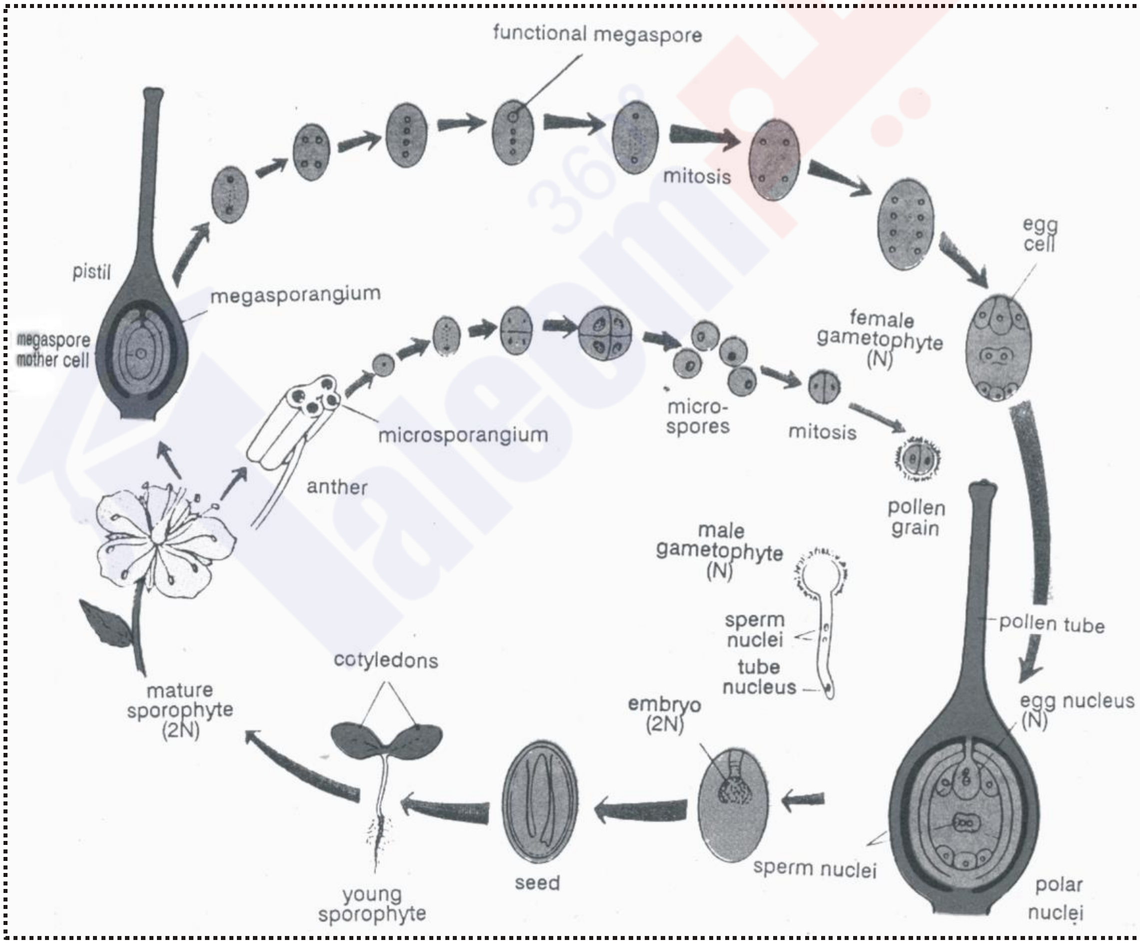
Q. ***Brief male gametophyte of angiosperm. (See E)***

Q. ***What do you know about female gametophyte of angiosperm? (See F)***

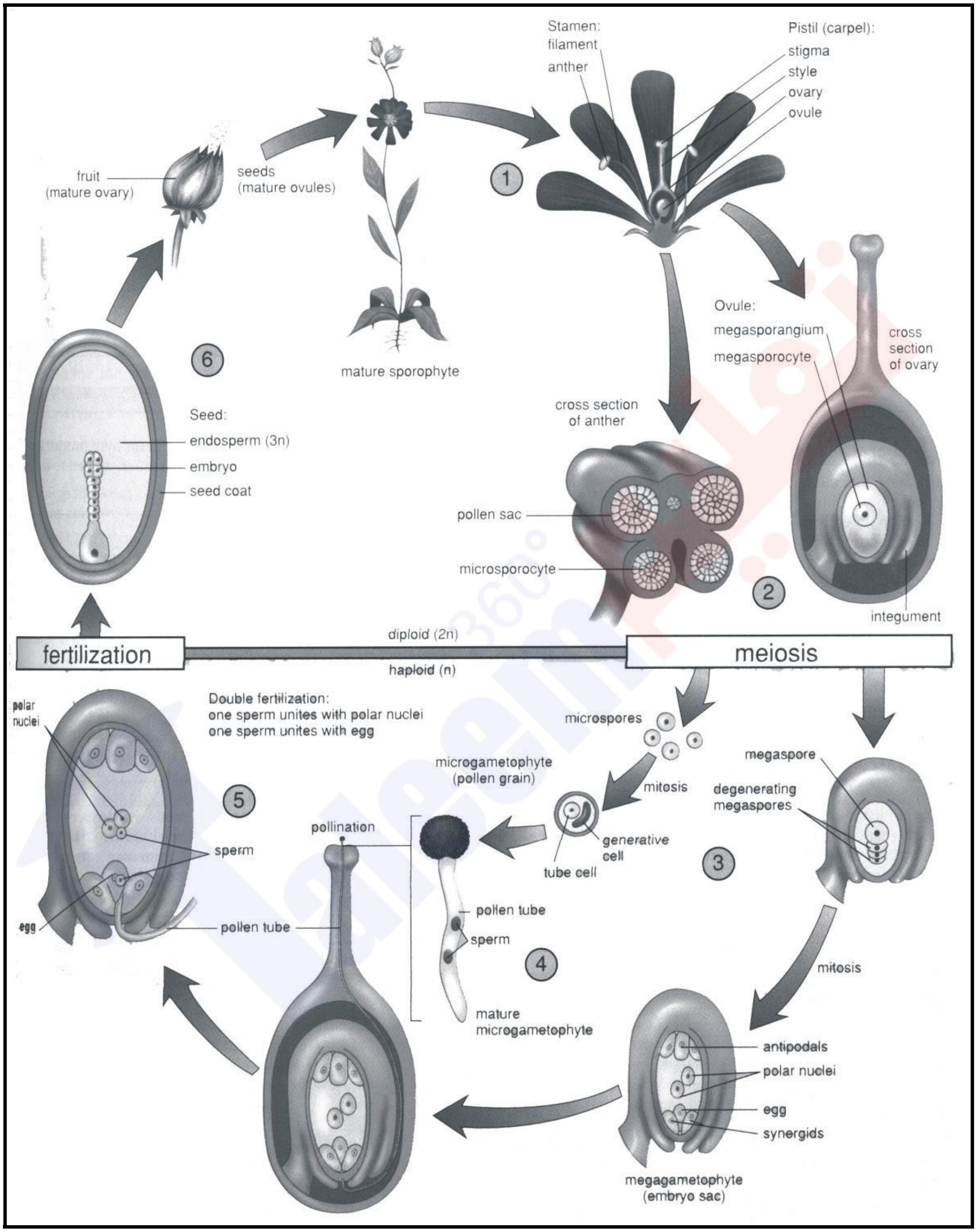
Q. ***Write a short note on double fertilization. (See G)***

Q. ***What do you know about formation of seed and fruit? (See H)***

THINKING ROOM



FOR CONCEPT


Stamen:
filament
anther
Pistil (carpel):
stigma
style
ovary
ovule
1
fruit
(mature ovary)
seeds
(mature ovules)
mature sporophyte
Ovule:
megasporangium
megasporocyte
cross section of ovary
6
Seed:
endosperm (3n)
embryo
seed coat
cross section of anther
pollen sac
microsporocyte
2
integument
fertilization
diploid (2n)
haploid (n)
meiosis
polar nuclei
Double fertilization:
one sperm unites with polar nuclei
one sperm unites with egg
microspores
megaspore
microgametophyte (pollen grain)
mitosis
degenerating megaspores
5
pollination
generative cell
tube cell
3
sperm
pollen tube
sperm
egg
pollen tube
4
mitosis
mature microgametophyte
antipodals
polar nuclei
egg
synergids
megagametophyte (embryo sac)

Q.11 Differentiate between Monocot and Dicot.

Ans. DICOT AND MONOCOT

Sr.	Dicot	Monocot
1.	**Seed:** Plants with two cotyledons in their seeds are called dicotyledenous or dicot e.g. pea and gram.	Plants with single cotyledon in their seeds are called monocot e.g. corn, wheat, grasses.
2.	**Number of Sepals and Petals** These have 4 to 5 sepals and petals or multiple of these numbers.	These have 3 sepals or petals or multiple of these numbers.
3.	**Vascular Tissue:** The vascular bundles are in form of ***ring*** in the cortex of stem.	Vascular bundles are ***scattered*** in the cortex of stem.
4.	**Leaf Venation:** Leaf venation is ***reticulate*** i.e., veins form net work in lamina.	Leaf venation run ***parallel*** in the lamina.
5.	**Presence or Absence of Wood.** These may be ***herbaceous*** (without wood) or ***woody***.	These are always herbacous without wood.
6.	**Symmetry of Flower** Symmetry of flower may be regular or irregular.	Symmetry of flower may be regular or irregular.
7.	**Primary and Secondary Wood** Due to presence of cambium between xylem and phloem ***secondary wood*** is present.	Due to absence of cambium between xylem and phloem only primary tissue is present.
8.	**Primary Growth and Secondary Growth:** Primary as well as secondary growth takes place increase in length is due to division of cells of tip of shoot and root is called primary growth. Due to division of cells of cambium increase in diameter takes place which is called secondary growth.	Only primary growth takes place, cambium is absent, therefore, no secondary growth.

Q.12 Give Characters, Economic Importance and Familiar Plants of Family Rosaceae (Rose Family).

Ans. ROSE FAMILY (ROSACEAE) GENERA AND SPECIES:

In world = 100 genera and 2000 species.

In Pakistan = 29 genera and 213 species.

Vegetative Characters:

(1) Plant may be *herb, shrub* or *tree*.

(2) *Stem* have usually *spines*.

(3) *Leaves* alternate, rarely opposite, simple or compound.

(4) A pair of stipule may be present at base of leaf the ***stipules*** sometimes adnate to petiole (attached).

Fig. Rosaceae A-twig; bB-young stamen; B1-englarged open anther, showing pollen in it; C-ctyle hairy and stigma bilabiate; C1-enlarged bilabiat stigma.

FLORAL CHARACTERS:

Inflorescence: ***Solitary*** or may be ***racamose cymore cluster***.

Flower: Bisexual ***actinomorphic***, often ***perigynous***, usually showy scented.

Calyx: ***Sepals 5***, rarely 4, united at the base.

Corolla: ***Petals 5*** or multiple of five and are free (***Polypetalous***), large and showy.

Androecium: Stamen numerous, sometimes 5 or 10.

Gynoecium: I-numerous, ***separate (apocarpous)*** or ***united (Synacarpous)***, ovary generally superior, sometime inferior.

Placentation: Basal when carpel is ***single*** or ***apocarpous*** and axile when many carpels are syncarpous (fused).

Familiar Plants:

(i)	*Pyrus – pears*	*(ii)*	*Rosa (Rose)*	*(iii)*	*Malus (apple)*
(iv)	*Fragaria (Strawberry)*	*(v)*	*Almond*	*(vi)*	*Apricot*

Q.13 *Write down economic importance of rosaceae.*

Ans. ECONOMIC IMPORTANCE:

It provides us fruits.

(i) ***Decoration:*** It is used in decoration purposes e.g., rose.

(ii) ***Ornamental:*** Cultivated in garden for ornamental purpose in parks and gardens.

(iii) ***Sticks:*** The branches of crataegus is used to make walking sticks.

(iv) ***Tobacco Pipes:*** Wood of pyrus pastia is used for making tobacco pipes.

(v) ***Gulkund:*** Petals of rose are used in making gulkund.

(vi) ***Ark:*** Ark gulab is used for curing eyes diseases.

(vii) ***Perfumes:*** Rose oil is used as perfumes.

Q.14 *Give Characters, Economic Importance and familiar plants of family Solanaceae (Potato Family).*

Ans. $\boxed{\text{SOLANACEAE}}$ **(*POTATO FAMILY*)**

GENERA:

In world = 90 genera and 2000 species.

SPECIES:

In Pakistan = 14 genera and 52 species.

VEGETATIVE CHARACTERS:

It is called *potato family*. These may be *herbs, shrubs* and sometimes *tree* and vines. Leaves are alternate and rarely become opposite in floral region, petiolate or rarely sessiles.

FLORAL CHARACTERS:

Inflorescence: Axillary cyme, ***combination of cymes***, sometimes ***helicoid*** or ***umbellate*** cyme.

Flowers: Bisexual, ***actinomorphic*** or weakly ***zygomorphic***, hypogynous and ***pentamerous***.

Calyx: Sepals 5, united (***gamosepalous***) persistent.

Corolla: Petals 5, united (***Gamopetalous***) persistent.

Androecium: Stamen 5, epipetalous (attached to petals) ***didynamous*** i.e. arranged in two whorls of 4 and 2 each.

Gynoecium: Bicapiallary (two carpels) syncarpous (fused), ovary obliguely placed, bilocular or 4 locular by false septa.

Placentation: Axile.

Familiar Plants:

(1) *Solanum tuberosum* (potato)

(2) *Solanum molangena.*

(3) *Capsicum annum* (chilli)

(4) *Lycopersicum esculentum* (Tomato)

(5) *Solanum nigrum* (mako).

(6) *Atropa belladona*.

(7) *Nicotiana tobacum* (Tobacco)

(8) *Dature alba*.

Fig. Solanaceae: Solanum nigrum, A- twig, B-Flower C-fruit, D-seed

Q.15 Discuss economic importance of solanaceae.

Ans. ECONOMIC IMPORTANCE OF SOLANACEAE:

(1) Vegetables: It is used as vegetable like *tomato, bringal, potato, chilly*.

(2) Vitamins: It is a rich source of vitamin C and A e.g. chilly and simla mirch.

(3) Drugs: From Tobacco nicotine is obtained and used in drugs.

(4) Cigarretes: Dried leaves of tobacco are used to make cigarretes.

(5) Medicines: (i) *Atropa belladona* and datura are used in medicine.
(ii) Ak – Mako is used as medicine.

(6) Ornamentals: Cultivated in gardens for ornamental purposes.

Q.16 (a) Discuss general and floral characteristics of Fabaceae / pea family / papilionaceae.

Ans. FAMILY FABACEAE / PEA FAMILY:

Genera = 400
Species = 9000

This family is found all over the world, but common in warm temperate regions. In Pakistan, 82 genera and 587 species are present.

FLORAL FEATURES:

Calyx: Sepals 5, gamasepalous to form hairy tube.

Corolla: Papillionaceous, petals 5, the upper petal is large called standard or vexillum two lateral petals united to form boat shaped structure called keel or carina.

Androecium: Stamen 10, diadelphus (united by their filaments into two groups 9 stamen united to form sheath around the pistil and 10^{th} is free.

Gynoecium: Carpel with one locule, ovary superior with long style which is bent.

Placentation: Marginal.

Fruit: Legume or pod.

Familiar Plants:

(i)	*Lathyrus odoratus* (sweet pea)	(لیتھائرس اوڈوریٹس)
(ii)	*Arachis hypogea* (Mong Phalli).	(اریکس ہائیوجیا)
(iii)	*Cicer arietinum* (channa).	(سائیسر اری ٹی نم)
(iv)	*Dalbergia sisso* (shesham)	(دلبرجیا سیسو)
(v)	*Medicageo sativa* (Alfa Alfa).	(میڈی کے گوسٹا ئیوا)
(vi)	*Pisum sativum* (edible pea).	(پائزم سٹی وم)

Q.16 (b) What do you know about the importance of Fabaceae Family?

Ans. (1) Protein and Oils: It is a source of high protein and oils i.e. pulses like *gram, pea,* kidney *bean* etc.

(2) Fodders: It is used as fodder of cattle like horse, cow sheep etc. e.g. *Medicago sativa* (Alfa Alfa), Trifolium.

(3) Edible Seeds: Seeds of Arachis hypogea (مونگ پھلی) are edible and also used for extraction of oil (تیل نکالنا) used as vegetable oil after hydrogenation.

(4) Dye: From Indigofera *tinctoria* indigo dye is obtained and from *Butea monosperma* yellow dye is achieved.

(5) Furniture and Fuels: Many tree provide ***timber*** for making furniture and fuel e.g. Dalbergia and Butea.

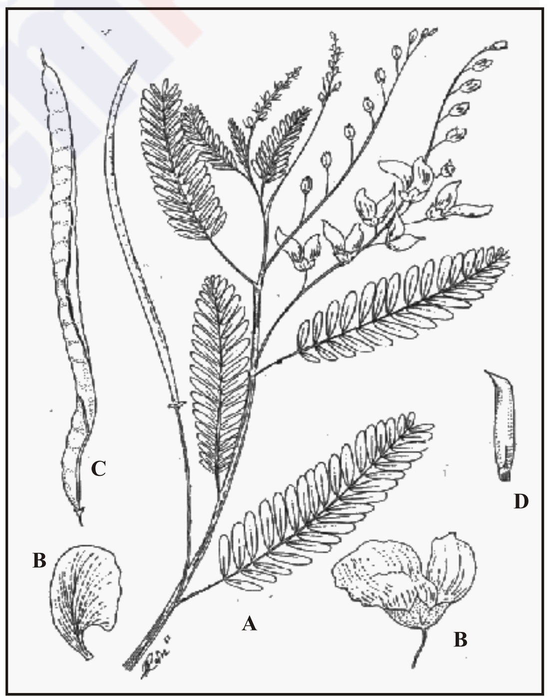


Fig. Fabaceae (Papilionaceae): Sesbania sesbar; A-twing; B-flower; B1 standard verillium; C-fruit a legume; D- carpel.

(6) **Medicines:** These are used as medicines e.g. *Glycyrrhiza glabra* for cough and cold *Clitoria* ternatea for snake bite.

(7) **Ornamental Plants:** (زیبائشی پودے) Used as ornamental plants e.g., ***Lathyrus butea*** and Clitoria.

Q.17 Give characteristics, Economic Importance and Familiar Plants of Family Caesalpiniacea Cassia Family. (OR) Write down an account on Cassia Family.

Ans. CASSIA FAMILY

Genera and Species:

In World = 152 genera and 2300 species

In Pakistan = 16 genera and 60 species.

Vegetative Characters:

Mostly trees or shrubs, sometimes ***climbers*** stem, erect, woody, herbaceous or climbing leaves compound, pinnately divided rarely simple.

FLORAL CHARACTERS:

Inflorescence:

Racemose: Axillary or terminal recemose or panicle or spike rarely cymose.

Flower: Bisexual, zygomorphic rarely actionomorphic, perigynous.

Calyx: Sepals 5, coloured, free, or connate at base.

Corolla: Petals 5 polypetalous.

Androecium: 10 stamens or fewer or numerous. Free or united.

Gynoecium: Carpel 1, ovary superior, unilocular, stigma simple.

Placentation: Marginal.

Fruits: Legume (پھلی).

Familiar Plants:

(i) *Tamarindus indica* (Imli). (ٹیمارنڈس انڈیکا)

(ii) *Cassi fistula* (Amaltas). (کیشیا فسٹیولا)

(iii) *Bauhinia verigata* (Kachnar) (باؤنیا ویری گیٹا)

ECONOMIC IMPORTANCE:

(1) **Medicine:** It is used as medicine e.g. leaves of *Cassia alata* are used ***to cure ring worm*** and skin diseases, Cassia *senna* and C. obovata leaves yield drug senna which is ***laxative*** oil of *Cynometra cauliflora* is used for sin diseases.

(2) **Vegetables:** Bauhinia variegata (Kachnar) is used as vegetable.

(3) ***Tataric Acid:*** Tamarindus indica (Imli) is edible and is rich source of tataric acid.

(4) The bark of tamarindus and bauhinia are used in ***tanneries***.

(5) The wood of Haematoxylon yields haematoxylin ***dye***.

(6) Grown as ***ornamental plants*** i.e., Kachnar.

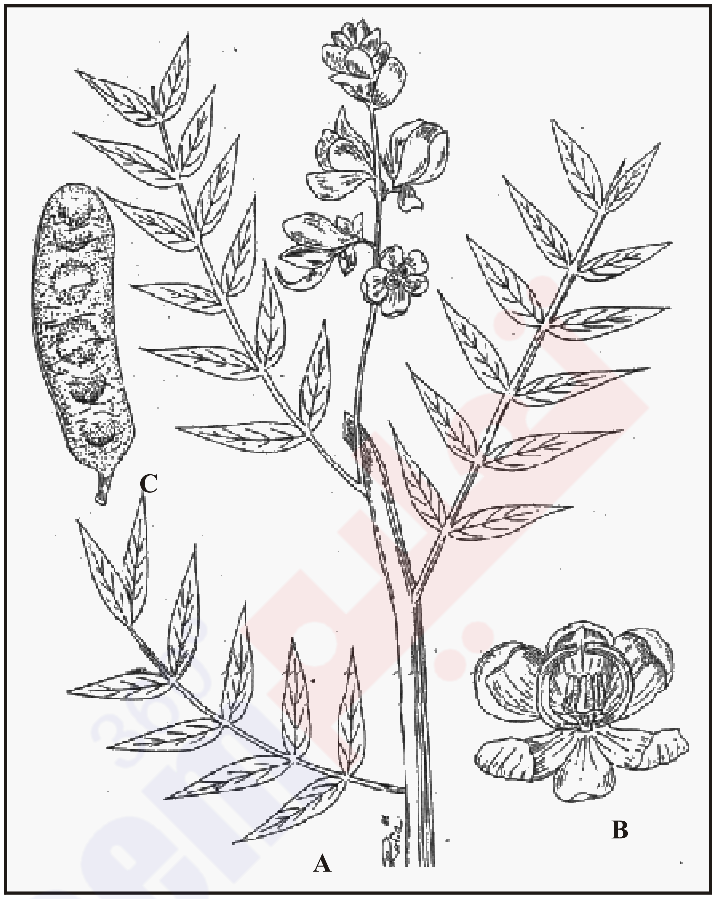


Fig. Caesalpiniaceae: Cassia senna; A twig, B-flower; C- fruit

Q.18 Give Characters, Economic Importance and familiar plants of family Mimosaceae (Acacia Family).

Ans. **MIMOSACEAE**

GENERA AND SPECIES:

In World = 56 genera and 2800 species.

In Pakistan = 4 genera and 18 species.

VEGETATIVE CHARACTERISTICS:

Habit and Habitat: Mostly trees or shrubs, rarely herbs or climbers mostly xerophyte stem, woody, leaves, compound, pinnately divided, alternate, stipulate, stipules modified into thorns.

FLORAL CHARACTERS:

Inflorescence:

Umbel: Spike like or head or umbel rarely raceamose or globose umbel.

Flower: Bisexual, actionmorphic, hypogynous or slightly. Perigynous bracteate.

Calyx: Sepals 5, gamasepalous, toothed.

Corolla: Petals 5 or polypetalous or gamapetalous.

Androecium: Stamen 5 – numerous, free adnate to petals.

Gynoecium: Carpel 10, unilocular ovary, superior ovules many.

Placentation: Marginal.

Fruit: Legume.

Familiar Plants:

(i) *Acacia nilotica* (Kikar) (اکیشیانیلاٹیکا)

(ii) *Albizzia lebbek* (Beric) (البزیالیبک)

(iii) *Mimosa pudica* (touch me not). (مائموساپوڈیکا)

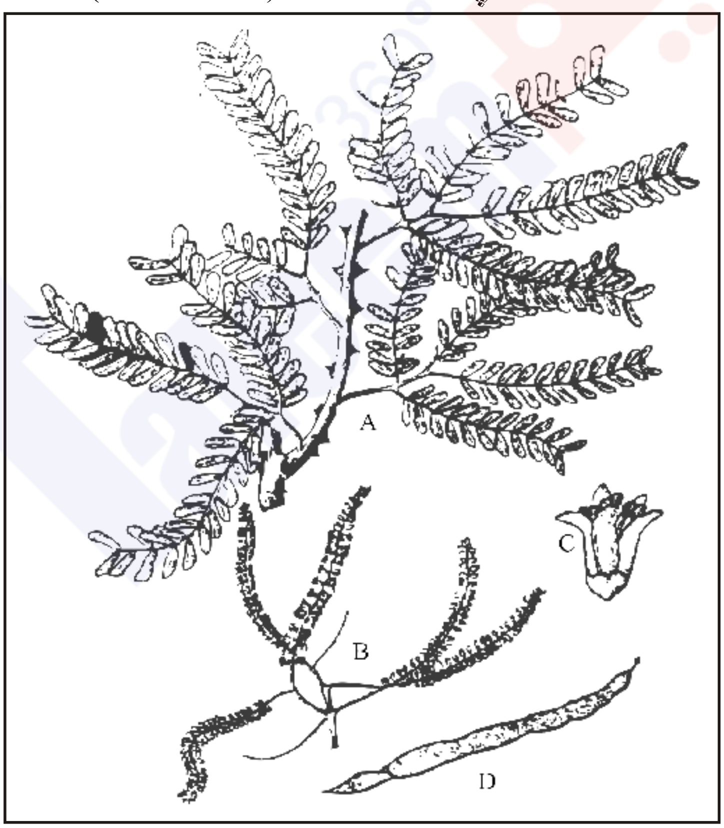


Fig. Mimosaceae: Prospsis cineraria; A-twig, B-infloresences; C-flower; D-fruits

Economic Importance:

(1) Wood of *Acacia* and *Albizza* is used for construction purposes, making furnitures and used as fuel. Wood of Albizza is used in cabinet work and railway carriage.

(2) From *Acacia nilotica* gum is obtained.

(3) From *Acacia catechue* a dye katria is obtained.

(4) Tender leaves of a *nilotica* are used as blood purifier.

(5) Cultivated for ornamental purposes.

Q.19 Give Characters, Economic Importance and familiar plants of family Poaceae (Graminae) Grass Family.

Ans. **POACEAE**

In World = 600 generals and 10,000 species.

In Pakistan = 158 genera and 492 species.

Vegetative Characters:

Stem: Annual or perennial herbs stem jointed and hollow nodes, leaves are solitary, sometimes crowded at the base of stem, alternate, ***exstipulate ligulate***, sessile, leaf base form sheath around stem, simple.

FLORAL CHARACTERS:

Inflorescence: Mostly spikelets arranged variously in groups.

Rachila: Each spikelets consists of bracts arranged along axis called rachilla.

Glumes: Two lower empty bracts of rachilla called glumes, two bracts other than glumes called lemma palea enclosing flower.

Floret: The whole structure consisting of lemma, palea and flower is called floret.

Awns: The glume bears stiff bristles called awns.

Flower: Usually bisexual, sometimes unisexual, in-conspicuous, sessile bracteate, incomplete, zygomorphic hypogynous.

Perianth: (Sepals and Petals) absent or representaed by 2 – 3 scales called lodicules.

Androecium: Stamens 1 – 6 usually 3.

Gynoecium: Carples 3 united, free, stigma feathery.

Grainy Fruit: Grains or ***caryopsis*** fruit in which wall of ovary is dry and fused with ***testa***.

Familiar Plants:

(i) ***Triticum vulgare*** (wheat). (ٹری ٹیکم ولگیر)

(ii) ***Zea mays*** (corn). (ذی میز)

(iii) ***Avena sativa*** (Oat) (اوینا سٹیوا)

(iv) *Oryza sativa (Rice)* (اورائیزا سٹیوا)

(v) *Saccharum officinarum* (sugarcane) (سیکرم افسینیرم)

(vi) Bambosa (Bamboo) (بمبوسہ)

Fig. Poaccae (Gramineae): Chloris barbata; A-Habit; B-Spikelet; C-gulumes; D-fertile lamma, E-flower, F-Fruit;

ECONOMIC IMPORTANCE

(1) **Foods:** This family is of great importance for both man and animals. It provides food e.g. ***cereals, millets*** are food of man and many ***fodder crops*** are food of animals e.g. ***wheat, oat, corn barley*** and ***rye plants*** etc.

(2) **Fodder:** Dry stem and leaves of cereals crops are used as fodder of animals.

(3) **Sugar:** Sugar is obtained from the juice of sugarcane.

(4) **Lawns:** Grasses are used in lawn.

(5) **Ornamental:** Cultivated as ornamental purposes.

(6) **Making material:** Bambosa (Bamboo) is used as building material in huts, making ***boats carts*** and ***pipes, mats, basket, hats***. Its leaves are given to horse as cure of cough and cold.

(7) **Aromatic Oil:** Aromatic oil is extracted form lemon grass used in ***perfumes***.

(8) **Alcohol:** Ethyl alcohol and ***beverages*** are prepared from cereals.

(9) **Ropes:** Fibers of ***Saccharum munja*** are used in making ropes.

HELP LINE

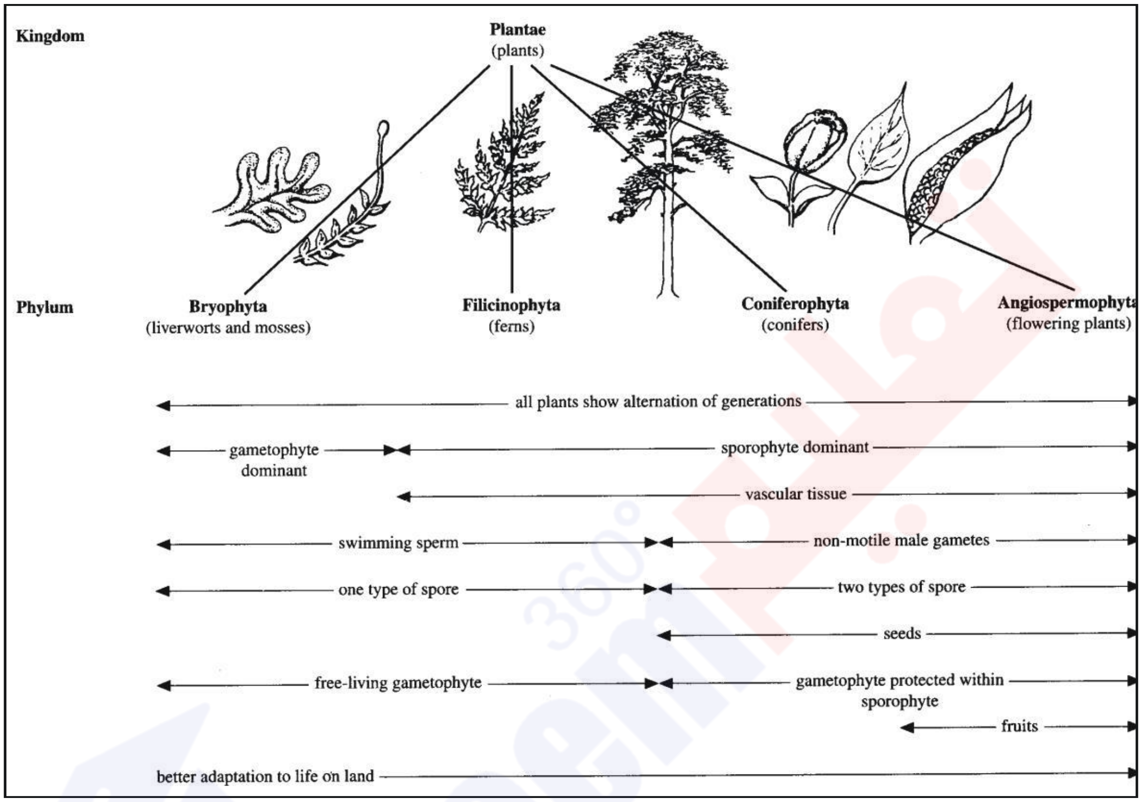


Fig. Classification of plants and some of the main trends in plant evolution

IMPORTANT DEFINITIONS

Alternation of Generation: "The alternate occurrence of sporophyte and gametophyte generations in a plant is called alternation of generation

Antheridium: The male sex organ of the lower plants. (OR) A multicellular sperm producing organ with jacket of sterile cells.

Antherozoid: A motile male gamete produced by lower plants and some gymnosperms.

Archegonium: A multicellular egg producing structure with a jacket of sterile cells. (OR) The female sex organ of the lower plants.

Axis: The stem and root (if present) of plant.

Axil: The upper angle formed by the junction of leaf with the stem.

Cambium: A zone of dividing cells between xylem and phloem.

Evolution: Descent with modification.

Egg: A large non flagellated female gamete is called egg.

Foot: The absorbing organ of the embryonic sporophyte in liverworts, mosses and vascular cryptogams.

Gamete: A sex cell i.e. sperm or egg.

Heterospory: The production of more than one type of spore by a species. (OR) Production of microspores that grow into male gametophytes and megaspores that develop into female gametophytes.

Ligule: An outgrowth from the upper side of the microphyll in Selaginella.

Microspore: Smaller male haploid spore producing a male gametophyte. (also called pollen grain).

Megaspore: The non motile female haploid spore having reserve food for gametophyte.

Microsporophyll: A leaf bearing one or more microsporangia is called microsporophyll.

Megasporophyll: A leaf bearing one or more megasporangia is called megasporophyll.

Microphyllous Leaves: A typical leaf of lower plants which is relatively small with single leaf. (OR) ***Macrophyllous Leaves:*** Trace (Vein) or megaphyllous.

Megasporphyllous Leaves: The typical leaves of lower plants and seed plants which are relatively large with many veins.

Node: Point of attachment of a leaf or branch is known as node.

Ovule: A megasporangium covered by an integument.

Phloem: A vascular tissue which conducts food is called phloem.

Reproduction: Replication or multiplication of individuals is called reproduction.

Seed: The structure that develops from the fertilized ovule, having an embryo which is surrounded by protective coat.

Sperm: The motile male gamete is called sperm.

Sporophyll: A modified leaf that bears sporangia. (OR) A leaf bearing one or more sporangia.

Sporangium: A structure containing spores.

Spore Mother Cell: The cell that gives rise four spores by meiosis.

Sporophyte: The spore producing diploid generation in the life cycle of a plant.

Spore: Asexual unicellular reproductive unit is called spore.

Strobilus: A group of closely packed sporophylls bearing sporangia arranged around a central axis.

Vein: Xylem and phloem strand in a leaf.

Zoospore: A motile asexual reproductive cell is called zoospore.

Zygote: The diploid cell produced by the union of two gametes.

Xylem: A vascular tissue which conducts water.

Gametophyte: The gamete producing haploid generation in the life cycle of a plant.

Q.20 How sporangia are protected in vascular plants? (OR) Write a short note on the protection of sporangia in pteridophytes (club mosses and horsetails).

Ans. PROTECTION OF SPORANGIA:

The oldest vascular plants i.e. *Rhynia*, have sporangia, which were present at the tips of upright branches. These sporangia were not protected with the passage of time, due to evolution, protection of sporangia was provided by cones.

CONE FORMATION:

"Cone is closely packed structure sporophyll around a central axis bearing sporangia."

Example: Club mosses and horsetail, pteridophytes, pinus (Gymnosperm)

Club Mosses:

Sporophylls protect to sporangia in club mosses. A group of sprophylls combines together to form cone. In this way, sporangia are protected by envelope of sporophylls.

Horsetails:

Horsetails have well developed cones. Sporangia are produced on little branches. Each branch ends in a flattened head called PELTATE HEAD. Sporangia are attached just below the peltate head. Here sporangia are completely covered for protection.

IMPORTANT CONCEPTS, SUMMARIES & KEY POINTS

Q.1 *Briefly discuss the evolution of pollen tube. (OR) Write down the importance of pollen tube in success of seed plant. (OR) Describe the emancipation from dependence on H_2O for fertilization and the evolution of pollen tube.*

Ans. EVOLUTION OF POLLEN TUBE:

Water is necessary for the fertilization in early land plants like liverworts, mosses: primitive. Vascular and ferns. But seeded plants (Gymnosperm and Angiosperm) do not need water for fertilization. Because the seeded plants are mostly terrestrial.

The megaspores is enclosed in the integuments. So the evolution of pollen tube parallels the evolution of seed is equally important when pollen grain reaches the come or flower it germinates and form pollen tube. This pollen tube grows toward the ovule because egg is present inside the ovary thus pollen tube is developed for transformation of sperms to egg.

Q.2 *Differentiate between Angiosperms and gymnosperms.*

Ans.

Gymnosperms	Angiosperms
1. Mostly *woody* but few herbs.	1. Mostly herbs, but woody too
2. Usually *perennials*.	2. Usually annual, binneal (few perennials)
3. *Xylem* without vessels	3. Xylem has vessels.
4. *Phloem* without companion cells.	4. Phloem has companion cells.
5. *Cones* unisexual.	5. Flower commonly bisexual (few unisexual)
6. *Ovule* are naked.	6. Ovules in carpels.
7. *Archegonia* present.	7. Archegonia absent but carpel present.
8. *Pollen grain* directly settles on micropyle.	8. Pollen grain falls on stigma, travel through style, then ovary and finally in ovule. * Pollen grain $\rightarrow$ Stigma $\rightarrow$ Style $\rightarrow$ Ovary $\rightarrow$ Ovule

9. Endosperm is haploid.	9. Endosperm is Triploid.
10. Endosperm develops before fertilization.	10. Endosperm develops after fertilization.
11. Double fertilization is absent.	11. Double fertilization is premier
12. Seeds are exposed.	12. Seeds are enclosed in ovary. Ovary develops food.
13. Non flowering/Naked seeded.	13. Flowering/enclosed seeded.
Examples: *Pinus excelsa* *Pinus gerardiana (Chilgoza)* *Pinus longifolia* *Picea smithiana* *Cedrus deodara (Diar)* *Abies pindrow* *Cupressus* *Cycas revolute* *Taxus baccata and Thuja etc.*	***Examples:*** *Arachis hypogea* *Solanum tuberosum* *Oryza sativa, Lycopersicum esculentum* *Triticum spp., Rosa indica* *Avena sativa Malus sp.,* *Zea mays, Pyrus sp.* *Acacia arabica, Fragaria vesca,* *Albizzia labbek,* *Cassia fistula,* *Pisum sativum*

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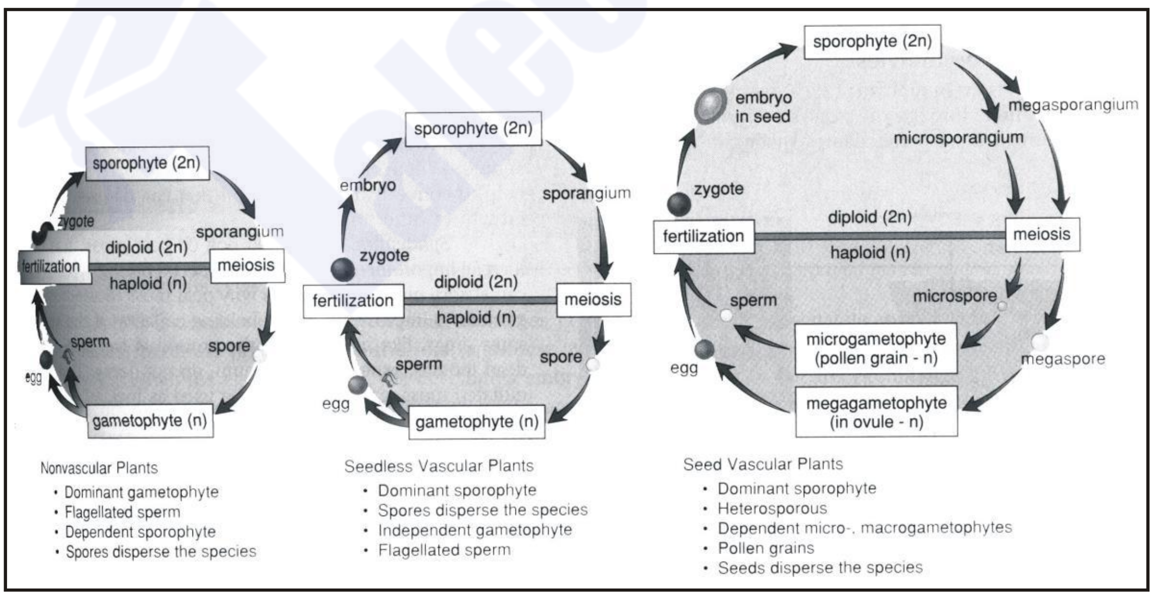

Q.3 Draw the labeled diagrams of following:

(a)	*Flower*	*(b)*	*Antheridium*
(c)	*Carpel/Pistil*	*(d)*	*Archegonium*
(e)	*T.S.of capsule of Stamen (or Moss)*		
(g)	*Cone of gymnosperm (female)*	*(h)*	*Sporangium of petridophyte*
(i)	*Ovule*	*(j)*	*Placentation*

Q.4 Differentiate between Bryophytes and Pteridophytes:

Ans.

Bryophytes	Pteridophytes
1. A group with most developed. ***Gametophyte*** is adult body. =➔ Non-Vascular plants	1. A group with first dominant: ***Sporophyte*** is adult body. =➔ Vascular plants
2. The opening face of land plants	2. The opening face of Vascular plants
3. Gametophytic =➔ Sporophytic alternation of generation.	3. Sporophytic =➔ Gametophytic alternation of generation
4. Sporophyte with =➔ Foot =➔ SETA =➔ CAPSULE	4. Sporophyte with =➔ Foot =➔ SETA =➔ CAPSULE
5. Sporophyte born upon gametophyte	5. Both sporophyte and gametophyte are independent and separate.
6. Sporophyte always homosporous	6. Sporophyte homo- and heterosporous.
7. sporophyte has limited growth.	7. Sporophyte has unlimited growth.
8. Non sporangia but capsule in which spores are produced.	8. Sporangia present, spores are produced in it.
9. Thallus or (always thallose) (a) Hepaticea (Liverwort) – *Marchantia* (b) Musci (Mosses) – *Funaria* (c) Anthoceroteae (Hornwort) – *Anthoceros*	9. May be thallose and foliose. Psilopsida Lycopsida Sphenopsida Pteropsida

Q.5 Define Annual, Biennial and perennial plants.

Ans. Annual Plants: Plant that germinate, grow, reproduce and die within a year.

Biennial Plants: Plant which completes its life cycle in two years, growing only vegetatively in first year. Which are used to produce leaves, flowers, seeds etc, in the second year.

Perennial Plants: Plant that lives for indefinite period i.e., more than two years.

DIAGRAMS FOR CONCEPT

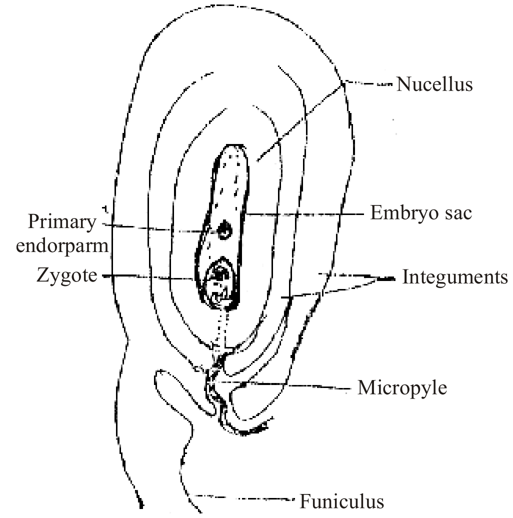

Fig. (i) Ovule

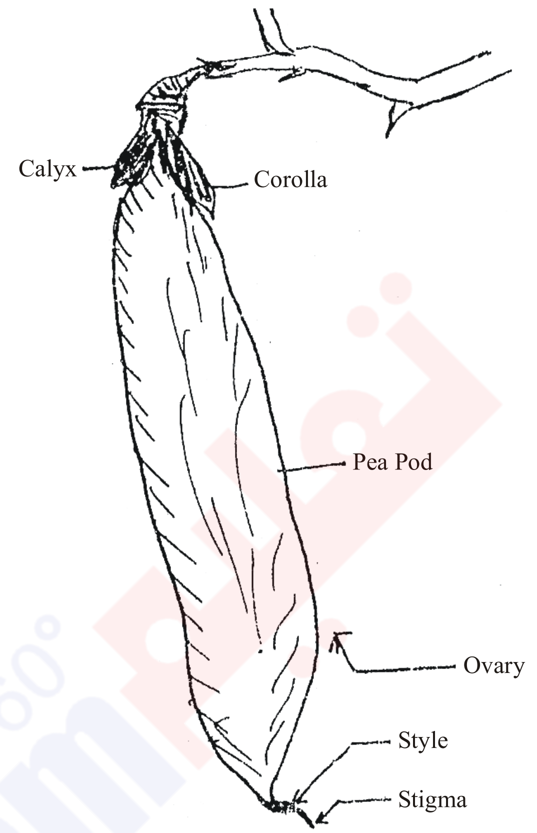

Fig. Pea Pod

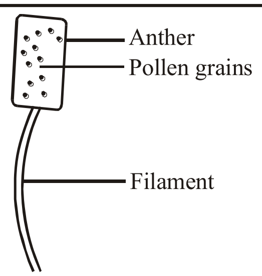

Fig. Stamen

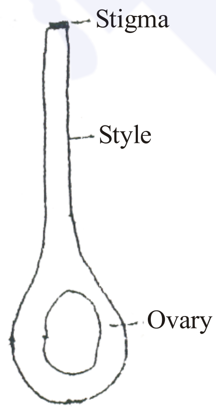

Fig. (c) Carpel

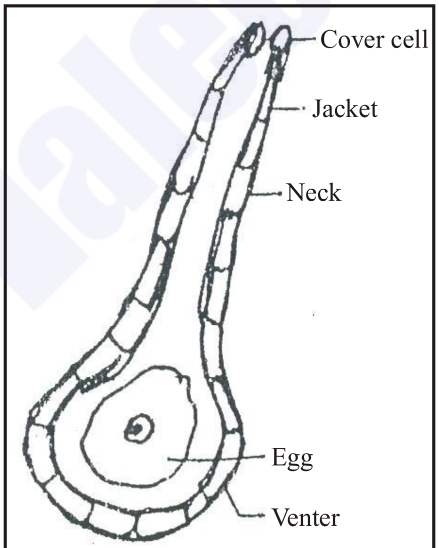

Fig. (d) Archegonium

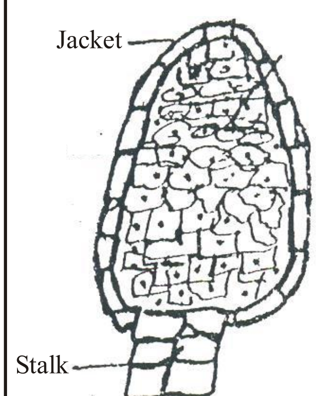

Fig. (b) Antheridium

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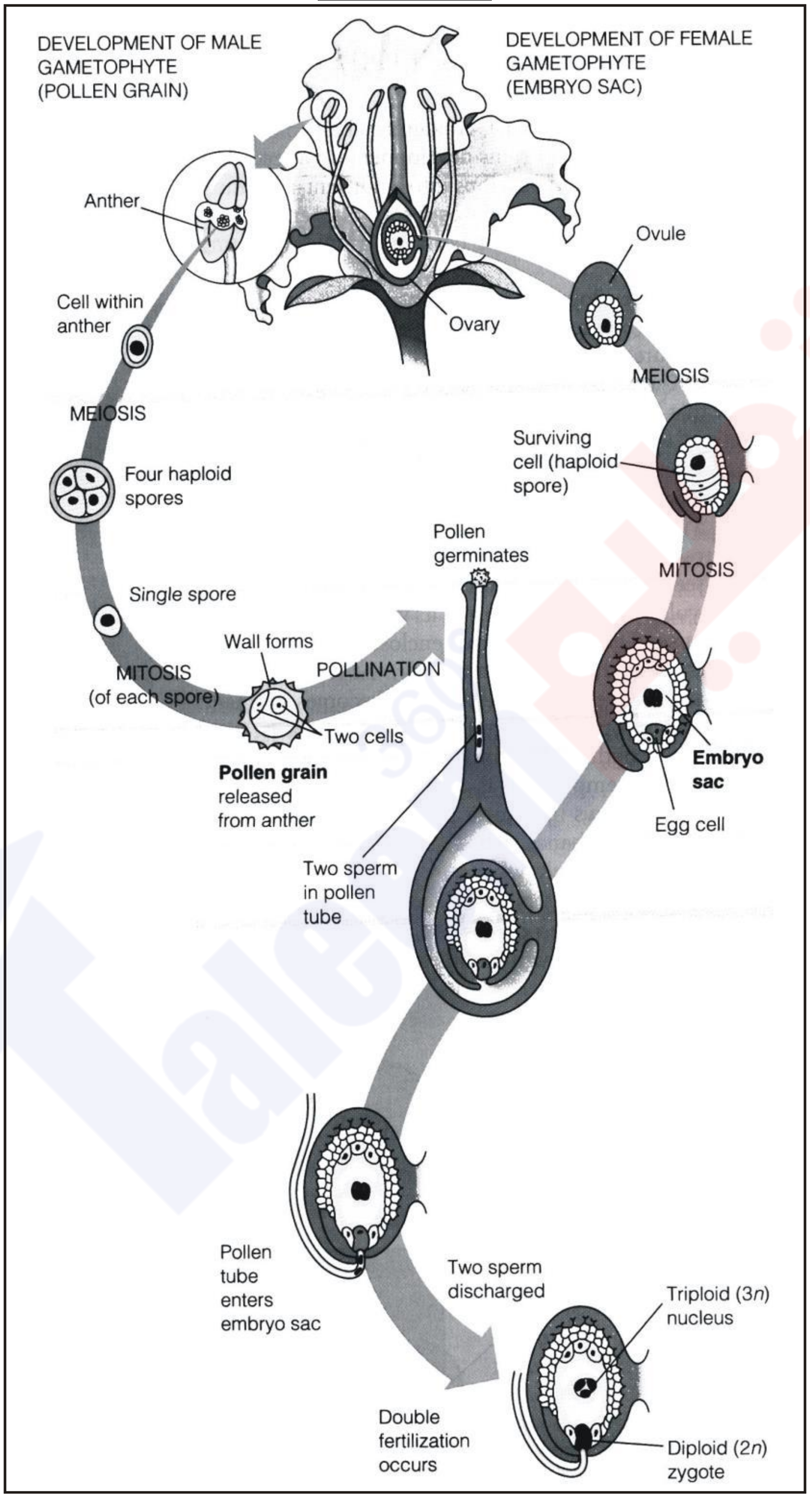

DEVELOPMENT OF MALE GAMETOPHYTE (POLLEN GRAIN)
DEVELOPMENT OF FEMALE GAMETOPHYTE (EMBRYO SAC)
Anther
Ovule
Cell within anther
Ovary
MEIOSIS
MEIOSIS
Four haploid spores
Surviving cell (haploid spore)
Pollen germinates
MITOSIS
Single spore
Wall forms
MITOSIS (of each spore)
POLLINATION
Two cells
Pollen grain released from anther
Embryo sac
Egg cell
Two sperm in pollen tube
Pollen tube enters embryo sac
Two sperm discharged
Triploid (3n) nucleus
Double fertilization occurs
Diploid (2n) zygote

DIFFICULT WORD MEANINGS

Words	Meanings	Words	Meanings
Categories	مختلف انداز میں/اقسام	Indefinite	غیر مستقل
Beyond	پیچھے	Hornworts	سینگ نما برائیوفائٹس
Conducting	جن سے گزر سکے/ جو گزارے	Conspicuous	نمایاں
Cuticle	بیرونی تہہ	Oospore(egg)	بیضہ/ انڈا
Conspicuous	نمایاں	Protected	محفوظ
Capsule	خول	Cortex	تنے یا جڑ کے اندرونی ٹشو
Chemotactically	ایسی حرکت جو کیمیکل سے متعلقہ ہو	Symbiont	تعلق میں باہمی مفاد پہنچانے والے
Antherozoid (Sperm)	پودے کا سپرم	Beneficial	فائدہ مند/ مفاد فراہم کرنے والے
Evaporation	آبی بخارات	Subterranean	نیچے/ زمین میں
Evolved	سے نکلا/ سے بنا	Anchoring	زمین میں دھنسے
Versatile	کئی طرح کا/ ہر فن مولا/ کئی کام کرنے والا	Regarded	کے لحاظ سے
Terrestrial	زمینی/ زمینی ماحول	Expanded	پھیلے ہوئے
Reduced	کمی/ کم	Approximately	قریباً
Antheridiophores	ایسی شاخیں جن پر پودے کا نر حصہ ہو	Assumed	فرض کیا
Mats	بچھا ہوا/ دری	Aerial	ہوائی
Alternation	ادل بدل/ متبادل	Strobili	کون نما/ چند ٹریڈوفائٹس کا جنسی حصہ
Clusters	گچھا/ گروپ	Ligule	چھوٹا سا ابھار جو تنے وغیرہ سے نکلے
Sunken	دھنسا ہوا/ ڈوبا ہوا	Whorl	گھیرا
Exhibit	نمائش/ دکھائی دیتے ہوئے	Aggregated	اکٹھے/ جمع ہوئے
Excessive (Extra)	بہت زیادہ	Clusters	گچھا
Stem	تنا	Fusion	ملاپ/ ملنا
Mud	مٹی/ گیلی مٹی	Distributed	تقسیم

Pattern	انداز	Showy	دکھائی دینے والا
Herb	جڑی بوٹی/نرم ونازک پودا	Commercial	صنعتی
Adventitious	ایسی جڑیں جو باہر بھی نظر آئیں	Rotate	گھومنے والا/ پھرنے والا
Dominant	غالب	Cigarettes	سیگریٹ
Rupture	ٹوٹا ہوا	Tendrils	کسی چیز پر چڑھ جانے والی بیلیں
Dispersed	پھیلا ہوا	Aquatic	آبی ماحول
Prothallus	تھیلس سے قبل	Alternate	متبادل
Venter	کارپل کا نچلا پھولا ہوا حصہ	Inflorescence	پھولوں کا گچھا
Thallus	ایسا پودا جس میں جڑ، تنا اور پتے نہ ہوں	Unilocular	جس میں ایک locate ہو
Significant	ظاہر/نمایاں	Ornamental	زیبائشی
Retention	رہنا/ باقی رہنا	Edible	قابلِ خوراک
Pollen	زردانے	Laxative	ایسی دوائی جو قبض کشا ہو
Escape	نکلنا/ باہر آنا	Permitted	جسے اجازت ہو
Primitive	قدیمی/ پرانے انداز کا	Hollow	اندر سے خالی/کھوکھلا
Integumented	تہہ دار/ غلاف والا	Florets	پھول کے حصے
Conspicuous	واضح/نمایاں	Split(breakdown)	ٹوٹنا
Whisky	شراب کی قسم	Systole	دل کا سکڑنا
Versatile	کئی رخ رکھنے والا/کئی کام کرنے والا	Diastole	دل کا پھیلنا
Fodder	چارہ	Gynaecium	گائینیشیم/ پھول کا مادہ حصہ/رحم گل
Millets	Grain used for food	Androecium	اینڈروشیم/ پھول کا حصہ
Cereals	گندم، جو وغیرہ کے دانے	Style	سٹائل/کارپل کی گردن
Descending	نیچے کی جانب	Ovule	اووری/ بیضہ دانی
Stigma	کارپل کی اوپر والی سطح جہاں زردانہ آتا ہے/سربقچہ/سٹگما	Pollen tube	پولن ٹیوب/ زرنالی
Ovary	اووری/ بیضہ دانی	Tegmen	اندرونی غلاف
Micropyle	سوراخچہ	Testa	بیرونی غلاف
Integument	غلاف	Actinomorphio	

Q.1 Fill in the blanks:

(i) The sporophyte is __________ and __________ generation and the gametophyte is __________ and __________.

(ii) The motile asexual reproductive cells are characteristics of __________ and are called __________.

(iii) The sexual reproduction is said to be oogamous or heterogamous if two fusing gametes are __________.

(iv) In the stem of monocotyledons the bundles are __________ while in the stem of dicotyledons they are __________.

(v) The double fertilization is the characteristic feature of __________.

(vi) Stem roots and leaves are the __________ parts and flowers, fruits and seeds are the __________ parts of the plant.

(vii) __________ is the phenomenon of the production of two kinds of spores in the plants.

(viii) The naked seeded plants are included in the group __________.

ANSWERS:

(i) (2n), asexual Spore producing, (n), sexual, gamete producing

(ii) Kuverwritsm gennae

(iii) Dissimilar

(iv) Scattered, in a ring

(v) Angiosperm

(vi) Vegetative, reproductive

(vii) Heterospory

(viii) Gymnosperms

Q.2 Short Questions:

(i) (a) How are ferns better adapted to life on land than liverworts and mosses?

(b) Which of the following are nutritionally self supporting.

Ans. (a) Ferns posses vascular tissues, which make them better adapted an land as compare to liverworts and mosses.

(b) Mature liverwort and moss gametophyte.

Mature liverwort and moss sporophyte.

(c) Gametophyte generation in mature liverwort and moss are nutritionally self supporting.

(ii) **(a)** **The chances of survival and development of wind-blown pollen grain are much less than those of spores of Adiantum. Comment on this statement.**

(b) **Account for the fact that megaspores are large and microspores are small.**

(c) **What important advances have angionsperms made toward the seed plant life?**

Ans. (a) Adiantum can grow only moist and shady places.

(b) Megaspore should contain more food to produce complex structure.

(c) Flower and seed enclosed in the ovary.

(iii) **Write a note on the alternation of generations.**

Ans. See text.

(iv) **What is the importance of the following?**

Ans. (a) **Seed:** It is a **dormant embryo** with stored food for next generation.

(b) Double Fertilization.

(c) Double fertilizer ensure the production of embryo and sometimes of endosperm.

(d) Heterospory

(e) It is an advanced step towards the seed production.

(f) Pick and match the following in column C:

No.	Column A	Column B	Column C
1.	Fern sporophyte	involves vegetative parts of plants	is a diploid generation.
2.	The moss plant	is the first cell of sporophyte	is gametophytic generation
3.	The gamete	is the last cell of gametophyte	are haploid cells.
4.	The spores	are asexual reproductive cell of gametophyte	are asexual reproductive cell
5.	Vegetative reproduction	are haploid cells	involves vegetative parts of plants
6.	The oospore	is gametophytic generation	is the first cell of sporophyte.

7.	The gamete	is a diploid generation.	is the last cell of gametophyte.
8.	The Spore mother cell	is the first cell of gametophytes	divides by reduction division to form haploid spores.
9.	The spore	with naked seeds	is the first cell of gametophytes
10.	Gymnosperms are the plants	divides by reduction division to form haploid spores.	with naked seeds.

Q.3 Each question has four options. Encircle the correct answer.

(i) All bryophytes (mosses, liverworts, and hornworts) share certain characteristics. These are:
  (a) Reproductive cell in protective chambers and a waxy cuticle.
  (b) A waxy cuticle, true leaves, and reproductive cells in protective chambers.
  (c) Vascular tissues, true leave, and a waxy cuticle.
  (d) Reproductive cells in protective chambers and vascular tissues.
  (e) Vascular tissues a waxy cuticle.

(ii) A heterosporous plant is one that:
  (a) Produces a gametophyte that bears both sex organs.
  (b) Produces microspores and megaspores in separate sporangia, giving rise to separate male and female gametophytes.
  (c) Is a seedless vascular plant.
  (d) Produces two kind of spores, one asexually by mitosis and one type by meiosis.
  (e) Reproduces only sexually.

(iii) The male gametophyte of an angiosperm is the:
  (a) Anther (b) Embryo sac (c) Microspore
  (d) Germinated pollen grain (d) Ovule

(iv) Important terrestrial adaptations that evolved exclusively in seed plants include all of the following except:
  (i) Pollinaiton by wind or animal instead of fertilization by swimming sperm.
  (ii) Transport of water through vascular tissues.
  (iii) Retention of the gametophyte plant within the sporophyte.
  (iv) Dispersal of new plants seeds.
  (v) Protection and nourishment of the embryo within the seed.

ANSWER:

(i) (a) (ii) (b) (iii) (d) (iv) (b)

Q.4 Extensive Questions:

(i) To what does alternation of generations refer in the plants? Define sporohyte and gametophyte, with which stage is an adult animal comparably? How are they reproductively dissimilar?

Ans. **Alternation of Generation:** The phenomenon of alternation of gametophyte and sporophyte in the life history of a plant is called alternation of generation.

Sporophyte and Gametophyte: Spore producing plant is called sporophyte while, gamete producing plant is called gametophyte. Gametophyte stage is comparable to an adult animal as both produce gametes. Gametophyte produce their reproducing male and female gametes in antheridia and archegonia while animals produce their male and female in testes and ovaries.

(ii) What is a seed? Why is the seed a crucial adaptation to terrestrial life?

Ans. **Seed:** *A mature and fertilized ovule is called seed.*

Seeds can withstand very hard any dry conditions for a very long period and hence have a crucial adaptation to terrestrial life.

(iii) In what way do the flowering plant differ from the rest of the seed plants/ what is the stigma/ is fertilization in angiosperms direct or indirect? Form what tissue does angiosperm fruit develop?

Ans. Flowering plants produce their seeds hidden in the ovaries. This character is peculiar to flowering plants.

Stigma is the terminal part of carpel, which receives the pollen. Fertilization is fo direct type. Fruite developed from the pericarp or ovary wall.

(vi) What two classes comprise the angiosperms? How do the two classes structurally differ from one another/ which class derived from the other ? Explain.

Ans. Angiosperm are divided into 2 classes:

(i) The Monocotyledonae.

(ii) The Dicotyledonae.

Monocots have only one cotyledon (embryo leaf) in their seeds while dicots have two cotyledons in their seeds.

Monocots have primitive characters and it is believed that licots are derived from monocots.

Chapter 10

KINGDOM ANIMALIA

Q.1 Basic and key terms of Animalia.

Ans. **ANIMAL**

A *multicellular heterotrophic* organism which is developed from haploid (IN) non-motile egg and haploid motile sperm while originated from protista is known as animal.

Heterotroph + Multicellular + Multicellular sex organs + Embryo = ***Animal***

Invertebrates: The *lower* animals ***without notochord*** *or vertebral column* are called invertebrates.

Vertebrates: The *lower* animals which belong to sub-phylum vertebrate of phylum chordata in which notochord replaced in adult stage by a vertebral column.

Chordates: Those animals which belong to phylum chordata and possess notochord in their life history are called chordates.

Example: Fishes, Amphibians (frog), Reptiles, Aves, Mammals.

Protochordates: The animals ***without cranium*** are called protochordates.

Vertebral Column: The backbone which is a series of vertebrae and made up of bones or cartilages.

Notochord: The longitudinal running which lies between the dorsal nerve tube and gut for internal support. In most chordates, it is replaced by vertebral column.

Symmetry: The geometrical view of an organism is called symmetry.

(a) ***Radial Symmetry:*** The arrangement of body parts around a central axis and without left and right sides, they have identical two halves by cutting of any diameter.

(b) ***Bilateral Symmetry:*** The arrangement of body parts in which left and right sides, anterior and posterior ends, dorsal and ventral surfaces are found.

Dorsal: Dorsal means ***upper surface*** of the body.

Ventral: Ventral means ***lower surface*** of the body.

Diploblastic: The simple body plan consists of outer ***ectoderm*** and inner ***endoderm*** and has ***Mesoglea*** between the derms.

Triploblastic: The complex body plan consists of *three* germinal layers i.e. endoderm, mesoderm and ectoderm.

Coelom: (سیلوم) The *body cavity* of an individual is called coelom.

Enteron: A body cavity with a *single opening* to the environment is called enteron.

Tissue: A group of cells, often similar in structure and origin and perform specific function is called tissue.

Q.2 Introduce the kingdom which includes animals.

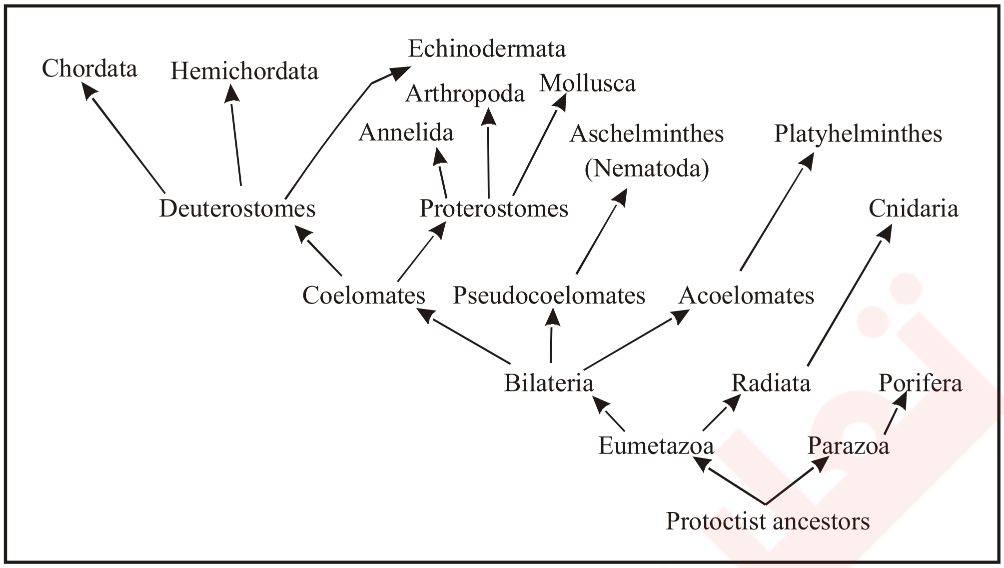
Ans. Animals are included in Kingdom Animalia *(Latin, anima – breath or soul)*. Traditionally there are two kingdom systems i.e. *Protozoa* including unicellular animals and *Metazoa* including multicellular animals. According to *Whittakar* Protozoa belong to kingdom protoctista.

KINGDOM ANIMALIA

It includes animals which are ***heterotrophs*** and develop from two dissimilar haploid gametes i.e. large ***immotile egg*** and small ***motile sperm***.

Most of the biologists believe that animals evolved from protoctists. But many questions are still unanswered about the origin of different animals.

The Relationship of Different Phyla



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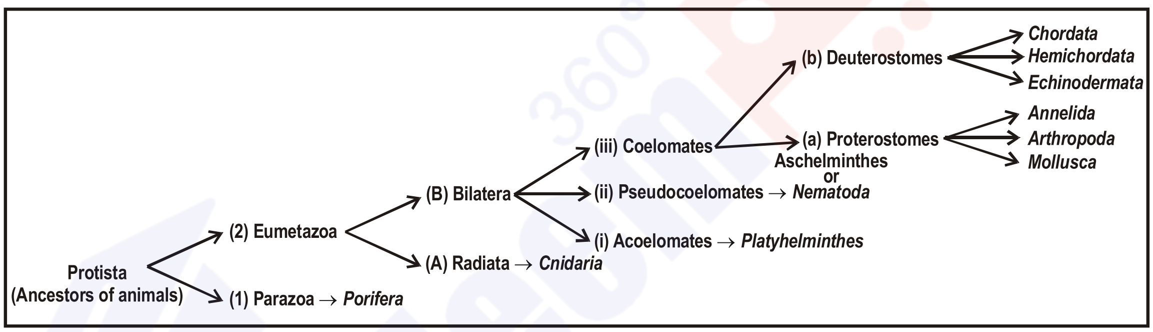

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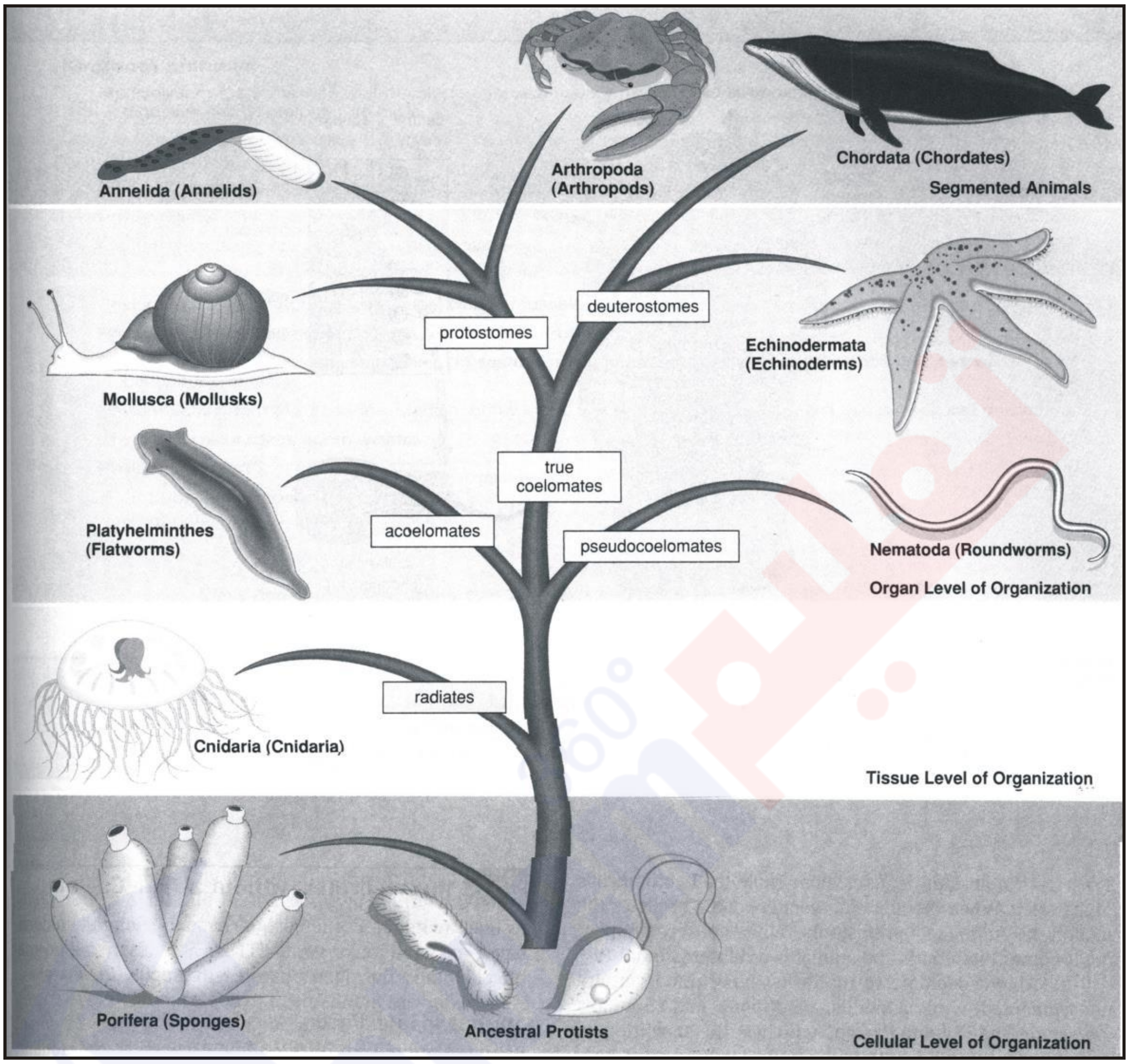

Annelida (Annelids)
Arthropoda
(Arthropods)
Chordata (Chordates)
Segmented Animals
deuterostomes
protostomes
Echinodermata
(Echinoderms)
Mollusca (Mollusks)
true
coelomates
acoelomates
pseudocoelomates
Platyhelminthes
(Flatworms)
Nematoda (Roundworms)
Organ Level of Organization
radiates
Cnidaria (Cnidaria)
Tissue Level of Organization
Porifera (Sponges)
Ancestral Protists
Cellular Level of Organization

Q.3 Discuss in detail the development of complexity in animals.

Ans. Both the kingdoms, Fungi and Plantae are multicelluler like kingdom Animalia but in Animalia the cells are joined by complex functions which are involved in the transportation and communication through the cells. The animals include microscopic to largest sea mammals such as Whale.

Kingdom Animalia include two subkingdoms i.e.:

(a) Subkingdom Parazoa.

(b) Subkingdom Eumetazoa.

(a) Subkingdom Parazoa (Phylum Porifera):

These animals lack tissues organized into organs and have indeterminate shape, and are ***asymmetrical***.

(b) Subkingdom Eumetazoa:

These have organs and systems with ***radial symmetry*** (grade Radiata) or ***bilateral symmetry*** (grade Bilateria) Eumetazoa are divided into *three* groups on the basis of presence, absence or type of body cavity in them.

Acoelomate: They include animals which do ***not have a body cavity***.

Pseudocoelomata: They include animals which include ***false coelom***.

GRADE RADIATA:

(i) These have **radial symmetry**.

(ii) They are ***diploblastic***.

(iii) The body parts are *arranged around a central axis* in such a way that any plane passing through the central axis divides the animal in halves that are almost **mirror image** of each other e.g., *Cnidaria Coelentrata*).

(iv) In Sea anemone cylindrical *body can be cut in two equal halves vertically in any plane*.

GRADE BILATERIA:

(i) These include ***bilateral symmetrical*** animals i.e., the animal is divided into two equal halves, ***right and left*** on drawing imaginary line.

(ii) The animals have ***distinct anterior*** *and* ***posterior*** *end*.

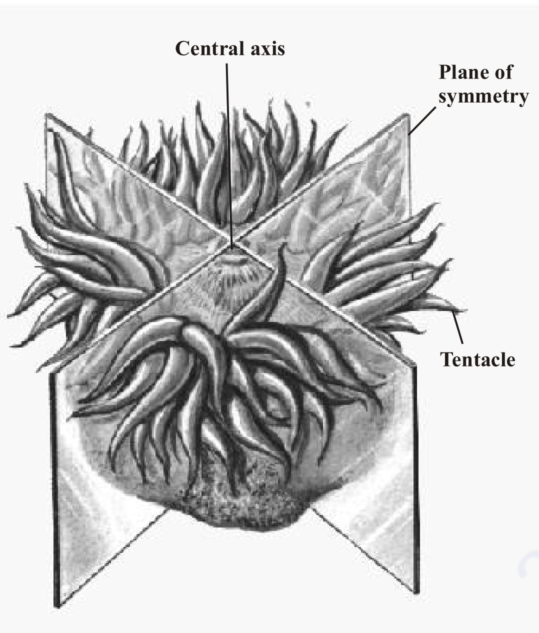
(iii) The body has ***distinct dorsal*** *and* ***ventral surface***.

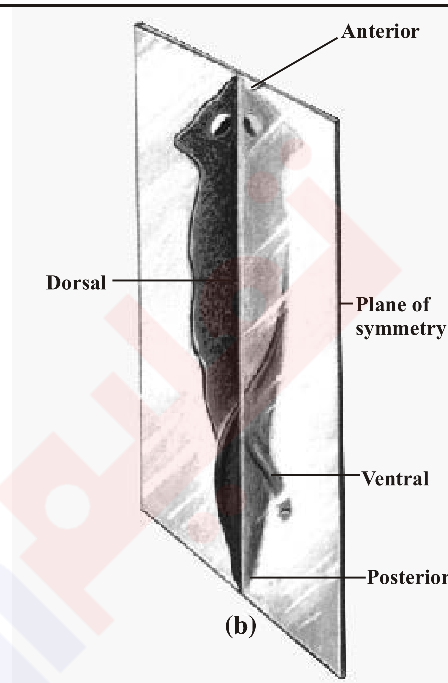
(iv) The grade bilateria includes phyla **Platyhelminthes, Nematoda, Annelida, Mollusca, Arthropoda, Echinodermata, Hemichordata** and **Chordata**.

(v) The larva of Echinodems have ***bilateral symmetry***.

(vi) The animals have ***triploblastic*** organization.

(vii) The animals included in bilateria may be **acoelomata, pseudocoelomata** or **coelomata**.





Series Proterostomia (*Protostomes*)	Series Deuterostomia (*Deuterostomes*)
1. ***Cleavage*** or division of the zygote is spiral and *determinate.*	1. Cleavage is *radial and indeterminate.*
2. During ***development*** process the *mouth* in these animals *arises* from the *blastopore* or from its anterior margin.	2. During embryonic development mouth is formed at some distance anterior to the blastopore and *blastopore* forms the anus.
3. ***Coelom*** or body cavity is formed due to splitting of mesoderm (*Schizocoelous*).	3. Coelom is developed as an outpouching of archenterons (*Enterocoelous*).
4. ***Mesoderm*** is derived from cells on lip of blastopore.	4. Mesoderm is derived from wall of developing gut (Archenteron).
5. This series proterostomia includes animals belonging to ***phyla*** Aschelminthes (Nematode), Annelida, Mollusca and Arthropoda.	5. This series includes animals belonging to phyla Echinodermata, Hemichordata and Chordata.

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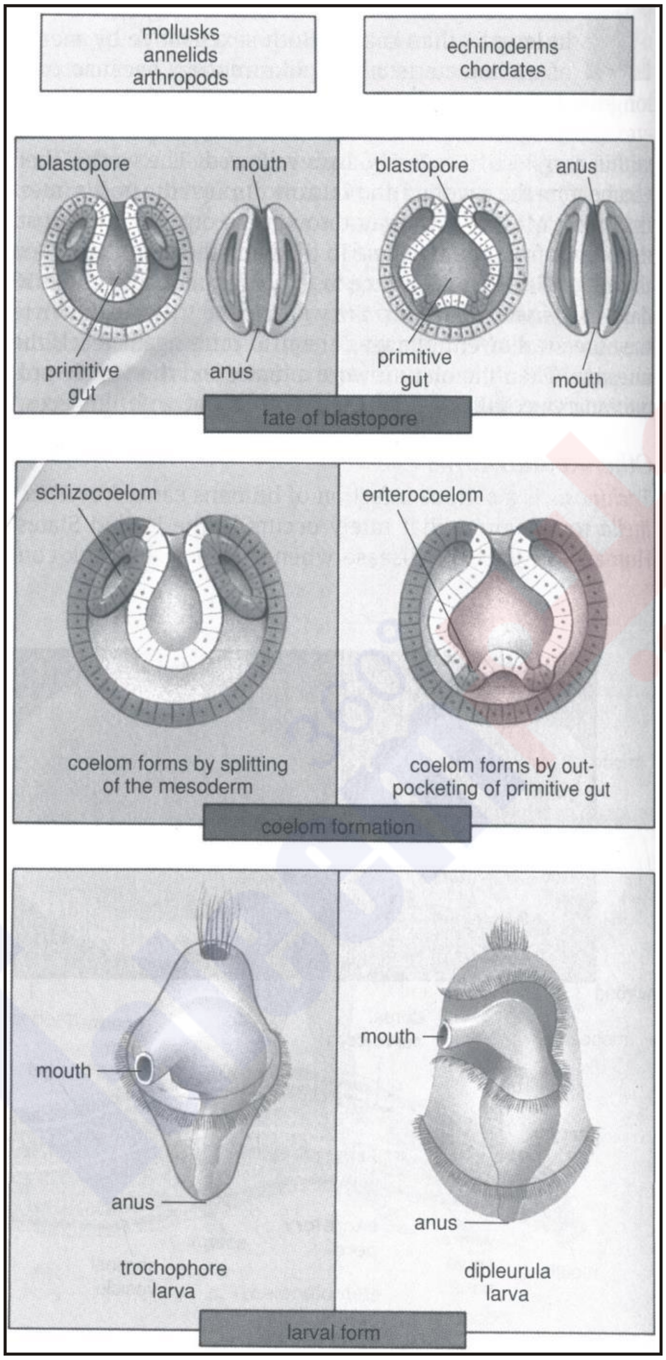


Q.4 Give a comparison of protostomes and deuterostomes:

Ans. Consult above.

Q.5 (a) What do you mean by symmetry: give examples.

Ans. **SYMMETRY**

The geometrical view of an organism is called symmetry.

(i) Radial Symmetry: The arrangement of body parts around a central axis and without left and right sides, they have identical two halves by cutting of any diameter.

(ii) Bilateral Symmetry: The arrangement of body parts in which left and right sides, anterior and posterior ends, dorsal and ventral surfaces are found.

Q.5 (b) Define the followings.

Dorsal: Dorsal means ***upper surface*** of the body.

Ventral: Ventral means ***lower surface*** of the body.

Diploblastic: The simple body plan consists of outer ectoderm and inner endoderm and has ***mesoglea*** between the derms.

Triploblastic: The complex body plan consists of ***three germinal layers*** i.e. endoderm, mesoderm and ectoderm.

Coelom: The ***body cavity*** of an individual is called coelom.

Enteron: A body ***cavity with a single opening*** to the environment is called enteron.

Tissue: A ***group of cells***, often similar in structure and origin and perform specific function is called tissue.

Q.6 (a) What is bilateral symmetry? Give examples:

Ans. See Q.5 (ii).

Q.6 (b) Explain spiral and radial cleavages.

Ans. (i) **Spiral and Determinate Cleavage**

In this case lines or planes of cleavage are not symmetrical between poles instead these are diagonal to the polar axis and produce unequal cells around the axis of polarity and all the blastomeres have determinate role involved in embryo formation.

(ii) **Radial and Indeterminate Cleavage**

In this case the cleavage are symmetrical to the polar axis and produce tiers of cells on top of each other and the fate of each blastomere is not pre-determined. In certain cases any one blastomore can produce a complete embryo.

Q.6 (c) Differentiate between diploblastic and triploblastic.

Ans.

Diploblastic	Triploblastic
1. They belong to division ***radiate***.	1. They belong to division ***bilateria***.
2. The body is divided into ***two layers*** i.e., ectoderm and endoderm and have a non-cellular jelly like mesenchyma or mesogloea.	2. Thy body is divided into ***three layers*** i.e., ectoderm, endoderm and mesoderm. Ectoderm forms integument and nervous system, mesoderm forms muscles, skeleton and reproductive system, and endoderm forms digestive system like liver.
3. They have no spectalized transport system.	3. They have ***specialized organs*** and system for various activities.
4. Transportatio mostly occurs by diffusion.	4. Transportation occurs by blood ***vascular system***.
5. They have no specialized nervous system rather have network of nervous.	5. They have cerebral ganglia or brain.
6. They have ***radial symmetry***.	6. They have ***radial*** or ***bilateral symmetry*** and may be a coelomate, pseudocoelomate or coelomate.
7. They have ***gastrovascular cavity*** with single opening called mouth, through which ingestion and egestion occurs. Thus have ***sac-like digestive system*** phylum cnidaria or coelentrata.	7. They have well developed digestive system i.e. tubular digestive system.

Q.6 (d) Differentiate between the followings.

Ans. Differences between Acoelomate, Pseudocoelomate and Coelomate:

Acoelomate	Pseudocoelomate	Coelomate
1. They do not have body cavity or coelom.	They possess false coelom or pseudocoelom.	In these coelom is a cavity present between the body wall and the alimentary canal and is lined by mesoderm.
2. Phylum ***Platyhelminthes*** are acoelomate.	***Aschelminthes*** have pseudocoelom.	These include animals from ***Annelids*** to ***Chordates***.
3. The ***mesoderm*** forms a loose, cellular tissue called mesenchyma or ***parenchyma***.	Pseudocoeloms is not homologuos to ***coelom*** and is not lined by coelomic ***epithelium*** and have no relation with reproductive or excretory organ.	The mesoderm splits into outer parietal layer and inner ***visceral layer*** (ودزی اسار).

4. In these have ***sac-type gut*** with no special transport system.	These develop from the ***blastocoel*** of the embryo and it is bounded externally by the muscles and internally by the cuticle of the intestine.	The animals which possess coelom or true body cavity are called coelomates e.g., Annelids to Chordates.

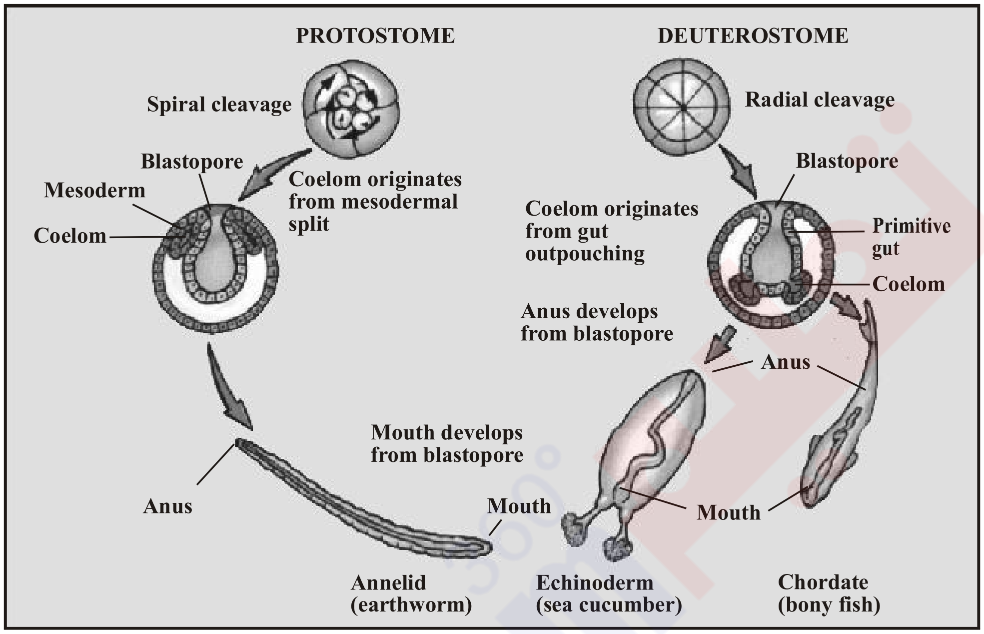
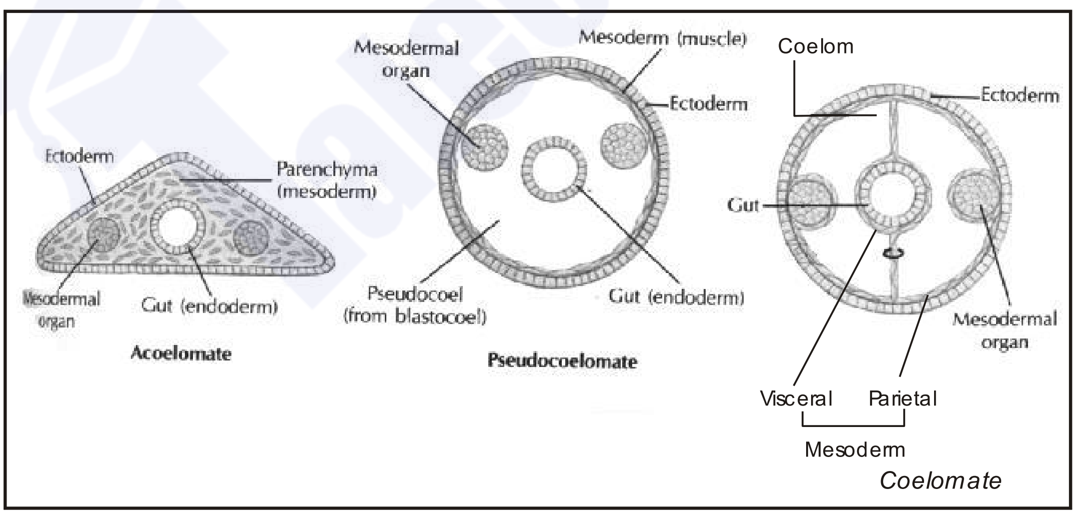


Fig. Patterns of embryonic development of coelom and of egg cleavage in protostomes and deuterostomes



Q.7 Write down the general characters of phylum proifera (Parazoa).

Ans. Proifera is derived from Latin word ***porus – pore*** and ***ferra – to bear***. Thus Porifera are ***pore bearing animals*** and are called ***Sponges***. The phylum includes *5000 species* and out of it, ***150 species*** are fresh water.

GENERAL CHARACERISTICS OF PORIFERA

(1) These are ***multicellular aquatic*** animals with organized tissues or organs.

(2) Sponges ***lack symmetry***.

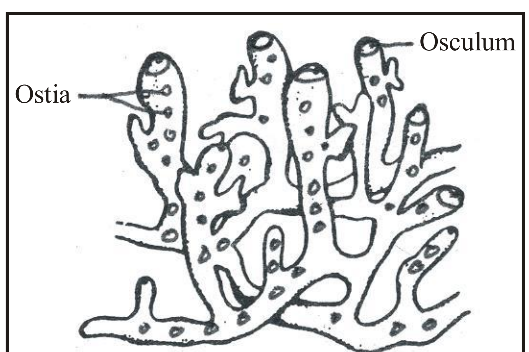
(3) The body wall is differentiated into ***two layers*** outer and inner called ***pinacoderm*** and ***choanoderm*** respectively. The middle layer is gelatinous mesenchyma.

(4) Pinacoderm is formed of cells called ***pinacocytes*** choanderm is formed of flagellated collar cell (***choanocytes***) and mesenchyma is formed of ***amoeboid cells*** with ***spicules*** or ***spongifibres***.

Fig. Sycon

(5) The size the of animals ***ranges from few millimeter wide*** to more than one meter e.g., ***Scolymastra*** joubini a barrel like glass ponge of Antarctica is more than metre tall.

(6) There is a ***single cavity*** inside the body, the ***spongocoel*** (سپونجوسیل) which in most sponges is divided into flagellated chambers or canals, lined by flagellated choanocytes.



Sponge (Sycon)

(7) ***The pores*** (***ostia***) are present on the body wall which are involved in water circulation.

(8) Sponges are ***sessile***, therefore ***food come into contact through water*** currents and moved in by flagella of choanoeytes.

(9) They ***depend 20% on zooplankton***, phytoplankton and ***80% on detrital organic particles for food***.

(10) The ***waste material either diffuse*** out of the sponge directly trough the body wall ***or flow out*** through ***osculum***.

(11) The ***larva are motile***.

(12) They do not have well defined nervous system. But ***neurosensory*** and neuron cells help to coordinate the flow of water.

(13) The skeleton is formed of needle like structures called ***spicules*** of which may be calcareous or siliceous. The skeleton of both Sponge is formed of sponging fibres. Osculum and ostia also possess spicules.

(14) **Asexual reproduction** is sponges occur by ***budding the buds*** may be internal or external. The internal buds are called ***gemmules***.

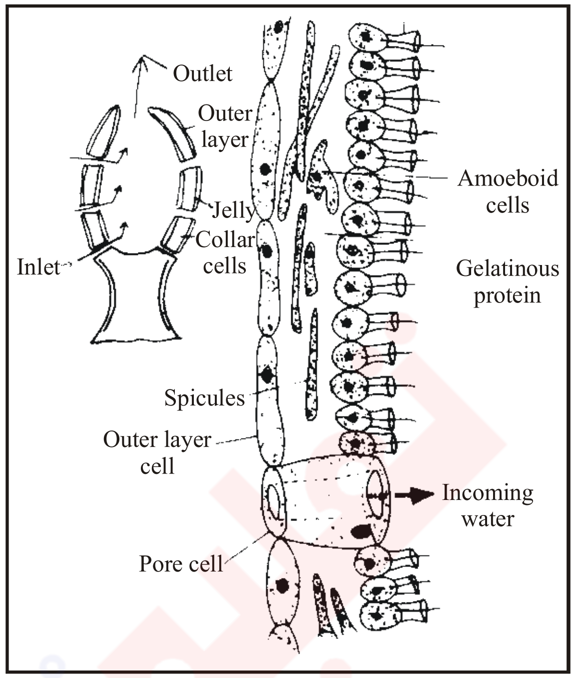


Fig. Arrangement of water circulation and cells of a sponge

(15) Sponges can also **reproduce sexually**. Mostly they are ***hermaphrodite*** i.e., possess both male and female sex organs in the same individual.

(16) Mostly poriferans are ***protandrous*** i.e. ***male sex develops before the female***.

(17) The proiferans in which **sexes are separate**, sperms are released in water and carried to egg by amoeboid cells.

(18) Fertilization takes place ***in mesenchyma and zygote forms***.

(19) ***Embryo develops into blastula and larva***.

Examples:

(i) Sycon (سائی کان) —— ***Marine*** sponge

(ii) Leucosolenia (لیکوسولنیا) —— Formed of group of ***erect tubes***

(iii) Euplectella (یوپلیکٹیلا) —— A delicate sponge made of ***glassy frame work*** also known as venus ***flower basket***.

(iv) Spongilla (سپانجیلا) —— ***Fresh water*** sponge

Q.8 Discuss the importance of sponges.

Ans. (1) The skeleton of sponges can be ***used for washing*** and bathing by man.

(2) Synthetic material can be used for $\boxed{\text{making artificial sponges}}$.

(3) Natural sponges are still the demand of many $\boxed{\text{factories}}$.

(4) Mediterranean sea is the **source of best commercial sponges**.

(5) Sponges can $\boxed{\text{absorb water}}$ to great extent.

(6) In $\boxed{\text{surgical operations}}$ they are used to absorb fluids and blood.

(7) Sponges are $\boxed{\text{used in building}}$ which make them $\boxed{\text{sound proof}}$.

Q.9 Discuss the general characters of phylum coelenterata.
OR
What are the general characteristics of cnidaria?

Ans. **COELENTERATA**

(1) Coelenterate are also known as ***Cnidaria*** due to the presences of special cells called **cnidocytes** which give rise to **nematocysts** or ***stinging cells*** present in the **tentacles**.

(2) Cnidarians are **diploblastic** i.e., have outer **ectoderm** and inner **endoderm**.

(3) Ectoderm give rises to nematocyst and endoderm cells are involved in digestion of food.

(4) **Mesoglea** (لِی زدا گیا) is jelly – like between the ectoderm and endoderm.

(5) Coelentrates possess **gastrovascular cavity** or ***enteron*** with a single opening called mouth thus the animals have ***sac like digestive system***.

(6) Coelentrates have **radial symmetry**.

(7) The members belonging to the phylum may be **microscopic** (like hydra) to **macroscopic** Branchioceranthus, a hydrozoan polyp having two meters.

(8) The may occur in two basic forms, the **polyps** and **medusae**.

(9) Polyps are cylindrical and ***nutritive in function*** thus called **gastrozoids**.

(10) Medusae are **umbrella like**, free **swimming** and involved in sexual reproduction due to the **presence of gonads**.

(11) Tentacles are present on the anterior part of the animal surrounding **mouth**. These bear nematocyst or **stinging cells** which are involved in offense and defense.

(12) They are ***Carnivorous*** and feed on crustaceans like Cyclop, Daphnia etc. Tentacles trap the animal due to nematocyst and moved towards mouth and later the process of digestion occurs in the enteron.

(13) There is ***no central nervous system*** rather the nerves which are irregular net or **plexus** in the body wall.

(14) Most of the **corals** have hard **exoskeleton** formed of **calcium carbonate** (C_aCO_3) secreted from epidermal cells. They form small coral islands or large **coral reefs**.

(15) Some colonial coelentrates have upto five different types of **zooids**, involved in different functions for colony e.g., ***Physalia*** (فائی سیلیا).

(16) Most species are ***sessile like Hydra***, Obelia, Corals etc., some are colonial like Sea fans, while others are free – living and motile e.g., ***jelly fish***.

(17) They can reproduce both asexually and sexually.

(18) **Asexual reproduction** occurs by budding which develops into new individual after getting detached from the parental animal.

(19) **Obelia** reproduce both **asexually** and **sexually**. The animal produces zooids (*blastostyle*) which gives rise to medusae when released in water develop reproductive organs which give rise to **gametes** that unite to form zygote later obelia colony forms from it.

(20) They have ***alternation of generation***, one reproduces by sexual means and other by asexual means, both the generation are diploid. One is free living and other in attached.

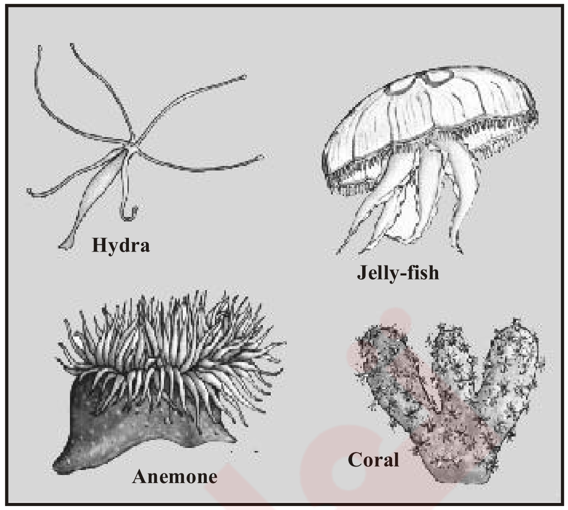


Fig. Coelenterates (Cnidarians)

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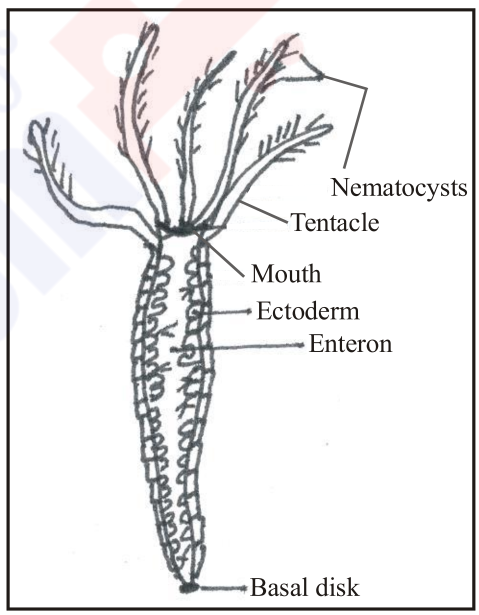

Fig. Hydra

(21) The occurrence of structurally and functionally more than two different types of individuals, (called zooids) within the same organism is called ***polymorphism***.

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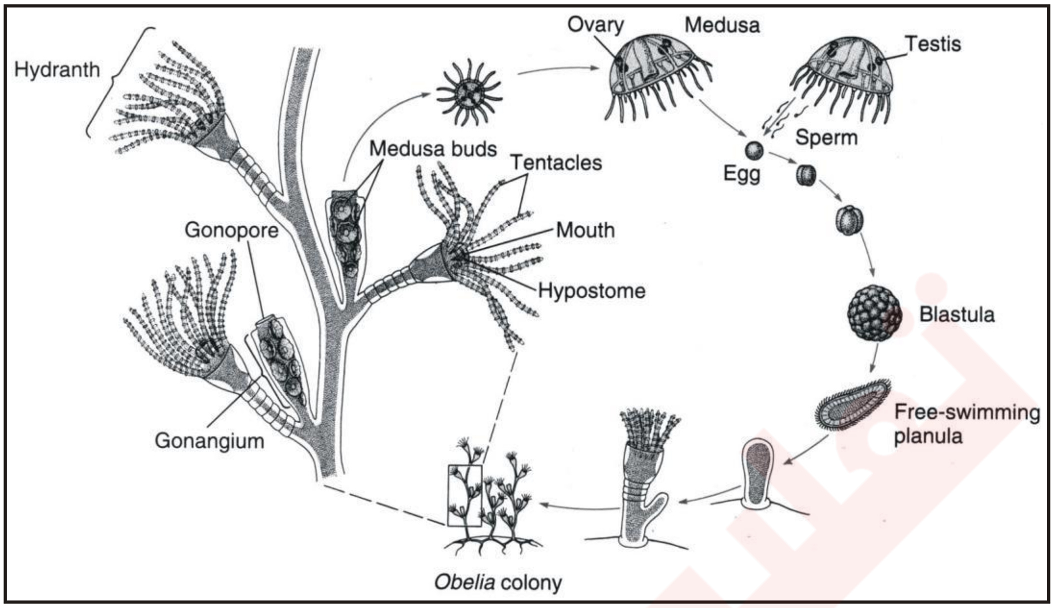

Examples:

(i) ***Hydra:*** The organism live in **fresh water exist in polyp** form and ***alternation of generation is absent***.

(ii) ***Obelia:*** The animal is ***marine*** in habitat and ***have*** **alternation of generation**.

(iii) ***Aurelia:*** The animal is commonly called ***Jelly fish***. The polyp form is reduced and medusa is dominant in it.

(iv) ***Actinia:*** The animal is known as ***Sea Anemone***. It has ***only polyp*** form. **Enteron** is divided by large partitions called **mesenteries** (میزنٹریز).

(v) ***Madrepore:*** The animal body is covered of calcium carbonate. The animals are commonly called ***corals***. The skeleton forms large coral reefs and even small coral islands.

Q.10 Write short note on coral reefs.

Ans. **CORALS**

Corals forms from the secretions produced by specialized polyp which are covered and involved in cups.

Tentacles are ***involved in feeding*** and withdraw itself within mouth when not feeding. The coral occur in the form of ***colonies*** and form a ***stony network or mass***.

Living polyps are present on the surface layer of corals and the underneath mass are dead stony structures without any polyps, forms coral reefs. These are chemically formed of **calcium carbonates (limestone)**.

Corals provide ***place for variety of sea life***.

OCCURRENCE:

Coral reefs are formed in the coastal waters of **Florida**, West Indies, East coast of Africa, Australia Island of **Coral sea**.

Q.11 Discuss its general characteristic of phylum platyhelminthes with suitable examples?

Ans. **GENERAL CHARACTERISTICS OF PHYLUM PLATYHELMINTHES**

(1) They are **commonly called flatworm** having soft **dorsoventrally compressed** body.

(2) They are **triploblastic acoelomate** i.e., the body is differentiated into thre layers called ***ectoderm***, ***mesoderm*** and ***endoderm***.

(3) They have **bilateral symmetry**.

(4) The animals belonging to the phylum have ***unsegmented body***.

(5) Mostly the animals are **endoparasites** e.g., **Taenia solium** (tapeworm) **Fasciola hepatica** (***liver fluke***) and Schistosoma (**blood fluke**).

(6) Some of these species cause ***human diseases***.

(7) Few are **free living** and found in freshwater e.g., ***Dugesia*** (planaria).

(8) The size of the animals range from **few millimeters** i.e., **10 mm** in case of planaria to **several meters** like worm.

(9) **Digestive system is poorly developed** or may be absent as in the tape worm.

(10) **Excretory system consists of branching** tubes ending in bulb – like cells, the ***flame cells***.

(11) Nervous system is well developed have an enterior **cerebral ganglia** or ***brain*** with a network of neuron over the body.

(12) They do not possess respiratory and circulatory system.

(13) The **parasite species** absorb nutrients from the living host i.e., liver fluke.

(14) The **free – living species** like planaria feed on small animals and decayed dead bodies.

(15) In free – living forms planaria are motile due to the presence of **cilia** on their undersides.

(16) In parasitic forms the movement is restricted.

(17) They can reproduce both **asexually** and **sexually**.

(18) Asexually the species reproduce by ***fission*** in which the animal constricts in the middle into two pieces, each of which **regenerate** the lost part.

(19) Sexually reproducing species are **hermaphrodite** i.e., both male and female sex organs are present in the same individual.

(20) Sometimes **larval form exist**.

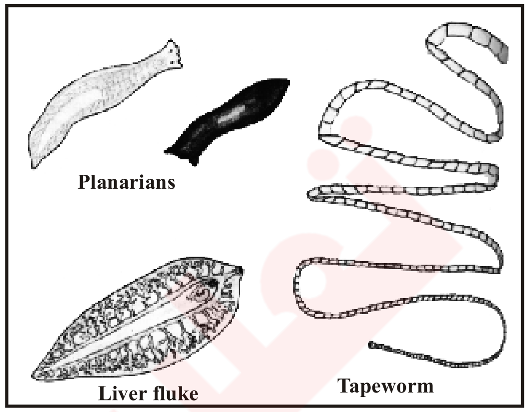

Fig. Examples of animals platyhelminthes

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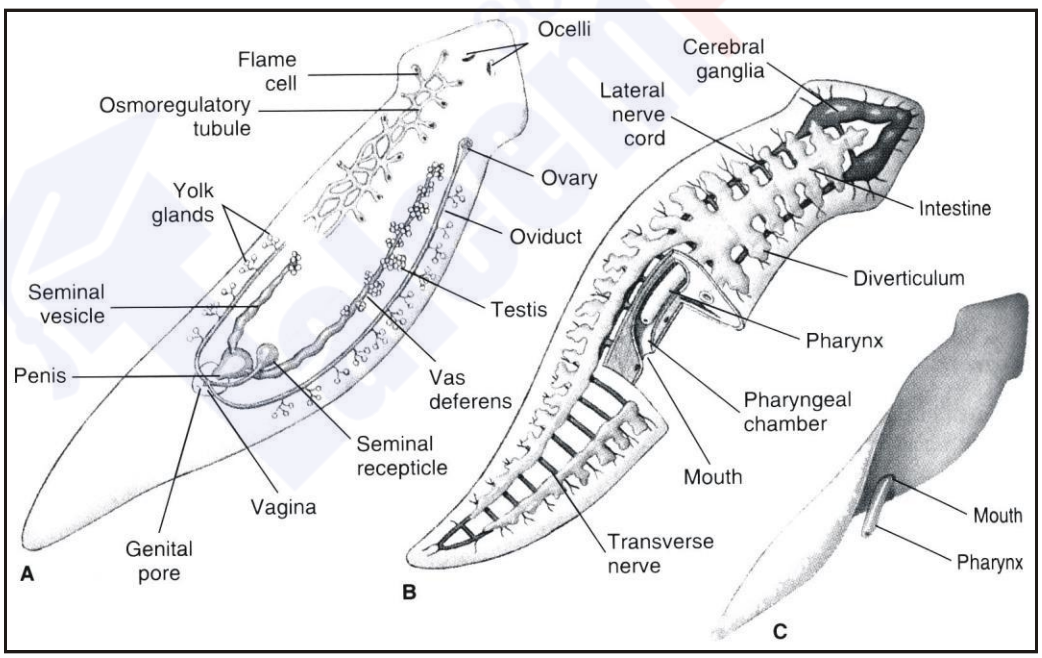

Fig. Structure of a planarian. A, Reproductive and excretory systems, shown in part. Inset at left is enlargement of a flame cell. B, Digestive tract and ladder-type nervous system. Pharynx shown in resting position. C, Pharynx extended through ventral mouth.

Examples:

(i) ***Dugesia (Planaria):*** It is free – living with a ciliated outer surface.

(ii) ***Fasciola (Liverfluke):*** The animal is an **endoparasite** live **in sheep** and occasionally in human beings. It attached to the host tissue by means of sucker. It completes its life cycle in **two hosts**, a **snail** and **sheep or man**. It lives in the bile duct of its host.

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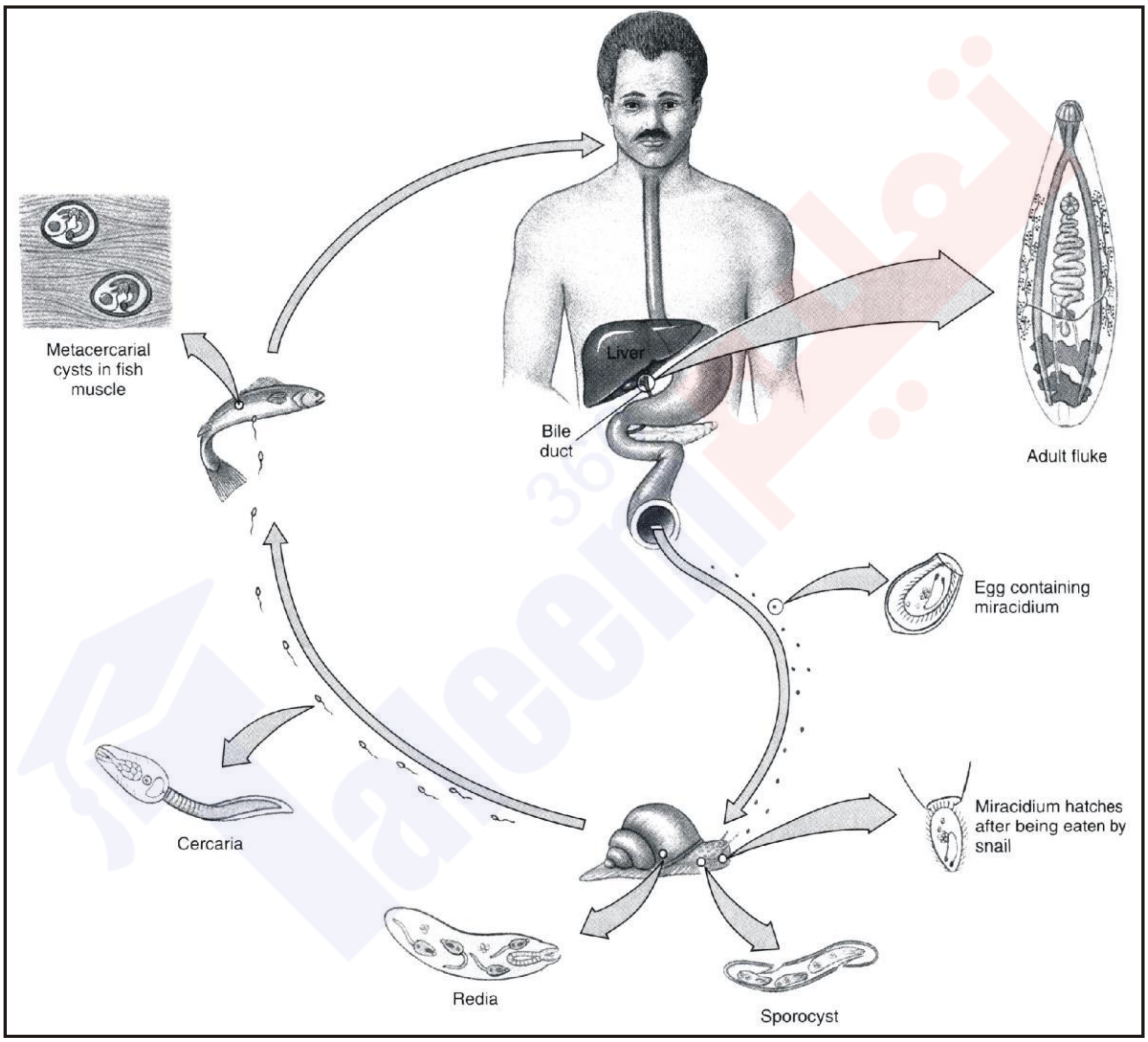

Fig. Life cycle of human liver fluke

(iii) ***Taenia (Tapeworm):*** It is also an **endoparasite** complete life cycle in two hosts i.e., **human cattle or pig** is an intermediate host. There body is **ribbon – like** and divided into segments called proglottids having sex organs. The segments continue to break off and are excreted from the intestine along with faeces.

Q.12 What are various adaptation for parasitic mode of life?

Ans. **ADAPTATIVE CHARACTERS OF PARASITIC PLATYHELMINTHES**

Following are the various characters of parastic platyhelminthes:

(1) They ***do not have epidermis*** but possess *resistant cuticle* over the body that protects the animal.

(2) They have ***adhesive organs*** like ***suckers*** and ***hooks*** meant for the attachment to the host.

(3) They have ***degenerated muscular and nervous system***.

(4) They have *simple digestive system* due to their ***dependence on host***.

(5) They have ***complex reproductive system***. The ova are produced in large number which ensures the survival chance of the animal.

(6) They have ***complex life cycle*** and have two or more host.

Q.13 Write short note on infestation and disinfestations.

Ans. (a) INFESTATION

The life cycle of Taenia (Tapeworm) completes into two hosts i.e., man and cow. Man as a host in man the development of Taenia's zygote begins while it is same the uterus of female. The last segments or proglottids and their uteri contain completely developed embryo, later mature proglottides break off from the body and pass out body of man along with faeces.

Embryo:

The embryo inside the egg is round in shape and has six chitinous hooks which show limited movement of contraction.

Cow as a Host:

Further development of Taenia completes in a second host i.e., Cow. The parasite remains embedded in the voluntary muscles of a cow. If an improperly cooked beef is eaten by a person, the parasite which survived further develops in the man intestine.

(b) DISINFESTATION

If the parasite enter the intestine of man it is difficult to remove it completely. Therefore beef should be ***cooked properly*** before eating it. If the parasite once enters in the digestive system certain ***medicines*** are recommended to remove it completely. Platyhelminthes parasites have the ability of **regeneration and if only head remains inside** the intestine it can grow into new tapeworm. For the complete removal of parasite in addition to drugs physician also give ***anema*** to the patient.

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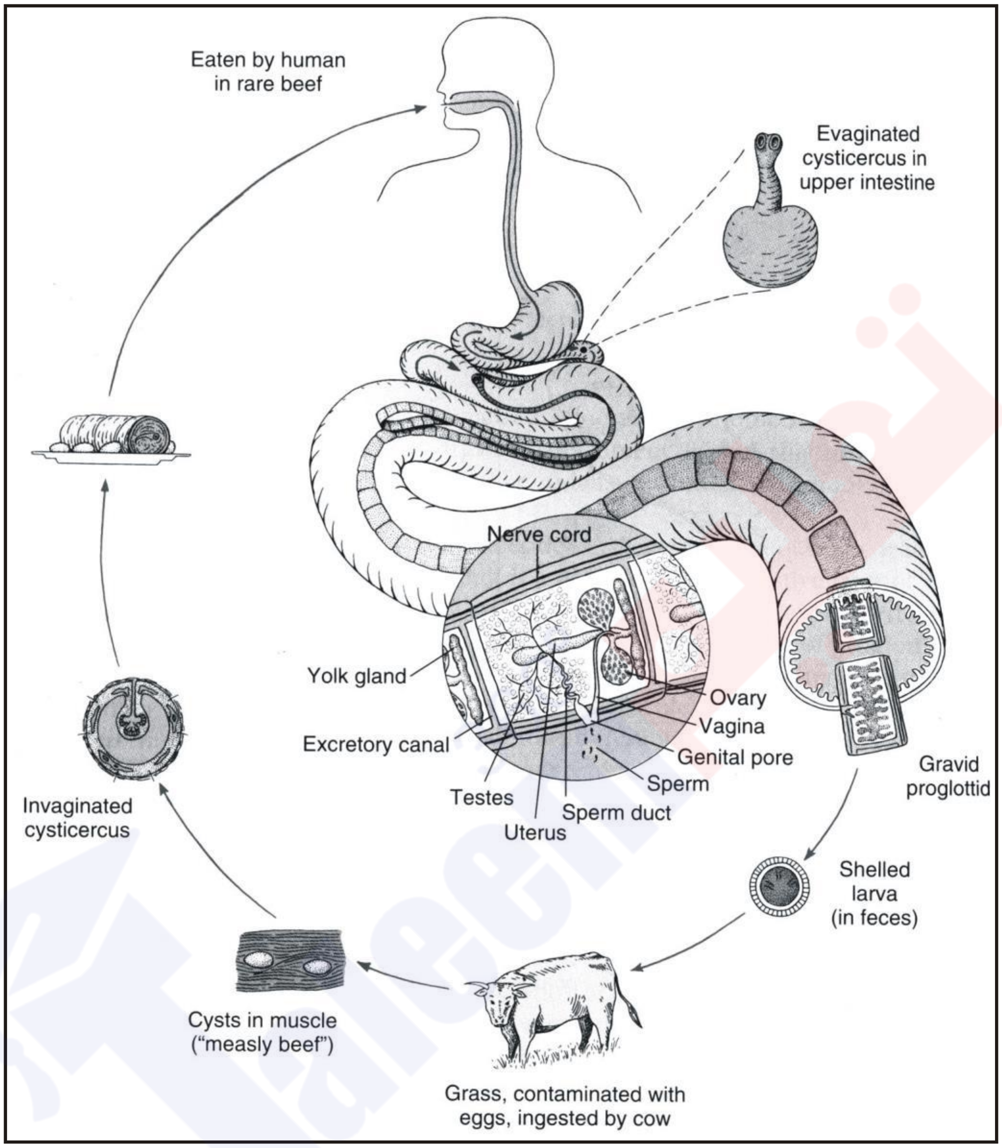


Fig. Life cycle of the beef tapeworm, Taentarhynchus. Ripe proglottids break off in the human intestine, pass out in the feces, crawl out of the feces onto grass, and are ingested by cattle. The larve hatch in the cow's intestine, freeing oncospheres, which penetrate into muscles and encyst, developing into "bladder worm". A human eats infected rare beef, and the cysticercus is freed in the intestine, where it attaches to the intestine wall, forms a strobila, and matures.

Q.14 Write down the general characteristics of Aschelminthes.

Ans. GENERAL CHARACTERISTICS OF ASCHELMINTHES

(1) This is also known as phylum ***Nematoda*** commonly called ***Roundworm*** due to rounded body of the animal.

(2) They are ***triploblastic*** animals having distinct three layers ectoderm, mesoderm and endoderm.

(3) They are ***pseudocoelomate*** because the body cavity is pseudocoelom which is formed from hollow space, the blastocoel present in the blastula.

(4) They include elongated worms with pointed ends. The name Nematoda means ***"pointed ends"***.

(5) The animal have mouth at without enterior end with a ***distinct head*** without any special sense organs. Whereas posterior end possess an ***anus***.

(6) They have a number of vacuolated cells filled with a protein-rich fluid which develop high ***hydrostatic pressure***.

(7) They range they range in size from microscopic forms to length of up to one metre.

(8) They have ***tube like digestive system***. A fluid filled space is present between the body wall and alimentary canal. It provides "tube within tube" type structure in nematodes.

(9) The excretory system consists of *two* longitudinally running ***excretory canals*** which unite at the anterior end to form a single canal that opens to the exterior through an excretory pore on the ventral surface.

(10) They have ring around the ***pharynx***, which give rise to dorsal, ventral and lateral ***nerve cords*** running throughout the length of the worms.

(11) The sense organs are in the form of ***sensory papillae*** –present on the lips at the anterior end.

(12) The ***circulatory*** and ***respiratory*** systems are ***absent***.

(13) ***Respiration*** occurs through general ***body surface***.

(14) **Locomotion** is by ***undulating waves*** of contraction and relaxation of muscles. Which are arranged in four bands, two dorso-lateral and two ventro lateral.

(15) They do not have circular muscles thus the **bending is dorso-ventral** only.

(16) The species included in the phylum are ***unisexual***.

(17) The female gonads are called ***ovaries*** that produce egg and male gonads are called ***testes*** producing sperms.

(18) They have ***larval stage*** in their life cycle.

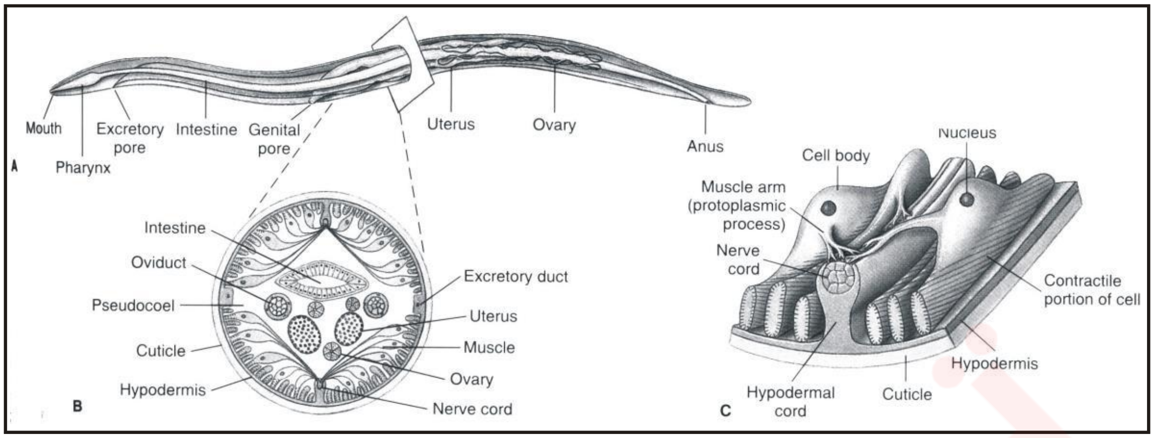


Fig. A, Structure of a nematode as illustrated by an Ascaris female. Ascaris has two ovaries and uteri, which open to the outside by a common genital pore. B, Cross section. C, Relationship of muscle cells to hypodermis and hypodermal cord.

Q.15 Discuss the various diseases caused by different genera of Phylum Nematoda.

Ans. The members of phylum Nematoda are **parasite** causing certain diseases in man and plants

Ascaris lumericoides: It is an intestinal parasite of man.

Rhabditis: The number of species of the genus are often found in soil, organic miller, water, faces of **man** and **animals**.

Enterobius vermicularis (Pinworms): This nematode is cosmopolitan but found commonly in Europe and America. They live in the large intestine of man i.e., caccum, colon and appendix.

The major **symptoms** caused due to their movement are:

- Intense itching of anus.
- Inflammation of mucous membrance of colon and appendix.
- Insomnia and loss of appetite.

Acyclostoma duodenale (Hookworm): The worm lives as a parasite in man small intestine, results in holding the villi of intestine and sucks blood and body fluid. During feeding they produce an anticoagulant to prevent clotting of blood and after feeding leave the wound bleeding. In children they cause anemia and retard mental and physical growth. Round worms are present everywhere especially in the soil and cause breaking down of organic matter. Billions thrive in each acre of topsoil. A single rotting apple may contain **90,000** worms.

Q.16 Discuss the general characteristics of the segmented worms.

Ans. **GENERAL CHARACTERISTICS OF ANNELIDA**

(1) They include metamerically **segmented** worms. The word annelid is from Latin word meaning ***'little ring'***.

(2) The subdivisions may be indicated externally by constrictions of the body surface. Internally the segments are separated from each other by ***septa*** extending across the coelom.

(3) The ***gut, blood vessels*** and ***nerve cord*** are continuous throughout the length of body penetrating each segment.

(4) The species included in the phylum are ***triploblastic*** in organization.

(5) The animal included in the phylum have ***bilateral symmetry***.

(6) They have well developed alimentary canal having a distinct mouth at end. The mouth is overhung by a lobed structure, the **prostomium**.

(7) Digestive system is poorly developed in parasite species.

(8) They are called **coelomate** due to true coelom i.e., the mesoderm splits into parietal layer of which lines the body wall, and the viscral layer which covers the alimentary canal, the space between the two layers of mesoderm, is the coelom, and is filled in by coelom fluid, which act as hydrostatic skeleton.

(9) Excretion occurs by spcialized structures called ***nephridia*** which are ciliated organs present in each segment in the body cavity.

(10) They have well developed ***central nervous system*** having single ***brain*** with soild double, longitudinal, ventral ***nerve cord***. The nerves arise in each segment from the nerve cord.

(11) They have **closed circulatory system** i.e., blood flow in a ***network of vessels*** called blood vessels. Through it gaseous and nutrient exchange occurs.

(12) They do not have respiratory system gaseous exchange occurs by means of ***diffusion through the skin*** into blood capillaries. The skin is kept moist by mucous, and coelomic fluid.

(13) The body wall is formed of *two* types of muscles i.e., ***circular and longitudinal muscles***. The former are arranged along the radius of the body and the later are arranged along the length of the body.

(14) Locomotion results by the ***interaction of muscles*** and ***hydrostatic skeleton, contraction of circular muscle*** produces a ***pressure in the coelomic fluid*** that forces the body to elongate. Similarly contraction of longitudinal muscles produce a pressure in the coelomic fluid that would cause the body to widen. The organs of locomotion in annelids are ***chitinous chaetae or setae*** embedded in sacs earthworm

or ***parapodia*** present in the body wall (Nereis). The chactae are absent in leech.

(15) Reproduction takes place by sexual method.

(16) Mostly the annelieds are **hermaphrodite** i.e., male and female sexes are present in the same animal e.g. earthworm and leech.

(17) In some annelids like Nereis sexes are separate.

External fertilization occurs and produce a free swimming ***trochophore larva***.

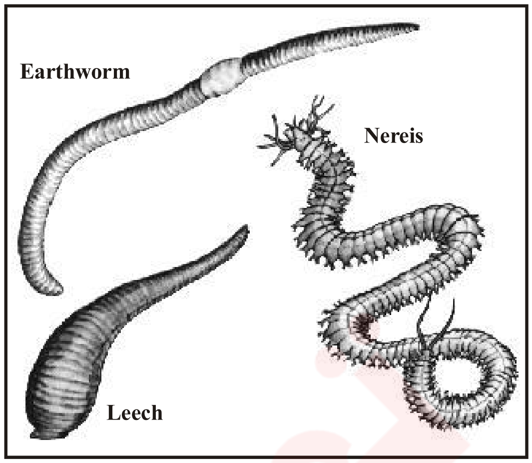
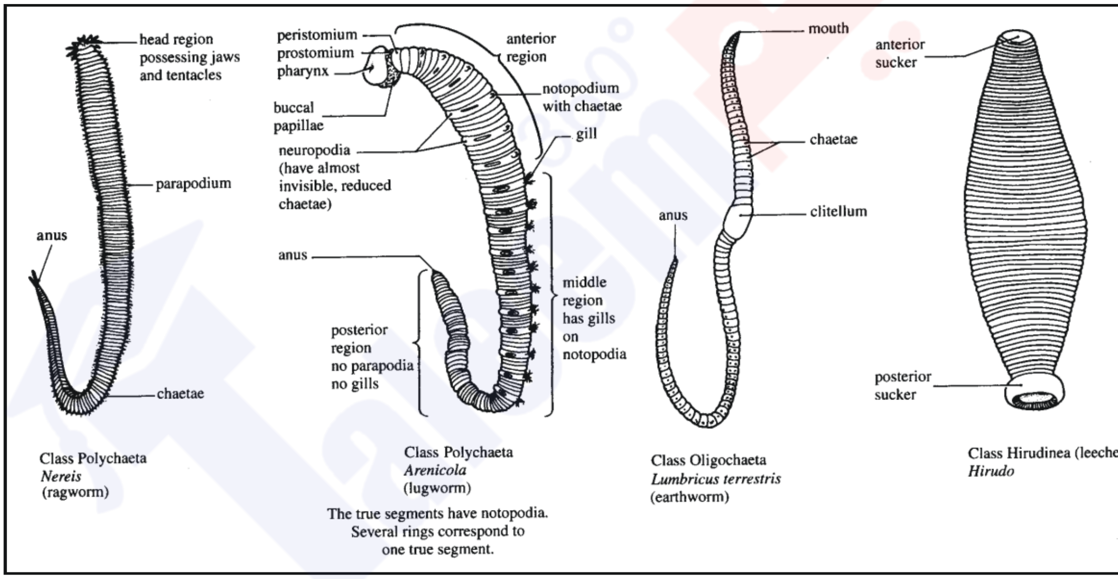


Fig. Example of animals belonging to Phylum annelida

ITEMS FOR SPECIAL ATTRATION



Example:

Organisms	Habitat
Nereis	marine
Stylaria	fresh water
Earthworm	damp soil
Hirudo (***Leech***)	ectoparasite

Q.17 *Write short note on the importance of Earthworm in improving the fertility of the soil?*

Ans. **Earthworm** burrow itself in the soil thus permits greater penetration of air into the soil and ***improves drainage capacity*** of the soil. Plant roots can easily penetrate through such soil. When earthworm moves in and out of the soil, ***mixing and churning of soil*** occurs and thus the inorganic particles are brought up to the surface from lower region. Therefore earthworm is known as the **natural plough**.

Q.18 *How many classes are found in Annelida? Write short note on each of them.*

Ans. Phylum Annelida can be divided into *three* classes:

(1) Class Polychaeta (2) Class Oligoechaeta (3) Class Hirudinea

(1) CLASS POLYCHAETA (Chaeta means long hair):

(i) The members of this class have distinct head region with eyes and structure known as ***palps*** and ***tentacles***.

(ii) The animals include din the class are ***unisexual***.

(iii) Locomotory organs are called ***parapodia***.

(iv) They are aquatic in habitat ***mostly marine***.

(v) During their life cycle they form ***Trochophore larva***.

Examples: Nereis, Chaetopterus

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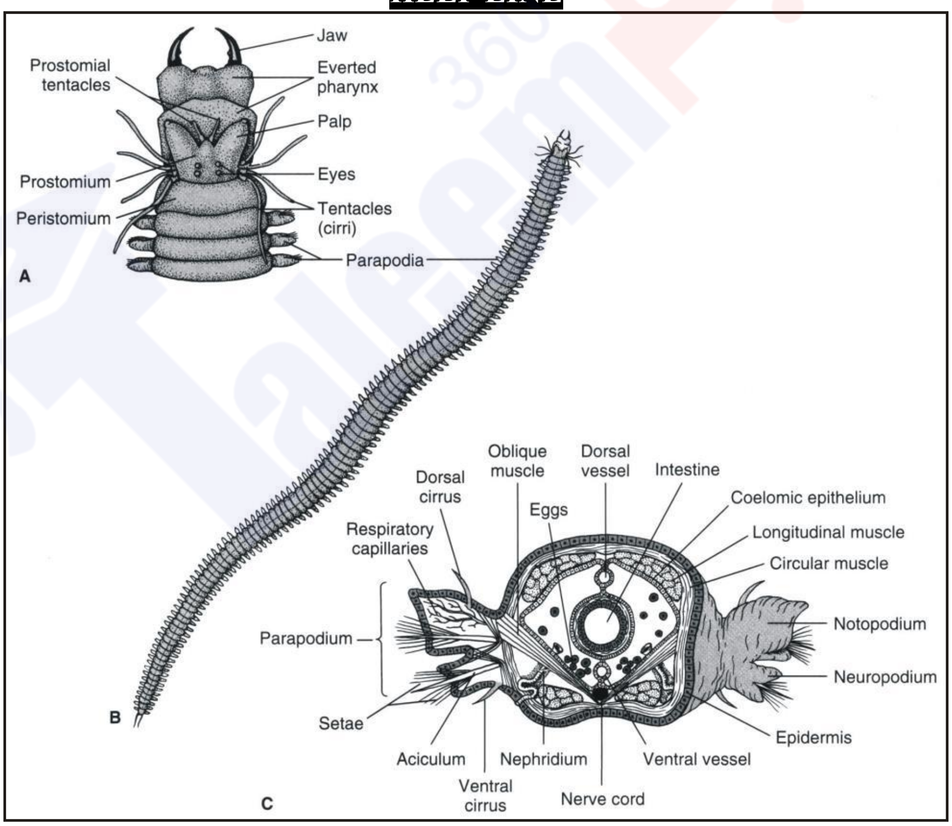


(2) CLASS OLIGOCHAETA:

(i) The number of this class have internal and ***external segmentation***.

(ii) They do not have distinct or prominent ***head region***.

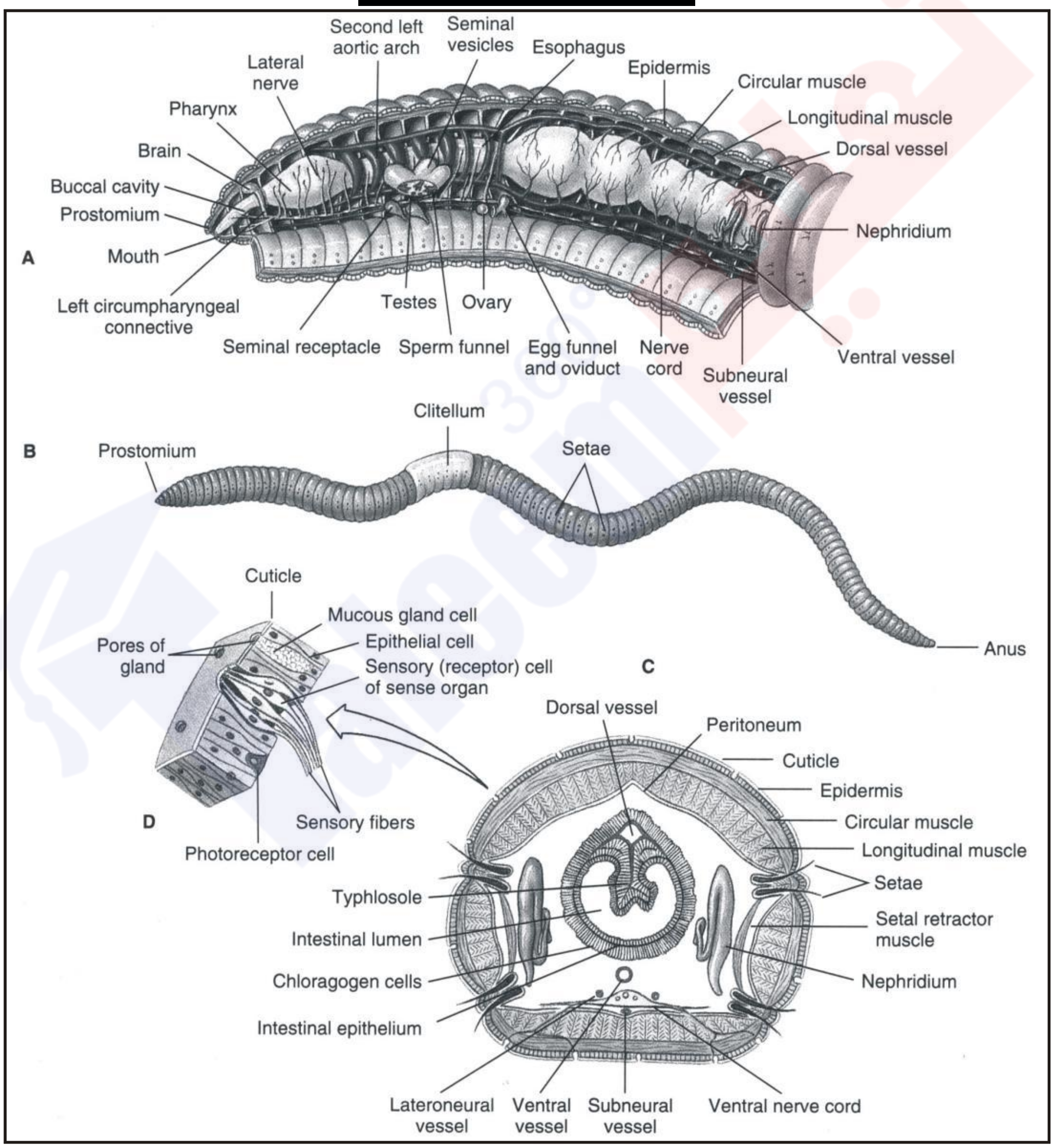
(iii) The animals included in the class are ***hermaphrodite*** (male and female sex organs are in the same animal.

(iv) They do not produce any ***larva*** during their life cycle.

(v) They may be ***terrestrial or aquatic*** in habitat.

Example: Lumbricus terrestris, Pheretima posthuma.

SPECIAL ATTENTION



(3) CLASS HIRUDINEA:

(i) They have body with **fixed number of segments**, with additional ***circular rings*** or markings called ***annuli*** on each segment.

(ii) They do not have locomotory organs and move due to contraction of the body and with the help of ***suckers***.

(iii) The animals included in the class are ***hermaphrodite***.

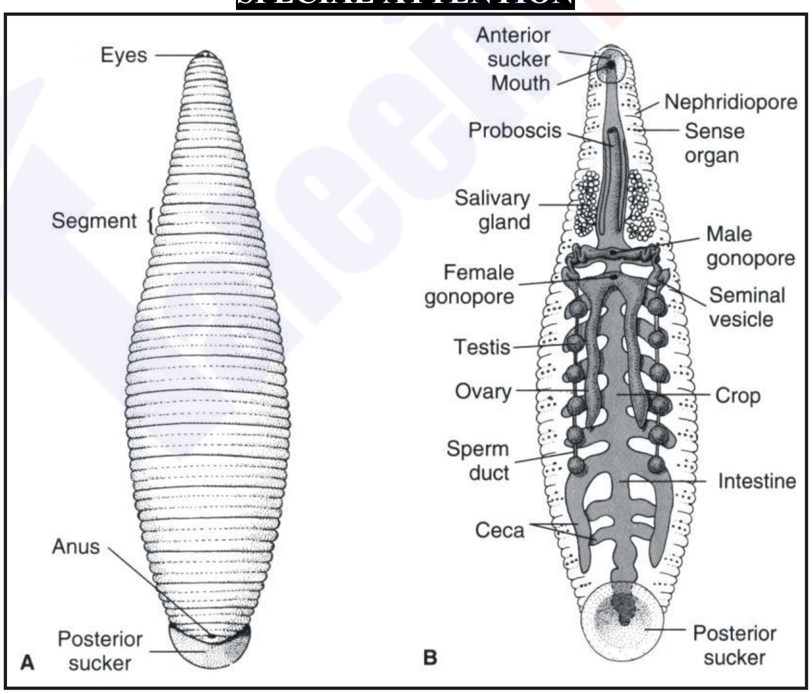
(iv) They produce ***trochohore larva*** during their life cycle.

(v) They do not have ***distinct head***.

(vi) In ***leech*** chitinous ***jaws*** are present meant for puncturing the skin of the host. They have an anticoangulant secretion which is passed into the wound to allow smooth flow of blood into its digestive system where it can be stored for a long time.

Example: *Hirudo medicinalis*.

SPECIAL ATTENTION



Q.19 (a) Give an account of the major groups of Arthropods?
(b) Classify arthropoda.
(c) What is the economic importance of insects?

Ans. (a) PHYLUM: ARTHROPODA – ***Animals with Jointed Legs*:**

General Characteristics:

- This phylum contains more species than any other phylum.
- The **body is segmented**.

  Each segment is attached to its neighbour by means of a modified portion of **cuticle** which is thin and flexible.

  They posses **jointed appendages**. These appendages have been modified for specialized functions.
- These are believed to have **common origin with annelids** because both have some common characteristics such as segmented body, appendages and cuticle.
- Arhtropods have exploited every type of habitat on land and in water. The aquatic species include **both freshwater and marine**. Many of these can fly, therefore visit air periodically.
- Arthropods are variable structurally. Some are **worm-like centipedes**, **flying insects** with the body divided into distinct **regions, the head, thorax and abdomen**.

  The body is covered with **waterproof chitinous cuticle** secred by the epidermis.
- The coelom is not present as the main body cavity. Instead a **haemocoel** has developed. It is reduced coelom and communicates with blood vascular system.
- The digestive system is in the form of **alimentary canal with two opening, the mouth and anus**.

  It is divided into different parts each performing a specific function.

  The food comprises of small plants and animals.
- A well developed excretory system comprising of **Malapighian tubules** is present in arthropods.

  The **nitrogenous wastes** are excreted in the form of solid **uric acid**.
- A highly developed nervous system is present.

  It consists of paired **ganglia (simple brain)** connected to a ventral double nerve cord.

A ganglion is present in each segment.

Nerves arise form these ganglia.

The **sensory organs** are usually a pair of **compound** eyes and **antennae**.

- Most arthropods possess an extensive **tracheal system** formed of air tubes called tracheae for the exchange of gases.

  Main tubes opens to the exterior through openings, called **spiracles**.

  Aquatic arthropods respire through **gills**.

- The **blood circulatory** system in arthropods is unique.

  It is **open circulatory**.

  The blood flows in the body cavity bathing the tissues of the body.

  The primitive heart and a main blood vessel.

  Blood is colourless as it is **without haemoglobin**.

- The **skeleton** is external, i.e., *exoskeleton*.

  It is in the form of an outer covering, the cuticle light in weight; and is formed chiefly of **chitin**. It provides surface for the attachment of muscles which help in locomotion.

- The arthropods exhibit **active and swift movements**.

  They swim, crawl or fly depending upon the habitat they occupy.

  The organs of locomotion are paired appendages and same cases paired wings also.

- The **sexes are separate**.

  The **testes** and **ovaries**, produce **sperm** and **eggs** respectively.

- Life history has the process of metamerphosis i.e., different structural changes during lifecycle.

(b) CLASSES OF ARTHROPODA

Phylum Arthropoda is the *largest* group having great diversity in them. Some important classes are:

(a) Class Crustacea (b) Class Insecta

(c) Class Arachnida (d) Class Myriapoda

(i) **Class Crustacea**

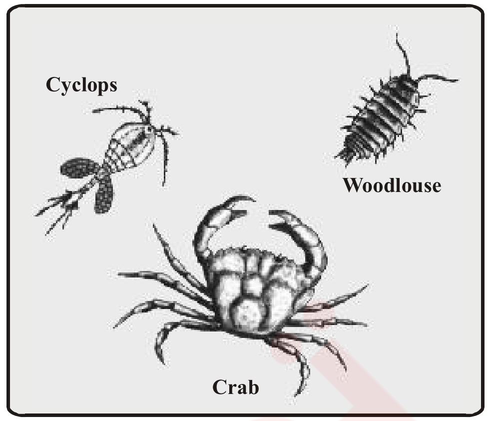


Fig. Example of Class Crustacea

(i) There are about *26,000* species of crustaceans.

(ii) These are ***aquatic arthropods*** and have gills for respiration.

(iii) In ***cephalothorax***, on the dorsal side the exoskeleton have the deposition of salt in addition to chitin which makes it more firm. The exoskeleton is called **carapace** (hard chitunous plates).

(iv) There major functions of appendages are to capture food, walking, swimming, respiration.

(v) Coelom is reduced and ***haemocoel*** is present.

(vi) *Two* pairs of antenea are present on the head region.

(vii) Pair of ***mandibles*** (jaws) and two pairs of maxillae are present.

(viii) The organisms are ***unisexual***.

Examples: Daphnia, Cyclops, Crabs, Lobsters, Prawn, Wood Louse etc.

(ii) **Class Insecta**

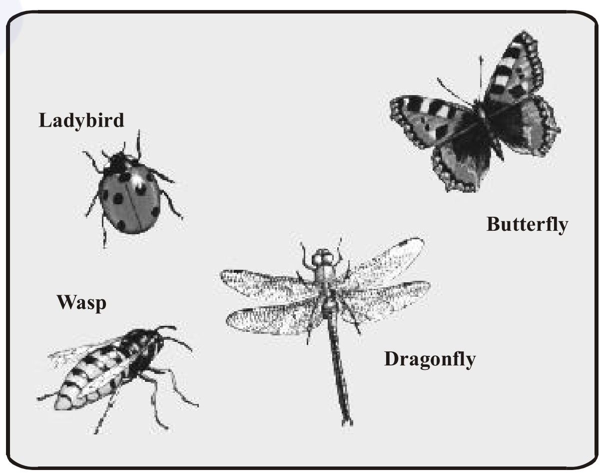


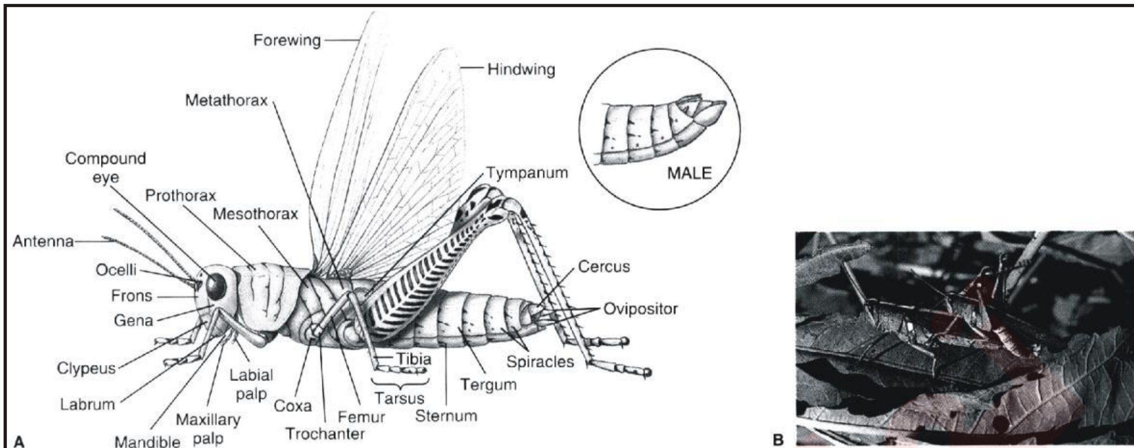
Fig. Example of Insects

(i) Around *70%* of all known species of animals are insects.

(ii) ***They are the only invertebrates that can fly and survive to a large extent away from water***. They are widely distributed including the hot, burning sands of deserts, the cold, icy regions of poles, hot springs.

(iii) Most insects are **herbivorous**, feeding on all sorts of plant material while a large number are **carnivorous**.

SPECIAL ATTENTION



A, External features of a female grasshopper. The terminal segment of a male with external genitalia is shown in inset. **B,** A pair of grasshoppers, *Schistocerca obscura* (order Orthoptera), copulating. The African desert locust mentioned in the chapter prologue (p. 490) is *Schistocerca gregaria.*

(iv) Insects have segmented body divided into **three** parts, i.e., ***head, thorax and abdomen***. Mostly segments of the head are fused and cannot be discerned. *Thorax* is formed of three segments and *Abdomen* has eight to eleven.

(v) The entire body is covered by ***exoskeleton*** of ***chitin*** called ***cuticle*** which provides mechanical support to the muscles. ***The cuticle is replaced by a process of moulting called ecdysis***.

(vi) They have joined appendages attached to different parts of the body.

(vii) The head bears pair of joined feelers called antennae.

(viii) The thorax possess *three* pairs of walking legs. Sensory and reproductive structures are present in the abdomen.

(ix) They bear two pairs of wings attached to the last two thoracic segments.

(x) Insects undergoes various development stages such as egg, larva, pupa and adult. These changes are called **metamorphosis**. In some metamorphosis is incomplete. The larva resembles adult and called ***nymph*** or in star. It lives in the same habitat as adult.

CONCEPTUAL VIEW

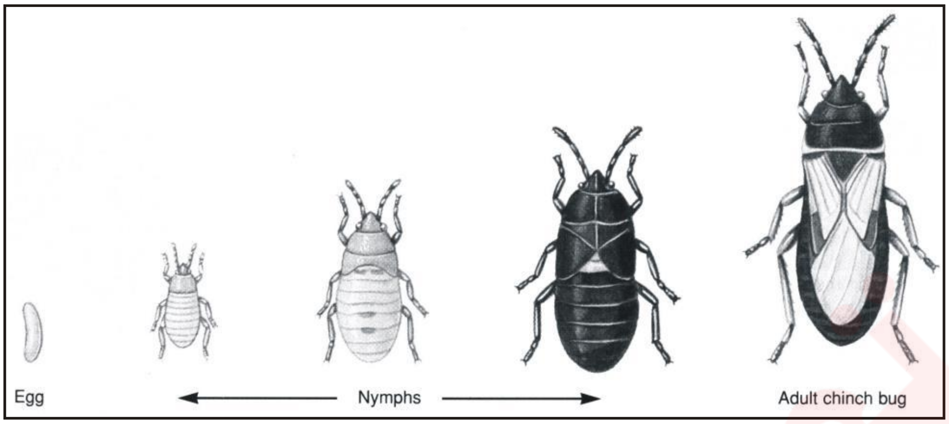


Fig. Life history of a hemimetabolous insect.

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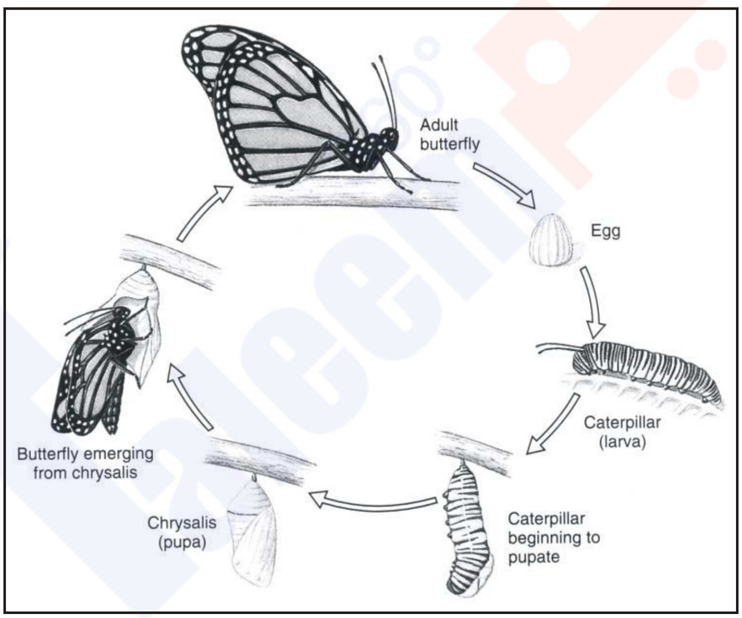


Fig. Holometabolous (complete) metamorphosis in a butterfly, Danaus plexippus (order Lepoidoptera). Eggs hatch to produce first of several larval instars. The last larval instar molts to become a pupa. The adult emerges at the pupal molt.

(iii) Class Arachnida

(i) These invertebrates have their body divided into *two* parts i.e., cephalothorax which consists of the head jointed to the thorax, and the abdomen.

(ii) They possess ***four pairs of legs*** attached with cephalothorax.

(iii) Respiration occurs by means of ***gills***, lungs or special structures called book lungs. Excretion takes place by means of ***malpighian tubules***.

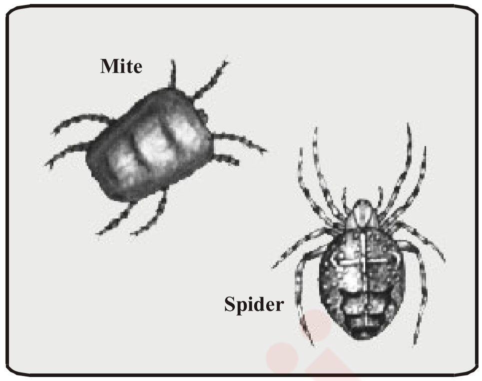


Fig. Arachinds

(iv) They possess ***simple eyes***.

(v) They are ***unisexual***.

(vi) They lack metamorphosis.

Examples: Scorpions, Spider, Mites, Ticks etc.

(iv) Class Myriapoda

(i) These are ***land*** animals usually found under logs, rocks and soil.

(ii) They possess many walking legs and ***long segmeneted bodies***.

(iii) The exoskeleton is hard like insects Myriapod ***breath by tracheal system***.

(iv) The paired legs on the first segment are modified into ***poison claws***.

Examples: Millipede, Centipedes etc.

(c) ECONOMIC IMPORTANCE

(i) ***Grasshoppers*** feed on leafy vegetation and attach various cultivated valuable corps and garden plants.

(ii) ***Cockroach*** destroys food, clothes, shoes, cardboard boxes etc.

These are also responsible for carrying dirt and germs of plague, leprosy, cholera, dysentery, tuberculosis on its body as well as in the alimentary canal.

(iii) ***Trypanosoma*** get into the blood stream of man or cattle and cause sleeping *sickness*.

(iv) ***Mosquitoes, houseflies*** are insect vectors of diseases.

(v) ***Termites*** are very destructive insects as they feed on both dead wood and living plants.

(vi) ***Locust*** cause vast damage to standing crops.

Housefly contaminates food and cause cholera, hepatitis etc.

BENEFICIAL EFFECTS

(i) ***Silkworm*** feeds on mulberry leaves and ***produces silk*** of high quality.

(ii) ***Butterfly*** caterpillars prey scale insects thus are beneficial for ***destruction of insect*** pests.

(iii) Insects help in ***cross pollination***.

(iv) ***Honey Bees*** are important for the ***production of honey***.

(v) ***Spiders*** are useful to man as they ***feed on various insect*** pests.

(vi) Some insects act as ***scavengers*** and eat up dead animals and vegetable matter. Fish depend on certain insect larva for food.

Q. Define metamorphesis. How is this found in arthropods?

Ans. **METAMORPHOSIS**

"The process during which an animal under goes a rapid change from larval to adult stage".

Life history of insects is characterized by metamorphosis (meta = change + morphe = form). *This is an abrupt change of form or structure during the life cycle.* There are three morphologically distinct stages in the life cycle, the egg finally develops into **larva** which is converted into motionless **pupa** that finally develops into an **adult**. In some primitive insects the metamorphosis is incomplete. The larva resembles adult and called **nymph** or **instar**. It lives in the same habitat as adult.

Q.20 Discuss in detail the general characteristics and classification of Phylum Mollusca.

Ans. **MOLLUSCA**

(1) The phylum consists of diverse group of organisms such as ***slow-moving snails*** *and* ***slug***, ***bivalved*** clams and highly ***active cephalopods***.

(2) They include over *50,000* living species being the second largest invertebrates.

(3) **Among molluscs *Gaint Squid is the largest invertebrate.***

(4) These are **triploblastic coelomates** having **bilateral symmetry**.

(5) The body is enclosed by a **glandular epithelial envelope called mantle** which secretes ***calcareous shell***. So exoskeleton is calcarious. They protect the body but cause hindrance in locomotion, therefore, some active mollusks show reduction or loss.

(6) Some are ***exclusively aquatic*** *e.g.,* ***cephalopoda***. Some are terrestrial living in moist places.

(7) The body is short and **unsegmented**.

(8) They body is divided into **head**, a **ventral muscular foot** of internal organs.

(9) The space between the shell and mantle cavity contains **gills**.

(10) In the mouth cavity of many mulluscs, **rasping tongue – like radula** having many ***horny teeth***.

(11) Excretion occurs by a specialized structures called **nephridia**.

(12) ***Open circulatory system*** *is present except* ***in cephalopoda***.

(13) The members of the phylum have *complex digestive, respiratory, circulatory, excretory, nervous and reproductive systems.*

(14) The digestive system have *two* openings i.e., **mouth and anus**.

(15) The ***coelom*** is divided into **sinuses** or blood spaces.

(16) ***Heart*** pumps the blood into the **sinuses**.

(17) A respiratory pigment of blue in colour, called ***haemocyanin*** is present.

(18) **Respiration** occurs *by* ***gills***. "In some ***snails***, the mantle cavity is converted into a lung".

(19) **Nervous system** consist of three pairs of interconnected **ganglia** in the head, foot and body region.

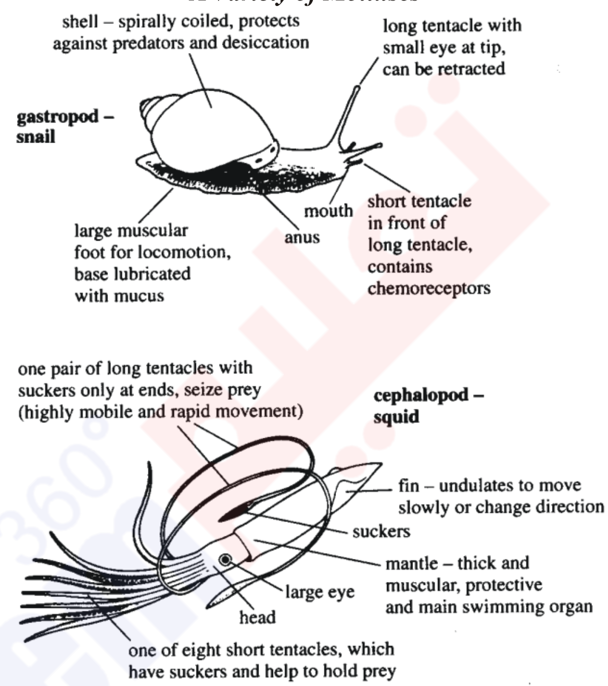
(20) **Locomotion** is by means of ***muscular foot***. Some members are **sessile** i.e., unable to move.

(21) Molluscs are **unisexual**.

(22) The larva is called **Trochophore**.

(23) The **brain of octopus** is large and complex enclosed in a shell – like case of cartilage. Octopus has got great ability of learning.

A Variety of Molluscs



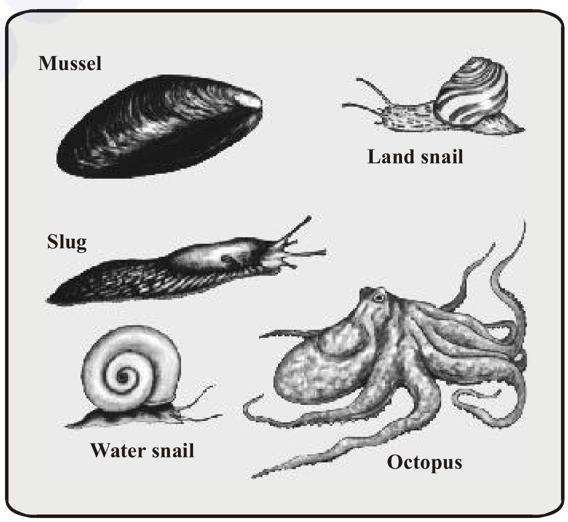


Fig. Example of mollusks

Q.21 Which is the largest invertebrate?

Ans. Gaint Squid.

Q.22 How many classes are found in Mollusea? Write short notes on it.

Ans. **CLASSES OF MOLLUSCA**

Phylum Mollusca are divided into **six** classes. The major three classes are:

(a) Gastropoda

(b) Bivalvia (Pelecypoda)

(c) Cephalopoda

(a) Gastropoda:

(i) The members of the class are ***asymmetrical***.

(ii) The body is covered with coiled ***one piece shell***.

(iii) The animal can defend itself by withdrawing its body into the shell.

(iv) The class includes both ***aquatic*** and ***terrestarial*** animals.

(v) The aquatic species possess lungs but in land form the mantle cavity is covered by lungs.

Examples: Helix *aspersa* (garden snail) *Limad*. (slug).

(b) Bivalvia (Pelecypoda):

(i) The members belonging to this class have ***bilateral symmetry***.

(ii) The body is laterally compressed and enclosed into two ***pieces of shells***. Thus called *bivalves*. *Respiration* is by ***plate-like gills***.

Example: *Mytilus* (marine mussel), ***Anodonata*** (fresh water mussel), ***Ostrea*** (oyster).

(c) Cephalopoda:

(i) These also have ***bilateral symmetry*** with ***dorso-ventral body***.

(ii) All species are aquatic.

(iii) The shell in these species is much reduced and internal. In some cases shell is absent.

(iv) The membranes belonging to the class are **highly developed** and **active**.

Example: *Loligo* (squid), the gaint squid is the largest invertebrate i.e., 15 meters (about soft) including tentacles or arms.

Q.23 Write short note on the Economic Importance of Phylum Mullusca.

Ans. **BENEFICIAL EFFECT**

(i) Some members of Mulluscs are great ***source of food*** for man in many parts of the world.

(ii) Large quantity of clams, oysters and mussels are eaten in Far east, Europe and America.

(iii) Oysters are regarded as ***delicacy***.

(iv) ***In button industry*** shells of fresh water mussels are used.

(v) Shells of oysters are mixed with tar ***for making roads*** in America. Shells of mussels are also used for making ornaments especially some oysters are used for making the ***valuable pearls*** e.g., the pearl oyster. Some kinds like the Achatina are edible.

HARMFUL EFFECTS

(i) **Slugs** and **shipworms** are harmful molluscs.

(ii) Slugs are ***injurious in gardens*** and cultivation.

(iii) They eat leaves and ***destroy plant*** roots and stems.

(iv) ***Teredo***, a shipworm ***damages wooden parts*** of ship.

(v) Some snails like the water snails are carrier of the ***disease bilbarzia***.

Q.24 Discuss the general characters of phylum Echinodermata. (GRWO4)

Ans. **GENERAL CHARACTERISTICS OF PHYLUM ECHINODERMATA**

(1) Echinoderms include about ***5,000*** specifies.

(2) They are ***exclusively marine***, most are ***free living*** and some are ***sessile***.

(3) The body is covered by delicate epidermis.

(4) **Exoskeleton** is formed of calcium developed from mesoderm.

(5) Echimoderms are tripoblastic coelomates having ***radial symmetry*** but the ***larva have bilateral symmetry***.

(6) **Lower surface** (**oral**) possess mouth and anus is on upper surface (**aboral**).

(7) The body may be flattened like biscuit (cake urchin), ***star-shaped*** with short arm (star fish) globular (sea urchin) star-shaped with long arms (brittle star) or ***elongated*** (sea cucumber).

(8) They have ***water vascular system*** (coelomic compartment) in their coelom consisting of complex system of tubes and spaces surrounding the mouth and passing into the arms and tube feet. Circulation of water occurs through these channels. Water moves through three canals through a sieve-like plate called ***madreporite*** present on the upper surface.

(9) **Locomotion** is by means of ***tube feet*** which is soft present along the edges of grooves in the arms.

(10) Echinoderms are less specialized but have specialized organs for digestion and reproduction.

(11) ***Nervous system*** is poorly developed and ***lack brain*** but have ***nerve ring*** around the pharyngeal region.

(12) Respiratory excretory and circulatory systems are poorly developed.

(13) Animals belonging to phylum are ***unisexual*** and ***fertilization is external***.

(14) The larva e.g., ***bipinnearia*** and ***brachiolaria*** are complex having bilateral symmetry like chordates.

(15) The ability to produce the lost parts (***regeneration***) is common in them.

(16) Echinoderms have single structural and physiological organization, therefore, ***deserve to be placed below annelids but due to following characters are placed before chordates***.

Similarities between Chordata and Echinodermata:

(a) Both chordates and echinoderms have radial cleavage during embryonic development.

(b) The ***blastopore*** forms, the arms in echinoderms and chordates (Deuterostomes).

(c) ***Phosphocreatin*** is present in both. It is

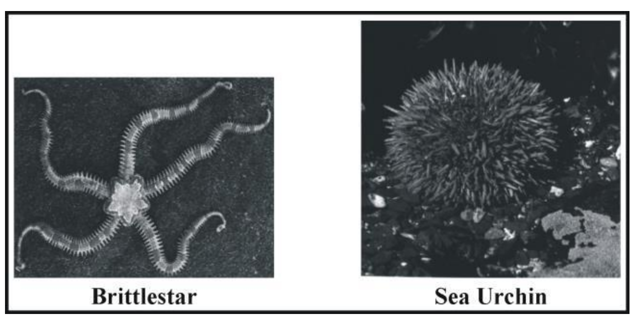


Fig. Examples of Echinoderms

Example: Asterias (starfish), ***Sea urchin*** (sea cucumber), ***Cake urchin***, ***Brittle star.***

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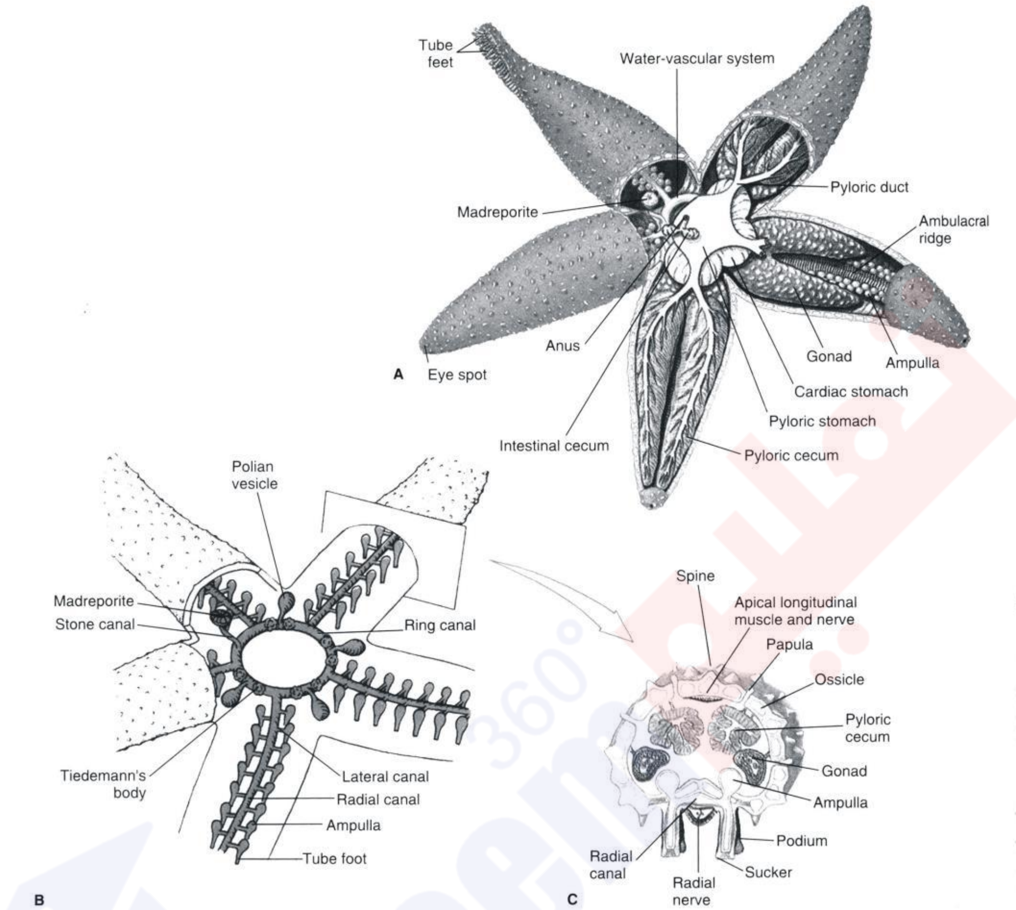

A, Internal anatomy of a sea star. **B,** Water-vascular system. **C,** Cross section of arm at level of gonads, illustrating open ambulacral groove. Podia (tube feet) penetrate between ossicles. (Polian vesicles are not present in *Asterias*.)

Q.25 (a) Discuss the affinities of Echinoderms with Hemichordata?

Ans. *Echinodermata are placed near to Hemichordata* because they have no close relationship with most of invertebrates rather show some close similarities with Hemichordata. Following are the common features:

(i) Formation of coelom and **retention of blastopore** as the site for future anus.

(ii) Mesoderm is derived from the cells close to the blastopore.

(iii) They have **mesodermal exoskeleton** which is ectodermal in origin while in invertebrates the blastopore develops into mouth.

According to the findings the above mentioned resemblance between Hemichordata are neither accidental nor due to convergent evolution because the two are closely related and both emerged from the same (common) ancestors.

a. Echinoderms also show great close resemblance with Chordates because both having mesodermal skeleton are deuterostomous (branch of animal kingdom).

b. Both lower Chordates and Echinoderms have similar early development.

Q.25 (b) Why Echinodermata is not placed after annelida? (OR) Why Echinodermata is placed before chordata?

Ans. See (16) of Q.24.

Q.26 Write down the general characteristics of phylum Hemichordata?

Ans. **GENERAL CHARACTERS OF HEMICHORDATA**

(1) They have a close resemblance with both Echinodermata and Chordata.

(2) Both Echinodermata and Hemichordata belong to the group **Deuterostome** the branch of Animal kingdom.

(3) They are also called ***Prechordates***.

(4) The animals included in the phylum have **soft bodies** and **worm-like**.

(5) Their body is divided into an anterior ***proboscis, collar*** and ***trunk***.

(6) Their body wall is made of **unicellular epidermis** with mucus-secreting cells.

(7) They possess **straight digestive tract** but may show variation.

(8) The **coelomic cavities** are related to the *three* body regions i.e. proboscis, collar coelomic pouches.

(9) The circulatory consists of a **median dorsal** and **ventral vessel**.

(10) **Gill slits** forming a dorsal row behind collar form the respiratory system.

(11) The excretory system has a single **glomerulus** connected to blood vessels.

(12) The nervous system has a **sub-epidermal plexus** of cells and fibres.

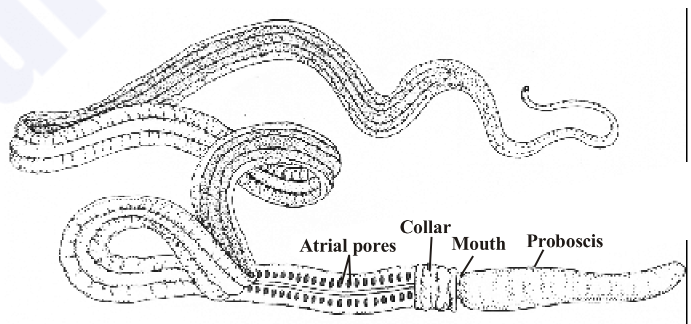

Fig. Balanoglossus and saccoglossus

Examples: *Balanoglossus, Saccoglossus* etc.

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Position in Animal Kingdom

1. Hemichrodates belong to the deuterostome branch of the animal kingdom and are enterocoelous coelomates with radial cleavage.
2. Hemichordates show some of both echinoderm and chordate characteristics.
3. A chordate plan of structure is suggested by gill slits and a restricted dorsal tubular never cord.
4. Similarity to the echinoderms is shown in larval characteristics.

Biological Contributions

1. A tubular dorsal nerve cord in the collar zone may represent an early stage of the conditions in chordates; a diffused net of nerve cells is similar to the uncentralized, subepithelial plexus of echinoderms.
2. The gill slits in the pharynx, also characteristic of chordates, serve primarily for filter feeding and only secondarily for breathing and are thus comparable to gill slits in the protochordates.

Q.27 Discuss the salient features/diagnostic features of phylum chordata?

Ans. **PHYLUM CHORDATA**

Classification of Phylum Chordata

Phylum Chordata

Group Protochordata Acrania)

(1) **Subphylum Urochordata** (u′ ro-kor-da′ta) (Gr. *oura*, tail, + L. *chorda*, + *ata*, characterized by)

(Tunicata): tunicates. Notochord and nerve cord in free-swimming larva only; ascidian adults sessile, encased in tunnic.

(2) **Subphylum Cephalochordata**

(set′ a-lo-kor-da′ta) (Gr. *kephatē*, head, + L. *chorda*, cord): **lancelets (amphioxus)**. Notochord and nerve cord found along entire length of body and persist throughout life; fishlike in form.

Superclass Gnathostomata (na′tho-sto′ma-ta) (Gr. *gnathos*, jaw + *stoma*, mouth): **jawed fishes, all tetrapods**. With jaws and (usually) paired appendages.

Class Chondrichthyes (kon-drik′thee-eez) (Gr. *chondros*, cartilage, + *ichthys*, a fish): **sharks, skates, rays, chimaeras**. Streamlined body with heterocercal tail; cartilaginous skeleton: five to seven gills with separate openings, no operculum, no swim bladder.

Class Osteichthyes (os′e-ik′thee-eez) (Gr. *osteon*, bone, + *ichthys*, a fish): **bony fishes**. Primitively fusiform body but variously modified; mostly ossified skeleton; single gill opening on each side covered with operculum; usually swim bladder or lung. A paraphyletic group.

Group Craniata

(3) Subphylum Vertebrata (ver′te-bra′ta)

(L. *vertebrates,* backboned). Bony or cartilaginous vertebrae surrounding spinal cord (vertebrae absent in agnathans); notochord only in embryonic stages, persisting in some fishes; also may be divided into two groups (superclasses) according to presence of jaws.

Superclass Agnatha **(ag′na-tha) (Gr. *a*, without, + *gnathos*, jaw)** (Cyclostomata): hagfishes, lampreys. **Without true jaws or paired appendages. Probably a paraphyletic group.**

Class Myxini (mik-sin′y) (Gr. *mysa*, slime): **hagfishes**. Terminal mouth with four pairs of tentacles; buccal funnel absent; nasal sac with duct to pharynx; 5 to 15 pairs of gill pouches; partially hermaphroditic.

Class Cephalaspidomorphi **(sef-al-less′pe-do-morf′e) (Gr. *kephatē*, head, + *aspidos*, shield, *morphē*, form)** (Petromyzones): lampreys**. Suctorial mouth with horny teeth; nasal sac not connected to mouth; seven pairs of gill purches.**

Class Amphibia (am-fib′e-a) (Gr. *amphi*, both or double, + *bios*, life): **amphibians**. Ectothermic tetrapods; respiration by lungs, gills, or skin; development through larval stage; skin moist, containing mucous glands, and lacking scales.

Class Reptilia (rep-til′e-a) (Gr. *amphi*, both or double, + *bios*, life): **amphibians**. Ectothermic tetrapods; respiration by lungs; embryo develops within shelled egg; no larval stage; skin dry, lacking mucous glands, and covered by epidermal scales. A paraphyletic group.

Class Aves (ay′veez) (L. pl. of *avis*, bird): **birds**. Endothermic vertebrates with front limbs modified for flight; body covered with feathers; scales on feet.

Class Mammalia (ma-may′lee-a) (L. *mamma*, breast): **mammals**. Endothermic vertebrates possessing mammary glands; body more or less covered with hair; well-developed neocerebrum.

Phylum chordata have three major diagnostic features:

(1) Notochord

(2) Hollow Dorsal nerve Cord

(3) Gills

(1) Notochord:

The phylum derives its name due to the presence of notochord. It is present in all Chordates either in the larval or embryonic or throughout life.

Notochord is a rod-like semiarid body with *vacuolated cells* which are filled with proteinaceous material. It is present in most cases along the length of the body between enteric canal and the dorsal hollow central nervous system. Its function is to *support and to stiffen the body* that is to act ***as skeletal axis***.

The endoskeleton is the chief basic factor in development and specialization of higher animals. *The notochord is replaced by vertebral column in higher chordates*.

(2) Hollow Dorsal Nerve Cord:

This forms the central nervous system.

It is **dorsal** in position and **hollow**.

This is involved in controlling various metabolic activities of the body.

In higher chordates brain forms enclosed in a bony case called skull.

(3) Gills:

In the embryonic stage all the chordates develop paired gills, in some there are non-functional, in others these are functional for some period in their life history e.g., frogs.

In some these are functional throughout their life e.g. *Amphioxus, fish* etc.

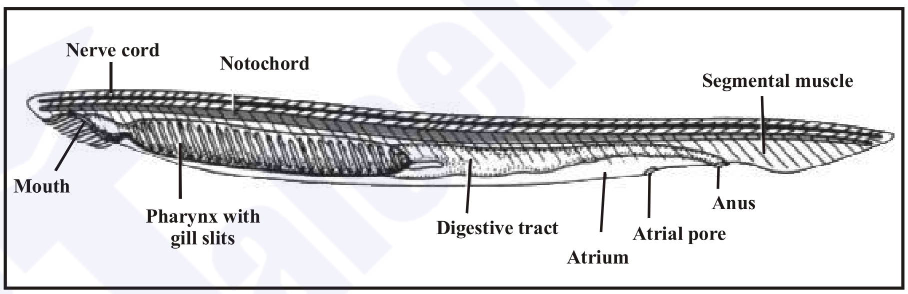

Fig. Amphioxus

Q.28 Protochordata is divided into how many sub-phyla?

Ans. PROTOCHORDATA (ACRANIA – WITHOUT CRANIUM):

Protochardata is divided into three sub-phyla:

(1) Sub phylum *Urochordata*

(2) Sub phylum *Cephalochordata*

(3) Sub phylum *Vertebrata*

URO ———	means tail
CEPHALO –	means head
VERTE ——	means backbone

(1) Urochordata:

They posses **notochord** and nerve.

Adults are sessile and enclosed in a covering called **tunio or tunic**.

Thus are called **tunicata** e.g. **Molgula**.

(2) Cephalochordata:

In this sub phylum notochord and nerve cord extend along the entire length of the body and persist throughout life e.g., **Amphioxus**.

(3) Vertebrata or Craniata:

They have cranium (skull) in which animals have vertebral column.

Q.29 How many super class are found in vertebrates? Discuss the characteristics of different classes of Pisces?

Most fishes today are ray-finned fishes. They have the following characteristics.

- bony skeleton
- gills
- two-chambered heart
- skin with scales
- swim bladder
- jaws

Ans. The sub phylum vertebrata is divided into ***two super classes***.

(1) ***Pisces (Fishes)***

(2) ***Tetrapods (four footed)***

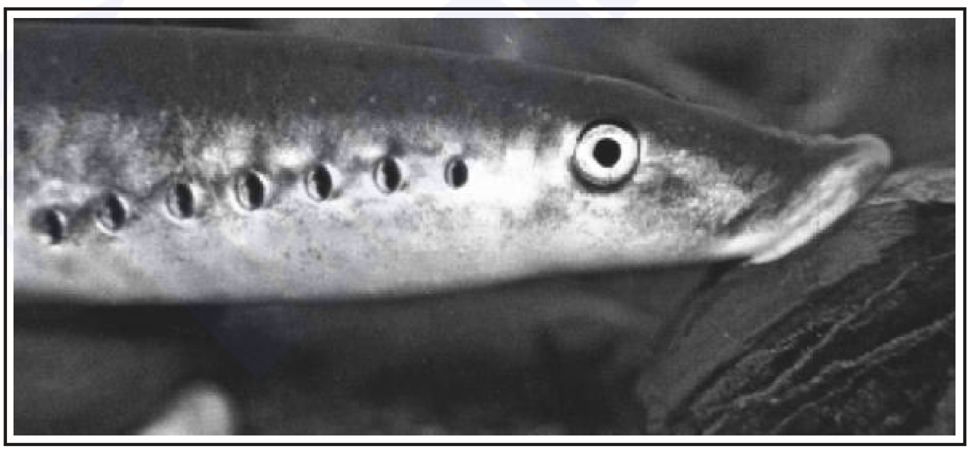

Fig. Lamprey

(1) PISCES

It includes *three* classes i.e. *cyclostomata, chondrichthyes* and *osteichthyes*. "***Theyes means fishes***".

CLASS CYCLOSTOMATA (Jawless Fishes):

(1) They include **jawless fishes**.

(2) Body is **long eel-like**.

(3) *Paired appendages are absent*.

(4) Ventral suitainial mouth.

(5) *Six* to *fourteen pairs* of gills.

(6) Sexes may be separate i.e., ***Lamprey*** or they may be hermaphrodite like ***Hagfish***.

(7) Scales are absent.

(8) Skeleton is **cartilaginous** (ہڈی نما مگر نرم و لچکدار).

(9) Heart has **one auricle**.

(10) ***Stomach is absent*** in digestive system.

(11) **Fertilization occurs externally** and have long larval period e.g. **Lamprey**.

CLASS CHONDRICHTHYES: (کونڈرک تھیز) (Cartilaginous Fishes)

They have the following characters:

(1) Body is **fusiform**.

(2) **Mouth ventral** and **olfactory sacs** not connected to mouth cavity.

(3) **Placoid scales** are present on the body.

(4) Endoskeleton is entirely **cartilaginous**.

(5) Digestive system with **J-shaped stomach**.

(6) Circulatory system has many **pairs of aortic arches**.

(7) Respiration occurs with the help of **5 – 7 pairs of gills** with the covering i.e., **operculum**.

(8) Swim bladder is absent.

(9) **Sexes are separate**.

(10) May be **oviparous** (lay eggs) or **viviparous** (give birth).

Second largest vertebrate is shark ranging **30 – 50** feet in length.

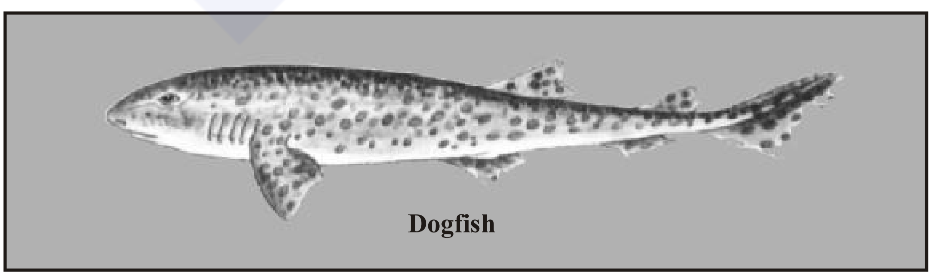

Fig. Cartilage fish

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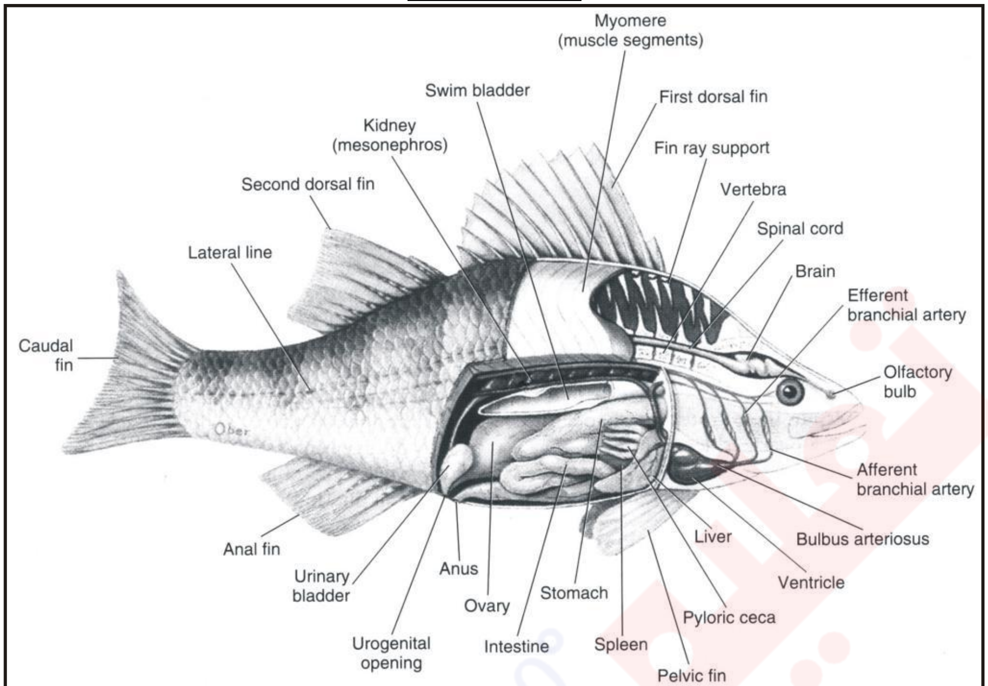

Internal anatomy of the yellow perch *Perca flavescens,* a freshwater teleost fish.

Skates and Rays:

(i) These are ***bottom dwelling fishes***. The anterior pairs of fins (***pectoral fins***) are much enlarged and are used for swimming like wings e.g., Sting and Electric Rays.

(ii) The Sting Rays have ***long and whip-like*** tail has sharp spines which can inflict dangerous wounds.

(iii) The Electric Ray have certain ***absorbed muscles*** modified into powerful ***electric organ*** which can give several shocks and stun their prey.

Economic Importance of Sharks:

(1) These sharks are highly destructive to fish Lobsters and Crabs.

(2) They are used as a food in certain countries by man.

(3) Commercially the oil is extracted fro the liver of shark and in used in medicine as a source of **Vitamin A and D**.

(4) ***Leather goods*** can be made from the skin of shark.

CLASS OSTEICHTHYES: (اوسیک تھیز) (*Bony Fishes*)

These are also known as ***bony fishes***. They have the following characteristic features:

(1) Cartilaginous skeleton is replaced by **bony skeleton**.

(2) **Notochord** may persist in parts.

(3) The skin possess embedded **dermal scales** whole may be **ganoid, cycloid** or **ctenoid** scales. Placoid scales were absent.

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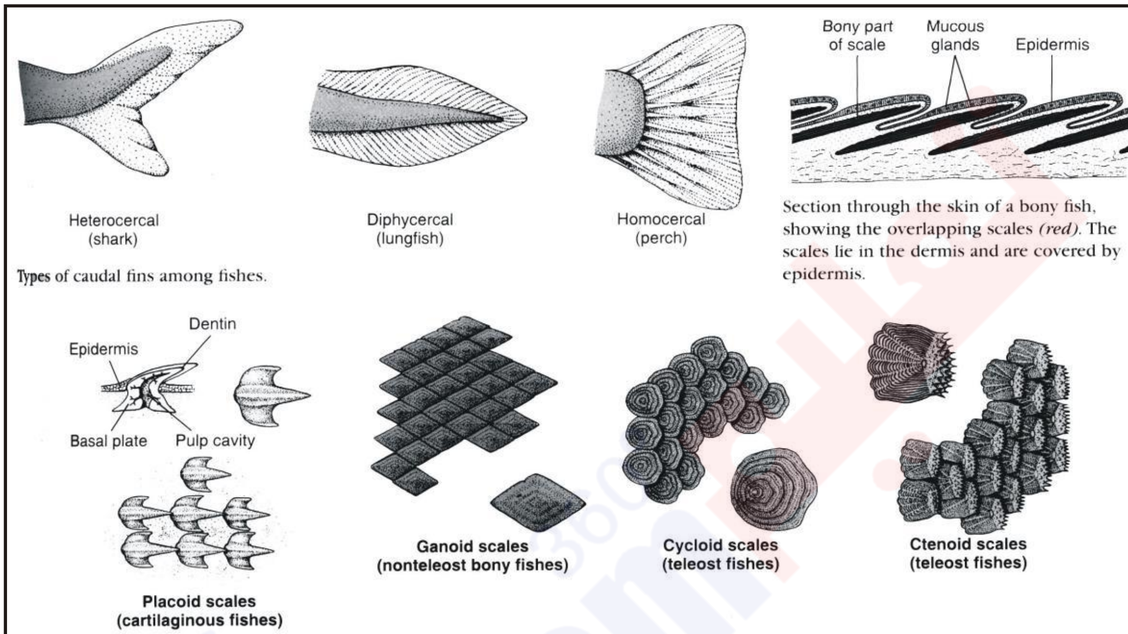


Types of caudal fins among fishes.

Section through the skin of a bony fish, showing the overlapping scales *(red)*. The scales lie in the dermis and are covered by epidermis.

Types of fish scales. Placoid scales are small, conical toothlike structures characteristic of Chondrichthyes. Diamond-shaped ganoid scales, present in primitive bony fishes such as the gar, are composed of layers of silvery enamel (ganoin) on the upper surface and bone on the lower. Advanced bony fishes have either cycloid or ctenoid scales. These are thin and flexible and are arranged in overlapping rows.

(4) Fins both, median (single) or paired and have fin rays of cartilage on bone.

(5) **Terminal mouth**, jaws may or may not have teeth.

(6) Both median (single) or **paired fins** are present. Fin rays of cartilage or bone.

(7) **Respiration is by gills** in addition to bony gill arches and covered by operculum.

(8) **A swim bladder** in usually present with or without connection with the pharynx. Thus helps in *buoyancy*.

(9) **Heart is two chambered** with an atrium and ventrical.

(10) "Blood has nucleated red cells".

(11) Brain with **10 pairs** of ***cranial nerves***.

(12) Sexes are separate with ***paired gonads***.

(13) *Fertilization is usually external*.

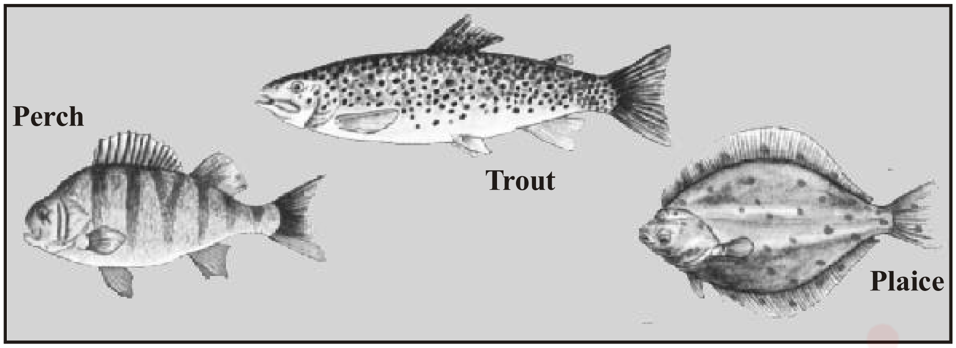


Fig. Bony fishes

Q.30 Highlight the different adaptive characters developed in the animals living in aquatic habitat.

Ans. ADAPTATIONS IN AQUATIC HABITAT

Following are the most **common adaptative characters in the animals** living in aquatic habitat:

(1) Stream-lined body
(2) Swim bladder
(3) Fins
(4) Circulatory system
(5) Respiratory system
(6) Excretory organs
(7) Lungs

(1) Stream-lined Body:

This means ***boat shaped structure***. Such structure offers ***little resistance to water*** while swimming.

(2) Swim Bladder:

That is present in most bony fishes it may or may not be connected to the pharynx. It is **hydrostatic organ** and helps in changing the gravity of fish by filling it self with gas. ***Due to it fish can easily float or swim deep in water***.

The ***gases*** that fill the swim bladder are either *oxygen, carbondioxide* and *nitrogen* which may be secreted by the glands in the swim bladder. The fishes in which the swim bladder is connected to pharynx the bladder may be filled by gulping of air.

(3) Fins:

They may be paired i.e., **pectoral** and **pelvic** or unpaired present on the dorsal, caudal (tail) and portion. Fins play important role in keeping the balance of fish thus ***help in swimming***.

(4) Circulatory System:

Heart is divided into *two chambers*, with afferent and efferent bronchial system.

(5) Respiratory System:

Gills are the respiratory organs meant for receiving oxygen dissolved in water and remove carbon dioxide in water as the gills have network of blood carbon dioxide in water as the gills have network of blood capillaries.

(6) Excretory Organs:

Kidneys are present in fish involved in the process of excretion.

(7) Lungs:

in ancient fish like Dipnoi showed modification of aquatic breathing system to meet the conditions of terrestrial life by developing lungs.

Q.31 What are the differences between water and land habitats?

Ans. DIFFERENCES BETEEN AQUATIC AND LAND HABITATS

(1) The concentration of ***oxygen is more in air*** than in water.

(2) Water contains different kinds of ***salts dissolved in water***.

(1) ***Temperature*** habitat is more protected as compared to the aquatic habitat.

(2) Water provides more ***support*** to the body as compared to the air.

(3) Land provides great variety of ***breeding places*** than does water.

Q.32 What are the different adaptative characters which animals developed, when they invaded on land?

Ans. ADJUSTMENTS ON LAND

Following are the different adaptative characters which animals developed when they invaded on land:

(1) ***They developed skin*** for the protection of the body against dry conditions of land.

(2) ***The eggs are protected*** by shells from drying and mechanical injury. The egg is large is size which provides enough space for the storage of food.

(3) ***They have developed lungs*** for respiration instead of gills.

(4) ***Circulatory system is well developed*** may be open or close type. Heart is divided into *three* or more chambers.

(5) ***They have developed limbs*** i.e., fore limb and hind limb for walking, running, climbing, flying. In birds forelimbs are modified into wings and in man fore limbs are meant for taking in food.

(6) ***Sensory organs*** have become more advance and specialized.

Q.33 What are the different evolutionary changes in the organs of the amphibian in contrast to the fishes?

Ans. **EVOLUTIONARY CHANGES IN AMPHIBIANS FISHES**

Amphibian include the animals which can *live both in the aquatic and terrestarial* conditions. ***Fossil record of Devonian period provides evidences that large population of lobe-fined fishes (dipnoi) came to live in shallow fresh water. Some of them used to crawl from one pool to another and therefore spent sometime on land. From this group amphibians have arisen***. Amphibians have certain characters of aquatic animals and have developed number of characters which were necessary for terrestrial life. Thus they have transition stage between the Fish and Reptiles.

Q.34 Classify tetrapods. Discuss the characteristic features of Amphibia?

SUMMARY

These features in particular distinguish amphibians:

- usually tetrapods
- usually lung in adult
- metamorphosis
- smooth and moist skin
- three-chambered heart

Ans. Tetrapods are divided into four major classes:

(1) Amphibia (2) Reptilia

(3) Aves (Birds) (4) Mammalia

Characteristic Features of Amphibia

(1) They possess **bony skeleton**. Animals may have **tail or without tail**.

(2) They are **tetrapods** having fore limb and hind limb but some are ***legless*** (e.g. caecilians) ***webbed feet*** are often present.

(3) They have **smooth and moist and glandular skin**. In some glands are ***poisonous***, pigment cells (chromatopores) are present. Scales are absent.

(4) Animals belonging to the class **respire by gills at larval stage** but in adults respiration occurs by means of **lungs** (pulmonary) and skin (cutaneous respiration.

(5) ***Heart is three chambered*** i.e., two auricles and a ventricle but in frog in addition to it sinus venosus, truncus arteriosus are also present. Double circulation takes place through the heart.

(6) **Sexes are separate**, *fertilization is external*, larval stage exist in them.

(7) The process of **metamorphosis** occur in them.

(8) Amphibians are ***anamniotes***.

(9) Amphibians are ***cold blooded*** (**Poikilothemic**).

(10) **Hibernation** during winter occurs in them.

Example: Frogs. Toads, Salamander

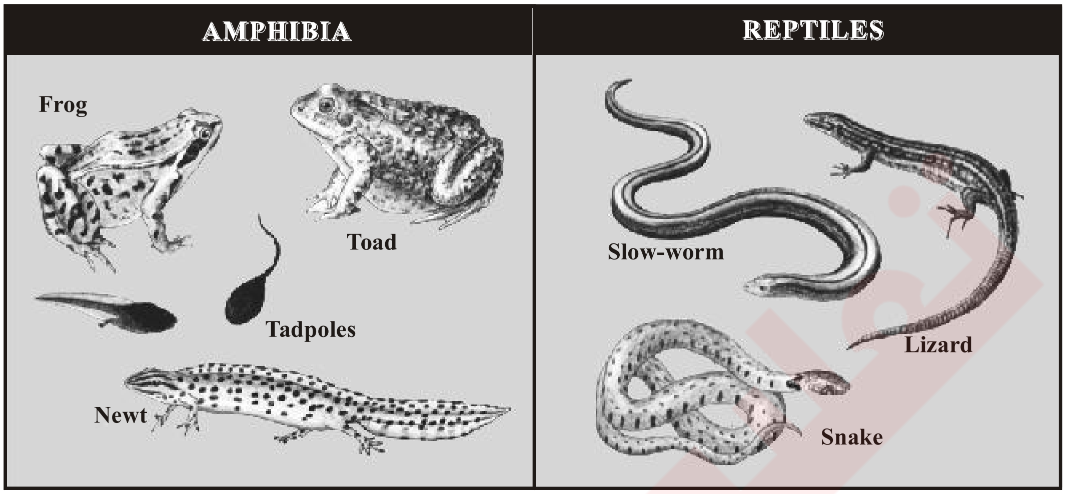


Fig. Imphibians and Reptiles

Q.35 Discuss the characteristic features of class Reptilia?

Ans. **REPTILIA**

Reptiles have the following characteristic features:

(1) They are ***cold blooded*** (**Poikilothermic**) and hibernate in winter like amphibian.

(2) They have developed better limbs for **efficient locomotion**.

(3) They have dry **scaly skin**.

(4) **The ventricle of heart is incompletely partitioned** ensuring more oxygen supply through blood circulation to all parts of the body. In crocodiles ventricle is completely partitioned into two.

(5) They have some sort of **copulatory organ** necessary for internal fertilization.

(6) The **amniotic eggs** of reptiles the shell is leathery which can resist dryness and injury. They have large yolky eggs.

(7) They have **three embryonic membranes** i.e. ***amnion, allantois*** and ***chorion***.

HELP LINE

These features in particular distinguish reptiles:

- usually tetrapods
- lungs with expandable rib cage
- shelled egg
- dry, scaly skin

Q.36 Discuss the evolutionary links of reptiles?

Ans. **EVOLUTIONARY LINKS OF REPTILES**

They were found in **Mesozoic period (225.65 million years)**. The climatic conditions became less suitable in tertiary period. Therefore they became extinct. The existing reptiles belong to four, out of a dozen or more main lines that have existed.

The lizards and snakes of the present day are the reptiles which occupied earth first of all, secondary the tuatra (sphenodon) of New Zealand, which have survived upto today with little change.

Modern birds are thought to be evolved from the third presently occurring reptile i.e., crocodile.

Present day reptiles have been derived from dinosaurs of Jurassic (136 – 195) million years) and **Cretaceous (136 – 165) million years)** period.

Modern reptiles are present in the temperate and tropical zone. They flourished most in tropical region.

Q.37 Discuss the evolution of Birds (aves).

Ans. **EVOLUTION OF BIRDS**

Birds are world wide in distribution, like mammals, birds possess highest development in the animal kingdom. ***It is believed that both of these have evolved from reptiles*** along different lines. Archaeopteryx was the earliest known bird fossil. Their two species were found from the rocks of ***Jurassic period*** of earth's history.

Archaeoptreyx was about the size of ***a crow with skull*** similar to the present day birds. It had ***bony teeth*** in the ***jaw socket*** unlike modern birds which do not have teeth. Jaws extended into a beak with long tail. Each wing had three claws. They (gaint reptiles of the past) with the exception of feather. Fossil record shows that certain other birds also posses teeth. From the above discussion it is quite evident that birds have evolved from reptiles.

Q.38 Write down the characteristic features of Aves.

Ans. **CHARACTERISTIC FEATURES OF AVES**

(1) The body of birds is **stream – lined and spindle shaped** with four division ***head, neck, trunk*** and ***tail***.

(2) They are ***warm blooded*** (**Homeothermic**).

(3) Fore – limbs are modified into **wings** which are adapted for flying. Hind limbs are meant for perching and in some like ostrich are involved in running.

(4) There is the **epidermal exoskeleton** of feathers. Legs bear ***scales***.

(5) They have **light skeleton *with air spaces*** which is an adaptation for flying.

(6) The **skull has large sockets**, jaws extend into ***horny beak***.

(7) Teeth are absent.

(8) They have **well developed circulatory system**, have ***four chambered heart*** with only right ***aorta*** which curves to the right side and then bends backward.

(9) The **lungs have extensions** known as ***air sacs*** which extend into the bones also.

(10) **Syrinx** is the ***organ of voice*** present at the lower end of trachea near the origin of the two bronchi.

(11) Bladder is absent, ***urine is semi solid***.

(12) Birds are ***unisexual***.

(13) ***Fertilization*** *is internal*.

(14) **Eggs** are of large size with ***much yolk***.

(15) **Only one ovary** and *oviduct is functional*.

(16) Present birds do not possess teeth rather have developed a thick muscular structure (**gizzard**) which is used for crushing food.

(17) In certain ***wings*** are ***vestigial organ*** and have lost the power of flight. Thus are called *running birds* e.g., ***Ostrich, Kiwi, Rhea***.

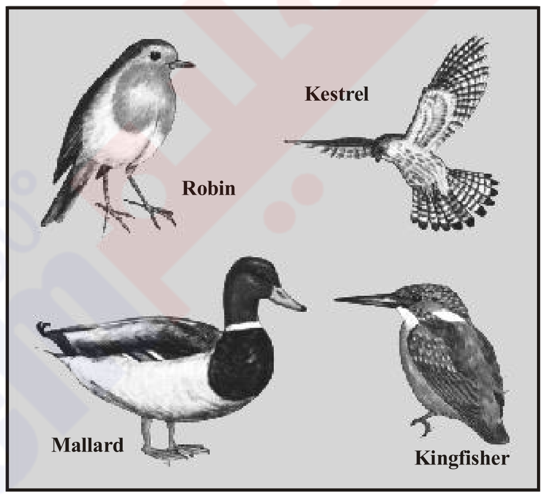


Fig. Birds

Q.39 Discuss the evolutionary trends of class mammalia.

Ans. **EVOLUTION IN MAMMALS**

According to Linnaeus the animals which nourish their young ones on mother milk are considered to be mammals. ***Mammals are said to be the most advanced and developed group of animals because they have well developed brain***.

Mammals have ***evolved from reptilian ancestors***, the ***cotylosaurs*** whose fossilized bones in preserved form give such evidences about the evolution of mammals. The ancestors of reptiles were found in the ***jurassic period*** along with the reptiles and therefore have been called mammal-like reptiles. Some were of the size of mice and lived on trees. One of these early reptile was varanope that was formed as fossil in Texas. Mammal – like reptiles comprises at least *five* groups of Mammals became dominant in the **Cenozoic period**.

Q.40 Write down the general characteristics of Mammals?

Ans. **MAMMALIA**

Mammals possess the following general characteristics:

(1) Scales are absent mostly they have ***hair*** on their body.

(2) They have ***muscular diaphragm*** that separates the thoracic and abdominal cavities. This is the unique character of this class.

(3) The **lower jaw** is composed of only one large bone and articulates directly with skull.

(4) External ear or **pinna** is present. Ear possess a chain of three bones i.e., ***Incus, Malleus*** and ***Stapes***.

(5) They have **deciduous (worn out) and permanent teeth** in some mammals e.g., man have two sets of teeth in whole life milk teeth in early age and permanent teeth take place after they are worn out.

(6) They have **four chambered** heart with only *left aortic arch* (in birds it is right).

(7) They are **homeothermic** (warm blooded) animals.

(8) Nucleus is absent in ***red blood cells*** (Erythrocytes).

(9) The mammals have well developed voice apparatus the ***larynx*** and ***epiglottis***.

(10) Mostly mammals give birth to the young ones (***viviparous***) but some lay eggs like birds (**oviparous**).

(11) Mammals feed their young ones produced from the ***mammary glands*** of the mother.

(12) Mammals are **world wide** in distribution i.e., on land, water, air (e.g. Bat).

Q.41 Classify mammalia. Write short note on each of them.

Ans. **SUB CLASSES OF MAMMALIA**

Class mammalian is divided into *three* sub-classes.

(1) Prototheria (*Egg laying mammals*).

(2) Metatheria (*Pouched mammals*).

(3) Eutheria (*Placental mammals*)

(1) **SUB CLASS PROTOTHERIA** **(*Egg Laying Mammals*):**

They have the characteristic of both reptiles and mammals.

They provide evidences that mammals have originated or ***evolved from reptilians***.

Some are adaptive for aquatic life e.g., ***Duck-Bill Platypus*** which has a bill similar to that of a duck and webbed toes.

It has ***thick fur*** on its body. The female has mammary glands to feed the young ones.

They have **cloaca** and ***cloacal opening instead of separate opening for digestive system and urinogenital systems***. Reptilian also possess these two later characters.

Examples: Duckbill platypus, Echidna (spiny ant eater) found in Australia.

(2) **SUB CLASS METATHERIA** **(*Pouched Mammals*):**

They are also known as pouched or *marsupial mammals*.

The marsupium or ***abdominal pouch*** is present where they rear their young when they are born at immature stage.

They feed on the milk produced from the mammary glands present in the marsupium.

Example: Opossum, Kangaroo and Tasmanian Wolf found in Australia & America.

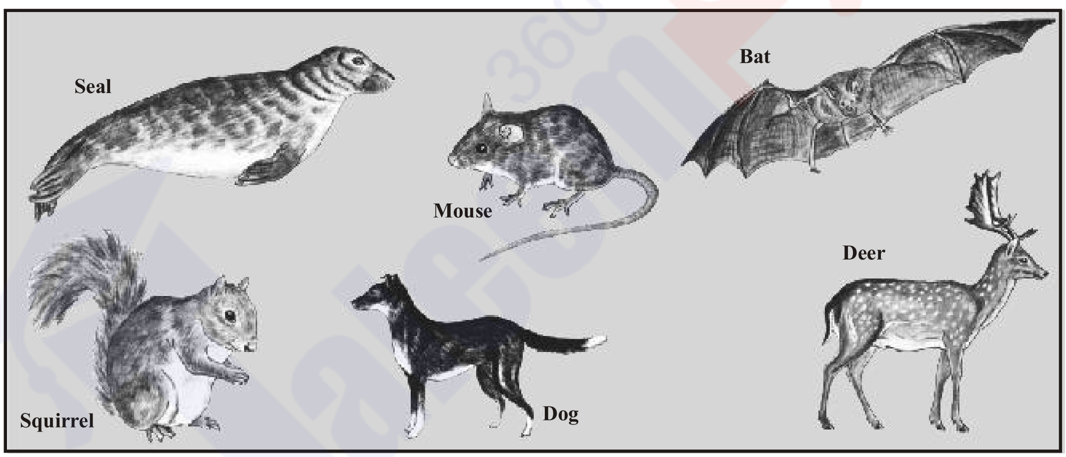


Fig. Mammals

(3) **SUB CLASS EUTHERIA** **(Placental Mammals):**

The subclass is also known as *placental mammals*.

Placenta formation occurs between the mother uterus and foetus, placenta has endocrine in function i.e., produce ***certain hormones*** (***Estrogen*** and **Progesterone**).

It is maximum advance. Hairs is a well developed character. In ***Pangolin hairs*** have modified into scales and in Porcupine spines.

Examples: Man, Whale, Elephant, Horse, Rat, Bat, etc.

SHORT QUESTIONS

Q.1 *Which invertebrates are radial symmetrical?*

Ans. Radial symmetrical invertebrates are:

(i) Cnidaria.

(ii) Echinodermata.

Q.2 *Which phylum is diploblastic?*

Ans. Cnidaria is diploblastic.

Q.3 *Which invertebrates are bilateral symmetrical?*

Ans. Platyhelminthes, Phylum Nematoda, Phylum Annelida, Phylum Arthropoda, Phylum Mollusca, Phylum Echinodermata (in early stage, adult body is radial symmetrical) and Phylum Chordata.

Q.4 *Which phyla have haemocoel?*

Ans. (i) Phylum Arthropoda

(ii) Phylum Mollusca.

Q.5 *Which phyla are acoelomate?*

Ans. Phylum Platyhelminthes is acoelomate.

Q.6 *Which phyla have metameric segmentation?*

Ans. Phylum Annelida, Phylum Arthropoda and Phylum Chordata.

Q.7 *Which kinds of coelomates found in Bilatera?*

Ans. Bilatera may be:

Acoelomates (i.e. Platyhelminthes)

Pseudocoelomates (i.e. Nematoda)

Coelomates.

Q.8 *Which Phylum of invertebrates found only in marine habitat?*

Ans. The member of phylum Echinodermata are exclusively marine.

Q.9 (a) What do you know about Habit and Habitat?

Ans. (i) Habit

The *form, size* or *appearing structure of an organism is called habit*. e.g. Unicellular, tree like or bush like, microscopic or macroscopic, oval or rectangular etc.

(ii) Habitat

The address of an organism is called habitat (OR) The living area of an organism is called habitat e.g., aquatic, terresterial, fresh water, marine etc.

Q.9 (b) Differentiate between Platyhelminthese and Nematodes.

Ans.

Platyhelminthes	Nematodes
(i) They are ***flat worms***.	(i) These are ***round worms***.
(ii) Body is ***dorso ventrally*** flattened.	(ii) Body is ***cylinderical***.
(iii) The epidermis is soft and ciliated or is covered by cuticle.	(iii) Cilia are entirely absent from epidermis.
(iv) A true body cavity or coelom is absent so they are ***acoelomate***.	(iv) Here the space between body wall and alimentary canal is filled by a cavity called ***pseudocoele***. So they are ***pseudo coelomate***.
(v) Digestive system is ***sac like***.	(v) Digestive system is ***tube like***.
(vi) Excretion is carried out with the help of ***flame cells***.	(vi) ***Protonephridial system*** is present for excretion.
(vii) All the body muscles are uniformly distributed.	(vii) Below expidermis, single muscular layer is divided into four longitudinal rows.
Examples: *Planaria, Taenia*	***Example:*** *Ascaris, Filaria*.

Q.10 Compare the Classes of Arthropoda:

Ans. Classificaiton of Arthropoda

Phylum Arthropoda is mainly divided into four classes.

Class Crustacea	Class Myriapoda	Class Insecta	Class Arachnida
(i) Mainly aquatic	Mainly Terrestrial	Mainly terrestrial	Terrestrial
(ii) It has **cephalo-thorax**	Clearly defined **Head**	Well defined **Head**. **Thorax** and **abdomen**	Divisions into ***prosoma*** and ***opisthosoma***.

(iii) Abdomen typically of **11 segments**.	All body segments similar	Abdomen typically **11 segments**	Abdomen with **13 segments**.
(iv) Exhibits larval forms	No Larval form	Larval Stages with complicated metamophosis	No Larval form
(v) Gas exchange by **gill**	Gas exchange by **trachea**	***No gills*** in adults Gas exchange by **Trachea**	Gas exchange by lungs. Gill books or by **Trachea**
Examples **Daphnia** (water fleas), **cray fish**.	Examples **Centipede millipede**	Examples **Cockroach**, all **insects Butterflies**	Examples **Scorpions, Spiders**
(vi) Walking legs present	With ***numerous*** pairs of ***legs***.	***Three pairs of legs***.	***Four pairs*** of legs.

Q.11 (a) What is coelom?

(b) What are pseudopodia?

Ans. (a) COELOM

It is a true body cavity present in ***coelomate***. They are usually lined by mesoderm. A coelom is found in all higher triploblastic animals which are grouped together as coelomate phyla. The coelom constitutes one or more perivisceral spaces abounding the heart, alimentary canal and other organs. It contains a fluid, coelomic fluid. Coelom is usually formed by the ***split of mesoderm***.

(b) PSEUDOPODIA

The word *pseudos means false and podium means foot like*. They are locomotory organellees in amoeba. These are given out from any part of the body surface in the form of temporary finger like processes. They continuously change in the size and shape. Due to repetition of the same process again and again animal moves forward.

Functions:

(i) They help in locomotion.

(ii) They are also helpful in engulfing food.

Q.12 What are water vascular system and canal system?

Ans. WATER VASCULAR SYSTEM

It is the system present only in phylum Echinodermata. This system is modified part of coelom and it consists of ***a system of sea water filled canals***. ***Water circulates in these canals***.

Function: It plays most vital role in the locomotion of the animal.

CANAL SYSTEM:

This system is the diagnostic feature of phylum porifera. The thick body wall of sponges is folded in produce an ***arrangement of passaages or canals, for the entrance*** of ***water currents***. This arrangement of canals or passage is termed as canal system. Water enters into this system by ***ostia*** then circulates into various canals and then passes out by ***osculum***.

Function:

(i) It brings food and serves the purpose of ***nutrition***.

(ii) It helps in the ***exchange of gases***.

(iii) It is also helpful in ***excretion***.

Q.13 (a) Compare Bilateral and Radial symmetry.

Ans. BILATERAL AND RADIAL SYMMETRY:

	Bilateral Symmetry	Radial Symmetry
1.	In this symmetry, an animals is cut into two equal halves in a ***single plane***.	The bodies of these animals can be cut into two equal halves in ***more than one planes***.
2.	Both body planes are ***mirror image*** of one another.	Both body planes are ***not mirror image*** of one another (Body is ***wheel like***).
3.	Arrangement of organs is on the ***longitudinal axis*** of body (both sides).	Arrangement of body organs is one the ***central axis*** of the body, plane usually passes through centre of body.
	Example: Arthropods, Molluscs.	***Example:*** Echinoderms, coelenterata

Q.13 (b) Differentiate between acoelomates and coelomates.

Ans. ACOELOMATE AND COELOMATED ANIMALS

The mesoderm whether it spilts or not results in the formation of two groups of animals.

Acoelomate Animals:

The simple triploblastic animals which have no body cavity or coelom are known as acoelomate animals (*Platyhelminthes*). In these animals the mesoderm do not split and usually forms a lose cellular tissue called *mesenchyma* or *Parenchyma*.

Coelomate Animals:

In some higher triploblastic animals either the mesoderm splits into two layers, the outer one is called somatic mesoderm and inner one is called visceral or splanchic layer, the space between two layers of mesoderm is an extensive fluid filled, this space is called coelom. A coelom is found in all higher triploblastic animals which are grouped together as coelomate phyla (*Annelida, Arthropoda, Mollusca Echimodermata, Hemichorada* and *Chordata*). ***The coelom is usually filled with a fluid known as coelomic fluid***.

Q.14 What is the biological name of common frog?

Ans. The biological name of common frog is *Rana tigrina*.

Q.15 Give the name of three Germinal Layers.

Ans. 1. Ectoderm 2. Endoderm 3. Mesoderm

Q.16 Given the name some parasites belonging to phylum nematoda?

Ans. (i) *Ascaris lumbricoides* living in human intestine.

(ii) *Trichinella* —— Intestinal parasite.

(iii) *Guinea* worm causing Abseuses on skin.

Q.17 What is metamorphosis?

Ans. The series of changes which occurs from the larval stages upto the formation of adult is called metamorphosis.

Q.18 How a biological name is written?

Ans. The first part of biological name represents the ***genus*** and is written with ***capital*** first letter and second name represents the ***species*** and is written with small first letter e.g. *Rana tigriana*.

Q.19 What is mesoglea?

Ans. (a) Mesoglea:

It is a ***non-cellular***, ***Jelly like*** cementing layer present in coelentrates.

Functions:

It usually ***binds the outer layer*** of ectoderm and an inner layer of endoderm.

Q.20 What is the role of nematocysts?

Ans. **NEMATOCYST**

In case of ***coelentrates***, they are ***sensory cells***. They are present in the body wall of coelentrates in the form of ***stinging cells***.

Function:

(i) They usually serve for ***offence*** and ***defence***.

(ii) They are also helpful in ***food capturing***, they ***secrete sticky poisonous substance*** with the help of which prey is paralysed.

Q.21 What do you know about tube feet?

Ans. **TUBE FEET**

They are present in ***Echinoderms***.

Each tube feet is in the form of ***hollow slender*** process present in each ***ambulacral grove***, (i.e. in each arm).

Each tube feet is divided into three parts. (i) i.e. An upper sac like ***ampulla*** (ii) a middle tubular ***podium*** (iii) lower disc like ***sucker***.

Functions:

(i) In case of Echinoderms they are ***chief organs of locomotion***.

(ii) They are also used as ***respiratory organs***.

(iii) As they are provided with suckers, so they ***posses great power of distension***.

Q.22 Define: Trachea, Brief the structure and function of contractile vacuole.

Ans. (a) **Trachea**

These arise from the main tracheal trunks and branch off profusely and very fine branches penetrate to all parts of the body.

(b) Contractile Vacuole

They are present in phylum protozoa especially in Amoeba and Paramecium. In paramecium, they are present one on either end of the cell. Body is the form of two large hollow, rounded water filled spaces.

Function: They play important role in ***Osmoregulation***. A number of ***radiating canals*** open into each contractile vacuole.

The excess of water present into the cytoplasm due to continuous endosmosis, is collected by radiating canals and is poured into the contractile vacuole. Then, it increases in size and in turn contracts to discharge its contents to the exterior. Together with water, a part of CO_2 and nitrogenous products are also discharged.

Q.23 Differentiate the following:

(i) Cartilage and Bony Fishes (ii) Snake and lizard

(iii) Flightless and Flying Birds

Ans. (i) CARTILAGE AND BONY FISH

Cartilagnous Fish:

It is a ***primitive*** group of fishes. Their endoskeleton is made up of ***cartilage bone*** is absent air or ***swim bladder is absent***. They have ***spindle shaped body*** i.e. narrow towards ends.

Examples: *Ray, Skate, Sawfish.*

Bony Fishes

It is a ***modern group*** of fishes. They have skeleton composed chiefly or partly of bone. ***Swim bladder is present*** in bony fishes.

Examples: *Labeo, Cod fish, Carp.*

(ii) SNAKE AND LIZARD

Even though both are reptiles but show some differences.

Snake:

Snakes have ***long limbless body***. ***Scales are present*** on the body. ***No eyelids*** are present, eyelids are replaced by ***transparent spectacles*** which prevents the entrance of dust lizard particles while digging mud.

Lizards:

Fore limbs and ***hind limbs*** present; ***eyelids are movable***, limbs are ***pentadactyl***. Many lizards have horns or spines on to their surfaces.

(iii) FLIGHTLESS AND FLYING BIRDS

Flightless Birds:

These birds have small incompetent wings or wings are totally absent but powerful leg muscles that permit them to run rapidly. Head is small, neck is very long and flexible.

Examples: Kiwi, Eml, Ostrich, Rhea.

Flying Birds:

These birds are adapted for flying, well developed feathers are present and they help in flying, Beaks and toes show various modifications according to various habitats. They usually make nests in the holes of trees where eggs are laid

Q.24 Discuss Notochord and Nerve Cord:

Ans. (i) Notochord:

Notochord and is the ***first skeletal structure*** to appear ***in vertebrate embryos***. It is a ***stiff skeletal rod***, make up of ***living cells***, and is located immediately ***ventral to central nervous system*** and dorsal to the alimentary canal, extending from the midbrain to the tip of the tail. In adult vertebrates, its fate is variable, in fishes it persists throughout life while in tetrapods it is replaced by vertebrate column.

(ii) Nerve cord:

It is made up of nerve cells or neurons, and is a part of nervous system.

SOME IMPORTANT QUESTIONS

Q.1 Differentiate between perissodactyla and Perissodactyla and Aertiodactyla.

Ans. Perissodactyla

They are *large,* ***hoofed animals,*** *the 3rd* digit of the fore and hind limbs carry weight of the body. So they are called odd-toed mammals. Examples Horse, Zebra, Rhinoceros.

Artiodactyla

These are the terrestrial and semi-aquatic animals. Fore and hind limbs bear rarely ***four digits*** so they are called even-toed mammals.

Examples: *Camel, Cow, Buffalo, Sheep, Goat, Hippopotamus.*

Q.2 What is homeothermism?

Ans. (a) Homoiothermism

By this process, the blood of animals is kept warm, the animals are called ***warm blooded*** animals and they can maintain their body temperature constant by internal regulation of heart gain and loss.

Example: Mammals, Aves. In case of Mammals the skin is covered by hair and in Aves skin is covered by feathers which acts as instulator, it keeps the body temperature constant especially in winter.

Q.3 What is Sea Urchin?

Ans. (i) It is belonging to ***Echinodermata***.

(ii) It has ***no arms***.

(iii) ***Calcarious*** plates in body wall to form rigid structure.

(iv) It is ***triploblastic***.

Q.4 What do you know about Star Fish?

Ans. Star Fish

(i) It is star shaped ***Echinoderm***.

(ii) Body is flattened.

(iii) Few ***calcarious plates*** in body.

(iv) Moveable spines are present.

(v) It is triploblastic.

Q.5 What do you know about placoid and cycloid scales?

Ans. Placoid These are tooth like **scales** found in cartilaginous fishes (chondrichthyes).

Cycloid These are thin and round **scales** and made up of bones and found in bony fishes (osteicthyes).

Q.6 Which classes of chordata are without external ear?

Ans. Class chondricthyes, class Osteicthyes, class Amphibia, class Reptilia, class Aves are without external ears. While class Mammalia has external ears in addition to middle and inner ears.

Q.7 Differentiate among the classes of Mollusca.

Ans.

Class Gastropoda	Class Bivalvia or Pelycopoda	Class Cephaldopoda
1. **Examples**: *Land snail, Slug Limpets*	1. *Marine Mussel, Oyster*	1. *Cuttle fish, Squid Octopus.*
2. Terrestrial, Aquatic Marine fresh H_2O	2. Aquatic	2. Aquatic most complex and largest.
3. Asymmetrical	3. Bilateral Symmetrical	3. Bilateral symmetry.
4. ***One piece coiled shell***	4. Two ***halves*** shell	4. ***Shell reduced***, internal or absent.
5. ***Flat foot*** for locomotion	5. ***Reduced foot*** for burrowing in sand and mud.	5. Foot modified into head and ***tentacles***.
6. Head, eye and sensory tentacles	6. Reduced head tentacles absent.	6. Well developed head, well developed eyes, tentacles with suckers.
7. **Radula:** Rasping tongue – like structure used in feeding.	7. ***Filter feeder***	7. Radula and ***horny beak***.
8. Anus is anterior	8. Anus is posterior.	8. Anus is posterior.

Q.8 Which molluscs has well developed eyes?

Ans. Cuttle fish has well developed eyes.

Q.9 What is the role of radula?

Ans. Radula is rasping tongue like structure uses for feeding. In other words, it is "Tongue" of molluses; a horny strip, teeth are present on its surface for rasping food.

Q.10 Which two classes of subphylum a vertebrate are homeotermic?

Ans. Class Aves and class Mammalia are homeothermic i.e. Warm blooded.

Q.11 What do you know about operculum?

Ans. The gill cover is called operculum. It is found in bony fish (Ostrichtheys).

Q.12 Which fishes have internal fertilization?

Ans. Cartilaginous fishes have internal fertilization while bony fishes have external fertilization.

Q.13 Which classes of arthropoda have no larval stages?

Ans. Centipedes	(Class Chilopoda)		
Millepedes	(Class Diplopoda)		have no larval forms.
Arachnids	(Class Arachnida)		

Crustacea and Insecta class have larval forms.

Q.14 Which class of Arthropoda is without compound eyes?

Ans. The all members of class ***Arachnida have simple eyes*** and no compound eyes. While other *four* classes may have compound eyes.

Q.15 Assign the Phyla of following animals and what are the biological name of the followings (Examine yourself).

Ans.
- (i) ***Earthworm*** – *Pheritima posthuma*
- (ii) ***Leech*** – *Hirudo medicinales*
- (iii) ***Man*** *(Homo sapiens)*
- (iv) ***Housefly***
- (v) ***Octopus*** – *Octopus vulgaris*
- (vi) ***Starfish*** – *Asterias sapiens*
- (vii) ***Liver fluke*** – *Fasciola hepatica*
- (viii) ***Mosquito*** – *Anopheles sapiens*
- (ix) ***Squid*** – *Loligo sp.*
- (x) ***Fresh water mussel*** – *Anodonta sp.*
- (xi) ***Cuttle fish*** – *Sepeia officinalis*
- (xii) ***Land snail*** – *Helix ospersa*
- (xiii) ***Pigeon*** – *Columba sp.*
- (xiv) ***Frog*** – *Rana tigrina*
- (xv) ***Toad*** – *Bufo sp.*

(xvi) ***Eagle*** – *Aquila*

(xvii) ***Butterfly*** – *Prieris sp.*

(xviii) ***Scorpion*** – *Scorpio sp.*

(xix) ***Cock roach*** – *Periplaneta americana*

(xx) ***Ragworm*** – *Nereis*

(xxi) – *Ascaris lumbricoides*

(xxii) ***Planaria*** – *Dugesia*

(xxiii) ***Tapeworm*** – *Taenia lumbricoides*

(xxiv) ***Hook worm*** – *Acyclostoma duodenale*

(xxv) ***Pin worm*** – *Enterobius vermicularis*

(xxvi) ***Garden snail*** – *Helix aspersa*

(xxvii) ***Marine Mussel*** – *Mytilus sapiens*

SUMMARY

These features in particular distinguish placental mammals:

- body hair
- differentiated teeth
- constant internal temperature
- internal development
- mammary glands
- well-developed brain
- infant dependency

SUMMARY

These characteristics especially distinguish primates from other mammals:

- opposable thumb (and in some cases, big toe)
- nails (not claws)
- single birth
- expanded forebrain
- emphasis on learned behavior.
- extended period of parental care

DIFFICULT WORD MEANINGS

Words	Meanings	Words	Meanings
Communications	پیغام رسانی	Adult	بالغ / پیدائش کے قابل
Diploblastic	دو تہوں والے	Varying	مختلف
Halves	حصے / دو حصوں میں	Offence	حملہ کرنا
Blastopore	سوراخ ایمبریو کی اسٹیج پر ہو	Domestic	گھریلو
Margin	کنارا / کنارے پر	Hazard	رکاوٹ
Radial	ٹائر کی طرح گول / گول / سرکل	Glandular	رطوبتی اخراج والا
Cleavage	(ایمبریو) بناوٹ میں ہونے والی خلیائی تقسیم	Delicate	نرم ونازک
Blastomere	ایمبریو کے ابتدائی سیل	Exhibit	دکھائی دینا / ظاہر ہونا
Symmetry	جیومٹریکل شکل	Exclusively	خاص طور پر
Sac type	تھیلی نما / پاکٹ کی طرح	Radiate	جس سے rays نکلیں
Flagellated	جن پر فلیجیلا ہوں	Peculiarties	مخصوص / خاص
Osculum	Sponge کی بالائی سطح پر بڑا سوراخ	Exception	کے سوا
Correspodence	Communication	Mantle	بیرونی خول / تہہ
Medusae	سیلنٹریٹ کے لائف سائیکل کی ایک طرز	Inflect	(To bend) جوڑ سکے / جھکنے والا
Calcareous	جن کے باہر کیلشیم کا خول ہو	Bladder	مثانہ
Ciliated	ایسے جاندار جن پر سیلیا ہوں	Modification	تبدیلیاں / تغیر
Segments	حصے / خانے / دھارے	Terrestrial	زمینی / زمین پر رہنے والے
Adaptation	اپنے آپکو ڈھالنا (Adjustments)	Undergo	عمل میں / چلتا ہوا
Cosmopoliton	ہر جگہ پر پائے جانے والے	Socket	جکڑنے والا

Penetration	اندر داخل ہونا	Resemblance	مشابہت
Appendages	جوڑ/ حصے	Perching	کانٹے دار مچھلی
Cuticle	بیرونی سخت تہہ	Adapted	اختیار کیا
Extensive	پھیلا ہوا/ بڑھے ہوئے	Evolved	سے نکلنا
Distinct	نمایاں/ واضح	Thoracic	چھاتی کے متعلق
Metamorphosis	ڈویلپمنٹ/ استحالہ	Mandible	نچلا جبڑا
Homeothermic	وہ جانور جن کے خون کا درجہ حرارت یکساں رہے/ قائم تپیشے	Irratibility	قوتِ حس
Placenta	ماں اور (پیٹ کے اندر) بچے کے درمیان کنکشن	Poikilothermic	جن کے جسم کا درجہ حرارت ماحول کے درجہ حرارت کے ساتھ بدلے/ تغیر تپیشے
Coelom	باڈی کیویٹی	Pseudo-	غلط/ خراب/ نما
Ganglion	نیوران کا گچھا/ نیوران کا رنگ/ نچلے لیول کا دماغ	Nervous system	عصبی نظام
Nephridium	نچلے لیول کے جانداروں کا گردہ نما سٹرکچر	Hermaphrodite	ایسا جاندار/ جسم جس میں نر اور مادہ دونوں عضو ہوں
Malpighian tubules	کیڑوں کے گردہ نما سٹرکچر	Amphibia	دو گلے/ خشکی اور پانی کے جانور
Maxilla	اوپر والے جبڑے کی بڑی ہڈی	Mammo	چھاتی سے متعلقہ
Polyp	غیر جنسی سیلنڈر یٹا	Medusae	تیرنے والے/ جنسی سیلنڈر یٹا
Radula	سکریپ کرنے والا	Occipital condyl	آکسی پیٹل کونڈائل/ کھوپڑی کے پیچھے وہ جوڑ جہاں سے پہلی ورٹی برا کو حرکت ملتی ہے
Ornithoid	پرندوں کی طرح	Placoid	مچھلی پر کانٹے دار نوکیلے سکیل
Platy/flat	پلیٹ کی طرح	Proto-	پہلا/ ابتدائی/ آبائی/ قدیم
Rasping	جبڑوں کے بغیر منہ مگر زبان پر دانت	Zoid	جانور نما

Q.1 Fill in the blanks:

(i) Protozoa have been placed in a separate kingdom known as __________.

(ii) The sponges do not have any symmetry and are therefore called __________.

(iii) Between ectoderm and endoderm the coelenterate have a non-cellular __________.

(iv) Taenia solium has __________ and __________ for attachment to the intestine of host.

(v) In annelids the body segmentation of the type known as __________.

(vi) In insects there are __________ pairs of legs present in the __________ region of the body.

(vii) The organ of locomotion in molluscs is the __________.

(viii) In animals where there are definite left and right sides the symmetry is __________.

(ix) The system in which water move inside the body of an echinoderm is called __________.

(x) Coelom is the body cavity formed from the __________ layer.

ANSWERS:

(i)	Protoctista	(ii)	Asymmetrical	(iii)	Mesoglea
(iv)	Sucker, hooks	(v)	Metameric	(vi)	Three. thorax
(vii)	Muscular foot	(viii)	Bilateral	(ix)	Water vascular system
(x)	Mesoderm				

Q.2 Each question had three options. Encircle the correct answer:

(i) Vertebrates that develop embryonic membrane around their embryo are called (Amniotes, Anamniotes)

(ii) In animals the bodies of which can be divided in two equal halves only in one plane are (asymmetrical, bilaterally symmetrical, radially symmetrical).

(iii) Animals that have their body cavity filled with parenchyma are (A coelomates, Coelomate, Pseudocoelomates).

(iv) The vertebrates in which placenta is formed during the development of faetus are (Pisces. Aves. Mammals).

(v) In amphibians the necessary requirements to spend their life history are (land. Water, or both).

(vi) Trypanosoma causes the disease (Malaria, Sleeping sickness).

(vii) In annelids the organs for excretion are (Flame-cells, nephridia, kidneys).

(viii) In mollusca the foot is used for (capturing prey, locomotion, or both).

(ix) In arthropods the body cavity is (Haemocoele, pseudocoeloms, enterocoel)

ANSWERS:

(i)	Amniotes	(ii)	Bilaterally symmetrical	(iii)	Acoelomate
(iv)	Mammals	(v)	Both	(vi)	Sleeping sickness
(vii)	Nephridia	(viii)	Locomotion	(ix)	Haemocoel

CHAPTER 11

MODEL SUBJECTIVE QUESTIONS

Prepared for new pattern of examination subjective part:

- What is bioenergetics? Give role of photosynthesis and evolution of respiration. (3)
- Write a note on photosynthetic reactants and products. (3)
- What is relationship between photosynthesis and respiration. (3)
- When does there is no absorption of carbon dioxide and oxygen? (3)
- What is compensation point? (2)
- What is role of water in photosynthesis? How was proved that oxygen was released from water not from carbon dioxide? (4)
- Write a note on chloroplast. (4)
- Write a note on photosynthetic pigments. (6)
- Write a note on chlorophylls. Differentiate between chlorophylla and chlorophyll b. (6)
- Draw structural formula of chlorophyll. (3)
- Differentiate between chlorophyll a and chlorophyll b. (3)
- Write a note on accessory pigment. What is their role in photosynthesis? (2)
- Discuss the role of light in photosynthesis. (6)
- What are absorption spectrum and action spectrum? Give their comparison. (4)
- Write a note on light dependent reaction. (6)
- What are absorption spectrum and action spectrum? Give their comparison. (4)
- Write a note on light dependent reaction. (6)
- What are photo-system? Give their types and components. (3)
- Write a note on non-cyclic phosphorylation. (4)
- Write note on cyclic phosphorylation. (4)
- What is chemiosmosis? Give its mechanism. (4)
- Describe Calvin cycle or dark reaction. (4)
- Draw labeled diagram of Calvin cycle.
- Write a note on aerobic and anaerobic respirations. (4)
- Differentiate between aerobic and anaerobic respirations. (4)
- What is ATP? Give its importance or uses. (3)

- What is biological oxidation? (2)
- Describe different reaction of glycolysis. (6)
- Draw diagram of cycle of glycolysis. (6)
- Give pyruvic acid oxidation. (4)
- Discuss krebs cycle with labeled diagram. (6)
- Draw labeled diagram of process of glycolsis. (3)
- Describe respiratory chain or electron transport chain of respiration. (4)
- Write a note on oxidative phosphorylation. (3)
- Differentiate between photosynthesis and respiration. (4)

DEFINITIONS

Terms	Definitions
Absorption spectrum	The plot showing absorption of light of different wave lengths by a compound is called absorption spectrum.
Accessory pigments	The pigments absorb light of different wavelength and broadens the absorption spectrum are called accessory pigments.
Action spectrum	The plot showing relative effectiveness of different wavelengths (colour) of light for photosynthesis is called action spectrum.
Aerobic respiration	The respiration which occurs in the presence of oxygen is called aerobic respiration.
Anaerobic respiration	The respiration occurs in absence of oxygen is called anaerobic respiration.
Cellular respiration	The step by step breakdown of the C-chain molecules and the release of energy within the cell are called cellular respiration.
Chlorophyll	Green pigment is called chlorophyll.
Chlorophyll a	$C_{55}H_{72}O_5N_4Mg$
Chlorophyll b	$C_{55}H_{70}O_6N_4Mg$
Compensation point	The point when there is no net gas exchange between leaves and atmosphere at dawn and dusk is called compoensation point. At this point rate of respiration becomes equal to rate of photosynthesis in plants.
Cyclic phosphorylation	The returing back of the same excited electrons to the excited

	chlorophyll by producing a molecule of ATP it is called Calvin cycle. Or back and forth movement of electron generate ATP this is known as cyclic phosphorylation
Cytochromes	Cytochromes act as intermediates during the transport of electrons. These are the iron containing proteins.
Bioenergetics	The quantitative study of energy relationship in the biological systems is called bioenergetics.
External respiration	The exchange of respiratory gases (CO_2 and O_2) between the organism and its environment is called external respiration.
Glycolysis	The breakdown of glucose up to formation of two molecules of Pyruvic acid is called glycolysis.
Grana (Granum)	The stacked columns of thylakoids are called grana.
Krebs cycle	The series of chemical reactions which completed the oxidation of glucose is called Krebs cycle. It occurs in mitochondria.
Light	Light is electromagnetic energy or radiations.
Non-cyclic phosphorylation	The formation of ATP during non-cyclic flow of electrons is called non-cyclic phosphorylation.
Oxidation	The addition of oxygen or removal of electron from compound is called oxidation.
Oxidative phosphorylation	The process by which energy released during oxidation reactions is stored in high energy phosphate bonds.
Oxidizing agent	The compound, which has capability to remove electron from a compound is called oxidizing agent.
Phosphorylation	The addition of phosphate groups to molecules. By this process ATP is formed.
Photo phosphorylation	The synthesis of ATP due to light energy is called photophosphorylation.
Photolysis	The splitting of water and release of oxygen during photosynthesis is called photolysis.
Photosynthesis	Photosynthesis is a process in which energy-poor inorganic oxidized compounds of carbon (CO_2) and hydrogen water (H_2O) are reduced to energy rich carbohydrates (sugar-glucose) by using light energy.
Photosystem	Photosynthetic pigments are organized into clusters called photosystems.
Pigment	The substances which absorb visible light (380 – 750 nm

	wave length) are called pigments.
Reducing agent	The compound, which has capability to add electron in a compound is called reducing agent.
Reduction	The addition of electron or hydrogen into compound is called reduction.
Respiration	The breakdown of complex carbon compounds and the release of maximum usable energy with in the cell are called respiration.
Thylakoids	The thylakoids are set of interconnected flat disc like sacs.
Transport chain	The transfer of electron through a series of respiratory chain from NADH to oxygen is called electron transport chain.

Chapter 12

NUTRITION

Q.1 What is Nutrition?

Ans. **Definition:** *"The process of acquiring energy and materials for cell metabolism is known as nutrition".* (OR) "The process of taking of nutrients and assimilating and utilizing them for maintenance of life, growth and repair of cells is called nutrition."

All living organisms work like machine, so continuous supply of energy is essential for working.

This energy is obtained from nutrients of food etc.

Q.2 What are nutrients?

Ans. Nutrients are components of food. These components are carbohydrates, proteins and fats etc. These provide energy. They are used as raw material for the synthesis of protoplasm (cytoplasm + nucleoplasm).

The other nutrients such as water, electrolytes, minerals and vitamins are also essential to metabolic process or metabolism. (making + breaking of molecules).

Q.3 Describe autotrophic and heterotrophic methods of nutrition.

Ans. On the basis of nutrition, animals are divided into two catagories (classes):

(i) Autotroph (or) Autotrophic organism

(ii) Heterotroph (or) Heterotrophic organism

(i) Autotrophic

(Auto=self, troph=nourishing)

Autotrophs (or) Autotrophic organisms have ability to produce their organic food (carbohydrates, lipids and proteins) from inorganic molecules (CO_2 and H_2O) Plants are an example of autotrophic organisms. They use CO_2 and H_2O as raw materials. They take their raw material from surroundings or environment.

Definition: *"An organism able to build organic compounds from CO_2, H_2O and inorganic salts is called autotrophic organism.*

(ii) Heterotrophic

Definition: "The organism incapable to build organic compounds from inorganic compounds which obtains organic molecules from other organisms is called heterotrophic organism".

Man and other animals, majority of bacteria and fungi are hetertrophic organisms. They depend on plants and other organisms for organic compounds or molecules.

Q.4 (a) Which elements are needed for plants for synthesis of organic molecules?

(b) Which are the main sources of elements for plant nutrition?

Ans. (a) ELEMENTS NEEDED BY PLANTS

Elements means primary part of a substance (or) thing. In other words, element is made up of similar atoms which cannot be decomposed.

Plants are autortophs Generally autotrophs are photosynthetic organisms. All plants need C, O_2 and H_2 for the synthesis of organic compounds. In this case, these predominant elements (CO_2 and H_2) are taken from inorganic source i.e. CO_2 and H_2O.

There are many other elements which enter in the composition of plants:

(i) ***Nitrogen:*** It is an important part of protein.

(ii) ***Phosphorus:*** It is present in ATP, Nucleic acids i.e. DNA and RNA and other compounds.

(iii) ***Magnesium:*** It is a very important component of chlorophyll.

(iv) ***Iron:***

Cytochromes have iron.

(b) Source of Nutrients: (SOIL)

The major source of nutrients is soil. These nutrients are essential for growth and life of plants.

(i) Crops fail to grow if we grow again and again in the same field without adding the nutrients i.e. fertilizers etc.

(ii) Farmers use animal manure, sewage sludge or artificial fertilizers for nutrition of plants.

(iii) Urea, super phosphate and ammonium nitrates like chemical fertilizers are commonly used in Pakistan.

Common deficiency diseases/symptoms:

Deficient Elements	Symptoms
Nitrogen (N)	(i) Stunted growth (ii) Chlorosis in old leaves.
Phosphorus (P)	(i) Stunted growth in roots
Potassium (K)	(i) Margins of premature leaves become Yellow and Brown. (ii) Ultimately death of plant.
Magnesium (Mg)	(i) Chlorosis
Chlorosis*: A disease by which plant becomes unhealthy and yellow or of pale colour is appeared by fall of chlorophyll.*	

Q.5 Describe different methods of feeding in plants.

Ans. **METHODS OF FEEDING IN PLANTS**

The plants generally make their own food material, however some special methods of nutrition are also present which are given below:

(1) Saprophytic Nutrition

A kind of nutrition in which food is obtained form non-living matter is called saprophytic nutrition.

(i) Feed on Dead Organic Matter:

The saprophyte feed on dead matter like dead leaves in the soil or rotting tree trunks.

(ii) Production of Extracellular Enzymes:

These plants produce extracellular enzymes, which digest the decaying matter and absorb the soluble product back into their cells.

(iii) Bacterial Breakdown:

Some bacteria break down the protein of dead plants and animals and release nutrients which are taken up by the plant roots and thus help in nitrogen cycle e.g. *Mushrooms* and *Rhizopus*, etc.

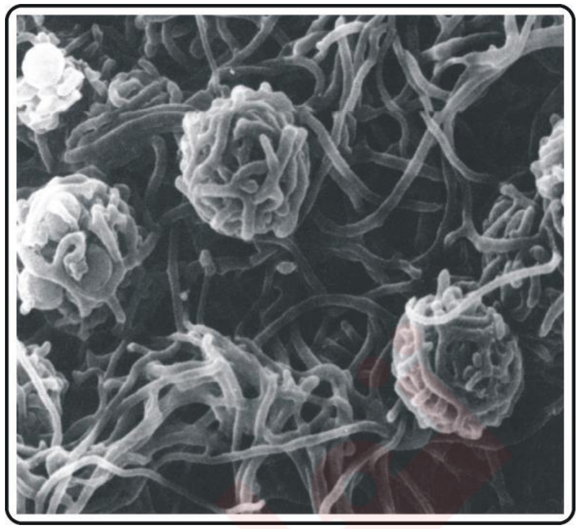


Fig. Lichens

(2) Parasitic Nutrition

A kind of nutrition in which food is obtained from living organisms is called parasitic nutrition. The organisms that feed on living organisms and also cause diseases in them are called parasite.

The parasites attach themselves with the host for their nourishment e.g. *Puccinia* is a parasitic fungus that destroys the wheat plants.

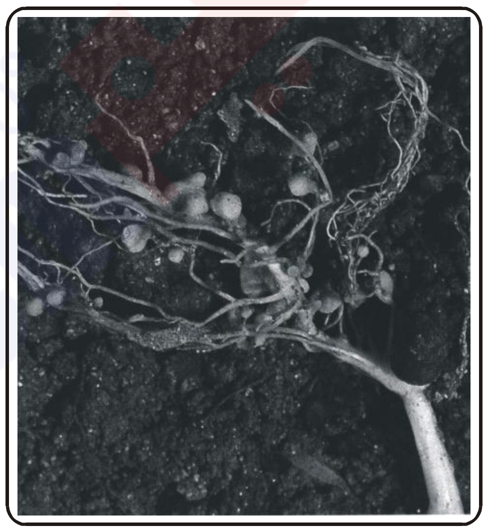


Fig. Nodules of Leguminous Plant Roots

(3) Symbiotic Nutrition

A kind of nutrition in which mutual beneficial relationship occur between two different species for achievement of food is called symbiotic nutrition. Each partner of mutual beneficial association is called symbiont. Lichens and Mycorrhizae are famous example of symbiosis.

Lichens:

The lichens are compound organisms which are made up of a fungus and algal cells. ***The alga make food and the fungus supply water and minerals***, and also protection ***against desiccation***.

Mycorrhiza:

Mycorrhiza is a mutual relationship between a fungus and roots of higher plants. ***The plant provides food to fungus*** because plant is photosynthetic partner. On the other hand, the long ***hyphae of fungus collect minerals*** and chemicals like P from soil and then supply to root of plants. Thus both exchange benefits in case of mycorrhizae.

(4) Insectivorous: Nutrition in Autotrophs

Such type of nutrition in which an autotroph fulfills its organic need by trapping and digesting insects is called insectivorous nutrition, in autotroph.

Actually, all of the insectivorous plants are true autotrophs, but when they capture prey, their growth becomes rapid. Usually these plants grow in such soil, where the amount of nitrogen is less. So by digesting these animals, they especially obtain nitrogen from them. *In some plants insects are decomposed by bacteria, but many of them are decomposed by enzymes which are secreted by the leaves* e.g. pitcher plant, venus fly trap etc.

(a) Pitcher Plant (Sarcaenia pupurea):

Pitcher plant in which *leaves are modified into a sac or pitcher* like structure which are partly filled with water. The end of the leaf is modified to form a *hood* which partly covers the open mouth. Small insects that fall into the pitcher are prevented from climbing out of means of numerous *stiff hairs*. The insects are decomposed by the inner surface of the pitcher.

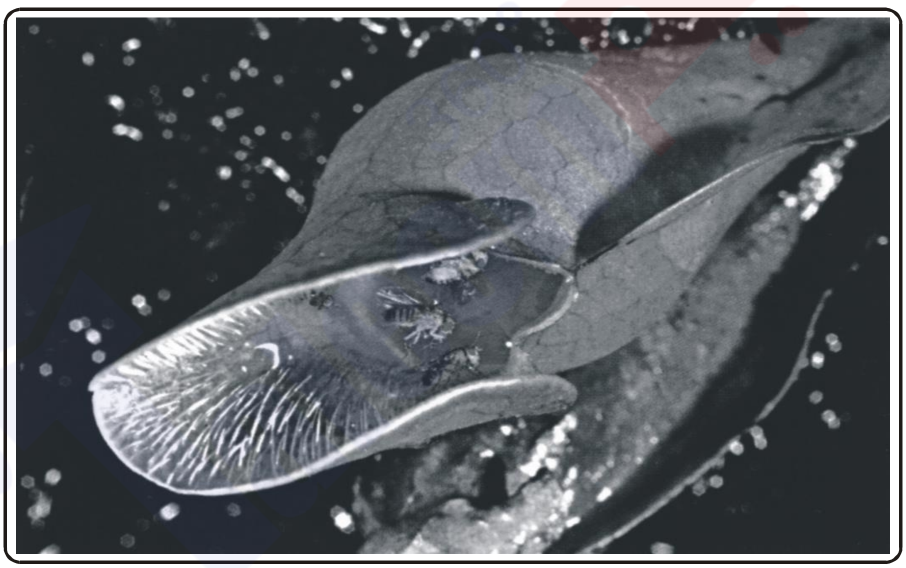
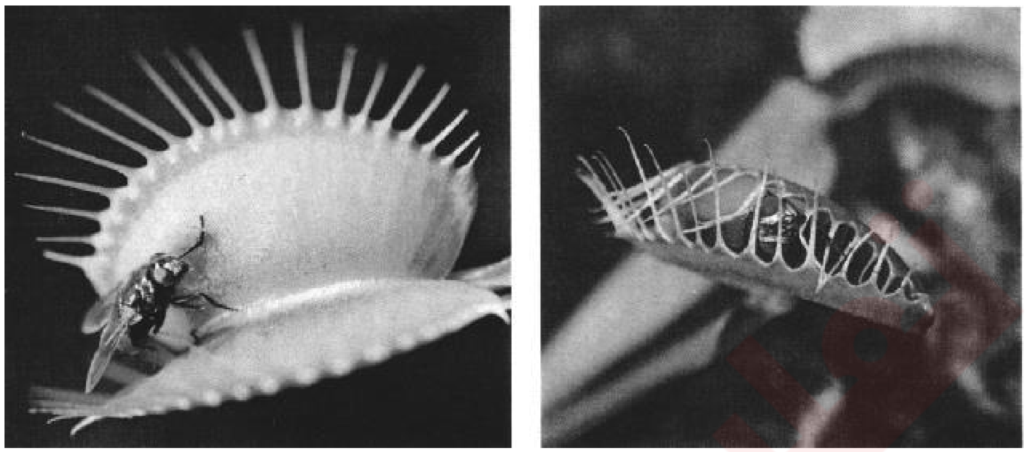


Fig. Pitcher plant (Sarcenia pupurea). Several fruit flies are entrapped within the leaf.

(b) Venus Fly Trap (Dionaea muscipula):

The leaf is *bilobed* and midrib is present between two lobes. There is a row of long stiff bristles along the margin of each lob.

When an insect touches small *sensitive hairs* on the surface of the leaf, the lobes quickly come together with their bristles interlocked. The trapped insect is then digested and absorbed by the surface of leaves.



(a) (b)

Fig. Leaf of Venus fly trap (Dionaea muscipula) (a) Fly is about to trigger the hair. (b) The two halves of the leaf trapping the fly.

Sundew (Drosera intermedia):

The leaves of sundew posses hair like structures i.e. *Tentacles*.

There are glands at the tip of its Tentacles.

The insects are attracted by the plant odour and then entrapped ultimately. The insects are digested and the products are absorbed.

Fig. Leaf of Sundew (Drosera intermedia) a dragonfly is caught in the sticky fluid on the ends on the leaf of the glandular hair.

Q.6 Describe different method of animal nutrition.

Ans. **NUTRITION OF ANIMALS**

In large animals every cell need nourishment for living, yet most of the cells cannot leave their position. So the food must be delivered to them. To do this the digestive system is specialized to ingest the food, propel it throughout the digestive tract and digest it. The digested food is then absorbed in the lumen of the digestive tract, and undigested matter is removed from the digestive tract.

On the basis of method of nutrition, the animals are classified into the following:

(1) Detritivores:

"The animals which ***feed on*** detritus or ***organic debris*** are called detritivores".

The detritus is organic debris obtained from decomposing plants and animals e.g. ***Earthworm*** is a common example of ***detritus feeder***.

(2) Herbivores:

"The ***plant eater animal*** are called herbivores" i.e. reptiles, birds and mammals.

The latter are hoffed grazing animals. The herbivores contain premolars and molars with large surface e.g. ***horse, deer, sheep*** etc.

(3) Carnivores:

"The meat eater or animals eater are called carnivores".

They have large canine teeth for catching and tearing the prey. Incisors, premolars and molars are also present e.g. *lion, dog, cat* etc.

(4) Omnivores:

"***Plant eater plus meat eater*** animals are called omnivores".

(OR)

"The animal which eat both plant and animal food are called omnivores" e.g. ***crows, red fox* and *rats*** etc.

They have the teeth structurally and functionally intermediate between the extreme of specialization attained by the teeth of herbivores and carnivores.

In aquatic animals following methods of nutrition are present.

(5) Filter Feeders

"The aquatic animals that obtain their food by filtering the water are called filter feeders".

A common *mussel* possesses ***two large gills covered with cilia***. The movement of cilia cause a current of water to enter animal via an inhalent *siphon*. The water which enters contain the food such as microscopic alga etc. The trapped food particles are then swept towards the mouth. Certain types of *whales* are also filter feeders.

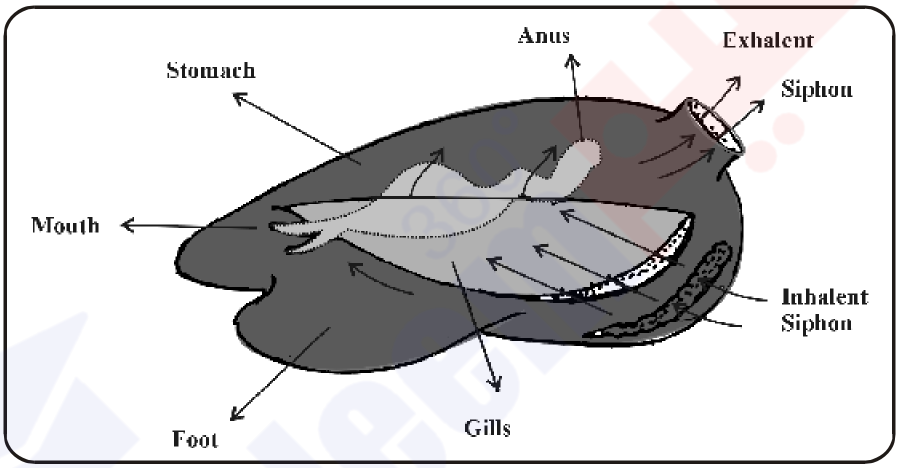


Fig. Filter feeding in mussel

(6) Fluid Feeders:

"Those animals which ingest the food in liquid form are called fluid feeders".

Examples:

Aphids and mosquitoes are such type of organisms that get their food in liquid form. Aphid suck the phloem juices out of the green stem by inserting their delicate stylets. Mosquitoes are also fluid feeder because they suck the blood from the skin capillaries by piercing the skin.

(7) Macrophagous Feeders:

"The animals which take food in the form of large pieces are called macrophagous feeders".

The animals which take in food in the form of large pieces like the *Hydra*, *Snail* etc. Snail feed by using rasping organ, the radula, leaves are held by the lips of snail. The radula moves back and forth over the leaves with its teeth scraping the food. In this way tiny fragments of leaves are pushed toward the mouth. *Spotted dogfish feed* macrophagous particles of food by swallowing.

Q.7 Write a short note on different types of parasitic nutrition.

Ans. **PARASITIC NUTRITION**

Following types of parasitic nutrition are present in different parasites:

(1) **Ectoparasite:** "A parasite that lives upon the host is called ectoparasite".

Flea and Lice: Flea and lice live in the fur or feathers of mammals and birds and suck blood from their skin. ***Aphids*** in plants are the ectoparasites. ***Leech*** is also an example of ectoparasite.

(2) **Endoparasite:** 'A parasite that lives inside the body of host is called endoparasite".

Examples: Entamoeba *histolytica,* ***tapeworm*** and ***round worms*** are the endoparasites. In many cases the host may be weakened by the presence of parasite or its metabolism may be upset by the excretory product of the parasite.

(3) **Obligate Parasite:** The parasite that ***cannot live without their host*** is called obligate parasite e.g. ***viruses***.

(4) **Facultative Parasite:** "The parasite which may ***live independently*** is called facultative parasite". e.g. ***leech*** etc.

Q.8 Describe the general method of digestion and absorption in the animals.

Ans. **DIGESTION AND ABSORPTION**

All animals have similar requirements, although these requirements differ in detail. The characteristics processes involved in the nutrition are given below:

(i) **Ingestion:** Taking in food is called ingestion.

(ii) **Digestion:** The break down of large complex and indiffusible molecules into small, simple and diffusible molecules with the help of enzymes is called digestion.

There are two types of digestion.

(a) ***Intracellular Digestion:*** The digestion which takes place inside the cell is called intracellular digestion.

(b) ***Extracellular Digestion:*** The digestion which takes place outside the cell of body is called extracellular digestion.

(iii) **Absorption:** The uptake or intake of the diffusible food molecules from the digestive tract into the blood stream is called absorption.

(iv) **Assimilation:** When digested food becomes part of protoplasm.

Egestion: The elimination of undigested matter from the body is called egestion.

Q.9 Write a short note on digestion in Amoeba.

Ans. **DIGESTION IN AMOEBA**

Ingestion of Tiny Organisms:

Amoeba feeds on tiny organisms which live with it in fresh water. Food may be ingested at any point by pseudopodia which fuse together, forming the food vacuole.

Digestion: Amoeba has intracellular digestion. Food vacuole play important role in digestion.

(i) **Vacuole:** The food vacuole undergoes many changes as the digestion proceeds.

(ii) **Lysosomes:** Lysosomes which ***contain hydrolytic enzymes fuse*** with the food vacuole and enzymes are secreted into it.

(iii) **Killing and Softening Food:** The first phase is killing and softening the food in the acidic medium and later it becomes alkaline.

Absorption: The product of ***digestion are passed into the canals*** and finally into the ***surrounding cytoplasm*** and subsequently utilized in various metabolic reactions.

Egestion: The undigested matter is removed from the organisms in the surrounding water by egestion.

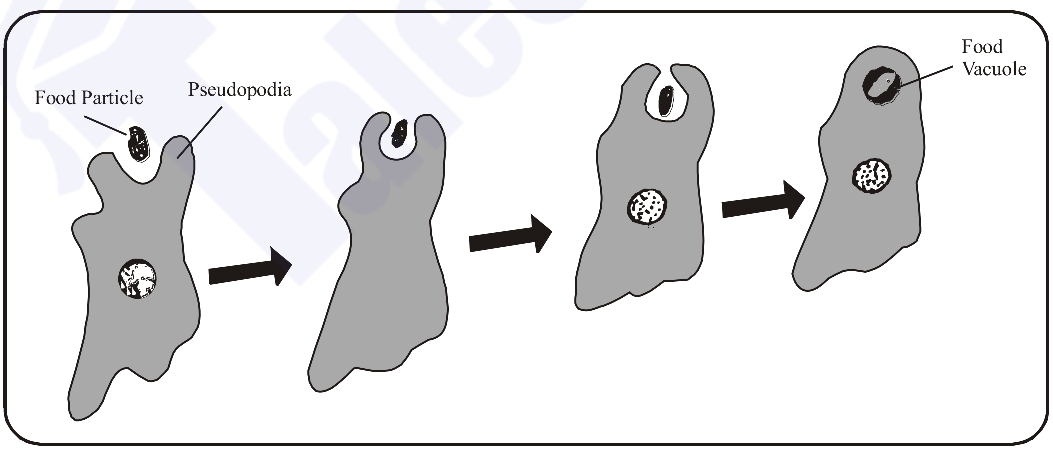


Fig. Amoeba ingesting food by pseudopodia

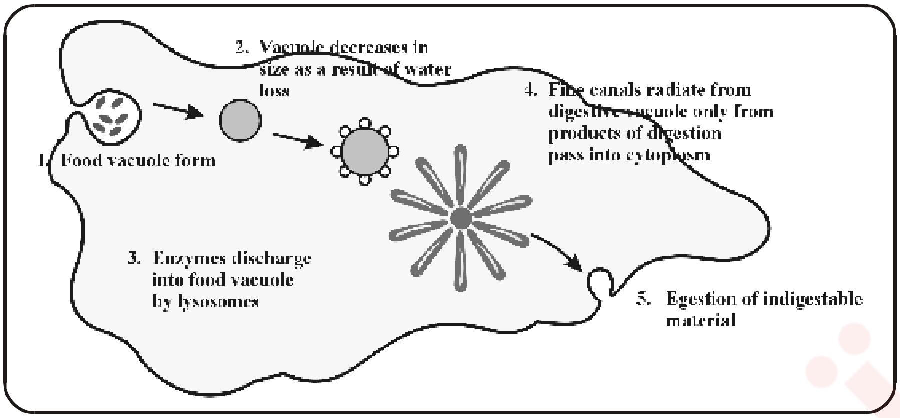


Fig. Ingestion, digestion and absorption in Amoeba

Q.10 Describe the digestion in Hydra.

Ans. **DIGESTION IN HYDRA**

Hydra is an aquatic animal. It belongs to phylum coelenterata. It has only one opening which is called mouth. This single opening also acts as anus. The digestive system of Hydra is called *gastro vascular* digestive system. The digestive cavity of Hydra is called *coelenteron*.

Nematocysts: Tentacles have numerous *stinging cells* called nematocysts. Each nematocyst consists ***of a hallow thread coiled*** within a capsule and ***a tiny hair like trigger projecting*** outside.

Process of Digestion: When a prey (such as Daphnia or Cyclops) comes in contact with the trigger, the hollow thread of the nematocyst turns inside out, ejects its poison and the prey is paralysed. With the tentacles the prey is pushed into the digestive cavity

Digestion: The endodermis has glandular cells and digestive cell. In glandular cells of gastroderm extracellular digestion occur. Digestive cells of gastoderm ingest food and becomes the reason of intracellular digestion.

Flagellate cells and contraction of the body cavity help in breaking food into particles.

Absorption: The small particles of food are then engulfed by phagocytic action of gastrodermal cells.

Indigestible food is expelled out from the gastrovascular cavity via mouth. Such a type of digestive system is called *sac like digestive system*, in which only one opening is present.

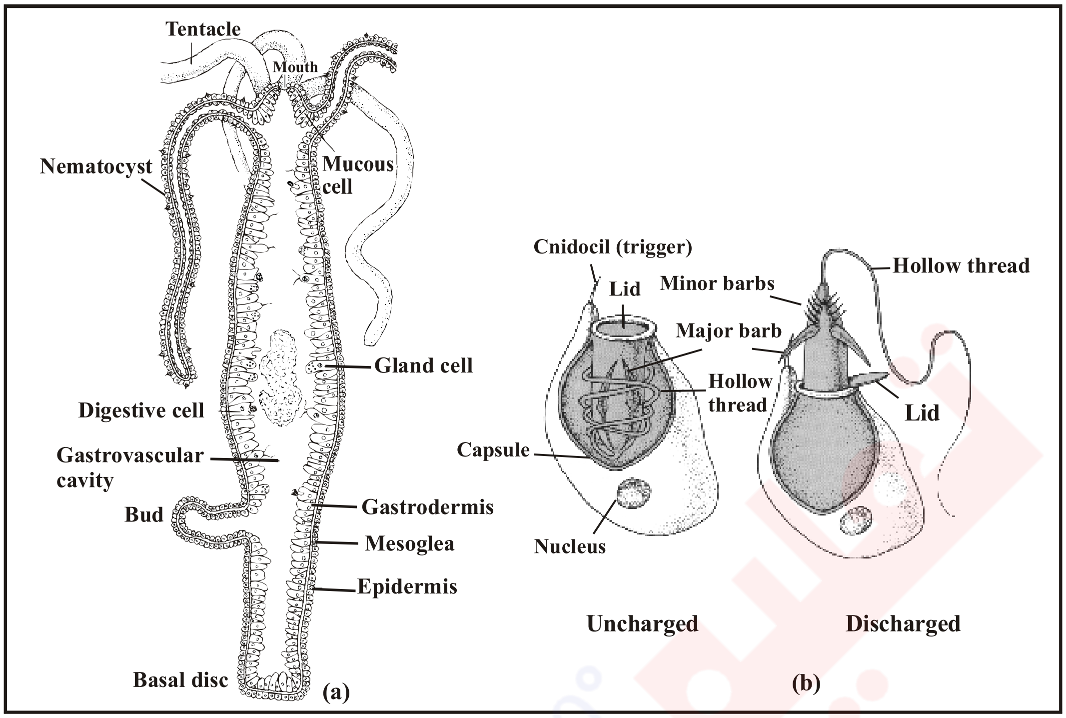


Fig. Hydra: (a) Longitudinal section showing the detail of wall and the gastrovascular cavity (b) nematocysts (discharged and un-discharged)

Q.11 Describe digestion in planaria.

Ans. **DIGESTION IN PLANARIA**

Planaria is a flatworm. It belongs to phylum *platyhelminthes*. There is only *one opening* for ingestion and egestion in planaria.

Mouth: It is present on the ventral surface near the middle of the body.

Pharynx: The mouth leads into a *tubular* and *muscular* structure which is pharynx.

Intestine: The pharynx leads to intestine. The intestine is then divided into three branches. A branch extending forward. Two lateral branches are extending backward. There are caecal on intestine. Caecal increases the absorbing surface.

PROCESS OF DIGESTION:

Ingestion: Planaria engulfs the prey by protruding pharynx through the mouth and pushes it into the Gastrovascular Cavity.

Digestion: Food is digested in the intestine by extracellular digestion. The food is broken down by enzymes. The small particles of food are then engulfed by the *phagocytic cells*.

Absorption: So both *extracellular* and *intracellular* digestion is found in planaria. Absorption takes place by diffusion. Branched intestine also facilitate diffusion.

Egestion: Undigested food is egested through the mouth.

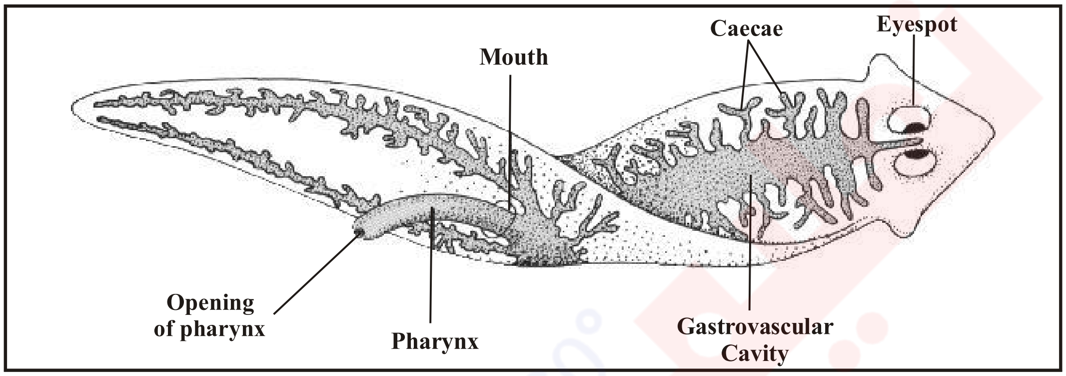


Fig. Planaria showing much branched gastrovascular cavity and extruded pharynx

Q.12 Describe digestion in cockroach.

Ans. **DIGESTION IN COCKROACH**

Cockroach has **tubular** type of digestive system. It is divided into three parts.

(i) **Foregut:** The foregut has mouth cavity, ***pharynx, crop*** and ***gizzard***. A pair of salivary glands is present in the thorax region. ***Salvia*** is secreted by salivary glands which is poured into the mouth cavity.

(ii) **Midgut:** The midgut is short and narrow tube. It is called stomach. ***The hepatic caecae open into the anterior end of the midgut***.

(iii) **Hindgut:** The hindgut is a long coiled tube, the terminal part of which is a thick walled chamber, ***the rectum which open to the exterior through anus***.

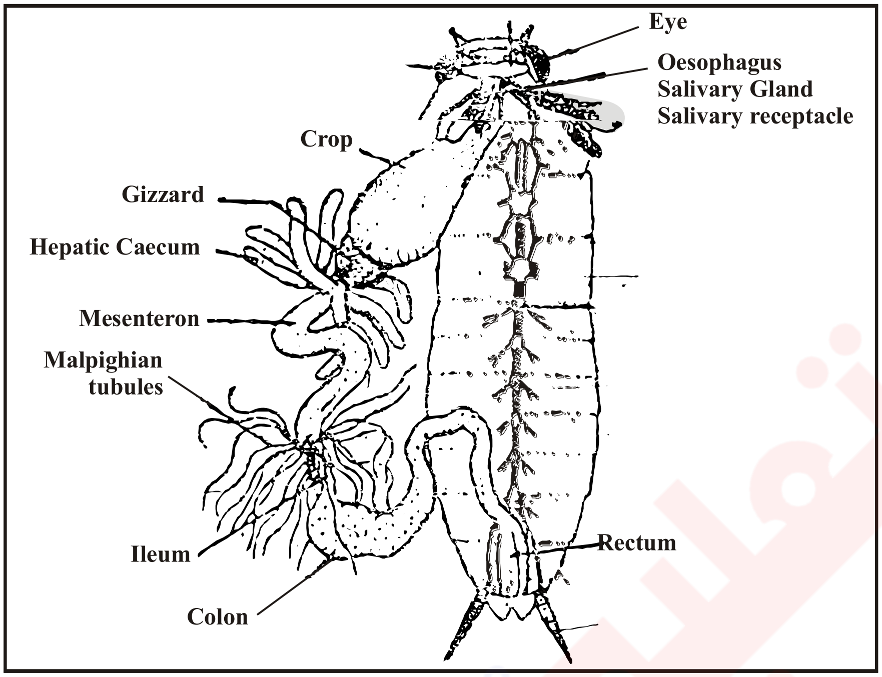


Fig. Cockroach digestive system

PROCESSES OF DIGESTION

Ingestion: Cockroach ingests all types of food.

Digestion: The mandibles help in cutting and mixing the food with saliva and then partially digested food is stored in the crop. The enzymatic secretions of hepatic caecae and midgut digest the food completely.

Crop: The partly digested food is stared in crop.

Gizzard: Food leaves the crop chunk by chunk and after being ground in the gizzard it moves into the midgut.

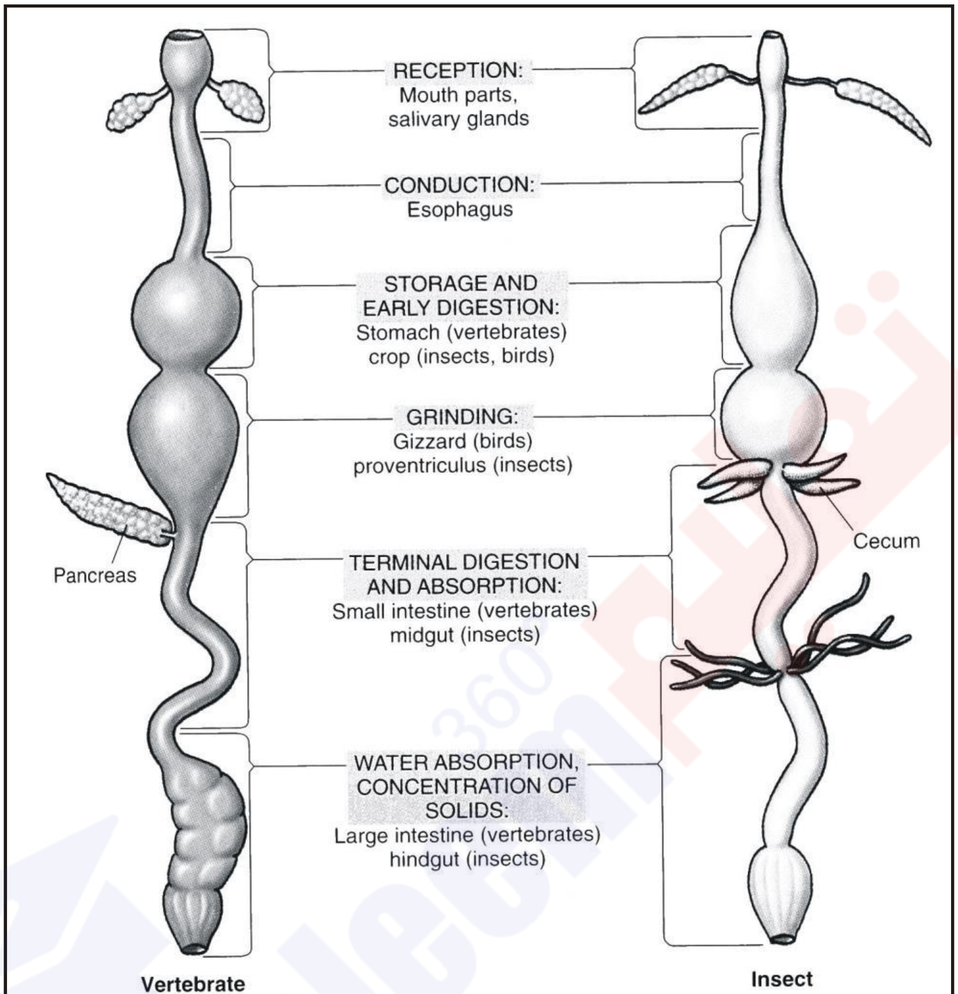
Hepatic Caecae: The enzymatic secretion of hepatic caecae and midgut digest the food completely.

Rectum: The indigested food after temporary starage in the rectum, as fecal matter is then egested out through anus.

Tubular Digestive System: Cockroach has a tubular digestive system having mouth for ingestion and anus or **Cloacal Aperture** for egestion.

More Efficient than Sac Digestive System: It is more efficient system than sac like digestive system having specialized organs or partitions for efficient digestion and absorption of food.

THINK ABOUT IT



Generalized digestive tracts of a vertebrate and an insect, showing the major functional regions of the metazoan digestive system.

CONCEPTUAL

Table Path of Food

Organ	**Function**
Mouth	Reception and chewing of food; digestion of starch
Esophagus	Passageway
Stomach	Storage and mechanical breakdown of food; acidity kills bacteria; digestion of protein
Small intestine	Digestion of all foods; absorption of nutrients
Large intestine	Absorption of water (and some vitamins); storage of nondigestible remains
Anus	Defecation

Q.12.1 How is digestion occur in oral cavity of man?

(i) Selection of food **(ii) Grinding or mastication.**

(iii) Lubrication **(iv) Digestion.**

Ans. (i) SELECTION OF FOOD

When food enters the oral cavity, it is tasted, smelled and felt. If the taste or smell is unpleasant or if hard objects like bone are present in the food, it is rejected. Tongue being sensory and muscular organ plays the most important role through its taste buds.

(ii) GRINDING OR MASTICATION

After selection the food is ground by molar teeth. This is useful for:

(a) The esophagus allows relatively small pieces to pass through it.

(b) Small pieces have much more surface for enzymes to attack.

(iii) LUBRICATION

Secretion of Saliva: Saliva is secreted by three pairs of glands.

(a) ***Sublingual Glands:*** These are situated below the tongue.

(b) ***Sub maxillary Glands:*** These are situated behind the jaw.

(c) ***Parotid Glands:*** These are situated in front of internal ear.

(iv) **PRODUCTION OF SALIVA**

Saliva produced by these glands contains three important ingredients:

(i) Water and mucus.

(ii) Sodium bicarbonate and some other salts.

(iii) Carbohydrate digesting enzyme amylase (or) ptyalin.

(v) **DIGESTION** **(Role of Amylase):**

Digestion of glucose and starch take place in mouth or oral cavity with the help of amylase.

Q.13 Draw the digestive system of man.

Ans. The digestive system of man is of tubular type which extends from the mouth to the anus. The digestive system of man has the following parts:

(i)	Oral cavity	(ii)	Oesophagus
(iii)	Stomach	(iv)	Small intestine
(v)	Large intestine	(vi)	Rectum

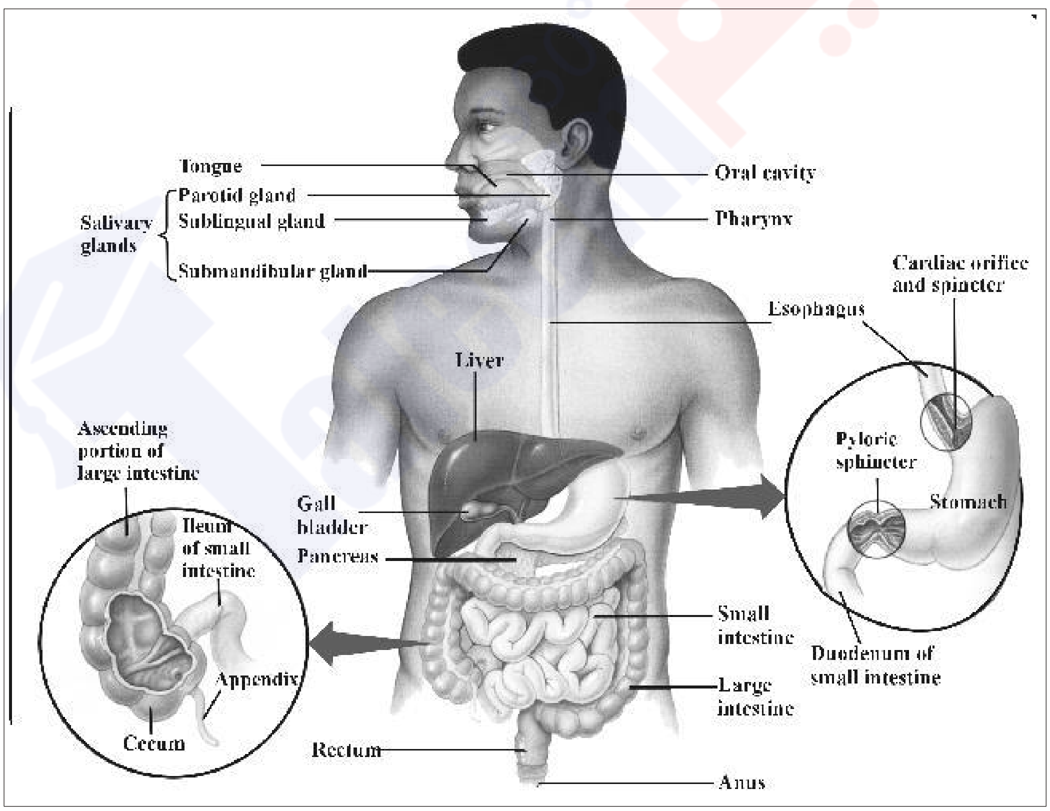


Fig. The digestive system of man

EASY TO DRAW

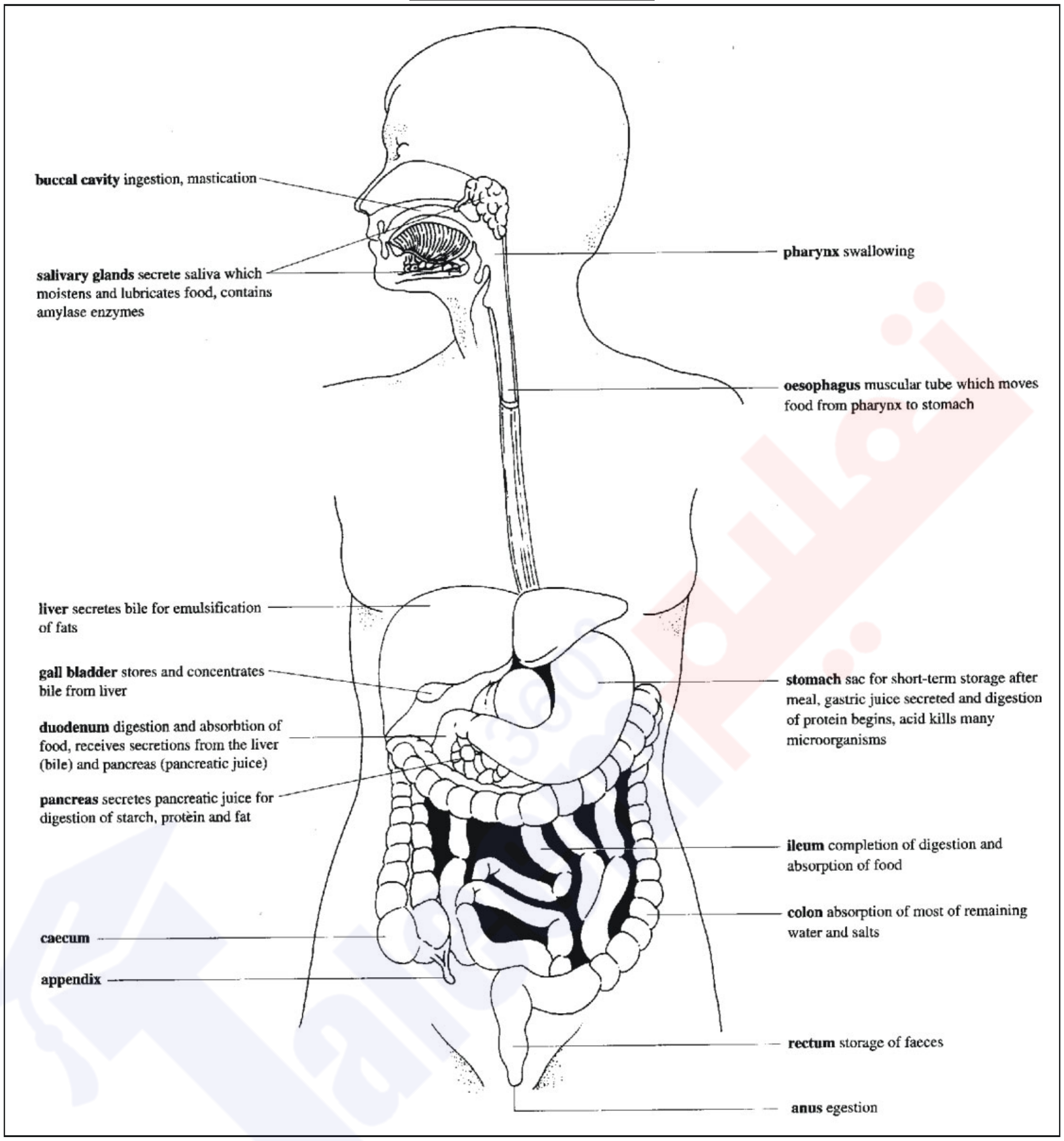


Fig. Digestion in man

Q.14 What is saliva? Give its function.

Ans. SALIVA

Saliva is a viscous liquid:

(i) It contains water and mucus.

(ii) It has sodium bicarbonate and other salts.

(iii) Amylase or ptyalin (carbohydrate digesting enzymes) are present in saliva.

Functions:

(i) Saliva *moistens* dry food.

(ii) It helps swallowing by *lubricating* action.

(iii) It provides enzyme i.e. amylase or ptyalin for the *digestion of starch*.

(iv) It keeps mouth and teeth *clean*.

(v) Sodium bicarbonate and other salts are *antiseptic*. Fresh saliva is *alkaline* with a pH of nearly "8". It quickly loses carbondioxide and gets pH 6.

Q.15 How is swallowing of food take place in the alimentary canal?

Ans. (1) As a result of mastication, the softened, partly digested, slimy food is rolled into small oval jump called bolus.

(2) Bolus is then pushed to the back of the mouth by the action of tongue and muscles of pharynx which ensure that the food does not enter the windpipe.

Following are the events that take place in the swallowing of food:

(i) Tongue: The tongue moves in the mouth and forces the bolus to the back of the mouth cavity.

(ii) Closing of Nasal Opening: The movement of the tongue helps in closing the nasal opening and opening of windpipe.

(iii) Larynx Cartilage: The larynx cartilage round the top of the windpipe moves upward.

(iv) Glottis: The glottis is partly closed by the contraction of a ring muscle.

(v) Epiglottis: The food does not enter the partly open glottis, because epiglottis diverts the food mass to one side of the opening and safely down the oesophagus.

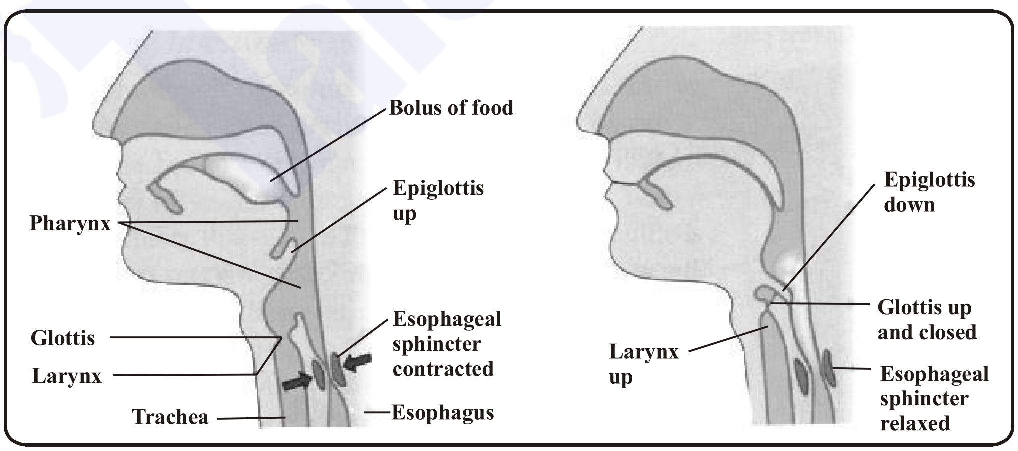


Fig. Swallowing in man

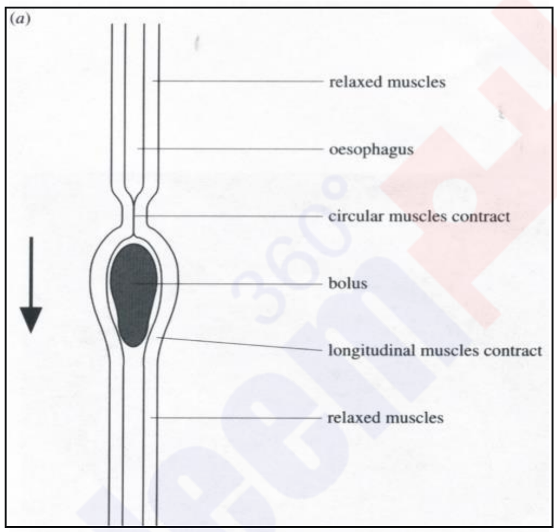
Q.16 What is peristalsis? How it causes the food to pass through the oesophagus?

Ans. PERISTALISIS

The digestive tract has the characteristic movement by which food moves along the cavity of the canal called peristalsis. (Passing of alternate waves of contraction and relaxation along a hollow viscous).

Explanation: It consists of the wave of contraction of the circular and longitudinal muscles proceeded by the wave of relaxation thus squeezing the food down along the canal. Peristalsis starts just behind the food from the buccal cavity *along the oesophagus to the stomach* and then the whole alimentary canal.

JUST A CONCEPT



Q.17 What is antiperistalsis and why it is caused?

Ans. ANTIPERISTALSIS

Occasionally the food may be passed from intestine back into the stomach and even in the mouth which is called antiperistalsis.

CAUSES OF ANTIPERISTALSIS:

Hunger Contractions:

Hunger contractions are peristaltic contractions which are increased by low blood glucose level and are sufficiently strong to create an uncomfortable sensation often called Hunger Pangs. Hunger pangs occur usually 12-24 hours after previous meal or in less time in some people.

Q.18 Describe the main steps of structure and function of stomach and how the stomach digest the food. (OR) Describe the digestion in stomach of man in detail. (GRWOS)

Ans. **DIGESTION IN STOMACH**

The stomach is "j" shaped bag like structure situated below the diaphragm on the left side of the abdominal cavity.

STRUCTURE:

Elastic Muscular Bag:

It is an elastic muscular bag that stores food from meals for some time. The stomach wall is composed of three principal layers:

(i) ***Connective Tissue:*** An outer layer (formed by *connective tissue*).

(ii) ***Smooth Muscles:*** A middle layer (formed by *smooth muscles*).

(iii) ***Connective Tissue and Mucosa:*** An inner most layer mucosa (formed by *connective tissue glands*).

The middle layer consists of an outer longitudinal and an inner circular muscles. These muscular layers helps in digestion.

Gastric Glands:

The inner layer of the stomach possesses numerous tubular glands called gastric glands. These are composed of following kinds of cells:

(i) ***Mucous Cells:*** These cells produce ***mucus***.

(ii) ***Parietal or Oxyntic Cells:*** These cells secrete hydrochloric acid (***HCl***).

(iii) ***Zymogen Cells or Chief Cells:*** These cells secrete ***pepsinogen***. The secretion of all these cells is collectively called gastric juice.

Mucus: Mucus is a thick secretion that covers the inside of the stomach. It prevents the underlying walls from being digested.

Hydrochloric Acid: It is secreted by stomach in concentrated form:

(i) **Adjusts the pH:** It adjusts the pH of stomach contents ranging from 2-3 pepsin to act on proteins.

(ii) **Softens the Food:** It also soften the food.

(iii) **Kills:** It kills many microorganisms in the food.

Pepsin: Pepsin is an enzyme.

$$\underset{\text{(inactive)}}{\text{Pepsinogen}} \xrightarrow{HCl} \underset{\text{(active)}}{\text{Pepsin}}$$

It is secreted in an inactive form called pepsinogen. Pepsinogen is activated to pepsin, when exposed to the acidic medium. Pepsin hydrolyses the proteins. After stomach, the food enters into the intestine.

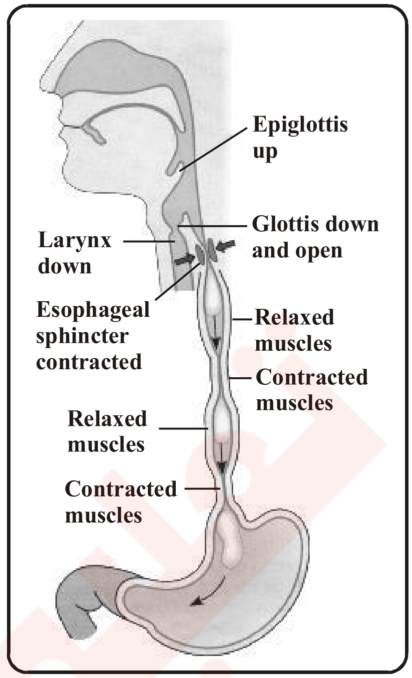


Fig. Different stages of peristaltic movement in the esophagus

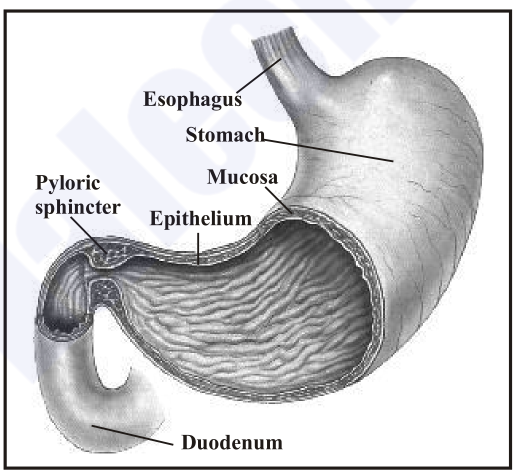


Fig. (a) Sagittal section of human stomach showing internal ridges and sphincters

Stomach
- Cardiac region (with mucus secreting cells)
- Fundic region (with oxyntic and chief cells)
- Pyloric region (with mucus secreting cells)

Cardiac sphincter is present between oesophagus and cardiac part while pyloric sphincter between pyloric part and duodenum

Q.19 *Describe the digestion in small intestine of man in details.*

Ans. **DIGESTION IN SMALL INTESTINE**

When the chyme (partially broken food) passes from stomach into duodenum its acidity stimulates the release of secretions. The small intestine has following parts:

(i) Duodenum (ii) Jejunum (iii) Ileum

Digestion in Duodenum:

Duodenum is *about 20-25 cm long*. When chyme reaches into duodenum, the release of secretions of pancreas and duodenumal cells take place.

ENZYME SECRETED BY PANCREAS:

Pancreas:

It is a *pinkish* large gland. It is an *exocrine* tissue which secretes a juice that flows through the pancreatic duct into the duodenum. This *pancreatic juice* digests all types of food i.e. carbohydrates, fats and proteins.

Amylase: This enzyme digests the carbohydrates. It is prepared by pancreas and is also called amylopsin.

Lipase: It digests the small percentage of fats into fatty acid and glycerol. It is also secreted in inactive form which is activated by the enterokinase.

Trypsin: It digests proteins into peptides. Pancreatic juice also contains sodium bicarbonate which partly neutralized the chyme. It is also secreted in inactive form which is actwated by the enterokinase.

Liver:

It secretes bile. Bile may be temporarily stored in the gallbladder. Then it is released into the duodenum through the bile duct. The bile is green watery fluid but without enzymes. Its *green color* is due to the bile pigments, which are formed by the break down of haemoglobin in the liver. Bile contains salts, which acts on fats. They break the fats into globules, which are easily digested by water soluble lipase.

CONCEPTUAL VIEW

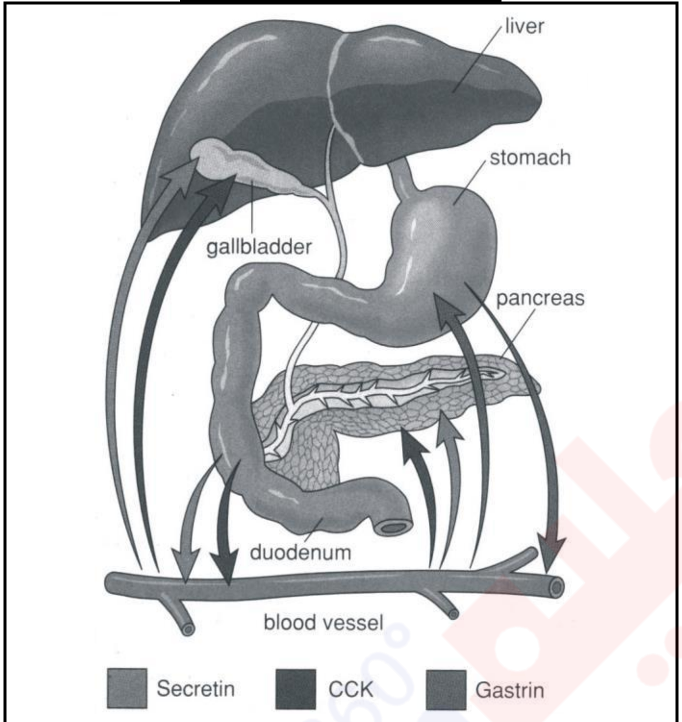


Fig. Accessory digestive glands

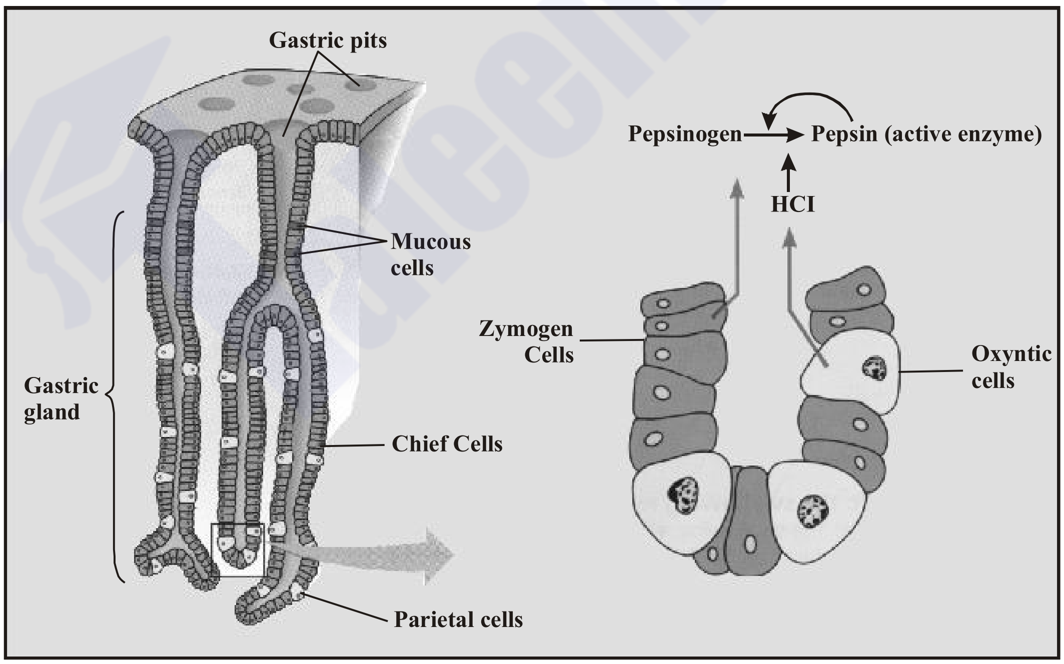


Fig. Section through stomach wall (c) Details of gastric gland in the stomach wall

Jaundice:

If bile pigments are prevented from leaving digestive tract, they may accumulate in blood and cause a condition called jaundice.

Gallstone:

Cholesterol secreted by the liver may block the release of gall bladder's secretion.

Deammonification:

Liver converts toxic substance ammonia (which is a waste product of amino acids metabolism) to less toxic compound urea which is then excreted by kidneys.

Jejunum:

It is the second portion of the small intestine extending from the duodenum to the ileum. It is *2.4 meter in length* comprising about *two fifth of the small intestine*. The food which escapes undigested from the duodenum is completely digested in this part.

Ileum:

The undigested food passes through the ileum and enters the large intestine.

ATTENTION

Differences among duodenum, jejunum and Ileum:		
Duodenum	**Jejunum**	**Ileum**
(i) More Circular folds	(i) Numerous and larger circular folds	(i) Less circular folds
(ii) —	(ii) Less villi	(ii) Abundant villi
(iii) Thicker wall	(iii) —	(iii) Less thick wall

Q.20 Give a detailed note on the absorption of food particles in the small intestine.

Ans. **ABSORPTION IN SMALL INTESTINE**

The small intestine consists of *duodenum*, *jejunum* and *ileum*. Nearly all absorption of the products of digestion takes place in the ileum.

Structure of Ileum: The surface of the ileum has *many folds*, which exhibit *velvety appearance* due to the presence of numerous finger like outgrowths called ***villi***.

(b) Detail of Villus Structure:

Each villus is richly supplied with *blood capillaries* and a vessel called *lacteal* of lymphatic system with a covering of *epithelial cells*. The electron microscope reveals that these cells have countless closely packed cylindrical processes called *micro-villi*.

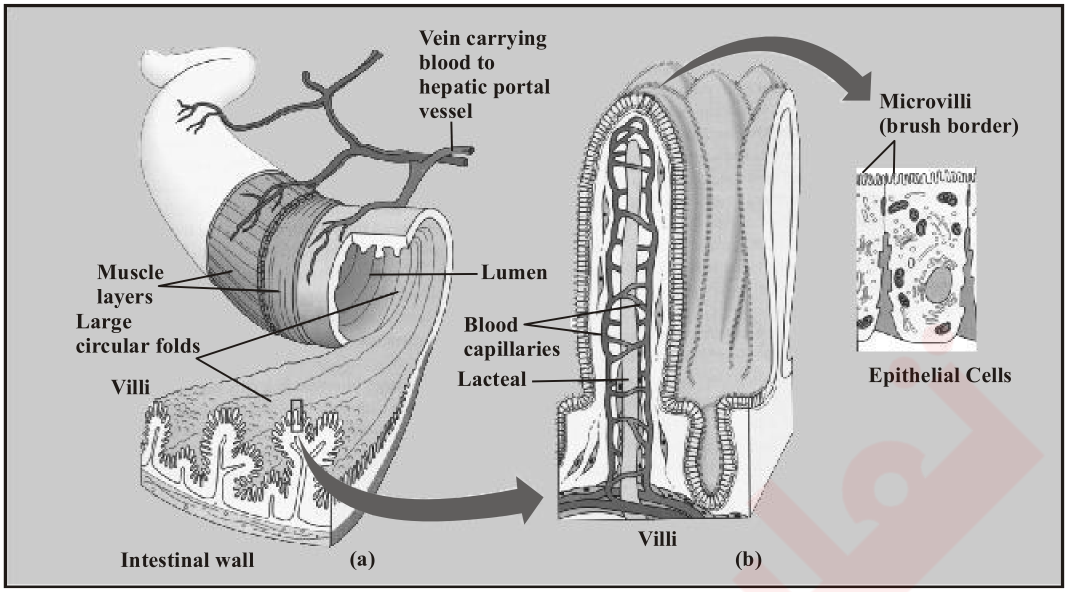


Fig. (a) Part of wall of small intestine showing glands and villi.
(b) Detail of villus structure.

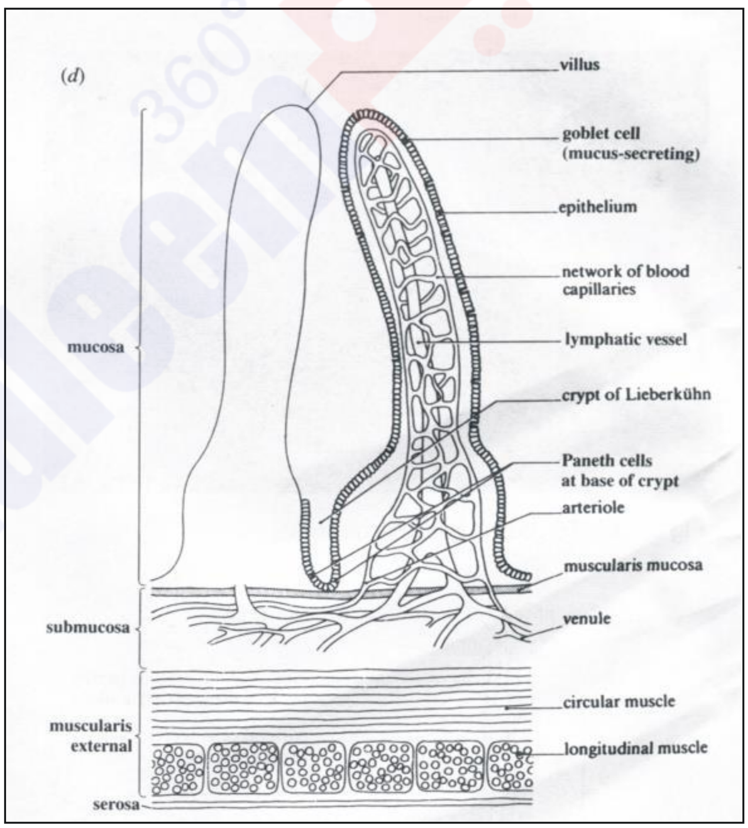
Absorption of Sugars and Amino Acids:

Simple sugars and amino acids are absorbed into the blood capillaries through the microvilli by diffusion. Some fatty acids and glycerol are also absorbed into blood stream.

Absorption of fatty acids and glycerol:

A large proportion of fatty acids and glycerol enters the epithelial cells of villi, where they recombine into fats. These fats then enter the lacteals.

Protein present in the lymph vessels combine with the fat molecules to form lipo protein droplets. These pass into the blood stream.



Gathering of Waste Product:

The intestinal contents are pushed along the alimentary canal by normal peristaltic activity. At the end of the ileum, there is an *ileocolic sphincter* that opens and closes time to time and allow a small amount of residue from the ileum to enter the large intestine.

Enzymatic Digestion in the Small Intestine

CARBOHYDRATES					
Starch (a polysaccharide)	Pancreatic amylase →	Maltose (a disaccharide)	Disaccharides	Maltase, Sucrase, Lactase (etc.) →	Monosaccharides
PROTEINS					
Polypeptides	Trypsin, Chymotrypsin →	Smaller polypeptides	Small polypeptides and dipeptides	Aminopeptidase, Carboxypeptidase, Dipeptidase →	Amino acids
NUCLEIC ACIDS					
DNA and RNA	Nucleases →	Nucleotides	Nucleotides	Other enzymes →	Nitrogenous bases, sugars, and phosphates
FATS					
Fat globules	Bile salts →	Fat droplets (emulsified)	Fat droplets	Lipase →	Fatty acids and glycerol

Q.21 Give a detailed note on structure function and malfunction of large intestine.

Ans. **LARGE INTESTINE**

The large intestine is a part of alimentary canal that starts after the small intestine.

Structure: The large intestine is composed of the following parts:

(i) Caecum (ii) Colon (iii) Rectum

(i) ***Caecum:*** It is a blind sac that projects from the large intestine between ileum and colon. It is pouch that is beginning of large intestine.

(ii) ***Colon:*** It is the part of large intestine that exists between the caecum and rectum.

(iii) ***Rectum:*** The last part of the large intestine is called rectum.

Appendix: From the blind end of the caecum, there arises a finger like process called appendix.

Appendicitis: The appendix some time get inflammed due to entrapping and then putrification of food causing appendicitis.

FUNCTIONS OF LARGE INTESTINE:

The material that reaches the large intestine contains large amount of *water and salts* which are *absorbed into the blood*. The undigested material also contains large amount of bacteria which are also absorbed in the large intestine.

MALFUNCTIONS OF LARGE INTESTINE:

Due to malfunctioning, the absorption of water and salts does not take place and cause the following diseases:

(a) Diarrhoea:

When water and salts are not absorbed due to drug action or infection, a condition known as diarrhea occurs.

(b) Constipation:

When excessive absorption of water takes place a condition known as constipation occurs.

Rectum:

It is the part where feces are temporarily stored and ejected through anus at intervals.

Table: Functions of the Digestive Organs

Organ	Function	Secretion
Oral Cavity		
Teeth	*Mastication (cutting and grinding of food); communication.*	None
Lips and cheeks	*Manipulation of food; hold food in position between the teeth; communication.*	Saliva from buccal glands (mucus only).
Tongue	*Manipulation of food; holds food in position between the teeth; cleansing teeth, taste.*	Some mucus; small amount of serous fluid.
Salivary Glands		
Parotid glands	*Secretion of saliva through ducts to superior and posterior portions of oral cavity.*	Saliva with amylase
Submandibular glands	*Secretion of saliva in floor of oral cavity.*	Saliva mucus only.
Pharynx	*Swollowing*	Some mucus
Esophagus	*Movement of food by peristalsis from pharynx to stomach.*	Mucus
Stomach	*Mechanical mixing of food; enzymatic digestion; storage; absorption.*	
Mucous cells	*Protection of stomach wall by mucus production.*	Mucus

Parietal cells Zymogen cells Endocrine cells	*Decrease in stomach pH.* *Protein digestion.* *Regulation of secretion and motility.*	Hydrochloric acid. Pepsinogen Gastrin
Accessory Glands Liver →	*Secretion of bile into duodenum*	Bile
Gall bladder →	*Bile storage; absorbs water and electrolytes to concentratate bile.*	No secretions of its own, stores and concentrates bile
Pancreas →	*Secretion of several digestive enzymes and bicarbonate ions into duodenum.*	Trypsin, chymotrypsin, pancreatic amylase, pancreatic lipase, bicarbonate ions.
Small Intestine Duodenal glands	*Protection*	Mucus
Goblet cells	*Protection*	Mucus
Absorptive cell	*Secretion of digestive enzymes and absorption of digested materials.*	Enterokinase, amylase, peptidases, sucrase, maltase, lactase, lipase.
Endocrine cells	*Regulation of secretion and motility.*	Gastrin, secretin
Large Intestine Goblet cells	*Absorption, storage, and food movement.* *Protection*	Mucus

Q.22 Write a detailed note on the common diseases related to nutrition? OR Discuss:

(a) Dyspepsia (b) Food poisoning (c) Botulsim
(d) Obesity (e) Anorexia Nervosa (f) Bulimia nervosa
(g) Piles

Ans. Following are some of common diseases related to nutrition:

(a) DYSPEPSIA

Incomplete or ***imperfect digestion*** is called dyspepsia. Dyspepsia is not a disease in itself. Actually it is symptomatic of other diseases.

Symptoms: This is characterized by ***abdominal discomfort, flatulence, heartburn, nausea*** and vomiting. These symptoms may occur irregularly and in different patterns from time to time.

Reasons: Dyspepsia may occur ***due to excessive acidity*** in stomach or faulty function of stomach and intestine or insufficient quality or quantity of bile secretions.

(b) FOOD POISONING

The food poisoning indicates an illness from indigestion of food *containing toxic substances*.

By Bacteria: The commonest causes of food poisoning are the toxins produced by bacteria, Salmonella and Campylobacter. These bacteria live in the intestine of cattle, chicken and duck without causing disease symptoms.

By Contaminated Food:

Human, however, may develop food poisoning if they drink milk, eat meat or eggs which are contaminated with these bacteria.

Symptoms:

The symptoms of food poisoning are diarrhoea, vomiting and abdominal pain. They occur from 12-24 hours after eating contaminated food. Infection is most likely if, unpasteurized milk is used or if meat is not properly cooked.

The liquid that escapes during defrosting frozen meat contains *Salmonella* bacteria. The dishes and utensils while the meat is defrosting must not be allowed to come in contact with any other food.

(c) BOTULISM (A Severe Food Poisoning):

A severe form of food poisoning is botulism.

Causing Agents: This is caused by toxins produced by bacteria known as *Clostridium botulinum*.

Reasons: Botulism is developed by the use of improperly canned or otherwise preserved foods, especially meat. The toxin produced by these bacteria is very powerful and have selective action on central nervous system, causing cardiac and respiratory paralysis.

Symptoms: The early symptoms of this disease are fatigue, dizziness, double vision, headache, nausea, vomiting, diarrhoea and abdominal pain.

(d) OBESITY (Over Weight):

The obesity is the over weighting in which a person has *abnormal amount* of fat in the body.

(a) If one eats too much food than body requirement, the surplus is stored as fat so becomes *over weight* or obese.

(b) There is *fat stored in adipose tissue* in the abdomen around the kidneys and under the skin.

(c) Certain cells *accumulate drops of fat in their cytoplasm*. As fat drops increase in size and number, they join together to form one globule of fat in the middle of the cell, pushing the cytoplasm into thin layer and the nucleus to one side. Group of fat cells or adipose tissue.

(d) Some people never seem fat no matter how much they eat, while others lay down fat when their intake only just exceeds their need.

(e) The explanation probably lies in the balance of hormones which to some extent is determined by heredity.

Effects of Obesity: An obese person is much more likely to suffer from *high blood pressure*, *heart disease*, diabetes mellitus, *stomach disorder* than a person who has normal body weight.

(e) ANOREXIA NERVOSA (*Loss of appetite by fear*)

"This term is employed to the *loss of appetite due to the fear of becoming obese*". Such a feeling is common in humans females between the age of 12 and 21 years. Fear does not come to an end even when weight is reduced to dangerous level. If patient refuses to eat, she must be guided and treated psychologically. Anorexia is a disease which affects girls usually from the start of puberty.

(1) The illness is characterized by the loss of appetite due to the fear of becoming obese.

(2) The anorexic girls over estimate the size of her own body and so insist that she is over weight when in reality her weight has dropped to a dangerous level.

(3) These girls are often immature mentally. They cannot face the challenges of puberty and growing sexuality.

Harmful Effects: The ***loss of feminine*** *characteristics* enable the girl to retreat into a ***child like state*** in which she feels safe.

Treatments: Psychiatric therapy is usually required to ***treat anorexic girls***. Such patients are fed through any other route other than alimentary canal that is intramuscularly or intravenously. The recovery is very slow. It may take 2–4 years and in some cases longer.

(f) BULIMIA NERVOSA (*Overeating, then induced vomiting*)

In Older Girls:

The Bulimia Nervosa is *neurotic* in slightly ***older girls***.

Reasons: It is due to overeating fattening food such as fried food or cream cakes. This overeating is followed immediately by self induced vomiting, fasting or purgatives. The frequent vomiting and purging may cause physical effects including serum electrolyte imbalance and frequent repeating infections.

Treatment: Treatment of ***bulimics*** is likely to be prolonged.

The initial treatment is to overcome the effects of weight loss and malnutrition. It is necessary to undertake the treatment in hospital under strict supervision.

(g) PILES (*Thickening of Mucus, Anal Fissure*):

The piles or hemorrhoids (پھاڑ) are masses of dilated, tortuous veins (swelling or bulging) in the anorectic mucosa.

Bleeding During Bowl Movement: These masses may sometimes start bleeding during bowl movement.

Constipation: Situation may aggregate when the patient suffers from constipation.

The urge to defecate is depressed and it becomes difficult to expel the faeces.

Distension of Rectum: This may cause other symptoms of ill health because of the physical distension of the rectum.

Cures: The only therapy required is the improvement of the hygiene and the use of food softness such as roughage in food or *laxatives*.

The patients are advised *not to sit on hard seats*.

Depending on severity of the symptoms, sometimes the hemorrhoids have to be *removed surgically*.

(g) ULCER

The inner wall of digestive tract is normally covered with mucous, which protects it from enzymes.

Self Eating of Stomach and Duodenum: When the mucous layer is broken down, the digestive enzymes begin to eat away the walls of stomach or duodenum. This result in a sore called ulcer.

Hole Formations in Wall: An ulcer is so severe that a hole develops in the wall of the digestive tract and the contents of the tract spill into the abdominal cavity, leading to severe infections which may prove to be fatal, if immediate medical care is not taken.

Peptic Ulcer: The ulcer due to *excessive secretions of gastric* acid is called peptic ulcer. Excess gastric acid secretion is an important factor of peptic ulcer.

Reasons of Peptic Ulcer:

Smoking, spicy food, alcoholic, beverages, coffee, tea and *stress* should be avoided by the patients suffering from ulcer.

+ SOME CONCEPTUAL SHORT QUESTIONS

Q.1 Differentiate the physiology of human liver and pancreas in digestive system.

Ans. **Liver and Pancreas** *Liver* produces *bile*. Bile is released in duodenum. Bile is without enzymes but it *emulsifies* the fats.

Pancreas secretes several enzymes and bicarbonate ions which come into small intestine for digestive role.

Q.2 Differentiate between tubular and vascular digestive systems.

Ans. **Tubular and Vascular Digestive Systems** *Vascular digestive system* is sac like in structure, it has single opening for mouth and anal function. It is primitive. e.g. Hydra.

Tubular digestive system has anterior end and posterior end-Anterior end of digestive system has mouth and posterior end has anus. It is advance system. e.g. Man etc.

Q.3 What is the main similarity between trypsin and pepsin and what is difference between its?

Ans. **Trypsin and Pepsin** Both trypsin and pepsin are digestive enzymes. Both digest the proteins. ***Pepsin*** performs its function in stomach because it requires acidic medium.

Trypsin is alkaline loving. So it digests the protein in small intestine. Small intestine has alkaline medium.

Q.4 Differentiate between gastrin and secretin.

Ans. **Gastrin** Gastrin is a ***hormone*** which is secreted by stimulation of extra proteins in the food. Gastrin is secreted ***from secretory cells of gastric linning*** (endocrine linning). Ultimately, more gastric juice is produced by extra secretion of gastrin. Gastrin promotes production of gastric juice.

Secretin Secretin is that ***hormone*** which stimulates pancreatic and hepatic secretions. ***Mucosa of intestine*** is source of secretin.

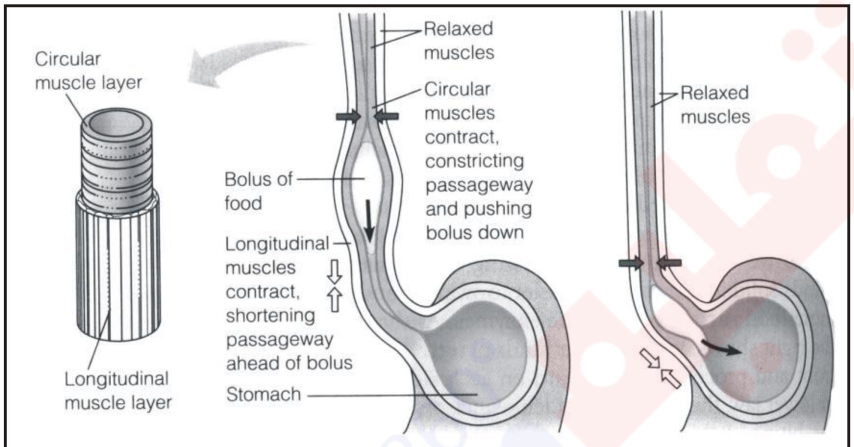
Secretin promotes production of pancreatic juice and inhibits gastric juice.

Q.5 Why are caecae and villi important?

Ans. **Caecae** like structures ***increase surface area and absorbing area*** in the digestive system of organisms. ***e.g., planaria***.

Villi are the finger like small projections ***which promote, absorption of digested food***. ***e.g., man***.

CONCEPTUAL TOUCH



Muscle layers of the esophagus and their roles in peristalsis

DIFFICULT WORD MEANINGS

Words	Meanings	Words	Meanings
Nutrients	غذائی اجزا	Bile	افراز کرتا ہے (مائع صفرا)
Utilization	استعمال	Canines	
Accomplished	تکمیل/مکمل	Incisors	سامنے والے چار دانت کے پیچھے دونو کیلے دانت
Maintenance	مرمت/فعالیت	Peristalsis	حرکاتِ دوری
Predominant	غلبہ/شرکت/مضبوط	Siphon	سوراخ
Swollowing	نگلنا	Mucous	لعاب
Ascertain	اندازہ لگانا/ ماپنا/تولنا	Masquitoes	مچھر
Chlorosis	کلوروفل کی کمی	Villi	دھاگہ نما اُبھار (ولائی)
Premature	نابالغ	Obligate	جنہیں ہوسٹ لازمی چاہیئے
Diagonosis	تشخیص	Terrestrial	زمین پر رہنے والے
Catalogued	درجہ بندی	Elimination	اخراج
Decaying	گلنا سڑنا	Embedded	لپٹا ہوا
Parasitic	طفیلی/خوراک اور رہائش کے لئے دوسرے پر انحصار کرنے والا	Phagocytic	نگلنے والا
Incisors	سامنے والے چار دانت	Engulf	نگلنا
Supplement	خوراک کی فراہمی	Chunk	روٹی وغیرہ کا ٹکڑا
Bristles	ابھار/کانٹے نما/دھاگا نما ابھار	Esophagus (Food pipe)	غذا کی نالی
Entagled	جکڑے جانا/پکڑے جانا	Small Intestine	چھوٹی آنت

Exhibit	اظہار/نمائش	**Lubrication**	چکنا کرنا
Large intestine	بڑی آنت	**Windpipe (Trachea)**	ہوا کی نالی
Capillaries	عروقِ شعریہ (باریک خون کی نالیاں)	**Elastic**	لچکدار
Bladder	مثانہ	**Pharynx**	حلق/گلا
Trachea	سانس کی نالی کا ہر حصّہ برونکیل ٹیوب کہلاتا ہے	**Trachea**	سانس کی نالی جس کے ذریعے پھیپھڑوں میں ہوا جاتی ہے
Diaphragm	حاجز حجاب (پیٹ اور چھاتی کے درمیان ایک تہہ)	**Pancreas**	لبلبہ
Gallbladder	پتّا	**Liver**	جگر
Spleen	تلی	**Red carpuscles**	خون کے سرخ جسیمے
White corpuscles	سفید جسیمے	**Lungs**	پھیپھڑے
Stomach	معدہ	**Plasm**	پلازمہ (خون میں موجود مائع پلازمہ کہلاتا ہے)
Concave	مقعر	**Anus**	مقعد (وہ سوراخ جس کے راستے غیر ہضم شدہ خوراک جسم سے خارج ہوتی ہے)
Anemia	کسی شخص میں سرخ جسیموں کی کمی کا واقع ہونا انمیا (بیماری) ہے	**Hemophilia**	جسم سے خون کا نکلنا بند نہ ہونا ہیموفلیا بیماری ہے
Gastric juice	معدے کا جوس/عرق معدہ	**Peristalsis**	پیری سٹالیس/حرکت انقباضی/ ایسوفیگس سے معدے تک ہونے والی یہ ردمک ویوکنٹریکشن اور ری لیکیشن
Herbivores	سبزی خور	**Carnivores**	گوشت خور

Omnivores	ہمہ خور/سبزی/گوشت خور	Holozoic	جن میں تیار شدہ خوراک منہ کے ذریعہ داخل ہو
Holophytic	خودخوراک تیار کرنے کی صلاحیت رکھنے والے	Digestion	/ Break down بڑے مالیکیولز کا چھوٹے مالیکیولز میں ٹوٹنا اور قابل انجذاب بننا
Absorption	عمل انجذاب/جذب ہونا	Assimilation	ہضم شدہ خوراک کا پروٹوپلازم بننا
Waste products	فاسد مادے/ناقابلِ ہضم کا اجزا	Mastication	چبانا
Obesity	چربی بڑھ جانا/موٹا ہو جانا	Hemorrhoid	نالیوں کا پھولنا
Piles			

Q.1 Fill in the blanks:

(i) Plants absorb minerals in their ________ form, as found in the soil ________.

(ii) In plants the most common nutrient deficiencies are of ________, ________, and ________.

(iii) A plant requires ________ for holding its cell together.

(iv) Chlorosis is usually by insufficient ________.

(v) In ________ the trapped insects are decomposed by bacteria.

(vi) The structure in the mouth that prevent food from entering the nasal cavities is the________.

(vii) The stomach functions to ________, ________ and food ________.

(viii) ________ is the common example of detritivores.

(ix) Pancreas produces ________ which stimulates the conversion of glycogen to ________.

(x) Vomiting occurs due to______ movements.

ANSWER:

(i) Ionic, Rhizosphere

(ii) Chlorosis, stunted growth, premature death

(iii) Peptic substance

(iv) Nitrogen

(v) Pitcher plant

(vi) Soft palate

(vii) Chum, digest secretion, absorb

(viii) Earthworm

(ix) Pancreatic amylase-maltose

(x) Antiperistalsis

Q.2 Each question had four options. Encircle the correct answer.

(i) A plant requires nitrogen and sulfur for its:
(a) Cell wall (b) Enzymes
(c) Starch deposits (d) DNA replication

(ii) A plant requires potassium of:
(a) Synthesizing protein, (b) Synthesizing chlorophyll
(c) Opening and closing of stomata

(iii) Insectivorous plants live in soils that are deficient in:
(a) Water (b) Oxygen
(c) Nitrogen (d) Iron

(iv) Most vitamins function as:
(a) Catalyst (b) High energy compound
(c) Gastro vascular cavity (d) Mouth

(v) Digestion in hydra and planaria takes place within its:
(a) Coelom (b) Alimentary canal
(c) Gastro vascular cavity (d) Saturated fatty acids.

(vii) The structure in the mouth that prevent food from entering the nasal cavities is the:
(a) Epiglottis (b) Soft platae
(c) Tongue (d) Pharynx

(viii) A mammalian herbivore has:
(a) Fewer teeth than carnivore (b) Flatter teeth than a carnivore
(c) More teeth than a carnivore (d) More pointed than a carnivore

(ix) Many humans become ill from consuming milk and milk products because they lack:
(a) Bacteria in their intestines (b) Rennin
(c) Lactase (d) Hydrochloric acid

(x) Which of the following animals has no need for a gallbladder?
(a) Cat (b) Man
(c) Lion (d) Goat

ANSWER:

(i)	(b)	(ii)	(c)	(iii)	(c)	(iv)	(a)	(v)	(c)	(vi)	b
(vii)	(b)	(viii)	(b)	(ix)	(c)	(x)	(d)				

Q.3 Extensive questions:

(i) Name one parasitic plant.

Ans. Cuscuta (dodder)

(ii) Describe its method of nutrition, explaining why normal nutrition is not possible.

Ans. *Cuscuta is a parasitic plant.* It is *leafless, without chlorophyll.*

It twins around the branches of plants.

Its roots enter the branches reach the phloem and absorb food from it.

As it does not have chlorophyll so it cannot prepare the food so it has to depend on other method of nutrition.

(iii) What are advantages and disadvantages of the parasitic mode of life compared with that of a free living organism,

Ans. The biggest ***advantage*** is they get ready made food and it is the safest way.

But ***disadvantage*** is, they was die of there is no host.

(iv) What is the advantage of a digestive tract as compared with a digestive cavity?

Ans. Since digestive cavity is compatible to sac like, all the digestion will take place at one place, so it is no very effective mode of digestion, while digestion will take place at one place, so it is no very effective mode of digestion, while digestive tract is compatible to tube. Like and different parts will perform specific functions, so each part can digest the food well.

(v) How do the digestive tract of herbivores differ from those of carnivores?

Ans. *The stomach of herbivores is simple* while that of camivores is complex and has many chambers to completely digest the cellulose.

(vi) What prevents the wall of stomach from being digested?

Ans. Layers of gastric mucosae prevent the wall of stomach from being digested.

(vii) Why do malnourished children usual have large abdomens?

Ans. Malnorished children usually have large abdomen because of following two main reasons:

(1) Their ***muscles are weak*** and because of weak abdominal muscles these are unable to hold the visceral organs in a better way.

(2) Being malnourished these children feel hunger almost all the time and what they eat is mostly contaminated. This ***contaminated food*** have more chances of having endoparasites.

(xiv) What are functions of human liver?

Ans. The liver ***produce bile*** which intact is compose of highly toxic substances, and is released in the duodenum. In the inside of digestive system after performing ***emulsification of food*** moves out along with faces.

(xv) How we can control obesity?

Ans. We can control abesty by:

(a) Reduce intake of extra sugar & fats.

(b) Regular exercise.

(xvi) What measures should be taken to avoid food poisoning?

Ans. (a) Improper canned or preserved foods especially meat contain bacteria salnonella so the dishes and utensils should be cleaned properly

(b) When the mean is defrositing, must not be come in contact with any other type of food.

(xvii) Can we get along without large intestine?

Ans. As large intestine performs the function of absorption, storage and elimination of face. So if it is removed, all these essential processes of like are stopped and more life.

(xviii) How is gastric juice production regulated?

Ans. It is regulated by:

(a) Presence of more protein in food stimulates the production of ***gastrin.***

(b) ***Gastrin*** carried by blood in true, stimulates the gastric glands to produce more gastric juice.

Chapter 13

GASEOUS EXCHANGE

Q.1 Define energy and respiration. Why is respiration is necessary? What is cellular respiration?

Ans. ENERGY: *The ability to do work is called energy.*

Respiration: *Exchange of respiration gases between organism and its environment, or between blood and tissues is called respiration.*

Activities require expenditure of energy and it is only possible, with the continuous supply of energy. Energy is produced by the process of respiration. In respiration, the oxidation of material takes place and energy is produced. For oxidation, oxygen is required and it is provided, while CO_2 is to be expelled out i.e., gaseous exchange has to take place.

Respiration occurs at two levels i.e. organism level and cell level.

Organism Level: At organism level, the respiration is also called ***breathing*** or ***ventilation***. Moist, permeable surface is required for breathing, as oxygen is absorbed and carbon dioxide is released.

Cellular Respiration: Cellular respiration is the ***biochemical*** part of respiration.

In cellular respiration energy is extracted from the food in the form of ATP which is further utilized during other activities.

Q.2 What are the advantages and disadvantages of gaseous exchange in air and water?

OR

In what ways air is better respiratory medium than water.

Ans. During the organism respiration, the gaseous exchange is carried out only by diffusion. Exchange of respiratory gases takes place between the body fluid (blood) etc. and outside medium, the outside medium may be air or water. *Air is* *better respiratory medium than water*, oxygen can be obtained more easily from air than from water because of following reasons.

(i) ***Oxygen content*** of air is much higher than the oxygen content of equal volume of water. 1 litre air contains 200 ml oxygen while water has 10 ml of O_2**.**

(ii) ***Oxygen diffuses*** about 8000 times more quickly in air than in water.

(iii) Water is 8000 ***times*** more dense than air, therefore its ventilation is far more difficult than the ventilation of air. In other words, water is 50 times more viscous, which makes it more difficult for exchange of gases as compared to air.

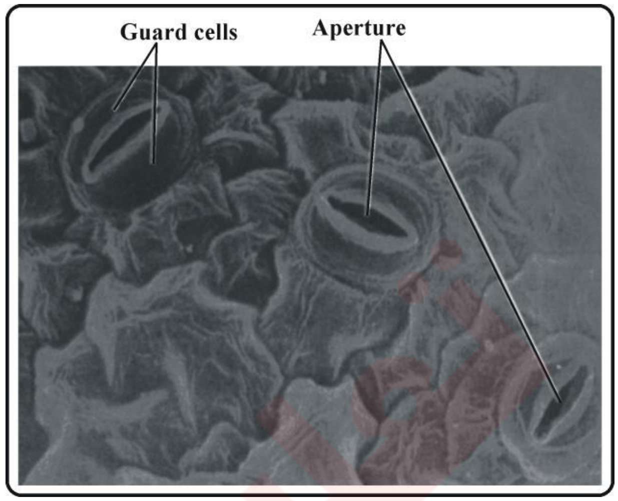
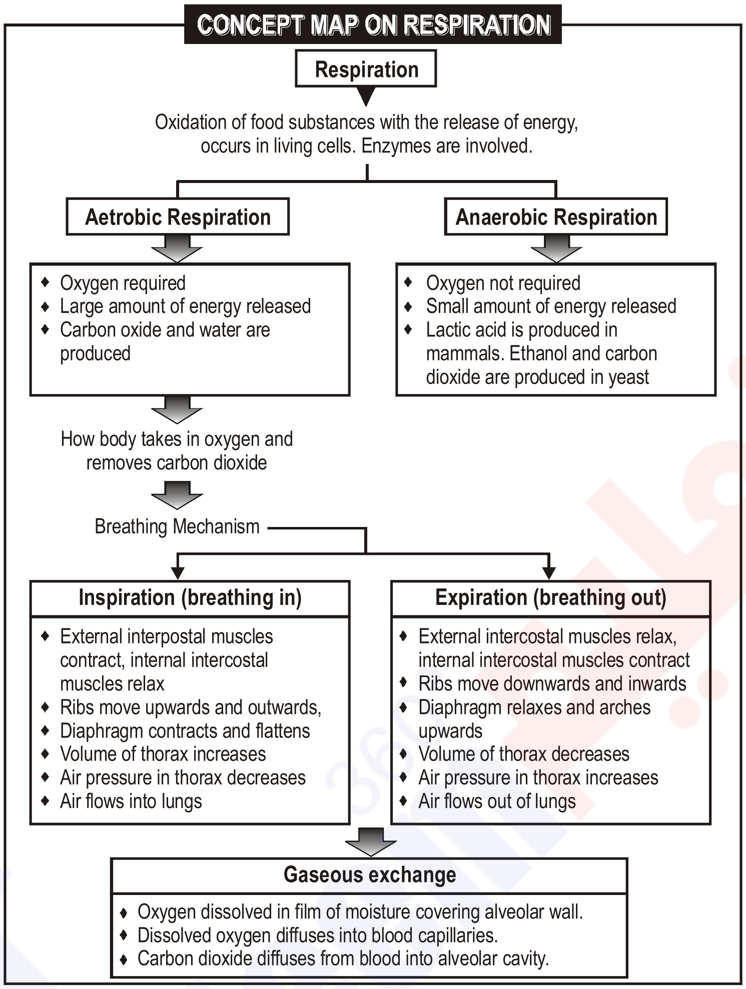


Fig. Stomata on leaf surface



(c) How does gaseous exchange occur in plants?

Ans. **GASEOUS EXCHANGE IN PLANTS**

Plants, like animals require energy for their functions and, they also get their energy from respiration.

There is no special organ or system present for gaseous exchange in plants. ***The mesophyll cells*** which are specialized for photosynthesis, have large air spaces. These air spaces are directly involved in exchange of respiratory gases. ***In plants, stomata are the main structures for the exchange of gases,*** they are largely present in the leaves and in young stems.

Cork tissue is present in the older stem which is formed of dead cells***, Lenticels are the special pores involved in gaseous exchange present in cork tissue.***

Land plants get their oxygen directly from air through stomata

It is estimated that there are 12,000 stomata present per square centimeter of leaf surface in Tobacco plants. Between the mesophyll cells, intercellular spaces or air spaces, the exchange of gases from the moist surface of mesophyll cells takes place.

Air spaces cover about 40% area of leaf.

Roots get their oxygen from air present in the spaces between soil particles.

Aquatic plants get oxygen from water by diffusion.

Q.3 (a) Write a note on photorespiration.

Ans. PHOTORESPIRATION

Photorespiration is an energy dependent process during which oxygen is absorbed and carbon dioxide is released.

This process can be defined as Respiratory activity which occurs in plants during day time is called photorespiration.

The oxygen absorbed in this process is not useful to produce energy such as ATP and is derived from the early reaction of photosynthesis.

In ***photorespiration*** another enzyme ***Ribose biphosphate*** carboxylase/oxygenase (rubisco) fixes oxygen instead of carbon dioxide. It decreases the overall carbon dioxide fixation process and also plant growth.

In photorespiration. Ribulose 1,5 biphosphate (RuBP) reacts with oxygen. The ***rubisco is carboxylase*** as ***well as oxygenase***. Where ribulose adds carbon dioxide to RuBP, it act as ***carboxylase***. It is an acceptor molecule — on the other hand when rubisco acts as oxygenase it addBoth these reactions complete with each other.

Glycolate, a two carbon compound is produced when RuBP reacts with oxygen.

$$\boxed{RuBP + O_2 \longrightarrow Glycolate}$$

The glycolate diffuses into the membrane bounded organelles known as ***Peroxisome***, which are located adjacent to chloroplasts. These are usually present in the mesophyll cells in large converted into glycine, in the peroxisomes.

$$\boxed{Glycolate \longrightarrow Glycine}$$

Glycine which is smallest amino acid soon after its formation diffuse into mitchondria. In mitchondria two glycine molecules react and form serine one molecule of CO_2.

$$\boxed{2\ Glycine \longrightarrow Serine + CO_2}$$

Thus process in which RuBP is converted into serine is called photorespiration. In photorespiration ATP uses and NADPH produced in the light reaction just like Calvin-Bason cycle. But in fact photorespiration is reverse of Calvin cycle.

During this process carbondioxide is released instead of fixation into carbohydrates. In most plants photorespiration reduces. The amount of carbon fixed into carbohydrates by 25%.

Carboxylase Oxygenase

Rubisco *enzyme performs dual function i.e., as an* ***oxygenase*** *as well as* ***carboxylase***. The relative concentration of carbondixoide and oxygen in the leaf is the most important factor which decides that rubisco will act as oxygenase and when it will work as carboxylase. When oxygen is more than rubisco acts as oxygenase and photorespiration starts.

In a hot and dry, day the oxygen level inside the leaf rises. This is because the stomata close to prevent the loss of water. The carbondioxide level falls because it is being consumed and the oxygen level rises closed stomata do not let it go out.

Photorespiration is not essential for all plants and many plants grow normally without the process of photorespiration.

It reduces the net photosynthesis.

There is a question that why photorespiration exists?

The reason is that the active site of rubisco is evolved to bind both oxygen and carbon dioxide both together. The photorespiration starts when the quantity of oxygen become more.

Q.4 What are the properties of respiratory surface?

Ans. **RESPIRATORY SURFACE**

Respiratory surfaces in animals are the sites where exchange of gases takes place. In animals respiration takes place through ***gills*** and ***lungs***. They exhibit following features.

$$\boxed{\text{Surface area} \propto \text{exchange of gases}}$$

(1) **Large Surface Area and Moisture:** The surface area should be large. So when there is more surface area there will be more exchange of gases.

(2) **Thin Epithelium:** The distance through which diffusion has to take place should be minimum.

In most animals the *epithelium which separates air and blood is only two celled thick.*

As a result, the distance for diffusion is very short.

(3) **Ventilation:** There is a big difference in concentration of gases in lungs and blood, which brings about ***diffusion.***

(4) **Capillary Network:** There should be an extensive network of capillary net ***through which blood should cross over all the time at an adequate speed.***

It helps in rapid diffusion of oxygen.

Q.5 Describe the process of gaseous exchange in following animals.

(1) Hydra	***(2) Earthworm***
(3) Cockroach	***(4) Fish***
(5) Frog	***(6) Bird***

Ans. (1) HYDRA

* There are **no special organs** for respiration in hydra.

* The exchange of gases takes place *through whole of the surface of body.* Both internal and external parts are in contact with water.

* Outer cells exchange gases with the outer water, while cells lining the digestive cavity exchange gases with water coming into the body cavity.

* In this way, the surface lining of the *enteron acts as an efficient respiratory surface.*

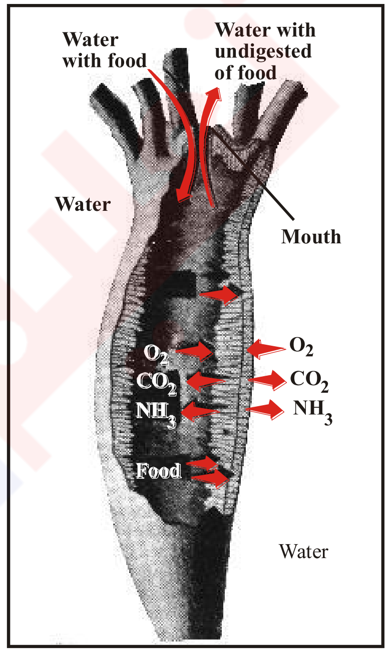


Fig. Respiration of Hydra

(2) EARTHWORM

Earthworm does not have any specialized respiratory organs. Gaseous exchange occurs mainly **through skin,** which is richly supplied with blood capillaries. *Skin is always kept moist* by the secretion of **epidermal mucous gland cells.**

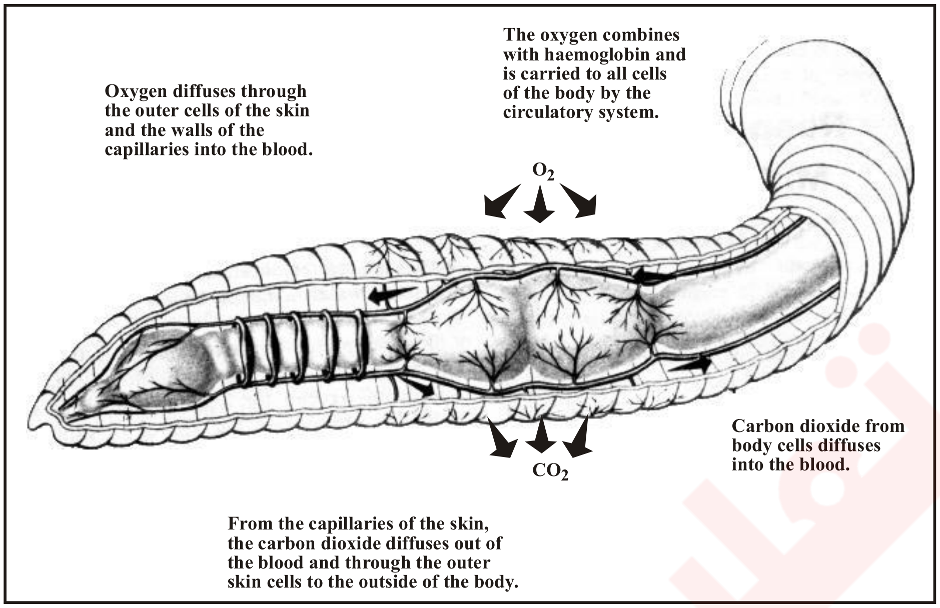


Fig. Respiration in Earthworm

Coelomic fluid also comes on the skin through the pores.

Oxygen dissolved on the wet surface and then diffuses into the blood. **In the blood oxygen combines with haemoglobin and form oxyhaemoglobin.**

As earthworms have *closed circulatory system*, blood does not come in direct contact with tissue. So oxygen must diffuse through tissue fluids and coelomic fluids.

Carbon dioxide is removed from the tissues by the blood carried in the plasma to skin, from where it is extracted.

(3) COCKROACH

The cockroach has specialized respiratory system. **It consists of branching system of air tubules which are lined by chitin and called trachea.**

Spiracles:

There are two pairs of apertures, present on the lateral sides of the body spiracles. These apertures are called spiracles, which open into air tubes or trachea.

Trachea:

Two pairs of spiracles are present in thorax while rest *eight are in each of the eight abdominal segments.* The main trachea divide and subdivide into very fine thin walled tubles called ***tracheoles***.

Tracheoles:

The tracheoles end into blind ducts which are filled with fluid, in which the oxygen dissolves. They are in close contact with cells, so air with oxygen passes through network of air tubes.

Diffusion of CO_2 and O_2:

The oxygen then diffuses to the cells and carbon dioxide goes back to tracheoles and then goes out.

Some of the carbondioxide dissolves in body fluid and passes out through soft areas in cuticle.

Expansion and Contraction of Abdominal Muscles:

By the expansion and contraction of the abdominal muscles, air is pumped in and out of the trachea. **The first four pairs of spiracles open, when abdomen expands,** as the resulting air rushes into tracheoles through these spiracles.

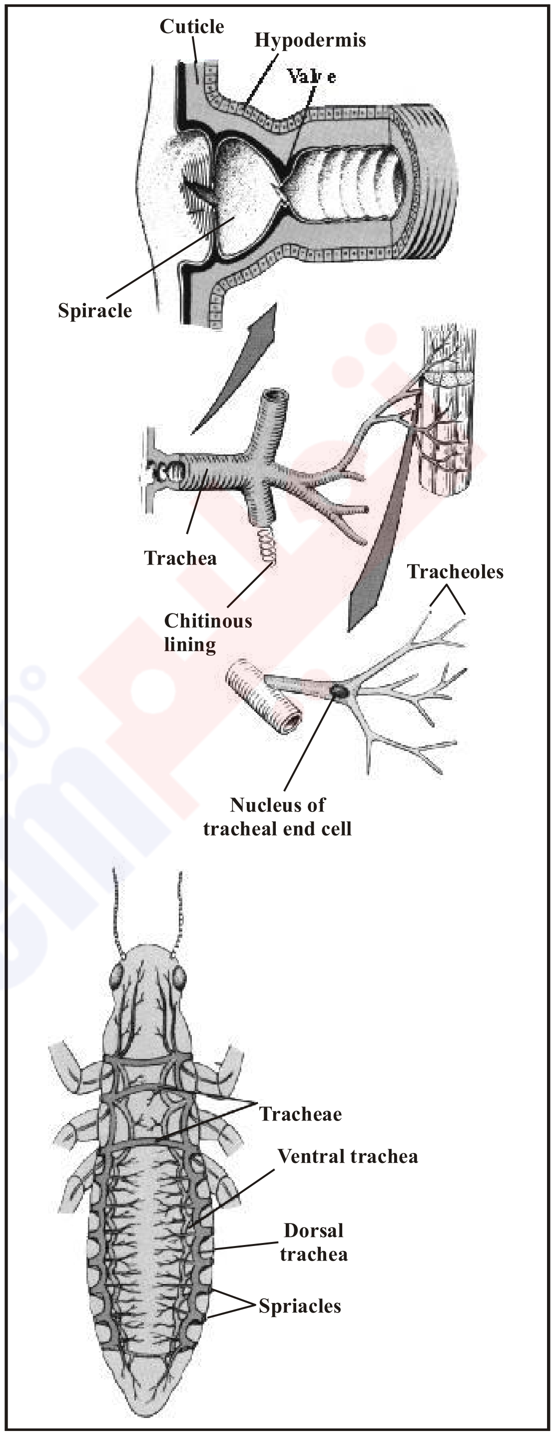


Fig. Respiration of Cockroach

The anterior four pairs of spiracles close and posterior six pairs open, when abdomen contracts.

Due to this force, air comes out of the body. In this way, ***exhalation*** and ***inhalation*** take place.

Air is directly supplied through tracheoles to the tissue cells and blood is not involved in the transport of gases.

EASY TO DRAW **THINKING ROOM**

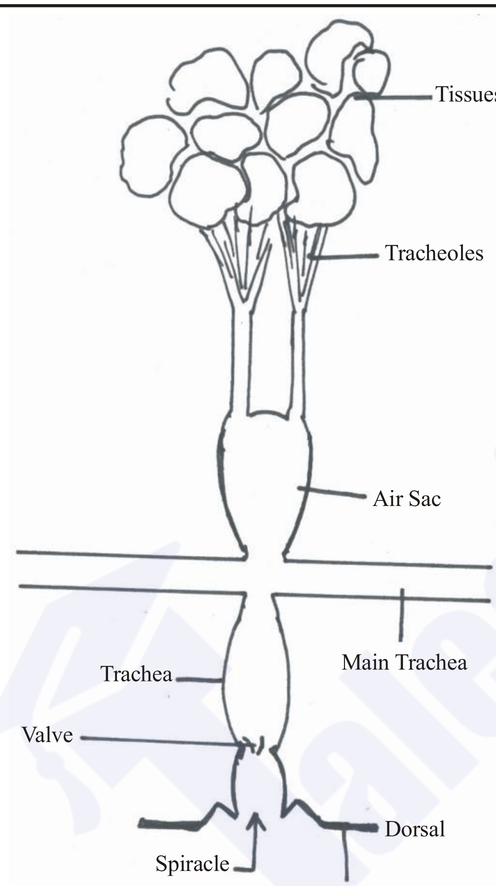


Fig. Respiration of Cockroach

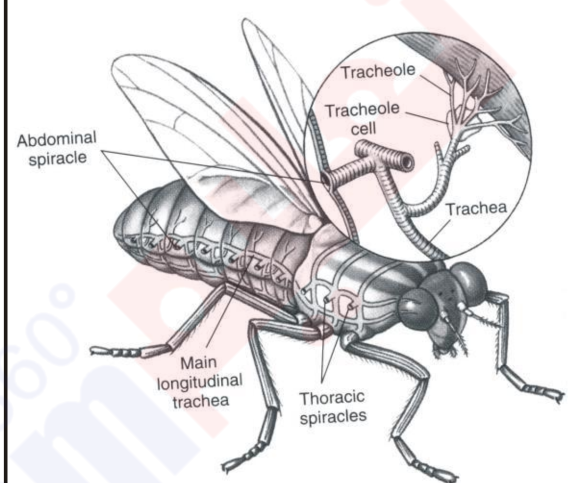


Fig. Tracheal system of insects. Air enters through the spiracles, then travels through tracheae to reach tissues at tracheoles.

(4) FISH

Gills: (at the junction of head & trunk):

In aquatic animals gills are more effective and highly modified organs for gaseous exchange. In fish, ***gills are present in pairs on either side of the body*** almost at the junction of head and trunk.

In cartilaginous fish, there are **four to five pair of gills** which open through the gill slits and they are visible on the surface of pharynx.

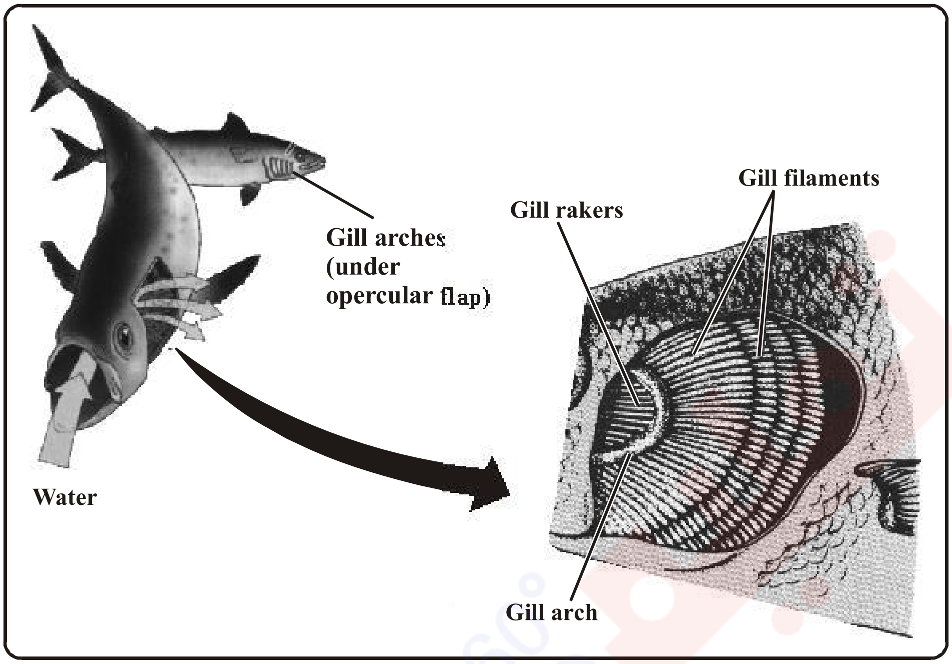


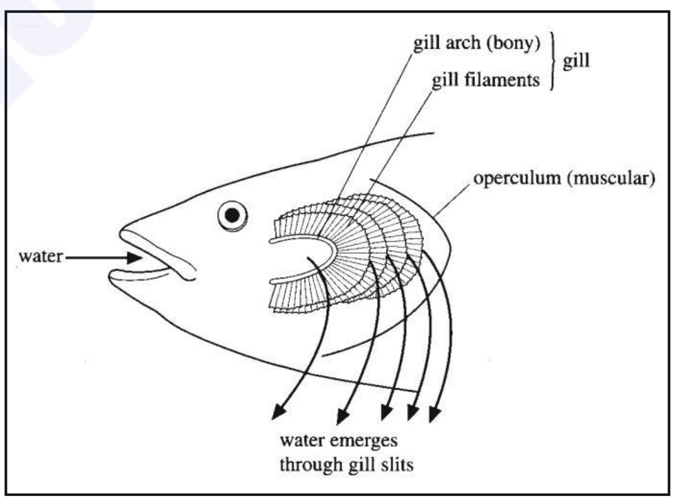
Fig. Water flows unidirectionally over the gills of a fish

Gills may be placed in ***bronchial cavities*** which are covered by operculum (Bony fishes).

Gills have great surface area for exchange of gases and gill surface is all the time ventilated by constant flow of water.

(ii) Heart:

Heart in the fishes is single circuit and the blood flows in only one direction. The deoxygenated blood from different parts of the body is received by heart, and it is pumped into gills from heart.



(iii) Exchange of Gases:

As water passes over the gills, the exchange of gases between blood and water takes place.

(5) FROG

In frog, the gaseous exchange occurs the:

(i) Lungs (ii) Skin (iii) Buccal Chamber

Pulmonary respiration is the exchange of gases through the lungs.

Nostrils: In frog, when the nostrils open, the mouth is closed and air enters through the ***nostrils.*** When the air enters, the nostrils close. The buccal cavity floor is raised, as the result, air is pushed into the lungs. This is known as *inhalation or inspiration* or intake of air.

Exhalation occurs exactly in reverse order in sequence of inspiration.

Structure of Lungs: In frog, lungs are ***balloon like simple sacs*** when they are fully expanded or filled with air. Thin walled *air chambers* are present in the lungs in order to increase the surface area of lungs. The walls of these air chambers are richly supplied with *capillaries*.

The ***main sites for exchange of gases*** in lungs are these blood containing areas. After gaseous consumed air, moves out of the lungs through the nostrils. ***The removal of consumed air out of the lungs is called exhalation or expiration.***

The gaseous exchange through the skin is known as cutaneous respiration. The buccal chamber is also richly supplied with blood vessels for gaseous exchange.

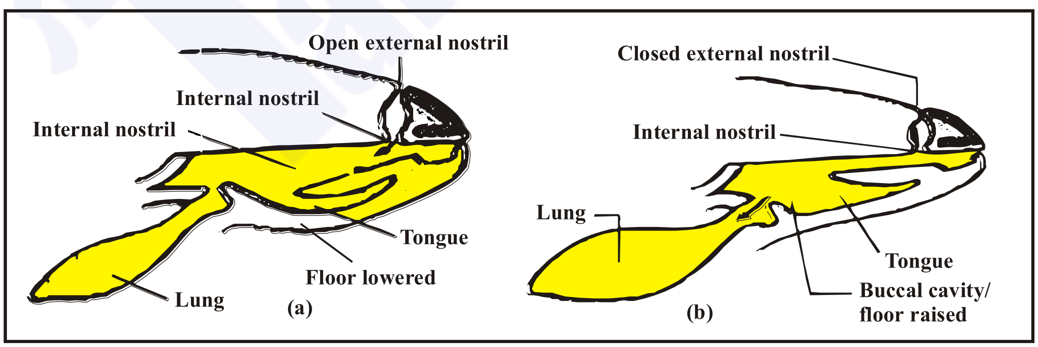


Fig. Two stages in inspiration (Buccal respiration)

(6) BIRDS

Active Animals: Birds are very ***active animals*** with ***high metabolic*** rate, thus they need large amount of oxygen. Therefore, in birds respiratory system is most efficient and elaborate.

One Way Flow of Air: In birds, there is one-way flow of air. Through the lungs, air is renewed after inspiration.

Parabronchi:

* Parabronchi are *tiny thin walled ducts* present in lungs.
* The parabronchi are opened at both ends and air is constantly ventilated.

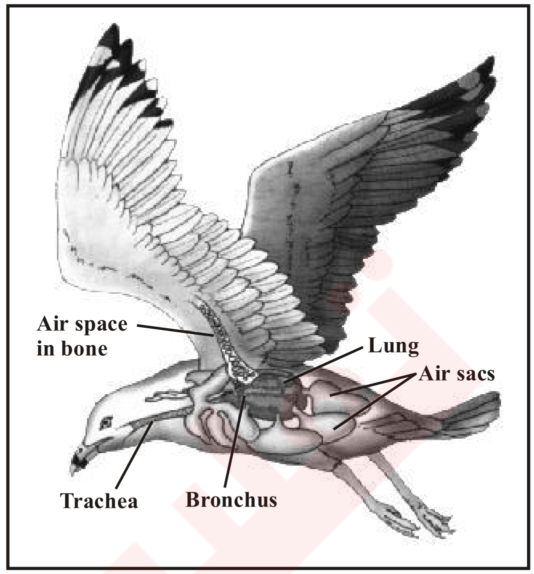
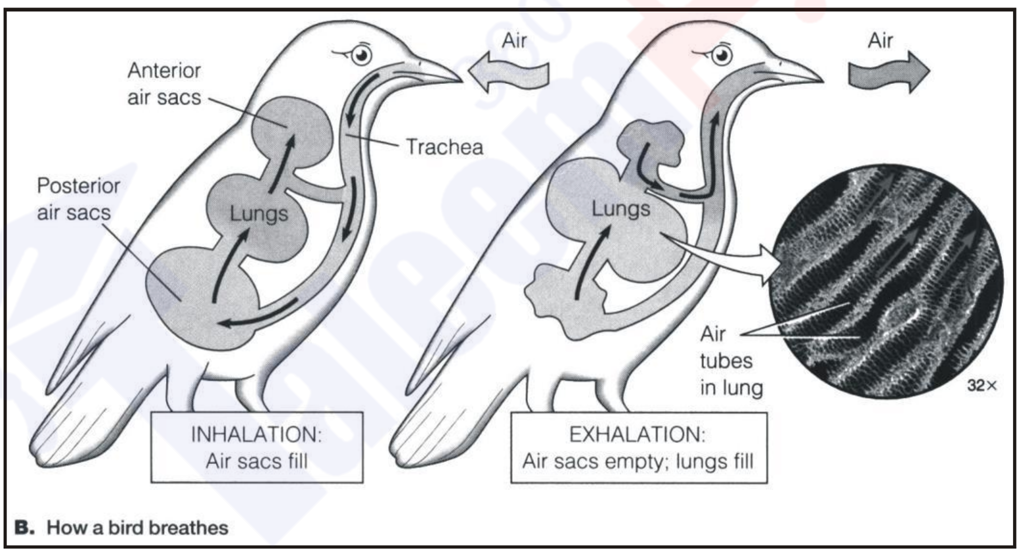


Fig. The Respiratory System of Bird



The chief sites of gaseous exchange are thin walls of these parabronchi.

* The blood flow direction in the lungs is opposite to the air flow through the parabronchi.
* This counter current exchange increases the amount of oxygen which enter the blood.
* No air remains in parabronchi, in this respect, lungs in the birds are very efficient.

Q.6 Describe the process of gaseous exchange in man.

Ans. **GASEOUS EXCHANGE IN MAN**

In man respiratory system consists of lungs and air passages, which are responsible to carry fresh air to the respiratory sites.

Air Passage Ways:

Air passage ways consist of ***nostrils, nasal cavities, pharynx, larynx, trachea, bronchi, bronchioles*** and ***alveolar ducts***. The ***alveolar ducts*** ultimately lead into the ***alveolar sacs***.

Nasal Cavities:

The nasal cavities have, ***mucous membrane,*** mucous ***secreting glands, hairs*** and ***ciliated epithelium.*** These cavities have three subdivisions due to the projection of bones in them. ***Nasal cavities have internal openings into the pharynx, throat or glottis.*** Through the external nostrils, air enters into the nasal cavity, where it is filtered with the help of hair, cilia and mucous. Dust and other particles come out in nasal cavities.

Pharynx (Throat):

* *Nostril opens into the pharynx.*
* It is a ***muscular passage*** and ***lined with mucous membrane***.
* Palate divides the pharynx into ***nasal pharynx*** and ***oral pharynx***.
* In pharynx, the passage of air and food is regulated to trachea and esophagus, respectively.

Larynx:

The upper end of the trachea is surrounded by a complex ***cartilaginous structure*** *called larynx or* ***voice box****.*

Epiglottis:

Epiglottis is *cartilaginous*. It is controlled by muscles.

Epiglottis ***serves as a lid*** and ***hinge like in action.*** During swallowing it automatically *covers the opening of the larynx* and prevent the entry of food or liquids into the larynx.

Glottis is the cavity of the larynx and it also has mucous membrane covering.

Vocal Cord:

* Vocal cords are the ***fibrous structures*** present in larynx.
* They are ***two in number*** and have thin edges.

* As air passes through larynx, the vocal cords become stretched and ***produce sound.***

* *By tongue and lips, this sound changed into words.*

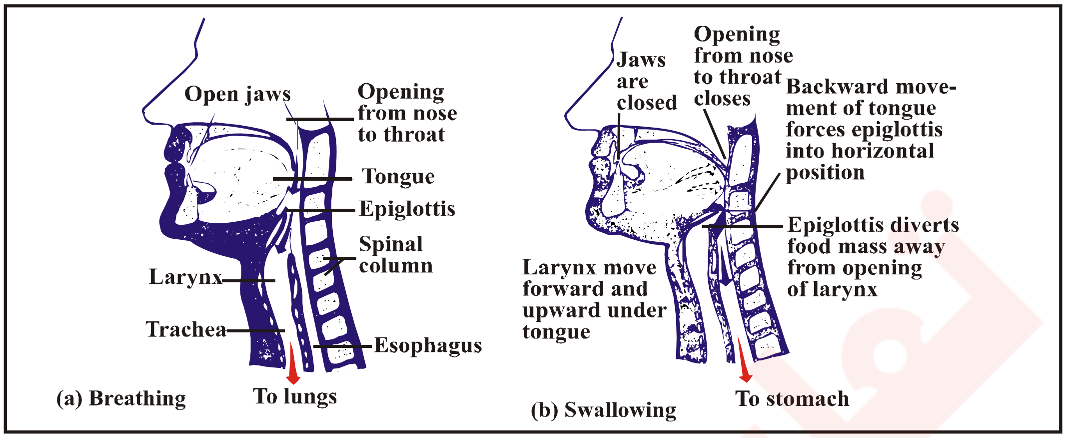


Fig. Events in the throat associated with breathing (a) and swallowing (b) The commonly held belief that the epiglottis closes downward upon the larynx when food is swallowed is not quite true. The closure is probably never complete; the degree of closure is determined partly by the backward movement of the tongue during swallowing (which forces the epiglottis into a more or less horizontal position) and partly by the upward movement of the larynx (which brings it up under the epiglottis). Food does not enter the partly open larynx and obstruct breathing primarily because the epiglottis diverts the food mass to one side of the opening and safely down the esophagous.

Trachea:

Larynx leads to the trachea which is **tubular structure and is supported by "C"** shaped cartilages. Due to these cartilages, trachea does not collapse and provides a passage for air to move.

Trachea after passing through neck, enters the chest cavity, where it divides into two bronchi. Each bronchus on entering into the lungs divides and sub divides into smaller tubes and channels. Bronchi have same cartilage rings as the trachea, but these rings are replaced by irregularly distributed cartilage plates.

Smaller bronchi when attain the diameter of 1.0 mm or less then that they are called bronchioles.

Bronchioles are made up of ***circular and smooth muscles*** and they totally ***lack cartilage.***

ALVEOLI

The bronchioles are divided and subdivided into the lungs and open into a large number of **air sacs.** The air sacs have cluster of ***grapes like structure***.

Each air sac consists of several single layered microscopic structure called alevoli. These are the functional units of lungs. ***Each alveolus is provided by a rich network of blood capillaries,*** which are excellent sites for the exchange of gases.

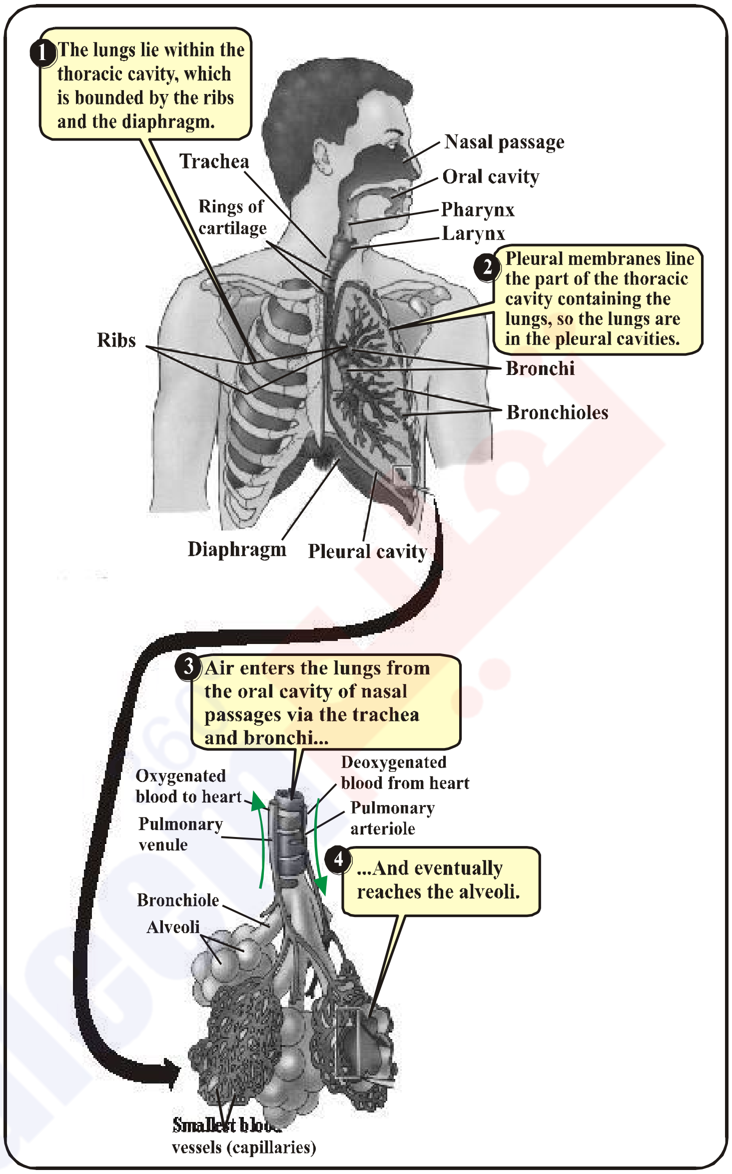


Fig. Human Respiration

Lungs

Lungs are closed sacs, which are connected to outside by the way of the treachea and nostrils or mouth. Because of the presence of millions of alveoli, lungs become *spongy*.

Lungs are ***placed in chest*** cavity which are bounded by ***ribs*** and side muscles.

The floor of the chest is called ***diaphragm***.

Lungs are covered with double layered thin membranous sacs called ***pleura***.

Breathing

Breathing is a mechanical process which is concerned with pumping in and out air to and from lungs. It comprises of *inhaling* or taking in air or inspiration and *exhaling* or expelling of air from the lungs or expiration.

HELPLINE

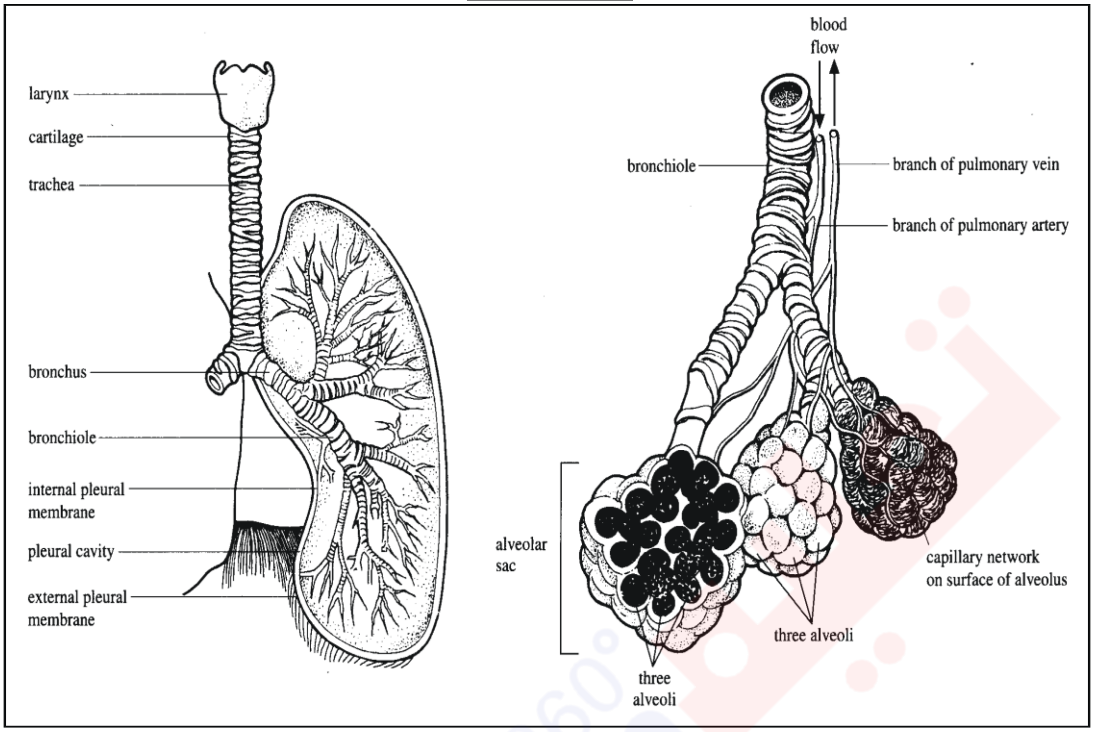


Fig. Human trachea and lungs

When a person is at rest the rate of ***breathing is 15 – 20 time per minute***. During exercise it may rise upto 30 – 40 times per minutes.

HELP LINE

Table Path of Air

Structure	Description	Function
Nasal cavities	Hollow spaces in nose	Filter, warm, and moisten air
Pharynx	Chamber behind oral cavity and between nasal cavity and larynx	Connection to surrounding regions
Glottis	Opening into larynx	Passage of air into larynx
Larynx	Cartilaginous organ that contains vocal cords (voice box)	Sound production
Trachea	FLexible tube that connects larynx with bronchi (windpipe)	Passage of air to bronchi
Bronchi	Major divisions of trachea that enter lungs	Passage of air to each lung
Bronchioles	Branched tubes that lead from the bronchi to the alveoli	Passage of air to each alveolus
Lungs	Soft, cone-shaped organs that occupy a large portion of the thoracic cavity	Gas exchange

Q.7 Describe the mechanism of breathing in man?

Ans. BREATHING IN MAN

Breathing is a ***mechanical process***, in which air containing more oxygen or fresh air is pumped into the lungs and air with more carbon dioxide is pumped out of the lungs.

The process of breathing consists of two phases:

(1) Inspiration (2) Expiration.

(1) Inspiration (Inhalation):

The space in ***chest cavity is increased*** during inspiration in two ways.

(i) Firstly, the muscles of ribs contract, as the result ***ribs elevate upwards*** and forwards.

(ii) And secondly, the muscles of diaphragm also contract, as the result, ***diaphragm becomes less dome like***.

(iii) The upward and outward movement of the ribs and the downward movement of diaphragm, increases in the volume of chest cavity and reduces pressure.

(iv) ***Due to reduction is pressure, lungs expand. A vaccum is created inside the lungs due to expansion in vacuum the air rushes from the outside. This phase is called inspiration.***

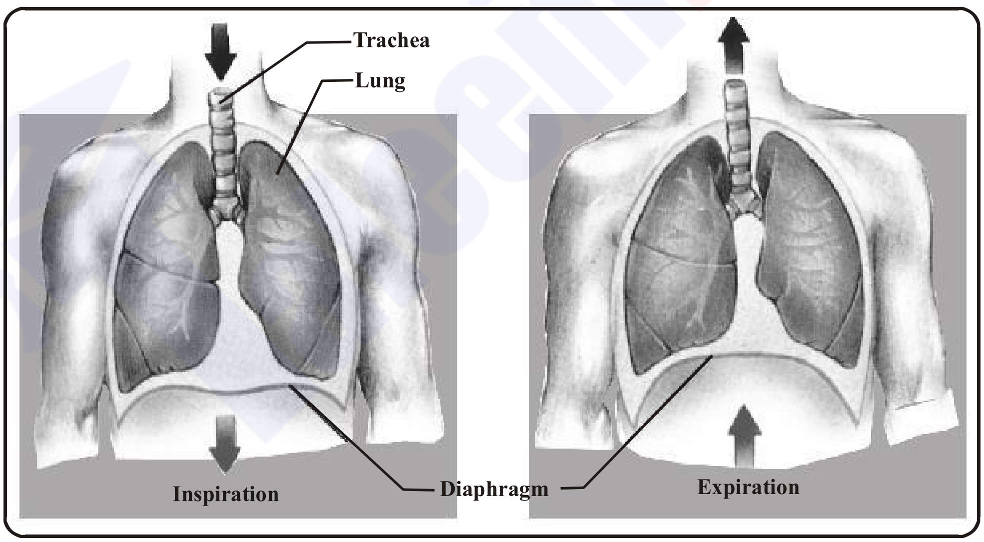


Fig. Movement of Diaphragm

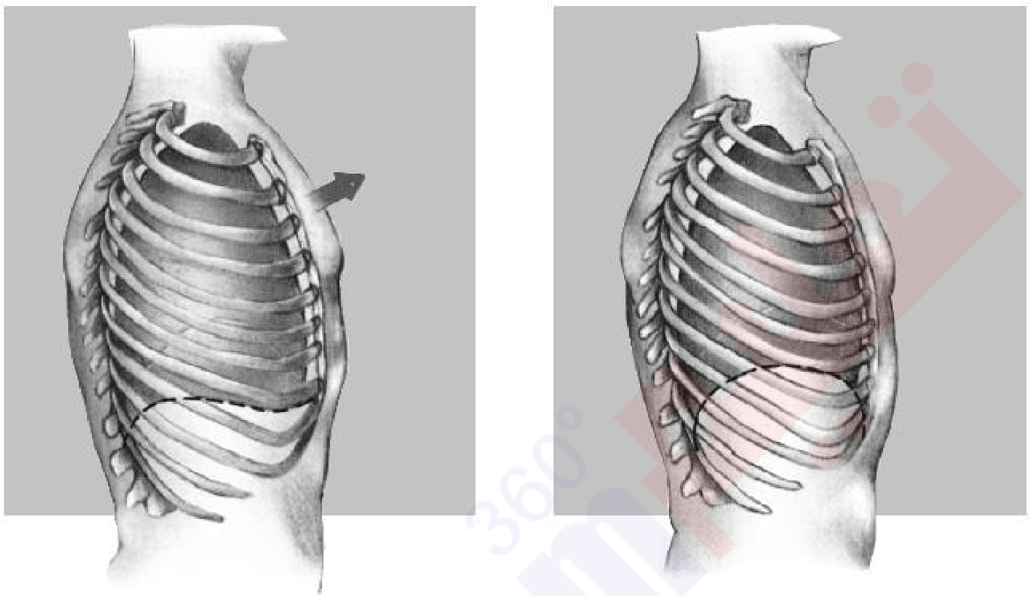
(2) Expiration (Exhalation):

(i) ***During expiration the muscles of ribs are relaxed. As a result the ribs move downward and inward.***

(ii) The space from the side of chest cavity becomes less. At the same time the muscles of diaphragm also relax.

(iii) It become dom like, as the result, from the floor, the volume of chest cavity also reduces.

(iv) The reduction in space of the chest cavity exerts pressure on lungs. The lungs press the air inside and air moves out of them. This is expiration.



Inspiration Expiration

Q.8 How does transportation of oxygen and carbon dioxide takes place?

Ans. (a) TRANSPORT OF OXYGEN

Haemoglobin is the respiratory pigment in human beings. It is present ***in red blood corpuscles,*** and is made up of ***574 amino acids.***

The haemoglobin ***combines with oxygen*** and form ***bright red Oxyhaemoglobin.*** In the condition of low oxygen concentration and less pressure, the Oxyhaemoglobin is splits into *normal purple-red coloured* haemoglobin and oxygen.

In red blood cells this respecting of oxyhaemoglobin facilitated by ***carbonic anhydrase enzyme***. In this way, haemoglobin acts as a efficient *oxygen carrier*.

A small quantity of oxygen also gets dissolved in the blood plasma.

$$Hb + O_2 \xrightarrow{\text{Carbonic anhydrase}} HbO_2$$

(Haemoglobin) (Oxy-haemoglobin)

Dark red Bright red

COMBINATION OF O_2 AND HAEMOGLOBIN AT SEA LEVELS

At sea level, the haemoglobin can absorb maximum oxygen. Normal human blood absorbs and carries maximum amount of oxygen about ***20 ml/100 ml of blood, at the sea level***.

This is the maximum capacity of haemoglobin for oxygen when it is fully oxygenated. ***The blood of alveoli of the lungs under normal conditions is not completely oxygenated.***

In the lungs, when oxygen tension is 100 mm mercury, then haemoglobin gets 98% saturation, it means it contains 19.6 ml of oxygen per 100 ml of blood.

In cells and tissues, the oxygen saturation of haemoglobin decreases very sharply, when oxygen pressure falls below 60 mm mercury. As the result large quantity of oxygen liberates from haemoglobin. In the tissue where oxygen tension is low, oxyhaemoglobin dissociates rapidly.

There are three important factors which affect the capacity of heamoglobin to combine with oxygen.

(1) Temperature:

Increase in temperature, decreases the oxygen carrying capacity of blood.

(2) Carbondioxide:

Increased carbon dioxide tension favours the greatest liberation of oxygen from blood to the tissue.

(3) pH:

pH also affects the oxygen carrying capacity of blood. As the ***pH of the blood declines, there is an increase in hydrogen ions in blood and these hydrogen ions combine with the protein part of the haemoglobin to combine oxygen is reduced conversely***. An increase in pH of blood results in an increased ability of haemoglobin to bind oxygen.

(b) TRANSPORT OF CARBON DIOXIDE

Carbon dioxide is more soluble than oxygen in the tissue fluid. There are different states for carbon dioxide transportation.

(i) Major part of carbon dioxide (about 70%) is transported in combination with water. As carbon dioxide from tissue fluid enters. The capillaries it combines to form carbonic acid.

$$\boxed{CO_2 + H_2O \longrightarrow H_2CO_3}$$

The carbonic acid quicily ionized and produced hydrogen ions and bicarbonate ions.

$$\boxed{HO_2 + CH_2O \longrightarrow H^+ + HCO_3}$$

When blood enters in lungs it contains CO_2 in the form of bicarbonate ions. Here bicarbonate ions combine with hydrogen ions to form carbonic acid. The carbonic acid splits into water and carbon dioxide. Carbon dioxide diffuses out into space of alveolar space from the capillaries of the lungs.

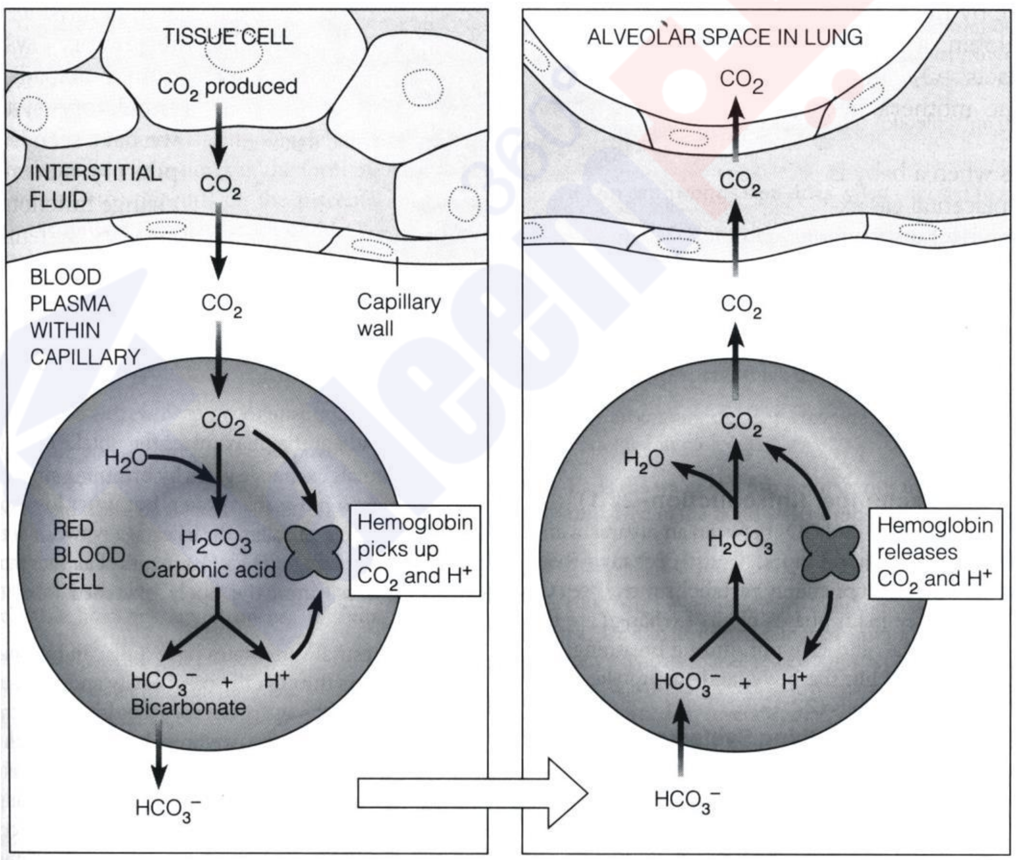
$$HCO_3 + H^+ \longrightarrow H_2CO_3 \longrightarrow CO_2 + H_2O$$

(ii) About ***20% of the carbon dioxide is carried*** in the form of ***carboxyhaemoglobin.***

(iii) About ***5% of the carbon dioxide is carried from the body fluids*** to the capillaries of lungs by the plasmic proteins.

(iv) ***Small amount of carbon dioxide is also carried by corpuscles,*** combined with potassium.

HELPLINE



A. CO_2 transport in the body tissues **B.** CO_2 transport in the lungs

Q.9 Write a note on some respiratory disorders in man. OR
Write notes on: (i) Emphysema (ii) Asthma (iii) Tuberculosis (iv) Cancer

Ans. (i) Emphysema (Break Down of Alveoli, Smoker's Cough):

Emphysema is more common in ***smokers***.

Emphysema is the break down of alveoli and increases the resistance in air passage.

The chemicals present in the smoke *weaken the walls of alveoli*. Smoke also cause the *irritation*, resulting in to **cough**, called *smoker's cough*. This coughing results into the break down of weak alveoli. The person suffering from emphysema cannot oxygenate his blood properly and least ***exertion*** makes him *breathless* and *exhausted*.

(ii) Asthma

Asthma is a serious respiratory disorder.

It is associated with ***severe paroxysm*** of ***difficult breathing***.

Asthma is followed by a period of complete relief and ***attack is repeated at regular intervals***. It is an allergic reaction.

Allergy may be due to pollen, spores, pollution, humidity, cold etc, which increases the ***spasmodic contraction*** of small bronchioles during asthma.

Some inflammatory chemicals like histamines release into the blood that cause severe contraction of bronchiole.

(iii) Tuberculosis (*Lung infection by Mycobacterium*)

Tuberculosis is the general name a group of diseases of respiratory system caused by ***Mycobacterium tuberculosis.***

In the pulmonary tuberculosis inside of the ***lung is damaged*** resulting in ***cough*** and ***fever***. It is more common in poor people because ***malnutrition*** and poor living conditions facilitate the growth of *Mycobacterium*.

This disease is ***cureable*** with proper medical alternation.

(iv) Cancer

The uncontrolled growth of parts of the body is called cancer.

Lung cancer is one of the most serious diseases of respiratory system.

Cancer or carcinoma is a ***malignant tumor*** of unlimited growth, that expands.

This tumor replaces the lung tissue and also block it.

Smoking and ***pollution*** are the major reasons of cancer.

It is estimated that 90% of lung cancer is *caused by smoking* and more than 10 compounds of tobacco smoke are involved in the reason of cancer.

HELP LINE

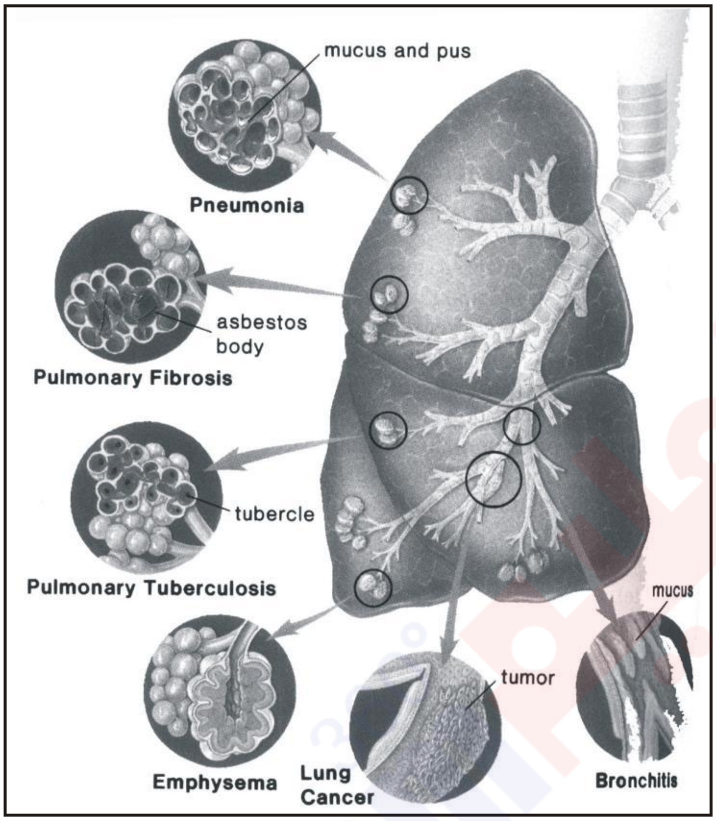


Fig. Common bronchial and pulmonary infectious diseases and disorders.

Q.10 Write notes on:
(a) Respiratory pigments
(b) Lung capacity

Ans. (a) Respiratory Pigments

The pigments carrying the oxygen in the blood are called respiratory pigments. There are various types of respiratory pigments.

Heamoglobin is the most important, which is present in vertebrates including man.

Haemoglobin:

Haemoglobin is *present in the red blood cells*.

In man, it *increases the oxygen carrying capacity* of blood up to 75 times.

Myoglobin:

Myoglobin is *present in the muscle fibres* and is also known as muscle haemoglobin.

It acts as our intermediate compound for the transport of oxygen from haemoglobin to aerobic metabolic processes of the muscle cells.

Haemocyanins, Haemoerythrin, Chlorocorius:

These pigments are ***found in invertebrates***, haemocyanin is blue in colour due to presence of copper and is present in Mollusca and Arthropods.

(b) Lung Capacities:

In an adult human being, the total inside capacity of lung is about 5 litres when the lungs are fully inflated.

The exchange of gases is only about half a litre when at rest or asleep while during exercise the volume of air is taken inside the lungs and expelled is about *3.5 litres*.

In other words, *during exercise there is a residual volume of 1.5 litre which we expel.*

Q.11 Are Tuberculosis, Asthma and Cancer cureable diseases?

Ans. (i) **Tuberculosis** is a cureable disease because *Mycobacterum tuberculosis* may be is killed by antibiotics.

(ii) **Asthma** may be cureable if allergic reactions are avoided and by avoiding the allergy causing agents and utilization of antibiotics.

(iii) In early stage **cancer** may be controlled by *chemotherapy* and *Radiotheropy*, otherwise, it becomes uncureable, ultimately.

Q.12 What are histamines and how they are controlled?

Ans. *Histamines are those chemical which are secreted by the body in response to allergic agents*.

Histamines secretions become the reason of different allergies.

Allergies may be cured by Anti-histamine drugs like Avil & Incidal etc..

Q.13 What is cancer?

Ans. ***Uncontrolled growth*** of cells or tissues of body organ results tumor formation or disturbed amount or function of cells or tissue is called cancer.

Q.14 What is the distribution of following pigments:

(i) Haemocyanins (ii) Haemoglobin (iii) Myoglobin.

Ans. ***(i)*** ***Haemocyanin*** found is Mollusca and Arthropods.

(ii) ***Haemoglobin*** found in RBCs.

(iii) ***Myoglobin*** found in muscles fibres.

Q.15 Give representation of chemical reactions of transport of CO_2.

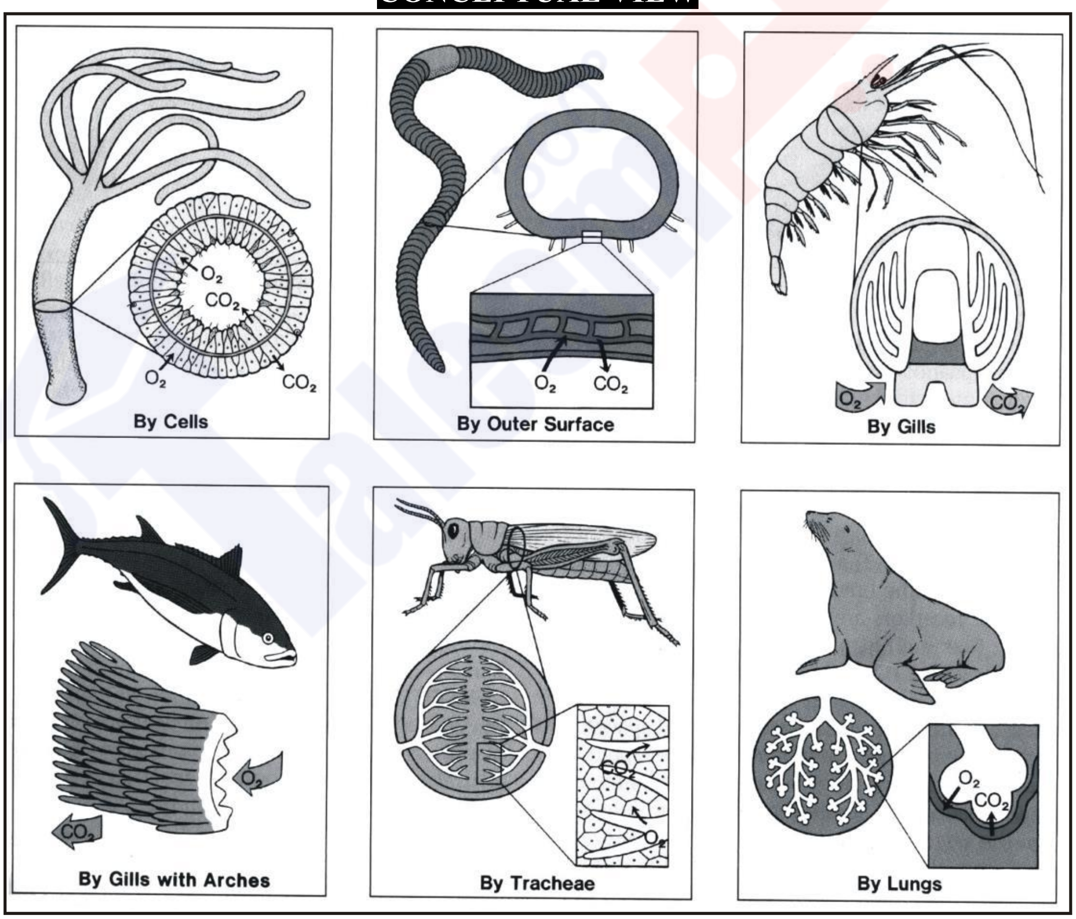
Ans.

$$CO_2 \text{ from Cell} \longrightarrow \underbrace{CO_2 + H_2O \longrightarrow H_2CO_3}_{\text{(1) In capillaries}} \longrightarrow H^+ + HCO_3$$

$$H^+ + HCO_3 \xrightarrow{\text{(2) Capillaries \& lungs}} H_2CO_3$$

$$CO_2 \text{ goes out of the body} \longleftarrow \underbrace{CO_2 + H_2O}_{\text{(3) Alveolar space}} \longleftarrow H_2CO_3$$

CONCEPTUAL VIEW



DIFFICULT WORD MEANINGS

Words	Meanings	Words	Meanings
Extracts	نکالنا	Posterior	پچھلے
Ventilation	ہوا کا آر پار ہونا	Inhalation	ہوا اندر کھینچنا
Conducting	پاس کرنا	Trachea	ہوا کی نالی
Vessel	نالی / ویسل	Visible	دکھائی دینے والا
Lenticels	تنے یا برانچ میں سوراخ	Ventilated	جس سے ہوا گزرے
Enormous	کئی / بہت زیادہ	Cutanious	جلد سے متعلقہ
Tobacco	تمباکو	Nostrils	نتھنے / ناک کے سوراخ
Estimated	گنا ہوا / اندازے سے	Muscularly	پٹھے
Promptly	جلدی سے	Subdivides	مزید تقسیم
Exciting	متحرک / پر جوش	Diaphragm	پیٹ اور چھاتی کو علیحدہ کرنے والی ساخت
Ribulose	ایک شوگر کا نام	Consumed	استعمال ہونا
RuBP	ایک کیمیکل	Rhythmically	تواتر کے ساتھ / متواتر
Diffuses	to diffuse / scatter	Associated	سے متعلق
Calvin-Benson	ایک کیمیائی عمل کا نام	Expansion	پھیلاؤ
Fixation	فکس کرنا	Ribs	پسلیاں
Carboxylase	ایک انزائم	Pigment	ڈائی / کیمیکل جو جذب کرے / دھبہ
Rubisco	روبیسکو (ایک کیمیکل / انزائم)	Splits	توڑنا
Moist	گیلا / نمی والا	Liberation	اخراج
Extensive	پھیلا ہوا	Dissociates	توڑنا
Adequate	مناسب / موزوہ	Declines	کم ہونا / اترنا / نیچے کی جلد

Gradient	moving by step	Diffuse	ملنا/انجذاب
Cuticle	اوپر والی تہہ	Pulmonary	پھیپھڑوں سے متعلقہ
Tracheoles	انتہائی باریک ہوا یا سانس کی نالیاں	Malignant	کینسر کا باعث
Domelike	گنبد نما/آرک کی طرح	Invasion	اندر داخل ہونا
Spiracular	چھوٹے چھوٹے سوراخ بیرونی جانب	Exhausted	تھکا ہوا
Tumor	گلٹی	Inflammation	سوجن اور درد
Spasm	Muscle contraction	Affinity	صلاحیت/تعلق
Manifest	نمائش/اظہار	Expelled	دھکیلا/دھکیلنا
Asthama	دمہ	Constituents	اجزا
Emphysema	تمباکو نوشی کی کھانسی	Exhaled	باہر نکالنا
Exertion	تھکاوٹ	Domelike	گنبد نما
Spasmadic	غیر ارادی طور پر پٹھوں کا کھنچاؤ	Paroxysm	جذبات کی اچانک انتہا

Q.1 Fill in the blanks:

(i) ―――――― is the most abundant protein in the world.

(ii) Haemoglobin is a complex molecule which contains ―――――― atmos and 574 amino acids.

(iii) The opening of larynx is called ――――――.

(iv) When the smaller bronchi attain the diameter of ―――――― mm or less they are called bronchioles.

(v) There are about ―――――― stomata per square centimeter of leaf surface of tobacco plant.

ANSWERS:

(i) Rubisco (ii) 9512 (iii) Glottis

(iv) One (v) 12000

Q.2 Write whether the statement is true or false. Correct the statement if it is false?

Ans.

	STATEMENT	T/F	CORRECT STATEMENT
(i)	ATP is generated during organismic respiration.	F	ATP is generated during cellular respiration.
(ii)	Water is a better respiratory medium than air.	F	Air is a better respiratory medium than water.
(iii)	The earthworm does not posses specialized organs for respiration.	T	
(iv)	In parabronchi of birds, the blood flows in the opposite direction of air flow.	T	
(v)	Ring shaped cartilages are present in trachea of man.	F	C-shaped cartilages are present in the trachea of man.

Q.3 Each question has four options. Encircle the correct answer:

(i) Air spaces between mesophyll cells of a leaf comprises ―――――― of the total volume:

(a) 20% (b) 30%

(c) 40% (d) 50%

(ii) The respiratory system is most efficient in ————:

(a) Man (b) Bird

(c) Fish (d) Snake

(iii) Respiratory pigment present in muscles is called ————:

(a) Myoglobin (b) Globin

(c) Haemoglobin (d) Haemocyanis

(iv) Blood contains ———— oxygen when haemoglobin is 98% saturated per 100 ml of blood.

(a) 5 litres (b) 4 litres

(c) 4.5 litres (d) 19.6 ml

(v) How much air lungs can hold when they are fully inflated:

(a) 5 litres (b) 4 litres

(c) 4.5 litres (d) 3.5 litres

ANSWERS:

(i) (c) (ii) (b) (iii) (a) (iv) (d) (v) (a)

Q.4 Short Questions:

(i) How does breathing differ from respiration?

Ans. Breathing is simply exchange of gases, while respiration is the oxidation of food to release energy.

(ii) How much carbon dioxide is present in venous and arterial blood?

Ans. Venous blood has 54 ml of CO_2 per 100 ml of blood while arterial blood contains about 50 ml of CO_2 per 100 ml of blood.

(iii) How does air always remain in the lungs of human beings?

Ans. 1.5. litres

(iv) What are the products which are produced during photorespiration?

Ans. Serine

(v) How much a water medium is denser than air medium for exchange of respiratory gases?

Ans. 50 times

Chapter 14

TRANSPORT

Q.1 What is translocation?

Ans. **TRANSLOCATION**

The movement of substances through the conducting or vascular tissue of plants is called translocation.

Xylem translocates mainly H_2O, mineral salts, organic substances and hormones from the roots to the aerial parts of plants.

Phloem translocates variety of organic and inorganic solutes, mainly from the leaves or storage organs to other parts of plants.

Q.2 Define transport. What is the importance of transport in living bodies?

Ans. **TRANSPORT**

"The movement of any object from one place to another with help or without help of other body is known as transport".

Importance: Living cells or living bodies have reservoirs of making and breaking of different chemicals. These chemicals are formed or broken down in different chemical reactions. Energy is also obtained in such reactions. Maintenance of life taking of specific chemicals and removal of certain chemicals are essential. For these purposes transport is compulsory process.

In unicellular, transport is very easy and simplest. In multicellular, division of labour of different tissues or organs are found and transport is complex.

Q.3 Define Osmosis, Osmotic Potential, Water potential, solute potential and pressure potential.

Ans. **OSMOSIS**

The movement of water molecules from a region of their ***high concentration*** (a dilute solution) ***to the region of their low concentration*** (more concentrated solution) through a partially permeable membrane is called osmosis.

Solute Potential (or Osmotic Potential) (γ_S):

"The lowering of concentration of water molecules by the effect of dissolving of solute molecules in the pure water is called solute potential". In other words:

The measure of the change in water potential of the system due to the presence of solute molecules is known as solute potential.

Water Potential:

"The tendency of water molecules to move from one place to another is called water potential".

* Keep in mind for conception:

* $\left\{\begin{array}{l}\text{Greater of water molecules} \propto H_2O \text{ potential} \propto \text{K.E.} \\ \text{Increase of solutes means decrease of } H_2O \text{ potential}\end{array}\right\}$

Pressure Potential (γ_P) (Turgor Potential):

"The pressure tending to force the water from one place to another is called pressure potential".

Examples: When water enters plant cells by osmosis, pressure may build up inside the cell making the cell turgid and increasing pressure potential. (OR) "The build up of pressure inside the cell after the endosmosis due to water or solution is called water potential".

* Pure water or water molecules $\propto$ pressure potential.

Q.4 (a) Explain water potential with reference to osmotic and pressure potentials.

Ans. Water Potential (Symbolized by Greek Letter Psi = Ψ_W):

Water molecules possess kinetic energy. Molecules of liquid or gaseous form they move about rapidly and randomly from one place to another. It means greater the concentration of the water molecules in a system the greater is the total kinetic energy of water molecules. In other words, water molecules are directly proportional to kinetic energy.

In plants cells two factors i.e., (1) Osmotic potential and (2) Pressure potential.

(1) **Solute concentration** = (Osmotic or solute potential = Ψ_S)

(2) **Pressure generated when water enters and inflates plant cells** = (Pressure potential = Ψ_p).

(a) *Pure water has maximum water potential which by definition is zero.*

(b) Water moves from a region of higher Ψ_w ——— to lower Ψ_w.

(c) All solutions have lower Ψ_w than **pure water** and so have negative value of Ψ_w (at atmospheric pressure and at a defined temperature).

(d) **Osmosis means:** "The movement of water molecules from a region of higher water potential to a region of lower water potential through a partially permeable membrane".

(1) Osmotic (Solute) Potential = Ψ_s:

The osmotic (solute) potential Ψ_s is a measure of the change in water potential (Ψ_w) of a system due to the pressure of **solute molecules**.

Ψ_s is always negative. More solute molecules present, lower (more negative) is the Ψ_s.

(2) Pressure Potential (Ψ_p) (Turgor Potential):

If pressure greater than atmospheric pressure is applied to pure water or a solution, its water **potential** increase.

It is equivalent to pumping water from one place to another. Such a situation may arise in living systems.

When water enters plant cells by osmosis pressure may be build up inside the cell making the cell turgid and increasing the pressure potential. Thus the total water potential is sum of Ψ_s and Ψ_p.

Ψ_w	=	Ψ_s	+	Ψ_p
water potential		solute potential		pressure potential

If we use the term water potential, the tendency for water to move between any two systems can be measure; not just from cell to cell in a plant but also from soil to root from leaf to air of from soil to air. The steeper the potential gradient the faster is the flow of water along it.

The following example would help understand the concept of water potential. Two adjacent vacuolated cells are shown with Ψ_w, Ψ_p and Ψ_s.

Q.4 (b) Examine the following diagram and give answers of the following questions.

Ans.

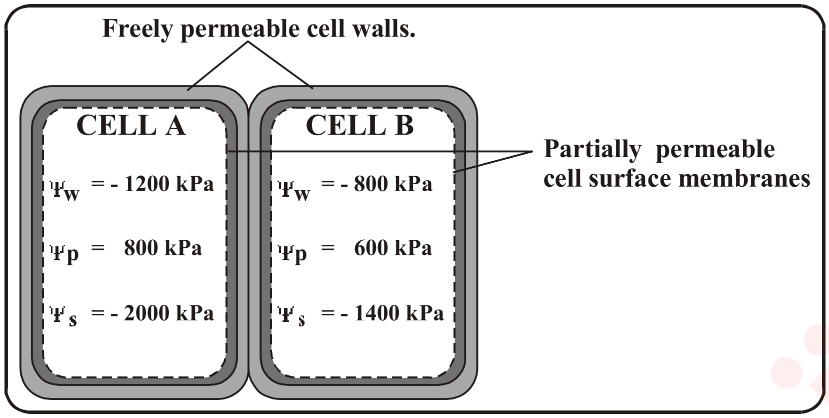


Fig. Two adjacent vacuolated cells

(a) Which cell has the higher water potential?

(b) In which direction will water move by osmosis?

(c) What will be the water potential of the cells at equilibrium?

(d) What will be the solute potential and pressure potential of the cells at equilibrium?

> Kpa = 1000 Pascals – which is the pressure exerted by a vertical force of one Newton on an area of I metre square.

Q.4 Briefly describe the vascular system.

Ans. **Definition of Vascular System**

The system in which tubular structures carry fluids, which is transported from one place to another.

Both animals and plants have vascular systems.

In plants, the xylem and phloem form vascular system.

Q.5 Differentiate between Active transport and Osmosis.

Ans.

Osmosis	Active Transport
Movement of molecules from high concentration to low concentration through the partial permeable membrane is called osmosis. (High Conc.) $\xrightarrow{\text{Partial permeable membrane}}$ (low conc.)	The movement of molecules from low concentration to high concentration by the expenditure of energy is called active transport. (Low conc.) $\xrightarrow{\text{Expenditure of energy}}$ (high conc.)

Q.6 Differentiate between endosmosis and exosmosis.

Ans.

Endosmosis	Exosmosis

(1)	The kind of osmosis in which movement of water molecules takes place *inside from outside* the cell is called endosmosis.	(1)	The kind of osmosis in which movement of water molecules occurs from inside to outside the cell is termed as exosmosis.
(2)	Turgor pressure develops on cell wall due to endosmosis (or) Deplasmolysis occurs due to endosmosis.	(2)	Shrinkage of protoplast occurs due to exosmosis and plasmolysis takes place.
(3)	Living cell has higher water potential.	(3)	Living cell has lower water potential.
(4)	Pressure potential is increased by endosmosis.	(4)	Pressure potential is decreased by exosmosis.

Q.7 Briefly discuss structure and function of roots.

Ans. **MAJOR FUNCTIONS OF ROOTS**

(i) Roots *absorb minerals and water* from the soil.

(ii) Roots *anchor the plant* body in soil.

(iii) *Diffusion, osmosis* and *active transport* processes are involved in it.

Structures of Roots:

(i) Mostly, the roots are extensively *branched*.

(ii) Think tiny hair like structures known as *root hairs* are present in cluster forms.

(iii) Root hairs are extensions of *epidermal cells* which increase the absorbing area. These surround 67% area of root surface.

(iv) From roots hairs water enters in *Epidermis*. After it water reaches in *Cortex*. Then water goes into *endodermis* and *pericycle* respectively. Ultimately water enters into vascular bundle i.e. xylem *Tracheids* and *vessels* tissue involve in ascent of sap.

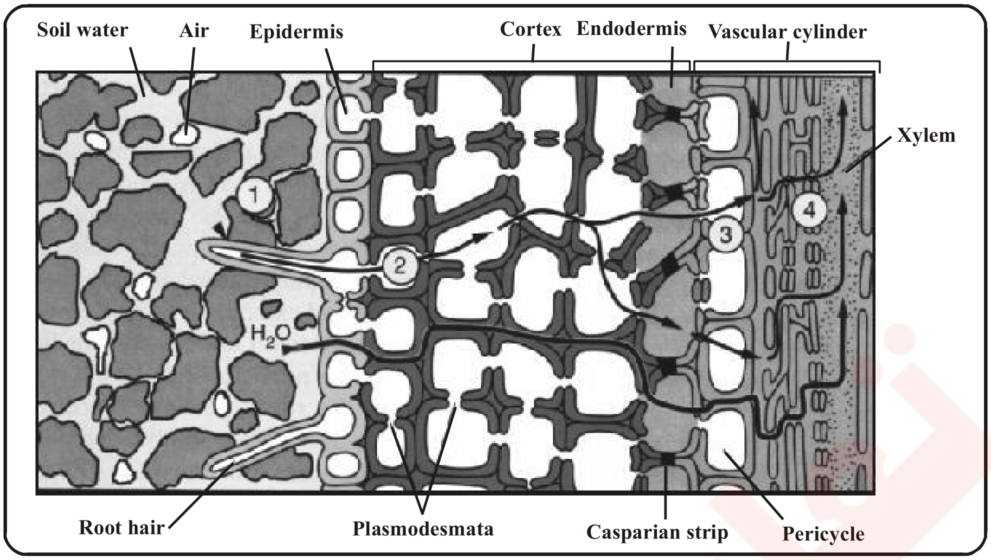


Fig. Mineral and water uptake by roots. The Caesarian strip separates the extracellular space in the root into two compartments: an outer compartment that is continuous with the soil water, and an inner compartment that is continuous with the inside of the conducting cells of the xylem. The black lines a pathway for both water and minerals; the blue line is an alternative pathway for water alone.

EASY TO DRAW

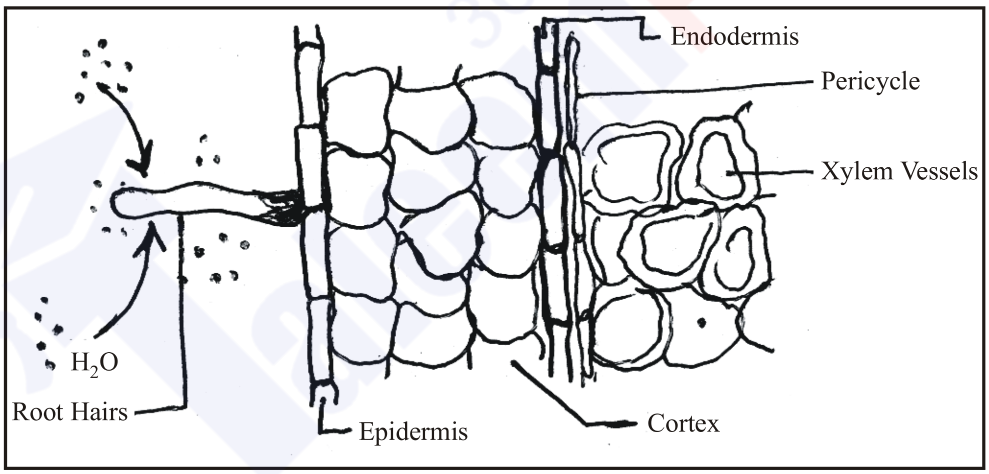


Fig. Showing movement of H_2O is root

Q.8 Give the details of the processes, which involved in absorption by roots.

Ans. **LIST OF INVOLVED PROCESSES**

(i) Diffusion
(ii) Osmosis

} Passive Transport

(iii) Cohesion and Adhesion

(iv) Active Transport

H_2O uptake and transport occurs by two main processes i.e. passive transport and active transport. In case of passive transport no expenditure of energy is involved while in case of active transport energy is involved.

PASSIVE TRANSPORT

Passive transport means diffusion and osmosis.

(i) **Diffusion:** Diffusion is the process in which ions or molecules move from higher concentration to lower concentration.

(ii) **Osmosis:** Osmosis is the process in which ions or molecules move from higher concentration to lower concentration via semi permeable membrane.

(a) Symplast Pathway:

The pathway through which molecules move due to osmosis via plasmodesmota, cortex, endodermis, pericycle and then to xylem respectively is called symplast pathway.

Keep in Mind: This movement occurs *through the free spaces* between the cells *without entering into cytoplasm*.

(b) Facilitated Diffusion:

The diffusion which carry nutrients from the soil to the epidermal cells of roots through their cell membranes is called facilitated diffusion.

(c) Apoplast Pathway:

The diffusion of ions with H_2O which takes place by mass flow *through cell wall and free spaces* between the cells is known as apoplast pathway.

In this pathway, the moving ions cross the endodermis and enter into cytoplasm or possibly their vacuoles by diffusion or active transport. These ions ultimately reach the to xylem cells.

(d) Vacuolar Pathway:

The pathway through which ions or molecules move via cell membrane cytoplasm and tonoplast (vacuolar membrane) and reach the xylem cells called vacuolar pathway.

(iii) Active uptake or Transport (OR) Active Transport:

The uptake of materials from lower concentration to higher concentration (against concentration gradient) by the help of energy is called active uptake. Energy is used in the form of ATP. Due to use of energy the active transport is dependable.

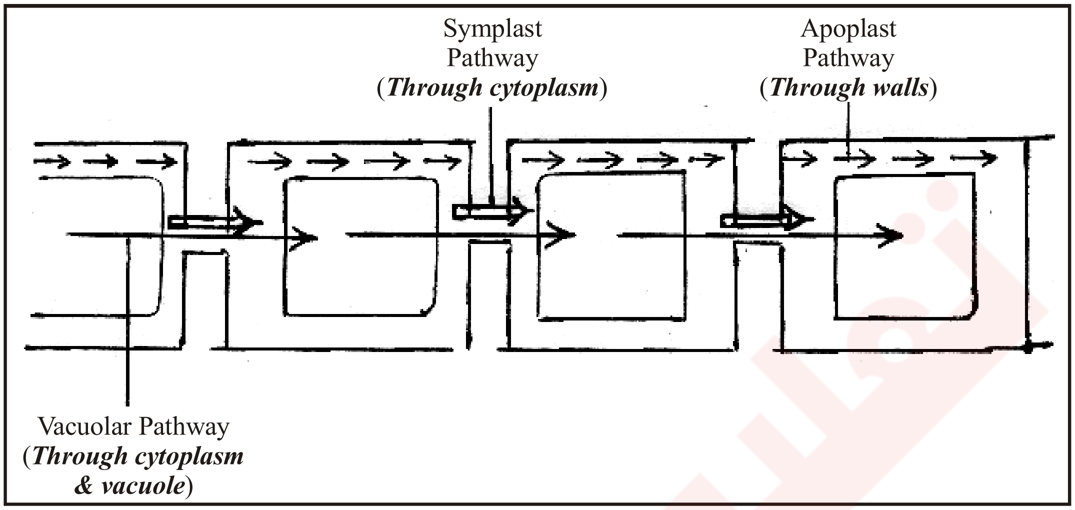


Fig. Different pathways through which molecules move

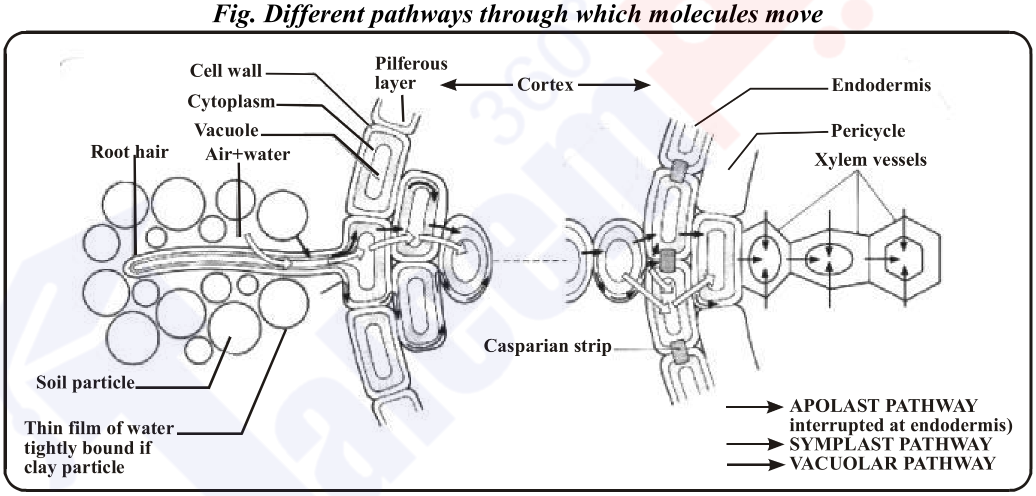


Fig. Diagramatic representation of water andion movement across a root showing transverse section. The apoplast pathway is of greatest importance for both water and solutes. The symplast pathway is less important, except for salts in the region of the endodermis. Movement along the vacuolar pathway is negligible.

Q.9 What are plasmolysis and Deplasmolysis?

Ans. Plasmolysis

The shrinkage of protoplast due to exosmosis of water from living cell when placed in more concentrated solution is called plasmolysis.

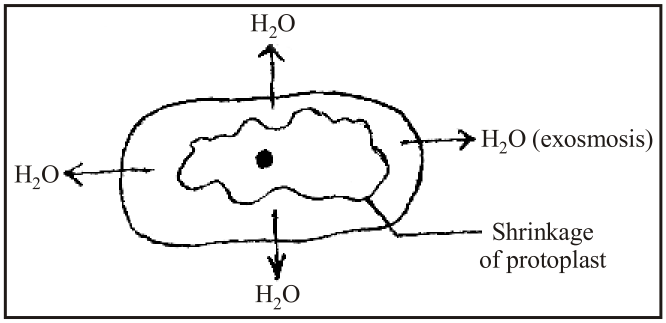


Fig. Plasmolysed cell

Deplasmolysis

The process in which shrinked protoplast of living cell becomes normal by the endosmosis when placed in H_2O.

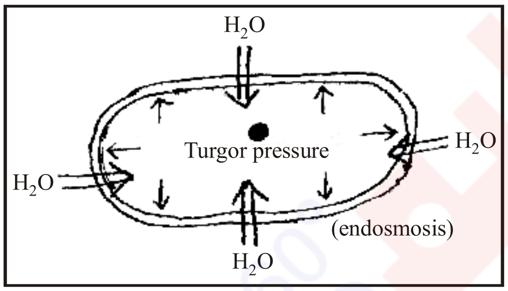


Fig. Deplasmolysed cell

Q.10 Write down relationship between plasmolysis and pressure potential?

Ans. When shrinked or plasmolysed cell is placed in pure water, in this way, water enters the cell by endosmosis. Endosmosis occurs because pure water has higher water potential than protoplast of living cell.

After entrance of water, pressure is exerted on the cell wall. So, the rigidity against the cell wall is due to pressure of H_2O. *"The pressure exerted by the protoplast against the cell wall is called pressure potential"*.

The result of pressure potential is appeared in the form of turgidity.

(1) Turgidity $\propto$ Pressure Potential

(2) Pressure Potential $\propto$ pure water.

(3) Deplasmolysis $\propto$ endosmosis

(4) Plasmolysis $\propto$ 1/ pressure potential.

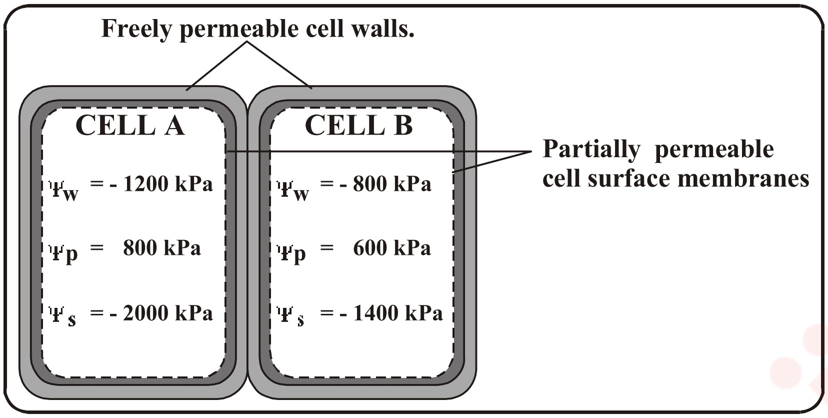


Fig. Two adjacent vacuolated cells

Q.11 Describe relationship of water potential to other potential.

Ans.

Ψ_W	=	Ψ_S	+	Ψ_P
Water	=	Solute potential		Pressure potential
Ψ_W	=	Ψ_π	+	Ψ_P

Q.12 What do you know about following terms:
(i) Turgor Pressure (ii) Matric Potential

Ans. The pressure of turgid state of cell due to hydrostatic pressure is known as turgor pressure;

(OR)

The force causing imbibition or H_2O holding capacity in a matrix of any sort γ_w water potential is called matric potential.

Q.13 What is imbibition? Give its importance.

Ans. **IMBIBITION**

"The process of take up of H_2O of components of cell wall (cellulose) in which volume of components is increased but they do not dissolve known as imbibition".

IMPORTANCE OF IMBIBITION:

(i) **Ascent of Sap:** In 1874, Sacks suggested that the water molecules move along the cell walls of xylem vessels due to imbibition.

(ii) **Without Dissolving in H_2O:** The component of cell wall i.e. cellulose can take up water and as a result increase in volume, but the components do not dissolve in water.

(iii) **Increase of Volume:** After take up of H_2O the components of cell wall increase in volume and in this way dissolving does not occurred.

(iv) Water Movement and Apoplast Pathway: The root cell walls imbibe water from soil and this water moves by apoplast pathway.

Q.14 (a) What is ascent of sap? Discuss ascent of sap with reference to Cohesion-Tension theory, root pressure and imbibition.

Ans. (1) ASCENT OF SAP

"The pull up of water and dissolved materials through the xylem tissues towards the leaves is known as ascent of sap".

Water and dissolved materials are collectively called sap and ascent means pulled up.

* *Dissolved minerals go upward via root hair → epidermis → cortex → endodermis → pericycle → xylem → branches or leaves.*

Factors Involved in ascent of SAP:

Following factors are involved in ascent of sap:

(1) Cohesion Tension Theory (2) Root Pressure (3) Imbibitions

(1) Cohesion Tension Theory:

It was proposed by *Dixon*. This theory produces a reasonable explanation of flow of water and minerals upwards from the roots to leaves of plants, in bulk flow or mass flow. The flow of water depends on the following:

(i) Cohesion:

It is the *attraction among water molecules*, which hold water together, forming a solid chain-like column within the xylem tubes. The water molecules form hydrogen bonds between the molecules.

(ii) Tension:

It is provided when this *water chain is pulled up* the xylem, transpiration provides the necessary energy or force. Tension is between the molecules, *by hydrogen bonds*. Column of water within xylem is at strong enough and as unbreakable as a steel wire of the same diameter. This xylem water is tension enough to pull water up to 200 meters (more than 600 feet) in plants.

(iii) Adhesion:

It may be added that the water molecules also *adhere to the cell wall of xylem cells*, so that the column of water in xylem tissue does not break. The composition of cell wall provides necessary adhesion to water molecules that helps water to creep up. The cellulose component of cell wall especially has great affinity with water. It can imbibe water.

(iv) Strong Xylem Walls:

It is essential that the xylem walls should **have high tensile strength** if they are not to buckle inwards, as happen when sucking up a soggy straw. The lignin and cellulose provides strength to cell wall of xylem vessels.

By cohesion-tension of water molecules, and the transpiration pull providing necessary energy, the sap (water and molecules) in xylem tissue is pulled upwards to the leaves.

The total water pulled up in the leaves is transpired, except about 1% which is used by plant in various activities including photosynthesis.

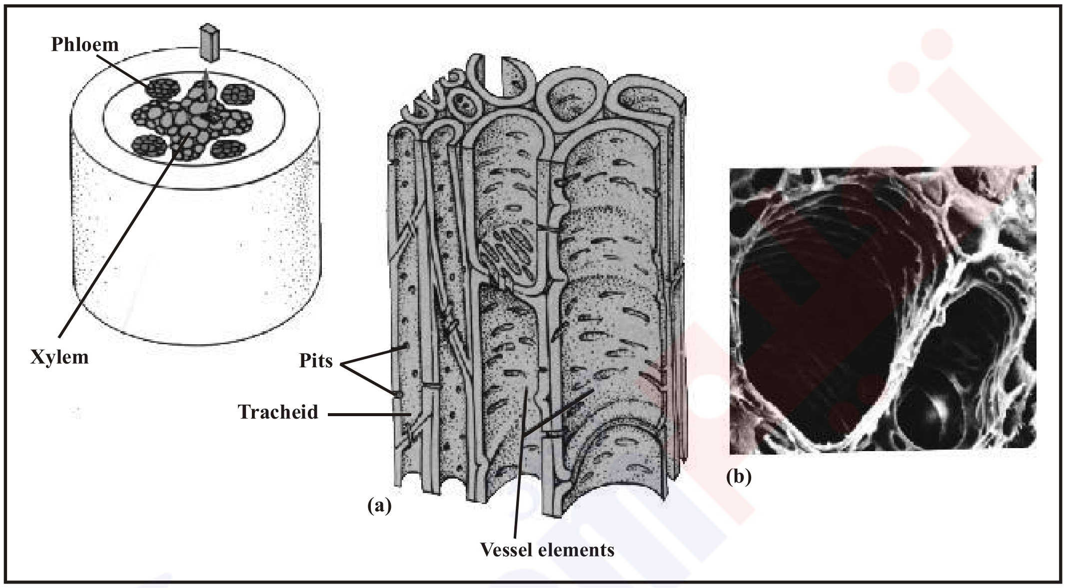


Fig. (a) Xylem tissue elements involved din transportation of water and dissolved minerals

(b) Scanning electron micrograph of two large vessel elements for a cucumber roots

Q.15 (a) Describe the mechanism of transpiration pull with reference to cohesion.

Ans. (1) Mechanism of Transpiration Pull in Cohesion Tension Theory

The evaporation of water from the aerial parts of the plant especially through stomata of leaves is a process called *transpiration*.

As a leaf transpires the water potential of its *mesophyll cell* drops.

This drop causes water to move by osmosis from the xylem cells of leaf into dehydrating mesophyll cells.

The water molecules leaving the xylem are attached to other water molecules in the same xylem tube by ***hydrogen bonds*** (cohesion of water molecules). Therefore when one water molecules moves in the xylem, the process continues all the way to the root where water is pulled from the xylem cells ***tracheids*** and ***vessels***.

This pull also causes water to move down its concentration gradient transversely from the root epidermis (root hairs) to cortex endosmosis and to pericycle.

In short, this pulling force or transpiration pulled is so strong that it also reduces the water potential of root epidermal cells. Then water in the soil moves from its higher water potential to lower water potential of epidermis of root by osmosis.

Q.15 (b) What is the role of root pressure in ascent of sap?

Ans. **ROOT PRESSURE**

Root pressure is the 2nd force which involved in the movement of H_2O and dissolved minerals in the xylem tissue.

Creation of Root Pressure:

* Root pressure is ***created by the active secretion of salts*** and other solutes from the other cells into the xylem sap.
* This ***lowers the water potential of xylem*** sap. Water enters the xylem cells by osmosis, thus increasing the level of sap in the xylem cells.
* As a result of root pressure the sap in the xylem ***does not rise to enough height*** in most plants. It is also least effective during the day. It has been estimated that a positive hydrostatic pressure of around 100 to 200 KPa (exceptionally 800 KPa) is generated by root pressure, which is not enough to push water upwards to required height in most plants. But it is no doubt a contributing factor in small plants, which transpire slowly.

* It is further added that the root pressure, is a prominent factor in those plants, ***which live in humid climate***, where the rate of transpiration is very low.

* Root pressure has not been observed in gymnosperms, which are tall plants. In these plants, and under normal transpiration rate, the xylem sap, which is responsible for development of root pressure, is under tension instead of pressure.

Q.15 (c) Discuss guttation, give its importance.

GUTTATION

"Occuring under condition of high humidity when of liquid-water on to a plant surface transpiration cannot occur but water absorption in high"

Closely associated with root pressure is a phenomenon called guttation or exudation. *Guttation is loss of liquid water through water secreting glands or hydathodes near terminal tracheids of the bundle ends around the tips and margins of leaf*. The *dew drops* that can be seen on the tips of grass leaves or strawberry leaves are actually guttation droplets exuded from hydathodes the specialized pores.

Guttation or exudation is more notable when transpiration is suppressed, and the relative humidity is high as at night. The guttation is in fact due to *positive pressure*, the root pressure developed in xylem tissue of roots.

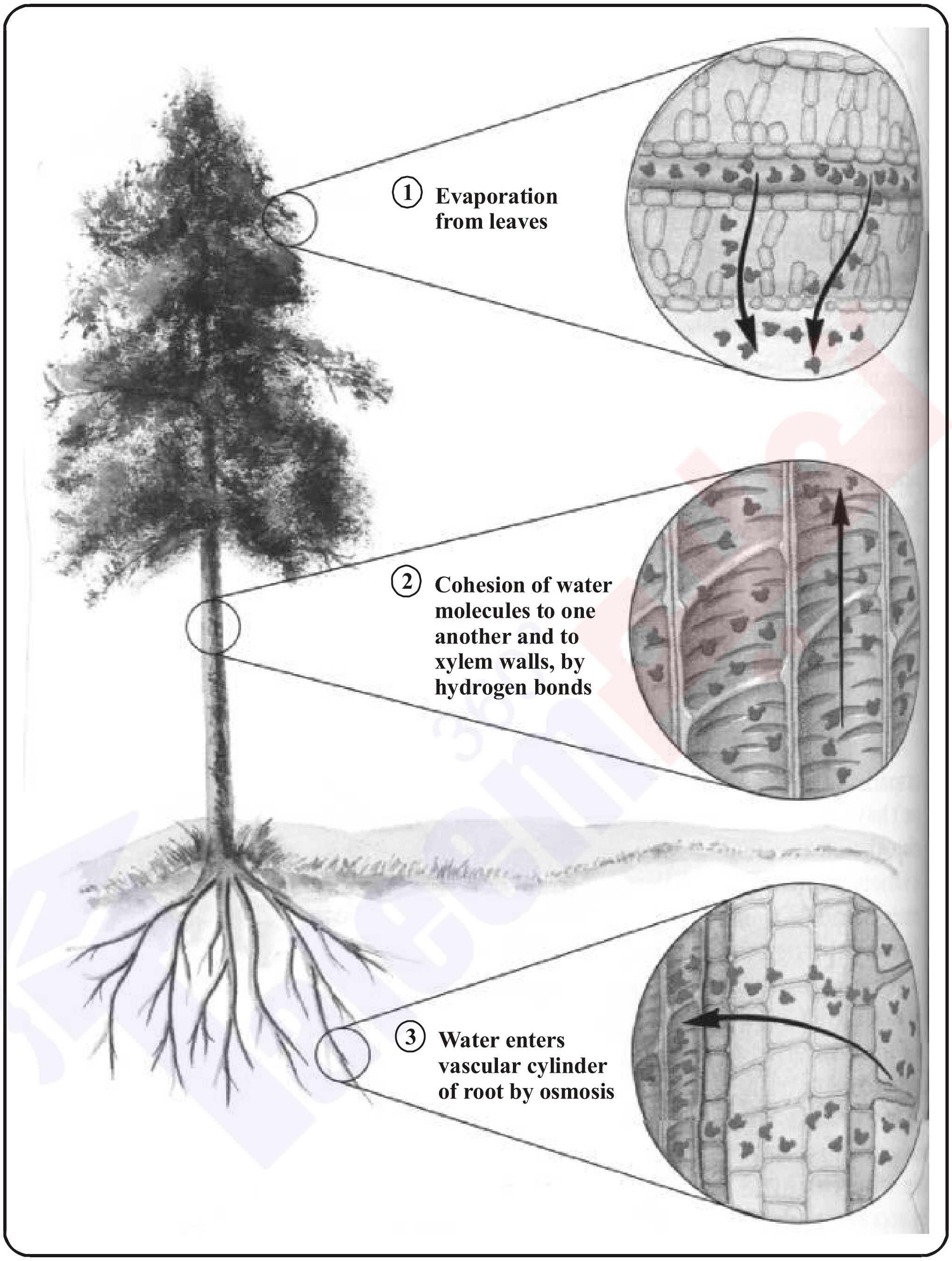


Fig. The cohesion-tesion theory of water flow from root to leaf

Imbibition

Another importance force in ascent of sap is imbibition. Sacks in 1874 suggested that the water molecules move along the cell walls of xylem vessels due to imbibition.

The cell wall components especially cellulose can take up water and as a result it increase in volume, but the components do not dissolve in water, this is called imbibition. In this process the constituent particles of a particular substance take up water by surface attraction and increase in volume. The amount of attraction and increase of dry cell walls of plant cells, and of protoplasm for water is often very great and considerable imbibition forces may be developed in plant body.

The root cell walls imbibe water from the soil and this water moves by apoplast pathway.

Fig. Guttation by strawberry leaves

Q. What is transpiration? Discuss its types.

Ans. **TRANSPIRATION**

The loss of water from the aerial parts of the plants is called transpiration.

(i) Cuticular Transpiration

The loss of water in the form of water vapours through the cuticle of leave is called cuticular transpiration. About 5-7% of total transpiration takes place through this route.

(i) The cuticle present on the upper and lower epidermis of leaves is not completely impermeable to water and some water is lost in the form of vapours through cuticle.

(b) Thinner the cuticle the greater is the rate of transpiration.

(c) At night when the stomata are almost closed cuticular transpiration takes place. Most of the factors, which affect rate of transpiration in general, are also important in controlling the rate of cuticular transpiration.

(ii) Lenticular Transpiration

Lenticular transpiration is the loss of water vapours through lenticels present in the stem of same plants. All plants do not possess lenticels.

(a) The lenticular transpiration is ***1-2%*** of the total transpiration by a plant.

(b) The openings like stomata are also involved in the exchange of gases between environment.

(c) When there is strong light and high temperature the loss of vapours is rapid because it is governed by diffusion.

Lenticels ***are aerating pores found in the bark through which exchange of gasses take place***, and water is lost in the form of water vapours (transpiration). Externally, they appear as scores or small protrusions on the surface of stem. The lenticels commonly develop below a stoma, and its cells increase in number and size, epidermis gets ruptured. Communication is thus established between the atmosphere and the internal tissues of the stem of the plant.

Structure of Lenticels:

Lenticels consist of a loose mass of small, ***thin-walled cells*** (complementary cells). At each lenticel the cork cambium instead forms oval, spherical, or irregular cells, which are very loosely arranged, having lots of intercellular spaces.

(iii) Stomatal Transpiration

It is a type of transpiration in which the water vapours escape through the stomata.

(a) ***Stomata are the openings guarded by guard cells*** are present in the epidermis of leaf and stem of plants.

(b) In isobilateral leaves the stomata are present, inboth upper and lower epidermis e.g. lily and maize leaf. Stomata only on lower epidermis. In dorsiventral leaves the stomata are confined to only the lower epidermis.

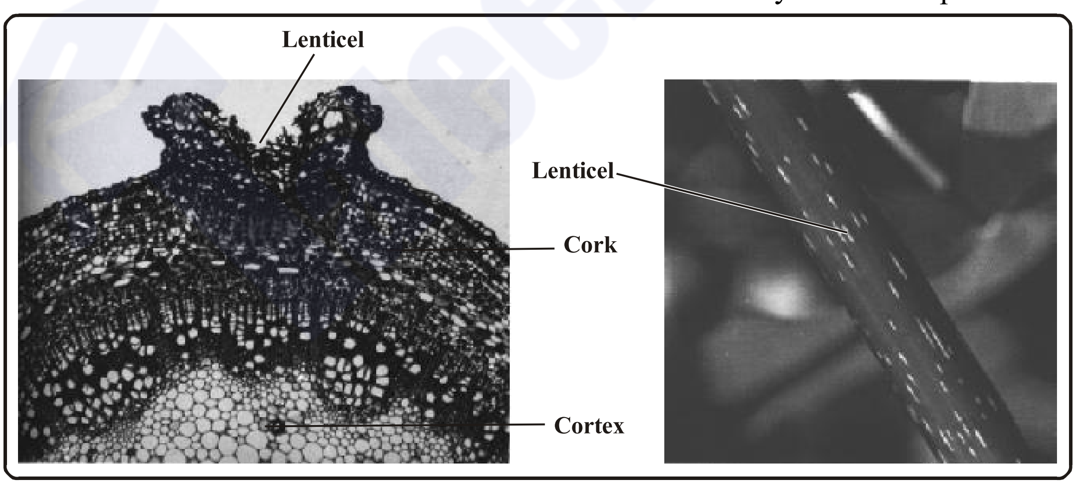


Fig. Left: the waterproof outer bark (layer of dark cells on the surface) on this section of stem is interrupted at the center of the lenticel. Thus the more loosely arranged cell layer beneath, with their numerous intecellular air spaces, are exposed to the atmosphere, right: the individual lenticels can be seen as white areas on the surface of a young stem.

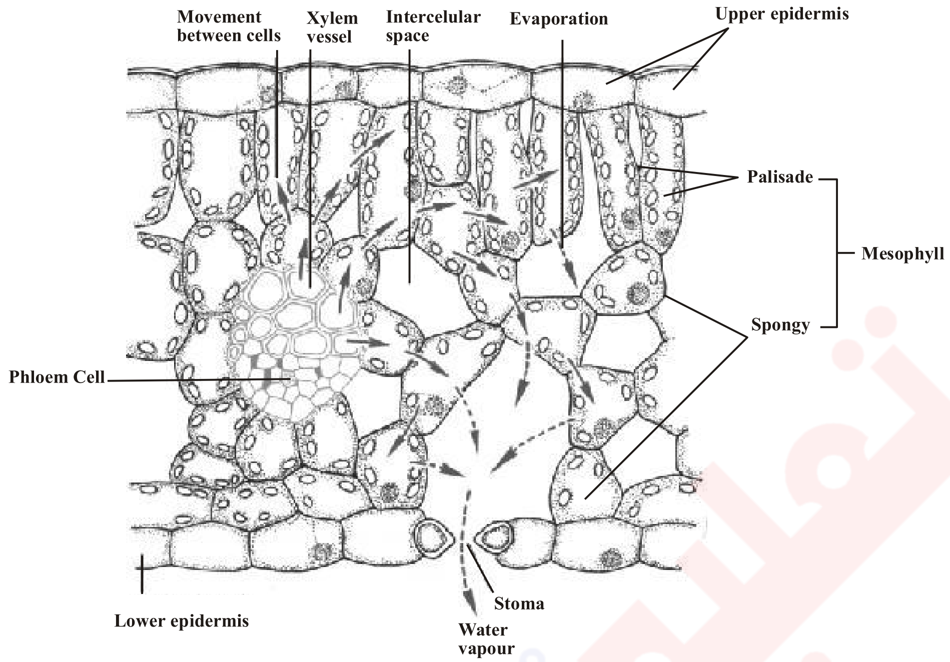


Fig. The water pathway through the leaf. Water is drawn from the xylem into the cell walls of the mesophyll, where it evaporates into the air spaces within the leaf. By diffusion water vapour then moves through the leaf air space, through the stomatal pore, and across the boundary layer of still air that adheres to the outer leaf surface CO_2 also diffuses into the leaf through stomata along a concentration gradient.

Structure of Guard Cells:

The guard cells are normally ***dumble or bean-seed-shaped***. In the inner concave side of two guards. Cells have very thick cell wall, but the ***outer convex side*** has thin cell wall. The guard cells are the only cells, of leaf epidermis, which have chloroplast and thus are involved in the process of photosynthesis.

In monocots e.g., grasses, there are also subsidiary cells on the outer side of each guard cell. It is interesting to note that radial dignment of cellulose microfibrils in the cell wall of guard cells. When these guard cells are turgid, the stoma between them then opens and when guard cells are flaccid the stoma between them closes. The degree of opening of stomatal pores also affects the rate of transpiration, 90% of total transpiration, is stomatal.

The cells of mesophyll of leaf provide enormous surface area for the loss of water in the form of vapours.

The ***pathway of water vapours*** loss to the atmosphere can be divided in the three regions:

(a) The air space inside the leaf.

(b) The stomatal pore (the size of the open stoma).

(c) Layer of still air next to the surface of leaf which depends on dimensions, and surface features of leaf, such as hairness and also on wind speed. The thinner layer of still air, the greater is the rate of transpiration.

The Water Pathway Through the Leaf:

Water is drawn from the xylem into the cell walls of the mesophyll, where it evaporates into the air spaces within the leaf. By diffusion, water vapour that moves through the leaf air space, through the stomata pore, and across the boundary layer of still air that adheres to the outer leaf surface. CO_2 also diffuses into the leaf through stomata along a concentration gradient.

EXAMINE YOUR SELF

Q. Differentiate between stoma and stomata.

Q. Distinguish between lenticel and stomata.

Q. Brief structure of guard cells.

Q. Differentiate between imbibition and endocytosis.

Q. Differentiate between adhesion and cohesion.

Q. Distinguish between root pressure and transpiration pull.

Q.15 (b) Write down the different hypothesis about the opening and closing of stomata.

Ans. **OPENING AND CLOSING OF STOMATA**

Guard Cells:

The guard cells function as multisensory hydraulic valves. Environmental factors such as light intensity and quality temperature relative humidity and intracellular CO_2 concentration are revised by guard cells. These signals are integrated into well defined stomatal responses.

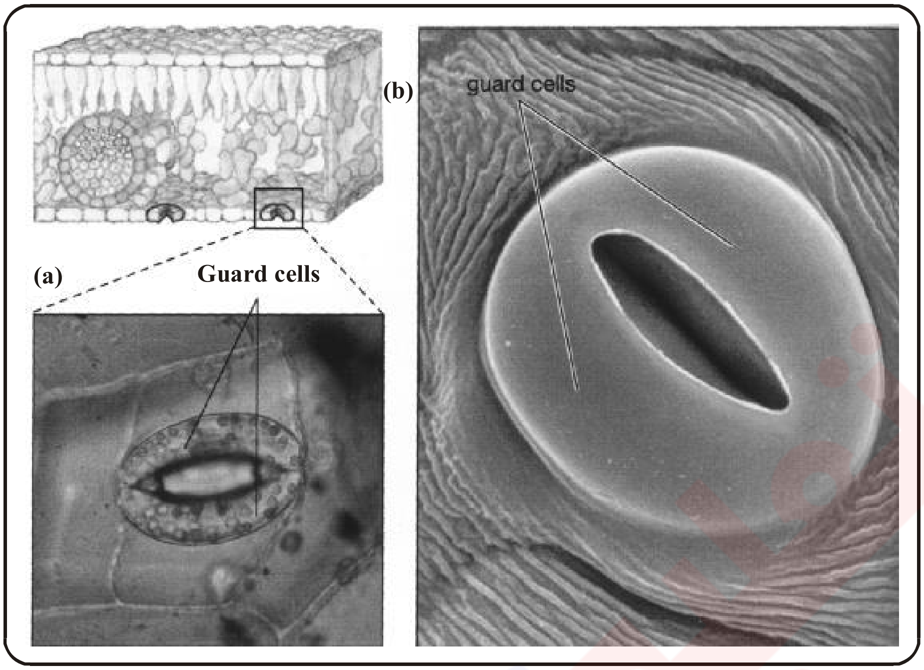


Fig. Stomata. Stomata seen through (a) the light microscope and (b) scanning electron microscope. In the light micrograph, note that the guard cells contain chloroplasts (the green ovals within the cells) but that the other epidermal cell do not.

HYPOTHESIS ABOUT THE OPENING AND CLOSING OF STOMATA

There are two hypothesis, which may explain the opening and closing of stomata:

(i) Starch Sugar Hypothesis:

H. Van Mohl proposed that guard cells are the only photosynthesizing cells in the guard cells of epidermis of leaf.

Opening:

As a result of photosynthesis sugars are produced in the guard cells during the day time when light is available. When sugar level sizes i.e. solute concentration increases or water potential decreases and the guard cells become turgid, and they separate from one another and stoma or pore opens.

Closing:

During night there is no photosynthesis in sugar the either converted into soluble starch or are used in respiration decreases free sugars in cells. So the osmotic potential of guard cells is lowered, and water leaves the guard cells. They became flaccid and stoma or pore between them closes. The thinner the layer of still air the faster is the rate of transpiration.

(ii) Influx of K+ Ions:

Potassium concentration in guard cell increases several folds when stomata open depending upon plant species and experimental conditions.

The light during daytime activates proton pump in the cell membrane of guard cells. The pigments in the chloroplasts of guard cells modulate this response. When epidermal peels floating in the solution of KCl_2 are illuminated stomatal opening can be observed.

The plants opening its stomata by actively pumping potassium in guard cell.

Q.15 (c) Write a note on factor and which affect on the rate of respiration.

Ans. FACTORS AFFECTING THE RATE OF TRANSPIRATION

Important factors, which affect the rate of transpiration in plant are:

(i)	***Light***	(ii)	***Temperature***
(iii)	***CO_2 Concentration***	(iv)	***Humidity and Vapour Pressure***
(v)	***Wind***	(vi)	***Availability of Soil Water***

(i) Light:

Light is the most important factor affecting the transpiration. We know 90% of transpiration is through the stomata of plant. The light directly controls the opening and closing of stomata.

In strong light the rate of transpiration is much as compared with dim-light or no light. Light causes potassium ions to be pumped through the stimulus via pigments of leaf cells actively through cell membrane of guard cells. As the potassium actively enters the guard cells, water follows and guards cells become turgid. Some of the stomata opens. At night light is not present to activate the pigments the potassium pumping stops. The extra potassium present within guard cells diffuses out and the water follows and guard cells become **flaccid.** So stoma closes and water is conserved in the plant causing water to follow by osmosis. Guard cells become turgid and stoma or pore opens. When potassium leaves the guards cell (during night) water leaves the guard cells by exosmosis and guard cells become flaccid and stoma or pore between guard cell closes.

(ii) Temperature:

When the sunlight is strong on a bright and sunny day the environmental temperature is increased by concentration and conduction. ***The higher temperature reduces the humidity of the surrounding*** air. Some water vapour diffuse at a faster rate. As steeper the gradient the faster is the rate of diffusion. So water diffuses rapidly from the air spaces in the leaves outside through stomata.

The evaporation of water from surfaces of mesophyll cells also increases, thus increase in the rate of transpiration. At high temperature when leaf cells start abscisic acid is released. This hormone stops the active transport of K^+ into guard cells, overriding the affect of light and CO_2 concentration. So pumping stops and stomata closes.

The rate of transportation doubles every rise in 10°C in the temperature. Every high environmental temperature i.e., 40-45°C causes closure of stomata, so that plant does not loose much needed water. It also stops wilting of leaves and of plants (herbaceous plant). If higher temperature are maintained in the environment for a longer duration and soil water is limited, the plants would wither and may die.

(iii) Carbondioxide Concentration:

Low carbon dioxide concentration, as during the daytime, stimulates the active transport of potassium ions into guard cells. The transport causes stomata to open and allow CO_2 to diffuse in the mesophyll cell of the leaves.

At night cellular respiration in the absence of photosynthesis raises CO_2 level. This halts the inward transport of K^+ and thus of water allowing the ***guard cells to close and transpiration almost stops***.

(iv) Humidity and Vapour Pressure:

When air is dry the rate of diffusion of water molecules, from the surface of more water is lost, increasing the rate of transpiration. In humid air. The steepness of gradients is much reduced and diffusion process rate is reduced. ***They decrease the rate of transpiration appreciably***.

(v) Wind:

The air in motion is called wind. It causes ***increase in rate*** of diffusion of water molecules.

The rate of evaporation from the surface of mesophyll cells increases, and these water vapours also diffuse from the leaf air spaces to outside at a faster rate through, stomata, when they are open during daytime.

During night the affect of wind does not significantly increases rate of transpiration. When air is still, the rate of movement of water molecules (diffusion) is slowed down thus ***reducing the rate of transpiration***.

(vi) Availability of Soil Water:

If there is little water in the soil, less is brought or transported to the leaf cells and less is lost in the environment by transpiration. If there is little water in the soil, the soil solution becomes more concentrated and its water potential decreases. So less water or no water enter by osmosis into the root cells through the cell membranes of these cells.

So when the rate of absorption of water in root cell is reduced, the rate of transpiration is reduced.

Q.16 What are the factors affecting the rate of transpiration? Describe them in detail.

Ans. **IMPORTANCE OF TRANSPIRATION**

Transpiration Steam: Rate of transpiration for plant is very important as the transpiration steam is necessary to distribute mineral salts throughout the plant, since these move with water.

Transport: Water is transported to photosynthesizing cells of leaves.

Cooling Effect: It cools the plant. This is important in higher temperatures.

Wilting: If the rate of transpiration is high, there would be much loss of water from the plant. So at high temperatures the stomata almost close and reduction in the rate of transpiration is noted. This stops wilting of leaves and of plants (herbaceous plants).

Q.17 Why is transpiration necessary evil? Also give its importance.

Ans. **TRANSPIRATION AS NECESSARY EVIL**

Transpiration has been described as necessary evil because it is an inevitable, but potentially harmful, consequence of existence of cell surfaces from which evaporation occurs.

Water vapours escape along the route used for gaseous exchange between the plant and its environment, which is essential for photosynthesis and respiration.

Loss of water from the plant can lead to wilting, serious desiccation and often death of plant if conditions of drought are experienced. There is good evidence that even mild water stress results in reduced growth rate and in crops to economic losses through reduction of yield.

Importance

Transpiration is of very great importance for the plant:

(i) ***Water is conducted*** or transported in most tall plants with the courtesy of transpiration pull.

(ii) ***Minerals dissolved*** in water are distributed throughout plant body by transpiration stream.

(iii) ***Evaporation of*** water from the exposed surface of cells of leaves has cooling affect on plant.

(iv) Wet surface of leaf cells allow ***gaseous exchange***.

Q.18 Give comparison between transpiration and exudation (Guttation).

Ans. COMPARISON OF TRANSPIRATION AND EXUDATION

Sr. No.	Transpiration	Exudation (Guttation)
(i)	The water is lost in the ***form of vapours***.	Water is lost in the ***form of liquid***.
(ii)	Water vapours are in the ***form of pure water***.	The water droplets also ***contain dissolved minerals***.
(iii)	When Vapours ***escape through stomata, cuticle leaf, lenticels*** of stem.	Water escapes ***through hydathodes***, present at the tip or margin of leaf.
(iv)	The opening and closing of stomata (which accounts for 90% of transpiration) is regulated by the guard cells.	***Hydathodes are always open***, and the flow of water outside is not regulated by cells surrounding the hydathodes.
(v)	The loss of vapours in transpiration is most effective when sunlight is available i.e. ***during daytime***.	Light is not necessary for exudation (guttation). ***During night the rate of loss of water is more*** as transpiration is almost absent.
(vi)	The loss of water from the surface of mesophyll cells produces the ***transpiration pull*** and water is brought on and conducted to the leaves.	The ***root pressure*** pushes water and forced out through hydathodes.
(vii)	All plants exhibit transpiration.	The plant exhibiting guttation (exudation) are pistia, rose, garden nasturtium etc.

Q.19 Describe the translocation of food through phloem. What are the patterns of transport of organic solutes?

Ans. **PHLOEM**

The phloem is generally found on the outer side of primary and secondary vascular tissue in plants with secondary growth.

Structure of Phloem:

The phloem constitutes the inner bark. The cells of phloem that conduct or transport ***sugars*** and other ***organic material*** throughout the plant are called ***sieve elements***.

In addition to sieve elements, phloem also contains companion cells, parenchyma and in some cases fibers, sclereids and latex containing cell (laticifers). However, only sieve tube cells are directly involved in transport.

Adaptations of Sieve Tube:

Sieve areas portions of cell wall; characterize sieve elements where ***pores interconnect the conducting cells***. Some of the sieve areas of sieve tube members are differentiated into ***sieve plates***. Sieve plates have larger pores than the other sieve areas in the cell, and are generally formed in and walls of sieve tube members where the individual cells are joined together to form the longitudinal series called a sieve tube. Sieve plate pores of sieve tubes are essentially open channels that allow transport between cells.

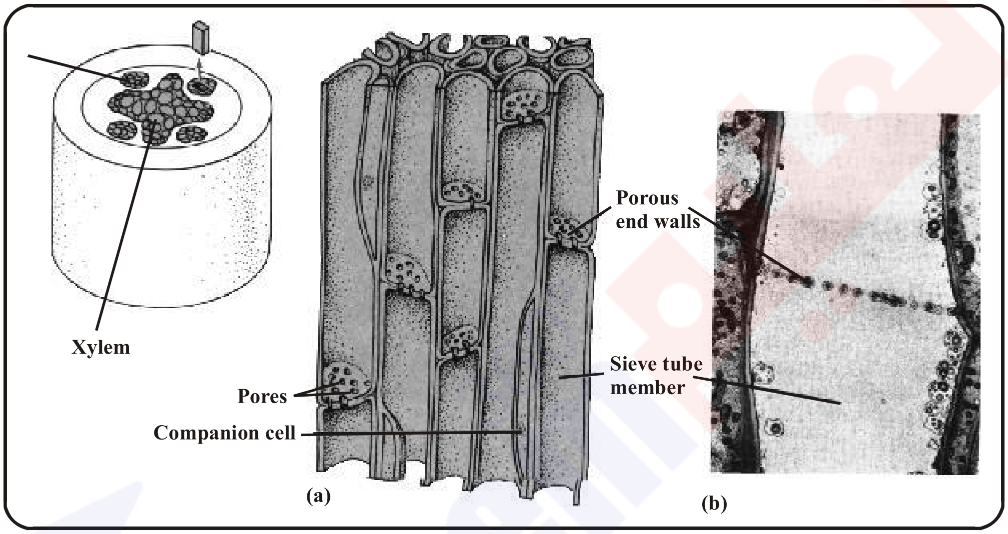


Fig. This diagram shows part of the root phloem consisting of sieve tube members stacked end to end. Adjoining end walls have common process. Each sieve tube member is associated with a companion cell (b) sieve tube member showing the pores in its end walls. Note the scarcity of cytoplasmic components in these sugar conducing cells.

Function of Phloem:

Each sieve tube member is associated by one or more ***companion cells***. Sieve tube and comparison cells are in communication with each other. ***Plasmodesmeta*** companion cells supply ATP and proteins to sieve tube. The photosynthetic products form photosynthesizing cells, the mesophyll.

Patterns of Transport:

Phloem transport does not occurs exclusively in an upward or downward direction and is not defined with respect of gravity.

Transport or translocation occurs from the areas of supply (sources) to areas of metabolism on shortage (sinks). The areas of sources include any exporting organ typically a mature leaf that is capable of:

(i) Storing photosynthate in excess of its own needs.

(ii) Storage organ during the exporting phase of its development, in biennials e.g. beet root (Beta meritinia) is a sink in first growing season, but becomes source in the next growing season, when sugars are utilized in growth of new shoots.

(iii) ***Sinks*** are the areas of metabolism or storage roots, tuber, developing fruits and for normal development.

The movement in phloem is from sources to sink in most of the plants during active photosynthesis. But when the plants are deciduous in which the leaves fall off during autumn, the movement in phloem is from sink to source i.e., growing tips of shoots of the plants.

Q.20 Describe the mechanism of phloem translocation.

Ans. **THE MECHANISM OF PHLOEM TRANSLOCATION/TRANSPORT**

There are two main theories about the translocation through phloem:

(1) Diffusion (2) Pressure Flow Theory

(1) Diffusion:

Diffusion is far too slow to account for the velocities of sugar movements in phloem i.e., one meter per hour, while the rate of diffusion is 1 meter per eight year. So we are left with pressure flow theory.

(2) Pressure Flow Theory:

Ernst Munch first proposed the hypothesis in 1930. Now this hypothesis has been given status of theory.

Accounting to this Theory:

The flow of solution in the sieve elements to be driven by an osmotically generated pressure gradient between source and sink.

Transport of Sucrose:

(i) The ***glucose*** is converted to non-reducing sugar i.e., ***sucrose***, which is actively transported through the bundle sheath cells to the companion cell of the smallest vein in leaf short distance transport (involving 2-3 cells).

(ii) ***The sucrose diffuses through plasmodesmata to sieve element or sieve element***. It raises the concentration of sucrose the sieve element on sieve tube cell. The pathway taken by sucrose is symplastic in most cases but some apoplast movement does take place.

(iii) The sucrose is actively transported to sieve elements as the ***water moves by osmosis from the near by xylem in leaf vein***.

The increase hydrostatic pressure of the sieve tube or element.

(iv) ***Hydrostatic pressure*** moves the sucrose and other substance in the sieve tube cells and move to sink. The movement of sucrose is ***apoplastic***. In the shortages sinks, such as sugar beet root and sugar cane stem, sucrose is removed into apoplast prior to entering ***symplast*** of the sink.

(v) ***In symplastic pathway*** sucrose (on sugar) move through plasmodesmata to the receiver cell. Thus according to pressure flow theory, the pressure gradient is established as a consequence of entry of sugars in the sieve elements at the source, the removal of sugar (sucrose) at the sink. The energy driven entry of sugars in sieve tube ***generate high osmotic pressure*** in the sieve tube elements of source causing a steep drop in the water potential.

(vi) ***The presence of sieve plates greatly increases the resistance along the pathway*** and results in generation and maintenance of substantial pressure gradient in the sieve elements between sources and sink.

(vii) The sieve elements contents are physically pathway by ***bulk flow***, much like water circulates throughout the plant between the transpiration (xylem) and ***translocation*** (phloem) pathway.

The pressure flow theory accounts for the mass flow molecules within phloem. It may be noted that photosyntheate or carbohydrates from the mesophyll cells to phloem tissue involves diffusion and active transport (carrier, mediated transport). Then in phloem tissue the movement of materials is according to pressure flow theory.

Again in sink cells when the sugar are the carbohydrates are passed from the phloem tissue diffusion and carrier mediated, either passive or active take place.

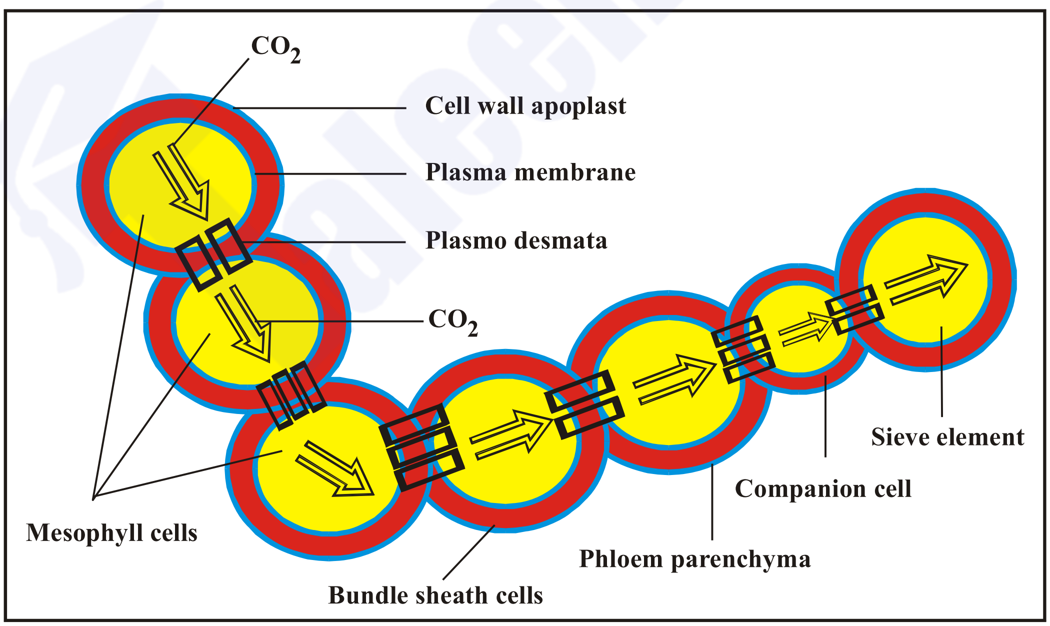


Fig. Movement of sugars from mesophyll cells to sieve elements

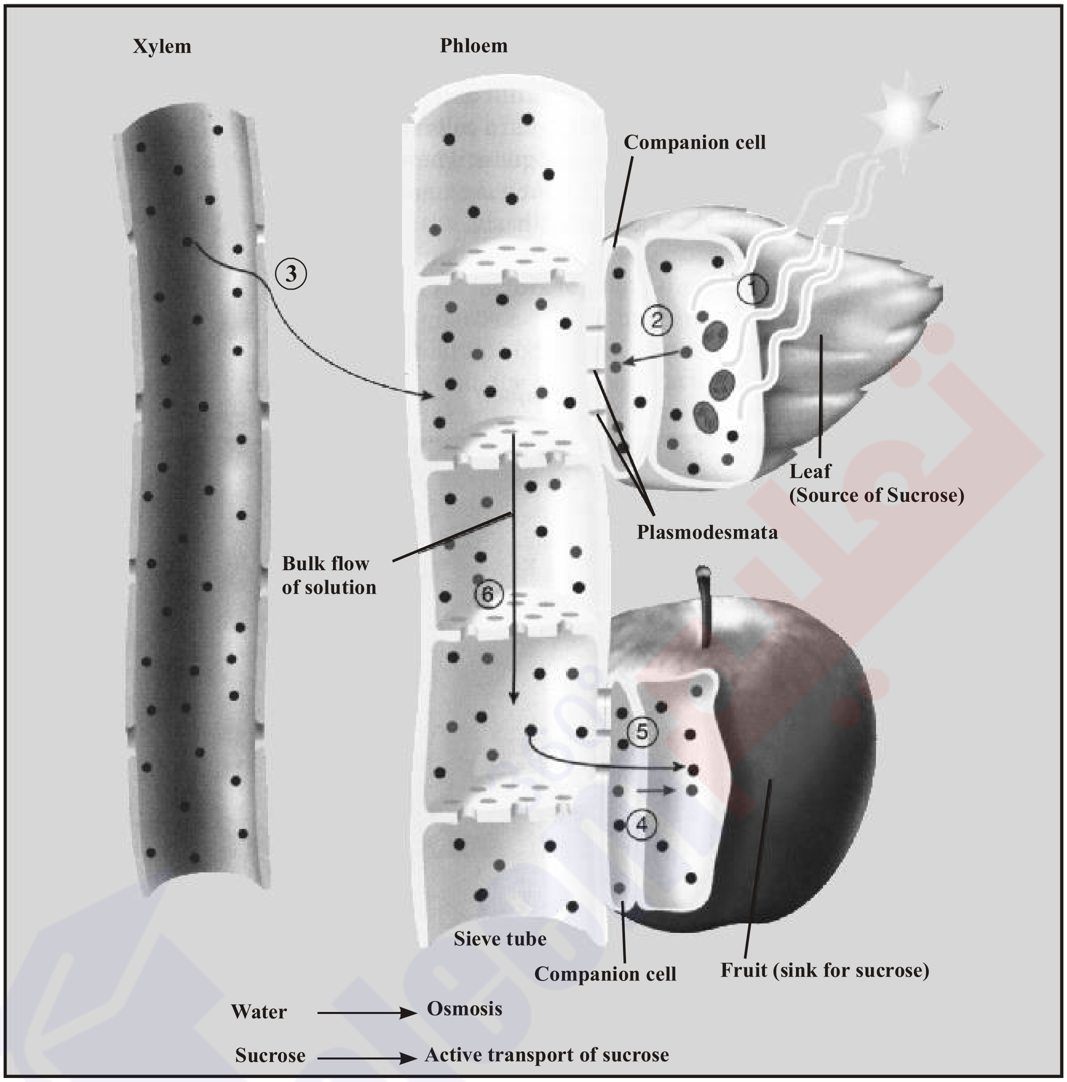


Fig. The Pressure-flow theory (a) A photosynthesizing leaf manufactures sucrose (red dots), which (2) is actively transported (red arrow) into a nearby companion cell. The sucrose diffuses to sieve-tube element through plasmodesmata, raising the concentration of sucrose. (3) Water (blue dots leaves nearby xylem and moves into the "leaf end" of the sieve tube by osmosis (blue arrow), raising the hydrostatic pressure. (4) The same sieve tube connects to a developing fruit (sink); sucrose enters the companion cells by diffusion through plasmodesmata. It is then actively transported out of the companion cells and into the fruit cells. (5) water moves out of the sieve tube by osmosis, lowering the hydrostatic pressure within the tube. (6) High pressure in the leaf end of the phloem and low pressure in the fruit end cause water, together with any dissolved solutes, to flow in bulk from leaf (source) to fruit. (Black arrow).

Q.21 Why is transport system not necessary in unicellular organism? Describe the process of transportation in:
(a) Hydra (b) Planaria

Ans. **TRANSPORT IN UNICELLULAR ORGANISMS**

Unicellular animals have maximum surface area to volume ratio and most of the substances move in or move out by simple diffusion. Osmosis, active transport and facilitated diffusion. So there is no special transport system involved.

Transport in Multicellular Organisms

It belongs to group **Cnidaria**. It is ***fresh water*** in habit.

Body Structure:

The body is two layered and outer ectoderm and inner **endoderm**. In between them in **mesoglea**, which is non cellular gelatinous layer. The outer surface of the **ectoderm** cells are exposed to the water in which the animal lives.

Intake of Materials:

Water, dissolved O_2, and food are taken into **coelenteron (enteron)** of Hydra by movement of ***tentacles*** and ***flagella***, which are present in most cells of endoderm. The food material may be absorbed by cells or are taken up by **endocytosis.**

Transport:

The endoderm cells take up the food and O_2 along with water directly from the water in the coelenteron. The wastes pass from endoderm cells in the water is coelenteron. The water escapes through mouth by movement of ***tentacles*** and flagella to the outside. The ectoderm cells directly exchange materials with the surrounding water and get nutrition from endodermal cells.

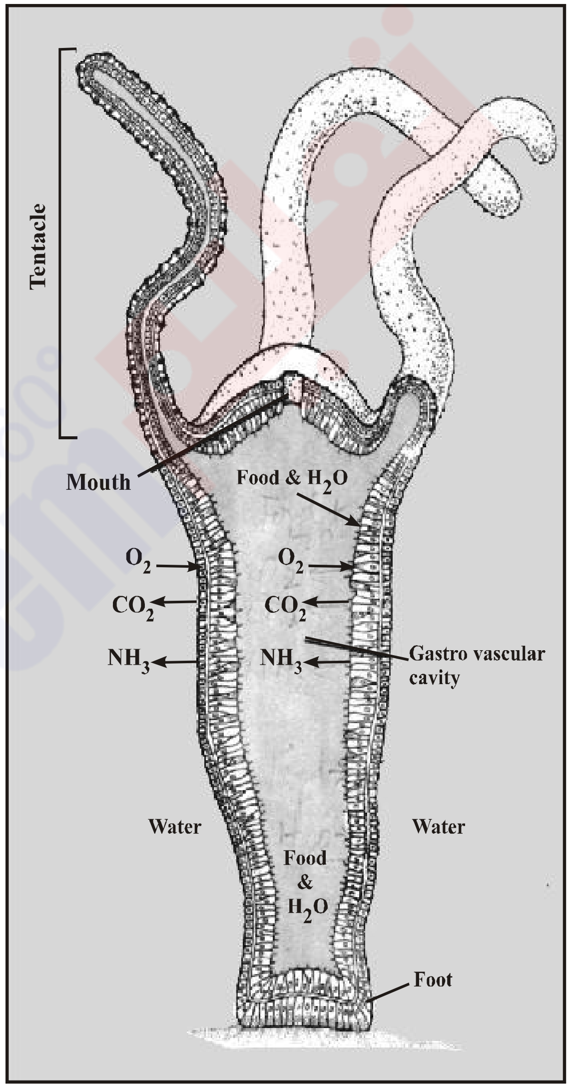


Fig. Transportation in Hydra

Excretion (By Diffusion):

The indigestible and partly digested food is removed by exocytosis or diffusion.

Q.22 How does transportation occur in unicellular and simple aquatic animals?

Ans. **Transportation in unicellular** and simple aquatic animals takes place by means of ***simple diffusion***, osmosis, active transport and facilitated diffusion. These animals especially unicellular have maximum surface area to volume ratio. They do not posses well organized and developed transport system.

Q.23 Discuss transportation system in Hydra.

Ans. **Hydra** lives in fresh water. The animal is ***diploblastic*** i.e., the body is divided into two layers; the outer ectoderm and inner endoderm; in between them is **mesoglea** which is non-cellular or jelly like. The animal is completely exposed to the water thus dissolved oxygen, food and water are taken into the ***coelentron*** (entron) of Hydra by the movement of tentacles, and flagella which are present in most cells of endoderm.

The absorption of food material is done by **endocytosis** by endodermal cells. The indigestible and partly digested food is removed by **exocytosis** from these cells, into digestive cavity (coelentron), ectodermal cells get food from endodermal cells by diffusion. The ectoderm cells directly exchange materials with the surrounding water. They also obtain nutrients from endodermal cells.

Q.24 Why is planaria not has special transport system?

Ans. (i) The body of planaria is ***dorsoventrally compressed*** i.e. ***flat***. Most of its cells are exposed to the outer water and by diffusion exchange of material takes place.

(ii) The animal being ***acoelomate*** do not have body cavity and the mesodermal layer (***mesenchyma***) is composed of loosely packed cells between ectoderm and endoderm. The materials such as oxygen diffuses in the ectoderm, mesoderm and lastly into endoderm cells whereas removal of waste occurs through the same route but in reverse direction. Digestive system possess ***intestinal caecae*** which reach to almost every cell of the body and digested food is provided to the cells by diffusion. The endoderm cells, can also acquire water, dissolved minerals, little oxygen and remove waste into the ***gut***.

Q.25 Write down the characteristics of circulatory system in complex multicellular animals.

Ans. **CHARACTERISTICS OF CIRCULATORY SYSTEM**

A circulatory system is meant for the ***rapid mass flow of materials*** form one part of the body to the other, where diffusion would be too slow. Circulatory system has the following three characteristics:

(i) A circulatory fluid—the ***blood***.

(ii) A contractile pumping device—may be ***modified blood vessel*** or a ***heart***.

(iii) Tubes, which can transport, the circulatory fluid (blood) to and from cells of the body. These tubes are the ***blood vessels*** through which exchange between blood and body cells takes place.

Q.26 *Differentiate between open and close circulatory system. Discuss with reference to the circulatory system of earthworm and cockroach.*

Ans. (a) Open Circulatory System

In such type of circulatory system ***blood does not flow in vessels*** rather if flows freely in the body cavity e.g., such circulatory system is present in phylum. **Arthropoda** (crustaceans, spiders, insects), phylum **Mollusca** (snails and clams) and group of **protochordates**, the **tunicates.**

(b) Closed Circulatory System

In such circulatory system ***blood is transported within blood vessels*** throughout the body such type of circulatory system is present in annelids, cephalopod, mulluscs (squids and octopus), echinoderms and vertebrates.

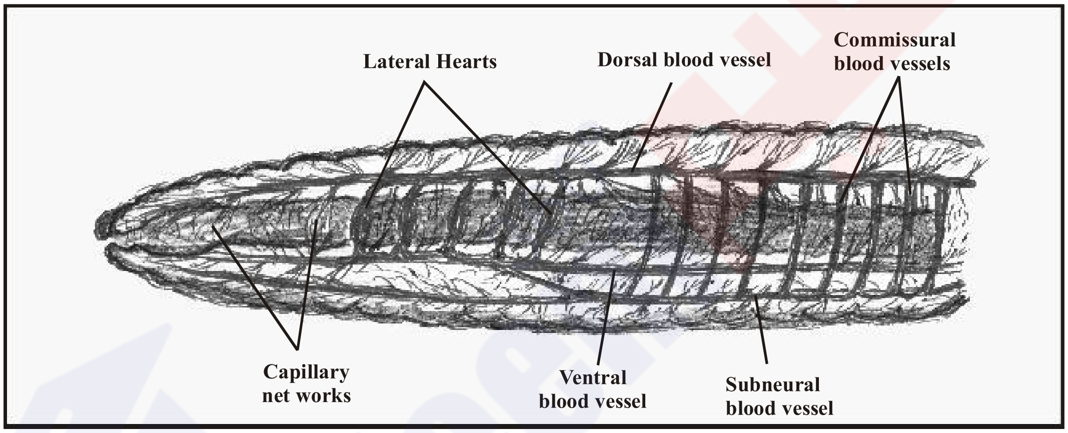


Fig. Closed circulatory system of earthworm

COMPARISON BETWEEN CLOSED AND OPEN CIRCULATORY SYSTEM

Close Circulatory System (Earthworm)		Open Circulatory System (Cockroach)
1.	***Blood always remain in the blood vessels***, and does not come in direct contact with other cells of the body.	***Blood does not remain enclosed in the blood* vessels** and come in direct contact with other body cells, and bathes them.
2.	Inter connected system of ***arteries, veins***, and ***capillaries*** present.	There are ***no typical arteries***, **veins and *capillaries*** and for much of the time the blood called ***haemolymph*** flows in the cavities orisinuses of body cavity (haemocoel) around the viscera (***perivisceral sinus***) and around the nerve cord (***perineural sinus***).

3.	Exchange of nutrients and waste products between the blood and tissues via tissue fluid occurs through ***capillaries***.	Exchange of nutrients and waste products between the blood and tissue occurs when ***blood directly bathes the tissues***.
4.	The system also transport gases i.e., oxygen and carbondioxide.	This system does not transport gases i.e., oxygen and carbon dioxide. (The gases transported by ***tracheal system***).
5.	***Respiratory pigment haemoglobin*** is dissolved in blood. Nucleated white blood cells are present.	***No respiratory pigment*** and blood is colourless in which nucleated white blood cells float.
6.	This is regarded as the most advanced type, having greater efficiency, ***maintainance of blood pressure*** and economy of blood volume.	This is regarded as primitive having lesser efficiency and does not maintain ***blood pressure***.
7.	In earthworm there are ***4 or 5 pairs of lateral hearts*** present on the lateral side of oesophagus in 7^{th} to 13^{th} segments. Hearts pumps the blood from the dorsal to the ventral vessel.	In cockroach the heart is ***13-chambered*** tubular vessel present in the ***pericardial sinus*** and placed in mid-dorsal region below terga in abdominal region. On the side of the heart chambers there are alary muscles helping in the flow of blood. Each heart chamber has a pair of lateral openings, the ***ostia***.
8.	There are three main longitudianally running blood ***vessels***: ***dorsal***, ***ventral*** and ***sub-neural***, which are interconnected through capillaries and commissural vessels.	The portion of the tubular dorsal vessel which extends in the thoracic and head region is called the ***'aorta'***. It opens anteriorly in the haemocoel of the head by funnel shaped opening.
9.	The ***dorsal vessel collects blood from the 14^{th} segment backwards***. In the first 13 segments it becomes distributing channel and sent its blood to hearts and anterior end of the body ***Ventral vessel is the chief distributing*** vessel with backward flow. The ***subneural vessel is collecting vessel and the flow of blood is backwards***. It communicates with dorsal blood vessel through ***commissural vessels***.	The flow of blood from heart to, aorta to, haemocoel in head, to perivisceral sinus, to perineural sinus, to perivisceral sinus, to ***pericardial sinus***, and to heart through ostia.

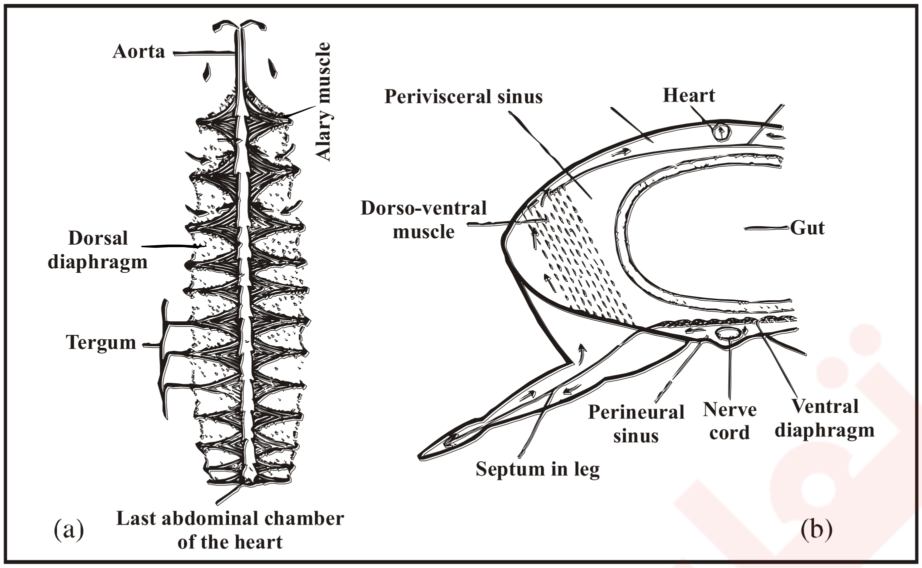


Fig. Open circulatory system of cockroach
(a) Heart with alary muscle and dorsal diaphragm.
(b) T.S. of cockroach through thorax showing various sinuses.

Q.27 Write a short note on blood circulatory system in vertebrates.

Ans. ***Close type blood circulatory system is present in vertebrates***. Blood flows in ***arteries, veins*** and ***capillaries***. In addition ***lymphatic system*** is also involved in transportation.

Heart is the pumping organ which pumps blood to the body via aorta and arteries.

Arteries carry oxygenated blood (except pulmonary artery) and veins carry deoxygenated blood (except pulmonary vein which carries oxygenated blood) as in man.

The ***capillaries*** are the sites where exchange of materials between blood and body tissues takes place.

Q.28 Discuss the comparative study of vertebrate heart?

Ans. **HEART OF AMPHIBIA**

In amphibians the *heart is* ***three chambered*** with regard to auricles and ventricles.

- There are two **auricles** and one **ventricle.**
- In addition **sinus venosus** and **truncus artiosus** are also present. Sinus venosus *receives deoxygenated blood from two superior vena cava* (precavals) and one inferior vena cava (postcaval) from different parts of the body. This blood passes to the right auricle.

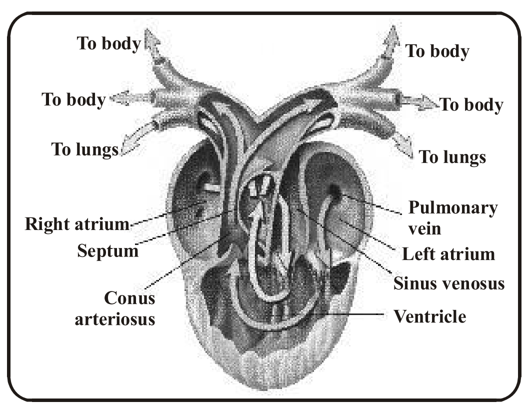


Fig. Structure of heart of frog

- The oxygenated blood from lungs is poured via pulmonary veins into left auricle.
- Both auricles contract simultaneously and blood is passed onto the ventricles. There is a ***complete mixing of oxygenated and deoxygenated blood*** in the ventricle. When ventricle contracts, it pushes blood via truncus arteriosus, to two **carotids**, two **systemics**, and two **pulmocutaneous arches.**

Heart of Reptiles

The heart of reptiles and all other **amniotes** practically function as ***four chambered heart***. There are ***two autricles*** in the heart of reptiles.

The reptiles have **incompletely partitioned ventricle**; but in crocodiles, the **interventricular septum** is complete and heart is four chambered.

In all reptiles the left and right systemic arches carry oxygenated blood and arise from a region of ventricle called **cavum venosum** into which left ventricle directs its blood.

*The deoxygenated blood from the right atrium is directed towards the entrance of the pulmonary trunk which is also located or starts from a pocket the **cavum pulmonale**, on right side of ventricle – in the animals (reptiles)* which do not have completely divided ventricle.

Although the two systemic arches start from the ventricle separately, they are also interconnected at their base by an opening. The hearts of reptiles, birds and mammals function as **double circuit heart.**

Heart of Birds and Mammals

In the birds and mammals, the **heart is four chambered**, and *oxygenated and deoxygenated blood* does not mix at all.

The **ventral aorta** is divided into two trunks, the **pulmonary trunk** arises from right ventricle and leads to the lungs.

*The **aortic trunk** emerges from the left ventricle and leads to carotid and systemic arches*.

The left systemic disappears in birds and right systemic, most of it, disappears in mammals.

In reptile, birds and mammals, as a result of these modifications, all blood returning to the right side of the heart passes to the lungs. After oxygenation, blood returns to left atrium from the lungs via pulmonary veins.

Left atrium passes this blood to left ventricle – which on contraction pumps it to different parts of the body, and again blood returns to right atrium.

Pulmonary circulation is by pulmonary arch carrying deoxygenated blood from right ventricle of heart to lungs, and the blood returns to left atrium after oxygenation via pulmonary veins.

Likewise the systemic arch distributes blood to different parts of the body, and then the blood from the body returns to the heart, in the right atrium via precaval and postcaval. This is **systemic circulation**.

*So the hearts of amphibians, reptiles, birds and mammals have both **pulmonary** and **systemic circulation**.*

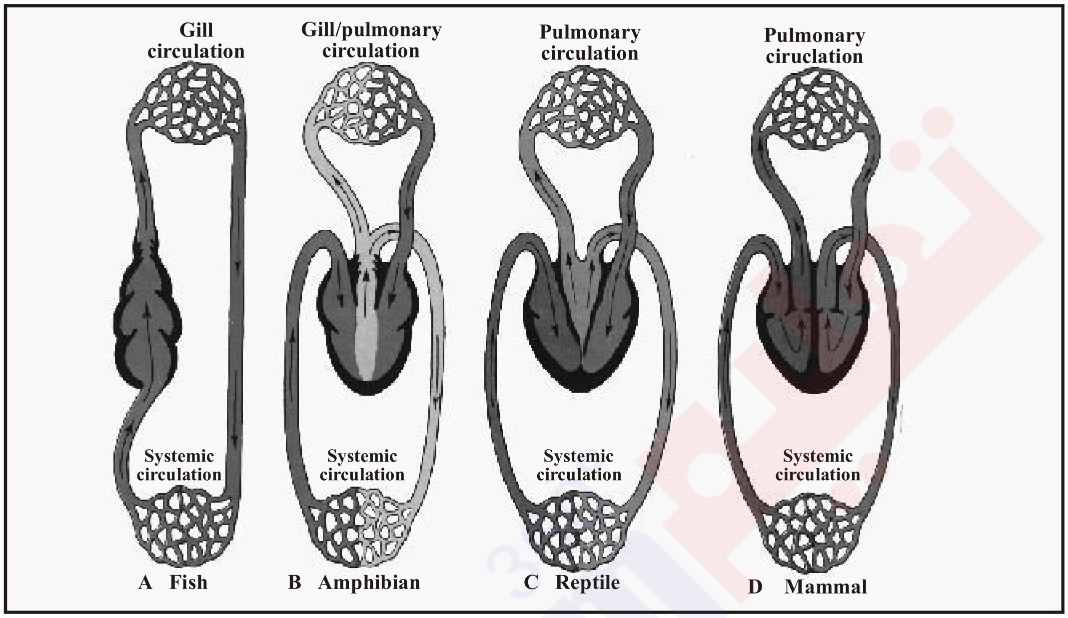


Fig. A schematic comparison of vertebrate heart and circulation of blood. (A) In modern fish the blood is pumped to the gills, where it picks up oxygen. The oxygenated blood (red) then passes without further pumping to the systemic circulation, where it gives up its oxygen before returning to the heart. (B) In amphibians the blood that has picked up oxygen in the gills and/or lungs returns to the heart, from which it is pumped into the systemic circulation. Extensive mixing (purple) of the pulmonary and systemic flows occurs in the heart. (C) In reptiles the pattern is much the same, except that the ventricles are partially divided, so less mixing takes place. (D) in mammals and birds the two halves of the heart are effectively separated.

Transport in Man

In humans, in addition to blood circulatory system, there is also another transport system, the *lymphatic system*.

Blood Circulatory System:

The circulatory system of humans have the same 3 basic components

(a) *Circulatory fluid* : the ***blood***

(b) The *pumping organ* : the ***heart***

(c) The *blood* ***vessels***, arteries, capillaries and veins.

Q.29 What is the composition of blood? Discuss the composition and function of Plasma.

Ans. **COMPOSITION OF BLOOD**

The blood is the medium in which dissolved nutrients, gases, hormones, and wastes are transported through the body.

It is made up of two main components,

(i) plasma and

(ii) cells or cell like bodies (white blood cells, red blood cells, platelets).

The weight of the blood in our body is about 1/12th of our body.

Plasma:

It has been estimated that in normal person plasma constitutes about **55% by volume** of the blood, and cells or **cell-like bodies about 45% by volume** of the blood.

Plasma is primarily water in which *proteins, salts, nutrients and wastes are dissolved.*

Water constitutes about **90% of plasma, 10% are dissolved substances**. Most of the dissolved substances are maintained at a constant or nearly constant level, but other occurs in varying concentrations.

The substances dissolved or present in plasma vary in their concentrations, with the condition of the organism and with the portion of the system under examination.

The solutes can be divided into six categories:

(i) Inorganic Ions or Mineral Ions:

Together the inorganic ions and salts make up **0.9 per cent of the plasma**, of humans, by weight; more than two thirds of this amount is sodium chloride the ordinary table salt. Even if the total concentration of dissolved substances remains the same, shifts in the concentration of particular ion can create serious disturbances. The normal **pH of human blood is 7.4**; and it is maintained between narrow limits, because the change in *pH would affect the chemical reactions of the body.*

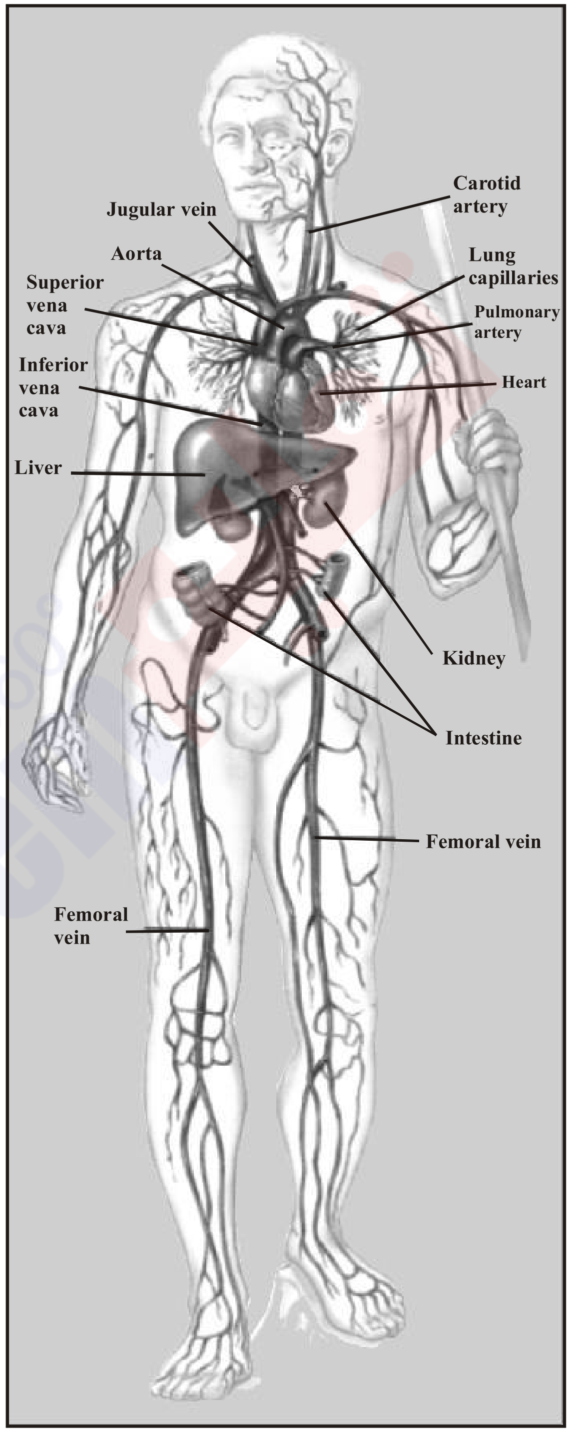


Fig. The human circulatory system

(ii) The Plasma Proteins:

The plasma proteins constitute **7-9 percent** by weight of the plasma. Most of these proteins are synthesized in the liver. Some of the globulins, called **immunoglobulins** or antibodies, are produced in response to antigens, by **lymphocytes** cells; and then are passed to plasma, and lymph.

The proteins like **prothrombin** acts as a catalyst in blood clotting process. Fibrinogen takes part in the blood clotting process. Immunoglobulins play important role in body's defences against disease.

(iii) Organic Nutrients in the Blood:

Organic nutrients in the blood include, *glucose, fats, phospholipids amino acids* and lactic acids. Some of them enter the blood from the intestine (absorption). *Lactic acid* is produced in muscles as a result of glycolysis, and is transported by blood to liver. *Cholesterol* is an important constituent, it is metabolized to some extent, but also serves as precursor of steroid hormones.

(iv) Plasma Contains Nitrogenous Waste Products:

Plasma also contains nitrogenous waste products as a result of cellular metabolism. These products are carried from the liver where they are produced, to the organs from where they are removed i.e., kidneys. **Urea** and small amounts of **uric acid** are present in plasma.

All the hormones in the body are carried by blood – so they are present in the plasma.

The gases such as CO_2, O_2 are present in the plasma of the blood.

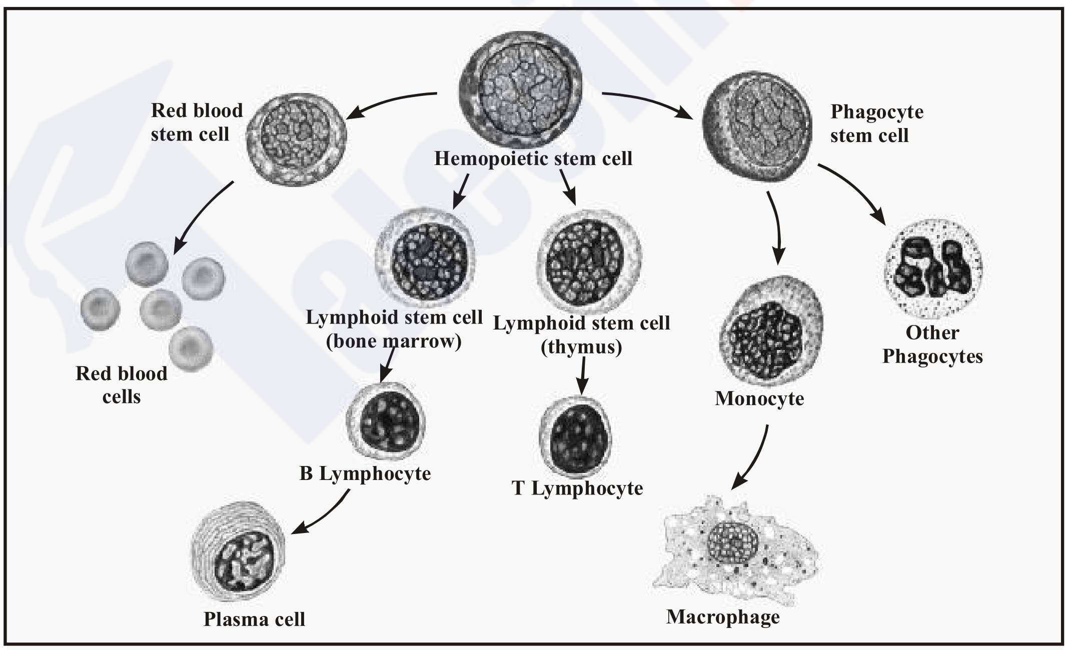
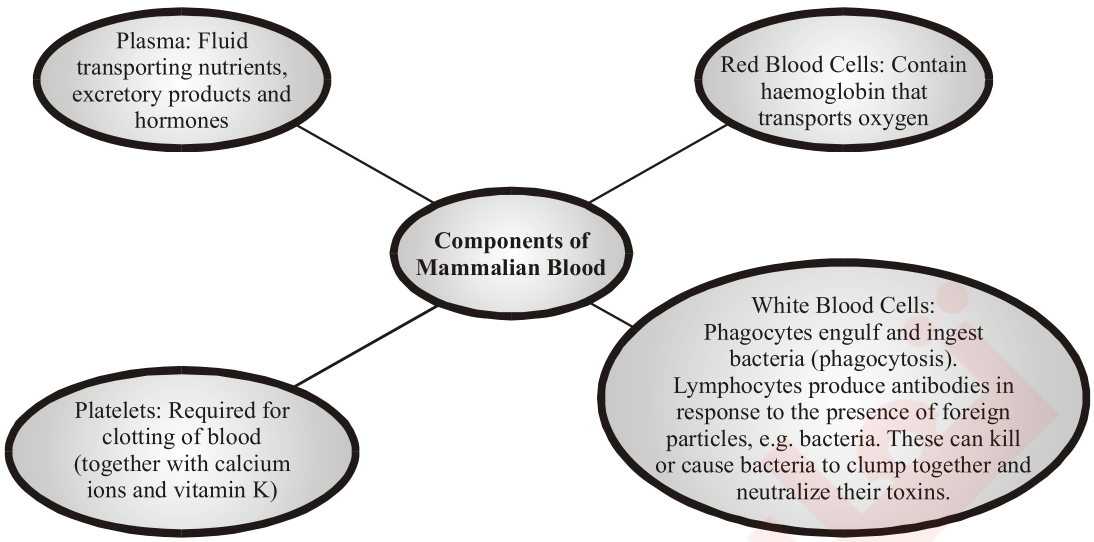


Fig. Red blood cells (erythrocytes) and white blood cells (Leucocytes) both develop from stem cells in bone marrow.

➢ Concept map showing the components of the mammalian blood



➢ Differences between red blood cells and white blood cells:

Red blood cell	White blood cell
♦ Contains haemoglobin	♦ Haemoglobin absent
♦ No nucleus	♦ Nucleus present
♦ Circular, biconcave in shape	♦ Irregular in shape
♦ Transports oxygen	♦ Phagocytosis or production of antibodies

- ➢
  - ♦ Mammals have a double circulation: pulmonary and systemic circulation.
  - ♦ The transport system consists of the blood system and the lymphatic system.
- ➢ Essential features of blood circulatory system:
  - ♦ Heart: to pump blood round the body.
  - ♦ Thick-walled arteries: to carry blood from heart.
  - ♦ Thin-walled veins: to bring blood back to heart.
  - ♦ Microscopic blood capillaries: to allow exchange of substances.
  - ♦ Valves in heart, veins and the arteries emerging from heart ventricles: to ensure unilateral blood flow, thus preventing backflow.
- ➢ A heartbeat consists of a ventricular systole and diastole.
- ➢ The lymphatic system helps to return most of the excess tissue fluid back to the bloodstream.
- ➢ Tissue fluid is plasma without the proteins, but it contains white blood cells. Serum is plasma without fibrinogen.
- ➢ Atherosclerosis is the deposition of fatty substances (cholesterol) on the inner walls of an artery.
- ➢ The formation of a local blood clot in an artery is called a thrombosis.

Q.30 Write down the properties of blood cells and cell like bodies?

Ans. BLOOD CELLS AND CELL LIKE BODIES:

These include red blood cells, (**Erythrocytes**), white blood cells (**leucocytes**) and platelets.

(a) Red Blood Cells (*Erythrocytes*):

Most Numerous: These are most numerous of the cells in the blood.

In males: *A cubic millimeter contains* ***5-5 ½ million*** of them in males.

In females: **4-4 ½ million** in females

Absence and Presence of Nucleus: These cells, when formed, have nucleus, but is lost before they enter the circulatory fluid or blood.

Cytoplasmic Compositions: 5% of the cytoplasm of red blood cells is the *red pigment, called haemoglobin*. The remaining 5% consists of *enzymes, salts* and other *proteins*.

Limited Division: The red blood cells once mature, do not divide.

Biconcave and Elastic: These cells are biconcave and have an elastic cell membrane.

Production in Red Bone Marrow: Red blood cells are formed principally in the red bone marrow of short bones, such as the sternum, ribs and vertebrae.

Formation in Embryo: In the embryonic life, they are formed in the liver and spleen.

Life Span: The average life span of red blood cell is about four months after which it breaks down and disintegrated in the liver and spleen – partly by phagocytes by Phagocytosis.

Destroying Period: About 2-10 million red blood cells are formed and destroyed every second in a normal person.

Transport CO_2 and O_2: Their main function is to transport O_2 and CO_2.

(b) WHITE BLOOD CELLS (*leucocytes*):

Colourless: These blood cells are colourless, as they do not contain pigments.

Amount: One cubic milimetre of blood contains 7000 to 8000 of them.

Larger than RBCs: They are much larger than the red blood cells.

Cytoplasmic and Nuclear Variety: There are at least five different types which can be distinguished on the basis of the shape of the nucleus and density of granules in the cytoplasm.

Main Types of WBCO: They can be grouped into two main types, granulocytes and agranulocytes.

(1) **Granulocytes** include (a) ***neutrophils,*** (b) ***eosinophils*** and (c) ***basophils***. They are formed in the red bone marrow.

(2) **Agranulocytes** are formed in lymphoid tissue, such as those of the lymphocytes (B and T).

(a) **Monocytes** stay from 10-20 hours in the blood, then enter tissues and become tissue macrophages, performing phagocytic function.

(b) **Lymphocytes** have life spans of months or even years; but this depends on the body's need for these cells.

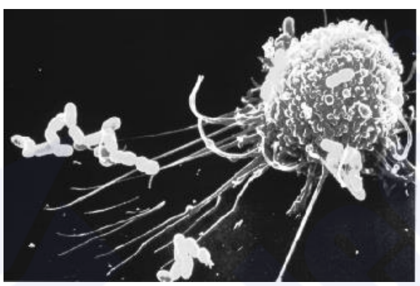


Fig. A macrophage in Action

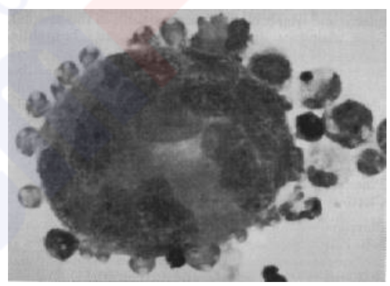


Fig. The production of platelets

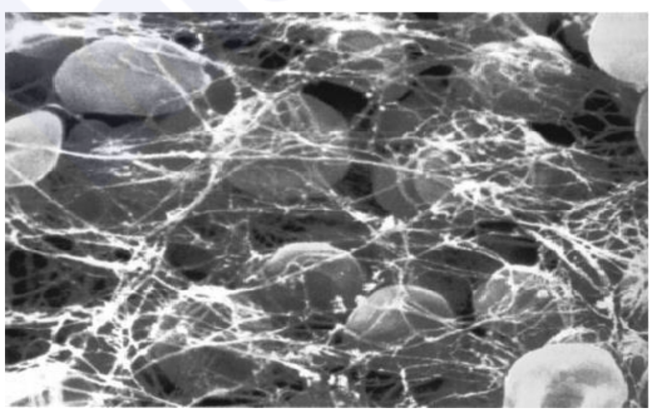


Fig. Blood clotting

CONCEPTUAL VIEW

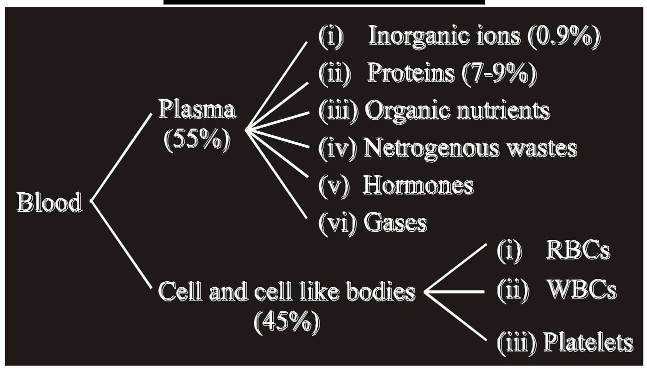
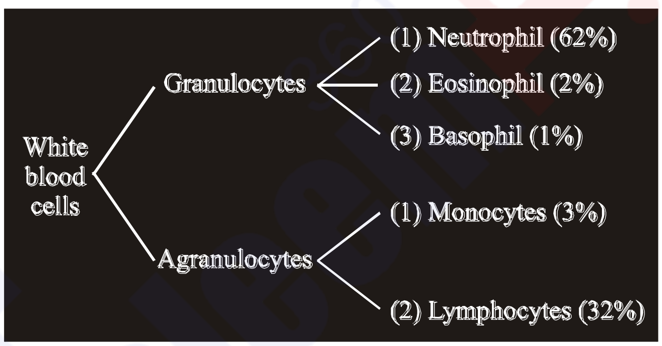


TABLE: SHOWING DIFFERENT CELL TYPES COMPARING THEIR CHARACTERISTICS & FUNCTIONS

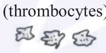
Cell Type	Description	Average Number Present	Major Functions
Red blood cell (erythrocyte)	***Biconcave*** *disc without nucleus, Approximately* ***8 μm*** *in diameter*	***5,000,000 per mm^3***	***Transports oxygen*** and a small amount of carbon dioxide.
White blood cell (leucocytes) (a) Granulocytes		***7500 per mm^3***	
1. Neutrophil	*About twice the size of red blood cells, nucleus* ***two to five lobed****.*	***62% of white cells***	Destroys small particles by **phagocytosis**.
2. Eosinophil	*About twice the size of red blood cells,* ***nucleus bilobed****.*	***2% of white cells***	Inactivates inflammation-producing substances; attacks parasites.
3. Basophil	*About twice the size of red blood cells nucleus bilobed.*	***Less than 1% of white cells***	**Releases heparin** to prevent blood clots and **histamine**, which causes **inflammation**.

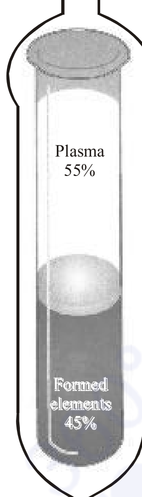
(b) Agranulocytes			
4. Monocyte	*Two to three times larger than red cells, nuclear shape from round to lobed.*	***3% of white cells***	Gives rise to macrophage, which destroys larger particle by **phagocytosis**.
5. Lymphocyte	*Slightly larger than red cell, nucleus nearly fills cell.*	***32% of white cells***	Functions in the **immune response** by producing **anti bodies**.
Platelet	*Membrane bounded cytoplasmic fragment of cells in bone marrow called megakaryocytes*	***250,000 per mm^3***	Involved in **blood clotting**.

CONCEPTUAL VIEW



Scheme shows kinds and % age of white blood cells

Formed Elements	Function and Description	Source
Red Blood Cells (erythropytes)  4 million–6 million per mm^3 blood	Transport O_2 and help transport CO_2 7–8 µm in diameter Bright-red to dark-purple biconcave disks without nuclei	Red bone marrow
White blood cells (leukocytes)	Fight infection	Red bone marrow
Granular leukocytes*  Basophil 20-50 per mm^3 blood	10–12 µm in diameter Spherical cells with lobed nuclei , large, irregularly shaped, deep-blue granules in cytoplasm	
 Basophil 100–400 per mm^3 blood	10–14 µm in diameter Spherical cells with bilobed nuclei , coarse, deep-red, multi-lobed sized granules in cytoplasm	
 Neutrophil	10–14 µm in diameter Spherical cells with multi-lobed nuclei, line, pink granules in cytoplasm	
Agranular leukocytes*  Lymphocyte 1,500–3,000 per mm^3 blood	5–17 µm in diameter (average 9–10 µm) Spherical cells with large, round nuclei	
 Monocot 100–700 per mm^3 blood	14–24 µm in diameter Large spherical cells with kidney-shaped, round, or lobed nuclei	
Platelets* (thrombocytes)  150,000–300,000 per mm^3 blood	**Aid clotting** 2-4 µm in diameter Disk-shaped cell fragments with no nuclei; purple granules in cytoplasm	**Red bone marrow**



Plasma	Function	Source
Water (90–92% of plasma)	Maintains blood volume; transports molecules	Absorbed from intestine
Plasma proteins (7–8% of plasma) Albumin	Maintain blood osmotic pressure and pH Maintain blood volume and pressure	Liver
Fibrinogen immunoglobuline	Clotting transport, tight infection	Absorbed from intestinal villi
Salts (less than 1% of plasma)	Maintain blood osmotic pressure and pH; aid metabolism	Lungs Tissues
Gasses Oxygen Carbon dioxide	Cellular respiration End product of metabolism	Absorbed from intestinal villi
Nutrients Fats Glucose Amino acids	Food for cells	Absorbed from intestinal villi
Urea	Nitrogenous waste	Liver
Hormones, vitamins, etc.	Aid metabolism	Vaned

*with Wright's stain

Fig. Composition of blood.
When blood is transferred to a test tube and is prevented from clotting, it forms two layers. The transparent yellow top layer is plasma, the liquid portion of blood. The formed elements are in the bottom layer. The tables describe these components in detail.

Functions

Protect from Invaders: Leucocytes protect the body against foreign invaders, and use circulatory system to travel to the site of invasion.

Destroy Bacteria: Monocytes and neutrophils travel through capillaries and reach the site of wound where bacteria have gained entry.

Feed on Bacteria: Macrophages and neutrophils feed on bacterial invaders or other foreign cells, including cancer cells.

Pus Result: They typically die in the process, and their dead bodies accumulate and contribute to the white substance called pus, seen at infection sites.

Produce Heparin: Basophils produce heparin – a substance that inhibit blood clotting.

Chemical Productions: These also produce chemicals, such as histamine, that participate in allergic reactions and in response to tissue damage and microbial invasion.

Provide Immunity: Lymphocytes help to provide immunity against the disease.

(c) PLATELETS:

Fragments: They are not cells, but are fragments of large cells called megakaryocytes.

Nucleus Absent: There is no nucleus in them.

No Pigments: There is no pigment in them.

Conversion of Fibrinogen: Platelets help in conversion of fibrinogen, a solid plasma protein, into insoluble form, fibrin.

Enumash RBCs: The fibrin threads enumash red blood cells and other platelets in the area of damaged tissue, ultimately forming a blood clot.

Clot Formations: The clot serves as a temporary seal to prevent bleeding until the damaged tissue can be repaired.

Q.31 What are the major functions of human blood?

Ans. **FUNCTIONS OF BLOOD**

The overall functions of blood in humans can be listed as follows:

Maintain Osmotic Pressure:

The plasma proteins maintain colloid osmotic pressure of blood (75% by albumins, 25% by globulins and almost none by fibrinogen).

Transport Material:

Blood helps in transport of materials, in the body including nutrients, water, salts and waste products. All hormones are transported by blood from the endocrine tissues to the larger cells.

Transport Gases:

Gases O_2 and CO_2 are transported by blood.

Defence Mechanism:

Blood helps in body defences against disease Neutrophils and monocytes engulf and destroy invading microorganisms e.g. bacteria.

Immunity:

Blood provides immunity by the lymphocytes.

As Buffer: Blood produces interferon, and antitoxins which are proteins, and protects our body from nuclete aids of invading organism; and toxins of the invaders. Blood acts as a buffer to maintain the acid – base balance i.e., concentration of H+ and OH ions of the body.

Homeostasis: Helps in maintaining the body temperature, concentration of water and salts, thus helps in homeostasis.

Exchange Material:

Blood helps in the exchange of material between blood and body tissue through blood capillaries.

Maintain Internal Environment: Blood helps the body in maintaining the internal environment, by producing heparin, histamines, and also maintaining the amounts of chemicals in the body to a constant or nearly constant level.

Blood Clotting: Helps in blood clotting process.

CONCEPT

Table Body Fluids

Name	**Composition**
Blood	Formed elements and plasma
Plasma	Liquid portion of blood
Serum	Plasma minus fibrinogen
Tissue fluid	Plasma minus most proteins
Lymph	Tissue fluid within lymphatic vessels

Q.32 Discuss various diseases which are result due to the disorder in blood.

Ans. DISORDERS:

There are certain disorders, related to the blood. Some of them are discussed below:

(i) Leucaemia (Blood Cancer):

(1) It is the result of **uncontrolled production of white blood cells** (leucocytes). This is called by a cancerous mutation of a **myelogenous** or **lymphogenous** cell.

(2) The **leucaemia** is usually characterized by greatly increased numbers of abnormal white blood cells in the circulating blood.

(3) Myelogenous cells (bone marrow cells) are in the bone marrow – and may spread throughout the body, so that white blood cells are produced in many other organs. These white blood cells are not completely differentiated, and so are defective.

(4) Leucaemia may be of different types depending on the type of white blood cells, which are undifferentiated and being produced at a faster, **basophilic leucaemia**, **monocytic or lymphocytic leucaemia**.

(5) It is a very serious disorder and the **patient needs to change the blood regularly with the normal blood, got from donors**. *It can be cured by bone marrow transplant – which is in most cases effective, but very expensive treatment*.

(ii) Thalassaemia (*G. Thalassa = The Sea; Haema = Blood*):

It is also called Cooley's anaemia on the name of Thomas B. Cooley American pediatrician. **It is genetically transmitted haemoglobin abnormality.** It is characterized by the **presence of microcytes by spleenomegaly (enlargement of spleen) and by changes in the bones and skin.**

Common in Children:

This disease is more common in children especially of Mediterranean parents. The blood of these patients is to be replaced regularly, with normal blood.

Cure:

It can be cured by ***bone marrow transplant*** – which is very expensive – and does not give 100% cure rate. Haemoglobin molecule in most cases, does not have β chains in it, instead F. chain is present (F is foetal haemoglobin).

(iii) Oedema:

It means the **presence of excess fluid in the tissues of the body. The excess fluid may be in the cells, or outside the cells.**

Caused by Osmosis of H_2O:

The intracellular oedema is caused by osmosis of water into the cells, and cause, depression of metabolic systems (due to lack of nutrition and O_2 in the tissues) especially and the Na-pump.

(i) Abnormal leakage of fluid from the blood capillaries or failure of the lymphatic system or return fluid from the interstitial fluid.

(ii) *Oedma is caused be renal retention of salts and water.*

Disturbs the Mineral Exchange:

Oedema disturbs the exchange and concentration of, minerals and ions in the blood and body cells. Affects blood pressure, increases heart load etc.

Q.33 Describe the structure and function of human heart.

Ans. STRUCTURE OF HEART

Human heart is located in the chest cavity. It is enclosed in a double membranous sac called pericardial cavity which is filled with pericardial fluid. Pericardium protects the heart and prevent it from over extension. Heart is formed of three layers:

(i) **Epicardium** - outermost

(ii) **Myocardium** - middle

(iii) **Endocardium** - inner most

The myocardium is formed of special type of muscles called cardiac muscles formed of myofibrils and myofilaments of ***myosin*** and ***actin***. The arrangement and mechanism of contractility of there is similar to those in skeletal muscle fibre. The difference is that myocardium have branched cells, in which the successive cells are separated by junctions called intercalated discs.

Action of Heart

It contracts ***automatically*** and ***rhythmically***, ***imposed by automatic nervous system*** of the body.

Functions of Heart

It is divided into ***four chambers***, two upper ***thin-walled atria*** and two lower ***thick walled ventricles***. The atria receives blood and pass on to the ventricle which distribute it to the body. Human heart functions as a ***double pump*** and is involved in ***pulmonary and systemic circulation***. There is a complete separation of deoxygenated blood (right side) and oxygenated blood (left side) in heart.

Pathway of Blood Circulation

Right atrium receives deoxygenated blood from ***pre-caval*** collected from head, shoulder, arms etc. and from ***post-caval*** collected from abdomen, hind limbs etc. The blood is passed on to right ventricle through tricuspid valve having 3 flaps.

Flaps

The flaps are attached with fibrous cords called **chordeae tendinae**, to the **papillary muscles** which are extensions of wall of the right ventricle.

Ventricles

When right ventricle contracts, the blood is passed to trunk, which carry blood via left and right ***pulmonary arteries*** to the lungs. ***Semilunar valves*** are present at the base of ***pulmonary trunk***. After oxygenation in lungs the blood is brought by pulmonary veins to the left atrium, which passes this blood via ***bicuspid valve*** (having two flaps) to the left ventricle. The flaps of ***bicuspid valve*** are similarly attached through chordeae tendinae, with ***papillary muscles*** of wall of ***left ventricle***. The left ventricle contracts and pushes the blood through aorta to all parts of the body (except lungs). At the base of ***aorta*** semilunar valves are also present. The valves of the heart control the direction of flow of blood. The wall of left ventricle is thicker (about 3 times) than that of the ***right ventricle***.

Aorta

(i) At the base of aorta, first pair of arteries, the ***coronary arteries****, arise, and supply blood to the heart*.

(ii) The ***aorta*** forms an arch, and before descending down gives three branches *supplying blood to head, arms and shoulders*.

(iii) Aorta moves down in the chest cavity. It gives many small branches to the chest wall and then passes down to the ***abdominal region***.

(iv) The branches supply blood to different parts of alimentary canal, kidneys and the lower abdomen.

(v) Aorta bifurcates into **iliac** arteries. Each of which divides into two femoral and sciatic arteries supplying blood to legs.

(vi) The blood from the upper part of the body is collected by different veins, which join to form ***superior vena cava***, which passes blood to ***right atrium***.

Iliac Vein

Two iliac veins are formed by veins which collect blood from legs and unite to form ***inferior vena cava***. It receives renal vein from each kidney, hepatic veins from liver before it enters to right atrium. The liver receives ***hepatic portal vein*** which is formed by many veins collecting deoxygenated blood with absorbed food from different parts of alimentary canal.

Q.34 Describe the cardiac cycle in detail.

Ans. **THE CARDIAC CYCLE:**

It is the sequence of events, which take place during the completion of one heartbeat. Heart beat involves three distinct stages.

Relaxation Phase-Diastole:

The deoxygenated blood enters right atrium through vena cava and oxygenated blood enters left atrium through pulmonary veins. The walls of the atria and that of ventricles are released. As the atria are filled with blood, they become distended and have more pressure than the ventricles. This relaxed period of heart chambers is called diastole.

Atria Contract with Systole:

The muscles of atria when they are filled and distended with blood, simultaneously contract. The blood passes through tricuspid and bicuspid valves, into the two ventricles which are relaxed.

Ventricle Contract-Ventricular Systole:

When the ventricles receive blood from atria, both ventricles contract simultaneously and the blood is pumped to pulmonary artery and aorta. The tricuspid and ***bicuspid*** valves close and bulb sound is made. Ventricular systole ends and ventricles relax at the same time semilunar valves at the base of pulmonary artery and aorta dose (***Lubb, dub*** can be heard with the help of ***stethoscope***).

The complete ***heartbeat*** consists of one systole and one diastole and lasts for about ***0.8 seconds***. In one's life heart contracts about ***2.5 billion times***, without stopping.

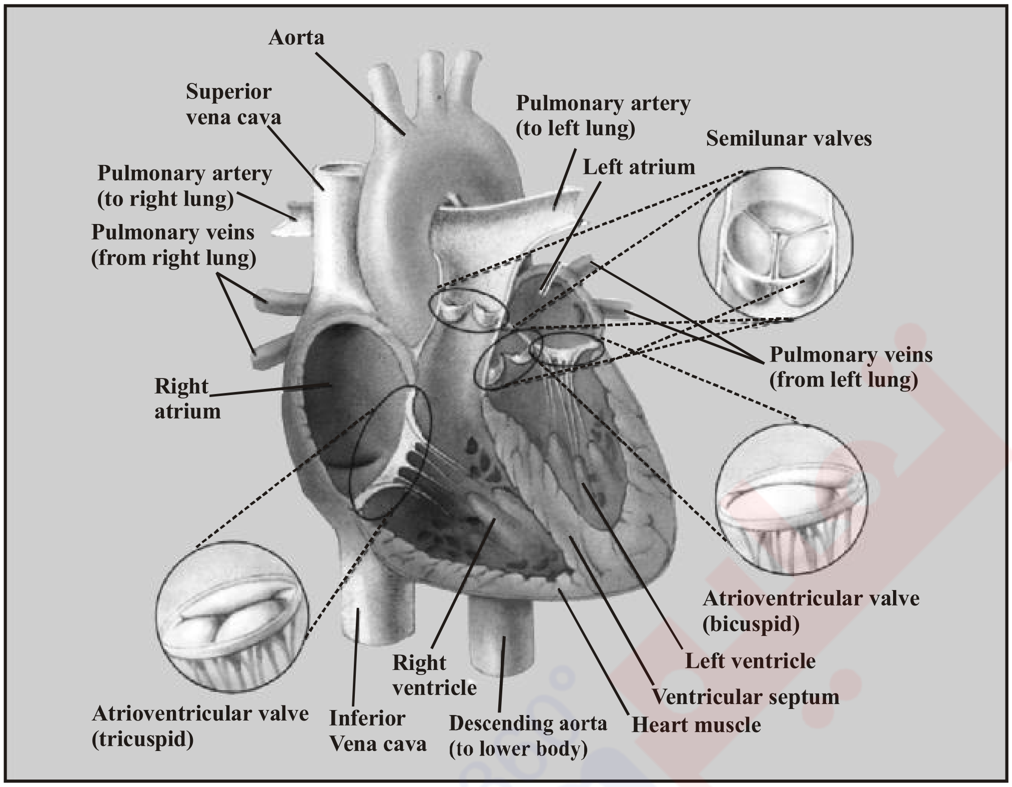


Fig. The human heart and its valves and vessels.

EASY TO DRAW

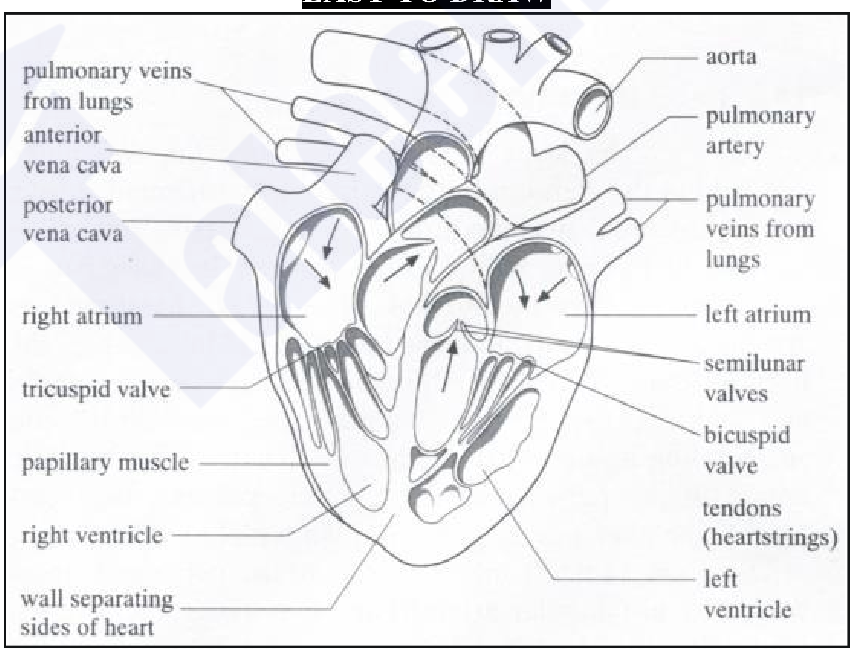


Fig. Human heart

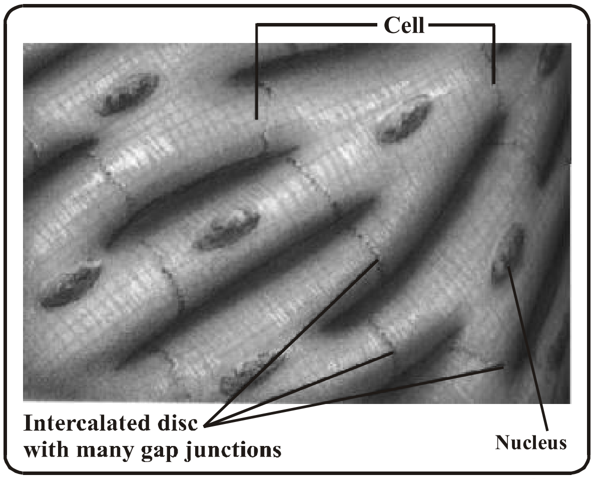


Fig. The structure of cardiac muscle

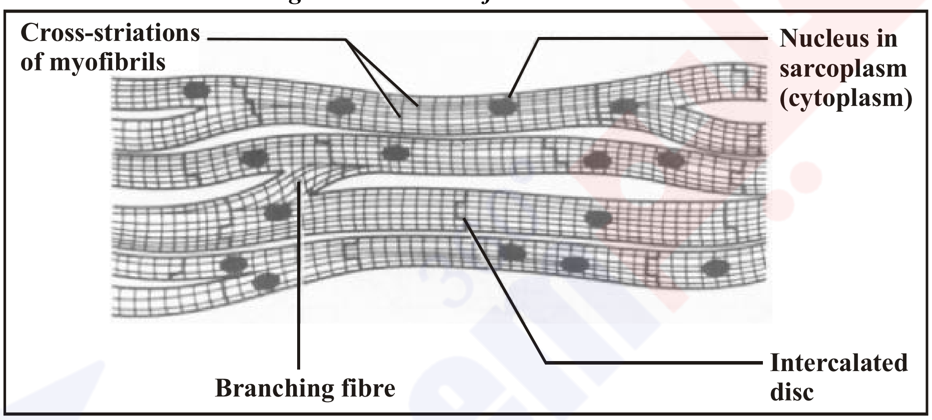


Fig. Structure of cardiac muscle

Q.35 Write notes on:
(a) Mechanism of heart excitation and contraction
(b) Elctrocardiogram
(c) Artificial pace maker
(d) Blue babies

Ans. MECHANISM OF HEART EXCITATION AND CONTRACTION

The heartbeat cycle starts when **sino-atrial** node (***pace maker*:** *a small group of specialized muscle cells at the top of right at rium*) at the upper end of right atrium sends out electrical impulses to the atrial muscles. It causes both atria to contract. The sino-atrial node is a vestige of the sinus venosus seen in the heart of lower vertebrates.

It is close to the point of entry of the vena cava. It consists of a small number diffusely oriented cardiac fibers, possessing few myofibrils, and few nerve endings from the nervous system.

Impulses from the node are propagated by the special electro conductive muscle cells to the musculature of the atrium and to an ***atrioventricular node***.

The atrial muscle fibers are completely separated from those of the ventricles by atriovenctricular septum of connective tissue, except for the region in the right atrium called atrioventricular node (AV node). From atrioventricular node, an atrioventricular bundle of muscle fibers propagate the regulatory impulses via the interventricular septum to the ***myocardium*** of the ventricles. ***There is a delay of approximately 0.15 second*** in ***conductance from*** the S-A node to A-V node, thus permitting fatrial systole to be completed before ventricular systole begin. The heart's electrical activity during heart beat can be studied by E.C.G. machine i.e., ***electrocardiogram machine***.

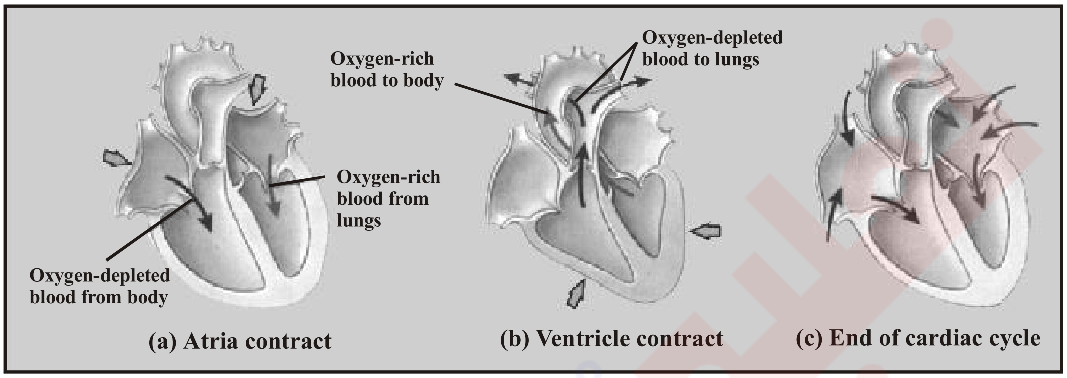
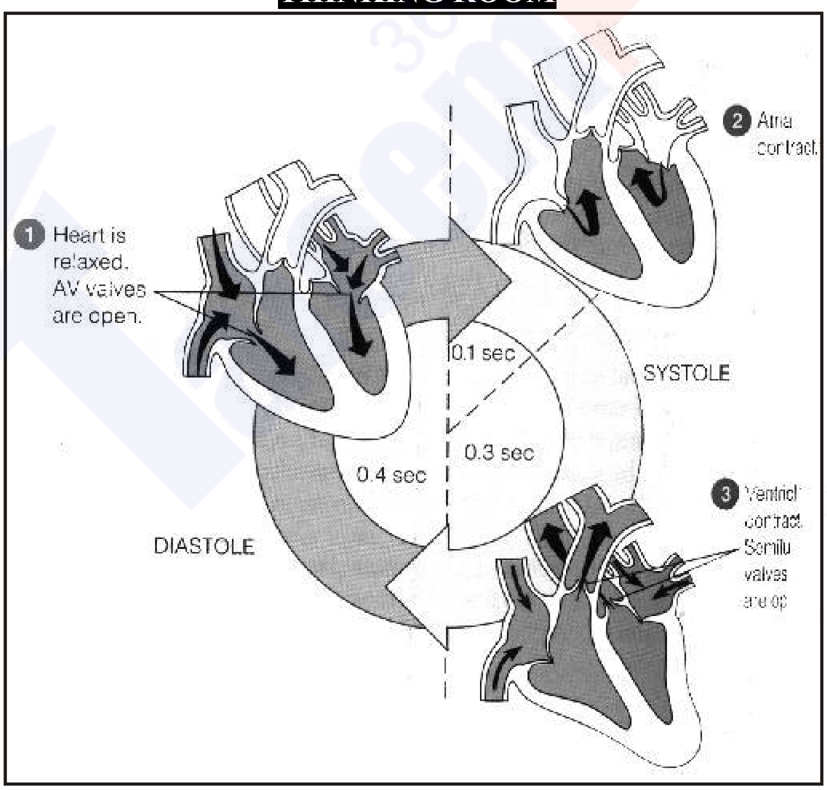


Fig. The cardiac cycle

THINKING ROOM



Electrocardiogram (E.C.G.)

It is an electrographic interpretation of the electrical flour of impulses, in the heart and is taken by E.C.G. machine and its record is called electrocardiogram.

Method:

As the cardiac impulse possess through the heart, electrical currents spread into the tissues surrounding the heart. A small proportion of these spread all the way on the surface of the body. If electrodes are placed on the skin on opposite sides of the heart, electrical potentials generated by these currents can be recorded.

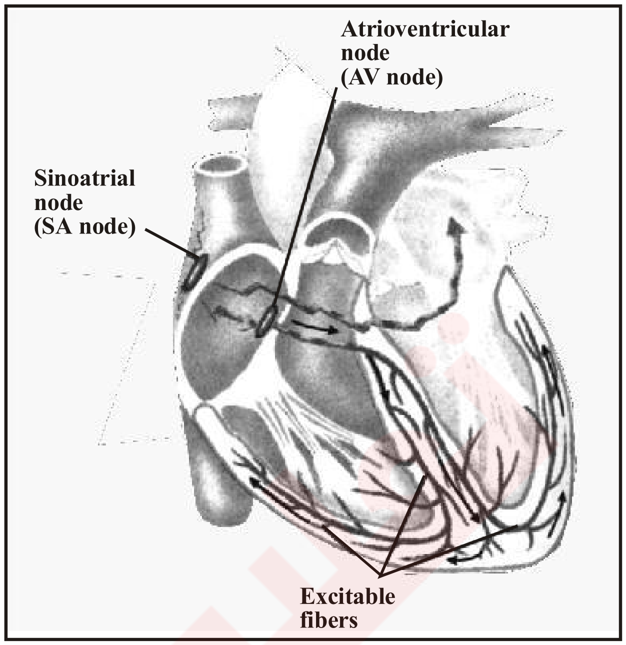
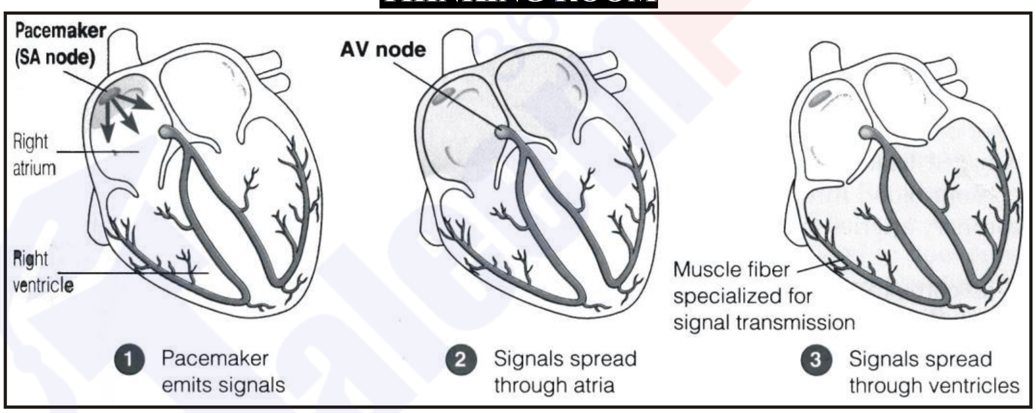


Fig. The Heart's Pacemaker and its connections

THINKING ROOM



Artificial Pacemaker:

Pacemaker is responsible for initiating the impulses, which trigger the heart beat rate. The impulses pass from S-A node to musculature (muscles) of arteries and atrio-vertricular node. (A-V node) From here these impulses are passed on to the myocardium of ventricles via artioventricular muscle fibers.

If there is some block in the flow of the electrical impulses, or if the impulses initiated by pacemaker are weak; it may lead to death of the indivi. So artificial pacemaker which is battery operated electrical stimulus e.g., if A-V pathway is blocked, the electrodes of artificial pacemaker are attached to the ventricle. Then this pacemaker provides continued ***Rhythmic impulses*** that take over the control of the ventricles. Batteries are replaced once every five years.

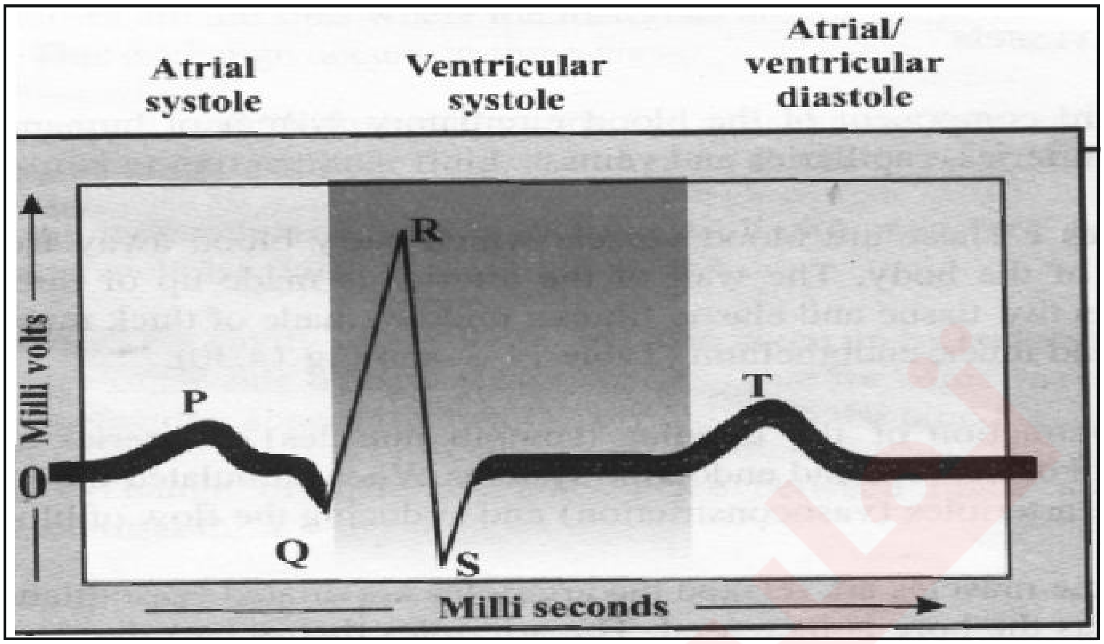


Fig. A normal electrocardiogram (ECG) indicates that the heart is functioning properly. The P wave occurs just prior to atrial contraction; the QRS waves occurs just prior to ventricular contraction; and the T wave occurs when the ventricles are recovering from contraction.

Blue Babies:

"Hole in the heart". Failure of ***interatrial foramen*** to close or of ***ductus arteriosus*** to fully contrict results in ***cyanosis*** (blueness of skin) of newborn, because blood continues to be shunted away from the lungs resulting in insufficient oxygen in the blood. Changes, after birth, are slow to take place resulting in mixing of blood between two atria and the mixed blood is supplied to the body of new born babies that produces blue babies. In some cases the interatrial foramen is not completely closed.

Atrial Septal Defect (Blue-babies):

This is commonly known as ***hole in the heart***. Before birth, most oxygenated blood from the placenta enters the left atrium from the right atrium through the ***foramen ovale*** in the septum. There is a valve-like structure across the opening, consisting of two partly overlapping membranes. The 'valve' is open when the pressure in the right atrium is higher than in the left. This diverts blood flow from the right to the left side of the heart, bypassing the pulmonary circulation, which in the unborn child is not functional because the fetus derives his oxygen supply through the placenta. After birth, when the pulmonary circulation is established and the pressure in the left atrium is the higher, the two membranes come in contact, closing the 'valve'. Later the closure becomes permanent due to ***fibrosis***.

When the membranes do not overlap, an opening between the atria remains patent after birth. In many cases it is too small to cause symptoms in early life but they may appear later. In severe cases blood flows back to the right atrium from the left. This increases the right ventricular and pulmonary pressure, causing ***hypertrophy of the myocardium and eventually cardiac failure***.

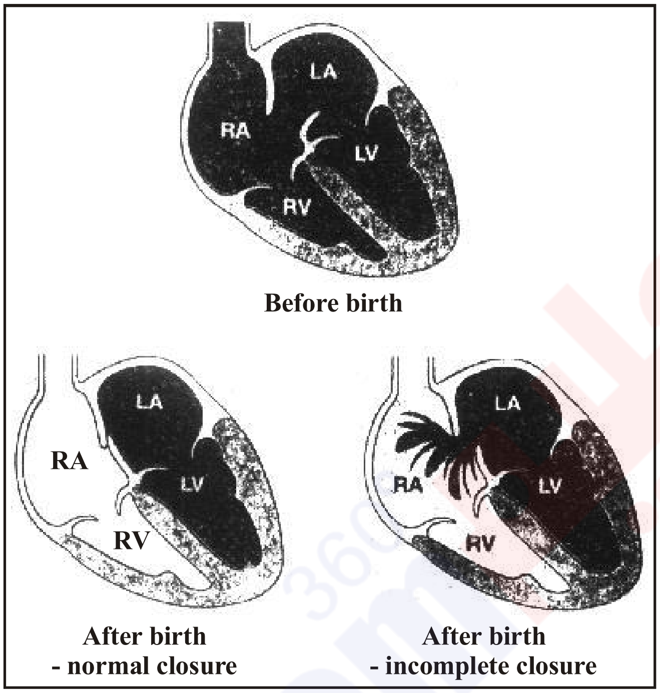


Fig. Atrioseptal valve: normal and defective closure after birth.

Q.36 Describe the structure and function of different types of blood vessels.

Ans. **BLOOD VESSELS**

There are three types of blood vessels:

(1) Arteries (2) Capillaries (3) Veins

(1) ARTERIES

(i) The arteries ***carry blood away from the heart to different parts*** of the body.

(ii) ***Structure:*** The wall of the arteries is made up of ***three layers***:

(a) Tunica intima (b) Tunica media (c) Tunica extrema or adventitia

(iii) **Tunica media** has thick muscular wall, along with elastic fibers. This is important to withstand higher blood pressure during ventricular systole.

(iv) The arteries divide into two smaller vessels called ***arterioles***.

In arterioles there is more circular muscle than elastic tissue.

(v) **Functions:** The contraction of the circular (***smooth muscles***) of arteries and arterioles is under the control of nervous and endocrine systems. When, the muscle contracts, the arterioles (***vasoconstriction***) and reducing the flow of blood in them.

(vi) When the muscles are relaxed the arteries are dilated (***vasodilatation***) more blood flows in them, and the cavity's diameter is increased.

(vii) The arterioles themselves divide repeatedly until they form a dense network of microscopic vessels. These final branches are called capillaries.

Arteriosclerosis:

It consists atheromo and arteriosclerosis i.e., ***deposition of hard yellow plague of lipoid material*** in the inner most layer of the arteries.

They may be related to light level of ***cholesterol*** in the blood.

Atherosclerosis:

It is the ***degenerative arterial change*** associated with advancing age.

Primarily, a ***thickening of middle layer of arteries*** is usually associated with some degree of ***atheroma***.

So, Atheriosclerosis causes narrowing and hardening of arteries. This increases the risk of formation of thrombus and if thrombus is formed in the brain or heart it is fatal. So atherosclerosis is a major condition predisposing a person to heart attack.

(2) **CAPILLARIES**

(i) These are blood vessels with walls only ***one cell thick***.

(ii) The blood appears confined within the capillary walls.

(iii) The capillaries with the result that water and dissolved substances pass through it. They exchange oxygen, carbon dioxide dissolved food and excretory products with the tissue around capillary.

(iv) The capillary network is so dense that no living cell is far from a supply of oxygen and food.

(v) In the liver every cell is in direct contact with capillary.

Exchange of Material:

The capillaries are the sites where the materials are exchanged between the blood and body tissues, which occur in three ways:

(vi) Active transport, diffusion and through the cells lining the capillary wall into the interstitial or extracellular fluid, and then to the body cell, and vice versa.

(vii) Materials from the cavity of capillaries are also taken up by endocytosis, and then passed to the other side by exocytosis. It is true for some materials entering from the intercellular spaces (extra cellular fluid) to the blood.

Thus the exchange of materials takes placed between blood and tissues via extra cellular or interstitial fluid.

(viii) Capillaries join with one another to form venules.

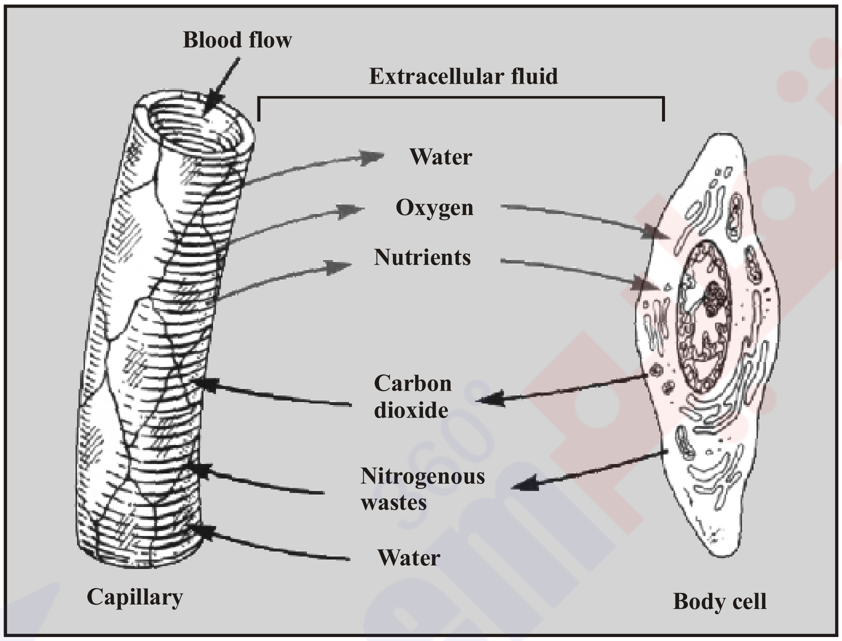


Fig. The exchange of gases and nutrients in a capillary

(3) VEINS

(i) The veins are blood vessels, which ***carry blood from different parts*** of the body, towards the heart.

(ii) Capillaries join to form ***venules*** which further join to form veins.

(iii) They are wider and have thinner walls than arteries.

(iv) They have ***inextensible fibrous tissue*** replacing the elastic tissue of the latter.

(v) The ***semilunar valves*** are present in the veins. These valves prevent back flow of blood.

(vi) The pressure of surrounding ***muscles***, when they contract, tends to squash the veins or assist the return of blood towards heart.

(vii) The walls of veins have the same ***three layers*** present as in arteries.

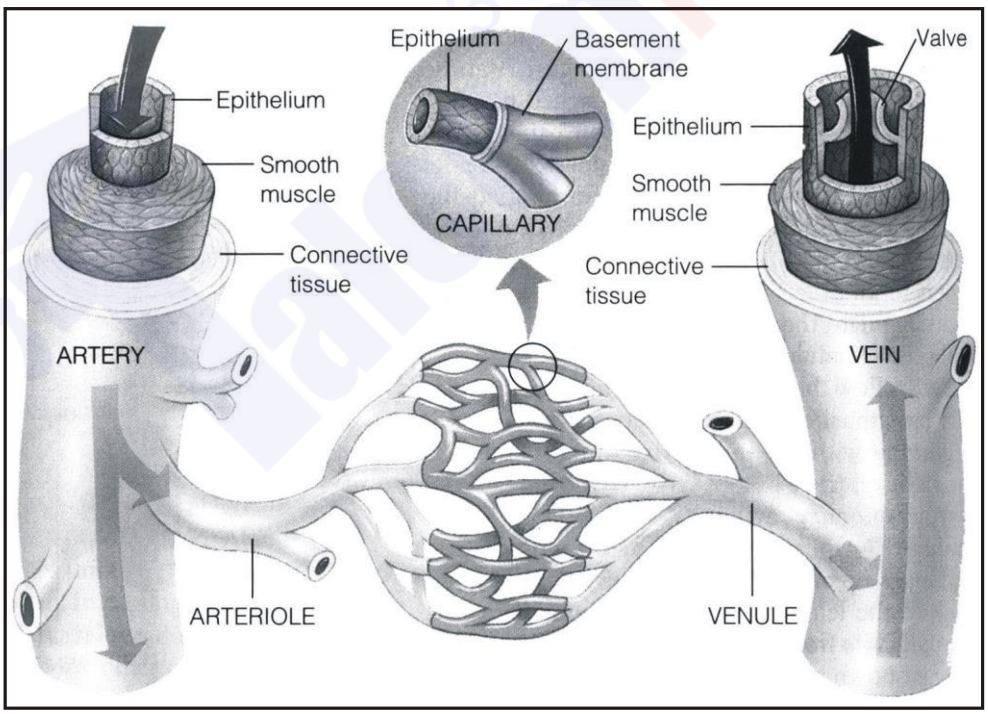
(viii) Veins join to form larger veins, and ultimately form ***vena cava***, (inferior vena and superior vena cava) which pour the blood into atrium, of the heart, as the blood is collected from the body.

(ix) The oxygenated blood from the lungs is brought to the left atrium by ***pulmonary veins***. In the veins the pressure of the blood is low.

(x) The pressure within capillaries causes a continuous leakage of fluid from the blood plasma into the spaces that surround the capillaries and tissues. This fluid, known as ***interstitial fluid*** consists primarily of water, in which the dissolved nutrients, hormones, gases, wastes and small proteins from the blood are present.

Larger proteins, red blood cells and platelets cannot go to the intercellular spaces of capillary wall, so they remain within capillaries. But some white blood cells can squeeze out through the interventricular spaces of capillary spaces of capillary wall. Interstitial fluid is the medium through which the exchange of material between the blood and nearby cells occurs.

CONSIDERABLE VIEW



COMPARISON IN STRUCTURE AND FUNCTION OF AN ARTERY, CAPILLARY AND VEIN

	Arteries	Veins	Capillaries
(1)	These ***transport blood*** away from the heart to the various parts of body through capillaries.	These ***collect blood*** from body through capillaries and transport it towards heart.	These link arteries with veins.
(2)	All arteries carry ***oxygenated blood*** except pulmonary artery.	All veins carry ***deoxygenated blood*** except pulmonary veins.	These have ***mixed*** oxygenated and deoxygenated blood.
(3)	There are ***no valves*** in them except at the base of pulmonary trunk and aorta.	***Valves are present***. These prevent the back flow of blood.	There are ***no valves***.
(4)	Have high blood pressure.	Have low blood pressure.	Failing pressure in these.
(5)	Wave of blood pressure of pulse due to heartbeat can be detected.	No pulse	No pulse
(6)	Blood flow rapid ***400-500 mm per second*** in aorta and decreasing in arteries and arterioles.	Rate of blood flow increase from smaller to larger ones.	Blood ***flow slowest***, less than 1 mm per second.
(7)	Have ***smaller bore*** and thick wall.	Have ***larger bore*** and ***thin walls***.	Large bore ***wall one cell*** in thickness.
(8)	***Thick muscle layer*** and elastic fibres present. The elasticity helps changing the pulsating flow of blood.	***Thin muscle layer*** and less elastic fibre. So are less elastic.	***No muscles*** of elastic fibres.
(9)	***No exchange*** of materials.	***No exchange*** of materials.	***Responsible for exchange*** of materials.

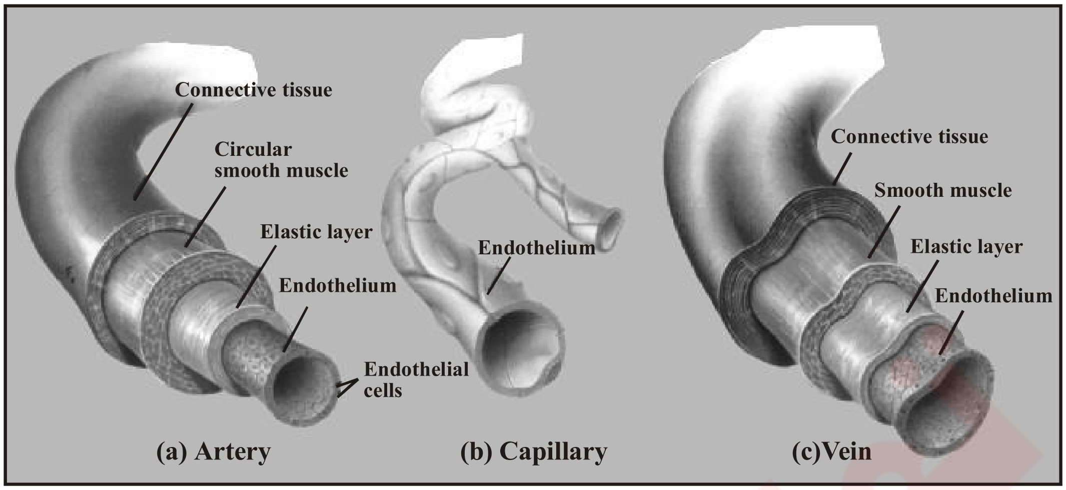


Fig. Showing the comparison in structure of artery, capillary and vein

Q.37 Write notes on rate of flow of blood and blood pressure. Write down some disorders of circulatory system related with blood pressure.

Ans. **BLOOD PRESSURE**

It is the measure of **force with which blood pushes up against blood vessel walls**. It is the force that keeps blood flowing from the heart to all the capillary networks in the body. (OR) ***The pressure of the blood on the walls of vessels depend on the energy of heart action.***

The pressure is generated by the contraction of ventricles (ventricle systole) and is the highest in aorta, then gradually reduces in arteries.

The walls of arteries are elastic and during systole the flow of blood stretches them and it is felt as pulse. Please shows the differences between systolic and diastolic pressures. During diastole, the relaxation phase of the cardiac cycle, the heart is not exerting pressure on the blood in the arteries and pressure in them falls. The elastic recoil of the previously stretched artery walls maintain same pressure on the blood.

Normal Blood Pressure:

There is a regular cycle of pressure in the larger arteries.

The pressure reaching is high point during systole (systolic pressure which in normal individuals is 120 mm Hg) and at low point during diastole (diastolic pressure which in normal individuals ranges between 75-85 mm Hg).

Thus blood moves from a region of higher pressure towards a region of lower pressure.

The decline of the blood pressure in successive parts of systemic circuit is the result of friction between the flowing blood and the walls of the blood vessels.

Several other changes occur along the route of blood flow:

(i) The ***difference between systolic and diastolic pressure*** diminishes until it disappears in the capillaries and veins.

(ii) The ***rate of blood flow*** tends to fall as the blood moves through the branching arteries and arterioles.

(iii) The ***rate is lowest in the capillaries,*** and increases again in the venules and veins.

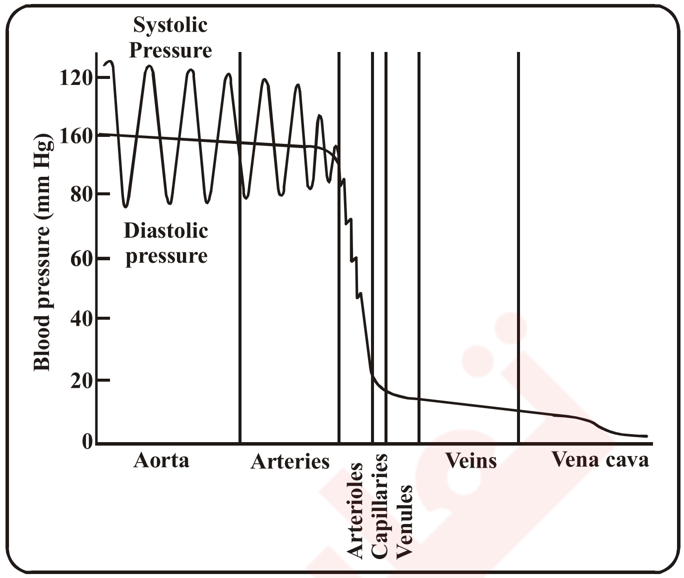


Fig. (a) Graph of blood pressure in different parts of the human circulatory system.

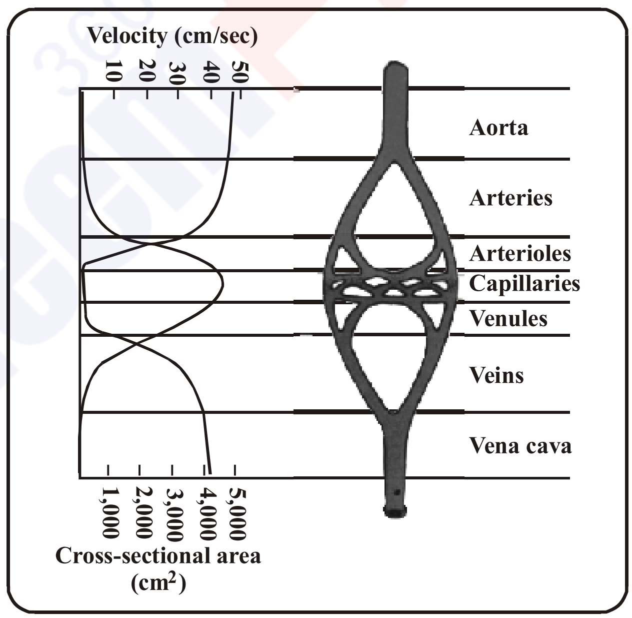


Fig. (b) charge in the velocity of blood flow in the various parts of a systemic circulatory pathway.

These changes in rate of blood flow result from changes in the total cross section of the vessel system. Linear rate of flow is inversely proportional to cross sectional area.

Blood Flow in Veins:

The flow of blood in veins is maintained by the *contraction of surrounding muscles* and *the action of semilunar valves,* which prevent back flow of blood; when standing still on your feet for a long period, you may have noticed your feet beginning to swell, and sudden onset of fatigue. The reason is that, there is not enough muscle action in your legs to push the blood forward towards the heart. Likewise if someone is hospitalized and is bedridden, for a longer time, pooling of blood may lead to formation of a clot in a leg in (thromophlebitis) a potentially fatal, development which may block supply of blood to vital organs of the body i.e., brain and heart. Muscular activity including breathing movements help normal flow of blood in the body.

Q.38 Write notes on the following:

(a) Hypertension

(b) Heart attack (Myocardial infarction)

(c) Haemorrhage

Ans. **HYPERTENSION**

It is condition of high blood pressure.

(1) Prolonged high blood pressure ***damages the lining of the blood vessels***. Hypertension also leads to (2) ***weakening heart muscles*** (which has become thickened due to the continuous strain imposed on it) and ***declining efficiency of its pumping action***. Blood may then back up in the heart and lungs are other are other fatal condition called ***congestive heart failure***. Hypertension is associated with *thrombus formation*.

Thrombus:

Aggregation of blood factors like platelets and other cellulary elements.

Thrombus is a solid mass on plug of blood constituents (***clot***) in a blood vessel. This mass may ***block the vessels in which it forms***. It may ***be dislodged and carried to some other location in the circulatory system in this*** case it is called an ***embolus***. It may be a sudden blocking.

Thrombosis:

Thrombous formation is called thrombosis. ***Thromboembolism*** is ***leading cause of deaths in western civilization***.

Reasons: Thrombus formation may be due to the following reasons:

(i) *Irration* or *infection* of living blood vessels.

(ii) *Reduced rate of blood flow*, due to long periods of inactivity.

(iii) *Pneumonia and tuberculosis, emphysema* etc.

Thrombophlebitis (*Thrombus in Leg*):

When thrombus is formed in the leg veins, the condition is called ***thrombophlebitis***.

HEART ATTACK (*MYOCARDIAL INFARCTION*)

Blockage of blood vessel in the heart by an embolus or by locally formed (thrombus) causes necrosis of portion of heart muscles, a condition familiarly known as a heart attack a myocardial infraction.

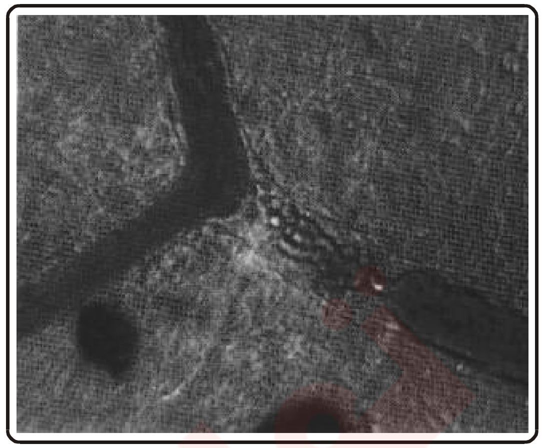
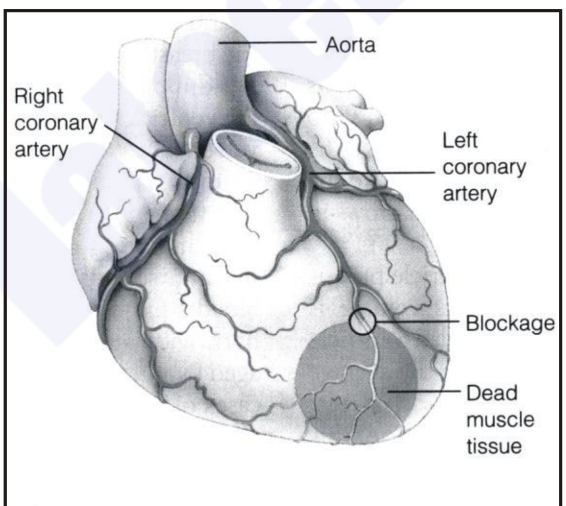


Fig. A thrombus in a small blood vessel. The thrombus (tangled red mass) has blocked blood flow near a point where the vessel branches. The blood has pulled away from the left end of the thrombus and is beginning to pull away from the right end also.



A. Blockage of a coronary artery, resulting in a heart attack

Causes: Heart attack is due to disruptions of control system of the heart with accompanying arrhythmias, especially ventricular fibrillation.

Prevention:

We can prevent or avoid these situations or malformation/functions to:

(i) Avoid too much *fatty food* (especially rich in cholestrol).

(ii) Maintain normal *body weight*.

(iii) *Avoid stress* and tension.

(iv) *Control our blood pressure* by regular walk and exercises.

(v) Do not smoke.

STROKE: (*Cerebral Infaraction*)

If the normal flow of blood is blocked by an embolus (or a locally formed thrombus) a blood vessel in the brain, and calluses ***necrosis*** of the surrounding neural tissue (owing to lock of O_2) the condition is called a stroke or cerebral infarction. The symptoms of the stroke very depending on the part of the brain that has been damaged.

Haemorrhage

It is the discharge of blood from the blood vessels. Especially important is a brain haemorrhage.

Causes: Brain haemorrhage results from *bursting of any of the arteries supplying the brain*. When the wall of the arteries become hard and losses its elasticity and higher blood pressure would result in ***brain haemorrhage***.

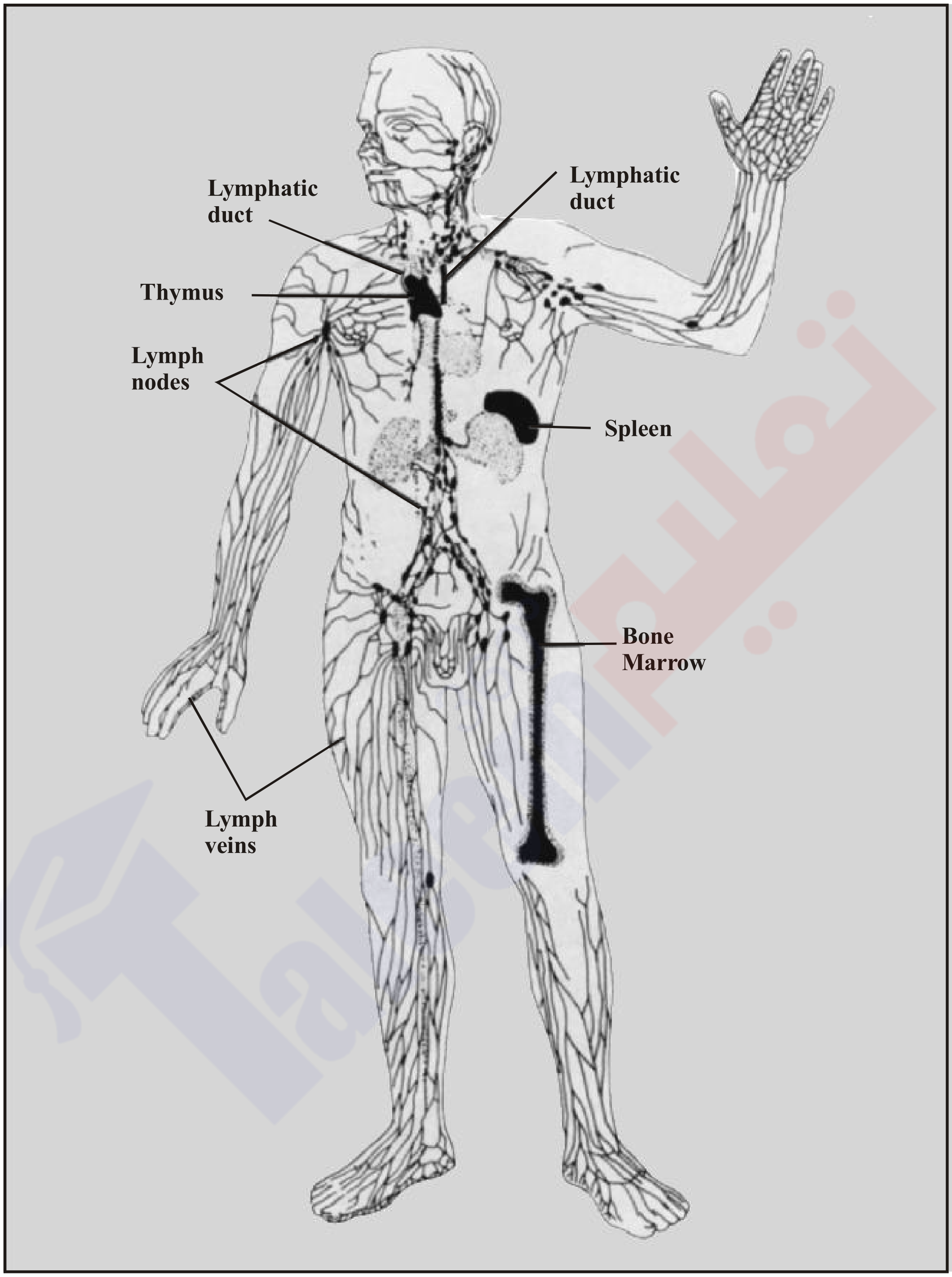


Fig. Human lymphatic system

Prevention:

To avoid brain haemorrhage the blood pressure must be controlled between normal limits:

To prevent the haemorrhage, following measures should be taken:

- ***Less cholesterol*** should be included in our food.
- Maintenance of ***normal blood pressure***.
- Avoid *over weight*.
- *No smoking*
- Do *regular exercise*.
- *Avoid stress* and tension.

Q.39 Describe the lymphatic system of human in man. Also gives its functions.

Ans. LYMPHATIC SYSTEM

Lymphatic system is responsible for the transport of materials from the tissues of the body to the blood.

Components of Lymphatic System:

The system comprises of lymph capillaries, lymph vessels, lymphoid masses, lymph nodes, and the fluid. It flows in the system called lymph.

Lymph Capillaries:

The lymph capillaries, like the blood capillaries, have walls ***made up of a single layer of cells***, but the intercellular opening in the walls of *lymph* vessels are larger than those of the capillaries of blood vascular system.

So larger molecules, from the interstitial fluid can also enter the lymph capillaries.

Lymph:

Lymph capillaries and blindly in both tissues, where pressure from the accumulation of interstitial fluid or extra cellular fluid forces the fluid into the lymph capillaries.

When this fluid enters the lymph capillaries, it is called “lymph”. The lymph vessels empty in veins, so lymph is a fluid in transit between interstitial fluid and the blood.

LYMPH VESSELS:

Lymph vessels join to form larger lymph vessels and ultimately from ***thoracic lymphy duct***, which open into ***subclavian vein***. The flow of lymph is always towards the ***thoracic duct***.

In the intestine, the branches of lymph capillaries within villi are called ***lacteals***, because after absorption of digested food, these appear milky. The lymph like veins have valves.

Maintenance of Lymph Flow:

The flow of lymph in lymph vessels is maintained by:

- *Activity of skeletal muscles*.
- *Movement of viscera.*

Rhythmical changes in the intrathoracic pressure that results from breathing. The valves which prevent back flow of lymph.

Lymph Nodes:

Along the pathway the lymph vessels have at ***certain points, masses of connective tissue where lymphocytes are present***. These are Lymph evades. Several afferent lymph vessels enter a lymph node, which is drained by a single, efferent lymph vessels.

Lymph nodes are present in the neck Lymph nodes are present in ***neck region, maxilla*** and ***groin*** of humans.

Lymphoid Masses:

In addition several lymphoid masses are present in the walls of digestive tract, called ***Peyer's patches*** in the mucosa and submucosa. The largest mass is ***spleen*** and ***thymus, tonsils*** and ***adenoids*** are all lymphoid masses. They produce lymphocytes.

Function of Lymphatic System

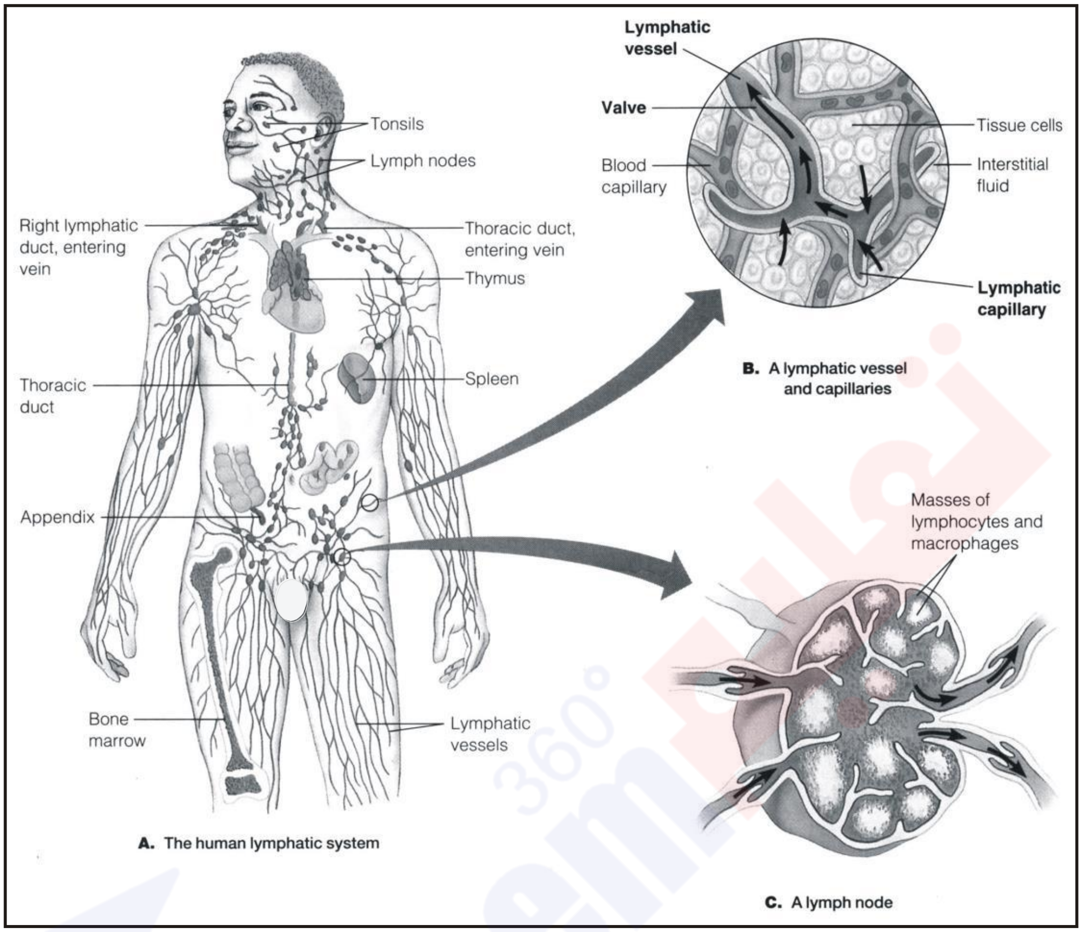
These are several functions performed by lymphatic system:

(1) In an average person, about three litres more fluid more fluid leaves the blood capillaries than is reabsorbed by them each day. Lymphatic system returns this excess fluid and its ***dissolved proteins*** and other substance to the blood.

(2) The ***lacteals of villi absorb large fat globules*** which are released by interstitial cells after the product of digestion of fats are absorbed. *After a fatty meal these fat globules may make up 1% of the lymphatic fluid or lymph*.

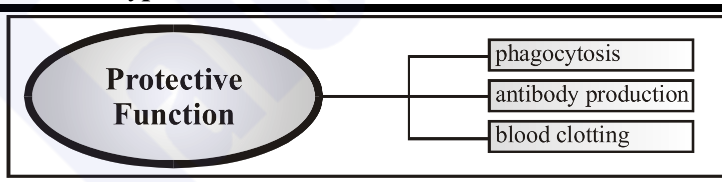
(3) The lymphatic system helps ***defend the body against foreign invaders***, such as bacteria and viruses. Lymph nodes contain *lymphocytes*, and *macrophages*. Lymphocytes and macrophages destroy the bacteria and viruses. *The painful swelling of lymph nodes that certain diseases (**mumps is an extreme example**) is largely a result of the accumulation of dead lymphocytes and macrophages and dead viruses infested cells they have engulfed*.

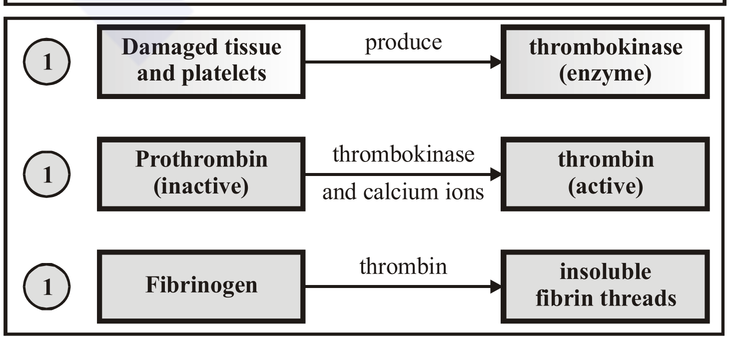
(4) Just as the lymph nodes filter lymph, the ***spleen filters blood***, exposing it so macrophages and lymphocytes that destroy foreign particles and aged red blood cells.



A. The human lymphatic system
B. A lymphatic vessel and capillaries
C. A lymph node

Q.40 (a) What is immunity?
(b) Describe its types in details.





Ans. $\boxed{\text{IMMUNITY}}$ **(*SECRUITY AGAINST A PARTICULAR DISEASE*):**

Sir Mc Faland Burnet has defined immunity, as:

"The capacity to recognized the intrusion of any foreign material to the body and to mobilize cells and cell products to help remove the particular sort of foreign material with greater speed and effectiveness".

The vertebrates have a mechanism to defined their bodies against the foreign invaders called the immune system.

Component of Immune System: Immune system includes:

(a) ***The antibodies***

(b) ***The lymphocytes (B & T)***

(a) Antibodies:

Antibodies are special types of **protein**.

These antibodies are ***immunoglobulins***, which are synthesized by vertebrates in response to antigen and immobilize it, or sets in motion events that ultimately cause its destruction.

Antigen or ***immunogen*** is a foreign substance, often a protein that stimulates the formation of antibodies. Antibodies are specific i.e., cause the destruction of the antigen which stimulated their production.

(b) Lymphocytes:

Antibodies are manufactured in B-lymphocytes and then secreted into the lymph and blood where they circulate freely:

Types of Lymphocytes:

Lymphocytes are of two types:

(i) ***T-Lymphocytes*** (ii) ***B-Lymphocytes***

They have been named due to their relationship with **Thymus** gland, and **Bursa** of **Fabricius** respectively. The influence of the thymus gland is essential in making T-cells immunolgoically competent. Bursa of Fabricius is lymphoid structure present in the wall of cloaca of young bird from where B-lymphocytes were discovered, to have role in immune system.

Responses: There are two types of responses depending on the type of lymphocyte involved:

(i) Cell-mediated Response:

T-cells (pressing membrane receptors) recognize antigen are stimulated to proliferate and produce a clone of T-cells. These cells then either combat (to fight) microorganisms or effect the rejection of foreign tissues (in case a transplant of tissue is involved).

(ii) Humoral Immune Response:

B-cells recognize antigen in a similar way to T-cells. However their response is different:

(a) *They form plasma cell clone.*

(b) *These plasma cells synthesize and liberate antibodies into the blood plasma and tissue fluid.*

(c) *Antibodies attach to the surfaces of bacteria and speed up their **phagocytosis**, or combine with and neutralize toxins produced by microorganism, by producing antitoxins.*

Antitoxins are always protein and destroy the toxin, in response of which they were produced.

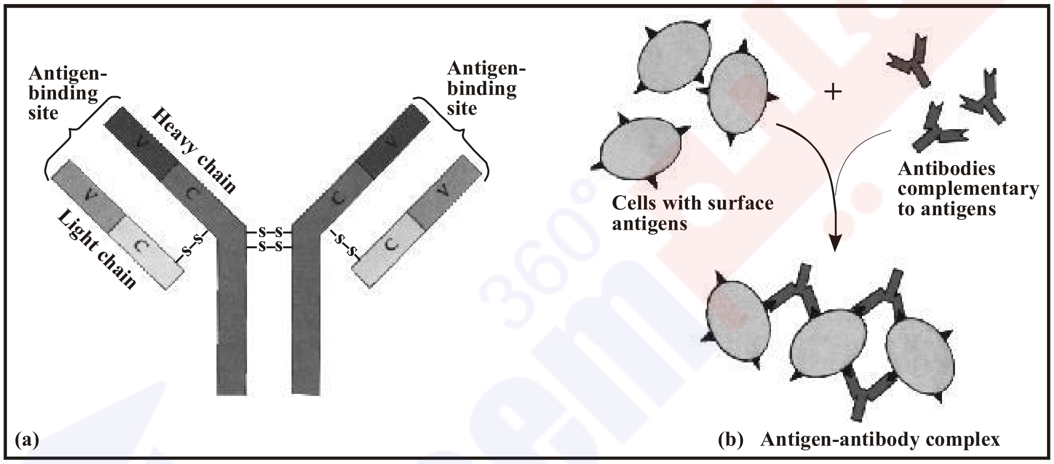


Fig. (a) An antibody molecule consists of four polypeptide chains – two identical light chain and two identical heave chains – linked by disulfide (- S – S -) bridges. Variable amino acid sequences (V) in the light chains and upper regions of the heave chains determine which antigen will bind to that particular antibody. Constant amino acid sequences (C) are the same for all the antibodies in one class (b) Large antigen-antibody complexes will form it there are multiple copies of the antigenic molecule on the foreign cell's surface.

The variable regions of the antibody, present at the tips of its molecule arms, form highly specific binding sites for antigens. These ***binding sites*** a lot like the active sites of enzymes. Each binding site has a particular shape and electrical charge, so only certain molecules can fit in and bind. The binding sites are so specific that each antibody can bind at most a few types of antigen molecule perhaps only certain molecules can fit in and bind. The binding sites are so specific that each antibody can bind at most a few types of antigen molecule perhaps only one. That is why it is said that antibodies are memory cells, remain in the spleen and lymph nodes long after the initial exposure to the antigen, and they may persist for the life time of the animal.

This is why when we get ***vaccination***, against a specific disease (antigen), we become immune to that infection or disease. We get vaccination against, Polio, Smallpox, measles, mumps etc., once in our life time and then protected or become immune to that infection in our future life.

(b) TYPES OF IMMUNITY Immunity is of two types:

"Production of antibodies by use of vaccines."

(1) Active Immunity:

*The **use of vaccines**, which stimulate the **production of antibodies** in the body and making a person immune against the disease or infection, is called immunity.*

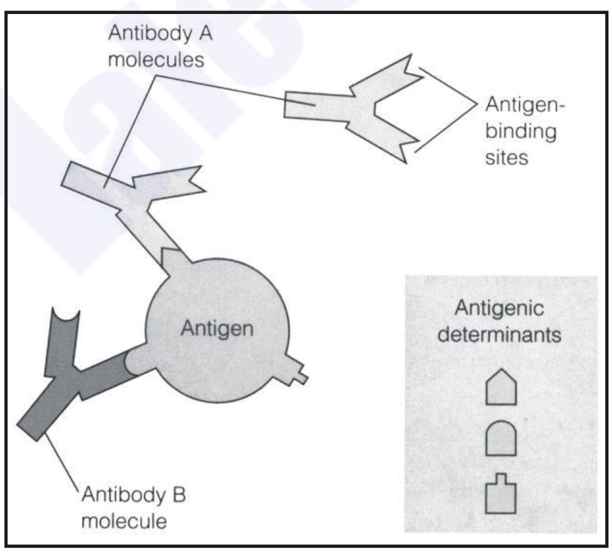
The production of memory cells and the immunity that provide is the underlying mechanism of vaccination. Most of the vaccines consist of non-virulent, mutant strains of the poliovirus. These mutants are unable to cause polio but they have at least one antigenic determinant in common, with the virulent poliovirus and thus activate the production of memory cells that recognize and respond to the erippling attain likewise, we can protect our bodies by vaccines of certain other disease. Small pox, a major killer disease of the past, has been completely eradicated. It is of two types:

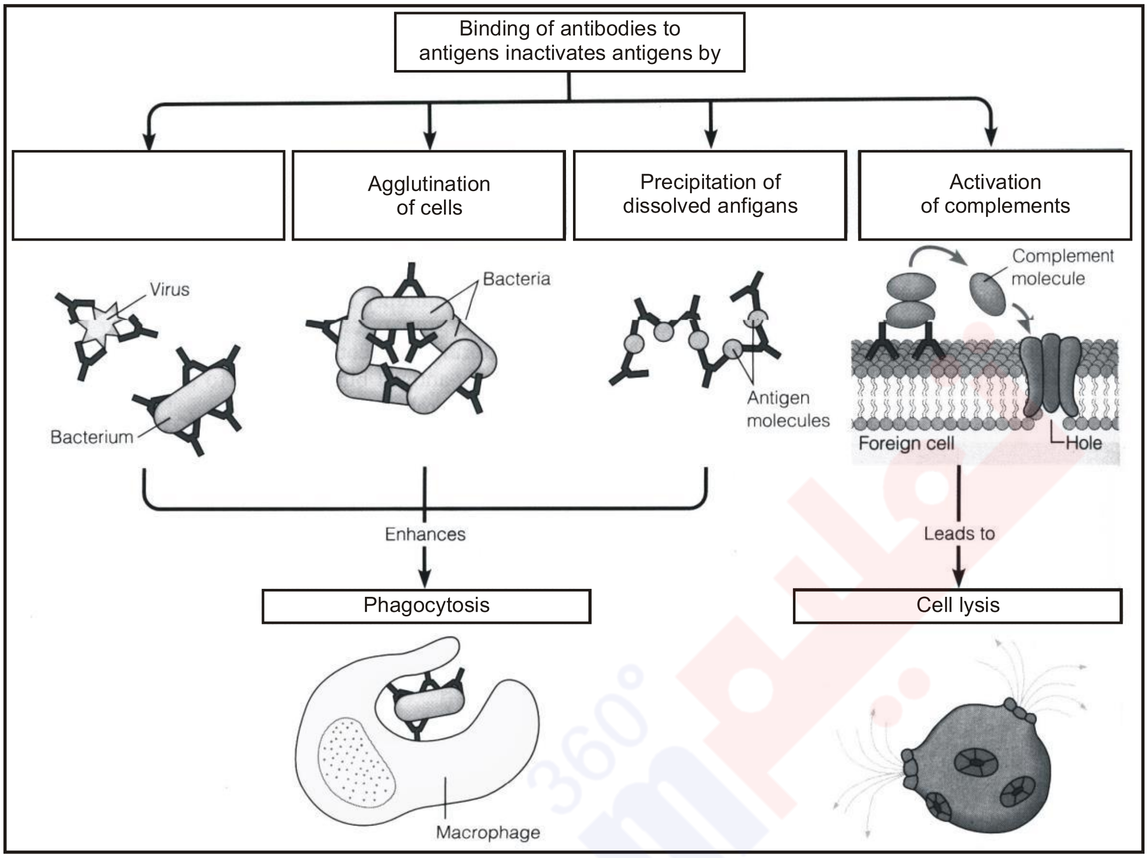
(a) Artificially Induced Active Immunity:

If active immunity has been achieved by ***artificially introducing antigens*** in the body, so it is called artificially induced active immunity. In short, as vaccine is given for immunity purpose.

(b) Naturally Induced Immunity:

When a person is ***exposed to an infection*** (antigen) becomes ill and in most cases survives then this immunity, developed against that disease is called naturally induced immunity. In short, antigens are produce itself due to disease or attack of pathogens.





(2) PASSIVE IMMUNITY:

"Immunity produced by injecting blood or serum". In passive immunity, ***antibodies are injected*** in the form of antisera to make a person immune against a disease (infection). In this way, no antigens are given for production of antibodies, actually antibodies are given.

Antisera:

Antisera are the sea, containing specific antibodies. Blood serum taken from another individual or animal that has been recently exposed to a particular pathogen (or snake bite venom = toxin) will have high concentration of antibodies targeted against that antigen, partially pumped serum containing the appropriate antibody is injected into blood of a person, (to be made immune) ***antigen antibody complexes*** are formed which are taken up by phagocytes and destroyed. The patient is spared the complications (or possibly death) caused by the infection or venom.

Importance:

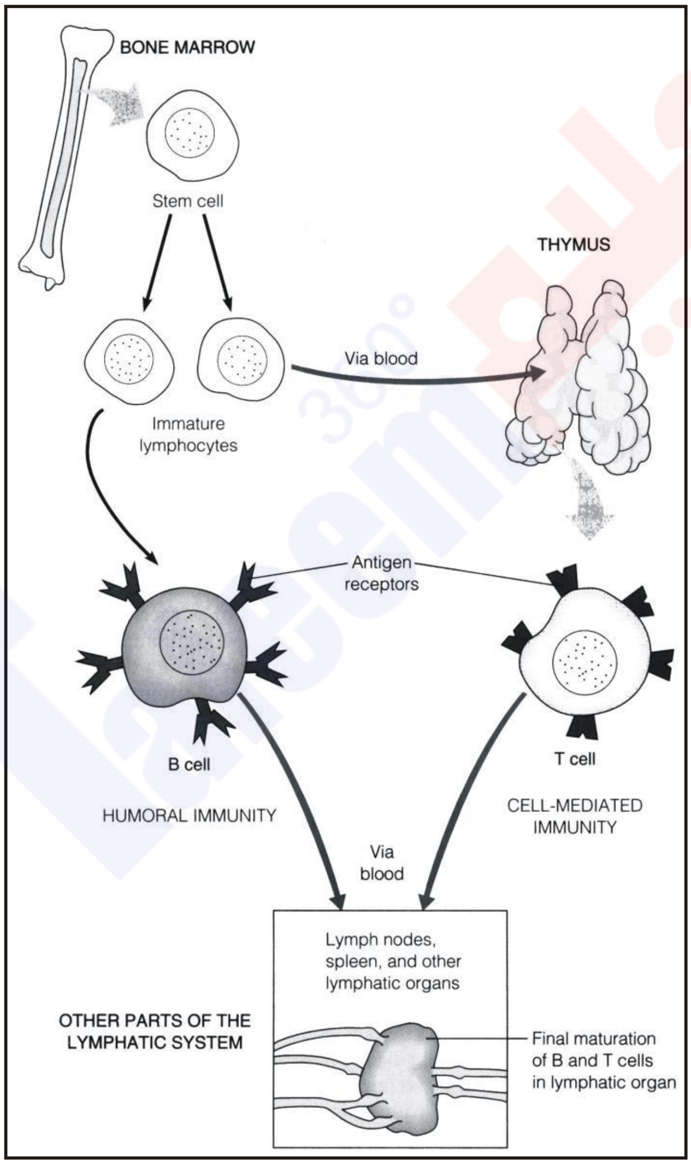
Passive immunity ***response is immediate***, but not long lasting. Because 120 time is taken for the production of sufficient level of antibodies, (as antibodies are being injected) and after the level of antibodies is reduced or they are used up. *No more antibodies production is there.*

Methods of Immunizations:

The method of passive immunization is ***used to combut active infections of tetanus, infection hepatitis, rabies snake bite venom*** etc. In the case of snake bite venom, immunity is produced as the person is injected in the blood stream, not the antibodies, but the antitioxins so the serum is called **antivenom serum**.

The fundamental purpose of immune system is to distinguish between the animal's own cells and large molecules, and those from another source (antigens) and then to destroy the later.

CONCEPTUAL VIEW



DIFFICULT WORD MEANINGS

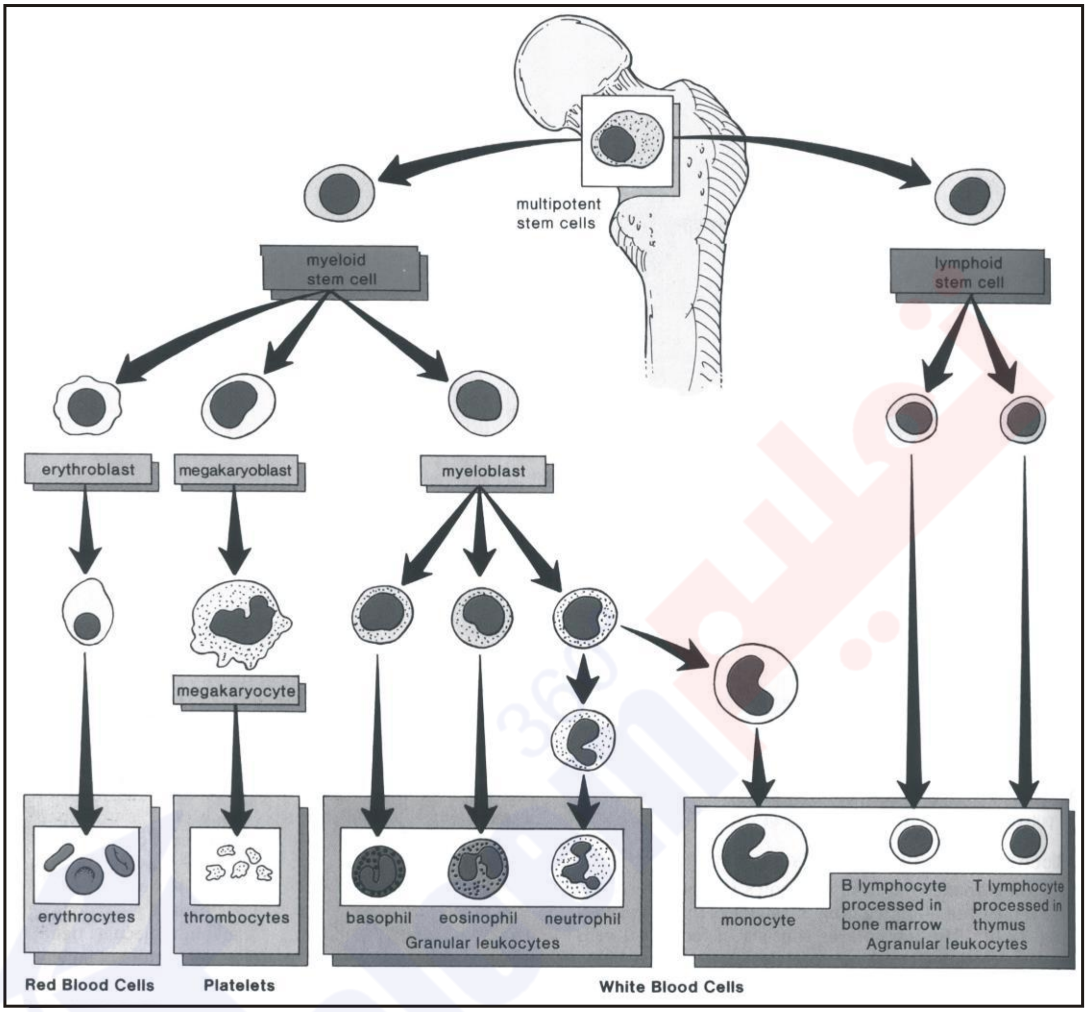
Words	Meanings	Words	Meanings
Antitoxin	زہر کے خلاف	Endocytosis	سیل کے اندر داخل ہونے کا عمل
Antigen	باہر سے دخل ہونے والے کیمیکل یا زندہ شے	Exocytosis	سیل سے اخراج کا عمل
Absorption	جذب کرنا	Excretory system	نظام اخراج
Adhesion	جڑاؤ/چپکے ہونا	Exosmosis	سیل سے باہر بہاؤ
Ascent of sap	محلول کا چڑھاؤ	Endosmosis	سیل کے اندر جانب بہاؤ
Antibody	قوت مدافعت والی پروٹین	Ectoderm	بیرونی تہہ
Bleeding	مادہ نکلنا/خون رسنا	Endoderm	اندرونی تہہ
Assimilation	جزوبدن بننا	Groin	حصہ ٹانگ اور پیٹ کے جوڑ پر (تقریباً)
Axilla(arm pit)	بغل	Heparin	ہیپارین/وہ پروٹین جو خون کو جمنے نہیں دیتی
Circulatory system	نظام دورانِ خون	Approximately	تقریباً
Congestive	کسی حصے میں غلط طور سے خون اکٹھے ہونا	Agranulocyte	بلڈ سیل جو دانے دار سائٹو پلازم نہ رکھیں
Cnduction of water	پانی پہنچانا	Organic nutrient	نامیاتی مرکبات
Concentration	مقدار	Catalyst	کیمیکل جو ریکشن کو تیز کریں
Concentration gradient	اجزائی مقدار	Cholestrol	چکنائی کی ایک قسم
Cardiac	دل سے متعلقہ	Phagocytosis	وہ عمل جس میں سیل ٹھوس چیز نگلے
Cortexresponse	پودوں میں ٹشوز کی قسم ردِ عمل	Hydathodes	تنے اور برانچوں پر سوراخ

Cohesion	آپس میں چپکنا (مالیکیول کا)	Homeostasis	بیرونی ماحول کے مقابلہ میں اندرونی ماحول کا بمطابق ضرورت رہنے کا عمل (توازن رکھنے والا عمل)
Discontinuous	غیر مسلسل	Imbibition	کسی چیز کے اندر داخل ہونا مگر حل پذیری نہ ہونا
Disruption	رکاوٹ	Immunity	قوتِ مدافعت
Necro	موت سے متعلقہ	Induced	مسلط کردہ
Exchange	تبادلہ/لین دین	Blood clotting	خون کا جمنا (زخم پر)
Epidermis	اوپر والی تہہ	Lacteal	چھوٹی آنت کی چکنائی جذب کرنے والی نالی
Eleborate	اظہار	Lymphocyte	سفید خون کے سیل کی قسم
Legume	پھلی نما ساخت	Osmoregulation	محلول کی ایڈجسٹمنٹ
Lenticel	تنوں میں سوراخ	Osmotic potential	محل اور منحل کا مستقل رہنا
Multisensory	کئی جگہوں سے حساس	Osmosis	نفوذ پذیری
Mesophyll	پتے میں درمیانی بافتیں (ٹشوز)	Plasmodesmata	دو سیل کے درمیان راستہ
Myo	پٹھے/مسل سے متعلقہ	Pathway	گزرگاہ/عمل کی سمت/روٹ
Mineral	معدنیات	Synthesize	پیدا کرنا/قدرتی بننا
Mycorrhiza	فنجائی ہائفی اور پودوں کی جڑوں کے درمیان باہمی مفاد کا تعلق	Symbiotic	باہمی مفاد
Negligible	ناقابل غور	Valve	والو/وال
Auircle	آریکل/اذن	Ventricle	وینٹریکل/بطن

Lymph	لمف/سرخ جسیمے نہ ہونے کے سبب سے خون سے مختلف اس میں لمفوسائیٹ اور مونوسائیٹ لیکوڈ میں تیرتے رہتے ہیں	**Venule**	انتہائی باریک وین
Arteriole	انتہائی باریک شریان	**Transport**	ترسیل/ایک جگہ سے دوسری جگہ جانا
Diffusion	نفوذ	**Permeable**	مسامدار
Osmosis	ولوج/زیادہ مالیکیولز کا سیل ممبرین سے گزر کر زیادہ سے کم کی طرف جانا	**Plasmolysis**	سیل کا سکڑنا/پاشیدگی
Cardiac infarction	دل کے کچھ ٹشوز کا بے جان ہو جانا	**Haemophilia**	مردوں کی جینیٹک بیماری جس میں خون رستا رہتا ہے، زخم نہیں بھرتا اور کلاٹنگ نہیں ہوتی
Hepatic	جگر سے متعلقہ	**Renal**	گردے سے متعلقہ
Mesentric	پیٹ کے عضو سے متعلقہ	**Gastric**	معدے/ہاضمے سے متعلقہ
Femur	ٹانگ کے اوپر والے حصے کی ہڈی/تھائی کی ہڈی	**Nasal**	ناک سے متعلقہ
Scavanger	مردہ جانداروں کو کھانے والے	**Subclavian**	کالر بون/کالر ہڈی سے متعلقہ
Plasmolysis	پلازم کا سکڑنا(Shrinkage)	**Cyanosis**	آرٹری میں ہیموگلوبن کے باعث، پیدائش کے بعد بچے کی جلد کا نیلا ہو جانا
Pulmonary	پھیپھڑوں سے متعلقہ	**Atherosclerosis**	آرٹری کے اندر کولیسٹرول یا چکنائیوں کا اکٹھا ہونا
Pneumonia	نمونیہ	**Atheroma aretriosclerosis** (Plaque of degenerated thickened arterial intima)	ایسی بیماری جو آرٹری وال کے موٹے ہونے پر ہو اور لچک کم ہو
Symptoms	علامتیں	**Interstitial fluid**	سیل کا درمیانی سیال مادہ

Secretion	رطوبت	Pulsating	
Stress	جسمانی تناؤ/تناؤ	Hypertension	دل کا دورہ/ بہت زیادہ تناؤ
Tension	تناؤ	Lymph	RBC کے بغیر خون کی حالت
Transversally	متوازی/کراس	Impulse(wave)	ویو/لہر
Turgidity	پھیلاؤ اور سختی	-iole/ule	اُس کا لاحقہ ہوگا جو چیز بہت باریک ہو مثلاً نالیاں
Transpiration	بخارات کا نکلنا پتوں اور تنے سے آبی	Leucocytes	سفید خون کے سیل
Tuberculosis	ٹی بی	Agranulocytes	غیر دانے دار
Descending	نیچے کی جانب جاتا ہوا	Granulocytes	دانے دار سائیٹو پلازم والا
Response	ردِعمل/ جواب	Catalyst	غیر نامیاتی ایکشن کو تیز کرنے والا کیمیکل
Urine	پیشاب	Phagocytosis	سیل کے اندر کسی ٹھوس کا داخلہ
Hepatic	جگر (جگر سے متعلقہ)	Villi	آنت کی سطح (اندرونی جانب) دھاگہ نما ابھار جو چوسنے کی سطح میں اضافہ کرتے ہیں
Ascending	اوپر کی جانب جاتا ہوا	Angina	دردِ سینہ

CONCEPTUAL TOUCH



TRANSPORT BY BLOOD SYSTEM

Table for Conceptual View

Substance	From	To
O_2	lungs	whole body
CO_2	whole body	lungs
Urea	Liver	kidney
Hormones	Glands	target cells
Digested food	Intestine	whole body
Heat	Abdomen muscles	whole body

Q.1 Fill in the blanks:

(i) In the process of facilitated diffusion, the carrier molecules are ——————.

(ii) Pure water has a water potential which is equal to ——————.

(iii) The insects which feed on the phloem of plants are the ——————.

(iv) The substance produced by basophils which inhibits blood-clotting is ——————.

(v) The most abundant compound of blood plasma of man is ——————.

ANSWERS:

(i)	Proteins	(ii)	Zero	(iii)	Aphids
(iv)	Heparin	(v)	Water		

Q.2 Each question has four option. Encircle the correct answer:

(i) Which of the following is not true of guard cells?
- (a) They are present in the epidermis of leaf
- (b) They are connected with plasmodesmata with other epidermal cells
- (c) They contain chloroplasts
- (d) They are kidney shaped

(ii) The casparian strips are present in:
- (a) Cortex cells of roots (b) Endodermis cell of roots
- (c) Cells of pericycle (d) Cell of phloem

(iii) Lymph most closely resembles with:
- (a) Blood (b) Plasma
- (c) Interstitial fluid (d) Urine

(iv) Hydathodes are associated with:
- (a) Transpiration (b) Guttation
- (c) Conduction (d) None of the above

(v) According to pressure flow theory, which of the following serves as sink?
- (a) Leaves (b) Stem
- (c) Roots (d) None of the above

(vi) Which of the following is true about mammals?
- (a) They have right aortic arch only
- (b) They have left aortic arch only
- (c) They have left and right aortic arches
- (d) They do not have aortic arch

(vii) The process that most likely/directly enables a root hair cell to absorb minerals by active transport and enables a muscle cell to contract is:

(a) Circulation (b) Excretion

(c) Respiration (d) Assimilation

(viii) Which of the following process cause substances to more across membranes without the expenditure of cellular energy?

(a) Endocytosis (b) Active transport

(c) Diffusion (d) None of the above

(ix) Cardiac muscle can he distinguished from other muscles fibres because cardiac muscle.

(a) Contain only action

(b) Voluntary in action

(c) Lacks regular arrangement of sarcomas

(d) Has intercalated discs

ANSWERS:

(i)	(b)	(ii)	(b)	(iii)	(c)	(iv)	(b)	(v)	(c)	(vi)	(b)
(vii)	(c)	(viii)	(c)	(ix)	(d)						

Q.3 Write whether the statement is true or false and write the correct statement if it is false:

Ans.

	Statement	T/F	CORRECT STATEMENT
(i)	The intercellular openings in the blood capillaries are larger than the openings in the lymph capillaries	F	The inter cellular opening in lymph capillaries are larger than the opening in the blood capillaries
(ii)	Between left auricle and right ventricle the value present is called bicuspid value.	F	Between the left auricle and the left ventricle, the valve present is called tricuspid valve.
(iii)	The pace make of he heart of man is the AV node.	F	Pace maker in the heart of man is S.S. node.
(iv)	Each sieve tube member is associated with one or more trachied cells.	F	Each sieve tube member is associated with one or two companion cells.
(v)	The blood cells are formed, in human body by a process called	F	The blood cells are formed in the human body by the process called

	homeostasis.		haemopoises.