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CHAPTER-1
THE LIVING WORLD

Biodiversity: All the different kinds of flora (plants), fauna (animals), and microorganisms found in an area are called biodiversity.

Nomenclature: Giving a name to a particular organism that is universally acceptable.

ICBN- International Code for Botanical Nomenclature
ICZN- International Code of Zoological Nomenclature

CLASSIFICATION: Classification is the process by which anything is grouped into convenient categories based on some easily observable characters.

SYSTEMATICS: The study of systematic arrangement of organisms is known as systematics

TAXONOMY: Process of classification is known as taxonomy

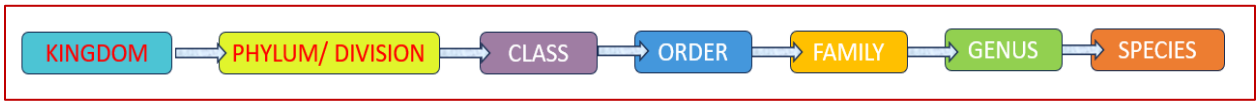
NEED OF CLASSIFICATION

- It helps in the identification of any species.
- It helps in the understanding of biodiversity and evolutionary path.
- It helps in the systematic study of any organism

BINOMIAL NOMENCLATURE

- Proposed by **Carolus Linnaeus**
- Biological names are generally in Latin and written in italics.
- It consists of genus and species name and is known as genetic and species epithet respectively. For example- in *Mangifera indica* (Mangifera is genus and indica is species).
- If the scientific name is handwritten both genus and species are separately underlined and if printed then should be in italics.

TAXONOMICAL HIERARCHY



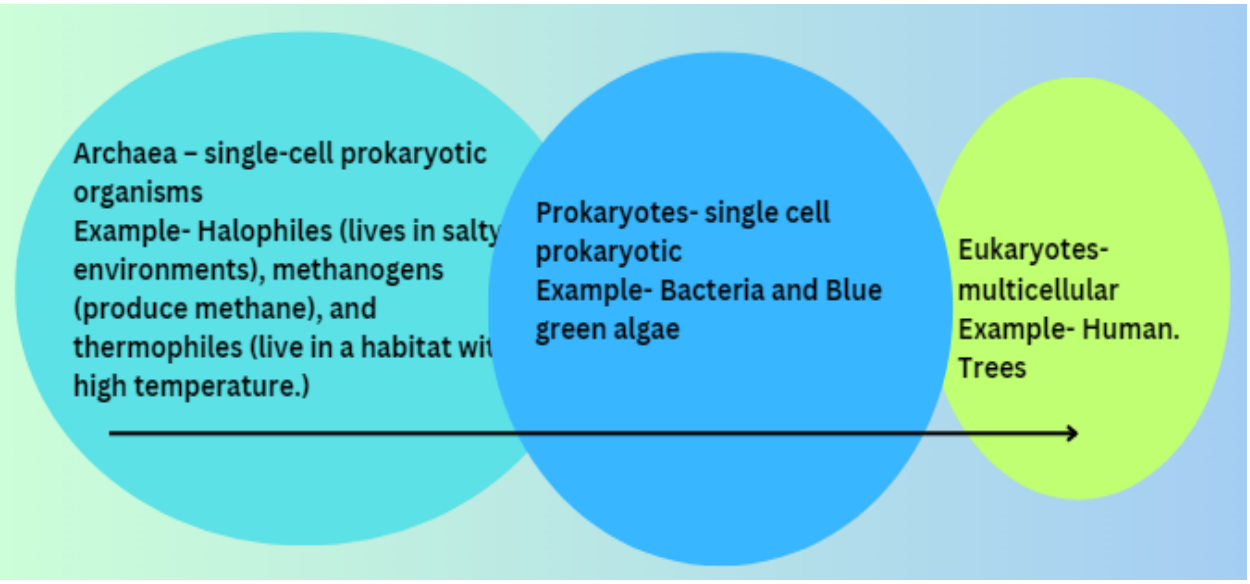
SPECIES

- Species are groups of living organisms that share certain characteristics and are capable of interbreeding.
- Example-

Scientific name	Genus	Species
Mangifera indica	Mangifera	indica

Solanum tuberosum	Solanum	tuberosum
Solanum nigrum	Solanum	nigrum
Panthera leo	Panthera	leo
Panthera tigris	Panthera	tigris
Homo sapiens	Homo	sapiens

THREE DOMAINS OF LIFE



IMPORTANT QUESTIONS

Very Short Answer Type Questions

1- **Identify the botanical name of the potato-**

a- *Solanum nigrum* *b- Solanum tuberosum* *c- Sonaum nigrum* *d- None of these*

Ans: *b*

2- **Flora and fauna in biodiversity represents-**

a- Plants and animals respectively
b- Animals and plants respectively
c- Plants
d- Animals

Ans: a

3- **ICBN is related to the nomenclature of-**

a- Animals b- Microorganisms c- Fungus d- None of these

Ans: d, it is related to the nomenclature of plants.

4- **Amongst family, species and genera which will show the least similarity?**

a- Species b- Family c- Genus d- Both b and c

Ans: b

5- Archaea are-

a- Single cell b- Prokaryotic c- Halophiles d- All are correct

Ans: d

6- Which statement is correct about the "Magnifera Indica"-

a- Magnifera b- Indica c- Both are incorrect d- Both are correct

7- Blue-green algae are-

a- Eukaryotic b- Prokaryotic c- Viroids d- None of these

Ans: b

8- *Panthera leo* is-

a- Tiger

b- Cat

c- Lion

d- Leopard

9- Solanum is a –

a- Kingdom b- Order c- Genus d- Species

10- Which one of the following shows greater biodiversity-

a- A pond having 1000 individuals of rohu fish

b- A pond having 100 rohu fish and 100 zooplanktons

Ans: b

Short Answer Type Questions

1- **Define the following:**

a-Phylum b- Class

Ans: Phylum: Phylum consists of one or more related classes with common characteristics**.**

Class: Class consists of one or more related orders with common features.

2- **Why do we need to classify the different organisms?**

Ans: It helps in the identification of any species, helps in understanding biodiversity and evolutionary path, It helps in the systematic study of any organism

3- **What are the different defining properties of a living organism?**

Ans: Consciousness

A living organism can grow.

All living organisms can reproduce.

All living organisms show Metabolism

4- **Endemism is a very important parameter in defining biodiversity. Explain endemism.**

Ans: Endemism is property showing that a particular species occurs in a single defined geographic location.

5- **How do taxonomy and systematic differ from each other?**

Ans: Taxonomy: It is the process of classification.

Systematics: It is the study of the systematic arrangement of organisms.

6- **Write the correct sequence of the taxonomic hierarchy.**

Ans: Kingdom---Phylum/ Division ---Order---Family ---Genus ---Species

Long Answer Type Questions

1- Explain the nomenclature mechanism proposed by Carolus Linnaeus.

Ans: he proposed the binomial nomenclature system.

The mechanism of nomenclature of an individual is -

- ✓ Names are generally in Latin.
- ✓ It contains the generic name (first name) and species name.
- ✓ The first word of the genus starts with a capital letter while the specific epithet starts with a small letter.
- ✓ If handwritten, both genus and species are underlined separately; if printed then should be in italics.

2- In a brief explain the concept of species. Also, provide three examples of species.

Ans: A group of organisms that can reproduce with one another and able to produce fertile offspring is known as species.

Individuals of a species share fundamental similarities as a species.

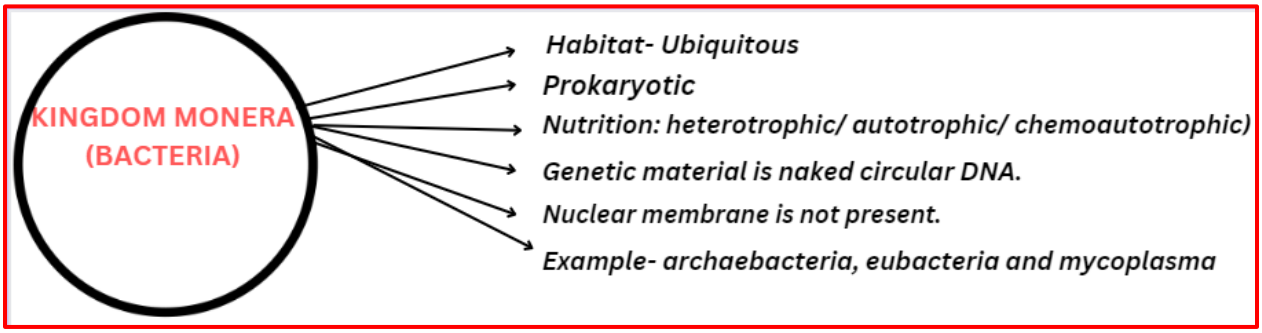
Solanum nigrum- Genus (Solanum) species (nigrum)

Panthera leo- Genus (Panthera species (leo)

Panthera tigris- Genus (Panthera) species (tigris)

CHAPTER-2
BIOLOGICAL CLASSIFICATION

Classification	Proposed by	Kingdoms
Two kingdom classification	Linnaeus	Plantae and Animalia
Five kingdom classification	R.H. Whittaker	Monera, Protista, Fungi, Plantae, Animalia.



Classification on the basis of shapes

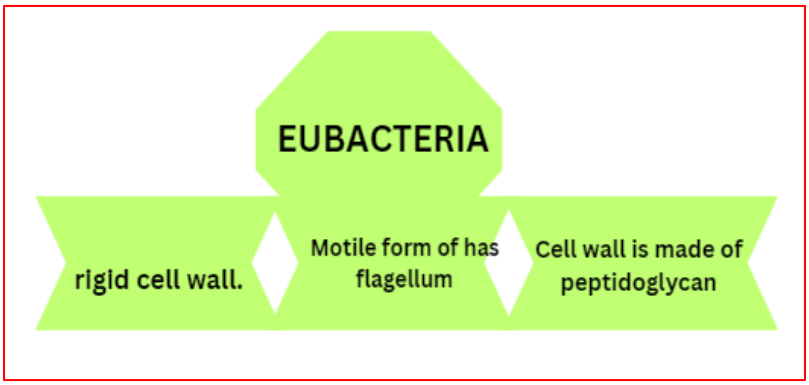
Group	Coccus	Bacillus	Vibrium	Spirillum
Shape	Spherical	rod-shaped	comma-shaped	Spiral

ARCHAEBACTERIA

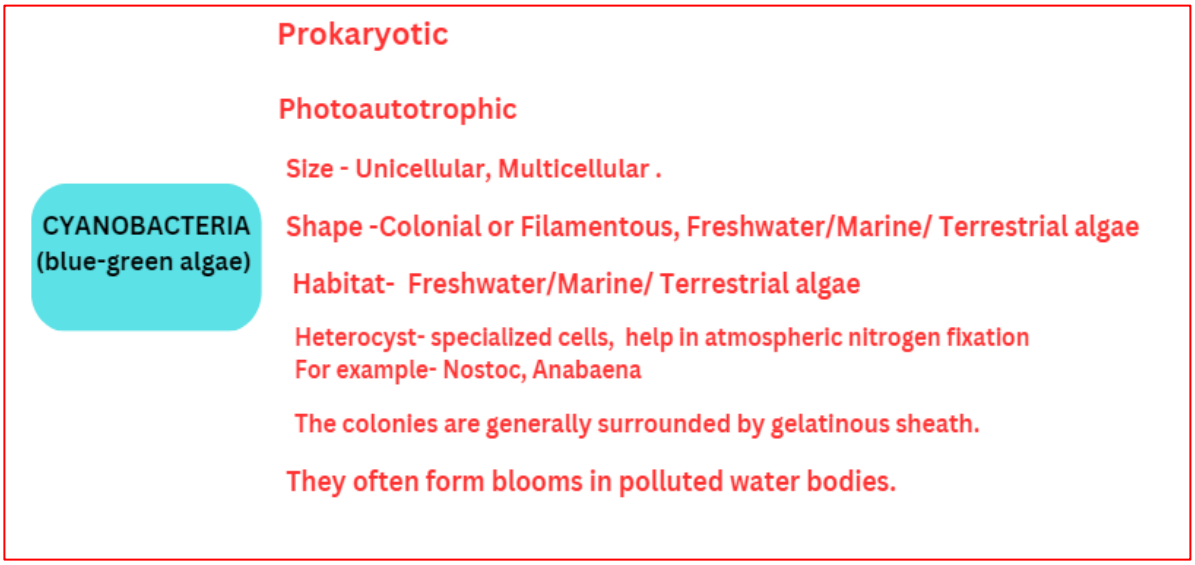
Habitat:

halophiles	salty areas
Thermoacidophiles	hot springs
Methanogens	Marshy area, gut of several ruminant animals

EUBACTERIA



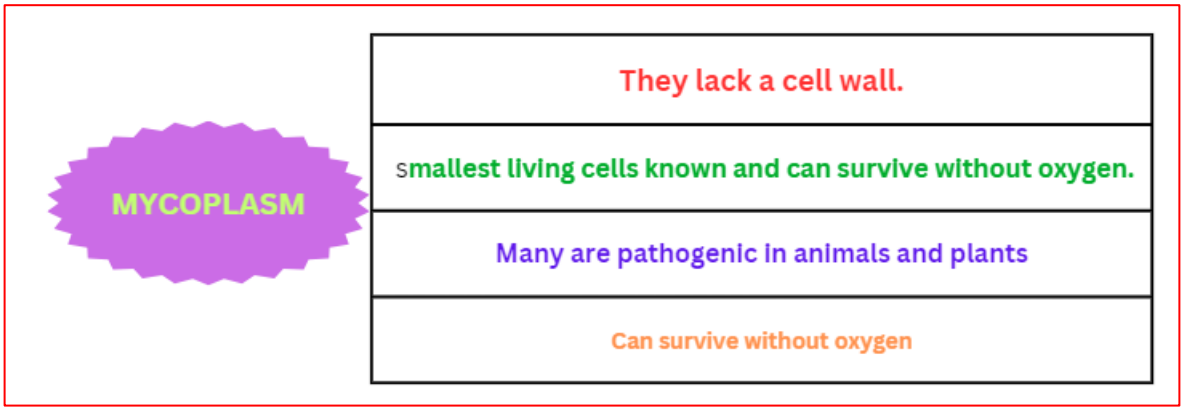
CYANOBACTERIA (blue-green algae)



Reproduction

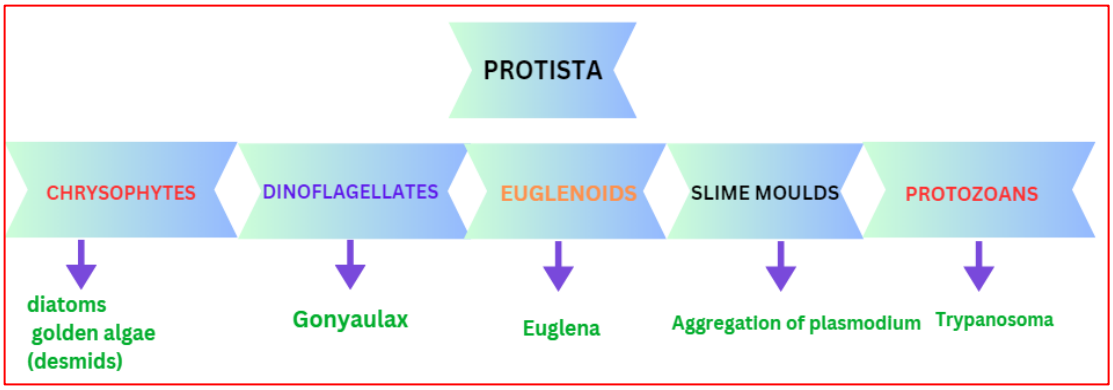
- Under unfavourable conditions, they produce spores. When favourable conditions return, they regain their life cycle.
- Asexual reproduction- Fission, Budding
- Sexual reproduction- by transfer of DNA from one bacterium to another

Mycoplasma



KINGDOM PROTISTA

- These are unicellular eukaryotes (the nuclear membrane is present).
- Mostly aquatic
- Some shows connecting link properties with plants as well animals.
- It includes Chrysophytes, Dinoflagellates, Euglenoids, Slime moulds and Protozoans
- Reproduction –Asexual, Sexual



CHRYSOPHYTES:

- ✓ Habitat: Freshwater as well as marine water.
- ✓ Mostly photosynthetic.
- ✓ Diatom's cell wall is silica-rich and overlaps like a soap box. Diatoms form diatomaceous earth
- ✓ Chief producer in ocean
- ✓ This group includes diatoms and golden algae (desmids)

DINOFLAGELLATES

- ❑ Habitat: Mostly marine and photosynthetic.
- ❑ Colour: Yellow, green, brown, blue or red
- ❑ Cellulose plate: The cell wall has stiff cellulose plates on the outer surface.
- ❑ Mostly bear two flagella
- ❑ Red Dinoflagellates (Example: Gonyaulax) make the sea appear red (red tides).

EUGLENOIDS

- Habitat: Freshwater
- Pellicle: Protein-rich layer
- Flagella- 2, a long and other short
- Both photoautotrophic and heterotrophic
- Example: Euglena

SLIME MOULDS

- ❖ Nutrition: saprotrophs
- ❖ Plasmodium: Aggregation of plasmodium
- ❖ Produce spore

PROTOZOAN

Amoeboid protozoans	These organisms live in fresh water, sea water or moist soil. They may form pseudopodia (false feet) as in Amoeba. Marine forms have silica shells on their surface. Example: Amoeba, Entamoeba
Flagellated protozoans	The members of this group are either free-living or parasitic. They have flagella. Example: Trypanosoma
Ciliated protozoans	These are aquatic Thousands of cilia are present They have a cavity (gullet) that opens to the outside of the cell surface. Example: Paramecium
Sporozoans	Characterized by infectious spore-like stage in their life cycle. Plasmodium (malarial parasite)

KINGDOM -FUNGI

- Eukaryotic, heterotrophic organisms.
- Filamentous except for yeast which is unicellular
- Hyphae- It is a long, slender thread-like structure. The Network of hyphae forms mycelium.
- Coenocytic hyphae- multinucleated and aseptate hyphae
- Cell wall – made up of chitin and polysaccharides

REPRODUCTION

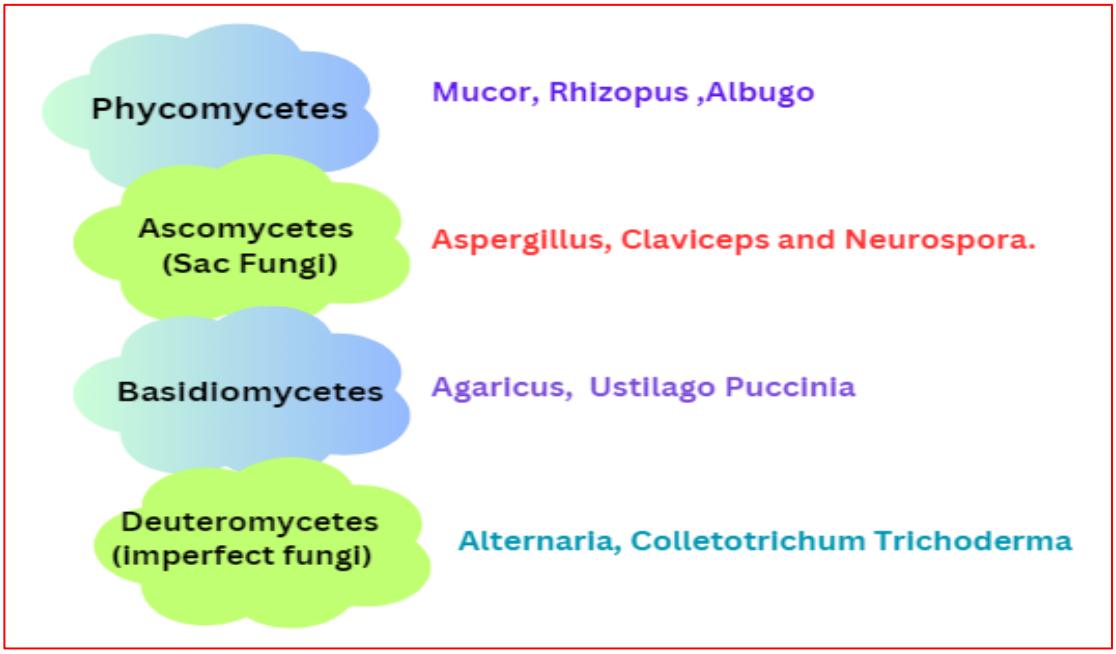
Vegetative means – fragmentation, fission and budding
Asexual reproduction - by spores (conidia/ sporangiospores/ zoospore)
Sexual reproduction- by oospores, ascospores and basidiospores.

The sexual cycle involves the following three steps:

(i) Fusion of protoplasm between two motile or non-motile gametes called plasmogamy.
(ii) Fusion of two nuclei called karyogamy.
(iii) Meiosis in zygote resulting in haploid spores.

MECHANISM OF SEXUAL REPRODUCTION

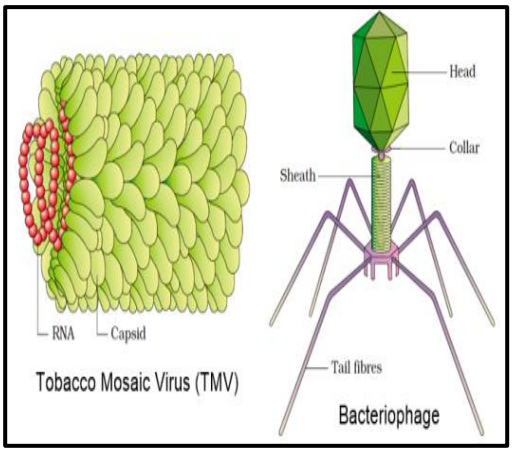
- Fusion of two haploid hyphae
- Diploid stage (2n) is formed. The diploid stage form fruiting bodies in which reduction division occur to for spores.
- In some fungi (ascomycetes and basidiomycetes for some time nuclei do not fuse and form a dikaryotic stage (n + n). Such a condition is called a dikaryon.



Fungi	Mycelium	Asexual reproduction	Sexual reproduction	Examples
Phycomycetes	Aseptate and coenocytic.	Zoospores (motile) Aplanospores (non-motile). .	Zygospore is formed by the fusion of two gametes (sexually compatible hyphae)	Mucor, Rhizopus (the bread mould), Albugo (parasitic fungi on mustard).
Ascomycetes (Sac Fungi)	Branched and septate.	Conidia are produced exogenously on conidiophores.	The fruiting body is ascocarps. Ascospores are produced in ascocarps.	Aspergillus, Claviceps and Neurospora.
Basidiomycetes	Branched and septate.	Not Found	Dikaryon stage is observed. The fruiting body is basidiocarps. They produce Basidiospores. arranged as fruiting	Agaricus (mushroom), Ustilago (smut) Puccinia (Rust fungus).
Deuteromycetes (imperfect fungi)	Septate and branched	Conidia	Not known	Alternaria, Colletotrichum Trichoderma

VIRUSES

- The Viruses are non-cellular organisms that are characterized by having an inert crystalline structure outside the living cell.
- A virus is a nucleoprotein and is composed of protein and genetic material (either DNA or RNA). The protein coat (capsid) is made of monomers (capsomere)
- Viruses are obligate parasites
- Bacteriophages – these are dsDNA viruses and infect bacteria
- ✓ Diseases of animals caused by viruses- AIDS, mumps, smallpox, herpes and influenza.



- ✓ Diseases of plants caused by viruses - mosaic formation, leaf rolling and curling, yellowing and vein clearing, dwarfing and stunted growth.

Dmitri Ivanowsky (1892)	Recognised certain microbes as causal organism of the mosaic disease of tobacco
M.W. Beijerinek (1898)	Contagium vivum fluidum (infectious living fluid)
W.M. Stanley (1935)	viruses could be crystallized

VIROIDS

- Discovered by T.O. Diener (1971)
- Viroids are infectious agents that are composed of only a single circular strand of nucleic acid. Unlike viruses, which contain proteins within their structure,
- Viroids are composed of only RNA or DNA, making them the smallest known infectious agents. Causes potato spindle tuber disease.

LICHENS

- Lichens show symbiotic associations between Phycobiont (algae) and Mycobiont (Fungi).
- Phycobiont: Autotrophic and prepare food for fungi
- Mycobiont: Provide shelter and absorb mineral nutrients and water for algae.
- Lichens are very good pollution indicators as they do not grow in polluted areas.

IMPORTANT QUESTIONS

Very Short Answer Questions

1- Thermoacidophiles can be found in-

a- Polar area
b- Hot spring
c- As mesophytes
d- Epiphytes
Ans: b

2- Which characteristics are expressed by fungi -

a- Multicellular
b- Coenocytic hyphae
c- Mycelium
d- All of these
Ans: d

3- Non-cellulosic cell wall is a characteristic feature of-

a- Monera
b- Plants
c- Cell wall
d- All of these

Ans: a

4- Which of the following statement describe "contagium vivum fluidum"-

a- Infectious nonliving fluid
b- Infectious living fluid
c- Noninfectious living fluid
d- Noninfectious nonliving fluid

Ans: b

5- Fungal cell wall is made up of -

a- Cellulose
b- Pectin
c- Chitin
d- Peptidoglycan

Ans: c

6- Which group of bacteria is present in the rumen of cattle and useful in the production of biogas?

a- Aerobic bacteria
b- Anaerobic bacteria
c- Methanogens
d- None of these

Ans: c

7- PSTV is a disease caused by-

a- Virus
b- Virion
c- Viroid
d- Bacteria

Ans: c

8- Bacteria present in curd are-

a- Rod-shaped
b- Coma shaped
c- Round shaped
d- Spiral

Ans: a

9- Deuteromycetes are called imperfect fungi because-

a- No asexual reproduction in observed
b- No sexual reproduction is observed

c- No vegetative reproduction is observed
d- All are incorrect
Ans: b

10- Who proposed the Contagium vivum fluidum -

a- M.W. Beijerinek
b- Stanley Hall
c- Robert Hooke
d- Robert Kotch
Ans: a

Short Answer Type Questions

1- Which specific structure in cyanobacteria may be helpful for farmers and why? Give two examples of cyanobacteria that possess the structure.
Ans: Structure is Heterocyst, useful for farmers as helps in nitrogen fixation.
Example: Nostoc, Anabaena

2- Which group of protistans is responsible for the red colour of the red sea? Give one example of such Protista.
Ans: Dinoflagellates, Gonyaulax

3- Give an example of one organism which behaves as both a phototrophic and heterotrophic mode of nutrition based on the availability of sunlight. Also, mention the group to which it belongs.
Ans: Euglena, belongs to Euglenoids (Protista)

4- Two kingdom classifications are insufficient and therefore, are not used in modern classification. Explain your answer with two reasons.
Ans: this system has the following demerits:
i- It does not distinguish between eukaryotes and prokaryotes.
ii- Classification does not include unicellular and multicellular organisms.

5- Why it is called Monerans especially bacteria show the most extensive metabolic diversity. Give three examples.
Ans: bacteria show different types of nutrition-
- Heterotrophic (saprotrophic and parasitic)
- Autotrophic (photoautotrophic, chemoautotrophic)
- Symbiotic relationship

6- Write different steps that are involved in the sexual reproduction of fungi.
Ans: i- plasmogamy ii- karyogamy iii- meiosis in zygote resulting in the haploid sore formation

7- Mention two examples to prove fungi show a symbiotic association.
Ans: With algae in Lichen
With the root of higher plants such as mycorrhiza

8- **Explain the dikaryon stage in fungi. Also, give two examples that show such assemblage.**

Ans: In some fungi, the after-fusion of two haploid cells karyogamy does not take place for little time. At this stage, mycelium contains two nuclei (dikaryon stage).

Example: In some fungi, after the fusion of hyphae (plasmogamy) the karyogamy (fusion of nucleus) does not take place immediately. This results in the formation of the dikaryon stage.

Example: Ascomycetes and basidiomycetes

9- **Who discovers Viroids? Name one plant disease caused by Viroids.**

Ans: T.O. Dinner discovered Viroids.

Potato spindle tuber disease is caused by them

10- **What is diatomaceous earth? How it is formed?**

Ans: the earth formed by diatoms is called diatomaceous earth. The diatoms cell wall is very rich in silica. Diatoms have left behind large amounts of cell wall deposits in their habitat; this accumulation over billions of years is referred to as 'diatomaceous earth'.

Long Answer Type Questions

1- **Who proposed the five-kingdom classification? Compare all the kingdoms on the basis of their nutritional requirement.**

Ans: R. H. Whittaker

Monera- Autotrophic (chemosynthetic /photosynthetic) and Heterotrophic (saprophytic /parasitic)

Protista: Autotrophic (Photosynthetic) and Heterotrophic

Fungi: Heterotrophic (Saprophytic/ Parasitic)

Plantae: Autotrophic (Photosynthetic)

Animalia: Heterotrophic (Holozoic/ Saprophytic etc.)

2- **Protozoans are a very important kingdom. Give a detailed account of the classification of protozoans and list their examples.**

Ans: Amoeboid protozoans: they live in freshwater/seawater/ moist soil. They may form pseudopodia (false feet) as in Amoeba. Marine forms have silica shells on their surface. Example: Amoeba, Entamoeba

Flagellated protozoans: The members of this group are either free-living or parasitic. They have flagella. Example: Trypanosoma

Ciliated protozoans: These are aquatic. Contains cilia all over the body. They have a cavity (gullet) that opens to the outside of the cell surface. Example: Paramecium

Sporozoans: these are characterized by an infectious spore-like stage in their life cycle. Plasmodium (malarial parasite)

3- **What are the characteristic features of Basidiomycetes?**

Ans: They are commonly called club fungi.

A dikaryotic stage is seen in basidiomycetes

Basidiomycetes generally refer to fungi whose spore development occurs in basidia.

They possess well-developed, branched, and septate mycelium.

Basidiospores are produced exogenously

4- A- Viruses are supposed as connecting links between living and non-living. Give two features of both living and non-living properties shown by a virus.

b- i) Name the fruiting bodies of basidiomycetes and ascomycetes.

(ii) Give an example of one edible fungus and one plant pathogen

c- Classify bacteria on the basis of their shapes.

a- Ans: living- They are inactive outside the body of a host, they possess DNA or RNA

Non-living: They can be stored in the form of crystals, they cannot replicate without a living host

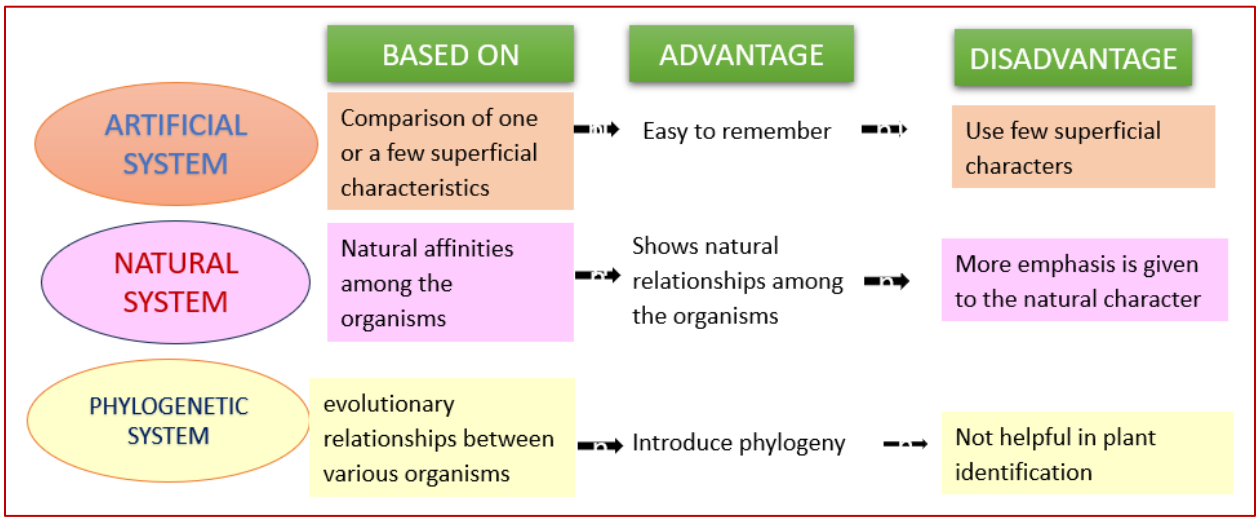
b- Ans: (i) Basidiocarps and Ascocarps

(ii) Edible fungus- Mushroom, Plant pathogen- Ustilago

c- Cocci (round shape), Spirillum (spiral shape), Bacillus (rod shape), Vibrio (comma shape)

Chapter-3
Plant Kingdom

Types of Classification Systems



Types of Taxonomies

Numerical Taxonomy	Based on quantity, Numbers and codes are assigned to all the characters and the data are then processed using a computer
Cytotaxonomy	Based on cytological information like chromosome number, structure, behaviour
Chemotaxonomy	Based on the evidence from chemical constituents

ALGAE

- Algae are chlorophyll-bearing, simple, thalloid, autotrophic organisms.
- Shape- Colonial forms (Volvox), filamentous (Ulothrix, Spirogyra).
- Reproduction: vegetative, asexual and sexual methods.
- Vegetative reproduction: fragmentation
- Asexual reproduction: by spores like zoospores.
- Sexual reproduction: by fusion of two gametes.
- Isogamous: a fusion between morphologically similar gametes.
  Gametes may be flagellated (Ulothrix) or non-flagellated (Spirogyra).
- Anisogamous: Fusion of two gametes dissimilar in size, as in Eudorina
- Oogamous: Fusion between one large, non-motile (static) female gamete and a smaller, motile male gamete. e.g., Volvox, Fucus

ECONOMIC IMPORTANCE

- Acts as a chief producer in the ocean.

- At least half of the total carbon dioxide fixation on earth is carried out by algae through photosynthesis.
- Form the basis of the food cycles of all aquatic animals.
- As food- species of Porphyra, Laminaria and Sargassum
- Production of hydrocolloid (water-holding substances) : algin (brown algae) and carrageen (red algae) Agar: Gelidium and Gracilaria
- Protein-rich supplement: Chlorella

CLASSES OF ALGAE

- Chlorophyceae Phaeophyceae Rhodophyceae

CHLOROPHYCEAE (GREEN ALGAE)

- Unicellular, colonial or filamentous.
- Main pigment: chlorophyll a and b
- Chloroplast: discoid, plate-like, reticulate, cup-shaped, spiral or ribbon-shaped
- Pyrenoids: storage bodies in the chloroplast, contains proteins and starch.
- Cell wall: the inner layer (cellulose) and an outer layer (pectose)
- Vegetative reproduction- fragmentation, spores
- Asexual reproduction- flagellated zoospores produced in zoosporangia.
- Sexual reproduction: isogamous, anisogamous or oogamous.
- Examples: Chlamydomonas, Volvox, Ulothrix, Spirogyra and Chara

PHAEOPHYCEAE (BROWN ALGAE)

- Mainly marine.
- May be simple branched, filamentous forms (Ectocarpus) or profusely branched (kelps)
- Pigment: Chlorophyll a, c, carotenoids, **fucoxanthin** and xanthophylls
- Reserve food- laminarin or mannitol
- Cell wall- gelatinous coating of algin.
- Holdfast- structure through which plant is attached to the substratum
- Frond: leaf-like photosynthetic organ
- Vegetative reproduction- fragmentation.
- Asexual reproduction- biflagellate zoospores
- Sexual reproduction- isogamous, anisogamous or oogamous.
- Example: Ectocarpus, Dictyota, Laminaria, Sargassum and Fucus

RHODOPHYCEAE (RED ALGAE)

- Mostly marine
- Pigment: r-phycoerythrin in their body.
- Reserve food- Floridian starch (which is very similar to amylopectin and glycogen)
- Vegetative reproduction- fragmentation.
- Asexual Reproduction- non-motile spores
- Sexual Reproduction- oogamous
- Example- Polysiphonia, Porphyra, Gracilaria and Gelidium

Classes	Common Name	Major Pigments	Stored Food	Cell Wall	Flagellar Number and Position of Insertions	Habitat
Chlorophyceae	Green algae	Chlorophyll *a, b*	Starch	Cellulose	2-8, equal, apical	Fresh water, brackish water, salt water
Phaeophyceae	Brown algae	Chlorophyll *a, c,* fucoxanthin	Mannitol, laminarin	Cellulose and algin	2, unequal, lateral	Fresh water (rare) brackish water, salt water
Rhodophyceae	Red algae	Chlorophyll *a, d,* phycoerythrin	Floridean starch	Cellulose, pectin and poly sulphate esters	Absent	Fresh water (some), brackish water, salt water (most)

BRYOPHYTES (AMPHIBIANS OF THE PLANT KINGDOM)

- Plant - thallus-: may be prostrate or erect
- Rhizoid- Unicellular or multicellular
- The main plant body of the bryophyte is gametophyte (haploid)
- The male sex organ (antheridium) produces biflagellate antherozoids.
- The female sex organ (archegonium) produces a single egg.
- An antherozoid fuses with the egg to produce the zygote.
- Zygotes produce a multicellular body (sporophyte).
- The sporophyte is attached to the photosynthetic gametophyte and derives nourishment.
- Some cells of the sporophyte undergo reduction division (meiosis) to produce haploid spores.
- These spores germinate to produce gametophyte.

BRYOPHYTES

(Mosses and Liverworts)

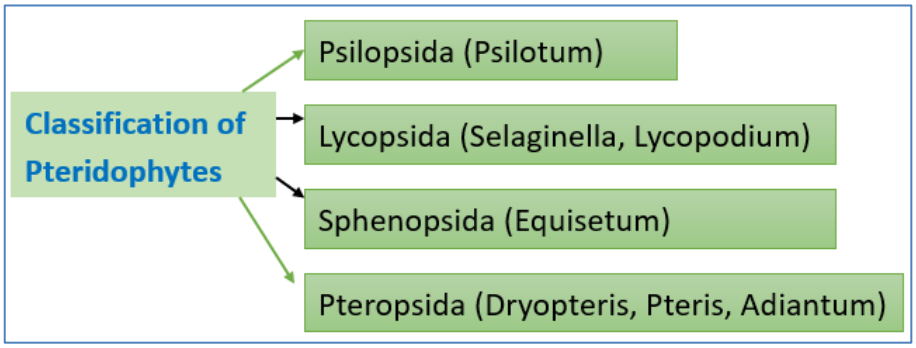
- The plant body of a liverwort is thalloid The thallus is dorsiventral and closely appressed to the substrate.
- The leafy members have tiny leaf-like appendages in two rows on the stem-like structures.
- Asexual reproduction- fragmentation, gemmae
- The sporophyte is differentiated into a foot, seta and capsule.
- After meiosis, spores are produced within the capsule.
- These spores germinate to form free-living gametophytes.
- Example- Marchantia

- Gametophyte which consists of two stages- protonema stage and leafy stage.
- Protnema- creeping, green, branched, filamentous stage.
- Leafy stage- develops from the secondary protonema
- Rhizoids- multicellular and branched
- Vegetative reproduction- fragmentation and budding
- Sporophyte consists of a foot, seta and capsule.
- After meiosis, spores are produced within the capsule.
- Examole- Funaria, Polytrichum and Sphagnum

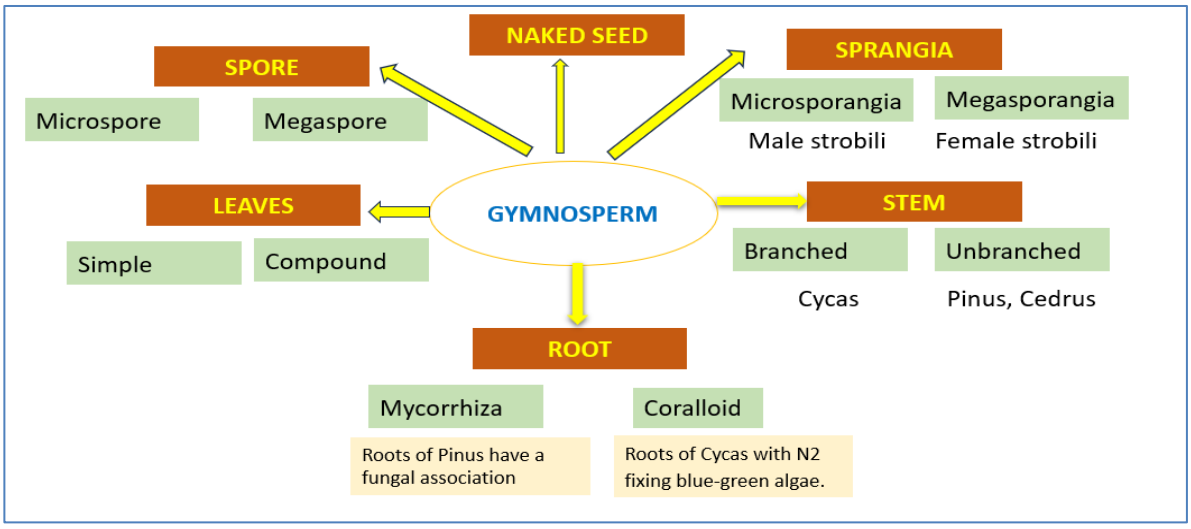
PTERIDOPHYTES

- These are the first vascular plants that bear vascular tissues – xylem and phloem.
- Habitat: cool, damp, shady places, some in sandy places
- Main plant body is a sporophyte which is differentiated into true root, stem and leaves
- Leaves- small (microphylls) as in Selaginella or large (macrophylls) as in ferns.
- Sporophylls- The sporophytes bear sporangia that are subtended by leaf-like appendages called sporophylls.
- Sometime sporophylls may form distinct compact structures called strobili or cones (Selaginella, Equisetum).
- The sporangia produce spores by meiosis in spore mother cells.
- The spores germinate to give rise to inconspicuous, small but multicellular, free-living, mostly photosynthetic thalloid gametophytes called prothallus.
- The gametophytes bear male and female sex organs called antheridia and archegonia. Fusion of the male gamete with the egg result in the formation of a zygote.

- Zygote develops in sporophyte.
- Usually pteridophytes are homosporous (all the spores are of similar kinds) while some genera like Selaginella and Salvinia are heterosporous (produce two kinds of spores, macro, and micro)
- The megaspores and microspores germinate and give rise to female and male gametophytes, respectively.
- The female gametophytes in these plants are retained on the parent sporophytes for variable periods. The zygotes' development into young embryos occurs within the female gametophytes. This event is a precursor to the seed habit considered an important step in evolution.



GYMNOSPERM



- They have naked seeds.
- The roots are generally tap roots.
- The spores are produced within sporangia that are borne on sporophylls which are arranged spirally along an axis to form lax or compact strobila or cones.
- Male strobili have microsporophylls and microsporangia. They produce microspores (pollen grain). Female strobili have megasporophylls with ovules
- The ovules are borne on megasporophylls which may be clustered to form the female cones.

- In the ovule the megaspores develop into a multicellular female gametophyte that bears archegonia or female sex organs.
- Following fertilization, the zygote develops into an embryo and the ovules into seeds.

Important Questions

1- **Spirogyra belongs to** –
   a- Chlorophyceae b- Rhodophyceae c- Phaeophyceae d- Sphenopsida
   Ans: a

2- **Naked seed is peculiar features of –**
   a- Bryophyta
   b- Gymnosperm
   c- Pteridophyta
   d- Algae
   Ans: b

3- **Coralloid seeds are a feature of-**
   a- Cycas b- Pinus c- Riccia d- Marchantia
   Ans: a

4- **Equisetum belongs to the-**
   a- Lycopsida
   b- Sphenopsida
   c- Psilopsida
   d- None of these
   Ans: d

5- **Identify the feature which is not present in sporophytes-**
   a- Foot b- Gemma c- Seta d- Capsule
   Ans: b

6- **Evolutionary relationship is the basis of**
   a- Phylogeny
   b- Natural system
   c- Artificial system
   d- All of these
   Ans: a

7- **Water and food-conducting tissues were first observed in-**
   a- Algae b- Gymnosperm c- Angiosperm d- Pteridophyta
   Ans: d

8- **Which of the following is based on the evidence from chemical constituents**
   a- Numerical taxonomy
   b- Chemotaxonomy
   c- Cytotaxonomy
   d- None of these
   Ans: c

9- **In bryophytes the sporophyte produces spores. The spores are formed by –**

a- Mitosis b- Meiosis c- Equational division d- Amitosis

Ans: b

10- **Algin is the product of-**

a- Red algae b- Brown algae c- green algae d- Bryophyta

Short answer questions-

1. **Illustrate the classification of pteridophytes**.
    a. Ans: Psilopsida (Psilotum)
    b. Lycopsida (Selaginella, Lycopodium)
    c. Sphenopsida (Equisetum)
    d. Pteropsida (Dryopteris, Pteris, Adiantum)
2. **List the name of stored foods in any two algal groups.**

    Ans: Floridian starch in Rhodophyceae. Mannitol in Phaeophyceae.
3. **Mention any two adaptive features of leaves of gymnosperms.**

    Ans: In conifers, the needle-like leaves reduce the surface area. Their thick cuticle and sunken stomata also help to reduce water loss
4. **What do you mean by seed habit in pteridophytes?**

    Ans: The female gametophytes in these plants are retained on the parent sporophytes for variable periods. The zygotes' development into young embryos occurs within the female gametophytes. This event is a precursor to the seed habit considered an important step in evolution.
5. **Write one advantage of natural and artificial systems of classification.**

    Ans: Artificial system- Easy to remember

    Natural system- Shows natural relationships among the organisms
6. **Give one example of branched and unbranched Gymnosperms.**

    Ans: unbranched (Cycas) or branched (Pinus, Cedrus).
7. **Mention the cell wall composition of Chlorophyceae.**

    Ans: Cell wall: the inner layer (cellulose) and an outer layer (pectose)
8. **What are the unique reproductive strategies utilized by algae?**

    Ans: Many small algae reproduce asexually by ordinary cell division or by fragmentation, whereas larger algae reproduce by spores. Algae also reproduce by sexual reproduction.

Long answer questions-

1. **List properties of brown algae based on the following features-**
    a. **Habitat, shape, pigment, reserve food, cell wall, leaf, and reproduction.**

    Ans- Mainly marine.

    May be simple branched, filamentous forms (Ectocarpus) or profusely branched (kelps)

    Pigment: Chlorophyll a, c, carotenoids, fucoxanthin and xanthophylls

    Reserve food- laminarin or mannitol

    Cell wall- gelatinous coating of algin.

Holdfast- structure through which the plant is attached to the substratum
Frond: leaf-like photosynthetic organ
Vegetative reproduction- fragmentation.
Asexual reproduction- biflagellate zoospores
Sexual reproduction- isogamous, anisogamous, or oogamous.

2. **Describe the characteristic features of Liverworts.**

Ans: Gametophyte consists of two stages- the protonema stage and the leafy stage.
Protonema- creeping, green, branched, filamentous stage.
Leafy stage- develops from the secondary protonema
Rhizoids- multicellular and branched
Vegetative reproduction- fragmentation and budding
Sporophyte consists of a foot, seta and capsule.
After meiosis, spores are produced within the capsule.
Examples- Funaria, Polytrichum and Sphagnum

3. **Explain the followings-**

a- Pigment system in the algae

b- Reserve foods in algae

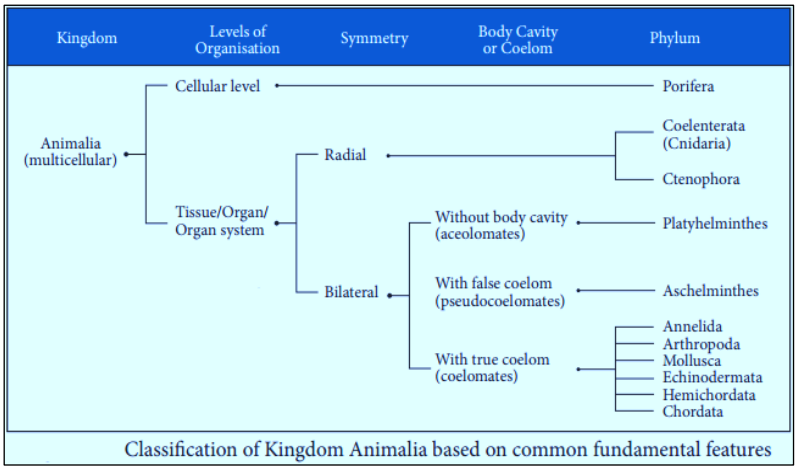
Ans: a-- Chlorophyceae- Chlorophyll a, b
Phaeophyceae- Fucoxanthin
Rhodophyceae- phycoerythrin
b- Chlorophyceae- Starch
Phaeophyceae- Mannitol, Laminarin
Rhodophyceae- Floridian Starch

CHAPTER-4
ANIMAL KINGDOM

Classification of animals

Animals are classified on the following basis-

- Levels of Organisation- cellular/ tissue/ body level
- Body symmetry- symmetrical/ asymmetrical/radial symmetry
- Nature of coelom- coelomate/ acoelomate// pseudocoelomate
- Circulatory System- open/ closed
- Segmentation
- Notochord



Classification of Kingdom Animalia based on common fundamental features

ANIMAL KINGDOM

- PORIFERA
- COELENTERATA
- CTENOPHORA
- PLATYHELMINTHES
- ANNELIDA
- ARTHROPODA
- MOLLUSCA
- ECHINODERMATA
- HEMICHORDATA
- CHORDATA

CHORDATA

CYCLOSTOMATA

CHONDRICHTHYES

OSTEICHTHYES

AMPHIBIA

AVES

MAMMALIA

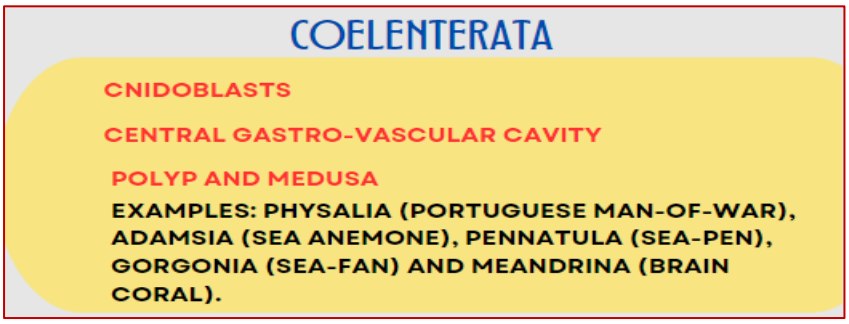
PHYLUM – PORIFERA (sponges)

PORIFERA

WATER TRANSPORT OR CANAL SYSTEM
OSTIA
SPONGOCOEL
OSCULUM
SPICLES
HERMAPHRODITE
EXAMPLES: SYCON (SCYPHA), SPONGILLA (FRESH WATER SPONGE) AND EUSPONGIA (BATH SPONGE).

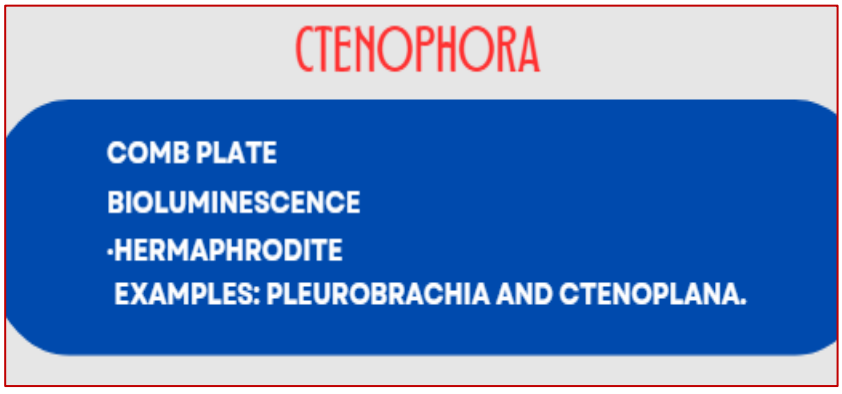
- cellular level of organization.
- Ostia: minute pores through which water enters, Spongocoel: central cavity in the body
- Osculum: water goes outside through it, Water transport system helps in food gathering, respiratory exchange and removal of waste. Choanocytes (collar cells): line the Spongocoel and the canals.
- Spicules/ Spongins: skeleton fibers
- Hermaphrodite: Sexes are not separate
- Asexual Reproduction: fragmentation, Sexual reproduction: by the formation of gametes.
- Fertilization: internal, development is indirect.

PHYLUM – COELENTERATA (CNIDARIA)



- Cnidoblasts or cnidocytes: contain the stinging capsules (nematocysts) on the tentacles and the body. These are used for anchorage/ defense/ capture of prey.
- They have a central gastro-vascular cavity with a single opening, mouth on hypostome.
- Cnidarians exhibit two basic body forms called polyp and medusa.
  Polyp: sessile and cylindrical e.g., Hydra, Adamsia
  Medusa: free swimming and umbrella-shaped e.g., Aurelia or jellyfish.
  Metagenesis: alternation of generation; polyps produce medusae asexually and medusae form the polyps sexually.

PHYLUM – CTENOPHORA (sea walnuts or comb jellies)



- Comb plate: eight rows of ciliated plates for locomotion.
- Reproduction: only by sexual means, Fertilization: external with indirect development.

Examples: Pleurobrachia and Ctenoplana.

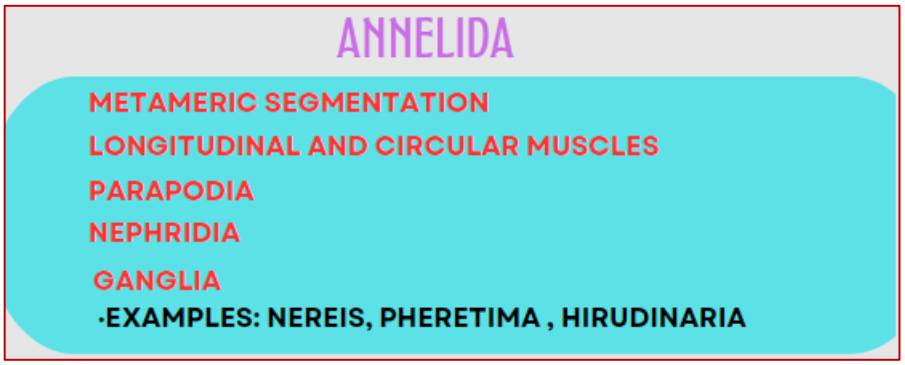
PHYLUM – PLATYHELMINTHES (flatworms)

- Flame cells: osmoregulation and excretion
- Fertilization: internal and development is indirect.
- Planaria possess high regeneration capacity.

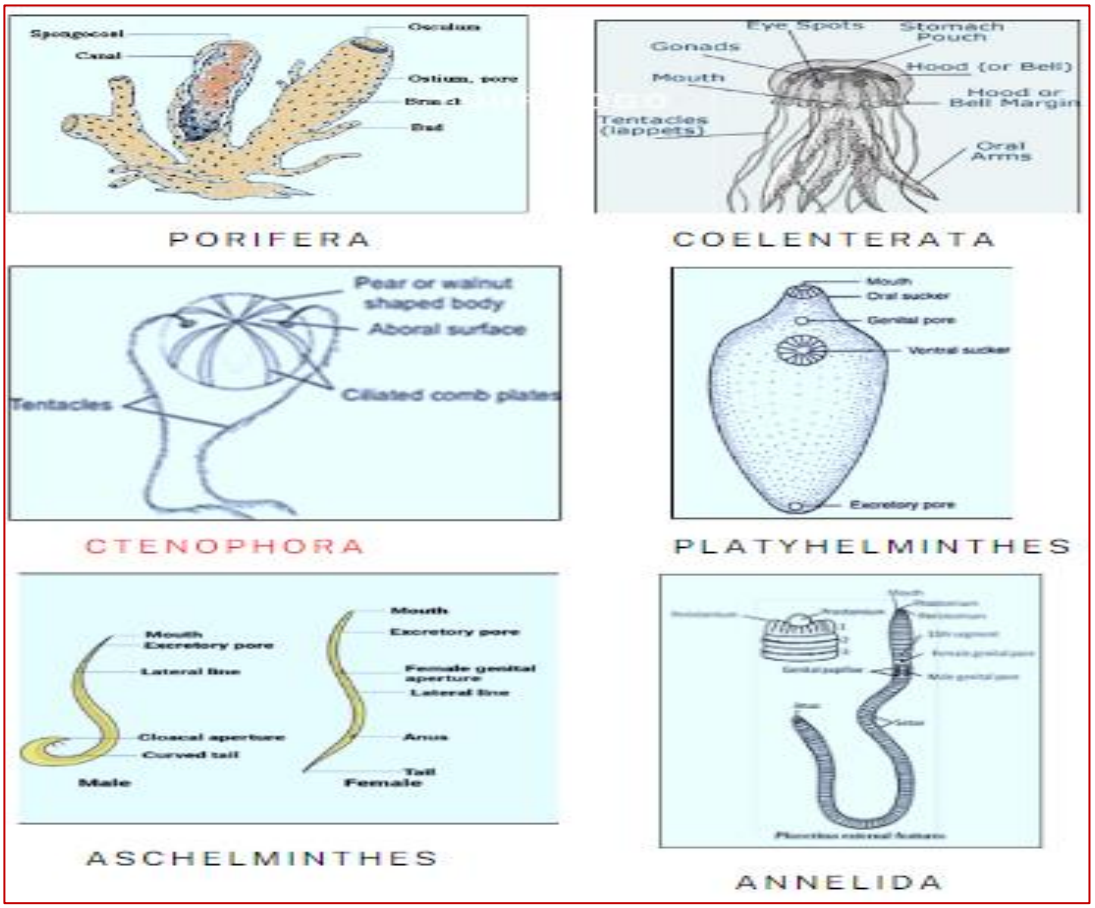
PHYLUM – ASCHELMINTHES (roundworms)

- Alimentary canal is complete with a well-developed muscular pharynx.
- Excretion occurs by excretory tube and the excretory pore.
- Often females are longer than males.

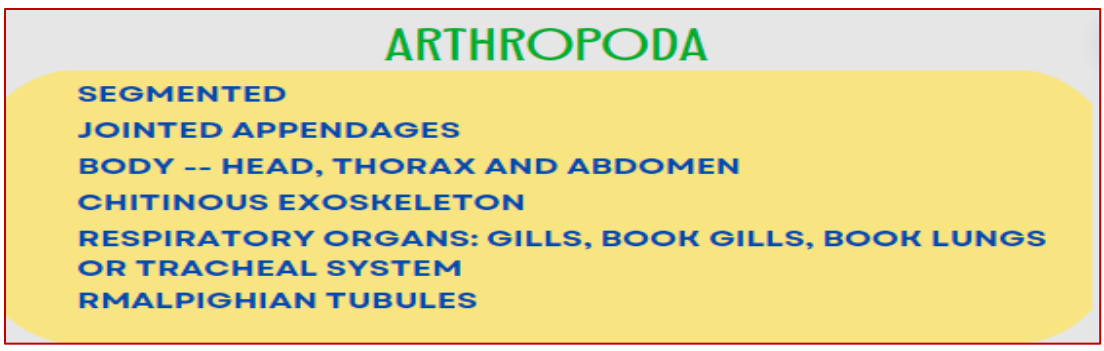
PHYLUM – ANNELIDA



- They have longitudinal and circular muscles for locomotion.
- Aquatic annelids like Nereis possess lateral appendages, and parapodia, which help in swimming.
- Circulatory system- closed type
- Nephridia: helps in osmoregulation and excretion.
- Ganglia: Neural system consists of paired ganglia.
- Dioecious (Nereis) , monoecious (earthworms and leeches)
- Reproduction: sexual.

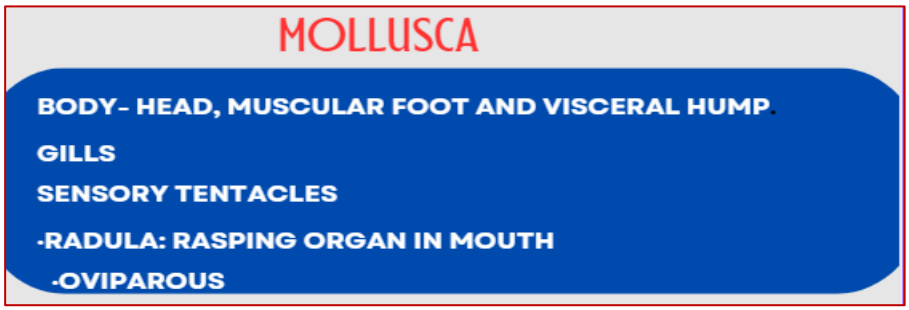


PHYLUM – ARTHROPODA



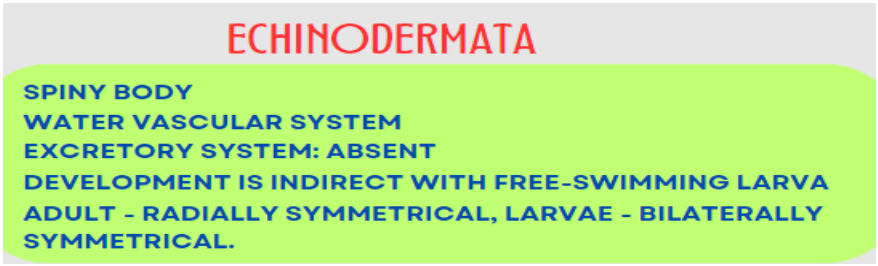
- Circulatory system: open type.
- Sensory organs: antennae, eyes (compound and simple), statocysts or balancing organs are present.
- Excretion: by Malpighian tubules.
  Examples: Apis (Honey bee), Bombyx (Silkworm), Laccifer (Lac insect) Vectors – Anopheles, Culex and Aedes (Mosquitoes) Gregarious pest – Locusta (Locust) Living fossil – Limulus (King crab).

PHYLUM – MOLLUSCA



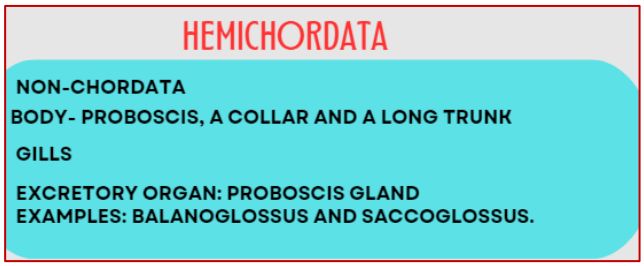
- They are bilaterally symmetrical, triploblastic, coelomate animals with the organ-system level of organization.
  Examples: Pila (Apple snail), Pinctada (Pearl oyster), Sepia (Cuttlefish), Loligo (Squid), Octopus (Devil fish), Aplysia (Seahare), Dentalium (Tusk shell) and Chaetopleura (Chiton)

PHYLUM – ECHINODERMATA

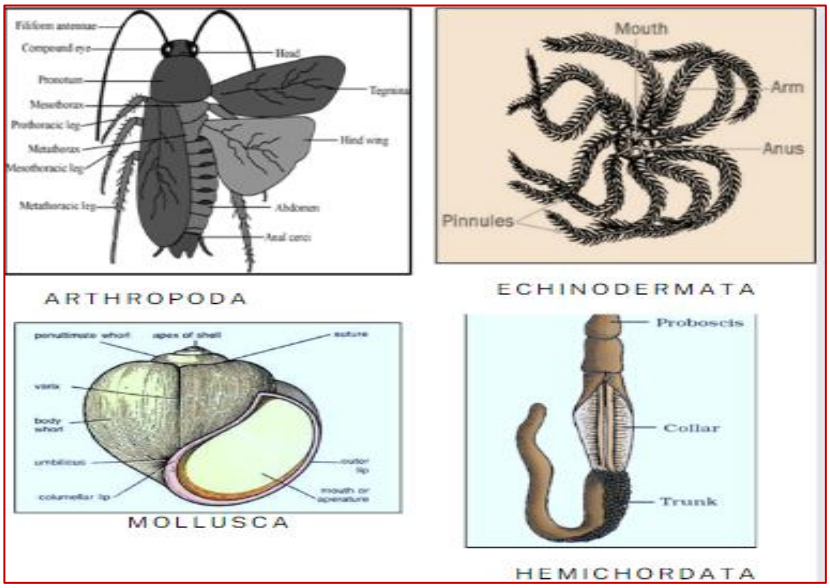


- Spiny body and contains endoskeleton of calcareous ossicles.
- They are triploblastic and coelomate animals with the organ-system level of organization.
- Digestive system: complete with the mouth (ventral side) and anus (dorsal side).
- Sexes are separate, Reproduction is sexual
- Examples: Asterias (Star fish), Echinus (Sea urchin), Antedon (Sea lily), Cucumaria (Sea cucumber) and Ophiura (Brittle star).

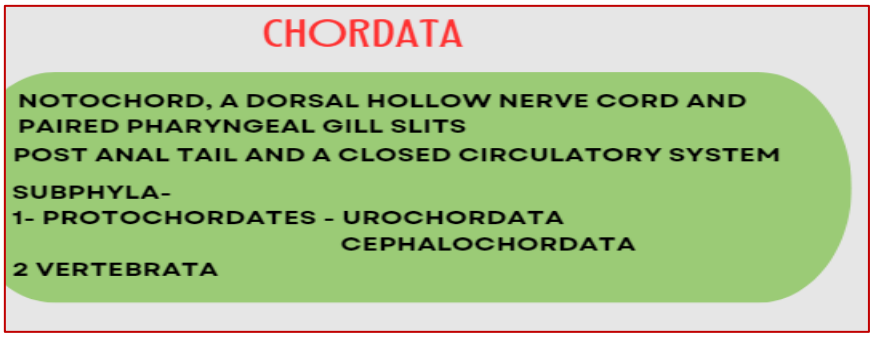
PHYLUM – HEMICHORDATA



- Non-Chordata (have a rudimentary structure in the collar region called stomochord, a structure similar to notochord).
- They are bilaterally symmetrical, triploblastic and coelomate animals with the organ-system level of organization.
- Sexes are separate; Fertilization is external; Development is indirect.

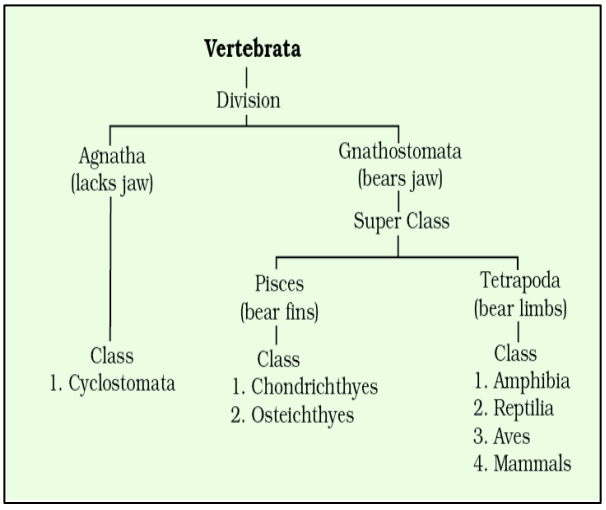


PHYLUM – CHORDATA



Phylum Chordata is divided into three subphyla:

- Protochordates: Urochordata/ Tunicata and Cephalochordates- marine
- Vertebrata: Vertebrata possess notochord during the embryonic period. The notochord is replaced by a cartilaginous or bony vertebral column in the adult. Vertebrates have a ventral muscular heart with two, three or four chambers, kidneys for excretion and



osmoregulation, and paired appendages which may be fins or limbs.

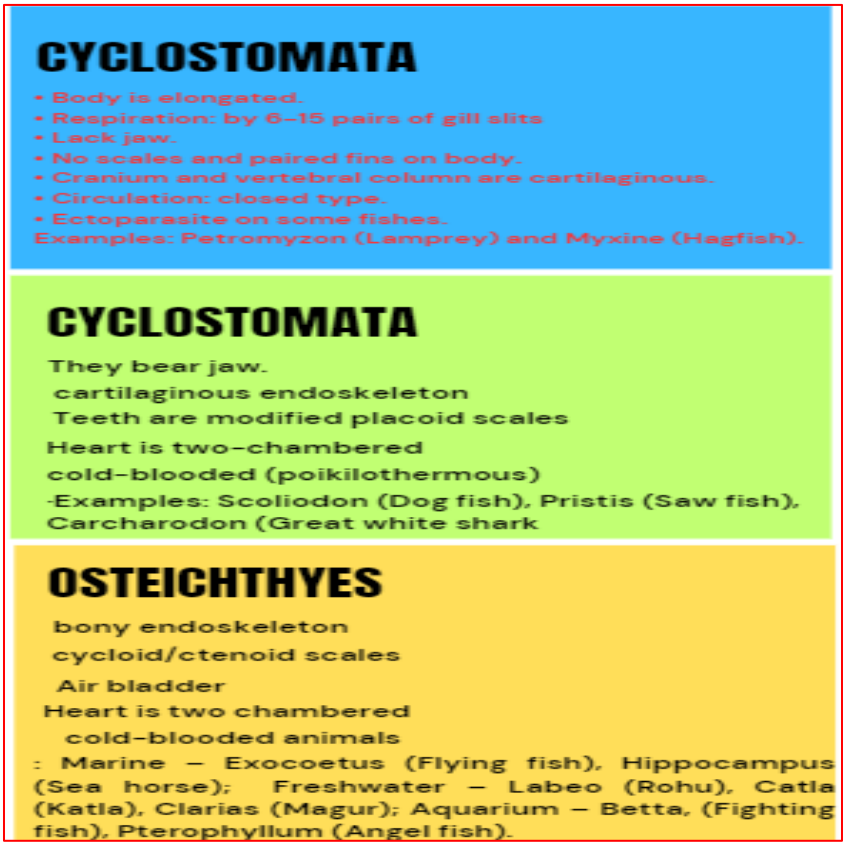
- In Urochordata, the notochord is present only in the larval tail. E.g. Ascidia, Salpa, Doliolum
- In Cephalochordate, notochord extends from head to tail region and is persistent throughout their life. E.g., Branchiostoma (Amphioxus or Lancelet).

CLASS – CYCLOSTOMATA

CLASS – CHONDRICHTHYES

CLASS – OSTEICHTHYES

CLASS – AMPHIBIA



- Habitat: Aquatic/ terrestrial
- Body is divisible into a head and trunk, and mostly has two pairs of limbs.
- Skin is Moist, eyes have eyelids.
- Tympanum: ear
- Alimentary canal, urinary and reproductive tracts open into a common chamber called cloaca which opens to the exterior.
- Respiration: by gills, lungs and through the skin.
- Heart: three-chambered (two auricles and one ventricle).
- These are cold-blooded animals.
- Sexes are separate, Fertilization is external.
- They are oviparous and development is indirect.

  Examples: Bufo (Toad), Rana (Frog), Hyla (Tree frog), Salamandra (Salamander), and Ichthyophis (Limbless amphibian).

CLASS – AVES

- Feathers are present except in a few like Ostrich.
- Endoskeleton is bony and the long bones are pneumatic (hollow with air cavities).
- The digestive tract of birds has additional chambers, the crop and gizzard.
- Heart: four-chambered.
- Warm-blooded (homoiothermic)
- Respiration is by the lungs.
- Sexes are separate, Fertilization is internal.
- They are oviparous and development is direct.

Examples: Corvus (Crow), Columba (Pigeon), Psittacula (Parrot), Struthio (Ostrich), Pavo (Peacock), Aptenodytes (Penguin), Neophron (Vulture).

CLASS – MAMMALIA

- Characteristic features are the presence of mammary glands, hairs on the skin, and external ears (pinnae).
- Different types of teeth are present in the jaw.
- Heart: four-chambered.
- warm-blooded animals
- Respiration: lungs.
- Sexes are separate and fertilization is internal.

  Examples: Oviparous-Ornithorhynchus (Platypus); Viviparous - Macropus (Kangaroo), Pteropus (Flying fox), Camelus (Camel), Macaca (Monkey), Rattus (Rat), Canis (Dog), Felis (Cat), Elephas (Elephant), Equus (Horse), Delphinus (Common dolphin), Balaenoptera (Blue whale), Panthera tigris (Tiger), Panthera leo (Lion).

IMPORTANT QUESTIONS

Very Short Answer Types Questions

1- **What is the highest level of organization in animals.**
   a- Cellular Level
   b- Tissue level
   c- Organ level
   d- None of these
   Ans: c

2- **Coelenterates belong to which of the following -**
   a- Acoelomate
   b- Coelomate
   c- Pseudocoelomate
   d- All of these
   Ans: a

3- **Which phylum belongs to pseudocoelomate-**
   a- Coelenterate s
   b- Aschelminths
   c- Arthropoda
   d- Vertebrates
   Ans: b

4- **In Porifera and Annelida the symmetry observed are---------- and ---------- respectively.**
   Ans: Porifera- asymmetrical, Annelida- bilateral symmetry

5- **What is the role of the water canal system in Porifera-**
   a- Food gathering
   b- Respiratory exchange
   c- Removal of wastes
   d- All of these

Ans: d

6- **Assertion: In hermaphrodites, the sexes are not separate.**
Reason: eggs and sperm are produced by the same individuals.
a- Both A and R are true and R is the correct explanation of A.
b- Both A and R are true, but R is not the correct explanation of A.
c- A is true, but R is false.
d- A is false, but R is true.
Ans: a

7- **Mention common names of Adamsia and Ancylostoma.**
Ans: Adamsia (Sea anemone), Ancylostoma (Hookworm).

8- **The head, muscular foot, and visceral hump are the property of which phylum.**
Ans: Mollusca

9- **Name two animals that belong to hemichordate.**
Ans: Balanoglossus and Saccoglossus.

10- **Living fossil – Limulus (King crab) belong to which phylum?**
Ans: Arthropoda

Short Answer Types Questions

1- **Write two functions of feathers in Aves.**
Ans: i- help in flight
ii- help in maintaining body temperature

2- **Mention the body cavity type found in Platyhelminthes, Aschelminths, and Echinodermata.**
Ans: Platyhelminthes (acoelomate), Aschelminths (pseudocoelomate), Echinodermata (coelomate)

3- **Write two differences between vertebrates and invertebrates.**
Ans: Vertebrates are animals that have a backbone or spinal column, while invertebrates are animals that lack a backbone.
Vertebrates have a complex skeletal system, while invertebrates have a simpler skeletal system.

4- **What are polyps and medusa?**
Ans: Polyps and medusas are both types of jellyfish, belonging to the same phylum – Cnidaria. Polyps are typically stationery and medusas are generally free-swimming.

5- **Which structures help in the movement of annelids?**
Ans: longitudinal and circular muscles and parapodia.

6- **Write any two characteristic features of phylum Arthropoda.**
Ans: jointed paired appendages, the body can be divisible into head, thorax, and abdomen.

7- **Give an example of a roundworm, Ectoparasite on fish, jawless vertebrate, Fish possessing poison sting.**
Ans: Ascaris, Cyclostomata, Cyclostomata, Ichthyophis

8- **(i)Explain Protochordates.**
(ii) How presence of notochord differs in Protochordates?
Ans: (i) Subphyla Urochordata and Cephalochordata are often referred to as protochordate and (ii) In In Urochordata notochord is present only in larval tail

In Cephalochordate notochord extends from head to tail and is persistent throughout their life.

9- **Define metamerism. Give the name of one phylum which shows this property.**

Ans: In some animals, the body has many segments, which show serial repetition of parts. This kind of segmentation is called metameric segmentation, and the phenomenon is known as metamerism. E.g. Annelida

10- **Explain any four types of excretory systems in animals by citing examples of each.**

Ans: water canal system: Porifera, Nephridia- Annelida, Malpighian tubule- Arthropoda, Kidney- mammals

11- **Describe class – Chondrichthyes by giving three peculiar features and two examples of s – Chondrichthyes**

Ans: Cartilaginous endoskeleton, Notochord is persistent throughout life, they have jaws.
e.g. Scoliodon (Dogfish), Carcharodon (Great white shark)

12- **Write the importance of the tympanum, cloaca, air bladder, and radula.**

Ans: A tympanum represents the ear.

The Alimentary canal, urinary and reproductive tracts open into a common chamber called the cloaca.

The air bladder regulates buoyancy.

Radula is present in the mouth as a rasping organ.

Long Answer Types Questions

1- **Distinguish between the Chordates and Non-Chordates.**

Ans: Chordates- Notochord present, CNS is dorsal, hollow, and single, Pharynx perforated by gill slices, Heart is ventral, post-anal (tail) is present

Nonchordates- Notochord absent, CNS are ventral solid and double, Gill slits are absent, Heart is dorsal, Past-anal tail is absent.

2- **Explain the distinguishing features of Phylum – Ctenophora.**

Ans: These are sea walnuts or comb jellies. Ctenophora members are marine, radially symmetrical, diploblastic organisms with tissue level of organization. They have comb plates for locomotion. One characteristic feature of Ctenophora is bioluminescence. These are hermaphrodites and only by sexual reproduction occurs.

Examples: Pleurobrachia and Ctenoplana.

3- **Give a brief account on-**

(i) **Respiration of porifera, Arthropoda, Mollusca, Echinodermata and Cyclostomata of animal kingdom.**

(ii) **Excretory system of Porifera, Arthropoda, Hemichordata, Platyhelminthes, and Annelid**

Ans: Respiratory system- porifera- water canal system, arthropods- book gills, book lungs or tracheal system, Mollusca- feather-like gills, Echinodermata- water vascular system, Cyclostomata- gill slits.

Excretory system- Porifera- water canal system, Arthropoda- Malpighian tubule, Hemichordata- proboscis gland, Platyhelminthes- flame cells, Annelid- nephridia

4- **List the adaptive features of birds.**

Ans: feathers- help in flight and maintaining body temperature. Additionally, feathers are waterproof, which helps to protect birds from bad weather.

hollow bones (pneumatic bones)- help in buoyancy

beak- the capture of food, Different types of birds have beaks adapted to different methods of feeding. For example, woodpeckers have long, pointed beaks that are perfect for digging into trees and finding insects. On the other hand, hummingbirds have long, thin beaks that can reach into flowers to drink nectar.

5- List five differences between chordates and non-chordates.

Ans: Chordates- Notochord, CNS is dorsal, Heart is ventral, Gills in the pharynx, Post anal tail present

Non-chordates- Notochord absent, CNS is solid, Heart is dorsal, Gills absent, Post anal tail absent.

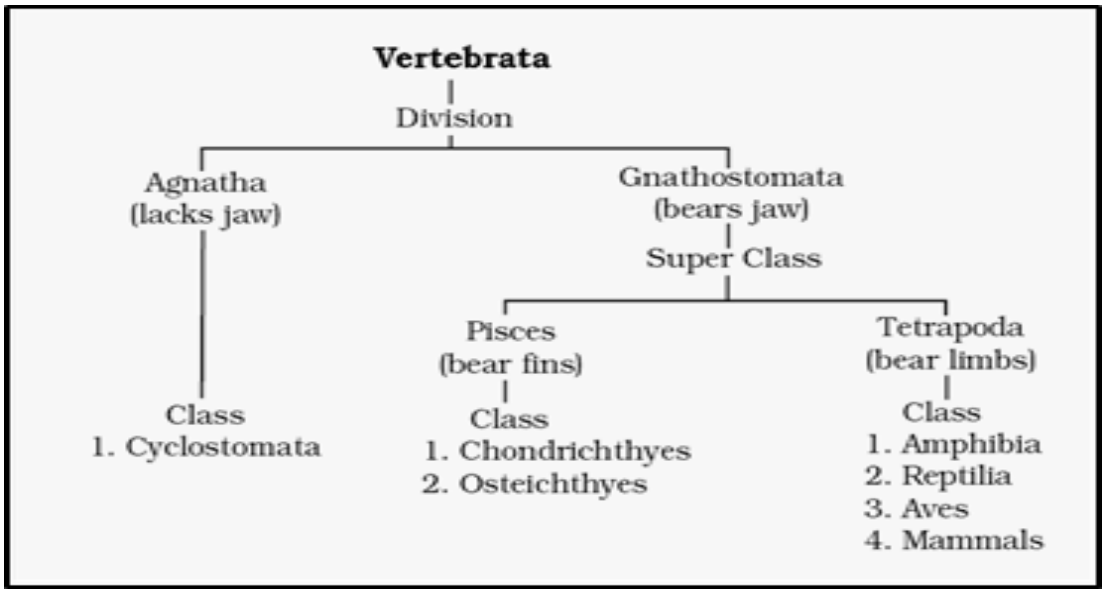
6- Identify the classes by observing the following features-

The body is covered with hairs, long pneumatic bones, respire with the help of skin, lungs and gills, air bladder, Teeth are modified placoid scales which are backwardly directed

Ans: Mammals, Aves, Amphibians, Osteichthyes, Chondrichthyes

7- Explain classification of vertebrates only by using graphical representation.

Ans:



Chapter-5
Morphology of Flowering Plants

ROOT

ROOT

TYPES

- **Primary root:** Direct elongation of the radical forms the primary root. It bears lateral roots (secondary, tertiary) roots.
- **Tap Root:** The primary roots and their branches. E.g. Mustard
- **Fibrous System:** These roots originate from the base of the stem E.g. Monocot plants
- **Adventitious roots:** When root arises from parts other than radicle. E.g. Grass, Monstera, Banyan tree

REGIONS

ROOT CAP	It protects the apex of the root in the soil. It is absent or replaced by root pockets in Eichornia, Pista, Lemna
MERISTEMATIC	divide repeatedly
ELONGATION	undergo rapid elongation and enlargement and are responsible for the growth in length.
MATURATION	Mature Cells

Modifications of Root

PROP	Hanging root, support, e.g.- Banyan (Ficus benghalensis)
STILT	From lower node, support e.g. – Maize
PNEUMATOPHORE	Roots come out of the ground and grow vertically upwards in swampy area. It Help to get oxygen for respiration. e.g. *Rhizophora*
STORAGE	Tuber (sweet potato) Fasciculated – root arise in bunch e.g.- Dahlia, Asparagus

FUNCTIONS

- **Absorption of water minerals from the soil**
- **Anchorage to the plant parts**
- **Storing reserve food material**
- **Synthesis of plant growth regulators.**

THE STEM

STEM

It develops from the plumule of the embryo.
The stem bears nodes and internodes.
The stem bears buds, which may be terminal or axillary.

Function

- **Bears branches, fruits and leaves.**
- **It conducts water, minerals and photosynthetic product.**
- **Some perform the function of storage.**
- **Few stems perform vegetative reproduction**

Food store — Underground stems of potato, ginger, turmeric, zaminkand, Colocasia

Vegetative reproduction — In grass, strawberry, mint, jasmine, Pistia banana, pineapple, chrysanthemum,

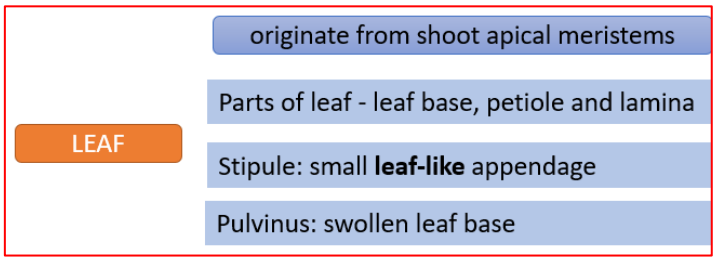
Tendril — Develop from axillary buds, are slender and spirally coiled and help plants to climb. E.g. cucumber, pumpkins, watermelon, grapevines.

Thorns — Axillary buds are modified into woody, straight and pointed thorns. They protect plants from browsi animals Eg - Citrus, and Bougainvillea.

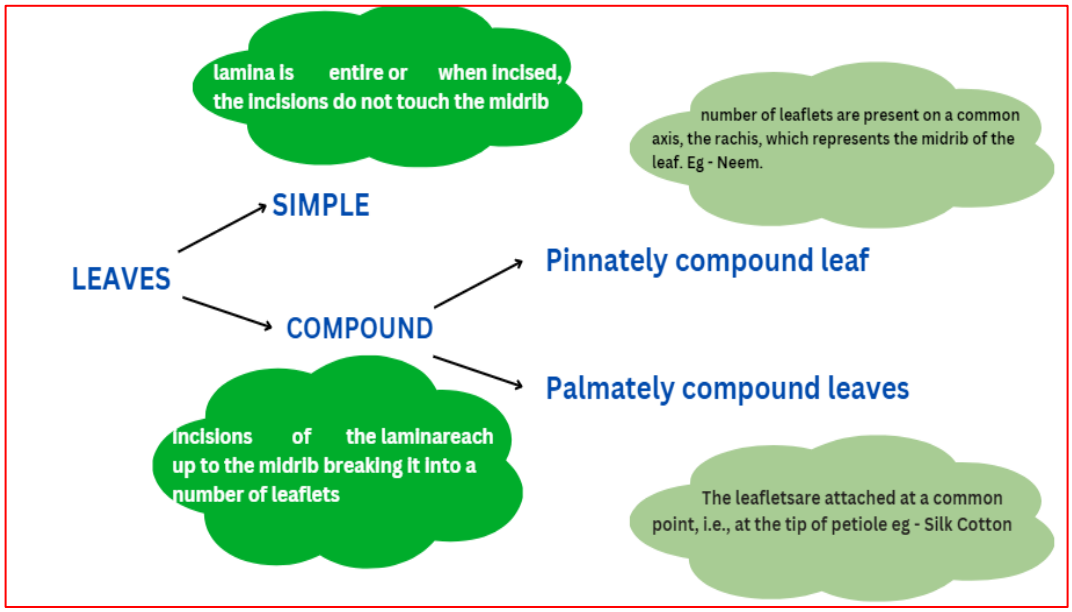
Phylloclade — Plants of arid regions modify their stems into flattened (Opuntia), or fleshy cylindrical (Euphorbia) structures. They may perform photosynthesis.

Cladode — Phylloclade with one internodes Perform photosynthesis. e.g. Asparagus, Ruscus

THE LEAF



- Venation: The arrangement of veins and the veinlets in the lamina of leaf is termed as venation.
  RETICULATE- vein lets form a network. Eg – Dicot
  PARALLEL- veins run parallel to each other within a lamina. Eg – monocot



Phyllotaxy

- Phyllotaxy is the pattern of arrangement of leaves on the stem or branch.

Alternate	A single leaf arises at each node in an alternatemanner. E.g., china rose, mustard and sunflower
Opposite	A pair of leaves arise at each node and lieopposite to each other. e.g.- *Calotropis,* guava
Whorled	More than two leaves arise at a node andform a whorl. e.g., *Alstonia.*

Modifications of Leaves

MODIFICATION IN LEAVES

Tendril: for climbing as in peas

Spine: for defence as in cacti

Storage: fleshy leaves of onion and garlic store food

Photosynthesis by petiole: Australian acacia, the leaves are small and short-lived. The petioles in these plants expand, become green and synthesize food.

To trap Insects: Venus fly trap

THE INFLORESCENCE

- The arrangement of flowers on the. floral axis is termed as **inflorescence**
- A flower is a modified shoot wherein the shoot apical meristem changes to floral meristem.

Racemose	The main axis continues to grow, the flowers are borne laterally in an acropetal succession	
Cymose	**T**he main axis terminates in a flower, hence is limited in growth. The flowers areborne in a basipetal order	
Acropetal - new flowers and buds are at the apex and the older flowers are at the base **Basipetal -** new flowers are at the bottom		

The Flower

- It is the reproductive structure meant for sexual reproduction in flowering plants.
- It consists of calyx, corolla, androecium and gynoecium.
- Perianth: non-reproductive part of the flower, consisting of floral leaves surrounding the androecium and gynoecium.

FLOWER

ZYGOMORPHIC
(Bilateral symmetry)
- e.g., pea, gulmohur, bean, Cassia.

ACTINOMORPHIC
(Radial symmetry)
- e.g., mustard, datura, chili

ASYEMMETRIC
(Irregular)
- e.g., Canna

Bracteates

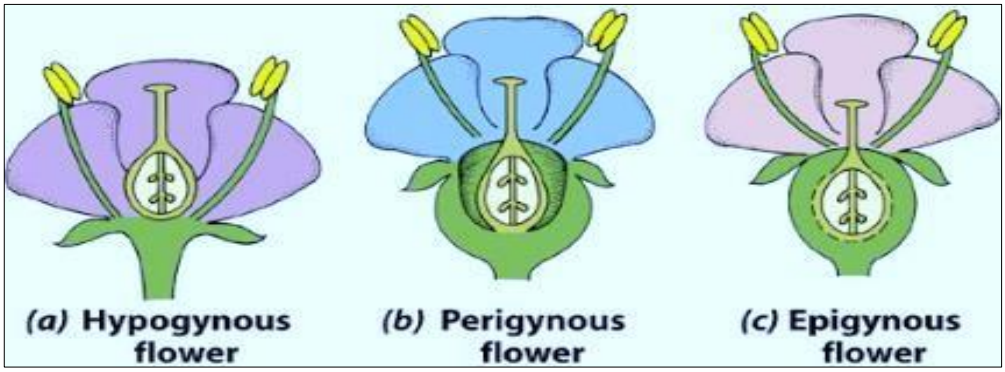
Flowers with bracts, reduced leaf found at the base of the pedicel

Ebracteate

without bracts

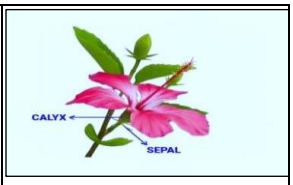
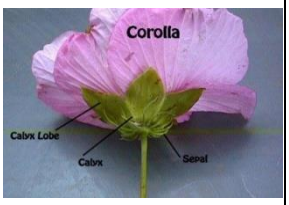
- Flower may be Unisexual Bisexual.
- Trimerous, tetramerous or pentamerous: - when the floral appendages are in multiple of 3, 4 or 5, respectively.

On the basis of the position of gynoecium, the flower may be classified as below-



- **Hypogynous/ Superior ovary**: gynoecium occupies the highest position. e.g., mustard, china rose and brinjal.
- **Perigynous/ Half inferior**: gynoecium is situated in the center and other parts of the flower are located on the rim of the thalamus almost at the same level. e.g., plum, rose,
- **Epigynous flowers/ Inferior ovary**: the margin of the thalamus grows upward enclosing the ovary completely and getting fused with it, the other parts of the flower arise above the ovary. E.g. guava and cucumber.

Parts of a Flower

Calyx- group of sepals	Outermost whorl, mostly green. Protect the flower in the budstage. Gamosepalous (sepals united) or Polysepalous (sepals free).	
Corolla – a group of petals	Brightly coloured to attract insects for pollination. Gamopetalous (united petals) ,Polypetalous(free petals) Corolla may be tubular (sunflower), bell-shaped (campanula), funnel-shaped (Petunia) or wheel-shaped (Solanum nigrum)	

Aestivation:

The mode of arrangement of sepals or petals in the floral bud with respect to the other members of the same whorl is known as aestivation

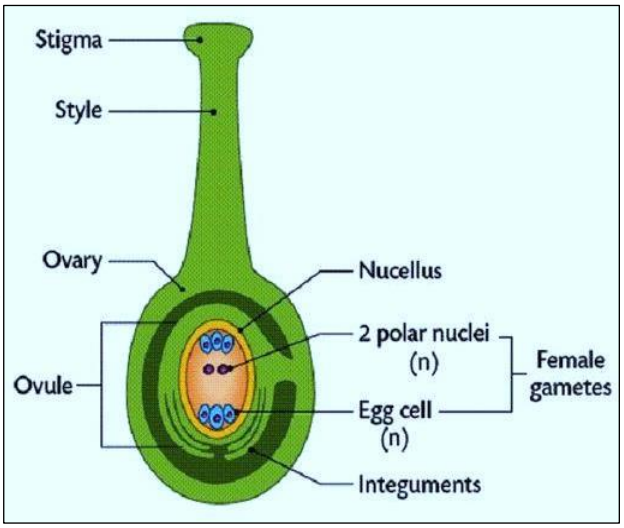
Valvate	When sepals or petals in a whorl just touch one another at the margin, without overlapping, as in *Calotropis*
Twisted	If one margin of the appendage overlaps that of the next one and so on. e.g.- China rose, lady's finger and cotton

Imbricate	If the margins of sepals or petals overlap one another but not in any particular direction. Eg *Cassia* and Gulmohur
Vexillary (papilionaceous)	In pea and bean flowers, there are five petals, the largest (standard) overlaps thetwo lateral petals (wings) which in turn overlap the two smallest anterior petals (keel).

ANDROECIUM

- It is a male reproductive part and is composed of stamens.
- Each stamen consists of a stalk/ filament and an anther.
- Anther is usually bilobed and each lobe has two chambers, the pollen-sacs.
- The pollen grains are produced in pollen-sacs.
- Staminode: sterile stamen
- Epipetalous: stamens are attached to the petals as in brinjal
- Epiphyllous: when attached to the perianth as in lily.
- The stamens may be united into one bunch (Monadelphous) as in China rose, or two bundles (diadelphous) as in pea, or into more than two bundles (polyadelphous) as in citrus.

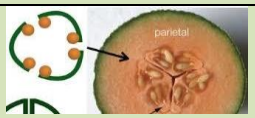
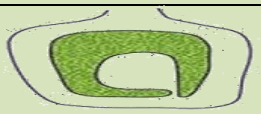
GYNOECIUM



- It is the female reproductive part and is made up of one or more carpels.
- A carpel consists of a stigma, style, and ovary.
- The style connects the ovary to the stigma.
- The stigma is the receptive surface for pollen grains.
- Each ovary bears ovules attached to a flattened, cushion-like placenta.
- Apocarpous: carpels are free
- Syncarpous: carpels are fused, as in mustard and tomato.
- After fertilization, the ovules develop into seeds and the ovary matures into a fruit.

PLACENTATION:

The arrangement of ovules within the ovary is known as placentation

Marginal	The placenta forms a ridge along the ventral suture of the ovary and the ovules are borne onthis ridge forming two rows, as in pea.	
Axile	When the placenta is axial and the ovules are attached to it in a multilocular ovary. E.g. China rose,tomato, and lemon.	
Parietal	Ovules develop on the inner wall of the ovary or on the peripheral part. e.g., mustard and *Argemone*.	
Free central	Ovules are borne on a central axis and septa are absent, as in *Dianthus* and *Primrose* the placentation is called **free central.**	
Basal	The placenta develops at the base of the ovary and single ovule is attached to it, as in sunflower, or marigold.	

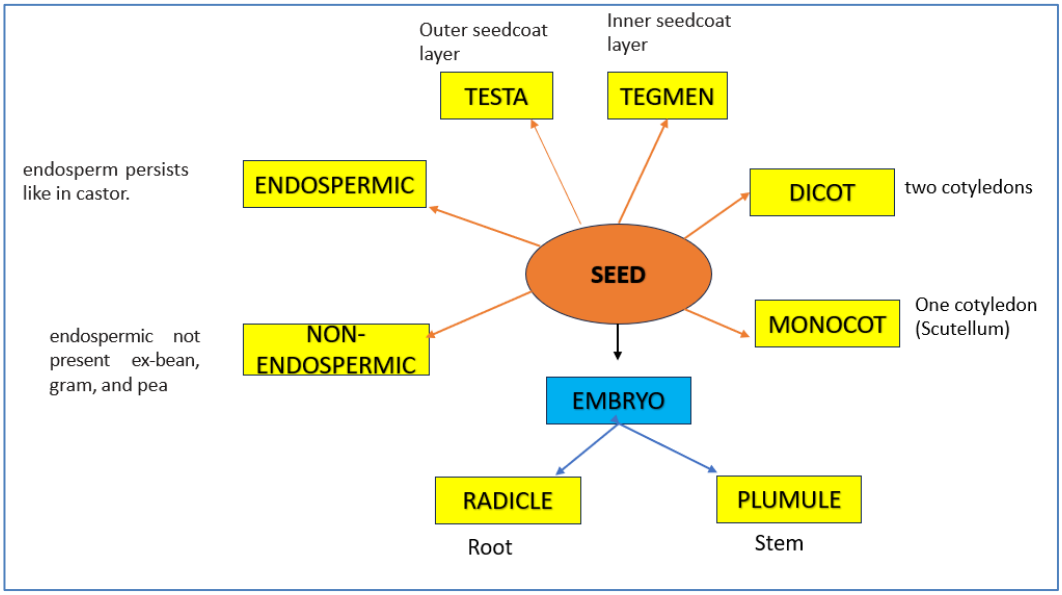
THE FRUIT

- The fruit is a mature or ripened ovary.
- Parthenocarpic fruit- fruit is formed without fertilization of the ovary.
- Generally, the fruit consists of a wall or **pericarp** and seeds.
- The pericarp may be dry or fleshy.
- When the pericarp is thick and fleshy, it is differentiated into the outer **epicarp,** the middle **mesocarp** and the inner **endocarp**.
- In mango and coconut, the fruit is known as a drupe. They develop from monocarpellary superior ovaries and are one-seeded.

THE SEED

- The ovules develop into seeds.
- A seed is made up of a seed coat and an embryo.
- The **hilum** is a scar on the seed coat through which the developing seeds were attached to thefruit. Above the hilum is a small pore known as **Micropyle**.

FAMILY: SOLANACEAE (Potato Family)



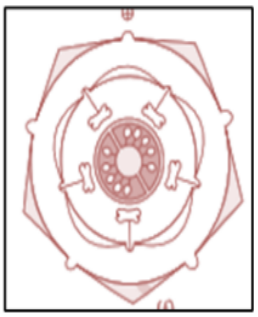
SOLANACEAE

Vegetative Characters

Plants mostly herbs, shrubs and rarely small trees
Stem: herbaceous rarely woody aerial; erect, cylindrical, branched, solid or hollow, hairy or glabrous, Underground stem in potato (Solanum tuberosum)
Leaves: alternate, simple, rarely pinnately compound, exstipulate; venation reticulate

Floral character

- Inflorescence : Solitary, axillary or cymose as in Solanum
- Flower: bisexual, actinomorphic
- Calyx: sepals five, united, persistent, valvate aestivation
- Corolla: petals five, united; valvate aestivation
- Androecium: stamens five, epipetalous
- Gynoecium: bicarpellary, syncarpous; ovary superior, bilocular, placenta swollen with many ovules
- Fruits: berry or capsule
- Seeds: many, endospermous



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Economic Importance

- Many plants belonging to this family are source of food (tomato, brinjal, potato), spice (chilli); medicine (belladonna, ashwagandha); fumigatory (tobacco); ornamentals (petunia).

IMPORTANT QUESTIONS

Very Short Answer Questions

1- **What are the hanging roots of a banyan tree called?**
   a- Stilt root
   b- Prop root
   c- Pneumatophores

d- Mangroves

Ans: b

2- The root is covered at the apex by a thimble-like structure called

a- Lateral meristem

b- Intercalary meristem

c- Root cap

d- None of these

Ans: c

3- Monocot plants are characterized by the presence of which types of roots?

a- Taproot

b- Pneumatophores

c- Adventitious root

d- All of these

Ans: c

4- The regions of the stem where leaves are born are called-

a- Node

b- Internode

c- Bud

d- Axillary bud

Ans: a.

5- Which type of venation is present in maize plants?

a- Parallel

b- Reticulate

c- No venation

d- Both a and b types

Ans: a

6- Assertion: Phyllotaxy is the pattern of arrangement of leaves on the stem or branch.
Reason: Alstonia has vexillary type phyllotaxy**.**

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is a correct explanation of Assertion (A).

(b) Both Assertion (A) and Reason (R) are true but Reason (R) is not a correct explanation of Assertion (A).

(c) Assertion (A) is true and Reason (R) is false.

(d) Assertion (A) is false and Reason (R) is true.

Ans: c

7- Assertion: Calyx is the main reproductive part of the flower.
Reason: Androecium is the site where the male gamete is formed.

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is a correct explanation of Assertion (A).

(b) Both Assertion (A) and Reason (R) are true but Reason (R) is not a correct explanation of Assertion (A).

(c) Assertion (A) is true and Reason (R) is false.

(d) Assertion (A) is false and Reason (R) is true

Ans: d

8- **Fill in the blank with the correct answer-**

a- _____is known as sterile stamen.

b- Banana is a _____ fruit.

Ans: a- staminode b- Parthenocarpic

9- **The fruit formed_____is called a parthenocarpic fruit**.

Ans: Without fertilization

10- **_____is a scar on the seed coat through which the developing seeds were attached to the fruit.**

Ans: The hilum

Short Answer Type Questions

1- **Give two examples of stem modifications.**

Ans: Stem Tendrils- cucumber

Stem Thorns- e.g., Citrus

2- **Give a diagrammatic representation system of different regions of root in flowering plants and label its four parts.**

Ans: Figure 5.3, page, 67, NCERT

3- **Mention the origin point of prop root, stilt roots and give a brief suitable example of each.**

Ans: Prop: Hanging root, support, e.g.- Banyan (Ficus benghalensis)

Stilt: From the lower node, support e.g. – Maize

4- **Explain the main parts of the photosynthetic organ of a plant.**

Ans: The leaf consists of three main parts-leaf base, petiole, and lamina, Leaf base: The leaf is attached to the stem by the leaf base, Petiole: The petiole help hold the blade to light, Lamina: It is the green expanded part of the leaf with veins and veinlets.

5- **What are two layers of a seed coat?**

Ans: Seed coat two layers, the outer testa and the inner tegmen.

6- **Write the location and importance of the aleurone layer.**

Ans: The outer covering of the endosperm separates the embryo by a proteinous layer called the aleuronic layer.

7- **Rahul's father asked him one day in the garden if all roses are of the same type while sunflowers are of different types. Rahul, who was a student of biology, answered all the questions correctly.**

i- How do the stamen of China rose, pea, and citrus differ from each other?

ii- Differentiate actinomorphic and zygomorphic flowers by citing suitable examples.

iii- How can you differentiate a pinnately and a palmately compound leaf?

iv- What are cymose and racemose types of inflorescence?

Ans: i- China rose- Monadelphous, pea- diadelphous, citrus- polyadelphous

Ii- Actinomorphic: the flower can be divided into two equal radial halves in any radial plane passing through the center. e.g., mustard

Zygomorphic: the flower can be divided into two similar halves only in one particular vertical plane. e.g., pea

iii- Pinnately Compound Leaf- The midrib of the leaves is present on a common axis called the rachis.

Palmately Compound Leaf- Leaflets are attached at the tip of the petiole.

iv- Ans: Racemose: The main axis continues to grow; the flowers are borne laterally in acropetal succession.

Cymose: The main axis terminates in a flower, hence is limited in growth. The flowers are borne in a basipetal order

Long Answer Type Questions

1- **Explain the floral, characteristics of Solanaceae.**

Ans: Inflorescence: Solitary, axillary or cymose as in Solanum

Flower: bisexual, actinomorphic

Calyx: sepals five, united, persistent, valvate aestivation

Corolla: petals five, united; valvate aestivation

Androecium: stamens five, epipetalous

Gynoecium: bi-carpellary, syncarpous; ovary superior, bilocular, with many ovules

Fruits: berry or capsule

Seeds: many, endospermous

2- **Explain different types of placentation of flowering plants.**

Ans:

Marginal: The placenta forms a ridge along the ventral suture of the ovary and the ovules are borne on this ridge forming two rows, as in a pea.

Axile: When the placenta is axial and the ovules are attached to it in a multilocular ovary. E.g. China rose, tomato, and lemon.

Parietal: Ovules develop on the inner wall of the ovary or on the peripheral part. e.g., mustard and Argemone.

Free central: Ovules are borne on a central axis and septa are absent, e.g., Dianthus and Primrose the placentation is called free central.

Basal: The placenta develops at the base of the ovary and a single ovule is attached to it. e.g., sunflower, marigold.

3- **Give a detailed account on the structure of seeds of the monocot and dicot plants.**

Ans: the seed is developed from fertilized and mature ovules. It is composed of the outermost covering; the seed coat and an embryo.

The embryo contains a radicle (origin center for root) , an embryonal axis and cotyledons.

At the two ends of the embryonal axis are present the radicle and the plumule (shoot arises from plumule). The plumule and radicle are enclosed in sheaths which are called coleoptile and coleorhiza respectively.

Seeds may be endospermic (in which endosperm persists like in castor) or non-endospermic (bean, gram and pea, the endosperm is not present in mature seeds).

Dicotyledons have two cotyledons while monocots have one cotyledon (Scutellum).

4- Describe the male reproductive part in flowering plants.

Ans: male reproductive part is the androecium. It is composed of stamens. Each stamen consists of a filament and an anther.

The anther is usually bilobed with two chambers (pollen sac) in each lobe. The pollen grains are produced in pollen-sacs.

The stamens in a flower may either remain free (polyandrous) or maybe in the following forms-

- united into one bunch or one bundle (Monadelphous) as in China rose
- two bundles (diadelphous) as in pea
- More than two bundles (polyadelphous) as in citrus.

5- Briefly describe the various types of aestivations observed in Corolla.

Ans: Valvate: When sepals or petals in a whorl just touch one another at the margin, without overlapping, as in Calotropis

Twisted: If one margin of the appendage overlaps that of the next one and so on e.g.- china rose, lady's finger and cotton

Imbricate: If the margins of sepals or petals overlap one another but not in any particular direction. Eg Cassia and Gulmohur

Vexillary: In pea and bean flowers, there are five petals, the largest (standard) overlaps the two lateral petals (wings) which in turn overlap the two smallest anterior petals (keel); this type of aestivation is known as vexillary or papilionaceous

CHAPTER-6
ANATOMY OF FLOWERING PLANTS

THE TISSUES

- A tissue is a group of cells having a common origin and usually performing a common function.
- Meristem: The meristem is a type of tissue in plants that consists of undifferentiated cells capable of cell division.
- Meristematic Tissues are those tissues that are capable of active cell division.

THE TISSUE SYSTEM

A group of tissues performing a similar function, irrespective of its position in the plant body, is called a tissue system.

1- **Epidermal tissue system**
2- **Ground tissue system**
3- **Vascular tissue system**

Epidermal Tissue System

outer-most covering
comprises epidermal cells, stomata and the epidermal appendages – the trichomes and hairs.
made up of elongated, compactly arranged parenchymatous cells
Epidermis is usually single-layered
Cuticle is present on the outer surface which prevents the loss of water. It is absent in roots.
Stomatal pores are surrounded by two guard cells that enclose stomatal pores. ·The guard cells possess chloroplasts and regulate the opening and closing of stomata.
Sometimes specialized epidermal cells subsidiary cells) are present close to guard cell
The cells of epidermis bear a number of hairs.
Stomatal apparatus- The stomatal aperture, guard cells and subsidiary cells
Root hairs are unicellular while stem hairs (trichomes) are multicellular.
Root hairs absorb water and minerals from the soil.
The trichomes help in preventing water loss due to transpiration.

Ground Tissue System

consists of simple tissues (parenchyma, collenchyma and sclerenchyma).
form cortex, pericycle, pith
Mesophyll of leaves is a chlorophyll containing ground tissue
Parenchymatous- present in cortex, pericycle, pith and medullary rays, in the primary stems and roots.

Vascular Tissue System (Xylem + Phloem)

contains vascular bundle stem (Xylem + Phloem)

In dicotyledonous stems, cambium is present between phloem and xylem.

Open vascular bundle

cambium possess and have ability to form secondary xylem and phloem tissues. E.g. Dicotyledons

Close vascular bundle

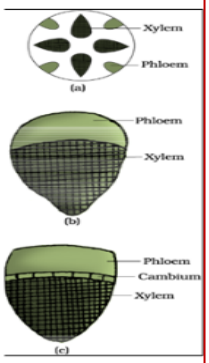
cambium is not present and can't form secondary tissues. E.g. monocotyledons

Radial vascular bundle

Xylem and phloem are arranged in an alternate manner. E.g. roots

Conjoint vascular bundle

The xylem and phloem are along the same radius of vascular bundles. e.g. Stems and leaves.



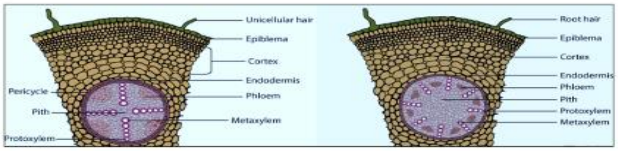
Dicotyledonous Root and Monocot root

Dicot Root

outermost layer is epiblema (form of root hairs)
Innermost layer in endodermis
Some endodermis cells form Caspian strips
Pericycle is parenchymatous
Pith is small or inconspicuous
Conjuctive tissue- The parenchymatous cells between the xylem and the phloem
two to four xylem and phloem patches
Cambium ring
Secondary growth occurs

Monocot Root

epidermis, cortex, endodermis, pericycle, vascular bundles and pith
Pith is large
more xylem and phloem
Cambium absent
No Secondary growth
xylem is polyarch type (usually more than six xylem bundles)



Stele- pericycle, vascular bundles and pith

Dicotyledonous Stem and Monocot Stem

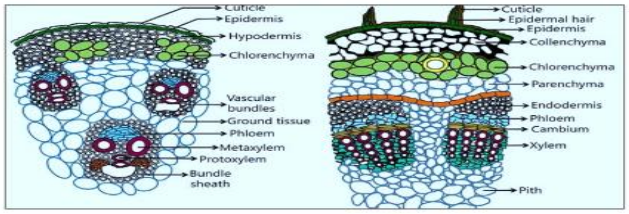
Dicot Stem

Ouetrmost epidermis may bear trichomes and few stomata
Cortex - multilayered
Pericycle: situated on the inner side of the endodermis.
Medullary ray: In between the vascular bundles
Vascular bundle - conjoint, open, with endarch protoxylem.
Pith: situated in the center and parenchymatous.

Monocot Stem

Hypodermis is sclerenchymatous
Vascular bundles are scattered, conjoint and closed, bundles are scattered, conjoint and closed
phloem parenchyma is absent.

Cortex- outer hypodermis (collenchymatous), rounded thin-walled parenchymatous cell layer, and innermost endodermis (starch sheath).



Dorsiventral (Dicotyledonous) Leaf and Isobilateral (Monocotyledonous)

Dicot Leaf

Dorsiventral

Epidermis: outermost, covers both the upper surface (adaxial epidermis) and lower surface (abaxial epidermis) and has cuticle.

More stomata are present on the abaxial epidermis

Mesophyll: between the upper and the lower epidermis. It is parenchymatous (palisade and spongy types) and contains chloroplasts

Vascular bundles: these are surrounded by a layer of thick-walled bundle sheath cells.

Monocot Leaf

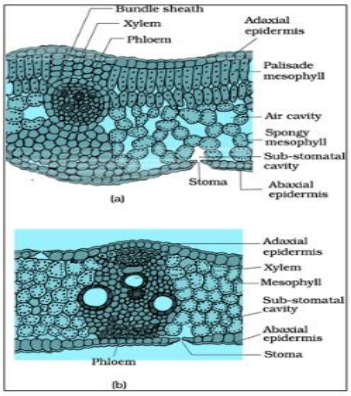
Isobilateral

similar to dicot leaves except

stomata are present on both surfaces of the epidermis

Bulliform cells present

mesophyll is not differentiated into palisade and spongy parenchyma



IMPORTANT QUESTIONS

Very Short Answer Type Questions

1- Identify the meristem on which axillary buds are present-

a- Shoot apical meristem

b- Lateral meristem

c- Root apical meristem

d- Both a and b

Ans: a

2- Apical and intercalary meristems are-

a- Primary meristem

b- Secondary meristem

c- Tertiary meristem

d- Amersitem

Ans: a

3- Trichomes are-

a- A type of root hair

b- A epidermal hair on the stem

c- Cells around the stomata

d- Waxy layer near the pericycle

Ans: b

4- Green pigment-containing parenchyma cells are known as-

a. Sclerenchyma

b. Chlorenchyma

c. Medullary ray

d. Collenchyma

Ans: b

5- Cambium is the feature of-

a- Closed vascular bundle
b- Open vascular bundle
c- Both a and b
d- None of these

Ans: b

6- In which types of leaves stomata are present on the lower side-

a- Isobilateral
b- Aquatic plants
c- Dorsiventral
d- Desert plants

And: c

7- The Casparian rings are present in

a. Endodermis
b. Cortex
c. Xylem
d. Phloem

Ans: a

8- Assertion: Some plants show secondary growth while others do not

Reason: The vascular bundle having cambium shows secondary growth.

a- Both Assertion (A) and Reason (R) are true and Reason (R) is a correct explanation of Assertion (A).
b- Both Assertion (A) and Reason (R) are true but Reason (R) is not a correct explanation of Assertion (A).
c- Assertion (A) is true and Reason (R) is false.
d- Assertion (A) is false and Reason (R) is true.

Ans: a

9- The phloem formed from vascular cambium is known as

a. Secondary phloem
b. Tracheids
c. meta phloem
b. None of these

Ans: a

10- Assertion: The permanent tissue is derived from meristematic tissues.

Reason: leaves arise from axillary buds present in permanent tissues.

a- Both Assertion (A) and Reason (R) are true and Reason (R) is a correct explanation of Assertion
b- Both Assertion (A) and Reason (R) are true but Reason (R) is not a correct explanation of Assertion (A).
c- Assertion (A) is true and Reason (R) is false.
d- Assertion (A) is false and Reason (R) is true.

Ans: c

Short Answer Type Questions

1- **How does Palm increase in girth despite being a monocotyledonous plant?**
Ans: The parenchymatous cells in the ground tissue enlarge and divide. Thus, due to repeated division, the girth of the stem increases.

2- **What is epiblema? Also, write its significance.**
Ans: in the dicot root the outermost layer is epiblema. Many of the cells of epiblema protrude in the form of unicellular root hairs.

3- **Write the significance of guard cells.**
Ans: facilitating the gaseous exchange and controlling transpiration in plants by regulating the opening and closing of stomata.

4- **Where the cambial ring develops. Write its role.**
Ans: Cambial rings develop in between the xylem and phloem of the dicot stem.
These rings are responsible for secondary growth.

5- **How do vascular bundles of monocot and dicot stem differ?**
An: Vascular bundles in the monocot stem are conjoint and closed.
In the dicot stem, vascular bundles are conjoint and open.

6- **Identify the group of plants on the basis of the following observations-**
a- Vascular bundles are arranged in rings
b- Vascular bundles are scattered.
c- Medullary rays are present.
d- Pith is absent
Ans: a,b – Dicot stem , b and d Monocot stem

7- **What are the differences between lenticels and stomata?**
Ans: Stomata: Minute pores found on the epidermis of the leaves.
Lenticels: Pores present on the stem

8- **How can you differentiate monocot root and dicot root on the basis of xylem?**
Ans: in dicot root fewer xylem bundles are present while in monocots more than six (polyarch) xylem bundles are present.

9- **Write characteristic features of root and stem epidermal origin hairs.**
Ans: The root hairs are unicellular elongations of the epidermal cells while stem hairs are multicellular.

10- **How Caspian strips are formed? Where these are observed?**
Ans: The tangential as well as radial walls of the endodermal cells have a deposition of water-impermeable, waxy material suberin in the form of Casparian strips. These are common in dicot root.

11- **Explain the bulliform cells and their importance.**
Ans: In grasses, certain adaxial epidermal cells along the veins modify themselves into large, empty, colorless cells. These are called bulliform cells. When the bulliform cells in the leaves have absorbed water and are turgid, the leaf surface is exposed. When they are flaccid due to water stress, they make the leaves curl inwards to minimize water loss.

11- **What are medullary rays and where these are present?**

Ans: In between the vascular bundles there are a few layers of radially placed parenchymatous cells, which constitute medullary rays. These are present in the dicot stem.

12- Define conjunctive tissue.

Ans: The parenchymatous cells which lie between the xylem and the phloem are called conjunctive tissue.

Long Answer Type Questions

1- Describe various types of vascular systems observed in flowering plants.

Ans: The vascular system consists of complex tissues, the phloem and the xylem.
The xylem and phloem together constitute vascular bundles.
Cambium is present in between the xylem and phloem of dicotyledonous stems.
On the basis of cambium the vascular bundles may be-
Open type: cambium is present
Closed type: cambium is absent e.g. in monocot.
On the basis of the arrangement of the xylem and phloem the vascular bundles may be-
Radial: xylem and phloem are arranged in an alternate manner along the different radii. E.g.- roots.
Conjoint: xylem and phloem are jointly situated along the same radius of vascular bundles. E.g. - stems and leaves. In these, the phloem is located only on the outer side of the xylem.

2- Explain the following about stomata-

(i) Origin of stomata
(ii) Regulation of opening and closing of stomata
(iii) **Structure of stomata**

Ans: (i) Stomata are present in the epidermis layer of leaves
(ii) The guard cells possess chloroplasts and regulate the opening and closing of stomata. When guard cells are in the flaccid condition the stomatal pore is closed and when turgid the pores are open.
(iii)Each stoma is composed of two bean-shaped cells known as guard cells which enclose the stomatal pore. The outer walls of guard cells (away from the stomatal pore) are thin and the inner walls (towards the stomatal pore) are highly thickened. Sometimes, a few epidermal Cells, in the vicinity of the guard cells, become specialized in their shape and size and are known as subsidiary cells. The stomatal aperture, guard cells, and the surrounding subsidiary cells are together called stomatal apparatus.

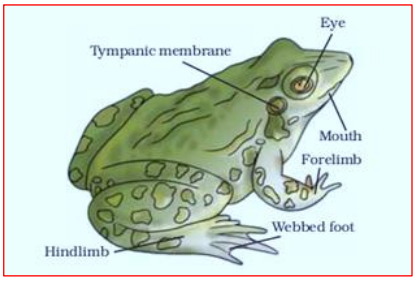
3- Diagrammatically compare the anatomy of a Dicot root and b Monocot root.

Ans: Figure 6.6, Page 91, NCERT

CHAPTER-7
STRUCTURAL ORGANISATION IN ANIMALS

FROGS

Phylum – Chordata
Subphylum – Gnathostomata
Superclass- Tetrapoda
Class- Amphibia
Order- Anura
Genus- Rana
Species- tigrina



Cold-blooded or poikilotherms
Ability of Camouflage
Shows summer sleep (aestivation) and winter sleep (hibernation)
Amphibian (both in water and land)

MORPHOLOGY

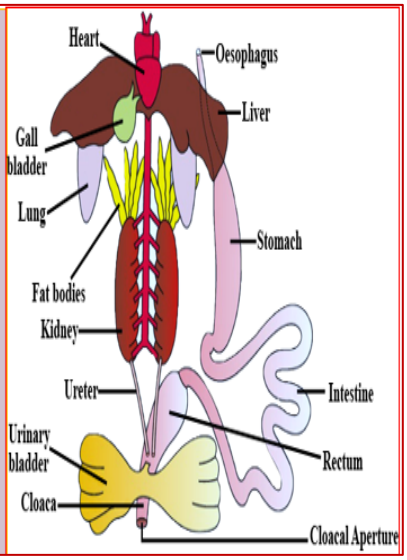
- Skin: moist, smooth with mucus.
- Body- triangular head and trunk.
- Mouth: with upper and lower jaws.
- Nostrils: A pair
- Eyes: with nictitating membrane.
- Tympanum: hearing organ , Pinna is absent.
- The forelimbs (have 4 digits) and larger hind limbs (have 5 digits)
- In males copulatory pad is present on the first digit of the forelimbs
- Frogs exhibit sexual dimorphism (males are smaller and darker)

ANATOMY

- Body cavity: accommodate

Digestive system

- Alimentary canal + digestive glands.
- Alimentary canal: short
- Mouth opens into the buccal cavity that leads to the esophagus through the pharynx.
- Food is captured by the bilobed tongue.
- Oesophagus: A short tube that opens into the stomach
- Stomach continues in the intestine, and rectum and finally opens outside by the cloaca.
- Stomach has gastric glands which secrete digestive juice and HCL.
- Liver: It secretes bile that is stored in the gall bladder.
- Pancreas: it secretes pancreatic juice.



Digestion of food

- The HCl and gastric juices digest food in the stomach.
- In the small intestine the duodenum receives bile from the gall bladder and pancreatic juices from the pancreas through a common bile duct.
- Bile emulsifies fat and pancreatic juices digest carbohydrates and proteins.
- Digested food is absorbed by the numerous villi and microvilli in the intestine.
- The undigested solid waste moves into the rectum and passes out through the cloaca.

Respiration

Cutaneous respiration: In water, the skin acts as an aquatic respiratory organ. Dissolved oxygen in the water is exchanged through the skin by diffusion.

Pulmonary respiration: through the lungs

During aestivation and hibernation gaseous exchange takes place through skin.

Pair of lungs is a thoracic region (upper part of the trunk).

Vascular System

- closed type.
- Heart is three-chambered- two atria and one ventricle.
- Heart is covered by a membrane called pericardium.
- A triangular structure called sinus venosus joins the right atrium.
- It receives blood through the major veins called the vena cava.
- The ventricle opens into a saclike conus arteriosus on the ventral side of the heart.
- The blood from the heart is carried to all parts of the body by the arteries (arterial system).
- The veins collect blood from different parts of the body to the heart and form the venous system.
- Hepatic portal system and renal portal system are present between the liver and intestine, kidney and lower parts of the body respectively

Blood

- It is composed of plasma and cells (RBS, WBC, Platelets).
- RBC- nucleated and contains hemoglobin.
- Role of blood: carries nutrients, gases and water to the respective sites during circulation.

Excretory system

- Frog is a ureotelic animal.
- It consists of a pair of kidneys, ureters, cloaca and urinary bladder.
- Kidney is composed of structural and functional units called uriniferous tubules or nephrons.

- In males the ureters act as a urinogenital duct which opens into the cloaca.
- In females the ureters and oviduct open separately in the cloaca.
- The system for control and coordination is highly evolved in the frog. It includes both the neural system and endocrine glands.

The chemical coordination

- It is carried out by hormones which are secreted by the endocrine glands. E.g. pituitary, thyroid, parathyroid, thymus, pineal body, pancreatic islets, adrenals and gonads.

The nervous system

- It consists of CNS + PNS + ANS
- Brain- fore-brain, mid-brain, and hind-brain.
- Forebrain- olfactory lobes, paired cerebral hemispheres and unpaired diencephalon.
- Midbrain- It has a pair of optic lobes.
- Hind-brain- It consists of the cerebellum + medulla oblongata.
- The medulla oblongata passes out through the foramen magnum and continues into the spinal cord.
- Spinal cord is enclosed in the vertebral column.
- There are ten pairs of cranial nerves arising from the brain.

Sensory organs

- Main sense organs are for touch (sensory papillae), taste (taste buds), smell (nasal epithelium), vision (eyes) and hearing (tympanum)
- Eyes in a frog are a pair of spherical structures situated in the orbit in the skull. These are simple eyes (possessing only one unit).
- Ear is an organ of hearing as well as balancing (equilibrium).

Reproductive system

- Both sexes are separate

Male reproductive system

Testes → 10-12 vasa efferentia → open into Bidder's canal → cloaca

A testis is found adhered to the upper part of the kidneys by a double fold of peritoneum called mesorchium.

The cloaca is a small, median chamber that is used to pass fecal matter, urine and sperm to the exterior

Female reproductive system

- It includes a pair of ovaries.
- A pair of oviducts arising from the ovaries opens into the cloaca separately.
- A mature female can lay 2500 to 3000 ova at a time.

Fertilization

- It is external and takes place in water.
- Development
- Development is indirect and involves a larval stage called tadpole.
- Tadpole undergoes metamorphosis to form an adult.

IMPORTANT QUESTIONS

Very Short Answer Types Questions

1- Cloaca is an organ for-

a- Reproduction b- Excretion c- Both a and b d- Neither a nor b

Ans: serves as the exit cavity for the excretory, urinary and reproductive systems

2- Nutrient storage and metabolism in frogs take place in-

a- Fat bodies b- Cloaca c- both a and b d- neither a and b

Ans: a

3- Pair optic lobe is present in-

a- Fore brain b- Mid brain c- Hind brain d- none of these

Ans: b

4- No of cranial nerves present in frogs in-

a- 10 b- 20 c- 15 d- infinite

Ans: 10

5- Tympanum is-

a- For excretion b- For respiration c- For reproduction d- For the hearing

Ans: d

6- In the forelimb of a frog how many digits are present-

a- 2 b- 4 c- 6 d- 8

Ans: 4

7- On the basis of excretory product, the frogs are-

a- Ammoniotelic b- ureotelic c- Uricotelic d- none of these

Ans: b

8- How many ova are released at a time by a female frog?

Ans: 2500 to 3000

9- In frogs respiration occur by-

a- Skin b- Lungs c- both a and b d- only nostril

Ans: c

10- Assertion- Frog has a short alimentary canal.

Reason- Frogs are carnivores.

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is a correct explanation of Assertion (A).

(b) Both Assertion (A) and Reason (R) are true but Reason (R) is not a correct explanation of Assertion (A).

(c) Assertion (A) is true and Reason (R) is false.

(d) Assertion (A) is false and Reason (R) is true.

Ans: a

Short Answer Types Questions

1- In what parts body of a frog can be categorized? At which stage larvae are present in the frog life cycle?

Ans: the body is divisible in the head and trunk. The tail is present in the larval stage (tadpole).

2- **What are the functions of Muscular and Nervous tissue?**
Ans: Muscular tissues are involved in Locomotion and movement.
Nervous tissue plays an essential role in control and coordination.

3- **Explain the types of respiration that occur in frogs**.
Ans: Cutaneous respiration: The skin acts as an aquatic respiratory organ in water. Dissolved oxygen in the water is exchanged through the skin by diffusion.
Pulmonary respiration: In these lungs are involved.

4- **What is the difference between cutaneous and pulmonary respiration?**
Ans: Cutaneous – by the skin. In water dissolved oxygen in the water is exchanged through the skin by diffusion.
Pulmonary- By lungs

5- **How can you identify the male frog only by viewing the morphological features?**
Ans: the male frog has a copulatory pad on the first digit of the forelimbs and vocal sacs.

6- **Why are blood, bone and cartilage called connective tissue?**
Ans: Blood, bone and cartilage are called connective tissue because of their special function of linking and supporting other tissues/organs of the body.

7- **Name the phylum and class to which the frog belongs. Also, mention the scientific name frog which is very common in India.**
Ans: Phylum- Chordata, Class- Amphibia
Species: Rana tigrina

8- **(i) Name the membrane which protects the eyes while the frog is in water.**
(ii) Mention the significance of webbed digits in frogs.
Ans: (i) Nictitating membrane
(ii) Helps in swimming

9- **Why do alimentary canals are short?**
Ans: The alimentary canal is short because frogs are carnivores and hence the length of the intestine is reduced.

10- **How many chambers are present in the heart?**
Ans: three-chambered heart with three chambers, two atria, and one ventricle

Long Answer Types Questions

1- **Answer the following related to the digestive system of frogs-**
(i) Where is bile stored in the body of a frog?
(ii) Which organ helps in catching the prey?
(iii) Draw the digestive system of a frog.
Ans: (i) Bile is stored in the gall bladder in frogs.
(ii)Tongue
(iii)Fig- 7.20 Page 117, NCERT

2- **Describe the control and coordination system in frogs.**
Ans: The nervous system consists of the CNS 9brain + spinal cord) and PNS (cranial and spinal nerves).

10 pairs of cranial nerves emerge out of the brain.

The spinal cord is enclosed in the vertebral column.

Different sense organs are sensory papillae, taste buds, eyes, tympanum etc.

The eyes in a frog are a pair of spherical structures situated in the orbit in the skull.

These are simple eyes (possessing only one unit).

3- Give a detailed account of the male reproductive system of frogs.

Ans: It consists of a pair of testes.

A testis is found attached to the upper part of the kidneys with the help of mesorchium. 10-12 Vasa efferentia arise from each

testis. They enter the kidneys on both side and open into the bidder's canal. Finally, it communicates with the urinogenital duct that comes out of kidneys and opens into the cloaca

Chapter-8
Cell-The Unit of Life

- A cell is the smallest, basic unit of life that is responsible for all of life's processes.

Anton Von Leeuwenhoek	**first saw and described a live cell**
Robert Hooke (1662)	Coined the term cell
Rudolf Virchow (1855)	cells divided and new cells are formed from pre-existing cells (Omnis cellula-e cellula)
Schleiden and Schwann	Proposed cell theory

Rudolf Virchow modified cell theory as

(i) All living organisms are composed of cells and products of cells. (ii) all cells arise from pre-existing cells.

(ii) All organisms are made up of cells.

(Viruses, viroids and prions are the exceptions to the cell theory.)

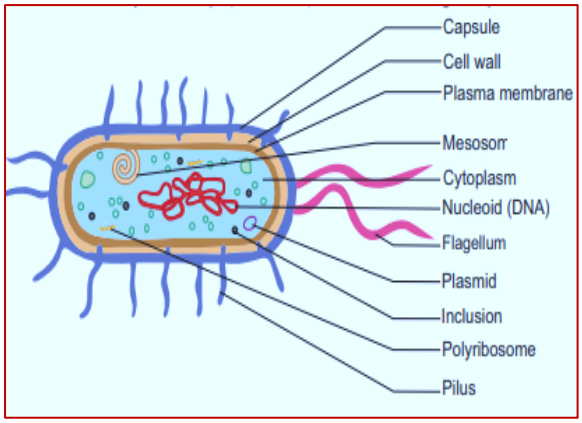
Comparison between types of cells

S. No	Plant cell	Animal Cell
1	Usually they are larger than animal cells	Usually smaller than plant cells
2	Cell wall present in addition to plasma membrane and consists of middle lamellae, primary and secondary walls	Cell wall absent
3	Plasmodesmata present	Plasmodesmata absent
4	Chloroplast present	Chloroplast absent
5	Vacuole large and permanent	Vacuole small and temporary
6	Tonoplast present around vacuole	Tonoplast absent
7	Centrioles absent except motile cells of lower plants	Centrioles present
8	Nucleus present along the periphery of the cell	Nucleus at the centre of the cell
9	Lysosomes are rare	Lysosomes present
10	Storage material is starch grains	Storage material is a glycogen granules

PROKARYOTIC CELLS

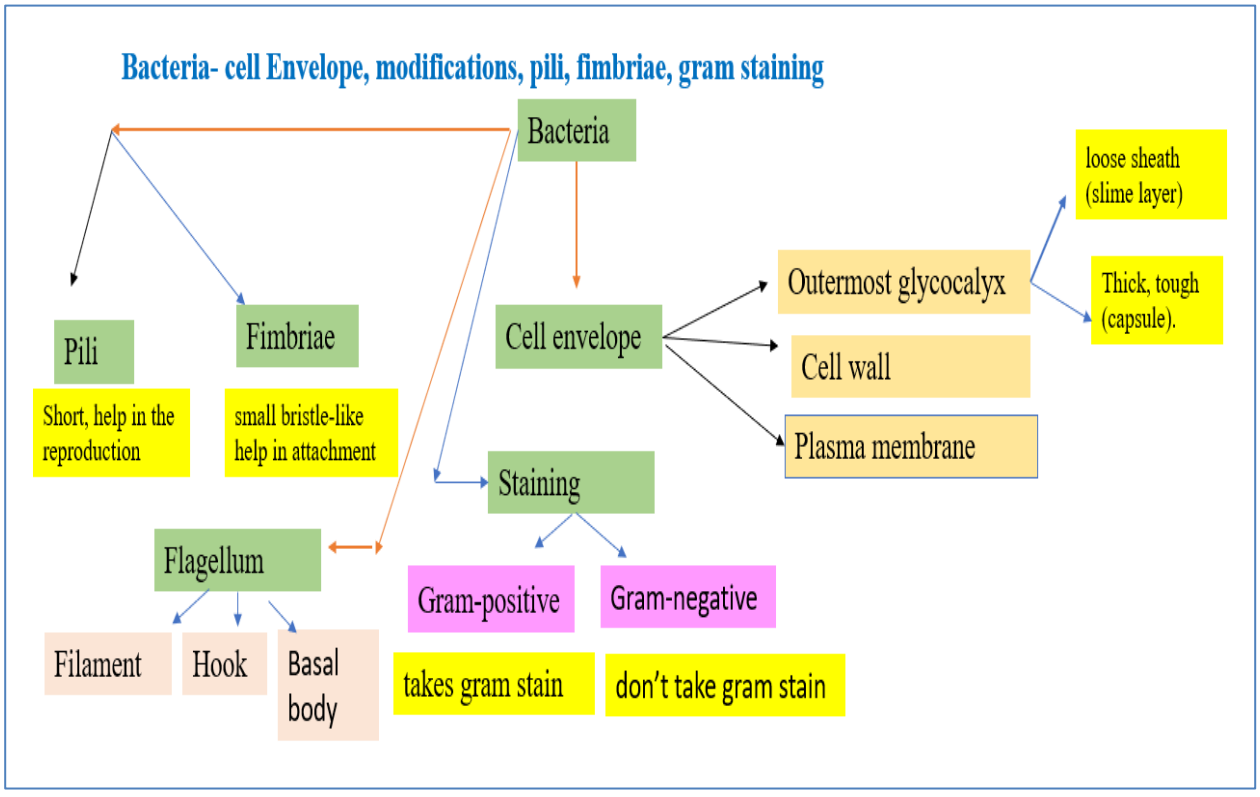
- Shapes of bacteria-

Bacillus	Rod shape
Coccus	Spherical
Vibrio	Comma shapes
Spirillum	Spiral shape



- All prokaryotes have a cell wall except in mycoplasma.
- Nuclear membrane is absent (well-defined nucleus).
- Some bacteria contain extrachromosomal circular DNA (plasmid). The plasmid DNA shows specific properties like resistance to antibiotics.
- Double membrane cell organelles like endoplasmic reticulum, Golgi body, and mitochondria are absent.
- Ribosome is of 70 S types. The subunits are 50 S and 30 S.
- The unfolding of plasma membranes called mesosomes. They help in cell wall formation, DNA replication, respiration, secretion processes etc.
- Pigment containing chromatophores are present in a few bacteria like cyanobacteria.
- Motile form has flagella.

  Examples: Bacteria, blue-green algae, mycoplasma and PPLO (Pleuro Pneumonia Like Organisms).



Ribosomes and Inclusion Bodies

- 70 S type: subunits - 50S and 30S
- Ribosomes are the site of protein synthesis.
- Polyribosomes or Polysome: Several ribosomes attach to a single mRNA.

Inclusion bodies:

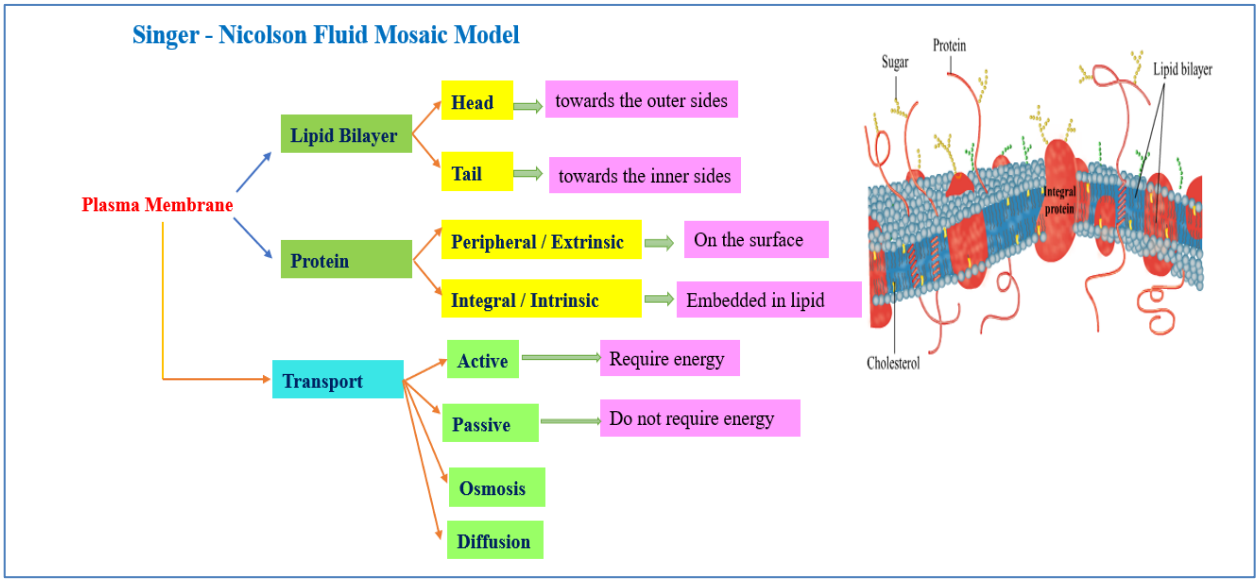
- These are reserve food materials. These lie free in the cytoplasm, e.g., phosphate granules, cyanophycean granules and glycogen granules.

- Gas vacuoles are found in blue green and purple and green photosynthetic bacteria.

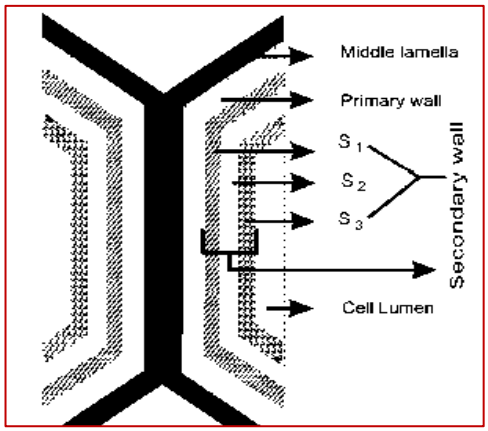
EUKARYOTIC CELLS

Cell Membrane/ plasma membrane

- It is a thin structure that holds the cytoplasmic content (cytoplasm).
- The membrane is selectively permeable.
- Cell membrane perform various functions like cell signaling, transporting nutrients and water, preventing unwanted substances from entering into the cell etc.



Cell Wall



- Cell wall forms an outer covering for the plasma membrane in plants, fungus and bacteria.
  Plant cell wall: cellulose, pectin, hemicellulose
  Alga: cellulose, galactans, mannans
  Bacteria cell wall: peptidoglycan layer
  Fungus cell wall: chitin
- It is a non-living and rigid structure.
- Cell wall is the outermost protective cover of the cell.
- In plants, cell wall shows three distinct regions (a) Primary wall (b) Secondary wall (c) Middle lamellae
- Middle lamella is made up of calcium and magnesium pectate
- Plasmodesmata: a cytoplasmic thread that acts as a channel between the protoplasm of adjacent cells through which many substances pass through.

Function: cell wall gives shape to the cell, protects the cell from mechanical damage and infection, helps in cell-to-cell interaction and provides a barrier to undesirable macromolecules.

Endomembrane System

Membranous organelles whose functions are coordinated are called as endomembrane systems e.g. endoplasmic reticulum (ER), Golgi complex, lysosomes and vacuoles

Endomembrane System

Endoplasmic Reticulum

- reticulum of tiny tubular structures
- scattered in the cytoplasm
- Associated with the nuclear membrane and cell surface membrane.
- Gives mechanical support to cell.

Rough	Smooth
Contain Ribosome	No Ribosome
Help in the Protein synthesis	Help in the synthesis of lipid and lipid-like steroidal hormones.

Golgi Body

- Flat, disc-shaped sacs or cisternae stacked parallel to each other
- It helps in packaging materials, formation of glycoproteins and glycolipids, transporting and storing of lipids, formation of lysosomes, production of digestive enzymes, Cell plate and cell wall formation, etc.

Cis Face	Trans face
convex / forming face	concave / maturing face

The cis and the Trans faces are interconnected

Lysosome/ Suicida Bag

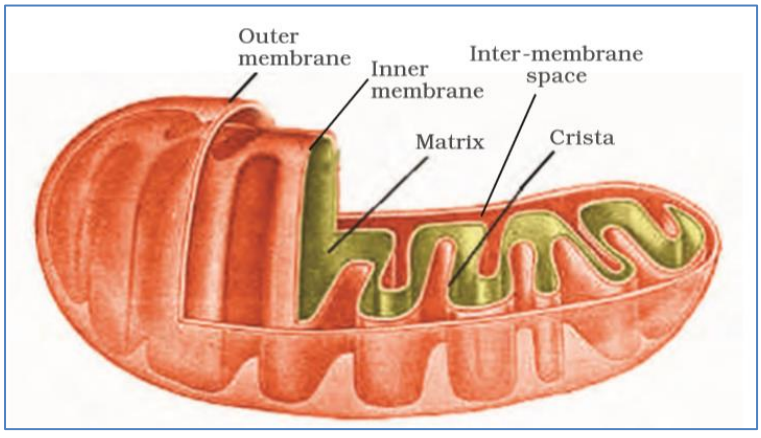
- These are formed from Golgi apparatus.
- Lysosomes are rich in hydrolytic enzymes (hydrolases – lipases, proteases, carbohydrases) optimally active at the acidic pH.

Vacuole

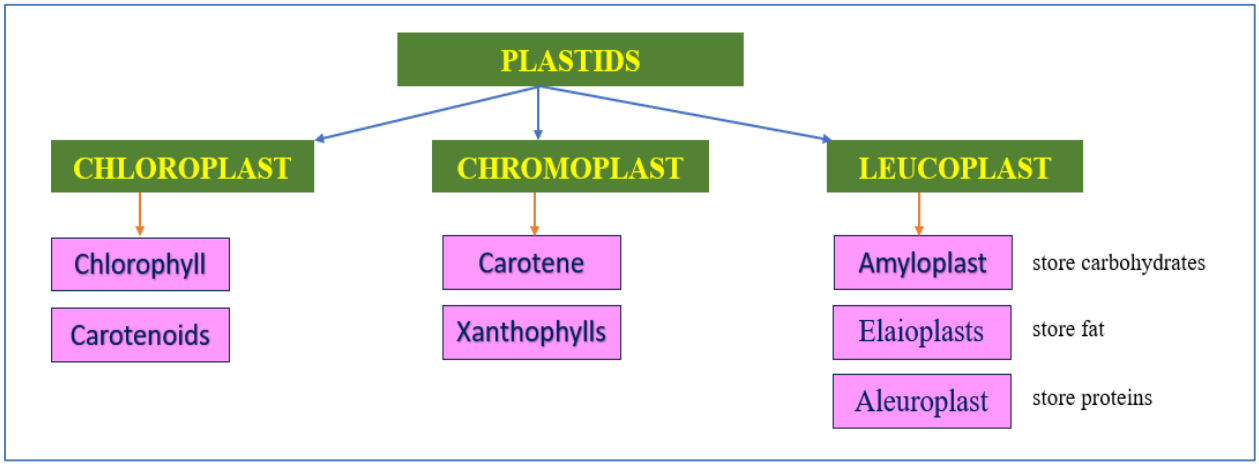
- Bounded by single layer of membrane (tonoplast)
- It contains water, sap, excretory product and other materials.
- In Amoeba the contractile vacuole helps in osmoregulation & excretion.
- In protists, food vacuoles are formed by engulfing the food particles

Mitochondria

- It has double membrane; outer and inner.
- The inner membrane forms a number of Infoldings called the cristae and it encloses mitochondrial matrix.
- Inner membrane consists of F1 particles (Fernandez Moran particles)/ Oxysomes.
- Mitochondria are the sites of aerobic respiration and ATP production; therefore, it is called as Power house of a cell.
- The mitochondrial matrix also possesses single circular DNA molecule, a few RNA molecules, ribosomes (70S) and the components required for the synthesis of proteins.
- The mitochondria divide by fission.

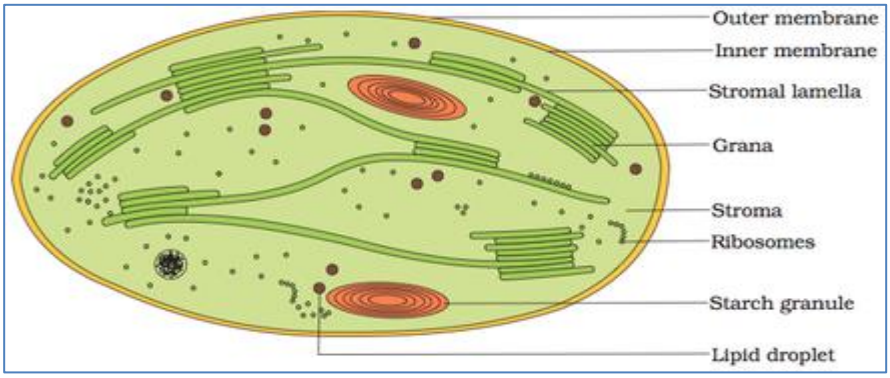


Plastids



Chloroplast

- Mostly present in the mesophyll cells of the leaves.
- Shape: lens-shaped, oval, spherical, discoid, ribbon-like
- Size: length (5-10µm) and width (2-4µm)
- Number: 1 per cell (Chlamydomonas) to 20-40 (mesophyll)
- It is a double membrane-bound. The inner membrane encloses the stroma
- In stroma flattened membranous sacs (thylakoids) are present. These are arranged in stacks called grana
- Some flat membranous tubules (stroma lamellae) are also present which connect the thylakoids of the different grana.
- The stroma contains double-stranded circular DNA, 70 S ribosomes and enzymes required for the synthesis of carbohydrates and proteins.
  Functions: chloroplast is involved in Photosynthesis (Light reactions take place in granum, Dark reactions take place in stroma) and photorespiration.



Ribosomes

- First observed by George Palade (1953).
- They are composed of ribonucleic acid (RNA) and proteins.

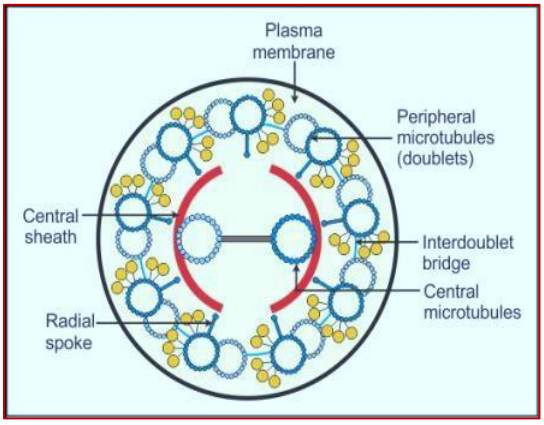
- Ribosomes are not surrounded by any membrane.
- Eukaryotic ribosomes: 80S (60 S and 40 s)
- Prokaryotic ribosomes: 70S (50 S and 30 s)
- 'S': Svedberg's Unit/ sedimentation coefficient
- Ribosomes are the sites of protein synthesis in the cell.

Cytoskeleton

- It consists of a network of filamentous proteinaceous structures like microtubules, microfilaments and intermediate filaments present in the cytoplasm.
- Function: mechanical support, motility, and maintenance of the shape of the cell.

Cilia and Flagella

- Cilia and flagella are hair-like outgrowths of the cell membrane. Both emerge from centriole-like structures called basal bodies.
- Flagella are longer than cilia. They are covered with plasma membranes.
- The core (axoneme), contains microtubules in a 9 + 2 array (nine doublets of radially arranged peripheral microtubules and a pair of centrally located microtubules).
- The central tubules are connected by bridges and are also enclosed by a central sheath, which is connected to one of the tubules of each peripheral doublet by a radial spoke.
- There are nine radial spokes.
- The peripheral doublets are also interconnected by linkers.



Centrosome and Centrioles

- Centrosome is formed of two centrioles. Both the centrioles lie perpendicular to each other.
- Centrioles consist of nine triplet peripheral fibrils made up of tubulin.
- The central part of the centriole is called a hub, is connected to the tubules of the peripheral triplets by radial spokes (9+0 pattern).
- The centriole forms the basal body of cilia or flagella and spindle fibers which forms the spindle apparatus in animal.

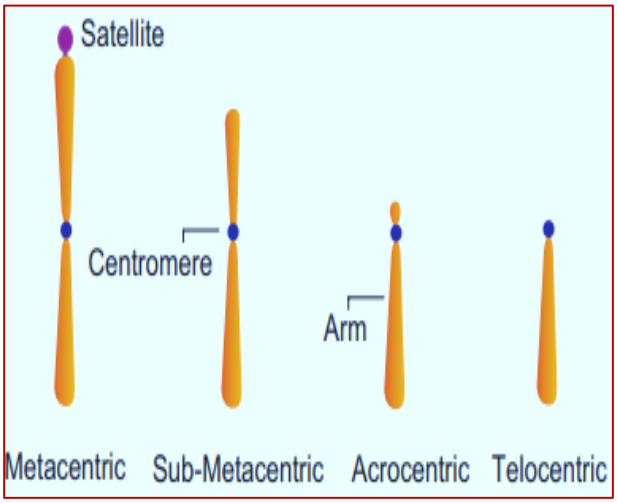
- Centrioles are present in animal cells.

Nucleus

- Nucleus is an important unit of cell that controls all activities of the cell.
- In eukaryotic cell it is surrounded by a double membranous nuclear envelope.
- The inner membrane is smooth while the outer membrane is rough due to the presence of ribosomes.
- The outer membrane is the continued endoplasmic reticulum.
- Some nuclear pores are present in the membrane which allows the movement of mRNA, proteins etc.
- Nuclear membrane encloses nucleoplasm, chromatin (nucleoprotein fibers) and nucleolus.
- Chromatin contains DNA and some basic proteins (histones), non-histone proteins, and RNA.
- In nucleolus ribosomal RNA synthesis occurs.
- Nucleus as a cell organelle was first described by Robert Brown as early as 1831. Later the material of the nucleus stained by the basic dyes was given the name chromatin by Flemming.

Chromosome

- The chromosomes are composed of thread-like strands called chromatin
- In humans forty six (23 pairs) of chromosomes are present.
- Each chromosome consists of two symmetrical structures called chromatids.
- Chromosome has narrow zones called constrictions; primary constriction and secondary constriction.
- On the sides of constrictions disc shaped kinetochores are present.



Based on the position of the centromere, the chromosomes can be classified into four types-

- Metacentric: centromere in the middle
- Sub-metacentric: centromere slightly away from the middle
- Acrocentric: Centromere close to its end
- Telocentric: terminal centromere.

❖ Satellite: Few chromosomes have non-staining secondary constrictions at a constant location. This gives the appearance of a small fragment called the satellite.

Microbodies -Many membrane-bound minute vesicles called microbodies that contain various enzymes are present in both plant and animal cells.

IMPORTANT QUESTIONS

Very Short Answer Questions

1- Expand PPLOs-

a- Pleuro polysome-like organism

b- Pleuro Pneumonia like Organisms

c- Polymorphic Pneumonia like Organisms

d- All are incorrect

Ans: b

2- From which category of cell PPLO belong?

a- Prokaryotes

b- Eukaryotes

c- Viruses

d- Mangifera indica

Ans: a

3- Cytoplasmic threads which connect the cytoplasm of the neighboring cells are named as-

a- cell wall

b- plasma membrane

c- middle lamella

d- plasmodesmata

ans: d

4- What is true about Plasmids-

a- Extrachromosomal

b- Circular

c- Genetic material

d- All are correct

Ans: d

5- Which structure in bacteria performs the same function as mitochondria in plant cells-

a- Plasmid

b- Mesosomes

c- Glycocalyx

d- Peptidoglycan

Ans: c

6- Assertion: Specialization of cells is useful for organisms.

Reason: It increases the operational efficiency of an organism.

(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(c) Assertion is true but Reason is false.
(d) Both Assertion and Reason are false.
Ans: a

7- **Assertion: The number of cells in a multicellular organism is inversely proportional to the size of organism.**
Reason: All the living cells of all species are of the same size.
(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is true but Reason is false.
(d) Both Assertion and Reason are false.
Ans: d

8- **Calcium pectate can be found in-**
a- Outer cell wall
b- Inner cell wall
c- Middle lamellae
d- Nucleus
Ans: c

9- **9+2 array arrangement in cilia and flagella represents-**
a- 9 peripheral and 2 central microtubules.
b- 2 peripheral and 9 central microtubules.
c- Two rows of 9 peripheral and 2 central microtubules.
d- All are incorrect
Ans: a

10- **Assertion: Ribosomes are non-membrane bound organelles found in the prokaryotic cells only.**
Reason: These are present only in the cytoplasm.
(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is true but Reason is false.
(d) Both Assertion and Reason are false.
Ans: d

Short Answer Questions

1- **What are the essential characteristics that make a cell the fundamental unit of life?**
Ans: Plasma membrane, Protoplasm, Genetic material, ribosomes etc.

2- **How do pili and fimbriae differ from each other?**
Ans: The pili are elongated and help reproduction.

The fimbriae are small bristle like fibres helps in attachment.

3- **Compare ribosomes of prokaryotic and eukaryotic cells.**
Ans: Eukaryotic cell ribosome: 80 S (60 S+ 40 S), Prokaryotic cell ribosome: 70 S (50 S + 30 S)

4- **Mention the difference between Cristae, Cisternae, and Thylakoids.**
Ans: Cristae- Infolding of inner membrane mitochondria. Cisternae- Disc-shaped sacs in Golgi apparatus, Thylakoids- Fat membranous sacs in the stroma of chloroplast.

5- **What is glycocalyx? Write its different forms**.
Ans: The outermost layer of cell envelope in bacteria is the glycocalyx. It could be a loose sheath called the slime layer in some; while in others it may be thick and tough, called the capsule.

6- **Some transport method across plasma membrane requires energy. Explain**
Ans: The movement across the membrane may require energy (active transport) or without any requirement of energy (passive transport). Energy is mainly required when movement occurs against the concentration gradient.

7- **Mitochondria, chloroplast, and peroxisomes are not part of the endomembrane system. Give reason.**
Ans: the function of some cell organelles is coordinated, these are called endomembrane systems like endoplasmic reticulum (ER), Golgi complex, lysosomes and vacuoles. Since the functions of the mitochondria, chloroplast and peroxisomes are not coordinated with the above components; these are not considered as part of the endomembrane system.

8- **Compare the role of smooth and rough endoplasmic reticulum.**
Ans: Rough ER- ribosomes attached to their outer surface and involved in protein synthesis and secretion.
Smooth ER- ribosomes are not present. It is the site for the synthesis of lipid, lipid-like steroidal hormones.

9- **Discuss the importance of cell membranes in maintaining cell integrity and regulating the transport of substances**.
Ans: The plasma membrane, or the cell membrane, provides protection for a cell. It also provides a fixed environment inside the cell, and that membrane has several different functions. One is to transport nutrients into the cell and also to transport toxic substances out of the cell.

10- **Explain the process by which lysosomes are formed. Name any three of the hydrolase enzymes present in lysosomes**
Ans: Lysosomes are formed by the process of packaging in the Golgi apparatus. The main hydrolytic enzymes are lipases, proteases, and carbohydrates.

11- **Give any two similarities between mitochondria and chloroplast.**
Ans: both contain 70 S Ribosome and circular DNA.

12- **What is the significance of ‘S’ in 70 S and 80 S ribosomes?**

Ans: 'S' (Svedberg's Unit) stands for the sedimentation coefficient; it is indirectly a measure of density and size.

11- **How do vacuoles behave differently in different organisms? Explain by giving two examples.**

Ans: Contractile vacuole in amoeba helps in osmoregulation and excretion.

In protists, food vacuoles are formed by engulfing the food particles.

Long Answer Type Questions

1- **Describe the structure of plasma membrane as illustrated by Singer and Nicolson.**

Ans: This states that the quasi-fluid nature of lipids enables the lateral movement of proteins within the overall bilayer. The cell membrane is composed of lipid bilayers and proteins.

The lipids layer has a polar head (towards the outer sides) and hydrophobic tails (towards the inner side). Proteins of the plasma membrane may be peripheral proteins (on the surface of the membrane) or integral proteins (partially or totally buried in the membrane).

The membrane is selectively permeable

Cell membranes perform various functions like cell signaling, transporting nutrients and water, preventing unwanted substances from entering the cell etc.

2- **Classify the chromosomes on the basis of the position of the centromere. Make a diagram of any one of these.**

Ans: Metacentric: centromere in the middle

Sub-metacentric: centromere slightly away from the middle

Acrocentric: Centromere close to its end

Telocentric: terminal centromere.

3- **(i) Explain the structure of chloroplast and its components.**

(ii) Some plastids are colourless. Give any three examples of such plastids.

Ans: Chloroplast is mostly present in the mesophyll cells of the leaves. These are of varied shape like lens-shaped, oval, spherical, discoid, ribbon-like, etc. It is double membrane-bound. The inner membrane encloses the stroma. In stroma flattened membranous sacs (thylakoids) are present. These are arranged in stacks called grana. Some flat membranous tubules (stroma lamellae) are also present which connect the thylakoids of the different grana. The stroma contains double-stranded circular DNA, 70 S ribosomes and enzymes required for the synthesis of carbohydrates and proteins.

(iii) Leucoplasts: colorless plastids. They may be Amyloplasts (store carbohydrates), Elaioplasts (store oils and fats), and Aleuroplast (store proteins).

4- **Who proposed the cell theory? Explain how the development of cell theory takes place.**

Ans: Schleiden and Schwann together formulated the cell theory. Rudolf Virchow (1855) first explained that cells divided and new cells are formed from pre-existing cells (Omnis

cellula-e cellula). He modified the hypothesis of Schleiden and Schwann to give the cell theory a final shape. Cell theory as understood today is:

(i) All living organisms are composed of cells and products of cells.

(ii) All cells arise from pre-existing cells

5- Compare the prokaryotic cell and eukaryotic cell on following basis-
Nuclear membrane, ribosome, energy production, DNA, cell division

Features	Prokaryotic cell	Eukaryotic cell
Nuclear membrane	Absent	Present
ribosome	70 S	80 S
energy production	Mesosomes	Mitochondria
DNA	Circular	Linear
cell division	Fission	Mitosis, Meiosis

Chapter-9
Biomolecules

- Biomolecule are any of numerous substances that are produced by cells and living organisms.
- Biomolecules may be inorganic and organic.
  Inorganic biomolecules: Minerals, gases and water
  Organic biomolecules: carbohydrates, fats, proteins, nucleic acids, vitamins, etc.

Analysis of chemical composition

- Grind living tissue trichloroacetic acid (Cl3CCOOH). The thick slurry is now strained to filtrate (acid-soluble) and retentate (acid-insoluble). The filtrate contains thousands of organic compounds and some inorganic compounds like sulphate, phosphate.
- The acid insoluble fraction, has only four types of organic compounds i.e., proteins, nucleic acids, polysaccharides and lipids.
- Weighs a small amount of living tissue and burnt it completely. The ash (dry weight) contains inorganic elements.

PROTEINS

- Proteins are polypeptides. They are linear chains of amino acids linked by peptide bonds
- Each protein is a polymer of amino acids. There are about 20 different amino acids exist naturally.
  Essential; amino acids: dietary amino acid
  Non-essential: synthesized inside the body
- Proteins carry out many functions in living organisms, some transport nutrients across cell membranes, some fight infectious organisms, some are hormones, some are enzymes,

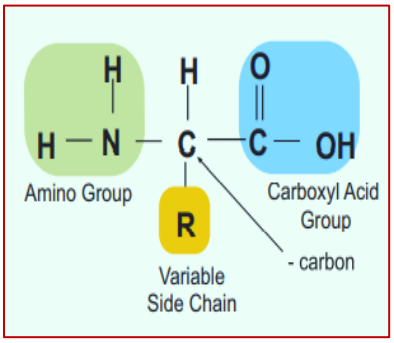
Collagen- The most abundant protein in the animal world

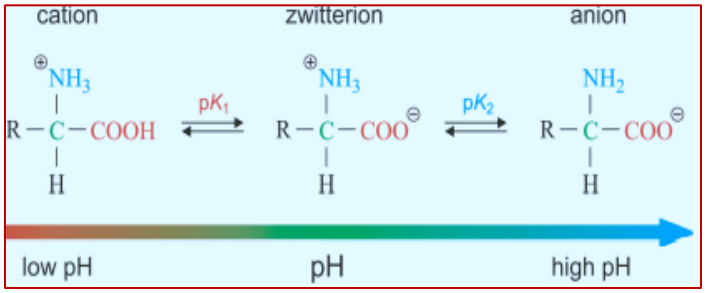
Ribulose bisphosphate Carboxylase-Oxygenase (RuBisCO)- The most abundant protein in the whole of the biosphere:

Protein	Functions
Collagen	Intercellular ground substance
Trypsin	Enzyme
Insulin	Hormone
Antibody	Fights infectious agents
Receptor	Sensory reception (smell, taste, hormone, etc.)
GLUT-4	Enables glucose transport into cells

Amino acids-Each amino acid consists of Carbon (a-carbon), basic amino group (NH2), carboxylic group (COOH), a hydrogen atom (H) and R group. Structurally amino acids differ only in the 'R' group.

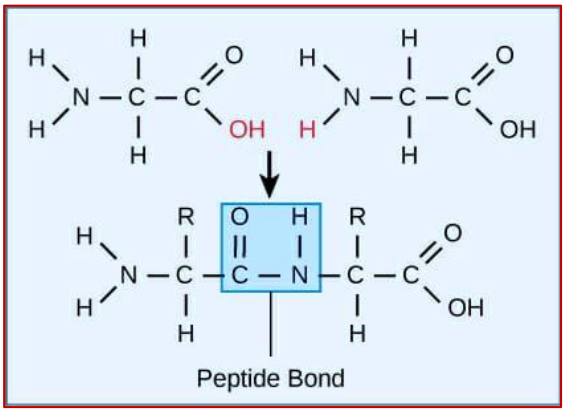
- Zwitter ion: at specific pH an amino acid behaves as a zwitterion i.e. contains both positive and negative charge.
- Based on the R group amino acids are classified as acidic, basic, polar, and non-polar.



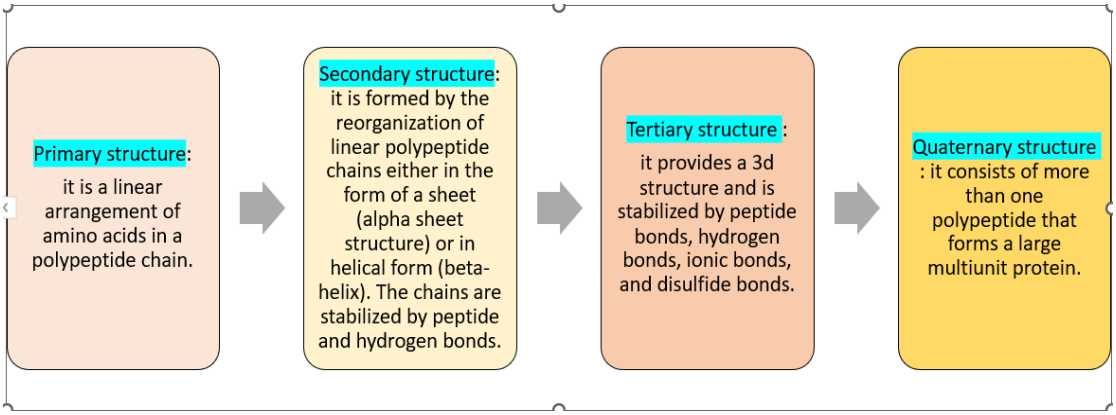


Peptide bond

- The amino group of one amino acid and the carboxyl group of another amino acid combine together with the loss of water and form a peptide bond. Many amino acids join to form polypeptides (proteins).



Structure of proteins



CARBOHYDRATE

- Carbohydrates are polyhydroxy aldoses (e.g. glucose) or ketoses (e.g. fructose).
- General formulae is (CH2O)n
- They are made up of saccharide monomers.
- Saccharide monomers join together by glycosidic linkage.

On the basis of the number of saccharide units, the carbohydrates may be

Monosaccharide: made up of single saccharide monomers e.g. Glucose, Fructose, Galactose

Disaccharide: made up of two saccharide monomers e.g. Lactose, Sucrose

Lactose: Galactose + Glucose

Sucrose: Glucose + Fructose

Polysaccharide (Glycans): made up of many saccharide monomers e.g. Starch, Glycogen, cellulose, Inulin.

Starch, glycogen and cellulose are polymers of glucose

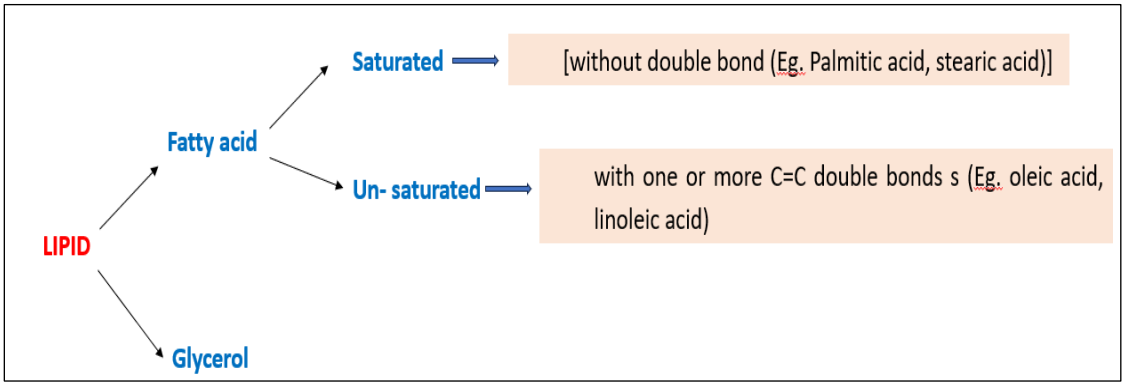
Inulin is a polymer of fructose

Chitin: polymer of N-acetyl glucosamine.

- In a polysaccharide chain (say glycogen), the right end is called the reducing end and the left end is called the non-reducing end.

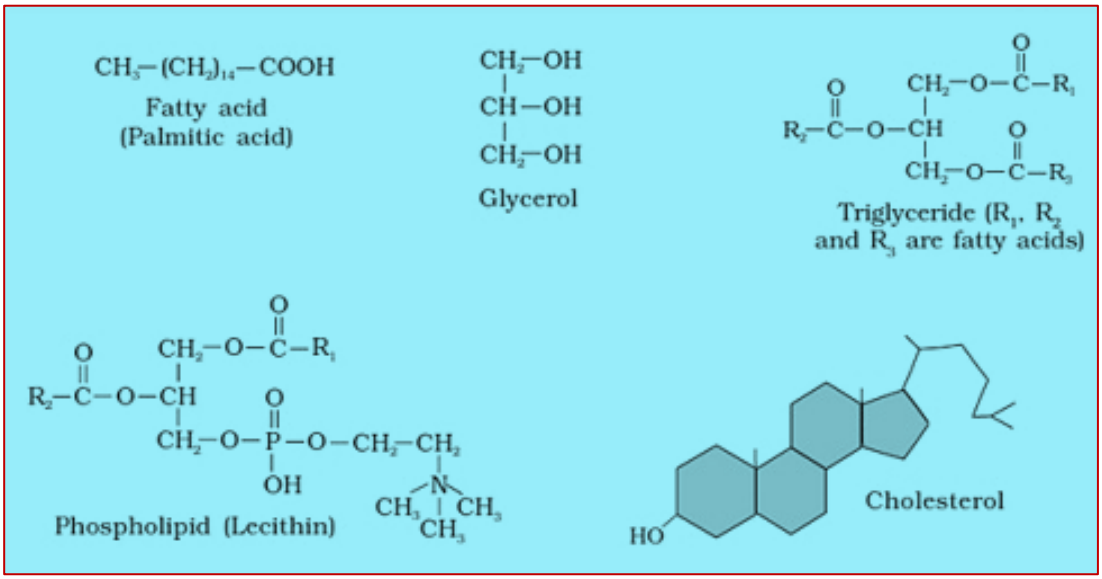
LIPID

- Lipids are fatty, waxy, or oily compounds that are soluble in organic solvents and insoluble in polar solvents such as water.
- They contain long hydrocarbon chains.
  Example: fatty acids, glycerol, triglycerides, phospholipids, steroids and waxes.



Glycerol

- It is trihydroxy propane.
- Triglycerides: Many lipids have glycerol esterified with acids. These are called as monoglycerides, triglycerides and triglycerides.

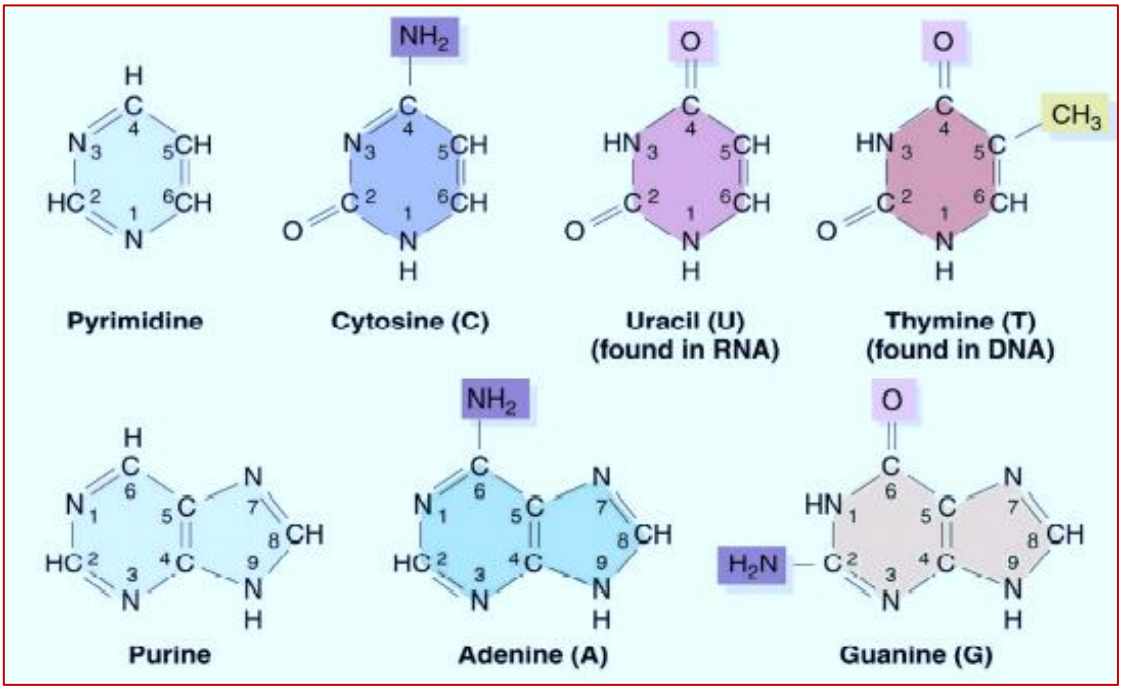


Phospholipids

- They have phosphorous and a phosphorylated organic compound. E.g. Lecithin

NUCLEIC ACID

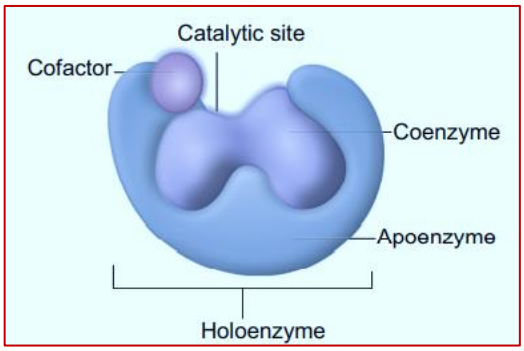
- In the cell two types of nucleic acids are present - DNA (deoxyribonucleic acid) and RNA (ribonucleic acid)
- DNA and RNA function as genetic material.
- These are polynucleotide which is made up of nucleotides.
- Nucleotides are joined together by a phosphodiester bond
- Nucleotide is composed of a nitrogen base, a pentose sugar (5-C) and a phosphate
- The nitrogen base is of two types-
  Purine: adenine (A) and guanine (G)
  Pyrimidine: cytosine (C), thymine (T) and uracil (U)
- Nucleotide: Nucleoside + phosphoric acid group
- Nucleoside: Nitrogenous bas + Pentose sugar



Watson - Crick Model

- DNA exists as a double helix.
- The two strands of polynucleotides are antiparallel
- Phosphodiester bond acts as back bone.
- Purine always form hydrogen bond with Pyrimidine (A pairs with T/U and G pairs with C)
- There are two hydrogen bonds between A and T and three hydrogen bonds between G and C.

ENZYMES

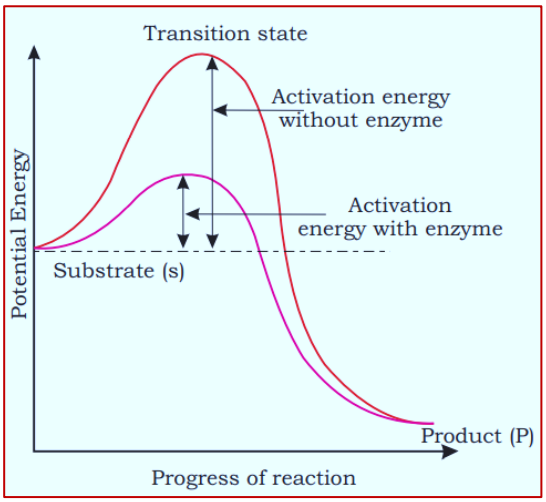


- All enzymes are proteins except ribozymes (nucleic acid).
- They act as catalysts. .
- They remain unchanged at the end of the reaction.
- Enzymes are highly substrate specific.
- Enzymes have active site where substrate binds.
- Enzymes get damaged at high temperatures i.e. denaturation.
- Complete enzyme (holoenzyme) has protein part (Apo enzyme) as well as non-protein part (cofactor)

Nature of Enzyme Action

- First, the substrate binds to the active site of the enzyme
- Formation of enzyme-substrate complex
- Formation of enzyme-product complex
- The enzyme releases the products of the reaction and the free enzyme is ready to bind to another molecule of the substrate.

Concept of activation energy



- The minimum amount of energy required by substrates to convert into the product is called an activation of energy.
- Enzymes lower the activation energy of the reaction they catalyse.

Co-factors (non-protein constituent) - prosthetic groups, co-enzymes and metal ions.

- Prosthetic groups: organic compounds, tightly bound to the apoenzyme. For example, in peroxidase and catalase, which catalyze the breakdown of hydrogen peroxide to water and oxygen, haem is the prosthetic group and it is a part of the active site of the enzyme.
- Co-enzymes: organic compounds, loosely bound to the apoenzyme. e.g., coenzyme NAD and NADP contain the vitamin niacin.
- Metal ions: e.g., zinc is a cofactor for the proteolytic enzyme carboxypeptidase.

Classification and Nomenclature of Enzymes

Oxidoreductase: These enzymes catalyze oxidation and reduction reactions. E.g.- Dehydrogenase
Transferase: These enzymes catalyze the transfer of functional groups such as methyl or phosphate groups. E.g. – Transaminase
Hydrolases: These enzymes catalyze the hydrolysis reactions E.g.- Digestive enzymes
Ligases: These enzymes catalyze the joining of two molecules by making a bond. E.g.- DNA ligase
Isomerases: These class of enzymes brings about the isomerization reaction. E.g.- Isomerase
Lyases: Lyases bring about lysis and cleavage of various bonds. E.g.- Decarboxylase

Factors Affecting Enzyme Activity

Temperature and pH:

At specific temperature and pH enzyme shows optimum reaction. Low temperature preserves the enzyme in a temporarily inactive state whereas high temperature destroys enzymatic activity because proteins are denatured by heat.

Concentration of Substrate

With the increase in substrate concentration, the velocity of the enzymatic reaction rises at first. The reaction ultimately reaches a maximum velocity (Vmax) which is not exceeded by any further rise in the concentration of the substrate.

Inhibitors

Some chemicals that may inhibit the rate of reactions are called inhibitors. When the inhibitor closely resembles the substrate in its molecular structure and inhibits the activity of the enzyme, it is known as a competitive inhibitor. e.g., inhibition of succinic dehydrogenase by malonate.

IMPORTANT QUESTIONS

Very Short Answer Type Questions

1- **What is true about enzyme ribozyme-**
   a- Non-protein enzyme
   b- Present in ribosome
   c- Both are correct
   d- Both are incorrect
   Ans: c

2- **Which monosaccharide is present in human blood-**
   a- Glycerol
   b- Glucose
   c- Inulin
   d- Maltose
   Ans: b

3- Which acid is commonly used to make slurry of tissue during analysis of biomolecules?

a- Hydrocholic acid
b- Sulphuric acid
c- Trichloroacetic acid
d- Acetic acid

Ans: c

4- Which bond is present between two nucleotides-

a- Peptide bond
b- Glycosidic bond
c- Phosphodiester bond
d- Hydrophobic bond

Ans: c

5- Assertion: Sucrose is a disaccharide.
Reason: It is made up of glucose and galactose.

(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is true but Reason is false.
(d) Both Assertion and Reason are false.

Ans: c

6- Assertion: Cellulose is a homopolymer.
Reason: It is made up of only one type of monosaccharide unit, glucose.

(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is true but Reason is false.
(d) Both Assertion and Reason are false.

Ans: a

7- Assertion: Co-enzymes are organic compounds loosely attached to apoenzymes
Reason: NADP is an example of a coenzyme.

(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is true but Reason is false.
(d) Both Assertion and Reason are false.

Ans: b

8- How many carbon atoms are present in Palmitic acid and Arachidonic acid respectively-

a- 16 and 20
b- 20 and 16
c- 12 and 20
d- 16 and 12

Ans: a

9- Chitin is an example of –

a- Tertiary protein
b- Hetero polysaccharide

c- Homo polysaccharide
d- Unsaturated fatty acid
Ans: b

10- Adenosine is composed of-

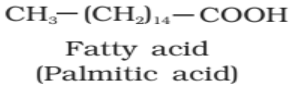
a- Adenine + Sugar
b- Adenine + Phosphate
c- Adenine + Adenine
d- Adenine + Thymine
Ans: a

Short Answer Type Questions

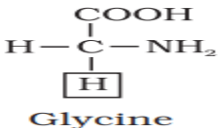
1- Give one example of each of the acidic and neutral amino acids.
Ans: acidic (glutamic acid), neutral (valine)

2- How unsaturated fatty acids differ from saturated fatty acids. Oils belong to which category.
Ans: Saturated- without double bond (Eg. Palmitic acid)
Unsaturated- with one or more C=C double bonds s (Eg. oleic acid)
Oils are unsaturated fatty acids

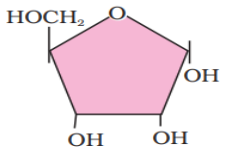
3- Give molecular structures of the followings-
Glycine, ribose sugar, Palmitic acid
Ans:



Fatty acid
(Palmitic acid)



Glycine



C5H10O5 (Ribose)

4- Mention the role of the following
GLUT-4, Collagen
Ans: GLUT-4- Enables glucose transport into cells
Collagen - Intercellular ground substance

5- Why does the shelf life of fruits increase in a refrigerator?
Ans: At low temperatures, the enzymatic activities of microorganisms slowdown, which helps to prevent the growth of food-spoiling microorganisms and ultimately prevents food spoilage.

6- Write the monomers of the following-
Inulin, starch, glycogen, cellulose
Ans: inulin: fructose
starch, glycogen, cellulose: glucose

7- When stained with iodine solution the starch gives bluish colour while cellulose remains unaffected. Give reason.
Ans: Starch forms helical secondary structures. In fact, starch can hold iodine molecules in the helical portion. The starch-iodine is blue in colour. Cellulose does not contain complex helices and hence cannot hold iodine.

8- What is the active site? Write its importance.
Ans: the active site is a cleft-like structure in enzymes.
It is the binding site for the substrate. At this site enzyme-substrate complex is formed.

9- What do you mean by Vmax in reference to enzymes?

Ans: With the increase in substrate concentration, the velocity of the enzymatic reaction rises at first. The reaction ultimately reaches a maximum velocity (Vmax) which is not exceeded by any further rise in the concentration of the substrate.

10- How do temperatures affect the rate of enzymatic reactions?

Ans: Low temperature preserves the enzyme in a temporarily inactive state whereas high temperature destroys enzymatic activity because proteins are denatured by heat.

11- Write two differences in the DNA and RNA.

Ans: DNA: contain Deoxyribose sugar and thymine base

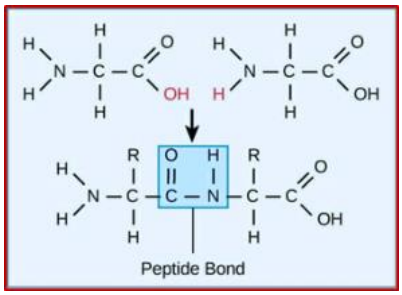
RNA: contain ribose sugar and Uracil base in place of thymine

12- Explain the structure of a quaternary protein.

Ans: haemoglobin consists of 4 subunits. Two subunits of α type and two subunits of β type together constitute the human haemoglobin (Hb).

13- Peptide bond formation is related with dehydration. Provide a diagram of a peptide bond.

Ans: peptide bond is formed when the carboxyl (-COOH) group of one amino acid reacts with the amino (-NH2) group of the next amino acid with the elimination of a water moiety (the process is called dehydration).



14- How are glycosidic bonds formed?

Ans: The glycosidic or ketone group of a monosaccharide bind with an alcoholic group of another organic compound to join the two compounds together.

Long Answer Type Questions

1- a- List the different types of lipids

b- Why are monosaccharide sugars known as reducing sugars?

Ans: a- Lipids are of three types: -

(i) Simple lipids: - they are alcohols or triglycerides containing fatty acid & glycerol.

(ii) Compound lipids: - They are simple lipids with a biologically active compound in them eg. glycolipids (carbohydrate lipid) lipoprotein (protein + lipids)

(iii) Derived lipids: - They are hydrolyzed products of simple lipids such as fatty acids & alcohol.

b- Such sugars are called reducing sugars because they have a free aldehyde or ketone group & can reduce Cu^{++} to Cu^{+}

2- Give a detailed account of the classification of enzymes.

Ans:

Oxidoreductase: These enzymes catalyze oxidation and reduction reactions. E.g.- Dehydrogenase
Transferase: These enzymes catalyze the transfer of functional groups such as methyl or phosphate groups. E.g. – Transaminase
Hydrolases: These enzymes catalyze the hydrolysis reactions E.g.- Digestive enzymes
Ligases: These enzymes catalyze the joining of two molecules by making a bond. E.g.- DNA ligase
Isomerases: These class of enzymes brings about the isomerization reaction. E.g.- Isomerase
Lyases: Lyases bring about lysis and cleavage of various bonds. E.g.- Decarboxylase

3- Explain the different types of protein structures that occur in nature.

Ans: Primary structure: it is a linear arrangement of amino acids in a polypeptide chain.

Secondary structure: it is formed by the reorganization of linear polypeptide chains either in the form of a sheet (alpha sheet structure) or in helical form (beta-helix). The chains are stabilized by peptide and hydrogen bonds.

Tertiary protein: it provides a 3d structure and is stabilized by peptide bonds, hydrogen bonds, ionic bonds, and disulphide bonds.

Quaternary protein: it consists of more than one polypeptide that forms a large multiunit protein.

4- (i) Describe the mechanism of enzymatic action.

(ii) What is the activation of energy?

Ans: (i) First, the substrate binds to the active site of the enzyme

Formation of enzyme-substrate complex

Formation of enzyme-product complex

The enzyme releases the products of the reaction and the free enzyme is ready to bind to another molecule of the substrate

(ii) The minimum amount of energy required by substrates to convert into product is called an activation of energy. Enzymes lower the activation energy of the reaction they catalyse.

5- (i) In what ratio are purine and pyrimidine present in DNA?

(ii) What is the antiparallel nature of DNA?

(iii) Who proposed the double helical model of DNA?

(iv) Define the bond which acts as the backbone of the polynucleotide strand.

Ans: Purine: Pyrimidine= 1:1

(ii) DNA is moistly double-stranded. The polarity of both strands is in opposite directions. The polarity of one strand is 5’ to 3’ then the other strand will have 3’ to 5’ end polarity.

(iii) Watson and Crick

(iv) Phosphodiester bond acts as a backbone.

It is formed in between 3’OH of one nucleotide and 5’ Phosphate of another nucleotide

6- (i) Describe the structure of phospholipids. Give one example.

(ii) Explain the composition of triglycerides.

(iii) list any four roles of lipids.

Ans: (i) Phospholipids have only 2 fatty acids attached to the glycerol while the 3rd glycerol binding site holds a phosphate group.

Example: Lecithin

(ii) Fat is ester of fatty acids with glycerol. When each molecule of glycerol reacts with three molecules of fatty acid, triglyceride is formed.

(iii) Lipids are storage products in plants (cotyledons) as well as animals (adipose tissues).

Plasma membrane of cell is made up of two layers of lipids.

They also form phospholipids, glycolipids, and sterols.

They take part in the synthesis of steroid hormones, vitamin D, and bile salts.

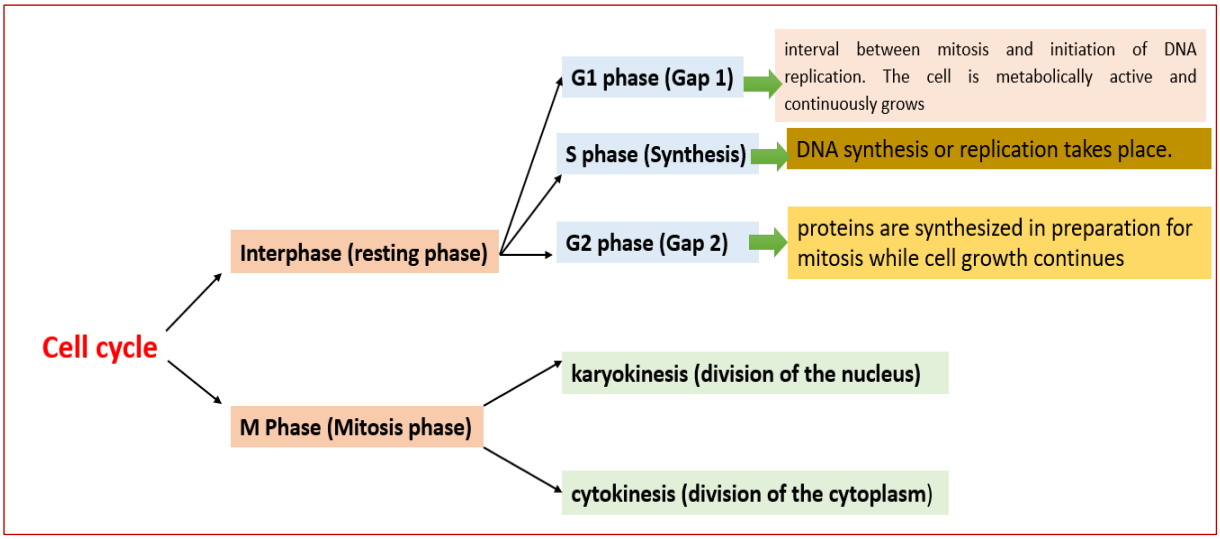
Chapter-10

Cell Cycle and Cell Division

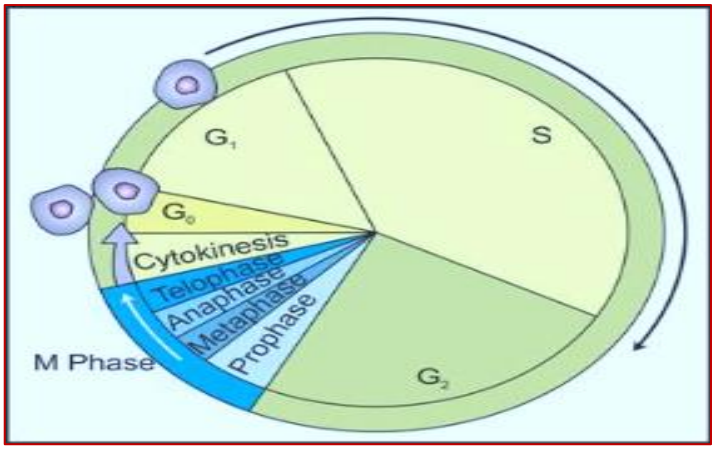
Cell cycle

- The sequence of events by which a cell duplicates its genome, synthesises the other constituents of the cell and eventually divides into two daughter cells is termed cell cycle.
- Different kinds of cells have varied duration for cell cycle phases.

Phases of cell cycle



- G0 Phase: Some cells (like heart cell) exit G1 and enters a quiescent stage called G0 , where the cell remains metabolically active without proliferation



M- Phase

MITOSIS (equational division)

The number of chromosomes in the parent and progeny cells is the same; it is also called equational division.

- Karyokinesis: Prophase, Metaphase, Anaphase, Telophase
- Cytokinesis

Prophase

- Initiation of condensation of chromosomes takes place.
- The centrosome begins to move towards opposite poles of the cell.
- Each centrosome radiates out microtubules called asters.
- The two asters together with spindle fibres form mitotic apparatus.
- Cells at the end of prophase do not show Golgi complexes, endoplasmic reticulum, nucleolus and the nuclear envelope.

Metaphase

- The complete disintegration of the nuclear envelope.
- Chromosome is made up of two sister chromatids, which are held together by the centromere. Small disc-shaped structures at the surface of the centromeres are called kinetochores. These structures serve as the sites of attachment of spindle fibres
- Spindle fibres attach to the kinetochores of chromosomes.
- Chromosomes are moved to the spindle equator and get aligned along the metaphase plate through spindle fibres to both poles.

Anaphase

- Centromeres split and chromatids separate.
- Chromatids move to opposite poles.

Telophase

- Chromosomes cluster at opposite spindle poles and their identity is lost as discrete elements.
- Nuclear envelope develops around the chromosome clusters at each pole forming two daughter nuclei. Nucleolus, Golgi complex and ER reform.

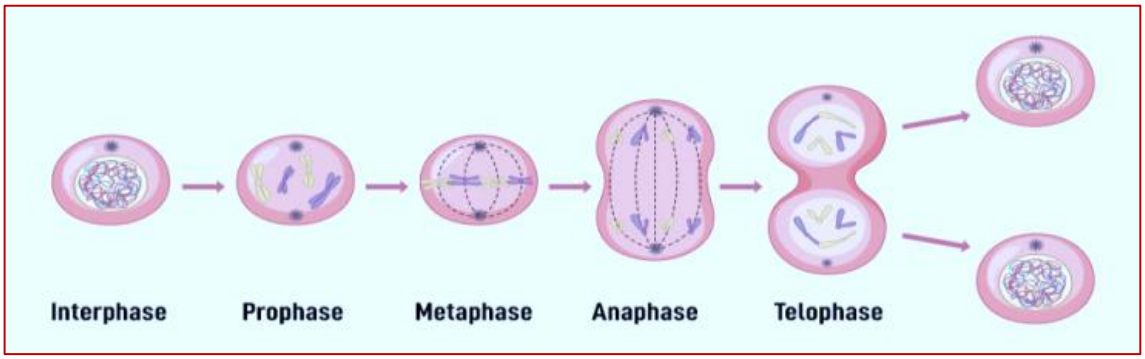
Cytokinesis

- After the Karyokinesis cell it divides into two daughter cells by the separation of cytoplasm called cytokinesis.
- In an animal cell, this is achieved by the appearance of a furrow in the plasma membrane. The furrow gradually deepens and ultimately joins in the centre dividing the cell cytoplasm into two.
- In plant cells, wall formation starts in the centre of the cell and grows outward to meet the existing lateral walls.

Significance of Mitosis

- Production of diploid daughter cells with identical genetic complement.
- The growth of multicellular organisms is due to mitosis. Maintain nucleo-cytoplasmic ratio.
- Damaged cells must be replaced by identical new cells by mitosis.

- Helps in regeneration.



MEIOSIS (Reductional division)

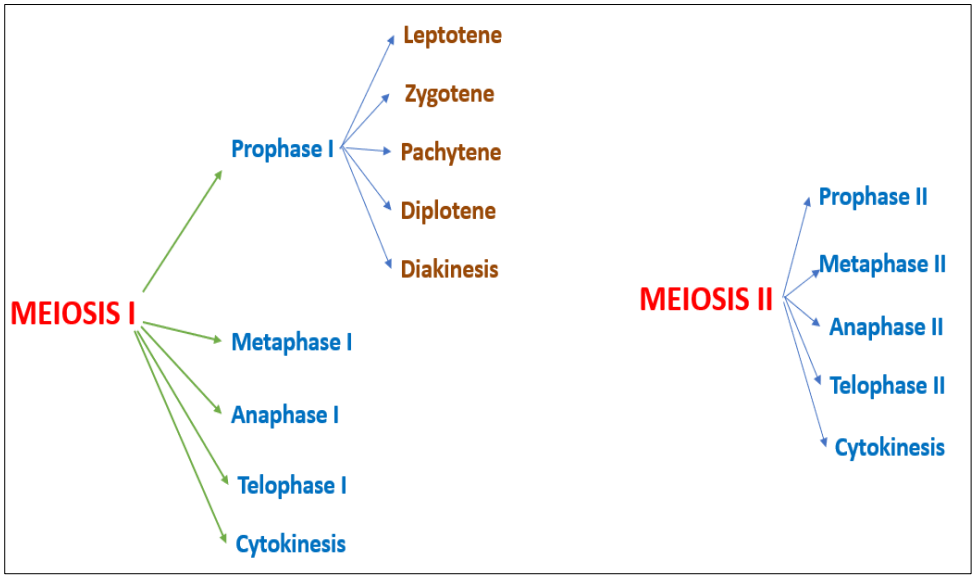
Meiosis is a type of cell division in sexually reproducing organisms that reduces the number of chromosomes in gametes.

The key features of meiosis are as follows:

- Meiosis involves two sequential cycles of nuclear and cell division called meiosis I and meiosis II but only a single cycle of DNA replication.
- Meiosis I is initiated after the parental chromosomes have replicated to produce identical sister chromatids at the S phase.
- Meiosis involves the pairing of homologous chromosomes and recombination between non-sister chromatids of homologous chromosomes.
- Four haploid cells are formed at the end of meiosis II.

Meiosis I	Meiosis II
Prophase I	Prophase II
Metaphase I	Metaphase II
Anaphase I	Anaphase II
Telophase I	Telophase II

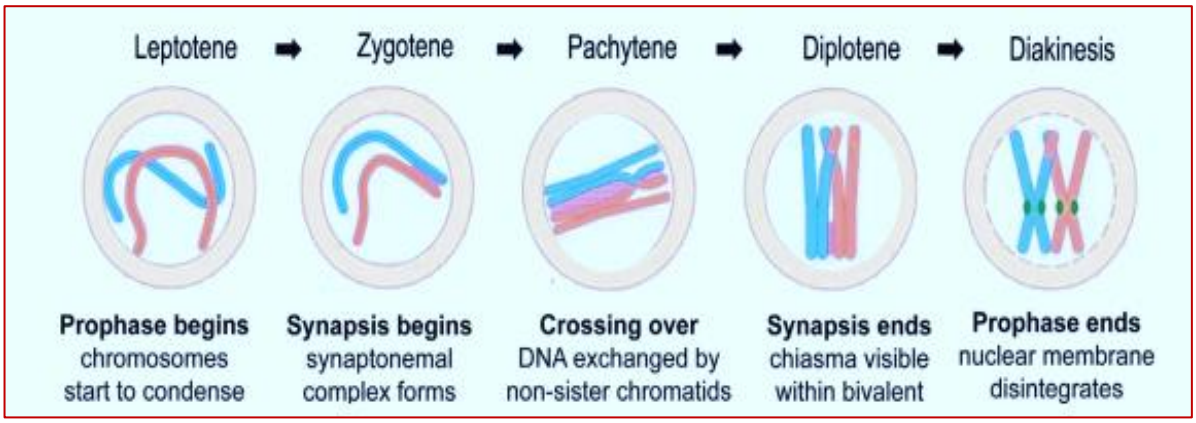
Meiotic events can be grouped under the following phases:



Meiosis I

Prophase I- Leptotene, Zygotene, Pachytene, Diplotene and Diakinesis.

- **Leptotene** - The compaction of chromosomes continues throughout leptotene.
- **Zygotene**- Chromosomes start pairing (synapsis) in between homologous chromosomes and formation of the synaptonemal complex. The complex formed by a pair of synapsed homologous chromosomes is called a bivalent or a tetrad.
- **Pachytene-** the appearance of recombination nodules (sites at which crossing over occurs between non-sister chromatids of the homologous chromosomes).
- Crossing over leads to the recombination of genetic material on the two chromosomes.
- **Diplotene-** Dissolution of the synaptonemal complex. The homologous chromosome of the bivalent separate from each other except at the sites of crossovers (chiasmata).
- **Diakinesis**- Terminalization of chiasmata. Nucleolus disappears and the nuclear envelope also breaks down.



Metaphase I:

- The bivalent chromosomes align on the equatorial plate. The microtubules from the opposite poles of the spindle attach to the kinetochore of homologous chromosomes.

Anaphase I:

- The homologous chromosomes separate, while sister chromatids remain associated at their centromeres.

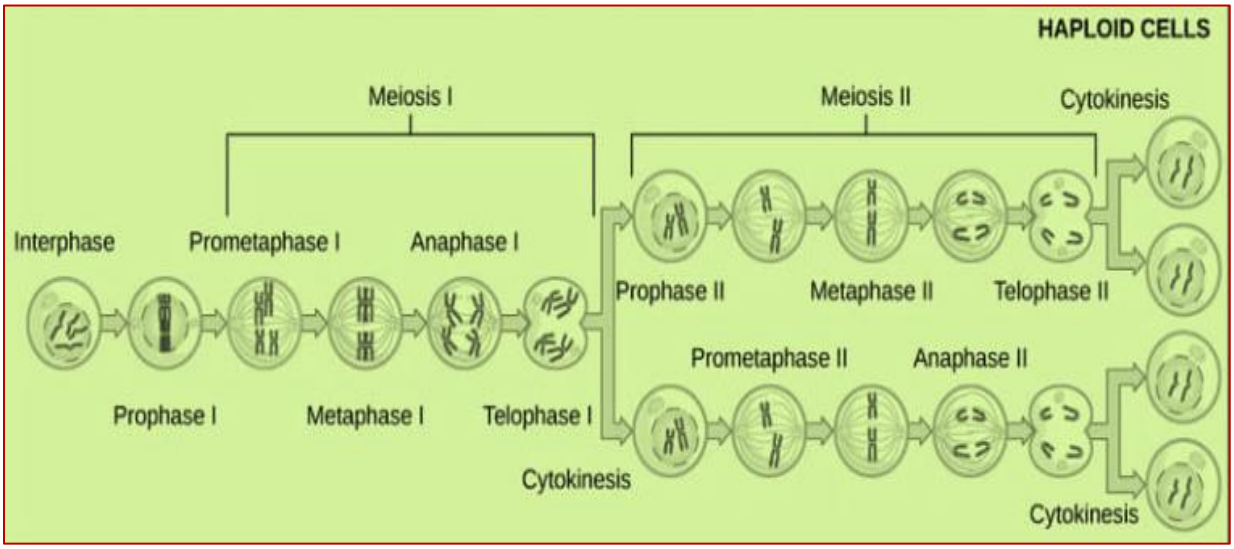
Telophase I:

- The nuclear membrane and nucleolus reappear, cytokinesis follows and this is called a dyad of cells.

Meiosis II

- **Prophase II:** The nuclear membrane disappears by the end of prophase II. The chromosomes again become compact.
- **Metaphase II:** chromosomes align at the equator and the microtubules from opposite poles of the spindle get attached to the kinetochores of sister chromatids.
- **Anaphase II:** splitting of the centromere of each chromosome (which was holding the sister chromatids together), allowing them to move toward opposite poles of the cell by shortening of microtubules attached to kinetochores.
- **Telophase II:** two groups of chromosomes once again get enclosed by a nuclear envelope

- **Cytokinesis** – results in the formation of a tetrad of cells i.e., four haploid daughter



Significance of meiosis

- Conservation of the specific chromosome number of each species.
- It also increases the genetic variability in the population.

IMPORTANT QUESTIONS

Very Short Answer Types Questions

1- How many daughter cells are formed after mitosis?

a- 2 b- 4 c- 0 d- 8

Ans: a

2- How many daughter cells are formed after mitosis?

a- 2 b- 4 c- 0 d- 8

Ans: b

3- Leptotene is a stage of which division-

a- Mitosis b- Amitosis c- Meiosis d- equational division

Ans: c

4- Which type of cell division increases genetic variability?

a- Mitosis b- Amitosis c- Meiosis d- equational division

Ans: c

5- DNA replication occurs at which stage-

a- G0 b- G1 c- G2 d- S phase

Ans: d

6- Assertion: Due to the inactivation of the cell cycle, some cells undergo the G0 phase. Reason: G0 phase occurs due to the non-availability of mitogen and energy-rich compounds.

(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is true but Reason is false.
(d) Both Assertion and Reason are false.
Ans: a

7- **Assertion: During metaphase, the chromosome has two chromatids.**
Reason: Replication of DNA takes place in the S-phase of interphase.
(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is true but Reason is false.
(d) Both Assertion and Reason are false.
Ans: a

8- **Assertion: In animal cells, during cytokinesis, there is the formation of a furrow in the plasma membrane takes place.**
Reason: In plant cells, the formation of the new cell wall starts with the formation of the cell plate.
(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is true but Reason is false.
(d) Both Assertion and Reason are false
Ans: b

9- **A bivalent consists of-**
a- 2 chromatids and 1 centromere
b- 4 chromatids and 2 centromeres
c- 2 chromatids and 2 centromeres
d- 1 chromatid and 1 centromere
Ans: b

10- **During cell division, the spindle fibres attach with** –
a- Kinetochore
b- Centromere
c- Chromonema
d- Chromosome
Ans: a

Short Answer Types Questions

1- **What is the quiescent phase in the cell cycle? During which phase of the cell cycle does this event occur?**

Ans: Some dividing cells at the end of the mitotic phase exit the cell cycle and enter into a vegetative inactive stage, also called the quiescent phase. This occurs during the G1 phase of the cell cycle.

2- How do plants and animals continue to grow all their lives?

Ans: The plants and animals grow by cell division. All the cells, usually involved in non-reproductive functions, multiply by mitosis.

3- Can you tell the name and the location of tissues having cells that divide all their life in higher plants?

Ans: Meristematic tissue is the tissue having cells that can divide all their life in higher plants

4- How do cytokinesis and Karyokinesis differ?

Ans: Karyokinesis: division of the nucleus

Cytokinesis: division of cytoplasm

5- What role does chromosomal replication play during interphase?

Ans: Interphase is a period between cell divisions. It is regarded as the resting stage of a nucleus since it shows no morphological changes; but physiologically, it is an active stage as the cell prepares for division and other biochemical changes.

6- Give two characteristic features of the prophase of mitosis.

Ans: Initiation of condensation of chromosomes takes place.

The centrosome begins to move towards opposite poles of the cell.

The growth of multicellular organisms is due to mitosis.

7- (i) Which of these events is not a part of Karyokinesis- a) Metaphase b) Prophase c) Interphase

d) Anaphase

(ii) In which phase do the centrosomes start moving to the opposite poles of the cell?

Ans: (i) interphase

(ii) Prophase

8- Define asters. Mention their role in the cell cycle.

Ans: Asters are made of microtubules, cytoskeletal proteins of the cell. Asters radiate from centrosomes on the opposite poles of the cells during cell division.

9- In which phase does the nuclear envelope disappear during equational division?

Ans: The nuclear envelope starts disintegrating in the prophase phase of the M phase. However, it is completely disintegrated in the metaphase stage.

10- What do you understand by homologous chromosomes?

Ans: These are chromosome pairs containing a maternal and a paternal chromatid that are similar in length, gene position, and are joined at the centromere.

11- (i) Which phase of mitosis involves the separation of chromatids?

(ii) Which phase of mitosis is associated with chromosomes aligned at the center of the cell and centromeres divide?

Ans: (i) Anaphase

(ii) Metaphase

12- Explain the Synaptonemal complex.

Ans: The synaptonemal complex (SC) is a protein structure that forms between homologous chromosomes (two pairs of sister chromatids) during meiosis and is thought to mediate synapsis and recombination during meiosis I in eukaryotes. The synaptonemal complex facilitates crossover between non-sister chromatids,

13- What are centrioles? Write their roles.

Ans: A centriole is a small structure made of microtubules which exist as part of the centrosome, which helps organize microtubules in the body. They help in cell division by forming microtubule organizing centres.

14- Why is meiosis necessary in sexually reproducing organisms?

Ans: It maintains the number of chromosomes constant in generation as meiosis is a reductional division.

15- Distinguish between the Anaphase of mitosis and the Anaphase of meiosis I.

Ans: Anaphase of mitosis- (i) Centromeres divide into two (ii) Chromatids separate and move towards the opposite direction (iii) Separated chromatids are identical.

Anaphase of Meiosis I- (i) Centromeres do not separate the chromosomes. (ii) Half the number of chromosomes moves towards opposite poles. (iii) Separated chromosomes are homologous.

Long Answer Types Questions

1- Write the main features of prophase I of meiosis I.

Ans: Leptotene - The compaction of chromosomes continues throughout leptotene.

Zygotene- Chromosomes start pairing (synapsis) in between homologous chromosomes and the formation of the synaptonemal complex. The complex formed by a pair of synapsed homologous chromosomes is called a bivalent or a tetrad.

Pachytene- the appearance of recombination nodules (sites at which crossing over occurs between non-sister chromatids of the homologous chromosomes).

Crossing over leads to recombination of genetic material on the two chromosomes.

Diplotene- Dissolution of the synaptonemal complex. The homologous chromosome of the bivalent separate from each other except at the sites of crossovers (chiasmata).

Diakinesis- terminalisation of chiasmata occurs. Nucleolus disappears and the nuclear envelope also breaks down.

2- List any five difference differences between mitosis and meiosis.

Ans:

Mitosis	Meiosis
One division	Two divisions
Number of chromosome remain the same	Number of chromosomes is halved
Homologous chromosomes line up separately on the metaphase plate	Homologous chromosomes line up in pairs at the metaphase plate
Homologous chromosome do not pair up	Homologous chromosome pairup to form bivalent
Chiasmata do not form and crossing over never occurs	Chiasmata form and crossingover occurs
Daughter cells are genetically identical	Daughter cells are genetically different from parent cell
Two daughter cells are formed	Four daughter cells are formed

3- (i) Describe various phases of the cell cycle.

(ii) Give a graphical representation of various phases of the cell cycle.

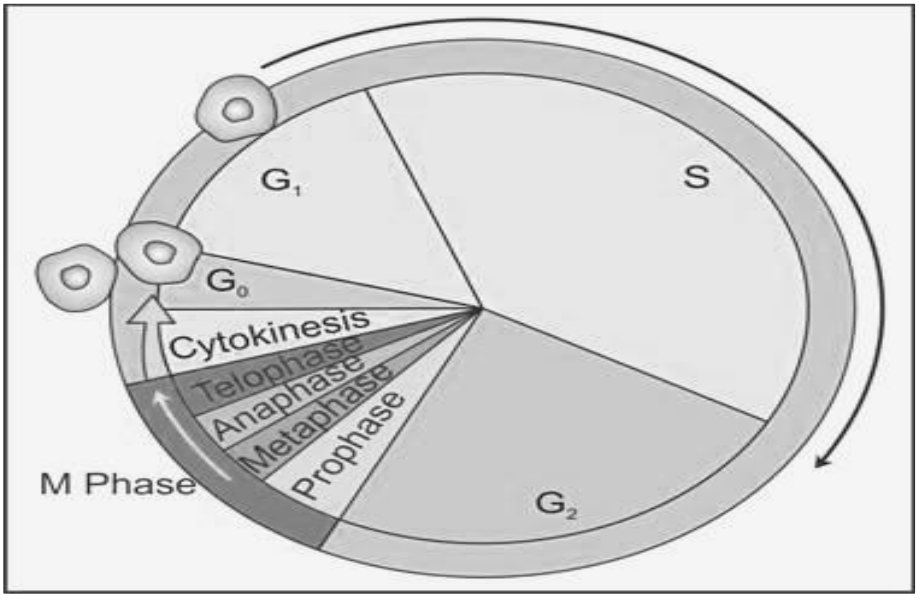
Ans: (i) G1 phase (Gap 1): it corresponds to the interval between mitosis and initiation of DNA replication. During the G1 phase the cell is metabolically active and continuously grows

S phase (Synthesis): DNA synthesis or replication takes place. A number of DNA doubles but none of the chromosomes remains the same.

G2 phase (Gap 2): proteins are synthesised in preparation for mitosis while cell growth continues

G0 Phase: Some cells (like heart cell) exit G1 and enters a quiescent stage called G0, where the cell remains metabolically active without proliferation

(ii)



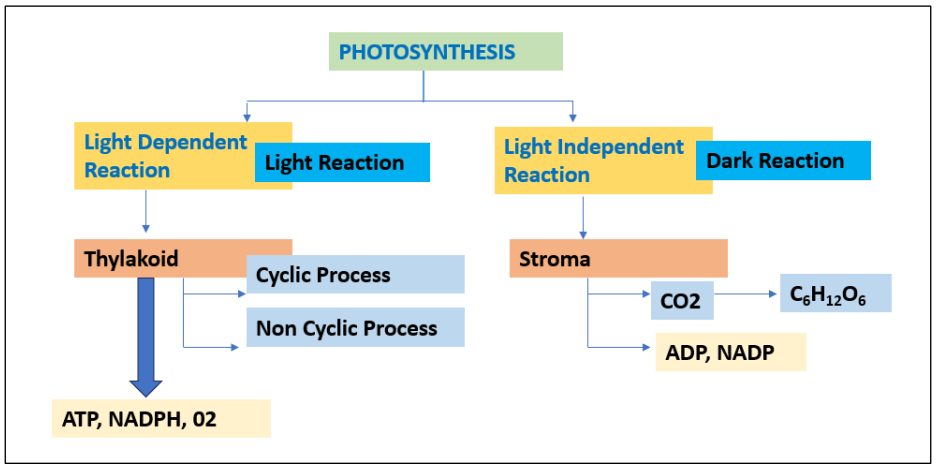
Chapter-13
Photosynthesis in Higher Plants

- The plants get energy from sun by converting solar or radiant energy into chemical energy by the process of Photosynthesis.
- It is a physico-chemical process by which they use light energy to drive the synthesis of organic compounds.

$$6CO_2 + 12H_2O \xrightarrow{\text{Light}} C_6H_{12}O_6 + 6H_2O + 6O_2$$

Early experiments

Joseph Priestley	Plants restore to the air whatever breathing animals and burning candles remove.
Jan Ingenhousz	Only the green part of the plants could release oxygen.
Julius von Sachs	Glucose is made in the green part of the plants and is usually stored as starch
T.W Engelmann	Bacteria accumulated mainly in the region of blue and red light of the split spectrum.
Cornelius van Niel	Photosynthesis is essentially a light-dependent reaction in which hydrogen from a suitable oxidizable compound reduces carbon dioxide to carbohydrates.
Calvin	C3 cycle

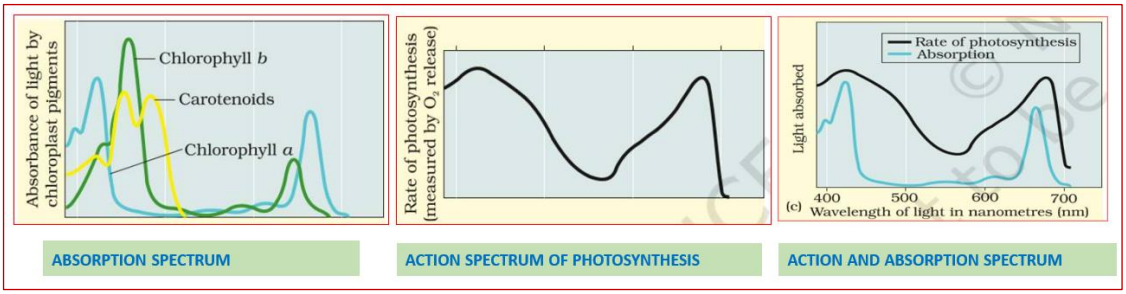


Where does photosynthesis take place?

Structure: Structure of chloroplast (as in the "cell" topic)

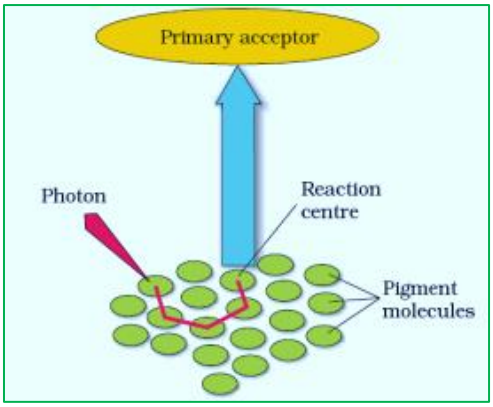
- The membrane system is responsible for light reaction (for trapping the light energy and also for the synthesis of ATP and NADPH).
- In stroma dark reaction (synthesis of sugar) takes place.
- Main photosynthetic pigments: Chlorophyll a, chlorophyll b, xanthophylls and carotenoids.

- Absorption spectrum- indicates the wavelengths of light absorbed by each pigment
- Action spectrum: the wavelengths that actually drive photosynthesis.
- Higher rate of photosynthesis occurs in the blue and the red spectrum.
- Chlorophyll is the major pigment responsible for trapping light, other thylakoid pigments like chlorophyll b, xanthophylls, and carotenoids, are called accessory pigments, also absorb light and transfer the energy to chlorophyll a.



What is the light reaction?

Light reaction/ Hill reaction/Photochemical phase



- It includes - light absorption, water splitting, oxygen release, and the formation ATP and NADPH.
- Thylakoid membrane contains Photosystem I (PS I) and Photosystem II (PS II).
- Reaction centre: The site in the chloroplast that receives the energy trapped by chlorophyll and accessory pigments and initiates the electron transfer process.
- In PS I (P700) chlorophyll a has an absorption peak at 700 nm, while in PS II (P680) the absorption maxima at 680 nm.
- LHC (light-harvesting complex)/antennae: LHC contains pigments that absorb light for photosynthesis, transferring it to photosystem reaction centers.

The electron transport/ Z Scheme

- In PS II absorbs 680 nm wavelength of red light.
- Due to this electron is removed and picked up by an electron acceptor.
- This electron is passed to cytochromes (electrons transport system)
- From cytochrome the electron is passed on to PS I.
- The exited electron from PS I (P700) is transferred to another acceptor molecule.
- Finally electrons with NADP+ and reduce to NADPH

Splitting of Water/ Photolysis of water

- It is the splitting of water molecules in the presence of light into proton, electron and oxygen.

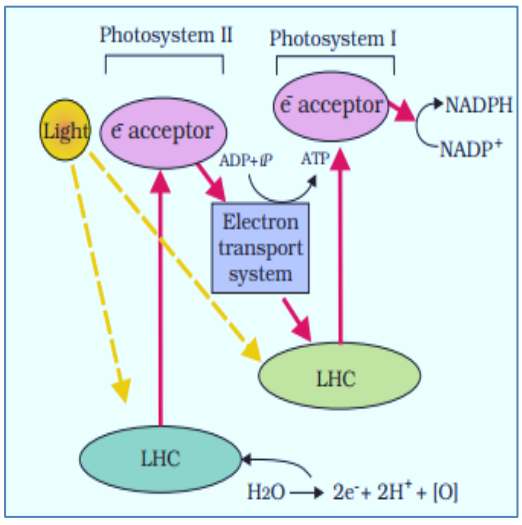
- This process occurs with the help of PS II, Mn and Cl.
- Water splitting complex is associated with the PS II, which itself is physically located on the inner side of the membrane of the thylakoid.

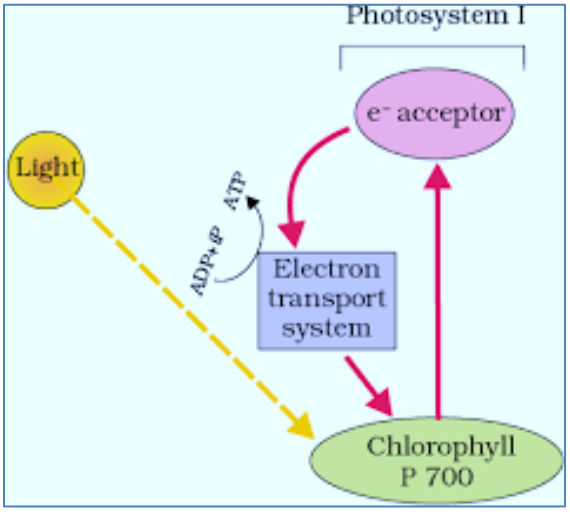
$$2H_2O \longrightarrow 4H^+ + O_2 + 4e^-$$

Cyclic and Non-cyclic Photo-phosphorylation

- Photophosphorylation is the synthesis of ATP from ADP and inorganic phosphate in the presence of light.
- Both PS II and PS I are connected to each other through an electron transport chain.
- When electron transferred from PSII and makes NADPH it forms non-cyclic photophosphorylation (Z-scheme). During this photolysis of water takes place and oxygen is evolved.
- In cyclic photophosphorylation continue with only PS I (P 700). It takes place in the lamellar region of the chloroplast. PS II is inactive here. This occurs when no longer NADP is available as an electron acceptor for non-cyclic photophosphorylation. This occurs when no longer N ADP is available as an electron acceptor for non-cyclic photophosphorylation.

Cyclic Photophosphorylation	Non-Cyclic Photophosphorylation
Only PS I is involved	PS I and PS II are both involved
Water is not required	Photolysis of water is required
Oxygen is not evolved	Oxygen is evolved
NADPH is not synthesized	NADPH is synthesized
Used to produce additional ATP in order to meet cell energy demands	Products can be used for the light independent reactions

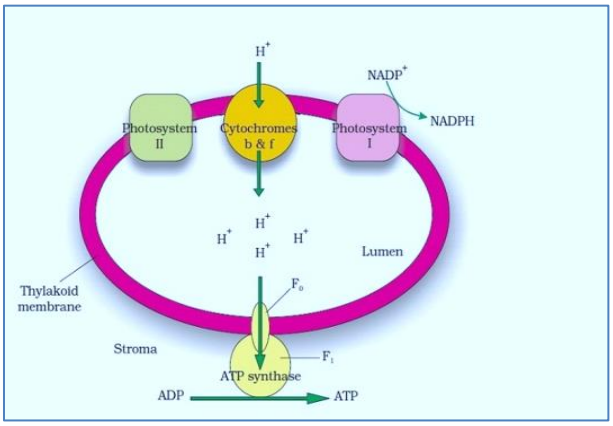




Chemiosmotic Hypothesis

- Proposed by P. Mitchell (1966)

- It explains the mechanism of ATP synthesis in the chloroplast.
- The basic components required for the process are proton gradient, ATP synthase, and proton pump.
- ATP synthase enzyme: it consists of two subunits (F0 and F1).
- It depends on proton gradient formation across the membranes of the thylakoid.
- Splitting of water molecules takes place inside the membrane. H^+ accumulates within the lumen of the thylakoid. . As a result, H^+ is increased inside the thylakoid lumen.
- As the electron moves through the photosystems, H^+ is transported across the membrane.
- NADP reductase enzyme removes H+ from the stroma during the reduction of NADPH and H+. This creates proton gradients across the thylakoid membrane and decreases of pH of the lumen.
- The ATPase provides channel that allows diffusion of H^+ back to the stroma.
- This releases energy to activate ATPase enzyme that catalyzes the formation of ATP and provides energy for the process.



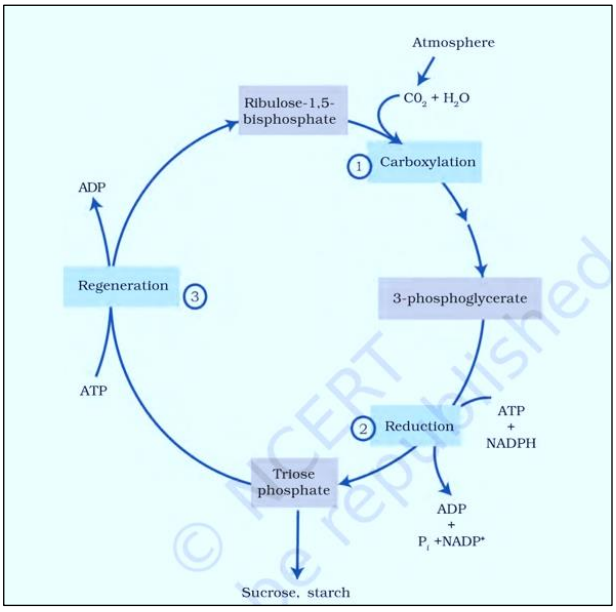
Dark reaction

C3 Cycle / Calvin Cycle

- Discovered by Melvin Calvin

Steps:

1.Carboxylation
2. Reduction
3. Regeneration



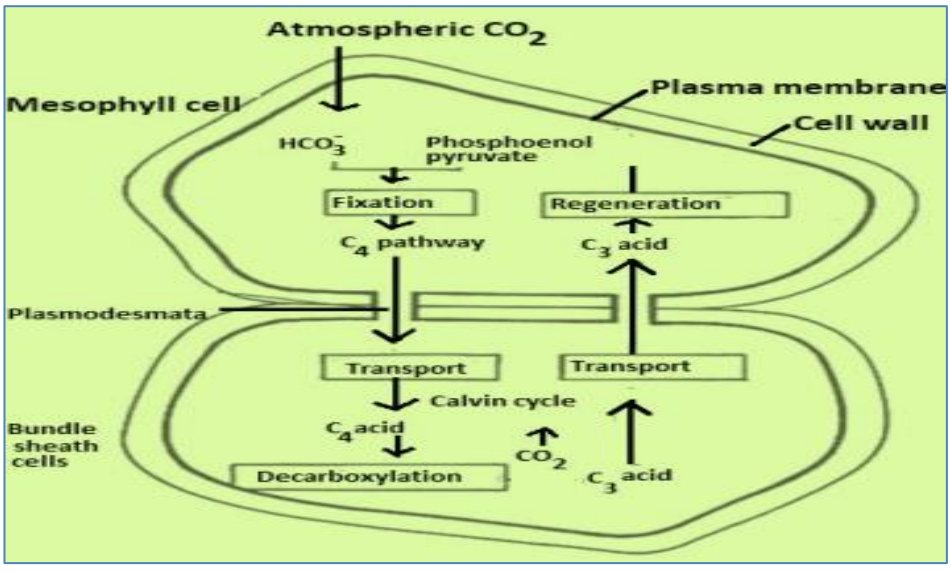
Carboxylation	• First CO2 acceptor molecule is Ribulose 1, 5 Bisphosphate (RUBP). • RUBP carboxylation takes place by the enzyme RuBP carboxylase (Rubisco). • The two molecules of 3-PGA (3 c) is formed.
Reduction	• These are a series of reactions that lead to the formation of glucose. • For every CO2 molecule entering the Calvin cycle, 3 molecules of ATP and 2 of NADPH are required. The fixation of 6 mol of CO_2 and 6 turns of the cycle are required for the formation of one molecule of glucose ($C_6H_{12}O_6$)
Regeneration	• The RuBP molecule is regenerated by using one ATP molecule.

The C4 Pathway/ Hatch & Slack Pathway

- First CO2 acceptor is 3 C, PEP (Phosphoenol pyruvate) of mesophyll cells
- First stable product is C4 oxaloacetic acid (OAA)
- C4 plants: maize, sorghum
  - They have Kranz anatomy in leaves (chloroplast are present in bundle sheath cells and mesophyll cells). Bundle sheath cells are characterized by having a large number of chloroplasts, thick walls impervious to gaseous exchange and no intercellular spaces.
  - They can tolerate higher temperatures
  - Such plants lack photorespiration and have greater productivity of biomass

Steps:

- The PEP combines with CO_2 to form OAA in the presence of the enzyme PEP carboxylase (PEPcase).
- The OAA converted into Malic acid. The malic acid enters the bundle sheath cell.
- Decarboxylation of malic acid results in the formation of 3C Pyruvate and the release of CO2.
- CO2 thus released enters into the Calvin cycle.
- The Pyruvate is transported back to the mesophyll cell where it again converts into 3C PEP.



Photorespiration/ C2 cycle

- It is the process where the enzyme RuBisCO oxygenates RuBP with the release of CO_2.
- It involves chloroplast, peroxisome and mitochondria
- First stable product is 2C-compound phosphoglycolate
- In this pathway ATP or NADPH is not formed; therefore, photorespiration is a wasteful process.
- Hydrogen peroxide is produced.

$$RuBP + CO_2 \xrightarrow{RuBisCo} 2 \times 3PGA$$

Factors affecting photosynthesis

- Blackman's law of limiting factor: If a chemical process is affected by more than one factor, then its rate will be determined by the factor which is nearest to its minimal value: it is the factor that directly affects the process if its quantity is changed.
- Light: Under low and high intensity the photosynthetic rate is low and high respectively. The photosynthetic rate is optimum in blue and red light.
- Carbon dioxide: An increase in concentration up to 0.05 percent can cause an increase in CO_2 fixation rates; beyond this the levels can become damaging over longer periods.
- Oxygen: The rate of photosynthesis decreases when there is an increase in oxygen concentration.
- Temperature: In general, the optimum temperature for photosynthesis is 25 ºC to 35 ºC.
- Temperature: The C4 plants respond to higher temperatures and show a higher rate of photosynthesis while C3 plants have a much lower temperature optimum.
- Water: Water stress causes the stomata to close hence reducing the CO2 availability.

C_3 Plants	C_4 Plants
1. CO_2 fixation takes place in mesophyll cells only	1. CO_2 fixation takes place mesophyll and bundle sheath
2. CO_2 acceptor is RUBP only	2. PEP in mesophyll and RUBP in bundle sheath cells
3. First product is 3C- PGA	3. First product is 4C- OAA
4. Kranz anatomy is not present	4. Kranz anatomy is present
5. Granum is present in mesophyll cells	5. Granum present in mesophyll cells and absent in bundle sheath
6. Normal Chloroplast	6. Dimorphic chloroplast
7. Optimum temperature 20° to 25°C	7. Optimum temperature 30° to 45°C
8. Fixation of CO_2 at 50 ppm	8. Fixation of CO_2 even less than 10 ppm
9. Less efficient due to higher photorespiration	9. More efficient due to less photorespiration
10. RUBP carboxylase enzyme used for fixation	10. PEP carboxylase and RUBP carboxylase used
11. 18 ATPs used to synthesize one glucose	11. Consumes 30 ATPs to produce one glucose.
12. Example: Paddy, Wheat, Potato and so on	12. Example: Sugar cane, Maize, *Sorghum*, *Amaranthus* and so on

IMPORTANT QUESTIONS

Very Short Answer Type Questions

1- What is the expanded form of NADPH?

a- Nicotinamide adenine dinucleotide phosphate
b- Nicotinamide adenine nucleotide phosphate
c- Nicotine adenine nucleotide diphosphate
d- Nicotinamide adenosine dinucleotide triphosphate
Ans: a

2- What is the use of NADPH?

a- Reducing agent
b- Oxidizing agent
c- Oxidoreductase
d- None of these
Ans: a

3- In C4 plants CO_2 combines with which of the following-

a- PEP
b- OAA
c- RuBP
d- None of these
Ans: a

4- Which stage of the Calvin cycle utilizes ATP-

a- Regeneration
b- Reduction
c- Carboxylation
d- Both a and b
Ans: d

5- Assertion: There is a decrease in photosynthesis if the cells are illuminated by 680 nm or more wavelength.
Reason: In the red drop phenomenon the rate of photosynthesis decreases.
(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) If Assertion is true but Reason is false.
(d) Both Assertion and Reason are false.
Ans: c

6- Assertion: The stromal thylakoids are rich in both PS I and PS II.
Reason: The grana membranes have numerous ATP synthetase enzymes.
(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(c) If Assertion is true but Reason is false.

(d) Both Assertion and Reason are false.

Ans: d

7- **Which scientist uses bell jars, candles and mice to prove that Plants restore to the air whatever breathing animals and burning candles remove?**

a- Joseph Priestley

b- Malvin Calvin

c- Virchow

d- Schleiden and swan

Ans: a

8- **Which organelle/ organelles are involved in photorespiration?**

a- Chloroplast

b- Mitochondria

c- Peroxisome

d- All of these

Asn: d

9- **To reduce 6 molecules of CO_2 into sugar how much ATP and NADPH is required?**

a- 18 ATP, 12 NADPH

b- 12 ATP, 18 NADPH

c- 12 ATP, 18 NADP

d- 18 ATP, 12 NADH

Ans: a

10- **Assertion: Oxidative phosphorylation requires oxygen.**

Reason: Oxidative photophosphorylation occurs in mitochondria.

(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(c) If Assertion is true but Reason is false.

(d) Both Assertion and Reason are false.

Ans:b

Short Answer Type Questions

1- **Why does photosynthesis consider a physicochemical process?**

Ans: photosynthesis is considered a physicochemical process as by this process light energy is used for the synthesis of organic compounds (like sugar).

2- **Mention any two ways that suggest the importance of photosynthesis.**

Ans: (i) it is the primary source of all food on earth

(ii) Responsible for the release of oxygen into the atmosphere

3- **What observation was made by T.W Engelmann during his experiment with prism and Cladophora?**

Ans: The bacteria were used to detect the sites of O2 evolution and these accumulated mainly in the region of blue and red light of the split spectrum.

4- **At high temperatures the rate of photosynthesis decreases. Give reason.**

Ans: Photosystem is an enzymatic-driven process. At high temperatures, results in the denaturation of enzymes and the rate of photosynthesis decreases.

5- **The Rubisco enzyme may act differently in cells. Explain.**

Ans: in the presence of oxygen it as Oxygenase while in the presence of CO_2, it acts as a carboxylase.

6- **Why is the RuBisCo enzyme more appropriately called RUBP Carboxylase-Oxygenase?**

Ans: Acts as Carboxylase when CO2 concentration is high.

Acts as Oxygenase when O2 concentration is high

7- **How do photosynthetic bacteria such as cyanobacteria conduct photosynthesis in the absence of chloroplasts?**

Ans: Cyanobacteria use photosynthetic pigments, such as carotenoids, phycobilin, and various forms of chlorophyll, which absorb energy from light.

8- **What are accessory pigments in plants? Give their examples.**

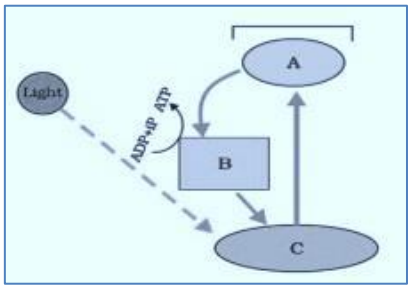
Ans: accessory pigments (chlorophyll b, xanthophylls, and carotenoids) absorb light and transfer the energy to chlorophyll a. They also protect chlorophyll from photo-oxidation.

9- **What terms are used for- wavelengths of light absorbed by each pigment and wavelengths that actually drive photosynthesis**

Ans: Absorption spectrum- indicates the wavelengths of light absorbed by each pigment

Action spectrum: the wavelengths that actually drive photosynthesis.

10- **Label A, B and C in the given diagram-**



Ans: A- electron acceptor, B- Electron system, C- P700

11- **(i) What does P700 and P680 means**

(ii) What is LHC?

Ans: (i) These are the absorption maxima of two photosystems in the chloroplast? (ii) The pigments are organized into two discrete photochemical light-harvesting complexes

(LHC) within the (PS I) and (PS II). The LHC is made up of hundreds of pigment molecules bound to proteins.

12- Photosynthesis may be light-independent. Explain the statement.

Ans: Dark reactions are light-independent reactions. Through various processes, carbon dioxide is reduced to glucose which does not require light. However, the formation of sugar depends on the product of light reaction (NADPH).

13- Diagrammatically represent the steps of light reaction.

Ans: fig: 13.5, Page 212, NCERT

14- When the leaf is stored in dark it may turns yellow or light green. Which pigment do you believe is the maximum durable?

Ans: Leaves need light to perform photosynthesis. When leaves are kept in dark the colour of leaves changes. They may turn in yellowish colour. The amount of light available determines the amount of chlorophyll pigment produced, which is required for photosynthesis. Chlorophyll-a molecule creation ceases in the absence of light, and they slowly degrade. The xanthophyll and carotenoid pigments become prominent during this process, turning the leaf yellow. As light is emitted, these pigments become more stable.

15- Identify the photosystem involved in the followings-

(i) Photolysis of water (ii) Production of NADPH

Ans: (i) PS II (ii) PSI and PSII

16- Illustrate the two roles of photosynthetic pigments other than chlorophyll in green plants.

Ans: (i) absorb light energy and transfer it to chlorophyll for photosynthesis.

(ii) Protect the chlorophyll molecule from photo-oxidation.

17- Some plants are called C3 and some others are called C4. Why they are called so?

Ans: C3 plants – First stable product is a 3 carbon compound – PGA

C4 plants – First stable product is a 4 carbon compound – OAA

18- What is photophosphorylation? Give any two differences between cyclic and non-cyclic photophosphorylation.

Ans: The formation of energy-rich ATP during photosynthesis is known as photophosphorylation.

Cyclic: The reaction center is P700, it is involved in the synthesis of only ATP.

Noncyclic: The reaction center is both P680 and P700. It is involved in the formation of both ATP and NADPH.

Long Answer Type Questions

1- Explain the chemiosmotic hypothesis of photophosphorylation.

Ans: it is described by P. Mitchell (1966) and known as the chemiosmotic hypothesis.

The basic components required for the process are proton gradient, ATP synthase, and proton pump. The ATP synthase enzyme consists of two subunits (F0 and F1). ATP formation depends on proton gradient formation across the membranes of the thylakoid. During light reaction in thylakoid molecule photolysis of water takes place. H^+

accumulates within the lumen of the thylakoid. As a result, H^+ is increased inside the thylakoid lumen. As the electron moves through the photosystems, H^+ is transported across the membrane. NADP reductase enzyme removes H^+ from the stroma during the reduction of NADPH and H^+. This creates proton gradients across the thylakoid membrane and decreases of pH of the lumen. The ATPase provides a channel that allows diffusion of H^+ back to the stroma. This releases energy to activate the ATPase enzyme that catalyzes the formation of ATP and provides energy for the process.

Figure 13.7 ATP synthesis through chemiosmosis, page 214, NCERT

2- Describe the biosynthetic pathway of carbon dioxide fixation that occurs during photosynthesis.

Ans: This process is explained by Melvin Calvin and is known as the C3 cycle. It occurs in the stroma of the chloroplast and includes the following steps:

Carboxylation: First CO2 acceptor molecule is Ribulose 1, 5 Bisphosphate (RUBP). RUBP carboxylation takes place by the enzyme RuBP carboxylase (Rubisco). The two molecules of 3-PGA (3 c) are formed.

Reduction: These are a series of reactions that lead to the formation of glucose. For every CO2 molecule entering the Calvin cycle, 3 molecules of ATP and 2 of NADPH are required. The fixation of 6 mol of CO_2, and 6 turns of the cycle are required for the formation of one molecule of glucose ($C_6H_{12}O_6$)

Regeneration: The RuBP molecule is regenerated by using one ATP molecule.

Figure 13.8 The Calvin cycle, Page 217, NCERT

19- Give a detailed account of Hatch and Slack cycle in the maize plant. Also make a suitable diagram.

Ans: This is also known as C4 cycle as the first stable product formed is 4 C OAA. The plants showing C4 cycle have a special arrangement known as Kranz anatomy. The PEP combines with CO2 to form OAA in the presence of the enzyme PEP carboxylase (PEPcase). The OAA converted into Malic acid. The malic acid enters the bundle sheath cell. Decarboxylation of malic acid results in the formation of 3C Pyruvate and the release of CO2. CO2 thus released enters into the Calvin cycle. The Pyruvate is transported back to the mesophyll cell where it again converts into 3C PEP.

Figure 13.9, page 219, NCERT

20- (i) Who proposed the law of limiting factor? Explain it with a suitable graph.

(ii) List out any four differences in the anatomy of leaves in C3 and C4 plants?

Ans: (i) It is proposed by Blackman (1905) Law of Limiting Factors comes into effect. This states that- If a chemical process is affected by more than one factor, then its rate will be determined by the factor which is nearest to its minimal value: it is the factor which directly affects the process if its quantity is changed.

Graph- Figure 13.10, Pages no 222, NCERT

(ii)

C_3 Plants	C_4 Plants
1. CO_2 fixation takes place in mesophyll cells only	1. CO_2 fixation takes place mesophyll and bundle sheath
2. CO_2 acceptor is RUBP only	2. PEP in mesophyll and RUBP in bundle sheath cells
3. First product is 3C- PGA	3. First product is 4C- OAA
4. Kranz anatomy is not present	4. Kranz anatomy is present
5. Granum is present in mesophyll cells	5. Granum present in mesophyll cells and absent in bundle sheath
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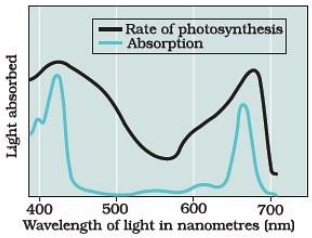
8. Fixation of CO_2 at 50 ppm	8. Fixation of CO_2 even less than 10 ppm
9. Less efficient due to higher photorespiration	9. More efficient due to less photorespiration
10. RUBP carboxylase enzyme used for fixation	10. PEP carboxylase and RUBP carboxylase used
11. 18 ATPs used to synthesize one glucose	11. Consumes 30 ATPs to produce one glucose.
12. Example: Paddy, Wheat, Potato and so on	12. Example: Sugar cane, Maize, *Sorghum*, *Amaranthus* and so on

3- In the figure given below, the black line (upper) indicates action spectrum for photosynthesis and the lighter line (lower) indicates the absorption spectrum of chlorophyll a, answer the followings:



a- What does the action spectrum indicate?

b. If chlorophyll a is responsible for the light reaction of photosynthesis, why do the action spectrum and absorption spectrum not overlap?

Ans: a- The action spectrum is the wavelength of light, that plants use for photosynthesis and the subsequent photochemical and biochemical reactions critical to plant growth.

b- The absorption spectrum of chlorophyll a does not exactly overlap with the action spectrum of photosynthesis. This is because, other than chlorophyll there are other pigments that are also involved in photosynthesis.

4- **(i) Find out the process/ location/ enzymes related to photosynthesis**.

a) enzyme in ATP production b) oxygen evolution c) glucose formation in C4 Cycle d) Synthesis of sugar molecule in C3 plants

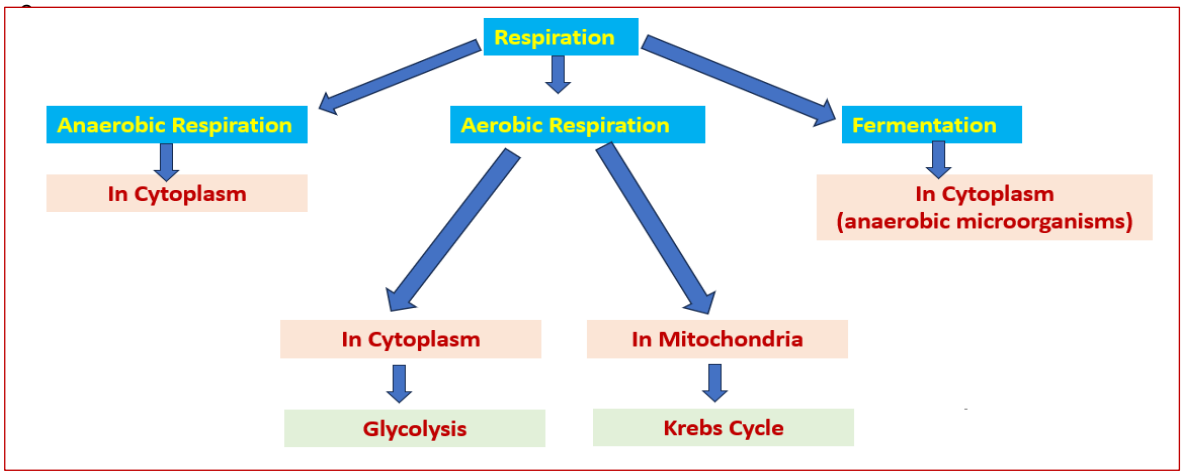
(ii) Where does enzyme PEPcase located and mention its role?

Ans: (i) a) ATPase enzyme b) Thylakoid c) bundle sheath cell d) Stroma of Chloroplast

(ii)PEPcase is located in mesophyll cells of C4 plants. These enzymes catalyse the formation of OAA by combing CO2 and PEP.

Chapter-14
Respiration in Plants

- The breaking of the C-C bonds of complex compounds through oxidation within the cells, leading to the release of a considerable amount of energy is called respiration.
- The compounds that are oxidized during this process are known as respiratory substrates.
- During the process of respiration, oxygen is utilized, and carbon dioxide, water and energy are released as products. released during respiration is stored in the form of ATP (Adenosine Tri Phosphate).
- h



Types of Respiration

Aerobic respiration	Anaerobic Respiration
1. It occurs in all living cells of higher organisms.	It occurs yeast and some bacteria.
2. It requires oxygen for breaking the respiratory substrate.	Oxygen is not required for breaking the respiratory substrate.
3. The end products are CO_2 and H_2O.	The end products are alcohol, and CO_2 (or) lactic acid.
4. Oxidation of one molecule of glucose produces 36 ATP molecules.	Only 2 ATP molecules are produced.
5. It consists of four stages-glycolysis, link reaction, TCA cycle and electron transport chain.	It consists of two stages-glycolysis and fermentation.
6. It occurs in cytoplasm and mitochondria.	It occurs only in cytoplasm.

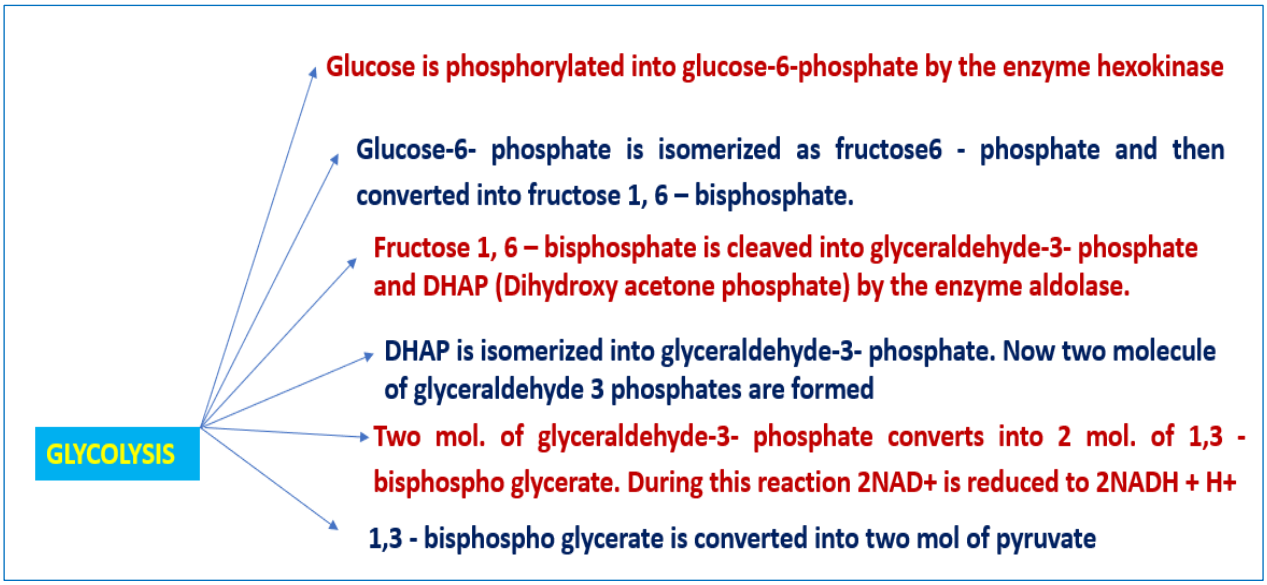
- **Fermentation**: it is a type of anaerobic respiration process that occurs in microorganisms (like yeast) and results in the production of CO_2, byproducts (alcohol, acid, etc.) and less amount of energy.
- Incomplete oxidation of glucose takes place.

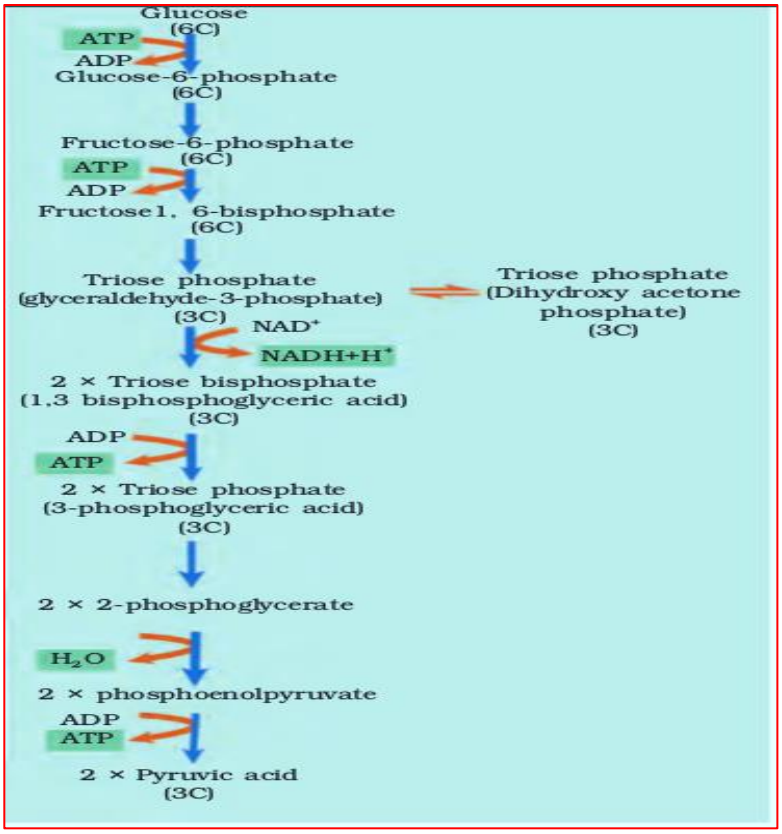
- In animal cells also, like muscles during exercise, when oxygen is inadequate for cellular respiration pyruvic lactic acid is formed which causes muscle fatigue.

Steps in cellular $C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + Energy$ **respiration**

- Glycolysis
- Krebs cycle
- Electron transport chain and oxidative phosphorylation

GLYCOLYSIS/ EMP Pathway





ATP consuming steps	No of ATP	ATP releasing steps	No of ATP
Glucose → Glucose-6-phosphate	1	(1,3 bisphosphoglyceric acid) → Triose phosphate (3-phosphoglyceric acid)	2
Fructose-6-phosphate → Fructose1, 6-bisphosphate	1	Phosphoenolpyruvate → Pyruvic acid	2
TOTAL	2		4
Net gain of ATP	4 – 2 = 2		

AEROBIC REACTION

- Site: Mitochondria
- The crucial events in aerobic respiration are:
  - ✓ The complete oxidation of pyruvate by the stepwise removal of all the hydrogen atoms, leaving three molecules of CO_2.
  - ✓ The passing on of the electrons removed as part of the hydrogen atoms to molecular O2 with the simultaneous synthesis of ATP.

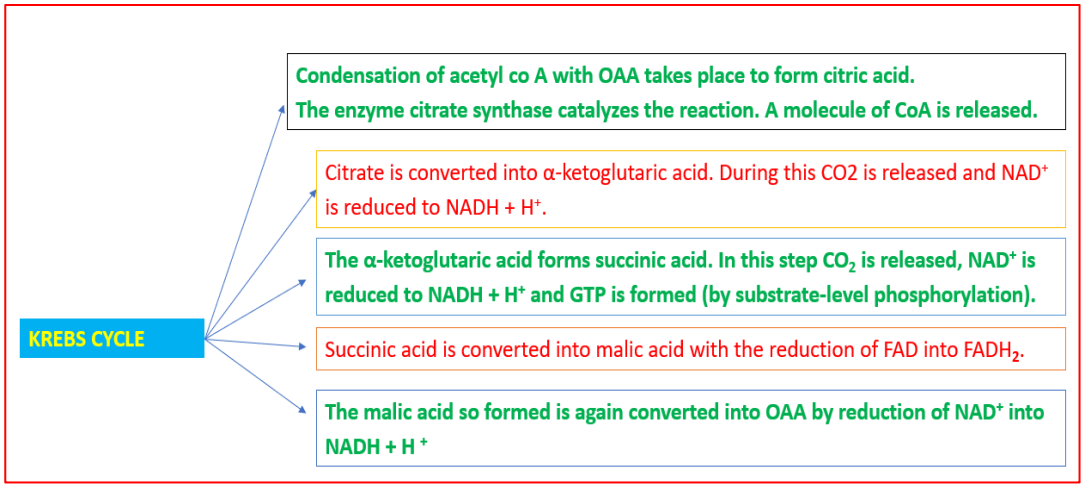
Pyruvate Oxidation (Link reaction)

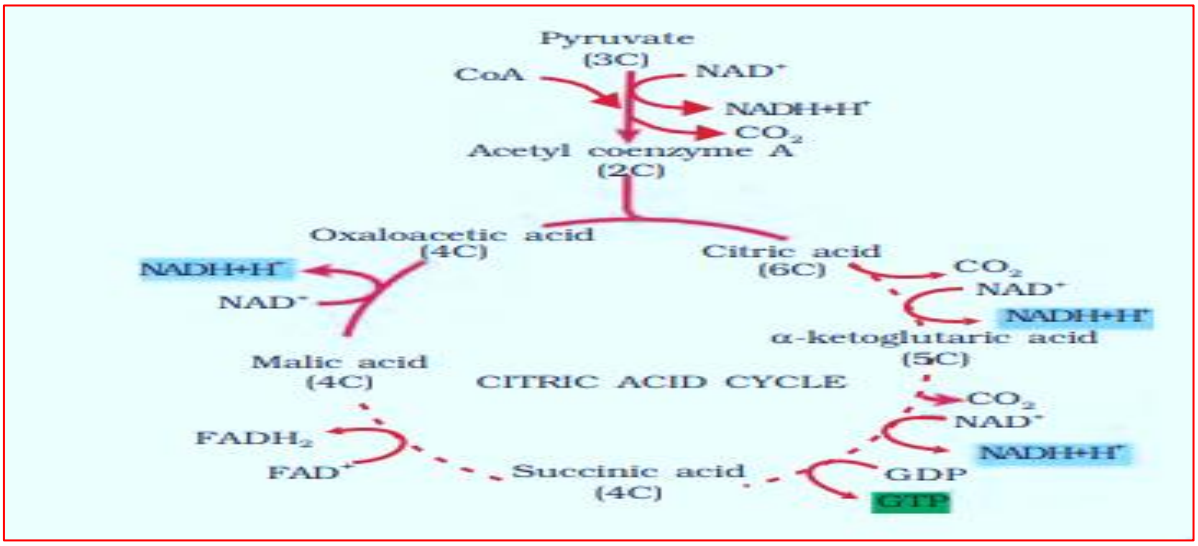
- Pyruvate (product of glycolysis) undergoes oxidative decarboxylation after it enters the mitochondrial matrix.
- The reaction is catalyzed by the enzyme pyruvic dehydrogenase and acetyl co A is formed along with CO_2 and NADH + H^+.

$$\text{Pyruvic acid} + \text{CoA} + \text{NAD}^+ \xrightarrow[\text{Pyruvate dehydrogenase}]{Mg^{2+}} \text{Acetyl CoA} + CO_2 + \text{NADH} + H^+$$

- The acetyl CoA then enters a cyclic pathway, the tricarboxylic acid cycle / Krebs' cycle (named after scientist Hans Krebs)

TCA CYCLE (tricarboxylic acid cycle)

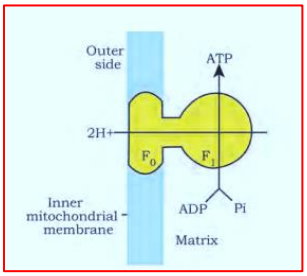


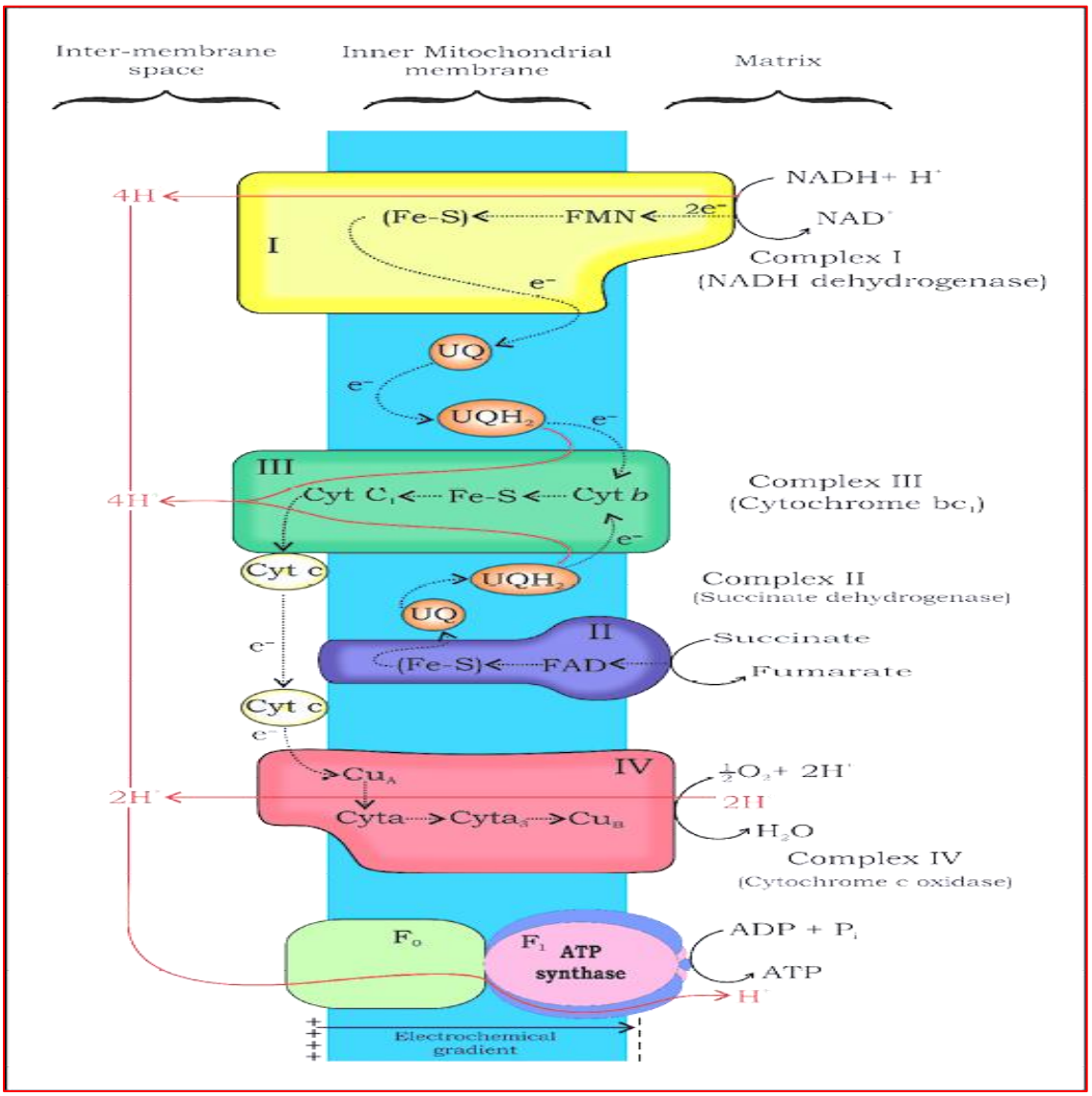


$$\text{Pyruvic acid} + 4NAD^+ + FAD^+ + 2H_2O + ADP + Pi \xrightarrow{\text{Mitochondrial Matrix}} 3CO_2 + 4NADH + 4H^+ + FADH_2 + ATP$$

Electron Transport System (ETS) and Oxidative Phosphorylation

- Oxidation of NADH + H^+ and FADH2 takes place through a series of Electron and hydrogen (proton) transport chain. The metabolic pathway, through which the electron passes from one carrier to another, is called the electron transport system (ETS).
- Complex I: NADH dehydrogenase, Complex II: succinate dehydrogenase, Complex III: cytochromes bc1, Complex IV: cytochromes a-a3, Complex V: ATP synthase
- ETS is present in the inner mitochondrial membrane and involves four complexes (I-IV).
- NADH2 is oxidized by NADH dehydrogenase and electrons are then transferred to ubiquinone (on the inner mitochondrial membrane).
- FADH2 is oxidized by succinate dehydrogenase and transferred electrons to ubiquinone.
- The reduced ubiquinone (ubiquinol) is then oxidized with transfer of electrons via cytochromes bc1 complex to cytochrome c.
- Cytochrome c is a small protein attached to the outer surface of the inner membrane and transfer electrons from complex III to complex IV.
- When electrons transferred from one carrier to another via complex I to complex IV, they are coupled to ATP synthesis of ATP from ADP and Pi.
- Oxygen plays a vital role in removing electrons and hydrogen ion and finally helps in the production of H2.





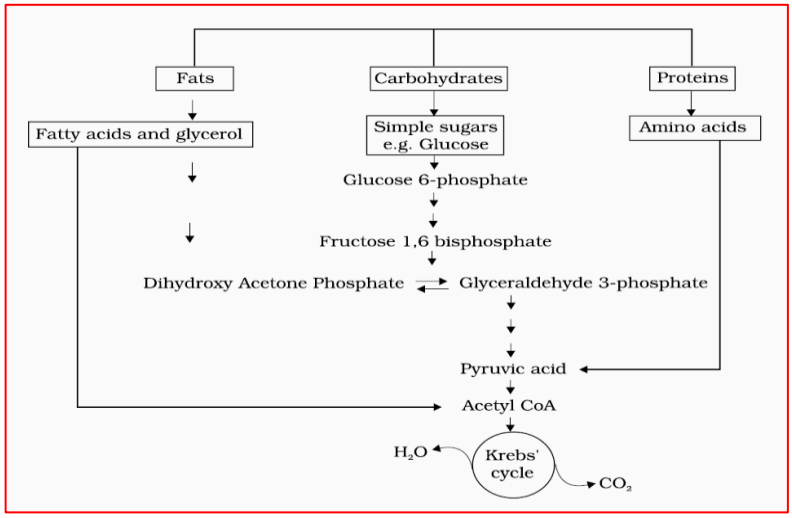
- ATP synthase- it consists of F1 and F0. The F1 (head) contains the site for the synthesis of ATP from ADP and inorganic phosphate. F0 forms the channel through which protons cross the inner membrane. The passage of protons through the channel is coupled to the catalytic site of the F1 component for the production of ATP.

THE RESPIRATORY BALANCE SHEET

Stages	CO_2	ATP	Reduced NAD^+	Reduced FAD	Total ATP Production
Glycolysis	0	2	2 ($2 \times 2 = 4$)	0	6
Link reaction	2	0	2 ($2 \times 3 = 6$)	0	6
Krebs cycle	4	2	6 ($6 \times 3 = 18$)	2 ($2 \times 2 = 4$)	24
Total	**6**	**4 ATPs**	**28 ATPs**	**4 ATPs**	**36 ATPs**

AMPHIBOLIC PATHWAY

- Respiratory pathway involves both anabolism and catabolism and therefore called an amphibolic pathway.
- Krebs cycle involves both the catabolism of carbohydrates and fatty acids and the anabolism of amino acids.



RESPIRATORY QUOTIENT

- The ratio of the volume of CO2 evolved to the volume of O2 consumed in respiration is called the respiratory quotient (RQ) or respiratory ratio.
- RQ of carbohydrate: 1
- RQ of fat and proteins: less than 1

$$RQ = \frac{\text{volume of } CO_2 \text{ evolved}}{\text{volume of } O_2 \text{ consumed}}$$

IMPORTANT QUESTIONS

Very Short Answer Type Questions

1- Glycolysis occurs in-

a- Cytoplasm
b- Mitochondria
c- Both in a and b
d- In vacuoles

Ans: a

2- Which even is more likely to occur in yeast cells-

a- Glycolysis
b- Krebs cycle

c- Fermentation

d- Both a and c

Ans: d

3- The scheme of the glycolysis is given by –

a- Embden

b- Meyerhof

c- Parnas

d- All of these

Ans: d

4- RQ value of Carbohydrates is –

a- 1 b- less than one c- more than 1 d- infinite

Ans: a

5- Assertion: Glycolysis is the last step of aerobic respiration.

Reason: There is a net gain of 28 molecules of ATP in glycolysis.

(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(c) Assertion is true but Reason is false.

(d) Both Assertion and Reason are false.

Ans: d

6- Assertion: The process of glycolysis is also known as the EMP pathway.

Reason: It is the only process of respiration in aerobic organisms.

(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(c) Assertion is true but Reason is false.

(d) Both Assertion and Reason are false.

Ans: c

7- Assertion: Fermentation is the incomplete oxidation of glucose into ethanol.

Reason: It occurs in all green plants and animal cells.

(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(c) Assertion is true but Reason is false.

(d) Both Assertion and Reason are false.

Ans: c

8- Assertion: The powerhouse of the cell is mitochondria.

Reason: Energy (ATP) is produced in mitochondria during aerobic respiration.

(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(c) Assertion is true but Reason is false.

(d) Both Assertion and Reason are false.

Ans: a

9- Assertion: Substrate-level phosphorylation is the direct synthesis of ATP.

Reason: It is very common in Glycolysis.

(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is true but Reason is false.
(d) Both Assertion and Reason are false.
Ans: b

10- **Assertion: Pyruvate formation takes place at the end of glycolysis.**
Reason: Oxygen is the terminal electron receiver during the electron transport chain.
(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) Assertion is true but Reason is false.
(d) Both Assertion and Reason are false.
Ans: c

Short Answer Type Questions

1- **Where and when does lactic acid formation take place in humans?**
Ans: In humans, anaerobic respiration takes place in the absence of oxygen during cellular respiration. Like after heavy exercise in muscle cells anaerobic respiration takes place.

2- **What is the role of the inner mitochondrial membrane in oxidative phosphorylation?**
Ans: electron transport chain/ electron carriers are ranged on the inner mitochondrial membrane.

3- **Why does anaerobic respiration produce less energy than aerobic respiration?**
Ans: Because in anaerobic respiration partial oxidation of substrate takes place while in aerobic respiration complete oxidation takes place.

4- **Write the end products of oxidative phosphorylation.**
Ans: ATP and water

5- **Write an equation for oxidative decarboxylation of pyruvate.**

$$\text{Pyruvic acid} + \text{CoA} + \text{NAD}^+ \xrightarrow[\text{Pyruvate dehydrogenase}]{Mg^{2+}} \text{Acetyl CoA} + CO_2 + \text{NADH} + H^+$$

6- **Give a Diagrammatic presentation of ATP synthesis in mitochondria.**
Ans: Figure 14.5, Page 234, NCERT

7- **Where is ETC found in eukaryotic cells?**
Ans: The electron transport system, can be found in the eukaryotic cell of the mitochondrial membrane.

8- **Mention the role of NADH synthesized in the EMP pathway during respiration.**
Ans: The NADH synthesized in glycolysis is transferred into the mitochondria and undergoes oxidative phosphorylation.

9- **Give the difference between Breathing and Respiration.**
Ans: Breathing - a biophysical process
Respiration- biochemical process.
Breathing- the process of inhaling oxygen and releasing carbon dioxide into the air

Respiration- Food is oxidized to release energy.

10- How many ATP molecules are formed during the glycolysis and fermentation process?

Ans: net gain in glycolysis is 2 ATP

In fermentation 2 ATPs are formed.

11- Mention the importance of the citric acid cycle.

Ans: ATP generation.

Formation of important intermediates compounds necessary for the synthesis of biomolecules like amino acids, nucleotides, etc.

12- Write formulae to derive the RQ value. Also, mention the RQ values of glucose and fatty acids.

Ans:

$$\text{RQ} = \frac{\text{volume of } CO_2 \text{ evolved}}{\text{volume of } O_2 \text{ consumed}}$$

The RQ value for glucose is 1 while the RQ value for fatty acid is less than one.

Long Answer Type Questions

1- Explain Glycolysis only by giving a flow chart.

Ans: Figure 14.1, page 229, NCERT

2- Give a detailed account of Kreb's cycle.

Ans: it is also known as the TCA cycle.

i. In the first step the acetyl co A condenses with OAA and forms citric acid with the help of the enzyme citrate synthase. A molecule of CoA is released during this step.

ii. Citrate is converted into α-ketoglutaric acid by decarboxylation and reduction of NAD^{+}.

iii. The α-ketoglutaric acid forms succinic acid. In this step CO2 is released, NAD+ is reduced to NADH + H+ and GTP is formed (by substrate-level phosphorylation).

iv. Succinic acid is converted into malic acid with the reduction of FAD into FADH2.

v. The malic acid is converted into OAA by the reduction of NAD+ into NADH + H +

vi. Krebs cycle is repeated twice for every glucose molecule where two molecules of pyruvic acid produce 6 CO2, 8 mol of NADH + H+, 2 mol of FADH2, and 2 mol of ATP.

Fig: 14.3. page 232, NCERT

3- Describe the process of the oxidative phosphorylation system in mitochondria.

- Ans: Oxidation of NADH + H+ and FADH2 takes place through a series of Electron and hydrogen (proton) transport chains. The metabolic pathway, through which the electron passes from one carrier to another, is called the electron transport system (ETS).
- Complex I: NADH dehydrogenase, Complex II: succinate dehydrogenase, Complex III: cytochromes bc1, Complex IV: cytochromes a-a3, Complex V: ATP synthase
- ETS is present in the inner mitochondrial membrane and involves four complexes (I-IV).
- NADH2 is oxidized by NADH dehydrogenase and electrons are then transferred to ubiquinone (on the inner mitochondrial membrane).
- FADH2 is oxidized by succinate dehydrogenase and transferred electrons to ubiquinone.
- The reduced ubiquinone (ubiquinol) is then oxidized with the transfer of electrons via cytochromes bc1 complex to cytochrome c.
- Cytochrome c is a small protein attached to the outer surface of the inner membrane and transfers electrons from complex III to complex IV.

- When electrons are transferred from one carrier to another via complex I to complex IV, they are coupled to ATP synthesis of ATP from ADP and Pi.
- Oxygen plays a vital role in removing electrons and hydrogen ions and finally helps in the production of H2.
- ATP synthase- it consists of F1 and F0. The F1 (head) contains the site for the synthesis of ATP from ADP and inorganic phosphate. F0 forms the channel through which protons cross the inner membrane. The passage of protons through the channel is coupled to the catalytic site of the F1 component for the production of ATP.

Chapter-15
Plant - Growth and Development

DEVELOPMENT

(Growth and Differentiation)

OPEN GROWTH →	Due to meristem, new cells are always being added to the plant body
CLOSE GROWTH →	limited in growth
PRIMARY GROWTH →	Due to apical meristem, new cells are added causing linear growth of the plant body
SECONDARY GROWTH →	Due to lateral meristems, vascular cambium and cork-cambium, increase in the girth

- The first step in the process of plant growth is seed germination.
- Growth can be defined as an irreversible permanent increase in size of an organ or its parts or even of an individual cell.
- Plant Growth Generally is Indeterminate. This ability of the plants is due to the presence of meristems at certain locations in their body.
- Growth is measured by a variety of parameters some of which are: increase in fresh weight, dry weight, length, area, and volume and cell number.

Phases of Growth

PHASES OF GROWTH

Meristematic phase- Represented by constantly dividing cells, both at the root apex and the shoot apex.
The cells in this region are rich in protoplasm, have large conspicuous nuclei, cell walls are thin and cellulosic with abundant plasmodesmata connections.

Elongation phase-Situated proximal to the meristematic zone.
This is characterized by increased vacuolation, cell enlargement and new cell wall deposition.

Maturation phase- More proximal to the phase of elongation, the phase of maturation is situated.
The cells of this zone attain their maximal size in terms of wall thickening and protoplasmic modifications.

Growth Rates

Arithmetic Growth Rate

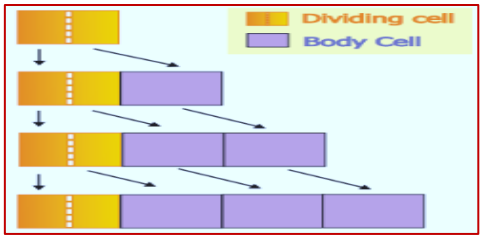
- The rate of growth is constant and it increases in an arithmetic manner.
- Only one cell is allowed to divide between the two-resulting progeny cell.
- One continues to divide but the other undergoes cell cycle arrest and begins to develop, differentiate and mature.
- Mathematically, it is expressed as

$L_t = L_0 + rt$

L_t = length at time 't'

L_0 = length at time 'zero'

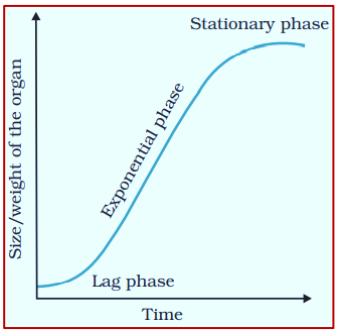
r = growth rate / elongation per unit time.



Geometric growth rate

- Geometric cell division results if all cells of an organism or tissue are active mitotically
- The exponential growth can be expressed as

$W_1 = W_0 e^{rt}$
W_t = final size (weight, height, number etc.)
W_0 = initial size at the beginning of the period
r = growth rate
t = time of growth
e = base of natural logarithms



Sigmoid growth curve

- Lag phase (lag phase): initial slow growth rate
- Exponential phase (log phase): rapid growth rate, here, both the progeny cells following mitotic cell division retain the ability to divide and continue to do so.
- Stationary phase: due to limited nutrient supply, the growth slows down leading to a stationary phase.

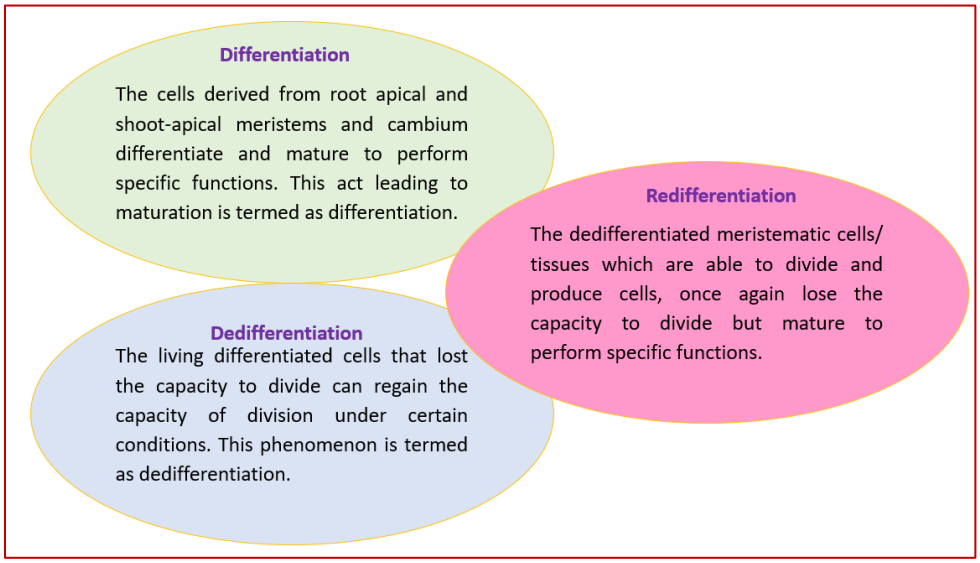
Absolute and relative growth rate:

- Measurement and the comparison of total growth per unit time are called the absolute growth rate.
- The growth of the given system per unit time expressed on a common basis, e.g., per unit initial parameter is called the relative growth rate

Conditions for Growth

- Water provides the medium for enzymatic activities needed for growth.
- Oxygen helps in releasing metabolic energy essential for growth activities.
- Nutrients (macro and micro essential elements) are required by plants for the synthesis of protoplasm and act as a source of energy.
- Optimum temperature – specific for each plant.

Differentiation, dedifferentiation and redifferentiation



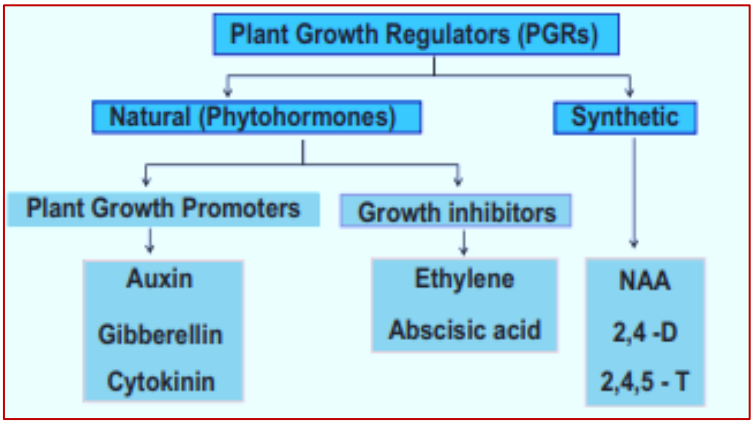
Development

- Development is a term that includes all changes that an organism goes through during its life cycle from germination of the seed to senescence.
- Plasticity: it is the ability of plants to follow different pathways in response to the environment or phases of life to form different kinds of structures.
  Examples: heterophylly in cotton, coriander and larkspur.
  In such plants, the leaves of the juvenile plant are different in shape from those of mature plants.
  In buttercup, the shape of leaves is different in different habitats (soil/ water).

PLANT GROWTH REGULATORS (PGR)/ Phytohormones

- Plant Growth Regulators are organic substances that are synthesized in minute quantities in one part of the plant body and transported to another part where they influence specific physiological processes.
- These are usually produced in the tips of roots, stems and leaves.
- These are transported through conductive systems.

Types:



- Plant growth promoters: involved in growth promoting activities, such as cell division, cell enlargement, pattern formation, tropic growth, flowering, fruiting and seed formation. e.g., auxins, gibberellins and cytokinins.
- Plant growth inhibitors: involved in various growth inhibiting activities such as dormancy and abscission. These play important role in stressful condition. E.g. The gaseous PGR, ethylene, Abscisic acid.

The Discovery of Plant Growth Regulators

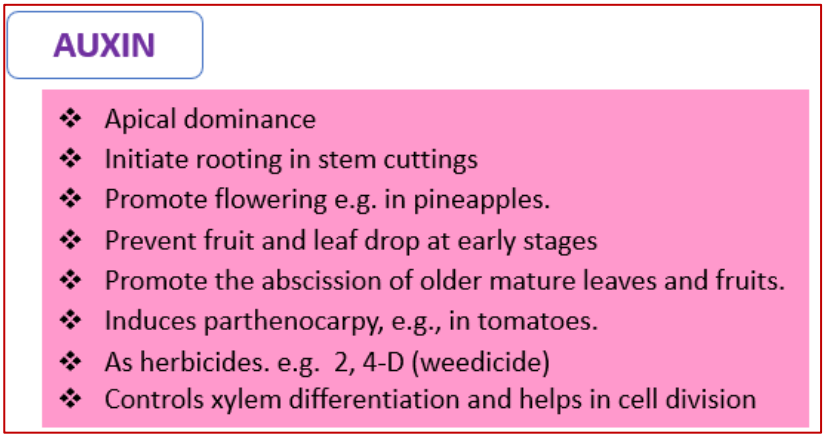
- **Darwin and his son Francis Darwin** observed phototropism in coleoptiles of canary grass and concluded that the tip of coleoptile was the site of stimulus that causes the bending of the coleoptile .Auxin was isolated by F.W. Went from tips of coleoptiles of oat seedlings.
- **Kurosawa** (1926) discover gibberellin acid while studying bakanae' (foolish seedling) disease of rice which caused by a fungal pathogen *Gibberella fujikuroi*.

- **F. Skoog** studies on callus differentiation on tobacco plant and effect of extracts of vascular tissues, yeast extract, coconut milk or DNA. Latter **Miller** identified kinetin and 9its role in cytokinesis during callus differentiation.
- **Independent workers**: Abscisic acid (ABA) (inhibitor-B, abscission II and dormin)
- **H.H. Cousins** discover ethylene, a gaseous PGR.

Physiological Effects of Plant Growth Regulators

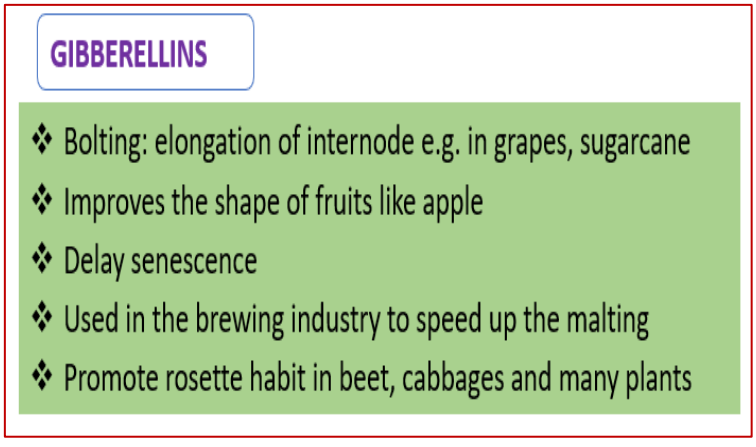
Auxin

- Auxin was first isolated from human urine.
  Examples: 3-acetic acid (IAA), indole butyric acid (IBA), synthetic auxin (NAA, 2, 4-D (2, 4-dichloro phenoxy acetic)



Gibberellins

- More than 100 gibberellins are known.
- Gibberellic acid (GA3) is most intensively studied form.



Cytokinins

- These are discovered from kinetin (a modified form of adenine, a purine) from the autoclaved herring sperm DNA.

CYTOKINES

- Similar chemical zeatin is observed in corn kernels and coconut milk.
- Natural cytokinins are synthesized in regions where rapid cell division occurs, for example, root apices, developing shoot buds, young fruits
- Helps to produce new leaves, chloroplasts in leaves, lateral shoot growth and adventitious shoot formation.
- Help overcome apical dominance.
- Promote nutrient mobilisation which helps in the delay of leaf senescence.

Ethylene

- It is a gaseous PGR.
- This is synthesised in large amounts by tissues undergoing senescence and ripening fruits.
- Ethephon (a type of ethylene) in an aqueous solution is readily absorbed and transported within the plant and releases ethylene slowly.

Role

- Horizontal growth of seedlings, swelling of the axis and apical hooks formation in dicot seedlings.
- It promotes senescence and abscission of plant organs.
- It enhances the respiration rate (respiratory climactic) and therefore ripening of ruit.
- Ethylene breaks seed and bud dormancy, initiates germination in peanut seeds, sprouting of potato tubers.
- Ethylene promotes rapid internode/petiole elongation in deep water rice plants.
- It also promotes root growth and root hair formation, thus helping the plants to increase their absorption surface.
- It is used in pine apple to initiate flowering and synchronising fruit-set.
- In mango it induces flowering.
- . Ethephon hastens fruit ripening in tomatoes and apples and accelerates abscission in flowers and fruits (cotton, cherry, and walnut).
- It promotes female flowers in cucumbers thereby increasing the yield.

Abscisic acid

- It acts as a general plant growth inhibitor and an inhibitor of plant metabolism.

ABSCISIC ACID

It inhibits seed germination.
As stress hormone: ABA stimulates the closure of stomata and increases the stress tolerance of plants.
ABA induces dormancy- seeds to withstand desiccation and other factors unfavourable for growth.
ABA acts as an antagonist to GAs.

IMPORTANT QUESTIONS

Very Short Answer Questions

1- What is the significance of the log phase during plant development-

a- Minimum growth
b- Maximum growth
c- Stationary growth
d- Negligible

Ans: b

2- Which PGR is known as the stress hormone-

a- Auxin
b- Cytokinin
c- Ethylene
d- Abscisic acid

Ans: d

3- Which plant growth regulator is used for ripening of the fruits-

a- Ethylene
b- Abscisic acid
c- Auxin
d- All of these

Ans: a

4- **The formation of interfascicular cambium is due to –**

a- Dedifferentiation
b- Differentiation
c- Redifferentiation
d- Meristem

Ans: a

5- C_2H_4 is derivative of-

a- Indole
b- Gas
c- Terpene
d- Carotenoids

Ans: b

6- In a leguminous plant, which growth substance acts as a stimulant during nodule formation?

a- IAA
b- ABA
c- Ethylene
d- All of these

Ans: a

7- Which of the following mainly produces auxins?

a- Apical Cambium
b- Root cambium
c- Apical shoot meristem

d- Abscisic acid

Ans: c

8- **Assertion: The plant growth is indefinite.**

Reason: Plants retain the capacity for continuous growth throughout their life.

(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(c) Assertion is true but Reason is false.

(d) Both Assertion and Reason are false.

Ans: a

9- **Assertion: Apical dominance is increased by the removal of the shoot tip.**

Reason: Due to the accumulation of auxin in lateral parts, growth is inhibited.

(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(c) Assertion is true but Reason is false.

(d) Both Assertion and Reason are false.

Ans: d

10- **Assertion: Auxins help to prevent fruit and leaf drop at early stages.**

Reason: Auxins promote the abscission of older mature leaves and fruits.

(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(c) Assertion is true but Reason is false.

(d) Both Assertion and Reason are false.

Ans: b

Short Answer Questions

1- **Give the name of two factors that govern and control plant developmental processes.**

Ans: intrinsic (internal) and extrinsic (external) to the plant.

2- **What would happen if the meristem ceases to divide?**

Ans: These cells form permanent tissues as they do not divide further.

3- **Mention any two parameters by which one can measure growth in plants.**

Ans: increase in fresh weight, dry weight, length, area, volume and cell number (any two)

4- **What is interesting facts about growth in terms of number and size in maize and watermelon respectively?**

Ans: maize root apical meristem can give rise to more than 17,500 new cells per hour, whereas cells in watermelon may increase in size by up to 3,50,000 times.

5- **Write two features of Meristematic cells near the root tip.**

Ans: Rich protoplasm

The cell wall is cellulosic and thin

6- **What is Plasticity? Give two examples of this.**

Ans: Plasticity is the ability of plants to follow different pathways in response to the environment or phases of life to form different kinds of structures.

Examples: heterophylly in cotton, coriander, and larkspur, leaves of buttercup

7- **Provide stages of germination and seedling development in beans.**

Ans: Figure 15.1, Page 240. NCERT

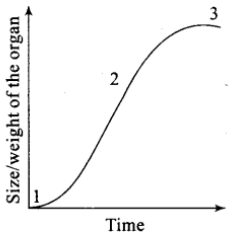
8- **Which hormone is considered a stress hormone and why?**

Ans: Abscisic acid is known as the stress hormone. It enhances plant tolerance to a variety of stresses. ABA promotes seed dormancy and ensures seed germination in favorable conditions. The hormone also stimulates leaf, fruit, and flower abscission.

9- **Plant growth is unique because plants retain the capacity for unlimited growth throughout their life. Explain.**

Ans: This ability of the plants is due to the presence of meristems at certain locations in their body. The cells of such meristems have the capacity to divide and self-perpetuate.

10- **In the figure of the Sigmoid growth curve given below, label segments 1,2 and 3.**



Ans: 1- lag phase, 2- log phase 3- stationary phase

11- **Name the enzyme responsible for –**

Apical dominance, bolting, fruit ripening, stress hormone

Ans: Auxin, Gibberellin, ethylene, Abscisic acid

12- **Name the mechanism by which the apical bud suppresses the growth of lateral buds? Suggest measures to overcome this phenomenon.**

Ans: The phenomenon is apical dominance.

This is due to the auxin hormone secreted by apical buds.

This can be overcome by decapitation (removal of apical buds).

13- **List a hormone that: is gaseous in nature,, used as weedicides, stimulates the closure of stomata, and increases the stress tolerance**

Ans: Ethylene, 2,4- D, Abscisic acid

14- **Mention mathematical formula of determining arithmetic growth and geometric growth in plants.**

Ans: arithmetic

$L_t = L_0 + rt$

L_t = length at time 't'

L_0 = length at time 'zero'

r = growth rate / elongation per unit time.

geometric

$W_1 = W_0 e^{rt}$

W_t = final size (weight, height, number etc.)

W_0 = initial size at the beginning of the period

r = growth rate

t = time of growth

e = base of natural logarithms

Long Answer Questions

1- **(i) Name the two plant growth inhibitor hormones.**

(ii) Compare their role by giving four examples of each.

Ans: (i) Abscisic Acid, Ethylene

(ii) Ethylene

Ethylene: it helps in the Horizontal growth of seedlings. Ethylene causes the ripening of fruits. It promotes senescence and abscission of plant organs, It enhances the respiration rate (respiratory climactic).

Abscisic acid: It inhibits seed germination. As a stress hormone, it stimulates the closure of stomata and increases the stress tolerance of plants. ABA induces dormancy- seeds to withstand desiccation and other factors unfavorable for growth. ABA acts as an antagonist to GAs.

2- (i) Distinguish differentiation, dedifferentiation and redifferentiation.

(ii) Explain the Sequence of the developmental process in a plant cell only with the flow chart.

Ans: (i) **Differentiation:** The cells derived from root apical and shoot-apical meristems and cambium differentiate and mature to perform specific functions. This act leading to maturation is termed as differentiation.

Dedifferentiation: The living differentiated cells that lost the capacity to divide can regain the capacity of division under certain conditions. This phenomenon is termed as dedifferentiation.

Redifferentiation: the dedifferentiated meristmatic cells/ tissues which are able to divide and produce cells, once again lose the capacity to divide but mature to perform specific functions.

(ii) Figure 15.8, Page 246, NCERT

3- (i) Give any four roles of auxin.

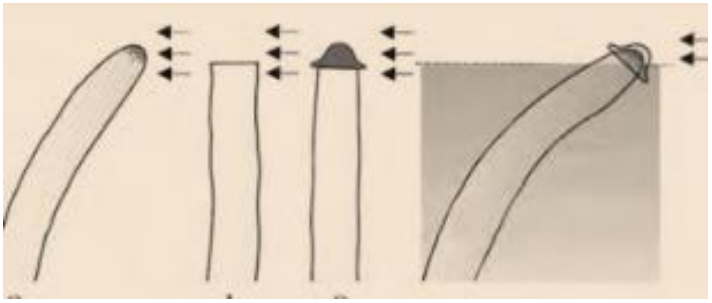
(ii) Provide one example of each of the derivatives of carotenoids, terpenes and adenine.

Ans: (i) In apical dominance, Auxin promotes cell division in the vascular cambium, Auxin promotes root initiation, It causes the development of callus in tissue cultures, Auxin is also involved in apical dominance and abscission.

(ii) Adenine derivatives (N6 -furfuryl amino purine, kinetin), carotenoids (Abscisic acid, ABA); terpenes (Gibberellic acid, GA3)

(iii) name the type of Cytokinin that occur in maize plant.

4- (i) Explain the mechanism by observing the following picture-



(ii) By application of which PGR the yield of sugarcane can be achieved up to 20 tons per acre.

(iii) Name the type of Cytokinin which is present in Maize plant.

Ans: Darwin and his son Francis Darwin when observed that the coleoptiles of canary grass responded to unilateral illumination by growing towards the light source (phototropism). After a series of experiments, it was concluded that the tip of the coleoptile was the site of transmittable influence that caused the bending of the entire coleoptile.

(ii) Gibberellin

(iii) Zeatin

5- Give a brief account of the discovery of Phytohormones.

Ans: **Darwin and his son Francis Darwin** observed phototropism in coleoptiles of canary grass and concluded that the tip of the coleoptile was the site of stimulus that causes the bending of the coleoptile. Auxin was isolated by F.W. Went from tips of coleoptiles of oat seedlings.

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Independent workers: Abscisic acid (ABA) (inhibitor-B, abscission II and dormin)

H.H. Cousins discover ethylene, a gaseous PGR.

Chapter-17

Breathing and Exchange of Gases

The process of exchange of O2 from the atmosphere with CO2 produced by the cells is called breathing.

Primary functions of the respiratory system

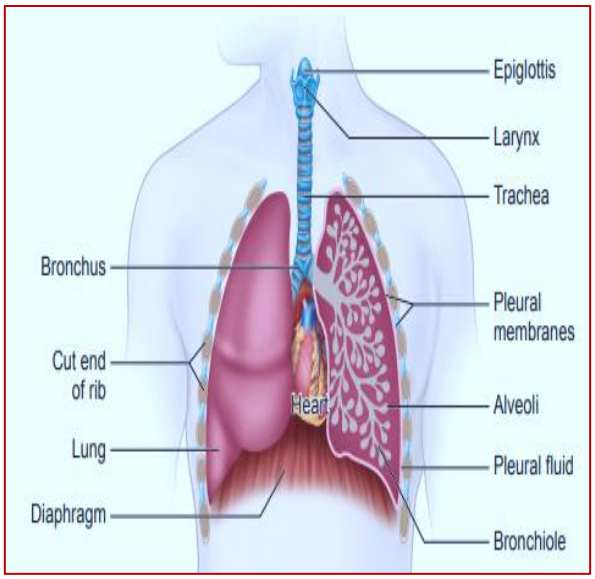
- To exchange O2 and CO2 between the atmosphere and the blood.
- To maintain homeostatic regulation of body pH.
- To protect us from inhaled pathogens and pollutants.
- To maintain the vocal cords for normal communication (vocalization).
- To remove the heat produced during cellular respiration.

Respiratory organs in various organisms

Respiratory organs in various organisms

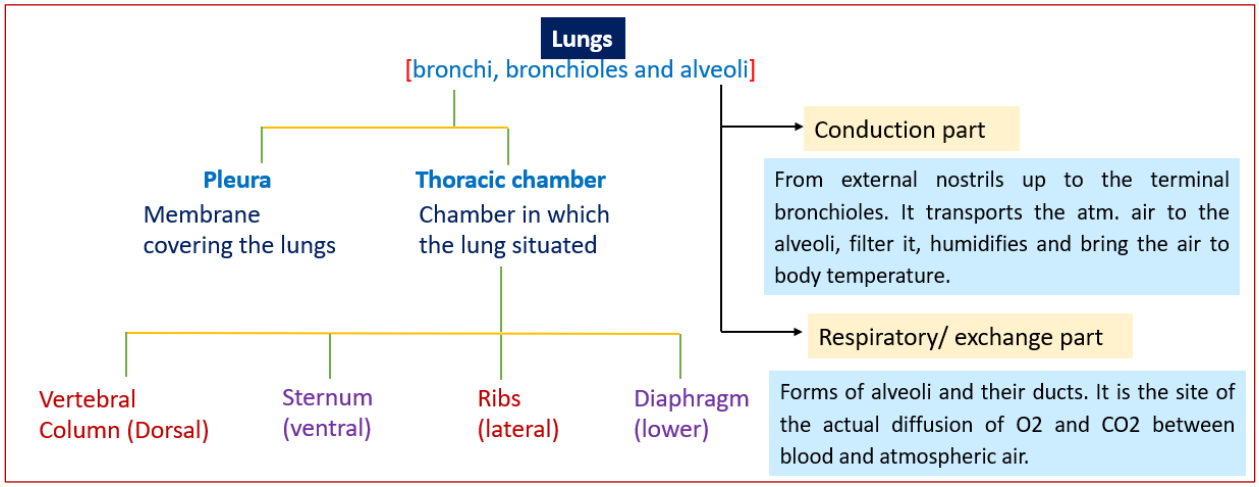
- Simple diffusion: sponges, coelenterates and flatworms
- Gills (branchial respiration): Aquatic Arthropods, Molluscs, fish
- Moist skin (cutaneous respiration): Earthworms, frogs
- Tracheal tube: Insects have tracheal tubes.
- Lung (pulmonary respiration): Amphibians, reptiles, birds and mammals

Human Respiratory System

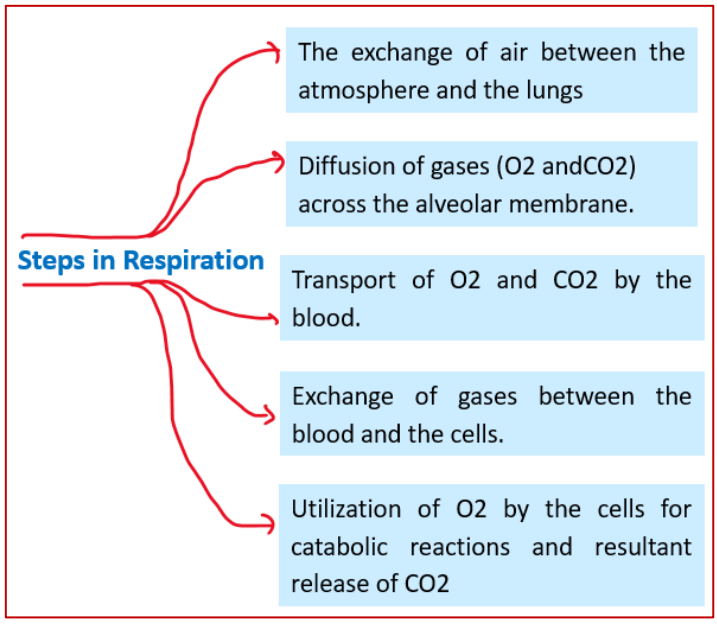


- The respiratory system includes external nostrils, nasal cavity, pharynx, larynx, trachea, bronchi and bronchioles and lungs which contain alveoli.
- Nostril leads to a nasal chamber.
- The nasal chamber opens into the pharynx (common passage for food and air).
- The pharynx opens through the larynx (cartilaginous sound box) region into the trachea.
- Epiglottis is a thin elastic cartilaginous flap that prevents the entry of food into the larynx.
- Trachea divides at the level of the 5th thoracic vertebra into the right and left primary bronchi.
- Each bronchi undergoes repeated divisions to form the secondary and tertiary bronchi and bronchioles ending up in very thin terminal bronchioles.
- The tracheae, primary, secondary and tertiary bronchi, and initial bronchioles are supported by incomplete cartilaginous rings.
- Each terminal bronchiole gives rise to bag-like structures called alveoli.

Lungs



Steps in Respiration

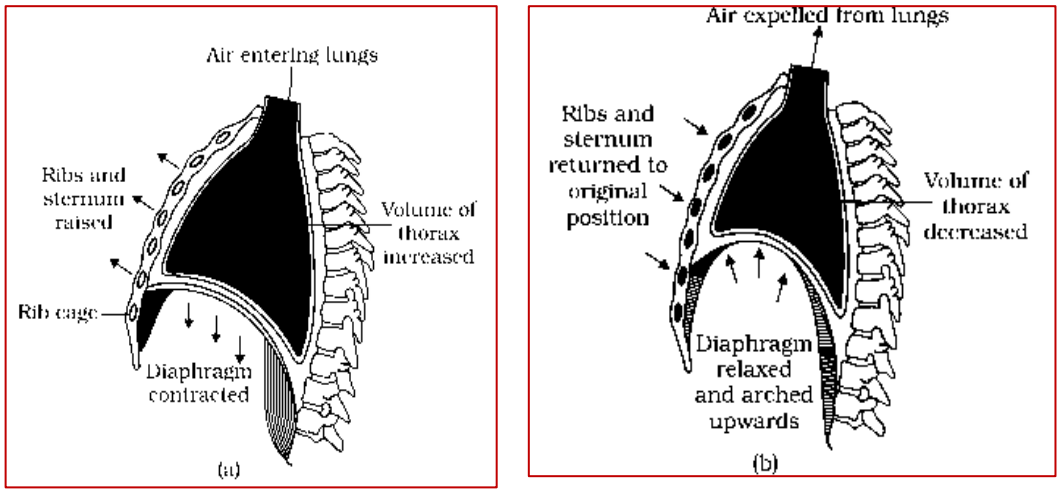


MECHANISM OF BREATHING

- It involves inspiration (intake of atmospheric air) and expiration (release out of alveolar air)
- The movement of air into and out of the lungs is carried out by creating a pressure gradient between the lungs and the atmosphere.
- Inspiration can occur if the pressure within the lungs (intra-pulmonary pressure) is less than the atmospheric pressure
- Expiration takes place when the intra-pulmonary pressure is higher than the atmospheric pressure.
- **INSPIRATION:** This is initiated by the contraction of the diaphragm muscles and external intercostal muscles, which pulls the ribs and sternum upwards and outwards and increases the

volume of the thoracic chamber in the dorso–ventral axis, forcing the lungs to expand the pulmonary volume. The increase in pulmonary volume and decrease in the intrapulmonary pressure forces the air from outside to enter the air passages into the lungs.

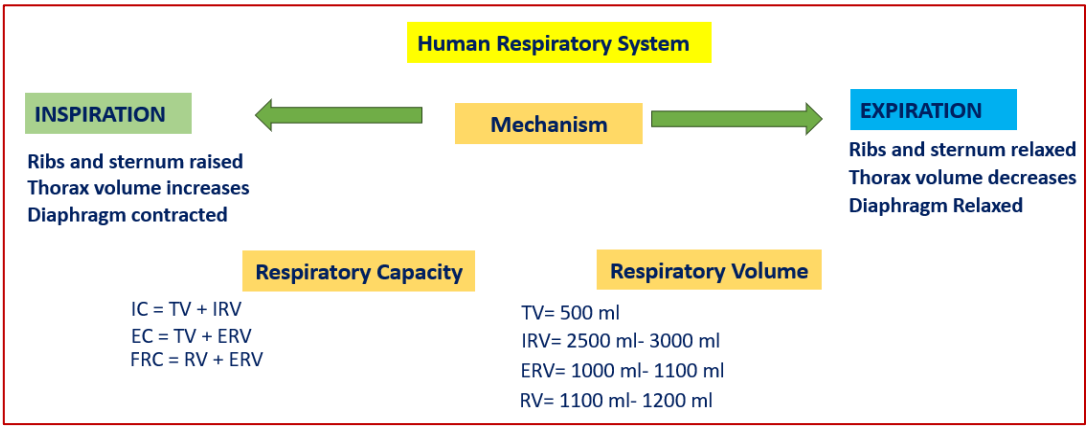
- **EXPIRATION:** Relaxation of the diaphragm allows the diaphragm and sternum to return to its original shape and the internal intercostal muscles contract, pulling the ribs downward reducing the thoracic volume and pulmonary volume. This results in an increase in the intrapulmonary pressure slightly above the atmospheric pressure causing the expulsion of air from the lungs.



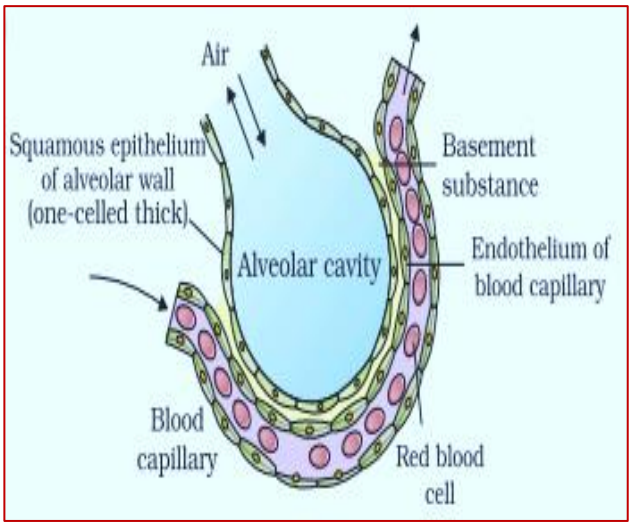
Inspiration	Expiration
Respiratory centre initiates the stimuli during inspiration. ↓ The diaphragm and exspiratory muscles contract. ↓ The thoracic volume increases as the chest wall expands. ↓ The intra pulmonary pressure is reduced. ↓ The alveolar pressure decreases than the atmospheric pressure ↓ Air is taken inside due to expansion of alveoli. ↓ Air flows into the alveoli until the alveolar pressure equalizes the atmospheric pressure and the alveoli get inflated.	Respiratory centre terminates the stimuli during expiration. ↓ The diaphragm relax but internal intercostal muscles contract. ↓ The thoracic volume decreases as the chest wall contracts. ↓ The intra pulmonary pressure is increased. ↓ The alveolar pressure increases than the atmospheric pressure. ↓ Air is sent out due to the contraction of alveoli. ↓ Air flows out of the alveoli until the alveolar pressure equalizes the atmospheric pressure and the alveoli get deflated.

Respiratory Volumes and Capacities

Vital Capacity (VC)	The maximum volume of air a person can breathe in after a forced expiration. This includes ERV, TV and IRV or the maximum volume of air a person can breathe out after a forced inspiration.
Total Lung Capacity (TLC)	The total volume of air accommodated in the lungs at the end of forced inspiration. This includes RV, ERV, TV and IRV or vital capacity + residual volume



EXCHANGE OF GASES



- Primary site of gas exchange is the alveoli.
- Exchange of gases also occurs between blood and tissues. O2 and CO2 are exchanged in these sites by simple diffusion.
- Diffusion is based on- Pressure/concentration gradient, the solubility of the gases, membrane thickness and partial pressure (pO2 / pCO2)
- Solubility of CO2 is 20-25 times higher than that of O2 therefore CO2 can diffuse much higher than O2.
- The diffusion membrane is made up of three major layers - the thin squamous epithelium of alveoli, the endothelium of alveolar capillaries and the basement substance.
- Due to pressure gradients, O2 from the alveoli enters the blood and reaches the tissues. CO2 enters the blood from the tissues and reaches the alveoli for elimination.

Table: pO2 and pCO2

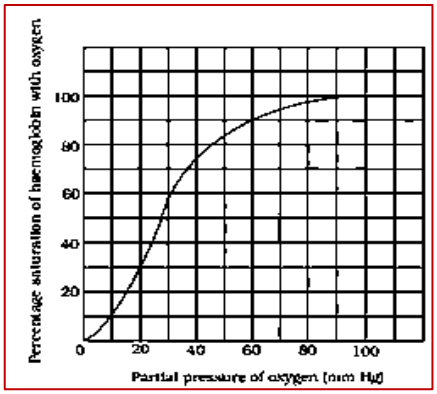
Respiratory Gas	Atmospheric Air	Alveoli	Blood (Deoxygenated)	Blood (Oxygenated)	Tissues
O_2	159	104	40	95	40
CO_2	0.3	40	45	40	45

TRANSPORT OF GASES

- Blood is the medium of transport for O2 and CO2.

O2 is transported by RBCs in the blood.	97 %
O2 is carried in a dissolved state through the plasma.	3 %
CO2 is transported by RBCs	20-25 %
CO2 carried as bicarbonate	70 %
CO2 is carried in a dissolved state through plasma.	7 %

Transport of Oxygen



- O2 binds with Haemoglobin (Hb) in RBCs and forms oxy Hb. One HB can bind up to 4 mol of O2.
- This binding depends on Po2, Pco2, p, temperature etc.
- **Oxygen dissociation curve:** A sigmoid curve is obtained when the % saturation of Hb with O2 is plotted against the pO2. In the alveoli, where there is high pO2, low pCO2, lesser H+ concentration and lower temperature, the factors are all favourable for the formation of oxyhaemoglobin.
- In the tissues, pCO2 is high, low pO2, high pH and higher temperature exist then oxyhaemoglobin dissociates. The OO2 is released in tissue.
- Every 100 ml of oxygenated blood can deliver around 5 ml of O2 to the tissues under normal physiological conditions.

Transport of Carbon dioxide

- Hb binds with CO2 and forms carbamino-haemoglobin.
- This binding depends on pO2 and pCO2 level.
- In tissues pCO2 is high than pO2, and more binding of carbon dioxide occurs with HB.
- In alveoli the pCO2 is low and pO2 is high CO2 dissociates and O2 bind with Hb.
- At the tissue site where pCO2 is high, CO2 diffuses into blood (RBCs and plasma) and forms $HCO3^-$ and H^+. The enzyme involved in carbonic anhydrase. At alveoli, reversible reaction takes place resulting in the formation of CO2 and H2O.
- RBCs contain a very high concentration of the enzyme, carbonic anhydrase, which facilitates the following reaction in both directions.

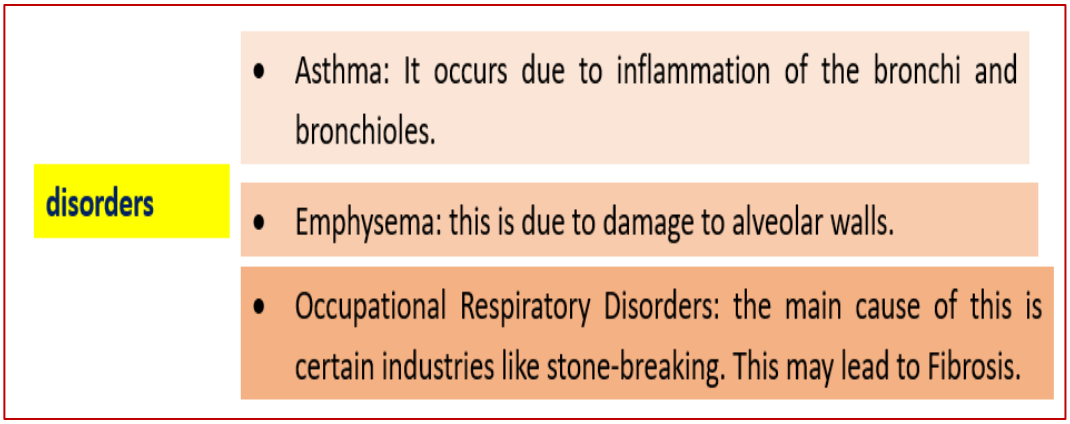
$$CO_2 + H_2O \xrightleftharpoons{\text{Carbonic anhydrase}} H_2CO_3 \xrightleftharpoons{\text{Carbonic anhydrase}} HCO_3^- + H^+$$

Regulation of respiration

- Respiratory rhythm centre situated in the medulla region of the brain regulate and maintain respiratory rhythm.

- Pneumotaxic centres in the pons region can alter the rate of respiration.
- This process is also assisted by a chemosensitive area is situated adjacent to the rhythm centre and receptors associated with the aortic arch and carotid artery which are highly sensitive to CO2 and hydrogen ions.

Disorders of the respiratory system



IMPORTANT QUESTIONS

Very short answer type questions

1- Asthma disease is related with-

a- Inflammation of bronchi and bronchioles
b- Inflammation of Alveoli
c- Inflammation of Diaphragm
d- Inflammation of Thoracic chamber

Ans: a

2- Intercostal muscles occur in:

a- Diaphragm
b- Ribs
c- Nasal chamber
d- Larynx

Ans: b

3- Conversion of C02 into H_2CO_3 is carried out by enzyme-

a- Hexokinase
b- Carbonic anhydrase
c- Corboxy peptidase
d- Both a and c

Ans: b

4- The exchange of the gases at the surface of alveoli takes place through-

a- Osmosis
b- Active transport

c- Simple diffusion
d- All of these
Ans: c

5- Spiracle can be observed in-
a- Mollusca
b- Echinodermata
c- Reptiles
d- Arthropoda
Ans: d

6- Which statement is incorrect about haemoglobin-
a- It is a protein
b- It helps in Oxygen transport
c- It helps in CO_2 transport
d- It is a triglyceride
Ans: d

7- Assertion: Trachea not collapsed even when there is no air in it.
Reason: Trachea is supported by the cartilaginous ring.
a- Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
b- Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
c- Assertion is true but Reason is false.
d- Both Assertion and Reason are false.
Ans: a

8- Assertion: Respiratory rhythm centre is moderated by the Pneumotaxic centre of the of the brain.
Reason: Pneumotaxic centers in the pons region can alter the rate of respiration.
a- Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
b- Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
c- Assertion is true but Reason is false.
d- Both Assertion and Reason are false.
Ans: b

9- Assertion. In arthropods, especially in insects, respiration is very efficient.
Reason. Insects have a special tracheal system. In this air is carried directly to the cells by tracheoles.
a- Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
b- Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
c- Assertion is true but Reason is false.
d- Both Assertion and Reason are false.
Ans: a

10- Assertion. The alveoli are richly supplied with blood.
Reason. Each bronchiole has 10 alveolar sacs.
a- Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
b- Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

c- Assertion is true but Reason is false.

e- Both Assertion and Reason are false.

Ans: d

Short answer type questions

1- **Write the respiratory organ of Birds and frog.**

Ans: Bird- Lung, Frog- Moist skin and lungs

2- **Define the partial pressure of a gas.**

Ans: It is the pressure exerted in a mixture of gases and is equal to the total pressure of the mixture of gases divided by the percentage of that gas in a mixture.

3- **Mention the role of the larynx and epiglottis.**

Ans: Larynx- sound production.

Epiglottis- prevents the entry of food into the larynx.

4- **What will happen if CO2 concentration is increases in blood?**

Ans: respiration rate becomes faster to compensate for oxygen requirement.

5- **What will happen if human blood becomes acidic?**

Ans: oxygen-carrying capacity of haemoglobin decreases.

6- **Draw the oxygen dissociation curve.**

Ans: Fig 17.5 Page 274, NCERT

7- **Write the appropriate vo9lumes of the following-**
Inspiratory Reserve Volume (IRV), Expiratory Reserve Volume (ERV)

Ans: IRV (2500 mL to 3000 Ml), ERV (1000 mL to 1100 Ml).

8- **Name the membrane that surrounds the lungs. Also, mention the role performed by that membrane.**

Ans: The name of the membrane is the pleura membrane. It reduces friction or resistance in the lungs.

9- **Write one disorder of the lungs that is associated with cigarette smoking. Also, mention the cause of the disease.**

Ans: Cigarette smoking causes emphysema disease. In this, the alveolar walls are damaged leading to decreased respiratory surfaces for the exchange of gases.

10- **Can you guess what happens to the intercostal muscles when we breath in or out?**

Ans: It moves outward when we breath in and moves inward when we breath out.

11- **How respiration does take place in frogs?**

Ans: Cutaneous respiration (with the help of moist skin)

Pulmonary respiration (with the help of the lungs)

12- **Diagrammatically represent the exchange of gases (O2 and CO2) at the alveolus and the body tissues with blood.**

Ans: Fig 17.3 Page 273, NCERT

13- **Mention the main parts involved in initiating a pressure gradient between the lungs and the atmosphere during the respiration process.**

Ans: The diaphragm and external and intercostal muscles between the ribs aid in the generation of a pressure gradient during respiration.

14- **Arrange the following parts of the human respiratory system in a proper sequence starting from the nose-**

Nasal cavity, External nostrils, trachea, pharynx, , bronchi

Ans: nasal cavity, pharynx, trachea, bronchi

15- **List the factors on which diffusion is based during exchange of gases-**

Ans: Pressure/concentration gradient, the solubility of the gases, membrane thickness and partial pressure (pO2 / pCO2)

Long answer type questions

1- **Describe the process of breathing in human.**

Ans: INSPIRATION: It is initiated by the contraction of the diaphragm muscles and external intercostal muscles. The muscles pull the ribs and sternum upwards and outwards and increase the thoracic volume forcing the lungs to expand the pulmonary volume. The increase in pulmonary volume and decrease in intrapulmonary pressure forces the air from outside to enter the air passages into the lungs.

EXPIRATION: Relaxation of the diaphragm allows the diaphragm and sternum to return to their original shape and the internal intercostal muscles contract, pulling the ribs downward and reducing the thoracic volume and pulmonary volume. This results in an increase in the intrapulmonary pressure slightly above the atmospheric pressure causing the expulsion of air from the lungs.

2- **(i) How the breathing process is regulated in humans?**

(ii) Describe any two disorders of the respiratory system.

Ans: (i) Respiratory rhythm centre situated in the medulla region of the brain regulate and maintain respiratory rhythm.

The pneumotaxic centre in the pons region can alter the rate of respiration.

This process is also assisted by a chemosensitive area situated adjacent to the rhythm centre and receptors associated with the aortic arch and carotid artery which are highly sensitive to CO2 and hydrogen ions.

(ii) Asthma is difficulty breathing causing wheezing due to inflammation of the bronchi and bronchioles.

Emphysema is a chronic disorder in which alveolar walls are damaged due to which the respiratory surface is decreased. One of the major causes of this is cigarette smoking.

3- **(i) How does haemoglobin help in the transport of oxygen from the lung to tissues?**

(ii) Name at least four factors which favours the formation of oxyhaemoglobin.

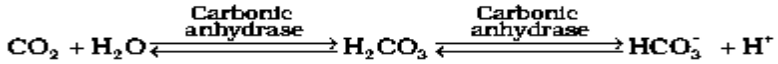
Ans: O2 and CO2 are transported across the human body through blood. 97% of the oxygen is transported from the lungs to the tissues in the form of oxyhaemoglobin via blood and 3% is transported in dissolved condition by the plasma.

Under high pO2, the oxygen easily binds with haemoglobin in the pulmonary capillaries. When this oxygenated blood reaches the different tissues, the partial pressure of oxygen declines and the bonds holding oxygen to haemoglobin become unstable. As a result, oxygen is released from the capillaries.

(ii) High pO2, , low pCO2, , lesser H+ concentration, and lower temperature

4- What is the role of the carbonic anhydrase enzyme in the transport of gases during respiration?

Ans: Carbon dioxide produced by the tissues diffuses passively into the bloodstream and passes into the red blood corpuscles where it reacts with water to form carbonic acid (H2CO3). This reaction is catalyzed by the enzyme, carbonic anhydrase found in the erythrocytes and takes less than one second to complete the process. Immediately after its formation, carbonic acid dissociates into hydrogen (H+) and bicarbonate (HCO3–) ions. The majority of bicarbonate ions ($HCO3^-$) formed within the erythrocytes diffuse out into the plasma along a concentration gradient. These combine with haemoglobin to form the haemoglobin acid (H.Hb).



5- Mention the main steps by which respiration takes place in humans.

Ans: (i) Breathing or pulmonary ventilation by which atmospheric air is drawn in and CO2 rich alveolar air is released out.

(ii) Diffusion of gases (O2 and CO2) across the alveolar membrane.

(iii) Transport of gases by the blood.

(iv) Diffusion of O2 and CO2 between blood and tissues.

(v) Utilization of O2 by the cells for catabolic reactions and resultant release of CO2

Chapter-18
Body Fluids and Circulation

BLOOD:

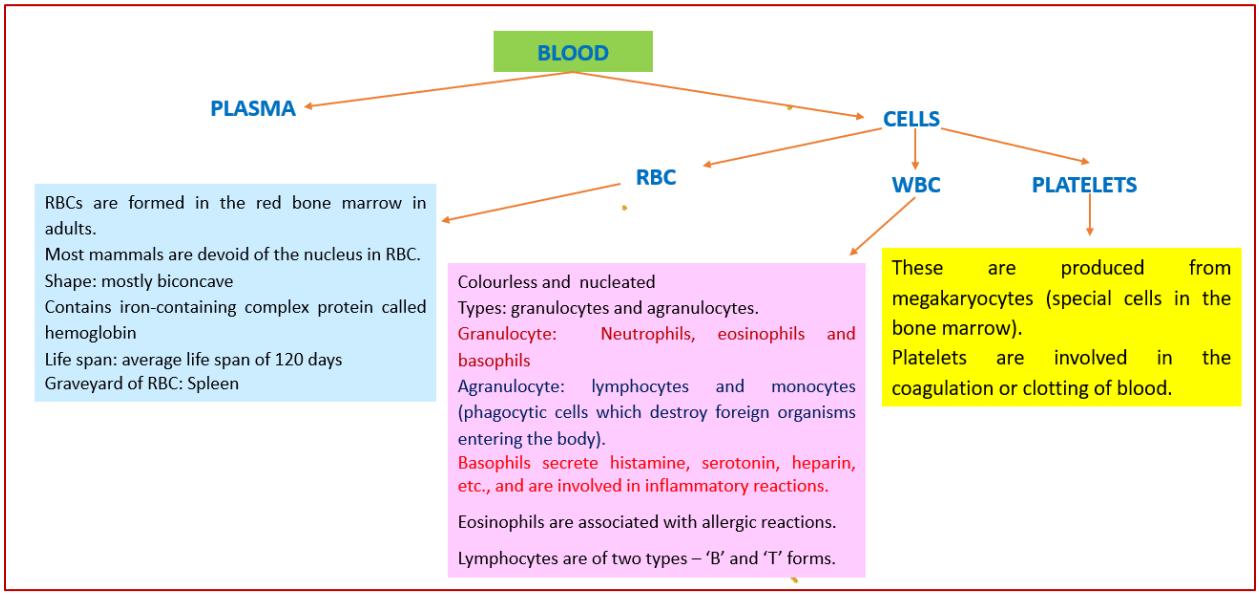
- Blood is a special connective tissue consisting of a fluid matrix, plasma, and formed elements.

PLASMA:

- Plasma is a viscous fluid constituting nearly 55 per cent of the blood. Plasma consists of water (90- 92 %, proteins (6-8%) like Fibrinogen, globulins and albumins and minerals.
  Fibrinogen: blood clotting
  Globulin: defence mechanism
  Albumin: osmotic balance.
- Plasma without clotting factors is called serum.

Formed Elements (RBC [Erythrocytes], WBC [leucocytes] and platelets)

Erythrocytes (RBC):



Blood Groups

ABO grouping

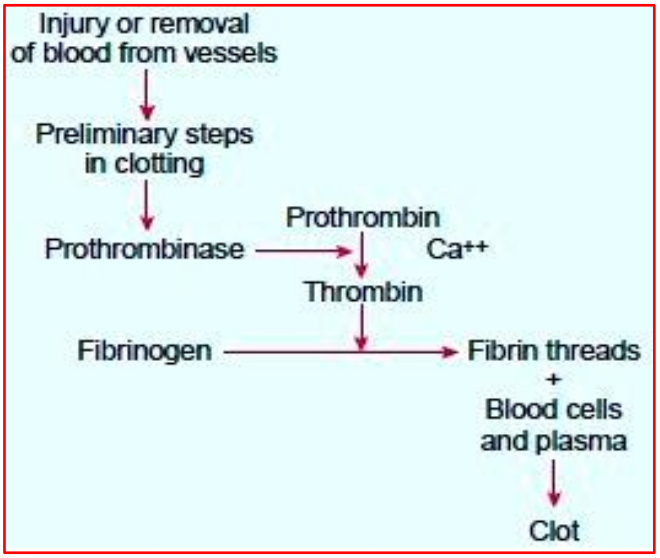
Blood Group	Antigens on RBCs	Antibodies in Plasma	Donor's Group
A	A	anti-B	A, O
B	B	anti-A	B, O
AB	A, B	nil	AB, A, B, O
O	nil	anti-A, B	O

Rh group

- The Rh blood group system is a human blood group system. It contains antigens similar to the Rhesus monkey proteins on the surface of RBC.
  Group 'O' - universal donor.
  Group AB- universal recipient.
  Rh+- Rh antigen present
  Rh- - Rh antigen absent
- An Rh-negative person if exposed to Rh-positive blood will form specific antibodies.
- **Erythroblastosis foetalis:** When a mother with Rh-negative and a foetus is Rh-positive; during her first pregnancy, Rh antigens of the foetus would not get exposed to the Rh-negative blood of the mother due to the placenta.
  However, at the time of delivery, the mother's blood may get exposed to a small amount of Rh-positive blood of the foetus.
  In such cases, the mother prepares the antibodies against the Rh antigen.
  In case of subsequent pregnancy, Rh antibodies from the mother's blood leak into the blood of the Rh-positive foetus resulting in either severe anaemia or jaundice in the foetus.

Coagulation of Blood

- On injury prothrombin is released in the presence of vitamin K.
- The prothrombin converts into the thrombin (active form) in the presence of thrombokinase and calcium ions.
- This thrombin converts into fibrinogen (inactive) into active fibrin.
- Fibrin thread then plugs the damaged part and appears like a clot.



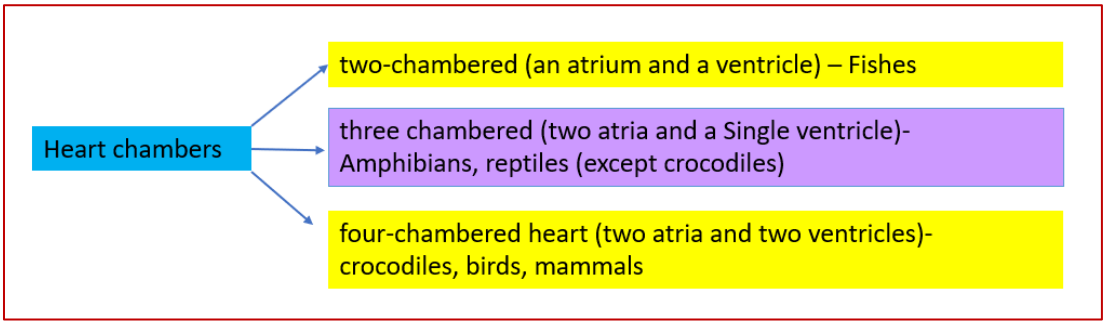
LYMPH (TISSUE FLUID)

- The fluid present in the lymphatic system is called lymph.

- It is a colourless fluid containing specialized lymphocytes that provide an immune response to the body.
- It is also an important carrier for nutrients, hormones, etc.
- Fats are absorbed through lymph in the lacteals present in the intestinal villi.

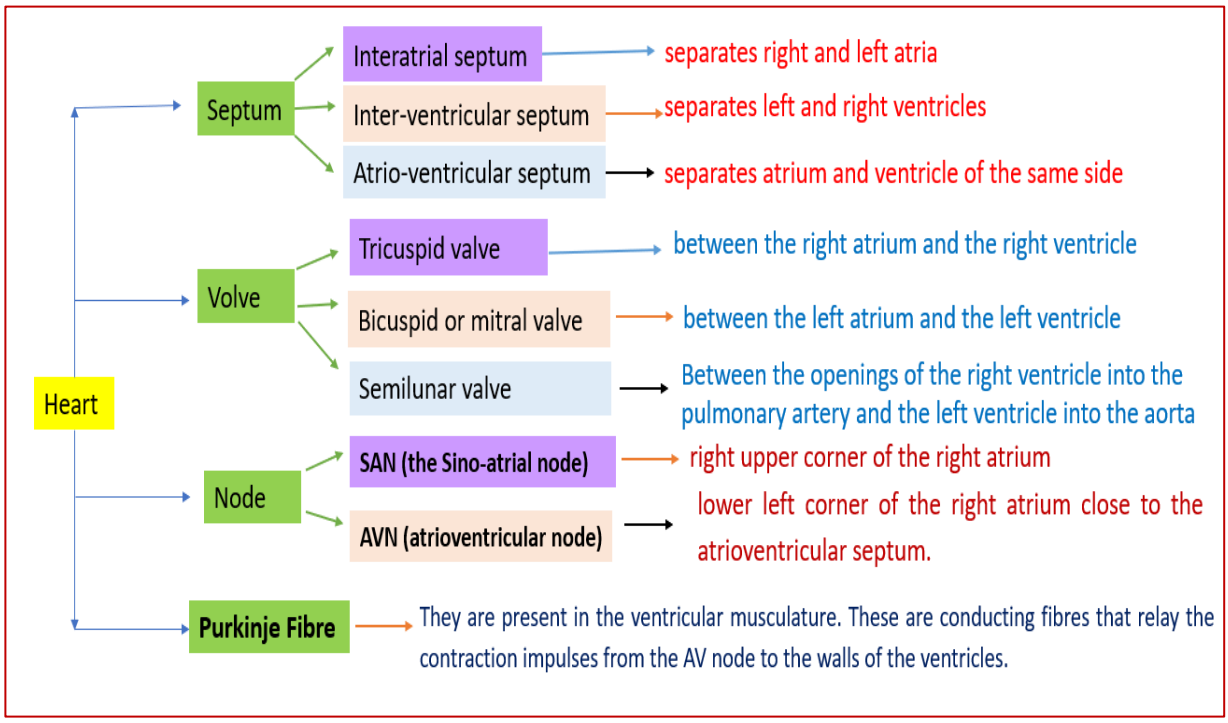
CIRCULATORY PATHWAYS

- Open circulatory system: blood pumped by the heart passes through large vessels into open spaces or Body cavities called sinuses. Ex. - Arthropods and molluscs.
- Closed circulatory system: blood pumped by the heart is always

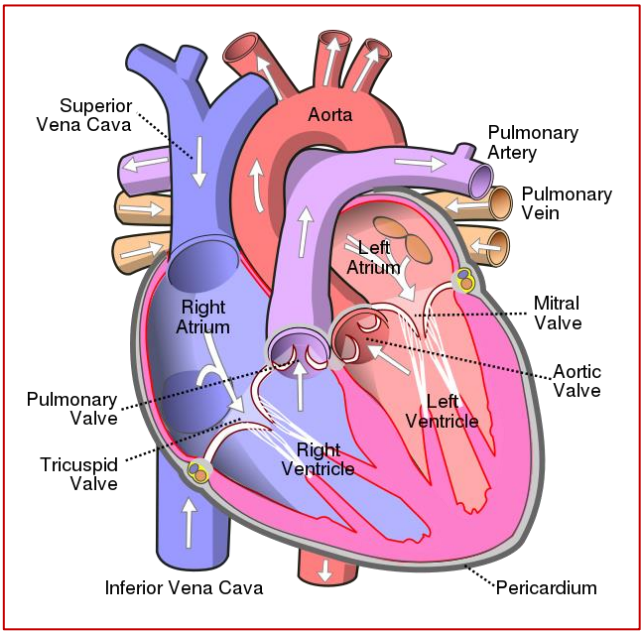


Human Circulatory System/ blood vascular system

- Heart is the mesodermally derived organ.
- It is protected by a double walled membranous bag, pericardium, enclosing the pericardial fluid.
- In the heart various valves are present. The valves allow the flow of blood only in one direction and prevent any backward flow.
- The walls of the ventricles are much thicker than that of the atria.

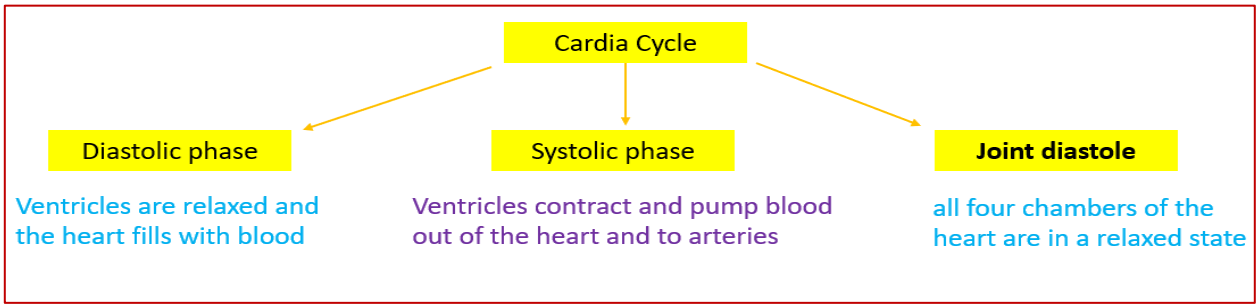


- The cardiac conduction system consists of SA Node, AV Node, AV bundle (bundle of His) and Purkinje fibres
- SA node (pacemaker) creates an action potential. The wave of excitation spreads across the atria, causing them to contract.
- Upon reaching the atrioventricular (AV) node, the signal is delayed. It is then conducted into the bundle of His, down the interventricular septum.
- The bundle of His and the Purkinje fibres spread the wave impulses along the ventricles, causing them to contract.

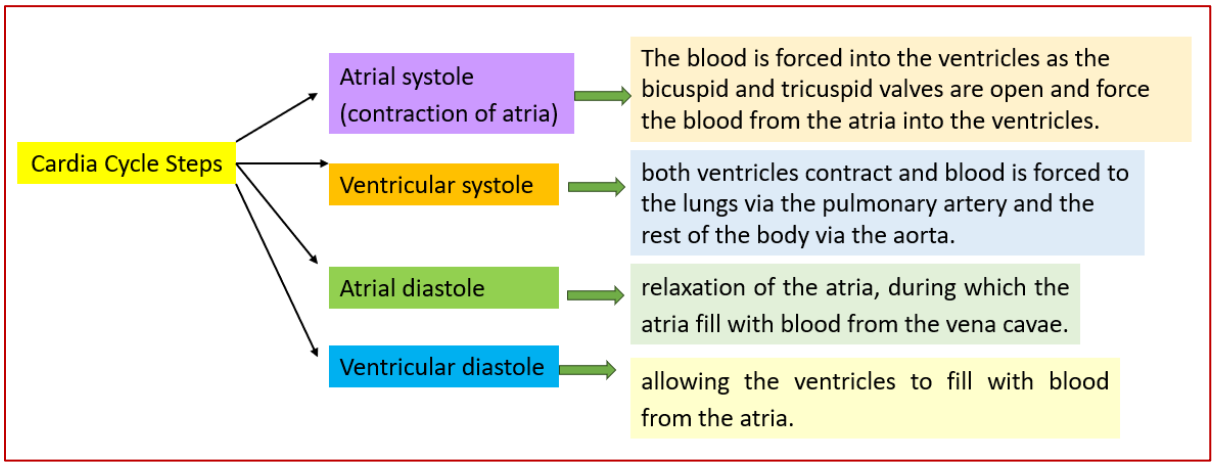


Cardiac Cycle

- The cardiac cycle consists of one heartbeat or one cycle of contraction and relaxation.



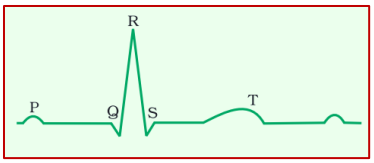
Steps:



This sequential event in the heart which is cyclically repeated is called the cardiac cycle and it consists of systole and diastole of both the atria and ventricles.

- **Stroke volume**: the volume of blood pumped by the heart during a cardiac cycle. i.e.- app. 70 mL
- **Cardiac output**: volume of blood pumped out by each ventricle per minute. i.e. – app 5000 mL.
- **Lub and Dub sound**: first heart sound (lub)- closure of the tricuspid and bicuspid valves
  second heart sound (dub)- closure of the semilunar valves.

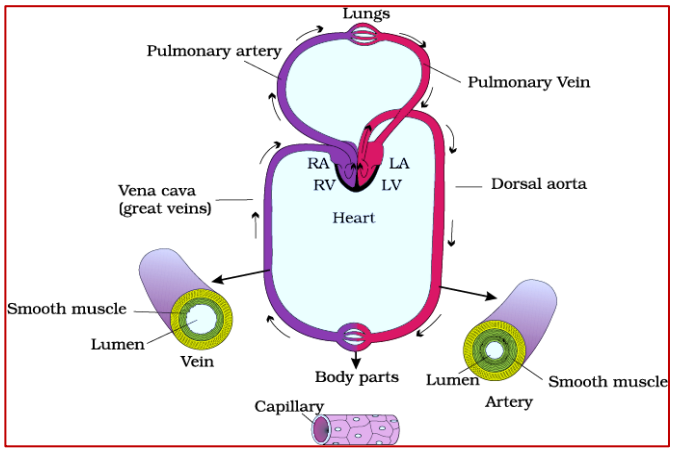
Electrocardiograph (ECG)- a graphical representation of the electrical activity of the heart during a cardiac cycle.



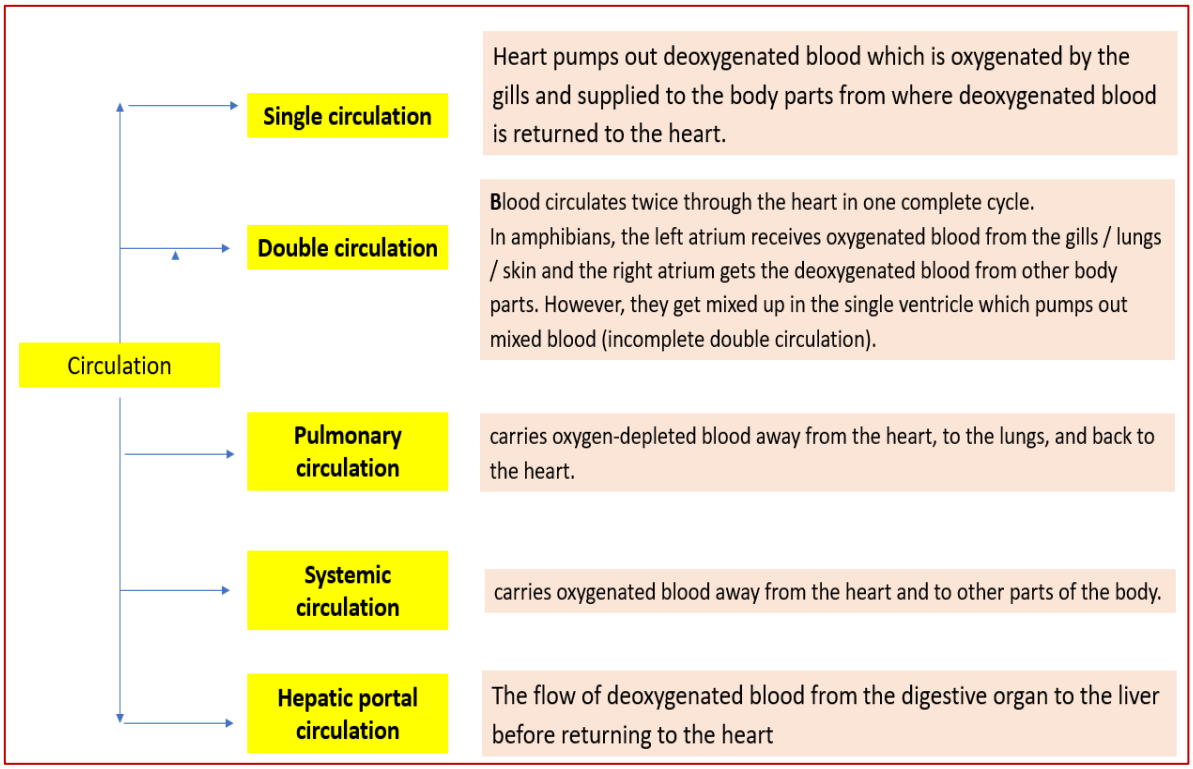
- ✓ **P-wave:** electrical excitation (or depolarisation) of the atria, which leads to the contraction of both the atria.
- ✓ **QRS** complex: depolarisation of the ventricles, which initiates the ventricular contraction.
- ✓ **T-wave**: the return of the ventricles from excited to the normal state (repolarisation). The end of the T-wave marks the end of systole.

DOUBLE CIRCULATION

- The blood flows through Blood Vessels—the arteries and veins.
- Each artery and vein consist of three layers:
  - ✓ **Tunica intima**: the inner lining of squamous endothelium
  - ✓ **Tunica media**: the middle layer of smooth muscle and elastic fibres
  - ✓ **Tunica externa**: the outer layer of fibrous connective tissue with collagen



REGULATION OF CARDIAC ACTIVITY



- Heart is myogenic: It is regulated intrinsically, i.e., auto-regulated by specialised muscles (nodal tissue).
- Medulla oblongata: A special neural centre in the medulla oblongata can moderate cardiac function through the autonomic nervous system (ANS).
- Cardiac output can be increased by the Sympathetic nerve of ANS and adrenal medullary hormone and decreased by PNS.

DISORDERS OF THE CIRCULATORY SYSTEM

- High Blood Pressure (Hypertension): > 120/80 mm Hg.
- Coronary Artery Disease (CAD)/ atherosclerosis: it is caused by the deposition of Ca, fat, cholesterol and fibrous tissues, which makes the lumen of arteries narrower.
- Angina/ angina pectoralis affects the vessels that supply blood to the heart muscle. It is caused by deposits of calcium.
- Heart Failure: when the heart is not pumping blood effectively.
- Cardiac arrest: heart stops beating
- Heart attack: heart muscle is suddenly damaged by an inadequate blood supply

IMPORTANT QUESTION

Very Short Answer Questions

1- What is the systolic and diastolic blood pressure of a healthy adult-

a- 120 mm Hg and 80 mm Hg

b- 80 mm Hg and 120 mm Hg

c- 120 mm Hg and 120 mm Hg

d- 80 mm Hg and 80 mm Hg

Ans: a

2- In an electrocardiogram the 'Q' wave represents-

a- End of systole

b- Start of systole

c- End of joint diastole

d- Beginning of joint diastole

Ans: b

3- Heart is covered by –

a- Pleural membrane

b- Nictitating membrane

c- Endometrium

d- Pericardium

Ans: d

4- Hemoglobin has a maximum affinity with -

a- O2 b- CO c- NH3 d- O

Ans: b

5- How many heart chambers are present in birds-

a- 2 b- 3 c- 4 d- all are incorrect

Ans: C

6- Which vitamin and ion are necessary for blood clotting?

a- Vitamin K, Ca ion

b- Vitamin A, Na ion

c- Vitamin C, Ca ion

d- Vitamin E, Na ion

Ans: a

7- Blood group AB has-

a- No antigen

b- No antibody

c- Have both antigens and antibodies

d- All are incorrect

Ans: b

8- Assertion: Heart Failure is a condition when the heart is not pumping blood effectively. Reason: In this heart muscle is suddenly damaged by an inadequate blood supply

a- Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

b- Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

c- Assertion is true but Reason is false.

d- Both Assertion and Reason are false.

Ans: c

9- Assertion: Lub and dub sounds are related with the heart.

Reason: Lub and dub sounds represents closure heart volves.

a- Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
b- Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
c- Assertion is true but Reason is false.
d- Both Assertion and Reason are false.
Ans: a

10- **Assertion: In Erythroblastosis foetalis mother is Rh-negative and the foetus is Rh-positive.**
Reason: In such cases, the mother prepares the antibodies against the Rh antigen.
a- Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
b- Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
c- Assertion is true but Reason is false.
d- Both Assertion and Reason are false.
Ans: a

Short Answer Questions

1- **Write one role of Globulin and Albumin.**
Ans: defence mechanism, Albumin: osmotic balance.

2- **List two differences between the stroke volume and cardiac output.**
Ans: Stroke volume: the volume of blood pumped by the heart during a cardiac cycle. i.e.- app. 70 mL
Cardiac output: volume of blood pumped out by each ventricle per minute. i.e. – app 5000 mL.

3- **In which organ red blood cells are destroyed. What is the lifespan of RBCs?**
Ans: Spleen, 120 days

4- **What is the role of Megakaryocytes? Mention the location where these are present.**
Ans: Formation of platelets, present in special cells in the bone marrow

5- **Write the antibodies present in the plasma of blood group AB and O.**
Ans: AB has no antibody and blood group O has antibodies a and b

6- **What is the role of the inter-ventricular septum?**
Ans: separates the left and the right ventricles

7- **Which type of circulation system is present in arthropods and molluscs?**
Ans: Open blood circulatory system

5- **Identify the artery/veins based on the following function-**
a- carries deoxygenated blood from the right ventricle to the lungs
b- carries oxygenated blood from the lungs to the left atrium.
Ans- a- pulmonary artery b- Pulmonary vein:

1- **What is a pacemaker in the heart? Write its role.**
Ans: SAN (Sinoatrial Node) is known as a pacemaker.
The SAN can generate the maximum number of action potentials, i.e., 70-75 min–1, and is responsible for initiating and maintaining the rhythmic contractile activity of the heart.

2- **(i) Mention one difference between artery and vein.**
(ii) Write the names of layers present in the blood vessels.
Ans: (i) Artery: Thin-walled, Vein: thick-walled.
(ii) Tunica intima, Tunica media and Tunica externa:

3- **Write about any two cardiac disorders in humans.**

Ans: Coronary Artery Disease (CAD)/ atherosclerosis: it is caused by the deposition of Ca, fat, cholesterol and fibrous tissues, which makes the lumen of arteries narrower.

Angina/ angina pectoralis affects the vessels that supply blood to the heart muscle. It is caused by deposits of calcium

4- **Classify the leucocytes and mention their types.**

Ans: Granulocyte: Neutrophils, eosinophils and basophils

Agranulocyte: lymphocytes and monocytes

5- **What is the importance of systemic circulation?**

Ans: Systemic circulation provides nutrients, O2 and other essential substances to the tissues and takes CO2 and other harmful substances away for elimination.

6- **Compare stroke volume and cardiac output.**

Ans: Stroke volume: blood pumped by the heart during a cardiac cycle. i.e.- app. 70 mL

Cardiac output: blood pumped out by each ventricle per minute. i.e. – app 5000 mL.

7- **Give a brief account the different valves present in the human heart. Also, locate their position.**

Ans: Tricuspid valve: between the right atrium and the right ventricle

Bicuspid or mitral valve- between the left atrium and the left ventricle.

Semilunar valve- The openings of the right ventricle into the pulmonary artery and the left ventricle into the aorta

8- **Explain tissue fluids by giving its function.**

Ans: The fluid present in the lymphatic system is called lymph. It is a colourless fluid containing specialized lymphocytes that provide an immune response to the body. It is also an important carrier for nutrients, hormones, etc.

9- **How complete partition of the ventricle among birds and mammals are advantageous?**

Ans: Complete partition of the ventricle is advantageous because there is no mixing of oxygenated and deoxygenated blood in the ventricle, so tissues of the body receive more oxygenated blood.

Long Answer Questions

1- **(a) Explain different types of blood groups and donor compatibility by making a table.**

(b) Why Rh compatibility of mother and foetus is a major concern?

Ans: (a) TABLE 18.1 Blood Groups and Donor Compatibility, Page 280, NCERT

(b) If the mother is Rh-negative and the foetus is Rh-positive then a serious condition of Erythroblastosis foetalis be observed.

In such cases during her first pregnancy, Rh antigens of the foetus would not get exposed to the Rh-negative blood of the mother due to the placenta. However, there is a chance of mixing maternal and foetus blood during delivery of the baby. In such cases, the mother prepares the antibodies against the Rh antigen. In a subsequent pregnancy, Rh antibodies from the mother's blood leak into the blood of the Rh-positive foetus resulting in either severe anaemia or jaundice in the foetus.

2- **Draw a well-labelled diagram of the human heart and label the following parts-**

(i)Right ventricle (ii) Vena cava (iii) vein which carries oxygenated blood from lungs (iv) Aorta (v) AVN (vi) bundle of his (vii) pacemaker (viii) cardiac tendineae (ix) Part which collects deoxygenated blood from various organ parts (x) part which collects oxygenated blood from the right atrium.

Ans: Figure 18.2 Section of a human heart, Page 283, NCERT

3- **Describe the mechanism of blood clotting after trauma where blood vessel injury is involved.**

Ans: Blood clotting, or coagulation, is a process that prevents excessive bleeding after injury of blood vessels. Platelets and various proteins play a significant role in this.

On injury, prothrombin is released in the presence of vitamin K. The prothrombin converts into the thrombin (active form) in the presence of thrombokinase and calcium ions. This thrombin converts into fibrinogen (inactive) into active fibrin. The Fibrin thread then plugs the damaged part and appears like a clot.

4- **Describe electrocardiograph. Explain the importance of various peaks observed during this process.**

Ans: ECG stands for electrocardiograph. It is a record of electrical events (depolarization and ventricles) during a cardiac cycle.

ECG provide the following information in the form of waves/ peaks-

P-wave: electrical excitation (or depolarisation) of the atria, which leads to the contraction of both atria.

QRS complex: depolarisation of the ventricles, which initiates the ventricular contraction.

T-wave: the return of the ventricles from excited to the normal state (repolarisation). The end of the T-wave marks the end of systole

5- **Explain the cardiac cycle in humans. Also, provide a schematic plan of blood circulation in humans**.

Ans: (a)The cardiac cycle comprises the following three phases.

(i) Atrial systole: The atria contract from anterior to posterior and the blood is sent to respective ventricles.

(ii) Ventricular systole: The ventricles contract and deoxygenated blood is sent to lungs for oxygenation, while oxygenated blood received from lungs is sent to different parts of the body through the aortic arch.

(iii) Joint diastole: All the chambers are in systole, called joint diastole.

(b) Figure 18.4, Page 287, NCERT

CHAPTER- 19

EXCRETORY PRODUCTS AND THEIR ELIMINATION

- Excretory system helps in collecting nitrogenous waste and expelling it outside the body.

Ammonotelism: Excrete ammonia. E.g., Many bonyfishes, aquatic amphibians and aquatic insects

Ureotelism: Excrete urea. E.g., Mammals, many terrestrialamphibians and marine fishes.

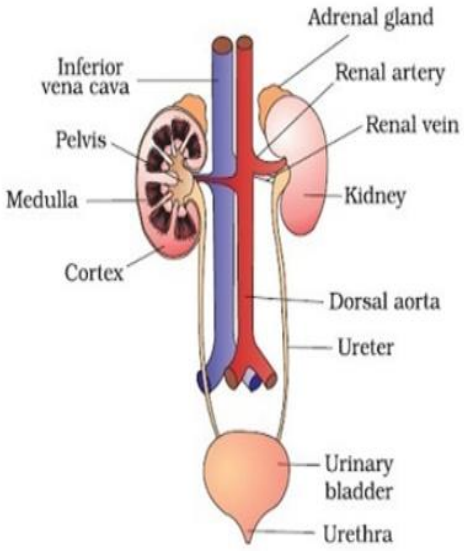
Uricotelism: Excrete uric acid. E.g., Reptiles, birds, land snailsand insects. This prevents the loss of water.

Specific excretory organs

Protonephridia or flame cells	Platyhelminthes, rotifers, some annelids and cephalochordate
Nephridia	Earthworms
Malpighian tubules	insects
Antennal glands	crustaceans

HUMAN EXCRETORY SYSTEM

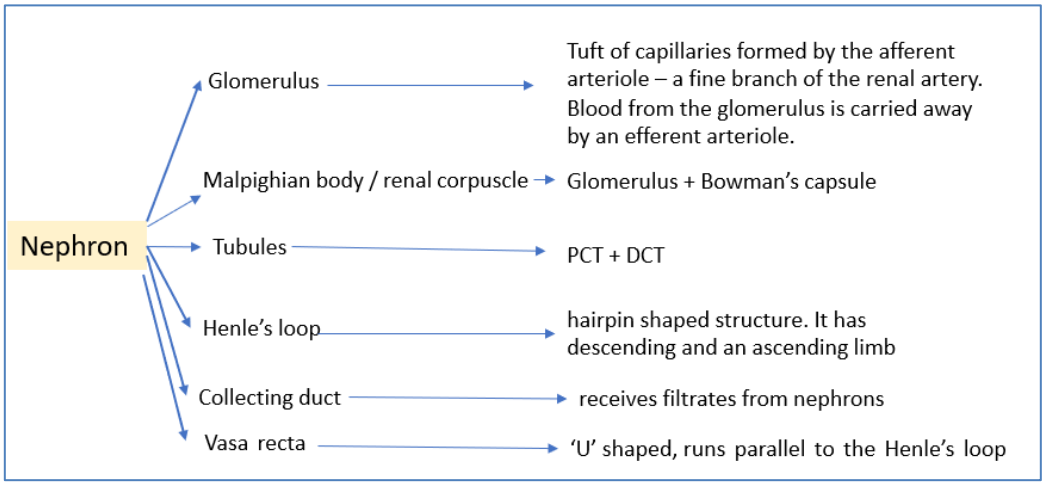
- It consists of a pair of kidneys, one pair of ureters, a urinary bladder and a urethra.
- Kidneys: reddish brown, bean-shaped structures
- Size: 10-12 cm in length, 5-7 cm in width, 2-3 cm in thickness, weight: 120- 170 g.
- The kidney has an outer cortex, inner medulla and pelvis.
- The medulla is divided into a few conical tissue masses called medullary pyramids / renal pyramids.
- The part of the cortex that extends in between the medullary pyramids is the renal columns of Bertini.
- At the center of the concave surface of the kidney, a notch (hilum) is present. Through the hilum ureter, blood vessels and nervesenter the kidney.
- Inner to the hilum is a broad funnel-shaped space (renal pelvis) located with projections called calyces. The calyces collect the urine and empties it into the ureter, which is stored in the urinary bladder temporarily.



- The urinary bladder opens into the urethra through which urine is expelled.
- Each kidney has nearly one million nephrons (functional unitsof the kidney).
- The Malpighian corpuscle, PCT, DCT are situated in the cortical region while loops of Henle into the medulla.
- The efferent arteriole emerging from the glomerulus forms a fine capillary network around the renal tubule called the peritubular capillaries.

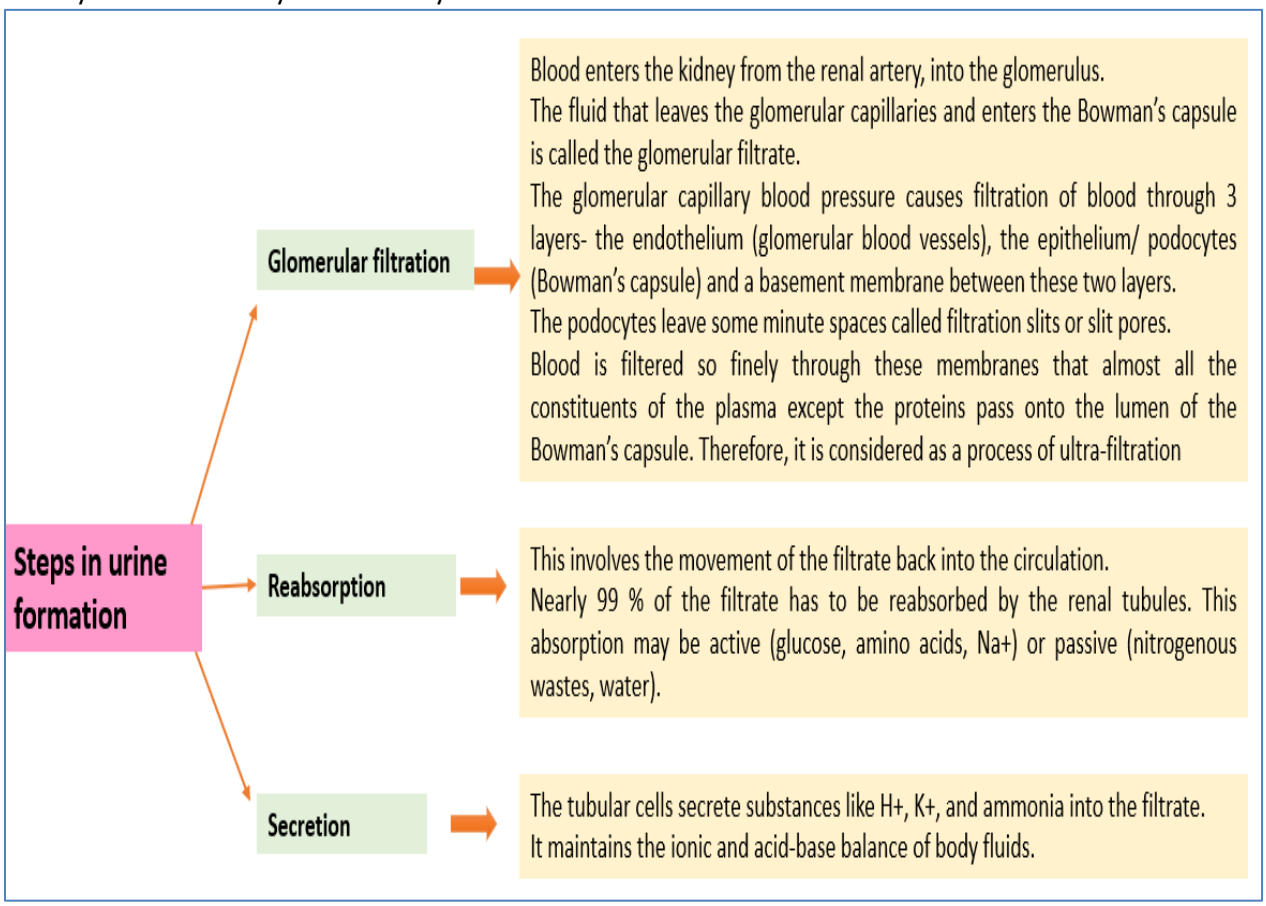
Types of nephrons

- ✓ Cortical nephrons: loop of Henle is too short and extends only very little into the medulla.
- ✓ Medullary nephrons: Loops of Henle are very long and run deep into the medulla.



URINE FORMATION

The nitrogenous waste formed as a result of the breakdown of amino acids is converted to urea in the liver by the Ornithine cycle or urea cycle.

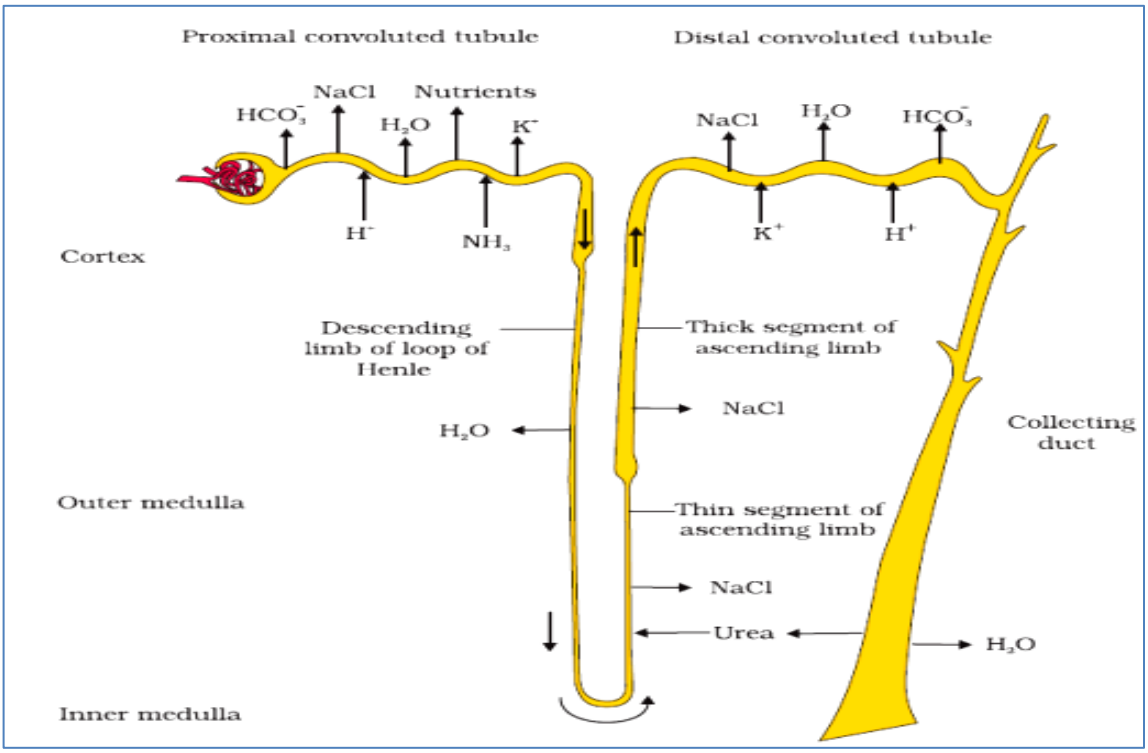


GFR (glomerular filtration rate): The amount of filtrate formed by the kidneys per minute (125 ml/minute) is called (GFR).
Regulation of GFR: The juxta glomerular apparatus (JGA) is formed by cellular modifications in the DCT and the afferent arteriole at the location of their contact.
When GFR decreases, the JG cells release **renin**, which stimulates the glomerular blood flow and thereby the GFR back to normal.

FUNCTION OF THE TUBULES

Function of tubules

PCT	DCT	Henle's Loop	Collecting Duct
Reabsorption of essential nutrients, 70-80 % of electrolytes, and water take place. It also helps to maintain the pH and ionic balance of the body fluids by selective secretion of hydrogen ions and ammonia into the filtrate and by absorption of HCO3 – from it.	It involves the conditional reabsorption of Na+ and water. DCT can also reabsorb HCO3– and secrete hydrogen, potassium, and NH3 ions selectively to keep the blood pH and Na- K balance.	In its ascending limb, reabsorption is at a minimum. It maintains the high osmolarity of medullary interstitial fluid. This concentrates the filtrate as it moves down.	Reabsorb a large amount of water (concentrate urine). To maintain osmolarity, the collecting duct allows fewer amounts of urea to enter themedullary interstitium. Maintain pH & ionic balance of blood by the selective secretion of H+ and K+ ions

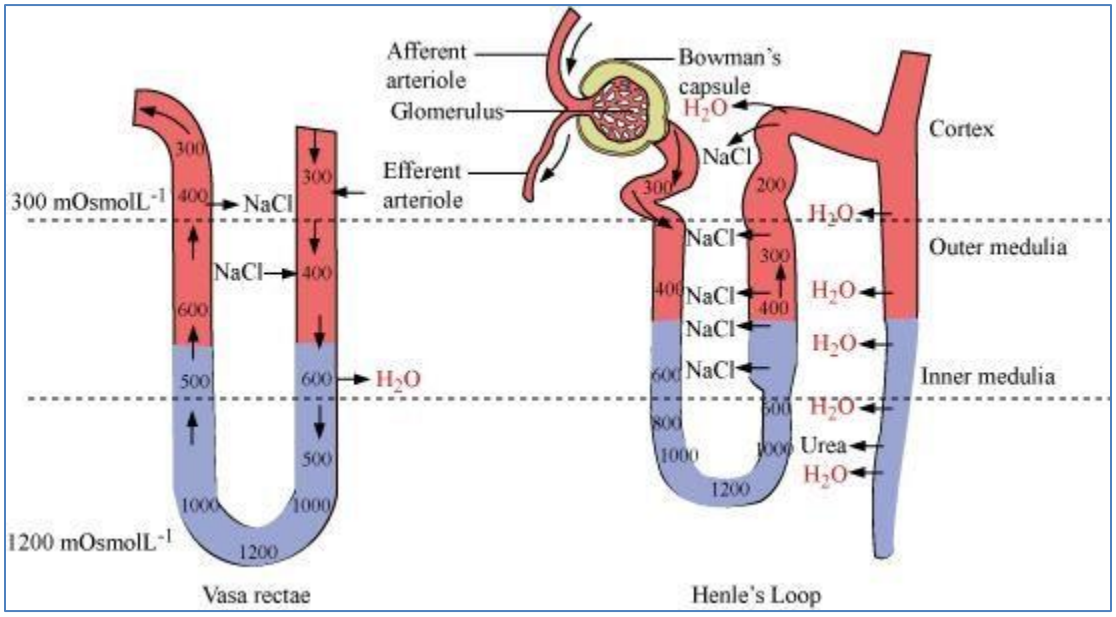


Mechanism of concentration of the filtrate

- The filtrate flows in opposite directions in the two limbs of Henle's loop, forming a counter current.

Blood also flows in a counter-current pattern through the two limbs of the vasa recta.

- The close proximity of the Henle's loop and the vasa recta, as well as the countercurrent inthem, help to maintain a rising osmolarity towards the inner medullary interstitium.
- The ascending limb of Henle's loop transports NaCl, which is exchanged with the descendinglimb of the vasa recta.
- The ascending section of the vasa recta returns NaCl to the interstitium.
- Small amounts of urea enter the ascending limb of Henle's loop's thin segment, which is thencarried back to the interstitium by the collecting tubule.
- This causes the concentration of urine. Human kidneys can produce urine nearly four times more concentrated than the initial filtrate formed.



Regulation of kidney function

- **ADH (antidiuretic hormone)/ Vasopressin -** released from neurohypophysis. It facilitates water reabsorption from the latter parts of the tubule, thereby preventing diuresis. The ADH can contract blood vessels and therefore increase blood pressure. An increase in blood pressure can increase the GFR.
- **JGA-** A fall in glomerular blood flow/glomerular blood pressure/GFR can activate the JG cells to release renin. Renin converts angiotensinogen in blood to angiotensin I and then to angiotensin II. Angiotensin II is a powerful vasoconstrictor and increases glomerular blood pressure and thereby GFR.
- **Aldosterone-angiotensin II** also activates the adrenal cortex to release Aldosterone. Aldosterone causes the reabsorption of Na+ and water from the DCT. This also leads to an increase in blood pressure andGFR. This complex mechanism is generally known as the Renin-Angiotensin mechanism
- **ANF (Atrial Natriuretic Factor):** An increase in blood flow to the atria of the heart can cause the release of ANF. It can cause vasodilation and thereby decrease the blood pressure. ANF acts antagonistically to the renin-angiotensin system, aldosterone and vasopressin.

Micturition

- The process of release of urine from the bladder is called micturition.

- The signal is sent by CNS to relax the urethra sphincter and cause urination.

Role of other organs in excretion

- Lungs: remove approx. 200mL/ minute CO_2 and significant quantities of water.
- Liver: secretes bile-containing substances like bilirubin, biliverdin, cholesterol, degraded steroid hormones, vitamins and drugs. Most of these substances ultimately pass out along with digestive wastes.
- Skin: Sweat produced by the sweat glands is a watery fluid containing NaCl, small amounts of urea, lactic acid, etc. Sebaceous glands eliminate certain substances like sterols, hydrocarbons and waxes through sebum.

Disorders of the excretory system

- Uremia: accumulation of urea in the blood
- Renal calculi: Stone or insoluble mass of crystallized salts (oxalates, etc.)
- Glomerulonephritis: Inflammation of glomeruli of the kidney

Hemodialysis

- A dialyzing machine (artificial kidney) is connected to the patient's body.
- The machine consists of a long cellulose tube surrounded by the dialyzing fluid in a water bath.
- The patient's blood is drawn from a convenient artery and pumped into the dialyzing unit after adding an anticoagulant like heparin.
- The tiny pores in the dialysis tube allow small molecules such as glucose, salts and urea to enter the water bath, whereas blood cells and protein molecules do not enter these pores (Similar to glomerular filtration).
- The cleared blood is then pumped back into the body through a vein

Kidney Transplantation

- It is the ultimate method for the correction of acute renal failures.
- This involves the transfer of a healthy kidney from one person (donor) to another person with kidney failure. Immunosuppressive drugs are usually administered to the patient to avoid tissue rejection.

IMPORTANT QUESTIONS

Very Short Answer Questions

1- In which organ urea is formed-

a- Kidney
b- Liver
c- Nephron
d- All of these
Ans: b

2- Uricotelism is significant as it -

a- Conserve water
b- Eliminate urea
c- Eliminate methane
d- Conserve nutrients
Ans: a

3- Uremia is described as-

a- Accumulation of uric acid in kidney
b- Accumulation of urea in the blood
c- Stone in kidney
d- Crystals in the kidney
Ans: b

4- The value of the GFR is-

a- 500 ml/ minute
b- 1000 ml / minute
c- 125 ml/minute
d- 1 liter/ minute
Ans: c

5- Which gland is responsible for the excretion-

a- Sebaceous glands
b- Liver
c- Both a and b
d- None of these
Ans: b

6- In mammalian kidneys, Bowman's capsules or Malpighian corpuscles occur in which part?

a- Medulla
b- Pith
c- Cortex
d- All are incorrect
Ans: c

7- Epithelium in the kidney perform which role-

a- Increase the surface area for reabsorption.
b- Reduce GFR
c- Increase GFR
d- Decrease surface area for secretion
Ans: a

8- Expand the ANF-

a- Atrial Natriuretic Factor
b- Atrial narcotic factor
c- Atrium natriuretic function
d- Atrial narcotic function
Ans: a

9- urethra sphincter is associated with-

a- Micturition
b- Absorption
c- Secretion
d- All of these

Ans: a

10- Which type of epithelium is present in the kidney-

a- Simple
b- Cuboidal
c- Simple cuboidal
d- Simple cuboidal brush border epithelium.

Ans: d

Short Answer Questions

1- Write any four examples of excretory organs other than kidney.

Ans:

Protonephridia/ flame cells	**Platyhelminthes,**
Nephridia	Earthworms
Malpighian tubules	insects
Antennal glands	crustaceans

2- What are the Columns of Bertini?

Ans: The cortex extends in between the medullary pyramids as renal columns called Columns ofBertini.

3- Define GFR and mention its value in healthy human beings.

Ans: The amount of filtrate formed by the kidneys per minute is called the glomerular filtration rate (GFR). GFR in a healthy individual is approximately 125 ml/minute, i.e., 180 liters per day.

4- Write the significance of the counter-current mechanism.

Ans: countercurrent mechanism is used to concentrate urine in the kidneys by the nephrons of the human excretory system.

5- Where are kidneys situated in human beings?

Ans: Between the levels of the last thoracic and third lumbar vertebra close to the dorsal inner wallof the abdominal cavity.

6- Besides many important functions Liver also helps in excretion. Explain.

Ans: Liver: secretes bile-containing substances like bilirubin, biliverdin, cholesterol, degraded steroid hormones, vitamins and drugs. Most of these substances ultimately pass out along with digestive wastes.
Inside the liver urea cycle takes place which results in the formation of urea.

7- What are glycosuria and ketonuria?

Ans: Glycosuria: the presence of glucose in urineKetonuria: the presence of ketone in urine

8- Draw the Malpighian body (renal corpuscle) and label any four parts.

Ans: Fig: 19.4, page 293, NCERT

9- (a) What is the Malpighian body or renal corpuscle?

(b) Name the group of animals to which Nephridia and green gland belongs.

Ans: (a) Glomerulus along with Bowman's capsule, is called the Malpighian body or renal corpuscle

(b) Nephridia- EarthwormsGreen gland- Insect

10- Give any three functions carried out by the kidney.

Ans: (a) Removes Urea and other nitrogenous wastes from the blood.

(b) Maintains osmotic balance

(c) It also maintains (pH) balance

Long Answer Questions

1- Explain the function of the tubules of the kidney.

Ans: Proximal Convoluted Tubule (PCT): In PCT reabsorption of essential nutrients, 70-80 % of electrolytes and water takes place. It also helps to maintain the pH and ionic balance of the body fluids by selective secretion of hydrogen ions and ammonia into the filtrate and by absorption of HCO_3^- from it.

Henle's Loop: In its ascending limb, reabsorption is at a minimum. It maintains the high osmolarity of medullary interstitial fluid. This concentrates the filtrate as it moves down. Distal Convoluted Tubule (DCT): It involves the conditional reabsorption of Na^+ and water.

DCT can also reabsorb HCO_3^- and secrete hydrogen, potassium, and NH_3 ions selectively to keep the blood pH and sodium-potassium balance in check.

Collecting Duct: It extends from the cortex of the kidney to the inner parts of the medulla. This region could reabsorb a large amount of water, resulting in concentrated urine.

To maintain osmolarity, the collecting duct allows fewer amounts of urea to enter the medullary interstitium. It also plays a role in the maintenance of pH and ionic balance of blood by the selective secretion of H^+ and K^+ ions

2- (a) Write the position and function of the JGA (juxtaglomerular apparatus).

(b) Draw Nephron and label its following parts-

Part associated with secretion of urea, ascending loop of Henle, a place where glomerular filtration takes place and efferent arteriole.

Ans: (a) The juxtaglomerular apparatus is a specialized structure formed by the distal convoluted tubule and the glomerular afferent arteriole. It is found between the afferent arteriole and the distalconvoluted tubule of the same nephron.

JGA cells secrete substance like renin that modulates blood pressure and renal blood flow and thus, GFR is regulated.

(b) Figure 19.3, page 292, NCERT

3- Explain in detail four ways to control kidney activity in humans.

Ans: ADH (antidiuretic hormone)/ Vasopressin - released from neurohypophysis. It facilitates water reabsorption from the latter parts of the tubule, thereby preventing diuresis. The ADH can contract blood vessels and therefore increase blood pressure. An increase in blood pressure can increase the GFR.

JGA- A fall in glomerular blood flow/glomerular blood pressure/GFR can activate the JG cells to release renin. Renin converts angiotensinogen in blood to angiotensin I and then to angiotensin

II. Angiotensin II is a powerful vasoconstrictor and increases glomerular blood pressure and thereby GFR.

Aldosterone- angiotensin II also activates the adrenal cortex to release Aldosterone. Aldosterone causes the reabsorption of Na+ and water from the DCT. This also leads to an increase in blood pressure and GFR.

ANF (Atrial Natriuretic Factor): An increase in blood flow to the atria of the heart can cause the release of ANF. It can cause vasodilation and thereby decrease the blood pressure. ANF acts antagonistically to the renin-angiotensin system, aldosterone and vasopressin.

4- (**a) State the importance of counter-current systems in renal functioning.**

(b) Diagrammatically represent the mechanism of concentration of urine.

Ans: (a) Vasa recta is responsible for the concentration of urine. The blood flows in opposite directions in two limbs of each vasa Recta. The blood entering its descending limb comes into close contact with the outgoing blood in the ascending limb. This is called a Counter-Current System. The two limbs of the loops of Henle form another Counter-Current System. The counter-current system significantly contributes to concentrating urine in mammals.

(b) Figure 19.6, Page 296, NCERT

5- (**a) Write the mechanism of action of the artificial kidney.**

(b) When does a patient require kidney transplantation?

Ans: (a) A dialyzing machine (artificial kidney) is connected to the patient's body.

The machine consists of a long cellulose tube surrounded by dialyzing fluid in a water bath. The patient's blood is drawn from a convenient artery and pumped into the dialyzing unit after adding an anticoagulant like heparin.

The tiny pores in the dialysis tube allow small molecules such as glucose, salts, and urea to enter into the water bath, whereas blood cells and protein molecules do not enter these pores(Similar to the glomerular filtration). The cleared blood is then pumped back to the body through a vein.

(b) Kidney transplantation is the ultimate method in the correction of acute renal failures(kidney failure). A functioning kidney is used in transplantation from a donor, preferably a close relative, to minimise its chances of rejection by the immune system of the host.

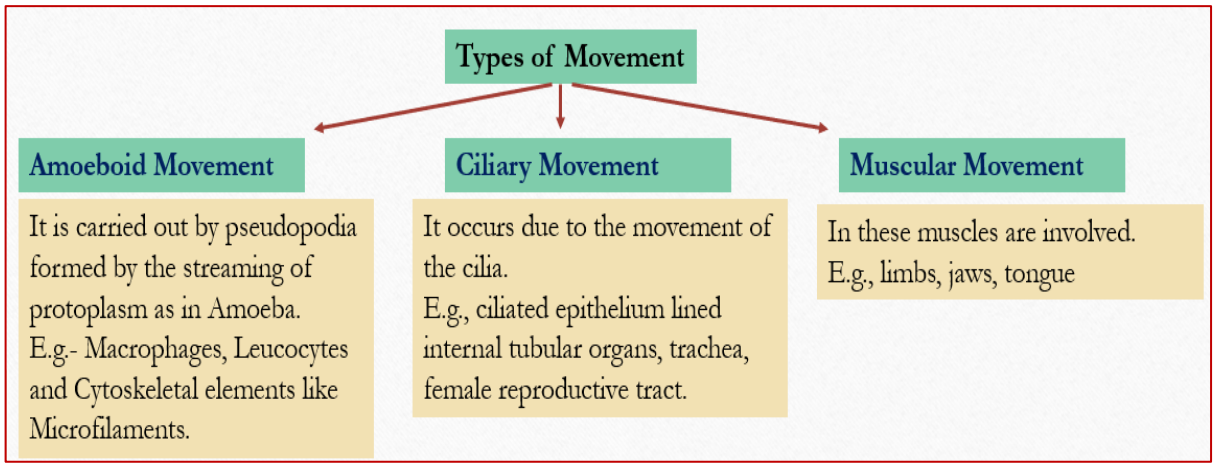
Chapter-20

SKELETAL SYSTEM AND ITS FUNCTIONS

Locomotion: It is the voluntary movement of an individual from one place to another.

Movement: It is the displacement of a body or a part of the body from its original position.

Types of Movement



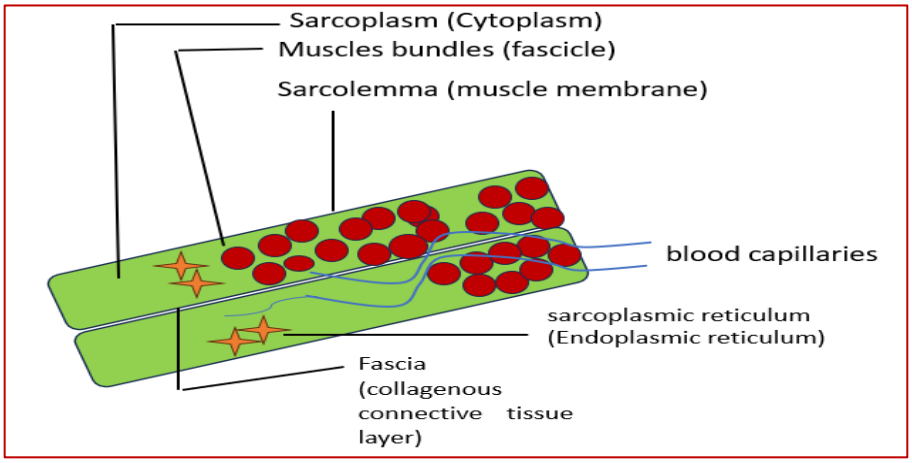
MUSCLE

- Muscles are specialized tissues of mesodermal origin. They have properties like excitability, contractility, extensibility and elasticity.
- Muscles are of three types- Skeletal Muscles Visceral Muscles Cardiac Muscles

Skeletal muscles

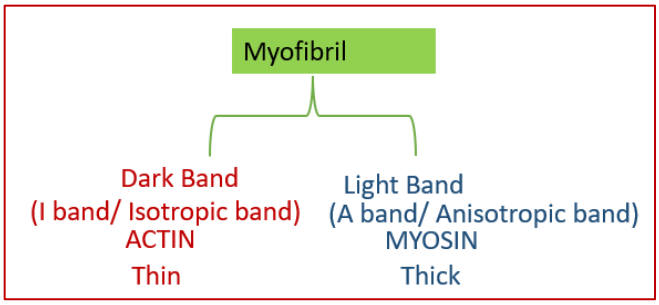
- These are also called striated muscles as they have light and dark bands.
- Skeletal muscles are attached to bones by tendons.
- Skeletal muscles are voluntary muscles.
- These are unbranched and cylindrical in shape.

Red muscle: It is due to pigment myoglobin. These are aerobic muscles.
White muscle: contain very less myoglobin. These are mainly anaerobic.

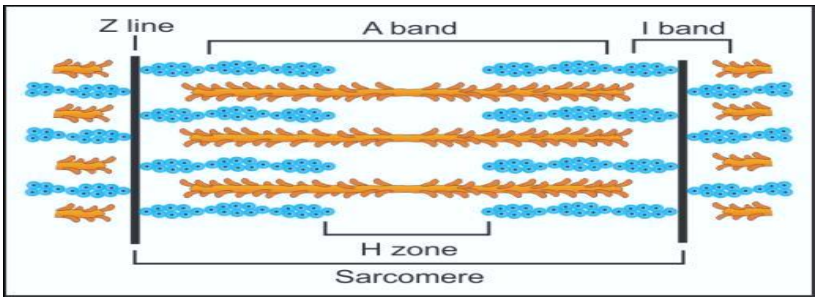


Structure of Skeletal Muscle

- Skeletal muscle is made of a number of muscle bundles (fascicles).
- The muscle fibre is a syncitium (contains many nuclei).
- The Sarcoplasmic reticulum stores calcium ions.
- In the sarcoplasm contains a large number of parallelly arranged filaments (Myofibrils).
- The 'A' and 'I' bands are arranged alternately throughout the length of the myofibrils.
- In the centre of each actin (I) band is an elastic fibre called the **'Z' line** which bisects it.
- In the middle of myosin (A-band) is a thin fibrous '**M' line**.



- The portion of myofibrils between two successive 'Z' lines is the functional unit of contraction called a **sarcomere**.
- At the resting stage thin filament overlaps the thick filament.
- This central part of the thick filament, not overlapped by thin filaments is called the **'H' zone**.



Structure of Contractile Proteins

Actin

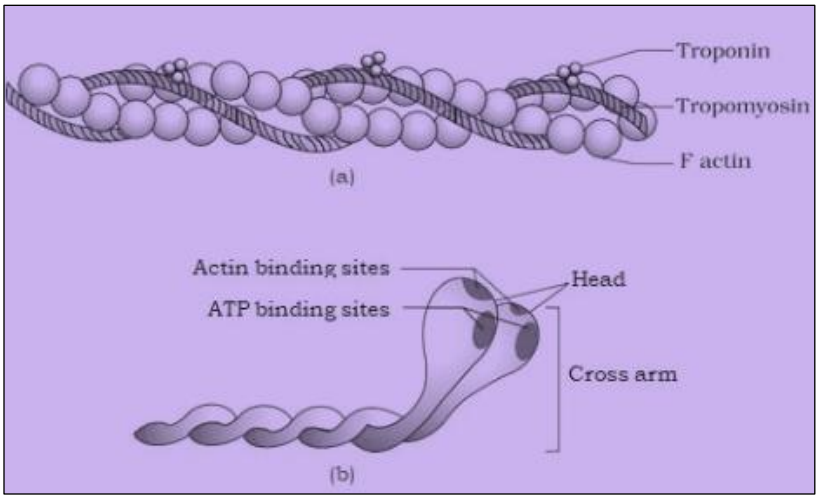
- Throughout the length of actin two filaments (tropomyosin) also run.
- A protein Troponin is also located at regular intervals on the tropomyosin.
- In the resting state a subunit of troponin masks the active binding sites for myosin on the actin filaments

Actin → **'F'** (filamentous) → **'G'** (Globular) actins

Myosin

- The HMM projected outwards at a regular distance and formed a cross arm.
- The globular head is an active ATPase enzyme and has binding sites for ATP and active sites for actin

Myosin → Meromyosin → Globular head with short arm / HMM (Heavy meromyosin)
Meromyosin → Tail / LMM (Light meromyosin)



Mechanism of Muscle Contraction

Sliding filament theory – It states that contraction of a muscle fibre takes place by the sliding of the thin filaments (actin) over the thick filaments (Myosin).

- Motor unit: A motor neuron and muscle fibres
- Neuromuscular junction or motor-end plate: The junction between a motor neuron and the sarcolemma.

Neural signal

Acetylcholine is released from the neuromuscular junction

Acetylcholine generates action potential in sarcolemma

Calcium ions released into the sarcoplasm

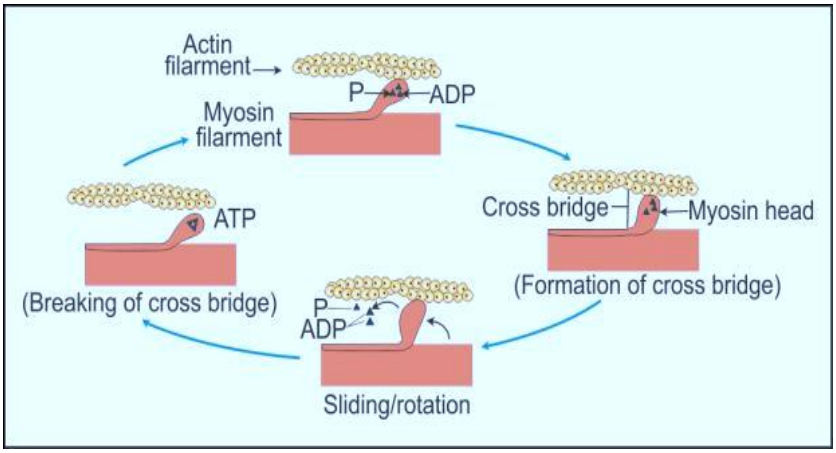
Ca++ binds with a subunit of troponin (expose active sites for myosin)

Myosin head binds with actin to form a cross bridge. [ATP-dependent process].

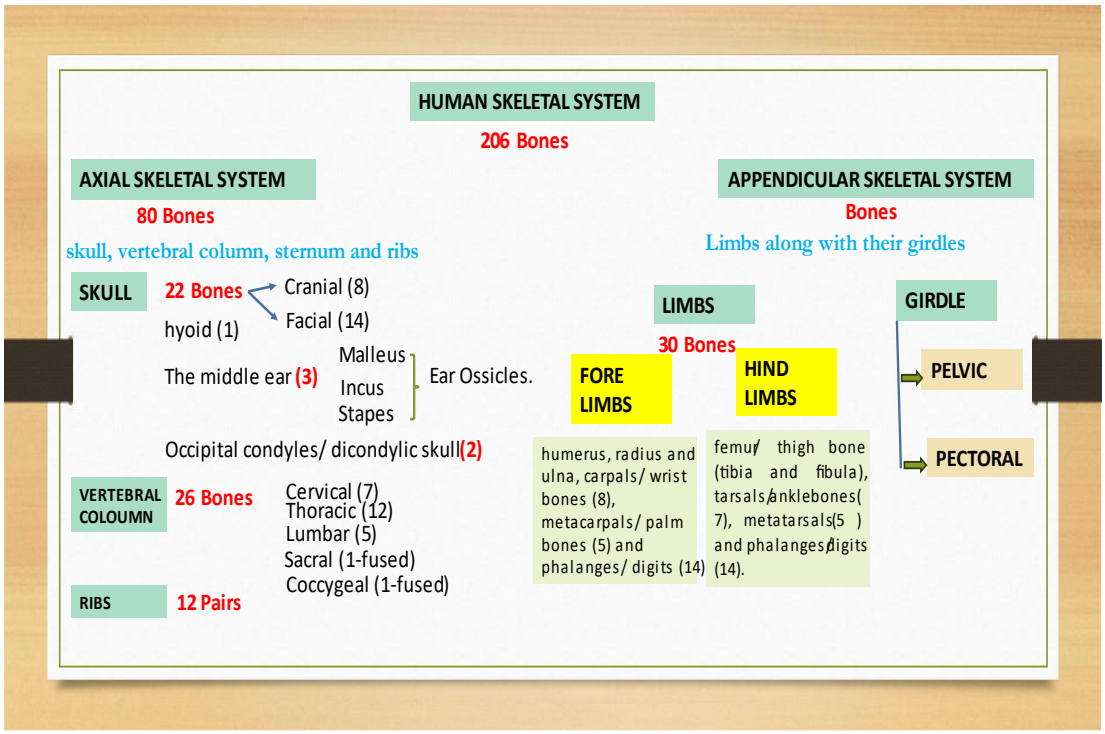
Cross bridge pulls the actin filaments towards the centre of the 'A' band.

Causes shortening of the sarcomere, i.e., contraction
['I' bands get reduced, whereas the 'A' bands retain their length.

- The process continues till the Ca++ ions are pumped back to the sarcoplasm. This causes the return of 'Z' lines back to their original position (relaxation).

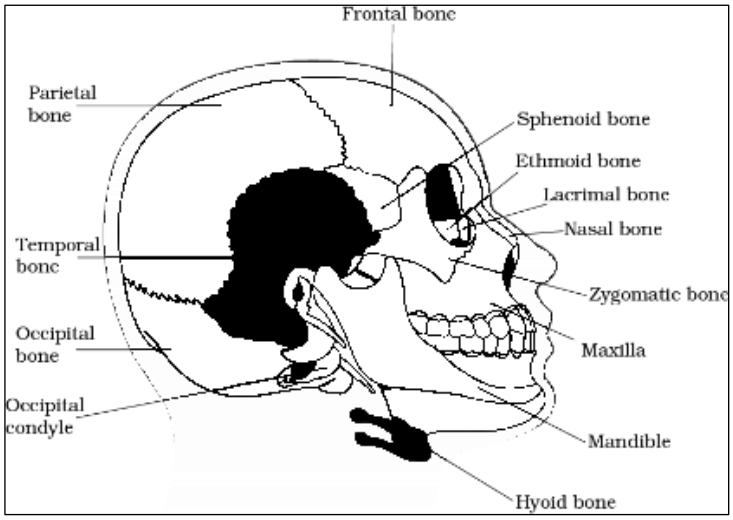


SKELETAL SYSTEM



- The skeletal system works as a support structure for your body. It gives the body its shape, allows movement, makes blood cells, provides protection for organs and stores minerals.
- The human skeletal system consists of specialised connective tissue bones (206) and a few cartilages.
- It can be broadly categorized into –

  The axial skeleton system
  The appendicular skeleton



Axial skeleton- (80 bones): skull, vertebral column, sternum and ribs

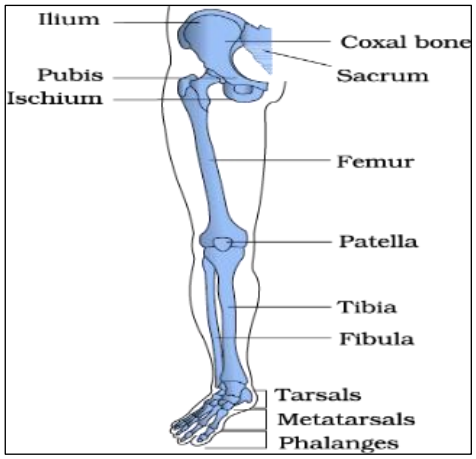
- The skull (22 bones) is composed of – cranial (8) and facial (14) and hyoid (1)
- The middle ear (3) contains – Malleus, Incus and Stapes, collectively called Ear Ossicles.
- Occipital condyles/ dicondylic skull (2) – it articulates the skull with the superior region of the vertebral column.

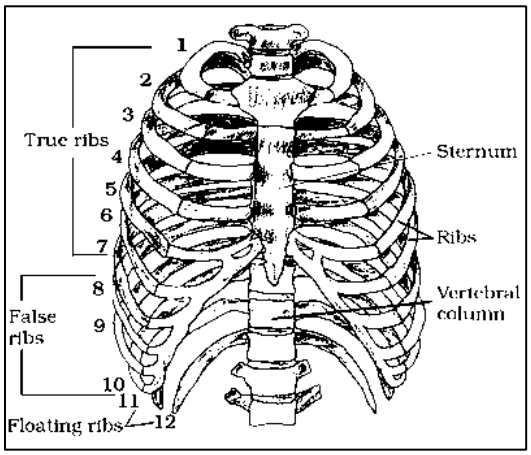
- The vertebral column (26): cervical (7), thoracic (12), lumbar (5), sacral (1-fused) and coccygeal (1-fused).
- Ribs (12 pairs of ribs) are bicephalic. Each rib is connected dorsally to the vertebral column and ventrally to the sternum (1).

  True ribs: First seven pairs. Dorsally, they are attached to the thoracic vertebrae and ventrally connected to the sternum.

  Vertebrochondral (false) ribs: 8^{th}- 10^{th} pairs of ribs do not articulate directly with the sternum but join the seventh rib.

  Floating ribs: 11^{th} - 12^{th} pairs of ribs are not connected ventrally.





Appendicular skeleton- Limbs along with their girdles

- Limbs- Each limb is made of 30 bones.
- Forelimb (hand): it consists of the humerus, radius and ulna, carpals/ wrist bones (8), metacarpals/ palm bones (5) and phalanges/ digits (14)
- Hind limb (leg) – it consists of the femur/ thigh bone (tibia and fibula), tarsals/ ankle bones (7), metatarsals (5) and phalanges/ digits (14).
- Patella (knee cap) – covers the knee ventrally.

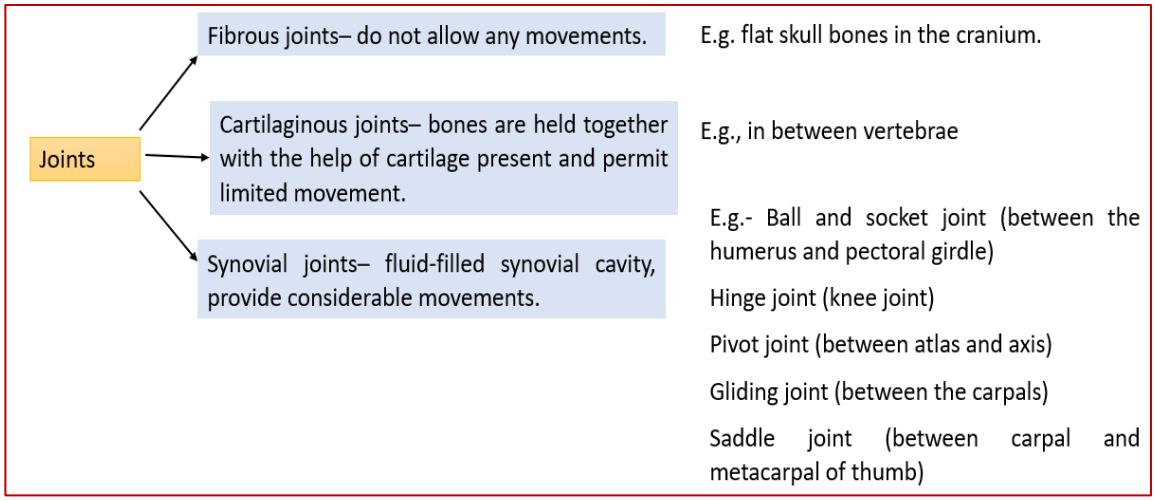
Girdles: Pectoral and Pelvic girdles

Pectoral girdle: Each half of the pectoral girdle consists of a clavicle and a scapula (large triangular flat bone).

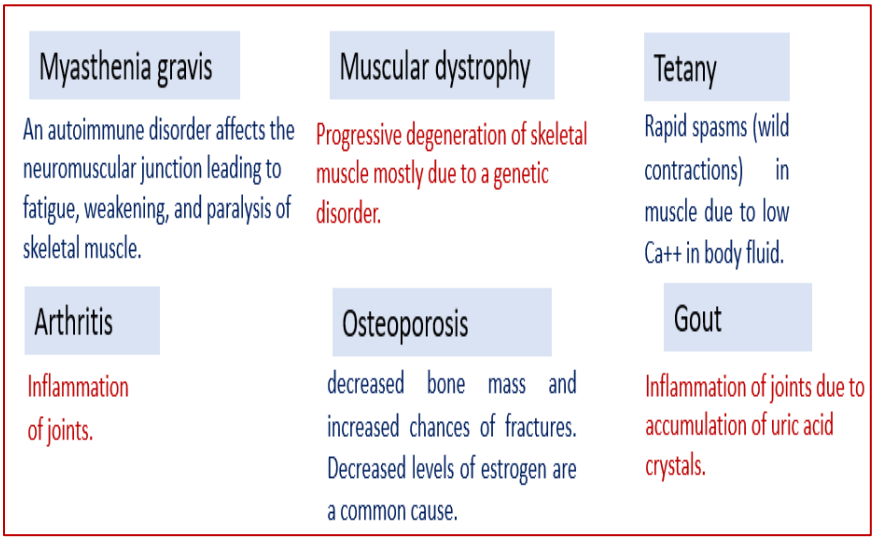
- The scapula has a spine (elevated ridge) which project as a flat, expanded process called the acromion. Below the acromion is a depression called the glenoid cavity.
- Glenoid cavity articulates with the humerus to form the shoulder joint.
- Each clavicle is a long slender bone with two curvatures. This bone is commonly called the collar bone.

  Pelvic girdle consists of two coxal bones.
- Coxal bone is formed by the fusion of three bones – ilium, ischium and pubis.
- It has a cavity called acetabulum to which the thigh bone articulates.
- The two halves of the pelvic girdle meet ventrally to form the pubic symphysis.

JOINTS



Disorders of the muscular and skeletal system



IMPORTANT QUESTIONS

Very Short Answer Questions

1- How many cranial bones are present in the skull of humans?

a- 8 b- 16 c- 4 d- 10

Ans: a

2- Which is true about myosin head-

a- It has ATPase activity

b- It has ADPase activity

c- It has NADPase activity

d- All are correct

Ans: a

Ans: Myosin head

3- Fascia is –

a- Cardiac tissue
b- Parenchyma tissue
c- Epidermis
d- Connective tissue
Ans: d

4- Which statement is correct about acetylcholine-
a- It is a neurotransmitter
b- It is released from synapsis
c- It helps in the transmission of impulses from one neuron to the other
d- All are correct
Ans: d

5- Ear ossicles is composed of-
a- Malleus, incus, and stapes
b- Malleus and incus
c- Malleus and stapes
d- Incus and Stapes

6- Macrophages and leucocytes shows which types of movement-
a- Thigmotropism
b- Geotropism
c- Amoeboid
d- Both a and b
Ans: c

7- Sarcoplasmic reticulum is rich in-
a- Ca b – Mg c- P d- Zn
Ans: a

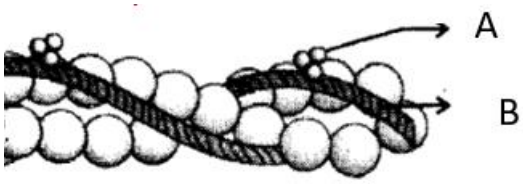
8- In shoulder joints which joint is present-
a- Hinge Joint
b- Pivot Joint
c- Ball and socket joint
d- None of these
Ans: c

9- last two pairs of ribs and which are not attached ventrally to the sternum are called as-
a- Bicephalic ribs
b- True ribs
c- Floating ribs
d- False ribs
Ans: c

10- Which hormones cause fluctuation of Ca++ level-
a- Parathyroid hormone
b- Pituitary hormone
c- Testosterone
d- Estrogen

Short Answer Types Questions

1- Labe a and b –

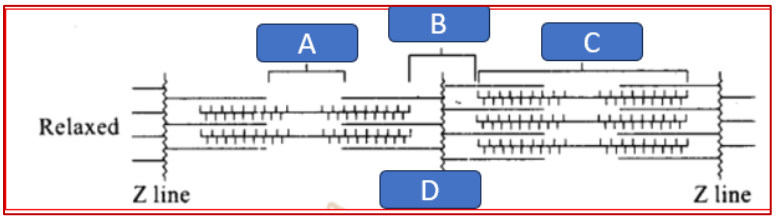


Ans: a- troponin b- tropomyosin

2- Mention the location of the 'Z' line in muscle fibre.
Ans: In the centre of each 'I' band is an elastic fibre called the 'Z' line which bisects it.

3- What is a sarcomere and where it is located?
Ans: sarcomere is the functional unit of contraction and it is located in between two successive 'Z' lines of myofibrils.

4- Label a, b,c and d



Ans: a- H zone b- I Band c- A band d- z line

5- Calcium ion plays a very important role in muscle contraction. Where does this ion locate in muscles?
Ans: Sarcoplasmic reticulum Some muscles are reddish in colour while others are not, give the reason.

6- List different parts of the forelimb?
Ans: humerus-radius and ulna, carpals/ wrist bones, metacarpals/ palm bones and phalanges/ digits

7- Give a diagrammatic cross-sectional view of a muscle showing muscle bundles and muscle fibres.
Fig: 20.1, Page 304, NCERT

8- Distinguish between skeletal muscle and cardiac muscle.
Ans: Skeletal muscle- attached to the skeleton, Muscle fibres are cylindrical, unbranched and in bundles.
Cardiac Muscle- present in the heart, cylindrical and branched

9- The rib cage contains both true and false rib bones. Explain.
Ans: True ribs: First seven pairs. Dorsally, they are attached to the thoracic vertebrae and ventrally connected to the sternum.
Vertebrochondral (false) ribs: 8^{th}- 10^{th} pairs of ribs do not articulate directly with the sternum but join the seventh rib.

10- How do muscles get energy for contraction?

Ans: Muscles need ATP energy for muscle contraction. It is produced by the myosin ATPase enzyme. Ca2+, Mg^{2+} ions, inorganic P ions, and ADP are required to produce ATP. ATP helps myosin bind to actin and cause muscle contraction.

11- Identify the diseases related to the following statements-

i- Caused due to imbalance in the estrogen hormone

ii- Low Ca+ concentration in blood

iii- Degeneration of skeletal muscles

iv- Inflammation of joints

Ans: (i) osteoporosis (ii) tetany (iii) Muscular dystrophy (iv) Arthritis

12- Differentiate between A-band and I-band.

Ans: Myosin (dark band/ 'A' band/ Anisotropic band)- thick

Actin (light band/ I- band/ isotropic band)- thin

13- A red muscle fibre works for a prolonged period, whereas a white muscle fibre gets fatigued. Give reason.

Ans: Red muscle has myoglobin pigment and a large number of mitochondria for aerobic energy production while white muscle fibres do not have myoglobin pigment and depend on anaerobic respiration for energy production.

14- Where is the pelvic girdle situated, Explain the structure of the pelvic girdle.

Ans: Pelvic girdle consists of two coxal bones. The Coxal bone is formed by the fusion of three bones – ilium, ischium and pubis. It has a cavity called acetabulum to which the thigh bone articulates. The two halves of the pelvic girdle meet ventrally to form the pubic symphysis.

15- Draw the Myosin monomer (Meromyosin) and label its four parts.

Ans: Figure 20.3, Page 306, NCERT

16- Explain the structure of thin filaments present in muscles.

Ans: Actin is a thin filament which is made of two 'F' (filamentous) actins helically wound to each other. 'F' actin is a polymer of monomeric 'G' (Globular) actins. Two filaments of tropomyosin run throughout the length of actin. A protein Troponin is also located at regular intervals on the tropomyosin.

Long Answer Types Questions

1- Give a brief account of the different types of joints present in the human skeletal system.

Ans: Fibrous joints– this type of joint does not allow any movements. E.g. flat skull bones in the cranium.

Cartilaginous joints– in these bones are held together with the help of cartilage present and permit limited movement. E.g., in between vertebrae

Synovial joints– these have a fluid-filled synovial cavity and provide considerable movements. e.g.- Ball and socket joint (between the humerus and pectoral girdle), Hinge joint (knee joint), pivot joint (between atlas and axis), gliding joint (between the carpals) and saddle joint (between carpal and metacarpal of thumb)

2- Discuss the role of Ca2+ ions in muscle contraction. Draw neat sketches to illustrate your answer.

Ans: In the resting, stage calcium is stored in the sarcoplasmic reticulum of muscles. When action potential generates the calcium ions are released from the sarcoplasmic reticulum and

bind with a troponin of actin filament and remove its masking effect. The myosin head then binds with actin to form a cross bridge and initiate the contraction process. When Ca++ ions are pumped back into the sarcoplasm the relaxation process occurs.

3- Describe the appendicular skeleton with the help of a suitable diagram.

Ans: appendicular skeleton is composed of limbs. Forelimb (hand): it consists of the humerus, radius and ulna, carpals/ wrist bones (8), metacarpals/ palm bones (5) and phalanges/ digits (14). Hind limb (leg) – it consists of the femur/ thigh bone (tibia and fibula), tarsals/ ankle bones (7), metatarsals (5) and phalanges/ digits (14).

Figure 20.10, Page 311, NCERT

4- (i) During muscular contraction what are the chemical changes that take place? Give a brief note on it.

(ii) Give a diagrammatic representation of stages in cross-bridge formation and breaking of the cross-bridge.

Ans:

(i) The neurotransmitter acetylcholine is released at the neuromuscular junction.

It stimulates the release of calcium ions from the sarcoplasmic reticulum of the muscle.

ATP is hydrolysed to release energy from the ATPase activity of the myosin head. This energy is used for cross-bridge formation and muscle contraction.

(ii) Figure 20.4, Page 307 NCERT

5- Give a detailed account of the structure of skeletal muscle.

Ans: Skeletal muscle composed of muscle bundles (fascicles). Each such bundle contains a number of muscle fibres which are connected by connective tissue the fascia. The muscles have a plasma membrane (sarcolemma), cytoplasm (sarcoplasm) and endoplasmic reticulum (sarcoplasmic reticulum).

The endoplasmic reticulum stores calcium ions. Sarcoplasm has a large number of parallelly arranged myofilaments or myofibrils.

The myofibril contains actin and myosin proteins that provide this specific banding pattern.

Actin (light band/ I- band/ isotropic band)- thin

Myosin (dark band/ 'A' band/ Anisotropic band)- thick

In the centre of each actin (I) band is an elastic fibre called the **'Z' line** which bisects it.

In the middle of myosin (A-band) is a thin fibrous '**M' line**.

The portion of myofibrils between two successive 'Z' lines is the functional unit of contraction called a **sarcomere**.

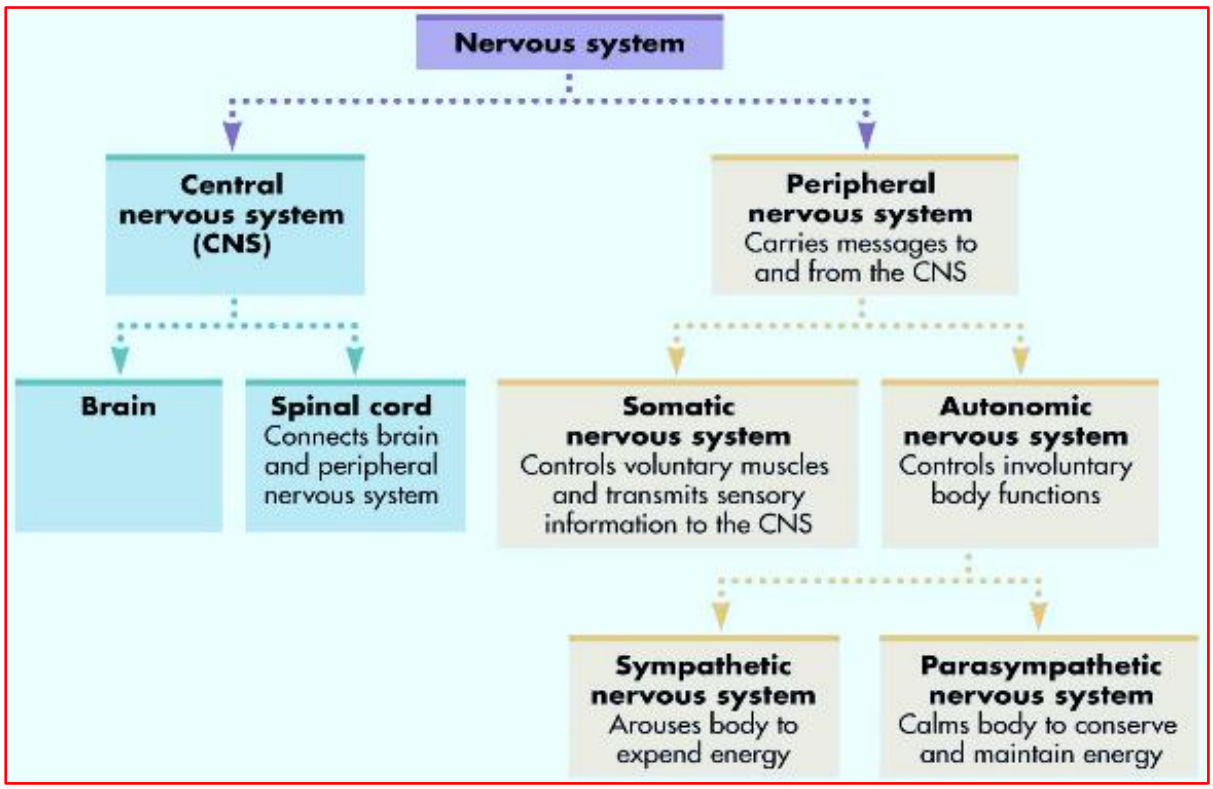
At resting stage thin filament overlaps the thick filament.

This central part of the thick filament, not overlapped by thin filaments is called the **'H' zone**

Chapter-21

Neural Control and Coordination

- Coordination is the process through which two or more organs interact and complement the functions of one another.
- In the human body, the neural system and endocrine system jointly coordinate and integrate all the activities of the organs.
- Neural system provides an organized network of point-to-point connections for quick coordination.
- The neural system is composed of neurons. In insects, it consists of the brain and many ganglia and neural tissues. Neurons can detect, receive and transmit different kinds of stimuli.



TYPES OF THE NEURAL SYSTEM IN HUMANS: -

- CNS (central neural system) – Brain and Spinal cord. It is the site for information processing and control.
- PNS (peripheral neural system)- all nerves associated with CNS.

The PNS can be grouped into

Somatic neural systems: relay impulses from CNS to skeletal muscles.
Autonomic neural system: transmits impulses from CNS to the involuntary system and smooth muscles.
The autonomic neural system is further classified into the sympathetic and parasympathetic neural systems.
The visceral nervous system: It is part of the PNS, that comprises the whole

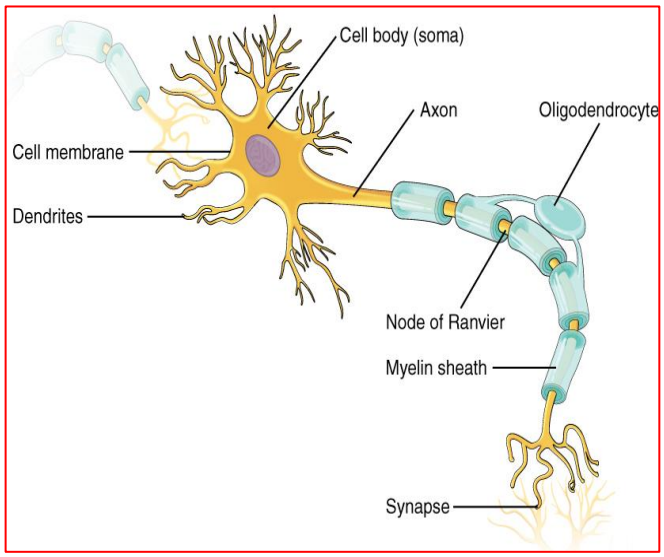
complex of nerves, fibers, ganglia, and plexuses by which impulses travel from the CNS to the viscera and from the viscera to the CNS.

Types of nerve fibers: -

- Afferent fibers- transmit impulses from tissue/organ to CNS.
- Efferent fibers- transmit regulatory impulses from CNS to concerned peripheral organs.

NEURON

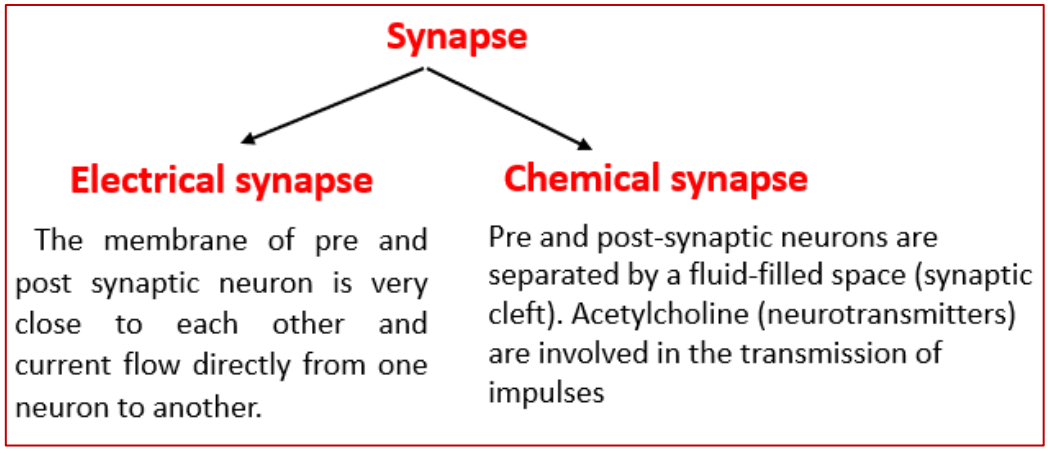
- The neuron (structural and Functional Unit of the Neural System) is made up of a - cell body (Cyton), dendrite and axon.
- Cell body contains cytoplasm, cell organelles and Nissl's granules. Short fibers projecting out from the cell body are dendrites. The axon is a long fiber having a branched structure at the end that terminates into a knob-like structure called a synaptic knob.
- The synaptic knob contains synaptic vesicle neurotransmitters.



- The axons transmit nerve impulses away from the cell body to a synapse or a neuromuscular junction.

SYNAPSE

- It is the point of contact between neurons where information is passed from one neuron to the next.



Based on the number of axons and dendrites neurons are of three types-

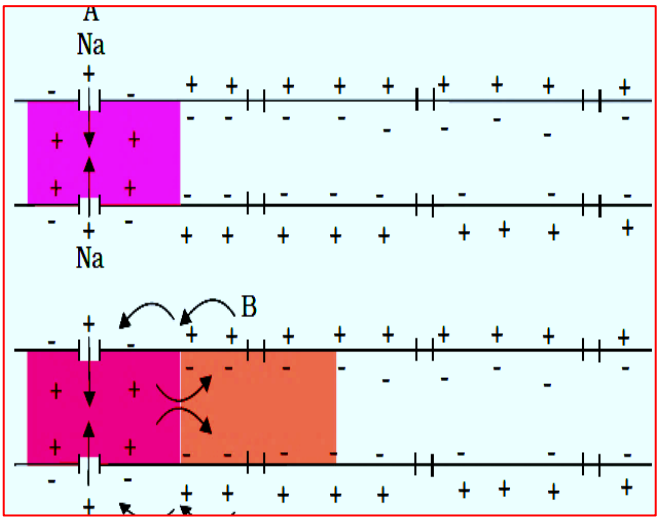
Type	Feature	Location
Multipolar	one axon and two or more dendrites	cerebral cortex
Bipolar	one axon and one dendrite	Retina
Unipolar	only one axon	embryonic stage

Types of axons-

Myelinated	fibers are enveloped with **Schwann cells** to form the myelin sheath around the axon. The gap between two myelin sheaths is called the **nodes of Ranvier.**	spinal and cranial nerves.
Unmyelinated	fibre is enclosed by Schwann cells that do not form the myelin sheath around the axon.	Found in the autonomous and somatic neural systems.

Generation and Conduction of Nerve Impulse

- Different types of ion channels are present in the neural membrane.
- These ion channels are selectively permeable to different ions.

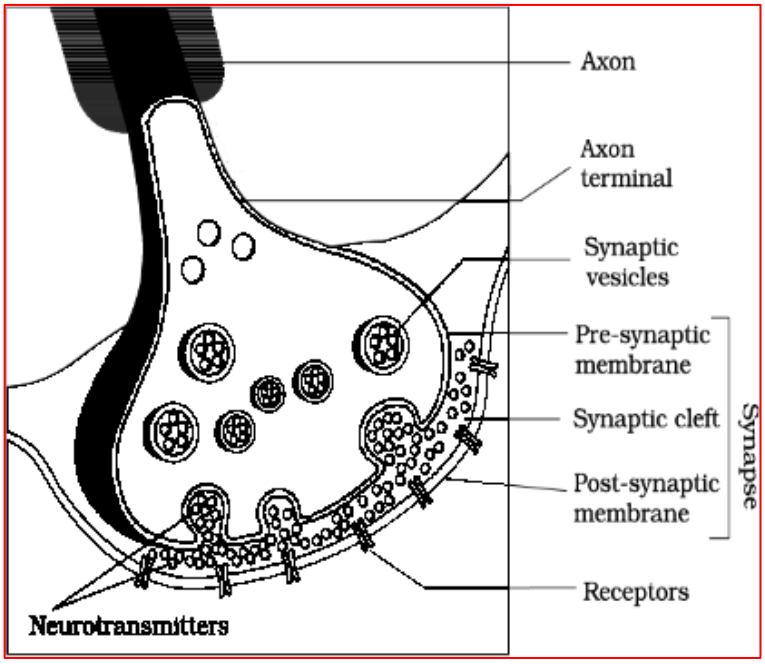


- In the resting stage when the neuron is not conducting impulse axonal membrane is more permeable to K^+ ions and nearly impermeable to Na^+ ions and negatively charged proteins present in the axoplasm.
- Thus axoplasm has a high concentration of K^+ and negatively charged proteins and a low concentration of Na^+.
- The fluid outside the axon contains a low concentration of K^+, and a high concentration of Na^+ and thus forms a concentration gradient.

- The ionic gradient across the resting membrane is maintained by the active transport of ions by the sodium-potassium pump.
- The Na- K pump transports 3 Na^+ outwards for 2 K^+ into the cell and hence the outer surface of the axonal membrane possesses a positive charge while its inner surface becomes negatively charged and therefore is polarised (resting potential).
- When a stimulus is applied at a site on the polarised membrane, the membrane at site A becomes freely permeable to Na+, which leads to a rapid influx of Na+ followed by the reversal of the polarity at that site, and the membrane is depolarised. (Action potential)
- Depolarisation is followed by the increase in permeability of K+ to the membrane leading to a change in polarization. (repolarisation).

TRANSMISSION OF IMPULSES

- A nerve impulse is transmitted from one neuron to another through synapses.
- When an impulse arrives at the axon terminal, the synaptic vesicles move toward the plasma membrane, fuse with it and release neurotransmitters (acetylcholine) in the synaptic cleft.
- The neurotransmitters bind to their specific receptors on the post-synaptic membrane and open ion channels allowing the entry of ions that can generate a new potential in the post-synaptic neuron.



IMPORTANT QUESTIONS

Very Short Answer Questions

1- Which of the following does not make the structure of neuron-

a- Axon b- Cyton c- Synaptic knob d- synaptic cleft

Ans: d

2- Which neural system transmits impulses from CNS to involuntary organs-

a- ANS b- PNS c- Both are correct d- Both are incorrect

3- What are the two components of the central nervous system?

a- Brain and spinal cord
b- Only brain
c- Only the spinal cord
d- Only neurons

Ans: a

4- Granular bodies (Nissl's granules) are a feature of which part of the neural system-

a- Dendron
b- Cyton
c- Node of Ranvier
d- Nissl granule

Ans: b

5- Resting membrane potential is maintained by

a- Acetylcholine
b- Sodium
c- Potassium
d- Both b and c

Ans: d

6- Where are receptor sites for neurotransmitters found?

a- Pre-synaptic membrane
b- Tips of axon
c- Post-synaptic membrane
d- Membrane of synaptic vesicles

Ans: c

7- Myelinated sheets are visible-

a- Spinal
b- Cranial nerves.
c- Both a and b
d- All are incorrect

8- What is correct about a polarised membrane-

a- axolemma is electrically positive outside
b- axolemma is positive inside.
c- Axolemma is electrically neutral
d- Axolemma is electrically negative outside

Ans: a

9- Where does a motor neuron stimulate a muscle fibre?

a- The neuromuscular junction

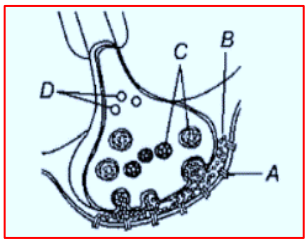
b- Inside sensory neuron
c- Actin filament
d- The sarcoplasmic reticulum
Ans: a

Short Answer Type of Questions

1- **What is the polarized state of the nerve membrane?**
Ans: State when the inner side of the nerve membrane is electronegative to its outer side.

2- **What is the meaning of the visceral nervous system?**
Ans: The visceral nervous system is a part of the peripheral nervous system. It consists of all the nerves that relay information between the CNS and visceral organs (soft internal organs of the body).

3- **Identify A,B, C, and D in the given diagram-**
Ans: A- postsynaptic knob, B- Neurotransmitters
C- Synaptic vesicles with neurotransmitters
D- Ions like Ca++



4- **What is synaptic cleft? Which chemical is released in this?**
Ans: Gap between the presynaptic and postsynaptic neurons. The chemical released is the neurotransmitter Acetylcholine.

5- **Label all the parts 1 – 8 in the given diagram-**

Ans: 1- dendron , 2- Cyton 3- Nucleus, 4- axon hillock

6- **Write the difference between Myelinated and Unmyelinated nerve fibre.**
Ans: Myelinated- fibres are enveloped with Schwann cells to form the myelin sheath around the axon. The gap between two myelin sheaths is called the nodes of Ranvier. Found in spinal and cranial nerves.
Unmyelinated- fibre is enclosed by Schwann cells that do not form the myelin sheath around the axon. Found in the autonomous and somatic neural systems.

7- **What are the different types of synapses present in the neural system?**
Ans: Electrical synapse- the membrane of pre and post-synaptic neurons is very close to each other and current flows directly from one neuron to another.
Chemical synapse- pre- and post-synaptic neurons are separated by a fluid-filled space called the synaptic cleft. Neurotransmitters are involved in the transmission of impulses.

8- **What is a reflex action? What neural system components are included in a typical vertebrate reflex arc?**

Ans: Reflex action is a spontaneous, reflexive, nerve-mediated response that takes place with a sudden stimulus. The simplest arrangement of a reflex arc consists of the receptor, an interneuron (or adjustor), and an effector; together, these units form a functional group.

9- **State the difference between chemical and electrical transmission.**

Ans: Electrical Transmission – It takes place within neurons, the synaptic cleft may or may not be present, and the transmission is very rapid.

Chemical Transmission: It takes place in between two neurons, the synaptic cleft is involved, and the rate is comparatively slow.

10- **Draw a well-labeled diagram of the nerve cell.**

Ans: fig 21.2, page 318, NCERT

Long Answer Types Questions

1 – (**a) Give a brief description of the conduction of nerve impulses across the neuron.**

(b) Make a diagram to show the axon terminal and synapse.

Ans: A nerve impulse is transmitted from one neuron to another through synapses.

When an impulse arrives at the axon terminal, the synaptic vesicles move towards the plasma membrane, fuse with it and release neurotransmitters (acetylcholine) in the synaptic cleft. The neurotransmitters bind to their specific receptors on the post-synaptic membrane and open ion channels allowing the entry of ions that can generate a new potential in the post-synaptic neuron.

(b) Figure 21.3 page 319, NCERT

2- **Explain the process of generation and conduction of nerve impulses.**

Ans: The ion channels of the neuron plasma membrane are selectively permeable. In the resting, stage membrane is more permeable to K+ ions and nearly impermeable to Na+ ions and negatively charged proteins present in the axoplasm.

Thus axoplasm has a high concentration of K + and negatively charged proteins and a low concentration of Na+ . This difference in concentration forms a concentration gradient. The ionic gradient is maintained by the sodium-potassium pump.

The Na- K pump transports 3 Na+ outwards for 2 K+ into the cell. Due to this the outer surface of the membrane acquires a positive charge while its inner surface becomes negatively charged and therefore is polarised (resting potential).

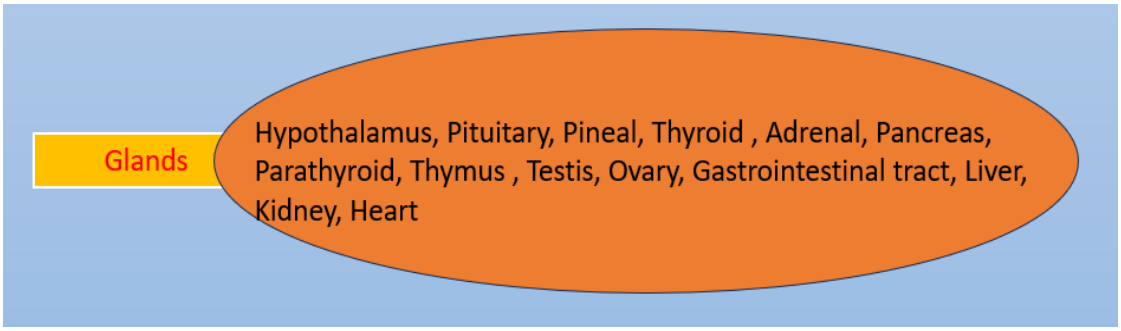
When a stimulus is applied at a site on the polarised membrane, the membrane at site A becomes freely permeable to Na+, which leads to a rapid influx of Na+ followed by the reversal of the polarity at that site, and the membrane is depolarised. (Action potential)

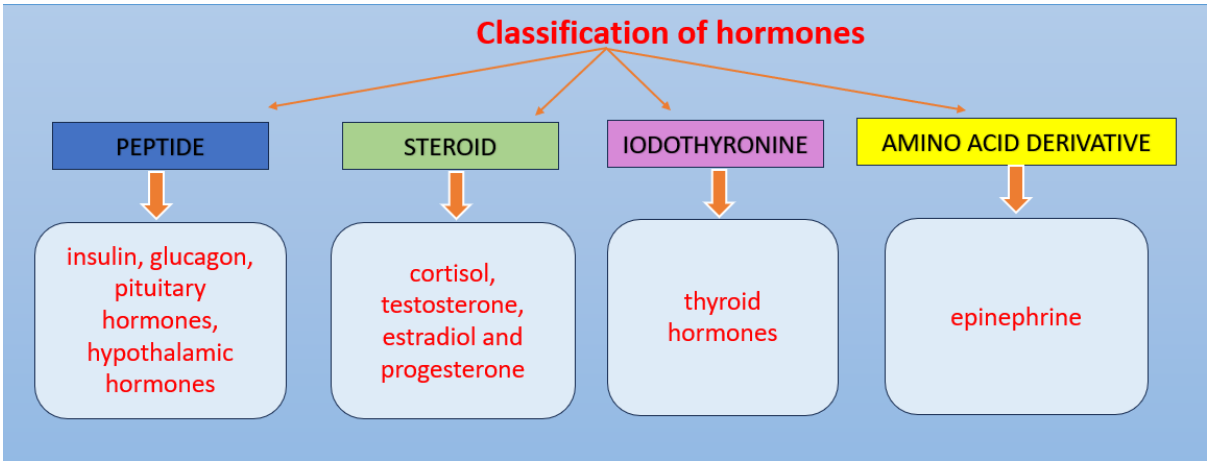
Depolarisation is followed by the increase in permeability of K+ to the membrane leading to a change in polarization. (repolarisation).

CHAPTER-22

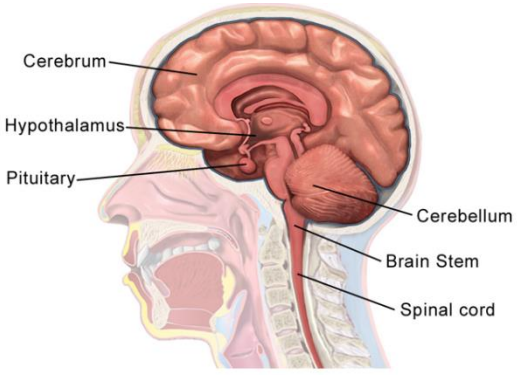
CHEMICAL COORDINATION AND INTEGRATION

- Endocrine glands lack ducts and are hence, called ductless glands. Their secretions are called hormones.
- Hormones are non-nutrient chemicals that act as intercellular messengers and are produced in trace amounts.





HYPOTHALAMUS

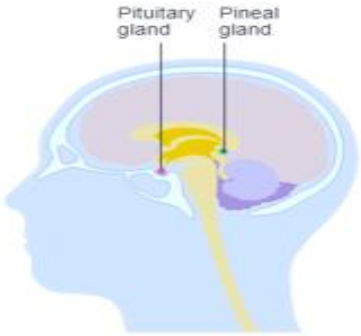


- Location: It is the basal part of the diencephalon, the forebrain.
- Hormones: It contains neurosecretory cells called nuclei which produce hormones.

Function:

- Releasing Hormone: Stimulates the secretion of pituitary hormones). **Gonadotrophin-releasing hormone** (GnRH) stimulates the pituitary to synthesize and release gonadotropins.
- Inhibiting hormones: Inhibit secretions of pituitary hormones. **Somatostatin inhibits** the release of growth hormones from the pituitary.

The Pituitary Gland



- Location: It is located in a bony cavity (sella tursica) and is attached to the hypothalamus by a stalk. It is divided anatomically into-
- Adenohypophysis- consists of pars distalis (anterior pituitary) and pars intermedia.
- Neurohypophysis (Posterior Pituitary).

Hormones:

- Anterior Pituitary-(Pars distalis)-
- Growth hormone (GH), prolactin (PRL), thyroid stimulating hormone (TSH), adrenocorticotrophic hormone (ACTH), luteinizing hormone (LH), and follicle-stimulating hormone (FSH)
- Pars intermedia- melanocyte-stimulating hormone (MSH).
- Posterior Pituitary (Neurohypophysis (pars nervosa) – oxytocin and vasopressin

Function:

GH	Over-secretion causes gigantism, acromegaly, and low secretion causes stunted growth (pituitary dwarfism).
Prolactin	Regulates mammary glands' growth and milk formation in them
TSH	Regulate thyroid hormones from the thyroid gland.
ACTH	Regulate the adrenal gland and stimulates the secretion of steroid hormones called glucocorticoids from the adrenal cortex
LH	In males helps in the synthesis and secretion of hormones androgens from the testis. In females, it induces ovulation from Graafian follicles
FSH	In males regulate spermatogenesis. In females regulates ovarian follicular development.
MSH	Acts on the melanocytes (melanin-containing cells) and regulates the pigmentation of the skin.
Oxytocin	In females, it stimulates a vigorous contraction of the uterus and helps in childbirth and lactation.
Vasopressin (Antidiuretic hormone)	Stimulates the resorption of water and electrolytes by the distal tubules and reduces the loss of water through urine (diuresis).

PINEAL GLAND

- Location: Located on the dorsal side of the forebrain
- Hormone: Melatonin
- Function: regulation of a 24-hour (diurnal) rhythm of our body. It also influences metabolism, pigmentation, the menstrual cycle, and our defence capability.

THYROID GLAND

- Location: It is a bilobed structure located on either side of the trachea. Both lobes are interconnected with connective tissue (isthmus). The thyroid gland is composed of follicles and stromal tissues.

Iodine is essential for the normal rate of hormone synthesis in the thyroid. The deficiency of iodine results in hypothyroidism and goiter (enlargement of the thyroid gland).

PARATHYROID GLAND

- Location: Four parathyroid glands are present on the back side of the thyroid gland, one pair each in the two lobes of the thyroid gland

Thyroid	T4 (tetraiodothyronine/thyroxine) T3 (triiodothyronine) TCT (Thyrocalcitonin)	**Regulate basal metabolic rate. Support the process of RBC formation.** **Control the metabolism of carbohydrates, proteins and fats.** **Help in the maintenance of water and electrolyte balance.** **TCT regulates blood calcium levels.**
Prathyroid	PTH (Parathyroid hormone)	❑ PTH is a hypercalcemic hormone (increases the Ca2+ levels in the blood). It acts on bones and stimulates the process of bone resorption ❑ PTH also stimulates the reabsorption of Ca2+ by the renal tubules and increases Ca2+ absorption from the digested food. ❑ Along with TCT, it plays a significant role in calcium balance in the body.

THYMUS

- Location: It is a lobular structure located between the lungs behind the sternum on the ventral side of the aorta.
- Hormone: Thymosins

Function:

- Development of the immune system.
- Differentiation of T-lymphocytes (provide cell-mediated immunity) and B-Lymphocyte (provide humoral immunity).

ADRENAL GLAND

- Location: One pair, one at the anterior part of each kidney. The gland is composed of two types of tissues adrenal medulla (centrally located) and adrenal cortex. The adrenal cortex can be divided into three layers, called zona reticularis (inner layer), zona fasciculata (middle layer) and zona glomerulosa (outer layer).

Hormone:

- Adrenal medulla- adrenaline (epinephrine) and noradrenaline (norepinephrine). These are commonly called catecholamines.
- Adrenal cortex- Corticoids (Glucocorticoids (Cortisol), mineralocorticoids (aldosterone)

Function:

- Adrenaline and noradrenaline are stress hormones/ Fight or Flight. These hormones increase alertness, pupillary dilation, piloerection (raising of hairs), sweating, increase heartbeat and rate of respiration etc.
- Stimulate the breakdown of glycogen resulting in an increased concentration of glucose in the blood. They also stimulate the breakdown of lipids and proteins.
- Glucocorticoids - carbohydrate metabolism, stimulate gluconeogenesis, lipolysis and proteolysis; and inhibit cellular uptake and utilization of amino acids.
- Cortisol is also involved in maintaining the cardiovascular system as well as kidney functions. It stimulates RBC production.
- Produces anti-inflammatory reactions and suppresses the immune response.
- Mineralocorticoids - regulate the balance of water and electrolytes
- Aldosterone acts mainly at the renal tubules and stimulates the reabsorption of Na+ and water and the excretion of $K^{+,}$ phosphate ions. Thus, aldosterone helps in the maintenance of electrolytes, body fluid volume, osmotic pressure, and blood pressure.
- Small amounts of androgenic steroids are also secreted by the adrenal cortex which plays a role in the growth of axial hair, pubic hair and facial hair during puberty.

The underproduction of hormones by the adrenal cortex alters carbohydrate metabolism causing acute weakness and fatigue leading to a disease called Addison's disease.

PANCREAS

- Location: It is a composite gland that acts as both exocrine and endocrine glands. The endocrine pancreas consists of α-cells and β-cells which form 'Islets of Langerhans'.
- Hormone: The α-cells secrete glucagon and β-cells secrete insulin.

Function:

- Glucagon (hyperglycemic hormone)- stimulates glycogenolysis (glucose forms from glycogen) and gluconeogenesis (formation of glucose from non-carbohydrate substrates). Both result in increased blood sugar. It also reduces cellular glucose uptake and utilization.
- Insulin (Hypoglycemic hormone): It enhances cellular glucose uptake and utilization.

Prolonged hyperglycemia leads to diabetes mellitus.

TESTIS

- Location: A pair of the testis is present in the scrotal sac (outside abdomen).
- Hormone: androgens mainly testosterone

Function:

- Androgens regulate the development, maturation and functions of the male accessory sex organs, secondary sexual characters and libido.
- Helps in spermatogenesis (formation of spermatozoa).
- These hormones produce anabolic (synthetic) effects on protein and carbohydrate metabolism.

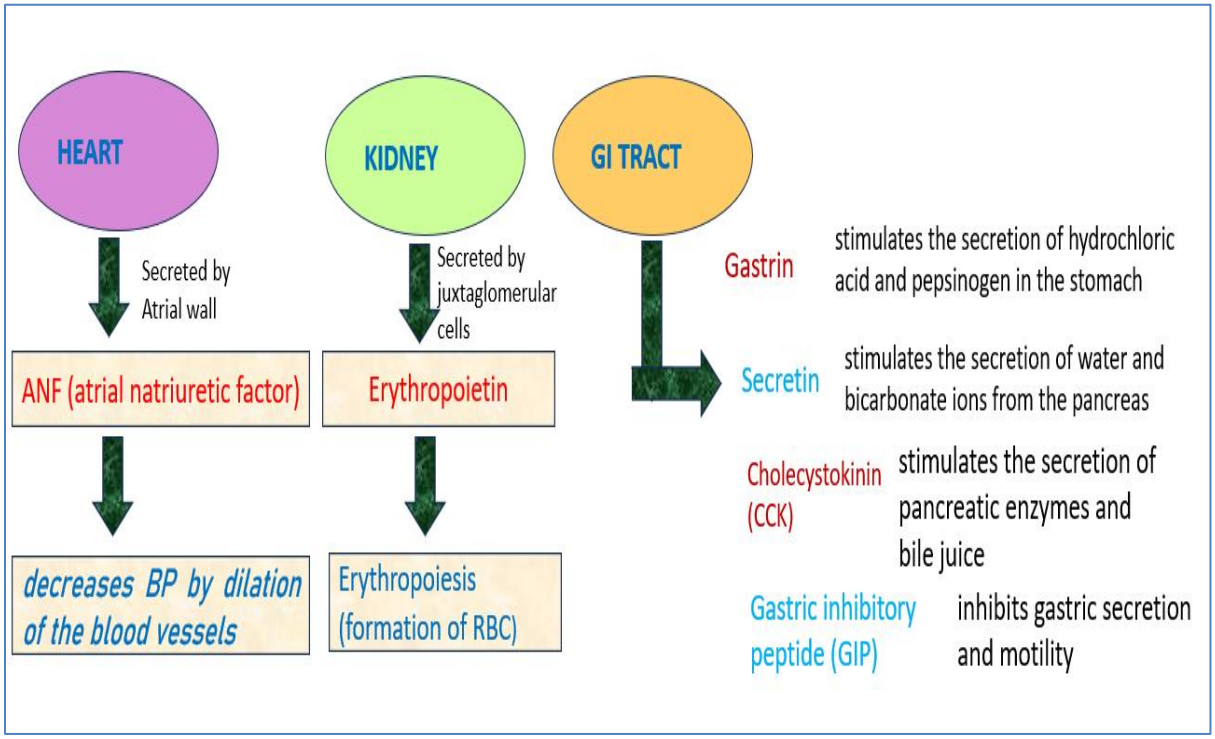
OVARY

- Location: abdomen
- Hormone: estrogen and progesterone

Function:

- Estrogens- help in the growth of secondary sex organs, development of growing ovarian follicles, the appearance of female secondary sex characters, and mammary gland development. Estrogens also regulate female sexual behaviour.
- Progesterone- maintains the endometrium lining of the uterus and supports a pregnancy. It also acts on the mammary glands and stimulates the formation of alveoli (sac-like structures which store milk) and milk secretion.

HEART, KIDNEY and GASTRO-INTESTINAL TRACT



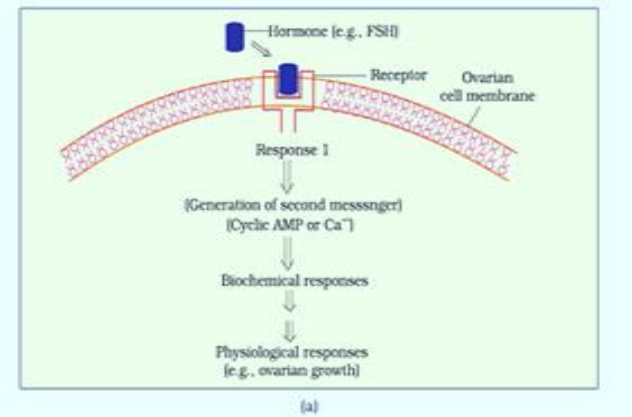
MECHANISM OF HORMONE ACTION

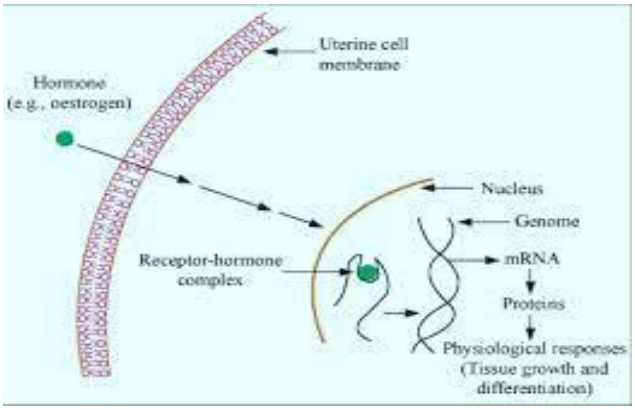
- Hormones bind to specific proteins on target tissues (hormone receptors) and form a hormone-receptor complex.

- Membrane-bound receptor: Hormone receptors present on the cell membrane.
  Intracellular receptor: present inside the target cell.
  Nuclear receptors: present in the nucleus.

Based on their chemical nature, hormones can be divided into groups:

- Hormones that interact with membrane-bound receptors normally do not enter the target cell, but generate second messengers (e.g., cyclic AMP, IP3 , Ca++ etc) which in turn regulate cellular metabolism
- Hormones that interact with intracellular receptors (e.g., steroid hormones, iodothyronines, etc.) mostly regulate gene expression or chromosome function.





IMPORTANT QUESTIONS

Very Short Answer Questions

1- Where does the pituitary gland precisely located in the skull of a human?

a- bony cavity called sella tunica
b- inside the trachea
c- behind the heart
d- in the spinal cord
ans: a

2- Follicle and stromal cells are present in-

a- Pancreas
b- Ovary
c- Thyroid
d- Adrenal gland
Ans: c

3- The anterior pituitary does not secrete which of the following hormones?

a- GH
b- FSH
c- Oxytocin

d- All of these

Ans: c

4- Injection of which of the following increases metabolic rate :-

a. Thyroxine
b. Adrenaline
c. Calcitonin
d. Estrogen

Ans: a

5- Catecholamines are secreted by –

a- Adrenal gland
b- Ovary
c- Pancreas
d- Testes

Ans: a

6- Cortex can be observed in-

a- Testes
b- Ovary
c- Adrenal gland
d- All of these

Ans: c

7- Which hormone regulates the proliferation of T- lymphocytes-

a- T4
b- Triiodothyronine
c- Adrenaline
d- Thymosin

Ans: d

8- Where does sperm formation take place-

a- Seminiferous tube
b- Vasa recta
c- Medulla and cortex
d- None of these

Ans: a

9- Which of the following regulates the pigmentation of the skin-

a- FSH
b- MSH
c- Thymosin
d- Glucagon

Ans: b

10- A deficiency of this element causes the swelling of the thyroid gland-

a. Potassium

b. Iodine
c. Phosphorous
d. All of these
Ans:

Short Answer Questions

1- **Mention the two types of hormones released from the hypothalamus and also mention their importance.**
Ans: Releasing hormones (which stimulate secretion of pituitary hormones) and inhibiting hormones (which inhibit secretions of pituitary hormones).

2- **Why does LH and FSH hormones are called gonadotropins?**
Ans: LH and FSH stimulate gonadal activity (testes and Ovary) and hence are called gonadotropins.

3- **Give an example of the endocrine gland which secretes hypercalcemic hormone. Also mention the name of the hormone.**
Ans: Parathyroid gland, PTH (parathyroid hormone)

11- **How kidney is related to RBC production?**
Ans: The juxtaglomerular cells of the kidney produce a peptide hormone called erythropoietin which stimulates erythropoiesis (formation of RBC).

4- **Write any four pituitary hormones.**
Ans: growth hormone (GH), prolactin (PRL), thyroid stimulating hormone (TSH), adrenocorticotrophic hormone (ACTH)

5- **A person is suffering from hypothyroidism disease. Write its cause and effects on a diseased person.**
Ans: A deficiency of iodine in our diet results in hypothyroidism. Hypothyroidism during pregnancy causes defective development and maturation of the growing baby leading to stunted growth (cretinism), mental retardation, low intelligence quotient, abnormal skin, and deaf-mutism.

6- **From which gland is the Catecholamines hormone released? Mention its role.**
Ans: The adrenal gland, stimulate the breakdown of glycogen resulting in an increased concentration of glucose in the blood

7- **Name any four hormones secreted by the GI tract.**
Ans: gastrin, secretin, cholecystokinin (CCK) and gastric inhibitory peptide (GIP).

12- **Give one example of a mineralocorticoid in our body. Specify their function.**
Ans: Aldosterone, maintain the balance of water and electrolytes in our body.

8- **What are the two main types of cells located in the Islet of Langerhans? List their role as an endocrine gland.**
Ans: α-cells and β-cells. The α-cells secrete a hormone called glucagon, while the β-cells secrete insulin

13- **Prolonged hyperglycemia results in which disease. How the disease can be managed?**
Ans: the disease is diabetes mellitus. Diabetic patients are successfully treated with insulin therapy.

9- **Explain how ovulation and release of progesterone hormones are linked in females.**
Ans: After ovulation, the ruptured follicle is converted to a structure called corpus luteum, which secretes mainly progesterone.

10- **Old aged persons have weak immunity. Give reason.**
Ans: Thymosins promote cell-mediated and humoral immunity. The thymus is degenerated in old individuals resulting in a decreased production of thymosins. As a result, the immune responses of old persons become weak.

Long Answer Questions

1- **Give a detailed account of the classification of hormones based on their chemical nature.**
Ans: (i) peptide, polypeptide, protein hormones (e.g., insulin, glucagon, pituitary hormones, hypothalamic hormones, etc.)
(ii) steroids (e.g., cortisol, testosterone, estradiol and progesterone)
(iii) iodothyronines (thyroid hormones)
(iv) amino-acid derivatives (e.g., epinephrine).

2- **Explain the mechanism of action of protein hormone only with the help of diagrammatic representation.**
Ans: Fig. 22.5 a, page 339 NCERT

3- **Give a brief account of the anatomy and role of the adrenal cortex.**
Ans: The adrenal cortex can be divided into three layers, called zona reticularis (inner layer), zona fasciculata (middle layer) and zona glomerulosa (outer layer).
The adrenal cortex secretes hormones collectively called corticoids.
Glucocorticoids- involved in carbohydrate metabolism. E.g.- Cortisol
Mineralocorticoids- regulate the balance of water and electrolytes in our body. e.g. aldosterone.

4- **Describe the various hormones and their roles that are associated with the pituitary gland.**
Ans: GH- Over-secretion causes gigantism, and acromegaly, low secretion causes stunted growth (pituitary dwarfism).
Prolactin- Regulates mammary glands' growth and milk formation in them
TSH: Regulate thyroid hormones from the thyroid gland.
ACTH: Regulate the adrenal gland and stimulates the synthesis and secretion of steroid hormones called glucocorticoids from the adrenal cortex
LH: In males helps in the synthesis and secretion of hormones androgens from the testis. In females, it induces ovulation from Graafian follicles

FSH: In males regulate spermatogenesis and in females regulates ovarian follicular development.

MSH: Acts on the melanocytes (melanin-containing cells) and regulates the pigmentation of the skin.

Oxytocin: In females, it stimulates a vigorous contraction of the uterus and helps in childbirth and lactation.

Vasopressin:(Antidiuretic hormone)- The kidney stimulates the resorption of water and electrolytes by the distal tubules and thereby reducing the loss of water through urine (diuresis).

5- a- Explain the endocrine nature of the heart.

b- Which hormone is secreted by the pineal gland? Mention any three roles of that hormone.

c- Write any two roles of the pancreas.

Ans: a- Atrial wall of our heart secretes a peptide hormone; atrial natriuretic factor (ANF), ANF decreases blood pressure. When blood pressure is increased, ANF is secreted which causes dilation of the blood vessels. This reduces blood pressure.

b- pineal gland secret melatonin hormone. It helps in the regulation of a 24-hour (diurnal) rhythm of our body. It also influences metabolism, pigmentation, and the menstrual cycle.

c- secret insulin and glucagon which regulate the level of sugar.

It also secretes digestive juices like pancreatic amylase which digest starch.

6- Identify and explain the pancreatic hormone which is hyperglycemic in nature. Also, mention the target cells of that hormone.

Ans: Glucagon is secreted from the pancreas.

Glucagon acts mainly on the liver cells (hepatocytes)

It stimulates hyperglycemic condition by following ways-

(i) glycogenolysis resulting in increased blood sugar (hyperglycemia).

(ii) Gluconeogenesis

(iii) It reduces the cellular glucose uptake and utilisation.

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