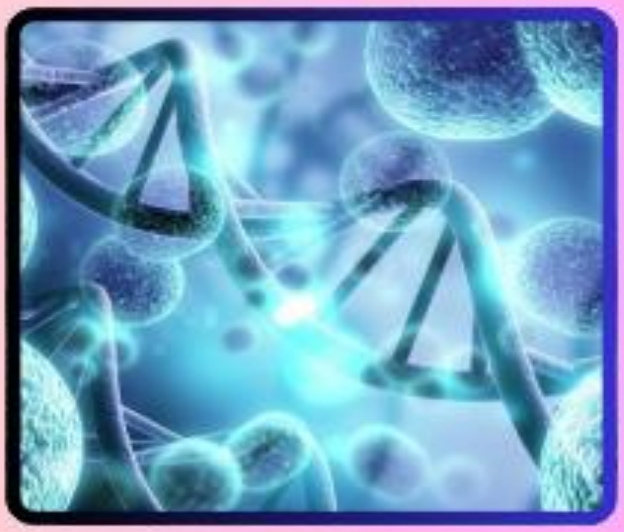
सेवाकालीन प्रशिक्षण
2023-24
स्नातकोत्तर शिक्षक
(जीवविज्ञान एवं जैव-प्रौद्योगिकी)

आज़ादी का अमृत महोत्सव

In-Service Course (ISC)
2023-24
For Post Graduate Teacher (Biology & Bio-Technology)



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VOLUME I (PART-A)

MINIMUM LEARNING MATERIAL

CLASS XI- BIOLOGY

INDEX

CHAPTER 1: THE LIVINGWORLD

GIST OF THE CHAPTER:

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

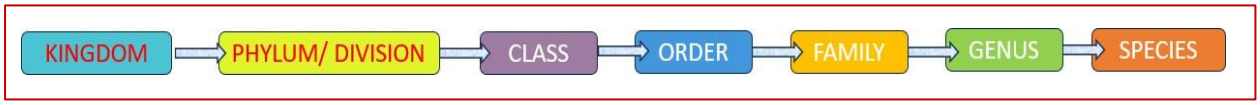
NEED OF CLASSIFICATION

- 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

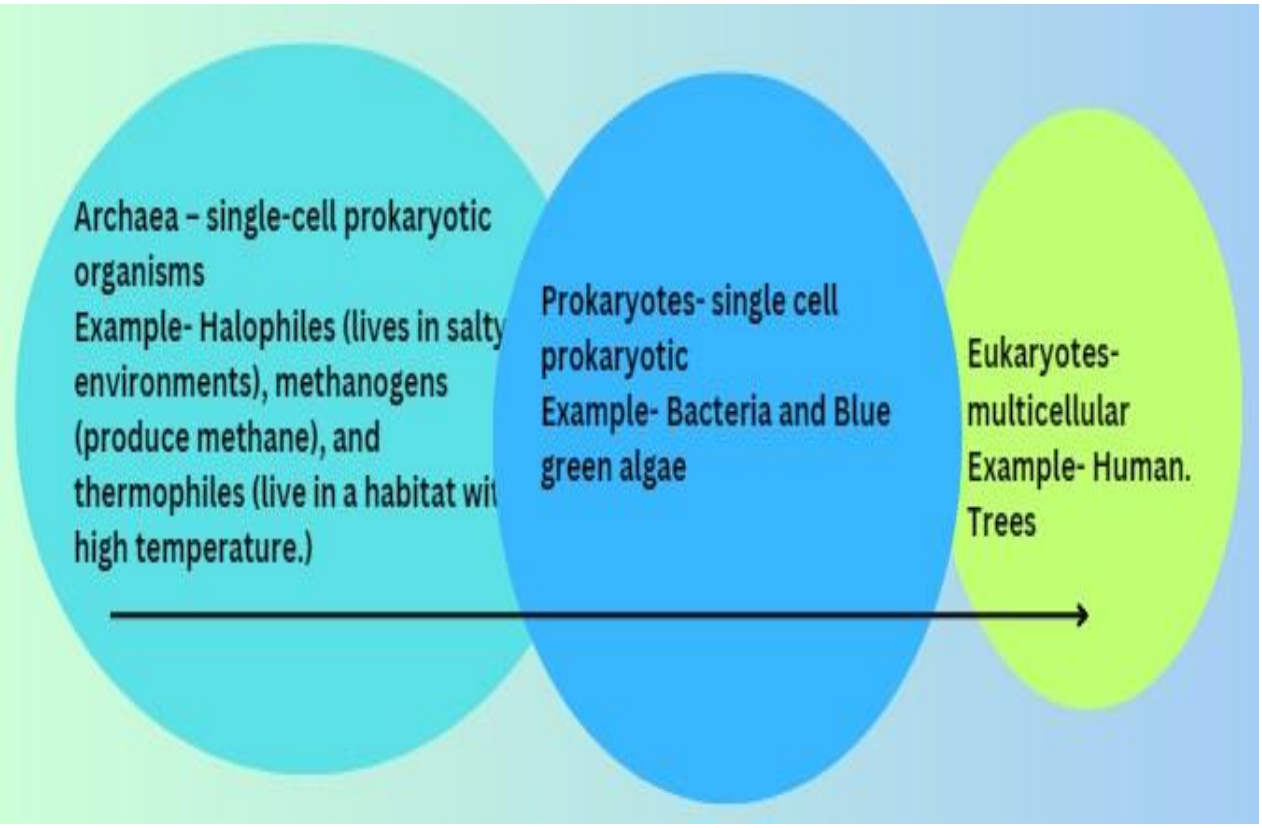


SPECIES

- 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



MULTIPLE CHOICE QUESTIONS

1- Identify the botanical name of the potato-

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

2- Flora and fauna in biodiversity represents-

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

nimal

3- ICBN is related to the nomenclature of-

a- Animals b- Microorganisms

c- Fungus d- None of these

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

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

5- Archaea are-

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

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

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

1	2	3	4	5	6	7	8	9	10
b	a	d	b	d	c	b	c	c	b

CHAPTER 2: BIOLOGICAL CLASSIFICATION

GIST OF THE CHAPTER:

Whittaker gave five kingdom classification & divide organisms into

Monera, Protista, Fungi, Plantae and Animalia.

He classified organisms on the basis of cell structure, body organisation, mode of nutrition, reproduction and phylogenetic relationships.

TABLE 2.1 Characteristics of the Five Kingdoms

Characters	Five Kingdoms				
	Monera	**Protista**	**Fungi**	**Plantae**	**Animalia**
Cell type	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Cell wall	Noncellulosic (Polysaccharide + amino acid)	Present in some	Present with chitin	Present (cellulose)	Absent
Nuclear membrane	Absent	Present	Present	Present	Present
Body organisation	Cellular	Cellular	Multiceullar/ loose tissue	Tissue/ organ	Tissue/organ/ organ system
Mode of nutrition	Autotrophic (chemosyn-thetic and photosynthetic) and Hetero-trophic (sapro-phytic/para-sitic)	Autotrophic (Photosyn-thetic) and Hetero-trophic	Heterotrophic (Saprophytic/ Parasitic)	Autotrophic (Photosyn-thetic)	Heterotrophic (Holozoic/ Saprophytic etc.)

Kingdom Monera

- Bacteria are the sole members of the Kingdom Monera.
- Photosynthetic autotrophic or chemosynthetic autotrophic.

Archaebacteria

- Found in extremely harsh habitats. such as extreme salty areas (halophiles), hot springs (thermoacidophiles) and marshy areas (methanogens).
- Methanogens are present in the gut of several ruminant animals such as cows and buffaloes & responsible for the production of methane (biogas) from the dung of these animals.

Eubacteria

- Presence of a rigid cell wall, motile, a flagellum.
- unicellular, colonial or filamentous, freshwater/marine or terrestrial.
- Colonies are generally surrounded by gelatinous sheath.
- Some of these organisms can fix atmospheric nitrogen in their specialised cells called heterocyst e.g. Nostoc and Anabaena.

Chemosynthetic bacteria

- Oxidize various inorganic substances such as nitrates, nitrites and ammonia

- Play important role in recycling nutrients like nitrogen, phosphorous, iron and Sulphur, such bacteria are present in extreme conditions and where sunlight cannot be reached.

Heterotrophic bacteria

- Most abundant, decomposers.
- Beneficial as well as harmful.
- Helps in production of antibiotics, nitrogen fixation in legumes.
- Some are pathogens and may cause diseases like Cholera, typhoid, tetanus and citrus canker.

Reproduction in bacteria

- By fission.
- Under unfavourable conditions, by production of spores.
- By Conjugation (i.e. DNA transfer from one bacterium to the other).

Mycoplasma

- smallest living cells
- survive without oxygen.
- lack a cell wall.
- pathogenic to animals and plants.

Protista

- Unicellular Eukaryotes
- Primarily aquatic.
- Link between plants, animals, and fungi.
- Some members possess flagella or cilia.
- Asexual and Sexual reproduction
- Sexual reproduction involves cell fusion and zygote formation.
- Kingdom Protista is further divided into following groups- Chrysophytes, Dinoflagellates, Euglenoids, slime moulds and protozoans

Chrysophytes

- Diatoms and golden algae also known as desmids.
- Fresh water as well as marine.
- Microscopic and float passively in water currents commonly known as plankton.
- Photosynthetic mode of nutrition.
- Cell walls form two thin overlapping shells, which fit together as in a soap box. The walls are embedded with silica and thus the walls are indestructible.
- When died left behind large amount of cell wall deposit, this accumulation over billions of years is referred to as ‘diatomaceous earth”.
- Diatomaceous earth is economically important as this soil is used in polishing, filtration of oils and syrups.
- Chief ‘producers’ in the oceans and produce huge biomass

Dinoflagellates

- Mostly marine and photosynthetic.
- yellow, green, brown, blue or red depending on the pigment present in them.
- The cell wall has stiff cellulose plates on the outer surface.
- Red dinoflagellates Gonyaulax undergo rapid multiplication and make sea appear red resulting in red tides.
- Release toxins harmful for marine life.

Euglenoids

- Mostly fresh water
- Instead of a cell wall, they have a protein rich layer called pellicle which makes their body flexible.
- They have two flagella, a short and a long one.
- Photosynthetic in the presence of sunlight and Heterotrophs (Predators) in absence of sunlight.
- Pigments are identical to higher plants.
- Example: Euglena

Slime Moulds

- Saprophytic protists.
- Their body moves along decaying twigs and leaves engulfing organic material.
- When aggregate form plasmodium which may grow and spread over several feet.
- During unfavourable conditions, plasmodium forms fruiting bodies bearing spores.
- Extremely resistant and survive for many year.
- The spores are dispersed by air currents.

Protozoans: Predators or parasites

Amoeboid protozoans

- Fresh water, sea water or present in moist soil.
- Move and capture prey by pseudopodia.
- Marine forms have silica shells on their surface.
- Example- Amoeba and entamoeba (parasites)

Flagellated protozoans

- Free-living or parasitic. Have flagella.
- Example- Trypanosoma (sleeping sickness)

Ciliated protozoans

- Aquatic, presence of thousands of cilia.
- Presence of cavity (gullet)
- Example - paramecium.

Sporozoans

- Sporozoans have an infectious spore-like stage in their life cycle.
- Example- Plasmodium (malaria).

Fungi

- Cosmopolitan occur in air, water, soil and on animals and plants. Heterotrophic
- Apart from yeasts which are unicellular, fungi are filamentous.
- Thread like structures called hyphae. The Network of Hyphae is known as mycelium.
- Mycelium can be septate or aseptate, multinucleated hyphae are known as coenocytic hyphae.
- Cell walls are composed of chitin and polysaccharides.
- Fungi can be saprophytes, parasites and symbionts
- When they are in symbiotic association with algae, called lichens and when they are in symbiotic association with roots of higher plants they are known as mycorrhiza.

Reproduction in fungi

- Vegetative Reproduction - fragmentation, fission and budding.
- Asexual Reproduction - conidia, sporangiospores or zoospores.
- Sexual Reproduction - Oospores, ascospores and basidiospores.

Sexual cycle:

1.Fusion of protoplasm between two motile or non-motile gametes called plasmogamy.

2. Fusion of two nuclei called karyogamy.

3. Meiosis- Meiosis in zygote result in haploid spores

When reproduces sexually, two haploid hyphae of compatible mating types come together and fuse.

In some fungi the fusion of two haploid cells immediately results in diploid cells (2n).

In other fungi (ascomycetes and basidiomycetes), an intervening dikaryotic stage (n + n, i.e., two nuclei per cell) called as dikaryon, which reduction division and leads to formation of haploid spores.

Phycomycetes

- Found in aquatic habitats and on decaying wood in moist and damp places or as obligate parasites on plants.
- Mycelium aseptate and coenocytic.
- Asexual reproduction – by endogenous zoospores (motile) or aplanospores (non-motile).
- A zygospore is formed by fusion of two gametes.
- Gametes - (isogamous) or dissimilar (anisogamous or oogamous).
- Examples -Mucor, Rhizopus and Albugo (the parasitic fungi on mustard).

Ascomycetes (sac-fungi)

- Mostly multicellular except unicellular, e.g., yeast
- Saprophytic, decomposers, parasitic or coprophilous (which grow on dung).

- Mycelium is branched and septate.
- Asexual spores - conidia
- Sexual spores - ascospores produced endogenously in sac like asci.
- Asci arranged in fruiting bodies called ascocarps.
- Examples - Aspergillus, Claviceps and Neurospora.

Basidiomycetes

- Grow in soil, on logs and tree stumps and in living plant bodies as parasites, e.g., rusts and smuts.
- Mycelium branched and septate.
- Asexual spores absent, but vegetative reproduction by fragmentation is common.
- Sex organs are not present, but plasmogamy by fusion of two vegetative or somatic cells of different strains or genotypes. Resultant structure is dikaryotic which forms basidium. Karyogamy and meiosis takes place in the basidium producing four basidiospores.
- The basidiospores are exogenously produced on the basidium. The basidia are arranged in fruiting bodies called basidiocarps.
- Examples- Agaricus (mushroom), Ustilago (smut) and Puccinia (rust fungus).

Deuteromycetes (Imperfect fungi)

- No sexual stage is known.
- When the sexual forms of these fungi were discovered, they were moved into classes they rightly belong to.
- Reproduction by asexual spores (conidia)
- The mycelium septate and branched.
- Some are saprophytes or parasites while a large number of them are decomposers of litter and help in mineral cycling.
- Examples -Alternaria, Colletotrichum and Trichoderma.

Viruses

- Non- Living when outside their specific host cell. Viruses are obligate parasites
- It is made of an outer protein coat and a genetic material (RNA / DNA).
- Virus that infects plants have single stand RNA and those infect animals have either single or double RNA or double stranded DNA.
- Bacteriophages are viruses that infect the bacteria.
- Viruses cause disease like mumps, small pox, herpes, influenza and AIDS.

Viroids

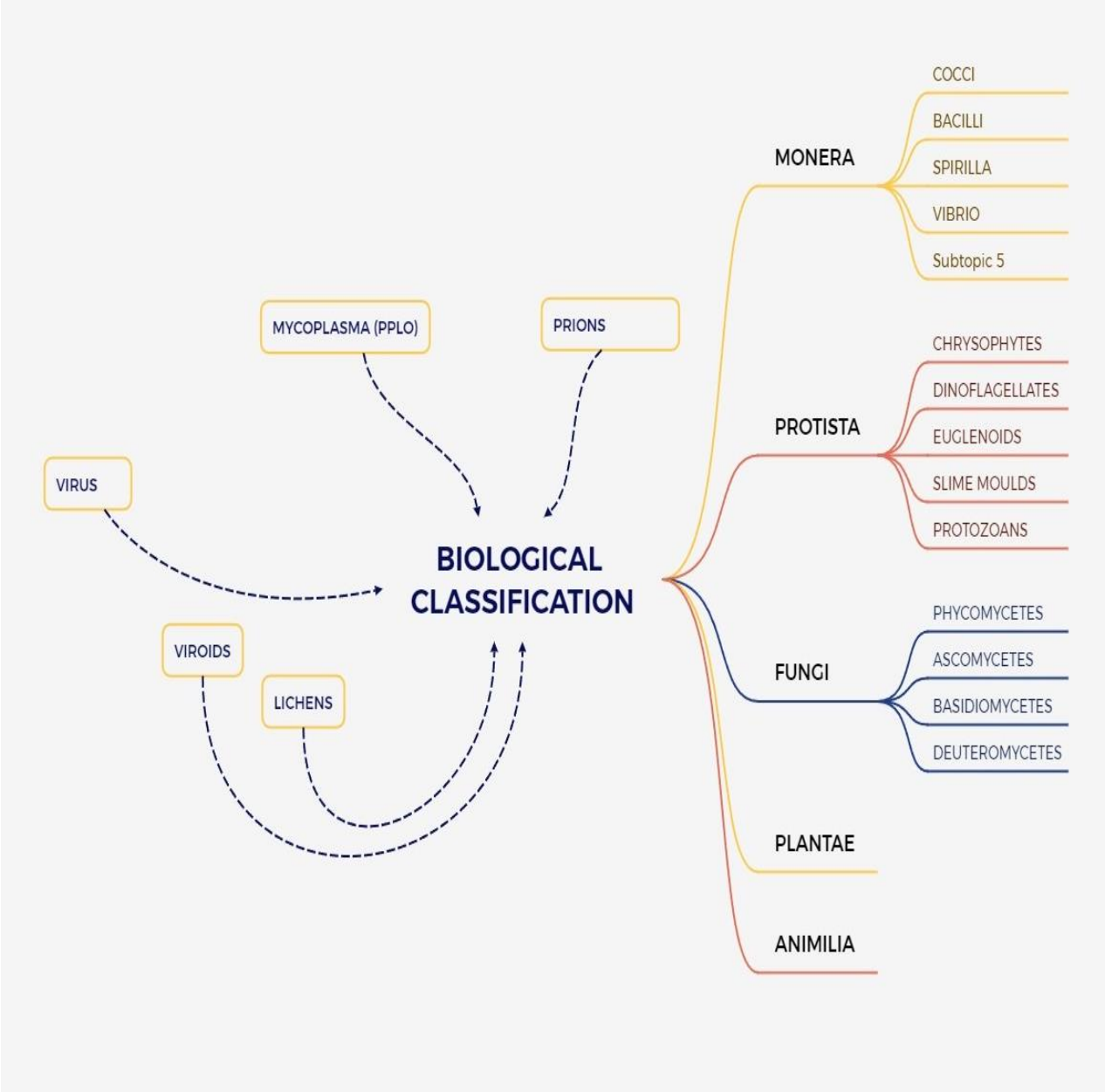
- Infectious agent smaller than viruses cause potato spindle tuber disease.

- It was found to be a free RNA; it lacked the protein coat that is found in viruses, hence the name viroid.
- The RNA of the viroid was of low molecular weight.

Lichens

- Lichen is the symbiotic association between algae and fungi.
- Phycobiont is algal component of lichen, which prepare food for fungi and Mycobiont is a fungal component of lichen, which provide shelter and absorb mineral nutrients and water for its partner.

MIND-MAP

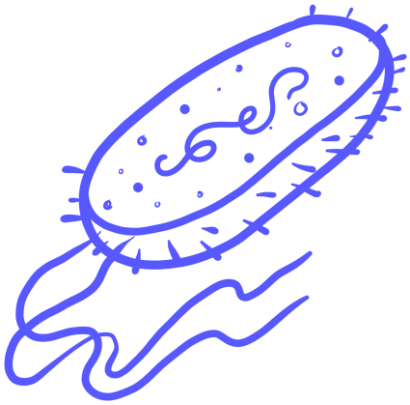


MULTIPLE CHOICE QUESTIONS

1. Which of the following is correctly matched?

Member	**Stored food**
A. Chrysophytes	i) fat
B. Dinoflagellates	ii) starch
C. Protozoa	iii) Fucoxanthin
D. Euglenoids	iv) Chrysolaminarin

2. Identify the shape of bacteria shown in the diagram



A. Bacilli B. Spirilla C. Vibrio D. Cocci

3. Read the following four statements (A-D) carefully and find correct statement

   A. Methanogens are found in arid zones

   B. Methanogens belong to Archaebacteria

   C. Methanogens can survive in hot springs

   D. Methanogens are aerobic bacteria

4. Which among the following is not an eukaryote?

   A. Nostoc B. Mycobacterium C. a and b both D. none of the above

5. Harsh conditions can be tolerated by

   A. Archaebacteria B. Eubacteria C. Chordata D. Eubacteria

6. Exogenous spores are found in

   A. Basidiomycetes B. Ascomycetes C. Both a and b D. none of the above

7. T.O Diener discovered

   A. bacteria B. fungi C. virus D. viroids

8. Plasmogamy is

A. Fusion of protoplasms of motile gametes

B. Fusion of protoplasms of non-motile gametes

C. none of the above

D. both a and b

9. The infection in Viroids is caused by

A. protein B. RNA C. DNA D. Glycophosphate

10. Which among the following is not a viral disease

A. AIDS B. COVID-19 C. Spindle tuber disease D. None of the above

11. Rohan's teacher has given him a slide which when he observed under microscope found to have following features filamentous structure and sporangium possibly it may belong to

A. Protista B. Monera C. Fungi D. Protozoan

12. Plasmodium belongs to which group of protozoans

A. Amoeboid B. Flagellated C. Ciliated D. Sporozoans

13. Read the characteristics carefully and identify the group which it belongs to:

Presence of pellicle, Have two flagella a short and a long one act as predator in the absence of sunlight

A. Chrysophytes B. Euglenoids C. Dinoflagellates D. Slime moulds

14. Read the characteristics carefully and identify the group which it belongs to:

Presence of cellulosic plates, have two flagella one longitudinal and cause red tides

A. Chrysophytes B. Euglenoids C. Dinoflagellates D. Slime moulds

15. Which one among the following is not criteria for five kingdom classification

A. Cell wall B. Mode of nutrition C. Major pigment D. Nuclear membrane and body organisation

ANSWERS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
C	A	B	C	A	A	C	D	B	C	C	D	B	C	C

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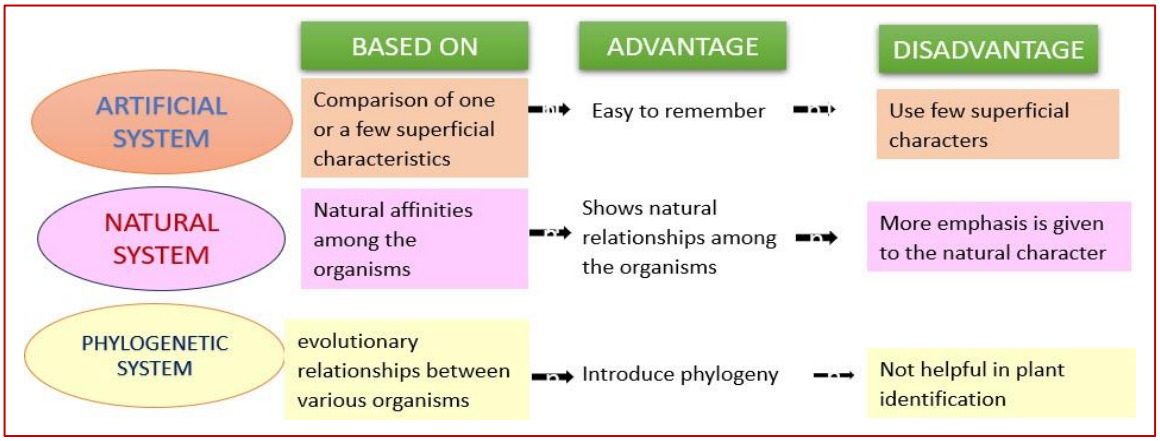
CHAPTER 3: PLANT KINGDOM

GIST OF THE CHAPTER:

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)	PHAEOPHYCEAE (BROWN ALGAE)	RHODOPHYCEAE (RED 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	• 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	• 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

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)

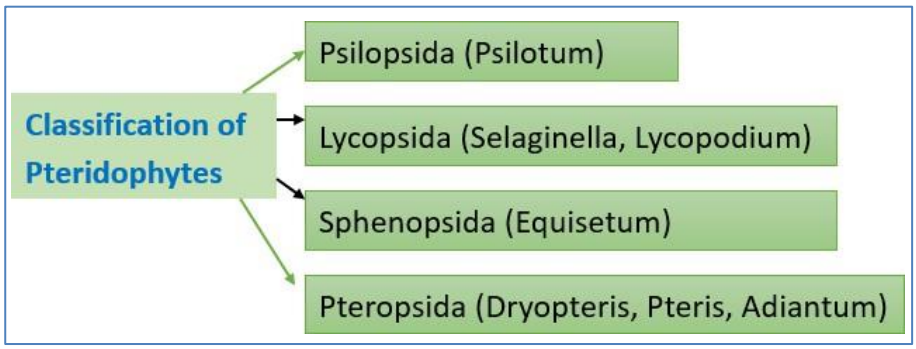
• The plant body of a liverwort is thalloid The thallus is dorsiventral and closely appressed to the substrate. • The leafy members have tiny leaf-like appendages in two rows on the stem-like structures. • Asexual reproduction- fragmentation, gemmae • The sporophyte is differentiated into a foot, seta 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

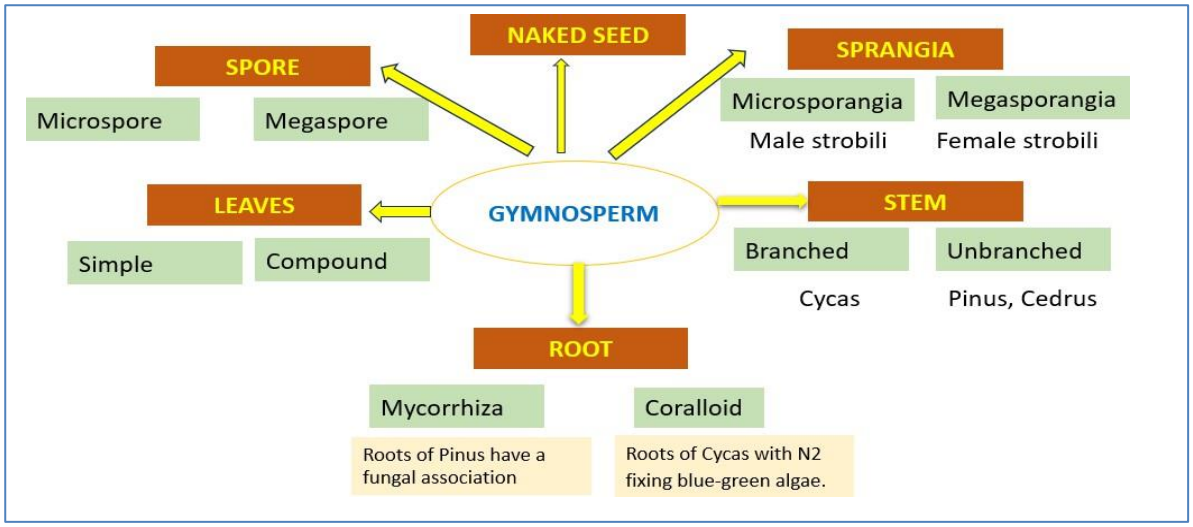
- These are the first vascular plants that bear vascular tissues – xylem and phloem.
- Habitat: cool, damp, shady places, some in sandy places
- Main plant body is a sporophyte which is differentiated into true root, stem and leaves
- Leaves- small (microphylls) as in Selaginella or large (macrophylls) as in ferns.
- Sporophylls- The sporophytes bear sporangia that are subtended by leaf-like appendages called sporophylls.

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)

- 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.

MULTIPLE CHOICE QUESTIONS

1- Spirogyra belongs to –
   a- Chlorophyceae b- Rhodophyceae c- Phaeophyceae d- Sphenopsida
2- 2. Naked seed is peculiar features of –
   a- Bryophyta
   b- Gymnosperm
   c- Pteridophyta
   d- Algae
3- Coralloid seeds are a feature of-
   a- Cycas b- Pinus
   c- Riccia d- Marchantia
4- Equisetum belongs to the-
   a- Lycopsida
   b- Sphenopsida
   c- Psilopsida
   d- None of these
5- Identify the feature which is not present in sporophytes-
   a- Foot b- Gemma
   c- Seta d- Capsule
6- Evolutionary relationship is the basis of
   a- Phylogeny
   b- Natural system
   c- Artificial system
   d- All of these
7- Water and food-conducting tissues were first observed in-
   a- Algae b- Gymnosperm
   c- Angiosperm d- Pteridophyta
8- Which of the following is based on the evidence from chemical constituents
   a- Numerical taxonomy
   b- Chemotaxonomy
   c- Cytotaxonomy
   d- None of these

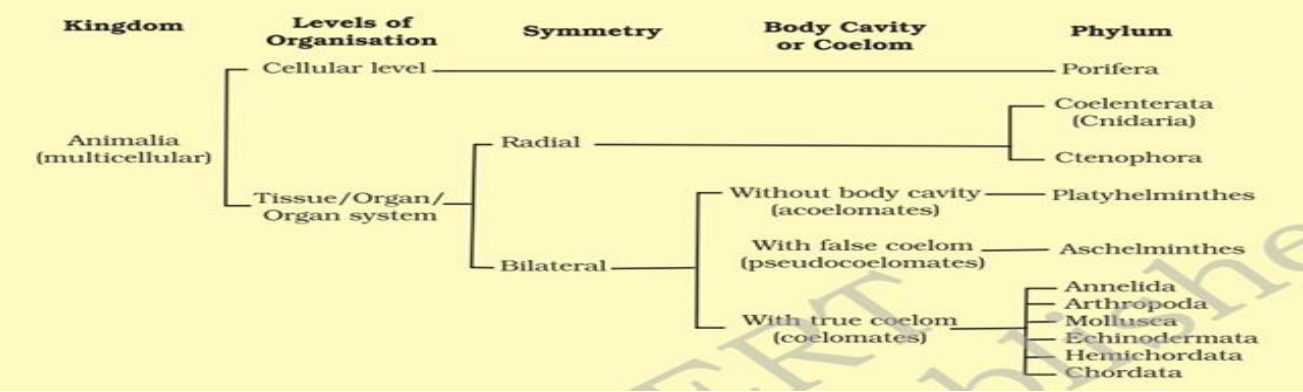
9- In bryophytes the sporophyte produces spores. The spores are formed by –
   a- Mitosis b- Meiosis
   c- Equational division d- Amitosis
10- Algin is the product of-
   a- Red algae b- Brown algae c- green algae d- Bryophyta

1	2	3	4	5	6	7	8	9	10
a	b	a	d	b	a	d	c	b	b

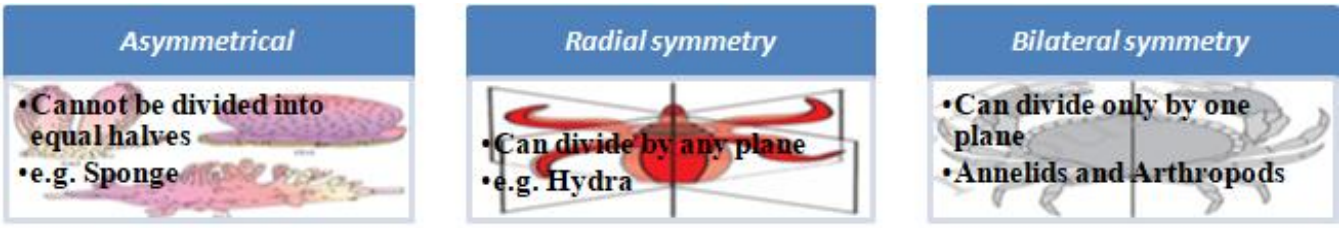
CHAPTER 4: ANIMAL KINGDOM

GIST OF THE CHAPTER

Level of organization

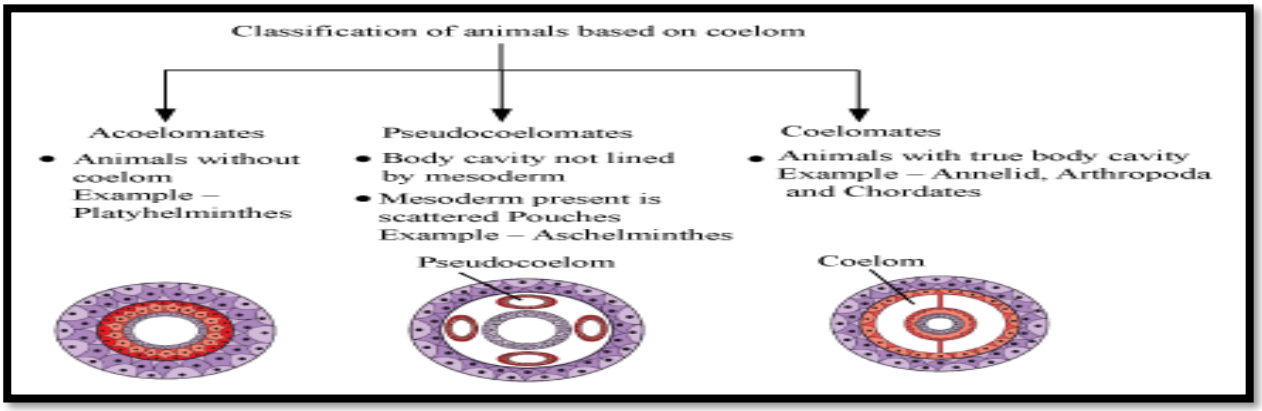


Symmetry

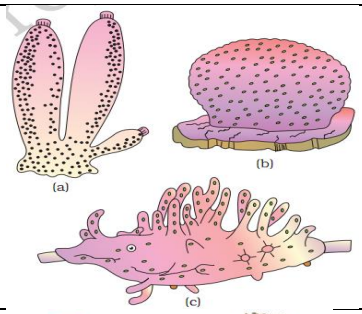
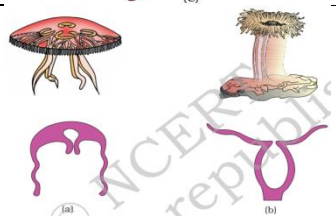
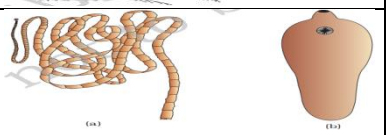
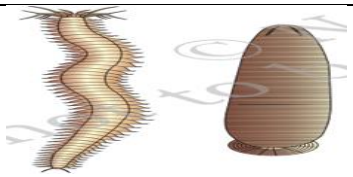
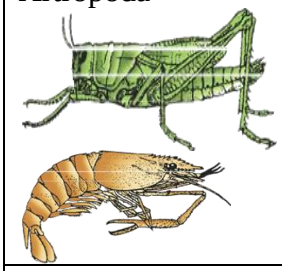
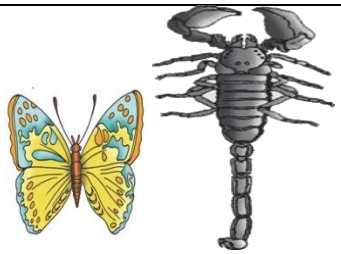
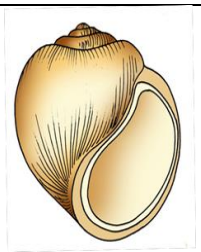
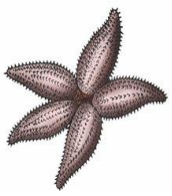


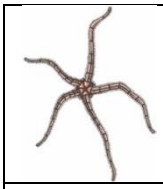
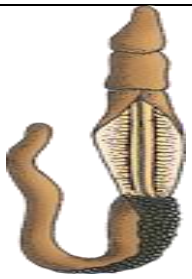
Classification on basis of germinal layers :

- **Diploblastic:** Cells arranged in two embryonic layers i.e. external ectoderm and internal endoderm. (Mesoglea may be present in between ectoderm and endoderm) e.g., Coelenterates. (Cnidarians)
- **Triploblastic**: Three layers present in developing embryo i.e., ectoderm, endoderm and mesoderm. e.g., Chordates.



- **Metamerism:** If body is externally and internally divided into segments with serial repetition of at least some organs then phenomenon is called metamerism. e.g., Earthworm.
- **Notochord**: Rod-like structure of mesodermal origin, formed during embryonic development on the dorsal side. e.g., Chordates.

Porifera- e.g., *Sycon, Euspongia*	Also called sponges, asymmetrical, cellular, water canal system, Digestion intracellular. Ostia (minute pores on body), spongocoel (body cavity) and osculum help in water transport. They are lined bychoanocytes (collar cells), Body wall has spicules and spongin fibers, Animals are hermaphrodite, Fertilization internal. Development is indirect	
Coelentrata- e.g., *Physalia, Adamsia*	Also called **Cnidarians**, marine and radially symmetrical, Sessile or free-swimming. Have **tissue level** of organization, Diploblastic, **cnidoblast**, **gastro-vascular, hypostome**. two body forms: **polyp** and **medusa** e.g., Hydra, Aurelia. **Metagenesis** occurs.	
Ctenophora- e.g., *Ctenoplana. Pleurobranchia*	Also called as **sea walnuts** or **comb jellies**, **comb plates** for locomotion, Bioluminescence	
Platyhelminthes e.g., *Taenia, Fasciola*	'Flat worms', Triploblastic Acoelomate, 'Flame cells', regeneration capacity.	
Aschehelminthes e.g., Ascaris, Wuchereria	called 'round worms', Pseudocoelomates, muscular pharynx, dioecious. Shows sexual dimorphism, Females longer than males	
Annalida- e.g.Pheretima ,Hirudinaria, Nereis	**Metamerically** segmented body, **parapodia** for movement. Have **nephridia** for osmoregulation and excretion. Circulatory system is closed type. Earthworm (*Pheretima*) and Leech (*Hirudinaria*) which are hermaphrodites (i.e., monoecious).	
Artropoda 	Body divisible into head, thorax, abdomen, Body covered by a chitinous exoskeleton, They have jointed appendages, Respiration by gills, book gills, lungs or tracheal system, Circulation is open type. Excretion through malpighian tubules. e.g., *Apis, Bombyx, Anopheles, Locusta, Limulus.*	
Mollusca 	Body divisible into **head, muscular foot** and **visceral hump** and is covered by a soft and spongy layer of skin called **mantle**, Unsegmented body, Body is covered by calcareous shell, Respiration and excretion by feather like gills (ctenedium) in mantle cavity, Head has sensory tentacles. **Radula**-file like rasping organ for feeding. e.g., *Pila, Pinctada, Octopus*	
Echinodermata e.g., Asterias, Cucumaria.	Endoskeleton of **calcareous ossicles,** Triploblastic and **eucoelomate,** Digestive system complete. Mouth ventral, Anus on dorsal side.Food gathering, respiration, locomotion carried out by **water vascular system**.Excretory system is absent.	

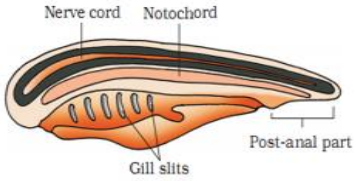
		
Hemichordata- e.g., *Balanoglossus*	Have small worm-like marine animals.Was earlier placed as sub-phylum of Phylum Chordata.Bilaterally symmetrical, triploblastic and coelomate.Body cylindrical, has proboscis, collar and trunk. Circulation is open type.Respiration by gills Excretion by proboscis gland.	

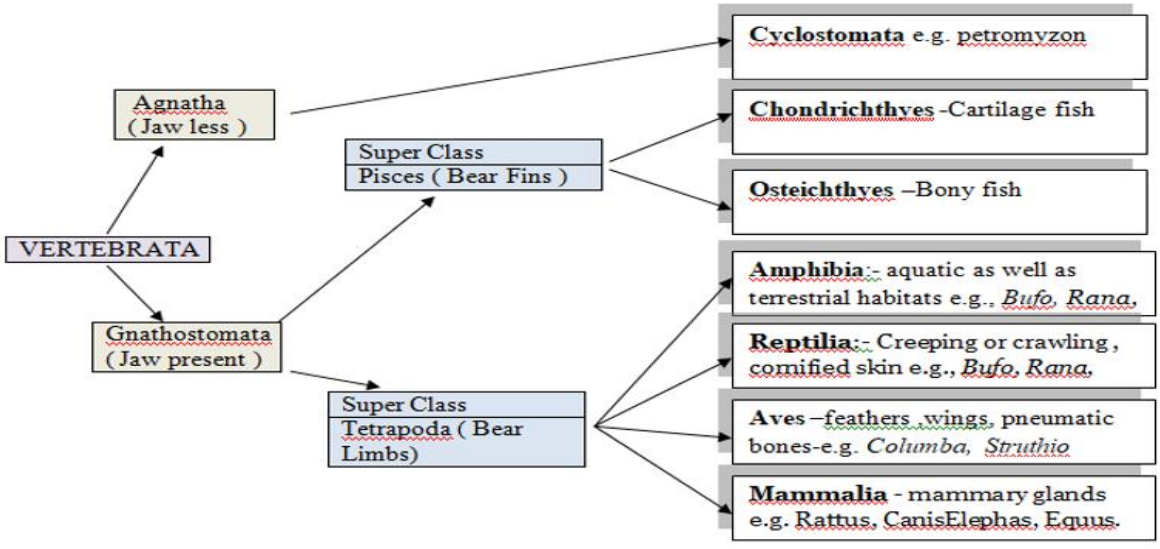
Chordata

Presence of a **notochord**, a **dorsal hollow nerve cord** and **paired pharyngeal gill slits.**

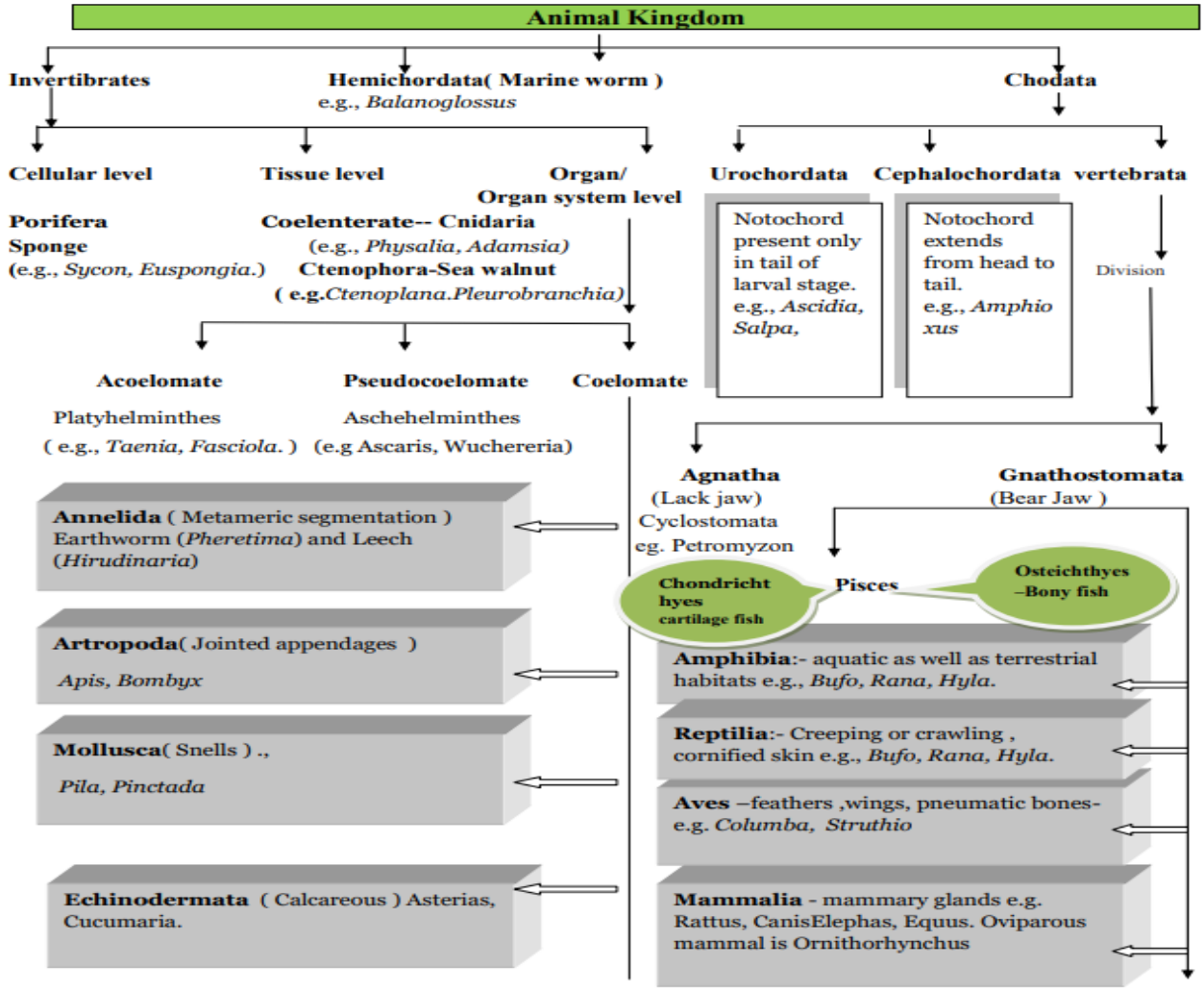
Table 1. Comparison of Chordates and Non-chordates

S.No.	Chordates	Non-chordates
1.	Notochord present.	Notochord absent.
2.	Central nervous system is dorsal, hollow and single.	Central nervous system is ventral, solid and double.
3.	Pharynx perforated by gill slits.	Gill slits are absent.
4.	Heart is ventral.	Heart is dorsal (if present).
5.	A post-anal part (tail) is present.	Post-anal tail is absent.





MIND MAP



MULTIPLE CHOICE QUESTIONS

Q1. True coelome is lined with

(a) Ectoderm and endoderm (b) Ectoderm and mesoderm

(c) Ectoderm on both sides (d) Mesoderm on both sides

Q2. Which of the following are the cold blooded animals?

(a) Birds and snakes (b) Birds and mammals

(c) Bat and rat (d) Frog and snake

Q3. Open circulatory system is present in

(a) Man (b) Cow (c) Earthworm (d) Cockroach

Q4. Tissue level organisation is found in

(a) Porifera (b) Annelida (c) Coelenterata (d) None of these

Q5. Which of these reptiles have four chambered heart?

(a)Turtle (b) Cobra (c) Crocodiles (d) Calotes

Q6. Which one of the following groups of animals is bilaterally symmetrical and triploblastic?

(a) Ctenophores (b) Sponges

(c) Coelenterates (Cnidarians) (d) Aschelminthes (Round worms)

Q7. Which one of the following pairs of animals comprises 'jawless fishes'?

(a)Lampreys and hag fishes (b)Guppies and hag fishes

(c)Lampreys and eels (d) Mackerals and Rohu

Q8. Peripatus is a connecting link between:

(a)Annelida and Arthropoda (b) Coelenterata Porifera

(c)Ctenophora and Platyhelminthes (d)Mollusca and Echinodermata

Q9. Which one of the following statements about all the four of *Spongilla*, Leech, Dolphin and Penguin is correct?

(a) All are bilaterally symmetrical

(b) Penguin is *homoiothermic* while the remaining three are poikilothermic

(c) Leech is a fresh water form while all others are marine

(d) Spongilla has special collared cells called choanocytes, not found in the remaining three

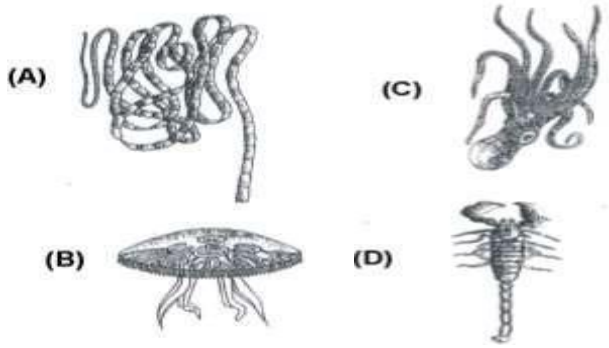
Q10. In which one of the following the genus name, its two characters and its class/phylum are correctly matched?

Option	Genus name	Two characters	Class/ Phylum
a	*Ascaris*	Body segmented	Annelida
		Males and females distinct	
b	*Salamandra*	A tympanum represents ear	Amphibia
		Fertilization is external	
c	*Pteropus*	Skin possesses hair	Mammalia
		Oviparous	
d	*Aurelia*	Cnidoblasts	Coelenterata
		Organ level of organization	

Q11.Which one of the following kinds of animals are *triploblastic*?

a) Corals b) Flat worms c) Sponges d) Ctenophores

Q12. The figure shows four animals (a), (b), (c) and (d). Select the correct answer with respect to a common characteristics of two of these animals.



a) (A) and (D) respire mainly through body wall

b) (B) and (C) show radial symmetry

c) (A) and (B) have cnidoblasts for self defence

d) (C) and (D) have a true coelom

Q13. Which of the following are correctly matched with respect to their taxonomic classification?

a) House fly, butterfly, tse tse fly, silverfish-Insecta

b) Spiny anteater, sea urchin, sea cucumber-Echinodermata

c) Flying fish, cuttlefish, silverfish – Pisces

d) Centipede, millipede, spider, scorpion- Insecta

Q14. Which of the following belongs to the same phylum?

a) Prawn, Scorpion, *Locusta*

b) Sponge, Sea anemone, Starfish

c) Malarial parasite, *Amoeba*, Mosquito

d) Earthworm, Pinworm, Tapeworm

Q15.Which one of the following options gives the correct categorisation of six animals according to the type of nitrogenous wastes (A, B, C), they give out

	(A) AMMONO TELIC	**(B) UREOTELIC**	**(C) URICOTELIC**
(a)	Aquatic Amphibia	Frog, Humans	Pigeon, Lizards, Cockroach
(b)	Aquatic Amphibia	Cockroach, Humans	Frog, Pigeon, Lizards
(c)	Pigeon, Humans	Aquatic	Cockroach, Frog

		Amphibia, Lizards	
(d)	Frog, Lizards	Aquatic Amphibia, Humans	Cockroach, Pigeon

Q16. A mammalian character without any exception is

(a) Vivipary (b) Presence of hairs on the body

(c) Presence of tail (d) Muscular diaphragm between thorax and abdomen

Q17. Which of these is true fish?

(a) Jelly fish (b) Flying fish (c) Silver fish (d) Star fish

Q18. Egg laying mammal is

(a) Armedilo (b)Duckbill platypus (c)Pangolin (d) All Of these

Q19.Which characters are related to given diagram?

(A) Bioluminescence (the property of a living organism to emit light).

(B) Digestion is both extracellular and intracellular.

(C) Sexes are not separate.

(D) Fertilisation is external with indirect development.

(a) A and B (b) A,B and C (c) A,B and D (d) A,B C and D

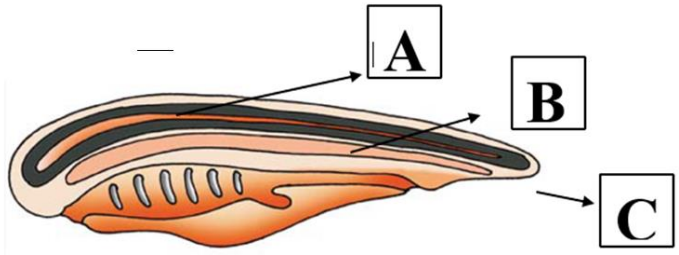
Q20. Animals of which phylum are not found in fresh water?

(a) Mollusca (b) Annelida (c) Arthropoda (d) Echinodermata

Q21. Flame cells are the excretory organs in

(a) Planaria (b)Hydra (c) Cockroach (d) Earthworm

Q22. Identify A, B and C in given diagram.



(a) Nerve cord , Notochord and Ectoderm

(b) Nerve cord , Notochord and post anal tail

(c) Notochord , nerve cord and endoderm

(d) Notochord , nerve cord and Gill slits

Q23. Which of these in birds indicate reptilian ancestry?

(a) presence of crop and gizzard (b) eggs with calcareous shell

(c) scales on their hind limbs (d) four chambered heart

Q24. Number of gills in Osteichthyes are

(a) 2 pairs (b) 6-15 pairs (c) 4 pairs (d) 5 pairs

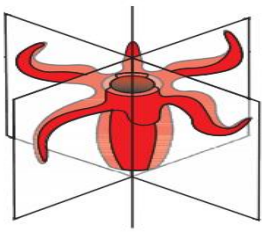
Q25 Green gland is the excretory organ of

(a) Prawn (b) Butterfly (c) Snail (d) Earthworm

Q26. Animals of which phylum have water vascular system?

(a) Porifera (b) Echinodermata (c) Cnidaria (d) Ctenophora

Q27.Which symmetry present in given diagram?



(a) Radial (b) Bilateral (c) Penta radial (d) none of these

Q28. Which of these statements is perfectly related to the phylum coelenterate?

(a) presence of cnidoblasts, diploblastic, have polyp and medusa

(b) bilateral symmetry, trploblastic,with organ level organisation

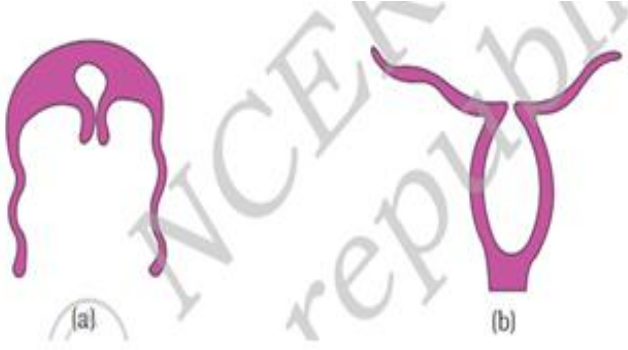
(c)bilateral symmetry, metamerically segmented ,have nephridia

(d) soft body, calcareous shell, muscular foot and radula present.

Q29.Which of these is known as Cuttlefish?

(a) Sepia (b) Octopus (c) Loligo (d) Asterias

Q30. Which is diagram represent asexual stage of Coelenterata ?



(a) a (b) b (c) a& b (d) None of these

ANSWER KEY

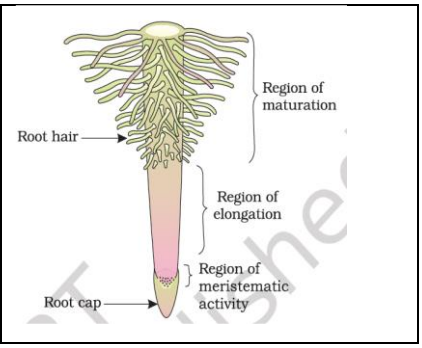
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
d	D	d	c	c	d	a	a	d	c
Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
b	D	a	a	a	d	b	b	c	d
Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30
a	B	c	c	a	b	a	a	a	b

PREPARED BY: MR PUKH RAJ

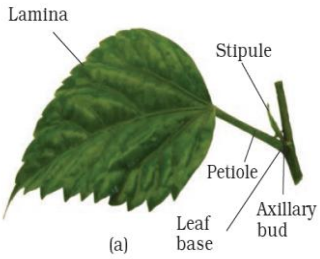
PGT BIOLOGY, K.V BEAWAR, RAJASTHAN

CHAPTER 5: MORPHOLOGY OF FLOWERING PLANTS

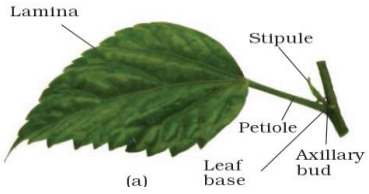
GIST OF THE CHAPTER

Types of roots -Taproot- Example Dicot Plants. Fibrous root-Monocot Plants	
Adventitious root-Aerial Root of Banyan Tree.	
Regions of root – Region of maturation-Root Hair Present	
Region of elongation-undergo rapid elongation and enlargement and are responsible for the growth of the root in length Region of meristematic tissues.	
Root cap-protects the tender apex of the root.	

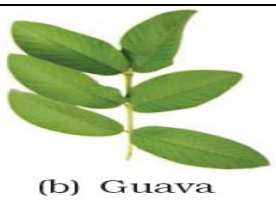
The stem: Plumule have nodes and internodes bears with axillary /terminal buds.

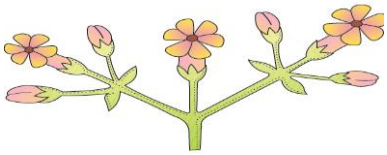
	
The leaf:	
1.Short apical meristem gives rise to leaves arranged in acropetal order.	
2.Do photosynthesis.	
3.Three main parts are leaf base, petiole and lamina (leaf blade).	
4.Have stipules.	
5.Leguminous petioles have pulvinus. (midrib).	
6.Venation - arrangement of veins and veinlets on a leaf.	

Types of venation :	
	
Reticulate venation Ex. Dicot leaf	Parallel venation Ex. Monocot leaf

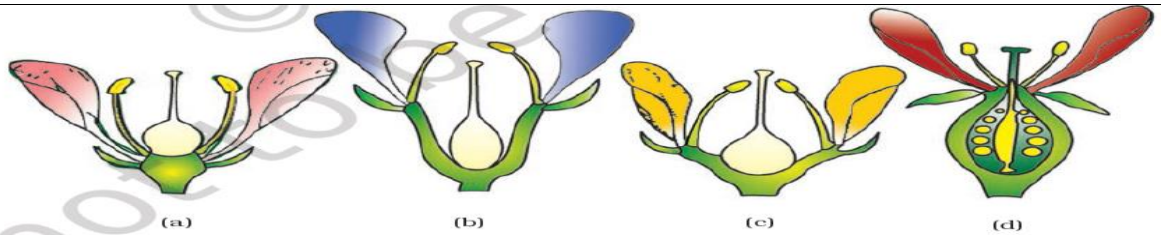
Types of leaves:	
 SIMPLE LEAF	Compound leaves - Pinnately compound and Palmately compound.  Pinnately compound (eg. Neem) Palmately compound (eg. Silk cotton)

Phyllotaxy: Pattern of arrangement of leaves on the stem /branch.

 (a) China rose ALTERNATE	 (b) Guava OPPOSITE	 (c) Alstonia WHORLED

The inflorescence: Arrangement of flowers on the floral axis.	
	
Racemose. Main axis continues to grow laterally (in an acropetal succession)	Cymose. Main axis terminates in a flower so limited growth (basipetal order)

The flower:
1.Four whorls. Sepal, petal, gynoecium, and androecium.
2.Thalamus/receptacle.
3.Trimerous/tetramerous/pentamerous/polymerous.
4.Bracteates/ebracteate/bract. (Protective sheet around the flower).
5.Bisexual/unisexual.
6.Actinomorphic (mustard) zygomorphic (pea) asymmetric (canna).

POSITION OF FLORAL PARTS ON THALAMUS
 (a) (b) (c) (d)
(a) Hypogynous, (b) and (c) Perigynous, (d) Epigynous

Parts of flower:
1. Calyx. Made of sepals. Can be gamosepalous (sepals united)/polysepalous (sepals free).
2. Corolla. Made of petals. Gamopetalous (petals united) / polypetalous (petals free).

Aestivation: Arrangement of sepals/ petals in floral bud.			
			
valvate (petunia, calotropis)	twisted (china rose)	imbricate (gulmohur)	vexillary (pea, bean)

Androecium.	Gynoecium

1.Staminode- sterile stamen. 2.Epipetalous. Attached to the petal (Brinjal). 3.Epiphyllous- attached to the perianth (Lily). 4. Polyadelphous – many bundles (citrus). 5.Monoadelphous- united as one bunch (China rose). 6.Diadelphous – united two bundles (pea).	1.Ovules attached on the wall of ovary called placenta. 2.Apocarpous - Free carpels (lotus, rose) 3.Syncarpous - Carpels are fused (mustard, tomato) 4.After fertilization ovules develops into seed. 5.Ovary develops into fruit 6. one/ more carpels.

Perianth: Fused petals and sepals.

Placentation: Arrangement of ovules within the ovary.

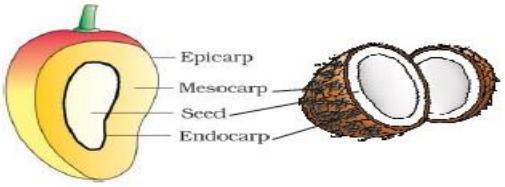
A	B	C	D	E
Marginal	Axile	Parietal	Free Central	Basal
Pea	China Rose	Mustard	Primrose	Sunflower

The fruit: It is a mature or ripened ovary, developed after fertilization.

Two parts of a fruit are pericarp and seeds.

2.Pericarp has epicarp, mesocarp and endocarp

3.Both mango and coconut are known as drupe fruits (fruits formed from single ovary /carpel)



Parthenocarpic fruit: Formation of fruits without fertilization of ovary. Ex. Seedless grapes.

The seed:

1.Fertilized ovules. 2.Made up of seed coat and an embryo.

3.Embryo with radical and plumule with one cotyledon or two cotyledon.

Structure of a dicot seed:

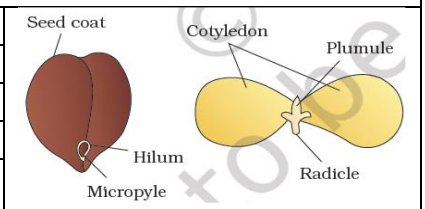
Seed coat, Testa and tegmen

Hilum - small pore (place where it is attached to fruit)

Micropyle. (water enters)

Endosperm, cotyledons, embryonal axis (plumule and radicle)

Mature seeds in dicot do not have endosperm called non-endospermic seeds. (stored food is



Structure of monocotyledonous seed:

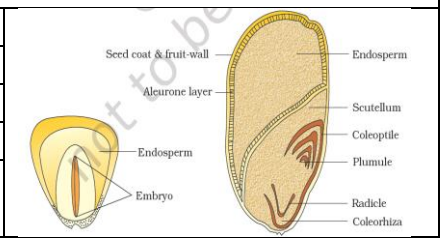
1.Mostely endosperm except orchids

2.Endosperm is bulky and store food

3.Aleurone layer (produce enzymes to hydrolise proteins for embryo)

4.Cotyledon is scutellum

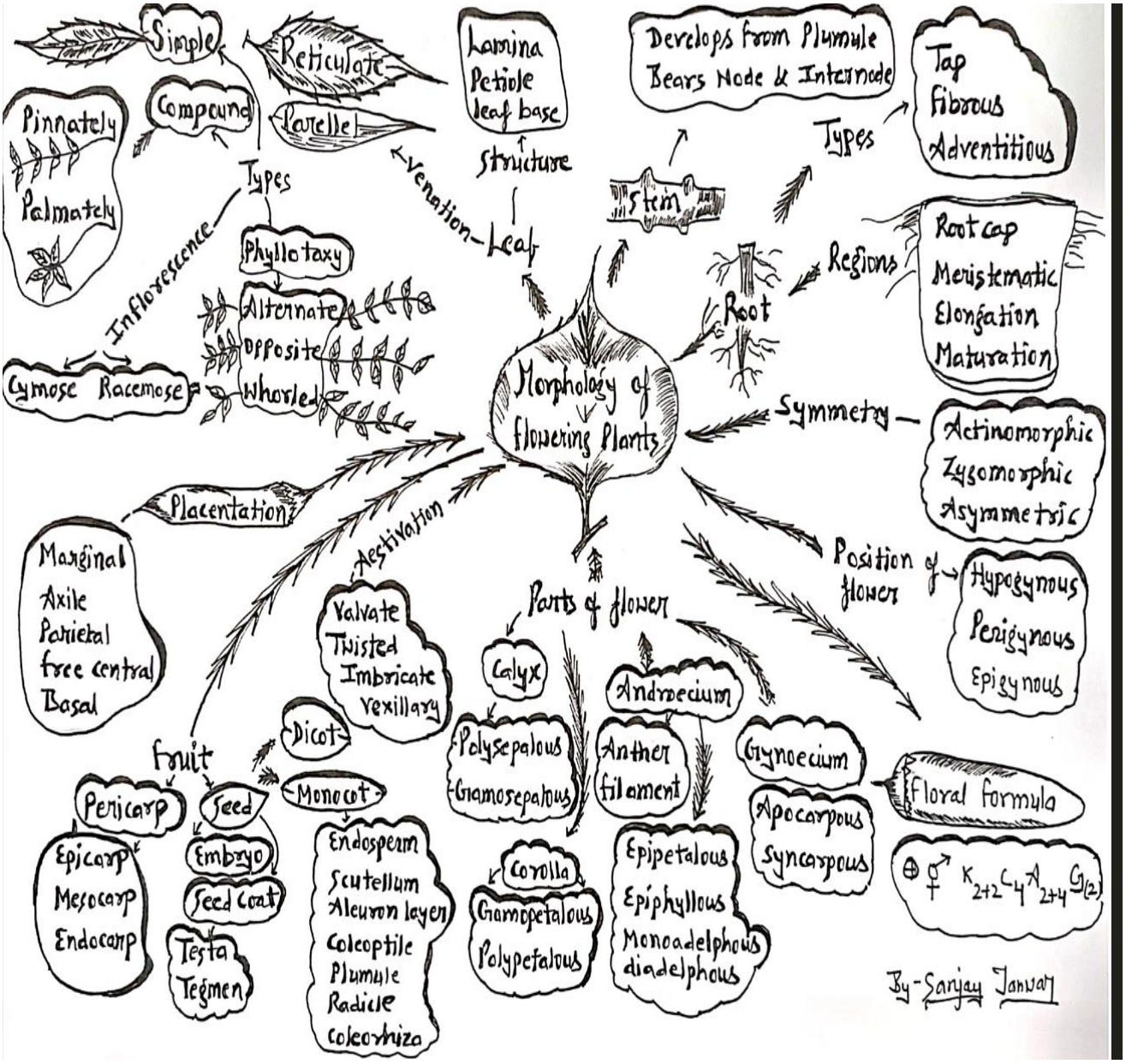
5.Protective coats- coleoptiles (piumule), coleorhizae (radical)



Semi – technical description of a typical flowering plant:	
Floral formula by symbols:	Family Solanaceae

Br - Bracteate _ K - Calyx G - Inferior ovary C - Corolla P - Perianth A - Androecium G - Gynoecium G Superior Ovary, G Inferior Ovary ♂ Male, ♀ Female, ⚥ Bisexual ⊕ Actinomorphic, % Zygomorphic	 ⊕ ♂ $K_{(5)}$ $\overline{C_{(5)}}$ A_5 $\underline{G}_{(2)}$ tomato, brinjal, potato), spice (chilli)

MIND MAP



MULTIPLE CHOICE QUESTIONS

01. In Ray plant (monocot)

(a) roots Primary root is short lived (b) Primary root replaced by fibrous

(c) Fibrous roots arise from the base of stem (d) All are correct

02. Adventitious root fount in which dicot plant-

(a) Grass (b) Monestra (c) Banyan tree (d) Sugarcane

03. Adventitious roots arise from part other than

(a) Hypocotyl (b) Epicotyl (c) Plumule (d) Radicle

04. Root is covered at the apex by a thimble-like structure called

(a) Root cap (b) Radicle (c) Coleorhiza (d) Coleoptile

05. Root hairs arise from

(a) Zone of cell division (b) Zone of cell elongation

(c) One of cell maturation (d) All of these

06. Find out the incorrect statement:

(a) Root increases in length due to region of elongation.

(b) Root cannot synthesize plant growth regulators.

(c) Meristematic region has thin-walled cell with dense cytoplasm.

(d) Root hair absorbs water and mineral from the soil.

07. Which of the following is incorrect about leaf?

(a) It is arranged in basipetal order (b) It develops from node

(c) It is generally flattened in shape (d) It is arranged in acropetal order

08. Which of the following is correct about venation?

A. Parallel venation is generally found in monocot.

B. Parallel venation is generally found in dicot.

C. Reticulate venation is generally found in dicot.

D. Reticulate venation is generally found in monocot.

(a) A and D only (b) B and C only (c) B and D only (d) A and C only

09. Find out the correct matching:

A. Palmately compound leaves – Leaf let attached to common axis rachis

B. Phyllotaxy – Pattern of arrangement of leaves on stemor branch

C. Pinnately compound leaves – Leaflet attached to a common point i.e. at the tip of petiole

D. Venation – Arrangement of veins and veinlets in the lamina of leaf

(a) A and B only (b) B and D only (c) C and D only (d) B and C only

10. Select the correct matching:

Column I	Column II	Column II
A. Alternate	X. Single leaf arises at each node	1. China Rose, mustard, sunflower
B. Whorled	Y. More than 2 leaf arises at node	2. Alstonia
C. Opposite	Z. Pair of leaf arises at node	3. Calotropis and guava

(a) A–Y–3, B–Z–2, C–X–1 (b) A–X–1, B–Y–2, C–Z–3

(c) A–Y–3, B–Z–1, C–Y–2 (d) A–Z–3, B–Y–2, C–X–1

11. Petals or sepals in a whorl just touch one another at the margin, without overlapping is found in

(a) Garden Pea (b) Calotropis (c) Cassia (d) China rose

12. Twisted aestivation is found in all except

(a) Gulmohar (b) China rose (c) Cotton (d) Mango

13. Which of the following is incorrect about dicot seed?

A Micropyle is present above the hilum.

B. At the ends of embryonal axis the radicle and plumule is present.

C. Seed coat has 2 layers.

D. Cotyledons are generally with food reserve.

14. What indicates A to E in the below figure.

(a) A–Androecium, B–Gynoecium, C–Corolla, D–Calyx, E–Pedicel

(b) A–Gynoecium, B–Calyx, C–Corolla, D–Pedicel, E–Androecium

(c) A–Corolla, B–Calyx, C–Gynoecium, D–Androecium, E–Pedicel

(d) A–Calyx, B–Gynoecium, C–Pedicel, D–Androecium, E–Corolla

15. The 'Eyes' of the potato tuber are:

(a) Stem buds (b) Shoot buds

(c) Adventitious root (d) Axillary buds

16. Which one of the following statements is correct?

(a) The fruit in grasses is not endospermic.

(b) A proteinaceous aleurone layer is present in maize grain.

(c) Apple is a parthenocarpic fruit.

(d) A sterile pollen tube is called a staminode.

17. Select the correct matching of Placentation with example:

Column I	Column II
1. Marginal	China Rose
2. Axile	Pea
3. Parietal	Argemone
4. Free Central	Marigold
5. Basal	Dianthus

(a) 1 and 5 (b) 2 and 4 (c) only 3 (d) 3 and 5

18. Epipetalous petals stage found in-

(a) Banana (b) Lady's Finger (c) Brinjal (d) Mango

19. Perigynous flowers are found in

(a) Guava (b) Cucumber (c) China rose (d) Rose

20. The wheat grain has an embryo with one large, shield-shaped cotyledon known as

(a) Coleorrhiza (b) Coleoptile (c) Scutellum (d) Epiblast

21. Select the correct matching:

Aestivation – Example

(a) Valvate – Cassia

(b) Imbricate – Cassia and Gulmohar

(c) Twisted – China rose, ladyfinger, calotropis

(d) Vexillary – Pea, Bean, Aloe, Tulip

22. Which is false for vexillary or papilionaceous aestivation?

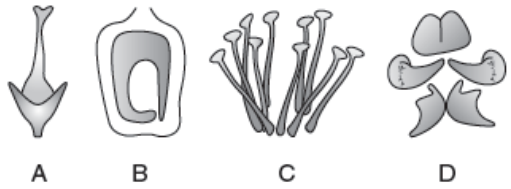
(a) The largest standard petal is anterior and overlaps wing.

(b) Two lateral petals are known as wing.

(c) The largest standard petal is posterior.

(d) Two smallest anterior petals are known as keel.

23. Identify the A to D in this figure.



(a) A–Petals, B–Carpel, C–Basal, D–Androecium

(b) A–Androecium, B–Basal, C–Carpel, D–Petals

(c) A–Carpel, B–Basal, C–Androecium, D–Petals

(d) A–Basal, B–Androecium, C–Petals, D–Carpel

24. Drupe Fruit arise from-

(a) monocarpellary superior ovaries and are one seeded

(b) Bicarpellary inferior ovary and two seeded

(c) Monocarpellary inferior ovary and one seeded

(d) Tricarpellary superior and are two seeded

25. In cymose the type of inflorescence is

A. Main axis terminates into flower.

B. Flower born in basipetal order.

C. Main axis not terminates into flower.

D. Flower born in acropetal order.

(a) A and B and C only (b) C and D only (c) A and B only (d) B and C only

26. Select the correct matching:

(1) hypogynous- plum, rose, peach

(2) perigynous- mustard, china rose and brinjal

(3) epigynous flowers- guava and cucumber, and the ray florets of sunflower

(a)1 and 3 (b) 1 and 2 (c) 2 only (d) 3 only

27. Select the correct matching:

Column I	Column II	Column II
A. hypogynous	X. gynoecium occupies the highest position	1. Superior Ovary
B. perigynous	Y. Gynoecium occupies almost at the same level	2. Half inferior
C. epigynous flowers	Z. ovary completely Embedded into thalamus	3. inferior

(a) A–X–1, B–Y–2, C–Z–3 (b) A–X–1, B–Y–2, C–Z–3

(c) A–Y–3, B–Z–1, C–Y–2 (d) A–Z–3, B–Y–2, C–X–1

28. Which of the following posses alternate phyllotaxy except?

(a) Calotropis (b) China rose (c) Sunflower (d) Mustard

29. An aggregate fruit is one which develops from

(a) Multicarpellary syncarpous gynoecium (b) Multicarpellary superior ovary

(c) Complete inflorescence (d) Multicarpellary apocarpous gynoecium

30. Match the followings and choose the correct option.

Group A	Group B
(a) Aleurone layer	(i) Without fertilization
(b) Parthenocarpic fruit	(ii) Nutrition
(c) Ovule	(iii) Double fertilization
(d) Endosperm	(iv) Seed

Options:

(a) (a)–(i), (b)–(ii), (c)–(iii), (d)–(iv)

(b) (a)–(ii), (b)–(i), (c)–(iv), (d)–(iii)

(c) (a)–(iv), (b)–(ii), (c)–(i), (d)–(iii)

(d) (a)–(ii), (b)–(iv), (c)–(i), (d)–(iii)

ANSWER KEY

1	2	3	4	5	6	7	8	9	10
d	C	d	a	c	b	a	d	c	b
11	12	13	14	15	16	17	18	19	20
b	A	b	a	d	b	c	c	d	c
21	22	23	24	25	26	27	28	29	30
b	a	c	a	c	d	a	a	b	b

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PGT BIOLOGY, K V BHILWARA, JAIPUR REGION, RAJASTHAN

CHAPTER 6: ANATOMY OF FLOWERING PLANTS

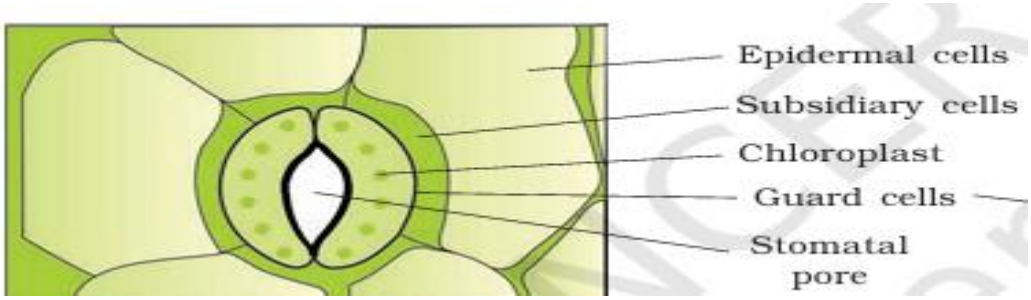
GIST OF THE CHAPTER:

Tissues - A group of similar cells performing same function.

Tissue system :

1. Epidermal tissue system

- Cuticle present- contains stomata.
- Guard cells, subsidiary cells, stomatal aperture constitute stomatal apparatus



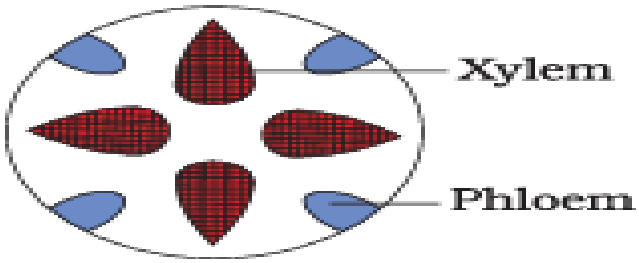
- **Trichomes** – (on stem) multicellular, secrete oils.
- **Root hairs**- single celled.

2. Ground tissues

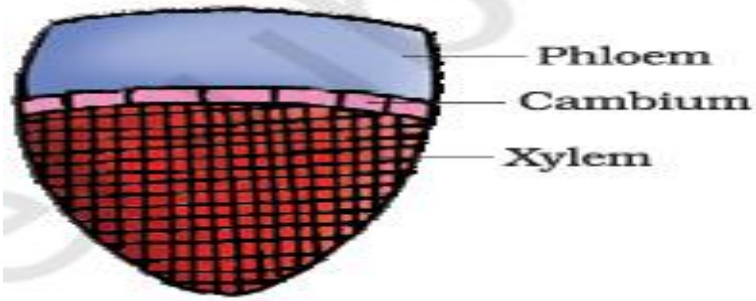
- Tissues except epidermal and vascular tissues.
- Mesophyll. (collenchyma, sclerenchyma, parenchyma)

3. Vascular tissue system

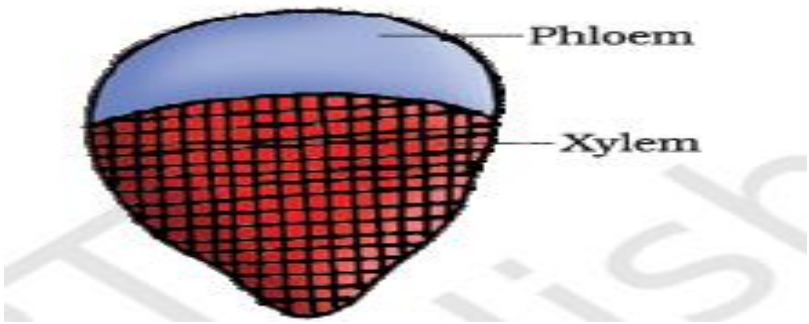
- Cambium. (lateral meristem)
- Radial vascular bundle – in roots



- Conjoint open vascular bundle - in dicot stem and leaves

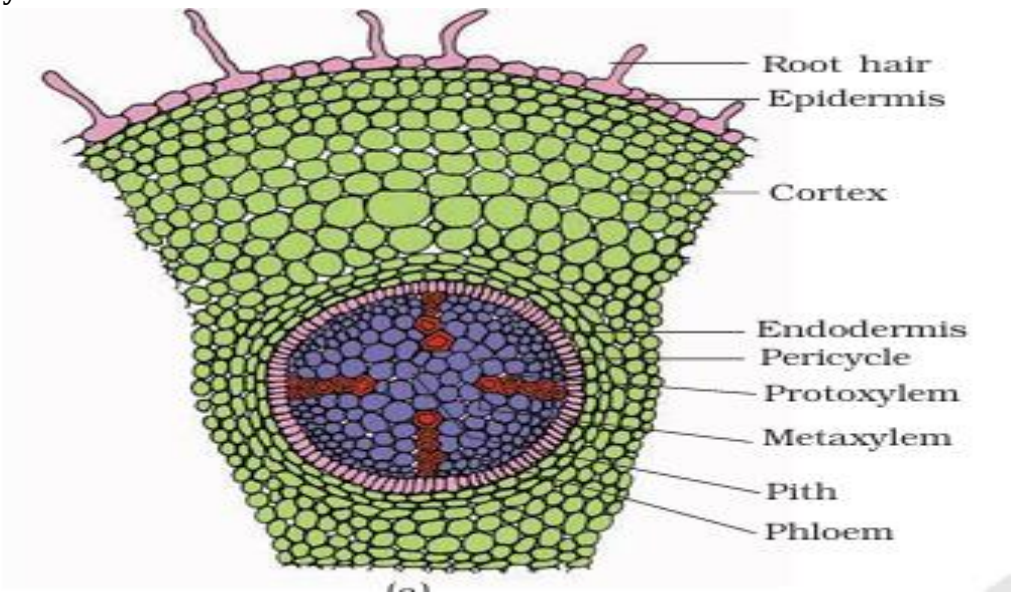


- Conjoint closed vascular bundle – in monocot stem and leaves



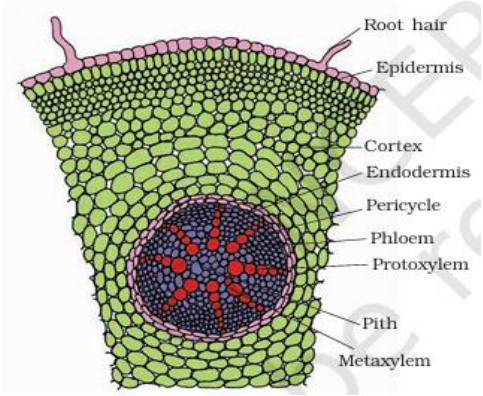
Anatomy of dicotyledonous and monocotyledonous plants:

1. **Dicotyledonous root**



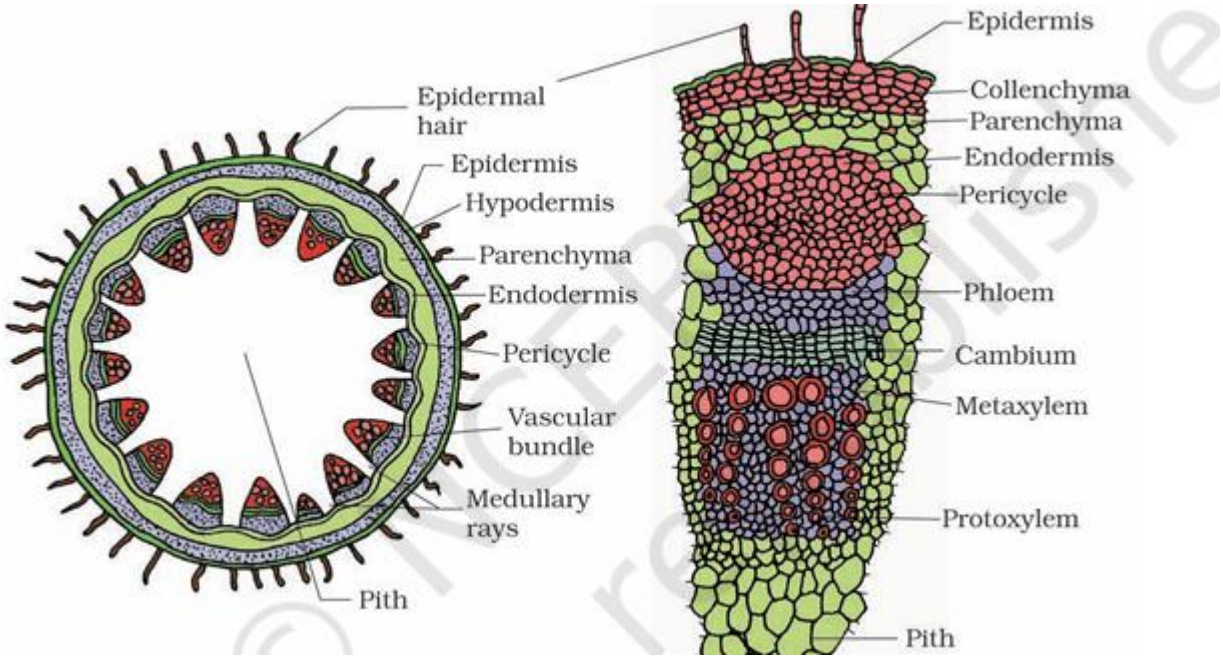
- **Epidermis** – root hair – cortex (parenchyma) endodermis – suberin layer as casparian strips
- **Pericycle** (lateral roots) pith is small – conjuctive tissues (between xylem and phloem
- Cambium ring (2-4 xylem and phloem)
- **Stele (endodermis, pericycle, vascular bundle and pith)**

2. **Monocotyledonous root**



- No cambium in the vascular bundles. (6 vascular bundles and are scattered) called polyarch –
- Pith is large – since no cambium, and no secondary growth

3. Dicotyledonous stem



•Epidermis, cuticle, trichrome, hypodermis (collenchyma-provide mechanical strength to young stem)

•Cortical layer (parenchyma) endodermis (starch sheath)

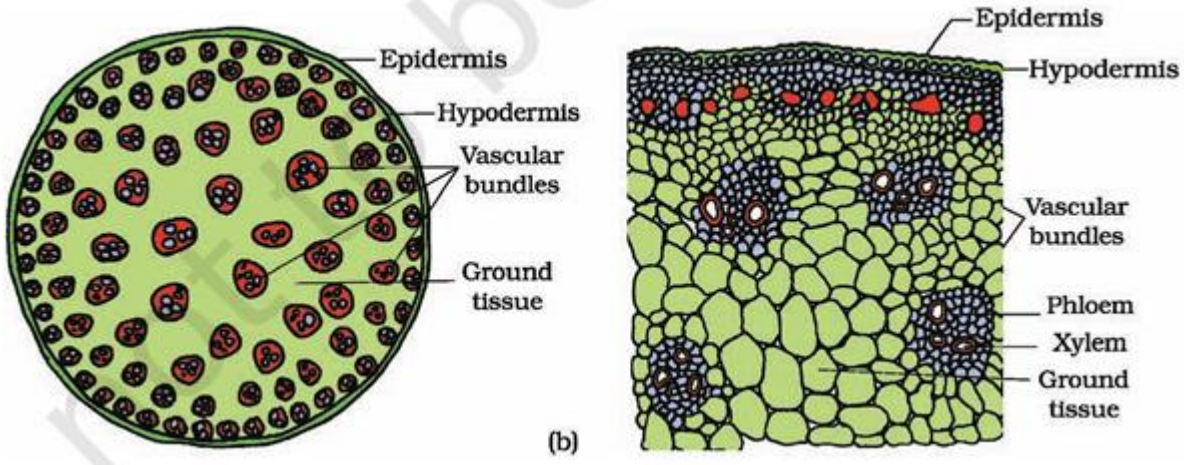
•Pericycle - vascular bundles – medullary rays

•Vascular bundles are in a ring

•Conjoint, open, and endarch protoxylem

•Pith is larger (parenchyma)

4. Monocotyledonous stem



•Epidermis – hypodermis (sclerenchyma), scattered vascular bundles covered by sclerenchymatous bundle sheath.

•Bundle sheath – vascular bundles are conjoint, closed, no cambium

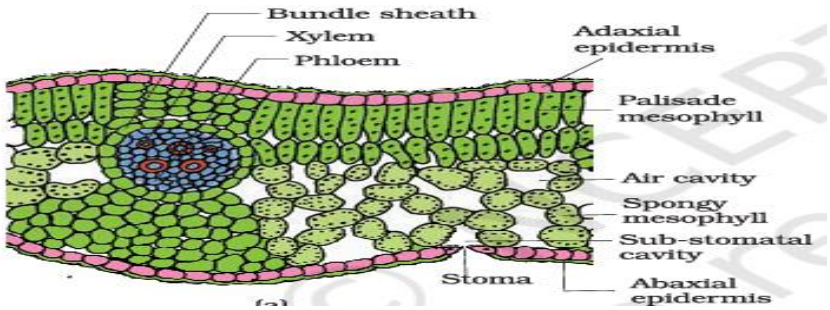
•Peripheral vascular bundles are smaller than centrally located.

•No secondary growth- no trichomes

•Water containing cavities are present- no distinct pith

Leaves :

1. **Dorsiventral leaf /dicot leaf:**



•Epidermis are adaxial epidermis (upper) and abaxial epidermis (lower)

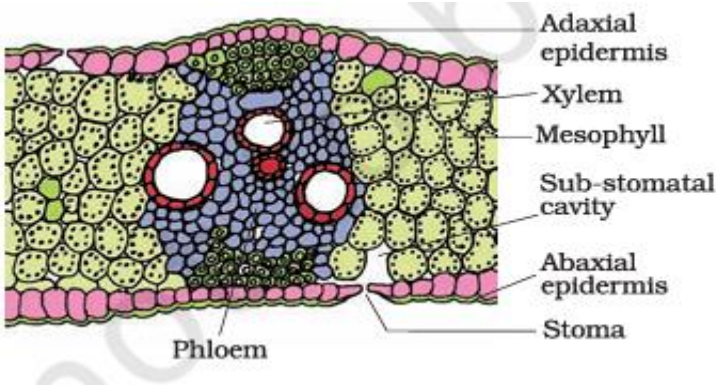
•Cuticle – stomata are more on lower epidermis

•Mesophyll – it has two types of cells, palisade parenchyma and spongy parenchyma

•Vascular system vascular bundle are present in vein and midrib

•Reticulate venation –vascular bundles are surrounded by bundle sheath

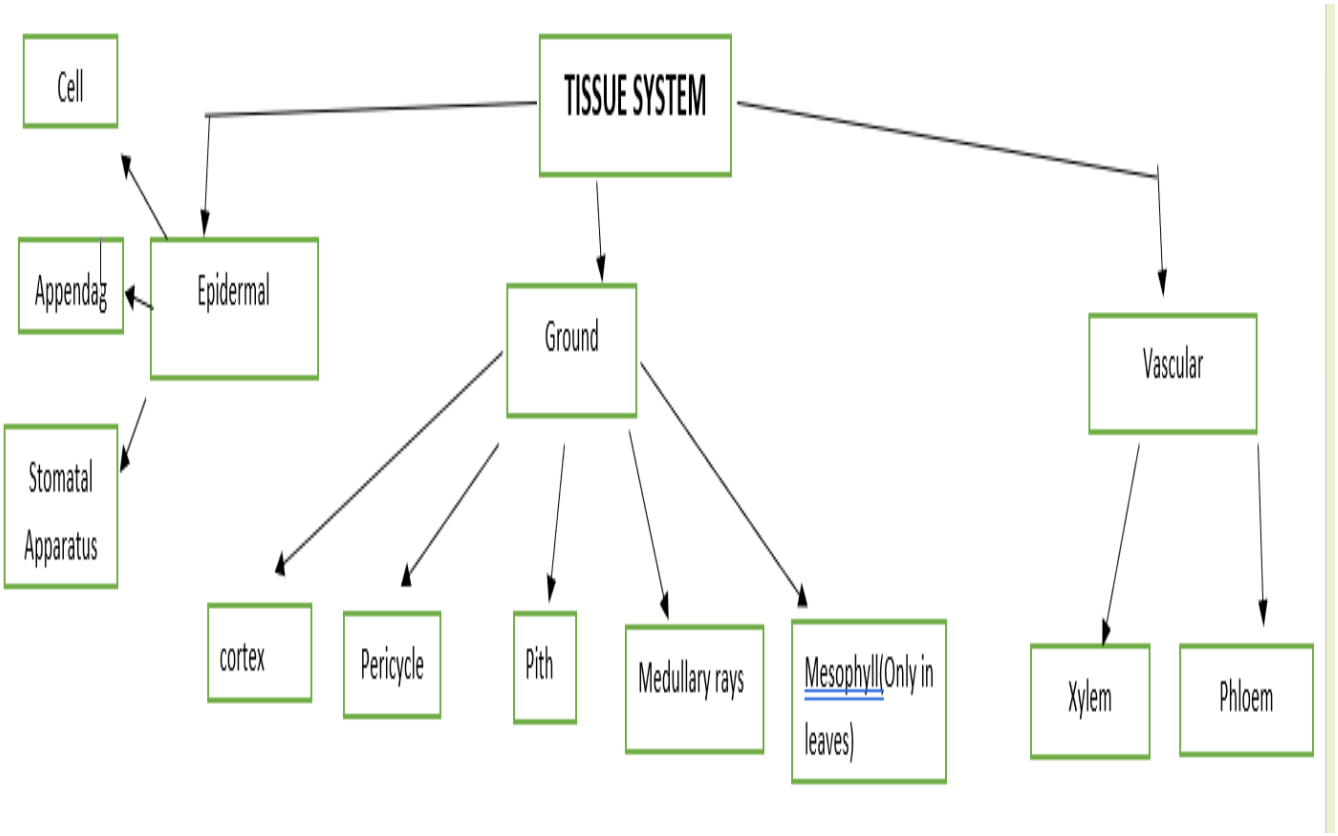
2. **Isobilateral / monocot leaf:**

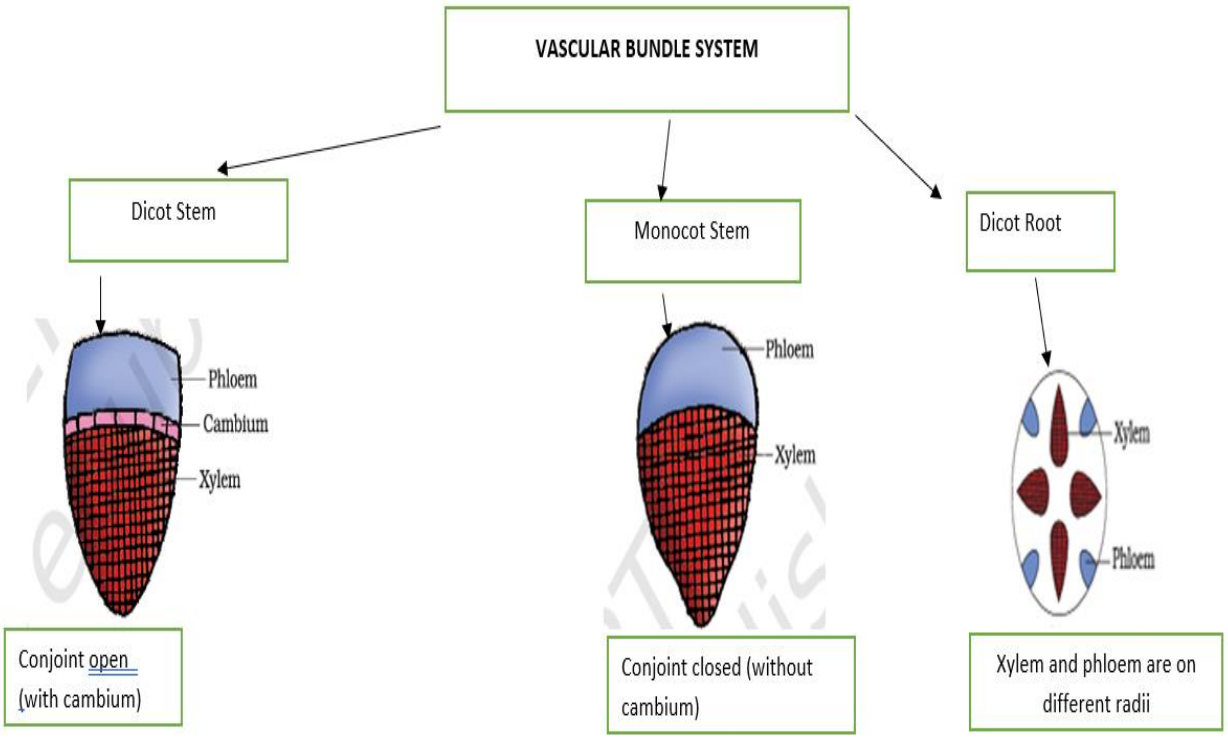


•Same anatomy as dorsoventral leaf – but no spongy parenchyma and stomata on both side

•**Bulliform** cells –Colourless, large, empty on adaxial surface. **Function**: -They form leaf curl to minimise water loss by property of turgidity and flaccid.

MIND MAP





MULTIPLE CHOICE QUESTIONS

1.The bean shaped structure present in stomata enclose the stomatal pore is

A) Guard cell B) Subsidary cell C) Epidermal cell D) cuticle

2. Epidermal hair present in the stem is known as

A) Root hair B) Trichome C) hypodermis D) Epidermis

3. The structure present in vascular bundles responsible for the secondary growth in dicot plants is-

A) Phellogen B) cambium C) annual rings D) Phelloderm

4. The vascular bundles which help in formation of secondary xylem and phloem with the presence of cambium are called as-

A) Open vascular bundles B) clause vascular bundles

C) close vascular bundles D) Linear vascular bundles

5.All the tissues on the inner side of endodermis such as pericycle ,vascular bundles and pith in dicot root constituents -

A) Conjuctive tissue B) Casparian strip C) Stele D) Pericycle

6. Ring arrangement of vascular bundles is characteristics feature of which type of part of plant-

A) Dicot root B) monocot stem C) monocot root D) Dicot stem

7.Identify the correct choice related to dicot leaf from the following: -

A) Mesophyll contain spongy and palisade parenchyama

B) More air space present between spongy parenchyma

C) Both A and B

D) No spongy and palisade parenchyma in mesophyll

8. The type of cell present in grasses which help in minimizing water losses: -

A) Bulliform cells B) bundle sheath cell C) subsidiary cell D) Epidermal cell

9. Which statement is not correct with respect vascular bundles of monocot root:-

A) Polyarch xylem bundles are present B) Ring form of vascular bundles

C) Pith is large and well developed D) They do not undergo any secondary growth.

10.Stomatal aperture, guard cell and subsidiary cell together constitutes:-

A) stomatal pore B) ground tissue C) cuticle D) stomatal apparatus

11.Example of plant in which secondary growth takes place: -

A) Neem B) grass C) Maize D) Cotton

12.Bundle sheath is characteristics of following tissue :-

A) Dicot leaf B) Monocot leaf C) Dorsiventral leaf D) both A and C

13. Collenchymatous cortex is a feature of which type of tissue :-

A) Dicot stem B) Dicot root C) Both A and B D) Monocot root

14. Identify the incorrect name of tissue system present in plants :-

A) Epidermal tissue system B) Ground tissue system

C) Conducting tissue system D) Conjunctive tissue system

15.Prenchymatous cells present between the xylem and phloem of dicot root are named as:-

A) Stele B) Conjunctive tissue C) Casparian strip D) Pericycle

Answer key

s.no.	Option
1	A
2	B
3	B
4	C
5	C
6	D
7	C
8	A
9	B
10	D
11	A
12	D
13	A
14	D
15	B

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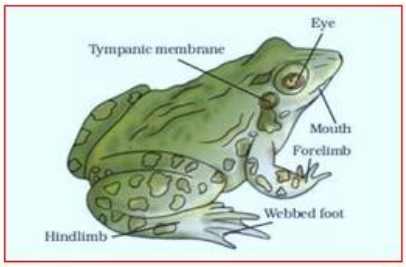
CHAPTER 7: STRUCTURAL ORGANISATION IN ANIMALS

GIST OF THE CHAPTER:

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

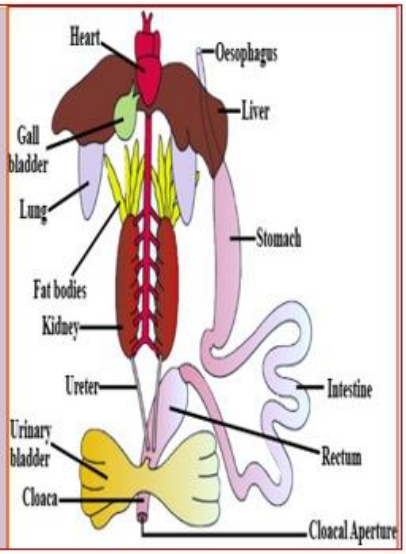
- Skin: moist, smooth with mucus.
- Body- triangular head and trunk.
- Mouth: with upper and lower jaws.
- Nostrils: A pair
- Eyes: with nictitating membrane.
- Tympanum: hearing organ , Pinna is absent.
- The forelimbs (have 4 digits) and larger hind limbs (have 5 digits)
- In males copulatory pad is 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.

- 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.

MULTIPLE CHOICE QUESTIONS

1- Cloaca is an organ for-

a- Reproduction b- Excretion

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

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

3- Pair optic lobe is present in-

a- Fore brain b- Mid brain

c- Hind brain d- None of these

4- No of cranial nerves present in frogs in-

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

5- Tympanum is-

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

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

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

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

a- Ammoniotelic b- ureotelic

c- Uricotelic d- none of these

8-In frogs respiration occur by-

a- Skin b- Lungs

c- both a and b d- only nostril Ans: c

9-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

1	2	3	4	5	6	7	8	9
c	a	b	a	d	b	b	c	a

CHAPTER 8: CELL- THE UNIT OF LIFE

GIST OF THE CHAPTER

Definition-A Cell is the basic Structural, Functional, and biological unit of all known Living Organisms. "Building Blocks of Life".

Discovery of the Cell-Robert Hooke
Cell Theory: -In 1830s, two German scientists called Matthias Schleiden and Theodor Schwann All living organisms are made of cells.

- Cells are basic structural or functional units of living organisms.
- All cells are born out of pre-existing cells through cell division.
- There are billions and trillions of cells in a tall tree or a large animal. A human body also has trillions of cells which have different shapes, sizes and functions.

Multicellular Organisms; -are made up of more than one cell.

Unicellular Organisms; -are made up of a single cell.

Single-celled organisms also perform all the necessary life processes like multicellular organisms, including. The only difference is that while a single cell performs all the functions in the unicellular organisms, multicellular organisms have a specialised group of cells to perform different functions. The specialised cells form tissues, which in turn form organs.

Shape of Cells
Amoeba, which is a single-celled organism, does not have a definite shape. Its shape keeps changing as it moves or feeds, protruding parts of its body to form 'pseudo' (meaning 'false') 'podia' (meaning 'feet'). These projects are known as pseudopodia.

Humans have millions of cells, such as white blood cells (found in blood), cells that make up muscles, and cells that form nerves. Their shapes vary according to the functions they perform.

Most cells are round, spherical or elongated. Some are spindle-shaped which are long and pointed at both ends. Nerve cells or neurons are quite long and are branched out to receive and transfer messages.

Shapes of the cells are maintained by a covering called **Cell Membrane or Plasma Membrane**.

Bacterial cells and plant cells have an additional rigid covering called a **Cell Wall**.

Size of Cells
The size of the cells may vary from a millionth of a metre (known as a micron) to a few centimetres but most of them cannot be seen with the naked eye. We need microscopes to see these microscopic cells.

Cell Structure and Function
In a unicellular organism, a single cell performs all the basic functions of life but in multicellular organisms there is division of labour.

1. Endoplasmic Reticulum filled lumen. It is of two types:

- **Rough Endoplasmic Reticulum (RER):** It is lined with ribosomes. It plays a key role in synthesis of protein as ribosome are attached to it.
- **Smooth Endoplasmic Reticulum** (SER): It does not have any ribosomes and hence, look smooth. It plays a key role in synthesis of lipids.

2. Ribosomes

Ribosomes are spherical bodies made up of RNA (ribonucleic acid) and protein enzyme. They do not have membranes and are present separately in cytoplasm. Ribosomes are the sites where the protein synthesis takes place.

3. Golgi Bodies

Smooth, flattened sac-like structures called Cisternae stack together in parallel rows to form Golgi bodies. Golgi Cis face receives protein from Endoplasmic reticulum and modifies, packages and stores it.It also dispatches proteins in vesicles to various destinations. The Golgi apparatus are responsible for the secretion of enzymes, hormones and proteins.

4. Mitochondria

Mitochondria are rod-shaped organelles with a double membrane. The outer membrane is smooth while the inner membrane folds over many times to form *cristae*. *Cristae* increase the surface area of the inner membrane by several times. *Matrix* is the fluid inside the mitochondria. Mitochondria act as energy production sites and are hence, known as the **Powerhouses of the Cell**.

Glucose + Oxygen → Carbon Dioxide + Water + Energy (ATP)

5. Lysosome

Lysosomes are sac-like structures surrounded by single-layered membranes. They contain powerful digestive enzymes that can break down all organic material. Lysosomes digest damaged cells and a variety of extra- and intra-cellular material. Since they remove cell organelles that are worn out or are not functioning properly and may even digest the entire cells (that are damaged or dead), they are also known as **Suicidal Bags**.

6. Vacuoles

Vacuoles are organelles enclosed by a membrane and filled with fluid. Plant cells usually have a large vacuole filled with a liquid called 'cell sap'. Cell Sap contains dissolved sugar and salts. Vacuoles in plant cells keep the cells firm or turgid. They store various substances including waste products of the cell. Animal cells may or may not have vacuoles. If they do have vacuoles, they are much smaller than the ones found in plant cells. vacuoles in animal cells store food, water, sugar, minerals and waste products of the cell. In Amoeba, vacuoles that contain food particles are also referred to as food vacuoles.

7. Plastids

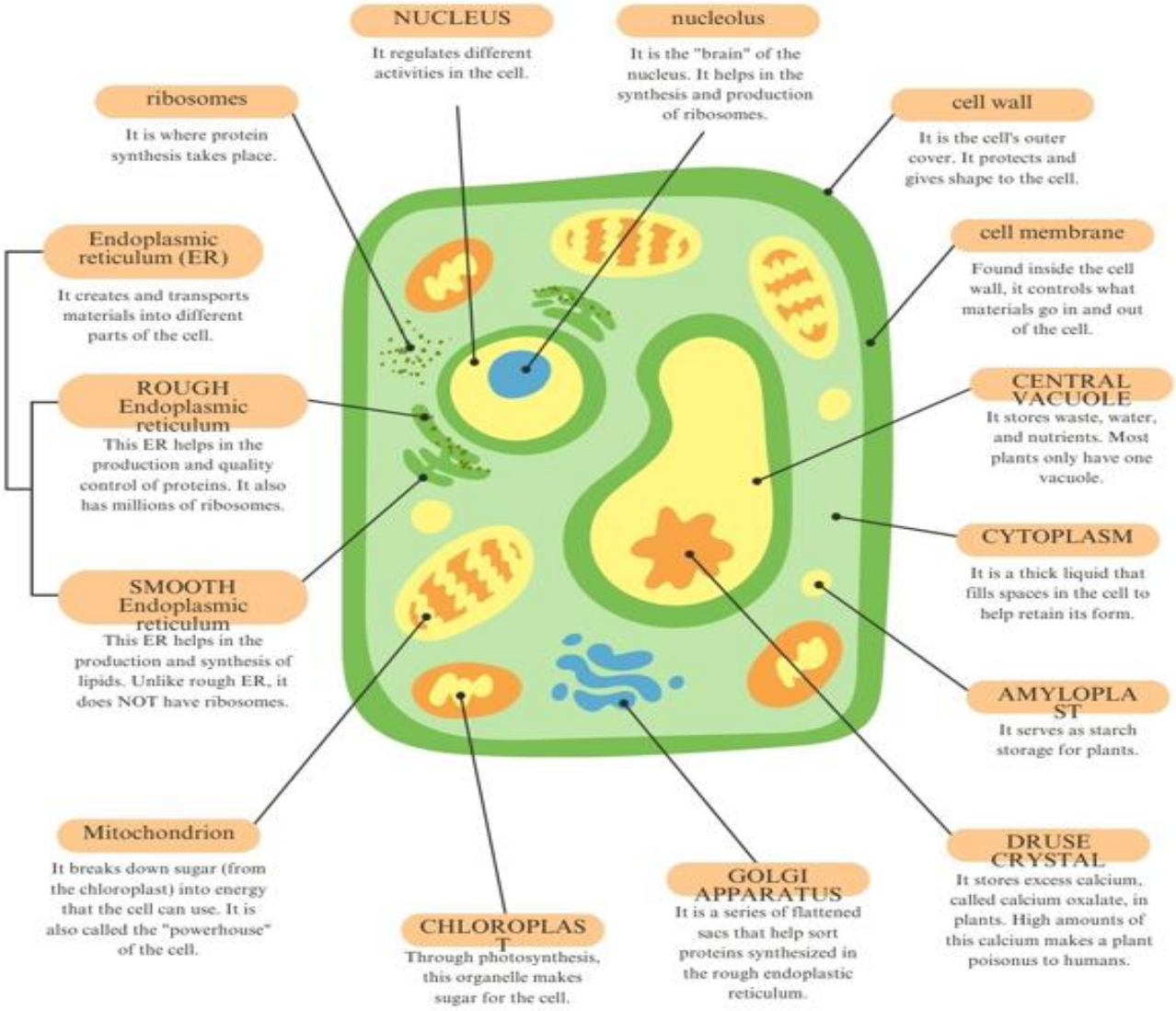
Plastids are also type of organelles that are found only in Plant Cells.

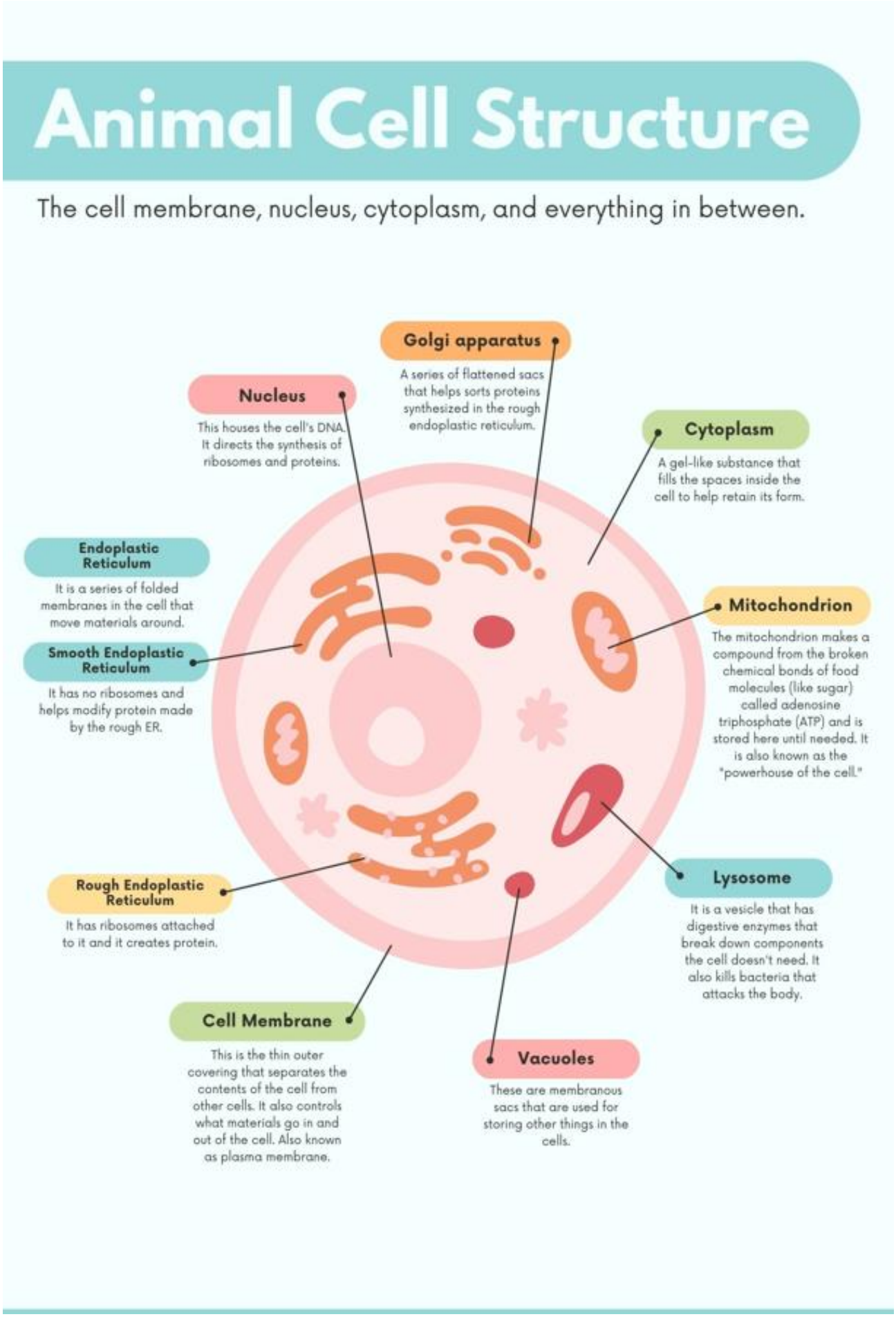
With double-layered membrane, these organelles are found in cytoplasm of the cells. They are of two types (depending on the colour of the pigment they contain);

- **Leucoplasts:** These colourless organelles store starch or other plant nutrients. **For Example**, Starch stores in potato cells. Leucoplast are of different types:
    - Amyloplast: stores starch
    - Elaioplast: stores fat
    - Proteinoplast/ Aleuroplast: stores protein
- **Chromoplasts:** These contain different-coloured pigments. Most important type of chromoplasts is **chloroplast** which contain green-coloured pigments called **Chlorophyll**.
- **Chloroplast:** Chloroplasts are the sites where photosynthesis takes place. Here, carbon dioxide and water combine in the presence of energy from the sunlight to produce food. Hence, chloroplasts help in synthesis of food by green plants.

MIND MAP

Plant Cell:Function



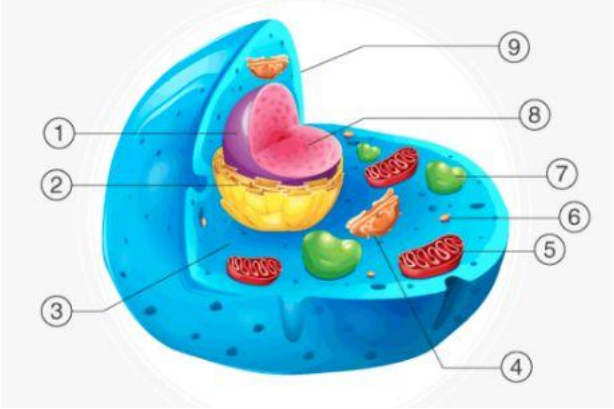


MULTIPLE CHOICE QUESTIONS

1. Which organelle is responsible for generating energy in a cell?
   a. Nucleus
   b. Golgi apparatus
   c. Mitochondria
   d. Endoplasmic reticulum
2. The function of the cell membrane is to:
   a. Store genetic material
   b. Control the movement of substances in and out of the cell
   c. Synthesize proteins
   d. Provide structural support to the cell
3. The site of protein synthesis in a cell is:
   a. Nucleus
   b. Golgi apparatus
   c. Ribosome
   d. Vacuole
4. The control centre of a cell is the:
   a. Cytoplasm
   b. Nucleus
   c. Cell membrane
   d. Vacuole
5. Prokaryotic cells lack which of the following organelles?
   a. Endoplasmic reticulum
   b. Golgi apparatus
   c. Nucleus
   d. Mitochondria
6. The organelle responsible for detoxifying harmful substances in the cell is the:
   a. Lysosome
   b. Vacuole
   c. Chloroplast
   d. Peroxisome
7. Which of the following is not a function of the Golgi apparatus?
   a. Modifying and packaging proteins
   b. Sorting and transporting lipids
   c. Generating energy
   d. Synthesizing carbohydrates
8. The function of the cytoskeleton is to:
   a. Provide mechanical support to the cell
   b. Store genetic material
   c. Control protein synthesis
   d. Regulate the cell cycle
9. Which organelle is responsible for the breakdown of waste materials in the cell?
   a. Lysosome
   b. Endoplasmic reticulum
   c. Nucleus
   d. Ribosome
10. The structure outside the cell membrane that provides additional support to plant cells is called the:
   a. Cell wall
   b. Endoplasmic reticulum
   c. Nucleus
   d. Golgi apparatus
11. Which cellular structure contains DNA and is responsible for controlling cellular activities?
   a. Nucleus
   b. Golgi apparatus

c. Mitochondria
d. Lysosome

12. The organelle that helps plants cells maintain their shape is the:
    a. Nucleus
    b. Vacuole
    c. Mitochondria
    d. Ribosome
13. Which of the following is responsible for the synthesis of lipids and detoxification of drugs in a cell?
    a. Chloroplasts
    b. Golgi apparatus
    c. Endoplasmic reticulum
    d. Lysosome
14. The process by which cells eliminate waste material from the cell is called:
    a. Exocytosis
    b. Endocytosis
    c. Diffusion
    d. Passive transport
15. Which cell structure is responsible for the storage of water, ions, and nutrients in plant cells?
    a. Lysosome
    b. Golgi apparatus
    c. Vacuole
    d. Mitochondria
16. Which organelle contains enzymes that break down fatty acids and neutralize harmful substances in the cell?
    a. Peroxisome
    b. Vacuole
    c. Lysosome
    d. Golgi apparatus
17. Which organelle is responsible for the synthesis of ribosomes in a cell?
    a. Nucleus
    b. Golgi apparatus
    c. Ribosome
    d. Peroxisome
18. The process by which solid particles are engulfed by cells is called:
    a. Phagocytosis
    b. Pinocytosis
    c. Diffusion
    d. Osmosis
19. Which organelle is responsible for the breakdown of old, worn-out cell components?
    a. Lysosome
    b. Vacuole
    c. Chloroplast
    d. Golgi apparatus
20. Which organelle is responsible for the synthesis of proteins within a cell?
    a. Nucleus
    b. Golgi apparatus
    c. Ribosome
    d. Endoplasmic reticulum



21. In the above-given cell diagram, numbered 2 is involved in protein transport. Identify the cell organelle.
    a. Lysosomes
    b. Ribosomes
    c. Mitochondria
    d. Endoplasmic reticulum
22. This cell organelle is called the commanding centre of the cell. Identify the cell organelle, which is numbered 1.
    a. Nucleus
    b. Ribosome
    c. Mitochondria
    d. Endoplasmic reticulum
23. In the above-given cell diagram, number 6 is called the site of protein synthesis. Identify the cell organelle.
    a. Ribosomes
    b. Lysosomes
    c. Golgi bodies
    d. Mitochondria
24. In the above-given cell diagram, numbered 4 is involved in cell secretion. Identify the cell organelle.
    a. Ribosomes
    b. Lysosomes
    c. Golgi bodies
    d. Mitochondria
25. This cell organelle is called the powerhouse of the cell. Identify the cell organelle, which is numbered 5.
    a. Nucleus
    b. Ribosome
    c. Mitochondria
    d. Endoplasmic reticulum
26. In the above-given cell diagram, numbered 9 shows fluid behaviour due to the mosaic of lipid and protein. Identify the cell organelle.
    a. Cell membrane
    b. Golgi apparatus
    c. Mitochondria
    d. None of these

Reasoning and Assertion questions:

27. Assertion: All living organisms are composed of cells and products of cells.
    Reason: All cells arise from pre-existing cells.

    a. Assertion is correct but Reason is incorrect
    b. Assertion is incorrect but Reason is correct

c. Both are correct
d. Both are incorrect

28. Assertion: Cell is the fundamental structural and functional unit of all living organisms.
Reason: Anything less than a complete structure of a cell does not ensure independent living.

a. Both A and R are correct but R is not the correct explanation for A
b. A is incorrect but R is correct
c. Both A and R are correct & R is the correct explanation for A
d. A is correct but R is incorrect

29. Assertion: The shape and size of cells are related to the specific function they perform.
Reasoning: Some cells like Amoeba have changing shapes. In some cases the cell shape could be more or less fixed and peculiar for a particular type of cell

a. Both A and R are correct but R is not the correct explanation for A
b. A is incorrect but R is correct
c. Both A and R are correct & R is the correct explanation for A
d. A is correct but R is incorrect

30. Assertion: Each kind of cell organelle performs a special function making new material in the cell, clearing up the waste material from the cell and so on.
Reasoning: Cells are found to have the same organelles, no matter what their function is.

a. Both A and R are correct but R is not the correct explanation for A
b. A is incorrect but R is correct
c. Both A and R are correct & R is the correct explanation for A
d. A is correct but R is incorrect

ANSWER KEY

1	2	3	4	5	6	7	8	9	10
C	B	C	B	C	D	C	A	A	A
11	12	13	14	15	16	17	18	19	20
A	B	C	A	C	A	A	A	A	C
21	22	23	24	25	26	27	28	29	30
D	A	A	C	C	A	C	C	C	A

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CHAPTER-9 BIOMOLECULES

GIST OF THE CHAPTER

- Molecules present in the living organism are known as biomolecules.Biomolecules are of two types- inorganic and organic.
- Examples of Inorganic biomolecules are minerals, gases and water.
- Organic biomolecules arecarbohydrates, fats, proteins, nucleic acids, vitamins, etc.
- **Primary metabolite**-compounds having identifiable functions and play roles in normal physiology.
- **Secondary metabolites**-compounds not having identifiable role in host organism.eg. - rubber, gum spices.
- Macromolecules are formed by polymerization of monomers. (except lipids)
- **Proteins** are polymers of monomers amino acids.
- The bond present between amino acids is **peptide bond**.
- Polysaccharides are polymers of the mono-saccharides which are linked **by glycosidic bonds.**
- Nucleic acids are polymers of nucleotides and are joined by **phosphodiester bond**.
- **Carbohydrates (polysaccharides)** are of two types -homopolymer and heteropolymer.
- Homopolymer is made up of only one type of monosaccharide units. Eg-cellulose, starch, glycogen, inulin, chitin.
- Heteropolymer is made up of two or more type of monosaccharides.
- Starch is the stored food of plants. It is a polymer of helically arranged glucose monomers which can hold iodine molecules and give blue black colour.
- Cellulose is a polymer of glucose molecules. It is the most abundant organic molecules on earth.
- Glycogen is the reserve food materials for animals, bacteria and fungi. In this, glucose molecules are arranged in highly branched bushlike chain.
- Chitin is a complex polysaccharide having units of N -acetyl glucosamine.
- **Proteins** are polypeptide chains made up of amino acids. There are 20 types of amino acids joined together by peptide bond between amino and carboxylic group.
- Amino acids are of two types- essential amino acids which are not synthesized by the body but can be obtained from food and non-essential amino acid which can be synthesized by the body from raw material.
- The main functions of protein in living cell are to fight with infections, act as hormones, antibodies, receptors.
- **Collagen is the most abundant protein in animal world.**
- **Primary structure of protein** is the basic structure of protein in which a number of polypeptides are involved having a linear sequence of amino acids. The first amino

acid of sequence is called N-terminal amino acid and last amino acid of peptide chain is called C-terminal amino acid.

- **Secondary structure** of protein-when the thread is folded in the form of helix.
- There are two types of secondary structure- alpha- helix and beta pleated.
- In alpha helix, the polypeptide chain is coiled spirally in right-handed manner.
- In beta pleated secondary proteins two or more polypeptide chains are interconnected by hydrogen bonds.
- In **Tertiary structure long protein** chain is folded upon itself like a hollow woollen ball to give rise to 3- dimensional, view of protein.
- **Quaternary structure of a protein** is the association of many polypeptides or sub units into a closely packed association E.g. Haemoglobin- In adult human haemoglobin 4 sub-units are involved. The two subunits are of alpha type and two subunits of beta type.
- A **nucleic acid** has three chemically distinct components- 1. heterocyclic compound (nitrogenous bases named adenine, guanine, thymine and cytosine.) Adenine and guanine are purines, Thymine and cytosine are pyrimidines, polysaccharides (ribose/ deoxy- ribose sugar) and phosphate or phosphoric acid.
- Nucleic acid containing deoxyribose sugar is called DNA (Deoxyribonucleic Acid) and those containing ribose sugars are called RNA Ribonucleic acid).
- **Enzymes-**Almost all enzymes are proteins which catalyze biochemical reactions in the cells.
- **Nature of enzyme action**-The tertiary structure of enzyme shows protein chains folding and forming crevices called active sites in which substrate fits and a short-lived enzyme substrate complex is formed which dissociates into products P and unchanged enzyme.
- E+S→ES→EP→E+P
- Proteinaceous enzymes exhibit substrate specificity, require optimum temperature and pH for maximum activity.
- Enzymes lower activation energy of reactions and enhance the rate of reactions.
- Ribozymes are some nucleic acids that behave like enzymes.
- Factors affecting enzyme activity-
- i) Temperature-Each enzyme shows its highest activity at a particular temperature and pH called optimum temperature and pH. Enzymes get denatured at high temperatures and become inactive at low temperatures.
- ii) Concentration of substrate- Increase in substrate concentration increases the rate of reaction due to occupation of more active sites of enzyme by substrate.
- When the binding of one chemical shuts off the activity of enzyme the process is called inhibition and chemical is called inhibitor.
- When inhibitor closely resembles the substrate in its molecular structure it is called competitive inhibitor.
- **Classification of enzymes-**
- Oxidoreductases/Dehydrogenases-
  S reduced + S' oxidised —› S oxidised + S' reduced
- Transferases- transfers a group between a pair of substrate.
  S -G + S'→ S + S'- G
- Hydrolases catalyses the hydrolysis of ether, peptide, ester, glycosidic bonds C-C ETC.
- Lyases-enzymes that catalyse removal of groups.
- Isomerase- Interconvert optical, geometric or positional isomers.
- Ligase- link together two compounds.

- The protein portion of enzyme is called **apoenzyme**. The non protein constituents of enzymes that make an enzyme catalytically active are called co- factors. They are -
  a) **Prosthetic groups**-organic compounds tightly bound to apoenzyme
  b) **Co enzyme**-organic compounds transiently bound to apoenzyme
  c) **Metal ions** which form one coordinate bond with the active site of enzyme and one or more coordination bond with substrate.

IMPORTANT DIAGRAMS AND STRUCTURES

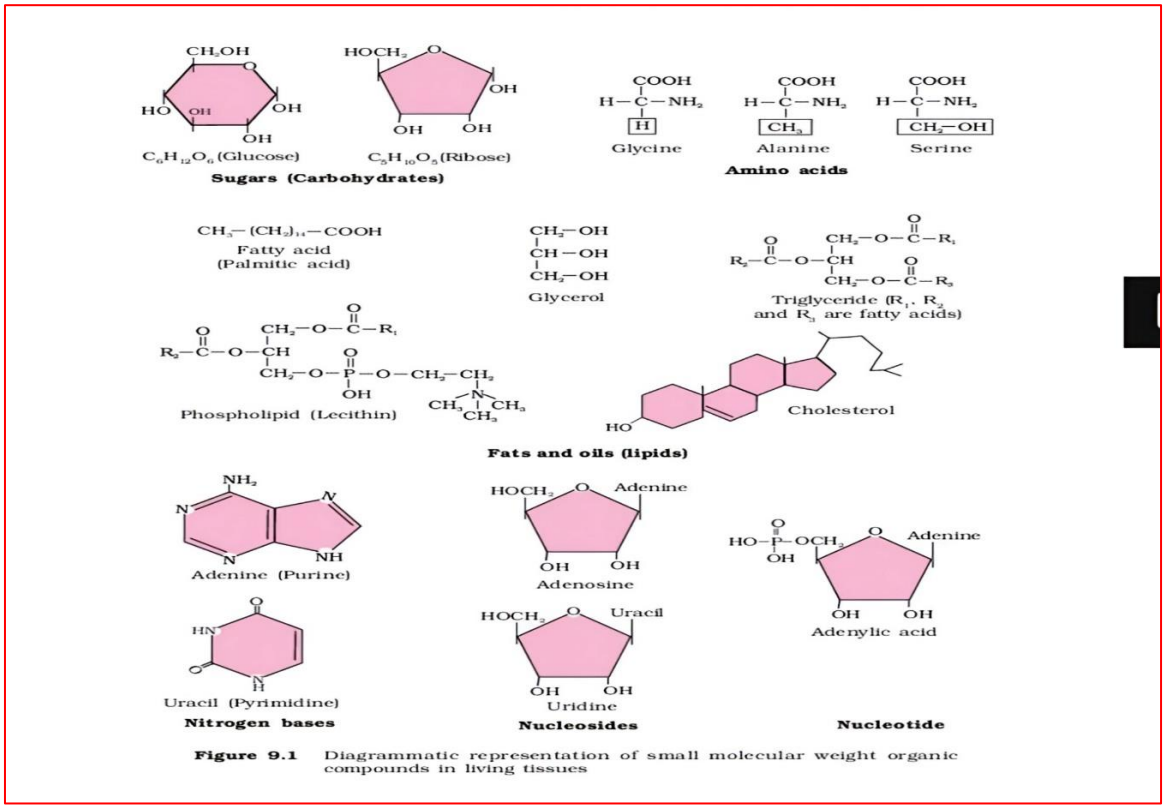


Figure 9.1 Diagrammatic representation of small molecular weight organic compounds in living tissues

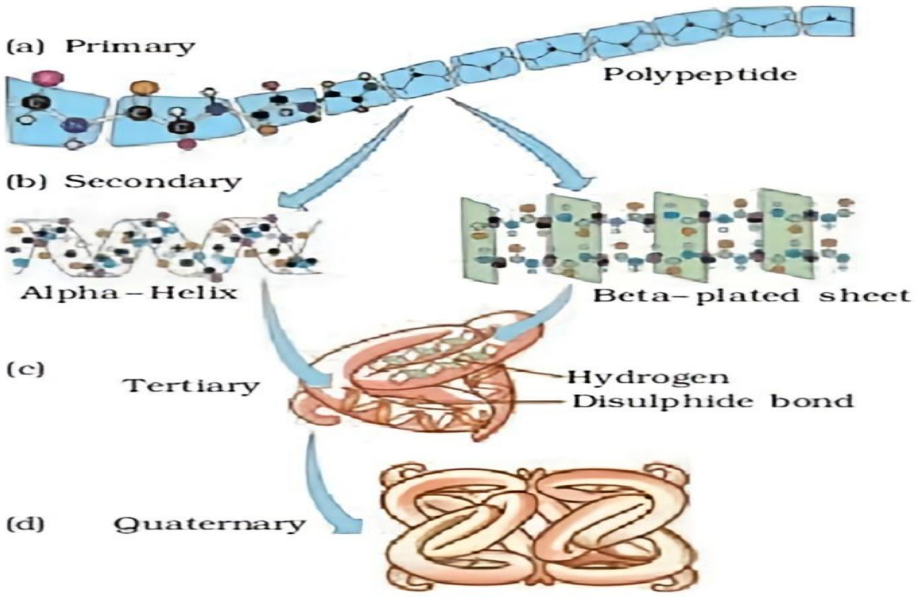


Figure 9.3 Various levels of Protein Structure

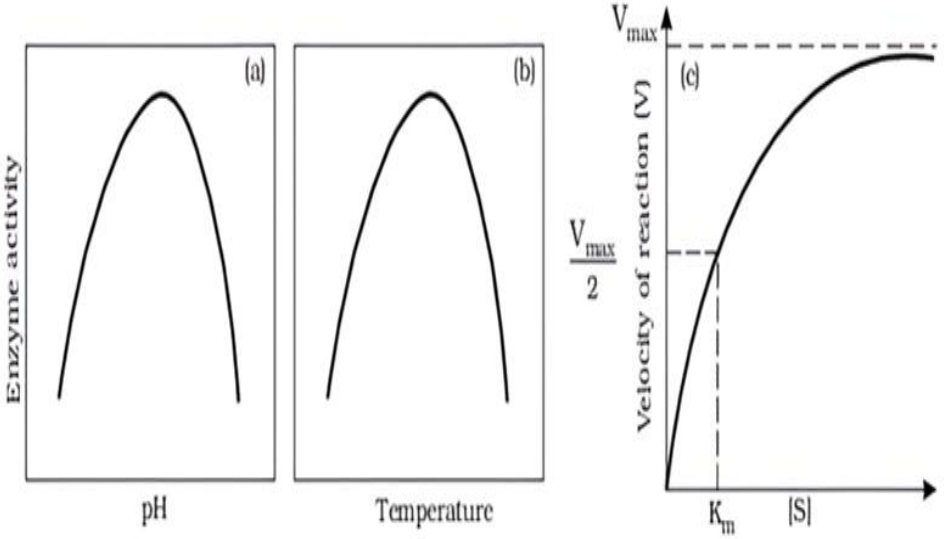


Figure 9.5 Effect of change in : (a) pH (b) Temperature and (c) Concentration of substrate on enzyme activity

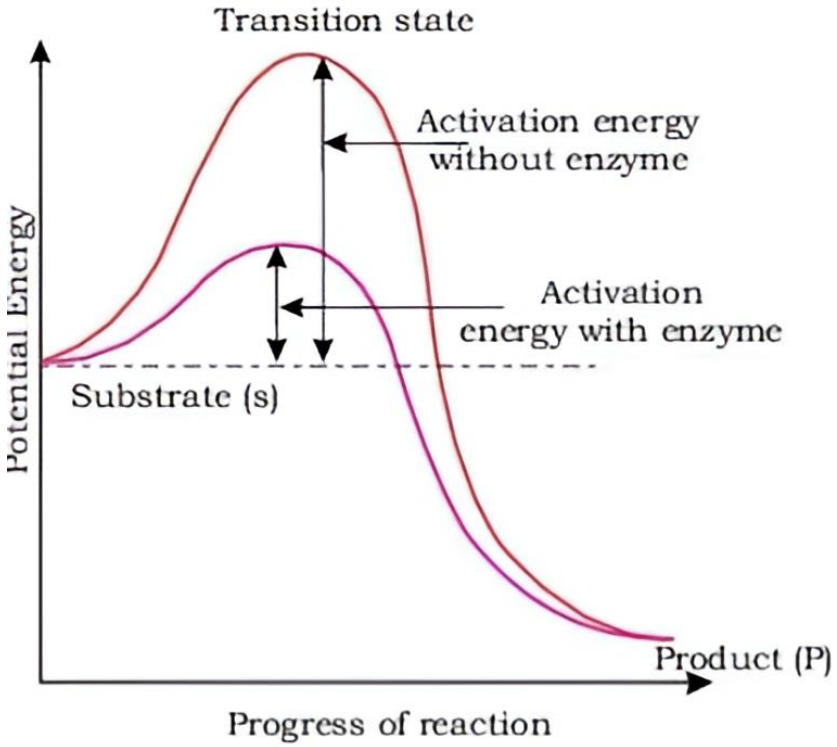
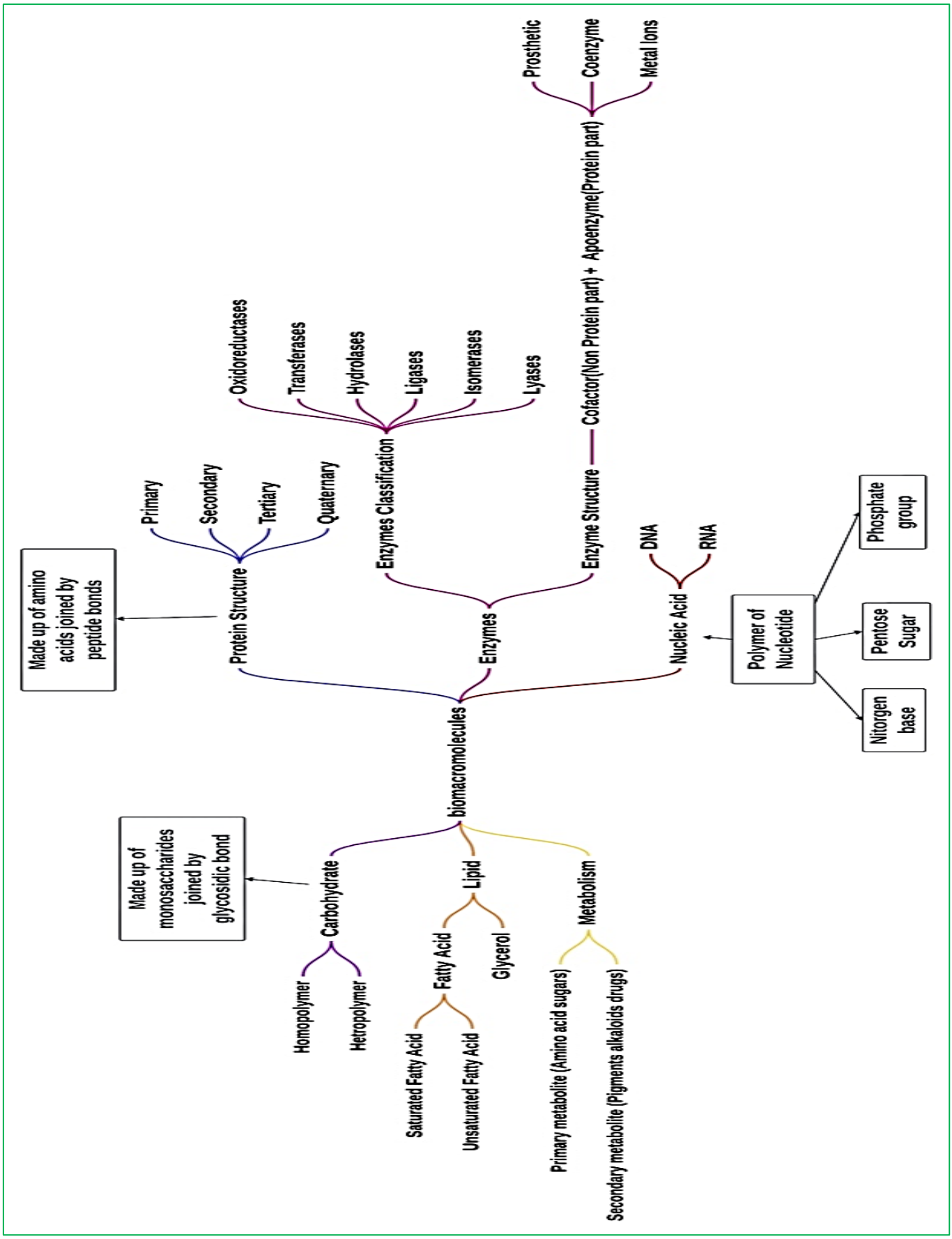


Figure 9.4 Concept of activation energy

MIND MAP



MULTIPLE CHOICE QUESTIONS

1. Inulin is a polymer of-
    a) Glucose
    b) Fructose
    c) Mannose
    d) Ribose
2. Chitin is a-
    a) Homopolysaccharide
    b) Heteropolysaccharide
    c) Oligosaccharide
    d) Monosaccharide
3. The bond formed between two adjacent monosaccharide is-
    a) Peptide bond
    b) Ester bond
    c) Glycosidic bond
    d) Ionic bond
4. The chemical and physical property of amino acid is based on-
    a) –NH2 group
    b) –COOH group
    c) –R group
    d) All of these
5. The most abundant protein in animal world is-
    a) RuBisCo
    b) Collagen
    c) Elastin
    d) Albumin
6. Essential amino acids are those which are-
    a) Not synthesized by our body
    b) Not required by our body
    c) Synthesized by our body
    d) Only used to form proteins
7. In the primary structure of protein-
    a) Left end represents → 1st amino acid (C-terminal amino acid)
    b) Right end represents → Last amino acid (N terminal amino acid)
    c) Left end represents → 1st amino acid (N-terminal amino acid)
    d) Right end represents → 1st amino acid (C-terminal amino acid)
8. Which of the following is correct about human Haemoglobin (Hb)?

a) Made up to 2-alpha and 2-beta subunits
b) Present in RBC
c) Use to carry O2 and CO2
d) All of these

9. Sugar + Nitrogen bases + Phosphate forms-
   a) Nucleoside
   b) Nucleotide
   c) Peptide
   d) Glycoside
10. The bond present between two nucleotides is known as-
   a) Phosphoester linkage
   b) Phosphodiester linkage
   c) Glycosidic linkage
   d) Peptide linkage
11. Which of the following is an acidic amino acid?
   a) Valine
   b) Glutamine
   c) Lysine
   d) Arginine
12. The biomolecule whose weight is less than____ dalton (Da) is referred to as biomicromolecule.
   a) 800
   b) 18
   c) 1000
   d) 10000
13. Which structure is absolutely necessary for the many biological activities of proteins-
   a) 1° b) 2° c) 3° d) 4°
14. Which one of the following is a secondary metabolite?
   a) Amino acid
   b) Sugar
   c) Spices
   d) Protein
15. Which one of the following statement is incorrect?
   a) Primary metabolites have identifiable functions.
   b) Some secondary metabolites have ecological importance.

c) Secondary metabolites like rubber, drugs, spices, scents and pigments are useful to human welfare

d) Secondary metabolites are not found in fungi, microbes and plants.

16. Which one of the following is not a polymer?

a) Rubber

b) Morphine

c) Protein

d) Cellulose

17. Which one of the following are secondary metabolites?

a) Flavonoids and rubber

b) Antibiotics, coloured pigments and essential oils

c) Scents, gums, spices

d) All the above

18. Almost all enzymes are-

a) Protein

b) Nucleic acid

c) Carbohydrates

d) Vitamins

19. Nucleic acids that behave like enzymes and are called-

a) DNase

b) RNase

c) Nuclease

d) Ribozymes

20. _____ of an enzyme is a crevices or pocket into which substrate fit.

a) Inactive site

b) Active site

c) Allosteric site

d) Any of these

21. Select the incorrect statement from the following:

a) Active enzyme has tertiary structure having many active sites (substrate binding sites).

b) Enzymes are biocatalyst.

c) Enzymes occur in viruses.

d) Enzymes are mainly protein in nature.

22. Select the correct statement from the following:

a) Inorganic catalysts work efficiently at high temperature and high pressure while enzymes get damaged at high temperature (above 40°C).

b) Ribozymes are nucleic acids behaving like enzyme.

c) Thermophilic organisms living in hot vents and sulphur springs have enzymes that are stable and retain their catalytic power even at high temperatures (80–90°C).

d) All of these.

23. Which of the following is a unique feature about the enzyme?

a) They are not consumed by the enzyme-mediated reaction.

b) They are not altered by the enzyme-mediated reaction.

c) They lower the activation energy.

d) All of these

24. The catalytic cycle of an enzyme action can be described in the following steps. Arrange them in sequence accordingly.

1. The binding of the substrate induces the enzyme to alter its shape, fitting more tightly around the substrate. 2. The substrate binds to the active site of the enzyme, fitting into the active site.

3. The enzyme releases the products of the reaction and the free enzyme is ready to bind to another molecule of the substrate and run through the catalytic cycle once again.

4. The active site of the enzyme, now in close proximity of the substrate breaks the chemical bonds of the substrate and the new enzyme product complex is formed

a) 1 → 2 → 3 → 4

b) 2 → 1 → 4 → 3

c) 1 → 2 → 4 → 3

d) 2 → 1 → 3 → 4

25. Each enzyme shows its highest activity at particular temperature and pH called the _____ temperature and _____ pH.

a) optimum, optimum

b) minimum, minimum

c) maximum, maximum

d) minimum, maximum

26. Inhibition of succinate dehydrogenase by malonate is an example of-

a) Non-competitive inhibition

b) Negative feed back

c) Allosteric inhibition

d) Competitive inhibition

27. Enzymes catalysing the linking together of two compounds, for example enzymes which catalyse the joining of C-O, C-S, C-N, P-O, etc., bonds, belongs to the class of-

(a) Isomerases b)Transferases c)Hydrolases d) Ligases

28. How many types of cofactors can be identified?

a) 1 b) 2 c) 3 d) 4

29. Cofactors are-

a) Prosthetic groups
b) Co-enzymes
c) Metallic ions
d) All of these

30. Zn is an activator of _____ enzyme.

a) Carbonic anhydrase
b) Carboxypeptidase
c) Carboxylases
d) All of these

ANSWER KEY

1	2	3	4	5	6	7	8	9	10
b	b	c	d	a	a	c	d	b	b
11	12	13	14	15	16	17	18	19	20
b	c	d	c	d	b	d	a	d	b
21	22	23	24	25	26	27	28	29	30
c	d	d	b	a	d	d	c	d	d

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CHAPTER 10: CELL CYCLE AND CELL DIVISION

GIST OF THE CHAPTER

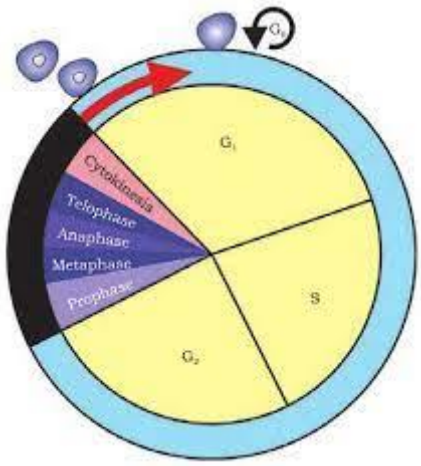
→ **CELL CYCLE: -** The sequence of events by which a cell duplicates its genome and eventually divides into two daughter cells is called cell cycle.

→ Cell Cycle is divided into two phases-

1) Interphase - It is the phase between two M phases. During this phase, the cell prepare itself for nuclear division.

2) M phase: - It is the phase when cell division takes place.

→ The interphase is further divided into three phases: -



i) G_1 phase / Gap 1 phase: -

In this phase, cell is metabolically active and continuously grows.

ii) S phase: In this phase, DNA synthesis or replication takes place.

→ Chromosome number remains same but DNA content gets doubled.

→ In animal cells, DNA replication takes place in nucleus and centrioles duplicates in cytoplasm.

iii) G2 phase: - In this phase, proteins are synthesized & cell growth continues.

Quiescent stage (G0): - Some cells in adult animals do not exhibit division. These cells exit G1 phase to enter an inactive stage called quiescent stage (G0).

MITOSIS: -

Also called as equational division because the numbers of chromosomes remain same is parental and daughter cells.

Mitosis is divided into four stages: - Prophase, Metaphase, Anaphase and telophase.

i) Prophase-

→ Chromatin material takes the shape of chromosome.

→ Centrosome begins to move towards opposite poles of the cell.

→ Nuclear envelop and nucleolus starts disappearing.

ii) Metaphase-

→Spindle fibers attach to kinetochores of chromosomes.

→Chromosomes are moved to spindle equator and get arranged at metaphase plate.

iii) Anaphase-

→Centromeres split and chromatids separate.

→Chromatids move towards the opposite poles.

iv) Telophase-

→ Chromosomes cluster at opposite spindle poles and their identity is lost as discrete elements.

→ Nuclear envelope develops around the chromosomes forming two daughter nuclei.

→ Nucleolus, Golgi body and ER reform.

Cytokinesis: - Division of cytoplasm after Karyokinesis into two daughter cells.

1) Cell furrow: - In animal cells, furrows are appeared in plasma membrane that deepens gradually and joins to divide cytoplasm.

2) Cell plate- In plant cells, wall starts to form at center and grows outwards. The formation of cell wall begins with plate formation.

Significance of mitosis: -

1) Produces diploid daughter cells with identical genetic complement.

2) Helps in repair of cells.

3) Helps in growth of organism.

MEIOSIS - Also called as reductional division because it reduces the number of chromosomes into half and results in the production of haploid daughter cells.

It involves two phases - meiosis I and meiosis II.

Meiosis I -

Prophase I: -

→ **Leptotene**- Chromosomes becomes distinct & visible.

→ **Zygotene** - Chromosomes start pairing together (synapsis).

Synaptonemal complex formed by a pair of homologous chromosomes is called bivalent or tetrad.

→ **Pachytene -** crossing over between non sister chromatids of homologous chromosomes takes place.

→ **Diplotene** - dissolution of synaptonemal complex, separation of bivalent except at X like structure called chiasmata.

→**Diakinesis**- terminalization of chiasmata, nuclear membrane and nucleolus disappears.

Metaphase I - Bivalent chromosome aligns at equatorial plate, spindles get attached to the pair of homologous chromosomes.

Anaphase I - Homologous chromosomes separate and move towards the opposite poles.

Telophase I - Nuclear membrane and nucleolus reappears and cytokinesis follows.

Meiosis II: -

Prophase II - initiated immediately after cytokinesis, nuclear membrane disappears, chromosomes become compact.

Metaphase II- Chromosomes align at equator.

Anaphase II- Splitting of centromere and chromosomes move to opposite poles.

Telophase II. Chromosomes get enclosed by nuclear membrane followed by cytokinesis to form four haploid daughter cells.

Significance of meiosis: -

1) Meiosis forms the gametes that are essential for sexual reproduction.

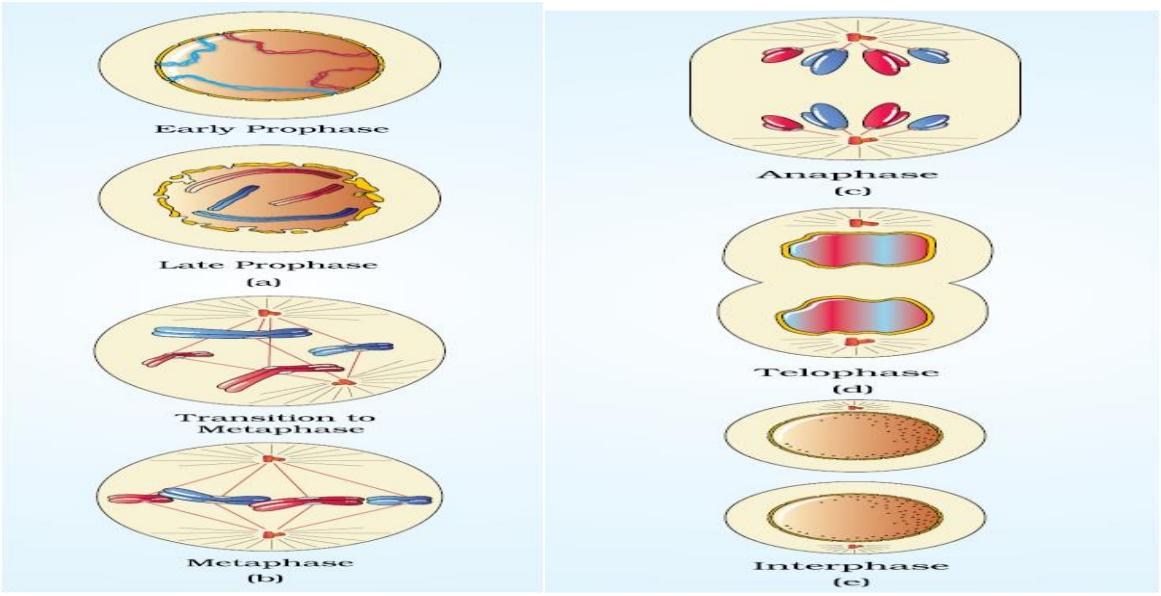
2) Introduces new recombination of traits.

3) Helps in maintenance of chromosome number of sexually reproducing organism.

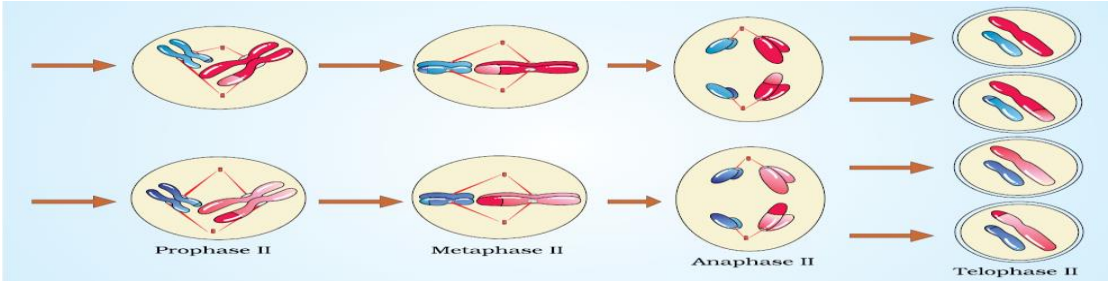
4) Provides evidence of basic relationship of organisms.

IMPORTANT DIAGRAMS: -

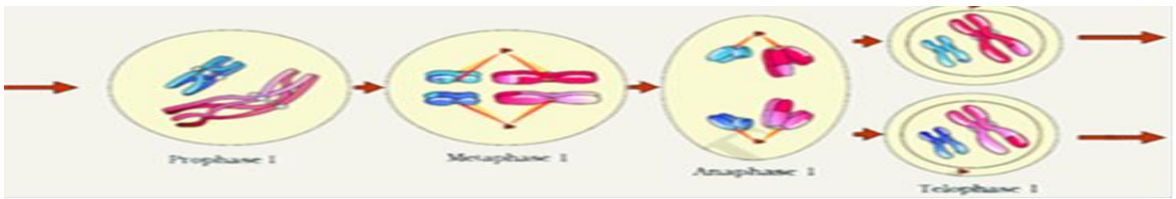
1. **MITOSIS: -**



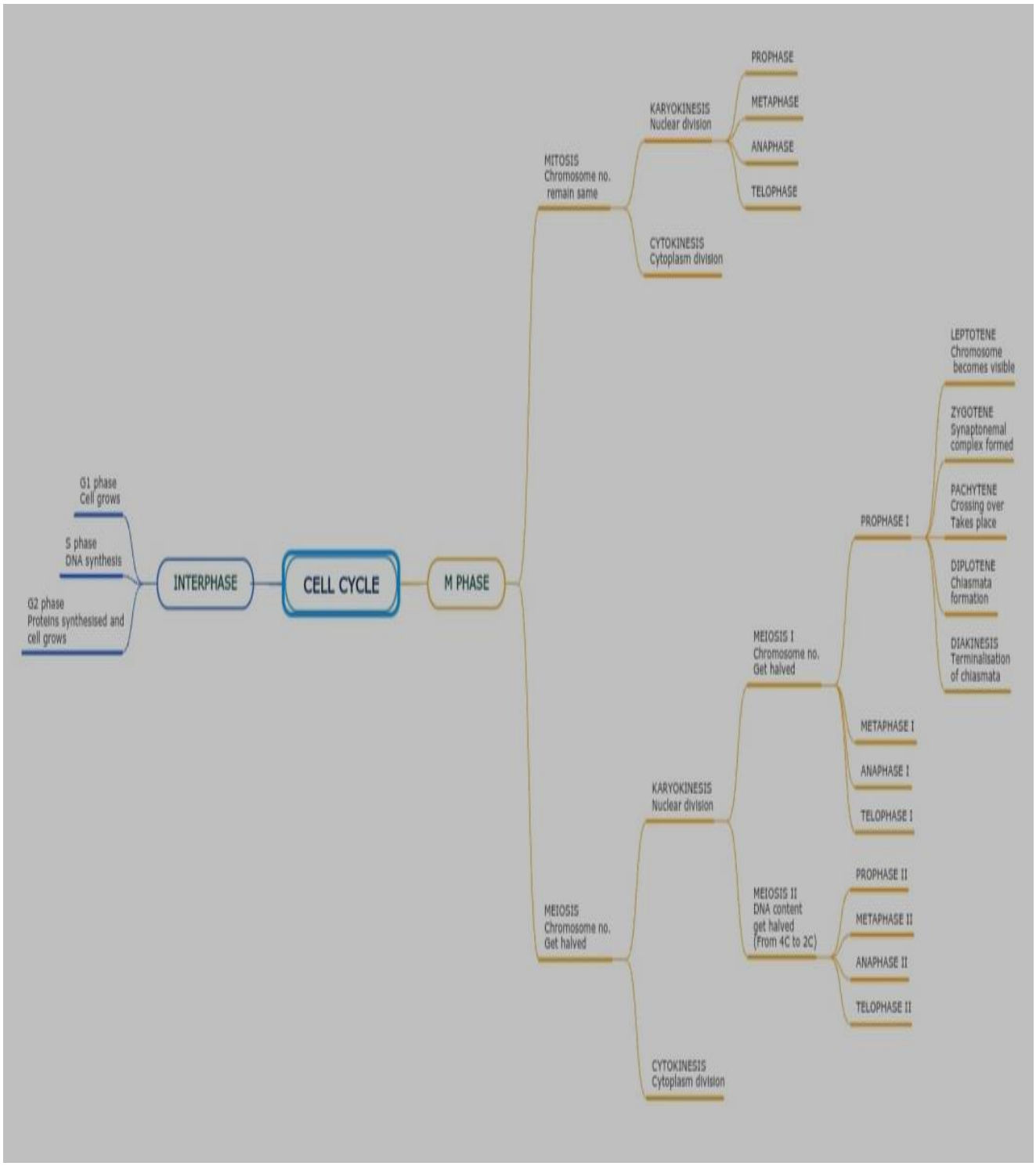
MEIOSIS I



MEIOSIS II



MIND MAP



MULTIPLE CHOICE QUESTIONS

Q. 1 The sequence of events by which a cell duplicates its genome, and divides into two daughter cells is termed as: -

a) cell division b) cell cycle c) mitosis d) meiosis

Q. 2 Yeast can progress through the cell cycle in about: -

a) 90 min. b) 30 min. c) 60 min. d) 24 hours

Q. 3 Somatic cell division is another name of:-

a) meiosis b) cell cycle c) mitosis d) amitosis

Q. 4 Chiasmata can be seen in:-

a) zygotene b) pachytene c) diplotene d) leptotene

Q. 5 DNA replicates itself during which phase of cell cycle?

a) S phase b) M phase c) G2 phase d) G1 phase

Q. 6 In which phase of meiosis crossing over takes place?

a) zygotene b) pachytene c) diplotene d) leptotene

Q. 7 If a cell divides in 10 minutes. At this rate it can fill a 100 ml beaker in two hours.

How much time does it take to fill a 50 ml beaker?

a) 30 minutes b) 60 minutes c) 29 minutes d) One minute

Q. 8 Which of the following statements is correct?

a) mitosis is not equational division

b) meiosis is equational division

c) mitosis is reductional division

d) meiosis is reductional division

Q. 9 An imaginary plate on equator on which chromosomes get arranged during cell division is formed during

a) prophase b) metaphase c) anaphase d) telophase

Q. 10 Which of the following statements about the cell cycle is false?

a) in M phase, cell grows physically

b) in G1 phase, cell grows physically larger and copies organelles

c) in S phase, replication of DNA takes place

d) in G2 phase, preparation of mitosis takes place

Q. 11 Significance of meiosis is:-

i. Variation and Evolution

ii. Conservation of chromosome number of species

iii. Growth and repair

a) Only ii b) only i and ii c) i, ii and iii d) only ii and iii

Q. 12 Zygotene can be characterized by the formation of:-

a) chiasmata b) chromosomes c) crossing over d) synapsis

Q. 13 How many cells are formed at the end of meiosis and mitosis?

a)4, 2 b) 2, 4 c) 2, 2 d) 4, 4

Q. 14 In plant cell, cytokinesis is different from animal cell. How?

a) by cell furrow in plant cell and cell plate in animal cell

b) by cell plate in plant cell and cell furrow in animal cell

c) by cell plate in plants and animals both

d) by cell furrow in plants and animals both

Q. 15 A cell with 32 chromosomes divides meiotically. How many chromosomes can be seen in daughter cells after meiosis I ?

a) 32 b) 16 c) 64 d) 8

ANSWER KEY

Ques. No	Answer	Ques. No	Answer
1	B	9	B
2	A	10	A
3	C	11	B
4	C	12	D
5	A	13	A
6	B	14	B
7	B	15	B
8	D		

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CHAPTER 11: PHOTOSYNTHESIS IN HIGHER PLANTS

GIST OF THE CHAPTER

Photosynthesis is a physico-chemical process by which green plants use light energy to derive synthesis of organic compounds. It is an enzyme regulated anabolic process.

$6\ CO_2 + 12\ H_2O$ ----------> $C_6H_{12}O_6 + 6\ H_2O + 6O_2$

Importance of Photosynthesis:

1). It is primary sources of food production on planet earth.
2). Light, chlorophyll, CO_2, water and minerals are essential for . It occurs in green cells of the plants.
3). Photosynthesis is also source of Oxygen generation on the earth.

Oxygen is released during photosynthesis is from Water molecules but not from Carbon Dioxide. It was reported by C.Von Niel , who discovered photosynthesis in purple & green sulphur bacteria.

Site of Photosynthesis : CHLOROPLAST
Photosynthesis has two phases
I Phase : Light reaction takes place in GRANA
II Phase : Dark reaction takes place in STROMA
Photosynthetic pigments are Chlorophyll—a (blue-green)
Chlorophyll---b (yellow-green)
Carotenoids (carotenes-orange; xanthophylls-yellow)

These pigments are found in Thylakoids of Grana.

Chlorophyll-b, carotenes and xanthophylls arre called accessory pigments/antenna molecules, because they absorb light and transfer energy to reaction center i.e., chlorophyll-a molecule and protect them from photooxidation. In light reaction two photosystems are operated. They are

Photosystem I : In this reaction centre is P700
Photosystem II: In this reaction centre is P680
Lighr phase consists two parts

I. Cyclic photophosphorylation, involves PS I, it generates ATP.
II. Non-Cyclic photophosphorylation involves PS I and PS II. During this process ATP and NADPH are generated, and also photolysis of water takes place in which molecular oxygen is liberated.

Dark reaction takes place in Stroma part of chloroplast. Dark reaction/ C3 Cycle has three phases are found

A. CARBOXYLATION
B. REDUCTION
C. REGENERATION

To synthesize one molecule of Glucose six turns of C3 cycle to take p[lace.

In tropical grasses like Maize, Sorghum Carbon Dioxide fixed by an alternative pathway called C4 pathway. C4 leaves have dimorphic chloroplasts i.e., Mesophyll chloroplasts and Bundle sheath chloroplasts

In mesophyll chloroplasts C4 pathway takes place
In bundle sheath chloroplast C3 pathway takes place.

	C3 Plants	C4 Plants
1	First CO_2 acceptor is RUBP	PEP
2	First stable compound is 3-PGA	OAA
3	One type chloroplasts are found Mesophyll chloroplasts	Two types of chloroplasts, mesophyll chloroplasts and bundle sheath chloroplasts
4	Do not tolerate high light intensities, high temperature	They can tolerate

5	Photorespiration is found	Not found

In photosynthesis also (like respiration) ATP synthesis is linked to development proton gradient across membrane.

Photorespiration: During high light intensities and high temperatures in C3 plants it takes place in illuminated green cells which is resulted in excess evolution of Oxygen

Factors affecting Photosynthesis:

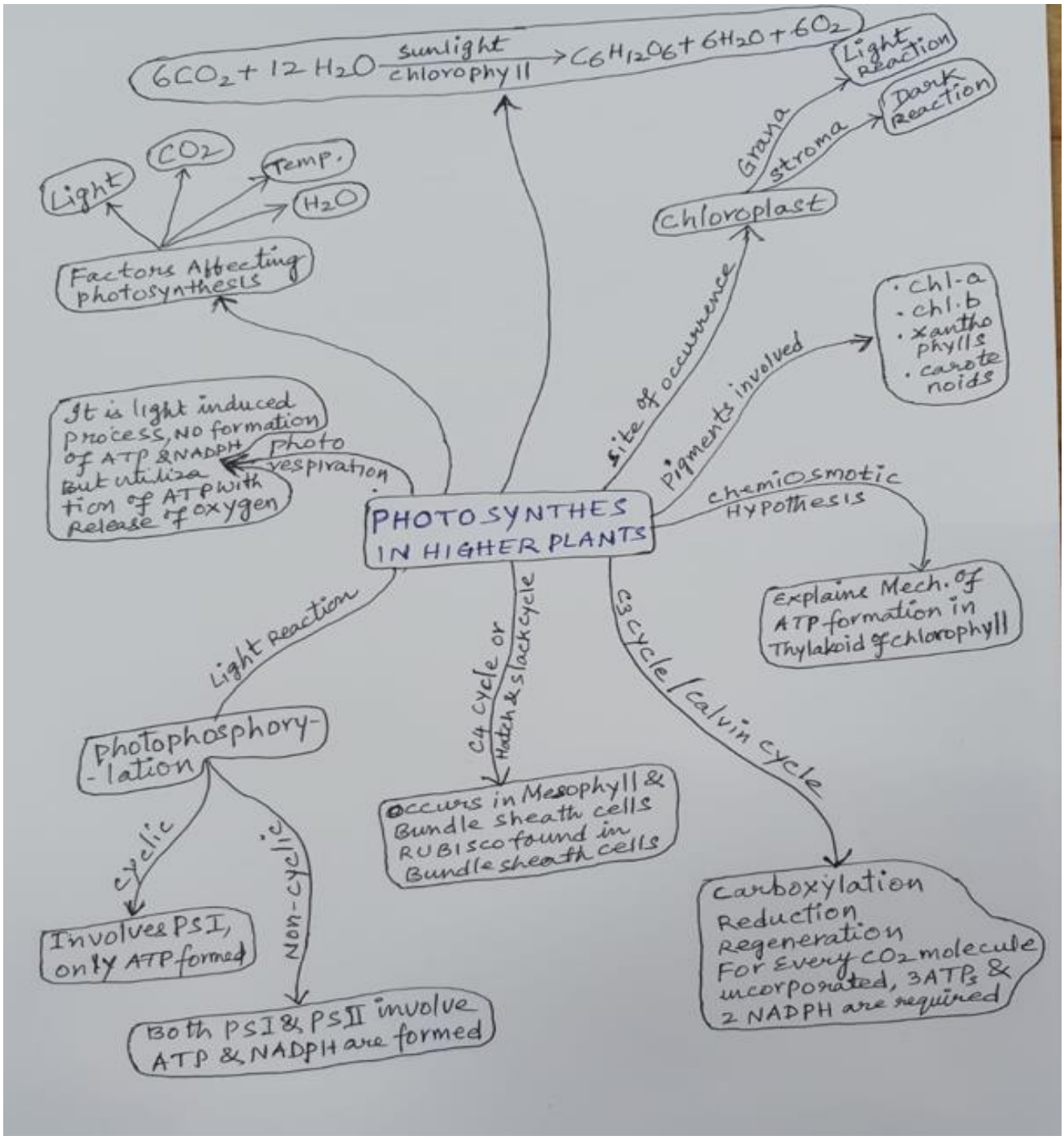
Law of Limiting Factors: If a chemical process is affected by more than one factor, then photosynthetic rate will be determined by the factor which is nearest to its minimal value.

Light: It has impact in three ways, i.e., Duration Intensity and Quality

CO2 and Temperature: In low concentration rate is slow as they increase in their concentration rate also goes on increase till their respective optimal ranges photosynthetic rates decline.

Water It is very important factor, water stress causes the stomata to close hence reducing the CO2 availability, and general metabolic activity also declines.

MIND MAP



MULTIPLE CHOICE QUESTIONS

1). Photosynthetic pigments found in the chloroplast present in

a. chloroplast membrane b. Stroma c. Grana d. Plastoglobules

2). One of the following pigments acts as a reaction centre photosynthesis

a. Cytochrome b. P700 c. Carotene d. Phytochrome

3). In cyclic photophosphorylation initial electron acceptor is

a. Plastocyanin b. Cytochrome c. Ferredoxin d. Fe-S protein

4). In C4 plants malic acid formation during CO2 fixation occurs in the cells of

a. Mesophyll cells b. Bundlesheath cells c. Epidermis d. Phloem

5). Primary CO2 acceptor in C3 plants.

a. RUBP Carboxylase b. PEP Carboxylase c. Citrate synthetase d. Pyruvic kinase

6). First stable compound in C3 plants.

a. OAA b. 3-PGA c. RUBP d. PEP

7). Primary CO2 acceptor in C4 plants.

a. RUBP b. PEP c, Alpha KGA d. Fumaric acid

8). List the CO2 acceptor in bundle sheath cells in C4 plants from the following options.

a. RUBP b. PEP c. DHAP d. 3- PGAl

9). Find the first stable compound in C4 cycle from following

a. RUBP b. PEP c. PGA d. OAA

Stroma of chloroplast contain

a. Light independent reaction enzymes. b. Ribosomes

c. Chlorophyll d. Light dependent reaction enzymes

11. Name the abundant protein found on earth

a. collagen b. RUBISCO c. Fibrinogen d. Actin

12. A process that makes an important difference between C3 & C4 plants is

a. photosynthesis b. Photorespiration c. Transpiration d. Glycolysis

13. Chemiosmotic theory of ATP synthesis in the chloroplast and mitochondria is based on

a. Protein gradient b. Accumulation of potassium ions

c. Accumulation of sodium ions d. Membrane potential

14). Anoxygenic photosynthesis is characteristic of

a. Ulva b. Spirogyra c. Rhodospirillum d. Chlamydomonas

15). The element essential for photolysis of water

a. Boron b. Zn c. Mn d. Cu

16). For formation of one glucose molecule, how many turns of Calvin cycle required

a. 8 turns b. 6 turns c, 4 turns d. 2 turns

17). Which stage of Calvin cycle utilizes ATPs

a. Carboxylation b. Reduction c. Regeneration d. Both b & c

18). Light affects photosynthesis in following terms

a. Duration b. Intensity c. Quality d. All

19). For assimilation of one CO2 molecule during photosynthesis, the energy required in the form of ATP and NADPH2 are

a. 2 ATP and 2 NADPH b. 5 ATP and 3 NADPH

c. 3 ATP and 2 NADPH d. 18 ATP and 12 NADPH

20). Stomata are opened during night time in

a. C3 plants b. C4 plants c. CAM Plants d. Gymnosperms

21). In non-cyclic photophosphorylation following photosystem(s) involve

a. PS I b. PS II c. Thylakoids d. A and b

22). Who discovered photosynthesis in purple-green bacteria

a. C V Niel b. Calvin c. Hatch d. Slack

23). During light reaction, light energy is converted into

a. radiant energy b. Chemical energy c. Static energy d. Potential energy

24). Oxygen released during photosynthesis is from

a. Water b. CO2 c. Chlorophyll d. Thylakoid

25). Special feature of C4 leaf is

a. Presence of two types of chloroplasts b. Kranz anatomy

c. opening of stomata at night d. Both a and b

26). Law of limiting factors proposed by

a. Blackman b. Hoffman c. Ruben d. Kamen

27). The type of carbon compounds involve in CO2 fixation in mesophyll and bundle sheath chloroplasts respectively in C4 plants

a. 3 & 5 carbon compounds b. 5 & 3 carbon compounds

c. 4 & 6 carbon compounds d. 6 & 4 carbon compounds

28). What is the primary product of the light dependent reactions of photosynthesis

a. Glucose b. ATP c. NADPH d. b & c

29). Sites of light and dark reactions respectively

a. Stroma and grana b. Grana and stroma c. Grana d. Stroma

30). Which of the following external factor can limit the rate of photosynthesis in plants

a. Temperature b. Oxygen concentration c. CO2 concentration d. Light intensity.

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CHAPTER 12: RESPIRATION IN PLANTS

GIST OF THE CHAPTER

*****All living organisms need energy for various life activities like transportation, movement, excretion, absorption, reproduction, etc.

*The energy needed is obtained by oxidation of some organic molecules called as 'food'.

During the process of photosynthesis, the light energy is converted into chemical energy and stored in the bonds of carbohydrates.

*The breakdown of food material within the cell to release energy is termed 'Cellular respiration'. This energy used to synthesise ATP

*The compounds which undergo oxidation to release energy are called Respiratory substrates. Carbohydrates, fats, proteins and organic acids can act as respiratory substrates.

***Plants also respire:** - (i)Plants also take oxygen and give out carbon dioxide.

(ii)In plants/trees gaseous exchange takes place through stomata and lenticels.

(iii)Different parts of plants respire individually i.e., separately.

(iv)Transport of gases is limited region in the plant.

***Types of organisms on the basis of respiration: -**

(i)Aerobic organisms-organisms which compulsorily need oxygen for survival.

(ii)Facultative anaerobic organisms-anaerobic organisms which can survive in presence of oxygen

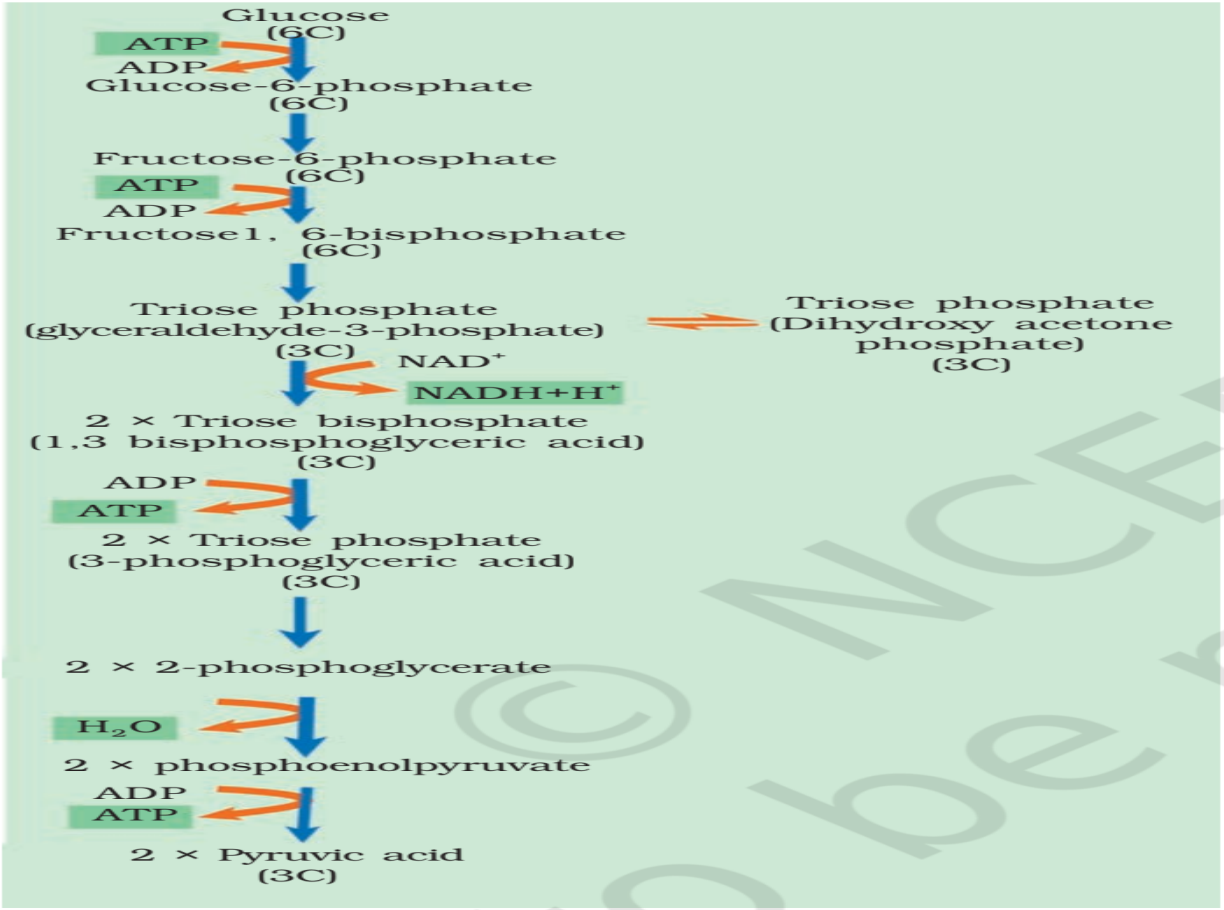
(iii)Obligate anaerobic organisms- survive ONLY in absence of oxygen.

***Five main steps in cellular respiration:-**

1. Glycolysis
2. Link reaction
3. TCA cycle /Krebs' cycle
4. Electron transport chain / Electron transport system
5. Oxidative phosphorylation.

***Glycolysis-**The process of partial oxidation of glucose into two molecules of pyruvic acid.Glycolysis occurs in the cytoplasm of cell.

***SCHEMATIC REPRESENTATION OF GLYCOLYSIS.**



***Link reactions**: Pyruvate molecules produced in glycolysis pathway undergoes oxidative decarboxylation in presence of Pyruvate dehydrogenase enzyme complex to form Acetyl CoA.

***Chemical equation of Link Reaction: -**

Pyruvic acid + CoA +NAD^+ →*→→ Acetyl CoA + CO_2 + NADH+ H^+

Mg^{2+} , Pyruvate dehydrogenase.

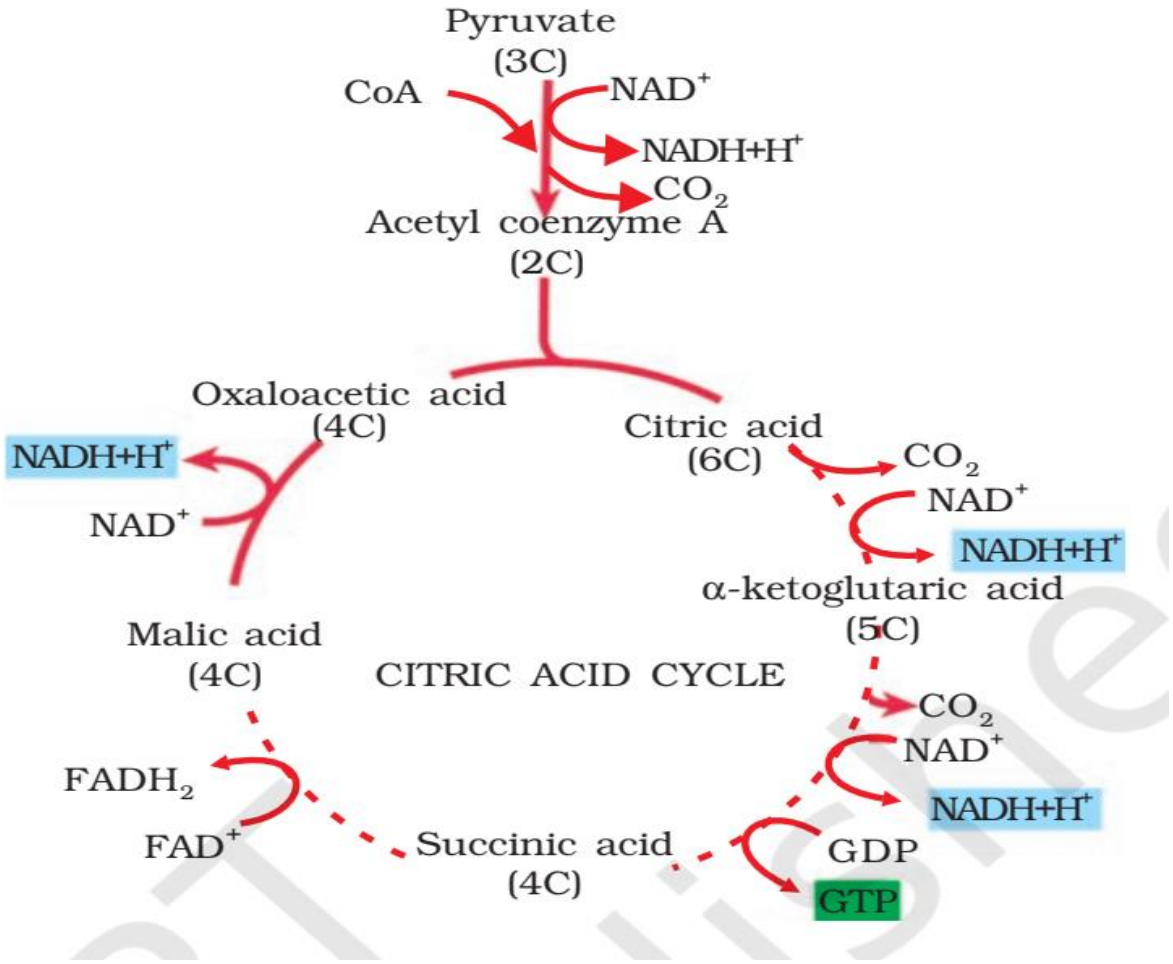
***TCA Cycle /Krebs' cycle.**

*This cyclic pathway occurring in matrix of mitochondria was first proposed by Sir Hans Krebs in 1937.

*It is process to release stored energy through oxidation of Acetyl CoA and produce ATP later.

*During TCA cycle, NADH+ H^+ and FADH2 are produce which are later used in ETC for ATP production.

Cyclic pathway of TCA cycle.



***Summary equation of TCA cycle:-**

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

***ELECTRON TRANSPORT CHAIN**

The electron transport chain is a series of four protein complexes (Electron carriers) that couple oxido-reduction reactions that creates an electrochemical gradient that leads to creation of ATP through oxidative phosphorylation.

***Location: Inner mitochondrial membrane.**

***Coomplex I: NADH dehydrogenase complex**

Electrons from $NADH+H^+$ are received by this complex and electrons are transferred to ubiquinone located in inner membrane.

***Complex II:Succinate dehydrogenase complex**

Ubiquinone receives electrons from complex II which later passes electrons to complex III.

***Complex III:Cytochrome bc complex**

Reduced ubiquinone transfers electrons through it.

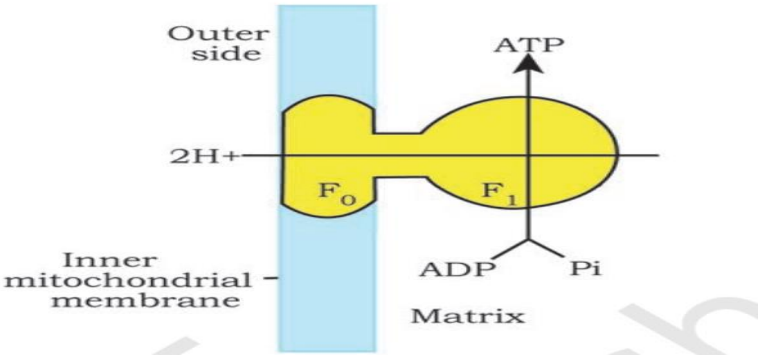
***Complex IV: Cytochrome c complex**

Electrons are removed from cytochrome c and transferred to molecular oxygen O_2 along with protons producing water.

****Oxygen plays a vital role in removal of hydrogen from the system.**

****During movement of electrons, protons are removed from matrix and transferred to inter mitochondrial membrane space. This creates proton gradient.**

The proton gradient is used by ATP synthetase Complex V (F0-F1 Particle) to produced ATP during oxidative phosphorylation.



F0 acts as an ion channel for protons to come back to mitochondrial matrix.

F1 component helps in coupling ADP and iP to form ATP.

Oxidation of 1 $NADH+H^+$ produces **three molecules of ATP** as three pairs of Protons are moved to intermembranial space which return back to matrix through F0-F1 particle.

Oxidation of 1 FADH2 **produces two molecules of ATP** as two pairs of Protons are moved to intermembranial space which return back to matrix through F0-F1 particle.

***Respiration is termed **as AMPHOBOLIC** pathway as it involves both anabolism and catabolism. During respiration breakdown and synthesis of fatty acids and proteins takes place.

****RESPIRATORY QUOTIENT:** The ratio of volume of CO_2 to the volume of O_2 consumed during respiration is termed Respiratory Quotient (RQ) or Respiratory ratio.

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

1.Respiratory quotient depends upon respiratory substrate.

2.Respiratory quotient of carbohydrates = 1

3. Respiratory quotient of Proteins & Fats = less than 1

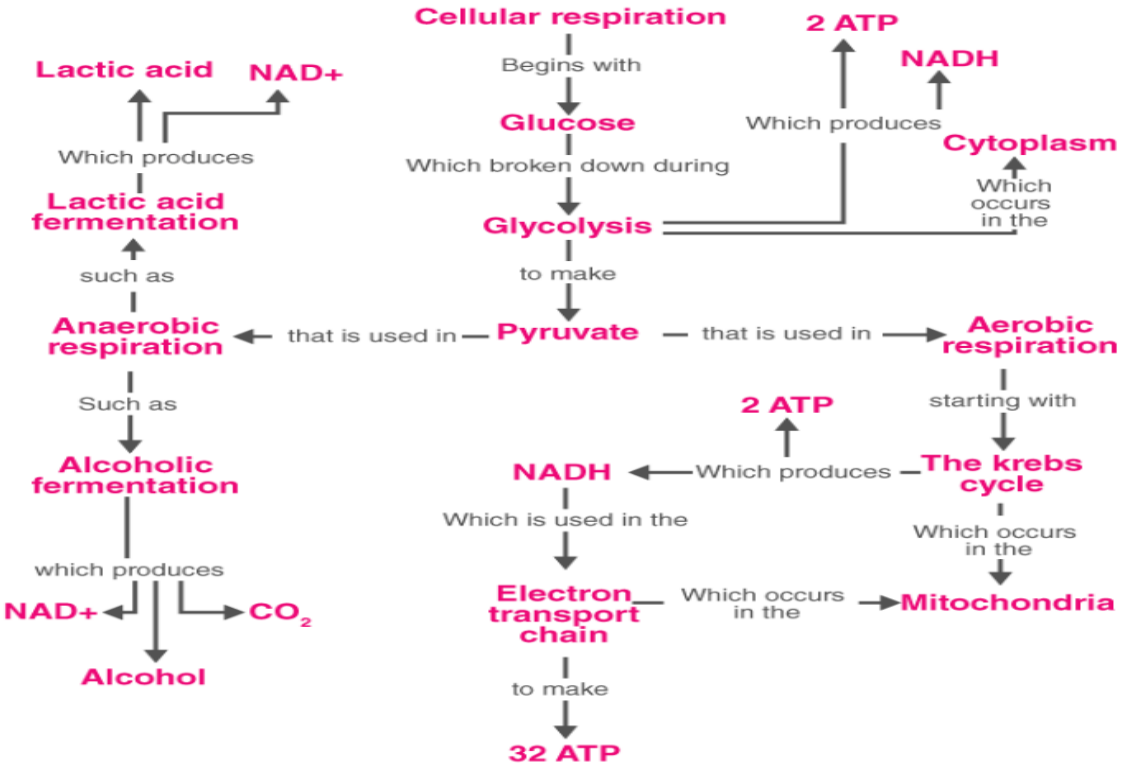
4. Respiratory quotient of organic acid = more than 1

*****Significance of Respiratory quotient: -**

a) Type of respiratory substrate can be known.

b) Condition of organism; whether normal nutrition or starvation can be known.

MIND MAP



MULTIPLE CHOICE QUESTIONS

1. All living organisms need energy for the following life activities:-

(i)Absorption (ii)Transport (iii)Movement (iv)Reproduction

a. Only ii b. ii and iii c. i and iv d. i, ii, iii & iv

2. Organism which can convert light energy into chemical energy is / are

a. Green plants b. Cyanobacteria c. Fungi d .Green plants and cyanobacteria

3. The process of breakdown of food materials within the cell to release energy is termed

a. Photosynthesis b. Cellular respiration c. Combustion d. Digestion

4. During oxidation of organic compounds the bonds that undergo breakdown

a. C-O b. S-S c. C-H d. C-C

5. Select the correct sequential order of oxidation of respiratory substrate in a typical cell in an animal depending on its availability

a. Proteins→ Fats→ Carbohydrates b. Fats→ Carbohydrates → Proteins

c. Carbohydrates→ Fats→ Proteins d. Fats→ Proteins → Carbohydrates

6. Read carefully the following statement relating to respiration. Choose the CORRECT statement.

(i)Energy is not released in a single-step during oxidation of respiratory substrate.

(ii)Energy is released in a single step during oxidation of respiratory substrate.

(iii)Energy released is trapped in form of ADP.

(iv)Organic molecules produced during respiration are used as precursors for synthesis of other molecules.

a. i and iii b. iii and iv c .ii and iv d i and iv

7. Structures which help in exchange of gases in woody tree trunks

a. Stomata b. Hydathodes c. Lenticels d. Tree wound.

8. In glycolysis, which takes place

a. Glucose is partially oxidized in presence of oxygen.

b. Glucose is completely oxidized in absence of oxygen.

c. Glucose is partially oxidized in absence of oxygen.

d. Glucose is completely oxidized in absence of oxygen.

9. Invertase enzyme catalyses the following reaction.

a. Maltose is broken down into two molecules of glucose.

b. Glucose is converted into glucose-6-phosphate

c. Sucrose is converted into maltose and glucose.

d. Sucrose is converted into glucose and fructose.

10. Conversion of Glucose-6-phosphate to Fructose-6-phosphate is termed as

a. Isomerisation b. Phosphorylation c. Hydration d. Oxidation

11. ATP synthesis occurs in which of following steps during glycolysis: -

a. Glucose converted into Glucose-6-phosphate, & Fructose-6-phosphate into Fructose-1.6-phosphate

b. Fructose 1,6-phosphate is split into PGAL and DHAP

c.1.3Bisphosphoglyceric acid into 3-Phosphoglyceric acid and Phosphoenol pyruvate into pyruvic acid.

d.Glucose-6-phosphate converted into Fructose-6-phosphate and PGAL into 1,3 Bisphosphoglyceric acid.

12. Conversion of 1.3 Bisphosphoglycerate to 3-Phosphoglycerate is catalysed by enzyme

a. Enolase b. Phosphoglyceromutase c. Hexokinase d. Aldolase

13. In which of following pathways does pyruvate produces during glycolysis, undergo further degradation

a. Lactic acid fermentation and Aerobic respiration

b. Aerobic respiration and Lactic acid fermentation

c. Alcoholic fermentation and Aerobic respiration

d. Lactic acid fermentation, Alcoholic fermentation and Aerobic respiration.

14. Site of glycolysis in a cell is

a. Mitochondria b. Cytoplasm c. Vacuole d. Endoplasmic reticulum.

15. The conversion of pyruvic acid into acetyl CoA is termed as

a. decarboxylation b. Oxido-reduction c. Dehydration d. Oxidative decarboxylation.

16. Acetyl CoA reacts with this molecule as it enters TCA cycle

a. Oxaloacetic acid b. Phosphoglyceric acid c. Malic acid d.Citric acid.

17. Reaction of Acetyl CoA with oxaloacetic acid is catalyzed by enzyme

a. Aconitase b. Citrate synthase c. Fumarase d. Malate dehydrogenase.

18. At how many steps in TCA cycle NAD+ is reduced to $NADH+H^+$

a. 1 b. 2 c. 3 d. 4

19. The site of TCA cycle is

a. Cytoplasm b. Mitochondrial Matrix c. Intermembranial space d. Inner mitochondrial membrane.

20. Identify the correct step of decarboxylation during TCA cycle.

a. Succinic acid to Malic acid b. Citric acid to α-Ketoglutaric acid

c. Malic acid to oxaloacetic acid d. None of these.

21. Number of molecules of ATP are produced by the complete oxidation of one molecule of Acetyl CoA is

a.30 b.24 c.18 d.12

22. Electron transport system (ETS) is present in

a. Mitochondrial matrix b. Inner mitochondrial membrane

c. Outer mitochondrial membrane d. Cristae.

23. A protein which acts as a mobile carrier to transfer electron between Complex III and Complex IV.

a. cytochrome bc_1 b. cytochrome a

c. cytochrome a_3 d. cytochrome c

24. Match column I with column II

	COLUMN I		**COLUMN II**
i	Complex I	1	Succinic dehydrogenase
ii	Complex II	2	Cytochrome bc complex
iii	Complex III	3	Cytochrome c oxidase
iv	Complex IV	4	NADH dehydrogenase

a. i-4, ii-1 , iii-2, iv-3 b. i-1, ii-2, iii-3 , iv-4

c. i-4, ii-2, iii-1, iv-3 d. i-4, ii-3, iii-2, iv-1

25.Match column I with column II

	COLUMN I		**COLUMN II**
i	F1 Particle	1	Hydroden acceptor
ii	Electron acceptor	2	Acetyl CoA
iii	Oxidative phosphorylation	3	ATP synthetase
iv	Molecular oxygen	4	Cytochrome c

a. i-3, ii-1, iii-4, iv-2 b. i-1, ii-2, iii-4, iv-2

c. i-2, ii-4, iii-1, iv-3 d. i-3, ii-4, iii-2, iv-1

26. Number of ATP molecule produced during oxidation of one molecule of $NADH+H^+$ is

a. Two b. Three C. One d. Five

27. In aerobic respiration, oxygen acts as final acceptor of

a. Carbon b. Sodium C. Proton d. Hydrogen.

28. Structures attached on cristae in mitochondria are

a. F2-F1 Particle b. F1-F0 Particle c. B1 Particle d. B0-B1 Particle.

29. Choose the correct statements from the following: -

1. Movement the $2H^+$ from intermembranial space to matrix is against the electrochemical proton gradient.

2. NADH is oxidized to NAD^+ vigorously during fermentation.

3. Oxidation of one molecule of FADH2 produces 2 ATP molecules.

4. In ETS, Cytochrome oxidase complex contains cytochrome a and a_3.

a. 1&2 b. 2&4 c. 3&4 d. 1&4

30. Given below is a equation of biochemical reaction involving fats, calculate its Respiratory quotient (RQ)

$2(C_{51}H_{98}O_6) + 145\ O_2 \rightarrow 102\ CO_2 + 98\ H_2O + Energy$

a. RQ=145/102 b. RQ=102/98 c. RQ=98/102 d. RQ= 102/145

ANSWER KEY:

Q.No	Answer	Q.No	Answer	Q.No	Answer
1	d	11	c	21	d
2	d	12	b	22	b
3	b	13	d	23	d
4	d	14	b	24	a
5	c	15	d	25	d
6	d	16	a	26	b
7	c	17	b	27	d
8	c	18	c	28	b
9	d	19	b	29	c
10	a	20	b	30	d

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CHAPTER 13: PLANT GROWTH AND DEVELOPMENT

GIST OF THE CHAPTER

Plant growth is a quantitative parameter and refers to an irreversible increase in size and weight of a cell, tissue or organ.

Plants are capable of growing throughout their life due to meristematic tissue present in plants.

Growth can be measured by an increase in cell number, length, area, volume and dry or wet weight.

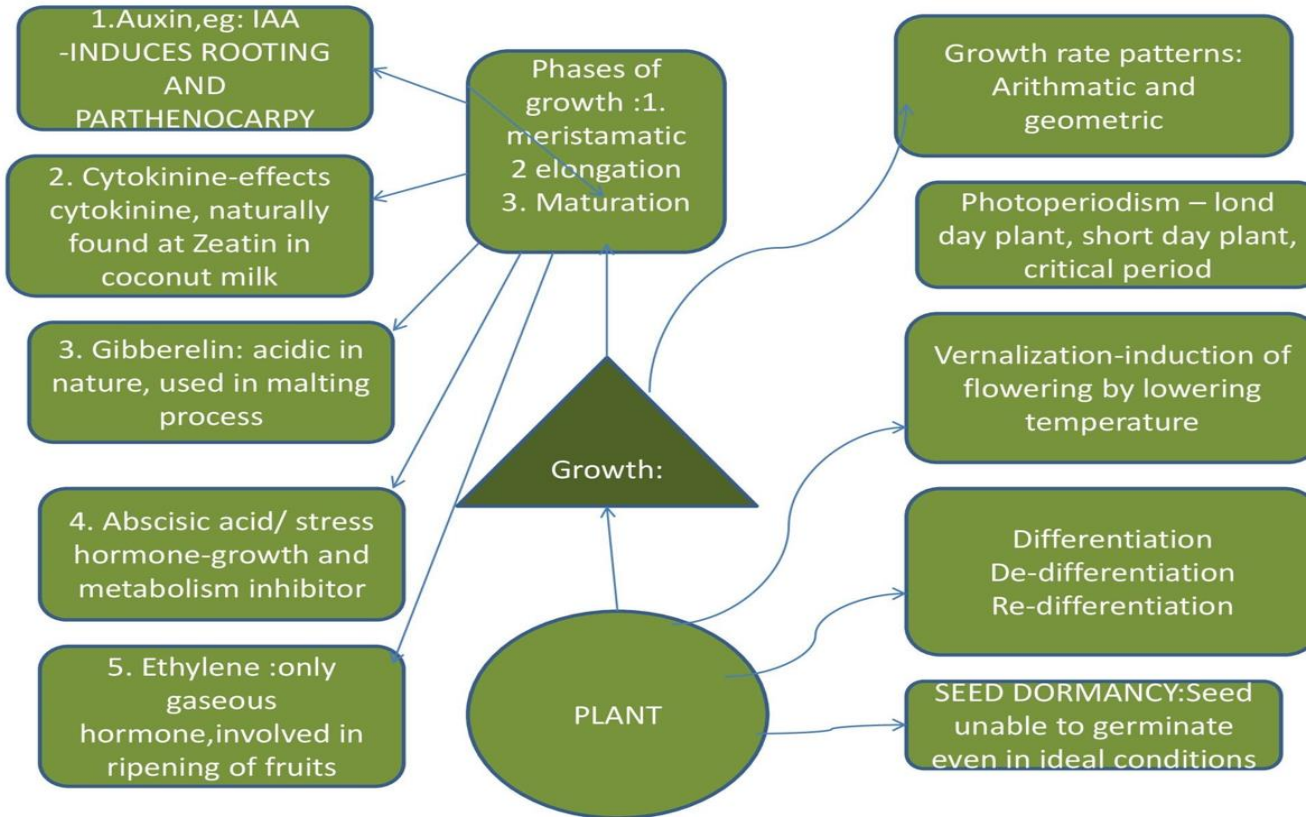
Primary growth-Apical meristem of root and shoot is responsible for primary growth. Secondary growth- it is due to lateral meristem ex. vascular cambium and cork cambium. The plant increase in girth due to secondary growth.

Cell division in root and shoot apical meristem, the growth could be arithmetic or geometric. They are three main phases of growth-lag phase, log phase and senescent phase.

A differentiated cell may differentiate and then redifferenciate , since differentiation in plant is open, the development is flexible i.e., the development is the sum of growth and differentiation. Plants exhibit plasticity in development ex., coriander.

Plant growth regulators (PGR) are chemicals used to modify plant growth increasing plant growth, suppressing shoot growth, increasing bloom, altering fruit maturity etc., Auxin, gibberellins, cytokinin, ethylene and abscisic acid, all phytohormones function individual and as well as the synergetic action of hormone together.

MIND MAP



MULTIPLE CHOICE QUESTIONS

1) Which of the following meristem is not responsible for the secondary growth of plants?

a) Lateral meristem

b) Vascular cambium

c) Apical meristem

d) Cork cambium

2) Seed dormancy is triggered by

a) Indole 3 acetic acid

b) Abscic acid

c) NAA

d) IBA

3) The plant hormone ina a gaseous state

a) auxin

b) cytokinin

c) gibberellins

d) Ethylene

4)What is the primary function of cytokinin in plant growth and development?

a) Inhibiting stem elongation

b) Promoting cell division and lateral bud growth

c) Enhancing root development

d) Inducing leaf senescence

5)What is the first step in the process of plant growth?

a) seed fermentation

b) seed desiccation

c) seed germination

d) seed dormancy

6)Which of the following is the most fundamental characteristic feature of a living being?

a) Growth

b) Differentiation

c) Increase of plant height

d) Increase of width of plant

7) Which plant hormone plays a crucial role in the formation and shedding of leaves and fruits?

a) auxin

b) gibberellins

c) Ethylene

d) Abscisic acid

8)The phenomenon of bending of a plant towards a source of light is known as

a) Gravitropism

b) phototropism

c) thigmotropism

d) hydrotropism

9)Which plant hormone is responsible for the closure of stomata during water stress to prevent water loss?

a) auxin

b) gibberellins

c) ethylene

d) abscisic acid (ABA)

10) What is the role of gibberellins in plant growth and development?

a) Inhibiting seed germination

b) promoting stem elongation and flowering

c) Inducing leaf abscission

d) Enhancing root growth

11) Which plant hormone is responsible for the closure of stomata during water stress to prevent water loss?

a) auxin

b) gibberellins

c) ethylene

d) abscisic acid

12) Typical plant growth shows---------- curve.

a) J shaped curve

b) S-shaped curve

c) I –shaped curve

d) parabolic growth

13) Which growth hormone accelerate the malting process in brewing industry?

a) auxin

b) gibberellins

c) ethylene

d) cytokinin

14) The hormone which controls cell division and cell differentiation

a) cytokinin

b) auxin

c)Abscisic acid

d) gibberellins

15) Which one of the following generally act as an antagonistic to gibberellin?

a) ABA

b) zeatin

c) ethylene

d) IAA

16) Which one of the following is a natural growth inhibitor?

a) ABA

b) GA

c) NAA

d) IAA

17) The first hormone isolated from human urine

a) gibberellins

b) auxin

c) cytokinin

d) abscisic acid

18) The formation of interfasicular cambium in plant is due to

a) non-differentiation

b) re-differentiation

c) differentiation

d) de-differentiation

19) Growth can be measured in various ways. which of these can be used as parameter to measure growth?

a) increase in cell number

b) increase in cell size

c) increase in length and weight

d) all the above

20) All the following plants are biennials except

a) sugar beet

b) cabbage

c) carrot

d) wheat

21) The PGR used to induce parthenocarpy in tomatoes is

a) auxin

b) giggerllin

c) cytokinin

d) ABA

22) Heterophyllous growth due to environment is an example of

a) sigmoidal growth

b) senescence

c) plasmatic growth

d) plasticity

23) Which of the following is the site of perception of light/dark in plants/

a) root apex

b) shoot apex

c) leaves

d) flower

24)What causes a green plant exposed to light on only one side to bend towards the source of light as it grows?

a) green plant needs light to perform photosynthesis

b) green plants need light because they are phototropic

c) light stimulate plant cells on the lighted side to grow faster

d) auxin accumulated on the shaded side stimulating greater cell elongation

25) Foolish seedling disease of rice led to the discovery of

a) GA

b) ABA

c) 24-D

d) IAA

26) Vernalization is the process of

a) flower induction by high temperature treatment

b) inhabitation of flowering by low temperature treatment

c) flower induction by light treatment

d) accerlation of the ability of plant to produce flowers by chilling treatment

27) Which of the following plant growth hormone increase the yield of sugar by increasing the length of stem in sugarcane/

a) cytokinin

b) ethylene

c) gibberellic acid

d) auxin

28) A physiological response of plants to the duration of light and darkness is

a) daily phase cycle

b) circadian rhythm

c) biological clock

d) photoperiodism

29) Which hormone promote more female flowers in cucumber?

a) ethylene

b) auxin

c) cytokinin

d) gibberellins

30) Bolting

a) Internodal elongation just prior to flowering

b) reduction in stem length just prior to flowering

c) reduction in stem length just after flowering

d) reduction in stem length just prior to flowering

ANSWER KEY

Q.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A.	c	b	d	b	c	a	c	b	d	b	d	b	b	a	a
Q.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
A.	a	b	b	d	d	a	d	d	d	a	d	c	d	a	a

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CHAPTER 14: BREATHING AND EXCHANGE OF GASES

GIST OF THE CHAPTER

Breathing: (External respiration) the process of exchange of O2 from the atmosphere with CO2 produced by the cells.

RESPIRATORY ORGANS:

Direct respiration by diffusion from the environment – sponges, coelenterates, flat worms etc.

Cutaneous or by skin – earthworm.

Tracheal system – insects.

Gills – aquatic arthropods mollusks

Lungs – terrestrial forms.

HUMAN RESPIRATORY SYSTEM:

External nostril opens into the nasal chamber through nasal passage.

- The nasal chamber opens into the nasopharynx.
- Nasopharynx opens through glottis of the larynx into the trachea.
- Larynx is a cartilaginous box which produce sound hence called sound box.
- Cartilaginous epiglottis covers the glottis during swallowing to prevent entry of food into trachea.
- Trachea is a straight tube extending up to themed-thoracic cavity, which divides into right and left primary bronchi at the level of 5th thoracic vertebra.
- Each bronchus undergoes repeated divisions to form the secondary and tertiary bronchi and bronchioles ending up in very thin terminal bronchioles.
- Trachea, primary, secondary and tertiary bronchi and initial bronchioles are supported by cartilaginous rings.
- Each terminal bronchiole gives rise to a number of very thin, irregular-walled and vascularised bags like structures called alveoli.
- The branching network of bronchi, bronchioles and alveoli comprises the lungs.
- There are two lungs which are covered by a double layered pleura, with pleural fluid in them.
- Lungs are situated in the thoracic chamber which is anatomically a air tight chamber.

The thoracic chamber is formed –

- Dorsally by vertebral column.
- Ventrally by sternum.
- Laterally by ribs.
- On the lower side by dome shaped diaphragm.

Respiration involves in following steps –

- Breathing or pulmonary ventilation by which atmospheric air is drawn in and CO2 rich alveolar air is released out.
- Diffusion of gases (O2 and CO2) across alveolar membrane.
- Transport of respiratory gases by blood.
- Diffusion of O2 and CO2 between blood and tissues.
- Utilization of O2 by the cells for catabolic reactions and resultant release of CO2.

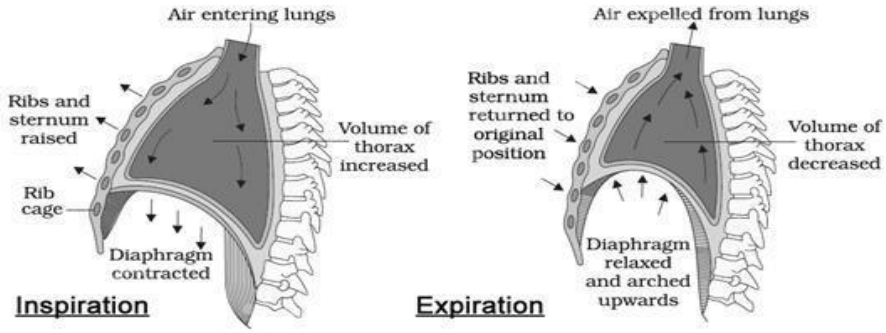
MECHANISM OF BREATHING:

Inspiration:

- Intake of atmospheric air into the lungs.
- It occurs if the pressure within the lungs (intra-pulmonary pressure) is lower than the atmospheric pressure.
- Contraction of diaphragm which increases the volume of thoracic chamber in the
- anterior posterior axis.
- The contraction of external intercostals muscles lifts up the ribs and the sternum causing an increase in the volume of thoracic chamber in the dorso ventral axis.
- It causes an increase in pulmonary volume decrease the intra-pulmonary pressure to less than the atmospheric pressure.
- It forces the air out side to move in to the lungs, i.e, inspiration.

Expiration:

- Relaxation of diaphragm and inter-costal muscles returns the diaphragm and sternum to their normal positions and reduce the thoracic and pulmonary volume.
- It increases in intrapulmonary pressure slightly above the atmospheric pressure.
- It causes the expulsion of air from the lungs, i.e, expiration.
- A healthy man breathes 12-16 times/minutes.
- The volume of air involved in breathing is estimated by spirometer.



Respiratory Volumes and Capacities :

- Tidal volume: volume of air inspired or expired during a normal breathing. It is about 500 ml.
- Inspiratory reserve volume: Additional volume of air, a person inspire by a forceful inspiration. It is about 2500-3000 ml.

- Expiratory reserve volume: Additional volume of air, a person expires by a forceful
- expiration. It is about 1000-1100 ml.
- Residual volume: Volume of air remaining in the lungs even after a forceful expiration. It is about 1200 ml.
- Inspiratory capacity: it includes tidal volume and Inspiratory reserve volume.
- Expiratory capacity: it includes tidal volume and expiratory reserve volume.
- Functional residual capacity: This includes ERV+RV.
- Vital capacity: IRV + TV + ERV.

EXCHANGE OF GASES :

- Alveoli are the primary site of exchange of respiratory gases.
- Exchange of gases also takes place between blood and tissues.
- Exchange of O2 and CO2 take place in the pressure gradient, by simple diffusion.
- Pressure contributed by an individual gas in a mixture of gases is called the partial pressure and is represented by pO2 for oxygen and pCO2 for carbon dioxide.

Diffusion of O2

- pO2 in alveolar air = 104 mm Hg.
- pO2 in venous blood = 40 mm Hg.
- O2 diffuses from alveoli to venous blood.

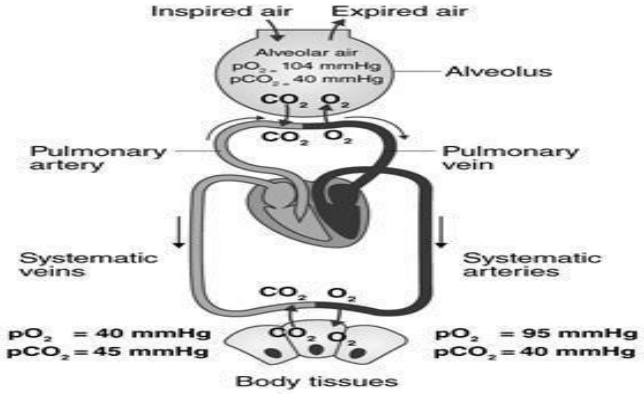
Diffusion of CO2

- pCO2 is venous blood = 45 mm Hg.
- pCO2 is alveolar air = 40 mm Hg
- CO2 diffuses from venous blood to alveoli.

Solubility of CO2 is 20-25 times higher than that of O2; the amount of CO2 that can diffuse through the diffusion membrane per unit difference in partial pressure is much higher compared to that of O2.

Respiratory membrane is formed by;

- Thin Squamous epithelium of the alveoli.
- Endothelium of alveolar capillaries
- Basement membrane between them.



TRANSPORT OF GASES :

- Blood is the medium of transport of O2 and CO2.
- About 97 per cent of O2 is transported by RBCs in the blood.
- 3 per cent of O2 is transported in the plasma in dissolved state.
- 20-25 per cent of CO2 transported in the RBC in the form of carbamino-haemoglobin.
- 70 percent CO2 carried as bicarbonate ion in plasma.
- 7 percent CO2 transported in dissolved state in plasma.

Transport of Oxygen :

- Haemoglobin is red coloured pigment present in the RBC.
- O2binds with haemoglobin reversibly to form oxy-haemoglobin.
- Each haemoglobin can binds maximum with four O2 molecules.
- Binding of Oxygen with haemoglobin is primarily related with partial pressure of O 2.
- Partial pressure of CO2, hydrogen ion concentration (pH) and temperature are the factors that influence this binding.
- A sigmoid curve is obtained when percentage of saturation of haemoglobin with O2 is plotted against the partial pressure of O2 (pO2). This curve is called oxygen dissociation curve.

Condition favourable for binding of haemoglobin with O2 at alveolar level;

- High pO2
- Low H^+ ion concentration.
- Low temperature.

Condition favourable for dissociation of HbO2 into Hb and O2 at tissue level;

- Low pO2
- High H^+ ion concentration.
- High temperature.

Every 100 ml of oxygenated blood can deliver around 5 ml of O2 to the tissues under normal physiological conditions.

Transport of Carbon dioxide:

- 20-25 percent of CO2 is carried out in the RBC by binding with the free amino group of haemoglobin by formation of carbamino-haemoglobin. When pCO2 is high and pO2 is low as in the tissues, more binding of CO2 occurs whereas, when the pCO2 is low and pO2 is high as in the alveoli, dissociation of CO2 from carbamino- haemoglobin takes place.
- 70 per cent of CO2 transported in the form of HCO3- in the plasma.
- CO2 from the tissue diffused into the plasma and along with the water it forms carbonic acid which dissociated into HCO3- and H^+. This reaction is catalysed by an enzyme called carbonic anhydrase present in the plasma membrane of RBC and plasma.

$$CO_2 + H_2O \xleftrightarrow{\text{Carbonic anhydrase}} H_2CO_3 \xleftrightarrow{\text{Carbonic anhydrase}} HCO_3^- + H^+$$

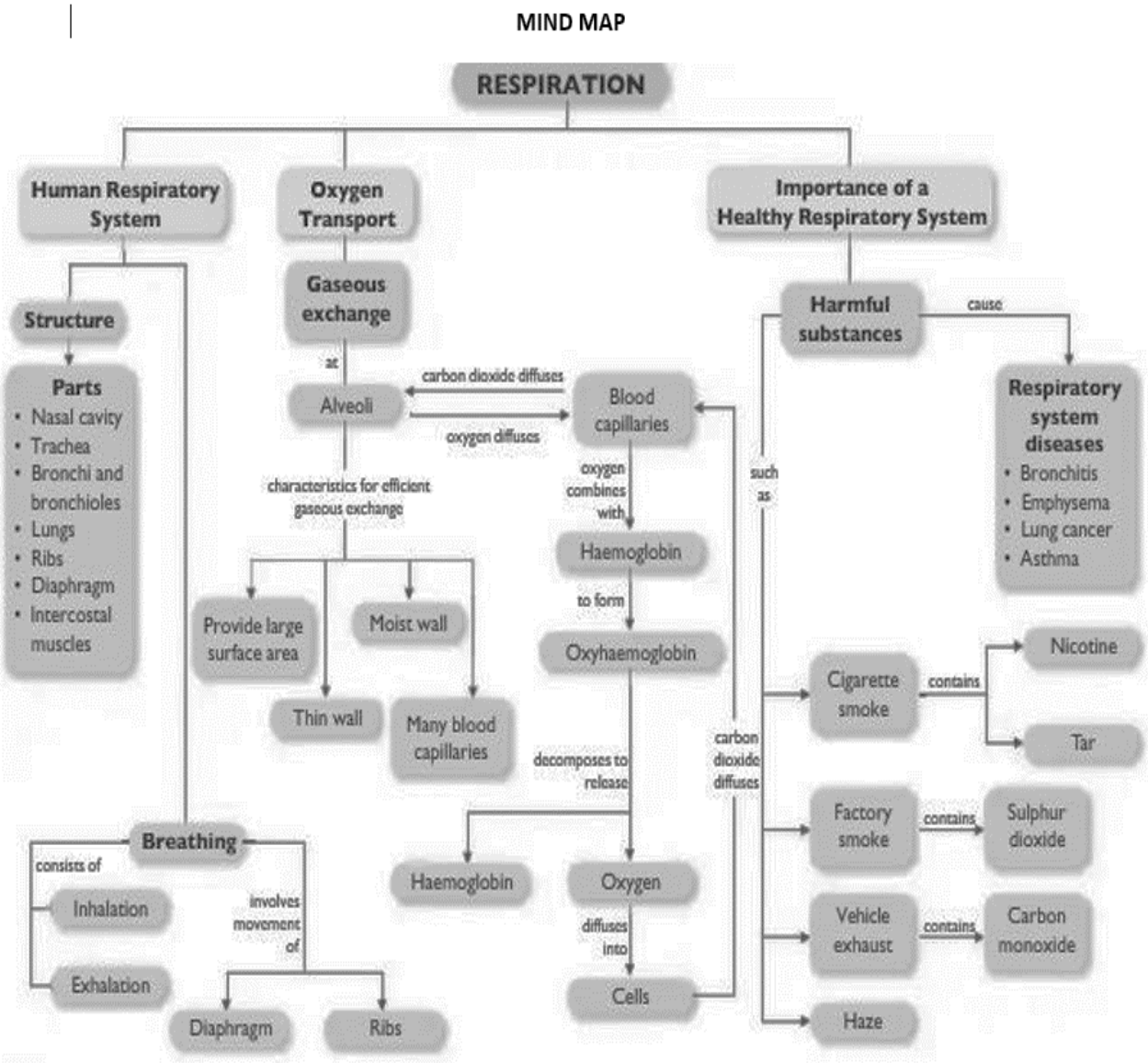
REGULATION OF RESPIRATION:

- Specialized centre present in the medulla region of the brain called respiratory rhythm centre is primarily responsible for regulation of breathing.
- Pneumotaxis centre of pons region of brain has moderate regulation.
- Neural signal from this centre can reduce the duration of inspiration and alter the rate of respiration.
- Chemo sensitive area adjacent to rhythm centre is sensitive to CO2 and H^+ ion.
- Receptors associated with aortic arch and carotid artery also can recognize changes in the CO 2 and H^+ concentration and send necessary signals to the rhythm centre for remedial actions.

DISORDERS OF REPIRATORY SYSTEM:

- Asthma: is a difficulty in breathing causing wheezing due to inflammation of bronchi and bronchioles.
- Emphysema: a chronic disorder in which alveolar walls are damaged due to which respiratory surface is decreased. It caused due to smoking.

MIND MAP



MULTIPLE CHOICE QUESTIONS

1. Haemoglobin that is bonded to carbon monoxide and therefore cannot transport oxygen, is called

   A) carboxyhaemoglobin

   B) methaemoglobin

   C) reduced haemoglobin

   D) carbaminohaemoglobin

2. CO_2 dissociates from carbaminohaemoglobin when

   A) CO_2 is high and pO_2 is low

   B) pO_2 is high and pCO_2 is low

   C) pCO_2 and pO_2 are equal

   D) None of the above

3. Mark the correct pair of muscles involved in the normal breathing in humans

   A) External and internal intercostal muscles

   B) Diaphragm and abdominal muscles

   C) Diaphragm and external intercostal muscles

   D) Diaphragm and intercostal muscles

4. It is known that exposure to carbon monoxide is harmful to animals because

   A) It reduces CO_2 transport

   B) It reduces O_2 transport

   C) It increases CO_2 transport

   D) It increases O_2 transport

5. Which of the following is entirely made of cartilage?

   A) Nasal septum

   B) Larynyx

   C) Glottis

D) Trachea

6. Respiration in mature mammalian erythrocytes are

A) Linear

B) Absent

C) Anaerobic

D) Aerobic

7. In cockroaches, inspiration occurs with

A) Relaxation of tergo-sternal muscles

B) Relaxation of abdominal muscles

C) Neither (1) nor (2)

D) Both (1) and (2)

8.Laryngeal prominence is also known as

A) Adams apple

B) Epiglottis

C) Thyroids

D) Laryngitis

9. The number of alveoli in human lungs is estimated to be around

A) 150 million

B) 500 million

C) 800 million

D) 1billion

10.Earth worm breathe through their

A) Pores on its anterior end

B) Head

C) Skin

D) Lungs

11. Gaseous exchange is held by _____

A) osmosis

B) simple diffusion

C) facilitated diffusion

D) co-transport

12. What is the primary site for exchange of gases in lungs?

A) Larynx

B) Trachea

C) Alveoli

D) Bronchi

13. Solubility of carbon dioxide is _____ than oxygen.

A) more

B) less

C) 50 times more

D) equal

14. What is the concentration of oxygen in expired air?

A) 19%

B) 4%

C) 10%

D) 16%

15. Partial pressure of oxygen in alveolar air is _____

A) 159 mm Hg

B) 90 mm Hg

C) 104 mm Hg

D) 45 mm Hg

16. On which of the following factors diffusion does not depend?

A) Solubility of gases

B) Thickness of the respiratory membrane

C) Partial pressure difference

D) Molecular weight of gases

17. Which one of the following does not consist diffusion membrane?

A) Thin squamous epithelium of alveoli

B) Cuboidal epithelium of alveoli

C) Basement membrane

D) Endothelium of blood capillaries

18.What is the partial pressure of carbon dioxide in alveolar air and in deoxygenated blood respectively?

A) 50 mm Hg, 45 mm Hg

B) 104 mm Hg, 45 mm Hg

C) 45 mm Hg, 40 mm Hg

D) 40 mm Hg, 45 mm Hg

19. Right comparison of partial pressure of oxygen and partial pressure of carbon dioxide in the atmospheric air than in alveolar air is _____

A) partial pressure of oxygen lesser, partial pressure of carbon dioxide higher

B) partial pressure of oxygen higher, partial pressure of carbon dioxide lesser

C) partial pressure of oxygen lesser, partial pressure of carbon dioxide higher

D) partial pressure of oxygen lesser, partial pressure of carbon dioxide lesser

20.Which group of animals exchange gases through their entire body surface?

A) Insects B) Fishes C) Flatworms D) Reptiles

21. What respiratory structure is found in most aquatic arthropods and molluscs?

A) Tracheal tubes B) Gills C) Lungs D) Moist skin

22.Which group of animals primarily relies on cutaneous respiration?

A) Insects B) Fishes C) Amphibians D) Reptiles

23.What respiratory organs do terrestrial forms use for gas exchange?

A) Gills B) Tracheal tubes C) Lungs D) Moist skin

24.Respiration is helpful in

A) Removing waste from the body

B) Producing energy with in the body

C) Production of protein

D) Production of carbohydrates

25.The surface from which the exchange of gas takes place is called?

A) Plasma surface

B) Respiratory surface

C) Respiration surface

D) Gaseous surface

26.Sound production in humans is controlled by

A) Epiglottis B) Lungs C)Larynx D)Pharynx

27.During exhalation the diaphragm moves

A) Apart B) Downwards C) Upwards D) Inwards

28.Bronchitis is a

A) Bacterial infection B) Viral infection

C) Protozoan infection D) Fungal infection

29.The muscle take part in rapid breathing

A) Muscle of rib cage

B) Muscle of neck region and abdominal region

C)Thoracic and abdominal muscles of neck region and thoracic region

D)Muscles of neck region and thoracic region.

30.The function of pneumotoxic centre is

A) To regulate inhalation

B) To maintain rhythmicity of respiration

C) Increases rate of exhalation

D) Does not play significant role

ANSWERS KEY

Q.NO	ANSWERS	Q.NO	ANSWERS	Q.NO	ANSWERS
1	A	11	B	21	B
2	B	12	C	22	C
3	D	13	A	23	C
4	B	14	D	24	B
5	B	15	C	25	B
6	C	16	D	26	C
7	D	17	B	27	C
8	A	18	D	28	A
9	B	19	B	29	B
10	C	20	C	30	A

PREPARED BY MR C CHELLAPANDIAN

PGT BIOLOGY, ANNA NAGAR, CHENNAI

CHAPTER 15: BODY FLUIDS AND CIRCULATION

GIST OF THE CHAPTER

Functions of the circulatory system:

- It transports nutrients from their sites of absorption to different tissues and organs for storage, oxidation or synthesis of tissue components.
- It also carries waste products of metabolism from different tissues to the organs meant for their excretion from the body.
- It transports respiratory gases between the respiratory organs and the tissues.
- It carries metabolic intermediates from one tissue to another for their further metabolism. For example, blood carries lactic acid from muscles to the liver for its oxidation.
- It also transports informational molecules such as hormones from their sites of origin to the tissues.
- It uniformly distributes water, H^+, chemical substances to all over the body.

Blood Vascular System:

- Higher animals have a well-developed circulatory system so that transport of substances in the body can be done very effectively. In them, the circulatory system consists of a central pumping organ called as heart and various blood vessels (arteries, veins and capillaries).
- Arteries conduct the blood from the heart to other tissues. Veins bring blood from other tissues to the heart. Some of the invertebrates and all vertebrates possess this system.
- The circulatory system was first discovered and demonstrated by William Harvey.
- The blood vascular system may be of two types – the open and the closed circulatory systems.

Open circulatory system:

- In many advanced invertebrates (prawns, insects and molluscs), the blood does not remain confined to blood vessels but it flows freely through the body cavity and channels called lacunae and sinuses in the tissues.
- The body cavity is known as haemocoel and the blood is haemolymph.
- In insects, the tissues are in direct contact with the blood.
- Haemolymph circulates in the whole body due to the contractile activity of heart.

Closed circulatory system:

- In closed circulatory system the blood flows through proper blood vessels named arteries, veins and blood capillaries.
- Arteries within the tissues divide into arterioles which then branch further to form capillaries. Capillaries then unite to form venules which come out of the tissues and veins.
- Arteries have thick, elastic and muscular walls which are made up of three concentric layers (Tunica externa, Tunica media and Tunica intern(A). All these layers have got smooth or involuntary muscles.
- Contraction and relaxation of smooth muscles alter the diameter of arteries and thus regulate the flow of blood through them.
- Capillaries are extremely fine thin blood vessels. The walls of capillaries are made of a single layer of endothelial cells. The muscles and elastic fibres are absent in them. These capillaries are highly permeable to water and small macromolecules. Various nutrients, respiratory gases, metabolites and other substances are exchanged between the blood and

tissues through these capillaries.

- Structurally, veins resemble arteries except the three layers that are very thin and more elastic. In the veins, the muscles and elastic connective tissues are poorly developed but the collagen fibres of the outer layer are very well developed.
- In most of the veins, the middle coat is extremely thin with practically no muscles. In many veins, semilunar valves are present in their lumen. These valves allow the flow of the blood only in one direction *i.e.* towards the heart.

Distinguish between Arteries and Veins:

Arteries	Veins
1. Blood flows away from the heart.	1. Blood flows towards the heart.
2. Blood flows with jerks and with great pressure.	2. Blood flows smoothly and with less pressure.
3. They always carry oxygenated blood except the pulmonary artery.	3. They always carry deoxygenated blood except the pulmonary vein.
4. Lumen of artery is small.	4. Lumen of vein is large.
5. Valves are absent.	5. Semilunar valves are present to prevent the back flow of blood.
6. They are deep seated.	6. They are usually superficial.
7. Their walls are elastic, thick and muscular.	7. Their walls are non-elastic, thin and fibrous.
8. non-collapsible.	8. Collapsible.

The heart:

- The heart is the central pumping organ of the blood vascular system. It is a hollow muscular structure and is made up of cardiac muscles. It works throughout the life rhythmically without getting tired. It is enclosed in a double membranous sac called pericardium which is filled with pericardial fluid.
- Mainly there are two chambers in a heart – Auricle or atrium that receives the deoxygenated blood from various parts of the body and a Ventricle that distributes the oxygenated blood to the body.
- The number of heart chambers varies in different animals.
- In fishes, the heart is only two chambered – one auricle and one ventricle. Both these chambers contain deoxygenated blood.
- In amphibians, the auricle is divided into right and left auricles. The blood after oxygenation from lungs is returned back to left auricle. Right auricle receives deoxygenated blood from various parts of the body. However, in the ventricle there is mixing up of deoxygenated and oxygenated blood.
- In reptiles (except crocodiles), the division of the ventricle also starts but it is not complete. So, the heart is incompletely four chambered. However, there are two auricles (left and right auricles). In them, the oxygenated and deoxygenated blood are kept separate. But in the ventricle, this separation is not perfect.
- Crocodiles, birds and mammals have a complete four-chambered heart. In them, the ventricle septum is complete so that there is no mixing up of oxygenated and deoxygenated blood at all.
- A structure called sinus venosus is present in the hearts of fishes, amphibians and reptiles. It receives deoxygenated blood from anterior and posterior vena cava and then that blood is poured into the heart. There is no sinus venosus in mammals.

Human Heart:

- The mammalian heart including man is a hollow, cone-shaped, muscular structure that lies in the thoracic cavity above the diaphragm and in between the two lungs.
- It is about the size of a fist measuring about 12 cm in length and 9 cm in breadth.
- It weighs about 300 grams. It is a four chambered organ – two atria or auricles and two ventricles.
- Deoxygenated blood is received into right auricle by superior vena cava (from anterior region) and inferior vena cava (from posterior region) of the body. These vena cavae opens directly into right auricle as there is no sinus venosus.
- Right auricle also gets blood from coronary veins (from the heart muscles itself).
- The right and left auricles are separated by inter-auricular septum. Similarly, right and left ventricles are also separated by inter-ventricular septum.
- Deoxygenated blood is then passed from the right auricle to the right ventricle through the atrioventricular aperture guarded by tricuspid valve (having three flaps). The blood is then pumped into lungs for oxygenation via pulmonary artery.
- After oxygenation, the blood is brought back into left auricle via four pulmonary veins. From left auricle, blood (now oxygenate(D) goes to left ventricle through atrioventricular aperture and this opening is regulated by bicuspid (having two flaps) or mitral valve.
- The left ventricle has also got chordae tendinae and papillary muscles which prevent the valves (both bicuspid and tricuspi(D) from being pushed into auricles at the time of ventricular contraction. Thus, the walls of left ventricle are thicker than the walls of right ventricle.
- The oxygenated blood from left ventricle is then distributed to all parts of the body with the help of aorta.
- The openings of the aorta and other major arteries are guarded by semilunar valves that prevent the back flow of blood.

Course of Circulation through Mammalian Heart:

- During a heartbeat, there is contraction and relaxation of auricles and ventricles in a specific sequence. The contraction phase is known as systole while relaxation phase is known as diastole. Various series of events that occur during a heartbeat is known as cardiac cycle.
- When both the auricles and ventricles are in relaxed or diastolic phase then it is referred as joint diastole. During this phase, the blood flows into the auricles from the superior vena cava and inferior vena cava. The blood also flows from the auricles to their respective ventricles through the atrioventricular valve. There is no flow of blood from the ventricles to the aorta and its main arteries as the semilunar valves remain closed in this phase.
- At the end of joint diastole, the next heart beat starts with the contraction of atria (atrial systole). In this phase, it now forces most of its blood into the ventricle which is still in the diastolic phase.
- During auricular systole, the blood cannot pass back into the superior and inferior vena cava because they are compressed by the auricular contraction and their openings to the auricles are blocked. Thus, auricles act as main vessel to collect and pump the venous blood into the ventricles. Thus, at the end of auricular systole, the auricles get empty.
- After the atrial systole is over, the auricular muscles relax and it enters into auricular diastolic phase.
- During auricular diastole, it again gets filled up with the venous blood coming from the superior and inferior vena cava.
- Along with the auricular diastole, the ventricular systole starts. This results in an increased pressure of blood in the ventricle and it rises more than the pressure of blood in the auricle which helps in closing of atrioventricular valves and thus the back flow of blood is prevented.

 The closure of AV-valve at the beginning of ventricular systole produces a sound "lubb" and is known as the first heart sound.

 Initially, when the ventricle starts contracting, the pressure of blood within it is lower than the pressure of blood within the aorta and so the semilunar valves do not open. Therefore, the ventricle contracts as a closed chamber.

 As the ventricular systole progresses more, the pressure of blood within the ventricle increases more than that of aorta as a result the semilunar valves now open and blood flows (with a spee(D) into the aorta and its main branches. The back flow of blood in the auricles is prevented as the AV-valves remain closed. at the end of ventricular systole, ventricular diastole starts.

 As the auricles are still continuing with their diastole, so all the four chambers are now in diastole known as joint diastole.

 In the ventricular diastolic phase, the pressure of blood in the ventricles falls below the pressure of blood in the aorta, so the semilunar valves get closed to prevent the back flow of blood from the aorta to the ventricles.

 The closure of semilunar valves at the beginning of ventricular diastole produces a sound "dup" and is known as the second heart sound.

 After the closure of the semilunar valves, the ventricles become closed chambers again.

 As the ventricular pressure is more than the atrial pressure, so the AV-valves remain closed.

 However, as the ventricular diastole continues, the pressure of blood in the ventricles falls below the pressure of blood in the auricles. At this point, the AV-valves open and blood starts flowing again from the relaxed auricles to the relaxed ventricles.

 Now when the joint diastole is over, the auricular systole starts and the blood is pumped into the ventricles.

Heart Rate and Pulse:

 In the resting condition, human heart beats at the rate of about 70 times per minute. But, the heart beat rate increases during exercise, fever and emotions like anger and fear.

 During each heartbeat, the blood is pumped from the ventricles of the heart into the aorta to be distributed to all parts of the body. This happens during the ventricular systole and is repeated every 0.8 seconds.

 The blood from aorta then goes to other arteries of the body parts causes a rhythmic contraction in the aorta and its main arteries. It can be felt as regular jerks or pulse in the regions where arteries are present superficially like wrist, neck and temples. This is known as arterial pulse.

 The pulse rate is same as that of heart beat rate. The heart beat rate differs from species to species. In general, the smaller the animal, greater the heartbeat. Hence, larger animals have lower heart rates. For example, an elephant has a normal heart beat rate of about 25 times per minute whereas mouse has a normal heart beat rate of several hundred per minute.

Automatic rhythmicity of the heart:

 The mammalian heart is a myogenic heart *i.e.* the heart beat originates from a muscle (but it is regulated by nerves).

 In the right atrium near the region where superior vena cava opens, a specialised muscle called sino-auricular node (S((A)node) is present from where the heart beat originates. It is also called as pace maker and is richly supplied with blood capillaries.

 A wave of contraction (systole) originates from S((A)node and spreads over to the whole heart.

 At the junction of right atrium and right ventricle, a tissue called auriculo-ventricular node (AV- node) is present that picks up the wave of contraction propagated by S((A)node

through bundle of His.

- Branches of the bundle of His spread over the ventricle forming the Purkinje system.
- The wave of contraction spreads over the ventricle through AV-node and its Purkinje system.
- The heart is supplied with Vagus (parasympatheti(C) and sympathetic nerve fibres. The Vagus nerve is inhibitory and when stimulated it slows down the heart beat while the sympathetic nerve is acceleratory and when stimulated it fastens the heartbeat. This happens because these nerves release chemicals (hormones) when stimulated.

Circulation:

- In vertebrates, the heart pumps blood into a closed circulatory system. The left ventricle ejects blood into the aorta which gives off arteries to tissues and organs (except lungs) then the blood is returned from these tissues and organs through two veins (superior and inferior vena cav(A) to the right atrium. This is known as the systemic circulation.
- The right ventricle pumps blood into the pulmonary trunk which divides into pulmonary arteries going to the lungs then blood is returned to the left atrium from the lungs through the pulmonary veins. This is called the pulmonary circulation.
- In some cases, before the blood can finally return to the heart, a vein returning blood from a system of capillaries divides again into a second capillary system in the tissues. Such type of vein is called as portal vein and it constitutes a portal system along with the capillary system to which it supplies blood.
- Veins after collecting deoxygenated blood from the organs normally pour the blood into right auricle. But sometimes, they pour their blood into some other organ by the portal veins before the heart. The blood from that organ is then collected and poured into the heart. For example, a hepatic portal vein returns blood from the intestine and breaks into a portal system of capillaries in the liver. This helps in the absorption of nutrients from the small intestine to reach first into the liver via the hepatic portal vein. The cells of the liver can take up these nutrients.
- Similarly, the blood coming from hypothalamus may be poured into anterior pituitary by a hypophysial portal vein. This portal system enables the hormones of hypothalamus to reach the anterior pituitary.

Arterial Blood Pressure:

- The pumping action of the heart maintains a pressure of blood in the arteries. This is called Arterial blood pressure. It helps to pump blood at a high velocity along the arteries in the closed circulatory system. The blood pressure is far lower in the open circulatory system.

Blood Flow in Veins:

- The blood pressure is low in veins because the blood flows through narrow arterioles and capillaries to enter wider veins. At many places in the body, this blood pressure is not sufficient to drive the blood through the veins back to the heart. Veins have thinner walls than arteries and are more easily compressed. There are also many valves inside the veins. These valves permit the flow of blood in the veins towards the heart and prevent blood flow in the reverse direction.
- Contraction of muscles and changes of body posture compresses the veins to move the blood inside them. During these both cases, blood moves towards the heart only because the venous valves prevent the blood flow in the opposite direction. This is a major process for venous blood flow. For example, if a person stands immobile for a long time, the blood flow in the leg veins remains suspended. This may lead to an accumulation of fluid in his leg tissues and a consequent swelling of his feet. If he walks for some time, the swelling subsides as blood begins to circulate again in the veins.

Lymph and Tissue Fluid:

 It occurs in the spaces in between the cells of a tissue and is called as interstitial fluid or tissue fluid. The exchange of any material (solid, liquid or gas) that occurs between the blood and the tissue cells always takes place through this fluid. Under the pressure of blood in the capillaries, some of the water and desired solutes are filtered out from the blood plasma into the tissue spaces to form the tissue fluid. The composition of this tissue fluid is very similar to the plasma except having much less protein. Proteins are less because some of the proteins are not filtered out from the capillary walls (impermeable).

 Some of the tissue fluid enters tiny channels called lymph vessels and the fluid collected in them is called lymph and this system is known as lymphatic system. These lymph vessels unite to form larger lymph vessels which ultimately drain into two large lymph vessels called thoracic duct and the right lymphatic duct. These open into veins returning the lymph finally into venous blood and so in the general circulatory system. This movement of lymph is mainly due to the squeezing action of the surrounding muscles. So, the lymphatic system is slow and uncertain.

 Exercise increases the rate of lymph circulation. Generally, the rate of lymph formation is equal to the rate of its return to the blood stream but sometimes, the formation rate of lymph exceeds the rate of its return to blood. The increased volume of fluid around the cells then creates a swelling called dropsy or oedema.

Functions of Lymph:

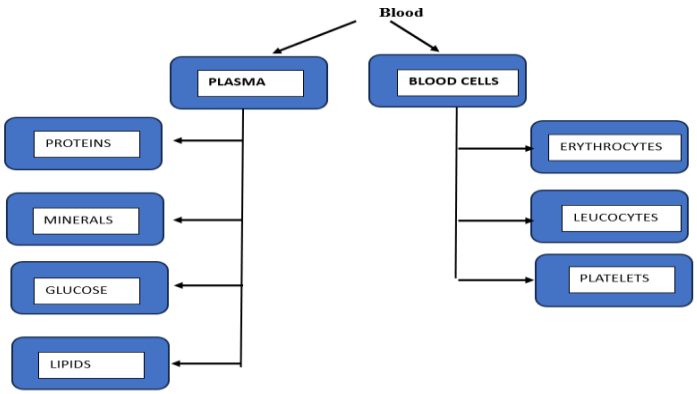
 It serves to return interstitial fluid into blood.

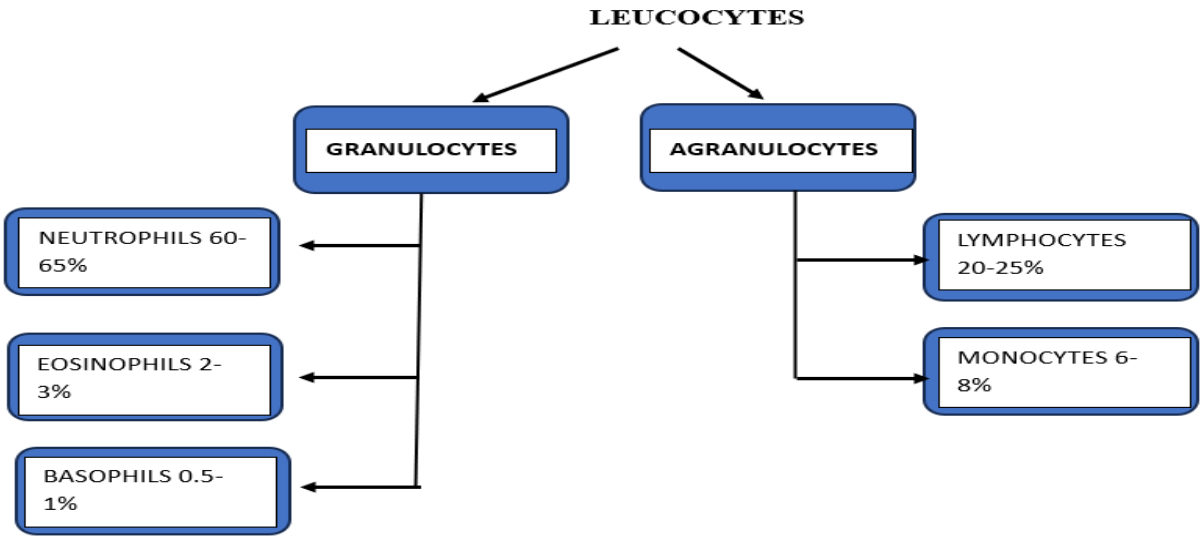
 The plasma proteins macromolecules synthesized by the liver cells cannot pass into the blood vessels but can diffuse into the lymph vessels through their wall and they come to the blood through lymph.

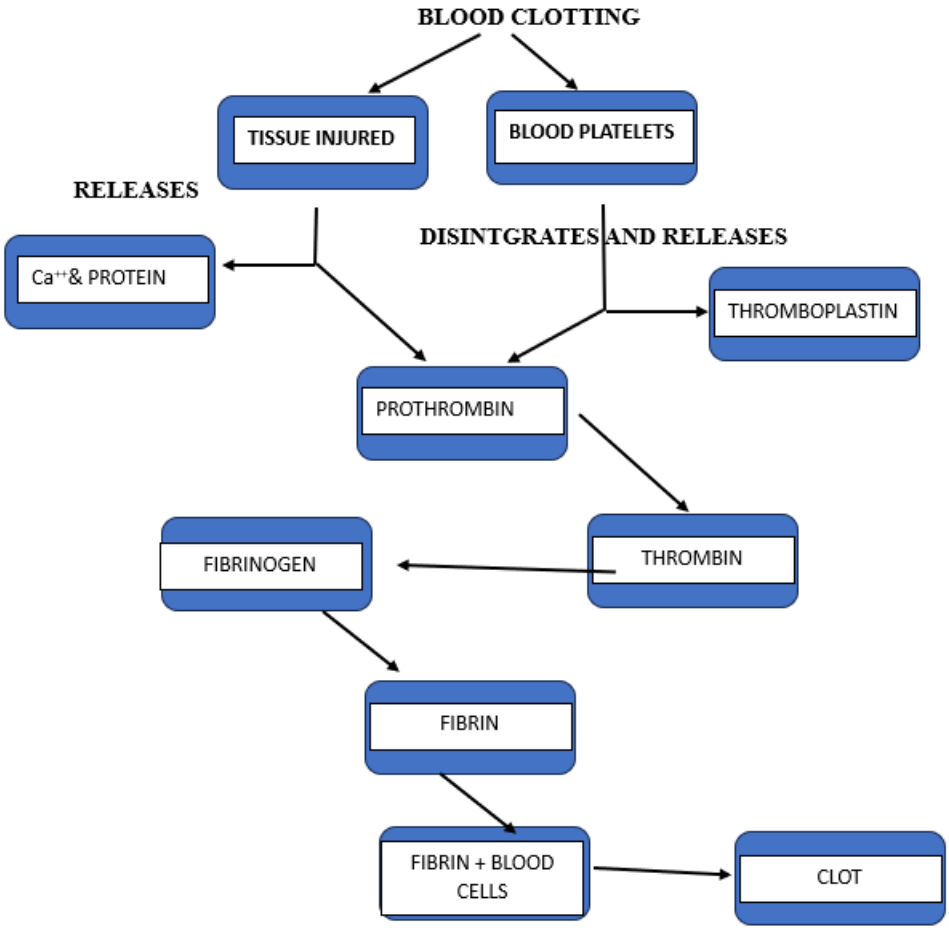
 It also carries absorbed fats and lipids from the small intestine to the blood in the form of chylomicron droplets.

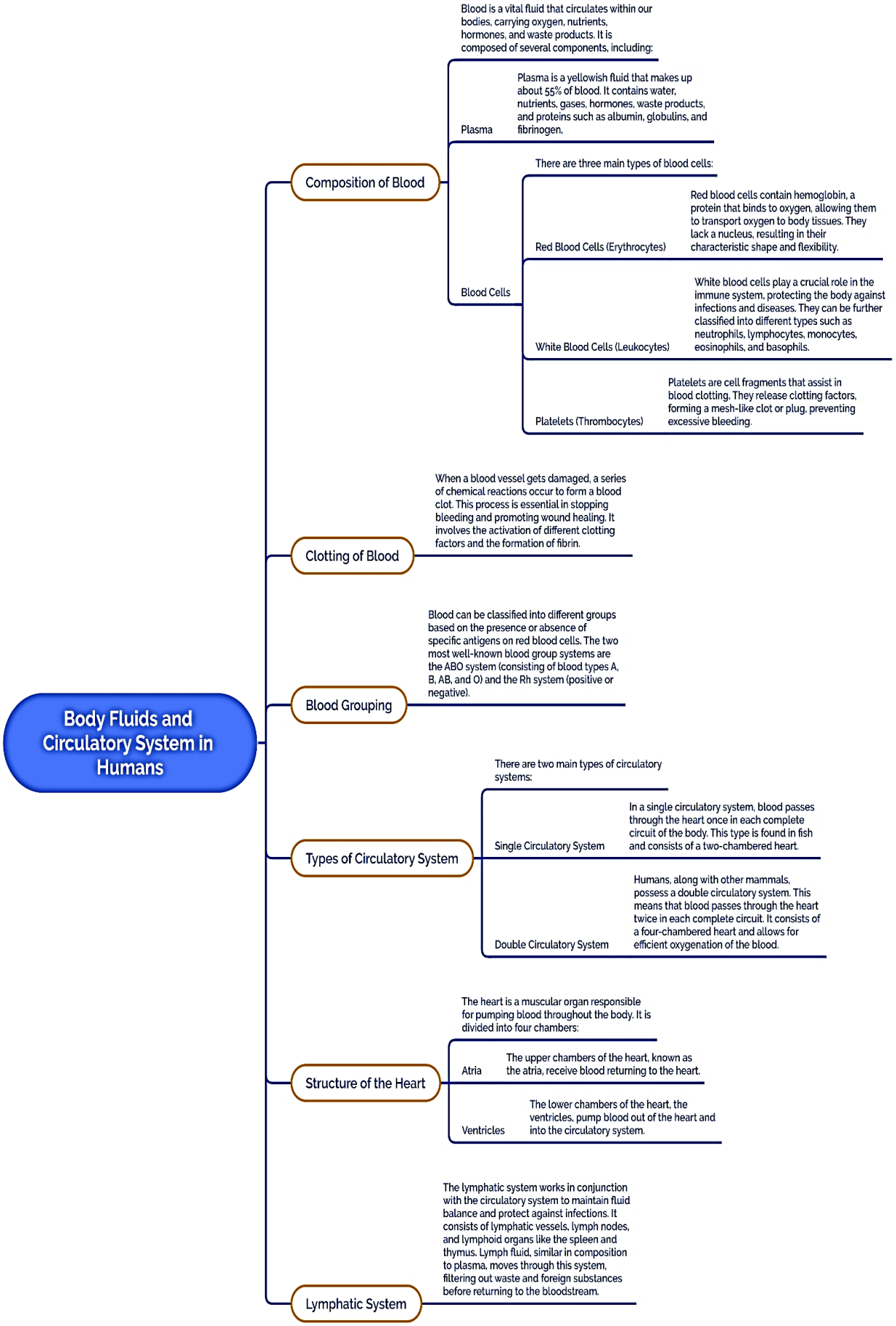
Disorders of Circulatory System:

- ✓ **High Blood Pressure (Hypertension):** It is the term for blood pressure that is higher than normal of 120/80. In the instrument, '120 mm of Hg' is Systolic (pumping) pressure and '80 mm of Hg' is Diastolic (resting) pressure. If repeated check which shows 140/90 and higher shows Hypertension. It may lead to heart diseases and also affect vital organs like brain and kidney.
- ✓ **Coronary Artery Disease (CA(D):** It is also known as Atherosclerosis. It is due to damage in the blood vessels of heart tissues. Basically, it is due to the deposition excess of Calcium, Fat, Cholesterol and Fibrous tissues which makes the lumen of arteries narrower.
- ✓ **Angina:** It is also known as 'Angina pectoris'. Its symptom is acute chest pain which is due to less oxygen supply to heart.
- ✓ **Heart Failure:** It is the state when heart is not pumping blood effectively to other organs of the body.




LEUCOCYTES
GRANULOCYTES
AGRANULOCYTES
NEUTROPHILS 60-65%
EOSINOPHILS 2-3%
BASOPHILS 0.5-1%
LYMPHOCYTES 20-25%
MONOCYTES 6-8%


BLOOD CLOTTING
TISSUE INJURED
BLOOD PLATELETS
RELEASES
DISINTGRATES AND RELEASES
Ca++& PROTEIN
THROMBOPLASTIN
PROTHROMBIN
FIBRINOGEN
THROMBIN
FIBRIN
FIBRIN + BLOOD CELLS
CLOT

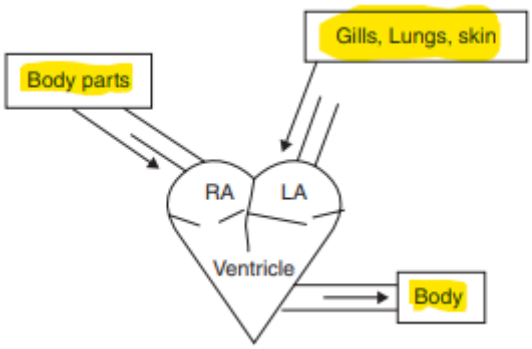

Body Fluids and Circulatory System in Humans
Composition of Blood
Blood is a vital fluid that circulates within our bodies, carrying oxygen, nutrients, hormones, and waste products. It is composed of several components, including:
Plasma
Plasma is a yellowish fluid that makes up about 55% of blood. It contains water, nutrients, gases, hormones, waste products, and proteins such as albumin, globulins, and fibrinogen.
Blood Cells
There are three main types of blood cells:
Red Blood Cells (Erythrocytes)
Red blood cells contain hemoglobin, a protein that binds to oxygen, allowing them to transport oxygen to body tissues. They lack a nucleus, resulting in their characteristic shape and flexibility.
White Blood Cells (Leukocytes)
White blood cells play a crucial role in the immune system, protecting the body against infections and diseases. They can be further classified into different types such as neutrophils, lymphocytes, monocytes, eosinophils, and basophils.
Platelets (Thrombocytes)
Platelets are cell fragments that assist in blood clotting. They release clotting factors, forming a mesh-like clot or plug, preventing excessive bleeding.
Clotting of Blood
When a blood vessel gets damaged, a series of chemical reactions occur to form a blood clot. This process is essential in stopping bleeding and promoting wound healing. It involves the activation of different clotting factors and the formation of fibrin.
Blood Grouping
Blood can be classified into different groups based on the presence or absence of specific antigens on red blood cells. The two most well-known blood group systems are the ABO system (consisting of blood types A, B, AB, and O) and the Rh system (positive or negative).
Types of Circulatory System
There are two main types of circulatory systems:
Single Circulatory System
In a single circulatory system, blood passes through the heart once in each complete circuit of the body. This type is found in fish and consists of a two-chambered heart.
Double Circulatory System
Humans, along with other mammals, possess a double circulatory system. This means that blood passes through the heart twice in each complete circuit. It consists of a four-chambered heart and allows for efficient oxygenation of the blood.
Structure of the Heart
The heart is a muscular organ responsible for pumping blood throughout the body. It is divided into four chambers:
Atria
The upper chambers of the heart, known as the atria, receive blood returning to the heart.
Ventricles
The lower chambers of the heart, the ventricles, pump blood out of the heart and into the circulatory system.
Lymphatic System
The lymphatic system works in conjunction with the circulatory system to maintain fluid balance and protect against infections. It consists of lymphatic vessels, lymph nodes, and lymphoid organs like the spleen and thymus. Lymph fluid, similar in composition to plasma, moves through this system, filtering out waste and foreign substances before returning to the bloodstream.

MULTIPLE CHOICE QUESTIONS

1. The given diagram shows circulation found in

(A) Amphibian (B) Reptiles

(C) Both (a) and (b) (D) Birds



2. Leukopenia is a condition of

(A) Decrease in WBC production (B) Decrease in RBC production

(C) Increase in WBC production (D)Increase in RBC production

3. How Erythroblastosis foetalis (Haemolytic diseases of the new born) can be avoided?

(A) By administering anti-rh-antigen to mother after first delivery

(B) By administering anti-rh-antibodies to mother after first delivery

(C) By administering rh-antigen to mother after first delivery

(D) By administering rh-antibodies to mother after first delivery

4. The other name of Lymph is

(A) Tissue Fluid (B) Middle man of the body

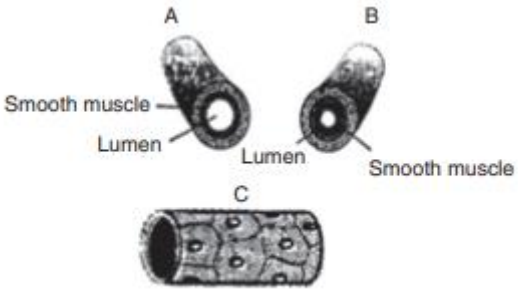
(C) Interstitial fluid (D) All of the above

5. How fats are absorbed through the Lymph?

(A) Lacteals of intestinal villi (B) Chorionic villi

(C) Alveoli (D) Microvilli

6. Identify the following blood vessels.



(A) A-Artery, B-Vein, C- Capillary

(B) A-Capillary, B-Artery, C- Vein

(C) A-Vein, B- Artery, C-Capillary

(D) A- Vein, B- capillary, C- Artery

7. Which component generate the maximum number of action potentials in human Heart?

(A) AV Node (B) AV Bundle (C) Bundle of HIS (D)SA Node

8. The stroke volume multiplied by the heart rate gives to

(A) Cardiac cycle (B) Cardiac input (C) Cardiac output (D) None of the above

9. The end of the T wave of standard ECG represents

(A) End of systole (B) Beginning of systole

(C) End of diastole (D) Beginning of diastole

10. Apart from Heart, high blood pressure affects which parts of human body?

(A) Kidney and liver (B) Brain and pancreas

(C) Lungs and spleen (D) Brain and kidney

11. Asthma disease is related with

(A) Inflammation of bronchi and bronchioles

(B) Inflammation of Alveoli

(C) Inflammation of Diaphragm

(D) Inflammation of Thoracic chamber

12. Intercostal muscles occur in:

(A) Diaphragm (B) Ribs (C) Nasal chamber (D) Larynx

13. Conversion of C02 into H2 CO 3 is carried out by enzyme

(A) Hexokinase (B) Carbonic anhydrase (C) Carboxy peptidase (D)Both a and c

14. 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

15. Spiracle can be observed in

(A) Mollusca (B) Echinodermata (C) Reptiles (D) Arthropoda

16. Which statement is incorrect about haemoglobin

(A) It is a protein

(B) It helps in Oxygen transport

(C) It helps in CO2 transport

(D) It is a triglyceride

17. 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.

18. Assertion: Respiratory rhythm centre is moderated by the Pneumotaxic centre of the of the brain.

Reason: Pneumotaxic centres 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.

19. 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.

20. 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) 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.

21. What is the primary function of blood in the human body?

(A) Transportation of nutrients and oxygen

(B) Regulation of body temperature

(C) Defence against pathogens

(D) All of the above

22. Which component of blood is responsible for oxygen transport?

(A) Red blood cells (B) White blood cells (C) Platelets (D) Plasma

23. What is the approximate volume of blood in an average adult human?

(A) 2 litres (B) 5 litres (C) 8 litres (D) 10 litres

24. Which of the following is not a component of the lymphatic system?

(A) Lymph nodes (B) Lymph vessels (C) Spleen (D) Pancreas

25. In the heart, the right atrium receives blood from which part of the body?

(A) Systemic circulation (B) Pulmonary circulation

(C) Coronary circulation (D) Hepatic circulation

26. What is the role of valves in the circulatory system?

(A) To control the flow of blood (B) To pump blood to the body

(C) To regulate blood pressure (D) To produce blood cells

27. Which blood vessels have the thinnest walls, allowing for the exchange of nutrients and gases with tissues?

(A) Arteries (B) Veins (C) Capillaries (D) Venules

28. What is the main function of the pulmonary circuit?

(A) Pumping blood to the body (B) Oxygenating blood

(C) Filtering blood (D) Distributing nutrient

29. Which of the following is a formed element in the blood responsible for blood clotting?

(A) Red blood cells (B) White blood cells (C) Platelets (D) Plasma

30. What is the average lifespan of a red blood cell in circulation?

(A) 1 day (B) 7 days (C) 30 days (D) 120 days

ANSWER KEY

1	2	3	4	5	6	7	8	9	10
C	**A**	**B**	**D**	**A**	**C**	**A**	**C**	**A**	**A**
11	12	13	14	15	16	17	18	19	20
A	**B**	**B**	**C**	**A**	**D**	**A**	**B**	**A**	**D**
21	22	23	24	25	26	27	28	29	30
D	**A**	**B**	**D**	**A**	**A**	**C**	**B**	**C**	**D**

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CHAPTER 16: 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.

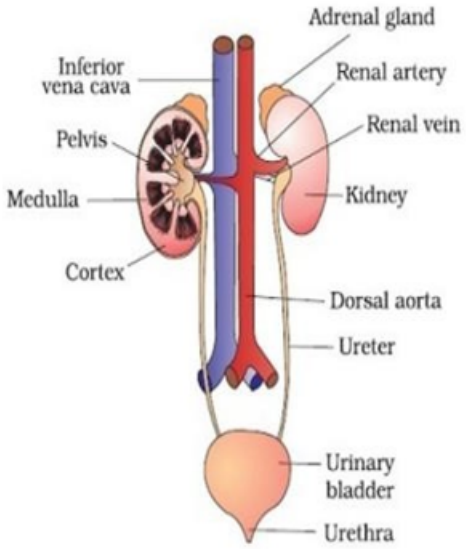
Uricotelism: Excrete uric acid. E.g., Reptiles, birds, land snailsand insects. This prevents the loss of water.

Specific excretory organs

Protonephridia or flame cells	Platyhelminthes, rotifers, some annelids and cephalochordate
Nephridia	Earthworms
Malpighian tubules	insects
Antennal glands	crustaceans

HUMAN EXCRETORY SYSTEM

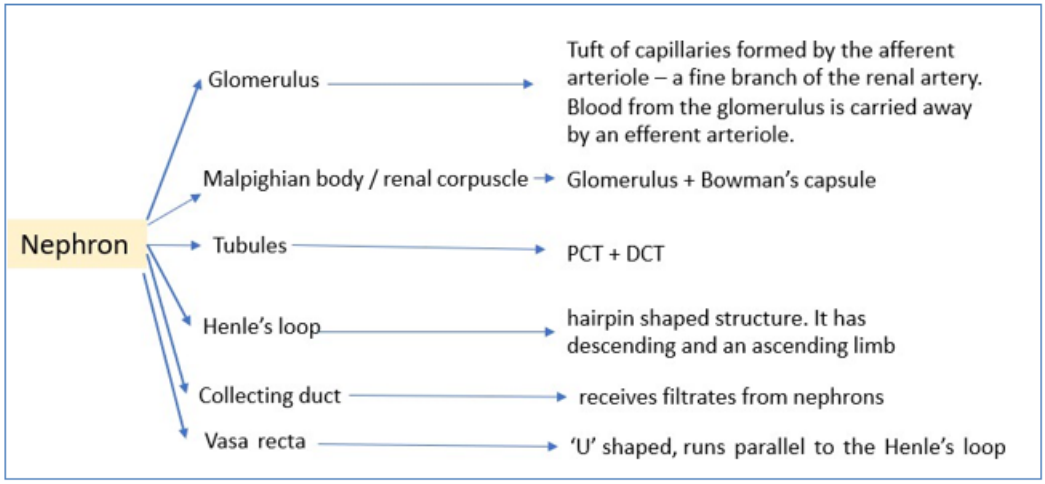
- It consists of a pair of kidneys, one pair of ureters, a urinary bladder and a urethra.
- Kidneys: reddish brown, bean-shaped structures
- Size: 10-12 cm in length, 5-7 cm in width, 2-3 cm in thickness, weight: 120- 170 g.
- The kidney has an outer cortex, inner medulla and pelvis.
- The medulla is 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 t he 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.

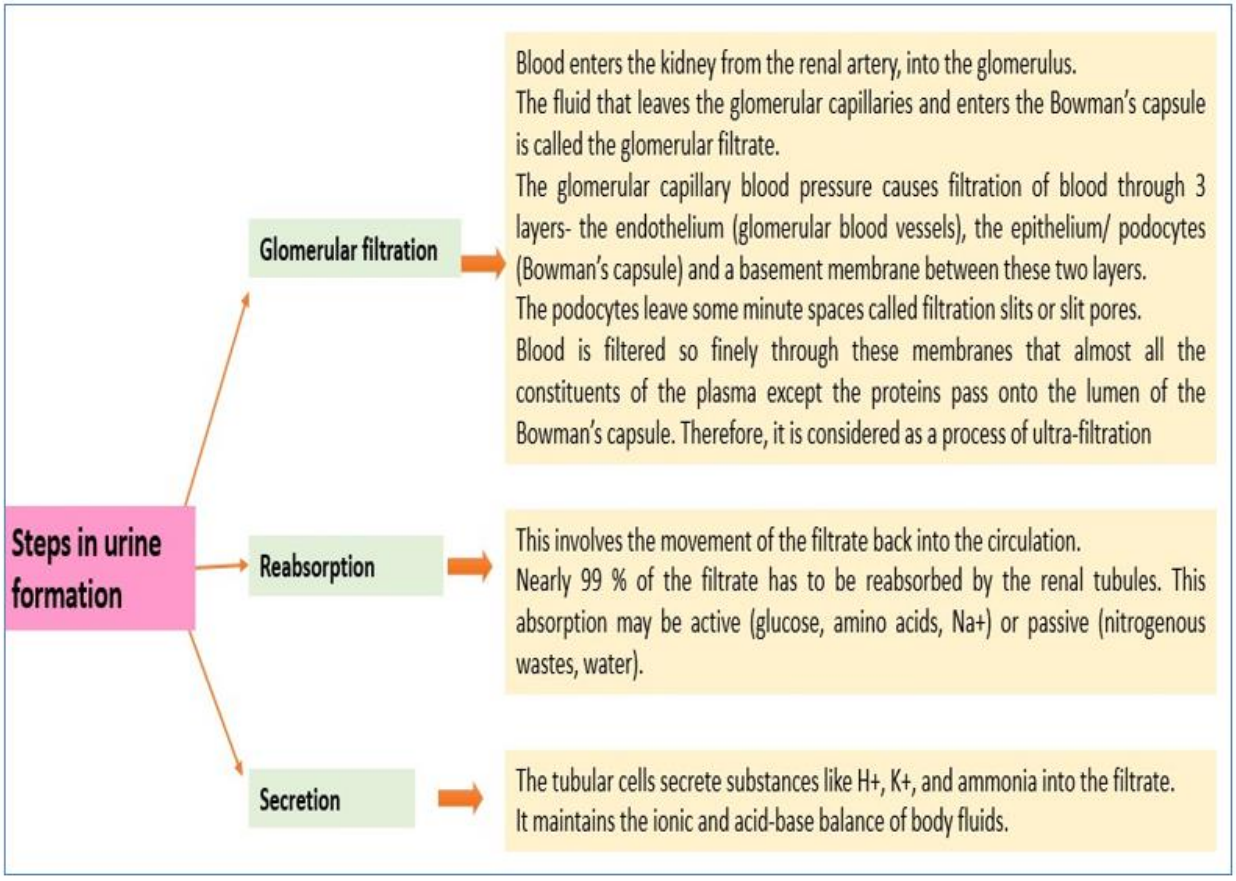
Types of nephrons

- ✓ 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).

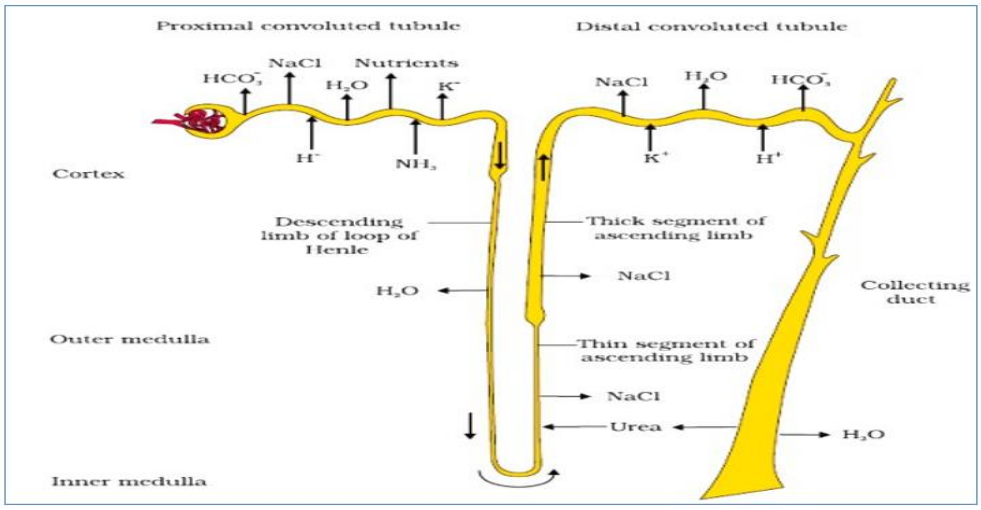
Regulation of GFR: The juxta glomerular apparatus (JGA) is formed by cellular modifications in the DCT and the afferent arteriole at the location of their contact.

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

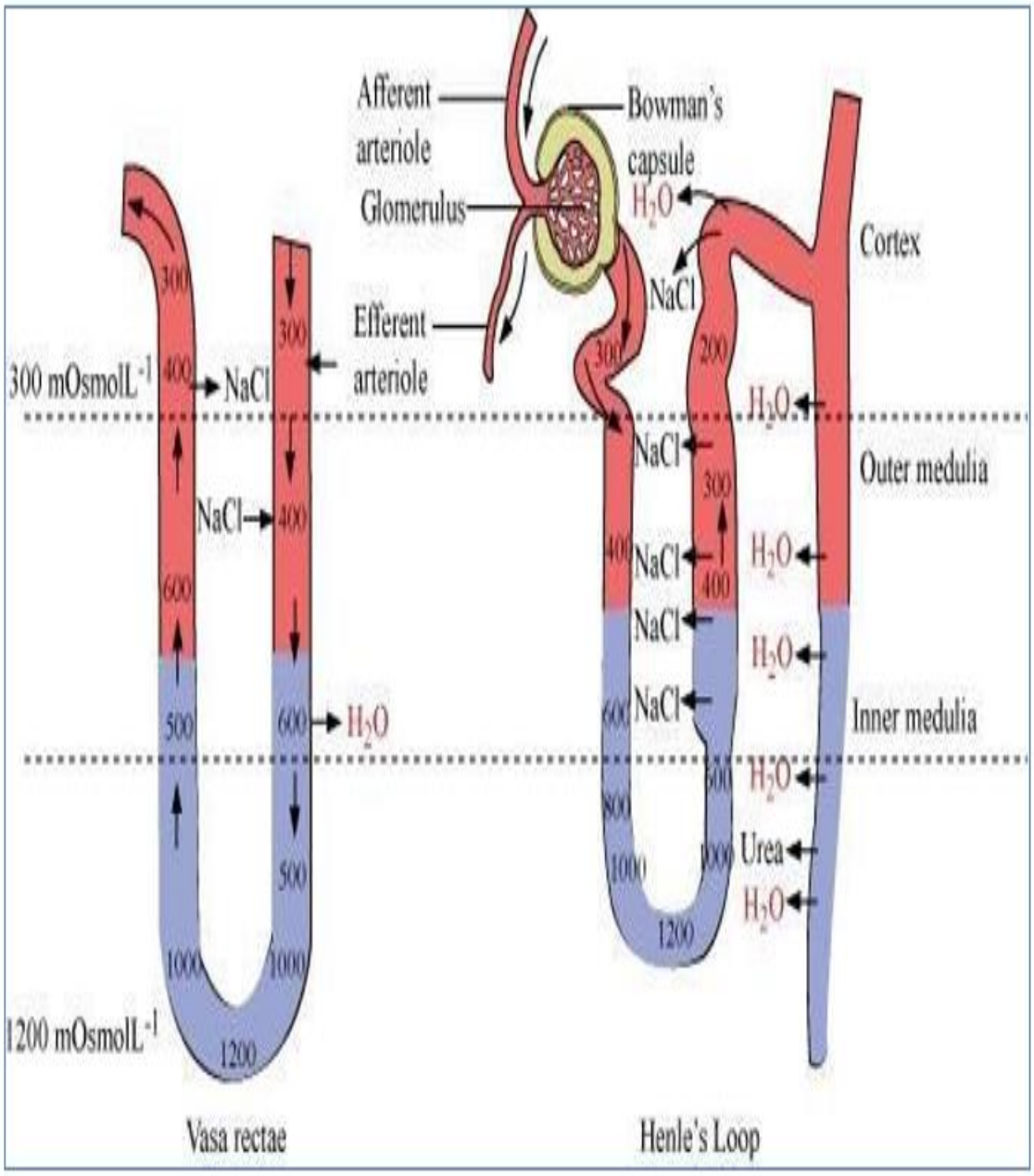
Function of tubules

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.lood 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.

MULTIPLE CHOICE QUESTIONS

1- In which organ urea is formed-
- a- Kidney
- b- Liver
- c- Nephron
- d- All of these

2- Uricotelism is significant as it -
- a- Conserve water
- b- Eliminate urea
- c- Eliminate methane
- d- Conserve nutrients

3- Uremia is described as-
- a- Accumulation of uric acid in kidney
- a- Accumulation of urea in the blood
- b- Stone in kidney

c- Crystals in the kidney

4- The value of the GFR is-

a- 500 ml/ minute
b- 1000 ml / minute
c- 125 ml/minute
d- 1 liter/ minute

5- Which gland is responsible for the excretion-

a- Sebaceous glands
b- Liver
c- Both a and b
d- None of these

6- In mammalian kidneys, Bowman's capsules or Malpighian corpuscles occur in which part?

a- Medulla
b- Pith
c- Cortex
d- All are incorrect

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

8- Expand the ANF-

a- Atrial Natriuretic Factor
b- Atrial narcotic factor
c- Atrium natriuretic function
d- Atrial narcotic function

9- urethra sphincter is associated with-

a- Micturition
b- Absorption
c- Secretion
d- All of these

10- Which type of epithelium is present in the kidney-

a- Simple
b- Cuboidal
c- Simple cuboidal
d- Simple cuboidal brush border epithelium.

1	2	3	4	5	6	7	8	9	10
b	a	b	c	b	c	a	a	a	d

CHAPTER 17: LOCOMOTION AND MOVEMENT

GIST OF THE CHAPTER

1. Types of movement
    1. Amoeboid movement
    2. Ciliary movement
    3. Muscular movement
    4. Flagellar movement
2. Types of muscles
    1. Skeletal muscle OR striated muscle
    2. Visceral muscle OR smooth muscle.
    3. Cardiac muscle.
3. Structure of Contractile protein
4. Mechanism of muscle contraction.
5. Skeletal System1.Axial system2.Appendicular system
6. Joints
7. Classification of joints
8. Disorder of muscular system
9. Disorder of skeletal System

Amoeboid movement. Movement with the help of pseudopodia formed by the cytoplasmic streaming. **Ex.** movement of leucocyte, macrophage and cytoskeletal element in our body.

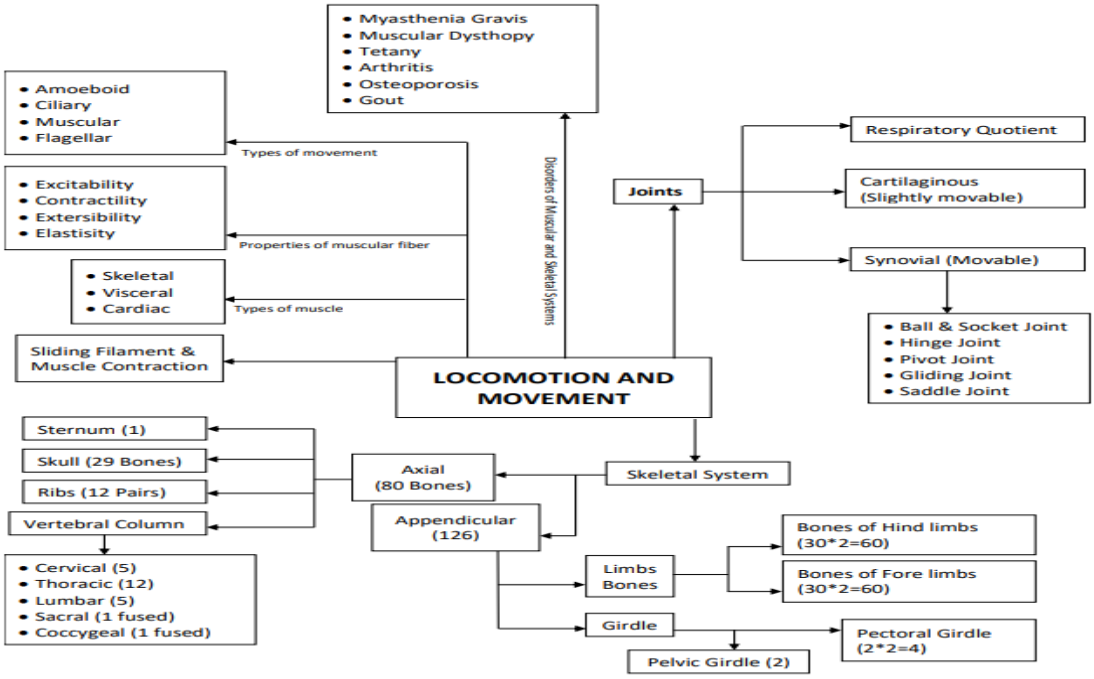
Ciliary movement - This movement occurs in most of our' internal tubular organ lined by the ciliated epithelium **Example**-Movement of Cilia in trachea and movement of ova in the reproductive tract. Muscular movement-The movement occurs because of the contractile property of the muscles. **Ex**. movement of our jaws, limbs, tongue etc.

Skeletal muscles -These have striped appearance under the microscope therefore they are called striated muscles. These associated with skeletal component of the body. These are under the voluntary control of the nervous system involved in locomotory actions and changes in body position. Visceral muscles-These do not exhibit any striation they are smooth muscles (non-striated) these are associated with the inner wall of the hollow visceral organs. These are involuntary muscles involved in action such as transportation of food through the alimentary canal etc. Cardiac muscles-There are also striated muscles. These are present in the heart. These are involuntary muscles and involved in the conduction of heart impulses.

Red Muscles Fibre - Myoglobin content is higher in them making them red in colour. They contain plenty of mitochondria they are aerobic muscles since large amount of oxygen is stored in them.

White Muscle Fibre - They contain less quantity of myoglobin and appear white in colour. They contain fewer mitochondria. They depend on anaerobic process for energy, hence are called anaerobic muscles.

MIND MAP



MULTIPLE CHOICE QUESTIONS

1. Name the ion responsible for unmasking of active site for myosin for cross bridge activity during muscle contraction.
    a. Calcium
    b. Magnesium
    c. Sodium
    d. Potassium
2. Which of the following joint would allow no movement?
    a. Synovial joint
    b. Fibrous joint
    c. Cartilaginous Joint
    d. Ball & Socket Joint
3. Autoimmune disorder is
    a. Tetany
    b. Gout
    c. Arthritis
    d. Myasthenia Gravis
4. Joint between Carpal and Metacarpal is-
    a. Pivot Joint
    b. Hinge Joint
    c. Ball and Socket Joint
    d. Saddle Joint

5. Glenoid cavity articulates
    a. Humorous with Scapula
    b. Clavicle with acromion
    c. Scapula with acromion
    d. Clavicle and scapula
6. What is the total number of bones in hind limb?
    a. 21
    b. 30
    c. 14
    d. 24
7. ATPase enzyme needed for muscle contraction is located in.
    a. Troponin
    b. Actinin
    c. Myosin
    d. None of these
8. Muscle immune to fatigue is
    a. Voluntary
    b. Cardiac muscle
    c. Striped muscle
    d. None of these
9. Study of muscle is called
    a. Osteology
    b. Morphology
    c. Arthrology
    d. Myology
10. Contractile unit of muscle fibre is called:
    a. Sarcomere
    b. Troponin
    c. I-band
    d. H-zone
11. Striated muscle and voluntary muscle are:
    a. Cardiac muscle
    b. Visceral muscle
    c. Skeletal muscle
    d. All of the above
12. Which of the following is important for muscle contraction and nerve impulse transmission:

a. Mg^{++} ion
b. Fe^{2+} ion
c. Ca^{2+} ion
d. Ca^{++} ion and Mg^{++} ion

13. Protein which is present in cartilage is:
    a. Cartilagin
    b. Collagen
    c. Chondrin
    d. All of these
14. Stimulation of a muscle fibre by a motor neuron occurs at:
    a. The Myofibril
    b. The Transverse Tubules
    c. The Sarcoplasmic Reticulum
    d. The Neuro-Muscular Junction
15. Who shows amoeboid movement?
    a. Amoeba
    b. Leucocytes
    c. Macrophage
    d. All of the above
16. Which muscle does not fatigue and possesses abundant blood supply during life span?
    a. Skeletal muscle
    b. Smooth muscle
    c. Cardiac muscle
    d. Both B and C
17. Name the muscle possesses multinucleus condition (Syncytium)?
    a. Skeletal muscle
    b. Smooth muscle
    c. Cardiac muscle
    d. None of the above
18. In which muscle, amount of myoglobin is high?
    a. Red muscle
    b. White muscle
    c. Non-striated muscle
    d. Both A and B
19. How many bones are present in the skull?
    a. 23

b. 22
c. 21
d. 20

20. Name the bone which makes the floor of the buccal cavity?
    a. Hyoid bone
    b. Vomer
    c. Mandible F
    d. Frontal
21. Some voluntary movement which results in change of place or location are called
    a. Motion
    b. Transformation
    c. Translocation
    d. Locomotion
22. Anatomical unit of the skeletal muscle is:
    a. Sarcomere
    b. Sarcolemma
    c. Muscle Bundle
    d. Muscle Fiber
23. ATPase enzyme of the muscle is located on
    a. Troposion
    b. Actin
    c. Myosin
    d. Actium
24. Functional unit of Contractile System of a striated muscles called:
    a. Myofibril
    b. Sarcomere
    c. Sarcosome
    d. Z-line
25. Actin binding site are located on
    a. Tropomyosin
    b. Troponin
    c. Mercomyosin
    d. Both a and b
26. During muscular contraction, the myosin head bind to the exposed active site on actin to form:
    a. Cross bridge

b. Motor end plate
c. Cross arm
d. Motor Unit

27. During muscle contraction
    a. GTP is broken down
    b. ATP is formed
    c. ATP is broken down
    d. None of these
28. Red muscle fibre is rich in:
    a. Mitochondria
    b. Golgi bodies
    c. Lysosome
    d. Ribosome
29. Aerobic muscles utilize the large amount of oxygen stored for ATP production because they have:
    a. Haemoglobin
    b. Mitochondria
    c. Myoglobin
    d. Both b and c
30. The lactic acid formed during muscle contraction is converted to glycogen in
    a. Liver
    b. Kidney
    c. Muscle
    d. Pancreas

Answers-:

Ques	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	a	b	d	d	a	b	c	b	d	a	c	d	c	d	d
Ques	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	d	a	a	b	a	d	d	c	b	c	a	c	a	d	a

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CHAPTER 18: NEURAL CONTROL AND COORDINATION

GIST OF THE CHAPTER

Neurons	The fundamental units of the brain and nervous system
Effector	A part of the body(gland , muscle, cell) which can respond to a stimulus according to the instructions sent from the nervous system
Afferent fibres	Carries impulse from Effector to CNS Efferent fibres Carries impulse from CNS to Effector
Multipolar neuron	With one axon and two or more dendrites; found in the cerebral cortex
Bipolar Neuron	With one axon and one dendrite, found in the retina of eye.
Nodes of Ranvier	These are the gaps formed between the myelin sheath
Synaptic cleft	A small gap between the axon terminal of the presynaptic neuron and the membrane of the postsynaptic cell, and this gap is called the synaptic cleft
Receptors	**A** cell or group of cells that receives stimuli.

CONCEPT:

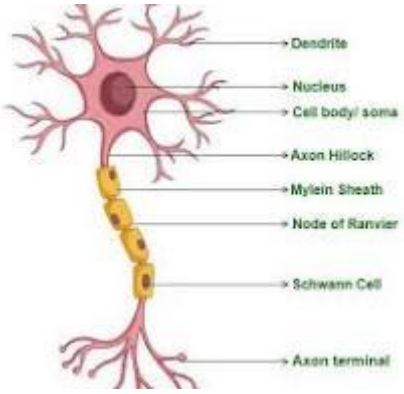
In man and other vertebrates, the physiological functions are co-ordinated by both the nervous and endocrine systems. ¬ The system that receives the stimulus transmits it to other parts of the body and the corresponding effect shown is known as a Nervous System. The nervous system performs three basic functions – receives stimuli through sensory neurons from internal and external environment and passes to the brain where the input stimuli is processed and then response is given back to the body parts through motor neurons.

In Invertebrates: ¬ In primitive invertebrates like Sponges lack neurons. In Hydra, all neurons are linked to one another forming a nerve net called plexus between the outer epidermis and inner gastrodermis. ¬ In Planaria, two nerve cords that converge to form a rudimentary brain. In Earthworm, it has a single ventral nerve cord and paired segmental ganglia.

Neural System of Human: The human nervous system consists of the following two major parts :

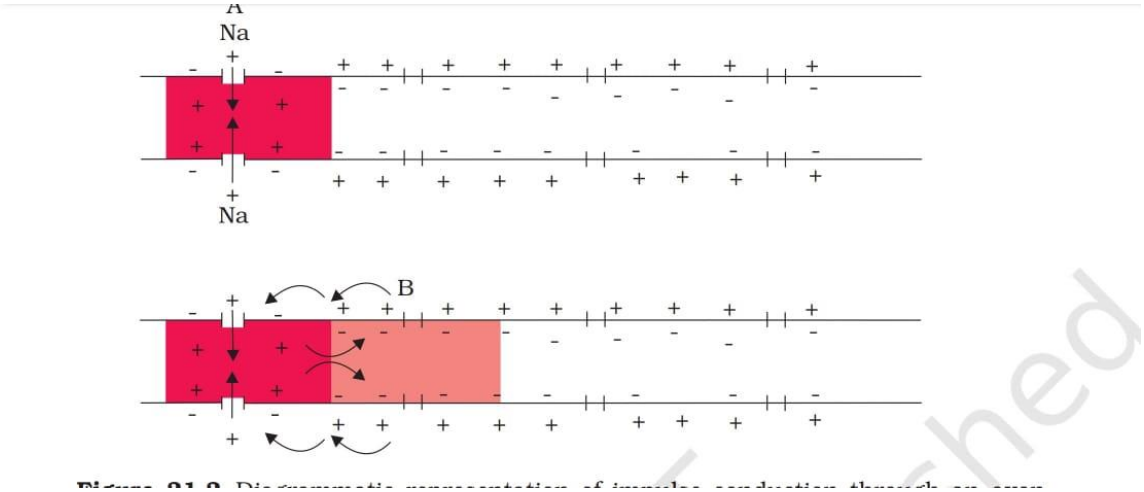
- **Central Nervous System (CNS)**: Comprises of Brain and Spinal cord. It is the site of information processing unit.
- **Peripheral Nervous System (PNS):** The nerves which arise from the CNS (brain and spinal cord).
  - **(i)** **Somatic Nervous System (Voluntary)**: It consists of sensory (afferent) neurons which transmit impulse from the receptors to the CNS and the motor (efferent) neurons which transmit response from the CNS to the effector (skeletal muscles).
  - **(ii)** **Autonomic Nervous System (Involuntary)**: It stimulates the glands and the other muscles of the body and responsible for the involuntary actions. The autonomic nervous system is further classified into sympathetic and parasympathetic neural system.

Neuron: microscopic structure having cell body, dendrites and axon. It may be Unipolar, bipolar or multipolar. The axon may be myelinated or non-myelinated. The myelinated nerve fi9bers are enveloped with schwann cells. The gap between two myelinated sheaths are called nodes of ranvier.



Conduction of Nerve impulse across neurons:

a. Resting potential: The permeability of plasma membrane to K+ ions is greater than its permeability to Na+ ions. So, the surface of axon carries a positive charge relative to its interior. This electrical potential difference across the plasma membrane is called resting potential and it ranges from -40mV to -90mV.
b. Action potential : When a threshold stimulus is applied on the axon membrane then depolarization is caused by a rapid change in membrane permeability. The membrane becomes more permeable to Na+ than to K+ ions. The interior becomes electropositive and the ECF (extra cellular fluid) becomes electronegative. The depolarization spreads and producing a local current which induces the nearby passive Na+ channels to open and to depolarize the nearby site.
c. Repolarisation : After about 0.5 minutes, permeability to K+ ion increases because the build-up of positive charge inside the cell which opens the voltage gated K+ channels. Movement of K+ ions outward, down their concentration gradient and then re-establishes the charge differences that existed before the stimulus occurred. The exodus of K+ ions lowers the number of positive ions within the cell and the potential falls back towards the resting potential.

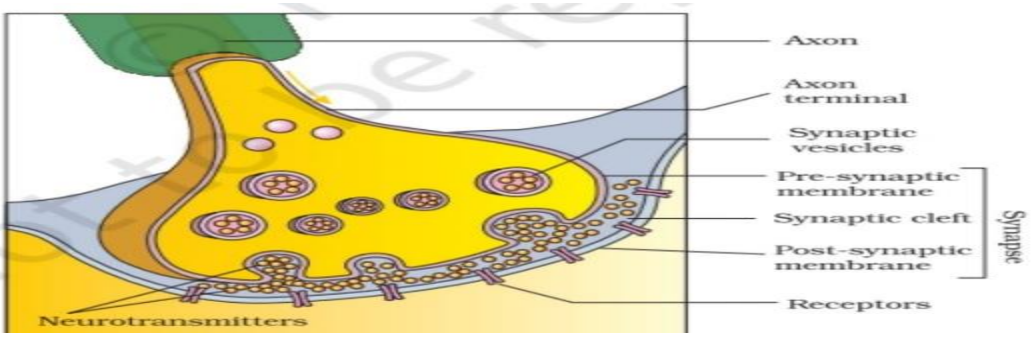


Transmission of impulses:

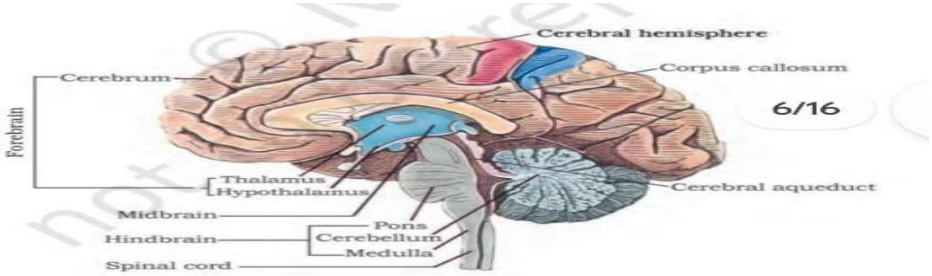
Nerve impulses transmitted from one neuron to another through synapse. Synapse includes the membranes of a pre and a post synaptic neuron, it may include a gap called synaptic cleft.

Synapses may be electrical synapse or chemical synapse. The chemical synapse includes pre and post synaptic neuron separated by synaptic cleft.

Axon terminal contains neurotransmitters which transmit the electric signal from one to another neuron.



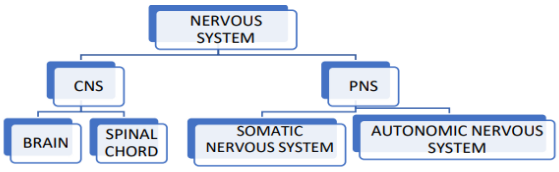
CENTRAL NEURAL SYSTEM:



Brain:

- it is the central information processing organ of body .it control voluntary movements, balance of the body, functioning vital involuntary organs, thermoregulation etc.
- it is protected by cranial meninges
- it is divided into forebrain, mid brain and hind brain
- The **forebrain** consists of cerebrum, thalamus and hypothalamus.
- The cerebrum is major part of the brain, it is divided into two cerebral hemispheres but remains connected by corpus callosum.
- Cerebral cortex contains the motor area, sensory area and association area
- The cerebrum wraps around thalamus, which is a coordinating centre for sensory and motor signal.
- Base of the thalamus a very important part called hypothalamus lies. It contains the centres for controlling body temperature, urge for eating and drinking.
- Midbrain The midbrain is located between the hypothalamus of the forebrain and pons of the hindbrain. The dorsal portion of the midbrain consists mainly of four round swellings corpora quadrigemina.
- Hindbrain The hindbrain comprises pons, cerebellum and medulla oblongata.
    - Pons consists of fibre tracts that interconnect different regions of the brain.
    - Cerebellum has very convoluted surface in order to provide the additional space for many more neurons.
    - The medulla of the brain is connected to the spinal cord. The medulla contains centres which control respiration, cardiovascular reflexes and gastric secretions. Three major regions make up the brain stem; mid brain, pons and medulla oblongata.

MIND MAP



BRAIN

It receives information carrying impulses . it correlates the stimuli and produces appropriate responses, it stores information

FORE BRAIN

Cerebrum

(Seat of intelligence
Memory ,consciousness ,will power
Voluntary actions)

diencephalon

Thalamus
Relays pain and pressure impulses

Hypothalamus
controls the body temperature, pituitary gland

MID BRAIN

(A small tubular part for reflexes involving eyes and ears)

HIND BRAIN

Cerebellum
(Coordinates muscular activity, balance of the body)

pons
(locates at the center of the brain below the cerebellum it carries impulses from one hemisphere and coordinates muscular movements on other sides of the body)

Medulla oblongata
controls activities of internal organs,heart beat breathing etc.

Spinal chord:

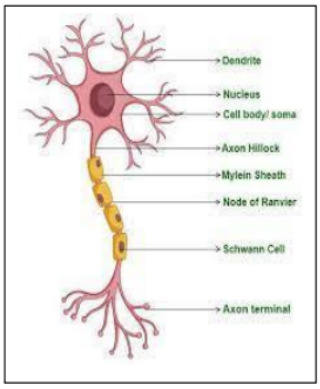
- Controls reflexes below the neck
- Conducts sensory impulses from the skin and muscles to the brain.
- Conducts motor responses from the brain to muscles of the trunk and limbs.

somatic nervous system

(it conveys information to skeletal or voluntary muscles)

cranial nerves- emerges from the brain. There are 12 pairs of cranial Nerve

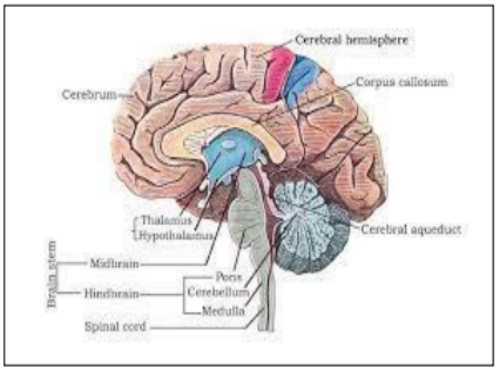
Spinal Nerve – emerges from the spinal chord. There are 31 pairs of spinal nerves



Autonomic Nervous System

sympathetic- nerve between neck and waist, stimulatory, accelerates heartbeat, dialates pupil, constricts blood vessels, inhabits secretion of saliva

Para – sympathetic- nerve above neck and below sacrum, calming, retards heartbeat, constricts pupil, dilates blood vessels , stimulates secretion



MULTIPLE CHOICE QUESTIONS

1. Visceral nervous system is a part of
    a. PNS
    b. CNS
    c. ANS
    d. Sympathetic nervous system
2. The thalamus and hypothalamus are present in
    a. Cerebellum
    b. diencephalon
    c. cerebrum.
    d. brainstem
3. The autonomic neural system transmits impulses
    a. from the CNS to the involuntary organs and smooth muscles of the body
    b. from smooth muscles of the body to CNS
    c. from Involuntary organs to CNS
    d. from PNS to CNS
4. the key co coordination centre for motor and sensory signals in the brain is
    a. hypothalamus
    b. thalamus
    c. mid brain
    d. brain stem
5. the sensory neuron enters spinal cord through
    a. the ventral root of the spinal nerve
    b. dorsal root of the spinal nerve
    c. both dorsal and ventral roots of the spinal nerves
    d. either dorsal or ventral root depending on the origin point.
6. Nissl's granules are present in
    a. Cell body
    b. Dendrons
    c. Axon
    d. Nerve endings
7. Find the correct statement
    a. Cerebral cortex contains multipolar neuron
    b. Cerebral cortex contains bipolar neuron

c. Embryonic stage contains bipolar neuron

d. Embryonic stage contains unipolar neuron.

8. Unmyelinated nerve fibre is enclosed by a Schwann cell that does not form a myelin sheath around the axon, and is commonly found in

a. autonomous and the somatic neural systems

b. only in autonomous neural systems

c. only in somatic neural systems

d. in CNS

9. Neurons are excitable cells because

a. They have Nissl's body

b. They are in polarised state

c. They are in depolarised state

d. They do not have ions in their membrane

10. Choose the correct answer

During the sodium – potassium pump across the axon membrane

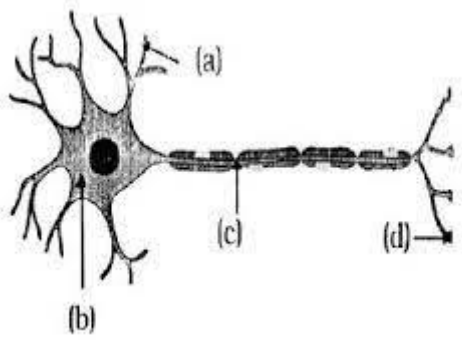
a. 3 sodium in and 2 potassium out

b. 2 potassium in and 3 sodium out

c. Only 3 sodium enters cell

d. Only potassium comes out

11. Select the correct answer



a. Cell body	b. dendron	c. nerve endings	d. axon
a. Dendron	b. cell body	c. axon	d. nerve ending
a. Cell body	b. dendron	c. axon	d. nerve ending
a. Axon	b. dendron	c. nerve endings	d. dendron

12. Neural system provides

a. Point to point connection
b. Cell to cell connection
c. Organ to organ connection only
d. Tissue to tissue connection only

13. Find the incorrect statement
    a. Neurons detect the stimuli
    b. Neuron receive the stimuli
    c. Neuron secretes the stimuli
    d. Neuron transmit the stimuli
14. The type of neuron found in lower invertebrate like Hydra is
    a. Unipolar
    b. Apolar
    c. Bipolar
    d. multipolar
15. Impulse transmission across an electrical synapse is
    a. Always faster than that across a chemical synapse
    b. Sometime faster than that across a chemical synapse
    c. Always slower than that across a chemical synapse
    d. Equal to the chemical synapse
16. At a chemical synapse, the membranes of the pre- and post-synaptic neurons are separated by a fluid-filled space called
    a. synaptic cleft
    b. neurotransmitter
    c. synaptic vesicle
    d. synapse
17. the nerve transmitter produced in the junction of neuromuscular and synapse is
    a. phosphokinase
    b. ATP
    c. NADP
    d. Acetylcholine
18. Which of the following group is neurotransmitter?
    a. Dopamine, Acetylcholine, noradrenaline
    b. Somatostatin, dopamine, noradrenaline
    c. Acetylcholine, serotonin, noradrenaline
    d. Melatonin, dopamine, acetylcholine
19. Greyish appearance of the cerebral cortex is due to

a. Neural cell bodies
b. Neural axon
c. Neural nerve endings
d. Schwann's cell

20. Select the correct statement regarding Schwann's cell
    a. Support muscle cell
    b. Surrounds the axon of myelinated nerve fibre
    c. Found in bone marrow
    d. Found in basement membrane of epithelial tissue.
21. Which of the following statements is incorrect
    a. The medulla contains centres of control respiration, cardiovascular reflexes and gastric secretions.
    b. The hind brain contains centres which control respiration, cardiovascular reflexes and gastric secretions.
    c. The hypothalamus controls the body temperature
    d. Acetylcholine is a neurotransmitter.
22. Brain stem forms the connections between
    a. the brain and spinal cord.
    b. Mid brain and hind brain
    c. Forebrain with mid brain
    d. Corpora with mid brain
23. Frontal lobe of cerebrum is concerned with
    a. Speech
    b. Cognition and memory
    c. Long term memory
    d. Visual processing of brain
24. An injury to hypothalamus may interrupt
    a. Regulation of temperature
    b. Body movement
    c. Loss of memory
    d. Locomotion
25. The part of the human brain referred as emotional brain is
    a. Corpus callosum
    b. Broca's area
    c. Limbic system
    d. Epithalamus

26. The outermost cranial appendage is

a. Pia mater
b. Dura mater
c. Arachnoid
d. Skull

27. Find the incorrect statement associated with the Midbrain

a. The central portion of the midbrain is composed of mainly four, round swellings known as corpora quadrigemina.
b. Located between the thalamus of the forebrain and pons of the hind brain
c. The canal called the cerebral aqueduct passes through the midbrain.
d. Hind brain and midbrain constitute the brain stem.

28. Which part of the brain is associated primarily with speech

a. Thalamus
b. Basal ganglia
c. Substantia Nigra
d. Broca area

29. What is the function of the Cerebral Aqueduct?

a. To release hormones into the blood
b. To connect the cerebellum to the spinal cord
c. To control involuntary functions
d. To provide a pathway for cerebrospinal fluid inside the brain

30. Pituitary gland is controlled by

a. Thalamus
b. Hypothalamus
c. Forebrain
d. Hindbrain

ANSWER KEY:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
a	b	a	a	b	a	b	a	b	b	b	b	c	b	a
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
b	d	a	a	b	b	a	b	a	c	b	c	d	b	b

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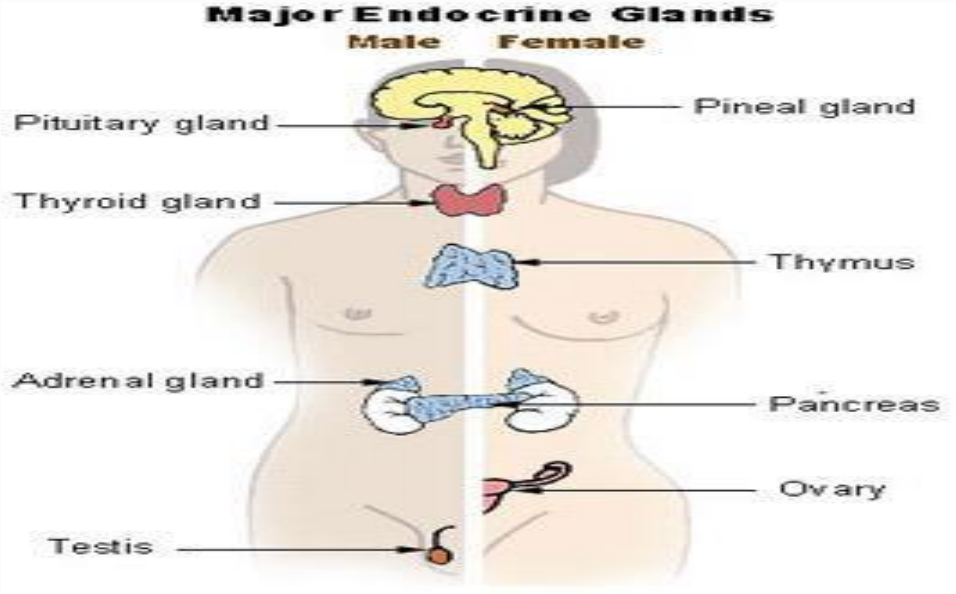
CHAPTER 19: CHEMICAL COORDINATION AND INTEGRATION

GIST OF THE ACTIVITY

In mammals, control and coordination is done by neural system and endocrine system jointly. As the nerve fibres do not innervate all cells of the body, the endocrine system is required to coordinate the functions.

Endocrine Glands: Endocrine glands are ductless glands. They release their secretion directly into blood which is then transported to specific target organs to initiate a particular metabolic change. The endocrine glands secrete chemicals called hormones. Hormones are non-nutrient chemicals which act as intercellular messengers and are produced in trace amount.
In human the following organs act as Endocrine gland since they involved in hormone secretion.



Hypothalamus: Contains several groups of neurosecretory cells called nuclei which produce hormones. Hormones released by Hypothalamus regulate the synthesis and secretion of pituitary hormones.

Hypothalamus produces two types of Hormones:

The hormones released from hypothalamus reaches the anterior pituitary through portal circulatory system and regulate its function.

The posterior pituitary is under direct control of hypothalamus.

Pituitary Gland

This gland is located in sella tursica, a bony cavity. It is attached to the hypothalamus by a stalk. Excess secretion of Growth Hormone causes over growth of the body leading to gigantism and low secretion causes stunted growth called dwarfism. Prolactin stimulates growth of mammary gland

and production of milk. TSH stimulates production and release of thyroid hormone. LH and FSH stimulate activity of the gonads. In male, LH stimulates synthesis and secretion of androgen Hormone from testis. In female, LH induces ovulation of fully mature ovum from ovary. Oxytocin helps in contraction of uterus during child birth and milk ejection from mammary glands. Vasopressin stimulates absorption of water and electrolyte in kidney. MSH acts on the melanocytes and regulates skin pigmentation.

The pineal Gland- located on dorsal side of forebrain and release melatonin hormone that helps to regulate diurnal rhythm of body like sleeps wake cycle and body temperature.

Thyroid Gland- composed of two lobes on either side of trachea connected by isthmus. Iodine is essential for synthesis of thyroid hormones. Deficiency of iodine leads to hypothyroidism (Goitre). During pregnancy, hypothyroidism may cause stunted growth of baby and mental retardation. Thyroid hormones regulate the basal metabolic rate. They support the process of red blood cell formation. They control the metabolism of carbohydrates, proteins and fats. Thyrocalcitonin hormone regulates blood calcium levels.

Parathyroid Gland– located on the back side of thyroid gland, secretes peptide hormone called parathyroid hormone (PTH). PTH regulates the calcium ion concentration in the blood. It also helps in reabsorption of calcium from renal tubules and digestive tracts.

Thymus– located on the dorsal side of heart and the aorta. This gland releases peptide hormone thymosins that help in differentiation of T-Lymphocytes for cell-mediated immunity. It also promotes production of antibodies to provide humeral immunity.

Adrenal Gland – located on anterior part of each kidney, composed of two types of tissues central adrenal medulla and outside adrenal cortex. Adrenal medulla secretes adrenaline and noradrenaline hormone commonly called as catecholamines. These hormones are also called as emergency hormone. These hormones increase alertness, pupilary dilation, sweating, heartbeat, rate of respiration, glycogenolysis. The adrenal cortex secretes glucocorticoids and mineralocorticoids. Glucocorticoids stimulate gluconeogenesis. Mineralocorticoids regulate water and electrolyte contents of the body.

Pancreas – acts as both endocrine and exocrine gland. Endocrine pancreas consists of "Islets of Langerhans" which contain α-cells and β-cells. The α-cells secrete hormone glucagon and β-cells secrete insulin. Both hormones are involved in maintenance of blood sugar levels.

Glucagon is a peptide hormone that stimulates glycogenolysis resulting in increased blood sugar.

Insulin is a peptide hormone that play major role in regulation of glucose homeostasis. It triggers rapid movement of glucose from blood to hepatocytes and adipocytes resulting in decreased blood glucose levels (hypoglycaemia).

Testis – perform dual functions as a primary sex organ as well as endocrine glands. Leydig cells or interstitial cells produce androgen mainly testosterone which regulate maturation of primary sex organs and spermatogenesis.

Ovary – produce two groups of steroid hormones called estrogen and progesterone. Estrogen is synthesized and secreted by growing ovarian follicles. After ovulation, ruptured ovum called corpus luteum, secretes progesterone. Estrogen produces wide range actions like growth of female secondary sex organs, development of growing ovarian follicles, and regulation of female sexual behaviour. Progesterone regulates pregnancy.

Hormones of Heart, Kidney and Gastrointestinal Tract

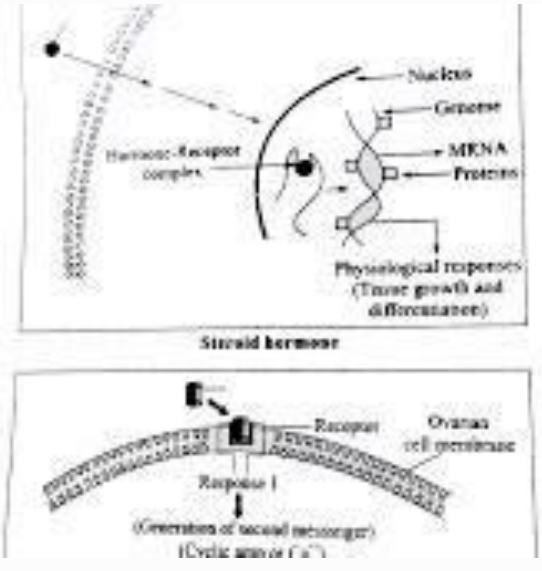
Atrial wall of heart secretes peptide hormone called atrial natriuretic factor (ANF) which decreases blood pressure. The juxtaglomerular cells of kidney produce erythropoietin hormone which stimulate erythropoiesis.

Gastro-intestinal tract secrete four major peptide hormones:

1. Gastrin stimulates the secretion of hydrochloric acid and pepsinogen.
2. Secretin acts on the exocrine pancreas and stimulates secretion of water and bicarbonate ions.
3. Cholecystokinin (CCK) stimulates the secretion of pancreatic enzymes and bile juice
4. Gastric inhibitory peptide (GIP) inhibits gastric secretion and motility.

Mechanism of Hormone Action

- Hormone produce their effects on target tissues by binding to specific protein called hormone receptors located in the target tissue.
- Binding of hormones to receptor leads to the formation of hormone receptor complex. This binding leads to change in target tissue.



On the basis of chemical nature, hormones are grouped as-

1. Peptide, polypeptide and protein hormones- insulin, glucagon, pituitary hormone, hypothalamic hormones.
2. Steroids- cortisol, testosterone, progesterone.
3. Iodothyronines- thyroid hormones.
4. Amino acid derivatives- epinephrine.

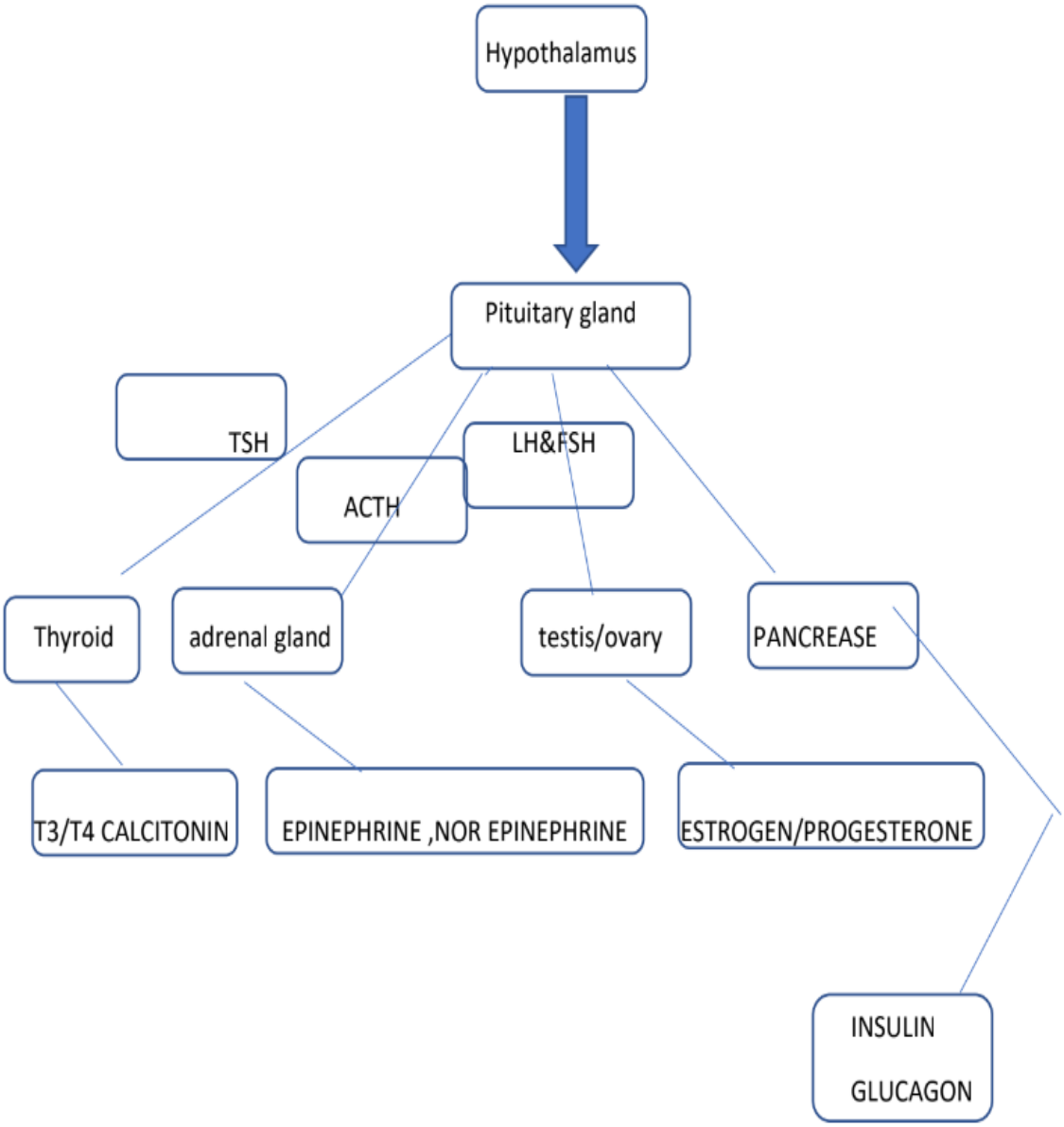
The hormones that bind with membrane bound receptors normally do not enter the target cells but generate second messenger which in turn regulate cellular metabolism. The hormones (steroid hormones) which interact with intracellular receptors mostly regulate gene expression or chromosome function by interaction with hormone-receptor complex with the genome. These biochemical actions result in physiological and developmental effects.

CHEMICAL COORDINATION AND INTEGRATION

Name and hormones of different endocrine glands:

1. Hypothalamus: releasing hormones
2. Pituitary gland:
    a. GH
    b. TSH
    c. FSH
    d. LH
    e. PROLACTIN
    f. ACTH
    g. ADH
3. THYROID:
    a. T3
    b. T4
    c. CALCITONIN
4. PANCREASE:
    a. INSULIN
    b. GLUCAGON
5. ADRENALIN GLAND:
    a. ADRENALIN
    b. NOR ADRENALIN
    c. GLUCOCORTICOID
    d. MINERALOCORTICOID
6. TESTIS:
    a. TESTOSTERON
7. OVARY:
    a. ESTROGEN
    b. PROGESTERONE
8. PLACENTA:
    a. hCG
    b. hPL
    c. RELAXIN
9. THYMUS:
    a. THYMOSIN
10. HEART:
    a. ANF
11. KIDNEY:
    a. ERYTHROPOIETIN
12. GASTRIC GLAND:
    a. GASTRIN

MIND MAP



MULTIPLE CHOICE QUESTIONS

1. During ovulation there is a many folds' rise in secretion of.

(a) LH (b) STH (c) FSH (d) MSH

2. Growth hormone activity

(a) Decreases with thyroxine (b) Increases with thyroxine

(c) Remains same (d) Fluctuates.

3. The main function of ADH hormone is to

(a) Cause contraction of the uterus and thus help in child birth

(b) Increase reabsorption of water in the kidney tubule

(c) Stimulate the secretion of milk in the mammary glands

(d) Lower the level of blood glucose

4. The hormone controls the secretion of estrogen

(a) hCG (b) Progesterone (c) LH (d) FSH

5. Somatostatin is secreted by

(a) Hypothalamus (b) Pituitary (c) Pineal (d) Thyroid

6. The term TSH stands for

(a) Thyroxine stimulate hormone

(b) Thymine stimulating hormone

(c) Thyroxine secreting hormone

(d) Thyroid stimulating hormone

7. In a woman suffering severe labour pain to fasten the parturition process the doctor administers a injection that contains a hormone that work on

(a) Activate the smooth muscles

(b) Increase the metabolic rate

(c) Release glucose into the blood

(d) Stimulate the ovary

8. Gonadotrophic hormones are produced in the

(a) Posterior part of pituitary

(b) Adrenal cortex

(c) Adenohypophysis of pituitary

(d) Interstitial cells of testis

9. The hormone that stimulates the secretion of glucocorticoids

(a) FSH (b) ACTH (c) Cortisol (d) LH

10. The high levels of testosterone in the blood would inhibit

(a) ICSH (b) FSH (c) GH (d) Prolactin

11. In the following terms one is a Gametokinetic factor.

(a) ACTH (b) GH (c) FSH (d) TSH

12. “Water drinkers’’ is the name given to persons who have

(a) Under secretion of ADH (b) Over secretion of ADH

(c) Absence of ADH (d) Over secretion of insulin

13. Melanocyte stimulating hormone

(a) Is same as melatonin (b) Is secreted by pars tuberalis of anterior pituitary

(c) Secretion is stimulated by hydrocortisone (d) Activity is inhibited by epinephrine

14. Degeneration of anterior pituitary results into

(a) Sterility (b) Extreme weakness (c) Hypoglycemia (d) AL Multiple disorders.

15. Which of the following secretes luteizing hormone

(a) Pituitary (b) Thyroid (c) Parathyroid (d) Adrenal

16. Name the hormone secreted by heart

(a) melatonin (b) cortisol (c) gastrin (d) Atrial natriuretic hormone

17. hormone secreted by pancreas

a) Steroid (b) insulin (c) thyroxin (d) prolactin

18. Which of the following secretes luteizing hormone

(a) Pituitary (b) Thyroid (c) Parathyroid (d) Adrenal

19. Pitressin is also called as

(a) ADH (b) LH (c) NADH (d) FSH

20. A number of drugs and alcohols suppress ADH secretion. This results in

(a) Loss of thirst (b) Loss of appetite (c) Loss of urine (d) More of urine

21. The important function of vasopressin hormone is to

(a) Cause contraction of the uterus and thus help in child birth

(b) Increase reabsorption of water in the kidney tubule

(c) Stimulate the secretion of milk in the mammary glands

(d) Lower the level of blood glucose

22. Contraction of the uterus, increase in arterial pressure and reduction in urine output are produced by

(a) Oxytocin and ACTH (b) Vasopressin and TSH

(c) ADH and ACTH (d) Oxytocin and vasopressin

23. Diabetes insipidus is under the control of

(a) Aldosterone (b) ADH (c) ACTH (d) TSH

24. Which of the following gland is an example of endocrine gland

(a) Gastric gland (b) Pancreas (c)Thyroid gland (d) Both B and C

25. A hormone is a ……..

(a) Glandular secretion (b) A chemical messenger

(c) Enzyme (d) A Complex organic substance

26. In the action of protein hormone the second messenger

(a) insulin (b) C-AMP (c) Gastrin (d) TSH

27. Name the hormone that controls the action of thyroid gland

(a)TSH (b)ACTH (c)FSH (d)STH

28. Name the hormone which is present in least amount during menstruation.

(a) Oestrogen (b) Progesterone (c)LH (d)Relaxin

29. Name the hormone that controls the urine volume.

(a) ADH (b) ACTH (c) LH (d) FSH

30. The alternative name of pituitary gland is……

(a) Hypophysis (b)Thyroid gland (c) Thymus gland (d) Pineal gland

ANSWER KEY

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
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d	b	a	a	d	b	d	b	d	d	b	a	c	a	a

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