I PUC BIOLOGY CDF MATERIAL

BOTANY

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BOTANY CDF FOR I PUC

1. The living world

1. **Characters of living organisms** :
   a) Growth and development b) Reproduction c) Metabolism d) Consciousness
   The above characteristic features exhibited by the living organisms which distinguish them from non living matter.
2. **Metabolism**: It refers to the sum total of all the chemical reactions occurring in the body of an organism. The constructive metabolic process in which complex molecules are formed from simpler molecules is called anabolism. The destructive metabolic process in which complex are broken down into simpler molecules is called catabolism.
3. **Taxonomy**: Branch of biology that deals about identification, nomenclature and classification of all living organisms based on characters in to different taxa.
4. **Binomial nomenclature**: The system of providing a name with two components(generic and specific epithet) is called "Binomial nomenclature"
5. **ICBN :** International Code of Botanical Nomenclature
6. **Classification:** Assigning the plants to specific groups on the basis of their similarities and dissimilarities is called classification.
7. **Taxon**: Each category referred to as unit of classification, in fact, represents a rank and is commonly termed as taxon.
8. **Species**: According to Ernest Mayr, A species is a group of actually inbreeding populations that are reproductively isolated from other. Species is the basic unit of classification. Term species is given by John Ray.
9. Hierarchial arrangement in the ascending order is as follows
   Species →Genus → Family →Order →Class → Division → Kingdom
10. **Herbarium**: It is store house of collected plant specimens that are dried pressed and preserved on sheets.
11. **Botanical gardens**: Specialized gardens have collections of living plants for reference, plant species in these gardens are grown for identification purposes. The famous botanical gardens are at Kew(England) Indian Botanical garden, Howrah (India) and National Botanical Research Insititute, Lucknow (India)
12. **Classification of Mango:**

Division:	Angiosperms
Class:	Dicotyledons
Order:	Sapindales
Family:	Anacardiaceae
Genus:	Mangifera
species:	indica

13. **Classification of Wheat:**

Division	:	Angiosperms
Class	:	Monocotyledons
Order	:	Poales
Family	:	Poaceae
Genus	:	Triticum species: aestivum

2. Biological classification

1. Five kingdom system of classification was proposed by R.H.Whittaker, the kingdoms are Monera, Protista, Fungi, Plantae, and Animalea.

Monera:

2. All prokaryotes included under Kingdom Monera. Rod shaped bacteria are called Bacilli, spherical shaped bacteria are called cocci while comma shaped ones are called vibrio.
3. Bacteria which survive in salty areas are called halophiles. Bacteria that live in hot springs are called thermoacidophiles, while bacteria in marshy areas are called methanogens.
4. Blue green algae are regarded as cyanobacteria. Specialized cells in cyanobacteria like Nostoc, Anaebena can fix atmospheric nitrogen are called heterocysts.
5. **Mycoplasma**: These are the group of bacteria that completely lack a cell wall and pleomorphic. They are the smallest living cells known and can survive without oxygen.

Protista:

6. **Diatomaceous earth:** Diatoms have left behind large amount cell wall deposits in their habitat; these accumulations over billions of years are referred to as in diatomaceous earth. It is used in polishing, filtration of oils and syrups.
7. **Dinoflagellates:** These are marine, photosynthetic they appear yellow, green, brown, blue or red depending on the main pigments presents in their cells.
   Eg: Red dinoflagellates (*Gonyaulax*),rapid multiplication that make the sea appear red
8. **Euglenoids:** Fresh water protists without cell wall, but covered by a protein rich layer called pellicle, with two flagella, a short and long one. In presence of light they are photosynthetic, in absence of light they behave like heterotrophs by predating on the other smaller organisms. **Eg:** Euglena
9. **Protozoans** : These are the primitive relatives of animals.
   a) They move and capture their pray by putting out pseudopodia **Eg:** Amoeba,
   b) Parasitic protozoa that cause diseases such as sleeping sickness, and processes one flagellum (Trypanosoma)
   c) Protozoans that are aquatic and actively moving organisms because of presence of thousands of cilia are called ciliated protozoans
      Eg: Paramoecium).
   d) Malaria parasite plasmodium is most notorious, because it causes malarial fever in human populations, it has infectious spore – like stage in their life cycle.
10. **Fungi**: Achlorophyllous, heterotrophic thallophytes. Most fungi are heterotrophic and absorb soluble organic matter from dead substrates and hence are called saprophytes. Those that depend on living plant and animals are called parasites.
11. Chitin is the nitrogen containing polysaccharides and is the main component of fungal cell wall.
12. Fungi can also live as symbionts – in association with algae as lichens and with roots of higher plants as mycorrhiz
13. **Mycelium:** Mass of interwoven hyphae of fungi is called mycelium. Hyphae are the branches of mycelium.
14. **Plasmogamy:** Fusion of protoplasms between two motile or non-motile gametes
15. **Karyogamy:** Fusion of two nuclei.
16. **Phycomycetes** : It is an algal fungi, because these members show algal character of producing zoospores at the time of asexual reproduction **Eg:** Albugo,
17. **Coenocytic hyphae**: Long, tubular, branched thread of filaments like structures having many nuclei.
18. **Zygomycetes:** Eg: Mucor, Rhizopus.
19. **Ascomycetes:** Penicillium (Caprophilous fungi (fungi that grow on dung)), unicellular fungi Saccharomyces (yeast), Asperigillus, Claviceps and, Nuerospora. Neurospora is

used extensively in biochemical and genetic work.

20. **Basidiomycetes:** Commonly known forms of basidiomycetes are mushrooms brackel fungi or puffballs.
    Eg: Agaricus(mushroom), Ustilago(Smut fungus), Puccinia(causative agent of rust in wheat).
21. **Deutiromycotina:** Alrternaria, Colletotricum, Trichodendron
22. Deutoromycotina are commonly called Fungi imperfecti is because of the lack of sexual reproduction, and the rest of divisions Phycomycetes, Zygomycetes, Ascomycetes, Basidiomycetes are collectively called fungi perfecti is due to presence of sexual reproduction.

Viruses:

23. Virus means venom or poisonous fluid was given by Pasteur. Viruses are obligate parasites. Virus is made up of nucleic acid (DNA or RNA), protein coat (Capsid).
24. Most of plant viruses have single stranded RNA, while most of animal viruses have Single or double stranded DNA.
25. Viroid is a virus like infectious agent possesses only a nucleic acid without protein coat. **Eg:** Potato spindle tuber virus. Prion is virus like agent but possesses only genetic material.
26. Bacteriophage is tad pole shaped, while TMV (Tobacco Mosaic Virus is rod shaped)
27. M.W.Ivanowsky recognized certain mosaic disease of tobacco.
28. Beijerinek made extraction from the infected plants of tobacco. It could cause infection in healthy plants and called the fluid as **contagium vivum fluidum** (infectious living fluid)
29. W.M.Stanley showed that viruses could be crystallized and crystals consist largely of proteins.
30. **Lichen:** These are the special group of plants in which an algal member and fungal member live together as symbionts. Algal partner is phycobiont and fungal partner is called mycobiont.

3. Plant kingdom

1. **The systems of classifications**:
   a) Artificial system: It is mainly based on few possible characters. Eg: Linnaeus sexual system of classification of angiosperms.
   b) Natural system: It is based on all possible natural affinities **Eg:** Classification of phenerogams by Benthom and Hookers
   c) Phylogenetic system of classification: It is based on evolutionary relationships between the various plants.
2. **Thallus**: Plant body that is not differentiated in to root, stem and leaves is called Thallus.
3. **Algae** : Chlorophyllous, autotrophic thallophytes of cryptogamae
4. **Isogamy**: It is the fusion of structurally and functionally similar gametes.
5. **Anisogamy**: It is the fusion of structurally and functionally dissimilar gametes.
6. **Oogamy** : It is fusion of small, motile or non-motile male gamete (spermatozoid or Sperm) with large non-motile female gamete
7. **Physiological anisogamy:** It is the fusion of structurally similar but functionally dissimilar gametes.
8. **Chlorophyceae**: Also celled green algae, major pigments are chl-a,b, its stored food is starch, cell wall material is cellulose.Eg: Chlamydomonos, Volvox, Ulothrix, Spirogyra, Chara.
9. **Phaeophyceae:** Also called brown algae. Its major pigments are chl-a,c fucoxanthin, stored foods are Mannitol, laminarin starch, cell wall material is cellulose and algin.Eg: Ectocarpus, Dictyota, Laminaria, Sargassum, Fucus.
10. **Rhodophyceae:** Also called red algae. Its major pigments are chl-a,d, phycoerythrin, Its stored foods are Floridian starch, cell wall materials are cellulose, pectin and

polysulphate esters, most importantly motile cells (gametes and spores) are absent. Eg: Polysiphonia, Porphyra, Gracilaria, Gelidium.

11. **Amphibians of plant kingdom**: Bryophytes are celled amphibians of plant kingdom because these plants can live in soil but require water for sexual reproduction.
12. **Antheridia** are the male; **archegonia** are the female reproductive organs.
13. **Bryophytes** are sub-divided into Liverworts (Marchantia), Mosses (Sphagnum, Polytrichum, Funaria)
14. In liverworts, the gametophyte is thalloid like, dorsiventral and closely appressed to the substratum. Eg: Marchantia
15. Gemmae are green, multicellular, asexual bud, which develop in small receptacles called gemma cups located on the thalli. Detached gemmae germinate to form new individuals.
    Eg: Marchantia.
16. **Mosses**: Leafy gametophytes of the division bryophyte are mosses. Gametophyte has two stages viz; first protonemal stage and second leafy stage.
17. **Protonema:** In the life cycle of mosses spore germinates into a creeping, green, branched and filamentous stage called protonema, it is the first stage of gametophyte.
18. Leafy gametophyte originates from secondary protonema and possesses upright slender axis bearing spirally arranged leaves. This stage bears sex organs.
19. In the life cycle of bryophytes, the haploid gametophyte is dominant, long, lived, green, independent where the diploid sporophyte is short lived and dependent partially upon the gametophyte.
20. **Vascular cryptogams:** Pteridophytes are called vascular cryptogams, is because of they possess xylem and phloem tissue in their roots, stems and leaves.
21. In the life cycles of pteridophytes, the diploid sporophyte is dominant, long lived, green, independent, where the haploid gametophyte is also green, autotrophic but completely independent from sporophyte.
22. **Prothallus**: In the life cycle of pteridophytes, spore germinates to give rise an inconspicuous, small but multicellular, free living, photosynthetic thaloid gametophyte called prothallus.
23. **Homospory:** It is the production of only one type of spores by the majority of pteridophytes is called homospory. Eg: Lycopodium.
24. **Heterospory:** It is the production of two kinds of spores i.e., male or micro and female or megaspores from micro and megasporangia respectively. Eg: Selagenella and Salvinia
25. **Gymnosperms**: These are the group of flowering woody plants with naked seeds. Eg: Cycas
26. **Cones or Strobilus:** Sporophylls are usually aggregated to form compact structures called cones or Strobilus.
27. **Megasporophylls:** The leaf like structure bearing megasporangiua. In angiosperms it is represented by carpel, while microsporophyll is represented by stamen.
28. **Megasporangium:** The structure in which megaspores are formed. In seed plants it corresponds to ovule.
29. Archegonium is the female reproductive organ in all bryo and pteridophytes. Antheridium is the male reproductive organ in algae, bryo and pteridophytes.
30. **Angiosperms**: (Angio = covered; sperma = seed), fruit yielding flowering plants.
31. **Dicotyledons:** (Di = two) Plants that produce seeds with two cotyledons.
32. **Monocotyledons:** (Mono = One) Plants that produce seeds with one cotyledons.
33. **Ovule:** It is an integumented megasporangium. It has integuments, nucellus, funiculus(stalk), micropyle.
34. **Double fertilization:** Occurrence of two types of fertilizations in the same ovule i.e happening of fertilizations in two places in embryo sacs of angiosperms is called double fertilization. One at female gamete that is called Syngamy. And one at secondary nucleus i.s triple fusion.
35. Syngamy results zygote (2n), that later gives rice to embryo. Triple fusion results Primary endosperm nucleus (3n) that gives rise to endosperm.

36. **Haplontic life cycle**: Life cycle in which only zygote or zygospore is diploid and the rest of the stages are haploid like plant body, gametes, spores that give haploid plants.
Eg: Spirogyra, Oedogonium, Chlamydomonos, Rhizopus.
37. **Dipontic life cycle**: Life cycle in which only spores and gametes are haploid, but the rest of the structures are diploid like zygote, plant body. The gametophyte phase is represented by the single to few celled haploid gametophyte. Eg: Fucus, Sargassum.
38. **Haplodiplontic life cycle:** In the members of bryophytes gametophyte is haploid and is dominant and dependent, long lived followed by partially dependent sporophyte which is diploid, here both phases alternates with each other in their life cycle.
39. **Diplohaplontic life cycle:** In the members of pteridophytes diploid sporophyte is dominant and is independent produces the haploid gametophyte, here both alternate with each other, so called diplohaplontic life cycle.

4. Morphology of flowering plants

1. **Tap root system**: Root system formed from radicle of embryonal axis and possesses primary root or tap root, branches or lateral roots. Eg: all dicots.
2. **Fibrous root system:** These are the tread like roots originates from the base of stem, but not from the radicle. **Eg:** All monocots
3. **Adventitious root system**: Roots that are developing from anywhere except the radicleis known as adventitious root system. **Eg:** Fibrous roots, Prop roots, Stilt roots etc.
4. **Root hairs:** Unicellular tubular epidermal extensions that appear like hairs of roots help in the absorption of water and minerals.

Modifications of roots:

5. Tap roots of carrot and turnip modify in to storage or tuberous roots.
6. Adventitious roots of sweet potato modifies into tuberous roots.
7. Prop roots are hanging roots that support banyan tree. In maize and sugarcane supporting roots coming out of the lower nodes of the stem are called Stilt roots.
8. In Rhizophora many roots come out of the ground and grow vertically upwards such roots are called pneumatophores, help to get oxygen for respiration.

Stem modifications:

9. Underground stems of potato, ginger, turmeric, zaminkand, colocasia are modified to store food in them.
10. Stem tendrils develop from axillary buds, tendrils are slender and spirally coiled and help plants to climb. Eg: Cucumber, Pumpkins, Watermelon, grapevines.
11. Thorns are found in many plants such as citrus, Bougainvillea. These are woody, straight, pointed structures help on providing protection from browsing animals.
12. In Opuntia and Euphorbia stems are modified in to phylloclades.
13. In aquatic plants like *Pistia & Eichornea* stem is modified into off-sets.
14. In banana, pineapple and chrysanthemum, some lateral branches are modified into sucker.
15. ***The Leaf***: Leaf is the lateral appendage, generally flattened structure borne on the stem. The part of leaf Stalk of leaf is called petiole. The parts of the leaf are leaf base, petiole, lamina with veins and vein-lets.
16. Petiole is the stalk of leaf, while pedicel is the stalk of flower.
17. **Pulvinus leaf base**: In some leguminous plants leaf base become swollen, which is called pulvinus leaf base.
18. **Venation**: Mode of arrangement of veins and vein-lets on the leaf blade or lamina is called venation. Dicots generally possess reticulate venation, while in monocots parallel venation is present.
19. **Phyllotaxy**: Mode of arrangement of leaves on stem is called phyllotaxy. In alternate phyllotaxy, a single leaf arises at each node in alternate manner. Eg: China rose.
20. In opposite phyllotaxy a pair of leaves arise at each node and lie opposite to each other. **Eg:** Calotropis

21. **Inflorescence**: Mode of arrangement of flowers on stem is called inflorescence; its axis is called peduncle. In recemose type of inflorescence the main axis continues to grow, the flowers are borne laterally in an acropetal succession. In cymose type main axis terminates in a flower, the flowers born on basipetal order.
22. **Thalamus:** Terminal end of pedicel or floral axis which supports the all floral appendages like sepals, petals, stamens and carpels. It is also called torus, receptacle.
23. **Actinomorphic flower:** A flower with radial symmetry can be divided in to two equal radial halves in any radial plane passing through centre. Eg: Mustard, Datura, Chilli
24. **Zygomorphic flower:** A flower with bilateral symmetry can be divided into two equal halves only in one particular, vertical plane. Eg: Pisum, Beans, Cassia
25. **Asymmetric flower**: A flower which can't be divided into two equal halves by any radial plane in to two equal halves is called asymmetric flower. Eg: Canna
26. **Hypogynous flower**: Flowers are described Hypogynous when the upper part of thalamus is slightly swollen and gynoecium occupies highest position, while the other flower parts like stamens, petals, sepals are situated below it, hence the ovary is superior. Eg: Mustard, China-rose, Brinjal.
27. **Epigynous flower**: Flowers are described epigynous when the thalamus is deep-cup like and the margins of the thalamus grows upwards enclosing the ovary completely and getting fuse with it, hence the ovary is inflower. Eg: Guava, Cucumber, Ray florets of Sunflower.
28. **Perigynous flower**: Flowers are described perigynous when the thalamus is disc shaped & gynoecium is situated at the centre and the other parts are located at the rim of the thalamus almost the same level. Ovary is half inferior and half superior. Eg: Plum, Rose, Peach etc.,

Part of flower:

29. Pedicel is the stalk of flower, tip of pedicel or floral axis is called receptacle or thalamus or torus. Calyx (group of sepals) and corolla (group of petals) are called accessory organs. Androecium (group of stamens) and gynoecium (group of carpels) are the reproductive organs.

Aestivation: Mode of arrangement of petals or sepals in relation to one other in a floral bud is called aestivation.

30. **Vexillary aestivation**: In Pea and bean flowers, there are five petals; the largest (Standard) petal overlaps the two lateral petals (wings) which in turn overlap the two smallest anterior petals (Keel). This type of aestivation is known as vexillary aestivation

Androecium

31. It is composed of stamens.
32. **Satminode**: Sterile stamen is called staminode. Eg: Cassia spp.
33. **Monodelpous stamens**: All the stamens of a flower are united in to one bundle by fusion of their filaments only, but the anthers are free. Eg: Hibiscus etc.,
34. **Diadelphous stamens:** All the stamens of the flower are united in to two bundles by fusion of their filaments only, but the anthers are free. Eg: *Pisum sativum.*
35. **Polydelphous stamens**: Filaments of all the stamens unite to form more than two groups, but the anthers are free. Eg: Citrus.

Gynoecium

36. It is composed of one or two or more carples. It shows three parts namely, ovary, style and stigma.
37. Apocarpous ovary : Carpels are free. Eg: Lotus, Rose.
38. Syncarpous ovary: Carpels are fused. Eg: Mustard, Tomato.
39. **Placentation**: Arrangement of ovules within the ovary on flattened cushion-like structure placenta is called placentation. Marginal (Eg:Pea), Parietal (Mustard, Argemon), Free central (Dianthus, Primerose), Basal placentation (Eg: sunflower, Marigold)
40. **Parthenocarpic fruit:** Fruit that is formed without fertilization of the ovary is called parethenocarpic fruit.
41. **Pericarp**: Wall of fruit is called pericarp, it is divided into three layers, outer epicarp,

mesocarp and endocarp in fleshy fruits, but not in dry fruits.

42. **Drupe:** Fleshy fruit that is developed from monocarpellary, superior ovary and is one seeded. Eg: Mango, Coconut.
43. **Testa and Tegmin**: Outer and inner layers of seed formed from outer and inner integuments respectively.
44. **Endosperm**: It is the food storing tissue formed by triple fusion during double fertilization. Eg: Castor seeds.
45. **Aleurone layer**: The outer covering of endosperm separates the embryo by a proteinous layer is called aleurone layer. Rice, Maize seeds etc.,
46. **Sculellum:** It is large shield shaped cotyledon which is closely pressed against the endosperm and helps in the translocation of nutrients from endosperm to the growing embryo at the time of germination and seedling growth.
47. **Plumule and Radicle**: Plumule is part lies in between the two cotyledons give rise to shoot system; radicle is the embryonic root gives rise to root system during seed germination.

Description of some important families:

48. Fabaceae(Papilionoideae) Important feature of the family
    a) Pulvinus leaf base is present. Flowers are zygomorphic
    b) Sepals are five, gamasepalous with imbricate aestivation.
    c) Petals are five, polypetalous, with papilionaceous corolla. It aestivation is vexillary
    d) Stamens are ten, diadelphous.
    e) Many plants are the sources of pulses (gram, moong, soyabean etc.,), some are yielding edible oils (Eg: Soyabean, ground nut).
49. Solonaceae (Potato family): Important feature of the family
    a) In Potato underground stem (stem tuber) is edible.
    b) Leaves are simple, alternative and extipulate.
    c) Sepals are five, gamasepalous, persistent in brinjal, tomato etc.
    d) Stamens are epipetalous, gynoecium is bicarpellary, bilocular, syncarpus.
    e) Some members are the good source of food (Eg: Tomato, brinjal, potato), spice (Chilli), medicine (belladonna, aswagandha), fumigator (tobacco)
50. Liliaceae (Lily family), it is a monocot family. Important feature of the family
    a) In some members stems are modified in to bulbs (Onion,Garlic), corm, rhizomes.
    b) Leaves are alternate, extipulate with parallel venation.
    c) Inflorescence is solitary/cymose, umbel type (Allium).
    d) Flowers are trimerous, Actinomorphic, tepals are 3+3
    e) Stamens are six (3+3), Gynoecium is tricarpellary, trilocular, syncarpus.
    f) Many members of the family are good ornamentals (tulip, Gloriosa); some are source of medicine (Aloe), vegetables (Asparagus) and Colchicine, a chemical mutagen (Colchicum autumnale.)

5. Anatomy of flowering plants

1. **Meristem**: Group of cells which are in continuous state of division and add new cells to the plant body (or) embryonic tissue consisting of actively dividing cells located in specific regions of plants is called meristem.
2. Meristems are of three types based on their position, viz; apical, intercalary, and lateral. Apical meristem occurs at the tips of roots, shoots and produce primary tissues.
3. **Intercalry meristems** occur between mature tissues in grasses. Both apical and intercalary meristems are primary meristems because they give primary tissues.
4. **Lateral meristem or secondary meristem**: Meristem that occurs in the mature regions of roots and shoots of many plants, particularly those that produce woody axis and appear later than primary meristem. Eg: Vascular cambium & Cork cambium
5. **Permanent tissues**: Tissues that have lost the ability to divide and formed to

perform specific functions. These are of three types based on the structure and function as follows; Simple, Complex and Special types.

6. **Simple tissues** are one which are made up of only one type of cells and perform the same function. They divided in to three types as follows;
Parenchyma : It occupies the major parts of the plant body perform various functions like photosynthesis, storage, secretion.
Collenchyma : It is the living mechanical tissue. It consists of cells which are much thickened at the corners due to the deposition of cellulose, hemicelluloses and pectin. It provides mechanical support to the parts of the plant such as young stem and petiole of a leaf.
Sclerenchyma : It is the dead mechanical tissue. It consists of long narrow cells with thick and lignified cell walls having a few or numerous pits.
7. **Complex tissue**: Tissue made of more than on type of cells and these work together as a unit. Xylem and Phloem are the complex or vascular tissues.
8. **Xylem**: It is the chief water conducting vascular tissue responsible for conduction of H_2O and inorganic solutes. It is made up of xylem vessels, xylem trachieds, xylem fibers and xylem parenchyma.
9. **Phloem**: It is the chief food conducting tissue responsible for conduction of organic solutes. It is composed by sieve elements, companion cells, phloem, and Phloem parenchyma.
10. **Protoxylem**: It is the first formed xylem lies towards pericycle in roots stele with vessels having narrow lumen, while in stems stele protoxylem lies towards medulla with vessels having narrow lumens.
11. **Metaxylem**: It is the later formed xylem lies towards medulla in roots stele with vessels having wider lumen, while in stems metaxlem lies towards pericycle with vessels having narrow lumens.
12. **Endarch**: It is the condition of primary xylem in which protoxylem lies towards the medulla while metaxylem lies towards periphery i.e pericycle. Eg: Stems
13. **Exarch**: It is the condition of primary xylem in which protoxylem lies towards periphery while metaxylem lies towards centre i.e medulla Eg: Roots.

Epidermal tissue system: It forms the outer most covering of the whole plant body and comprises epidermal cells,stomata and epidermal appendages like trichomes and hairs.

14. **Stomata**: These are the natural openings found in the epidermis of leaves and green parts of stem to regulate the process of transpiration and exchange of gasses.
15. **Stomatal apparatus**: It is made up of stomatal aperture, guard cells and surrounding subsidiary cells are together called stomata apparatus.
16. Cells of epidermis bear a number of hairs called root hairs; they are unicellular elongations of the epidermal cells and help absorb water and minerals from the soil. On stem the epidermal hairs are multicelullar called trichomes.

Ground tissue system:

17. **Mesophyll**: It is the bulk of tissue lying between upper and lower epidermis (excepting vascular bundle) is called mesophyll. In dicot leaves it is differentiated into palisade and spongy parenchyma, while in monocot leaves it is not differentiated in to palisade and spongy parenchyma but composed of similar cells.

Vascular tissue system:

18. **Vascular Cambium**: It is the lateral or secondary meristem found in between xylem and phloem tissues in vascular bundles which participates in secondary growth.
19. **Open and Closed vascular bundles**: Vascular bundles with a strip of cambium separating xylem and phloem tissues are called open vascular bundles. **Eg:** Dicot stems. In closed type of vascular bundles cambium is found to absent. **Eg:** Monocot stem
20. **Radial vascular bundles**: xylem and phloem strands are arranged alternatively on different radius in roots steles are called radial vascular bundles.

Dicotyledonous root & Monocotyledonous root:

21. **Casparian strips**: These are the bands found radial and transverse walls of endodermis made up of waxy subarised material and makes the cells impermeable to water.
22. **Conjunctive tissue**: Parenchymatous cells which lie between the xylem and the phloem are called conjunctive tissue.
23. Generally in roots vascular bundles are radial type, primary xylem is exarch, in dicots generally tetrarch type, while in monocots it is polyarch (more than four bundles) type.
24. In dicot roots pericycle shows cambium activity and participates in secondary growth, but in monocots roots do not undergo any secondary growth. Lateral roots arise from pericycle in roots.

Dicotyledonous stem:

25. Stem internally divided into three zones, viz; Epidermis, cortex, stele.
26. Cells of endodermis are rich in starch grains and the layer is also referred as **starch sheath**. Vascular bundles are arranged in a circle, each vascular bundle is conjoint, colleteral, **open** and endarch type.

Mnocotyledonous stem:

27. Internally stem of monocots is divided into epidermis, ground tissue and scattered vascular bundles, but cortex, endodermis, pericycle and medulla are found to be absent. Beneath the epidermis, sclerenchymatous hypodermis followed by ground parnchymatous tissue, scattered vascular bundles.
28. In monocots stem, vascular bundles scattered, but not arranged in a circle, but are conjoint, collateral, **closed** and endarch type.

Dorsiventral (Dicotyleeonous) leaf:

29. Mesophyll is differentiated in to palisade and spongy parenchyma. Palisade parenchyma lies beneath the upper epidermis, while spongy parenchyma lies beneath the lower epidermis. Stomata are larger in number in lower epidermis. Veins and vascular bundles are arranged reticulate on lamina.

Isobilateral (Monocotyledonous) leaf:

30. Mesophyll is not divided into spongy and palisade parenchyma, bur mesophyll is occupied by same kind of tissue. Stomata is equally distributed on both upper and lower epidermal layers. Vascular bundles or veins are arranged parallel on lamina.
31. **Bulliform cells or motor cells**: In grasses, certain adaxial epidermal cells along the veins modify themselves into large, empty, colourless cells.

Secondary growth in stems:

32. **Lateral meristem**: It is the cork or vascular cambium involves in secondary growth for lateral enhancement of the plant body. Eg: Cambium (Vascular & Cork cambia)
33. **Intrafascicular cambium**: In dicot stems, the cells of cambium present between primary xylem and primary phloem.
34. **Interfascicular cambium:** The cells of medullary rays, adjoining intrafascicular cambium become meristematic and form the interfascicular cambium.
35. **Secondary medullary rays**: At some places of stele the cambium forms narrow bands of parenchyma, which passes through the secondary xylem and the secondary phloem in the radial direction.
36. **Spring wood or Early wood**: In spring season, cambium is very active and produces a large number of xylary elements having vessels with wider cavities, the wood forming during this season is called spring wood.
37. **Autumn wood or later wood:** In winter, the cambium is less active and forms fewer xylary elements that have narrow vessels, and this wood is called autumn wood or late wood.
38. **Heart wood:** It is the region in the wood where dead elements with highly lignified walls is called heart wood. It does not conduct water but it gives mechanical support to the stem.
39. **Sap wood:** It is the peripheral region of the secondary xylem and is lighter in colour, involves in the conduction of water and minerals form root to leaf.
40. **Phellem:** It is the cork tissue which is dead formed by the cork cambium or

phellogen. Phellogen cuts the cells in to outer side which becomes dead later.

41. **Phelloderm:** It is the secondary cortex formed by phllogen or cork cambium towards inside to phellogen.
42. Periderm: Layer of cork, cork cambium and secondary cortex constitute the protection covering called periderm. Periderm = Phellum(cork) + Phellogen (cork cambium) + Phelloderm (secondary cortex)
43. **Bark:** Part of woody stem composed by secondary phloem and periderm (Phellum(cork) + Phellogen (cork cambium) + Phelloderm (secondary cortex))
44. **Lenticels:** There the chief aerating structures occurs as a raised corky spot in the periderm of stem. It is usually formed below and old stoma of stoma where the cork cambium is more active and cuts a mass of loosely arranged cells called complementary cells possess numerous intercellular spaces.
45. **Annual rings:** The two bands of secondary xylem, i.e., autumn wood and spring wood, produced in one year, is called and annual ring. The annual rings of woody angiosperms are much distinct and one can easily determine the age of plant by counting the annual ring, the study discusses is called dendrechronology.

Structure and functions

6.Cell : The unit of life

1. **Cell theory:** It is proposed by M.Schleiden and T.Schwann. This theory states that living beings are composed of cells, all cells are basically alike in structure and metabolic activities, functions of an organism depends on the activities and interactions of the cell, the cells are considered as structural and functional units of organisms.
2. **Omnis cellula – e – cellulae**: This statement is given by Rudolph Virchow, which means all cells are formed from pre-existing cells.
3. **PPLO`s:** (Pleuro Pneumonia Like Organisms). These are smallest cells of all. They belong to Mycoplasma. They lack cell wall.
4. **Mesosome**: It is the special membrane structure formed by the extensions of plasma membrane in to cytoplasm of prokaryotic cells. It helps in cell wall formation, DNA replication, respiration and secretion processes.
5. **Fluid mosaic model:** This is proposed by Singer & Nicolson. This explains the selective permeable nature of plasma membrane, protein molecules float as icebergs in a ocean of fluid lipid matrix.
6. **Endoplasmic reticulum:** Network or reticulum of tiny tubular structures scattered in the cytoplasm, extending from nuclear membrane to periphery. If it has ribosomes, then it (RER) involves in protein synthesis. If it has no ribosomes, then it (SER) involves in lipid synthesis.
7. **Golgi Complex:** It is made up of cisternae, vescicles, tubules. It involves in the cell wall material synthesis and production of lysosomes, discovered by Camello Golgi.
8. **Suicidal bags:** Lysosomes are called suicidal bags of the cell. These are spherical, single membrane bounded cell organelles filled with hydrolytic enzymes. Lysosomes are formed from Golgi complex and involves in autophagy, heterophagy, autolysis of the cell.
9. **Power house of the cell:** Mitochondria are called power houses of the cell, is because they covert potential energy in to kinetic energy and stores in the form of ATP. Benda coined the term Mitochondrion.
10. **Protein factories:** Ribosomes are called protein factories, because these are the sites of protein synthesis. These are of two types 70S and 80S. the former one are found in cytoplasm of prokaryotic cells, mitochondria, chloroplasts, while the later ones found in cytoplasm of all eukaryotic living cells.
11. **Leucoplasts:** These are colourless plastids, which are concerned with the storage of organic food material, further classified in to three types;

1. **Amyloplasts:** Starch storing leucoplasts are called amyloplasts. Eg: Potato tubers, Wheat, rice grains.
2. **Elaioplasts:** Fats oil storing leucoplasts are called elaioplasts. Eg: Endosperm of castor seeds.
3. **Aleuroplasts:** Protein storing leucoplasts are called Aleuroplasts. Eg: Seeds of pulses

12. **Cell brain or dynamic centre of the cell or Master control of the cell**: Nucleus. It coordinates and regulates the metabolic activities of the cell, found only in eukaryotic living cells. Discovered by Robert Brown.
13. **Ribosomal factories:** Nucleoli are called ribosomal factories because; these are the sites of ribosomal synthesis.

7. Biomolecules

1. **Primary metabolism:** Organic compounds with identifiable functions and play known role in normal physiological processes are called Primary metabolites. Eg: Carbohydrates, Proteins, fats.
2. **Secondary metabolites:** These are the metabolic products that do not have identifiable functions in the host organism are known as secondary metabolites. Eg: Alkaloids, Flavonoids, Antibiotics, gums etc.,
3. Proteins are polypeptide chains made up of amino acids liked with peptide bonds, so proteins are the polymers of aminoacids. Each aminoacid is made up of amino group, carboxylic group, hydrogen, R-group.
4. Callogen is the abundant protein in animal world, Ribulose biphosphate carboxylase, oxygenase is the most abundant protein in the whole of biosphere.
5. Polysaccharides are long chains of sugars. Starch is the storage carbohydrates in plants, glycogen is the storage carbohydrates in animals, and cellulose is the abundant organic substance on earth and forms structural component in plant cell.
6. Chitin is substance of exoskeleton of arthropods and fungal cell wall material.
7. Lipids are esters of fatty acids, each fatty acid has COOH group attached to a R-group, it may be CH3 or ethyl group (C2H5).
8. **Enzymes:** These are the organic catalysts in living organisms so called biocatalysts, without undergoing any changing its self, they can regulate the metabolic activities and accelerates the chemical reactions.
9. All enzymes are proteins, but all proteins are not enzymes. If enzymes are made up of only proteins, then called simple enzymes(Pepsin, Trypsin), while enzymes with protein and non-protein part are called holoenzymes or conjugated enzymes.
10. Protein part of an enzyme is called apoenzyme, non – protein part of holoenzyme is called cofactor.
11. Nucleic acids (DNA&RNA): These are the polymers of nucleotides. Nucleotide = N_2 base + Pentose sugar + Phosphate. Nucleoside = Nitrogen base + Pentose sugar. Adenine, Guanine N_2 bases are purines, while Thymine, Cytosine and Uracil are the pyrimidines.
12. Double hydrogen bonds are present in between adenine and thymine nitrogen bases of complementary nucleotides of double stranded DNA, Triple hydrogen bonds are present in between Guanine and Cytosien nitrogen bases of complementary nucleotides of double stranded DNA.

8.Cell cycle and Cell divisions

1. **Cell cycle:** The sequence of events by which a cell duplicates it genome, synthesis the other cellular constituents and eventually divides in to two daughter cell is termed as cell cycle.

2. **Phases of cell cycle**: Interphase and M (Mitosis & Meiosis)-phase.
3. **Interphase**: In the cell cycle the stage at which in between two successive divisions, during which no karyokinesis occurs but the following three stages takes place in nucleus.
   G_1 phase (Gap phase 1): Cell increase in size. RNA and proteins are synthesized in a large quantity S-Phase
   (Synthesis phase): DNA present in chromatin duplicates or doubles.G_2 phase (Gap phase 2): Synthesis of proteins and RNA continues. Various cell organelles are newly synthesized.
4. **Mitosis Or Somatic cell division Or Vegetative cell division Or Equational division Or Homotypic cell division:** It is defined as the division during which a parental cell (n, 2n, 3n, 4n etc cells) divides and produces two daughter cells which are genetically and phenotypically exactly similar to parental cell.
5. **yokinesis**: Division of nucleus, it has four sub-stages (Prophase, Metaphase, Anaphase & Telophase)
6. **Cytokinesis**: Division of cytoplasm is called cytokinesis.
7. **Prophase**: During this phase each chromosome splits longitudinally into two parts called chromatids, which united at the centromere. Later on nuclear membrane, nucleoli, nucleoplasm disappears.
8. **Metaphase**: During this phase formation of spindle fibers and orientation of chromosomes on equatorial region takes place. Metaphase chromosomes are ideal structures for the study of chromosomes.
9. **Anaphase**: During this phase Spindle fibers contracts, so pressure is caused on the centromeres, as a result centromere divides and chromatids are separated, spindle fibers pull the daughter chromosomes to the opposite poles, depending up on the position ofcentromere, daughter chromosomes appear in the shape of V, L, or I.
10. **Telophase**: During this phase daughter chromosomes arrived at the poles become thin, long and loose their visibility due to decondensation of chromatin. The nuclear membrane, nucleolus reappears. Finally two daughter nuclei are formed.
11. **Significance of Mitosis**:
    a) Growth of an organism is caused by mitosis.
    b) Daughter cells are identical with the parent cell. It is important in conserving the genetic integrity of the organism.
    c) In unicellular organisms, it helps in reproduction.
    d) It helps in rear and tear mechanism of the plant body and also useful in the healing of wounds.
    e) It is useful in the regeneration of lost parts and grafting in vegetative reproduction.
12. **Meiosis or Reduction division**: Division by which parental cell (2n,4n,6n,8n) divides into four daughter cells and their chromosomal number reduces to exactly half. During this division nucleus divides twice but chromosome divides only once.
13. **Meiosis occurs in two stages;** Meiosis I and Meiosis II. Meiosis is called heterophytic division, here chromosome number reduced to half in two daughter nuclei.
14. Meiosis I has four phases; Prophase I, Metaphase I, Anaphase I and Telophase I. Prophase I is divided in to five sub-stages based on chromosomal behavior.
    Leptotene, Zygotene,Pachytene, Diplotene & Diakinesis.
15. During leptotene nucleus enlarges in size, chromosomes are thin, elongated, slender.
16. During zygotene homologous paternal and maternal chromosomes attract each other and form pairs. Pair is called bivalent, Pairing is called synapsis.
17. **Pachytene**: It is the significant phase of all Prophase I phases.
    The following changes are taking place:

a) Long losting phase of meiosis is pahcytene. Each chromosome splits into two sister chromatids.
b) A bivalent containing four chromatids is called pahcytene tetrade or tetravalent.
c) The chromatids of one chromosome of bivalent are called sister chromatids, Chromatids of different chromosomes of a bivalent are called non-sister chromatids.
d) Non – sister chromatids are coiled with each other and the point of physical contact

with each other is called chiasmata.

e) Due to the formation of chiasmata genetic material is exchanged to have new genetic recombinations. This process is called crossing over.

f) The non-sister chromatid fragments are exchanged and are reconnected by an enzyme called **ligase.**

17. **Dipotene:** It is characterized by contraction and thickening of the chromatid which is called condensation. Homologous chromosomes repel with each other due to weakening of synaptic force.
18. **Diakinesis**: This is marked by terminalization of chiasma. The displacement of chiasmata is known as terminalization. Nucleolus, Nuclear membrane disappears.

Significance of Meiosis:

1) It helps in maintaining the chromosomal number constantly from one generation to the other.
2) New genetic recombination's are due to crossing over with leads in variations.
3) Variations lead to evolution.
4) Meiosis helps in the formation of gametes which are useful in sexual reproduction.

PLANT PHYSIOLOGY

9. *Transport In Plants*

Introduction

1. **Translocation**: Movement of organic solutes from the region of the synthesis (leaf) to the region target site (root) is called translocation. Or Bulk movement of substances through the conducting tissue or vascular tissue is called translocation.

Means of transport

2. **Diffusion**: Movement of molecules form the region of higher concentration to the region of lower concentration along the concentration gradient.
3. Membrane proteins provide sites at which such molecules cross the membrane. They do not set up a concentration gradient: a concentration gradient must already be present for molecules to diffuse even if facilitated by the proteins. This process is called **facilitated diffusion.**
4. The **popins** are proteins that form huge pores in the outer membranes of the plastids, mitochondria and some bacteria allowing molecules upto the size of small proteins to pass through.
5. In a **symport**, both molecules cross the membrane in the same direction; in an when a molecules moves across a membrane independent of other molecules, the process is called **uniport.**
6. **Transpiration**: The loss of water in the form of vapour from the aerial parts of the plant into the external atmosphere is called ***transpiration***.

Plant Water Relations

7. **Water potential (Ψ_w)**: It is the difference between free energy of water molecule of a pure solvent to free energy of water molecule of a solution. Water potential is denoted by Ψ_w. The components of water potential are osmotic potential, pressure potential and matric potential.
8. **Osmotic or solute potential**: The quantum by which water potential gets lowered on account of solutes is described as the osmotic potential or solute potential. It always as negative value. It is denoted by $\Psi\pi$ or Ψ_s
9. **Pressure potential**: The quantum of change in water potential owing to pressure is termed as ***pressure potential***. It is denoted by Ψ_p
10. **Matric potential:** The quantum by which water potential gets lowered on account of matric forces is matric potential. It is represented by Ψ_T.With in living, fully hydrated cells; the influence of matric potential to water potential is negligible.

11. Water potential value can be calculated by using the formula $\Psi\pi = \Psi_s + \Psi_p$

Osmosis:

12. **Osmosis**: It is the diffusion of water molecules from a region of lower concentration to the concentrated solution when the two are separated by means of a semi permeable membrane, Or Movement of solvents from the region of higher water potential to the region of lower water potential.
13. **Plasmolysis:** When a cell is placed in a hypertonic solution, the water potential gradient favours the loss of water from the cell, this shrinkage of protoplast of cell due to loss of water is called **plasmolysis**. It is by exosmosis, during endosmosis entry of water or solvents occur in the cell, the cell becomes turgid.
14. Hypertonic solution Exosmosis Plasmolysis Flaccidity
15. Hypotonic solution Endosmosis Deplasmolysis Turgidity.
16. **Imbibition**: It is the phenomenon in which surface adsorption of water molecule takes place by hydrophilic substances.
17. **Apoplast:** It is the system of adjacent cell walls that is continuous throughout the plant, except at the casparian strips of the endodermis in the roots.
18. **Symplast:** It is the system of interconnected protoplasts. Neighbowring cells are connected though cytoplasmic strands that extent through **plasmodesmata**.
19. The inner boundary of cortex, the endodermis, is impervious to water because of a band of suberised matrix called the casparian strip.
20. Mycorrhiza is a symbiotic association of a fungus with in a root system.

Water movement up a plant

21. **Guttation**: Loss of water in the form of droplets through specialized structures called hydathodes known as **guttation**.
22. Water is mainly pulled or pushed through the plant, and that the driving force for this process is transpiration from the leaves, this is reffered as cohesion-tension-transpiraiton pull.
23. **Transpiration :** The loss of water in the form of vapour from the aerial parts of the plant into the external atmosphere is called ***transpiration***.
24. **Cohesion**: mutual attraction between water molecules.
25. **Adhesion:** attraction of water molecules to polar surfaces such as the surface of tracheary elements
26. **Surface tension:** Water molecules are attacted to each other in the liquid phase more than to water in the gas phase.

Uptake of mineral ions:

27. **Active absorption:** The ion uptake by plants involving the utilization of metabolic energy is defined as active absorption.
28. **Passive absorption:** It is the transport propelled by physical driving forces, metabolic energy is not utilized for absorption.
29. **Phloem transport:** It conducts foods synthesized in the regions of source to the sink where storage occurs. It is bidirectional because the direction of movement in the phloem can be upwards or downwards, this contracts with that of the xylem where the movement is always unidirectional i.e upwards.
30. **Mass flow hypothesis or pressure flow hypothesis:** It was first explained by Ernest Munch, so also called munch flow hypothesis. This theory explains translocation process.

10. Mineral nutrition

Methods to study the mineral requirements of phloem:

1. **Hydroponics**: Technique of growing plants growing in a nutrient solution is known as hydroponics.

Essential mineral elements:

2. **Criteria of essentiality**:

1. The element must be absolutely necessary, for supporting normal growth and reproduction. In the absence of the element the plants do not complete their life cycle or set the seeds.

2. The requirement of the element must be specific and not replaceable by another element, In other words, deficiency of any one element cannot be met by supplying some other element.
3. The element must be directly involved in the metabolism.
3. **Macronutrients**: Nutrients generally required in large amounts are called macro nutrients. They include Carbon, Hydrogen, Oxygen, Nitrogen, Phosphorous, Sulphur, Potassium, Calcium, Magnesium.
4. **Micronutrients**: Also called trace elements, nutrients generally required in small quantities are called micronutrients. They include Iron, Manganese, Copper, Molybdenum, Zinc, Boron, Chlorine, Nickel.

Role of micro and macro nutrients:

5. **Nitrogen**: It is absorbed mainly as NO_3^- or NH_3. It is the most important constituent of proteins, nucleic acids, vitamins and hormones.
6. **Phosphorus**: It is absorbed by the plants from soil in the form of phosphate ions H_2PO^{-2} or HPO^2_4 . It is the constituent of cell membrane and all nucleic acids and few proteins, nucleotides and is required for all phosporylations.
7. **Potassium**: It is absorbed as K^+ ions. In plants is more abundant in the meristematic tissues, buds, leaves and root tips. It helps to maintain an anion-cation balance in cell and involved in protein synthesis and opening and closing of stomata.
8. **Calcium**: It is absorbed as calcium ions (Ca^{2++}). It occurs in middle lamella in the form of calcium pectates.
9. **Magnesium**: It is absorbed by plants in the form of divalent Mg^{2+}. It activates the enzymes of respiration, photosynthesis and are involved in the synthesis of DNA and RNA, It is the major constituents of the ring structure of chlorophyll and helps inmaintaining the ribosome structure.
10. **Sulphur**: It is absorbed by plants in the form of SO^{2-}_4. It is the important constituent element of two amino acids cysteine and methionine.
11. **Iron**: It absorbed by plant in the form of ferric ions(Fe^{3+}). It is required in large amounts in comparison to other micronutrients. It is an important constituent ferredoxin, cytochromes.It is essential for the formation of chlorophyll.
12. **Manganese**: It is absorbed in the form of Mn^{2+}. It activates many enzymes involved in photosynthesis, respiration and nitrogen metabolism. It mainly involves in the splitting of water molecule to liberate oxygen during photosynthesis.
13. **Zinc**: It is obtained to the plant in the form of Zn^{2+}ions. It activates various enzymes especially carboxylases. It is also needed in the synthesis of auxins.
14. **Boron**: It is absorbed as Borate ions (BO^3_3 or $B_4O^{2-}_7$). It is required for uptake and utilization of Ca^{2+}, membrane functioning, pollen germination, cell elongation, cell differentiation and carbohydrate translocation.
15. **Molybdenum**: Plant obtain in the form of molybdate ions (MoO^{2+}_2).It is the component of nitrogenase and nitrate reductase. It helps in nitrogen metabolism
16. **Chlorine**: It is absorbed in the form of chloride anions (Cl^-). It helps in determining the solute concentration and anion-cation balance in cells. It is essential for the water splitting reaction in photosynthesis, a reaction that leads to oxygen evolution.

Deficiency symptoms of essential elements:

17. **Critical concentration**: Concentration of the essential element below which plant growth is retarded is termed as critical concentration.
18. **Chlorosis**: It is the loss of chlorophyll leading to yellowing in leaves. This symptom is caused by the deficiency of elements N, K, Mg, S, Fe, Mn, Zn and Mo
19. **Necrosis or death of leaf tissues**: It is due to the deficiency of Ca,Mg,Cu,K.

Metabolism of Nitrogen:

20. **Nitrogen fixation:** The process of conversion of nitrogen (N_2) to ammonia is termed as nitrogen fixation.
21. ***Nitrosomonas and Nitrococcus*:** It oxidizes ammonia into nitrite.
22. ***Nitrobacter:*** It helps in the conversion of nitrite to nitrate.
23. *Psuedomonos and Thiobacillus*: These are called denitrificants. They convert the nitrate to nitrite and finally in to N_2 molecular nitrogen.

Biological nitrogen fixation:

24. Rhizobium is the rod shaped gram negative bacterium makes symbiotic association with the roots of leguminous plants, and found in nodules.
25. Frankia and Rhizobium are free living bacteria in soil, but as symbionts, can fix atmospheric nitrogen. Frankia also produces nodules in the roots of non-leguminous plants.
26. **Leg-haemoglobin**: It is the pink coloured pigment present in root nodules of leguminous plants secreted by root for sufficient supplement of oxygen to Rhizonium.
27. **Nitrogenase**: It is an important enzyme involves during nitrogen fixation, it converts atmospheric nitrogen to ammonia. Nitrogenase is a Mo-Fe protein.
28. **Transamination**: It involves the transfer of amino group from one amino acid to the keto group of a keto acid. Glutamic acid is the main amino acid from which the transfer of NH_2, the amino group takes place and other amino acids are formed through transamination, in presence of an enzyme transaminase.

11. Photosynthesis in higher Plants

1. Photosynthesis is an anabolic process in which carbohydrates are synthesized from carbon dioxide and water by green plants, using radiant energy of the sun, oxygen being a byproduct.

$$6CO_2 + 6H_2O \xrightarrow[\text{Chlorophyll}]{\text{Solar energy}} C_6H_{12}O_6 + 6O_2$$

2. Source of energy for photosynthesis is the radiant energy from the sun received in the form of visible light. The site of photosynthesis is chloroplast.
3. **Pigments involved in photosynthesis**:
   Chlorophyll – a,(bright or blue green colour Chlorophyll – b,(Thick or dark green colour)
   Xanthophylls, (Yellow colour)
   Cartenoids (Orange)
4. **Mechanism of photosynthesis**: Photosynthesis is divided in to two stages viz: Light reaction and Dark reaction. Light reaction is light dependent reaction while dark reaction is light independent reaction, the former one occurs only in presence of light, but dark reaction occurs 24 hrs in a day.
5. **Light reaction:** It is also called Photochemical reaction or Photophase or Hill reaction or Thylakoid reactions because it occurs in thylakoids.
6. **Photo systems:** Light harvesting complexes contain two parts; antenna and reaction centre. Antenna is made with hundreds of pigment molecules while reaction centre is made with only one chlorophyll molecules.There are two types of photosystems(I&II)
7. **Photo system I**: It is the light harvesting complex made up of hundreds of pigment molecules bound to proteins. Its reaction centre is chlorophyll – a and an absorption peak at 700 nm, hence it is also denoted by P_{700}. It involves in both cyclic and non-cyclic photophosporylations. It does not involve in photolysis of water.
8. **Photosystem II:** It is also an another light harvesting complex made up of antenna and reaction centre chlorophyll – a, but its absorption maxima is at 680nm and is called P_{680}
9. **Phosphorylation:** Synthesis of phosphate containing compound ATP is called phosphorylation. If it occurs in presence of light, hence it is called photophosphorylation. It is again two types, cyclic and non-cyclic.
10. **Cyclic photophosphorylation:** Only PSI involves, electrons released by P_{700} cycle back to it. Primary acceptor of electron is ferridoxin. It does not create reducing power. It does not involve in photolysis of water. It only product is ATP.

11. **Non-Cyclic photophosphorylation or Z-scheme:** Both PSI & PSII are involved. An electron released by P_{680} does not reach to the same level but passes to PSI through electron carriers. Primary electron acceptor is Pheophytin; it creates reducing power in the form of NADPH. It involves photolysis of water. Its products are ATP, NADPH, and Oxygen.
12. **Chemiosmotic hypothesis:** This theory was put forward by Piter Mitchel, according to this ATP synthesis is linked to development of a proton gradient across a membrane of thylakoid. When concentration of H^+ ions increases due to splitting H_2O molecule into lumen of thylakoid, more number of protons will be accumulated and pumped out through ATP ase across the membrane. Thus energy carried out by H^+ ions helps in the phosphorylation process at stroma side.
13. **Dark reaction or Stroma reaction or Carbon fixation:** It is the light independent reaction, occurs in stroma of chloroplast. In this process assimilatory power which produced during light reaction is utilized for the conversion of CO_2 in to carbohydrate called CO_2 fixation of carbondioxide reduction.
14. **Calvin cycle:** This cycle was discovered by Malvin Calvin. It is also called C_3 cycle, is because of the first formed chemical is three carbon containing compound during CO_2 fixation.This cycle appears in both C_3 and C_4 plants.
15. **Phases of dark reaction:** It has three sub – phases;
    a) **Carboxylation phase**: This reaction is catalyzed by the enzyme RuBP carboxylase and oxygenase. In presence of this enzyme CO_2 will be accepted by RuBp and converted in to two molecules of 3-phosphogyceric acid.
    b) **Reduction phase:** It includes the series of reactions that leads to the formation of glucose. The steps involve utilization of two molecules of ATP for phosphorylation and two of NADPH for reduction per CO_2 molecule fixed. The fixation of six molecule of CO_2 and 6 turns of the cycle are required for the removal of one molecule of glucose form the pathway.
    c) **Regeneration phase:** In this phase CO_2 acceptor RuBP regeneration occurs from G-3P molecules. Here one ATP molecule is required for one RuBP formation.
16. **C_4 cycle:** It was first observed by Hatch and Slack. This pathway found only in plant that is adapted to dry tropical regions. This process happens in two cells mesophyll and Bundle sheath cells. The primary CO_2 acceptor is phosphoenol pyruvate (PEP), the enzyme responsible for is PEP carboxylase. The first product formed is OAA (Oxalo Acetic Acid), which is four carbon compound. It occurs only in C_4 plants.
17. **Kranz anatomy:** Kranz means 'wreath'. This kind of anatomy occurs in the leaves of C_4 plants in which the bundle-sheath cells are arranged in a wreath like manner. Presence to two kinds of chloroplasts granular and agranular, the former ones found in mesophyll cells, while the later ones found in bundle sheath cells. **Eg:** Maize, Sorghum,
18. **Photorespiration:** Uptake of oxygen and release of CO_2 in the presence of light by plants is called photorespiration. It is also called C_2 cycle or glycolate metabolism or carbon oxidation cycle (PCO cycle). It is biologically waste process. This process involves the cooperation and coordination of chloroplast, peroxisome and mitochondria.
19. **Law of limiting factor:** F.F Blackmann proposed this law. According to this law when a process is conditioned as to its rapidity by a number of separate factors, the rate of the process is limited by the pace of slowest factor and this is called the limiting factor.

12. Respiration in plants

1. **Respiration**: Oxidation of food materials in to CO_2, H_2O and considerable amount of energy (ATP) is called respiration. Or The breaking of C-C bonds of complex compounds that are oxidized within the cells, leading to release of considerable amount of energy. It is a catabolic process.
2. **Respiratory substrates**: The compounds that are oxidized during this process are known as respiratory substrates.

3. **Cellular respiration:** Mechanism of breakdown of food materials within cell to release energy and the trapping of this energy for synthesis of ATP is called cellular respiration.
4. **Aerobic respiration**: It may be defined as stepwise, complete oxidation of fuel molecules such as glucose to simpler molecules like carbon dioxide and water, in the presence of molecular oxygen.

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + 686K.cal$$

5. **Anaerobic respirations**: It may be defined as incomplete or partial oxidation of fuel molecules into compounds such as ethyl alcohol, lactic acid, etc., in the absence of molecular oxygen.

$$C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2 + 56\ K.ca$$

6. **Fermentation**: Incomplete oxidation of glucose in absence of oxygen is called fermentation. It is generally carried out by anaerobes. Eg: Yeast
7. During aerobic respiration the complete oxidation of glucose molecule takes place in different four stages as follows;

   a) Glycolysis
   b) Oxidative decarboxylation of pyruvic acid
   c) Kreb's cycle or TCA cycle or citric acid cycle.
   d) Electron transport or oxidative phosphorylaiton.

8. **Glycolysis**: It is the first stage of respiration, it is common for both aerobic and anaerobic respirations, it occurs in cytoplasm. Various steps of the scheme glycolysis were discovered by Embden, Mayerhoff, and Paranas. So this step is also called EMP path way. Term is originated from the Greek word, glycos for sugar and lysis for splitting. Splitting of glucose into two molecules of pyruvic acids and net gain of 2 ATP molecules.
9. **Oxidative decarboxylation of pyruvic acid**: In this step, pyruvic acids that are formed during first step are translocated into mitochondrial. matrix through pyruvate translocator. Here each pyruvic acid is converted into acetyl Co-A.
10. **Krebs cycles**: In these steps two acetyl CoA molecules are produced from glucose molecule undergo series of reactions and produce the following products;
    a) Six CO_2 molecules b) Two ATP (GTP) molecules.
    c) Six $NADH+H^+$ molecules d) Two $FADH_2$ molecules.
11. **Oxidative phosphorylation**: Mechanism of ATP synthesis in presence of oxygen. This is accomplished when they are oxidized through the electron transport system and the electrons are passed on to O_2 resulting in the formation of H_2O. Energy found in $NADH_2$ and $FADH_2$ molecules is converted in to ATP molecules.
12. **Electron transport or oxidative phosphorylation** : It occurs with the involvement of three areas; Inter membrane space, Inner mitochondrial membrane and matrix.
13. Ubiquinol, Cytochrome c, Cytochrome bc_1, Cytochrome a and a_3 are the electron acceptors and donars involve.
14. Oxidation of one molecule of NADH gives rise to three molecules of ATP, while that of one molecule of $FADH_2$ produces 2 molecules of ATP.
15. The role of oxygen is limited to the terminal stage of the process. Yet the presence of oxygen is vital, since it drives the whole process by removing hydrogen from the system. Oxygen acts as the final hydrogen acceptor.
16. **Amphibolic pathway:** Respiration is the amphibolic pathway, because the respiratory pathway is involved in both anabolic and catabolic pathways.
17. **Respiratory quotient (RQ)**: The ratio of the volume of CO_2 evolved to the volume of O_2 consumed in respiration is called the respiratory quotient.
18. RQ of carbohydrates is 1, RQ of fats is less than one, when proteins are respiratory substrates the ratio would be about 0.9.

13. Plant growth and development

GROWTH

1. **Growth:** It is a permanent and irreversible change in size, volume or shape of an organ or organism.

GROWTH RATES

2. Growth takes place in either arithmetic pattern or geometric pattern.
3. At apical and lateral meristem the growth takes place by arithmetic pattern. (N=n+1). In arithmetic growth, the following mitotic cell division, only one daughter cell continues to divide while the other differentiates and matures.
4. The growth in a culture of bacteria or in a suspension of isolated protoplast takes place in geometric pattern. (2, 4, 8,....)
5. **Growth curve**: It is plotted as S-shaped or sigmoid form. It is plotted as Size v/s Time. The defined phases of growth curves are
   a) **Lag phase**: It is the initial growth phase.
   b) **Log phase**: Middle phase
   c) **Stationary or death or phase**: Final phase
6. ***Sigmoid curve***: A sigmoid curve is a characteristic of living organism growing in natural conditions.

DIFFERENTIATION, DEDIFFERENTIATION AND REDIFFERENTIATION

7. ***Differentiation***: Cells derived from root apical and shoot – apical meristem and cambium differentiate and mature to perform specific functions. This act leading to maturation is termed as ***differentiation***.
8. ***Dedifferentiation:*** The living differentiated cells, that by now have lost the capacity to divide can regain the capacity of division under certain conditions, this phenomenon is termed as ***dedifferentiation.***
9. ***Redifferentiation*** : Tissues are able to divide and produce cells that once again lose the capacity to divide but mature to perform specific functions i.e., get redifferentiated.

PLANT GROWTH REGULATORS

10. ***Plant growth regulators***: They are also called phytohormones. These are the organic substances synthesized in one part of the plant and moves to the site of action, where in low concentration it causes physiological response.
11. **Growth promoters** are Auxins, Gibberellins and Cytokinins.
12. **Growth inhibitors** are Abscisic acid, and Ethylene

THE DISCOVERY OF PLANT GROWTH REGULATORS

13. ***Phototropism***: It is the response by plants to unilateral illumination by growing towards the light source. Charles Darwin first reported phototropism in grass coleoptiles.
14. **Auxins** the term was used by F.W.Went, which means to increase.
15. **Bakane(Foolish seedling)** It is a disease of rice seedling, was caused by a fungal pathogen *Gibberella fujikuroi*. Kurasova reported the appearance of symptoms of the disease in uninfected rice seedling when they were treated with sterile filtrates of the fungus.
16. **Skoog and Miller:** Identified and crystallized the cytokinis promoting active substance that they termed as kinetin.
17. Cousins confirmed the release of volatile substances from ripened oranges that hastened the ripening of stored unripened bananas.
18. **Ethylene** is a gaseous phytohormone, which accelerates the ripening of the fruits.

PHYSIOLOGICAL EFFECTS OF PLANT GROWTH REGULATORS

I. AUXINS

19. **Auxins** : Cell elongation, Cell division, Differentiation, Root initiation, Apical dominance, Fruit formation, Senescence, Abscission, Parthenocarpy, Weed control, Phototropism and Geotropism, Feminization.
20. **Apical dominance:** Inhibition of growth of lateral buds by apical bud.
21. **Senescence:** The aging process of plant organ.
22. **Abscission:** Fall of plant organs due to weakening of tissue in their stalks, is because of abscisic acid.
23. **Parthenocarpy:** Development of fruits without the process of fertilization.
24. **Phototropism:** It is the positive response to unilateral illumination by growing towards the light source is called phototropism.
25. **Feminization:** Induction of female flowers on male plant is called feminization or sex expression.
26. **2,4**-D is the widely used herbicide, it is used to kill dicot weeds

II. GIBBERELLINS

27. Physiological effects of gibberellins are as follows;
    a) Seed germination & Overcoming dormancy
    b) Bolting – intrnodal elongation is very less and bunch of leaves are present atsingle point.
    c) Overcoming genetic dwarfism
    d) Induction of maleness: On female plant, male flowers are produced.
    e) Induces parthenocarpy.
    f) Increase the size of cluster of grapes.
    g) Etiolation – Abnormal internodal elongation of plant kept in dark
28. **Physiological effects of cytokinins**
    a) Cell division
    b) Morphogenesis – differentiation of short, root and callus formation .
    c) Overcoming apical dominance
    d) Induction of femaleness in male plants
    e) Mobilization of food materials and helps in delay of leaf senescence.
29. **Physiological effects of ethylene**:
    a) It is a fruit ripening hormone, it ripenes the fruits
    It breaks bud dormancy, initiates germination in pea nut seeds, sprouting potato tubers
    b) It is simple gaseous PGR, ethephon hastens fruit ripening in tomatoes and apples and accelerates abscission in flowers and fruits.
    c) It promotes female flowers in cucumbers there by increasing the yield.
30. **Physiological effects of <u>Abscisic acid</u>**:
    1) It is stress hormone. It inhibits growth and plant metabolism.
    2) It causes partial closure of stomata under drought and thus acts as antitranspirant
    3) It induces senescence.
31. **Phtoperiodism**: It is the response to duration and timings of light and dark periods.
32. **Short day plants**: They produce flowers in photoperiods less than critical day length. **Eg:** Cannabis
33. **Long day plants:** These flower in photoperiods more than critical day length. **Eg:** Spinach
34. **Day neutral plants**: They flower in any period. **Eg:** Tomato
35. **Critical day length**: It is that length of photoperiod above or below which flowering occurs.
36. **Vernalizations**: Ability of low temperature treatment to convert winter cereal into spring cereal.

ZOOLOGY – CDF MATERIAL

CHAPTER-1 Animal Kingdom

1. Cellular level of organization - Porifera – sponges.
   Tissue level of organization - Cnidaria
   Organ level of organization - Platyhelmatenthes
   Organ system level - Aschelminthes to chordata
2. **Asymmetrical**: Any plane that passes through the centre does not divide them into equal halves. Eg : Sponges
3. **Radial symmetry:** Any plane passing through the central axis of the body divides the organism into two identical halves. Eg: Coelentrates, Ctenophores Echinoderms. Bilateral symmetry.Animal body can be cut into two identical halves in a median saggital plane. Eg: Platyhelmatenthes to chordate.
4. **Acoelomates:** Body cavity is absent.Eg: Platyhelminthes.
5. **Pseudocoelomates:** Mesoderm is present as scattered pouches in between the ectoderm and endoderm. Eg: Aschelminthes
6. **Coelomates –** Animals with true body cavity. Eg: Annelida – to chordata
7. **Phylum –Porifera**
8. Water enters into the body through ostia, goes out through osculum.
9. Pinacocytes and Choanocytes or collar cells line the spongocoel and the canals.
10. Skeleton is made up of spicules or sponging fibres.
    Eg: Sycon (Scypha), Spongilla(Fresh water sponge),Espongia(bath sponge)
11. Unique feauture of sponges is water transport system (or) canal system.
    Phylum – Coelenteranta (Cnidaria)
    Cnidarians have 2 basic body forms i.e., polyp and medusa.
    Cnidirians are characterized by cnidoblastes or cnidocytes for defens and capture of prey.Cnidarians exhibits alternation of generation (Metagenesis) i.e., polyps produce medusa asexually and medusa forms the polyps sexually.Eg; Obelia.
    Eg: Physalia (Portuguese man-of-war), Adamsia(Sea anemone), Pennatula(Sea-pen), Gorgonia (Sea-fan) Meandrina (Brain coral)

Phylum –Ctenophora

12. Commonly known as sea walnuts or comb jellies. Body bears eight external rows of ciliated comb plates, which help in locomotion.
13. Bioluminescence (the property of a living organism to emit light) is well-marked in ctenophores.
14. Reproduction takes place only by sexual method. Eg: Pleurobrachia and Ctenoplana

Phylum – Platyhelminthes(Flatworms)

15. First Triploblastic animals, Acoelomates.
16. Flame cells help in osmoregulation and excretion.
    Eg: Taenia (Tapeworm), Fasciola(Liver fluke)

Phylum - Aschelminthes(Roundworms)

17. Bilaterally symmetrical, triploblastic and pseudocoelomates, females are longer than males, sexes are separate (dioecious)
    Eg: Ascaris (Round Worms)Wuchereria(Filaria worm),Ancylostoma (Hookworm)

Phylum – Annelida

18. Due to the segments or metamers phylum name is called as Annelida.
19. Aquatic annelids like Nereis possess lateral appendages, parapodia, which help in swimming
20. Nephridia for excretion and osmoregulation.
21. Nereis is dioecious, earthworms and leeches are monoecious.
22. Hirudinaria – Blood sucking leech.

Phylum – Arthropoda

23. The largest phylum of Animalia which includes insects.
24. These are bilaterally symmetrical, triploblastic, segmented and coelomates, with jointed appendages.

25. Sensory organs like antennae, eyes, statocysts or balance organs are present.
26. Excretion takes place through malpighian tubules, mostly dioecious.
27. Locusta is a gregarious pest.
28. Limulus(King crab) is a living fossil.
29. Anopheles, Culex and Aedes mosquitoes are vectors.
Eg: Apis (Honey bee) , Bombyx(Silkworm), Laccifer(Lac insect), Limulus (Living fossil).

Phylum – Mollusca

30. The second largest animal phylum, bilaterally symmetrical, triploblastic and coelomate animals.
31. The mouth contains a file-like rasping organ, called radula.
Eg: Pila(Apple snail), Pinctada(Pearl oyster), Sepia(Cuttlefish), Laligo(Squid), Octopus(Devil fish), Aplysia(Sea-hare),Dentalium(Tuskshell),andChaetopleura(Chiton)

Phylum – Echinodermata

These animals have endoskeleton of calcareous ossicles, hence the name Echinodermata.
32. The adults are radially symmetrical but larvae are bilaterally symmetrical,
33. Water vascular system – unique to echinoderms for locomotion, capture and transport of food and respiration. Eg: Asterias(Star fish), Echinus(Sea urchin), Antedon(Sea lily), Cucumaria(Sea cucumber), Ophiura(Brittle star).

Phylum - Hemichordata

35. Worm –like marine animals, body is cylindrical and is composed of an anterior proboscis, a collar and a long trunk. Open circulatory system
36. Respiration by proboscis gland. Eg: Balanoglossus and Saccoglossus.

Pyhlum - Chordata

37. Presence of a notochord, a dorsal hollow nerve cord and paired pharyngeal gill slits
38. Divided into three subphyla: Urochordata or Tunicata, Cephalochordata and Vertebrata.
39. Urochordata and Cephalochordata referred to as Protochordates, exclusively marine.
40. In Urochordata(Ascidia,Salpa,Doliolum) notochord is present only in larval tail, but in Cephalochordata(Branchiostoma: Amphioxus or Lancelet) it extends from head to tail persistent throughout their life.

Subphylum : Vertebrata

41. Vertibrata divides into two divisions Agnatha and Gnathostomata. Agnatha(jaw less) has one class Cyclostomata, Gnathostomata(bear jaws) contains two Super-classes Pisces and Tetrapoda;

Pisces contains two classes they are Chondrichthyes and Osteichthyes.
42. Class- Cyclostomes marine but migrate for spawning to fresh water, after spawning within few days they die. Their larvae, after metamorphosis, return to the ocean. Eg: Petromyzon(Lamprey) and Myxine(Hagfish)
43. Class- Chondrichthyes: Gill slits are separate without operculum, Poikilothermous(Coldblooded, some possess electric organs(Torpedo), some have Poison sting(Trygon). Air bladder is absent.Most of them are viviparous.
Eg: Scoliodon(Dog fish), Pristis(Saw fish), Carcharodon(Great white shark)
44. Class- Osteichthyes: Bony fishes, gills covered by operculum, skin is covered with cycloid/ctenoid scales, air bladder is present. Eg:Exocoetus(Flying fish), Hippocampus (Sea horse), Clarias(Magur), Betta(Fighting fish),
Pterophyllum(Angel fish)
45. Super class – Tetrapoda possess FOUR classes: Amphibia, Reptilia, Aves and mammals.
46. Class- Amphibia: a tympanum represents the ear, urinary and reproductive tracts open into a common chamber called cloaca.
47. Heart is three chambered, cold-blooded animals, Fertilisation is external, Oviparous.
Eg: Bufo(Toad), Rana(Frog),Hyla(Tree frog),salamandra,Icthyophis(Limbless amphibia)
48. Class- Reptilia: body covered by scales or scutes, usually three chambered, but crocodiles are four chambered, fertilization is internal.
Eg: Chelone(Turtle), Testudo(Tortoise), Chameleon(Tree lizard), Calotes(Garden lizard),Aligator, Hemidactylus(Wall lizard), Naja(Cobra), Bangarus(Krait), Vipera(Viper).

49. Class- Aves: Endoskeleton is fully ossified(bony) and the long bones are hollow with air cavities(Pneumatic).
50. Heart is four chambered, worm-blooded(homoiothermous) animals, fertilization internal Eg:Corvus(Crow),Columba(Pigeon),Psittacula(Parrot)Struthio(ostrich), Pavo(Peacock), Aptenodytes(Penguin), Neophron(Vulture)
51. Class- Mammalia: Presence of milk producing glands(mammary glands), Viviparous. Four chambered heart, possessing hair.Oviparous mammal is Ornithorhynchus(Platypus) Eg: Macropus(kangaroo), Pteropus(Flying fox), Camelus(Camel),Macaca(Monkey), Rattus(Rat),Canis(Dog),Felis(Cat),Elephas(Elephant),Equus(Horse), Delphinus(Commondolphin),Balaenoptera(Bluewhale),Pantheratigris(Tiger),Pantheraleo(Lion)

CHAPTER-2
STRUCTURAL ORGANIGATION IN ANIMALS

1. The body of a simple organism like Hydra is made of different types of cells and the number of cells in each type can be in thousands.
2. The tissue are different and are broadly classified into four types: (i) Epithelial, (ii) Connective, (iii) Muscular and (iv) Neural.

EPITHELIAL TISSUE

3. There are two types of epithelial tissues namely simple epithelium and compound epithelium.
4. Simple epithelium is composed of a single layer of cells and functions as a lining for body cavities, ducts, and tubes.
5. The compound epithelium consists of two or more cell layers and has protective function as it does in our skin.
6. The squamous epithelium is made of a single thin layer of flattened cells with irregular boundaries.
7. The cuboidal epithelium is composed of a single layer of cube-like cells.
8. The columnar epithelium is composed of a single layer of tall and slender cells.
9. If the columnar or cuboidal cells bear cilia on their free surface they are called ciliated epithelium.
10. Some of the columner or cuboidal cells get specialized for secretion and are called glandular epithelium.
11. Compound epithelium is made of more than one layer(multi- layered) of cells and thus has a limited role in secretion and absorption.
12. Three types of cell junctions are found in the epithelium and other tissues.These are called as tight, adhering and gap junctions.
13. Tight junctions help to stop substances from leaking across a tissue. Adhering junctions perform cementing to keep neighboring cells together.
14. Gap junctions facilitate the cells to communicate with each other by connecting the cytoplasm of adjoining cells, for rapid transfer of irons, small molecules and sometimes big molecules.

CONNECTIVE TISSUE

15. Connective tissues are classified into three types (i) Loose connective tissue, (ii) Dense connective tissue and (iii) Specialized connective tissue
16. Adipose tissue is another type of loose connective tissue located mainly beneath the skin.
17. Dense connective tissues divides into dense regular and dense irregular tissues.
18. Cartilage, bones and blood are various types of specialized connective tissues.
19. The intercellular material of cartilage is solid and pliable and resists compression
20. Bones have a hard and non-pliable ground substance rich in calcium salts and collagen fibres which give bone its strength.
21. Blood is a fluid connective tissue containing plasma, red blood cells(RBC), white blood cells(WBC) and platelets.

MUSCULAR TISSU

22. Muscles are three types, skeletal, smooth, and cardiac.

23. Skeletal muscle tissue(striated muscles) is closely attached to skeletal bones, voluntary in function.
24. Smooth muscle fibres(non-striated muscles) taper at both ends (fusiform) and do not show striations, involuntary in function.
25. Cardiac muscle tissue is a contractile tissues present only in the heart.

EARTH WARM

26. The common Indian earthworms are Pheretima and Lumbricus.
27. Earthworms have long cylindrical body, contains 100-120 metameres.
28. Anterior end consists of the mouth and the prostomium, which is sensory in function.
29. Segments 14-16 are covered by a prominent dark band of glandular tissue called "clitellum".
30. In each body segment, except the first last and clitellum, there are rows of S- shaped setae, embedded in the epidermal pits in the middle of each segment.
31. Between 26-35 segments, internal median fold of dorsal wall is present , called "typhlosole".
32. Pheretima exhibits a closed type of blood vessels, capillaries and heart.
33. The excretory organs occur as segmentally arranged coiled tubules called nephridia.
34. Nervous system is basically represented by ganglia.
35. Earthworm is hermaphrodite(bisexual) i.e, testes and ovaries are present in the same individual.
36. There are two pairs of testes present in the 10th and 11th segments.
37. Four pairs of spermathecae are located in 6th - 9th segments (one pair in each segment).
38. One pair of ovaries is attached at the inter-segmental septum of the 12th and 13th, female genital pore present on the 14th segment.
39. Two pairs of accessory glands are present one pair each in the 17th and 19th segments.
40. The cocoon holds the worm embryos. After about 3 weeks, each cocoon produces two to twenty baby worms with an average of four.

COCKROACH

41. The common species of cockroach ,Periplaneta americana.
42. Head is triangular in shape and lies anteriorly at right angle to the longitudinal body axis.
43. Thorax consist of three parts-prothorax, mesothorax and metathorax.
44. In both sexes, the 10th segment bears a pair of jointed filamentous structures called anal cerci.
45. The crop is followed by gizzard or proventriculus.
46. Gizzard helps in grinding the food particles.
47. At the junction of midgut and hindgut is present another ring of 100 -150 yellow coloured thin filamentous "malpighian tubules .
48. Blood vascular system of cockroach is an open type.
49. The respiratory system consitsts of a network of trachea, that open through 10 pairs of small holes called spiracles present on the lateral side of the body.
50. Excretion is performed by Malpighian tubules. Each tubule is lined by glandular and ciliated cells.
51. These insect excrete uricacid ,therefore, this insect is called uricotelic.
52. The nervous system of cockroach consists of a series of fused, segmentally arranged ganglia joined by paired longitudinal connectives on the ventral side.
53. Each eye consists of about 2000 hexagonal ommatidia(sing: ommatidium). With the help of several ommatidia, a cockroach can receive several images of an object.
54. Cockroaches are dioecious and both sexes have well developed reproductive organs.
55. Male reproductive system consists of a pair of tests lying one on each lateral side in the 4th-6th abdominal segments.
56. The female reproductive system consists of two large ovaries, lying laterally in the 2nd – 6nd abdominal segments.

FROGS

57. The most common species of frog found in India is Rana tigrina.
58. They have the ability to changes the colour to hide them from their enemies (camouflage).
59. During this period they take shelter in deep burrows to protect them from extreme heat and cold. This is called as summer sleep (aestivation) and winter sleep (hibernation).

60. In water, skin acts as aquatic respiratory organ (cutaneous respiration).
61. On land the buccal cavity, skin and lugs acts as respiratory organ , this respiration by lugs is called pulmonary respiration.
62. Tadpole larvae respire through gills (bronchial respiration)
63. The vascular system of frog is well-developed closed type.
64. The elimination of nitrogenous wastes is carried out by a well developed excretory system.
65. The excretory system consists of a pair of kidneys, ureters, cloaca and urinary bladder.
66. The frog excretes urea and thus is a ureotelic animal.
67. Frog has different types of sense organs, namely organs of touch (sensory papillae), taste (taste buds), smell (nasal epithelium), vision (eyes) and hearing (tympanum with internal ears).

CHAPTER-3

DIGESTION AND ABSORPTION

Mouth

1. The roof of the buccal cavity is called palate.
2. A number of rough projections called lingual papillae are present on the dorsal surface of the tongue.
3. The papillae contain taste buds helpful in the perception of taste (Sweet, sour, bitter, salty).
4. The arrangement of teeth in oral cavity of a mammal is called Dentition.
5. Human dentition has three unique features. Thecodont, heterodont and diphyodont.
6. Thecodont where all the teeth are hidden in bony sockets.
7. Heterodont where all the teeth are dissimilar both structurally and functionally.
8. The different types of teeth are incisors, canines, premolars and molars, Incisors are cutting or biting teeth, Canines are tearing teeth, Premolars and molars are grinding and crushing teeth.
9. Diphyodont where every person has 2 sets of teeth.
10. The first set is Lacteal teeth /milk teeth /deciduous teeth.
11. Milk teeth appear anytime between 6 -11 months of age, lasts for 12 years,There will be 20 milk teeth. Molars are absent.
12. Second set is permanent teeth replaces first set at age 6-12 years. Last molar teeth are called wisdom tooth appear at the age of 18-21.

Pharynx

13. It forms a common passage for both food and air, It has 3 regions uppermost Nasopharynx, middle Oropharynx, lower most laryngopharynx.
14. It opens into larynx through glottis on one side and oesophagus on the other side.
15. During swallowing of food, epiglottis closes glottis to prevent the entry of food into trachea.

Oesophagus

16. It penetrates diaphragm through an opening called oesophageal hiatus and joins the stomach.
17. The gastroesophageal sphincter at the junction of oesophagus with stomach ,prevents regurgitation of food.
18. Pharynx and oesophagus do not contribute to digestive process.Their muscular walls bring about swallowing and peristalsis.

Stomach

19. It is divided into cardiac, fundus, body and pyloric regions.
20. Cardiac sphincter-junction of oesophagus and cardiac stomach, pyloric sphincter -junction of pyloric stomach and intestine
21. Each empty stomach contains numerous folds or gastric rugae.

Small Intestine

22. Small intestine is the lo ngest part of alimentary canal, measures about 5-6m and is highly coiled, It is differentiated into 3 regions duodenum, jejunum and ileum.
23. Common hepato-pancreatic duct enter duodenum through ampulla. A sphincter of oddi regulates the entry of pancreatic juice into duodenum.

24. Jejunum is the middle coiled region (2.5m),Bothplicae and villi are abundant, Villi increase the surface area for absorption of digested food,villi in turn bear brush like border called microvilli
25. Intestinal glands located between villi to produce intestinal juice(succusentericus).
26. Ileum is the terminal narrow longest part (3.5m), contains aggregated lymphoid follicles called peyer's patches. Crypts of lieberkuhn occur at base of villi.
27. There is an ileocaecal valve at the junction of small intestine and large intestine.

Large Intestine

28. It is posterior most segment of alimentary canal with 5-6 feet long. It consists of caecum, colon and rectum. Extending from the caecum there is vermiform appendix.
29. Vermifofm appendix is vestigeal (non functional) in humans
30. Colon is further divided into ascending, transverse, descending and sigmoid colon.
31. Colon does not contain digestive glands. Rectum stores faeces and helps in defecation.
32. Large intestine absorbs water and electrolytes from und igested food and forms feces.

DIGESTIVE GLANDS

Salivary glands

33. There are 3 pairs of salivary glands. Parotid, submaxillary and sub lingual.
34. Parotid glands are the largest glands situated in front and below the ears.Parotid glands secret saliva to oral cavity through Stenson's duct.
35. Sub maxillary lie within the lower jaw,Their secretion is carried to oral cavity by wharton'sduct.Sub lingual are situated below the tongue on eitherside, They secrete saliva into floor of buccal cavity through Revinus's duct.
36. Saliva is a colourless fluid whose pH is about 6.7 to 7, contains the solutes include mucin, lysozyme, ptyalin, chlorides, bicarbonates Na, k etc,
37. Mucin makes saliva slippery and helps in swallowing. Lysozyme kills bacteria (bacteriolytic enzyme). Ptyalin or salivary amylase acts on starch to breakdown to maltose and glucose.

LIVER (Exocrine gland)

38. It is a highly vascularized largest gland in the body which secrets bile juice.It weighs about 1.5 – 1.8 Kg having 4 lobes (right, left, quadrate and caudate).
39. On the inferior surface there is a pear shaped gall bladder, Gall bladder stores and concentrates bile .Liver is covered by a delicate connective tissue called Glisson s capsule.
40. Internally liver has units called liver lobules or hepatic cords. These lobules contain hepatocytes and blood capillaries called sinusoids.
41. Fine bile canals from hepatic cell form larger ducts which become hepatic duct. These ducts merge to form common hepatic duct.It joins the cystic duct from gall bladder to become the common bile duct.

BILE JUICE

42. About 66 ml is secreted per day. Its color is greenish yellow alkaline fluid whose pH is 7-8.
43. It consists of water, bile salts (sodium taurocholate and sodium glycochlolate), cholesterol bile pigments (bilirubin and biliverdin), Inorganic salts and lipids.
44. Bile salts emulsify fats in digestive tract. Liver stores Vitamins, minerals and also synthesize **Vitamin A. Liver generates a lot of heat, it keeps the body warm.**
45. Prothrombin and fibrinogen are 2 blood proteins synthesized by the liver help in blood coagulation. In embryo liver takes part in synthesis of RBC.
46. It helps in gluconeogenesis, glycogenesis glycogenolysis and lipogenesis.
47. Bile juice neutralizes acidic chyme.. Cholesterol is also synthesized by liver.
48. It also helps in conversion of ammonia into urea, excretes toxic and metallic poisons.

PANCREAS (Heterocrine gland)

49. Pancreas is the second largest gland present in loop of duodenum measuring about 12-15 cm in length, Pancreas is both exocrine and endocrine in function.
50. Exocrine function is taken by pancreatic acinar cells which secrete an alkaline juice called pancreatic juice (500-800 ml).

51. Endocrine function is taken by endocrine cells called islets of Islets of Langerhans, secrete the hormones glucagon and insulin which play an important role in metabolism of carbohydrates.
52. Pancreatic juice is a colourless alkaline fluid whose pH is 8.
53. It consists of water, salts, digestive enzymes {Trypsin, chymotrypsin, carboxypolypeptidase, amylopsin, steapsin and nucleases} and traces of sodium bicarbonate, It plays an important role in protein, carbohydrate, lipid and nucleic acid digestion.

GASTRIC GLANDS

54. These are tubular glands present in the mucus membrane of stomach, secretes gastric juice.
55. There are 2 types of gastric glands, Cardiac gland occur in cardiac region secretes mucus, Fundus glands occur abundantly in fundus region. There are 4 types of cells in gastric glands.
56. Parietal cells secrete HCl,Peptic / Chief / Zymogen cells secrete Pepsinogen, gastric lipase and prorennin respectively.Prorennin is secreted only in infants.
57. Goblet Cells or Mucous cells secret Mucus.Argentaffin cells (endocrine cells) secretes Gastrin hormone. Stomach produces 3-4 Lt of gastric juice/day.
58. Gastric juice is acidic (1.5- 2 pH), contains HCl.
59. Gastric juice plays an important role in protein digestion.
60. HCl provides acidic nature for action of enzymes.HCl kills harmful bacteria. HCl dissolves many food substances and brings about curdling of milk. HCl changes proenzymes into active enzymes.

INTESTINAL GLANDS

61. It secretes intestinal juice (Succus entericus) due to the stimulation of the hormone enterokinin
62. 2 types of intestinal glands,(a)Crypts of lieberkuhn are found throughout the small intestine,(b)Brunner s gland which are found in duodenum secreting alkaline fluid.
63. Intestinal juice is a yellow coloured alkaline juice with pH 7-8.
64. It contains water, mucin, and digestive enzymes like enterokinase, intestinal amylase, maltase, sucrase, lactase, intestinal lipase, amino peptidase,dipeptidase, and nucleotidase.
65. Mucin lubricates food for smooth passage,Enterokinase is non digestive enzymes, but activates other enzymes

DIGESTION OF FOOD

Digestion in Mouth:

66. Mucin in saliva lubricates food,Lysozyme in saliva kills the bacteria.
67. Salivary amylase or ptyalin acts on polysaccharides (starch / Glycogen) and converts it into disaccharides (Maltose/Dextrins).Sodium bicarbonate provides alkaline medium for enzyme action,semi solid paste called bolus.
68. The bolus is passed on to the stomach via pharynx and oesophagus through act of swallowing known as deglutition,The movement of food is effected by a process called peristalsis.

Digestion in Stomach :

69. The food stays in stomach for a period of 3-4 hours, Gastric juice contains HCl, pepsinogen, prorennin and gastric lipase.

Carbohydrate digestion in stomach

70. Carbohydrate digestion in stomach does not take place because of acid medium.

Proteins Digestion

71. Two main protein digesting enzymes pepsin and rennin are present in gastric juice.
72. HCl makes food acidic with pH nearing 2.0. It converts pepsinogen and prorennin into activeenzymes pepsin and rennin.
73. Renin occurs only in infants, It is a milk curdling enzyme unique to mammals.

Fat Digestion

74. Stomach also secretes a lipase called gastric lipase,It splits the butter fat molecules found in milk, Small amount of fat may be broken down into fatty acids and glycerol.
75. Partially digested food mixed with stomach secretions in acid medium is called acid chyme.

Digestion in Small Intestine :

76. It is the region of complete digestion and absorption.
77. The intestinal mucosal secretions contains hormones like secretin, enterocrinin,

enterogastrin, cholecystokinin stimulates production of digestive secretion

ABSORPTION

78. Each villus contains 2 channels, a network of blood capillaries and lymphatic capillary or lacteal.
79. Monosaccharides, amino acids and short chain fatty acids pass into blood capillaries. Long chain fatty acids and monoglycerides are absorbed into the lacteal.
80. Balanced diet food should contain 440 gms carbohydrates, 50 gms of fat, 70 gms of proteins per day.

DISORDERS OF DIGESTIVE SYSTEM

Jaundice

81. It is defined as the yellow discoloration of body tissues(skin, eyes) due to accumulation of bilirubin, a bile pigment. The liver is affected.

Vomiting

82. It is the ejection of stomach contents through the mouth. This reflex action is controlled by the vomit centre in the medulla.A feeling of nausea precedes vomiting.

Diarrhoea

83. The abnormal frequency of bowel movement and increased liquidity of the faecal discharge is known as diarrhoea. It reduces the absorption of food.

Constipation

84. In constipation, the faeces are retained within the rectum as the bow el movements occur irregularly.

CHAPTER-4
BREATHING AND EXCHANGE OF GASES

1. The process of exchange of O from the atmosphere with CO2 produced by the cells is called breathing
2. Respiration through body surface or skin is called cutaneous respiration.eg: Lower invertebrates like sponges, coelenterates, flatworms and frogs.
3. Respiration through tracheal tubes called tracheal respiration. Eg: Insects.
4. Respiration through gills called bronchial respiration. Eg: Fishes
5. Respiration through lungs called pulmonary respiration. Eg:Reptiles, birds and mammals
6. Human respiratory system consists of external nostrils, Nasopharynx opens through glottis(covered by epiglottis) of the larynx (sound box)region into the trachea.
7. Trachea is a straight tube extending up to the mid-thoracic cavity, which divides at the level of 5th thoracic vertebra into a right and left primary bronchi.
8. Each bronchi undergoes repeated divisions to form the secondary and tertiary bronchi and bronchioles ending up in very thin terminal bronchioles which are terminated with alveoli.
9. The lungs which are covered by a double layered pleura, with pleural fluid between them. It reduces friction on the lung surface.
10. The lungs are situated in the thoracic chamber which is anatomically an air-tight chamber. The thoracic chamber is formed dorsally by the vertebral column, ventrally by the sternum, laterally by the ribs and on the lower side by the dome-shaped diaphragm.
11. Breathing involves two stages : inspiration during which atmospheric air is drawn in andexpiration by which the alveolar air is released out.
12. Inspiration is initiated by the contraction of diaphragm and the contraction of external intercostal muscles.
13. Expiration is relaxation of the diaphragm and the inter-costal muscles returns the diaphragm and sternum to their normal positions and reduce the thoracic volume and thereby the pulmonary

Volume.

14. **Tidal Volume (TV):** Volume of air inspired or expired during a normal respiration. It is approx. 500 mL., i.e., a healthy man can inspire or expire approximately 6000 to 8000 mL of air per minute.

15. Inspiratory Reserve Volume (IRV): Additional volume of air, a person can inspire by a forcible inspiration. This averages 2500 mL to 3000 mL.
16. **Expiratory Reserve Volume (ERV):** Additional volume of air, a person can expire by a forcible expiration. This averages 1000 mL to 1100 mL.
17. **Residual Volume (RV):** Volume of air remaining in the lungs even after a forcible expiration. This averages 1100 mL to 1200 mL. By adding up a few respiratory volumes described above, one can derive various pulmonary capacities, which can be used in clinical diagnosis.
18. **Inspiratory Capacity (IC):** Total volume of air a person can inspire after a normal expiration. This includes tidal volume and inspiratory reserve volume (TV+IRV).
19. **Expiratory Capacity (EC):** Total volume of air a person can expire after a normal inspiration. This includes tidal volume and expiratory reserve volume (TV+ERV).
20. **Functional Residual Capacity (FRC):** Volume of air that will remain in the lungs after a normal expiration. This includes ERV+RV.
21. **Vital Capacity (VC):** The maximum volume of air a person can breathe in after a forced expiration. This includes ERV, TV and IRV or the maximum volume of air a person can breathe out after a forced inspiration.
22. **Total Lung Capacity**: Total volume of air accommodated in the lungs at the end of a forced inspiration. This includes RV, ERV, TV and IRV or vital capacity + residual volume.
23. The alveolar PO2 is about 100mm Hg and the PO2 of venous blood is about 40mm Hg.
24. This pressure gradient is sufficient for the transfer of O2.
25. The PCO2 of venous blood is 46mm.Hg and that of alveolar air is only 6mm.Hg (1/10th of O2), it is adequate for CO2 transfer by diffusion. CO2 diffuses 20 times faster than O2.
26. Haemoglobin is a red coloured iron containing pigment present in the RBCs. O2 can bindwith haemoglobin in a reversible manner to form oxyhaemoglobin. Each haemoglobinmolecule can carry a maximum of four molecules of O2.
27. Low pO2, high pCO2, high H+ concentration and higher temperature are the conditions favourable for dissociation of oxygen from the oxyhaemoglobin.
28. Nearly 20-25 per cent of CO2 is transported by RBCs whereas 70 per cent of it is carried as bicarbonate.
29. About 7 per cent of CO2 is carried in a dissolved state through plasma. CO2 is carried by haemoglobin as carbamino-haemoglobin(about 20-25 per cent).
30. RBCs contain a very high concentration of the enzyme, carbonic anhydrase and minute quantities of the same is present in the plasma too. This enzyme facilitates the formation and dissociation of Carbonic acid
31. A specialisedcentre present in the medulla region of the brain called respiratory rhythm centre is primarily responsible for this regulation.
32. Another centre present in the pons region of the brain called pneumotaxic centre can moderate the functions of the respiratory rhythm centre.

Disorders of Respiratory system

Asthma:

33. Asthmais a difficulty in breathing causing wheezing due to inflammation of bronchi and bronchioles.

Emphysema:

34. Is a chronic disorder in which alveolar walls are damaged due to which respiratory surface is decreased. One of the major causes of this is cigarette smoking.

Occupational Respiratory Disorders:

35. In certain industries, especially those involving grinding or stone-breaking, so much dust is produced, long exposure to dust can give rise to inflammation leading to fibrosis (proliferation of fibrous tissues) and thus causing serious lung damage.

CHAPTER-5
BODY FLUIDS AND CIRCULATION

1. Arthropods and Molluscs have open type of circulatory system.
2. Annelids, echinoderms and all vertebrates including man have a closed circulatory system including heart, blood vessels and blood.
3. Blood circulation was first discovered by Sir William Harvey (1628).
4. In neurogenic heart, heart beat is initiated by nervous stimulation (all invertebrates except molluscs)
5. In myogenic heart, heart beat is initiated by specialized cardiac muscles called pacemaker. Eg. Molluscs and vertebrates.

HUMAN HEART

6. It is situated slightly to the left of mediastinum(mid way) above the diaphragm.
7. The heart beats 1, 00,000 times and pump s 7000 litres blood/day.
8. Heart wall consist of three layers outer pericardium, middle myocardium and inner endocardium.
9. Pericardium consists of outer parietal layer attached to fibrous pericardium and inner visceral layer (Epicardium) remains attached to myocardium.
10. Between parietal and visceral layer is the pericardial cavity filled with pericardial fluid.
11. Atria are thin walled and 3 times smaller than the ventricles.
12. Right auricle and left auricle is separated by interatrial septum.
13. Right auricle received deoxygenated blood from 2 large veins superior venacava and inferior venacava.
14. Left auricle receives oxygenated blood from lungs by pulmonary veins.
15. Sinu atrial node (SAN) is situated very close to opening of superior venacava.
16. The right ventricle and left ventricle are separated by inter ventricular septum.
17. Arising from right ventricles is pulmonary artery which supplies deoxygenated blood to lungs.
18. Arising from left ventricle is largest artery of our body called aorta.
19. Left ventricle is larger than right ventricle.
20. The right atrium opens into right ventricle and this opening is guarded by 3 thick triangular flaps called Tricuspid valve.
21. The left atrium opens into left ventricle and this opening is guarded by 2 thick triangular flaps called bicuspid valve or mitral valve.
22. The opening between aorta and left ventricle is guarded by aortic semi lunar valves.
23. The opening between right ventricle and pulmonary artery is also guarded by pulmonary semi lunar valves.
24. The inner surface of ventricles bear pyramid like muscular projections called papillary muscles.
25. The tips of papillary muscles are attached to tricuspid and bicuspid valves by strong chords called chordae tendinae.

WORKING OF HUMAN HEART

26. The contraction of heart is called systole, the relaxation of the heart is called diastole.
27. The sequence of cyclical events which takes place between a systole and a diastole of the heart is called cardiac cycle.
28. One cardiac cycle takes about 0.8 sec a nd involves 3 phases. The normal heart beat in an adult man is 72 beats/min.
29. The volume of blood pumped by left ventricles or right ventricle during each systole is called stroke volume.
30. The volume of blood pumped from the one of the ventricles per minute is called cardiac output, Cardiac output = stroke volume x heart rate per minute= 70ml x 72 beats / min= 5,040ml
31. During mild exercises or fast walking stroke volume may be 100ml and heart beat may be 100 beats / min, then cardiac output will be 10litres / min.Vigorous exercise increases 5-8 times output than normal.

32. Blood enters twice into heart before being distributed to different parts of the body.
33. It includes Pulmonary circulation (circulation between heart and lungs), Systemic circulation(circulation between heart and body parts)
34. The walls of the heart have their own blood supply called coronary circulation. These coronary arteries arise from the base of aorta just above the semi lunar valves.
35. The deoxygenated blood from the muscles of heart is collected by several coronary veins.
36. Coronary veins unite to form a coronary sinus which opens in the right atrium , this opening guarded by "thebesius valve".
37. Human heart is myogenic, the elements constituting the conducting system of heart are SAN, AVN, inter nodal pathways, bundle of His and Purkinje system.
38. The heart beat is initiated and regulated by SAN, a specialized bundle ofcardiac muscle cells, SAN is called natural Pace Maker of heart,AVN function is to activate ventricles.
39. Purkinje Fibres are also called conduction myofibres.
    SAN Produces 70-80 signals/min which initiates heart beat 70-80/min.

BEST AND TAYLOR THEORY ON BLOOD CLOTTING

40. It involves 4 substances for the process of clotting Prothrombin,Thrombokinase, calcium ions and fibrinogen.
41. Prothrombinis a protein formed by liver and is present in plasma of thecirculating fluid.
42. Prothrombin breaks down into smaller compounds like thrombin in thepresence of throbokinaseand Calcium ions.
43. Thrombokinase / Thromboplastinis a lipoprotein widely distributed in tissues acts as an enzyme. Blood does not clot in absence of calcium ions.
44. Fibrinogen is soluble proteins found dissolved in plasma, formed in liver. When there is an injury, thrombokinase is liberated from tissue.
45. Thrombokinase acts on prothrombin in presence of calcium ions and converts it into active thrombin.
46. The activated thrombin further catalyses conversion of soluble fibrinogen into insoluble fibrin threads.
47. The fibrin threads entangle blood cells and form clot in presence of vitaminK.
48. The absence of clotting factors in blood plasma is most frequent and serious cause of genetically determined clotting defect called haemophilia.
49. Aspirin, Heparin are principal clinically used drugs to prevent blood clotting.
50. Best and Taylor s theory doesn tconsider the role of platelets.
51. Hypertension / High blood pressure occurs when blood pressure increases above the normal blood pressure(120/80) (> 150 mm Hg/95mm of Hg).
52. The hardening of the arterial wall due to deposition of cholesterol and calcium salts leads to a circulatory disorders called Arteriosclerosis.
53. Atherosclerosis is irregular thickening of arterial walls and narrowing of their lumen due to yellow plaques and due to deposition of cholesterol
54. Hypertension causes harm to heart, brain and kidneys (cerebrovascular accident/stroke, atherosclerosis, heart attacks).
55. Hypotension / Low blood pressure occurs when blood pressure decreases below normal blood pressure (60-80mm Hg/35-40mm Hg).

DISORDERS

Myocardial infarction

56. Death of myocardial tissue due to inadequate supply of oxygenated blood is myocardial infarction, also known as heart attack or coronary thrombosis.
57. **CORONARY ARTERY DIESEASE:** Also known as atherosclerosis is cholesterol deposition in the form of plaque on the inner lining of arteries that supply blood to the heart muscle.
58. Angiography is technique used to scan blood vessel to show extent of blockage.
59. **Angina :** offen called angina pectoris. A symptom of acute chest pain appears when no enough oxygen is reaching the heart muscle.
60. Bypass Surgery: Defective coronary blood vessel is removed or bypassed by a suitable blood vessel from other parts of body.

CHAPTER-6
EXCRETORY PRODUCTS AND THEIR ELIMINATION

1. The process of excreting ammonia is Ammonotelism. Ex: Bony fishes, Tadpole larva.
2. Ureocotelic animals: Animals excrete pre-dominantly uric acid as a nitrogenous waste. The phenomenon is called uricotelism. Ex: Insects, birds, reptiles.
3. Ureotelic animals: These animals excrete pre-dominantly urea as their waste and phenomena is called ureotelism. Ex: Cartilageous fishes, mammals.
4. Protonephridia or flame cells are the excretory structures in Platyhelminthes (Flatworms,e.g.Planaria), Rotifers, some annelids and the cephalochordate – Amphioxus.
5. Protonephridiaare primarily concerned with ionic and fluid volume regulation, i.e., osmoregulation.
6. Nephridia are the tubular excretory structures of earthworms and other annelids.
7. Malpighian tubules are the excretory structures of most of the insects including cockroaches
8. Antennal glands or green glands perform the excretory function in crustaceans like prawns.
9. Kidney is a bean – shaped, light red or purple in colour covered by a connective tissue sheath called renal capsule.
10. It weighs about and measures about height and 6 – 7 cm width with a depression called Hilum. Through this renal artery a renal vein enters.
11. The concave surface is called hilus. In the region of hilusrenal artery enters and renal vein leaves.
12. Inner to the hilum is a broad funnel shaped space called the renal pelvis with projections called calyces.
13. The renal medulla is made up of 10 – 15 pyramids like bodies called renal pyramids. Each renal pyramid consists of thousand nephrons.

Structure of Nephron (Uriniferous tubules):

14. Nephron is structural and functional unit of kidney. There are 1 million nephrons per kidney. Each Nephron consists of malphigian corpuscles (MC) followed by nephric tubules and collecting tubules.
15. Malpighian corpuscles: It is also called renal corpuscles. It is part of Nephron and is the site of ultra filtration. It consists of glomerulus enclosed by Bowman s capsule.
16. **Glomerulus:** It is a soft mass of blood capillaries made up of wide afferent capillaries and narrow efferent capillaries.
17. **Bowmann's capsule:** It is two walled cup like structure that encloses Glomerulus. Its inner wall is called visceral layer. It is held to Glomerulus.
18. **Nephric tubules**: It is differentiated in to proximal convoluted tubule (PCT), loop of henle and distil convoluted tubule (DCT).
19. Henle's loop: It is hair pin like U shaped thin tubule present between PCT and DCT. It is differentiated in to descending limb and ascending limb, and device of water conservation and site of counter current mechanism, henle s loop is covered by blood capillaries mass called vasarecta.
20. Filtration is caused by effective filterate pressure which is 2 mm Hg.
21. Effective filterate pressure is the difference between glomerular hydrostatic press (GHP) 70 mm Hg is the combination of blood colloidal osmotic pressure 300 mm Hg + capsilular hydrostatic pressure 20 mm Hg.
22. The filtrate thus collected in Bowman s capsule is called primary urine which accounts 180litres per day.
23. **TUBULAR RE-ABSORPTION:** The process of absorption of substances from nephric filterate in to peritubular capillaries is called Tubular Re-absorption.
24. **TUBULAR SECRETION**: The process of secretion of substances from peri – tubular capillaries in to nephric filtrate is called tubular secretion.
25. This process urination is called micturation.
26. Urine is hypertonic to blood has pH 6 and is pale yellow in colour due to presence of urochrome pigment. It is concentrated with nitrogenous waste.
27. COUNTER CURRENT MECHANISM: It operates in Henle s loop of Nephron.

28. When osmotic pressure of blood increases it stimulate pituitary to release ADH (Anti – Diuretic Hormone or vasopressin) which in turn promoter retention of water is less urine output until normal osmotic pressure of blood is restored.
29. DIABETES INCIPIDES OR WATER DIURISES [POLYUREA]: It is a disorder of excretory system i.e., frequent discharge of large volumes of dilute urine (Hypotonic). Due to absence of ADH.

DISORDERS OF EXCRETORY SYSTEM

30. KIDNEY STONES OR RENAL CALCULI a solid mass or a crystal of calcium oxalate, magnesium phosphate, uric acid crystals accumulated in the urinary tract is called kidney stone.Kidney stones can be removed by Lithrotrypsy.
31. Malfunctioning of kidneys can lead to accumulation of urea in blood, a condition called uremia, which is highly harmful and may lead to kidney failure. Excess of urine in blood is called uremia
32. Glomerular Nephritis, It is caused by B – lympholytic streptococci bacteria. In this condition Glomerular capillaries are blocked by bacteria which prevents filtration.
33. DIALYSIS: The process of separating small diffusible particles from large non – diffusible particles by using a selectively permeable membrane is called dialysis

Haemoturia: Presence of blood in urine.
Dysuria: Painful urination.
Anuria: Decrease in urine formation.
Polyuria: Excess of urination.
Glycosuria: Excess of glucose in urea.

CHAPTER-7
LOCOMOTION AND MOVEMENT

Muscles:

1. Cilia is the main locomotory organ of paramecium
2. Hydra uses its tentacles for capturing its prey and also uses them for locomotion.
3. The 3 main types of movements are: - Amoeboid, ciliary, muscular.
4. Muscle is a specialized tissue of Mesodermal origin.
5. Based on their location muscles are divided into i) Skeletal ii) Visceral iii) Cardiac muscles
6. The muscles which are attached to the bones and activities are under the voluntary control of the nervous system they are also known as voluntary or skeletal or striated muscles.
7. Visceral muscles are located in the visceral organs of the body like alimentary canal, reproductive tart etc. They are also called smooth or involuntary or non-striated muscles.
8. Cardiac muscle is located in the heart. Their appearance is striated but they work as in voluntary muscles.
9. Each organized skeletal muscle in our body is made of a num ber of a muscle bundles[fascicles] held together by a common collagenous connective tissue layer called "fascia".
10. Each muscle bundle contains a number of muscles fibers. Each muscle fiber is lined by the plasma membrane called "sarcolemma "enclosing the "sarcoplasm".
11. The endoplasmic reticulum i.e.; sacroplasmic reticulum of the muscle fiber is the store house of calcium ions.
12. A large number of parallel arranged filaments in the sacroplasm called myofilaments or myofibrils. Each my ofibril has alternate dark and light bands on it.
13. The two important contractile proteins in the skeletal muscles are Actin and Myosin.
14. Troponin and Tropomyosin are the accessory (Regulatory) proteins present in the skeletal muscles.
15. The light bands in a sarcomere contain actin is called I-band or Isotropic band.
16. The dark band called "A" or Anisotropic band contains myosin.
17. Action filaments are thinner as compared to the myosin filaments.
18. In the centre of each "I" band is an elastic fiber called "Z" line which bisects the I-band.
19. The portion of the myofibril between two successive "Z" lines is considered as the functional unit of contraction and is called a "sarcomere".
20. This central part of thick filaments not overlapped by thin filaments is called the "H"-Zone.

21. Many monomeric protein called meromyosins constitute one thick filament – Myosin.
22. Meromyosin has 2 parts; a globular head with a short arm called the heavy meromyosin (HMM) and the tail region called the light meromyosin (LMM).
23. The globular head of Actin has an active ATPase enzyme and has binding sites for ATP a deactivate sites for actin.
24. Mechanism of muscle contraction is best explained by the sliding filament theory which states that contraction of a muscle fiber takes place by the sliding of the thin filaments over the thick filaments.
25. During the muscle contraction, Ca2+ released by the sarcoplasmic reticulum; binds to troponin (regulatory protein) which binds on the actin molecules to block myosin binding site.

Skeletal System

26. Bone and cartilage are specialised connective tissues. The former has a very hard matrix due to calcium salts in it and the latter has slightly pliable matrix due to chondroitin salts.
27. The Human skeletal system is made of 206 bones and a few cartilages, approximately.
28. Human skeletal system is divided into Axial and Appendicular skeleton.
29. Axial Skeleton: Axial skeleton comprises 80 bones distributed along the main axis of the body. The skull, vertebral column, sternum and ribs constitute axial skeleton.
30. The skull is composed of two sets of bones – cranial (8) and facial (14), which totals to 22 bones.
31. A single U-shaped bone (tongue bone) called hyoid is present at the base of the buccal cavity
32. Vertebral column is formed by 26 serially arranged units called vertebrae, which are dorsally placed.
33. First vertebra is the atlas and it articulates with the occipital condyles, second vertebra is the axis.
34. The vertebral column is differentiated into following regions starting from the skull:
    (a) Cervical -7, (b)Thoracic -12, (c) Lumbar -5, (d) Sacral -1-fused and
    (e) Coccygeal (1-fused)
35. Sternum is a flat bone on the ventral midline of thorax. It is also known as the breast bone.
36. There are 12 pairs of ribs. Each rib is a thin flat bone connected dorsally to the vertebral column and ventrally to the sternum.
37. A rib bone has two articulation surfaces on its dorsal end and is hence called bicephalic.
38. First seven pairs of ribs are called true ribs. Dorsally, they are attached to the thoracic vertebrae and ventrally connected to the sternum with the help of hyaline cartilage.
39. The 8th, 9th and 10th pairs of ribs do not articulate directly with the sternum but join the seventh rib with the help of hyaline cartilage. These are called vertebrochondral (false) ribs.
40. Last 2 pairs (11th and 12th) of ribs are not connected ventrally and are therefore, called floating ribs.
41. Thoracic vertebrae, ribs and sternum together form the rib cage.
42. Appendicular skeleton: The bones of the limbs along with their girdles constitute the appendicular skeleton. Each limb is made of 30 bones.
43. The bones of the fore limbs (hand) are Humerus, radius and ulna, carpals (wrist bones – 8 in number), metacarpals (palm bones – 5 in number) and phalanges (digits – 14 in number).
44. The bones of the hind limbs (legs) are Femer (thigh bone – the longest bone), tibia and fibula, tarsals (ankle bones – 7 in number), metatarsals (5 in number) and phalanges (digits – 14 in number) are the bones of the legs (hind limb). A cup shaped bone called patella cover the knee ventrally (knee cap).
45. Each half of pectoral girdle consists of a clavicle(collar bone) and a scapula.
46. Scapula is a large triangular flat bone situated in the dorsal part of the thorax between the second and the seventh ribs.
47. The dorsal, flat, triangular body of scapula has a slightly elevated ridge called the spinewhich projects as a flat, expanded process called the acromion.
48. Pelvic girdle consists of two coxal bones. Each coxal bone is formed by the fusion of three bones – ilium, ischium and pubis.

49. At the point of fusion of the above bones is a cavity called acetabulum to which the thigh bone articulates.
50. Joints have been classified into 3 major structural forms:-i) Fibrous joints ii) Cartilaginous joints iii) Synovial joints.
51. Fibrous joints don't allow any movement. This type of joint is found in the flat skull bones which fuse end-to-end with the help of dense fibrous connective tissue to form the cranium.
52. The cartilaginous joints, the bones involved are joined together with the help of cartilages.
53. The joint between the adjustmen in the vertebral column is of this pattern and it permits limited movements.
54. Synovial joints are characterized by the presence of a fluid filled synovial cavity between the articulating surfaces of the two bones. Such an arrangement alones considerable movement.
55. This joints help in locomotion and many other movements. For example t he ball and socket joint. (Between the numerous and pectoral girdle).
56. Myasthenia gravis: Auto immune disorders effecting neuromuscular junction leading to fatigue weakening and paralysis of skeletal.
57. Muscular dystrophy: Progressive degeneration of skeletal muscle mostly due to genetic disorder.
58. Tetany: Rapid spasms (wild contraction) in muscle due to low (Ca++ ions in body fluid).
59. Arthritis: It is the inflammation of joints.
60. Gout: It is the inflammation of joints due to accumu lations of uric acids crystals.

CHAPTER-8
NEURAL CONTROL AND COORDINATION

1. Neural System of all animals composed of highly specialized cells called neurons.
2. Human neural system is divided into three divisions:
   a) Central neural system (CNS)
   b) Peripheral neural system (PNS)
   c) Autonomous neural system (ANS)CNS includes the brain and the spinal cord.
3. CNS is the site of information processing and control.
4. PNS includes nerves associated with the CNS (brain and spinal cord) through cranial nerves and spinal nerves, PNS includes somatic and autonomic neural system.
5. Somatic neural system relays impulses from the CNS to skeletal muscles.Autonomic neural system transmits impulses from CNS to the involuntary organs and smooth muscles of the body.
6. Autonomic neural system classified into sympathetic and para sympathetic
7. Neuron is the structural & functional unit of neural system
8. Neuron is composed of 3 parts- Cell body, dendrites, axon
9. Cell body is also called cytonare perikarya.
10. Typical cell organelles present in the cytoplasm of cell body and dendrites are called Nissls granules
11. Cytoplasmic projections of the cell body are called dendrites. These are branched more in number. Dendrites transmit impulses towards the cell body.
12. Neurons are divided in to 3 types
13. Unipolar:-neuron with only one axon, found in the embryonic stage
14. Bipolar :neuron with one axon and one dendrite, found in retina of eye
15. Multipolar: neuron with one axon and two or more dendrites, found in cerebral cortex
16. The gaps between two adjacent myelin sheaths are called Nodes of Ranvier
17. Axon covered with myelin sheath is called Myelinated axon, found in spinal and cranial nerves
18. Axon not covered with myelin sheath called unmyelinated nerve fibre found in autonomous and somatic neural systems
19. The electrical potential difference across the resting plasma membrane is called as the resting potential
20. The electrical potential difference across the exited plasma membrane at the site A is called the action potential

21. Nerve impulse is transmitted from one neuron to another through junctions called synapses.
22. Minute space between membranes of pre-synaptic neuron and post-synaptic neuron is called synaptic cleft.
23. The central information processing organ of our body is brain. Brain act as the command and control system.
24. Brain is covered by 3 cranial meninges,outer layer called duramater, middle thin layer called arachnoid, inner layer is called piameter .
25. Brain is divided into 3 major parts: i) Fore brain ii) Mid brain iii) Hindbrain
26. Forebrain consists of cerebrum, thalamus and hypothalamus
27. Cerebrum divided into 2 cerebral hemisphere. This are connected by a tract of nerve fibres called corpus callosum.
28. The layer of cells which covers the cerebral hemisphere is called cerebral cortex. It is grey in colour because presence of cell bodies.
29. Hypothalamus contains sense centres which control body temperature, urge for eating and drinking and thermoregulation.
30. Hypothalamus secrete hormones called hypothalamic hormones
31. Mid brain located between thalamus of forebrain and pons of the hindbrain. A canal process through the midbrain is called cerebral aqueduct.
32. The dorsal portion of midbrain consists 4 round swellings called corpora quadrigemina
33. Midbrain and hindbrain form brainstem
34. Hindbrain comprises pons cerebellum and medulla oblongata
35. Medulla oblongata connected to spinal cord. The medulla contains centers which co ntrol respiration, cardiovascular reflexes and gastric secretions
36. A sudden withdrawal of body part which comes in contact with objects that are extremely hot, cold, pointed or poisonous are called reflex actions
37. One pair eyes are located in the sockets of skull called orbits
38. The wall of eyeball is composed of three layers. External layer is sclera, middle layer choroid, inner layer retina
39. Anterior portion of sclera is called cornea, anterior portion of choroid layer is called ciliary body. Ciliary body form a pigmented and opaque structure called iris
40. The aperture surrounded the iris is called pupil. Eye ball contains transparent crystalline lens.
41. Lens are held in place by ligaments
42. Retina contains 3 layers of cells from inside to outside- ganglion cells, bipolar, photoreceptor cells
43. Rods and cones are two types of photoreceptor cells
44. In human the daylight vision and colour vision are functions of cones and twilight vision is the function of the rods.
45. In human eye three types of cones that respond to red, green and blue lights
46. The photoreceptor cells are not present in the posterior pole of eye ball, hence these region is called blindspot
47. Space between cornea and lens is called aqueous chamber
48. Space between lens and retina is called vitreous chamber
49. Middle ear of human being contains three ossicles called malleus, incus, stapes
50. Middle ear cavity and pharynx are connected by Eustachian tube
51. Fluid filled inner ear is called Labyrinth. The coiled portion of labryrinth called cochlea
52. Organ of corti act as auditory receptors
53. Inner ear contains a complex system called vestibular apparatus. It helps us maintaining balance of the body and posture.
54. Vestibular apparatus composed of three semi circle of canals and the otolith organ.

CHAPTER-9
CHEMICAL CO-ORDINATION AND INTEGRATION

1. Endocrine glands lack ducts and are hence called ductless glands
2. Hormones are non –nutrient chemical which act as intercellular messengers and are produced in trace amounts

Human endocrine system

3. It consists of pituitary, pineal, thyroid, adrenal pancreas, parathyroid, thymus, and gonads are the endocrine bodies in our body
4. Gastrointestinal tract, liver, kidney heart also produce hormones
5. **The hypothalamus:** It contains neurosecretory cells called nuclei which produce hormones which regulate the synthesis and secretion of pituitary hormones
6. Hypo thalamus produce two types of hormones, the releasing hormones andthe inhibiting hormones
7. These hormones reach the pituitary glands through a portal circulating and regulate the functions of the anterior pituitary
8. The posterior pituitary is under the direct neural regulation of the hypothalamus
9. Pituitary gland:
10. It is located in a bony cavity called sellatarsica
11. It is divided into anatomically into an adenohypophysis and a neurohypophysis.
12. Adenohypophysis consists of two portions, pars distalis and par intermedia
13. The pars distalis region of pituitary commonly called anterior pituitary produces growth hormones(GH), prolactin(PRL), thyroid stimulating hormone (TSH),adrenocorticotrophic hormone(ACTH),luteinizing hormone (LH) and FSH.
14. Pars intermedia secretes only one hormone called melanocytestimulating hormones (MSH)
15. Neurohypothysis also known as posterior pituitary stores and releases two hormones called oxytocinand vasopressin
16. Oversecretion of GH – gigantism, Hyposecretion of GH – dwarfism
17. Prolactin regulates the growth of mammary glands and formation of milk in them
18. TCH stimulates the synthesis and secretion of thyroid hormones
19. Adrenocorticotro tropic hormones (ACTH) stimulates the synthesis secretion of steroid hormones called glucorticiods
20. In males LH stimulates synthesis and secretion of hormone called androgens
21. MSH (melanocyte stimulating hormones) regulates pigmentation skin
22. Vasopressin acts mainly at the kidney(DCT) and stimulates reabsorption of water and electrolytes also called anti-diuretic hormone(ADH)

Thyroid gland:

23. It has two lobes located on either side of tracheathis gland is composed of follicles and stromal tissues
24. The follicular cells of thyroid synthesize tetraiodothyronine (or) thyroxine (T4) and triiodethyronine (T3)
25. Iodine is essential for the normal rate of hormone synthesis in thyroid
26. Deficiency of iodine leads to hypothyroidism and enlargement of thyroid gland called goiter
27. Thyroid hormones control the metabolism of carbohydrates proteins and fats
    gland also secretes a protein hormone called thyrocalcitonin(TCT) which regulates the blood calcium levels
28. **Parathyroid gland:** This secretes parathyroid hormone(PTH) or Parathormone, PTH is hypercalcimic hormone, It plays significant role in calcium balance in the body along with TCT

Pineal gland:

29. Located on dorsal side of fore brian secrets hormone called "melatonin"
30. Melatonin influences metabolism, pigmentation ,menustrial cycle, defense capability
31. It maintains and regulates 24hrs rhythm of our body.

Thymus:

32. It is located on dorsal side of the heart and aorta, secretes thymosin(role - differentiation of T- lymphocytes)

Thymus is degenerated in old individuals resulting in decreased production of thysmosins so old persons become weak

Adrenal gland:

33. a pair of adrenal glands are located on anterior part of each kidney
34. Adrenal medulla secretes adrenaline / epinephrine or norepinephrine are called catecholamines which also called emergency hormones of fight or flight
35. Adrenal cortex secretes 'corticoids'Glucocorticoids, particularly cortisol , produces antiinflammatory reactions and suppresses immune response cortisol stimulates RBC production

Pancreas:(exocrine and endocrine gland)

36. Endocrine pancreas has islets of langerbans which has∝-cells(secretes glucagon) and β –cells(secretes insulin)
37. Glucagon(hyperglycemic homone) stimulates glycogenolysis resulting in hyperglycemia (increased blood glucose), also stimulates glucoeogenesis
38. Insulin acts on hepatocytes and adipocytes and enhance celluar glucose uptake and utilization resulting in decreased blood sugar level (hypoglycemia)
39. Insulin also stimulates conversion of glucose to glycogen in target cells (glycoge nesis)
40. Prolonged hyper glycemia leads to diabetes mellitus

Testis: testis are presents in the scrotal sac of male individuals,testis act as primary sex organs and as an endocrine glandstestis is composed of seminiferous tubules and stromal or interstitial tissuethe leyding cells or interstitial cells produce hormones called androgens mainly testosteroneandrogens stimulate the process of spermatogenesis

Ovary:

41. Ovary also produces two steroid hormones estrogens and progesterone
42. Estrogen is synthesized and secreted by growing ovarian follicles
43. After ovulation the ruptured follicle is converted to "corpus luteum" which secretes progesterone, Progestron supports pregnancy
44. Hormones of heart, kidney and gastrointestinal tract
45. Atrial wall of heart secretes atrialnatriurctic factor (ANF)which decreases B.P
46. Juxtaglomerular cells of kidney produceserythropoietin which stimulates formation of RBC (erythropoiesis)
47. Endocrine cells of gastrointestinal tract produces gastrin, secretin, cholecystokinin (CCK) and gastric inhibitory peptide (GIP)
48. Gastrin stimulates the secretion of Hcl and pepsinogen
49. Secretin acts on pancreas and stimulates secretion of water and bicarbonate ions
50. CCK acts on pancreas and gall bladder stimulates secretion of pancreatic enzymes and bile juice
51. GIP inhibits gastric secretion and motility

Mechanism of hormone action:

52. On the basis of their chemical nature, hormones can be divided into
    a. Peptide, polypeptide, protein hormones Eg: insulin, glucagon etc.
    b. Steroids Eg: cortisol, testosterone
    c. Iodothyronines (thyroid hormones)
    d. Amino acids derivatives eg: epinephrine