SURYA
POWER TO SCORE

BIOLOGY

Bio-Botany & Bio-Zoology

Five Marks Questions with Answers

VOLUME - I & II

11

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சதம் அடிப்போம்....

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BIO-BOTANY

5 Marks

1 LIVING WORLD

EVALUATION

1. Briefly discuss on five kingdom classification. Add a note on merits and demerits.

+ R.H.Whittaker, an American taxonomist proposed five kingdom classification in the year 1969.
+ The Kingdoms include **Monera, Protista, Fungi, Plantae and Animalia** .
+ The criteria adopted for the classification include cell structure, thallus organization, mode of nutrition, reproduction and phylogenetic relationship.

Merits

+ The classification is based on the complexity of cell structure and organization of thallus.
+ It is based on the mode of nutrition
+ Separation of fungi from plants
+ It shows the phylogeny of the organisms

Demerits

+ The kingdom Monera and protista accommodate both autotrophic and heterotrophic organisms, cell wall lacking and cell wall bearing organisms thus making these two groups more heterogeneous.
+ Viruses were not included in the system.

2. Give a general account on lichens.

+ The symbiotic association between algae and fungi is called **lichens.**
+ The algal partner is called **Phycobiont**or **Photobiont** and the fungal partner is called **Mycobiont.**
+ Algae provide nutrition for fungal partner in turn fungi provide protection and also help to fix the thallus to the substratum through rhizines.

+ Asexual reproduction takes place through fragmentation, Soredia and Isidia.
+ Phycobionst reproduce by akinetes, hormogonia, aplanospore etc., Mycobionts undergo sexual reproduction and produce ascocarps.

Classification

+ **Based on the habitat** – Corticolous, Lignicolous, Saxicolous, Terricolous, Marine and Fresh water lichens.
+ **Based on the morphology** -Leprose, Crustose, Foliose, Fruticose.
+ **Based on the the distribution of algal cells** - Homoiomerous and Heteromerous
+ **Based on the the fungal partner** - Ascolichen and Basidiolichen.

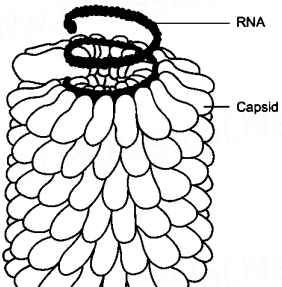
Uses

+ Lichens secrete organic acids.
+ Usnic acid produced from lichens show antibiotic properties.
+ They are considered as pollution indicators.
+ Reindeer moss is used as food for animals living in Tundra regions.

ADDITIONAL

1. Describe the structure of Tobacco Mosaic Virus (TMV) with the labeled diagram.

+ Electron microscopic studies have revealed that TMV is a rod-shaped helical virus measuring about 280x150µm with a molecular weight of 39x106 Daltons.
+ The virion is made up of two constituents, a protein coat called **capsid** and a core called **nucleic acid**.



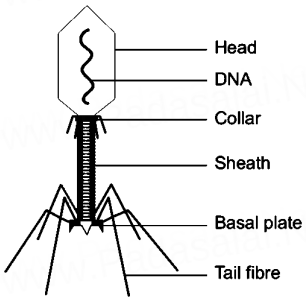
+ The protein coat is made up of approximately 2130 identical protein subunits called **capsomeres** which are present around a central single stranded RNA molecule.
+ The genetic information necessary for the formation of a complete TMV particle is contained in its RNA. The RNA consists of 6,500 nucleotides.

2. Tabulate the different Classes of viruses with the example.

Class	Example
Class 1 - Viruses with dsDNA	Adenoviruses
Class 2 –Viruses with (+) sense ssDNA	Parvo viruses
Class 3 –Viruses with dsRNA	Reo viruses
Class 4 –Viruses with (+) sense ssRNA	Toga viruses
Class 5 – Viruses with (–) antisense ssRNA	Rhabdo viruses
Class 6 – Viruses with (+) sense ss RNA –RT that replicate with DNA intermediate in life cycle	Retro viruses
Class 7 – Viruses with ds DNA – RT that replicate with RNA intermediate in life cycle	Hepadna viruses

3. Describe the structure of Bacteriophage.

+ The T_4 phage is tadpole shaped and consists of head, collar, tail, base plate and fibres.
+ The head is hexagonal which consists of about 2000 identical protein subunits. The long helical tail consists of an inner tubular core which is connected to the head by a collar.



+ There is a base plate attached to the end of tail. The base plate contains six spikes and tail fibres. These fibres are used to attach the phage on the cell wall of bacterial host during replication.
+ A dsDNA molecule of about 50 µm is tightly packed inside the head. The DNA is about 1000 times longer than the phage itself.

4. Tabulate the various types of Viral diseases.

Plant diseases	Animal diseases	Human diseases
1. Tobacco mosaic 2. Cauliflower mosaic 3. Sugarcane mosaic 4. Potato leaf roll 5. Bunchy top of banana 6. Leaf curl of papaya 7. Vein clearing of Lady's finger 8. Rice tungro disease 9. Cucumber mosaic 10. Tomato mosaic disease	1. Foot and mouth disease of cattle 2. Rabies of dog 3. Encephalomyelitis of horse	1. Common cold 2. Hepatitis B 3. Cancer 4. SARS(Severe Acute Respiratory Syndrome) 5. AIDS(Acquired Immuno Deficiency Syndrome) 6. Rabies 7. Mumps 8. Polio 9. Chikungunya 10. Small Pox 11. Chicken pox 12. Measles

5. General characteristic features of Bacteria

+ They are Prokaryotic organisms and lack nuclear membrane and membrane bound organelles.
+ The Genetic material is called nucleoid or genophore or incipient nucleus
+ The cell wall is made up of Polysaccharides and proteins
+ Most of them lack chlorophyll, hence they are heterotrophic (Vibrio cholerae) but some are autotrophic and possess Bacteriochlorophyll (Chromatium)
+ They reproduce vegetative by Binary fission and endospore formation.
+ They exhibit variations which are due to genetic recombination and is achieved through conjugation, transformation and transduction.

6. Differentiate the gram positive bacteria with the gram negative bacteria.

Characteristics	Gram positive Bacteria	Gram negative Bacteria
Cell wall	Single layered with 0.015μm-0.02μm	Triple layered with 0.0075μm-0.012μm thick

Rigidity of cell wall	Rigid due to presence of Peptidoglycans	Elastic due to presence of lipoprotein-polysaccharide mixture
Chemical composition	Peptidoglycans - 80% Polysaccharide - 20% Teichoic acid present	Peptidoglycans-3 to 12% rest is polysaccharides and lipoproteins. Teichoic acid absent
Outer membrane	Absent	Present
Periplasmic space	Absent	Present
Susceptibility to penicillin	Highly susceptible	Low susceptible
Nutritional requirements	Relatively complex	Relatively simple
Flagella	Contain 2 basal body rings	Contain 4 basal body rings
Lipid and lipoproteins	Low	High
Lipopolysaccharides	Absent	Present

7. List out the economic importance of bacteria on the basis of soil fertility.

Beneficial aspects	Bacteria	Role
Ammonification	1. Bacillus ramosus 2. Bacillus mycoides	Convert complex proteins in the dead bodies of plants and animals into ammonia which is later converted into ammonium salt
Nitrification	1. Nitrobacter 2. Nitrosomonas	Convert ammonium salts into nitrites and nitrates
Nitrogen fixation	1. Azotobacter 2. Clostridium 3. Rhizobium	(i) Converting atmospheric nitrogen into organic nitrogen (ii) The nitrogenous compounds are also oxidized to nitrogen (iii) All these activities of bacteria increase soil fertility

8. Write the name of antibiotics and their uses.

Beneficial aspects	Bacteria	Role
1. Streptomycin	Streptomyces griseus	It's cures urinary infections, tuberculosis, meningitis and pneumonia
2. Aureomycin	Streptomyces aureofaciens	It's used as a medicine to treat whooping cough and eye infections
3. Chloromycetin	Streptomyces venezuelae	It cure typhoid fever
4. Bacitracin	Bacillus licheniformis	It is used to treat syphilis
5. Polymyxin	Bacillus polymyxa	It cure some bacterial diseases

9. List out the industrial uses of bacteria.

Beneficial aspects	Bacteria	Role
1. Lactic acid	Streptococcus lactis and Lactobacillus bulgaricus	Convert milk sugar lactose into lactic acid
2. Butter	Streptococcus lactis, Leuconostoc citrovorum	Convert milk into butter, cheese, curd and yoghurt
3. cheese	Lactobacillus acidophobus, Lactobacillus lactis	
4. Curd	Lactobacillus lactis	
5. Yoghurt	Lactobacillus bulgaricus	
6. Vinegar (Acetic acid)	Acetobacter aceti	This bacteria oxidizes ethyl alcohol obtained from molasses by fermentation to vinegar(acetic acid)
7. Alcohol and Acetone (i) Butyl alcohol (ii) Methyl alcohol	Clostridium acetobutylicum	Alcohols and acetones are prepared from molasses by fermentation activity of the anaerobic bacterium
8. Retting of fibres	Clostridium tertium	The fibres from the fibre yielding plants are separated by the action of Clostridium is called retting of fibres

9. Vitamins	Escherichia coli	Living in the intestine of human beings produce large quantities of vitamin K and vitamin B complex
	Clostridium acetobutylicum	Vitamin B2 is prepared by the fermentation of sugar
10. Curing of Tea and Tobacco	Mycococcus candisans, Bacillus megatherium	The special flavor and aroma of the tea and tobacco are due to fermentation

10. List out the plant diseases caused by bacteria.

Name of the Host	Name of the disease	Name of the pathogen
Rice	Bacterial blight	Xanthomonas oryzae
Apple	Fire blight	Erwinia amylovora
Carrot	Soft rot	Erwinia caratovora
Citrus	Citrus canker	Xanthomonas citri
Cotton	Angular leaf spot	Xanthomonas malvacearum
Potato	Ring rot	Clavibacter michiganensis subsp. sepedonicus
Potato	Scab	Streptomyces scabies

11. List out the animal diseases causes by bacteria.

Name of the Animal	Name of the disease	Name of the pathogen
Sheep	Anthrax	Bacillus anthracis
Cattle	Brucellosis	Brucella abortus
Cattle	Bovine tuberculosis	Mycobacterium bovis
Cattle	Black leg	Clostridium chanvei

12. List out the human diseases caused by bacteria.

Name of the disease	Name of the pathogen
Cholera	Vibrio cholerae
Typhoid	Salmonella typhi
Tuberculosis	Mycobacterium tuberculosis
Leprosy	Mycobacterium leprae
Pneumonia	Diplococcus pneumonie
Plague	Yersinia pestis

Diphtheria	Corynebacterium diptheriae
Tetanus	Clostridium tetani
Food poisoning	Clostridium botulinum
Syphilis	Treponema pallidum

13. Describe the Mycoplasma or Mollicutes

+ The Mycoplasma are very small (0.1–0.5µm), pleomorphic gram negative microorganisms. They are first isolated by Nocard and co-workers in the year 1898 from pleural fluid of cattle affected with bovine pleuropneumonia.
+ They lack cell wall and appears like "Fried Egg" in culture. The DNA contains low Guanine and Cytosine content than true bacteria.
+ They cause disease in animals and plants. Little leaf of brinjal, witches broom of legumes phyllody of cloves, sandal spike are some plant diseases caused by mycoplasma.
+ Pleuropneumonia is caused by Mycoplasma mycoides

14. Diseases caused by Fungi in Human beings and Plants.

Name of the disease	Causal organism
Plant diseases	
Blast of Paddy	Magnaporthe grisea
Red rot of sugarcane	Colletotrichum falcatum
Anthracnose of Beans	Colletotrichum lindemuthianum
White rust of crucifers	Albugo candida
Peach leaf curl	Taphrina deformans
Rust of wheat	Puccinia graminis tritici
Human diseases	
Athlete's foot	Epidermophyton floccosum
Candidiasis	Candida albicans
Coccidioidomycosis	Coccidioides immitis
Aspergillosis	Aspergillus fumigatus

2 PLANT KINGDOM

EVALUATION

1. Differentiate haplontic and diplontic life cycle.

Haplontic life cycle

+ Gametophytic phase is dominant, photosynthetic and independent, whereas sporophytic phase is represented by the zygote. Zygote undergoes meiosis to restore haploid condition.
+ Example: Volvox, Spirogyra.

Diplontic life cycle

+ Sporophytic phase (2n) is dominant, photosynthetic and independent. The gametophytic phase is represented by the single to few celled gametophytes. The gametes fuse to form Zygote which develops into Sporophyte.
+ Example: Fucus, Gymnosperms and Angiosperms

ADDITIONAL

1. Describe the Economic Importance of Algae

Name of the Algae	Economic importance
Beneficial activities	
Chlorella, Laminaria, Sargassum, Ulva, Enteromorpha	Food
Gracilaria, Gelidiella, Gigartina	Agar Agar – Cell wall material used for media preparation in the microbiology lab. Packing canned food, cosmetic, textile paper industry
Chondrus crispus	Carrageenan – Preparation of tooth paste, paint, blood coagulant

Laminaria, Ascophyllum	Alginate – ice cream, paints, flame proof fabrics
Laminaria, Sargassum, Ascophyllum, Fucus	Fodder
Diatom (Siliceous frustules)	Diatomaceous earth– water filters, insulation material, reinforcing agent in concrete and rubber.
Lithophyllum, Chara, Fucus	Fertilizer
Chlorella	Chlorellin -Antibiotic
Chlorella, Scenedesmus, Chlamydomonas	Sewage treatment, Pollution indicators
Harmful activity	
Cephaleuros virescens	Red rust of coffee

2. Describe the Economic Importance of Bryophytes

+ A large amount of dead thallus of Sphagnum gets accumulated and compressed, hardened to form peat. In northern Europe peat is used as fuel in commercial scale (Netherlands).
+ Apart from this Nitrates, brown dye and tanning materials are derived from peat. Sphagnum and peat are also used in horticulture as packing material because of their water holding capacity.
+ Marchantiapolymorpha is used to cure pulmonary tuberculosis. Sphagnum, Bryum and Polytrichum are used as food.
+ Bryophytes play a major role in soil formation through succession and help in Soil conservation.

3. Describe the Economic Importance of Pteridophytes

Pteridophyte	Uses
Rumohra adiantiformis (leather leaf fern)	Cut flower arrangements
Marsilea	Food
Azolla	Biofertilizer
Dryopteris filix–mas	Treatment for tapeworm.

Pteris vittata	Removal of heavy metals from soils - Bioremediation
Pteridium sp.	Leaves yield green dye
Equisetum sp.	Stems for scouring
Psilotum, Lycopodium, Selaginella, Angiopteris, Marattia	Ornamental plants

4. Describe the Types of Stele

+ The term stele refers to the central cylinder of vascular tissues consisting of xylem, phloem, pericycle and sometimes medullary rays with pith.
+ There are two types of steles :- Protosteleand Siphonostele

Protostele:

+ In protostele xylem surrounds phloem. The type includes Haplostele, Actinostele, Plectostele, and mixed protostele.
+ **Haplostele**: Xylem surrounded by phloem is known as haplostele.Example: Selaginella.
+ **Actinostele**: Star shaped xylem core is surrounded by phloem is known as actinostele.Example: Lycopodium serratum.
+ **Plectostele**: Xylem plates alternates with phloem plates. Example: Lycopodium clavatum.
+ **Mixed prototostele**: Xylem groups uniformly scattered in the phloem. Example: Lycopodium cernuum.

Siphonostele:

+ In siphonostele xylem is surrounded by phloem with pith at the centre. It includes
+ Ectophloic siphonostele, Amphiphloicsiphonostele, Solenostele, Eustele, Atactostele and Polycylic stele.
+ **Ectophloic siphonostele** -The phloem is restricted only on the external side of the xylem. Pith is in centre. Example: Osmunda.

+ **Amphiphloicsiphonostele** -The phloem is present on both the sides of xylem. The pith is in the centre. Example: Marsilea.
+ **Solenostele** -The stele is perforated at a place or places corresponding the origin of the leaf trace.
+ **Ectophloic solenostele**– Pith is in the centre and the xylem is surrounded by phloem. Example: Osmunda.
+ **Amphiphloicsolenostele**– Pith is in the centre and the phloem is present on both sides of the xylem. Example: Adiantum pedatum.
+ **Dictyostele**– The stele is separated into several vascular strands and each one is called meristele.Example: Adiantum capillus-veneris.
+ **Eustele** -The stele is split into distinct collateral vascular bundles around the pith. Example: Dicot stem.
+ **Atactostele**- The stele is split into distinct collateral vascular bundles and are scattered in the ground tissue Example: Monocot stem.
+ **Polycyclicstele** -The vascular tissues are present in the form of two or more concentric cylinders. Example: Pteridium.

5. Differentiate between Gymnosperms and Angiosperms.

Gymnosperms	Angiosperms
Vessels are absent	Vessels are present
Phloem lacks companion cells	Companion cells are present
Ovules are naked	Ovules are enclosed within the ovary
Wind pollination only	Insects, wind, water and animal pollination occur
Double fertilization is absed	Double fertilization is present
Endosperm is haploid	Endosperm is triploid
Fruit formation is absent	Fruit formation is present
Flowers absent	Flowers present

6. Describe the Economic Importance of Gymnosperms

S.No	Plants	Products	uses
1.	Cycas circinalis, Cycas revoluta	Sago	Starch used as food
2.	Pinus gerardiana	Roasted seed	Used as a food
3.	Abies balsamea	Resin (Canada balsam)	Used as mounting medium in permanent slide preparation
4.	Pinus insularis, Pinus roxburghii	Rosin and Turpentine	Paper sizing and varnishes
5.	Araucaria (monkey's puzzle), Picea and Phyllocladus	Tannins	Bark yield tannins and is used in Leather industries
6.	Taxus brevifolia	Taxol	Drug used for cancer treatment
7.	Ephedra gerardiana	Ephedrine	For the treatment of asthma, bronchititis
8.	Pinus roxburghii	Oleoresin	Used to make soap, varnishes and printing ink
9.	Pinus roxburghii, Picea smithiana	Wood pulp	Used to make papers
10.	Cedrus deodara	wood	Used to make doors, boats and railway sleepers
11.	Cedrus atlantica	oil	Used in perfumery
12	Thuja, Cupressus, Araucaria, and Cryptomeria	whole plant	Ornamental plants/Floral Decoration

7. Write the Salient features of Angiosperms

+ Vascular tissue (Xylem and Phloem) is well developed.
+ Flowers are produced instead of cone
+ The embryosac (Ovule) remains enclosed in the ovary.
+ Pollen tube helps in fertilization, so water is not essential for fertilization.
+ Double fertilization is present. The endosperm is triploid.
+ Angiosperms are classified into Dicotyledons and Monocotyledons.

8. Differentiate between Dicotyledons and Monocotyledons.

Dicotyledons	Monocotyledons
Morphological Features ➢ Reticulate venation is present in the leaves. Presence of two cotyledons in the seed. Primary root radicle persists as Tap root. ➢ Flowers tetramerous or pentamerous. ➢ Tricolpate pollen is present.	**Morphological features** ➢ Parallel venation is present in the leaves. Presence of single cotyledon in the seed. Radicle does not persist and fibrous root is present. ➢ Flowers are trimerous. ➢ Monocolpte pollen is present.
Anatomical features ➢ Vascular bundles are arranged in the form of a ring in stem. ➢ Open vascular bundles present. ➢ Secondary growth is present.	**Anatomical features** ➢ Vascular bundles are scattered in the stem. ➢ Vascular bundles are closed. ➢ Secondary growth is absent.

3 VEGETATIVE MORPHOLOGY

EVALUATION

1. Write the similarities and differences between for the following :

Avicennia

Differences :

+ Breathing root
+ Some mangrove plants like **Avicennia**,develop special kinds of roots (Negatively geotropic) for respiration because the soil becomes saturated with water and aeration is very poor. They have a large number of breathing pores or pneumatopores for exchange of gases.
+ Example:**Avicennia**

Trapa

+ Photosynthetic or assimilatory roots
+ Roots of some climbing or epiphytic plants develop chlorophyll and turn green which help in photosynthesis is called **trapa**.
+ Example: **Trapanatans** (water chestnut)

Similarities :

+ Both are Root modified plants.

Banyan and silk cotton

Differences :

Banyan

+ Prop roots.
+ These roots grow vertically downward from the lateral branches into the soil.
+ Example:Banyan.

Silk Cotton

+ Buttress root.
+ In certain trees broad plank like outgrowths develop towards the base all around the trunk. They grow obliquely downwards and give support to huge trunks of trees. This is an adaptation for tall rain forest trees.
+ Example: **Silk cotton.**

Similarities :

+ Both are adventitious root modified plants.

Fusiform and Napiform root

Differences :

Fusiform root

+ These roots are swollen in the middle and tapering towards both ends.
+ Example: Radish

Napiform root

+ It is very broad and suddenly tapers like a tail at the apex.
+ Example: Beet root

Similarities :

+ Both are Tap root modified plants.
+ Both are storage roots.

Errata

2. Write the similarities and differences between

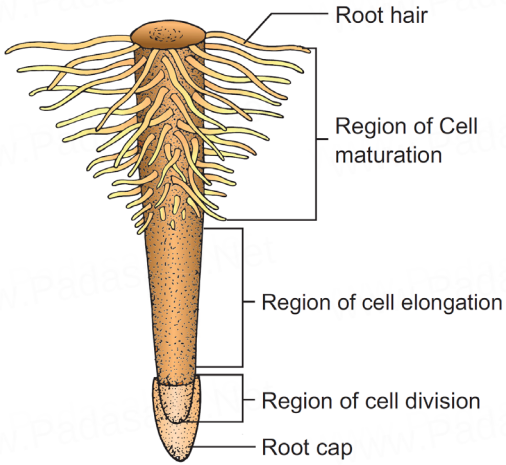
2. Radical buds and Foliar buds

Radical buds	Foliar buds
Radical buds are those that arises from the lateral roots which grow into plantlets. Example: *Millingtonia, Bergera koenigii (Murraya koenigii), Coffea arabica* and *Hedychium coronarium*.	**Foliar buds** are those that grow on leaves from veins or from margins of the leaves. Example: *Begonia* (Elephant ear plant) and *Bryophyllum* (Sprout leaf plant).

3. Phylloclade and cladode

Phylloclade	Cladode
This is a green, flattened cylindrical or angled stem or branch of unlimited growth, consisting of a series of nodes and internodes at long or short intervals. Phylloclade is characteristic adaptation of xerophytes where the leaves often fall off early and modified into spines or scales to reduce transpiration. Example: *Opuntia, Phyllocactus, Muehlenbeckia* (flattened phylloclade) *Casuarina, Euphorbia tirucalli, Euphorbia antiquorum* (cylindrical phylloclade).	Cladode is a flattened or cylindrical stem similar to Phylloclade but with one or two internodes only. Their stem nature is evident by the fact that they bear buds, scales and flowers. Example: *Asparagus* (cylindrical cladode), *Ruscus* (flattened cladode).

3. Draw and label the parts of regions of root.



ADDITIONAL

1. Write the Characteristic features of Root System

+ Root is the descending portion of the plant axis.
+ Generally non-green in colour as it lacks chlorophyll.
+ Does not possess nodes, internodes and buds (Exception in sweet potato and members of Rutaceae, roots bear buds which help in vegetative propagation)
+ It bears root hairs (To absorb water and minerals from the soil)
+ It is positively geotropic and negatively phototrophic in nature.

2. Explain the Tap root modification

Storage roots

Conical Root

+ These are cone like, broad at the base and gradually tapering towards the apex. Example: Daucus carota.

Fusiform root

+ These roots are swollen in the middle and tapering towards both ends. Example: Raphanus sativus

Napiform root

+ It is very broad and suddenly tapers like a tail at the apex. Example: Beta vulgaris

Breathing root

+ Some mangrove plants like Avicennia, Rhizophora, Bruguiera develop special kinds of roots (Negatively geotropic) for respiration because the soil becomes saturated with water and aeration is very poor.
+ They have a large number of breathing pores or pneumatopores for exchange of gases.

3. Write the Types of Stem

(i) Excurrent, **(ii) Decurrent,**
(iii) Caudex, **(iv) Culm.**

Excurrent

+ The main axis shows continuous growth and the lateral branches gradually becoming shorter towards the apex which gives a conical appearance to the trees. Example: Polyalthialongifolia, Casuarina.

Decurrent

+ The growth of lateral branch is more vigorous than that of main axis. The tree has a rounded or spreading appearance.
+ Example: Mangiferaindica, Azadirachtaindica, Tamarindus indicus, Aegle marmelos

Caudex

+ It's an unbranched, stout, cylindrical stem, marked with scars of fallen leaves. Example: Cocus nucifera, Borassusflabellifermis, Areca catechu

Culm

+ Erect stems with distinct nodes and usually hollow internodes clasped by leaf sheaths. Example: Majority of grasses including Bamboo.

4. Write a short note on Venation.

+ The arrangement of veins and veinlets on the leaf blade or lamina is called venation. Internally, the vein contains vascular tissues.
+ Conventionally venation is classified into two types namely, Reticulate venation and Parallel venation.

Reticulate venation

+ In this type of venation leaf contain a prominent midrib from which several secondary veins arise that branch and anastomose like a network.
+ This type of venation is common in all dicot leaves. It is of two types.

Pinnately reticulate venation (unicostate):

+ In this type of venation there is only one midrib in the centre

which forms many lateral branches to form a network. Example: Mangiferaindica, Ficusreligiosa, Nerium.

Palmately reticulate venation (multicostate):

+ In this type of venation there are two or more principal veins arising from a single point and they proceed outwards or upwards.
+ The two types of palmate reticulate venation are i. **Divergent type:**
+ When all principal veins originate from the base and diverge from one another towards the margin of the leaf as in Cucurbita, Luffa, Carica papaya, etc.,
+ ii. **Convergent:** When the veins converge to the apex of the leaf, as in Indian plum (Zizyphus), bay leaf (Cinnamomum)

Parallel venation

+ Veins run parallel to each other and do not form a prominent reticulum. It is a characteristic feature of monocot leaves. It is classified into two sub types.

Pinnately Parallel Venation (Unicostate)

+ When there is a prominent midrib in the center, from which arise many veins perpendicularly and run parallel to each other. Example: Musa, Zinger, Curcuma, Canna.

Palmate Parallel Venation (Multicostate)

+ In this type several veins arise from the tip of the petiole and they all run parallel to each other and unite at the apex. It is of two sub types.

Divergent type:

+ All principal veins originate from the base and diverge towards the margin, the margin of the leaf as in fan palm (Borassusflabellifer)

Convergent type:

+ All principal veins run parallel to each other from the base of the lamina and join at the apex as in Bamboos, rice, water hyacinth.

5. Write a short note on Phyllotaxy.

+ Phyllotaxy is to avoid over-crowding of leaves and expose the leaves maximum to the sunlight for photosynthesis.
+ The four main types of phyllotaxy are (1) Alternate (2) Opposite (3) Ternate (4) Whorled.

Alternate phyllotaxy

+ In this type there is only
+ one leaf per node and the leaves on the successive nodes are arranged alternate to each other. Spiral arrangement of leaves show vertical rows are called orthostichies. They are two types.

Alternate spiral:

+ In which the leaves are arranged alternatively in a spiral manner. Example: Hibiscus, Ficus.

Alternate distichous or Bifarious:

+ In which the leaves are organized alternatively in two rows on either side of the stem. Example: Monoonlongifolium (polyalthialongifolia).

Opposite phyllotaxy

+ In this type each node possesses two leaves opposite to each other.
+ They are organized in two different types.
+ **Opposite superposed:** The pair of leaves arranged in succession are in the same direction, that is two opposite leaves at a node lie exactly above those at the lower node.
+ Example: Psidium (Guava), Eugenia jambolana (Jamun), Quisqualis(Rangoon creeper).
+ **Opposite decussate:** In this type of phyllotaxy one pair of leaves is placed at right angles to the next upper or lower pair of leaves. Example: Calotropis, Zinnia, Ocimum

Ternate phyllotaxy

+ In this type there are three leaves attached at each node. Example: Nerium

Whorled (verticillate) type of phyllotaxy

+ In this type more than three leaves are present in a whorl at each node forming a circle or whorl. Example: Allamanda, Alstoniascholaris.

6. Write a short note on Ptyxis

+ **Reclinate** - when the upper half of the leaf blade is bent upon the lower half as in loquat (Eriobotrya japonica).
+ **Conduplicate** - when the leaf is folded lengthwise along the mid-rib, as in guava, sweet potato and camel's foot tree (Bauhinia).
+ **Plicate or plaited** – when the leaf is repeatedly folded longitudinally along ribs in a zig-zag manner, as in Borassusflabellifer.
+ **Circinate** - when the leaf is rolled from the apex towards the base like the tail of a dog, as in ferns.
+ **Convolute** - when the leaf is rolled from one margin to the other, as in banana, aroids and Indian pennywort. Musa and members of Araceae.
+ **Involute** - when the two margins are rolled on the upper surface of the leaf towards the midrib or the centre of the leaf, as in water lily, lotus, Sandwich Island Climber (Antigonon) and Plumbago.
+ **Crumpled** - when the leaf is irregularly folded as in cabbage.

7. Write a short note on Leaf duration

+ Leaves may stay and function for few days to many years, largely determined by the adaptations to climatic conditions.

Cauducuous (Fagacious)

+ Falling off soon after formation. Example: Opuntia, Cissusquadrangularis.

Deciduous

+ Falling at the end of growing season so that the plant (tree or shrub) is leafless in winter/summer season. Example: Maple, Plumeria, Lagerstroemia, Erythrina.

Evergreen

+ Leaves persist throughout the year, falling regularly so that tree is never leafless. Example: Mimusops, Calophyllum.

Marcescent

+ Leaves not falling but withering on the plant as in several members of Fabaceae.

8. Write a short note on Leaf symmetry.

Dorsiventral leaf

+ When the leaf is flat, with the blade placed horizontally, showing a distinct upper surface and a lower surface, as in most dicotyledons, it is said to be dorsiventral. Example: Tridax.

Isobilateral leaf

+ When the leaf is directed vertically upwards, as in many monocotyledons, it is said to be isobilateral leaf. Example: Grass.

Centric leaf

+ When the leaf is more or less cylindrical and directed upwards or downwards, as in pine, onion, etc., the leaf is said to be centric.

Heterophylly

+ Occurrence of two different kinds of leaves in the same plant is called heterophylly. Heterophylly is found in many aquatic plants.

4 REPRODUCTIVE MORPHOLOGY

EVALUATION

1. Explain the different types of fleshy fruit with suitable example.

a) Berry:

+ Fruit develops from bicarpellaryor multicarpellary, syncarpous ovary.Here the epicarp is thin, the mesocarpand endocarp remain undifferentiated.They form a pulp in which the seeds areembedded. Example: Tomato, Date Palm,Grapes, Brinjal.

b) Drupe:

+ Fruit develops frommonocarpellary, superior ovary. Itis usually one seeded. Pericarp isdifferentiated into outer skinny epicarp,fleshy and pulpy mesocarp and hard andstony endocarp around the seed. Example:Mango, Coconut.

c) Pepo:

+ Fruit develops from tri-carpellary inferior ovary. Pericarp terns leathery or woody which encloses, fleshy mesocarp and smooth endocarp. Example: Cucumber, Watermelon, Bottle gourd, Pumpkin.

d)Hesperidium:

+ Fruit develops frommulticarpellary, multilocular, syncarpous, superior ovary. The fruit wall is differentiated into leathery epicarp with oil glands, a middle fibrous mesocarp. Th e endocarp forms distinct chambers, containing juicy hairs. Example: Orange, Lemon.

e) Pome:

+ It develops from multicarpellary, syncarpous, inferior ovary. The receptacle also develops along with the ovary and becomes fleshy, enclosing the true fruit. In pome the epicarp is thin skin like and endocarp is cartilagenous. Example: Apple, Pear.

f) Balausta:

+ A fleshy indehiscent fruit developing from multicarpellary, multilocular inferior ovary whose pericarp is tough and leathery. Seeds are attached irregularly with testa being the edible portion. Example: Pomegranate.

2. Explain the different types of placentation with example.

Marginal placentation	The placentae along the margin of a unicarpellate ovary. **Example :** Fabaceae
Superficial placentation	Ovules arise from the surface of the septa. **Example :** Nymphaeceae
Free central placentation	The placentae along the column in a compound ovary without septa. **Example :** Caryophyllaceae, Dianthus, Primrose
Axileplacentation	The placentae arises from the column in a compound ovary with septa. **Example :** Hibiscus
Parietal placentation	The placentae on the ovary walls or upon intruding partitions of a unilocular, compound ovary. **Example :** Mustard, Cucumber
Basal placentation	The placentae at the base of the ovary. **Example :** Sunflower, Marigold

ADDITIONAL

1. Explainthe Fusion of stamens.

+ Two types: **Connation and Adnation**

Connation:

+ It refers to the fusion of stamens among themselves.
+ It is of 3 types : Adelphy, Syngenecious, Synandrous.

Adelphy:

+ Filaments connate into one or more bundles but anthers are free. It may be the following types.
  - ✍ **Monadelphous**: Filaments of stamens connate into a single bundle.Example: Malvaceae.
  - ✍ **Diadelphous**: Filaments of stamens connate into two bundles. Example: Fabaceae, pea.
  - ✍ **Polyadelphous**: Filaments connate into many bundles. Example: Citrus, Bombax

Syngenesious:

+ Anthers connate, filaments free. Example: Asteraceae.

Synandrous:

+ Filaments and anthers are completely fused. Example: Coccinea.

Adnation:

+ Refers to the fusion of stamens with other floral parts. **Epipetalous** (petalo-stemonous): Stamens are adnate to petals. Example: brinjal,Datura.

Episepalous:

+ Stamens are adnate to sepals. Example: Grevillea (Silver oak)

Epitepalous (epiphyllous):

+ Stamens are adnate to tepals. Example: Aphodelus, Asparagus

Gynostegium:

+ Connation product ofstamens and stigma is called **gynostegium**. Example: Calotropis and Orchidaceae.

Pollinium:

+ Pollen grains are fusedtogether as a single mass

2. Explain about the dry indehiscent Fruit.

+ Dry fruit which does not split open at maturity. It is subdivided into.

Achene:

+ Single seeded dry fruit developing from single carpel with superior ovary. Achenes commonly develop from apocarpous pistil, Fruit wall is free from seed coat. Example: Clematis, Delphinium, Strawberry.

Cypsela:

+ Single seeded dry fruit, develops from bicarpellary, syncarpous, inferior ovary with reduced scales, hairy or feathery calyx lobes. Example: Tridax, Helianthus.

Caryopsis:

+ It is a one seeded fruit which develops from a monocarpellary, superior ovary. Pericarp is inseparably fused with seed. Example: Oryza, Triticum.

Nut:

+ They develop from mulicarpellary, syncarpous, superior ovary with hard, woody or bony pericap. It is a one seeded fruit. Example: Quercus, Anacardium.

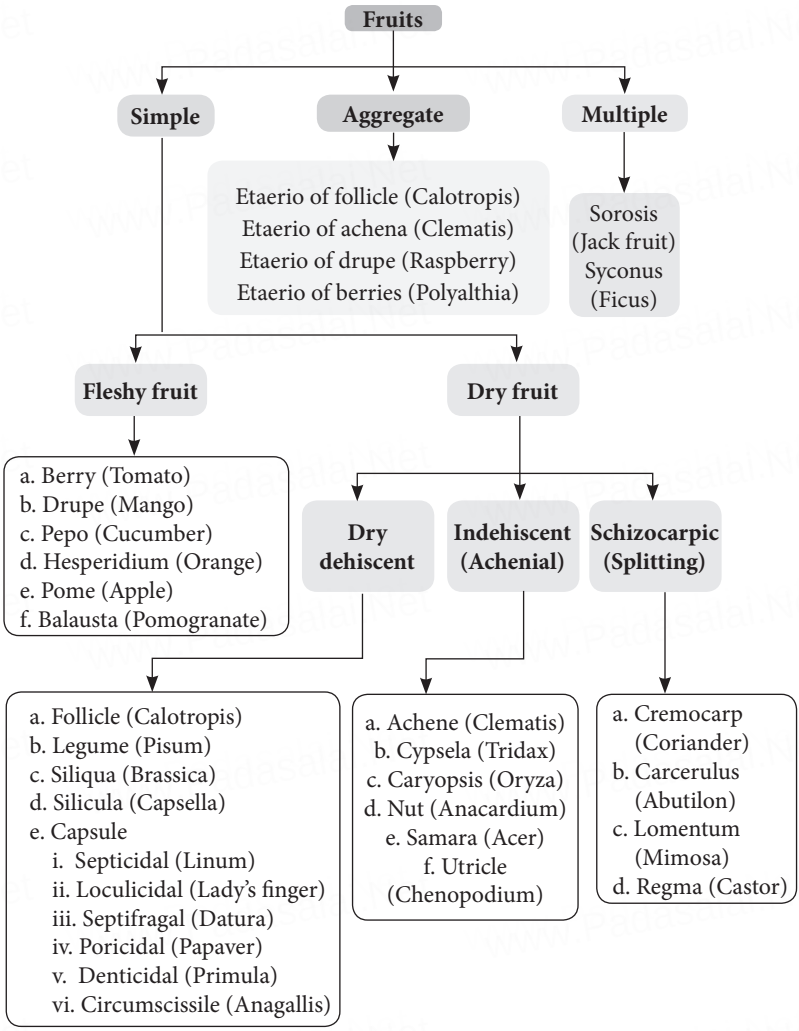
Samara:

✍ A dry indehiscent, one seeded fruit in which the pericarp devlops into thin winged structure around the fruit. Example: Acer, Pterocarpous.

Utricle:

+ They develop from bicarpellary, unilocular, syncarpus, superior ovary with pericarp loosely enclosing the seeds. Example: Chenopodium.

3. Write the flow chart of classification of fruits.



4. Describe the Mixed Inflorescence.

+ Inflorescences in which both racemose and cymose patterns of development occur in a mixed manner. It is of the following two types.

Thyrsus:

+ It is a '**Raceme of cymes**'. Indefinite central axis bears lateral pedicellate cymes, (simple or compound dichasia). Example: Ocimum, Anisomelus.

Verticil or Verticillaster:

+ Main axis bears two opposite lateral sessile cymes at the axil of the node,each of it produces monochasial scorpioid lateral branches so that flowers are crowded around the node. Example: Leonatis, Leucas.

5. Explain about the Dry dehiscent Fruit.

+ Pericarp is dry and splits open along the sutures to liberate seeds. They can be classified into following types.

Follicle:

+ Fruit develops from monocarpellary, superior ovary and dehisces along one suture. Example: Calotropis.

Legume or pod:

+ Fruit develops from monocarpellary, superior ovary and dehisces through both dorsal and ventral sutures. Example: Pisum.

Siliqua:

+ Fruit develops from bicarpellary, syncarpous, superior ovary initially one chambered but subsequently becomes two chambered due to the formation of false septum (**replum**). The fruit dehisces along two sutures. Example: Brassica.

Silicula:

+ Fruit similar to sliqua but shorter and broader. Example: Capsella, Lepidium, Alyssum.

Capsule:

+ Fruit develops from multicarpellary, syncarpous, superior ovary. Based on the dehiscence pattern they are sub divided into.

Septicidal:

+ Capsule splitting along septa and valves remaining attached to septa. Example: Linum, Aristolochia.

Loculicidal:

+ Capsule splitting along locules and values remaining attached to septa. Example: Lady's finger.

Septifragal:

+ Capsule splitting so that valves fall off leaving seeds attached to the central axis. Example: Datura.

Poricidal:

+ Dehiscence through terminal pores. Example: Papaver.

Denticidal:

+ Capsule opening at top exposing a number of teeth. Example: Primula, Cerastium.

Circumscissile (pyxidium)

+ Dehisces transversely so that top comes off as a lid or operculum. Example: Anagallis arvensis, Portulaca, Operculina.

5 TAXONOMY AND SYSTEMATIC BOTANY

EVALUATION

1. How does molecular markers work to unlock the evolutionary history of organisms?

+ Molecular Taxonomy is the branch of phylogeny that analyses hereditary molecular differences, mainly in DNA sequences, to gain information and to establish genetic relationship between the members of different taxonomic categories.
+ Different molecular markers like allozymes, mitochondrial DNA, micro satellites, RFLP (Restriction Fragment Length Polymorphism), RAPD (Random amplified polymorphic DNA), AFLPs (Amplified Fragment Length Polymorphism), single nucleotide polymorphism- SNP, microchips or arrays are used in analysis.
+ Molecular markers help in establishing the relationship of different plant groups at DNA level.
+ It unlocks the treasure chest of information on evolutionary history of organisms.

2. Give the floral characters of Clitoriaternatea.

Flower:

+ Bracteate, bracteolate, bracteoles usually large, pedicellate, heterochlamydeous, complete, bisexual, pentamerous, zygomorphic and hypogynous.

Calyx:

+ Sepals 5, synsepalous, green showing valvate aestivation. Odd sepal is anterior in position.

Corolla:

+ Petals 5, white or blue apopetalous, irregular papilionaceous corolla showing, descendingly imbricate aestivation.

Androecium:

+ Stamens 10, diadelphous (9) +1 nine stamens fused to form a bundle and the tenth stamen is free. Anthers are dithecous, basifixed, introse and dehiscing by longitudinal slits.

Gynoecium:

+ Monocarpellary, unilocular, with many ovules on marginal placentation, ovary superior, style simple and incurved with feathery stigma.

Fruit: Legume

3. How will you distinguish Solanaceae members from Liliaceae members?

General characters	Solanaceae	Liliaceae
Habit	Annual herbs, shrubs, small trees	Perennial herbs
Root	Branched tap root system	Adventitious and fibrous, typically contractile.
Stem	Herbaceous or woody tuberous at times	Bulbocus, rhizome, cladode, phylloclades
Leaf	Alternate, simple, rarely compound, unicostate reticulate venation	Radical or cauline, alternate, opposite, parallel venation
Inflorescence	Generally axillary or terminal cymose	Simple and branched racemes
Flowers	Pentamerous, actinomorphic or weakly zygomorphic due to oblique position of the ovary	Showy and actinomorphic, trimerous, slightly zygomorphic
Calyx	5 sepals, synsepalous valvate aestivation	Perianth 6, tepals in 2 whorls of 3 each apotepalous valvate or imbricate
Corolla	5 petals, sympetalous different shape of corolla tube, valvate	Absent

Androecium	Stamens 5, epipetalous dithecous anthers, longitudinal, porus dehiscence	Stamens 6 in 2 whorls of 3 each apopetalous valvate or imbricate
Gynoecium	Bicarpellary, syncarpous, obliquely placed ovary. Tetralocular, axile placentation	Tricarpellary, syncarpous, trilocular with ovules on axile placentation. Nectar secreting glands present in the ovary
Fruit	Capsule or berry	Septicidal or loculicidal capsule or berry

ADDITIONAL

1. Explain the Taxonomic Hierarchy.

+ Taxonomic hierarchy was introduced by Carolus Linnaeus. It is the arrangement of various taxonomic levels in descending order starting from kingdom up to species.
+ Species is the lowest of classification and shows the high level of similarities among the organisms. For example, Helianthus annuus and Helianthustuberosus. These two species differ in their morphology. Both of them are herbs but Helianthus tuberosus is a perennial herb.
+ Genus consist of multiple species which have similar characters but differ from the species of another genus. Example: Helianthus, Tridax.
+ Family comprises a number of genera which share some similarities among them. Example: Asteraceae.
+ Order includes group of families which show less similarities among them.
+ Class consists of group of orders which share few similarities.
+ Division is the next level of classification that consists of number of classes. Example: Magnoliophyta.
+ Kingdom is the highest level or rank of the classification. Example: Plantae

2. Write about the Bentham and Hooker system of classification.

Class I Dicotyledonae:

+ Plants contain two cotyledons in their seed, leaves with reticulate venation, tap root system and tetramerous or pentamerous flowers come under this class. It includes three sub-classes – Polypetalae, Gamopetalae and Monochlamydeae.

Sub-class 1. Polypetalae:

+ Plants with free petals and dichlamydeous flowers come under polypetalae. It is further divided into three series – Thalamiflorae, Disciflorae and Calyciflorae.

Series (i) Thalamiflorae:

+ Plants having flowers with dome or conical shaped thalamus and superior ovary are included in this series. It includes 6 orders and 34 families.

Series (ii) Disciflorae:

+ Flowers having prominent disc shaped thalamus with superior ovary come under this series. It includes 4 orders and 23 families.

Series (iii) Calyciflorae:

✍ It includes plants having flowers with cup shaped thalamus and with inferior or sometimes with half inferior ovary. Calyciflorae includes 5 orders and 27 families.

Sub-class 2. Gamopetalae:

+ Plants with united petals, which are either partially or completely fused to one another and dichlamydeous are placed under Gamopetalae. It is further divided into three series – Inferae, Heteromerae and Bicarpellatae.

Series (i) Inferae:

+ The flowers are epigynous and with inferior ovary. Inferae includes 3 orders and 9 families.

Series (ii) Heteromerae:

+ The flowers are hypogynous, superior ovary and with more than two carpels. Heteromerae includes 3 orders and 12 families.

Series (iii) Bicarpellatae:

+ The flowers are hypogynous, superior ovary and with two carpels.Bicarpellatae includes 4 orders and 24 families.

Sub-class 3. Monochlamydeae:

+ Plants with incomplete flowers either apetalous or with undiffernciated calyx and corolla are placed under Monochlamydeae. The sepals and petals are not distinguished and they are called perianth. Sometimes both the whorls are absent. Monochlamydeae includes 8 series and 36 families.

Class II Gymnospermae:

+ Plants that contain naked seeds come under this class. Gymnospermae includes three families – Gnetaceae, Coniferae and Cycadaceae.

Class III Monocotyledonae:

+ Plants contain only one cotyledon in their seed, leaves with parallel venation, fibrous root system and trimerous flowers come under this class. The Monocotyledonae has 7 series and 34 families.

3. Differences between classical and modern taxonomy.

Classical Taxonomy	Modern Taxonomy
It is called old systematics or Alpha (α) taxonomy or Taxonomy	It is called Neosystematics or Biosystematics or Omega (Ω) taxonomy
It is pre Darwinean	It is post Darwinean
Species is considered as basic unit and is static	species is considered as dynamic entity and ever changing

Classification is mainly based on morphological characters	Classification is based on morphological, reproductive characters and phylogenetic (evolutionary) relationship of the organism
This system is based on the observation of a few samples/ individuals	This system is based on the observation of large number of samples/individuals

4. Describe the Botanical description of Clitoriaternatea (Sangupushpam).

Habit:

+ Twining climber

Root:

+ Branched tap root system having nodules.

Stem:

+ Aerial, weak stem and a twiner

Leaf:

+ Imparipinnately compound, alternate, stipulate showing reticulate venation. Leaflets are stipellate. Petiolate and stipels are pulvinated.

Inflorescence:

+ Solitary and axillary

Flower:

+ Bracteate, bracteolate, bracteoles usually large, pedicellate, heterochlamydeous, complete, bisexual, pentamerous, zygomorphic and hypogynous.

Calyx:

+ Sepals 5, synsepalous, green showing valvate aestivation. Odd sepal is anterior in position.

Corolla:

+ Petals 5, white or blue apopetalous, irregular papilionaceous corolla showing, descendingly imbricate aestivation.

Androecium:

+ Stamens 10, diadelphous (9)+1 nine stamens fused to form a bundle and the tenth stamen is free. Anthers are dithecous, basifixed, introse and dechiscing by longitudinal slits.

Gynoecium:

+ Monocarpellary, unilocular, with many ovules on mariginal placentation, ovary superior, style simple and incurved with feathery stigma.

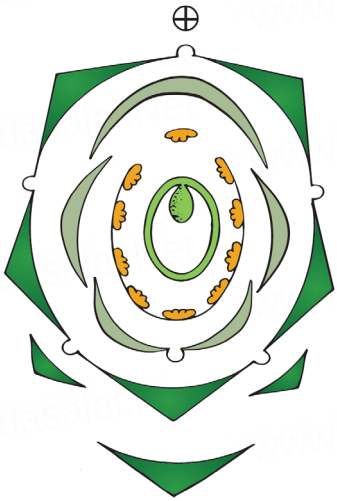
Fruit:

+ Legume

Seed:

+ Non-endospermous, reniform.

Floral Formula:



$Br.,Brl.,\%,\male, K_{(5)},C_5,A_{(9)+1},\underline{G}_1$

5. Write the economic importance of the family Fabaceae.

Economic importance	Useful parts	Uses
Pulses	Seeds	Protein and starch rich
Food plants	Tender fruits & leaves	Vegetables, greens
Oil plants	Seeds	Edible & used for cooking
Timber plants	Timber	For making furniture, cabinet articles & building materials
Medicinal plans	Roots, seeds	Purgative, used in leprosy & leukoderma
Fibre plants	Stem fibres	Making ropes
Pith plant	Stem pith	For packing, handicraft & fishing floats
Dye plant	Leaves, flowers, seeds	Indigo dye from leaves used to colour painting and printing
Green manuring	Entire plant	As green manure
Ornamental plants	Entire plant	Grows as ornamental plants

6. Write the Botanical Description of Datura metal.

Habit:

+ Large, erect and stout herb.

Root:

+ Branched tap root system.

Stem:

Stem is hollow, green and herbaceous with strong odour.

Leaf:

+ Simple, alternate, petiolate, entire or deeply lobed, glabrous exstipulate showing unicostate reticulate venation.

Inflorescence:

+ Solitary and axillary cyme.

Flower:

+ Flowers are large, greenish white, bracteate, ebracteolate, pedicellate, complete, heterochlamydeous, pentamerous, regular, actinomorphic, bisexual and hypogynous.

Calyx:

+ Sepals 5, green synsepalous showing valvate aestivation. Calyx is mostly persistant, odd sepal is posterior in position.

Corolla:

+ petals 5, greenish white, sympetalous, plicate (folded like a fan) showing twisted aestivation, funnel shaped with wide mouth and 10 lobed.

Androecium:

+ Stamens 5, free from one another, epipetalous, alternipetalous and are inserted in the middle of the corolla tube. Anthers are basifixed, dithecous, with long filament, introse and longitudinally dehiscent.

Gynoecium:

+ Ovary bicarpellary, syncarpous superior ovary, basically biloculear but tetralocular due to the formation of false septum. Carpels are obliquely placed and ovules on swollen axile placentation. Style simple long and filiform, stigma two lobed.

Fruit:

+ Spinescent capsule opening by four apical valves with persistent calyx.

Seed:

+ Endospermous.

Floral Formula:

$Br.,Ebrl.,\oplus,\male,\female,K_{(5)},\overset{\frown}{C}_{(5)},A_5,\underline{G}_{(2)}$

7. Tabulate the Economic Importance of the Family: Solanaceae.

Economic importance	Useful parts	Uses
Food plant	Underground stem tubers	As vegetables and for production of starch
Medicinal plant	Roots	Atropine used in belladonna plasters, tinctures, etc. for relieving pain, dilating pupils of eyes for eye-testing
Tobacco	Leaves	In cigarette, beedi, hukkah, pipes, for chewing & snuffing, etc.
Ornamental plant	Whole plant	As aesthetic nature grown in garden.

8. Write the Botanical Description of Allium cepa.

Habit:

+ Perennial herb with bulb.

Root:

+ Fibrous adventitious root system

Stem:

+ Underground bulb

Leaf:

+ a cluster of radical leaves emerges from the underground bulb, cylindrical and fleshy having sheathy leaf bases with parallel venation.

Inflorescence:

+ Scapigerous i.e. the inflorescence axis (peduncle) arising from the ground bearing a cluster of flowers at its apex. Pedicels are of equal length, arising from the apex of the peduncle which brings all flowers at the same level.

Flower:

+ Small, white, bracteate, ebrcteolate, pedicellate, complete, trimerous, actinomorphic and hypogynous. Flowers are protandrous.

Perianth:

+ Tepals 6, white,arranged in two whorls of three each, syntepalous showing valvate aestivation.

Androecium:

+ Stamens 6, arranged in two whorls of three each, epitepalous, apostamenous /free and opposite to tepals. Anthers dithecous, basifixed, introse, and dehiscing longitudinally.

Gynoecium:

+ Tricarpellary and syncarpous. Ovary superior, trilocular with two ovules in each locule on axile placentation. Style simple, slender with simple stigma.

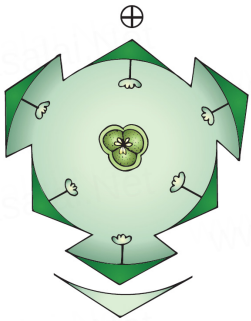
Fruit:

+ A loculicidal capsule.

Seed:

+ Endospermous

Floral Formula:



Br.,Ebrl.,⊕,♀,$\underset{(3+3)}{P}$+A_{3+3},$\underline{G}_{(3)}$

9. Write the Economic Importance of the Family: Liliaceae.

Economic importance	Useful parts	Uses
Food plant	Bulbs	Used as vegetable, stimulative, diuretic, expectorant with bactericidal properties.
Medicinal plant	Leaves	Leaves are the source of resinous drug, used as a purgative.
Fibre plant	Fibre	Used for cordage, fishing net, mattings, twines
Raticides & Insecticides	Bulbs	Used for killing rats Used as insecticide.
Polyploidy	Corm	Colchicine (alkaloid) used to induce polyploidy.
Ornamental plants	Plant	Some of the well known garden ornamentals.

6 CELL: THE UNIT OF LIFE

EVALUATION

1. Distinguish between prokaryotes and eukaryotes.

Features	Prokaryotes	Eukaryotes
Size of the cell	~1-5µm	~10-100µm
Nuclear character	Nucleoid, no true nucleus,	True nucleus with nuclear membrane
DNA	Usually circular without histone proteins	Usually linear with histone proteins
RNA/Protein synthesis	Couples in cytoplasm	RNA synthesis Inside nucleus/ Protein synthesis in cytoplasm
Ribosomes	50S+ 30S	60S + 40S
Organelles	Absent	Numerous
Cell movement	Flagella	Flagella and cilia
Organization	Usually single cell	Single, colonial and multicellular
Cell division	Binary fission	Mitosis and meiosis
Examples	Bacteria and Archaea	Fungi, plants and animals

2. Difference between plant and animal cell.

Plant cell	Animal Cell
Usually they are larger than animal cells	Usually smaller than plant cells

Cell wall present in addition to plasma membrane and consists of middle lamellae, primary and secondary walls	Cell wall absent
Plasmodesmata present	Plasmodesmata absent
Chloroplast present	Chloroplast absent
Vacuole large and permanent	Vacuole small and temporary
Tonoplast present around vacuole	Tonoplast absent
Centrioles absent except motile cells of lower plants	Centrioles present
Nucleus present along the periphery of the cell	Nucleus at the centre of the cell
Lysosomes are rare	Lysosomes present
Storage material is starch grains	Storage material is a glycogen granules

3. Draw the ultra-structure of plant cell.

ADDITIONAL

1. Comparison of Microscopes

Features	Light Microscope	Dark Field Microscope	Phase Contrast Microscope	Transmission Electron Microscope	Scanning Electron Microscope
Source of illumination for Image Formation	Visible light	Visible light	Visible light	Electrons	Electrons
Types of cells visualized	Individual cells can be visualised, even living ones.	Individual cells can be visualised, even living ones.	Individual cells can be visualised, even living ones.	Thin sections of the specimen are obtained. The electron beam pass through the sections and form an image with high magnification and high resolution.	The specimen is coated with gold and the electrons are reflected back and give the details of surface topography of the specimen.
Image	2-D	2-D	2-D	2-D	3-D
Nature of Lenses	Glass lenses	Glass lenses	Glass lenses	One electrostatic lens with few electromagnetic lenses	One electrostatic lens with few electromagnetic lenses
Medium	Air/oil	Air/oil	Air/oil	Vacuum	Vacuum
Specimen mounting	Glass slides	Glass slides	Glass slides	Mounted on coated or uncoated copper grids	Mounted on aluminium stubs and are coated in gold

Focusing and Magnification Adjustments	Changing objectives	Changing objectives	Changing objectives	Electrical, using deflection coil	Electrical, using deflection coil
Means for obtaining specimen Contrast	Light diffraction	Through patch stop	Through phase plate	Electron scattering	Electron scattering

2. Tabulate the comparison of types of cellular organization.

Features	Prokaryotes	Mesokaryotes	Eukaryotes
Size of the cell	~1-5µm	~5-10µm	~10-100µm
Nuclear character	Nucleoid, no true nucleus,	Nucleus with nuclear membrane	True nucleus with nuclear membrane
DNA	Usually circular without histone proteins	Usually linear but without histone proteins	Usually linear with histone proteins
RNA/Protein synthesis	Couplesin cytoplasm	Similar with eukaryotes	RNA synthesis Inside nucleus/ Protein synthesis in cytoplasm
Ribosomes	50S+30S	60S+40S	60S+40S
Organelles	Absent	Present	Numerous
Cell movement	Flagella	Glidingandflagella	Flagella and cilia
Organization	Usually single cell	Singleandcolony	Single, colonial and multicellular
Cell division	Binary fission	Binaryfission	Mitosis and meiosis
Examples	Bacteria and Archaea	Dinoflagellate, Protozoa	Fungi, plants and animals

3. Difference between plant and animal cells.

Plant cell	Animal Cell
Usually they are larger than animal cells	Usually smaller than plant cells
Cell wall present in addition to plasma membrane and consists of middle lamellae, primary and secondary walls	Cell wall absent
Plasmodesmata present	Plasmodesmata absent
Chloroplast present	Chloroplast absent
Vacuole large and permanent	Vacuole small and temporary
Tonoplast present around vacuole	Tonoplast absent
Centrioles absent except motile cells of lower plants	Centrioles present
Nucleus present along the periphery of the cell	Nucleus at the centre of the cell
Lysosomes are rare	Lysosomes present
Storage material is starch grains	Storage material is a glycogen granules

4. List of the Functions of cell wall

+ Offers definite shape and rigidity to the cell.
+ Serves as barrier for several molecules to enter the cells.
+ Provides protection to the internal protoplasm against mechanical injury.
+ Prevents the bursting of cells by maintaining the osmotic pressure.
+ Plays a major role by acting as a mechanism of defense for the cells.

5. Explain the Fluid Mosaic Model.

+ **Jonathan Singer** and **Garth Nicolson** (1972) proposed fluid mosaic model. It is made up of lipids and proteins together with a little amount of carbohydrate.

+ The lipid membrane is made up of phospholipid. The phospholipid molecule has a hydrophobic tail and hydrophilic head.
+ The hydrophobic tail repels water and hydrophilic head attracts water.
+ The proteins of the membrane are globular proteins which are found intermingled between the lipid bilayer most of which are projecting beyond the lipid bilayer. These proteins are called as **integral proteins**.
+ Few are superficially attached on either surface of the lipid bilayer which are called as **peripheral proteins**.
+ The proteins are involved in transport of molecules across the membranes and also act as enzymes, receptors (or) antigens.
+ The Carbohydrate molecules of cell membrane are short chain polysaccharides. These are either bound with '**glycoproteins**' or '**glycolipids**' and form a '**glyocalyx**'.
+ The movement of membrane lipids from one side of the membrane to the other side by vertical movement is called **flip flopping** or **flip flop movement**. This movement takes place more slowly than lateral diffusion of lipid molecule.
+ The phospholipids can have flip flop movement because the phospholipids have smaller polar regions, whereas the proteins cannot flip flop because the polar region is extensive.

6. What are the Functions of Cell Membrane?

+ The functions of the cell membrane are enormous which includes cell signaling, transporting nutrients and water, preventing unwanted substances entering into the cell, and so on.

Cell Transport

+ Cell membrane act as a channel of transport for molecules. The membrane is selectively permeable to molecules. It transports molecules through energy dependent process and energy independent process. The membrane proteins

(channel and carrier) are involved in movement of ions and molecules across the membrane

Endocytosis and Exocytosis

+ Cell surface membrane are able to transport individual molecules and ions. There are processes in which a cell can transport a large quantity of solids and liquids into cell (**endocytosis**) or out of cell (**exocytosis**)

Endocytosis:

+ During endocytosis the cell wraps the cell surface membrane around the material and brings it into cytoplasm inside a vesicle. There are two types of endocytosis:

Phagocytosis

+ Particle is engulfed by membrane, which folds around it and forms a vesicle. The enzymes digest the material and products are absorbed by cytoplasm.

Pinocytosis

+ Fluid droplets are engulfed by membrane, which forms vesicles around them.

Exocytosis:

+ Vesicles fuse with plasma membrane and eject contents. This passage of material out of the cell is known as **exocytosis**. This material may be a secretion in the case of digestive enzymes, hormones or mucus.

7. Describe the structure of Endoplasmic Reticulum

+ **Cisternae** - long, broad, flat, sac likestructures arranged in parallel bundlesor stacks to form lamella. The spacebetween membranes of cisternae isfilled with fluid.
+ **Vesicles** - oval membrane boundvacuolar structure.
+ **Tubules** - irregular shape, branched,smooth walled, enclosing a space

8. Describe the functions of golgi body.

+ Glycoproteins and glycolipids are modified.

+ Transporting and storing lipids.
+ Formation of lysosomes.
+ Production of digestive enzymes.
+ Cell plate and cell wall formation.
+ Secretion of Carbohydrates for the formation of plant cell walls and insect cuticles.
+ **Zymogen granules** (proenzyme/precursor of all enzyme) are synthesised.

9. Describe the structure of Mitochondria.

+ It was first observed by **A. Kolliker**(1880). **Altmann** (1894) named it as Bioplasts. **Later Benda** (1897, 1898), named as mitochondria. They are ovoid, rounded, rod shape and pleomorphic structures.
+ Mitochondrion consists of double membrane, the outer and inner membrane. The outer membrane is smooth, highly permeable to small molecules and it contains proteins called **Porins**, which form channels that allows free diffusion of molecules smaller than about 1000 Daltons and the inner membrane divides the mitochondrion into two compartments, outer chamber between two membranes and the inner chamber filled with matrix.
+ The inner membrane is convoluted (infoldings), called **crista** (plural: cristae). Cristae contain most of the enzymes for electron transport system. Inner chamber of the mitochondrion is filled with proteinaceous material called **mitochondrial matrix**.
+ The inner membrane consists of stalked particles called **elementary particles** or **Fernandez Moran particles**, F1 particles or Oxysomes. Each particle consists of a base, stem and a round head. In the head ATP synthase is present for oxidative phosphorylation. Inner membrane is impermeable to most ions, small molecules and maintains the proton gradient that drives oxidative phosphorylation

+ Mitochondria contain 73% of proteins, 25-30% of lipids, 5-7 % of RNA, DNA (in traces) and enzymes (about 60 types). Mitochondria are called **Power house of a cell**, as they produce energy rich ATP.
+ All the enzymes of Kreb's cycle are found in the matrix except succinate dehydrogenase.
+ Mitochondria consist of circular DNA and 70S ribosome. They multiply by fission and replicates by strand displacement model.
+ Because of the presence of DNA, it is semi-autonomous organelle. Unique characteristic of mitochondria is that they are inherited from female parent only.
+ Mitochondrial DNA comparisons are used to trace human origins. Mitochondrial DNA is used to track and date recent evolutionary time because it mutates 5 to 10 time faster than DNA in the nucleus.

10. Describe the structure of Chloroplast

+ Chloroplasts are vital organelle found in green plants. Chloroplast has a double membrane the outer membrane and the inner membrane separated by a space called **periplastidial space**.
+ The space enclosed by the inner membrane of chloroplast is filled with gelatinous matrix, lipo-proteinaceous fluid called **stroma**. Inside the stroma there is flat interconnected sacs called **thylakoid**. The membrane of thylakoid encloses a space called **thylakoid lumen**.
+ **Grana** (singular: Granum) are formed when many of these thylakoids are stacked together like pile of coins.
+ Light is absorbed and converted into chemical energy in the granum, which is used in stroma to prepare carbohydrates.
+ Thylakoid contain chlorophyll pigments. The chloroplast contains osmophilic granules, 70s ribosomes, DNA (circular and non-histone) and RNA. These chloroplast genomes encode approximately 30 proteins involved in

photosynthesis including the components of photosystem I & II, cytochrome bf complex and ATP synthase. One of the subunits of Rubisco is encoded by chloroplast DNA. It is the major protein component of chloroplast stroma, single most abundant protein on earth. The thylakoid contains small, rounded photosynthetic units called **quantosomes**. It is a semi-autonomous organelle and divides by fission.

Functions:

+ Photosynthesis
+ Light reactions take place in granum,
+ Dark reactions take place in stroma,
+ Chloroplast is involved in photorespiration.

11. Write the function of Lysosomes (Suicidal Bags of Cell)

+ **Intracellular digestion:** They digestcarbohydrates, proteins and lipidspresent in cytoplasm.
+ **Autophagy:** During adverse conditionthey digest their own cell organelles like mitochondria and endoplasmic reticulum
+ **Autolysis:** Lysosome causes self-destruction of cell on insight of diseasethey destroy the cells.
+ **Ageing:** Lysosomes have autolyticenzymes that disrupts intra-cellularmolecules.
+ **Phagocytosis:** Large cells or contentsare engulfed and digested bymacrophages, thus forming a phagosome in cytoplasm. These phagosome fusewith lysosome for further digestion.
+ **Exocytosis:** Lysosomes release theirenzymes outerside the cell to digestother cells

12. Describe the structure of Nucleus.

+ Nucleus is an important unit of cell which control all activities of the cell. Nucleus holds the hereditary information. It is the largest among all cell organelles. It may be spherical, cuboidal, ellipsoidal or discoidal.
+ It is surrounded by a double membrane structure called **nuclear envelope**, which has the inner and outer membrane.

The inner membrane is smooth without ribosomes and the outer membrane is rough by the presence of ribosomes and is continues with irregular and infrequent intervals with the endoplasmic reticulum.

+ The membrane is perforated by pores known as **nuclear pores** which allows materials such as mRNA, ribosomal units, proteins and other macromolecules to pass in and out of the nucleus. The pores enclosed by circular structures called **annuli**. The pore and annuli form the **pore complex**.
+ The space between two membranes is called **perinuclear space**. Nuclear space is filled with **nucleoplasm**, a gelatinous matrix has uncondensed **chromatin** network and a conspicuous **nucleolus**.
+ The chromatin network is the uncoiled, indistinct and remain thread like during the interphase. It has little amount of RNA and DNA bound to histone proteins in eukaryotic cells.
+ Chromatin is a viscous gelatinous substance that contains DNA, histone & non–histone proteins and RNA. H1, H2A, H2B, H3 and H4 are the different histones found in chromatin. It is formed by a series of repeated units called nucleosomes. Each nucleosome has a core of eight histone subunits.
+ During cell division chromatin is condensed into an organized form called **chromosome**. The portion of Eukaryotic chromosome which is transcribed into mRNA contains active genes that are not tightly condensed during interphase is called **Euchromatin**.
+ The portion of a Eukaryotic chromosome that is not transcribed into mRNA which remains condensed during interphase and stains intensely is called **Heterochromatin.**
+ Nucleolus is a small, dense, spherical structure either present singly or in multiples inside nucleus and it's not membrane bound. Nucleoli possesses genes for rRNA and tRNA.

13. What are the functions of the nucleus?

+ Controlling all the cellular activities Storing the genetic or hereditary information.

+ Coding the information in the DNA for the production of enzymes and proteins.
+ DNA duplication and transcription take place in the nucleus.
+ In nucleolus ribosomal biogenesis takes place.

14. Describe the Structure of chromosome.

+ The chromosomes are composed of thread like strands called **chromatin** which is made up of DNA, protein and RNA. Each chromosome consists of two symmetrical structures called **chromatids**.
+ During cell division the chromatids forms well organized chromosomes with definite size and shape. They are identical and are called **sister chromatids**.
+ A typical chromosome has narrow zones called **constrictions**.
+ There are two types of constrictions namely primary constriction and secondary constriction. The **primary constriction** is made up of **centromere** and kinetochore. Both the chromatids are united at centromere, whose number varies.
+ The **monocentric** chromosome has one centromere and the **polycentric** chromosome has many centromeres.
+ The centromere contains a complex system of protein fibres called **kinetochore**. Kinetochore is the region of chromosome which is attached to the spindle fibre during mitosis.
+ Besides primary there are **secondary constrictions,** represented with few occurrences.
+ Nucleoli develop from these secondary constrictions are called **nucleolar organizers**. Secondary constrictions contain the genes for ribosomal RNA which induce the formation of nucleoli and are called **nucleolar organizer regions**.

7 CELL CYCLE

EVALUATION

1. Differentiate between mitosis andmeiosis.

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

2. Differentiate cytokinesis in plant cells and animal cells.

Cytokinesis in Animal Cells

+ It is a contractile process. The contractile mechanism contained in contractile ring located inside the plasma membrane.
+ The ring consists of a bundle of microfilaments assembled from **actin** and **myosin**. This fibril helps for the generation of a contractile force.
+ This force draws the contractile ring inward forming a cleavage furrow in the cell surface dividing the cell into two.

Cytokinesis in Plant Cell

+ Division of the cytoplasm often starts during telophase. In

plants, cytokinesis cell plate grows from centre towards lateral walls centrifugal manner of cell plate formation.

+ Phragmoplast contains microtubules, actin filaments and vesicles from golgi apparatus and ER. The golgi vesicles contains carbohydrates such as pectin, hemicellulose which move along the microtubule of the pharagmoplast to the equator fuse, forming a new plasma membrane and the materials which are placed them becomes new cell wall.
+ The first stage of cell wall construction is a line dividing the newly forming cells called a cell plate. The cell plate eventually stretches right across the cell forming the middle lamella. Cellulose builds up on each side of the middle lamella to form the cell walls of two new plant cells.

3. Write about Pachytene and Diplotene of Prophase

Pachytene

+ At this stage bivalent chromosomes are clearly visible as tetrads.
+ Bivalent of meiosis I consists of 4 chromatids and 2 centromeres.
+ Synapsis is completed and recombination nodules appear at a site where crossing over takes place between non-sister chromatids of homologous chromosome.
+ Recombination of homologous chromosomes is completed by the end of the stage but the chromosomes are linked at the sites of crossing over.
+ This is mediated by the enzyme recombinase.

Diplotene

+ Synaptonemal complex disassembled and dissolves.
+ The homologous chromosomes remain attached at one or more points where crossing over has taken place.
+ These points of attachment where 'X' shaped structures occur at the sites of crossing over is called **Chiasmata.**
+ This substage may last for days or years depending on the

+ The chromosomes are very actively transcribed in females as the egg stores up materials for use during embryonic development.

ADDITIONAL

1. Describe the process of Mitosis Cell division.

+ Mitosis is divided into four stages prophase, metaphase, anaphase and telophase

Prophase

+ Prophase is the longest phase in mitosis. Chromosomes become visible as long thin thread like structure, condenses to form compact mitotic chromosomes.
+ In plant cells initiation of spindle fibres takes place, nucleolus disappears. Nuclear envelope breaks down. Golgi apparatus and endoplasmic reticulum are not seen.
+ In animal cell the centrioles extend a radial array of microtubules (Figure 7.4) towards the plasma membrane when they reach the poles of the cell. Th is arrangement of microtubules is called **an aster**. Plant cells do not form asters.

Metaphase

+ Chromosomes (two sister chromatids) are attached to the spindle fibres by kinetochore of the centromere. The spindle fibres is made up of tubulin. The alignment of chromosome into compact group at the equator of the cell is known as **metaphase plate**. This is the stage where the chromosome morphology can be easily studied. Kinetochore is a DNA–Protein complex present in the centromere DNA where the microtubules are attached. It is a trilaminar disc like plate. The spindle assembly checkpoint which decides the cell to enter anaphase.

Anaphase

+ Each chromosome split simultaneously and two daughter chromatids begins to migrate towards two opposite poles of a

cell. Each centromere splits longitudinally into two, freeing the two sister chromatids from each other. Shortening of spindle fi bre and longitudinal splitting of centromere creates a pull which divides chromosome into two halves. Each half receive two chromatids (that is sister chromatids are separated). When the sister chromatids separate the actual partitioning of the replicated genome is complete. A ubiquitine ligase is activated called as the **anaphase-promoting complex cyclosome (APC/C)** leads to degradation of the key regulatory proteins at the transition of metaphase to anaphase. APC is a cluster of proteins that induces the breaking down of cohesion proteins which leads to the separation of chromatids during mitosis (Figure 7.5).

Telophase

+ Two sets of daughter chromosomes reach opposite poles of the cell, mitotic spindle disappears. Division of genetic material is completed after this karyokinesis, cytokinesis (division of cytoplasm) is completed, nucleolus and nuclear membranes reforms. Nuclear membranes form around each set of sister chromatids now called **chromosomes**, each has its own centromere. Now the chromosomes decondense. In plants, phragmoplast are formed between the daughter cells. Cell plate is formed between the two daughter cells, reconstruction of cell wall takes place. Finally the cells are separated by the distribution of organelles, macromolecules into two newly formed daughter cells.

2. What are the significances of Mitosis?

+ Exact copy of the parent cell is produced by mitosis (genetically identical).
+ **Genetic stability** – daughter cells are genetically identical to parent cells.
+ **Growth** – as multicellular organisms grow, the number of cells making up their tissue increases. The new cells must be identical to the existing ones.

+ **Repair of tissues** - damaged cells must be replaced by identical new cells by mitosis.
+ **Asexual reproduction** – asexual reproduction results in offspring that are identical to the parent. Example Yeast and Amoeba.
+ In flowering plants, structure such as bulbs, corms, tubers, rhizomes and runners are produced by mitotic division. When they separate from the parent, they form a new individual.
+ The production of large numbers of offsprings in a short period of time, is possible only by mitosis. In genetic engineering and biotechnology, tissues are grown by mitosis (i.e. in tissue culture).
+ **Regeneration** – Arms of star fish

3. Explain the various stages under Meiosis I-Reduction Division.

Prophase - I

+ Prophase I is of longer duration and it is divided into 5 substages – Leptotene, Zygotene, Pachytene, Diplotene and Diakinesis.

Leptotene

+ Chromosomes are visible under light microscope. Condensation of chromosomes takes place. Paired sister chromatids begin to condense.

Zygotene

+ Pairing of homologous chromosomes takes place and it is known as **synapsis**. Chromosome synapsis is made by the formation of synaptonemal complex. The complex formed by the homologous chromosomes are called as **bivalent (tetrads)**.

Pachytene

+ At this stage bivalent chromosomes are clearly visible as tetrads. Bivalent of meiosis I consists of 4 chromatids and 2 centromeres. Synapsis is completed and recombination nodules appear at a site where crossing over takes place.

between non-sister chromatids of homologous chromosome. Recombination of homologous chromosomes is completed by the end of the stage but the chromosomes are linked at the sites of crossing over. This is mediated by the enzyme recombinase.

Diplotene

+ Synaptonemal complex disassembled and dissolves. The homologous chromosomes remain attached at one or more points where crossing over has taken place. These points of attachment where 'X' shaped structures occur at the sites of crossing over is called **Chiasmata**. Chiasmata are chromatin structures at sites where recombination has been taken place. They are specialised chromosomal structures that hold the homologous chromosomes together. Sister chromatids remain closely associated whereas the homologous chromosomes tend to separate from each other but are held together by chiasmata. This substage may last for days or years depending on the sex and organism. The chromosomes are very actively transcribed in females as the egg stores up materials for use during embryonic development. In animals, the chromosomes have prominent loops called **lampbrush chromosome**.

Diakinesis

+ Terminalisation of chiasmata. Spindle fibres assemble. Nuclear envelope breaks down. Homologous chromosomes become short and condensed. Nucleolus disappears.

Metaphase - I

+ Spindle fibres are attached to the centromeres of the two homologous chromosomes. Bivalent (pairs of homologous chromosomes) aligned at the equator of the cell known as **metaphase plate**. Each bivalent consists of two centromeres and four chromatids.The random distribution of homologous chromosomes in a cell in Metaphase I is called **independent assortment**.

Anaphase - I

+ Homologous chromosomes are separated from each other. Shortening of spindle fibers takes place. Each homologous chromosome with its two chromatids and undivided centromere moves towards the opposite poles of the cells. The actual reduction in the number of chromosomes takes place at this stage. Homologous chromosomes which move to the opposite poles are either paternal or maternal in origin. Sister chromatids remain attached with their centromeres.

Telophase - I

+ Haploid set of chromosomes are present at each pole. The formation of two daughter cells, each with haploid number of chromosomes. Nuclei are reassembled. Nuclear envelope forms around the chromosome and the chromosomes becomes uncoiled. Nucleolus reappears.In plants, after karyokinesis cytokinesis takes place by which two daughter cells are formed by the cell plate between 2 groups of chromosomes known as **dyad of cells (haploid)**.The stage between the two meiotic divisions is called **interkinesis** which is short-lived.

4. Explain the various stages under Meiosis II-Reduction Division.

Prophase - II

+ The chromosome with 2 chromatids becomes short, condensed, thick and becomes visible. New spindle develops at right angles to the cell axis. Nuclear membrane and nucleolus disappear.

Metaphase - II

+ Chromosome arranged at the equatorial plane of the spindle. Microtubules of spindle gets attached to the centromere of sister chromatids.

Anaphase - II

+ Sister chromatids separate. The daughter chromosomes move to the opposite poles due to shortening of microtubules.

Centromere of each chromosome split, allowing to move towards opposite poles of the cells holding the sister chromatids.

Telophase - II

+ Four groups of chromosomes are organised into four haploid nuclei. The spindle disappears. Nuclear envelope, nucleolus reappear.
+ After karyokinesis, cytokinesis follows and four haploid daughter cells are formed, called **tetrads**.

8 BIOMOLECULES

EVALUATION

1. Briefly outline the classification of enzymes.

Enzymes	Modeofaction	General scheme of reaction	Example
Oxidoreductase	Oxidation and reduction (redox) reactions	$A_{red}+B_{ox} \rightarrow A_{ox}+B_{red}$	Dehydrogenase
Transferase	Transfer a group of atoms from one molecule to another	A–B+C → A+C–B	Transaminase, phosphotransferase
Hydrolases	Hydrolysis of substrateby addition of water molecule	$A–B+H_2O \rightarrow A–H+B–OH$	Digestive enzymes
Isomerase	Control the conversion of one isomer to another by transfer ring a group of atoms from one molecule to another	A – B – C → A – C – B	Isomerase
Lyase	Break chemical bond without addition of water	A–B → A+B	Decarboxylase
Ligase	Formation of new chemical bonds using ATP as a source of energy	A+B+ATP → A–B+ADP+Pi	DNA ligase

2. DescribetheFactorsAffectingtheRateofEnzymeReactions.

Temperature

+ Heating increases molecular motion. Thus, the molecules of the substrate and enzyme move more quickly resulting in a greater probability of occurrence of the reaction. The temperature that promotes maximum activity is referred to as optimum temperature.

pH

+ The optimum pH is that at which the maximum rate of reaction occurs. Thus, the pH change leads to an alteration of enzyme shape, including the active site. If extremes of pH are encountered by an enzyme, then it will be denatured

SubstrateConcentration

+ For a given enzyme concentration, the rate of an enzyme reaction increases with increasing substrate concentration

Enzyme Concentration

+ The rate of reaction is directly proportional to the enzyme concentration.

Michaelis-Menton Constant

+ When the initial rate of reaction of an enzyme is measured over a range of substrate concentrations (with a fixed amount of enzyme) and the results plotted on a graph. With increasing substrate concentration, the velocity increases – rapidly at lower substrate concentration.
+ Inhibitors of Enzyme
+ Certain substances present in the cells may react with the enzyme and lower the rate of reaction. These substances are called inhibitors. It is of two types competitive and non-competitive.

3. Write the characteristic feature of DNA.

+ If one strand runs in the 5′-3′ direction, the other runs in 3′-5′ direction and thus are antiparallel (they run in opposite

direction). The 5′ end has the phosphate group and 3'end has the OH group.

+ The angle at which the two sugars protrude from the base pairs is about 120°, for the narrow angle and 240° for the wide angle. The narrow angle between the sugars generates a minor groove and the large angle on the other edge generates major groove.
+ Each base is 0.34 nm apart and a complete turn of the helix comprises 3.4 nm or 10 base pairs per turn in the predominant B form of DNA.
+ DNA helical structure has a diameter of 20 A° and a pitch of about 34 A°. X-ray crystal study of DNA takes a stack of about 10 bp to go completely around the helix (360°).
+ Thermodynamic stability of the helix and specificity of base pairing includes (i) the hydrogen bonds between the complementary bases of the double helix (ii) stacking interaction between bases tend to stack about each other perpendicular to the direction of helical axis. Electron cloud interactions (Π – Π) between the bases in the helical stacks contribute to the stability of the double helix.
+ The phosphodiester linkages give an inherent polarity to the DNA helix. They form strong covalent bonds, gives the strength and stability to the polynucleotide chain.
+ Plectonemic coiling - the two strands of the DNA are wrapped around each other in a helix, making it impossible to simply move them apart without breaking the entire structure. Whereas in paranemic coiling the two strands simply lie alongside one another, making them easier to pull apart.
+ Based on the helix and the distance between each turn, the DNA is of three forms – A DNA, B DNA and Z DNA

4. Explain the structure and functions of different types of Ribonucleic Acid (RNA).

+ Ribonucleic acid (RNA) is a polymeric molecule essential in various biological roles in coding, decoding, regulation and

expression of genes. RNA is single stranded and is unstable when compared to DNA.

Types of RNA

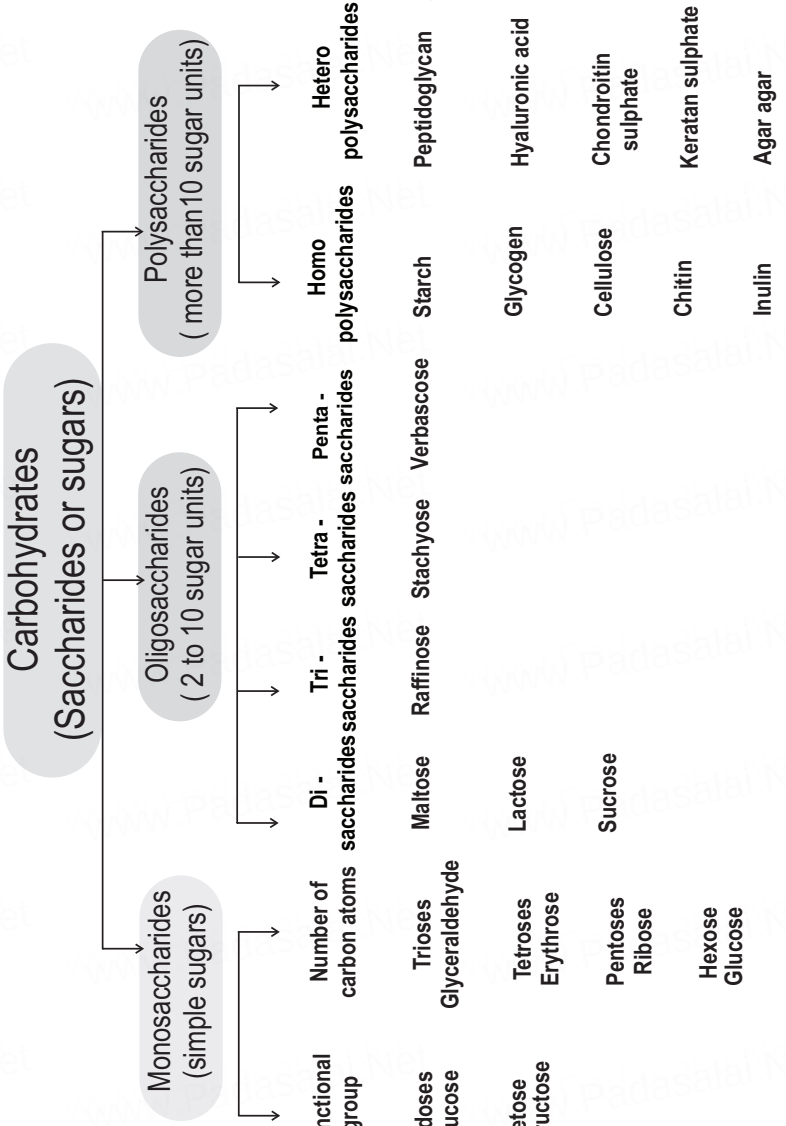
+ **mRNA (messenger RNA):** Single stranded, very unstable and comprises 5% of total RNA polymer. Prokaryotic mRNA (Polycistronic) carry coding sequences for many polypeptides. Eukaryotic mRNA (Mono-cistronic) contains information for only one polypeptide.
+ **Function :**Carries a copy of instructions for assembling amino acids into proteins.
+ **tRNA (transfer RNA)**: It is highly folded into an elaborate 3D structure and comprises about 15% of total RNA. It is also called as soluble RNA.
+ **Functions :**Translates thecode from mRNA and transfers amino acids to the ribosome to build proteins.
+ **rRNA (ribosomal RNA):** Single stranded, metabolically stable, makeup the two subunits of ribosomes. It constitutes 80% of the total RNA. It is a polymer with varied length from 120–3000 nucleotides and gives ribosomes their shape.
+ **Functions :**Genes for rRNA are highly conserved and employed for phylogenetic studies.

ADDITIONAL

1. Describe the Properties of Enzyme.

+ All are globular proteins.
+ They act as catalysts and effective even in small quantity.
+ They remain unchanged at the end of the reaction.
+ They are highly specific.
+ They have an active site where the reaction takes place.
+ Enzymes lower activation energy of the reaction they catalyse.

2. Draw the Flow chart of Carbohydrates.



3. Describe the Structure of DNA.

+ Watson and Crick shared the Nobel Prize in 1962 for their discovery, along with Maurice Wilkins, who had produced the crystallographic data supporting the model. Rosalind Franklin (1920–1958) had earlier produced the first clear crystallographic evidence for a helical structure.
+ James Watson and Francis Crick of Cavendish laboratory in Cambridge built a scale model of double helical structure of DNA which is the most prevalent form of DNA, the B-DNA. This is the secondary structure of DNA.
+ As proposed by James Watson and Francis Crick, DNA consists of right - handed double helix with 2 helical polynucleotide chains that are coiled around a common axis to form right handed B form of DNA. The coils are held together by hydrogen bonds which occur between complementary pairs of nitrogenous bases. The sugar is called 2′-deoxyribose because there is no hydroxyl at position 2′. Adenine and thiamine base pairs has two hydrogen bonds while guanine and cytosine base pairs have three hydrogen bonds.

Chargaff 's Rule:

A = T; G ≡ C

A + G = T + C

A : T = G : C = 1

As published by Erwin Chargaff in 1949, a purine pairs with pyrimidine and vice versa. Adenine (A) always pairs with Thymine (T) by double bond and Guanine (G) always pairs with Cytosine (C) by triple bond.

4. Describe the Features of different types of DNA.

Feature	B-DNA	A-DNA	Z-DNA
Type of helix	Right-handed	Right-handed	Left-handed
Helical diameter (nm)	2.37	2.55	1.84
Rise per base pair (nm)	0.34	0.29	0.37

Distance per complete turn (pitch) (nm)	3.4	3.2	4.5
Number of base pairs per complete turn	10	11	12
Topology of major groove	Wide, deep	Narrow, deep	Flat
Topology of minor groove	Narrow, shallow	Broad, shallow	Narrow, deep

9 TISSUE AND TISSUE SYSTEM

EVALUATION

1. Explain Sclereids with their types.

+ Sclereids are dead cells, usually these are isodiametric but some are elongated too.
+ The cell wall is very thick due to lignification.
+ Lumen is very much reduced.
+ The pits may simple or branched.
+ Sclereids are mechanical in function.
+ They give hard texture to the seed coats, endosperms etc.,

Types of Sclereids

Branchy sclereids or Stone cells

+ Isodiametric sclereids, with hard cell wall.
+ It is found in bark, pith cortex, hard endosperm and fleshy portion of some fruits.
+ Example: - Pulp of *Pyrus*.

Macro-sclereids

+ Elongated and rod shaped cells, found in the outer seed coat of leguminous plants.
+ Example: *Crotalaria and Pisum sativum*.

Osteo-sclereids or Bone cells

+ Rod shaped with dilated ends. They occur in leaves and seed coats.
+ Example: seed coat of *Pisum and Hakea*

Astro-sclereids

+ Star cells with lobes or arms diverging form a central body. They occur in petioles and leaves.

+ Example: *Tea, Nymphae and Trochodendron*.

Trichosclereids

+ Hair like thin walled sclereids. Numerous small angular crystals are embedded in the wall of these sclereids, present in stems and leaves of hydrophytes.
+ Example: *Nymphaea leaf* and Aerial roots of *Monstera*.

2. What are sieve tubes? explain.

+ Sieve tubes are long tube-like conducting elements in the phloem.
+ These are formed from a series of cells called sieve tube elements.
+ The sieve tube elements are arranged one above the other and form vertical sieve tube.
+ The end wall contains a number of pores and it looks like a sieve. So, it is called as sieve plate.
+ The sieve elements show nacreous thickenings on their lateral walls.
+ They may possess simple or compound sieve plates. The function of sieve tubes are believed to be controlled by campanion cells.
+ In mature sieve tube, Nucleus is absent. It contains a lining layer of cytoplasm.
+ A special protein (P. Protein = Phloem Protein) called slime body is seen in it.
+ In mature sieve tubes, the pores in the sieve plate are blocked by a substance called **callose**(callose plug).
+ The conduction of food material takes place through cytoplasmic strands.
+ Sieve tubes occur only in Angiosperms.

3. Distinguish the anatomy of dicot root from monocot root.

Characters	Dicot root	Monocot root
Pericyle	Gives rise to lateral roots, phellogen and a part of vascular cambium.	Gives rise to lateral roots only.
Vascular tissue	Usually limited number of xylem and phloem strips.	Usually more number of xylem and phloem strips,
Conjunctive tissue	Parenchymatous; Its cells are differentiated into vascular cambium.	Mostly sclerenchy-ma but sometimes parenchymatous. It is never differentiated in to vascular cambium.
Cambium	It appears as a secondary meristem at the time of secondary growth.	Absent.
xylem	Tetrarch	Polyarch

4. Distinguish the anatomy of dicot stem from monocot stem.

Characters	Dicot Steam	Monocot Steam
Hypodermis	Collenchymatous	Sclerenchymatous
Ground tissue	Differentiated into cortex, endodermis and pericycle and pith.	Not differentiated, but it is a continuous mass of parenchyma.
Starch sheath	Present	Absent
Medullary Sheath	Present	Absent
Vascular bundles	Collateral and open	Collateral and closed
	Arranged in a ring	Scattered in ground tissue
	Secondary growth occurs.	Secondary growth usually does not occur.

ADDITIONAL

1. Differentiate between Meristematic tissue and Permanent tissue.

Meristematic tissue	Permanent tissue
Cells divide repeatedly	Do not divide
Cells are undifferentiated	Cells are fully differentiated
Cells are small and Isodiametric	Cells are variable in shape and size
Intercellular spaces are absent	Intercellular spaces are present
Vacuoles are absent	Vacuoles are present
Cell walls are thin	Cell walls maybe thick or thin

2. Differentiate between Collenchyma and Sclerenchyma.

Collenchyma	Sclerenchyma
Living Cells	Dead cells
Contains Protoplasm	Cells are empty
Cell walls are cellulosic	Cell walls are lignified
Thickening of cell wall is not uniform	Thickening of cell wall is uniform
Keeps the plant body soft	Keeps plant body stiff and hard
Sometimes it has chloroplast	Do not have chloroplast

3. Differentiate between Fiber and Sclereids.

Fibre	Sclereids
Long cells	Short cells
Narrow, Elongated pointed ends	Usually short and broad
Occurs in bundles	Occurs individually or in small groups
Commonly unbranched	Maybe branched
Derived directly from meristematic tissue	Develops from secondary sclerosis parenchyma cells

4. Differentiate between Tracheids and Fibers

Tracheids	Fibres
Not much elongated	Very long cells
Possess oblique end walls	Possess tapering end walls
Cell walls are not as thick as Fibres	Cell wall are thick and lignified
Possess various types of thickenings	Possess only pitted thickenings
Responsible for the conduction and also mechanical support	Provide only mechanical support

5. Differentiate between Sieve Cells and Sieve tubes.

Sieve cells	Sieve tubes
Have no companion cells	Have companion cells
The sieve areas do not form sieve plates	The sieve areas are confined to sieve plates
The sieve areas are not well differentiated	The sieve areas are well differentiated
They are elongated cells and are quite long with tapering end walls	They consist of vertical cells placed one above the other forming long tubes connected at the walls by sieve pores
The sieve is smaller and numerous	The sieve pores are longer and fewer
Found in Pteridophytes and Gymnosperms	Found in Angiosperms

6. Write the anatomical differences between root and stem.

Characters	Root	Stem
Epidermis	Absence of cuticle and epidermal pores. Presence of unicellular root hairs.	Presence of cuticle and epidermal pores. Presence of unicellular and multicellular trichomes
Outer Cortical cells	Chlorenchyma absent	Chlorenchyma present

Endodermis	Well defined	ill-defined or absent.
Vascular bundles	Radial arrangement	Conjoint arrangement
Xylem	Exarch	Endarch

7. Differentiate between Stomata and Hydathodes.

Stomata	Hydathodes
Occur in epidermis of leaves, young stems.	Occur at the tip or margin of leaves that are grown in moist shady place.
Stomatal aperture is guarded by two guard cells.	Aperture of hydathodes are surrounded by a ring of cuticularized cells.
The two guard cells are generally surrounded by subsidiary cell.	Subsidiary cells are absent
Opening and closing of the stomatal aperture is regulated by guard cells	Hydathode pores remain always open
These are involved in transpiration and exchange of gases	These are involved in guttation.

8. Explain different types of parenchyma tissues.

+ **Aerenchyma:** Parenchyma which contains air in its intercellular spaces. It helps in aeration and buoyancy. Example: Nymphae and Hydrilla.
+ **Storage Parenchyma:** Parenchyma stores food materials. Example: Root and stem tubers.
+ **Stellate Parenchyma :**Star shaped parenchyma. Example: Petioles of Banana and Canna.
+ **Chlorenchyma:** Parenchyma cells with chlorophyll. Function is photosynthesis. Example: Mesophyll of leaves.
+ **Prosenchyma:** Parenchyma cells became elongated, pointed and slightly thick walled. It provides mechanical support.

9. Tabulate the various types and characteristics of tissue systems.

Types/ Characters	Epidermal tissue system	Ground / fundamental tissue system	Vascular / conduction tissue system
Formation	Forms the outermost covering protoderm	Forms the ground meristem	Forms the procambial bundles
Components	epidermal cells, stomata and epidermal outgrowths	Simple permanent tissues – Parenchyma and Collenchyma	Xylem and Phloem
Functions	Protection of plant body; absorption of water in roots; gas exchange for photo synthesis and respiration; transpiration in shoots	Gives mechanical support to the organs; prepares and stores food in leaf and stem	Conducts water and food; gives mechanical strength

10. List out the functions of Epidermal Tissue System.

+ This system in the shoot checks excessive loss of water due to the presence of cuticle.
+ Epidermis protects the underlying tissues.
+ Stomata is involved in transpiration and gaseous exchange.
+ Trichomes are also helpful in the dispersal of seeds and fruits, and provide protection against animals.
+ Prickles also provide protection against animals and they also check excessive transpiration
+ In some rose plants they also help in climbing.
+ Glandular hairs repel herbivorous animals.

10 SECONDARY GROWTH

EVALUATION

1. A transverse section of the trunk of a tree shows concentric rings which are known as growth rings. How are these rings formed? What are the significances of these rings?

+ The annual ring denotes the combination of early wood and late wood and the ring becomes evident to our eye due to the high density of late wood.Sometimes annual rings are called growth rings but it should be remembered all the growth rings are not annual.
+ In some trees more than one growth ring is formed with in a year due to climatic changes.
+ Additional growth rings are developed within a year due to adverse natural calamities like drought, frost, defoliation, flood, mechanical injury and biotic factors during the middle of a growing season,which results in the formation of more than one annual ring. Such rings are called pseudo- or false-annual rings.
+ Each annual ring corresponds to one year's growth and on the basis of these rings, the age of a particular plant can easily be calculated.
+ The determination of the age of a tree by counting the annual rings is called dendrochronology.

ADDITIONAL

1. Differentiate between Secondary Growth in Dicot stem and root.

Secondary growth in dicot stem	Secondary growth in dicot root
The cambial ring formed is circular in cross section from the beginning.	The cambial ring formed is wavy in the beginning and later becomes circular.

The cambial ring is partially primary (fascicular cambium) and partially secondary (Interfascicular cambium) in origin.	The cambial ring is completely secondary in origin.
Generally, periderm originates from the cortical cells.	Periderm originates from the pericycle.
More amount of cork is produced as stem is above the ground	Less amount of cork is produced as root is underground.
Lenticels of periderm are prominent.	Lenticels of periderm are not very prominent.

2. Differentiate between Phellem and Phelloderm.

Phellem (Cork)	Phelloderm (Secondary cortex)
It is formed on the outer side of phellogen.	It is formed on the inner side of phellogen.
Cells are compactly arranged in regular tires and rows without intercellular spaces.	Cells are loosely arranged with intercellular spaces.
Protective in function.	It synthesises and stores food.
Consists of non-living cells with suberized walls.	Consists of living cells, parenchymatous in nature and does not have suberin.
Lenticels are present.	Lenticels are absent.

3. Differentiate between vascular Cambium and Cambium.

Vascular cambium	Cork cambium
Also called cambium	Also called phellogen
It arises from procambium and interfascicular parenchyma in stems and from conjunctive parenchyma in roots	It arises from epidermis, cortex, phloem, or pericycle in both stems and roots
It comprises long fusiform and short ray initials	It comprises of homogenous cells

It produces secondary phloem towards the outer side and secondary xylem towards inner side	It produces phellem(cork) towards outer side and phelloderm (secondary cortex) towards inner side

4. Differentiate between Sap Wood (alburnum) and Heart Wood (duramen).

Sap Wood (Alburnum)	Heart Wood (Duramen)
Living part of the wood	Dead part of the wood.
It is situated on the outer side of wood	It is situated in the centre part of wood
It is less in coloured	It is dark in coloured
Very soft in nature	Hard in nature
Tyloses are absent	Tyloses are present
It is not durable and not resistant to microorganisms	It is more durable and resists microorganisms

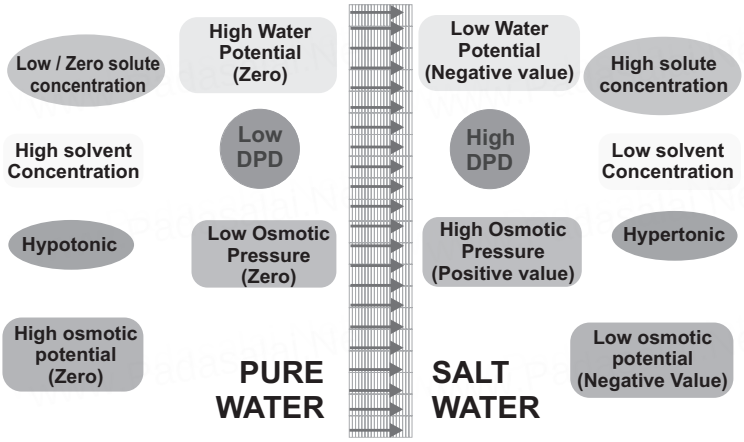
11 TRANSPORT IN PLANTS

EVALUATION

1. An artificial cell made of selectively permeable membrane immersed in a beaker. Read the values and answer the following questions:

a. Draw an arrow to indicate the direction of water movement.

DIAGRAM



b. Is the solution outside the cell isotonic, hypotonic or hypertonic?

+ Hypotonic.

c. Is the cell isotonic, hypotonic or hypertonic?

+ The cell is hypertonic.

d. Will the cell become more flaccid, more turgid or stay in original size?

+ The cell will become more turgid

e. With reference to artificial cell state, the process is endosmosis or exosmosis? Give reasons.

+ Endosmosis
+ **Reason:** Endosmosis is defined as the osmotic entry of solvent into a cell when it is placed in pure water, Hypotonic solution. The solution in the beaker outside the cell is pure water and water enters into the artificial cell which is placed inside the beaker of pure water.

ADDITIONAL

1. What are the characteristics of diffusion?

+ It is a passive process, hence no energy expenditure involved.
+ It is independent of the living system.
+ Diffusion is obvious in gases and liquids.
+ Diffusion is rapid over a shorter distance but extremely slow over a longer distance.
+ The rate of diffusion is determined by temperature, concentration gradient and relative density.

2. What are the Significance of diffusion in plants?

+ Gaseous exchange of O2 and CO_2 between the atmosphere and stomata of leaves takes place by the process of diffusion. O_2 is absorbed during respiration and CO_2 is absorbed during photosynthesis.
+ In transpiration, water vapour from intercellular spaces diffuses into atmosphere through stomata by the process of diffusion.
+ The transport of ions in mineral salts during passive absorption also takes place by this process.

3. Describe the types of Membrane permeability?

+ A solution is made up of solute particles dissolved in a solvent and the permeability of the above components depends on the nature of cell membranes, which is given below:

+ **Impermeable:** Inhibit the movement of both solvent and solute molecules. Example: Suberised, cutinesed or lignified cell walls.
+ **Permeable:** They allow diffusion of both solvent and solute molecules through them. Example: Cellulosic cell wall.
+ **Semi permeable:** Semi permeable allow diffusion of solvent molecules but do not allow the passage of solute molecule. Example: Parchment paper.
+ **Selectively permeable:** All bio membranes allow some solutes to pass in addition to the solvent molecules. Example: Plasmalemma, tonoplast, and membranes of cell organelles.

4. Explainapoplast.

+ The **apoplast** (Greek: *apo* = away; *plast*= cell) consists of everything external
+ to the plasma membrane of the living cell.
+ The apoplast includes cell walls, extra cellular spaces and the interior of dead cells such as vessel elements and tracheids.
+ In the apoplast pathway, water moves exclusively through the cell wall or the non-living part of the plant without crossing any membrane.
+ The apoplast is a continuous system.

5. Explainsymplast.

+ The **symplast**(Greek: *sym*= within; *plast*= cell) consists of the entire mass of cytosol of all the living cells in a plant, as well as the **plasmodesmata**, the cytoplasmic channel that interconnects them.
+ In the symplastic route, water has to cross plasma membrane to enter the cytoplasm of outer root cell; then it will move within adjoining cytoplasm through plasmodesmata around the vacuoles without the necessity to cross more membrane, till it reaches xylem.

6. Differentiate between active absorption and passive absorption?

Active absorption	Passive absorption
Active absorption takes place by the activity of root and root hairs	The pressure for absorption is not developed in roots and hence roots play passive role
Transpiration has no effect on active absorption	Absorption regulated by transpiration
The root hairs have high DPD as compared to soil solution and therefore water is taken by tension	The absorption occurs due to tension created in xylem sap by transpiration pull, thus water is sucked in by the tension
Respiratory energy needed	Respiratory energy not required
It involves symplastic movement of water	Both symplast and apoplast movement of water involved

7. Describe the Mechanism of Translocation.

+ Several hypotheses have been proposed to explain the mechanism of translocation. Some of them are given below:

Diffusion hypothesis

+ As in diffusion process, this theory states the translocation of food from higher concentration (from the place of synthesis) to lower concentration (to the place of utilization) by the simple physical process.

Activated diffusion theory

+ This theory was first proposed by **Mason** and **Maskell** (1936). According to this theory, the diffusion in sieve tube is accelerated either by activating the diffusing molecules or by reducing the protoplasmic resistance to their diffusion.

Electro-Osmotic theory

+ The theory of electro osmosis was proposed by **Fenson**(1957) and **Spanner** (1958). According to this, an electric-potential across the sieve plate causes the movement of water along with solutes.

Munch Mass Flow hypothesis

+ Mass flow theory was first proposed by **Munch** (1930) and elaborated by **Crafts** (1938). According to this hypothesis, organic substances or solutes move from the region of high osmotic pressure (from mesophyll) to the region of low osmotic pressure along the turgor pressure gradient.
+ Two chambers "A" and "B" made up of semipermeable membranes are connected by tube "T" immersed in a reservoir of water. Chamber "A" contains highly concentrated sugar solution while chamber "B" contains dilute sugar solution.

12 MINERAL NUTRITION

EVALUATION

1. Explain the insectivorous mode of nutrition in angiosperms?

+ Plants which are growing in nitrogen deficient areas develop insectivorous habit to resolve nitrogen deficiency.
+ **Nepenthes (Pitcher plant)**- Pitcher is a modified leaf and contains digestive enzymes. Rim of the pitcher is provided with nectar glands and acts as an attractive lid. When insect is trapped proteolytic enzymes will digest the insect.
+ **Drosera (Sundew)** - It consists of long club shaped tentacles which secrete sticky digestive fluid which looks like a sundew
+ **Utricularia (Bladder word)** - Submerged plant in which leaf is modified into a bladder to collect insect in water.
+ **Dionaea (Venus fly trap)** - Leaf of this plant modified into a colourful trap. Two folds of lamina consist of sensitive trigger hairs and when insects touch the hairs it will close.

ADDITIONAL

1. List out the Deficiency diseases and Symptoms of Minerals.

Name of the deficiency disease and symptoms	Deficiency minerals
Chlorosis (Overall)	Nitrogen, Potassium, Magnesium, Sulphur, Iron, Manganese, Zinc and Molybdenum.
a. Interveinal chlorosis	Magnesium, Iron, Manganese and Zinc
b. Marginal chlorosis	Potassium
Necrosis (Death of the tissue)	Magnesium, Potassium, Calcium, Zinc, Molybdenum and Copper.

Stunted growth	Nitrogen, Phosphorus, Calcium, Potassium and Sulphur.
Anthocyanin formation	Nitrogen, Phosphorus, Magnesium and Sulphur
Delayed flowering	Nitrogen, Sulphur and Molybdenum
Die back of shoot, Reclamation disease,Exanthema in citrus (gums on bark)	Copper
Hooked leaf tip	Calcium
Little Leaf	Zinc
Brown heart of turnip and Internal cork of apple	Boron
Whiptail of cauliflower and cabbage	Molybdenum
Curled leaf margin	Potassium

2. Briefly describe the functions, mode of absorption and deficiency symptoms of macro nutrients?

Nitrogen (N)

+ It is required by the plants in greatest amount.
+ It is an essential component of proteins, nucleic acids, amino acids, vitamins, hormones, alkaloids, chlorophyll and cytochrome.
+ It is absorbed by the plants as nitrates (NO_3).
+ Deficiency symptoms: Chlorosis, stunted growth, anthocyanin formation.

Phosphorus (P):

+ Constituent of cell membrane, proteins, nucleic acids, ATP, NADP, phytin and sugar phosphate. It is absorbed as $H_2PO_4^+$ and HPO_4^- ions.
+ Deficiency symptoms: Stunted growth,

Potassium (K):

+ Maintains turgidity and osmotic potential of the cell, opening

and closure of stomata, phloem translocation, stimulate activity of enzymes, anion and cation.

+ Deficiency symptoms: Marginal chlorosis, necrosis.

Calcium (Ca):

+ It is involved in synthesis of calcium pectate in middle lamella, mitotic spindle formation, mitotic cell division, permeability of cell membrane, lipid metabolism, activation of phospholipase, ATPase, amylase and activator of adenyl kinase.
+ It is absorbed as Ca^{2+} exchangeable ions.
+ Deficiency symptoms: Chlorosis, necrosis, stunted growth, premature fall of leaves and flowers.

Magnesium (Mg):

+ It is a constituent of chlorophyll, activator of enzymes of carbohydrate metabolism (RUBP Carboxylase and PEP Carboxylase) and involved in the synthesis of DNA and RNA.
+ It is essential for binding of ribosomal sub units.
+ It is absorbed as Mg^{2+} ions.
+ Deficiency symptoms: Inter veinal chlorosis, necrosis, anthocyanin (purple) formation and Sand drown of tobacco.

Sulphur (S):

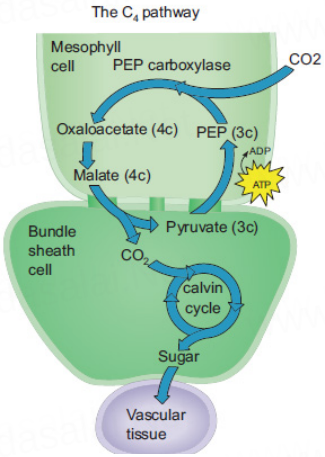
+ Essential component of amino acids like cystine, cysteine and methionine, constituent of coenzyme A, Vitamins like biotin and thiamine, constituent of proteins and ferredoxin. plants utilizesulphur as sulphate ions.
+ Deficiency symptoms: Chlorosis, anthocyanin formation, stunted growth, rolling of leaf tip and reduced nodulation in legumes.

13 PHOTOSYNTHESIS

EVALUATION

1. Grasses have an adaptive mechanism to compensate photo respiratory losses. Name and describe the mechanism.

\+ C4 cycle or Dicarboxylation pathway.



2. In Botany class, teacher explains, Synthesis of one glucose requires 30 ATPs in C4 plants and only 18 ATPs in C3plants. The same teacher explains C4 plants are more advantageous than C3 plants. Can you identify the reason for this contradiction?

C3 Plants	C4 Plants
CO_2 fixation takes place in mesophyll cells only	CO_2 fixation takes place mesophyll and bundle sheath
CO_2 acceptor is RUBP only	PEP in mesophyll and RUBP in bundle sheath cells
First product is 3C- PGA	First product is 4C- OAA

Optimum temperature 20° to 25°C	Optimum temperature 30° to 45°C
Fixation of CO_2 at 50 ppm	Fixation of CO_2 even less than 10 ppm
Less efficient due to higher photorespiration	More efficient due to less photorespiration
RUBP carboxylase enzyme used for fixation	PEP carboxylase and RUBP carboxylase used

3. When there is plenty of light and higher concentration of O_2, what kind of pathway does the plant undergo? Analyse the reasons.

+ Photorespiration is the excess respiration taking place in photosynthetic cells due to absence of CO_2 and increase of O_2.
+ This condition changes the carboxylase role of RUBISCO (RUBP carboxylase oxygenase) enzyme into oxygenase. C2 Cycle or photorespiration begins and operates in the chloroplast, Peroxisome and Mitochondria.

ADDITIONAL

1. Differentiate between photo system I and II.

Photosystem I	Photosystem II
The reaction centre is P_{700}	Reaction centre is P_{680}
PS I is involved in both cyclic and non-cyclic.	PS II participates in Non-cyclic pathway
Not involved in photolysis of water and evolution of oxygen	Photolysis of water and evolution of oxygen take place.
It receives electrons from PS II during non-cyclic photophosphorylation	It receives electrons by photolysis of water
Located in unstacked region granum facing chloroplast stroma	Located in stacked region of thylakoid membrane facing lumen of thylakoid.
Chlorophyll and Carotenoid ratio is 20:1 to 30:1	Chlorophyll and Carotenoid ratio is 3:1 to 7:1

2. Differentiate between cyclic photophosphorylation and non - cyclic phosphorylation.

Cyclic Photophosphorylation	Non-Cyclic Photophosphorylation
PS I only involved	PS I and PS II involved
Reaction centre is P_{700}	Reaction centre is P_{680}
Electrons released are cycled back	Electron released are not cycled back
Photolysis of water does not take place	Photolysis of water takes place
Only ATP synthesized	ATP and NADPH 1 H^1 are synthesized
Phosphorylation takes place at two places	Phosphorylation takes place at only one place
It does not require an external electron donor	Requires external electron donor like H_2O or H_2S
It is not sensitive to dichloro - dimethyl urea (DCMI)	It is sensitive to DCMI and inhibits electron flow

3. Differentiate between C_3 and C_4 plants.

C_3 Plants	C_4 Plants
CO_2 fixation takes place in mesophyll cells only	CO_2 fixation takes place mesophyll and bundle sheath
CO_2 acceptor is RUBP only	PEP in mesophyll and RUBP in bundle sheath cells
First product is 3C- PGA	First product is 4C- OAA
Kranz anatomy is not present	Kranz anatomy is present
Granum is present in mesophyll cells	Granum present in mesophyll cells and absent in bundle sheath
Normal Chloroplast	Dimorphic chloroplast
Optimum temperature 20° to 25°C	Optimum temperature 30° to 45°C

Fixation of CO_2 at 50 ppm	Fixation of CO_2 even less than 10 ppm
Less efficient due to higher photorespiration	More efficient due to less photorespiration
RUBP carboxylase enzyme used for fixation	PEP carboxylase and RUBP carboxylase used
18 ATPs used to synthesize one glucose	Consumes 30 ATPs to produce one glucose.
Efficient at low CO_2	Efficient at higher CO_2
Example: Paddy, Wheat, Potato and so on	Example: Sugar cane, Maize, *Sorghum*, *Amaranthus* and so on

4. Differentiate between photorespiration and Dark respiration.

Photorespiration	Dark respiration
It takes place in photosynthetic green cells	It takes place in all living cells
It takes place only in the presence of light	It takes place all the time
It involves chwloroplast, peroxisome and mitochondria	It involves only mitochondria
It does not involve Glycolysis, Kreb's Cycle, and ETS	It involves glycolysis, Kreb's Cycle and ETS
Substrate is glycolic acid	Substrate is carbohydrates, protein or fats
It is not essential for survival	Essential for survival
No phosphorylation and yield of ATP	Phosphorylation produces ATP energy
NADH2 is oxidised to NAD^+	NAD^+ is reduced to NADH2
Hydrogen peroxide is produced	Hydrogen peroxide is not produced
End products are CO_2 and PGA	End products are CO_2 and water

5. Tabulate the different between photosynthesis in plants and bacteria.

Photosynthesis in Plants	Photosynthesis in Bacteria
Cyclic and non-cyclic phosphorylation takes place	Only cyclic phosphorylation takes place
Photosystem I and II involved	Photosystem I only involved
Electron donor is water	Electron donor is H_2S
Oxygen is evolved	Oxygen is not evolved
Reaction centres are P_{700} and P_{680}	Reaction centre is P_{870}
Reducing agent is $NADPH+H^+$	Reducing agent is $NADH+H^+$
PAR is 400 to 700 nm	PAR is above 700 nm
Chlorophyll, carotenoid and xanthophyll	Bacterio chlorophyll and bacterioviridin
Photosynthetic apparatus chloroplast	It is chlorosomes and chromatophores

6. List out the Significance of Photosynthesis.

+ Photosynthetic organisms provide food for all living organisms on earth either directly or indirectly.
+ It is the only natural process that liberates oxygen in the atmosphere and balances the oxygen level.
+ Photosynthesis balances the oxygen and carbon cycle in nature.
+ Fuels such as coal, petroleum and other fossil fuels are from preserved photosynthetic plants.
+ Photosynthetic organisms are the primary producers on which all consumers depend for energy.
+ Plants provide fodder, fibre, fire wood, timber, useful medicinal products and these sources come by the act of photosynthesis.

14 RESPIRATION

EVALUATION

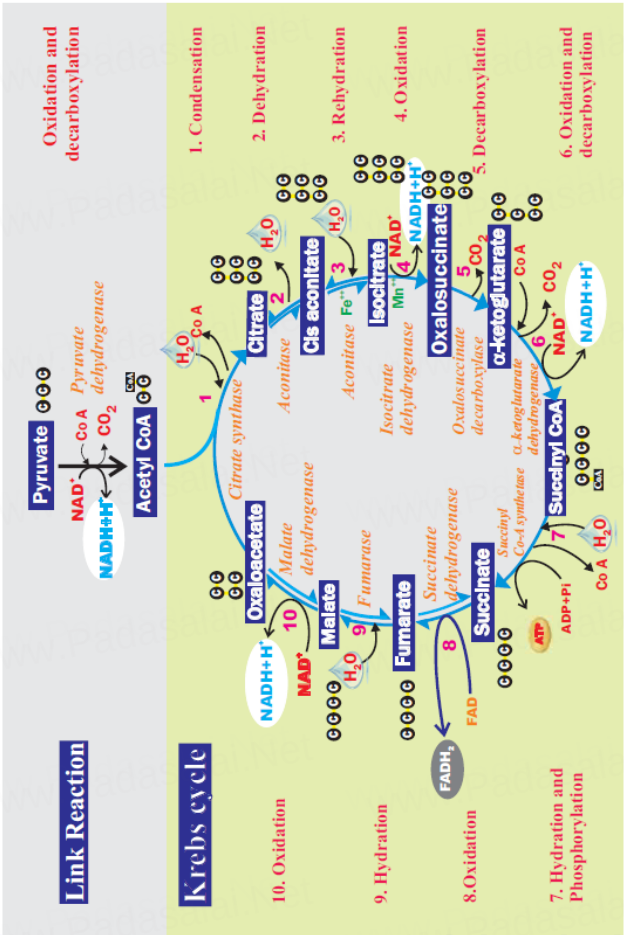
1. Explain the reactions taking place in mitochondrial inner membrane.

Krebs cycle or Citric acid cycle or TCA cycle

+ Two molecules of acetyl CoA formed from link reaction now enter into Krebs cycle.
+ It is named after its discoverer, German Biochemist **Sir Hans Adolf Krebs** (1937).
+ The enzymes necessary for TCA cycle are found in mitochondrial matrix except succinate dehydrogenase enzyme which is found in mitochondrial inner membrane.
+ TCA cycle starts with condensation of acetyl CoA with oxaloacetate in the presence of water to yield citrate or citric acid. Therefore, it is also known as **Citric Acid Cycle (CAC)** or **Tri Carboxylic Acid (TCA) cycle**.
+ It is followed by the action of different enzymes in cyclic manner. During the conversion of succinyl CoA to succinate by the enzyme succinyl CoA synthetase or succinate thiokinase, a molecule of ATP synthesis from substrate without entering the electron transport chain is called **substrate level phosphorylation.**
+ In animals a molecule of GTP is synthesized from GDP1Pi. In a coupled reaction GTP is converted to GDP with simultaneous synthesis of ATP from ADP1Pi. In three steps (4, 5, 9) in this cycle NAD_1 is reduced to $NADH_1$ H_1 and at step 7 where FAD is reduced to $FADH_2$.
+ Two molecules of pyruvic acid formed at the end of glycolysis enter into the mitochondrial matrix. Therefore, Krebs cycle is repeated twice for every glucose molecule where two

molecules of pyruvic acid produces six molecules of CO_2, eight molecules of NADH+ H_+, two molecules of $FADH_2$ and two molecules of ATP.

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



2. What is the name of alternate way of glucose breakdown? Explain the process involved in it?

+ Pentose phosphate pathway.
+ It was described by **Warburg**, **Dickens** and **Lipmann** (1938). Hence, it is also called **Warburg-Dickens-Lipmann pathway**.
+ It takes place in cytoplasm of mature plant cells. It is an alternate way for breakdown of glucose.
+ It is also known as **Hexose monophosphate shunt (HMP Shunt)** HMP shunt or **Direct Oxidative Pathway**.
+ It consists of two phases, oxidative phase and non-oxidative phase. The oxidative events convert six molecules of six carbon Glucose-6-phosphate to 6 molecules of five carbon sugar Ribulose-5 phosphate with loss of $6CO_2$ molecules and generation of 12 NADPH 1 H_1 (not NADH).
+ The remaining reactions known as **non-oxidative pathway**, convert Ribulose-5-phosphate molecules to various intermediates such as Ribose-5-phosphate(5C), Xylulose-5-phosphate(5C), Glyceraldehyde-3-phosphate(3C), Sedoheptulose-7-Phosphate(7C), and Erythrose-4-phosphate(4C).

$$6 \text{ x Glucose-6-Phosphate} + 12NADP^+ + 6H_2O \rightarrow 5 \text{ x Glucose-6-Phosphate} + 6CO_2 + Pi + 12NADPH + 12H^+$$

+ Finally, five molecules of glucose-6-phosphate is regenerated.
+ The overall reaction is: The net result of complete oxidation of one glucose-6-phosphate yield $6CO_2$ and $12NADPH + H_+$.
+ The oxidative pentose phosphate pathway is controlled by glucose-6-phosphate dehydrogenase enzyme which is inhibited by high ratio of NADPH to $NADP_+$.

3. How will you calculate net products of one sucrose molecule upon complete oxidation during aerobic respiration as per recent view?

Net Products gained during aerobic respiration per glucose molecule

STAGES	CO_2	ATP	Reduced NAD^+	Reduced FAD	Total ATP Production
Glycol-ysis	0	2	2(2 x 2 = 4)	0	6
Link reaction	2	2	2 (2 x 3 = 6)	0	6
Krebs cycle	4	2	6(6 x 3 = 18)	2(2 x 2 = 4)	24
Total	**6**	**4 ATP**	**28ATP**	**4ATP**	**36**

+ Complete oxidation of a glucose molecule in aerobic respiration results in the net gain of **36 ATP molecules in plants**.
+ Since huge amount of energy is generated in mitochondria in the form of ATP molecules they are called '*power house of the cell*'.
+ In the case of aerobic prokaryotes due to lack of mitochondria each molecule of glucose produces 38 ATP molecules.

Recent View

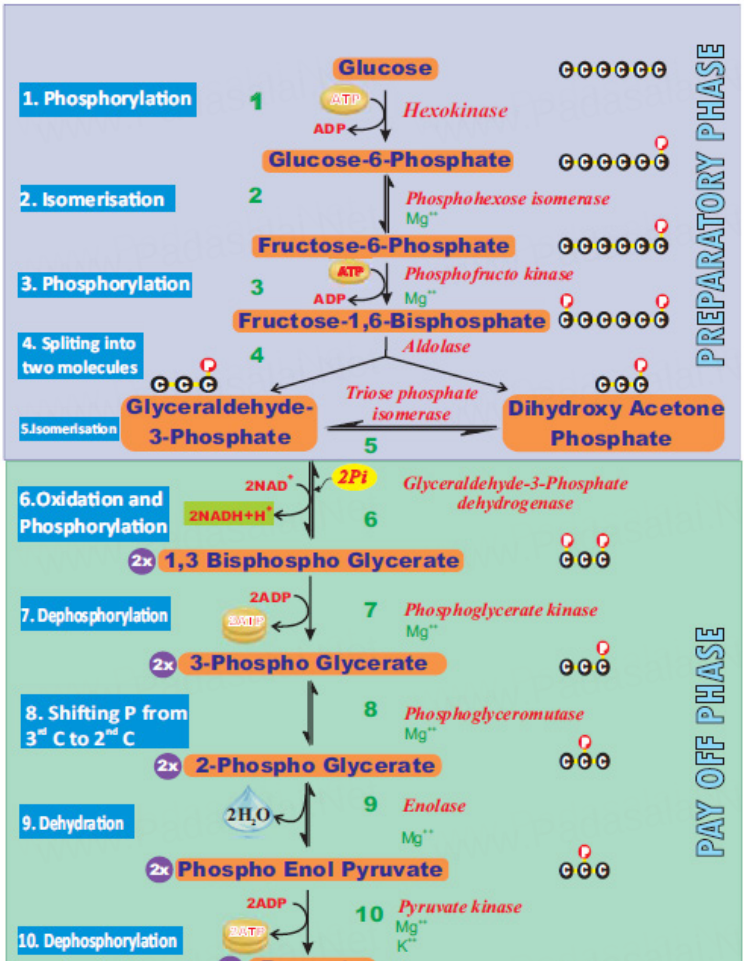
+ When the cost of transport of ATP s from matrix into the cytosol is considered the number will be 2.5 ATPs for each $NADH+H^+$ and 1.5 ATP s for each $FADH^2$oxidised during electron transport system.
+ Therefore, in plant cells net yield of 30 ATP molecules is from complete aerobic oxidation of one molecule of glucose. Sucrose is made up of a molecule of glucose and a molecule of produces monosaccharides.
+ Glucose and fructose are isomers.The fructose unit of Sucrose will be converted into Glucose in liver and adipose tissue.

Hence if one glucose molecule yields 30 ATP on complete oxidation.

+ Net products of one sucrose molecule upon complete oxidation during aerobic respiration = 60 ATP.

ADDITIONAL

1. Make a chart of Glycolysis (or) EMP path way.



2. Differentiate between Aerobic and Anaerobic Respiration.

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

3. Mention the Significance of Kreb's cycle.

+ TCA cycle is to provide energy in the form of ATP for metabolism in plants.
+ It provides carbon skeleton or raw material for various anabolic processes.
+ Many intermediates of TCA cycle are further metabolised to produce amino acids, proteins and nucleic acids.
+ Succinyl CoA is raw material for formation of chlorophylls, cytochrome, phytochrome and other pyrrole substances.
+ α-ketoglutarate and oxaloacetate undergo reductive amination and produce amino acids.
+ It acts as metabolic sink which plays a central role in intermediary metabolism.

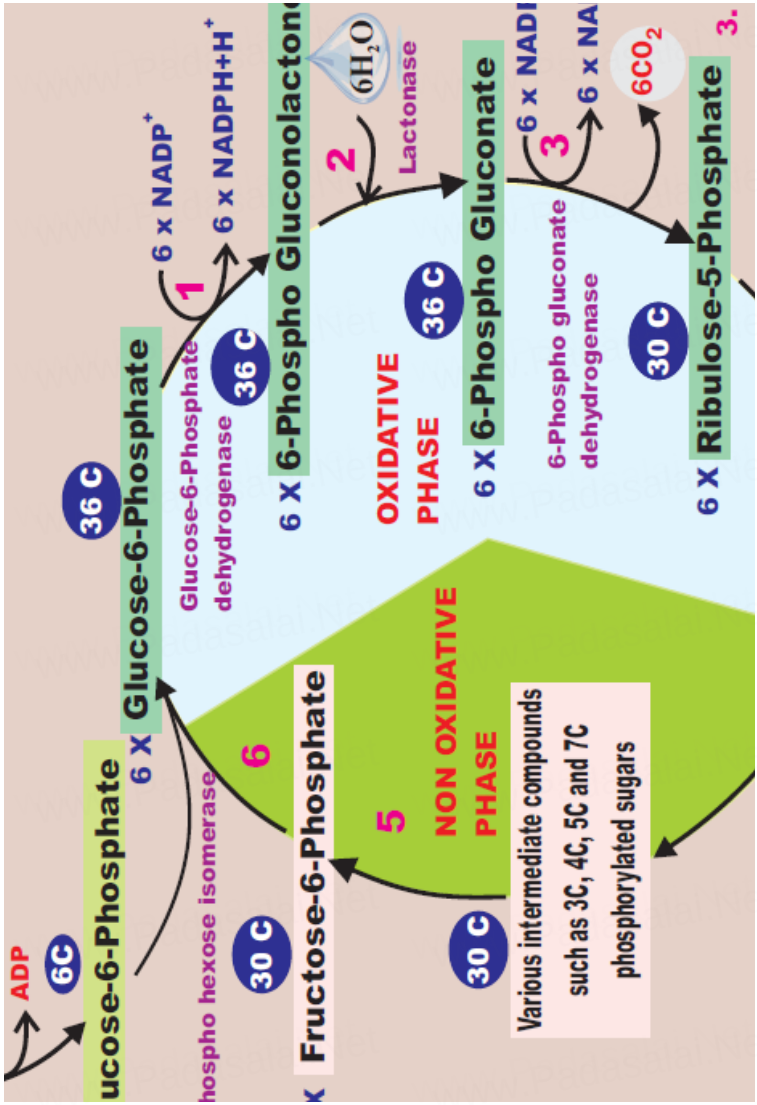
4. Compare between Alcoholic fermentation and Lactic acid fermentation.

Alcoholic fermentation	Lactic acid fermentation
It produces alcohol and releases CO_2 from pyruvic acid.	It produces lactic acid and does not release CO_2 from pyruvic acid.
It takes place in two steps.	It takes place in single step.
It involves two enzymes, pyruvate decarboxylase with Mg11 and alcohol dehydrogenase.	It uses one enzyme, lactate dehydrogenase with Zn11.
It forms acetaldehyde as intermediate compound.	Does not form any intermediate compound.
It commonly occurs in yeast.	Occurs in bacteria, some fungi and vertebrate muscles

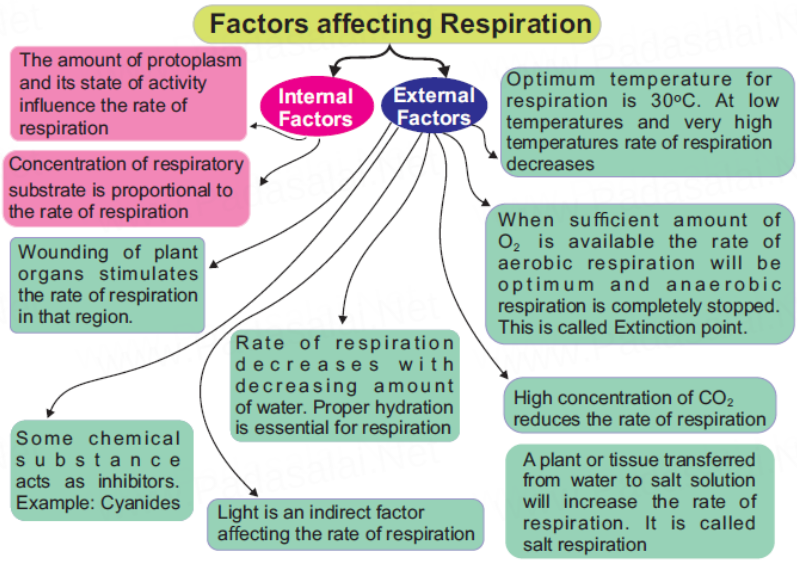
5. Compare the alcoholic fermentation and lactic acid fermentation?

Alcoholic fermentation	Lactic acid fermentation
It produces alcohol and releases CO_2 from pyruvic acid.	It produces lactic acid and does not release CO_2 from pyruvic acid.
It takes place in two steps.	It takes place in single step.
It involves two enzymes, pyruvate decarboxylase with Mg^{++} and alcohol dehydrogenase.	It uses one enzyme, lactate dehydrogenase with Zn^{++}.
It forms acetaldehyde as intermediate compound.	Does not form any intermediate compound.
It commonly occurs in yeast.	Occurs in bacteria, some fungi and vertebrate muscles.

6. Draw thepentose phosphate pathway or HMP shunt.



7. Draw the flow chart for the factors affecting Respiration.



15 PLANT GROWTH AND DEVELOPMENT

EVALUATION

1. Write the physiological effects of Cytokinin.

+ Cytokinin promotes cell division in the presence of auxin (IAA).
+ It induces cell enlargement associated with IAA and gibberellins.
+ It can break the dormancy of certain light-sensitive seeds like tobacco and induces seed germination.
+ It promotes the growth of lateral bud in the presence of apical bud.
+ It delays the process of aging by nutrient mobilization (known as **Richmond Lang effect**).
+ Cytokinin (i) increases rate protein synthesis (ii) induces the formation of inter-fascicular cambium (iii) overcomes apical dominance (iv) induces formation of new leaves, chloroplast and lateral shoots.
+ Plants accumulate solutes very actively with the help of cytokinin.

2. Describe the mechanism of photoperiodic induction of flowering.

Photoperiodic induction

+ An appropriate photoperiod in 24 hours' cycle constitutes one inductive cycle. Plants may require one or more inductive cycles for flowering.
+ The phenomenon of conversion of leaf primordia into flower primordia under the influence of suitable inductive cycles is called photoperiodic induction.
+ Example: *Xanthium* (SDP) – 1 inductive cycle and Plantago (LDP) – 25 inductive cycles.

Site of Photo inductive perception

+ Photoperiodic stimulus is perceived by the leaves. Floral hormone is synthesised in leaves and translocated to the apical tip to promote flowering.
+ This can be explained by a simple experiment on Cocklebur (*Xanthium pensylvanicum*), a short-day plant. Usually Xanthium will flower under short day conditions.
+ If the plant is defoliated and kept under short day conditions it will not flower.
+ Flowering will occur even when all the leaves are removed except one leaf. If a cocklebur plant is defoliated and kept under long day conditions, it will not flower.
+ If one of its leaves is exposed to short day condition and rest are in long day condition, flowering will occur
+ The nature of flower producing stimulus has been elusive so far. It is believed by many physiologists that it is a hormone called **florigen**. The term florigen was coined by **Chailakyan** (1936) but it is not possible to isolate.

3. Give a brief account on Programmed cell Death(PCD).

+ Senescence is controlled by plants own genetic programme and death of the plant or plant part consequent to senescence is called Programmed Cell Death.
+ In short senescence of an individual cell is called PCD.
+ The proteolytic enzymes involving PCD in plants are phytaspases and in animals are caspases.
+ The nutrients and other substrates from senescing cells and tissues are remobilized and reallocated to other parts of the plant that survives.
+ The protoplasts of developing xylem vessels and tracheids die and disappear at maturity to make them functionally efficient to conduct water for transport.
+ In aquatic plants, aerenchyma is normally formed in different parts of the plant such as roots and stems which encloses large air spaces that are created through PCD.

+ In the development of unisexual flowers, male and female flowers are present in earlier stages, but only one of these two completes its development while other aborts through PCD

ADDITIONAL

1. What are the Characteristics of Phytohormones?

+ Usually produced in tips of roots, stems and leaves.
+ Transfer of hormones from one place to another takes part through conductive systems.
+ They are required in trace quantities.
+ All hormones are organic in nature.
+ There are no specialized cells or organs for their secretion.
+ They are capable of influencing physiological activities leading to promotion, inhibition and modification of growth.

2. What are the physiological effects happened in Auxin?

+ They promote cell elongation in stem and coleoptile.
+ At higher concentrations auxins inhibit the elongation of roots but induce more lateral roots.
+ Suppression of growth in lateral bud by apical bud due to auxin produced by apical bud is termed as apical dominance.
+ It is responsible for initiation and promotion of cell division in cambium
+ Auxin stimulates respiration.
+ Auxin induces vascular differentiation.
+ Auxin prevents abscission.

3. Write the Physiological Effects of Ethylene.

+ Ethylene stimulates respiration and ripening in fruits.
+ It stimulates radial growth in stem and root and inhibits linear growth.
+ It breaks the dormancy of buds, seeds and storage organs.
+ It stimulates formation of abscission zone in leaves, flowers and fruits. This makes the leaves to shed.

+ Inhibition of stem elongation (shortening the internode).
+ In low concentration, ethylene helps in root initiation.
+ Growth of lateral roots and root hairs. This increases the absorption surface of the plant roots.
+ The growth of fruits is stimulated by ethylene in some plants. It is more marked in climacteric fruits.
+ Ethylene causes epinasty.

4. Write the Physiological effects of Abscisic Acid (ABA).

+ It helps in reducing transpiration rate by closing stomata. It inhibits K1 uptake by guard cells and promotes the leakage of malic acid. It results in closure of stomata.
+ It spoils chlorophylls, proteins and nucleic acids of leaves making them yellow.
+ Inhibition of cell division and cell elongation.
+ ABA is a powerful growth inhibitor. It causes 50% inhibition of growth in Oat coleoptile.
+ It induces bud and seed dormancy.
+ It promotes the abscission of leaves, flowers and fruits by forming abscission layers.
+ ABA plays an important role in plants during water stress and during drought conditions. It results in loss of turgor and closure of stomata.
+ It has anti-auxin and anti-gibberellin property.
+ Abscisic acid promotes senescence in leaves by causing loss of chlorophyll pigment decreasing the rate of
+ photosynthesis and changing the rate of proteins and nucleic acid synthesis.

5. What are the Phases of growth?

There are three phases of growth,

1. Formative phase
2. Elongation phase
3. Maturation phase

Formative phase:

+ Growth in this phase occurs in meristematic cells of shoot and root tips. These cells are small in size, have dense protoplasm, large nucleus and small vacuoles. Cells divide continuously by mitotic cell division. Some cells retain capability of cell division while other cells enter the next phase of growth.

Elongation Phase:

+ Newly formed daughter cells are pushed out of the meristematic zone and increases the volume. It requires auxin and food supply, deposition of new cell wall materials (intussusception), addition of protoplasm and development of central vacuole take place.

Maturation Phase:

+ During this stage cells attain mature form and size. Thickening and differentiation take place. After differentiation, the cells do not grow further.

6. Describe the types of senescence in plants.

+ Plant life comprises some sequential events, *viz*: germination, juvenile stage, maturation, old age and death. Old age is called **senescence** in plants. Senescence refers to all collective, progressive and deteriorative processes which ultimately lead to complete loss of organization and function.

Types of Senescence

+ **Leopold** (1961) has recognized four types of senescence:
  - ✍ Overall senescence
  - ✍ Top senescence
  - ✍ Deciduous senescence
  - ✍ Progressive senescence

Overall senescence:

+ This kind of senescence occurs in annual plants when entire plant gets affected and dies.
+ Example: Wheat and Soybean. It also occurs in few perennials also. Example: *Agave* and Bamboo.

Top senescence:

+ It occurs in aerial parts of plants. It is common in perennials, underground and root system remains viable. Example: Banana and *Gladiolus*.

Deciduous senescence:

+ It is common in deciduous plants and occurs only in leaves of plants, bulk of the stem and root system remains alive. Example: Elm and Maple.

Progressive senescence:

+ This kind of senescence is gradual. First it occurs in old leaves followed by new leaves then stem and finally root system. It is common in annuals

7. Describe the external factors affecting germination.

+ **Water:** It activates the enzymes which digest the complex reserve foods of the seed. If the water content of the seed goes below a critical level, seeds fail to germinate.
+ **Temperature:** Seeds fails to germinate at very low and high temperature. The optimum temperature is 25°C to 35°C for most tropic species.
+ **Oxygen:**It is necessary for germination. Since aerobic respiration is a physiological requirement for germination most will germinate well in air containing 20% oxygen.
+ **Light:** There are many seeds which respond to light for germination and these seeds said to be photoblastic.
+ **Soil conditions:** Germination of seed in its natural habit is influenced by soil conditions such as water holding capacity, mineral composition and aeration of the soil.

8. Describe the internal factors affecting germination.

+ **Maturity of embryo:** The seeds of some plants, when shed will contain immature embryo. Such seeds germinate only after maturation of embryo.
+ **Viability:** Usually seeds remain viable or living only for a particular period. Viability of seeds range from a few days

(Example: *Oxalis*) to more than hundred years. Maximum viability (1000 years) has been recorded in lotus seeds. Seeds germinate only within the period of viability.

+ **Dormancy**: Seeds of many plants are dormant at the time of shedding. A detailed treatment is given below.

9. What is Vernalization? Explain its Mechanism.

+ Besides photoperiod certain plants require a low temperature exposure in their earlier stages for flowering.
+ Many species of biennials and perennials are induced to flower by low temperature exposure (0°C to 5°C). This process is called Vernalization.
+ The term Vernalization was first used by **T. D. Lysenko** (1938).

Mechanism of Vernalization:

+ Two main theories to explain the mechanism of vernalization are:
+ Hypothesis of phasic development
+ Hypothesis of hormonal involvement

Hypothesis of phasic development

+ According to Lysenko, development of an annual seed plant consists of two phases. First phase is thermostage, which is vegetative phase requiring low temperature and suitable moisture. Next phase is photo stage which requires high temperature for synthesis of florigen (flowering hormone).

Hypothesis of hormonal involvement

+ According to Purvis (1961), formation of a substance A from its precursor, is converted into B after chilling. The substance B is unstable. At suitable temperature B is converted into stable compound D called Vernalin. Vernalin is converted to F (Florigen). Florigen induces flower formation. At high temperature B is converted to C and devernalization occurs

SURYA
POWER TO SCORE

BIO-ZOOLOGY

5 Marks

1 THE LIVING WORLD

EVALUATION

1. Explain the role of latin and greek names in biology.

+ Latin and Greek words commonly used in systematic names, to help those unfamiliar with classical languages to understand and remember the scientific names of organisms.
+ The binomial nomenclature used for animals and plants is largely derived from Latin and Greek words, some of the names used for higher taxa, such as orders and above.
+ The common language of science and scientific names were in Latin or Greek.
+ Moreover, Linnaeus were taught Latin, everywhere and uniquely suitable for naming plants and animals.

2. List any five salient features of the family felidae,

+ Obligate carnivores – need meat to survive ('hypercarnivores')
+ Mostly solitary, secretive and nocturnal.
+ Many occupy forested habitats.
+ Huge variation in size 2 kgs to 300 kgs.
+ They have large and sharp canine teeth.

ADDITIONAL

1. List out the basic need for classifications.

+ Toidentifyanddifferentiatecloselyrelatedspecies
+ Toknowthevariationamongthespecies
+ Tounderstandtheevolutionofthespecies
+ Tocreateaphylogenetictreeamongthedifferentgroups
+ Toconvenientlystudylivingorganisms

2. List out the rules of nomenclature.

+ The scientific name should be italicized in printed form and if handwritten, it should be underlined separately.
+ The generic name's (Genus) first alphabet shouldbe in uppercase.
+ The specific name (species) should be in lowercase.
+ The scientific names of any two organisms are not similar.
+ The name or abbreviated name of the scientist who first publishes the scientific name may be written after the species name along with the year of publication. For example Lion-Felisleo Linn., 1758 or FelisleoL., 1758.
+ If the species name is framed after any person's name the name of the species shall end with i, ii orae.
+ For example, a new species of a ground - dwelling lizard (Cyrtodactylus) has been discovered and named after Scientist Varad Giri, Cyrtodactylus varadgirii

3. Describe the tools for study of taxonomy. Or describe the classical taxonomical tools.

+ Tools and taxonomical aids may be different for the study of plants and animals. He rbarium and Botanical garden may be used as tools for the study of plant taxonomy.
+ In the case of animal studies, the classical tools are Museum, Taxonomical Keys and Zoological and Marineparks.
+ Taxonomical Keys: Keys are based on comparative analysis of the similarities and dissimilarities of organisms. There are separate keys for different taxonomic categories.
+ Museum: Biological museums have collection of preserved plants and animals for study and ready reference. Specimens of both extinct and living organisms can be studied.
+ Zoological parks: The seare places where wild animals are kept in protected environments under human care. It enable susto study their food habits and behaviour.
+ Marine parks: Marine organisms are maintained in protected environments.

+ Printed taxonomical tools consist of identification cards, description, field guides and manuals.

4. Describe the molecular taxonomical tools.

+ Technological advance menthas helped to evolve molecular taxonomical tools from classical tools to molecular tools.
+ The accuracy and authenticity are more significantin the molecular tools. The following methods are being used for taxonomical classification.
+ Molecular techniques and approaches such as
  - ✍ DNA barcoding- short genetic marker in an organism's DNA to identify it as belonging to a particular species
  - ✍ DNA hybridization- measures the degree of genetic similarity between pools of DNA sequences,
  - ✍ DNA finger printing- to identify an individual from asample of DNA by looking atunique patterns in their DNA
  - ✍ Restriction Fragment Length Polymorphisms (RFLP) analysis - difference in homologous DNA sequences that canbe detected by the presence of fragments of different lengths after digestion of the DNA samples
  - ✍ Polymerase Chain Reaction (PCR) sequencing- to amplify a specificgene, or portion of gene, are used as taxonomical tools.

5. Describe the automated species identification tools.

+ ItconsistsofCybertools.
+ Forexample:DAISY,ALIS,ABIS,SPIDA,Drawwing,etc.
+ ALIS-AutomatedLeafhopperIdentificationSystem.
+ DAISY-DigitalAutomatedIdentificationSystem.
+ ABIS-AutomaticBeeIdentificationSystem.
+ SPIDA-SpeciesIdentifiedAutomatically(spiders,waspandbeewingcharacters).
+ Drawwing-Honeybeewingidentification.

2 ANIMAL KINGDOM

EVALUATION

1. Observe the animal below and answer the following questions

a.Identifytheanimal

+ Adamsia(Sea anemone)

b.Whattypeofsymmetrydoesthisanimalexhibit?

+ Bilateral symmetry

c.IsthisanimalCephalized?

+ No.

d.Howmanygermlayersdoesthisanimalhave?

+ Two germ layers (Diploblastic animal).

e.Howmanyopeningsdoesthisanimal'sdigestivesystemhave?

+ Single opening (Hypostome or mouth). This opening serve both processes of ingestion and egestion.

f.Doesthisanimalhaveneurons?

+ No.

ADDITIONAL

1. Explain the basis of classification or Levels of organization

BasisofClassification

+ Multicellular organisms are structurally and functionally different but yet they possess certain common fundamental features such as the arrangement of cell layers, the levels of organisation, nature of coelom, the presence or absence of segmentation, notochord and the organisation of the organ system.

Levelsoforganisation

+ All members of Kingdom Animalia are metazoans (multicellular animals) and exhibit different patterns of cellular organisation.
+ The cells of the metazoansare not capable of independent existence and exhibit division of labour.
+ Among the metazoans, cells may be functionally isolated or similar kinds of cells may be grouped together to form tissues, organ and organ systems.

Cellularleveloforganisation

+ This basic level of organisation is seen in sponges. The cells in the sponges are arranged as loose aggregates and do not form tissues, i.e. they exhibit cellular level of organisation.
+ There is division of labour among the cells and different types of cells are functionally isolated.
+ In sponges, the outer layer is formed of pinacocytes (plate-like cells that maintain the size and structure of the sponge) and the inner layer is formed of choanocytes.
+ These are flagellated collar cells that create and maintain water flow through the sponge thus facilitating respiratory and digestive functions.

Tissueleveloforganization.

+ In some animals, cells that perform similar functions are aggregated to form tissues.
+ The cells of a tissue integrate in a highly coordinated fashion to perform a common function, due to the presence of nerve cells and sensory cells.
+ This tissue level of organisation is exhibited in diploblastic animals like cnidarians.
+ The formation of tissues is the first step towards evolution of body plan in animals. (Hydra - Coelenterata).

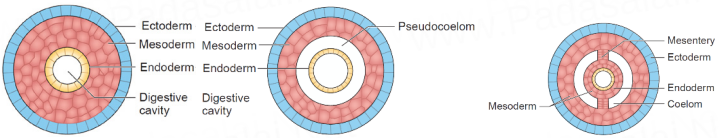
Organleveloforganization.

+ Different kinds of tissues aggregate to form an organ to perform a specific function.
+ Organ level of organisation is a further advancement over the tissue level of organisation and appears for the first time in the Phylum Platyhelminthes and seen in other higher phyla.

Organsystemleveloforganization.

+ The tissues are organised to form organs and organ systems.
+ Each system is associated with a specific function and show organ system level of organisation.
+ For example, the digestive system of Platyhelminthes has only a single opening to the exterior which serves as both mouth and anus, and hence called an incomplete digestive system.

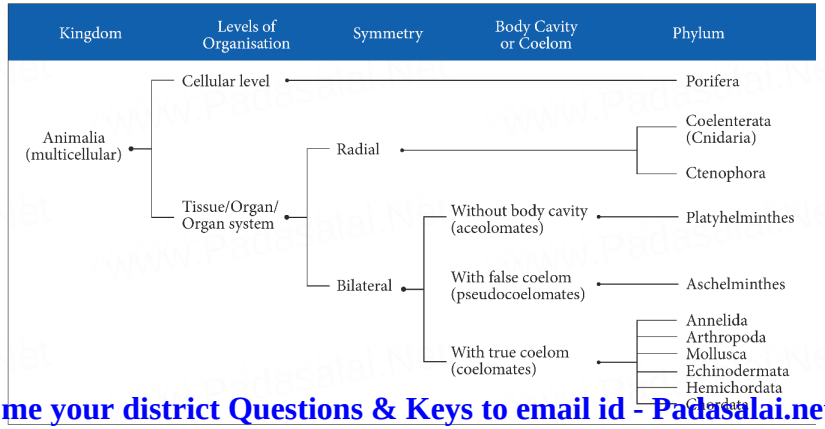
2. Describe about Coelom.



+ The presence of body cavity or coelom is important in classifying animals. Most animals possess a body cavity between the body wall and the alimentary canal, and is lined with mesoderm.

+ Animals which do not possess a body cavity are called acoelomates. Since there is no body cavity in these animals their body is solid without a perivisceral cavity, this restricts the free movement of internal organs. (e.g., Flatworms)
+ In some animals, the body cavity is not fully lined by the mesodermal epithelium, but the mesoderm is formed as scattered pouches between the ectoderm and endoderm. Such a body cavity is called a pseudocoel and is filled with pseudocoelomic fluid. Animals that possess a pseudocoel are called pseudocoelomates e.g., Round worms. The pseudocoelomic fluid in the pseudocoelom acts as a hydrostatic skeleton and allows free movement of the visceral organs and for circulation of nutrients.
+ Eucoelom or true coelom is a fluid-filled cavity that develops within the mesoderm and is lined by mesodermal epithelium called peritoneum. Such animals with a true body cavity are called coelomates or eucoelomates. Based on the mode of formation of coelom, the eucoelomates are classified into two types, Schizocoelomates – in these animals the body cavity is formed by splitting of mesoderm. (e.g., annelids, arthropods, molluscs). In Enterocoelomate animals the body cavity is formed from the mesodermal pouches of archenteron. (e.g., Echinoderms, hemichordates and chordates)

3. Write the flow chart of Classification of Kingdom Animalia.



4. Write a detailed account on the general characters of Phylum: Ctenophora

+ Ctenophora are exclusively marine, radially symmetrical, diploblastic animals with tissue level of organisation. Though they are diploblastic, their mesoglea is different from that of cnidaria. It contains amoebocytes and smooth muscle cells. They have eight external rows of ciliated comb plates (comb jellies) which help in locomotion, hence commonly called comb jellies or sea walnuts.
+ Bioluminescence (the ability of a living organism to emit light) is well marked in ctenophores. They lack nematocysts but possess special cells called lasso cells or colloblasts which help in food capture. Digestion is both extracellular and intracellular. Sexes are not separate (monoecious). They reproduce only by sexual means.
+ Fertilization is external and development is indirect and includes a larval stage called cydippid larva. e.g., Pleurobrachia
+ Examples: Pleurobrachia and Ctenoplana.

5. Write a detailed account on the general characters of Phylum: Platyhelminthes (Flatworms)

+ (G. Platy -broad or flat; helmin-worm) They have a dorsoventrally flattened body and hence called flatworms.
+ These animals are bilaterally symmetrical, triploblastic, acoelomate with organ system level of organisation. They show moderate cephalization and unidirectional movement. They are, mostly endoparasites of animals including human beings. Hooks and suckers are present in the parasitic forms and serve as organs of attachment. Their body is not segmented, but some exhibit pseudosegmentation. Some of the parasitic flatworms absorb nutrients directly from the host through their body surface. However, flatworms like liver fluke have an incomplete digestive system. Specialized excretory cells called flame cells help in osmoregulation and excretion.

+ Sexes are not separate (monoecious); fertilisation is internal and development is through larval stages (miracidium, sporocyst, redia, cercaria). Polyembryony is common in some flatworms (Liver flukes). Some members like Planaria show high regeneration capacity.
+ Examples: Taenia solium (tape worm), Fasciola hepatica (liver fluke), Schistosoma (blood fluke).

6. Write a detailed account on the general characters of Phylum: Annelida (Segmented worm)

+ (L. annulus -a ring, and G. edios- form) Annelids were the first segmented animals to evolve. They are aquatic or terrestrial, free living but some are parasitic. They are triploblastic, bilaterally symmetrical, schizocoelomates and exhibit organ system level of body organisation. The coelom with coelomic fluid creates a hydrostatic skeleton and aids in locomotion. Their elongated body is metamerically segmented and the body surface is divided into segment or metameres. Internally the segments are divided from one another by partitions called septa. This phenomenon is known as metamerism.
+ The longitudinal and circular muscles in the body wall help in locomotion. Aquatic annelids like Nereis have lateral appendages called parapodia, which help in swimming. Chitinous setae in Earthworms, and suckers in Leech help in locomotion. The circulatory system is of closed type and the respiratory pigments are hemoglobin and chlorocruorin.
+ Nervous system consists of paired ganglion connected by the lateral nerves to the double ventral nerve cord. They reproduce sexually.
+ Development is direct or indirect and includes a trochophore larva. Some are monoecious (earthworms) while some are dioecious (Neries and Leech).
+ Examples: Lampitomauritii (earthworm), Neries (sand worm), Hirudinaria (leech).

7. Give a detailed account on the general characters ofPhylum: Arthropoda

+ (G. arthros- jointed; podes- feet) This is the largest phylum of the Kingdom Animalia and includes the largest class called Insecta (total species ranges from 2-10 million). They are bilaterally symmetrical, segmented, triploblastic and schizocoelomate animals with organ system grade of body organisation. They have jointed appendages which are used for locomotion, feeding and are sensory in function.
+ Body is covered by chitinous exoskeleton for protection and to prevent water loss, It is shed off periodically by a process called molting or ecdysis. The body consists of a head, thorax, and abdomen with a body cavity called haemocoel. Respiratory organs are gills, book gills, book lungs or trachea. Circulatory system is of open type. Sensory organs like antennae, eyes (compound and simple), statocysts (organs of balance/ equilibrium) are present. Excretion takes place through malpighian tubules, green glands, coxal glands, etc. They are mostly dioecious and oviparous.
+ Fertilization is usually internal. Development may be direct or indirect. Life history includes many larval stages followed by metamorphosis.
+ Examples : Limulus, Palamnaeus

8. Comparison of chordates and non-chordates.

Chordates	Non-chordates
Notochord is present	Absence of notochord
Dorsal, hollow and single nerve cord	Double ventral solid nerve cord
Pharynx perforated by gill slits	Gill slits absent
Heart is ventrally placed	Heart is dorsal or laterally placed or absent
A post anal tail is present	Post anal tail is absent
Alimentary canal placed ventral to the nerve cord	Alimentary canal is placed dorsal to the nerve cord

9. Give a detailed account on the general characters of Subphylum: Urochordata or Tunicata

+ (G. Oura – A tail; L. Chord – cord) They are exclusively marine and are commonly called sea squirts. Mostly sessile, some pelagic or free swimming, exist as solitary and colonial forms.
+ Body is unsegmented and covered by a test or tunic. Adult forms are sac like. Coelom is absent, but has an atrial cavity surrounding the pharynx.
+ Notochord is present only in the tail region of the larval stage, hence named urochordata.
+ Alimentary canal is complete and circulatory system is of open type.
+ The heart is ventral and tubular. Respiration is through gill slits and clefts.
+ Dorsal tubular nerve cord is present only in the larval stage and a single dorsal ganglion is present in the adults. Mostly hermaphrodites, development indirect and includes a free swimming tadpole larva with chordate characters.
+ Retrogressive metamorphosis is seen
+ Examples: Ascidia, Salpa, Doliolum

10. Give a detailed account on the general characters of Subphylum: Cephalochordata

+ (L. Cephalo- 'head' ; G. chorda 'cord'.) Cephalochordates are marine forms, found in shallow waters, leading a burrowing mode of life.
+ They are small fish like coelomate forms with chordate characters such us notochord, dorsal tubular nerve cord and pharyngeal gill slits throughout their life.
+ Closed type of circulatory system is seen without heart. Excretion is by protonephridia. Sexes are separate, Fertilization is external.
+ Development is indirect and includes a free swimming larva
+ Example: Branchiostoma (Amphioxus or lancelet)

11. Give a detailed account on the general characters of Class: Cyclostomata

+ (G.cyklos–circle; stomata -mouth) All members of cyclostomata are primitive, poikilothermic, jawless aquatic vertebrates and are ectoparasites on some fishes.
+ Body is slender and eel-like bearing six to fifteen pair of gill slits for respiration.
+ Mouth is circular without jaws and suctorial. Heart is two chambered and circulation is of closed type. No paired appendages.
+ Cranium and vertebral column are cartilaginous.
+ Cyclostomes are marine but migrate to fresh waters for spawning (anadromous migration).
+ After spawning within a few days, they die. The larvae (ammocoete) after metamorphosis returns to the ocean.
+ Examples: Petromyzon (Lamprey) and Myxine (Hag fish).

12. Give a detailed account on the general characters of Class: Chondrichthyes

+ (G. chondros –cartilage; ichthys -fish) They are marine fishes with cartilaginous endoskeleton. Notochord is persistent throughout life.
+ Skin is tough covered by dermal placoid scales and the caudal fin is heterocercal (asymmetrical both externally and internally).
+ Mouth is located ventrally and teeth are modified placoid scales which are backwardly directed.
+ Their jaws are very powerful and are predaceous animals.
+ Respiration by lamelliform gills without operculum (gill cover).
+ Excretory organs are mesonephric kidneys. Two chambered heart is present.
+ Cartilaginous fishes are ureotelic and store urea in their blood to maintain osmotic concentration of body fluids. They are poikilothermic and viviparous.
+ Sexes are separate.

+ In males' pelvic fins bear claspers to aid in internal fertilisation.
+ Examples: Scoliodon (Shark), Trygon (Sting ray), Pristis (Saw fish)

13. Give a detailed account on the general characters of Class: Osteichthyes

+ (G. osteon –bone; ichthys -fish) It includes both marine and freshwater fishes with bony endoskeleton and spindle shaped body.
+ Skin is covered by ganoid, cycloid or ctenoid scales.
+ Respiration is by four pairs of filamentous gills and is covered by an operculum on either side. Air bladder is present with or without a connection to the gut. It helps in gaseous exchange (lung fishes) and for maintaining buoyancy in most of the ray finned fishes.
+ They have a ventrally placed two chambered heart.
+ Excretory organs are mesonephric kidneys and are ammonotelic. Presence of well developed lateral line sense organ.
+ Sexes are separate, external fertilization is seen and most forms are oviparous.
+ Examples: Exocoetus (Flying fish), Hippocampus (Sea horse)

14. Give a detailed account on the general characters of Class Aves

+ (L. Avis –bird) Aves are commonly known as birds. The characteristic feature of Aves is the presence of feathers and the ability to fly except for flightless birds (Eg. Ostrich, Kiwi, Penguin).
+ The forelimbs are modified into wings, and the hind limbs are adapted for walking, running, swimming and perching.
+ The skin is dry and devoid of glands except the oil gland or preen gland at the base of the tail.
+ The exoskeleton consists of epidermal feathers, scales, claws on legs and the horny covering on the beak.
+ The endoskeleton is fully ossified (bony) and the long bones are hollow with air cavities (pneumatic bones). The pectoral

muscles of flight (pectoralis major and pectoralis minor) are well developed.

+ Respiration is by compact, elastic, spongy lungs that are continuous with air sacs to supplement respiration. The heart is four chambered. Aves are homeothermic. Migration and parental care are well marked. Urinary bladder is absent.
+ Sexes are separate with well marked sexual dimorphism.
+ In males, the testes are paired but in females, only the left ovary is well developed while the right ovary is atrophied.
+ All birds are oviparous. Eggs are megalecithal and cleidoic.
+ Fertilization is internal.
+ Examples: Corvus (Crow), Columba (Pigeon)

15. Give a detailed account on the general characters of Class: Mammalia

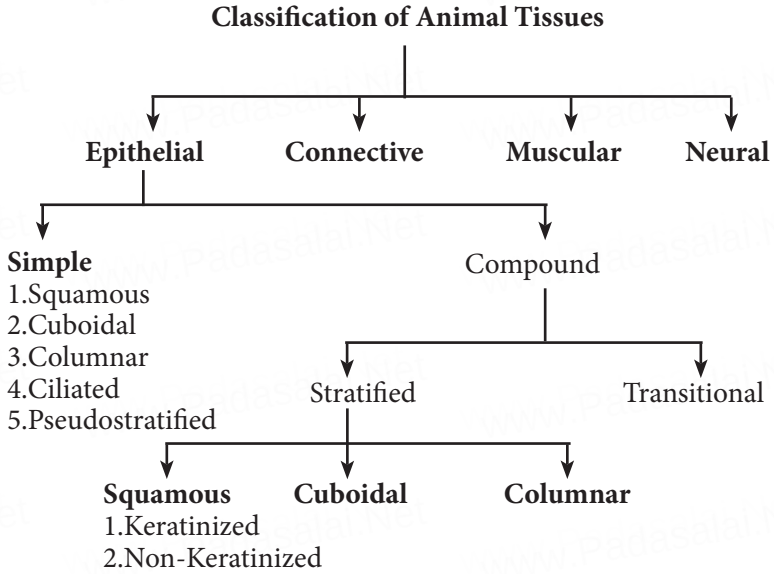
+ (L. Mamma – Breast) They are found in a variety of habitats.
+ Their body is covered by hair, a unique feature of mammals.
+ Some of them are adapted to fly or live in water. Presence of mammary glands is the most unique feature of mammals.
+ They have two pairs of limbs adapted for walking, running, climbing, burrowing, swimming and flying.
+ Their skin is glandular in nature, consisting of sweat glands, scent glands and sebaceous glands.
+ Exoskeleton includes horny epidermal horns, spines, scales, claws, nails, hooves and bony dermal plates.
+ Teeth are thecodont, heterodont and diphyodont.
+ External ears or pinnae are present.
+ The heart is four chambered and possess a left systematic arch.
+ Mature RBCs are circular, biconcave and non nucleated. Mammals have a large brain when compared to other animals They show greatest intelligence among all animals.

➢ Their kidneys are metanephric and are ureotelic. All are homeothermic, sexes are separate and fertilization is internal.

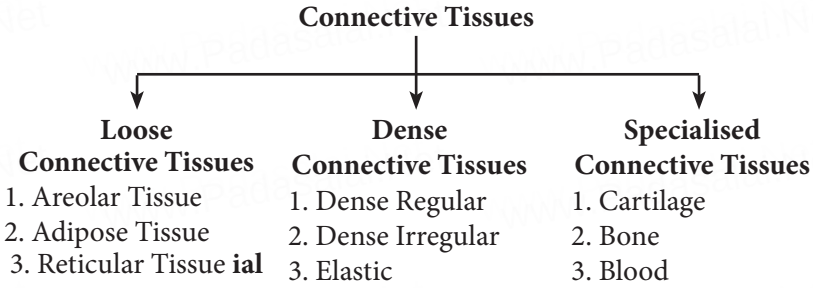
3 TISSUE LEVEL OF OGRANISATION

EVALUATION

1. Draw a flow chart for the classification of animal tissues.



2. Draw the flow chart of Connective Tissue.

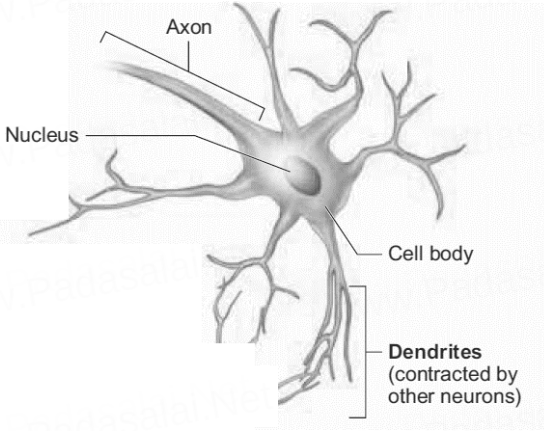


3. Explain the Muscle Tissue.

+ Each muscle is made of many long, cylindrical fibres arranged in parallel arrays.
+ These fibres are composed of numerous fine fibrils, called myofibrils.
+ Muscle fibres contract (shorten) in response to stimulation, then relax (lengthen) and return to their uncontracted state in a coordinated fashion. In general muscles play an active role in all the movements of the body.Muscles are of three types, skeletal, smooth and cardiac.
+ Skeletal muscle tissue is closely attached to skeletal bones.
+ In a typical muscle such as the biceps, the striated (striped) skeletal muscle fibres are bundled together in a parallel fashion.
+ A sheath of tough connective tissue encloses several bundles of muscle fibres
+ The smooth muscle fibres taper at both ends (fusiform) and do not show striations.
+ Cell junctions hold them together and they are bundled together in a connective tissue sheath.
+ The walls of internal organs such as the blood vessels, stomach and intestine contain this type of muscle tissue.
+ Smooth muscles are 'involuntary' as their functions cannot be directly controlled.
+ Unlike the smooth muscles, skeletal muscles cannot be controlled by merely thinking.
+ Cardiac muscle tissue is a contractile tissue present only in the heart.
+ Cell junctions fuse the plasma membranes of cardiac muscle cells and make them stick together.
+ Communication junctions (intercalated discs) at some fusion points allow the cells to contract as a unit, i.e., when one cell receives a signal to contract, its neighbours are also stimulated to contract.

4. Explain the Neural Tissue.

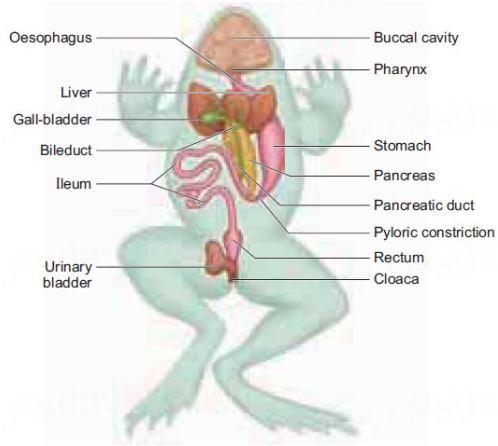
+ Nervous tissue exerts the greatest control over the body's responsiveness to changing conditions.
+ Neurons, the unit of neural system are excitable cells. neuroglial cells which constitute the rest of the neural system protect and support the neurons.
+ Neuroglia makes up more than one-half of the volume of neural tissue in our body.
+ When a neuron is suitably stimulated, an electrical disturbance is generated which swiftly travels along its plasma membrane.
+ Arrival of the disturbance at the neuron's endings, or output zone, triggers events that may cause stimulation or inhibition of adjacent neurons and other cells



4 ORGAN AND ORGAN SYSTEM IN ANIMALS

EVALUATION

1. Draw aneat labeled diagram of the digestives system of frog.



2. Explain the malere productive system of frog.

+ The male frog has a pair of testes which are attached to the kidney and the dorsal body wall by folds of peritonium called mesovarium.
+ Vasefferentia arise from eachtestis.
+ They enter the kidney son both side and openin to the bladdercanal.
+ Finally, it communicates with the urinogenitalduct thatcome sout of kidneys and open sinto the cloaca.

3. Explain the female reproductive system of frog.

+ Female reproductive system consists of pairedovaries, attached to the kidneys, and dorsal body wall by folds of peritoneum called mesovarium.

+ There is a pair of coiledoviducts lying on the sides of the kidney.
+ Each oviduct open sinto the body-cavity at the anteriorend by a funnel like opening called ostia.
+ Unlike the male frog, the female frog has separate genital ducts distinct from ureters.
+ Posteriorly the oviducts dilated to for movisacs before they open in t ocloaca.
+ Ovisacs store the eggs temporarily before the yaresent out through the cloaca.

ADDITIONAL

1. Morphological and anatomical differences between Lampitomauritii and Metaphire posthuma

S.No	Characters	Lampito mauritii	Metaphire posthuma
1.	Shape and size	Cylindrical 80 mm – 210 mm in length 3.5mm - 5.0 mm in width	Cylindrical 115 – 130 mm in length 5 mm in width
2.	Colouration	Light Brown	Dark Brown
3.	Segmentation	165 – 190 Segments	About 140 Segments
4.	Clitellum	14th – 17th Segments (4)	14th – 16th Segments (3)
5.	Spermathecal opening	Three pairs 6/7, 7/8 and 8/9	Four pairs 5/6, 6/7, 7/8 and 8/9
6.	Pharynx	3rd – 4th segment	Runs up to 4th Segment
7.	Oesophagus	5th segment	8th segment
8.	Gizzard	6th segment	8th – 9th segment
9.	Intestine	7th segment to anus	15th segment to anus
10.	Intestinal caeca	Absent	Present in 26th segment

11.	Lateral hearts	8 pairs from 6th to 13th segments	3 pairs from 7th to 9th segments
12.	Pharyngeal nephridia	5th _ 9th segment	4th – 6th segment
13.	Micronephridia	14th to last segment	7th to last segment
14.	Meganephridia	19th to last segment	15th to last segment
15.	Male genital pore	18th segment	18th segment
16.	Female genital pore	14th segment	14th segment

2. Describe the Respiratory System of Lampitomauritii (earthworm)

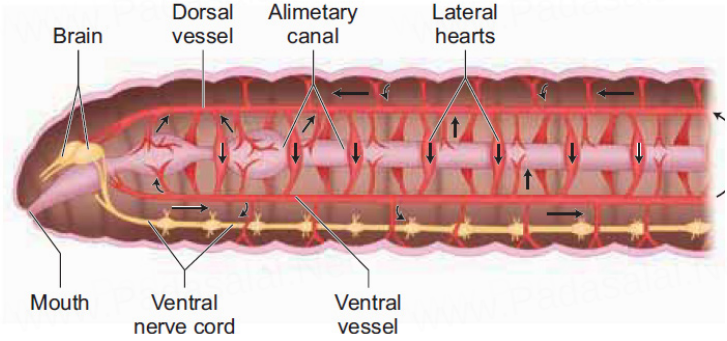
+ The earth worm has no special respiratory organs like lungs orgills. Respiration take splace through the body wall.
+ The outer surface of the skin is richly supplied with blood capillaries which aid in the diffusion of gases.
+ Oxygen diffuses through the skin into the blood while carbon dioxide from the blood diffuses out.
+ The skin is keptmoistby mucous and coelomic fluid and facilitate sex change of gases.

3. Describe the Nervous System of Lampitomauritii (earthworm)

+ The bilobed mass of nervoust issue called supra-pharyngealganglia, lieson the dorsal wall of the pharynx in the 3rd segment, is referred as the "brain". The ganglion found below the pharynx in the 4th segment is called the sub-pharyngealganglion.
+ The brain and the sub-pharyngealganglia are connected by apair of circum-pharyngeal connectives. They run one one achside of the pharynx. Thus a nerve ring is formed around the an terior region of the alimentarycanal.
+ The double ventral nerve cord runs backward from the sub-pharyngealganglion. The brain along withother nerves in the ring integrates sensory inputs and command muscular

responses of the body. The earthworm's recept or sarestimulated by a group of slendercolumnarcellsconnected with nerves.

+ The Photo receptors (sense of light) are found on the dorsal surface of the body.
+ Gustatory (sense of taste) and olfactory receptors (sense of smell) are found in the buccalcavity.
+ Tactile receptors (sense of touch), chemo receptors (detect chemical changes) and thermoreceptors (changes in temperature) are presentin the prostomium and the body wall.



4. Describe the Life cycle of Lampitomauritii (earth worm)

+ Lampitomauritii begins its life cycle, from the fertilized eggs. The eggs are held in a protective cocoon. The secocoons have an in cubation period of about 14-18 days after which they hatch toreleasejuveniles.
+ Thejuvenilesundergochangesintonon-clitellateformsinphase–I after about 15 days, whichthendevelopsaclitellum, called the clitellateat the end of the growth phase–II taking 15-17 days to complete.
+ During the reproductive stage, earth worm scopulate, and later shed their cocoons in the soil after about 10 days.
+ The life cycle of Lampitomauritii takes about 60 days to complete. Earth worm sare known as "friends of farmer" because they make burrows in the soil and make it porous

which help sin respiration and penetration of developing plantroots.

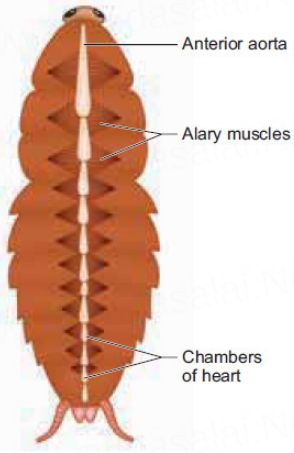
+ Vermi culture, vermicomposting, vermiwash and wormeryare inter-linked and inter dependent processes, collective lyreferred as Vermitech. Lampitomauritti help sin recycling of dead and decayed plant material by feeding on them.
+ Artificial rearing or cultivation of earth worm sin volves new technology for the better ment of human beings. This process is known as Vermi culture.
+ The process of producing compost using earth worm sis called Vermi composting.
+ Vermi wash is aliquidmanure or plant tonic obtained from earthworm. It is used a safoliar spray and help stoinduce plant growth. It is a collection of excretory products and mucus secretion of earthworms along with micronutrients from the soil organic molecules.
+ Earthworms can be used for recycling of waste food, leaf, litter and biomass to prepare a good fertilizer in container known as wormery or worm bin. It makes superior compost than conventional composting methods. Earth worm sare also used as baitin fishing.

5. Differencesbetweenmaleandfemalecockroach

S. No.	Character	Male cockroach	Female cockroach
1.	Abdomen	Long and narrow	Short and broad
2.	Segments	In the abdomen, nine segments are visible	In the abdomen, seven segments are visible
3.	Anal styles	Present	Absent
4.	Terga	7th tergum covers 8th tergum	7th tergum covers 8th and 9th terga
5.	Brood pouch	Absent	Present
6.	Antenna	Longer in length	Shorter in length
7.	Wings	Extends beyond the tip of abdomen.	Extends up to the end of abdomen.

6. Describe the Circulatory system of Periplaneta americana (cockroach)

+ Periplanetah as an open type of circulatory system. Blood vesselsarepoorly developed and open sinto the haemocoelin which the blood or haemolymph flows freely.
+ Visceral organs located in the haemocoelare bathed in blood.
+ The haemolyph is colourless and consists of plasma and haemocytes which are 'phagocytic' in nature. Heart is anelongated tube with muscular wall lying middorsally beneath the thorax.
+ The heart consists of 13 chambers with ostiaoneitherside. The blood from the sinusesenters the heart through the ostia and is pumped an teriorlytosinuses again.



+ The triangular muscles that are responsible for blood circulation in the cockroach are called alary muscles (13 pairs). Onepair of the semuscles is found in each segmento neither side of the heart.
+ In cockroach, there is an access orypulsatile vesicleat thebase of each antenna which also pumps blood.

7. Differences between a Frog and Toad

Characters	 Frog	Toad 
Family	Ranidae	Bufonidae
Body shape	Slender	More Bulky
Legs	Longer	Shorter

Webbed feet	present	Absent
Skin	Smooth and moist skin	Dry skin covered with wart like glands.
Teeth	Maxillary and vomerine teeth.	Teeth absent.
Egg formation	Lays eggs in clusters.	Lays eggs in strings.

8. Describe the Respiratory System of Ranahexadactyla (Frog)

+ Frog respires on land and in the water by two different methods. Inwater, skin acts as aquatic respiratory organ (cutaneous respiration). Dissolved oxygen in the water gets, exchanged through thesk in by diffusion.
+ Onland, the buccalcavity, skin and lungs act as the respiratory organs. Inbuccal respiration onland, the mouth remains permanently closed while the nostrils remain open.The floor of the buccalcavity is alternate lyraised and lowered, so air is drawn in to and expelled out of the buccalcavity repeatedly through the open nostrils.
+ Respiration by lungsis called pulmonary respiration.The lungs are apair of elongated, pink coloured sac-like structures presentin the upper part of the trunk region (thorax). Airenters through the no strils into the buccalcavity and then to the lungs.
+ During a estivation and hibernation gaseous exchange take splace through skin.

9. DescribetheExcretorysystemofRanahexadactyla(Frog)

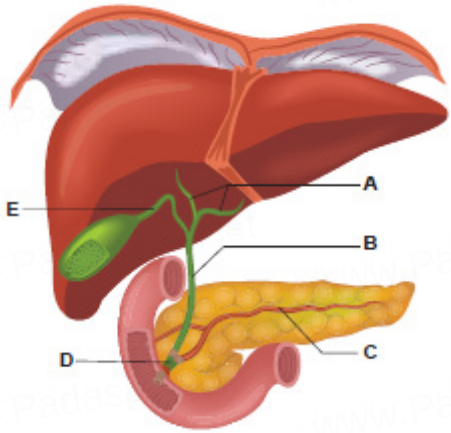
+ Elimination of nitrogenous waste and salt and water balance are performed by a well developed excretory system.
+ It consists of apair of kidneys, ureters, urinary bladder and cloaca.
+ Kidneys are dark red, long, flat organs situated on either side of the vertebral column in the body cavity. Kidneys are Mesonephric. Several nephrons are found in each kidney.

+ They separate nitrogenous waste from the blood and excreteurea, so frog sare called ureotelicorganisms.
+ Apair of uretersemerges from the kidneys and opens into the cloaca.
+ Athinwalled unpaired urinary bladder is presentventral to the rectumand opens in to the cloaca.

5 DIGESTION AND ABSORPTION

EVALUATION

1. Labelthegivendiagram.



A–Right and Lefthepaticductofliver
B–Commonbileduct
C–Pancreaticduct
D–Hepato - pancreaticduct
E–Cysticduct

ADDITIONAL

1. Describe the dentition of man.

+ Each tooth is embedded in a socket in the jawbone; thistype of attach ment is called the codont.
+ Human beings and manymammals form two sets of teeth during their life time, a set of 20 temporary milk teeth (deciduous teeth) which gets replaced by a set of 32 permanent teeth (adult teeth).

+ This type of dentition is called diphyodont.
+ The permanenttee thare of four different types (heterodont), namely, Incisors (I) chisel like cutting teeth, Canines (C) dagger shaped tearing teeth, Premolars (PM) forgrinding, and Molars (M) forgrinding and crushing.
+ Arrangement of teeth in each half of the upper and lower jaw, in the order of I, C, PM and M can be represented by a dental formula, in human the dental formula is 2123/2123.

2. Write a note on salivaryglands.

+ There are three pairs of salivaryglands in the mouth.
+ They are the largest parotidsgland in the cheeks, the sub-maxillary / sub-mandibular in the lower jawand the sublingualbeneath the tongue.
+ These glands have ducts such as Stenson's duct, Wharton's duct and Bartholin's duct or duct of Rivin is respectively.
+ Thes alivary juice secreted by the salivaryglands reaches the mouth through these ducts.
+ The daily secretion of saliva from salivaryglands ranges from 1000 to 1500 mL.

3. Write about protein energy malnutrition: (PEM)

+ Protein deficient diet during early stage of children may lead to protein energy malnutrition such as Marasmus and Kwashiorkor.
+ Symptoms are dry skin, pot-belly, oede main the legs andface, stunted growth, changes in hair colour, weakness and irritability.
+ Marasmus is anacute form of protein malnutrition.
+ Such child renaresuffer from diarrhoea, body become slean and weak (emaciated) with reduced fat and muscle tissue with thin and folded skin.

4. Describe the Histology of the Gut.

+ The wall of the alimentary canal from oesophagustorectum consists of four layers namelyserosa, muscularis, sub-mucosa and mucosa.

+ Theserosa (visceral peritoneum) is the outer mostlayerandis made up of thinsquamousepithelium with some connective tissues.
+ Muscular is ismade of smooth circular and longitudinal muscle fibres with a network of nerve cells and para sympathetic nerve fibres which control speristalsis.
+ The submucosallayeris formed of loose connective tissue containing nerves, blood, lymphvessels and the sympathetic nerve fibres that control the secretion sofintestinal juice.

5. Explainthe structure of liver.

+ The liver, the largest gland in our body issituatedinthe upper right side of the abdominalcavity, just below the diaphragm.
+ The liver consist softwomajor left and right lobes; and twominorlobes. The selobesare connected with diaphragm. Each lobehas many hepaticlobules (functional unitofliver) and is covered by athin connective tissue sheath called the Glisson's capsule.
+ Liver cells (hepatic cells) secretebile which isstoredand concentrated in a thin muscular sac called the gallbladder. The duct of gall bladder (cysticduct) along with the hepatic duct from the liver forms the common bileduct.
+ Liver has high power of regeneration and liver cell sarere placed by newones every 3-4 weeks.

6. Explain the functions of liver.

+ Destroysaging and defective blood cells.
+ Stores glucose in the form of glycogenor disperses glucose into the blood stream with the help of pancreatichormones.
+ Stores fatsoluble vitamin sandiron.
+ Detoxifies toxic substances.
+ Involves in the synthesis of non-essential a minoacidsandurea.

7. Describe the Digestion in the stomach

+ Food remains in the stomach for 4 to 5 hours, the rhythmic peristaltic movement churns and mixes the food with gastric

juice and make it in to a creamy liquid called chyme.

+ The gastric secretion is partly controlled by autonomic reflexes. The secretion of gastric juice begins when the food is in the mouth. The gastric juicec ontains HCl and proenzymes.
+ The proenzymepeps in ogen, onexposure to HCl gets converted in to the active enzymepepsin which convert sproteins into proteoses and peptones (peptides). The HCl provides an acidicmedium (pH1.8) which is optimum for pepsin, kills bacteria and other harmful organisms and avoid spetrifaction.
+ The mucus and bicarbonates present in the gastric juice playan importantrole in lubrication and protection of the mucosalepithelium from the eroding nature of the highlyacidic HCl.
+ Another proteolyticenzyme founding astric juice of in fantsisrennin helps in the digestion of milk protein, caseinogentocasein in the presence of calciumions. This enzyme secretion gradually reduces with aging.

8. Describe the Absorption and as similation of proteins, carbo hydrate sandfats.

+ Absorption is a process by which the end product of digestion passes through the in testinal mucosa into the blood and lymph.
+ The villi in the lumenofileumare the absorbing units, consisting of alactealductin the middle surrounded by fine network of blood capillaries.
+ The process of absorption involve sactive, passive and facilitated transport.
+ Small amounts of glucose, aminoacids and electrolytes like chloride ionsare generally absorbed by simple diffusion.
+ The passage of these substances into the blood depends upon concentration gradients. However, some of the substances like fructoseare absorbed with the help of the carrier ions like

Na^+. This mechanism is called facilitated transport.

+ Nutrients like a mino acids, glucose and electrolytes like Na^+ are absorbed into the blood against the concentration gradient by active transport.
+ The fatty acid sare absorbed by the lymph duct. Water soluble vitamin sare absorbed by simple diffusion or active transport.
+ Absorption of simple sugars, alcohol and medicines takes place in the stomach.
+ Certain drugs are absorbed by blood capillaries in the lower side of the tongue and mucosa of mouth.
+ Large in testineisal so involved in absorption of more amounts of water, vitamins, some minerals and certain drugs.

6 RESPIRTION

EVALUATION

1. Explain the conditions which creates problems in oxygen transport.

+ When a person travels quickly from sea level to elevations above 8000ft, where the atmospheric pressure and partial pressure of oxygen are lowered, the individual responds with symptoms of acute mountain sickness (AMS)–headache, shortness of breath, nausea and dizziness due to poor binding of O_2 with haemoglobin.
+ Diffusion of gases occurs in the alveolar region only and not in any other part of the respiratory system. Discuss.
+ In the alveolar region only, oxygen and carbon dioxide gases exchange take place.
+ Because the alveoli are lined by thin, vascularized and permeable to respiratory gases.
+ The primary site for the exchange of gases is the alveoli.

ADDITIONAL

1. Describe oxygen haemoglobin dissociation curve.

+ In the alveoli high pO_2, low pCO_2, low temperature and less H+ concentration, favours the formation of oxyhaemoglobin, whereas in the tissues low pO_2, high pCO_2, high H+ and high temperature favours the dissociation of oxygen from oxyhaemoglobin.
+ A sigmoid curve (S–shaped) is obtained when percentage saturation of haemoglobin with oxygen is plotted against pO_2.
+ This curve is called oxygen haemoglobin dissociation curve.
+ This S–shaped curve has a steep slope for pO_2 values between 10 and 50mmHg and then flattens between 70- and 100-mm Hg.

+ Under normal physiological conditions, every 100mL of oxygenated blood can deliverabout 5mL of O_2 to the tissues.

2. How is Carbon–dioxide transported?

Blood transports CO_2 from the tissue cells to the lungs in three ways

+ Dissolved in plasma About 7 – 10% of CO_2 is transported in a dissolved form in the plasma.
+ Bound to haemoglobin About 20 – 25% of dissolved CO_2 is bound and carried in the RBCs as carbamino-haemoglobin (Hb CO_2) CO_2 + Hb Hb CO_2
+ As bicarbonate ions in plasma about 70% of CO_2 is transported as bicarbonate ions.
+ This is influenced by p CO_2 and the degree of haemoglobin oxygenation.

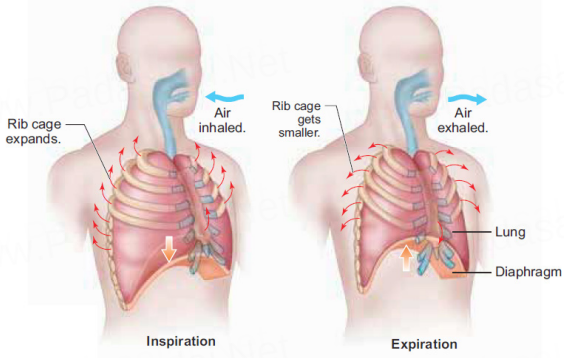
3. Explain the Human Respiratory System

+ The respiratory system includes the external nostrils, nasal cavity, the pharynx, the larynx, the trachea, the bronchi and bronchioles and the lungs which contain the alveoli. In human beings, air enters the upper respiratory tract through the external nostrils. The air passing through the nostrils is filtered by fine hairs and mucus lining the passage.
+ The external nostrils lead to the nasal chamber which opens into the nasopharynx which opens through the glottis of the larynx region into the trachea.
+ The trachea is semiflexible tube supported by multiple cartilaginous rings which extends up to the midthoracic cavity and at the level of the 5th thoracic vertebra where it divides into right and left primary bronchi, one bronchus to each lung.
+ Within the lungs the bronchi divide repeatedly into secondary and tertiary bronchi and further divides into terminal bronchioles and respiratory bronchioles.The fine respiratory bronchioles terminate into highly vascularised thin walled

+ The lungs are light spongy tissues enclosed in the thoracic cavity surrounded by an airtight space. The lungs are covered by double walled pleural membrane containing a several layers of elastic connective tissues and capillaries, which encloses the pleural fluid.

4. Explain the Mechanism of breathing

+ The movement of air between the atmosphere and the lungs is known as ventilation or breathing. Inspiration and expiration are the two phases of breathing.
+ Inspiration is the movement of atmospheric air into the lungs.
+ Expiration is the movement of alveolar air that diffuse out of the lungs.



Inspiration

+ It is initiated by the contraction of the diaphragm muscles and external intercostal muscles, which pulls the ribs and sternum upwards and outwards and increases the volume of the thoracic chamber in the dorso–ventral axis, forcing the lungs to expand the pulmonary volume.
+ The increase in pulmonary volume and decrease in the intrapulmonary pressure forces the fresh air from outside to enter the air passages into the lungs to equalize the pressure. This process is called inspiration.

Expiration

+ Relaxation of the diaphragm allows the diaphragm and sternum to return to its dome shape and the internal intercostal

muscles contract, pulling the ribs downward reducing the thoracic volume and pulmonary volume.

+ This results in an increase in the intrapulmonary pressure slightly above the atmospheric pressure causing the expulsion of air from the lungs. This process is called expiration.

5. Explain the Respiratory volumes.

+ Tidal Volume (TV) Tidal volume is the amount of air inspired or expired with each normal breath. It is approximately 500 mL., i.e. a normal human adult can inspire or expire approximately 6000 to 8000mL of air per minute. During vigorous exercise, the tidal volume is about 4–10 times higher.
+ Inspiratory Reserve volume (IRV) Additional volume of air a person can inspire by forceful inspiration is called Inspiratory Reserve Volume. The normal value is 2500–3000 mL.
+ Expiratory Reserve volume (ERV) Additional volume of air a person can forcefully exhale by forceful expiration is called Expiratory Reserve Volume. The normal value is 1000–1100 mL.
+ Residual Volume (RV) The volume of air remaining in the lungs after a forceful expiration. It is approximately 1100–1200 mL.

6. Describe the respiratory capacities.

+ Vital capacity (VC) the maximum volume of air that can be moved out during a single breath following a maximal inspiration. A person first inspires maximally then expires maximally. VC=ERV+TV+IRV
+ Inspiratory capacity (IC) The total volume of air a person can inhale after normal expiration. It includes tidal volume and inspiratory reserve volume. IC=TV+IRV
+ Expiratory capacity (EC) The total volume of air a person can exhale after normal inspiration. It includes tidal volume and expiratory reserve volume. EC=TV+ERV
+ Total Lung Capacity (TLC) The total volume of air which the lungs can accommodate after forced inspiration is called Total Lung Capacity. This includes the vital capacity and the residual volume. It is approximately 6000mL. TLC=VC+RV

+ Minute Respiratory Volume The amount of air that moves into the respiratory passage per minute is called minute respiratory volume.
+ Normal TV = 500mL; Normal respiratory rate = 12 times/ minute
+ Therefore, minute respiratory volume = 6 Litres/minute (for a normal healthy man).

7. Explain the various disorders of the Respiratory system

+ **Asthma** – It is characterized by narrowing and inflammation of bronchi and bronchioles and difficulty in breathing.
+ Common allergens for asthma are dust, drugs, pollen grains, certain food items like fish, prawn and certain fruits etc.
+ **Emphysema**– Emphysema is chronic breathlessness caused by gradual breakdown of the thin walls of the alveoli decreasing the total surface area of a gaseous exchange. i.e., widening of the alveoli is called emphysema.
+ The major cause for this disease is cigarette smoking, which reduces the respiratory surface of the alveolar walls.
+ **Bronchitis**– The bronchi when it gets inflated due to pollution smoke and cigarette smoking, causes bronchitis.
+ The symptoms are cough, shortness of breath and sputum in the lungs.
+ **Pneumonia**– Inflammation of the lungs due to infection caused by bacteria or virus is called pneumonia.
+ The common symptoms are sputum production, nasal congestion, shortness of breath, sore throat, etc.
+ **Tuberculosis**– Tuberculosis is caused by Mycobacterium tuberculae.
+ This infection mainly occurs in the lungs and bones.
+ Collection of fluid between the lungs and the chest wall is the main complication of this disease.

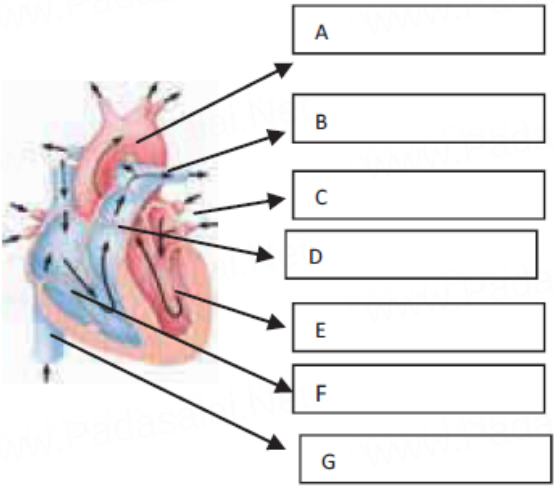
7 BODY FLUIDS AND CIRCULATION

EVALUATION

1. Select the correct biological term: Lymphocytes, red cells, leucocytes, plasma, erythrocytes, white cells, haemoglobin, phagocyte, platelets, blood clot.

+ Disc shaped cells which are concave on both sides – **Red cells (Erythrocytes)**
+ Most of these have a large, bilobed nucleus - **Leucocytes**
+ Enable red cells to transport blood - **Haemoglobin**
+ The liquid part of the blood - **Plasma**
+ Most of them move and change shape like an amoeba. - **Leucocytes**
+ Consists of water and important dissolved substances. - **Plasma**
+ Destroyed in the liver and spleen after circulating in the blood for four months. - **Redcells**
+ The substances which gives red cells their colour. - **Haemoglobin**
+ Another name for red blood cells. -**Erythrocytes**
+ Blood that has been changed to a jelly. - **Bloodclot**
+ A word that means cell eater. - **Phagocyte**
+ Cells without nucleus. -**Platelets**
+ White cells made in the lymphatic tissue. - **Lymphocytes**
+ Blocks wound and prevent excessive bleeding. - **Bloodclot**
+ Fragment of cells which are made in the bone marrow. -**Platelets**
+ Another name for white blood cells. -**Leucocytes**
+ Slowly releases oxygen to blood cells. - **Haemoglobin**
+ Their function is to help blood clot in wounds. -**Platelets**

2. Name and Label the given diagrams to show A, B, C, D, E, F, and G.



A – Aorta

B - Pulmonary artery

C - Pulmonary Veins

D - Semi Lunar Valve (DIAGRAM)

E - Left ventricle

F – Right ventricle

G - Inferior Vena Cava

3. Select the correct biological term:

Cardiac muscle, atria, tricuspid systole, auricles, arteries, diastole, ventricles,bicuspid valve, pulmonary artery, cardiac cycle, semi lunar valve, veins, pulmonary vein, capillaries, vena cava, aorta.

+ The main artery of the blood. - **Aorta**
+ Valves between the left atrium and ventricle. - **Bic**uspidvalve
+ Technical name for relaxation of the heart. -**Diastole**
+ Another name for atria. - **Auricle**

+ The main vein. - **Venacava**
+ Vessels which carry blood away from the heart. - **Aorta**
+ Two names for the upper chambers of the heart. - **Auricles**
+ Thick walled chambers of the heart. - **Ventricles**
+ Carries blood from the heart to the lungs. - **Pulmonaryartery**
+ Takes about 0.8 sec to complete. - **Cardiaccycle**
+ Valves situated at the point where blood flows out of the heart. –**Semilunarvalves**
+ Vessels which carry blood towards the heart. - **Veins**
+ Carries blood from the lungs to the heart. - **Pulmonaryvein**
+ The two lower chambers of the heart. - **Ventricles**
+ Prevent blood from re entering the ventricles after entering the aorta.-**Semilunarvalve**
+ Technical name for one heart beat. - **Cardiaccycle**
+ Valves between right atrium and ventricles. - **Tricuspidvalve**
+ Technical name for contraction of the heart. -**Systole**
+ Very narrow blood vessels. - **Capillaries**

ADDITIONAL

1. Explain about the plasma of Composition of Blood.

+ Plasma mainly consists of water (80- 92%) in which the plasma proteins, inorganic constituents (0.9%), organic constituents (0.1%) and respiratory gases are dissolved.
+ The four main types of plasma proteins synthesized in the liver are albumin, globulin, prothrombin and fibrinogen. Albumin maintains the osmotic pressure of the blood.
+ Globulin facilitates the transport of ions, hormones, lipids and assists in immune function. Both Prothrombin and Fibrinogenare involved in blood clotting.
+ Organicconstituents include urea, amino acids, glucose, fats and vitamins; and the inorganicconstituents include chlorides, carbonates and phosphates of potassium, sodium, calcium

and magnesium.

+ The composition of plasma is not always constant. Immediately after a meal, the blood in the hepatic portal vein has a very high concentration of glucose as it is transporting glucose from the intestine to the liver where it is stored.
+ The concentration of the glucose in the blood gradually falls after sometime as most of the glucose is absorbed. If too much of protein is consumed, the body cannot store the excess amino acids formed from the digestion of proteins.
+ The liver breaks down the excess amino acids and produces urea. Blood in the hepatic vein has a high concentration of urea than the blood in other vessels namely, hepatic portal vein and hepatic artery.

2. Explain the Blood groups

+ Commonly two types of blood groupings are done. They are ABO and Rh which are widely used all over the world.
+ ABO blood grouping
+ Depending on the presence or absence of surface antigens on the RBCs, blood group in individual belongs to four different types namely, A, B, AB and O. The plasma of A, B and O individuals have natural antibodies (agglutinins) in them.
+ Surface antigens are called agglutinogens. The antibodies (agglutinin) acting on agglutinogen A is called anti A and the agglutinin acting on agglutinogen B is called anti B.
+ Agglutinogens are absent in O blood group. Agglutinogens A and B are present in AB blood group and do not contain anti A and anti B in them.
+ Distribution of antigens and antibodies in blood groups are shown in Table
+ A, B and O are major allelic genes in ABO systems. All agglutinogens contain sucrose, D-galactose, N-acetyl glucosamine and 11 terminal amino acids.
+ The attachments of the terminal amino acids are dependent on the gene products of A and B. The reaction is catalysed

by glycosyl transferase.

Blood group	Agglutinogens (antigens) on the RBC	Agglutinin (antibodies) in the plasma
A	A	Anti B
B	B	Anti A
AB	AB	No antibodies
O	No antigens	Anti A and Anti B

3. Explain about the Rh factor.

+ Rh factor is a protein (D antigen) present on the surface of the red blood cells in majority (80%) of humans. This protein is similar to the protein present in Rhesus monkey, hence the term Rh.
+ Individuals who carry the antigen D on the surface of the red blood cells are Rh1 (Rh positive) and the individuals who do not carry antigen D, are Rh2 (Rh negative).
+ Rh factor compatibility is also checked before blood transfusion. When a pregnant women is Rh2 and the foetus is Rh1 incompatibility (mismatch) is observed.
+ During the first pregnancy, the Rh2 antigens of the foetus does not get exposed to the mother's blood as both their blood are separated by placenta. However, small amount of the foetal antigen becomes exposed to the mother's blood during the birth of the first child.
+ The mother's blood starts to synthesize D antibodies. But during subsequent pregnancies the Rh antibodies from the mother (Rh2) enters the foetal circulation and destroys the foetal RBCs.
+ This becomes fatal to the foetus because the child suffers from anaemia and jaundice. This condition is called erythroblastosis foetalis.
+ This condition can be avoided by administration of anti D antibodies (Rhocum) to the mother immediately after the first child birth.

4. Explain Erythroblastosisfoetalis.

+ During the first pregnancy, the Rh2 antigens of the foetus does not get exposed to the mother's blood as both their blood are separated by placenta.
+ However, smallamountofthefoetalantigen becomes exposed to the mother's blood during the birth of the first child.
+ The mother's blood starts to synthesizeD antibodies.
+ But during subsequent pregnancies the Rhanti bodies from the mother (Rh2) enters the foetal circulation and destroys the foetal RBCs.
+ This becomes fatal to the foetus because the child suffers from anaemia and jaundice.
+ This condition is called erythroblastosisfoetalis.

5. Explain the Coagulation of blood

+ If you cut your finger or when you get yourself hurt, your wound bleeds for some time after which it stops to bleed.
+ This is because the blood clots or coagulates in response to trauma. The mechanism by which excessive blood loss is prevented by the formation of clot is called blood coagulation or clotting of blood. Schematic representation of blood coagulation is shown.
+ The clotting process begins when the endothelium of the blood vessel is damaged and the connective tissue in its wall is exposed to the blood.
+ Platelets adhere to collagen fibres in the connective tissue and release substances that form the platelet plug which provides emergency protection against blood loss.
+ Clotting factors released from the clumped platelets or damaged cells mix with clotting factors in the plasma.
+ The protein called prothrombin is converted to its active form called thrombin in the presence of calcium and vitamin K. Thrombin helps in the conversion of fibrinogen to fibrin threads.

+ The threads of fibrins become interlinked into a patch that traps blood cell and seals the injured vessel until the wound is healed. After sometime fibrin fibrils contract, squeezing out a straw-
+ coloured fluid through a meshwork called serum (Plasma without fibrinogen is called serum). Heparin is an anticoagulant produced in small quantities by mast cells of connective tissue which prevents coagulation in small blood vessels.

6. Explain the Origin and conduction of heart beat.

+ The heart in human is myogenic (cardiomyocytes can produce spontaneous rhythmic depolarisation that initiates contractions). The sequence of electrical conduction of heart is shown.
+ The cardiac cells with fastest rhythm are called the Pacemaker cells, since they determine the contraction rate of the entire heart. These cells are located in the right sinuatrial (SA) node/ Pacemaker.
+ On the left side of the right atrium is a node called auriculo ventricular node (AV node). Two special cardiac muscle fibres originate from the auriculo ventricular node and are called the bundle of His which runs down into the interventricular septum and the fibres spread into the ventricles. These fibres are called the Purkinje fibres.
+ Pacemaker cells produce excitation through depolarisation of their cell membrane. Early depolarisation is slow and takes place by sodium influx and reduction in potassium efflux.
+ Minimum potential is required to activate voltage gated calcium (Ca+) channels that causes rapid depolarisation which results in action potential. The pace maker cells repolarise slowly via K1 efflux.

7. Describe Cardiac Cycle.

+ The events that occur at the beginning of heart beat and lasts until the beginning of next beat is called cardiac cycle. It lasts for 0.8 seconds.

+ The series of events that takes place in a cardiac cycle.
+ PHASE 1: Ventricular diastole- The pressure in the auricles increases than that of the ventricular pressure. AV valves are open while the semi lunar valves are closed. Blood flows from the auricles into the ventricles passively.
+ PHASE 2: Atrial systole - The atria contracts while the ventricles are still relaxed.
+ The contraction of the auricles pushes maximum volume of blood to the ventricles until they reach the end diastolic volume (EDV).
+ EDV is related to the length of the cardiac muscle fibre. More the muscle is stretched, greater the EDV and the stroke volume.
+ PHASE 3: Ventricular systole (isovolumetric contraction) - The ventricular contraction forces the AV valves to close and increases the pressure inside the ventricles.
+ The blood is then pumped from the ventricles into the aorta without change in the size of the muscle fibre length and ventricular chamber volume (isovolumetric contraction).
+ PHASE 4: Ventricular systole (ventricular ejection) - Increased ventricular pressure forces the semilunar valves to open and blood is ejected out of the ventricles without backflow of blood. This point is the end of systolic volume (ESV).
+ PHASE 5: (Ventricular diastole) -The ventricles begins to relax, pressure in the arteries exceeds ventricular pressure, resulting in the closure of the semilunar valves.
+ The heart returns to phase 1 of the cardiac cycle.

8. Describe Electrocardiogram (ECG).

+ An electrocardiogram (ECG) records the electrical activity of the heart over a period of time using electrodes placed on the skin, arms, legs and chest.
+ It records the changes in electrical potential across the heart during one cardiac cycle. The special flap of muscle which initiates the heart beat is called as sinu-auricular node or SA

node in the right atrium.

+ It spreads as a wave of contraction in the heart. The waves of the ECG are due to depolarization and not due to contraction of the heart.
+ This wave of depolarisation occurs before the beginning of contraction of the cardiac muscle.
+ A normal ECG shows 3 waves designated as P wave, QRS complex and T wave as shown in and the stages of the ECG graph are shown.
+ P Wave (atrial depolarisation)
+ It is a small upward wave and indicates the depolarisation of the atria.
+ This is the time taken for the excitation to spread through atria from SA node.
+ Contraction of both atria lasts for around 0.8-1.0 sec.
+ PQ Interval (AV node delay)
+ It is the onset of P wave to the onset of QRS complex. This is from the start of depolarisation of the atria to the beginning of ventricular depolarisation.
+ It is the time taken for the impulse to travel from the atria to the ventricles (0.12-0.21sec).
+ It is the measure of AV conduction time.
+ RS Complex (ventricular depolarisation)
+ No separate wave for atrial depolarisation in the ECG is visible.
+ A trial depolarisation occurs simultaneously with the ventricular depolarisation.
+ The normal QRS complex lasts for 0.06-0.09 sec. QRS complex is shorter than the P wave, because depolarisation spreads through the Purkinjiefibres.
+ Prolonged QRS wave indicates delayed conduction through the ventricle, often caused due to ventricular hypertrophy or due to a block in the branches of the bundle of His.
+ ST Segment

+ It lies between the QRS complex and T wave. It is the time during which all regions of the ventricles are completely depolarised and reflects the long plateau phase before repolarisation.
+ In the heart muscle, the prolonged depolarisation is due to retardation of K+ efflux and is responsible for the plateau.
+ The ST segment lasts for 0.09 sec.
+ T wave (ventricular depolarisation)
+ It represents ventricular depolarisation.
+ The duration of the T wave is longer than QRS complex because repolarisation takes place simultaneously throughout the ventricular depolarisation.

9. Explain about the Myocardial infarction (Heart failure).

+ The prime defect in heart failure is a decrease in cardiac muscle contractility.
+ The Frank- Starling curve shifts downwards and towards the right such that for a given EDV, a failing heart pumps out a smaller stroke volume than a normal healthy heart.
+ When the blood supply to the heart muscle or myocardium is remarkably reduced it leads to death of the muscle fibres.
+ This condition is called heart attack or myocardial infarction. The blood clot or thrombosis blocks the blood supply to the heart and weakens the muscle fibres.
+ It is also called Ischemic heart disease due to lack of oxygen supply to the heart muscles.
+ If this persists it leads to chest pain or angina. Prolonged angina leads to death of the heart muscle resulting in heart failure.

8 EXCRETION

EVALUATION

1. Identify the following structures and explain their significance in renal physiology?

(a) juxtaglomerular apparatus
(b) podocytes
(c) sphincters in the bladder
(d) renal cortex

a. Juxtaglomerular apparatus

+ Juxtaglomerular apparatus is a region where the distal tubule passes between the afferent and efferent arterioles.
+ This area of contact mediates tubule-glomerular feedback.
+ It regulates blood pressure and the filtration rate of the glomerulus.

b. Podocytes

+ The external parietal layer of the Bowman's capsule is made up of simple squamous epithelium and the visceral layer is made of epithelial cells called podocytes.
+ It plays an important role in glomerular function.

c. Sphincters in the bladder

+ Internal sphincter is smooth muscle within bladder that is passively contracted, controlled by parasympathetic neurons; external sphincter is skeletal muscle controlled by motor neurons, contracted by tonic stimulation.
+ They inhibit the release of urine.
+ They are under involuntary control.

d. Renal cortex

+ Renal cortex is the outer layer of the kidney that contains the nephron unitsultrafiltration occurs.
+ Erythropoietin is produced in the renal cortex.

2. Match each of the following substances with its mode of transportation in proximal tubular reabsorption.

a. Na^+- simple diffusion	b. Glucose - primary active transport
c. Urea - indirect active transport	d. Plasma - paracellular movement
e. proteins - facilitated diffusion	f. Water – endocytosis

Answer

a. Na^+-primary active transport	b. Glucose -indirect active transport
c. Urea – simple diffusion	d. Plasma –facilitated diffusion
e. proteins –endocytosis	f. Water – paracellular movement

3. Match the following terms.

a. α-receptor	- Afferent arteriole
b. Autoregulation	- Basal lamina
c. Bowman's capsule	- Capillary blood pressure
d. Capsule fluidpressure	- Colloid osmotic pressure
e. Glomerulus	- Gfr
f. Podocyte	- JG cells
g. Vasoconstriction	- Plasma proteins
	- Norepinepherine

Answer

a. α-receptor	-Capillary blood pressure
b. Autoregulation	-Gfr
c. Bowman's capsule	-Afferent arteriole
d. Capsule fluid pressure	- Plasma proteins
e. Glomerulus	-Colloid osmotic pressure
f. Podocyte	-Basal lamina
g. Vasoconstriction	- JG cells

1. Identify the biological term - Excretion, glomerulus, urinary bladder, glomerular filtrate, ureters, urine, Bowman's capsule, urinary system, reabsorption, micturition, osmosis, proteins.

a. A liquid which gathers in the bladder. **Urine**
b. Produced when blood is filtered in a Bowman's capsule. **Glomerular filtrate**
c. Temporary storage of urine. **Urinary Bladder**
d. A ball of inter twined capillaries. **Glomerulus**
e. Removal of unwanted substances from the body. **Excretion**
f. Each contains a glomerulus. **Bowman's capsule**
g. Carry urine from the kidneys to the bladder. **Ureter**
h. Scientific term for urination. **Micturition**
i. Regulation of water and dissolved substances in blood and tissue fluid. **Osmosis**
j. Consists of the kidneys, ureters and bladder. **Urinary system**
k. Removal of useful substances from glomerular filtrate. **Reabsorption**
l. What solute the blood contains that are not present in the glomerular filtrate? **Protein**

2. How are the kidneys involved in controlling blood volume? How is the volume of blood in the body related to arterial pressure?

+ Juxta glomerular apparatus (JGA) is a specialized tissue in the afferent arteriole of the nephron that consists of macula densa and granular cells.
+ The macula densa cells sense distal tubular flow and affect afferent arteriole diameter, whereas the granular cells secrete an enzyme called renin.
+ A fall in glomerular blood flow, glomerular blood pressure and glomerular filtration rate, can activate JG cells to release renin which converts a plasma protein, angiotensinogen (synthesized in the liver) to angiotensin

✍ Angiotensin converting enzyme (ACH) converts angiotensin I to angiotensin.

✍ Angiotensin II stimulates Na^+ reabsorption in the proximal convoluted tubule by vasoconstriction of the blood vessels and increases the glomerular blood pressure.

+ Angiotensin II acts at different sites such as heart, kidney, brain, adrenal cortex and blood vessels.
+ It stimulates adrenal cortex to secrete aldosterone that causes reabsorption of Na1, K1 excretion and absorption of water from the distal convoluted tubule and collecting duct.
+ This increases the glomerular blood pressure and glomerular filtration rate.
+ This complex mechanism is generally known as Renin-Angiotensin- Aldosterone System (RAAS).

3. What is the function of anti-diuretic hormone? Where is it produced and what stimuli increases or decreases its secretion?

+ When there is excessive loss of fluid from the body or when there is an increase in the blood pressure, the osmoreceptors of the hypothalamus respond by stimulating the neurohypophysis to secrete the antidiuretic hormone (ADH) or vasopressin.
+ ADH facilitates reabsorption of water by increasing the number of aquaporins on the cell surface membrane of the distal convoluted tubule and collecting duct.
+ ADH is produced in the neurohypophysis.

4. What is tubular secretion? Name the substances secreted through the renal tubules

+ Tubular secretion is the passage of waste material from the blood to the filtrate in the nephron.
+ Substances secreted through the renal tubules:- H^+, K^+, NH_4^+, uric acid, bicarbonate, creatinine and organic acids.

5. Explain the heart's role in secreting a hormone that regulates renal function? What hormone is this?

Atrial natriuretic peptide is a polypeptide hormone released by atrial myocytes (muscle cells) from the granules of the atria of

the heart in response to high blood pressure, hypervolemia and exercise. It is involved in the homeostatic control of body water and sodium.

ADDITIONAL

1. Describe the internal structure of kidney

+ The longitudinal section of kidney shows, an outer cortex, inner medulla and pelvis.
+ The medulla is divided into a few conical tissue masses called medullary pyramids or renal pyramids.
+ The part of cortex that extends in between the medullary pyramids is the renal columns of Bertini.
+ The centre of the inner concave surface of the kidney has a notch called the renal hilum, through which ureter, blood vessels and nerves innervate.
+ Inner to the hilum is a broad funnel shaped space called the renal pelvis with projection called calyces.
+ The renal pelvis is continuous with the ureter once it leaves the hilum.
+ The walls of the calyces, pelvis and ureter have smooth muscles which contracts rhythmically.
+ The calyces collect the urine and empties into the ureter, which is stored in the urinary bladder temporarily.
+ The urinary bladder opens into the urethra through which urine is expelled out.

2. Write a short note on Micturition.

+ The process of release of urine from the bladder is called micturition or urination.
+ Urine formed by the nephrons is ultimately carried to the urinary bladder where it is stored till it receives a voluntary signal from the central nervous system.
+ The stretch receptors present in the urinary bladder are stimulated when it gets filled with urine.

+ Stretching of the urinary bladder stimulates the CNS via the sensory neurons of the parasympathetic nervous system and brings about contraction of the bladder.
+ Simultaneously, somatic motor neurons induce the sphincters to close.
+ Smooth muscles contracts resulting in the opening of the internal sphincters passively and relaxing the external sphincter.
+ When the stimulatory and inhibitory controls exceed the threshold, the sphincter opens and the urine is expelled out.
+ An adult human on an average excretes 1 to 1.5L of urine per day.

3. Explain the role of other organs in excretion.

+ Apart from kidneys, organs such as lungs, liver and skin help to remove wastes.
+ Our lungs remove large quantities of carbon dioxide (18 l/ day) and significant quantities of water every day.
+ Liver secretes bile containing substances like, bilirubin and biliverdin, cholesterol, steroid hormones, vitamins and drugs which are excreted out along with the digestive wastes.
+ Sweat and sebaceous glands in the skin eliminate certain wastes through their secretions.
+ Sweat produced by the sweat 8.6 Role of other organs in excretion Apart from kidneys, organs such as lungs, liver and skin help to remove wastes.
+ Our lungs remove large quantities of carbon dioxide (18 l/ day) and significant quantities of water every day.
+ Liver secretes bile containing substances like, bilirubin and biliverdin, cholesterol, steroid hormones, vitamins and drugs which are excreted out along with the digestive wastes.
+ Sweat and sebaceous glands in the skin eliminate certain wastes through their secretions.
+ Sweat produced by the sweat glands primarily helps to cool the

body and secondarily excretes Na^+ and Cl_2, small quantities of urea and lactate.

+ Sebaceous glands eliminate certain substances like sterols, hydrocarbons and waxes through sebum that provides a protective oily covering for the skin.
+ Small quantities of nitrogenous wastes are also excreted through saliva.

4. Write a short note on Haemodialysis.

+ Malfunction of the kidneys can lead to accumulation of urea and other toxic substances, leading to kidney failure.
+ In such patient's toxic urea can be removed from the blood by a process called haemodialysis.
+ A dialyzing machine or an artificial kidney is connected to the patient's body.
+ A dialyzing machine consists of a long cellulose tube surrounded by the dialysing fluid in a water bath.
+ The patient's blood is drawn from a convenient artery and pumped into the dialysing unit after adding an anticoagulant like heparin.
+ The tiny pores in the dialysis tube allows small molecules such as glucose, salts and urea to enter into the water bath, whereas blood cells and protein molecules do not enter these pores.
+ This stage is similar to the filtration process in the glomerulus.
+ The dialysing liquid in the water bath consists of solution of salt and sugar in correct proportion in order to prevent loss of glucose and essential salts from the blood.
+ The cleared blood is then pumped back to the body through a vein.

9 LOCOMOTION AND MOVEMENT

EVALUATION

1. Explain the sliding- filament theory of muscle contraction.

+ Sliding filament theory in 1954, Andrew F. Huxley and Rolf Niedergerke proposed the sliding-filament theory to explain muscle contraction.
+ According to this theory, overlapping actin and myosin filaments of fixed length slide past one another in an energy requiring process, resulting in muscle contraction.
+ The contraction of muscle fibre is a remarkable process that helps in creating a force to move or to resist a load.
+ The force which is created by the contracting muscle is called muscle tension.
+ The load is a weight or force that opposes contraction of a muscle.
+ Contraction is the creation of tension in the muscle which is an active process and relaxation is the release of tension created by contraction.
+ Muscle contraction is initiated by a nerve impulse sents by the central nervous system (CNS) through a motor neuron.
+ When nerve impulse reaches a neuromuscular junction, acetylcholine is released.
+ It initiates the opening of multiple gated channels in sarcolemma.
+ The action potential travels along the T-tubules and triggers the release of calcium ions from the sarcoplasmic reticulum.
+ The released calcium ions bind to troponin on thin filaments.
+ The tropomyosin uncovers the myosin-binding sites on thin filaments.

+ Now the active sites are exposed to the heads of myosin to form a cross-bridge.
+ During cross-bridge formation, actin and myosin form a protein complex called actomyosin.
+ Utilizing the energy released from hydrolysis of ATP, the myosin head rotates until it forms a 90° angle with the long axis of the filament.
+ In this position myosin binds to an actin and activates a contraction – relaxation cycle which is followed by a power stroke.
+ The power stroke (cross-bridge tilting) begins after the myosin head and hinge region tilt from a 90° angle to a 45° angle.
+ The cross-bridge transforms into strong, high-force bond which allows the myosin head to swivel.
+ When the myosin head swivels it pulls the attached actin filament towards the centre of the A-band.
+ The myosin returns back to its relaxed state and releases ADP and phosphate ion.
+ A new ATP molecule then binds to the head of the myosin and the cross-bridge is broken.
+ At the end of each power stroke, each myosin head detaches from actin, then swivels back and binds to a new actin molecule to start another contraction cycle.
+ This movement is similar to the motion of an oar on a boat.
+ At the end of each power stroke, each myosin head detaches from actin, then swivels back and binds to a new actin molecule to start another contraction cycle.
+ The power stroke repeats many times until a muscle fibre contracts.
+ The myosin heads bind, push and release actin molecules over and over as the thin filaments move toward the centre of the sarcomere.
+ The repeatedly formation of cross-bridge cycles cause the sliding of the filaments only but there is no change in the lengths of either the thick or thin filaments.

+ The Z- discs attached to the actin filaments are also pulled inwards from both the sides, causing the shortening of the sarcomere (i.e. contraction).
+ This process continues as long as the muscle receives the stimuli and a steady flow of calcium ions.
+ When motor impulse stops, the calcium ions are pumped back into the sarcoplasmic reticulum, results in the masking of the active sites of the actin filaments.
+ The myosin head fails to bind with the active sites of actin and these changes cause the return of Z- discs back to their original position, i.e. relaxation.

2. What are the benefits of regular exercise?

+ The muscles used in exercise grow larger and stronger.
+ The resting heart rate goes down.
+ More enzymes are synthesized in the muscle fibre.
+ Ligaments and tendons become stronger.
+ Joints become more flexible.
+ Protection from heart attack.
+ Influences hormonal activity.
+ Improves cognitive functions.
+ Prevents Obesity.
+ Promotes confidence, esteem.
+ Aesthetically better with good physique.
+ Over all well-being with good quality of life.
+ Prevents depression, stress and anxiety.

ADDITIONAL

1. Describe the Types of movement.

+ **Amoeboid movement** –Cells such as macrophages exhibit amoeboid movement for engulfing pathogens by pseudopodia formed by the streaming movement of the cytoplasm.

+ **Ciliary movement** –This type of movement occurs in the respiratory passages and genital tracts which are lined by ciliated epithelial cells.
+ **Flagellar movement** –This type of movement occurs in the cells which are having flagella or whip-like motile organelle. The sperm cells show flagellar movement.
+ **Muscular movement** - The movement of hands, legs, jaws, tongue are caused by the contraction and relaxation of the muscle which is termed as the muscular movement.

2. Describe the Structure of a skeletal muscle fibre.

+ Each muscle fibre is thin and elongated. Most of them taper at one or both ends.
+ Muscle fibre has multiple oval nuclei just beneath its plasma membrane or sarcolemma.
+ The cytoplasm of the muscle fibre is called the sarcoplasm.
+ It contains glycosomes, myoglobin and sarcoplasmic reticulum.
+ Myoglobin is a red- coloured respiratory pigment of the muscle fibre.
+ It is similar to haemoglobin and contains iron group that has affinity towards oxygen and serves as the reservoir of oxygen.
+ Glycosomes are the granules of stored glycogen that provide glucose during the period of muscle fibre activity.
+ Actin and myosin are muscle proteins present in the muscle fibre.
+ Along the length of each myofibril there are a repeated series of dark and light bands.
+ The dark A-bands (Anisotropic bands) and the light I-bands (Isotropic bands) are perfectly aligned with one another.
+ This type of arrangement gives the cell a striated appearance.
+ Each dark band has a lighter region in its middle called the H-Zone (H-helles, meaning clear).
+ Each H-zone is bisected vertically by a dark line called the M-line (M-for middle).

+ The light I-bands also have a darker mid line area called the Z–disc (from the German "Zwischenscheibe" the disc inbetween the I-bands).
+ The myofibrils contain the contractile element, the sarcomere which is the functional unit of the skeletal muscle.
+ A Sarcomere is the region of a myofibril between two successive Z-discs.
+ It contains an A-band with a half I-band at each end. Inside the sarcomere two types of filaments are present namely the thick and thin filaments.
+ The thick filaments extend the entire length of the A-band, the thin filaments extend across the I-band and partly into the A-band.
+ The invagination of the sarcolemma forms transverse tubules (T–tubules) and they penetrate into the junction between the A and I-bands.

3. Describe the Types of skeletal muscle contraction

+ There are two primary types of muscle contractions - isotonic contraction and isometric contraction.
+ The types of contractions depend on the changes in the length and tension of the muscle fibres at the time of its contraction.

Isotonic contraction (iso- same, ton-weight/resistance)

+ In isotonic contraction the length of the muscle changes but the tension remains constant.
+ Here, the force produced is unchanged. Example: lifting dumbbells and weightlifting.

Isometric contraction (iso- same, metric-distance)

+ In isometric contraction the length of the muscle does not change but the tension of the muscle changes.
+ Here, the force produced is changed.
+ Example: pushing against a wall, holding a heavy bag.

4. List out the Functions of skeletal system

+ Support –It forms a rigid framework and supports the weight of the body against gravity.
+ Shape - It provides and maintains the shape of the body.
+ Protection – It protects the delicate internal organs of the body.
+ Acts as reservoir – It stores minerals such as calcium and phosphate. Fat (Triglyceride) is stored in yellow bone marrow and represents a source of stored energy for the body.
+ Locomotion – It acts as lever along with the muscles attached to it.
+ Strength – It can withstand heavy weight and absorbs mechanical shock.
+ As a haemopoietic tissue – Red and White blood cells are produced in the bone marrow of the ribs, spongy bones of vertebrae and extremities of long bones.

5. Describe the Structure of a typical long bone

+ A typical long bone has a diaphysis, epiphyses (singular-epiphysis) and membranes.
+ A tubular diaphysis or shaft, forms the long axis of the bone.
+ It is constructed of a thick collar of compact bone that surrounds a central medullary cavity or marrow cavity.
+ The epiphyses are the bone ends. Compact bone forms the exterior of epiphyses and their interior contains spongy bone with red marrow.
+ The region where the diaphysis and epiphyses meet is called the metaphysis.
+ The external surface of the entire bone except the joint surface is covered by a double-layered membrane called the periosteum.
+ The outer fibrous layer is dense irregular connective tissue.
+ The inner osteogenic layer consists of osteoblasts (bone-forming cells) which secrete bone matrix elements and osteoclasts (bone-destroying cells).

+ In addition, there are primitive stem cells, osteogenic cells, that give rise to the osteoblasts.
+ The periosteum is richly supplied with nerve fibres, lymphatic vessels and blood vessels.
+ Internal bone surfaces are covered with a delicate connective tissue membrane called the endosteum.
+ The endosteum covers the trabeculae of spongy bone and lines the canals that pass through the compact bone.
+ It also contains both osteoblasts and osteoclasts. Between the epiphysis and diaphysis epiphyseal plate or growth plate is present.

6. Describe the Types of joints.

+ Joints are essential for all types of movements performed by the bony parts of the body.
+ The joints are points of contact between bones.
+ Sometimes they are playing a protective role in the process.
+ Force generated by the muscles are used to carry out the movement through joints which helps human functional activity of daily living and ambulation.
+ The joint acts as a fulcrum of a lever.

(i) Fibrous joints or Synarthroses:

+ They are immovable fixed joints in which no movement between the bones is possible.
+ Sutures of the flat skull bones are fibrous joints.

(ii) Cartilaginous joints or Amphiarthroses:

+ They are slightly movable joints in which the joint surfaces are separated by a cartilage and slight movement is only possible.
+ E.g., Joints of adjacent vertebrae of the vertebral column.

(iii) Synovial joints or Diarthroses joints:

+ They are freely movable joints, the articulating bones are seperated by a cavity which is filled with synovial fluid.

+ E.g.

Pivot joint	between atlas and axis
Plane/gliding joint	between the carpals
Saddle joint	between the carpal and metacarpal
Ball and socket joint	between humerus and pectoral girdle
Hinge joint	knee joint
Condyloid or Angular or Ellipsoid	joint between radius and carpal

7. Describe the disorders of skeletal system

+ Arthritis and osteoporosis are the major disorders of skeletal system.

Arthritis:

+ Arthritis is an inflammatory (or) degenerative disease that damages the joints.
+ There are several types of arthritis.

(i) Osteoarthritis:

+ The bone ends of the knees and other freely movable joints wear away as a person age.
+ The joints of knees, hip, fingers and vertebral column are affected.

(ii) Rheumatoid arthritis:

+ The synovial membranes become inflamed and there is an accumulation of fluid in the joints.
+ The joints swell and become extremely painful.
+ It can begin at any age but symptoms usually emerge before the age of fifty.

(iii) Gouty arthritis or gout:

+ Inflammation of joints due to accumulation of uric acid crystals or I nability to excrete it.
+ It gets deposited in synovial joints.

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+ Inflammation of joints due to accumulation of uric acid crystals or inability to excrete it.
+ It gets deposited in synovial joints.

Osteoporosis:

+ It occurs due to deficiency of vitamin D and hormonal imbalance.
+ The bone becomes soft and fragile. It causes rickets in children and osteomalacia in adult females.
+ It can be minimized with adequate calcium intake, vitamin D intake and regular physical activities.

10 NEURAL CONTROL AND COORDINATION

EVALUATION

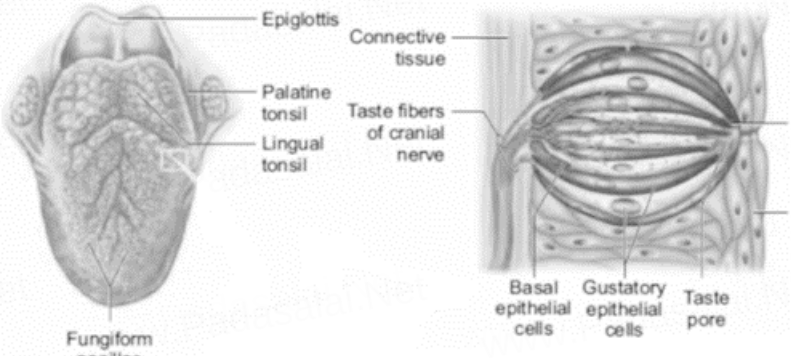
1. Name the first five cranial nerves, their nature and their functions.

Name of the cranial nerve	Nature of nerve	Function
Olfactory nerve	Sensory	Sense of smell
Optic nerve	Sensory	Sense of sight
Oculomotornerve	Motor	Movement of the eye
Trochlearnerve	Motor	Rotation of the eye ball
Trigeminalnerve	Mixed	Functioning of facial parts

2. The sense of taste is considered to be the most pleasurable of all senses.Describe the structure of the receptor involved with a diagram.

+ The sense of taste is considered to be the most pleasurable of all senses.
+ The tongue is provided with many small projections called papillae which give the tongue an abrasive feel.
+ Taste buds are located mainly on the papillae which are scattered over the entire tongue surface.
+ Most taste buds are seen on the tongue few are scattered on the soft palate, inner surface of the cheeks, pharynx and epiglottis of the larynx.
+ Taste buds are flask-shaped and consist of 50 – 100 epithelial cells of two major types Gustatory epithelial cells (taste cells) and Basal epithelial cells (Repairing cells) Long microvilli called gustatory hairs project from the tip of the gustatory cells and extends through a taste pore to the surface of the epithelium where they are bathed by saliva.

- Gustatory hairs are the sensitive portion of the gustatory cells and they have sensory dendrites which send the signal to the brain.
- The basal cells that act as stem cells, divide and differentiate into new gustatory cells



3. Describe the structures of olfactory receptors.

+ The smell receptors are excited by air borne chemicals that dissolve in fluids.
+ The yellow coloured patches of olfactory epithelium form the olfactory organs that are located on the roof of the nasal cavity.
+ The olfactory epithelium is covered by a thin coat of mucus layer below and olfactory glands bounded connective tissues, above.
+ It contains three types of cells: supporting cells, Basal cells and millions of pin shaped olfactory receptor cells (which are unusual bipolar cells).
+ The olfactory glands and the supporting cells secrete the mucus.
+ The unmyelinated axons of the olfactory receptor cells are gathered to form the filaments of olfactory nerve [cranial nerve I] which synapse with cells of olfactory bulb.
+ The impulse, through the olfactory nerves, is transmitted to the frontal lobe of the brain for identification of smell and the limbic system for the emotional responses to odour.

ADDITIONAL

1. What is Reflex action and Reflex arc. Explain them

+ When dust falls in our eyes, the eyelids close immediately not waiting for our willingness; on touching a hot pan, the hand is withdrawn rapidly.
+ Do you know how this happens?
+ The spinal cord remains as a connecting functional nervous structure in between the brain and effector organs.
+ But sometimes when a very quick response is needed, the spinal cord can effect motor initiation as the brain and brings about an effect.
+ This rapid action by spinal cord is called reflex action.
+ It is a fast, involuntary, unplanned sequence of actions that occurs in response to a particular stimulus.
+ The nervous elements involved in carrying out the reflex action constitute a reflex arc or in other words the pathway followed by a nerve impulse to produce a reflex action is called a reflex arc.

2. List out the Cranial nerves and their functions.

No.	Cranial nerves	Nature of nerve	Function
I	Olfactory nerve	Sensory	Sense of smell
II	Optic nerves	Sensory	Sense of sight
III	Oculomotor nerves	Motor	Movement of the eye
IV	Trochlear nerve	Motor	Rotation of the eye ball
V	Trigeminal nerve	Sensory and motor (mixed)	Functioning of facial parts
VI	Abducens nerve	Motor	Rotation of the eye ball
VII	Facial nerve	Mixed	Functioning of facial parts

VIII	Auditory/Vestibulocochlear nerve	Sensory	Maintains the equilibrium of the body / Auditory function
IX	Glossopharyngeal nerve	Mixed	Taste and touch
X	Vagus	Mixed	Regulation of the visceral organs
XI	Spinal accessory	Motor	Muscular movement of Pharynx, larynx, neck and shoulder
XII	Hypoglossal	Motor	Speech and swallowing

3. Differentiate between sympathetic and parasympathetic neural system

SYMPATHETIC NEURAL SYSTEM (SNS)	PARASYMPATHETIC NEURAL SYSTEM (PNS)
SNS originates in the thoracic and lumbar region of the spinal cord.	PNS originates in the cranial region of the brain and the sacral region of the spinal cord.
Sympathetic ganglia are linked up to form a chain.	Its ganglia remain isolated.
Preganglionic fibres are short and the postganglionic fibres are long.	Preganglionic fibres are long and the postganglionic fibres are short.
Noradrenaline is produced at the terminal ends of the postganglionic fibres at the effector organs. Hence the system is adrenergic.	Acetylcholine is produced at the terminal ends of the postganglionic fibres at the effector organs. Hence the system is cholinergic.
Active during stressful conditions preparing the body to face them.	Active during relaxing times restoring normal activity after a stress.
The overall effect is excitatory and stimulating.	The overall effect is inhibitory.
It is considered as the flight or fight system.	It is considered as 'The Rest and Digest System' or 'The Feed and Breed System'

4. Write a short on the Refractive errors of eye.

Myopia (near sightedness):

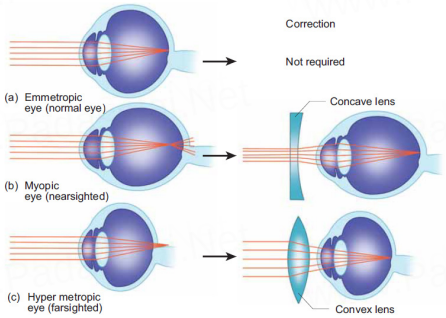
+ The affected person can see the nearby objects but not the distant objects.
+ This condition may result due to an elongated eyeball or thickened lens; so that the image of distant object is formed in front of the yellow spot.
+ This error can be corrected using concave lens that diverge the entering light rays and focuses it on the retina.

Hypermetropia (long sightedness):

+ The affected person can see only the distant objects clearly but not the objects nearby.
+ This condition results due to a shortened eyeball and thin lens; so the image of closest object is converged behind the retina.
+ This defect can be overcome by using convex lens that converge the entering light rays on the retina.

Presbyopia:

+ Due to aging, the lens loses elasticity and the power of accommodation. Convex lenses are used to correct this defect.
+ Astigmatism is due to the rough (irregular) curvature of cornea or lens. Cylindrical glasses are used to correct this error



Astigmatism

+ Due to the rough (irregular) curvature of cornea or lens.
+ Cylindrical glasses are used to correct this error.

5. Write a short on the Mechanism of hearing.

+ Sound waves entering the external auditory meatus fall on the tympanic membrane.
+ This causes the ear drum to vibrate, and these vibrations are transmitted to the oval window through the three auditory ossicles.
+ Since the tympanic membrane is 17-20 times larger than the oval window, the pressure exerted on the oval window is about 20 times more than that on the tympanic membrane.
+ This increased pressure generates pressure waves in the fluid of perilymph.
+ This pressure causes the round window to alternately bulge outward and inward meanwhile the basilar membrane along with the organ of Corti move up and down.
+ These movements of the hair alternately open and close the mechanically gated ion channels in the base of hair cells and the action potential is propagated to the brain as sound sensation through cochlear nerve.

6. Differentiate between rod and cone cells.

Rod cells	Cone cells
Rods are responsible for vision in dim light	The cones are responsible for colour vision and works best in the bright light.
The pigment present in the rods is rhodopsin, formed of a protein scotopsin and retinal (an aldehyde of vitamin A)	The pigment present in the cones is photopsin, formed of opsin protein and retinal.
There are about 120 millions rod cells	There may be 6-7 millions cone cells
Rods are predominant in the extra fovea region	Cones are concentrated in the fovea region

7. List out the sensory receptors present in the skin.

+ Tactile Merkel disc is light touch receptor lying in the deeper layer of epidermis.

+ Hair follicle receptors are light touch receptors lying around the hair follicles.
+ Meissner's corpuscles are small light pressure receptors found just beneath the epidermis in the dermal papillae. They are numerous in hairless skin areas such as finger tips and soles of the feet.
+ Pacinian corpuscles are the large egg-shaped receptors found scattered deep in the dermis and monitoring vibration due to pressure. It allows to detect different textures, temperature, hardness and pain
+ Ruffini endings which lie in the dermis responds to continuous pressure.
+ Krause end bulbs are thermoreceptors that sense temperature.

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+ Krause end bulbs are thermoreceptors that sense temperature.

11 CHEMICAL COORDINATION AND INTEGRATION

EVALUATION

1. Enumerate the role of kidney as an endocrine gland.

+ In kidneys, hormones such as renin, erythropoietin and calcitriol are secreted.
+ **Renin** is secreted by juxta glomerular cells (JGA), which increases blood pressure when angiotensin is formed in blood.
+ **Erythropoietin** is also secreted by the JGA cells of the kidney and stimulates erythropoiesis (formation of RBC) in bone marrow.
+ **Calcitriol** is sercreted by proximal tubules of nephron.
+ It is an active form of vitamin D3 which promotes calcium and phosphorus absorption from intestine and accelerates bone formation.

2. Write the causes for diabetes mellitus and diabetes insipidus.

Causes for diabetes mellitus

+ It is caused due to reduced secretion of insulin. As the result, blood glucose level is elevated.
+ Type I diabetes caused by the lack of insulin secretion due to illness or viral infections.
+ Type II diabetes caused due to reduced sensitivity to insulin, often called as insulin resistance.

Causes for diabetes insipidus

+ **Diabatesinsipidus**is caused due to hyposecretion of vasopressin (ADH) from neurohypophysis.

3. Name the layers of adrenal cortex and mention their secretions.

+ **Zonaglomerulosa** - an outer thin layer secretes mineralocorticoids.

+ **Zonafasciculata** - the middle widest layer secretes glucocorticoids such as cortisol, corticosterone and trace amounts of adrenal androgen and oestrogen.
+ **Zonareticularis** - an inner zone secretes the adrenal androgen, trace amount of oestrogen and glucocorticoids.

4. Growth hormone is important for normal growth. Justify the statement.

+ Growth hormone promotes growth of all the tissues and metabolic process of the body.
+ It influences the metabolism of carbohydrates, proteins and lipids and increases the rate of protein biosynthesis in the cells.
+ It stimulates chondrogenesis (cartilage formation), osteogenesis (bone formation) and helps in the retention of minerals like nitrogen, potassium, phosphorus, sodium etc. in the body.
+ GH increases the release of fatty acid from adipose tissue and decreases the rate of glucose utilization for energy by the cells.
+ It conserves glucose for glucose dependent tissues, such as the brain.

5. Pineal gland is an endocrine gland, write its role.

+ It maintains the normal sleep wake cycle.
+ It regulates the timing of sexual maturation of gonads.
+ It influences metabolism, pigmentation, menstrual cycle and defence mechanism of our body.

6. Comment on the functions of adrenalin.

+ Adrenalin increases liver glycogen breakdown into glucose and increases the release of fatty acids from fat cells.
+ During emergency it increases heart beat rate and blood pressure.
+ It stimulates the smooth muscles of cutaneous and visceral arteries to decrease blood flow.
+ It increases blood flow to the skeletal muscles thereby increases the metabolic rate of skeletal muscles, cardiac muscles and nervous tissue.

7. Predict the effects of removal of pancreas from the human body.

+ Pancreas is a composite gland which performs both exocrine and endocrine functions.
+ The pancreas secretes digestive enzymes and the islets of Langerhans secretes hormones like insulin and glucagon.
+ If pancreas is removed, the process of digestion will be incomplete since pancreatic enzymes play a major role in completion of digestion process in small intestine.
+ As an endocrine gland the removal of pancreas will impact the glucose level of the blood since insulin and glucagon hormones work antagonistically to maintain blood sugar level.
+ Increase or decrease in blood sugar level will lead to severe disorders and cells will not be able to get required amount of glucose from blood for their metabolic activities.

8. Hormones are known as chemical messenger. Justify.

+ Endocrine glands control and coordinate the body functions through secreting certain chemical messengers called hormones.
+ The endocrine system influences the metabolic activities by means of hormones which are chemical messengers released into the blood and circulated as chemical signals and acts specifically on certain organs or tissues called target organs or target tissues.
+ Hormones may speed up or slow down or alter the activity of the target organs.
+ Hormones are chemical messengers because they act as organic catalysts and coenzymes to perform specific functions in the target organs.
+ A single hormone may have multiple effects on a single target tissue or on different target tissues.
+ Many hormones exhibit long term changes like growth, puberty and pregnancy.
+ Hormones often influence many organs and organ systems at the same time.

+ Serious deficiency or excess secretion of hormones leads to disorders.
+ Hormones coordinate different physical, physiological, mental activities and maintain homeostasis.
+ Hormones are composed of water-soluble proteins or peptides or amines or fat-soluble steroids.

9. Briefly explain the thyroid gland.

+ The butterfly shaped thyroid gland is a bilobed gland located below the larynx on each side of upper trachea.
+ It is the largest endocrine gland in the body.
+ Its two lateral lobes are connected by a median tissue mass called isthmus.
+ Each lobe is made up of many lobules.
+ The lobules consist of follicles called acini (acinus in singular).
+ Each acinus is lined with glandular, cuboidal or squamous epithelial cells.
+ The lumen of acinus is filled with colloid, a thick glycoprotein mixture consisting of thyroglobulin molecules.

10. Write a detailed account of gastro intestinal tract hormones.

+ Group of specialized endocrine cells present in gastro-intestinal tract secretes hormones such as gastrin, cholecystokinin (CCK), secretin and gastric inhibitory peptides (GIP).
+ **Gastrin** acts on the gastric glands and stimulates the secretion of HCl and pepsinogen.
+ **Cholecystokinin (CCK)** is secreted by duodenum in response to the presence of fat and acid in the diet.It acts on the gall bladder to release bile into duodenum and stimulates the secretion of pancreatic enzymes and its discharge.
+ **Secretin** acts on acini cells of pancreas to secrete bicarbonate ions and water to neutralize the acidity.
+ **Gastric inhibitory peptide (GIP)** inhibits gastric secretion and motility.

ADDITIONAL

1. What are the functions of the Glucagon?

+ Glucagon is a polypeptide hormone.
+ It is a potent hyperglycaemic hormone that acts on the liver and promotes the breakdown of glycogen to glucose (Glygogenolysis), synthesis of glucose from lactic acid and from non-carbohydrate molecules (gluconeogenesis).
+ Releases glucose from the liver cells, increasing the blood glucose levels.
+ Since glucagon reduces the cellular uptake and utilisation of glucose it is called a hyperglycemic hormone.
+ Prolonged hyperglycemia leads to the disorder called diabetes mellitus.

2. Name the hormones of heart, kidney and gastro intestinal tract?

+ Some tissues of the heart, kidney and gastro intestinal tract acts as partial endocrine glands.
+ In the heart, cardiocytes on the atrial wall's secretes an important peptide hormone called atrial natriuretic factor (ANF).
+ When blood pressure is increased, ANF is secreted and causes dilation of the blood vessels to reduce the blood pressure.
+ In kidneys, hormones such as renin, erythropoietin and calcitriol are secreted.
+ **Renin** is secreted by juxta glomerular cells (JGA), which increases blood pressure when angiotensin is formed in blood.
+ **Erythropoietin** is also secreted by the JGA cells of the kidney and stimulates erythropoiesis (formation of RBC) in bone marrow.
+ **Calcitriol** is secreted by proximal tubules of nephron.

3. What is feedback mechanism?

+ Hormones circulate in the blood but their concentration can increase or decrease based on the requirement of the body.

+ This is controlled by feedback mechanisms.
+ These mechanisms control the secretion of endocrine glands by stimulating the hypothalamus, pituitary or both, which in turn governs the secretion of a particular hormone.
+ In positive feedback, the secretion of the hormone increases where as in negative feedback further secretion of hormone slows down.
+ Feedback mechanisms are the key factors for maintaining homeostasis in our body.

4. Write a short note on Pituitary gland or Hypophysis.

+ The pituitary gland (means to grow under) is ovoid in shape and is located in the **sellaturcica**, a bony cavity of the sphenoid bone at the base of brain and connected to the hypothalamic region of the brain by a stalk called **infundibulum**.
+ It is about one centimetre in diameter and 0.5 gm in weight.
+ The pituitary consists of two lobes, anterior glandular adenohypophysis and posterior neural neurohypophysis.
+ The anterior lobe originates from the embryonic invagination of pharyngeal epithelium called **Rathke's pouch** and the posterior lobe is originating from the base of the brain as an outgrowth of hypothalamus.
+ Anatomically the adenohypophysis has three lobes or zones namely pars intermedia, pars distalis and pars tuberalis.
+ The neurohypophysis is otherwise known as pars nervosa.
+ The anterior lobe of pituitary secretes six tropic hormones such as growth hormone (GH), thyroid stimulating hormone (TSH), adrenocorticotropic hormone (ACTH), follicle stimulating hormone (FSH), luteinizing hormone (LH), luteotropic hormone (LTH) and melanocyte stimulating hormone (MSH) (in lower animals only).
+ The posterior lobe of pituitary secretes the hormones namely vasopressin and oxytocin.

5. Write a short note on the Pineal gland

+ In human, the pineal gland or epiphysis cerebri or conarium is located behind the third ventricle of brain and is formed of parenchymal cells and interstitial cells.
+ It secretes the hormone, melatonin, which plays a central role in the regulation of circadian rhythm of our body and maintains the normal sleep wake cycle.
+ It regulates the timing of sexual maturation of gonads.
+ In addition, melatonin also influences metabolism, pigmentation, menstrual cycle and defence mechanism of our body.

6. Describe the Parathyroid gland

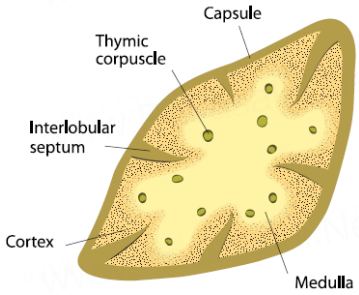
+ In human, four tiny parathyroid glands are found in the posterior wall of the thyroid glands.
+ This gland is composed of two types of cells, the chief cells and oxyphil cells.
+ The chief cells secrete parathyroid hormone (PTH) and the functions of oxyphil cells are not known.

Parathyroid hormone or Parathormone (PTH)

+ PTH is a hypercalcemic hormone.
+ It is a peptide hormone involved in controlling the calcium and phosphate homeostasis.
+ The secretion of PTH is controlled by calcium level in the blood.
+ It increases the blood calcium level by stimulating osteoclasts to dissolve the bone matrix.
+ As a result, calcium and phosphate are released into the blood.
+ PTH enhances the reabsorption of calcium and excretion of phosphates by the renal tubules and promotes activation of vitamin D to increase calcium absorption by intestinal mucosal cells.

7. Describe the Thymus gland

+ Thymus gland is partially an endocrine and partially a lymphoid organ.
+ It is a bilobed structure located just above the heart and aorta, behind the sternum.
+ It is covered by fibrous capsule and anatomically it is divisible into an outer cortex and an inner medulla.
+ It secretes four hormones such as thymulin, thymosin, thymopoietin and thymichumoral factor (THF).
+ The primary function of thymus is the production of immuno competent 'T' lymphocytes which provides cell mediated immunity.



8. What are the functions of function of adrenal hormones?

+ Glucocorticoids stimulate gluco-neogensis, lipolysis and proteolysis (the lifesaving activity).
+ Cortisol is a giuco-corticoid involved in maintaining cardio vascular and kidney functions.
+ It produces anti- inflammatory reactions and suppresses the immune response.
+ It stimulates the RBC production. It is also known as stress combat hormone.
+ Mineralocorticoids regulates water and electrolyte balance of our body.
+ Aldosterone stimulates the reabsorption of sodium and water and eliminates potassium and phosphate ions through excretion, thus it helps in maintaining electrolytes, osmotic pressure and blood pressure.
+ Adrenal androgen plays a role in hair growth in the axial region, pubis and face during puberty.

+ The adrenal medulla secretes the hormones adrenalin and noradrenalin and are referred as "3F hormone" (fight, flight and fright hormone).
+ Adrenalin increases liver glycogen breakdown into glucose and increases the release of fatty acids from fat cells.
+ During emergency it increases heart beat rate and blood pressure.
+ It stimulates the smooth muscles of cutaneous and visceral arteries to decrease blood flow.
+ It increases blood flow to the skeletal muscles thereby increases the metabolic rate of skeletal muscles, cardiac muscles and nervous tissue.

12 TRENDS IN ECONOMIC ZOOLOGY

EVALUATION

1. Animal husbandry is the science of rearing, feeding and caring, breeding and disease control of animals. It ensures supply of proper nutrition to our growing population through activities like increased production and improvement of animal products like milk, eggs, meat, honey, etc.

a. Poultry production depends upon the photoperiod. Discuss

+ Light is an important aspect of an animal's environment. Avian species as well as mammalian species respond to light energy in a variety of ways, including growth and reproductive performance. The value of regulating the photoperiod of poultry and livestock to stimulate reproduction has been recognized for many years and is used regularly by commercial poultry and livestock farmers.

b. Polyculture of fishes is of great importance.

+ Fishes proposed for polyculture should be able to live together without interfering or attacking other fishes.They should have high conversion efficiency so that they can effectively utilize the food.

2. Write the advantages of vermicomposting.

+ Vermicompost is rich in essential plant nutrients.
+ It improves soil structure texture, aeration, and water holding capacity and prevents soil erosion
+ It is a rich in nutrients and an eco-friendly amendment to soil for farming and terrace gardening.
+ It enhances seed germination and ensures good plant growth

3. What are the main duties of a worker bee?

+ During the first half of her life, she becomes a nurse bee

attending to indoor duties such as secretion of royal jelly, prepares bee-bread to feed the larvae, feeds the queen, takes care of the queen and drones, secretes bees wax, builds combs, cleans and fans the bee hive.

+ In the second half her life lasting for three weeks, she searches and gathers the pollen, nectar, propolis and water.

4. Give the economic importance of Silkworm

+ It is an economically importance insect being a commercial primary producer of silk.

5. Give the economic importance of prawn fishery

+ It is a tasty protein food.
+ Economic development can be achieved through prawn culture.
+ Prawn takes part in earning foreign currency.
+ It is much profitable to cultivate prawn in fresh water at a comparatively lower cost.

6. Give the economic importance of lac insect

+ Lac is largely used as a sealing wax and adhesive for optical instruments. It is used in electric industry, as it is a good insulator.
+ It is used in preparations of shoe and leather polishes and as a protective coating of wood.
+ It is used in laminating paper board, photographs, engraved materials and plastic molded articles.
+ Used as a filling material for gold ornaments.

7. What are the advantages of artificial insemination?

+ It increases the rate of conception
+ It avoids genital diseases
+ Semen can be collected from injured bulls which have desirable traits.
+ Superior animals located apart can be bred successfully.

8. Discuss the various techniques adopted in cattle breeding?

Inbreeding:

+ Breeding between animals of the same breed for 4-6 generations is called inbreeding.
+ It helps to restore fertility and yield.

Out breeding:

+ The breeding between unrelated animals is called outbreeding.
+ Individuals produced do not have common ancestors for 4-6 generations.
+ It helps to produce new and favourable traits, to produce hybrids with superior qualities and helps to create new breeds.

Out crossing:

+ It is the breeding between unrelated animals of the same breed but having no common ancestry, the offspring of such a cross is called outcross.
+ This method is suitable for breeding animals below average in productivity.

Cross breeding:

+ Breeding between a superior male of one breed with a superior female of another breed.
+ The cross bred progeny has superior traits (hybridvigour or heterosis.)

Interspecific hybridization:

+ In this method of breeding mating is between male and female of two different species.
+ The progeny obtained from such crosses are different from their parents, and may possess the desirable traits of the parents.

ADDITIONAL

1. List out the Advantages of Using Vermicompost

+ People are aware about benefits of organic inputs in farming.
+ Vermicompost is excellent organic manure for sustainable agro-practices.

+ So, marketing vermicompost is now a potential and flourishing industry.
+ Retail marketing of vermicompost in urban areas is most promising. Vermicompost is neatly packed in designed and printed packets for sale.
+ People of different age groups are involved in the production and selling of vermicompost.
+ Marketing of vermicompost can provide a supplementary income.
  - ✍ Vermicompost is rich in essential plant nutrients.
  - ✍ It improves soil structure texture, aeration, and water holding capacity and prevents soil erosion
  - ✍ Vermicompost is a rich in nutrients and an eco-friendly amendment to soil for farming and terrace gardening.
  - ✍ It enhances seed germination and ensures good plant growth

2. Write the different types of Silkworm

Species of silkmoth	Silk Producing States	Preferred Food (Leaves)	Type Of Silk
Bombyx mori	Karnataka, Andhra Pradesh and Tamil Nadu	Mulberry	Mulberry Silk
Antheraea assamensis	Assam, Meghalaya. Nagaland, Arunachala Pradesh and Manipur	Champa	Muga Silk
Antheraea mylitta	West Bengal, Bihar and Jharkand	Arjun	Tassar Silk
Attacus ricini	Assam, Meghalaya. Nagaland, Arunachala Pradesh and Manipur	Castor	Eri Silk

3. What are the uses of Silk

+ Silk fibers are utilized in preparing silk clothes. Silk fibers are now combined with other natural or synthetic fibers to manufacture clothes like Teri-Silk, Cot-Silk etc. Silk is dyed and printed to prepare ornamented fabrics.
+ They are generally made from Eri silk or tussar silk.

+ Silk is used in industries and for military purposes.
+ It is used in the manufacture of fishing fibers, parachutes, cartridge bags, insulation coils for telephone, wireless receivers, tires of racing cars, filter fibres, in medical dressings and as suture materials.

4. Describe the Structure of a Bee Hive

+ The house of honey bee is termed as bee hive or comb.
+ The hive consists of hexagonal cells made up of wax secreted by the abdomen of worker bees arranged in opposite rows on a common base.
+ These hives are found hanging vertically from the rocks, building or branches of trees.
+ The young stages of honey bees accommodate the lower and central cells of the hive called the brood cells.
+ In Apisdorsata, the brood cells are of similar in size and shape but in other species, brood cells are of three types viz., queen cell for queens, worker cell for workers and drone cells for drones.
+ The cells are intended for storage of honey and pollen in the upper portion of the comb whereas the lower portions are for brood rearing.

5. List out the Economic importance of Lac.

+ Lac is largely used as a sealing wax and adhesive for optical instruments.
+ It is used in electric industry, as it is a good insulator.
+ It is used in preparations of shoe and leather polishes and as a protective coating of wood.
+ It is used in laminating paper board, photographs, engraved materials and plastic moulded articles.
+ It is used as a filling material for gold ornaments.

6. List out the Advantages of Aquaponic gardening.

Water conservation:

+ No need of water discharge and recharge as the water is maintained by recycling process.

Soil:

+ Bottom soil may be loaded with freshwater.
+ Microbes in water can convert the waste materials into usable forms like ammonia into nitrates which are used by the plants.
+ Thus, the soil fertility is maintained

Pesticides:

+ n this system use of pesticides is avoided and hence it is eco-friendly.

Weeds:

+ Since the plants are cultured in confined conditions, growth of weeds is completely absent.
+ The utilization of nutrient by plants is high in this method

Artificial food for fishes:

+ In this system plant waste and decays are utilized by fishes as food.
+ So, the need for the use of supplementary feed can be minimized.

Fertilizer usage:

+ Artificial or chemical fertilizers is not required for this system since the plants in the aquaponics utilize the nutrients from the fish wastes dissolved in water Cultivable fishes like tilapia, trout, koi, gold fish, bass etc., are cultured in aquaponics.
+ Common cultivable plants like tomato, pepper, lettuce, cucumber, and rose are co-cultivated in this method.

7. Explain the Composite fish farming.

+ Few selected fishes belonging to different species are stocked together in proper proportion in a pond. This mixed farming is termed composite fish farming or polyculture.
+ The advantages include,
  - ✍ All available niches are fully utilized.
  - ✍ Compatible species do not harm each other.
  - ✍ No competition among different species is found.

✍ Catlacatla, LabeorohitaandCirrhinusmrigala (surface feeder) are the commonly used fish species for composite fish farming.

8. What are the Objectives of Animal breeding?

+ To improve growth rate
+ Enhancing the production of milk, meat. Egg etc.,
+ Increasing the quality of the animal products
+ Improved resistance to diseases
+ Increased reproductive rate

9. Describe the Multiple ovulation embryo transfer technology (MOET).

+ It is another method of propagation of animals with desirable traits.
+ This method is applied when the success rate of crossing is low even after artificial insemination.
+ In this method Follicle stimulating hormone (FSH) is administered to cows for inducing follicular maturation and super ovulation.
+ Instead of one egg per cycle, 6-8 eggs can be produced by this technology.
+ The eggs are carefully recovered non-surgically from the genetic mother and fertilized artificially.
+ The embryos at 8-32 celled stages are recovered and transferred to a surrogate mother.
+ For another round of ovulation, the same genetic mother is utilized.
+ This technology can be applied to cattle, sheep and buffaloes.
+ Advantage of this technology is to produce high milk yielding females and high-quality meat yielding bulls in a short time.

10. What are the uses of dairy products?

+ Milk products: Milk is produced by dairy animals which is an emulsion of fat and lactose.
+ Milk also contains enzymes which are destroyed during pasteurization.

+ Milk is a rich source of vitamin A, B2, B1, and deficient in Vitamin C.
+ Due to its high nutrition value, it serves as a complete food for infants.
+ Dairy products such as yoghurt, cheese, butter, ice cream, condensed milk, curd, and milk powder processed from milk make dairy, a highly farming attraction.

11. Describe the Stages involved in rearing.

+ There are some steps involved in rearing of chicken.

Selection of the best layer:

+ An active intelligent looking bird, with a bright comb, not obese should be selected.

Selection of eggs for hatching:

+ Eggs should be selected very carefully.
+ Eggs should be fertile, medium sized, dark brown shelled and freshly laid eggs are preferred for rearing.
+ Eggs should be washed, cleaned and dried.

Incubation and hatching:

+ The maintenance of newly laid eggs in optimum condition till hatching is called incubation.
+ The fully developed chick emerges out of egg after an incubation period of 21 – 22 days.
+ There are two types of incubation namely natural incubation and artificial incubation.In the natural incubation method, only a limited number of eggs can be incubated by a mother hen.
+ In artificial incubation, more number of eggs can be incubated in a chamber (Incubator).

Brooding:

+ Caring and management of young chicks for 4 – 6 weeks immediately after hatching is called brooding.

+ It can also be categorized into two types namely natural and artificial brooding.

Housing of Poultry:

+ To protect the poultry from sun, rain and predators it is necessary to provide housing to poultry.
+ Poultry house should be moisture- proof, rat proof and it should be easily cleanable and durable.

Poultry feeding:

+ The diet of chicks should contain adequate amount of water, carbohydrates, proteins, fats, vitamins and minerals.

12. What are the Benefits of Poultry farming?

+ It does not require high capital for construction and maintenance of the poultry farming.
+ It does not require a big space.
+ It ensures high return of investment within a very short period of time.
+ It provides fresh and nutritious food and has a huge global demand.
+ It provides employment opportunities for the people.

13. Describe the Duck Farming.

+ Duck is an aquatic bird and forms only 6% of our country's poultry population.
+ There are about 20 breeds of ducks.
+ The native one includes Indian Runner and Syhletmeta.
+ The exotic breeds include Muscori, Pekin, Aylesbury and Campbell.
+ Domesticated ducks have been derived from the wild duck named Mallard (Anasboscas).
+ Farming ducks is profitable as it can be combined with aquafarming practices.