KENDRIYA VIDYALAYA SANGATHAN

CHENNAI REGION

CLASS –XI

BIOLOGY

STUDY MATERIAL

2022-23

FORWARD

The student's study material is the product of an in house academic exercise undertaken by our subject teachers under the supervision of subject experts at different levels to provide the students a comprehensive learning support tool for the consolidation of your studies.

It consist of lesson concept maps, flow charts , pictorial representation of chapters , gist of lessons, competence based questions , MCQ questions , assertion and reasoning questions, case based questions, board previous years questions, practice papers and CBSE sample question papers.

The material has been developed keeping in mind the latest CBSE curriculum and question paper design. I hope this material will prove to be a good tool for quick revision and will serve the purpose of enhancing student's confidence level to help them perform better.

Planned study, hard work, good time management and sincerity will help the students to reach greater success.

BEST OF LUCK

Ms. T RUKMANI
Offg. Deputy Commissioner
KVS Chennai Region

A WORD TO MY DEAR STUDENTS

True education is about getting the best out of oneself —Mahatma Gandhi

I am delighted to release the Study Material in Biology for students, which is meticulously prepared by band of erudite Teachers of our coveted region. They have put in their experiences of classroom transactions in form of concise notes, Concept Map, compendium of questions, information tables and sets of ideal sample paper to give you all cutting edge. A good resource is best companion. It will definitely motivate you and guide you to bring best out of you.

I feel that the study material will prove equally helpful to Students and Teachers. It will cut down the preparation time for Teachers and will assist them to conduct timely assessment.

Wishing You success in Forthcoming exam & glittering career ahead.

Mr. P.I.T RAJA
Assistant Commissioner
KVS Chennai Region

ACKNOWLEDGEMENT

I, Dr. M. Manickasamy, Principal K V IIT Chennai extend my heartfelt thanks and gratitude to Ms. T. RUKMANI Offg. Deputy Commissioner, KVS Chennai Region and Mr. P.I.T RAJA Assistant Commissioner, KVS Chennai Region who have entrusted the preparation of student support material for class XI Biology.

I also extend my sincere gratitude to the Chennai region Biology teachers who have contributed to the making of student support material, which is useful for students community at different levels and also it will improve the performance the students concerned in forth coming annual exams.

I also extend my sincere thanks to Mrs. Sheeja Vinod, PGT Biology, KV CLRI, Chennai who brought the final shape for the study material with the team of teachers.

Last but not the least, I extend my in-depth gratitude to all my fellow colleagues, staff members whose contributions are inevitable to bring out this study support material.

THANK YOU ALL

Dr. M. Manickasamy
Principal
K V IIT
KVS Chennai Region

BIOLOGY STUDY MATERIAL

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CLASS 11 BIOLOGY (2022-23)

TIME : 3 HOURS **M.MARKS:70**

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	TOTAL MARKS	**70**

CHAPTERS

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UNIT-II	STRUCTURAL ORGANISATION IN PLANTS AND ANIMALS
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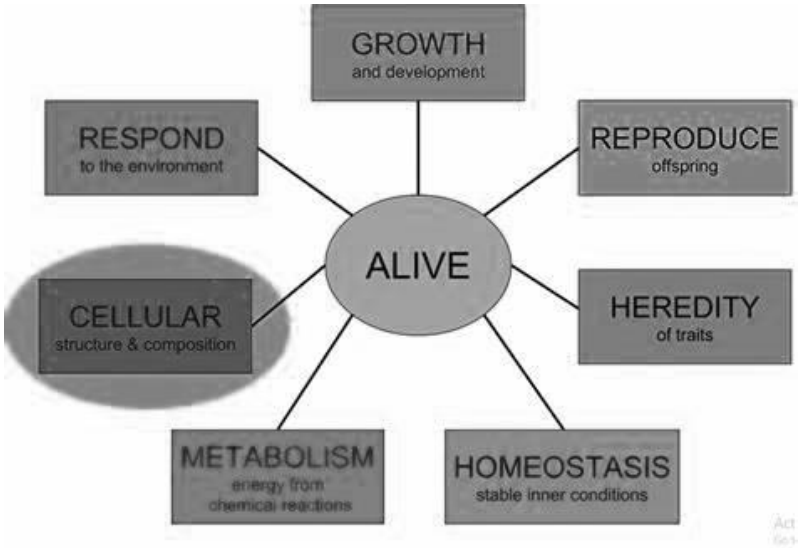
DELETED CHAPTERS

Chapter 11	Transport in Plants
Chapter 12	Mineral Nutrition
Chapter 16	Digestion and Absorbtion

CONCEPT MAP



POINTS TO REMEMBER

Characteristics of living organisms are as follows:

1. Definite shape and size
2. Organization (coordinated working of the body)
3. Cellular organisation
4. Growth and repair
5. Spontaneous movement
6. Nutrition (taking in and utilising food substances)
7. Respiration (energy released for body functions)
8. Excretion (throwing out of the body wastes)
9. Sensitivity (response tproducing young ones with similar traits)
12. Evolvability (changeabo external stimuli)
10. Maintaining internal conditions (homeostasis)
11. Reproduction (ility in future generations)
13. Life span and death

2.Two kingdom system of classification

1. The two-kingdom classification system was given by Carlous Linnaeus in 1758.
2. All organisms were placed in either the plant kingdom or the animal kingdom.
3. The animal kingdom includes unicellular protozoans and multicellular metazoans.
4. The plant kingdom includes all other organisms (prokaryotes, eukaryotes, photosynthetic plants, non-photosynthetic fungi).

3.Nomenclature of organisms

1. The scientific naming of an organism is called nomenclature.
2. The organisms are given scientific name by the International Code of Botanical Nomenclature (ICBN) and the International Code of Zoological Nomenclature (ICZN)

4.Rules of binomial nomenclature

1. Biological names are usually written in Latin. They are written in italics.
2. A biological name usually contains two terms. The first term shows the genus, while the

second term shows the species.
3. The biological name is underlined, when it is handwritten.
4. The first term of the biological name begins with a capital letter. The second and the subsequent terms begin with the small letter.

Classification

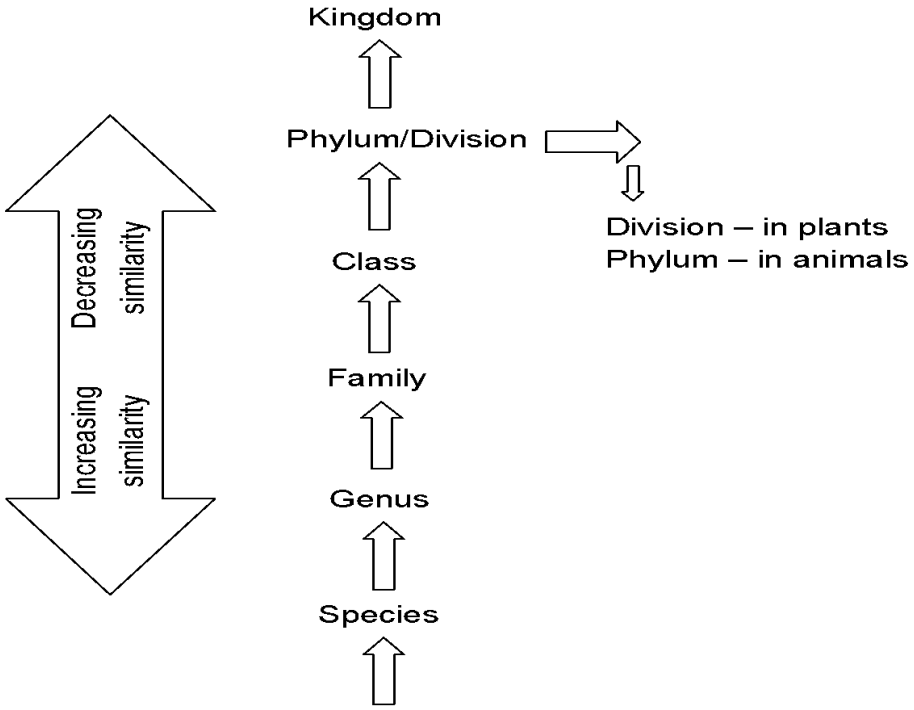
Classification is the process by which organisms are grouped into categories based on some easily observable characters.
Biological classification is the scientific arrangement of organisms in a hierarchy of groups and sub-groups on the basis of similarities and differences in their traits.
Advantages of Classification
(a) It helps to identify an organism easily.
(b) New organisms easily get correct place in their respective groups.
(c) It makes study of fossils easy.
(d) It also helps in building evolutionary features pathways.
(e) It becomes easy to know the of whole group by studying one or two organisms of the group.
Thus, based on these characteristics, all living organisms are classified into different taxa.
Nomenclature
Nomenclature is the system of naming living organism in a way that a particular organism is known by the same name all over the world

Scientific Names
A scientific name is given by biologists. These names represent a particular organism in every part of the world. The system of providing scientific names is called binomial nomenclature.
The scientific names must be
(a) acceptable in every part of the world.
(b) assigned on agreed principles and criteria.
(c) different for each species and not used for other organisms earlier.
Binomial Nomenclature
Binomial nomenclature was developed by Carolus Linnaeus in 1751 (Philosphica Botanica). All scientific names for animals under binomial nomenclature were given by Linnaeus in the tenth edition of his book Systerna Naturae (1758). Linnaeus named plants according to binomial nomenclature in his book Species Plantarum (1753). Binomial nomenclature is the system of providing distinct and appropriate names to organisms, each consisting of two words, first generic name {i.e., name of genus) and second specific epithet (i.e., name of species).
For example, Scientific name of mango is written as Mangifera indica. In this name, Mangifera represents the genus and indica is a particular species or specific epithet.
Rules of Binomial Nomenclature
Rules of binomial nomenclature were initially framed by Linnaeus in his books, Species Plantarum and Systema Naturae.
The rules framed by Linnaeus and by these codes are as follows
(i) The names are generally in Latin and written in italics. They are Latinised or derived from Latin irrespective of their origin.
(ii) The first word in a biological name represent the genus while, the second component denotes the specific epithet.
(iii) Both the words in a biological name, when handwritten are separately underlined or printed in italics to indicate their Latin origin.
(iv) The first word denoting the genus starts with capital letter while, the specific epithet starts with a small letter, e.g., Mangifera indica.
(v) Generic and common names may be same, e.g., Gorilla gorilla.
(vi) No names are recognised prior to those used by Linnaeus in 1753 for plants in Species

Plantarum and in 1758 for animals in the 10th edition of Systema Naturae.
(vii) The name of categories higher than the rank of genus are not printed in italics. Bold letters can, however be used.
(viii) When a species is transferred or revised, the name of the original worker is retained but in parenthesis, e.g., Syzygium cumini (L) Skeels.

Advantages of Binomial Nomenclature
(i) Binomial names are universally acceptable and recognised.
(ii) They remain same in all languages.
(iii) The names are small and comprehensive.
(iv) There is a mechanism to provide a scientific name to every newly discovered organism.
(v) The names indicate relationship of a species with other species present in the same genus.
(vi) A new organism can be easily provided with a new scientific name.

Taxonomic Categories



QUESTION AND ANSWER

1. A group of plants and animals with similar traits of any rank is

a. Taxon bSpecies
b. Genus d Order

Answer :a

2. Which is less general in characters as compared to genus?

a. Family b Division
b. Class dSpecies

Answer :d

3. What is the correct sequence?

a. Genus-species-order-kingdom b.Species-order-phylum-kingdom
b. Species-genus-order-phylum dKingdom-phylum-class-order

Answer:d

4. Metabolism refers to

a. Release of energy b..Gain of energy
b. Catabolism d.Gain or release of energy

Answer: d

5. What is nomenclature?

a. Genus name is written after species b.Genus and species names are written in italics
b. Genus and species have the same name d.The first letter of genus and species name is capital

Answer: b

6. The term phylum was coined by

a. Linnaeus b.Cuvier
b. Haeckel d.Theophrastus

Answer:c

7. The scientific name of mango is Mangifera indica

a. *Mangifera Indica*
b. *Mangifera indica*
c. Mangifera Indica
d. Answer:c

8. *Nicotiana* is a ————-

a. Species
b. Sub-species
c. Genus
d. Class

Answer :c

10. Energy flow and energy transformation in a living system follow

a. Biogenetic law
b. Law of thermodynamics
c. Law of limiting factor
d. Liebig's law of minimum

Answer:b

Short question and answer

Q.1. Name three botanists who contributed to the field of plant taxonomy.

Answer. The three botanists are:Carolus Linnaeus,G Bentham,Joseph Dalton Hooker

Q.2. Expand ICZN? (Clue: The organization that dictates the correct use of the scientific names of animals)

Answer. International Commission on Zoological Nomenclature

Q.3. What is a couplet in the taxonomic key?

Answer. A couplet in the taxonomic key is dichotomous.

Q.4 Define metabolism.

Answer: Metabolism is the process of conversion of food into energy by a series of chemical reactions.

Q.5. The mitotic cell division in amoeba represents growth or reproduction?

Answer. The phenomenon represents reproduction.

Q.6. Name a few botanical gardens in India. Also, name the largest botanical garden in the world.

Answer. Kew Royal Garden in London is the largest botanical garden in the world. Botanical gardens in India are:

- Indian Botanical Garden, Kolkata
- Lalbagh Botanical Garden, Bangalore
- Government Botanical garden, Ooty
- National Botanical Garden, Lucknow
- Assam State Botanical Garden, Guwaha

Q.7. Identify the correctly written scientific name for mango species- Mangifera indica/Mangifera Indica.

Answer. Mangifera indica.

Q.8 Match the correct pairs.

Column I	Column II
Family	Tuberosum
Kingdom	Polymoniales
Order	Solanum
Species	Plantae
Genus	Solanaceae

Answer Family- Solanaceae Kingdom- Plantae Order- Polymoniales Species- Tuberosum Genus- Solanum

Q.9. What is the lowest category of classification?

Answer. Species is the lowest category of classification

Q.10.What are the Taxonomic keys?

Answer. The Taxonomic keys are aids that assist in the identification of any organism in view of its attributes.

Q.11.Who is known as the Father of Taxonomy?

Answer. Carl Linnaeus is called the Father of Taxonomy.

Q.12. What are the 8 levels of taxonomy?

Answer. According to the modern taxonomic classification system the eight main levels of taxonomy are:

Domain, Kingdom, Phylum, Class, Order, Family, Genus, Species.

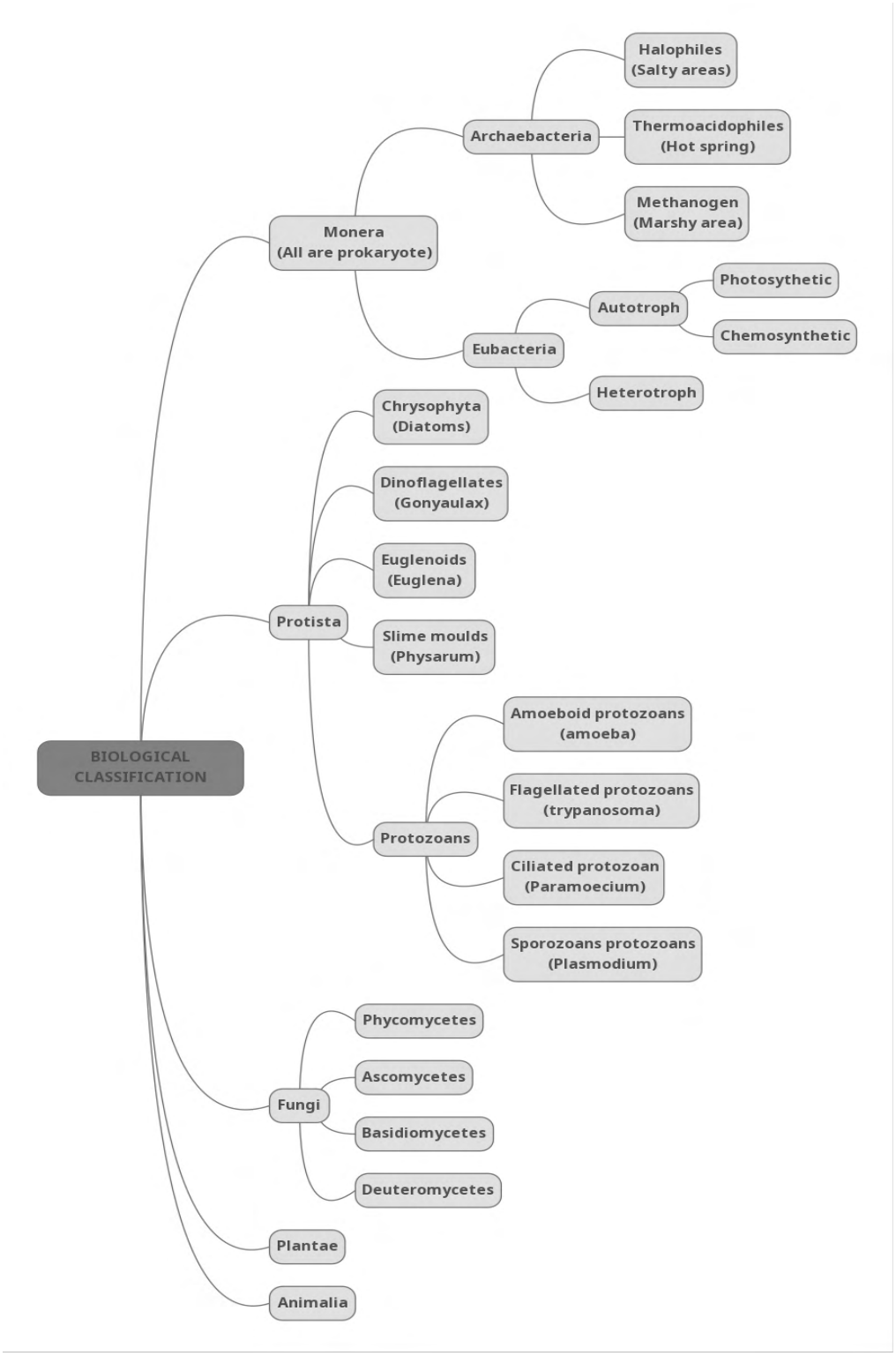
Competency based questions

Q.11. What do you mean by living? Explain the defining characteristics of living organisms.

A.1. Living means a thing that can grow, reproduce, has a cellular organization and is aware of its surroundings. Following are the defining characteristics of a living organism:

1. Growth– All living organisms have the ability to grow. Growth refers to the increase in the number and size of an organism.
2. Reproduction– All living organisms have the property of giving rise to a new individual. Reproduction can occur through sexual and/or asexual means.
3. Metabolism– All living organisms exhibit the process of metabolism. It is a series of chemical reactions which converts food into energy.
4. Cellular organization– Cell is the structural and functional unit of life. All living organisms are made up of one or more cells.

CONCEPT MAP


BIOLOGICAL CLASSIFICATION
Monera (All are prokaryote)
Archaebacteria
Halophiles (Salty areas)
Thermoacidophiles (Hot spring)
Methanogen (Marshy area)
Eubacteria
Autotroph
Photosythetic
Chemosynthetic
Heterotroph
Protista
Chrysophyta (Diatoms)
Dinoflagellates (Gonyaulax)
Euglenoids (Euglena)
Slime moulds (Physarum)
Protozoans
Amoeboid protozoans (amoeba)
Flagellated protozoans (trypanosoma)
Ciliated protozoan (Paramoecium)
Sporozoans protozoans (Plasmodium)
Fungi
Phycomycetes
Ascomycetes
Basidiomycetes
Deuteromycetes
Plantae
Animalia

POINTS TO REMEMBER

CLASSIFICATION OF ORGANISMS.

-Aristotle was the first to attempt a scientific basis for the classification of organisms.

-Linnaeus classified all organisms into two kingdoms, Plantae and Animalia.

-R.H.Whittaker proposed the five kingdom classification. The kingdom defined by him were named Monera, Protista, Fungi, Plantae and Animalia.The main criteria used by him for the classification include.

(i)Cell structure

(ii)Thallus organization

(iii)Mode of nutrition

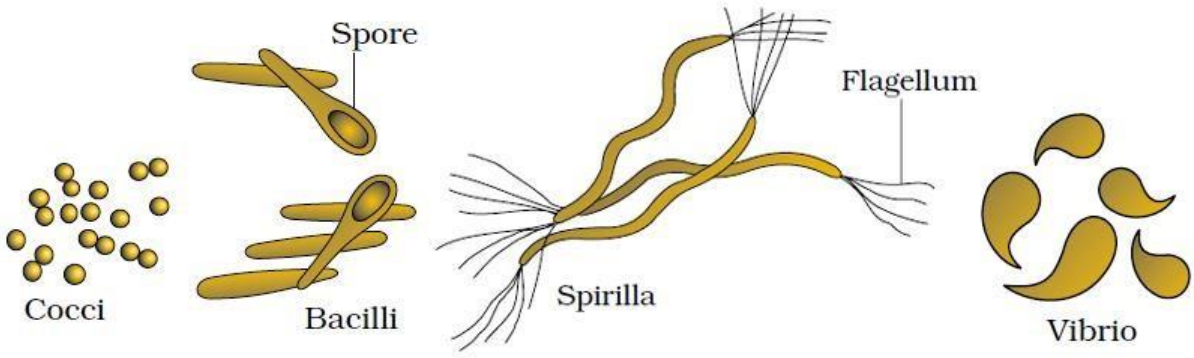
(iv)Reproduction

(v)Phylogenetic relationship

KINGDOM MONERA

-All Monerans are prokaryotic and unicellular.

-Based on their shape they are grouped into Coccus (spherical), Bacillus (rod-shaped) Vibrium (comma), Spirillum(spiral)



-They are grouped into Archaebacteria and Eubacteria.

ARCHAEBACTERIA.

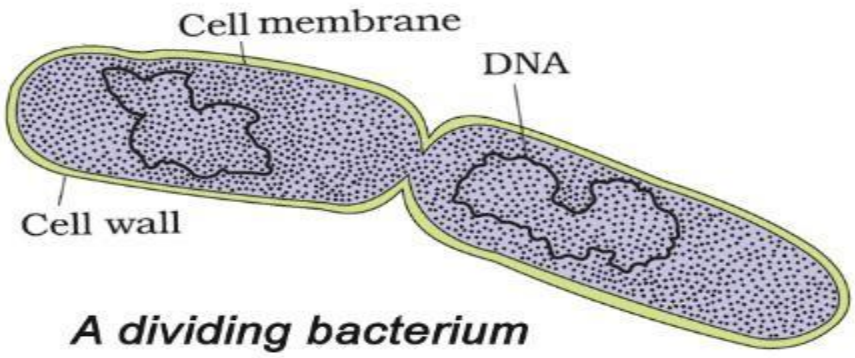
-They live in harsh habitats. There are three groups of Archaebacteria namely Halophiles (salty area), thermoacidophiles (hot spring) and Methanogen (marshy area)

EUBACTERIA.

-They are true bacteria.

-Have rigid cell wall

-Reproduce by binary fission, spore formation and also by DNA transfer from one bacterial cell to the other



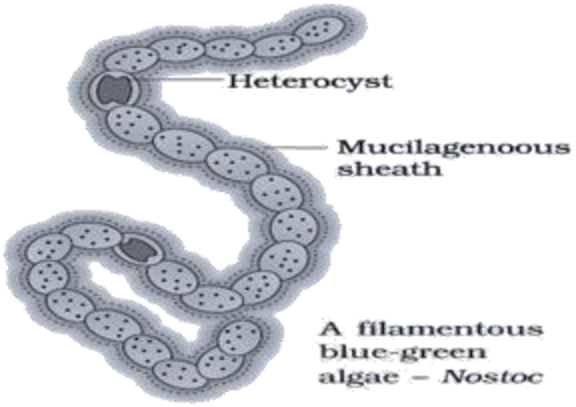
A dividing bacterium

-Cyanobacteria are photosynthetic autotrophs. They are unicellular, filamentous or colonial forms. Colonies are surrounded by a gelatinous sheath. Some of the members have the capacity to fix atmospheric nitrogen in special cells called heterocysts.

e,g, Nostoc and Anabaena.

-Chemosynthetic autotrophs oxidise the inorganic substances and release energy.

-Heterotrophic bacteria have a significant impact on human lives. Some are pathogens and cause diseases like typhoid, tetanus, diphtheria, tetanus, citrus canker etc.



A filamentous blue-green algae – *Nostoc*

KINGDOM PROTISTA

-All organisms belonging to this kingdom are unicellular and eukaryotic.

-The organisms of this kingdom are classified as follows:

CHRYSOPHYTES

-Includes diatoms and desmids.

-Cell wall is made up of silica

-Cell wall consists of two overlapping halves.

-Cell wall is indestructible and forms diatomaceous earth which is used for polishing, and filtration of oil and syrups.

DINOFLAGELLATES

-Have cellulosic cell walls that appear as plates on the outer surface.

-They have two flagella one in the longitudinal direction and the other lying transversely.

-The red dinoflagellates like Gonyaulax cause red tide in the ocean.

EUGLENOIDS

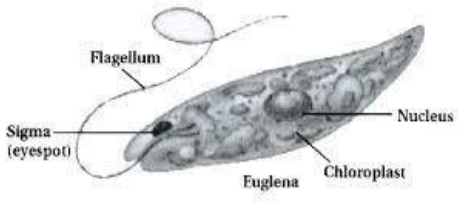
-They are mostly fresh water.

-Cell wall is absent, but has a protein-rich layer called a pellicle which gives flexibility to the body.

-They have two flagella, one is short and the other is long.

-They have photosynthetic pigments.

-In presence of sunlight they do photosynthesis and in the absence of sunlight, they live like predators. Example; Euglena



SLIME MOULDS

-Slime moulds are saprophytic

- The body moves along decaying twigs and leaves engulfing organic material.

- Under suitable conditions, they form an aggregation called plasmodium. It may spread over several feet.

- Under unfavourable conditions, plasmodium differentiates and forms fruiting bodies bearing spores at their tips. Spores have true walls. They are highly resistant and survive for many years. Spores are dispersed by air.

PROTOZOANS

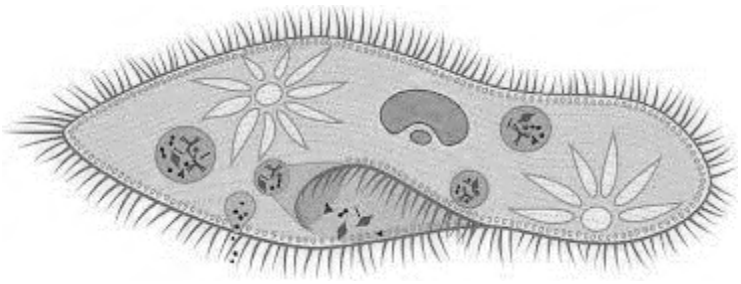
-They are heterotrophs (predators or parasites).

-There are 4 major groups of protozoans:

- Amoeboid protozoans: They live in freshwater, seawater or moist soil. They move and capture prey by putting out pseudopodia (false feet). E.g. Amoeba. Marine forms have silica shells on their surface. Some of them are parasites. E.g. Entamoeba.

- Flagellated protozoans: They are free-living or parasitic. They have flagella. The parasitic forms cause diseases like sleeping sickness. E.g. Trypanosoma.

- Ciliated protozoans: They are aquatic, actively moving organisms using thousands of cilia. They have a cavity (gullet) that opens to the outside. By the movement of the cilia, the water with food enters the gullet. E.g. Paramoecium.



- Sporozoans: They have an infectious spore-like stage in their life cycle. E.g. Plasmodium (malarial parasite).

KINGDOM FUNGI

- It is a unique kingdom of heterotrophic organisms.

- Except yeast, fungi are filamentous. Their bodies consist of thread-like structures called hyphae.

- The network of hyphae is known as mycelium.

- Hyphae are 2 types: Coenocytic hyphae: They are continuous tubes filled with multinucleated cytoplasm. Septate hyphae: They have septae or cross walls.

- Fungal cell wall is made of chitin & polysaccharides.

- Most fungi are saprophytes (absorb soluble organic matter from dead substrates). Some are parasites.

- Some live as symbionts. E.g. Lichens (fungi+ algae), mycorrhiza (fungi + roots of higher plants).

-Reproduction: Vegetative propagation: By fragmentation, fission & budding.

- Asexual reproduction: By spores such as conidia, sporangiospores and zoospores.

- Sexual reproduction: By oospores, ascospores and basidiospores. They are produced in distinct structures called fruiting bodies.

- The sexual cycle involves 3 steps:

a. Plasmogamy: Fusion of protoplasm between two motile or non-motile gametes.

b. Karyogamy: Fusion of two nuclei.

c. Meiosis in zygote to give haploid spores.

-Based on morphology of mycelium, mode of spore formation & fruiting bodies, Fungi are classified into different classes:

1. Phycomycetes
2. Ascomycetes
3. Basidiomycetes
4. Deuteromycetes

I. Phycomycetes

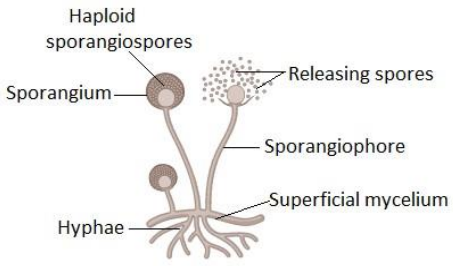
- They occur in aquatic habitats and on decaying wood in moist and damp places or as obligate parasites on plants.

- The mycelium is aseptate and coenocytic.

- Asexual reproduction: By motile zoospores or by non-motile aplanospores. These are produced in sporangium.

- Sexual reproduction: Zygospores are formed by the fusion of two gametes. These gametes are isogamous (similar in morphology) or anisogamous or oogamous (dissimilar).

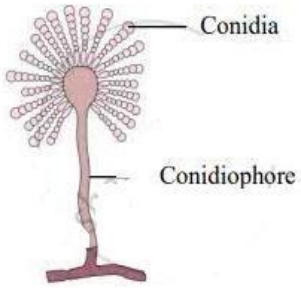
- E.g. Mucor, Rhizopus (bread mould) and Albugo (parasitic fungi on mustard).



Spore-releasing *Mucor*

II. Ascomycetes (sac-fungi)

- They are unicellular (e.g., yeast, Saccharomyces) or multicellular (e.g., Penicillium).
- Mycelium is branched and septate.
- They are saprophytic, decomposers, parasitic or coprophilous (growing on dung).
- Asexual reproduction: By conidia produced exogenously.
- Sexual reproduction: By ascospores produced endogenously in sac-like asci (sing. ascus).
- E.g. Aspergillus, Claviceps and Neurospora.



III. Basidiomycetes

- Includes mushrooms, bracket fungi or puffballs.
- The mycelium is branched and septate.
- The asexual spores are generally not found, but vegetative reproduction by fragmentation is common.
- Fruit body is called basidium producing four basidiospores exogenously.
- E.g. Agaricus (mushroom), Ustilago (smut) and Puccinia (rust fungus).

IV. Deuteromycetes

- Commonly known as imperfect fungi because only their asexual or vegetative phases are known.
- They reproduce only by asexual spores (conidia).
- The mycelium is septate and branched.
- Some are saprophytes or parasites. The majority are decomposers of litter and help in mineral cycling.
- E.g. Alternaria, Colletotrichum and Trichoderma.

KINGDOM PLANTAE

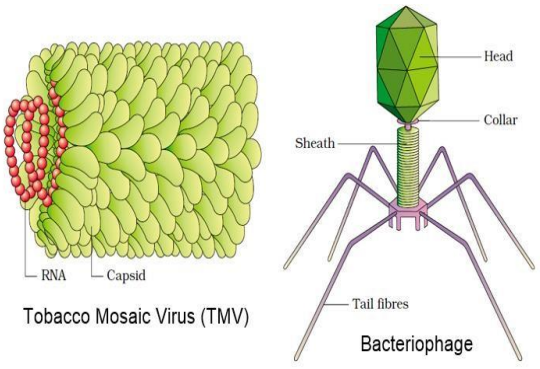
- Plants are eukaryotic chlorophyll-containing organisms with cellulosic cell walls.
- Some are partial heterotrophs (e.g. insectivorous plants like bladderwort & Venus flytrap) or parasites.
- Plantae includes algae, bryophytes, pteridophytes, gymnosperms and angiosperms.

KINGDOM ANIMALIA

- Animals are multicellular, heterotrophic, eukaryotic organisms without cell walls.

VIRUSES

- Viruses have an inert crystalline structure outside the living cell.
- When they infect a cell, they take over the machinery of the host cell to replicate themselves, killing the host.
- Generally, plant viruses have single-stranded RNA. Animal viruses have either single or double-stranded RNA or double-stranded DNA. Bacteriophages (viruses that infect bacteria) usually have double-stranded DNA.
- The capsid made of small subunits (capsomeres) protects the nucleic acid. Capsomeres are arranged in helical or polyhedral geometric forms.



VIROID

-It is an infectious agent with a free low molecular weight RNA and no protein coat. These are smaller than viruses. It is discovered by T.O. Diener (1971). He found that it caused potato spindle tuber disease.

LICHEN

- Lichens are symbiotic associations (mutually useful associations) between algae & fungi.
- The algal component is called phycobiont (autotrophic) and fungal component is mycobiont (heterotrophic).
- Algae prepare food for fungi and fungi provide shelter and absorb mineral nutrients and water for its partner.
- Lichens are very good pollution indicators. They do not grow in polluted areas

QUESTION AND ANSWER

1. Specialized cells for fixing atmospheric nitrogen in Nostoc are

(a) Akinetes

(b) Heterocysts

(c) Hormogonia

(d) Nodules

Answer: b

2. Which of the following shows coiled RNA strand and capsomeres?

(a) Poliovirus

(b) Tobacco mosaic virus

(c) Measles virus

(d) Retrovirus

Answer: b

3. The imperfect fungi which are decomposers of litter and help in mineral cycling belong to: (a) Basidiomycetes

(b) Phycomycetes

(c) Ascomycetes

(d) Deuteromycetes

Answer: d

4. Which of the following statements is false about the fungi?

a. They are eukaryotes
b. They are heterotrophs
c. They possess a purely cellulosic cell wall
d. None of the above

Answer: c

5.Which of the following organisms can be found in extreme saline conditions?

a. Eubacteria

b. Archaebacteria
c. Cyanobacteria
d. Mycobacteria

Answer:b

6.In which of the following kingdom are Archaebacteria and Nitrogen-fixing organisms are classified?

a.Animalia
b..Plantae
c..Monera
d..Fungi

Answer: c

7.Match the columns:

1. Basidiomycetes – A. Agaricus
2. Ascomycetes – B. Albugo
3. Phycomycetes – C. Trichoderma
4. Deuteromycetes – D. Saccharomyces

a.1-D, 2-A, 3-B, 4-C b.1-A, 2-D, 3-B, 4-C

c.1-A, 2-B, 3-D, 4-C d.1-C, 2-D, 3-A, 4-B

Answer: b

Answer the following questions.(Short answer type)

1. What are the basic criteria involved in the five kingdoms of classification?

(i)Cell structure (ii)Thallus organization

(iii)Mode of nutrition (iv)Reproduction

(v)Phylogenetic relationship

2. What is the nature of cell walls in diatoms?

-Cell wall is made up of silica
-Cell wall consists of two overlapping halves.
-Cell wall is indestructible and forms diatomaceous earth which is used for polishing, and filtration of oil and syrups.

3. Explain the followings,

(a)Heterocyst

Special cells present in cyanobacteria which fix atmospheric nitrogen.

(b)Phycobiont

These are the algal partner present in lichen.

(c)Mycobiont

The association of fungal partner in lichen is called Mycobiont.

4. Distinguish between Virus and Viroid

VIRUS	VIROID
Protien coat is present	Absent
Have DNA or RNA	Have only RNA with low molecular weight.

5. Characteristic features of following

(a)Euglenoid

-They are mostly fresh water.

-Cell wall is absent, but has a protein-rich layer called a pellicle which gives flexibility to the body.

-They have two flagella, one is short and the other is long.

-They have photosynthetic pigments.

-In presence of sunlight they do photosynthesis and in the absence of sunlight, they live like predators. Example; Euglena (draw neat labelled diagram)

(b)Slime mould

- Slime moulds are saprophytic
- The body moves along decaying twigs and leaves engulfing organic material.
- Under suitable conditions, they form an aggregation called plasmodium. It may spread over several feet.
- Under unfavourable conditions, plasmodium differentiates and forms fruiting bodies bearing spores at their tips. Spores have true walls. They are highly resistant and survive for many years. Spores are dispersed by air.

6. Explain the major groups of protozoans.

There are 4 major groups of protozoans:

-Amoeboid protozoans: They live in freshwater, seawater or moist soil. They move and capture prey by putting out pseudopodia (false feet). E.g. Amoeba. Marine forms have silica shells on their surface. Some of them are parasites. E.g. Entamoeba.

-Flagellated protozoans: They are free-living or parasitic. They have flagella. The parasitic forms cause diseases like sleeping sickness. E.g. Trypanosoma.

-Ciliated protozoans: They are aquatic, actively moving organisms using thousands of cilia. They have a cavity (gullet) that opens to the outside. By the movement of the cilia, the water with food enters the gullet. E.g. Paramoecium.

-Sporozoans: They have an infectious spore-like stage in their life cycle. E.g. Plasmodium (malarial parasite).

Case study question.

Archaebacteria are special since they live in some of the harshest habitats such as extreme salty areas (halophiles), hot springs (thermoacidophiles) and marshy areas (methanogens). Archaebacteria differ from other bacteria in having a different cell wall structure and this feature is responsible for their survival in extreme conditions. Methanogens are present in the gut of several ruminant animals such as cows and buffaloes and they are responsible for the production of methane (biogas) from the dung of these animals. There are thousands of different eubacteria or 'true bacteria'. They are characterised by the presence of a rigid cell wall, and if motile, a flagellum. The cyanobacteria (also referred to as blue-green algae) have chlorophyll similar to green plants and are photosynthetic autotrophs. The cyanobacteria are unicellular, colonial or filamentous, and freshwater/marine or terrestrial algae. The colonies are generally surrounded by a gelatinous sheath. They often form blooms in polluted water bodies. Some of these organisms can fix atmospheric nitrogen in specialised cells called heterocysts, e.g., Nostoc and Anabaena. Chemosynthetic autotrophic bacteria oxidise various inorganic substances such as nitrates, nitrites and ammonia and use the released energy for their ATP production. They play a great role in recycling nutrients like nitrogen, phosphorous, iron and sulphur. Heterotrophic bacteria are most abundant in nature. The majority are important decomposers. Many of them have a significant impact on human affairs. They are helpful in making curd from milk, production of antibiotics, fixing nitrogen in legume roots, etc. Some are pathogens causing damage to human beings, crops, farm animals and pets. Cholera, typhoid, tetanus, and citrus canker are well-known diseases caused by different bacteria. Bacteria reproduce mainly by fission. Sometimes, under unfavourable conditions, they produce spores. They also reproduce by a sort of sexual reproduction by adopting a primitive type of DNA transfer from one bacterium to the other. Mycoplasma is an organism that completely lacks a cell wall. They are the smallest living cells known and can survive without oxygen. Many mycoplasmas are pathogenic in animals and plants.

(1) _____bacteria is responsible for formation of biogas from cow dung / organic waste

(a) cyanobacteria

(b) Halophiles

(c) Thermoacidophiles

(d) Methanogens

Answer:d

(2) _____ are the bacteria that can grow and thrive in salty areas.

(a) Methanogens

(b) Halophobic

(c) Halophiles

(d) Thermoacidophiles

Answer:c

(3) True bacteria are characterised by _____

(a) Rigid Cell wall

(b) Flagellum present for locomotion

(c) Both a and b

(d) None of the above

Answer:c

(4) Name the eubacteria which are also referred to as blue-green algae.

Ans: The cyanobacteria are also referred to as blue-green algae, they have chlorophyll similar to green plants and are photosynthetic autotrophs.

(5) What is heterocyst?

Answer: Heterocyst is the specialised cells which facilitate nitrogen fixation. It is found in cyanobacteria e.g., Nostoc and Anabaena.

(6) What is the thermoacidophiles?

Answer: Thermoacidophiles are the bacteria that can survive, grow and thrive in extremely hot temperature conditions and acidic environments

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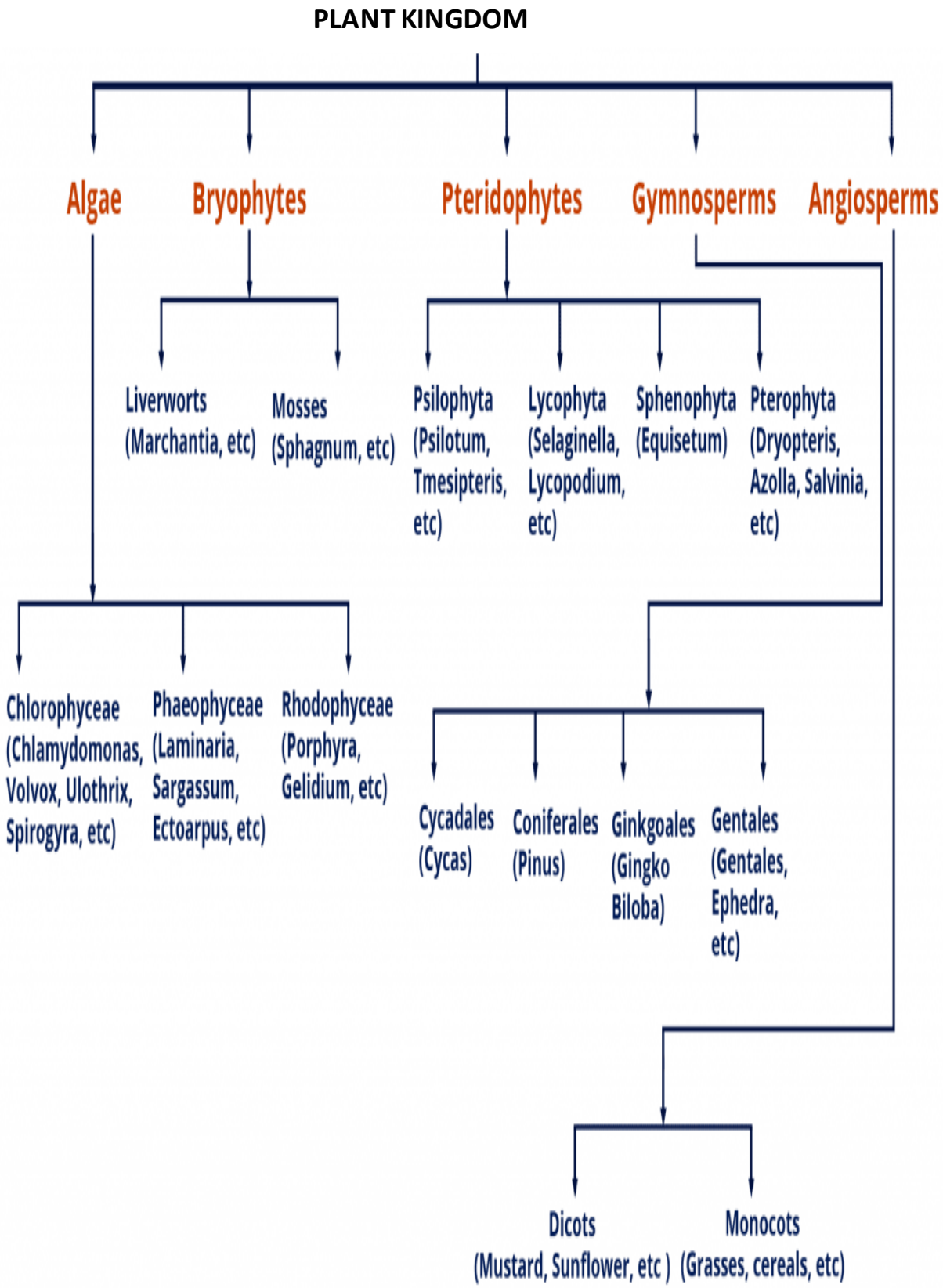
CONCEPT MAP


PLANT KINGDOM
Algae
Bryophytes
Pteridophytes
Gymnosperms
Angiosperms
Liverworts (Marchantia, etc)
Mosses (Sphagnum, etc)
Psilophyta (Psilotum, Tmesipteris, etc)
Lycophyta (Selaginella, Lycopodium, etc)
Sphenophyta (Equisetum)
Pterophyta (Dryopteris, Azolla, Salvinia, etc)
Chlorophyceae (Chlamydomonas, Volvox, Ulothrix, Spirogyra, etc)
Phaeophyceae (Laminaria, Sargassum, Ectoarpus, etc)
Rhodophyceae (Porphyra, Gelidium, etc)
Cycadales (Cycas)
Coniferales (Pinus)
Ginkgoales (Gingko Biloba)
Gentales (Gentales, Ephedra, etc)
Dicots (Mustard, Sunflower, etc)
Monocots (Grasses, cereals, etc)

POINTS TO REMEMBER

Eukaryotic, multicellular, chlorophyll containing and having cell wall.

- **Phylogenetic** system of classification based on evolutionary relationship
- **Numerical Taxonomy** use computer by assigning code for each character and analyzing the features.
- **Cytotaxonomy** is based on cytological information like chromosome number, structure and behaviour.
- **Chemotaxonomy** uses chemical constituents of plants to resolve the confusion.

Algae: These include the simplest plants which possess undifferentiated or **thallus like forms**.Reproductive organs are single celled called gametangia.

Characteristic of Algae

- Plant body is thallus, which may be unicellular, colonial, filamentous or parenchymatous.
- Usually aquatic but a few are found in moist terrestrial habitats like tree trunks, wet rocks, moist soil, etc.Vascular tissues and mechanical tissues are absent.
- Reproduction is vegetative by fragmentation, asexual by spore formation (zoospores) and sexual reproduction by fusion of two gametes which may be Isogamous (*Spirogyra*), Anisogamous (*Chlamydomonous*) or Oogamous (*Volvox*).

Green Algae-Chlorophyceae	Brown Algae-Phaeophyceae	Red Algae-Rhodophyceae
Mostly fresh water, salt water and sub aerial.	Mostly marine & rare in fresh water.	Mostly marine & few in fresh water.
Unicellular organisms are abundant.	Unicellular species are absent.	Unicellular species fewer.
Chlorophyll a and b type.	Chlorophyll a and c type.	Chlorophyll a and d type.
Reserve food is starch	Reserve food is laminarin.	Reserve food is floridean starch.
Cell wall is of cellulose.	Cell wall contains cellulose and algin.	Cell wall contains cellulose, pectin and poly-sulphate esters.
Fucoxanthin is absent	Fucoxanthin present.	Phycoerythrine is present.
Zoospores present.	Zoospores present.	Zoospores absent.
Chlamydomonas, Ulothrix, spirogyra. Volvox,Chara	Fucus, Sargassum, ectocarpus.Laminaria	Polysiphonia, Gelidium, Porphyra etc.

Economic importance-

1. A number of brown algae (*Laminaria, Sargassum*) are used as food in some countries.
2. Fucus and Laminaria are rich source of Iodine.
3. Laminaria and Ascophyllum have antibiotic properties.
4. Alginic acid is obtained from Fucus and Sargassum, which is used as emulsions.

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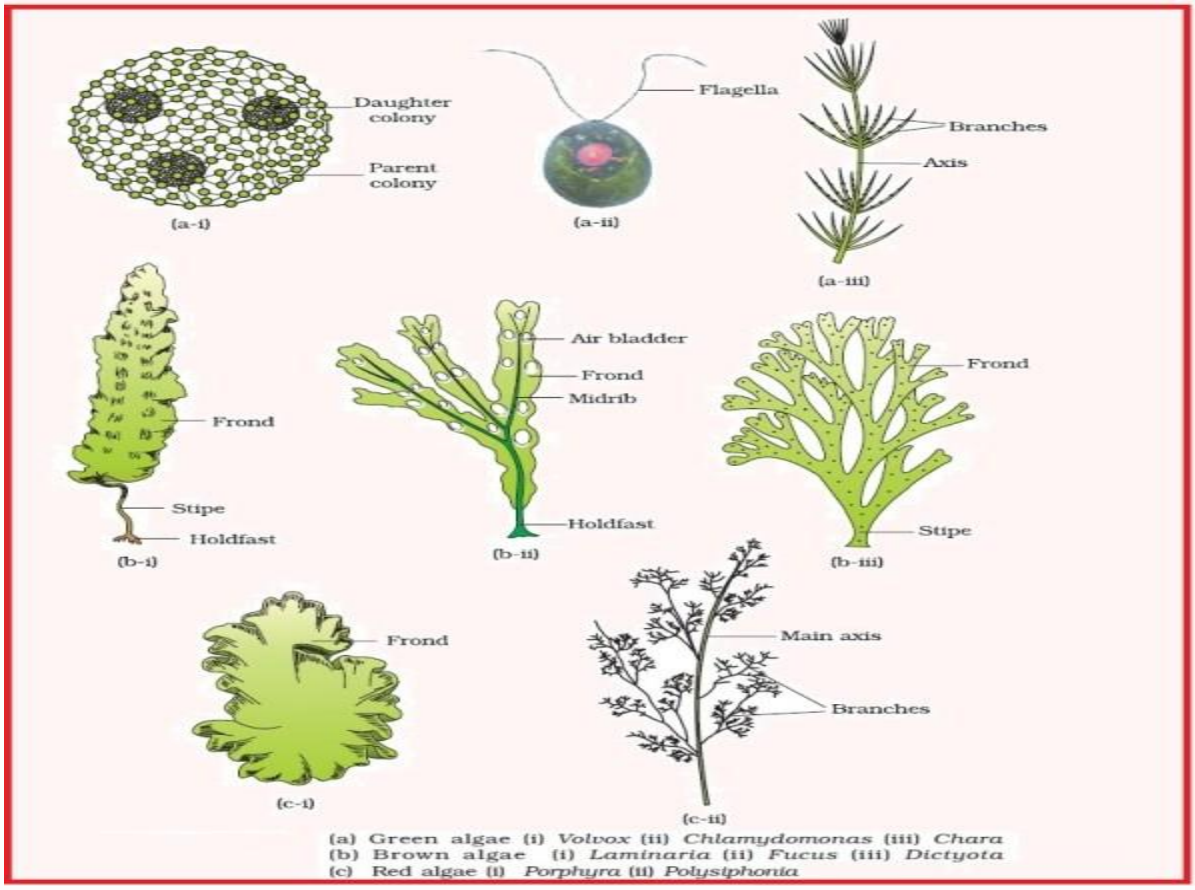


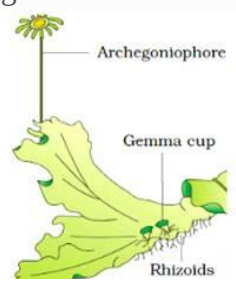
Bryophytes – They are non-vascular **Mosses and Liverworts**. Grow in moist shady region. They are called amphibians of plants kingdom because these plants live on soil but dependent on water for sexual reproduction

Characteristic features-

- Live in damp and shady habitats, found to grow during rainy season on damp soil, rocks, walls, etc.
- The dominant phase or plant body is free living gametophyte(Haploid)
- Roots are absent but contain rhizoids
- Vegetative reproduction is by fragmentation, tubers, gemmae, buds etc.
- Sex organs are multicellular and jacketed. The male sex organ is called **antheridium.** They produce biflagellate antherozoids. The female sex organ called **archegonium** is flask-shaped and produces a single egg.
- Sporophyte is dependent on gametophyte for nourishment.

Hepaticopsida (Liverworts)

- The plant body is thalloid, e.g., Marchantia. The thallus is dorsiventral and closely appressed to the substrate.
- Asexual reproduction by fragmentation, or by specialised structures called **gemmae.**
- Gemmae are green, multicellular, asexual buds, which develops in small receptacles called gemma cups. The gemmae becomes detached from the parent body and germinate to form new individuals
- During sexual reproduction, male and female sex organs are produced either on the same or on different thalli. The sporophyte is differentiated into a foot, seta and capsule. Spores produced within the capsule germinate to form free-living gametophytes.

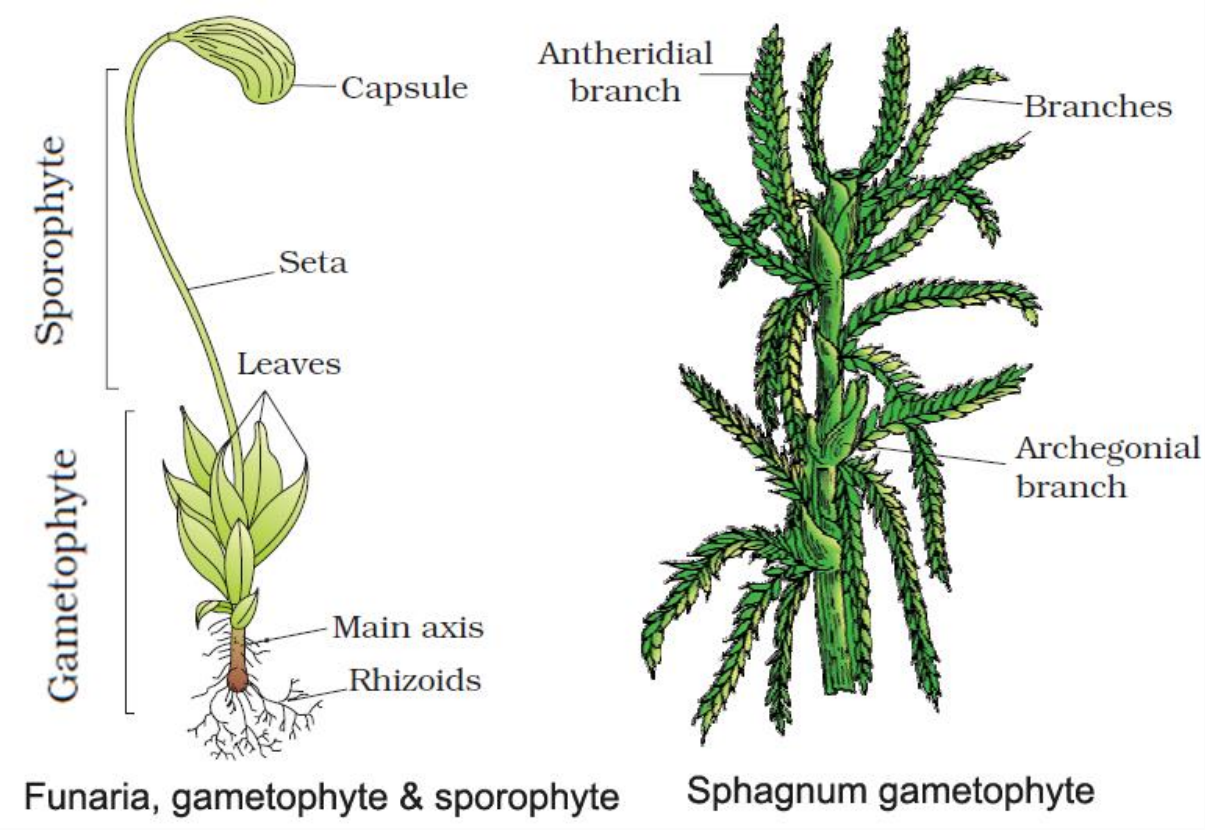


Marchantia female thallus

Marchantia male thallus

Bryopsida (Mosses)

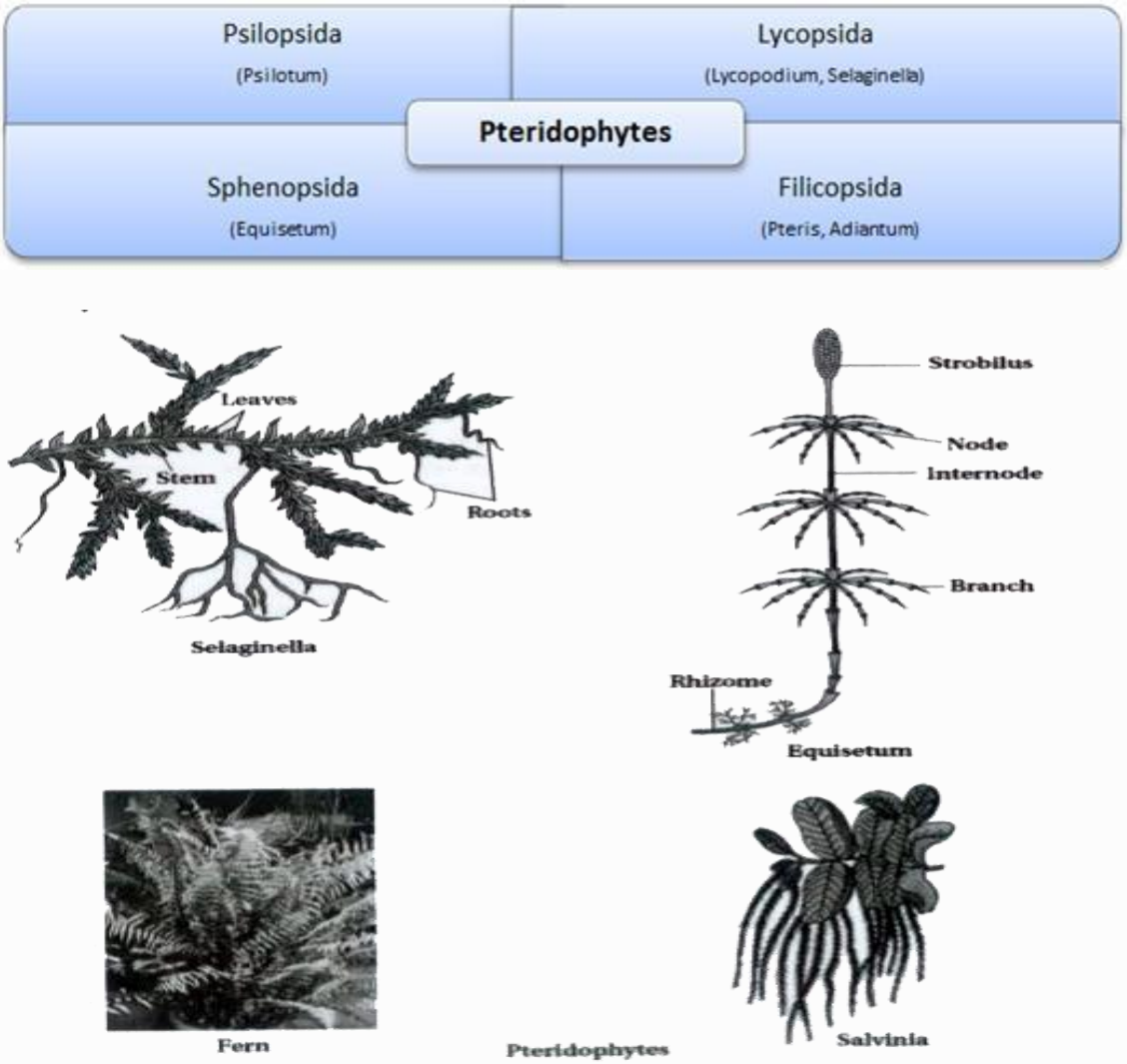
- The gametophyte of mosses consists of two stages-
- 1.) **protonema** stage, which develops directly from spores. It is creeping, green and frequently filamentous.
- **2.) leafy stage**, which develops from secondary protonema as lateral bud having upright, slender axes bearing spirally arranged leaves.
- Vegetative reproduction is by the fragmentation and budding in secondary protonema.
- In sexual reproduction, the sex organs antheridia and archegonia are produced at the apex of the leafy shoots.
- Sporophytes in mosses are more developed and consist of foot, seta and capsule.
- Examples are *Funaria, Polytrichum, Sphagnum* etc.



Funaria, gametophyte & sporophyte Sphagnum gametophyte

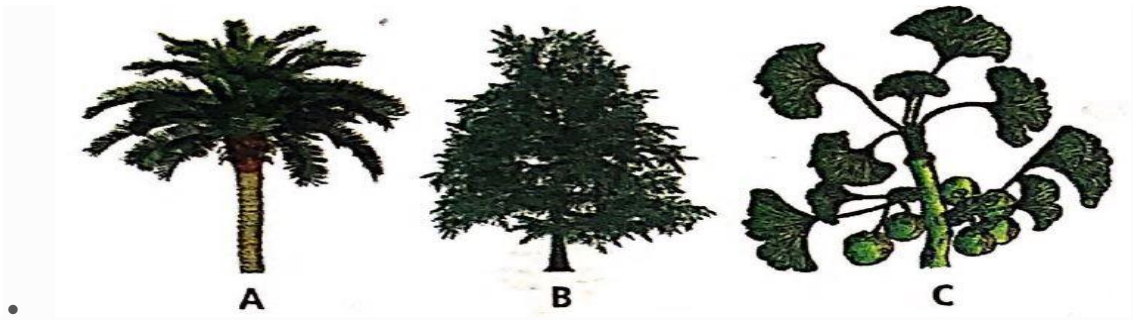
Pteridophytes

- They are seedless vascular plants that have sporophytic plant body and inconspicuous gametophyte. Sporophytic plant body is differentiated into true stem, roots and leaves.
- Vascular tissue are present but vessels are absent from xylem and companion cells and sieve tube are absent.
- Sporophytes bear sporangia that are subtend by leaf like appendages called **sporophylls**. In some plants (*Selaginella*) compact structure called strobili or cone is formed.
- Sporangia produce spores by meiosis in spore mother cells. Spores germinate to produce multicellular thalloid, **prothallus.**
- Gametophyte bears male and female sex organ called antheridia and archegonia. Water is required for fertilisation of male and female gametes.
- Most of Pteridophytes produce spores of similar kind (**homosporous**) but in *Selginella* and *Salvinia*, spores are of two kinds (**heterosporous**) larger called megaspore that produce female gametophyte and smaller microspore that produce male gametes.



Gymnosperms:

- Gymnosperms are those plants in which the ovules are not enclosed inside the ovary wall and remain exposed before and after fertilisation.
- They are perennial and woody, forming either bushes or trees. Some are very large (*Sequoia sempervirens*) and others are very small (*Zamia pygmia*).
- Stem may be unbranched (Cycas) or branched(Pinus). Root is taproot. Leaves may be simple or compound.
- They are heterosporous, produce haploid microspore and megaspore in male and female Strobili respectively.
- Male and female gametophytes do not have independent free-living existence. Pollination occurs through air and zygote develops into embryo and ovules into seeds. These seeds are naked.
- Example- Pines, Cycus, Cedrus, Ginkgo, etc.
- The female sex organs in a flower is the pistil or the carpel. Pistil consists of an ovary enclosing one or many ovules. Within ovules are present highly reduced female gametophytes termed **embryo-sacs**.
- Each embryo-sac has a three-celled egg apparatus – one egg cell and two synergids, three antipodal cells and two polar nuclei. The polar nuclei eventually fuse to produce a diploid secondary nucleus.



QUESTION AND ANSWER

1.)Rhodophyceae is called red algae because of the pigment
(a) Fucoxanthin (b) Phycoerythrin
(c) Carotenoids (d) Chlorophyll c

Answer (b)
2.) Which of the followings plant material is an efficient water imbibant?
(a) Agar (b) Cellulose
(c) Lignin (d) Pectin
Answer (a)
3.)In a monoecious plant
(a) Male and female sex organs are on the same individual
(b) Male and female gametes are of two morphologically distinct types
(c) Male and female sex organs are on different individuals
(d) All the stamens are fused to form one unit
Answer (a)
4)The seedless vascular plants whose sporophytes are larger than their small and independent gametophytes are
(a) Pteridophytes (b) Angiosperms
(c) Gymnosperms (d) None of these
Answer: (a)
5)Which of the following is a liverwort?
(a) Sphagnum (b) Funaria
(c) Marchantia (d) Polytrichum
Answer (c)
6) Transgenic plants are the ones
(a) Grown in artificial medium after hybridization in the field
(b) Produced by a somatic embryo in artificial medium
(c) Generated by introducing foreign DNA in to a cell and regenerating a plant from that cell
(d) Produced after protoplast fusion in artificial medium
Answer: (c)
7) Which of the following plants is used extensively for the study of photosynthesis?
(a) Amaranthus (b) Asparagus
(c) Chlorella (d) Sunflower
Answer (c)
8) Which of the following is used to grow microbes?
(a) Laminaria (b) Gelidium
(c) Chlorella (d) Sargassum
Answer (b) 9) .Isogamous condition with non-flagellated gametes is found in
(a) Chlamydomonas (b) Spirogyra
(c) Volvox (d) Fucus
Answer (b)

10) Gymnosperms produce neither flower nor fruit because they do not possess
(a) Embryo (b) Ovary
(c) Ovule (d) Seed
Answer (b)

SHORT QUESTIONS AND ANSWERS:

1. What is the basis of classification of algae?

The presence of pigments that give the traditional color on algae is the main basis for the classification of algae.

Name of the pigment	**Color imparted**	**Chlorophyll type**
Chlorophyceae	Green	Chlorophyll a and chlorophyll b
Phaeophyceae	Brown	chlorophyll a, chlorophyll c, fuxoxanthin
Rhodophyceae	Red	chlorophyll a and chlorophyll d, phycoerythrin

Now, algae are classified on different criteria such as:

(i) Flagellation (ii) Storage products (iii) Cellular organization (iv) Constitution of cell walls

2 Name three groups of plants that bear archegonia. Briefly describe the life cycle of any one of them.

Bryophytes, Pteridophytes, and Gymnosperms are the plants that bear archegonia.

The life cycle of Bryophytes

(i) Bryophytes are haploid, and they produce gametes. The sexual organs in bryophytes are multicellular.

(ii) The male sex organ is the antheridium, which produces biflagellate antherozoids. Female sexual organs are called archegonium, which produces a single egg.

(iii) Antheridium releases antherozoids into the water that come into contact with the archegonium.

(iv) An antherozoid fuses with the egg to produce the zygote.

(v) The zygote undergoes reduction division to produce a multicellular body called a sporophyte.

(vi) Sporophytes undergo reduction division to produce haploid spores.

(vii) These spores germinate to produce gametophyte.

3. Mention the ploidy of the following: Protonemal cell of a moss; primary endosperm nucleus in dicot, leaf cell of a moss; prothallus cell of a fern; gemma cell in Marchantia; meristem cell of monocot, ovum of a liverwort, and zygote of a fern.

Cell	**Type of Ploidy**
Protonemal cell of a moss	Haploid
Primary endosperm nucleus in dicot	Triploid
leaf cell of a moss	Haploid
Prothallus cell of a fern	Haploid
Gemma cell in Marchantia	Haploid

Meristem cell of monocot	Diploid
Ovum of a liverwort	Haploid
Zygote of a fern.	Diploid.

4.Write the economic Importance of Gymnosperms and Algae.

(i) Gymnosperms plants are used as ornamentals. Some are in formal gardens – used for bonsai

(ii) Their fibers are used in the preparation of paper pulp.

(iii) Turpentine and resins are obtained from conifers resin

(iv) Useful oils are extracted from gymnosperms like junipers, pines, hemlock, fir etc.

(v) Gymnosperm seeds are used as food products such as bakery items.

(vi) Occassionaly used to create silk and other textiles

Importance of Algae

(i) Algae fixes Carbon dioxide with the help of photosynthesis

(ii) It increases the level of dissolved oxygen in their immediate environment

(iii) They produce rich compounds that serve as food for aquatic animals.

(iv) Marine algae are used as food. Eg: Laminaria and Sargassum

(v) Certain algae are used as hydrocolloids

(vi) Agar is used in growing microorganisms and in the preparation of jellies.

(vii) Chlorella is used as food by space travellers.

5 What is heterospory? Briefly comment on its significance. Give an example:

The phenomenon of producing two different types of spores in the same plant is called heterospory. The importance of heterospory:

(i) Heterospory causes the growth of seeds in gymnosperms and angiosperms.

(ii) It is required in the differentiation of male and female gametophytes.

Examples: Salvinia, Selaginella (macro & microspores to gametophytes)

6) Explain briefly the following terms with suitable examples:-

(i) protonema (ii) antheridium (iii) archegonium (iv) sporophyll (v) isogamy

i) Protonema is the haploid stage in the bryophyte lifecycle where thread-like chain of cells are formed. Ex: In mosses protonema develops directly from a spore.

ii) Antheridium – The male sex organ, producing male gametes in bryophyte and pteridophytes is called antheridium. Ex: many fungi and algae have antheridia during their reproductive phases.

iii) Archegonium is a female reproductive organ of bryophytes which is flask-shaped and produces a single egg. Observed in pteridiophytes, gymnosperms, bryophytes, they are jacketed and multicellular, possessing a neck and a swollen venter.

iv) A leaf which bears sporangia is called as sporophyll, which may be microsporophyll or megasporophyll. These structures combine to form strobili.(cones) Ex: Pinus

vi) Isogamy – Sexual reproduction that takes place through fusion of two gametes which can be flagellated and are similar in size or non-flagellated (non-motile) but similar in size. Such reproduction is called isogamy. Ex: Ectocarpus

7) Differentiate between the following:-

(i) red algae and brown algae (ii) syngamy and triple fusion

i) 1. Red algae contain chlorophyll a and d but brown algae contain chlorophyll a and c.

2. In red algae, Phycoerythrin are present but brown algae have fucoxanthin.

3. If red algae reserve food in the form of floridean starch, it is laminarin in brown algae.

4. Red algae are not flagellated, and brown algae are flagellated.

ii) Syngamy is the fusion of the male gamete with the ovum whereas triple fusion is the fusion of another male gamete with two polar nuclei.

8) Match the following (column I with column II)

Column I	**Column II**
(a) Chlamydomonas	**(i) Moss**
(b) Cycas	**(ii) Pteridophyte**
(c) Selaginella	**(iii) Algae**
(d) Sphagnum	**(iv) Gymnosperm**

Solution:

Column I	**Column II**
(a) Chlamydomonas	(iii) Algae
(b) Cycas	(iv) Gymnosperm
(c) Selaginella	(ii) Pteridophyte
(d) Sphagnum	(i) Moss

9. Describe the important characteristics of gymnosperms.

The main characteristics of gymnosperms are as follows

(i) In Gymnosperm the ovules are not enclosed by ovary. They are exposed before and after fertilization. (ii) The seeds are naked (iii) The roots are taproots

(iv) Gymnosperms include medium sized trees or tall trees and shrubs.

(v) The stems are branched or unbranched. (vi) Leaves simple and compound

(vii) The plant body is separated into roots, stems and leaves and is sporophyte

(viii) They produce two kinds of spores, so they are called heterosporous

(ix) Fertilization takes place in the absence of external water from syphonogamy.

COMPETENCY BASED QUESTIONS (CASE 1)

The earliest systems of classification used only gross superficial morphological characters such as habit, colour, number and shape of leaves, etc. They were based mainly on vegetative characters or on the androecium structure (system given by Linnaeus). Such systems were artificial; they separated the closely related species since they were based on a few characteristics. Also, the artificial systems gave equal weightage to vegetative and sexual characteristics; this is not acceptable since we know

that often the vegetative characters are more easily affected by environment. As against this, natural classification systems developed, which were based on natural affinities among the organisms and consider, not only the external features, but also internal features, like ultra-structure, anatomy, embryology and phytochemistry. Such a classification for flowering plants was given by George Bentham and Joseph Dalton Hooker.

At present phylogenetic classification systems based on evolutionary relationships between the various organisms are acceptable. This assumes that organisms belonging to the same taxa have a common ancestor. We now use information from many other sources too to help resolve difficulties in classification. These become more important when there is no supporting fossil evidence. Numerical Taxonomy which is now easily carried out using computers is based on all observable characteristics. Number and codes are assigned to all the characters and the data are then processed. In this way each character is given equal importance and at the same time hundreds of characters can be considered. Cytotaxonomy that is based on cytological information like chromosome number, structure, behaviour and chemotaxonomy that uses the chemical constituents of the plant to resolve confusions, are also used by taxonomists these days.

1) In phylogenetic system of classification, it is believed that organisms belongs to the same taxa have _____

a) Common character
b) Common ancestor
c) Different character
d) All of the above

2.) **Linnaeus, gave the earliest artificial system of classification systems which was based on**

(a) structure of leaves
(b) Androecium structure
(c) Colour of leaves
(d) All of the above

3) **Why natural classification systems was developed, what was the need of it?**

4) **Define numerical taxonomy.**

5) **What are the basis of the phylogenetic classification system?**

Answer key

1) b **2)** b

3) The earliest systems of classification was totally based upon superficial external vegetative and sexual characteristics, such as habit, colour, number and shape of leaves, etc. this is not acceptable since we know that often the vegetative characters are get easily affected by environment. As against this, natural classification systems was developed.

Natural classification systems were based on natural affinities among the organisms and consider, not only the external features, but also internal features, like ultra-structure, anatomy, embryology and phytochemistry. Such a classification for flowering plants was given by George Bentham and Joseph Dalton Hooker.

4)Numerical taxonomy is the branch of taxonomy in which mathematical methods are used to evaluate observable difference and similarities between taxonomic groups of plant.

5) Phylogenetic classification system indicates evolutionary as well as the genetic relationship among organism, it is based on the fossil record, biochemical, anatomical, morphological, embryological, physiological, genetics, Karyotype, and other studies.

CASE 2

Algae are chlorophyll-bearing, simple, thalloid, autotrophic and largely aquatic (both fresh water and marine) organisms. They occur in a variety of other habitats: moist stones, soils and wood. Some of them also occur in association with fungi (lichen) and animals (e.g., on sloth bear). The form and size of algae is highly variable, ranging from colonial forms like Volvox and the filamentous forms like Ulothrix and Spirogyra.

The algae reproduce by vegetative, asexual and sexual methods. Vegetative reproduction is by fragmentation. Asexual reproduction is by the production of different types of spores, the most common being the zoospores. Sexual reproduction takes place through fusion of two gametes. The algae are divided into three main classes: Chlorophyceae, Phaeophyceae and Rhodophyceae.

1) _____ is the colonial form of algae.

a) Ulothrix b) Spirogyra

c) Volvox d) Chara

2) _____ are a micro compartment storage bodieslocated in the chloroplasts of algae.

a) Align b) Pyrenoids

c) Carragen d) Mannitol

3.) Name the animal which shows mutual association with algae.

4) Give reason – Why members of chlorophyceae class are named as green algae?

5) Name the pigment which determine the colour of the brown algae.

Answer key: 1) c 2) b

3) Sloth bear and algae share a mutual association, as the algae grows on the fur of sloth bear for shelter and water.

4) The members of chlorophyceae class have dominance of pigments chlorophyll a and b. Due to the dominance of these pigments they appear green, hence they are named as green algae.

5) The presence of Xanthophyll pigment and fucoxanthin pigment levels determine the colour of the brown algae.

CASE 3

The gymnosperms are plants in which the ovules are not enclosed by any ovary wall and remain exposed, both before and after fertilisation. The seeds that develop post-fertilisation, are not covered, i.e., are naked. Gymnosperms include medium-sized trees or tall trees and shrubs. One of the gymnosperms, the giant redwood tree Sequoia is one of the tallest tree species. The roots are generally tap roots. Roots in some genera have fungal association in the form of mycorrhiza (Pinus), while in some others (Cycas) small specialised roots called coralloid roots are associated with N2 – fixing cyanobacteria. The leaves may be simple or compound. In Cycas the pinnate leaves persist for a few years. The leaves in gymnosperms are well-adapted to withstand extremes of temperature, humidity and wind. In conifers, the needle-like leaves reduce the surface area. Their thick cuticle and sunken stomata also help to reduce water loss.

1.) In gymnosperms, seeds that develop after fertilisation are _____

a) Covered in ovary walls b) Not covered in ovary walls

c) Covered in ovary sheath d) None of the above

2.) Identify the correct characteristics of cycus

Characteristic 1 –Leaves pinnate for a few years

Characteristic 2 – Small specialised coralloid roots present

Characteristic 3 – Roots are associated with nitrogen fixing bacteria

Characteristic 4 – Male and female cone are present on different plant

a) Both 2 and 3

b) Only 2

c) 1, 2 and 3

d) All of the above

3) Name the special type of root found in cycus tree.

4) Why gymnosperms are referred as heterosporous group of plants.

5) What is the reason behind needle-like leaves adaptation in gymnosperms?

Answer key: 1) b 2) d

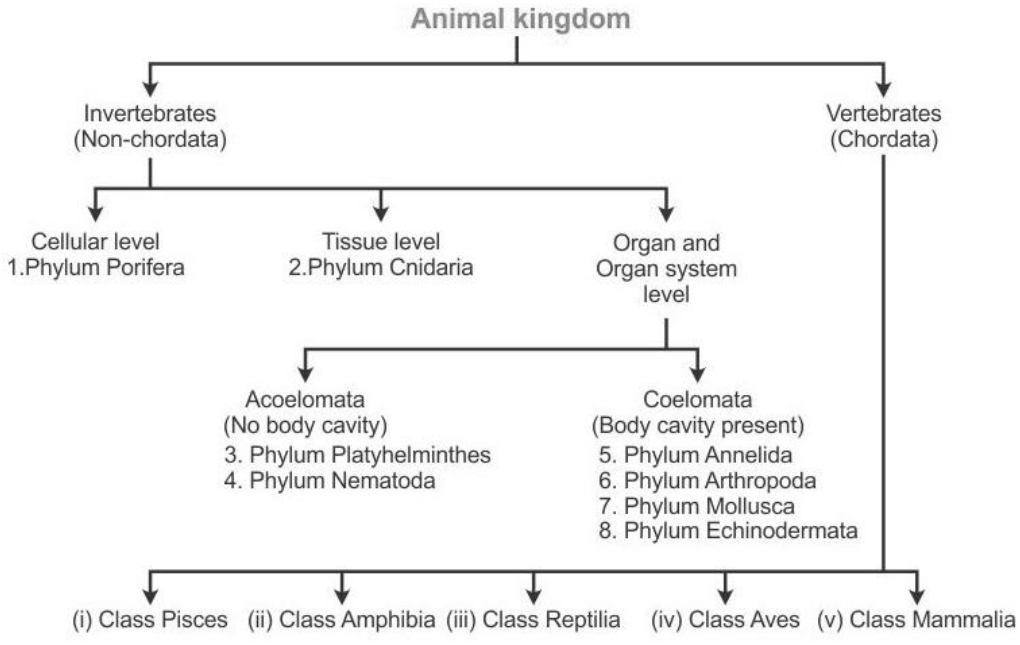
3) In cycus, small specialised roots i.e. coralloid roots are found. Coralloid roots shows symbiotic association with Nitrogen – fixing cyanobacteria.

4) Gymnosperms are referred as heterosporous group of plants, because they produce haploid microspores and megaspores

5) The leaves in gymnosperms are well-adapted to survive in extremes of temperature, humidity and wind. The needle-like leaves reduce the surface area. Their thick cuticle and sunken stomata also help to reduce water loss.

CHAPTER 4 – ANIMAL KINGDOM

CONCEPT MAP



POINTS TO REMEMBER

Animals are multicellular and heterotrophic organisms without cell wall and chlorophyll. Kingdom Animalia
Includes 11 major phyla:

1) Porifera 2)Cnidaria 3)Ctenophora 4)Platyhelminthes 5)Aschelminthes
6) Annelida 7) Arthropoda 8)Mollusca 9)Echinodermata 10)Hemichordata
11) Chordata

1. LEVELS OF ORGANIZATION .
Based on this, animals are grouped into four level

a. Cellular level of organization: Here, the cells are arranged as loose cell aggregates. E.g. Porifera.

b. Tissue level of organization: Here, the cells are arranged into tissues. E.g. Cnidarians and Ctenophores.

c. Organ level of organization: Here, tissues are arranged into organs. E.g. Higher animals (Platyhelminthes to chordates).

d. Organ system level of organization: Here, organs are associated to form organ system. Each system performs a specific physiological function. E.g. Aschelminthes to chordate Organ systems of various animals show complexities. E.g. Higher Animals

2 CIRCULATORY SYSTEM is 2 types: open & closed.

3. BODY SYMMETRY

It is the arrangement of similar body parts on 2 sides of main axis of the body. Based on symmetry, animals

are 2 types: Asymmetrical and Symmetrical.

Asymmetrical: Here, body cannot be divided into 2 equal halves. E.g. Most members of porifera.

Symmetrical: Here, body can be divided into 2 equal halves. It is 2 types.

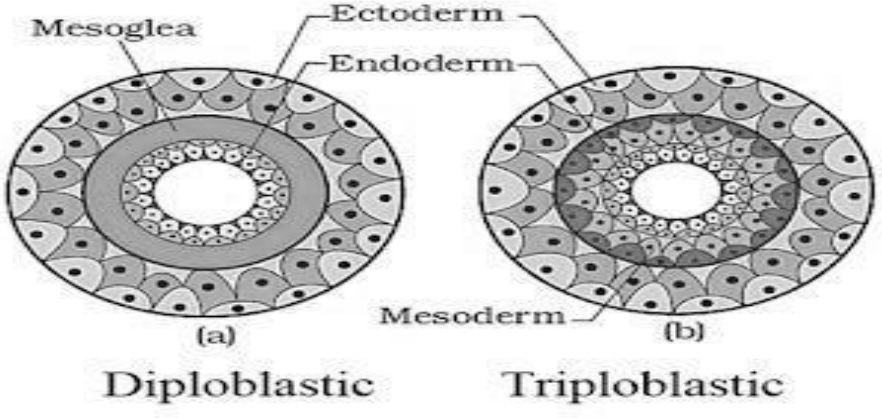
- Radial symmetry: Here, body can be divided into 2 equal halves in any vertical plane along central axis (oral-aboral axis) of the body. E.g. Members of Cnidaria, Ctenophores and Echinoderms (adult).

Bilateral symmetry: Here, body can be divided into right & left halves in only one plane.

E.g. Platyhelminthes to Chordata (except adult Echinodermata).

4. Germinal layers (Embryonic layers)

These are layers of embryo from which all the body organs are formed. Based on the number of germ layers, animals are 2 types- Diploblastic and Triploblastic.



a. Diploblastic animals: 2 germ layers- outer ectoderm and inner endoderm. In between these layers, an undifferentiated jelly-like layer called mesoglea is present. E.g. Cnidaria & Ctenophora.

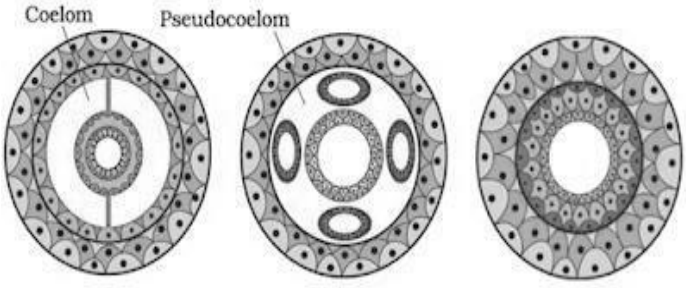
b. Triploblastic animals: 3 germ layers- Outer ectoderm, middle mesoderm and inner endoderm. E.g. Platyhelminthes to Chordata.

5. Coelom (body cavity:It is the cavity lined by mesoderm. It is seen between body wall and gut wall. Coelom separates the muscles of gut and body wall.

Based on the nature of coelom, animals are 3 types:

a. Acoelomate: No coelom. The space between body wall and digestive cavity is filled with matrix (parenchyma). E.g. Porifera to Platyhelminthes.

b. Pseudocoelomate: False coelom. Here, the body cavity is not lined by mesoderm. Mesoderm is scattered pouches. E.g. Aschelminthes.



c. Coelomate: True coelom. Here, the coelom arises from the mesoderm. Coelom is lined by peritoneal layer and filled with coelomic fluid. E.g. Annelida to Chordata.

Functions of coelom:

· It accommodates visceral organs.Coelomic fluid reduces friction between visceral organsIt acts as shock absorber.

6. Metamerism (segmentation

It is the phenomenon in which the body or organs is externally and internally divided into repeated segments (metameres). E.g. Annelids (earthworm etc.), Arthropods.*Notochord*

It is a mesodermally derived supporting rod formed on the dorsal side during embryonic development in some animals. Animals with notochord are called chordates and those without notochord are called non-chordates.

Phylum Porifera (Sponges): General Characters

1. Grades of organization:Cellular grade.
2. Symmetry:Asymmetrical. Some are radial.
3. Coelom:Acoelomate
4. Habit and habitat:Aquatic (mostly marine). Sedentary. Solitary/colonial.
5. Digestive system:Absent. Intracellular digestion.
6. Respiratory system:Absent
7. Circulatory system:Absent
8. Reproduction:Asexual (fragmentation) & Sexual.
9. Hermaphrodite (Monoecious): Male and female sex organs are seen in same individual.
   - Internal fertilization.Development is indirect.
10. Unique features:
    - Water canal (water transport) system. Millions of ostia (pores).
    - Water canal system: Here, water enters through minute pores (ostia) in the body wall into a central cavity (spongocoel), from where it goes out through osculum. Canal system is used for food gathering, gas exchange and removal of wastes.
    - Spongocoel & canals are lined with choanocytes (collar cells).
    - Body is supported by spicules and spongin fibres.
11. Examples:
    - *Sycon (Scypha), Spongilla* (fresh water sponge), *Euspongia* (Bath sponge)

· Phylum Cnidaria (Coelenterata): General Characters

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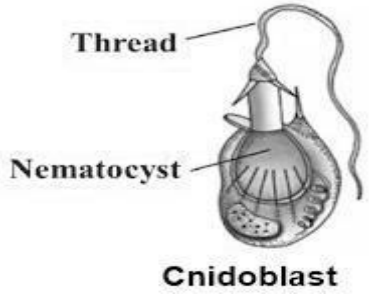
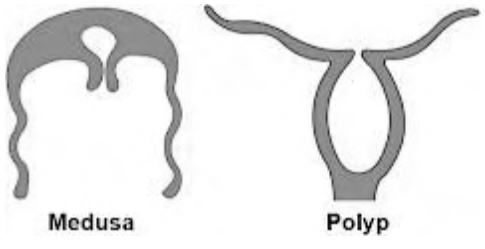
1. Grades of organization:Tissue grade.
2. Symmetry:Radial symmetry.
3. Germ layers:Diploblastic
4. Coelom:Acoelomate
5. Habit and habitat:Aquatic (mostly marine).Sessile/free swimming.,Solitary/colonial.
6. Digestive system:Incomplete.Intracellular & extracellular digestion.
7. Respiratory system:Absent
8. Circulatory system:Absent
9. Reproduction:
   - Polyp reproduces asexually (budding) and medusa sexually.
   - Most are separate sexes.,External fertilization.Development is indirect.
10. Unique features:Tentacles with cnidoblasts.
    - Tentacles: Finger-like structures which surrounds the mouth of coelenterates. Used for food capture & defense.
    - Cnidoblasts (Cnidocytes): These are stinging cells (present on the tentacles and the body) with a poison-filled capsule called *nematocyst*. Cnidoblast is used for anchorage,



defense and to capture prey.

- Gastro-vascular cavity (coelenteron) with an opening (mouth) on hypostome.
- Polyp & Medusa: 2 types of body forms in cnidarians.
- Polyp is tubular attached asexual form, with upwardly directed mouth & tentacles. E.g. *Hydra, Adamsia.*



- Medusa is umbrella like, free-swimming sexual form, with downwardly directed mouth & tentacles. E.g. *Aurelia* (Jelly fish).Some shows alternation of generation.
- Alternation of generation (Metagenesis): The phenomenon in which polyps produce medusae asexually and medusae form the polyps sexually. E.g. *Obelia.*
- Corals have skeleton (CaCO3).

Examples

- *Hydra, Obelia, Aurelia, Physalia* (Portuguese man of war), *Adamsia* (Sea- anemone), *Pennatula* (Sea pen), *Gorgonia* (Sea fan), *Meandrina* (Brain coral).

Phylum Ctenophora (Comb Jellies): General Characters

1. Grades of organization: Tissue grade.
2. Symmetry: Radial symmetry.

3. Germ layers:Diploblastic
4. Coelom:Acoelomate
5. Habit and habitat:Exclusively marine.Solitary & pelagic
6. Digestive system:Incomplete.Intracellular & extracellular digestion.
   Respiratory system:Absent
7. Circulatory system:Absent
8. Reproduction:Only Sexual.,Hermaphrodite.,External fertilization,Development is indirect.
9. Unique features:
   - Locomotion is by 8 vertical external rows of ciliated comb plates.,Tentacles present.
   - Shows Bioluminescence (property to emit light from the body).
10. Examples:*Ctenoplana, Pleurobrachia.*

Phylum Platyhelminthes (Flatworms): General Characters

1. Grades of organization:Organ & Organ system.
2. Symmetry:Bilateral symmetry.
3. Germ layers:Triploblastic.
4. Coelom:Acoelomate
5. Habit and habitat:Mainly aquatic. Endoparasites.Some are free-living.
6. Digestive system:Incomplete.
7. Respiratory system:Absent
8. Circulatory system:Absent
9. Reproduction:Asexual (fragmentation) and Sexual.
   - Hermaphrodite.Internal Fertilization.
   - Development is indirect.Many larval stages.
10. Unique features:
    - Unsegmented, dorso-ventrally flattened body (except tape worms).
    - Excretion and osmo-regulation by Flame cells (protonephridia).
    - Parasites have Hooks & suckers.
    - Some absorb nutrients from the host through their body surface.
11. Examples:

- *Taenia solium* (Tape worm), *Fasciola* (Liver fluke), *Planaria* (shows high regeneration capacity).

Phylum Aschelminthes (Roundworms): General Characters

1. Grades of organization:Organ system.
2. Symmetry:Bilateral symmetry.
3. Germ layers:Triploblastic.
4. Coelom:Pseudocoelomate.
5. Habit and habitat:Aquatic and terrestrial. Free living or parasitic in plants & animals.
6. Digestive system:Complete. Tubular alimentary canal with well-developed muscular pharynx.
7. Respiratory system:Absent
8. Circulatory system:Absent
9. Reproduction:
   - Dioecious (Sexes are separate).Sexual reproduction.
   - Internal fertilization.Development is direct or indirect.
10. Unique features:Body is circular in cross section.

- Syncytial epidermis.Thick cuticle.
- An excretory tube to remove body waste through excretory pore.
- Sexual dimorphism (Morphological differences between male and female. E.g. females are longer than males).

11. Examples:

- *Ascaris* (Roundworm), *Ancylostoma* (Hookworm), *Wuchereria* (Filarial worm).

Phylum Annelida (Segmented / Ringed Worms): General Character

1. Grades of organization:Organ system.
2. Symmetry:Bilateral symmetry.
3. Germ layers:Triploblastic.
4. Coelom:Coelomate.
5. Habit and habitat:Terrestrial, fresh water or marine. Free living or parasitic.
6. Digestive system:Complete.
7. Respiratory system:Cutaneous respiration. Some have branchial (gill) respiration.
8. Circulatory system:Closed type.
9. Reproduction:Sexual.
   - Earthworms & leeches are monoecious.Neries is dioecious.Development is direct or indirect.
10. Unique features:
    - Segmentation like rings.Longitudinal and circular muscles help in locomotion.
    - Locomotory organs are setae (in earthworm) or parapodia (in Neries).
    - Excretion by Nephridia.Paired ganglia connected by lateral nerves to a double ventral nerve cord.
11. Examples:
    - Pheretima (earthworm), Hirudinaria (blood sucking Leech), Neries (aquatic. Parapodia for swimming).

Phylum Arthropoda (Joint-Legged Animals): General Characters

Arthropoda is the largest phylum. Over two-thirds of all named species are arthropods.

1. Grades of organization:Organ system.
2. SymmetryBilateral symmetry.
3. Germ layers:Triploblastic.
4. Coelom:Coelomate.
5. Habit and habitat:Cosmopolitan.
6. Digestive system:Complete.
7. Respiratory system:
   - Gills/ book gills/ trachea/book lungs.
8. Circulatory system:Open type.
9. Reproduction:Mostly dioecious.
   - Usually internal fertilization.oviparous.Development is direct or indirect.
10. Unique features:
    - Jointed appendages.Body has 3 regions: head, thorax & abdomen.
    - Body is covered by chitinous cuticle (exoskeleton).Excretion by Malpighian tubules.
    - Sensory organs are antennae, compound & simple eyes, statocysts (balance organs).
11. Examples:

- Spider, Scorpion, Crab, Prawn, Insects etc.
- Economically important insects: *Apis, Bombyx, Laccifer*.
- Vectors: Mosquitoes (*Anopheles, Culex & Aedes*), Housefly etc.
- Gregarious pest: *Locusta*.
- Living fossil: *Limulus* (King crab).

Phylum Mollusca (Soft Bodied Animals): General Characters

Mollusca is the second largest phylum.

1. Grades of organizationOrgan system.Symmetry:Bilateral symmetry.
2. Germ layers:Triploblastic.:Coelomate.
3. Habit and habitat:Aquatic.Few are terrestrial.Digestive system:Complete.
4. Respiratory system:Gills in aq. forms and pulmonary sac in terrestrial forms.
5. Circulatory system:Open type.
6. Reproduction:Dioecious.Oviparous.Development is direct or indirect.
7. Unique features:Body has head, visceral mass (visceral hump) & muscular foot. Head has sensory tentacles.Calcareous shell.Feather-like gills for respiration & excretion.

- Mantle & radula are seen.Mantle (Pallium): The membrane which covers visceral mass. Space between the hump and mantle is called *mantle cavity*.
- Radula: File-like rasping organ present in the mouth of molluscs. It is used for feeding.
- Examples: *Pila* (Apple Snail), *Pinctada* (Pearl Oyster), *Sepia* (Cuttlefish), *Loligo* (Squid), *Octopus* (Devil fish), *Aplysia* (Sea Hare), *Dentalium* (Tusk shell), *Chaetopleura* (Chiton).

Phylum Echinodermata (Spiny Skinned Animals): General Characters

a. Grades of organization:Organ system.
   a. Symmetry:Adults radial. Larvae bilateral.
   b. Germ layers:Triploblastic.
   c. Coelom:Coelomate.Habit and habitat:Exclusively marine.
   d. Digestive system:Complete.Ventral mouth and dorsal anus.
   e. Respiratory system:Dermal branchiae (skin gills or papulae) and tube feet.
   f. Circulatory system:Open type.
   g. Reproduction:Dioecious.External fertilization.Development is indirect.Ciliated free-swimming larva.
   h. Unique features:They have an endoskeleton of calcareous ossicles (Spiny bodied).Head absent.

- Water vascular system present.
- Water vascular (ambulacral) system: In this system, sea water enters through a porous plate called madreporite and reaches the radiating canals and tube feet (podia). Its functions are locomotion, respiration, capture & transport of food and excretion.
- Excretory system absent.Shows autotomy & regeneration.

Examples: *Asterias* (Starfish), *Echinus* (Sea Urchin), *Echinocardium*, *Antedon* (Sea Lily), *Cucumaria* (Sea Cucumber), *Ophiura* (Brittle Star).

Phylum Hemichordata: General Characters

Hemichordata was earlier considered as a sub-phylum of Chordata. Like chordates, it has pharyngeal gill slits.

a. Grades of organization:Organ system.Symmetry:Bilateral,Germ layers:Triploblastic.
b. Coelom:Coelomate.Habit and habitat:Exclusively marine.

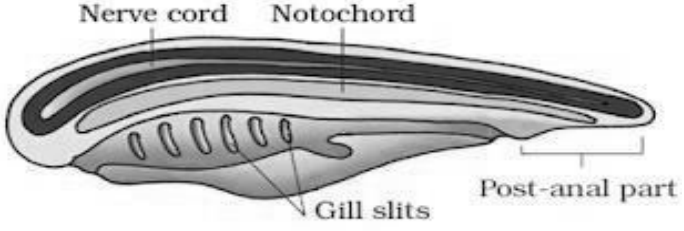
c. Digestive system:Complete.Respiratory system:Gills.Circulatory system:Open type.

d. Reproduction:Dioecious.External fertilization.Development is indirect.

e. Unique features:Worm-like cylindrical body formed of anterior proboscis, a collar and a long trunk.Collar bears stomochord (a rudimentary structure similar to notochord).Excretion by Proboscis gland.Examples: *Balanoglossus* (Tongue worm), *Saccoglossus.*

Phylum Chordata

1. It includes animals with notochord, dorsal tubular nerve cord and pharyngeal gill slits.



Chordata characteristics (Body plan)

2. Notochord is a flexible rod located in the mid dorsal line between the alimentary canal and the nerve cord in the embryo.

Differences between Chordata and Non-Chordata

Chordata	Non-Chordata
1. Notochord is found in the embryonic stage.	Absent
2. Central nervous system is dorsal, hollow and single	Ventral, solid and double
3. Pharyngeal gill slits present	Absent
4. Ventral heart	Dorsal heart (if present)
5. A post-anal part (tail) is present	Absent

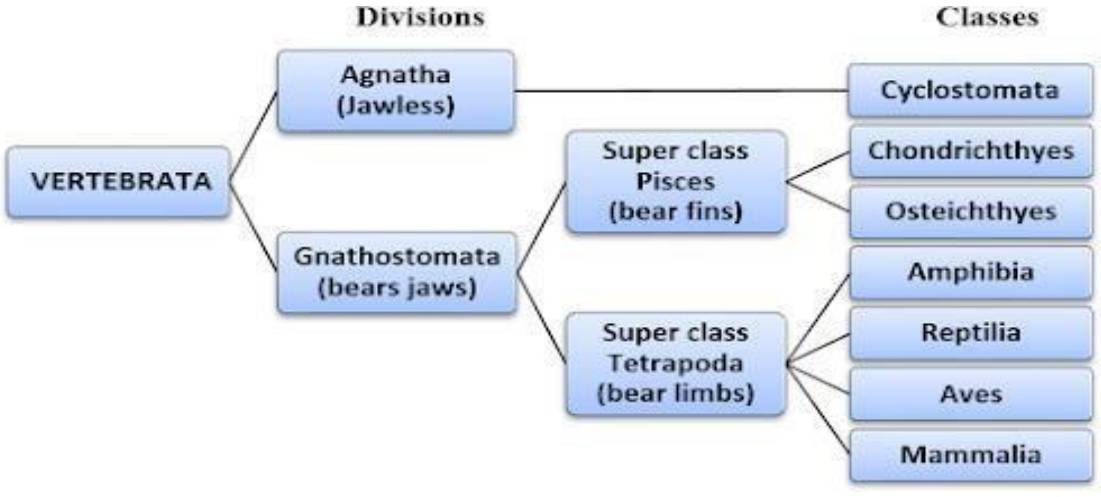
Phylum Chordata is classified into 3 subphyla: Urochordata, Cephalochordata & Vertebrata.

PROTOCHORDATA (ACRANIATA)	
Urochordata (Tunicata)	Cephalochordata
· Notochord present only in the larval tail. · Body is covered by a test made up of tunicin. · Exclusively marine. · Hermaphrodite. · E.g. *Ascidia, Salpa, Doliolum*	· Notochord from head to tail region and is persistent throughout life. · Fish-like body. · Exclusively marine. · Sexes are separate. · E.g. *Branchiostoma* (Amphioxus or Lancelet).

Vertebrata (Craniata)

1. Possess notochord during the embryonic period.
2. Notochord is replaced by a cartilaginous or bony vertebral column in the adult.
3. Ventral muscular heart.
4. Kidneys for excretion & osmoregulation
5. Paired appendages (fins or limbs).

Classification Of Vertebrata



Class Cyclostomata

- All are ectoparasites on some fishes.Elongated body without scales and paired fins.
- 6-15 pairs of gill slits for respiration. Sucking and circular mouth without jaws.
- Cartilaginous cranium and vertebral column.Circulation is a closed type.
- Marine, but migrate for spawning to fresh water. After spawning, they die. Their larvae, after metamorphosis, return to the ocean.E.g. *Petromyzon* (Lamprey) and *Myxine* (Hagfish).

SUPERCLASS PISCES (FISHES)

Class Chondricthyes (Cartilaginous fishes)

- Marine. Stream-lined body. Predaceous.Cartilaginous endoskeleton.
- Notochord is persistent throughout life.Ventral mouth.Gill slits without operculum. Powerful jaws.
- Skin with placoid scales. Teeth are modified placoid scales which are backwardly directed.
- No air bladder. So, they have to swim constantly to avoid sinking.Poikilotherms (cold-blooded).
- Two-chambered heart (one auricle and one ventricle).Sexes are separate. In males, pelvic fins bear claspers. Internal fertilization. Many of them viviparous.

  Examples: *Scoliodon* (Dogfish), *Pristis* (Saw fish), *Carcharodon* (Great white shark), *Trygon* (Sting ray- has poison sting), *Torpedo* (Electric ray- has *electric organ).*

Class Osteichthyes (Bony fishes)

- Marine & fresh water. Stream-lined body.

- Bony endoskeleton.Terminal mouth.4 pairs of gills covered by operculum on each side.
- Scales are Cycloid, ctenoid etc Air bladder for buoyancy.
- Poikilotherms (cold-blooded).Two-chambered heart (one auricle and one ventricle).
- Sexes are separate. External fertilization,Mostly oviparous. Development is direct.
- Examples:Marine: *Exocoetus* (flying fish), *Hippocampus* (seahorse)
- Fresh water: *Labeo* (Rohu), *Catla* (Katla), *Clarias* (Magur).Aquarium: *Betta* (Fighting fish), *Pterophyllum* (Angel fish).

SUPERCLASS TETRAPODA

Class Amphibia

- They live in aquatic & terrestrial habitats and need water for breeding.
- Body has head & trunk. Some have tail.*Moist skin* without scales. Most have 2 pairs of limbs.
- *Tympanum* represents ear.*3-chambered* heart (2 auricles + 1 ventricle).
- *Poikilotherms*
- Alimentary canal, urinary & reproductive tracts open into a *Cloaca* which opens to exterior.
- Respiration is by *gills* (in larva), *lungs* & *skin*
- Sexes are separate. External fertilisation. *Oviparous*.Development is indirect.

Examples: *Bufo* (Toad), *Rana* (Frog), *Hyla* (Treefrog), *Salamandra* (Salamander), *Ichthyophis* (Limbless amphibia).

Class Reptilia

- Dry & cornified skin, epidermal *scales* or *scutes*.Snakes and lizards shed their scales as *skin cast*.
- Limbs- 2 pairs (if present).Crawling mode of locomotion.*Tympanum* represents ear.
- *3-chambered* heart (but a septum partially separates ventricle). Heart is *4- chambered* in crocodiles.
- *PoikilothermsWell-developed alimentary canal.*
- Respiration by *lungs*.Internal fertilisation. *Oviparous*.Development is direct.

Examples: *Chelone* (Turtle), *Testudo* (Tortoise), *Chameleon* (Tree lizard), *Calotes* (Garden lizard), *Crocodilus* (Crocodile), *Alligator*, *Hemidactylus* (Wall lizard).

- Poisonous snakes: *Naja* (Cobra), *Bangarus* (Krait), *Vipera* (Viper) etc.
- Non-poisonous snakes: *Python* etc.

Class Aves (Birds)

- Presence of *feathers* and *beak*. Forelimbs are modified into *wings*.
- Dry skin without glands except the *oil gland* at the base of tail.
- Hind limbs have *scales* and are modified for walking, swimming or clasping tree branches.
- Hollow & pneumatic long bones.*Tympanum* represents ear.*4-chambered* heart.
- *HomoiothermsDigestive tract has additional chambers, the crop & gizzard.*
- Double respiration.*Air sacs* connected to lungs..Internal fertilisation.Oviparous.Development is direct.

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

- Presence of mammary glands (milk producing glands).
- Skin with hair.2 pairs of limbs for walking, running, climbing, burrowing, swimming or flying.
- External ear (Pinnae).4-chambered heart.HomoiothermsWell-developed alimentary canal.
- Dentition is Heterodont, thecodont & diphyodont.Respiration by lungs.Sexes are separate.
- Internal fertilisation.Viviparous (except Echidna and Platypus).Development is direct.

Examples: *Ornithorhynchus* (Platypus), *Macropus* (Kangaroo), *Pteropus* (flying fox), *Camelus* (Camel), *Macaca* (Monkey), *Rattus* (Rat), *Canis* (dog), *Felis* (Cat), *Elephas* (Elephant), *Equus* (Horse), *Delphinus* (Common dolphin), *Balaenoptera* (blue whale), *Panthera tigris* (Tiger), *Panthera leo* (lion).

· Poikilotherms (Cold-blooded animals): Animals that lack the capacity to regulate their body temperature.
· Homoiotherms (warm-blooded animals): Animals having ability to maintain a constant body temperature

QUESTION AND ANSWER

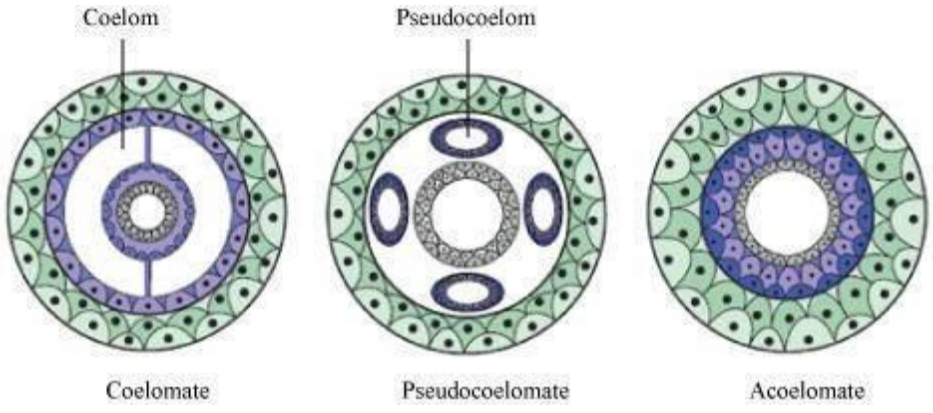
Question 1: What are the difficulties that you would face in classification of animals, if common fundamental features are not taken into account?
ANSWER: For the classification of living organisms, common fundamental characteristics are considered. If we consider specific characteristics, then each organism will be placed in a separate group and the entire objective of classification would not be achieved.

Classification of animals is also important in comparing different organisms and judging their individual evolutionary significance. If only a single characteristic is considered, then this objective would not be achieved.

Questn 2: If you are given a specimen, what are the steps that you would follow to classify it?
ANSWER: There is a certain common fundamental feature that helps in classification of living organisms. he features that can be used in classification are as follows.

On the basis of above features, we can easily classify a specimen into its respective category.

Question 3: How useful is the study of the nature of body cavity and coelom in the classification of animals?
ANSWER: Coelom is a fluid filled space between the body wall and digestive tract. The presence or absence of body cavity or coelom plays a very important role in the classification of animals. Animals that possess a fluid filled cavity between body wall and digestive tract are known as coelomates. Annelids, mollusks, arthropods, echinodermates, and chordates are examples of coelomates. On the other hand, the animals in which the body cavity is not lined by mesoderm are known as pseudocoelomates. In such animals, mesoderm is scattered in between ectoderm and endoderm. Aschelminthes is an example of pseudocoelomates. In certain animals, the body cavity is absent. They are known as acoelomates. An example of acoelomates is platyhelminthes.



Question 4: Distinguish between intracellular and extracellular digestion?
ANSWER:

Intracellular digestion		Extracellular digestion
The digestion of food occurs within the cell.	1.	The digestion occurs in the cavity of alimentary canal.
Digestive enzymes are secreted by the surrounding cytoplasm into the food vacuole.	2.	Digestive enzymes are secreted by special cells into the cavity of alimentary canal.
Digestive products are diffused into the cytoplasm.	3.	Digestive products diffuse across the intestinal wall into various parts of the body.
It is a less efficient method.	4.	It is a more efficient method of digestion.
It occurs in unicellular organisms.	5.	It occurs in multi cellular organisms.

Question 5: What is the difference between direct and indirect development?

ANSWER:

	Direct Development		Indirect Development
1.	It is a type of development in which an embryo develops into a mature individual without involving a larval stage.	1.	It is a type of development that involves a sexually-immature larval stage, having different food requirements than adults.
2.	Metamorphosis is absent.	2.	Metamorphosis involving development of larva to a sexually-mature adult is present.
3.	It occurs in fishes, reptiles, birds, and mammals.	3.	It occurs in most of the invertebrates and amphibians.

Question 6: What are the peculiar features that you find in parasitic platyhelminthes? ANSWER: *Taenia* (Tapeworm) and *Fasciola* (liver fluke) are examples of parasitic platyhelminthes. Peculiar features in parasitic platyhelminthes are as follows.

1. They have dorsiventrally flattened body and bear hooks and suckers to get attached inside the body of the host.
2. Their body is covered with thick tegument, which protects them from the action of digestive juices of the host.
3. The tegument also helps in absorbing nutrients from the host's body

Question 7: What are the reasons that you can think of for the arthropods to constitute the largest group of the animal kingdom?

ANSWER: The phylum, Arthropoda, consists of more than two-thirds of the animal species on earth. The reasons for the success of arthropods are as follows.

i. Jointed legs that allow more mobility on land
ii. Hard exoskeleton made of chitin that protects the body
iii. The hard exoskeleton also reduces water loss from the body of arthropods making them more adapted to terrestrial conditions.

Question 8: Water vascular system is the characteristic of which group of the following:

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

ANSWER: Water vascular system is a characteristic feature of the phylum, Echinodermata. It consists of an array of radiating channels, tube feet, and madreporite. The water vascular system helps in locomotion, food capturing, and respiration.

Question 9: "All vertebrates are chordates but all chordates are not vertebrates". Justify the statement.

ANSWER: The characteristic features of the phylum, Chordata, include the presence of a notochord and paired pharyngeal gill slits. In sub-phylum Vertebrata, the notochord present in embryos gets replaced by a cartilaginous or bony vertebral column in adults. Thus, it can be said that all vertebrates are chordates but all chordates are not vertebrates.

Question 10: How important is the presence of air bladder in Pisces?

ANSWER: Gas bladder or air bladder is a gas filled sac present in fishes. It helps in maintaining buoyancy. Thus, it helps fishes to ascend or descend and stay in the water current.

Question 11: What are the modifications that are observed in birds that help them fly?

ANSWER: Birds have undergone many structural adaptations to suit their aerial life. Some of these adaptations are as follows.

(i) Streamlined body for rapid and smooth movement

(ii) Covering of feathers for insulation

(iii) Forelimbs modified into wings and hind limbs used for walking, perching, and swimming

(iv) Presence of pneumatic bones to reduce weight

(v) Presence of additional air sacs to supplement respiration

Question 12: Could the number of eggs or young ones produced by an oviparous and viviparous mother be equal? Why?

ANSWER: The numbers of eggs produced by an oviparous mother will be more than the young ones produced by a viviparous mother. This is because in oviparous animals, the development of young ones takes place outside the mother's body. Their eggs are more prone to environmental conditions and predators. Therefore, to overcome the loss, more eggs are produced by mothers so that even under harsh environmental conditions, some eggs might be able to survive and produce young ones. On the other hand, in viviparous organisms, the development of young ones takes place in safe conditions inside the body of the mother. They are less exposed to environmental conditions and predators. Therefore, there are more chances of their survival and hence, less number of young ones is produced compared to the number of eggs.

Question 13: Segmentation in the body is first observed in which of the following:

(a) Platyhelminthes (b) Aschelminthes (c) Annelida (d) Arthropoda

ANSWER: The body segmentation first appeared in the phylum, Annelida (*annulus* meaning little ring).

Question 14: Match the following:

(a) Operculum	(i) Ctenophora
(b) Parapodia	(ii) Mollusca
(c) Scales	(iii) Porifera
(d) Comb plates	(iv) Reptilia
(e) Radula	(v) Annelida
(f) Hairs	(vi) Cyclostomata and Chondrichthyes
(g) Choanocytes	(vii) Mammalia
(h) Gill slits	(viii) Osteichthyes

ANSWER:

	Column I		Column II
(a)	Operculum	(viii)	Osteichthyes
(b)	Parapodia	(v)	Annelida
(c)	Scales	(iv)	Reptilia
(d)	Comb plates	(i)	Ctenophora
(e)	Radula	(ii)	Mollusca
(f)	Hairs	(vii)	Mammalia
(g)	Choanocytes	(iii)	Porifera
(h)	Gill slits	(vi)	Cyclostomata and Chondrichthyes

Question 15: Prepare a list of some animals that are found parasitic on human beings.

ANSWER:

S. No.	Name of organism	Phylum
1	*Taenia solium*	Platyhelminthes
2	*Fasciola hepatica*	Platyhelminthes
3	*Ascaris lumbricoides*	Aschelminthes
4	*Wuchereria bancrofti*	Aschelminthes
5	*Ancyclostoma*	Aschelminthes

16 . Differentiate between chondrichthyes and osteichthyes?

Chondrichthyes	Osteichthyes

1. The members of class chondrichthyes posses cartilaginous endoskeleton 2. Their skin bears placoid scales 3. Mouth is located ventrally 4. The gills slits are without and operculum. 5. They lack air bladder. 6. Fertilsation is internal 7. Many members are viviparous.	1. The members of class osteichthyes have boney endoskeleton. 2. Their skin is covered with cycloid/ctenoid scales. 3. The mouth is mostly terminal. 4. The gills are covered by an operculum on each side. 5. They posses air bladder 6. Fertilisation is external 7. They are mostly oviparous.

17. Match the following :

a. Amphibia	i. i.Air bladder
b. Mammals	ii. cartilaginous notochord
c. Chondrichthyes	iii. Mammary glands
d. Osteichthyes	iv. Pneumatic bones
e. Cyclostomata	v. Dual habitat
f. Aves	vi. Mouth without jaws

Ans. a-v,b-iii,c-ii,d-i,e-vi,f-iv

18. Draw a labeled diagram of cnidoblast . Mention its two functions.

Ref. fig.4.7 NCERT Text book.

Cnidoblasts are used by cnidarians for anchorage, defense and for the capture of the pray.

19. Creative and critical thinking.

Birds are vertebrates with wings and feathers.

Most birds can fly ,using power full muscles to flap their wings. But a few bird species do not have strong enough wings to fly, and so these birds are flightless.

Birds occur everywhere in the fields, forest, deserts, mountains and water, poles etc. They exhibit a verity of behaviors. They produce peculiar sound and communicate with the each other by songs and birdcalls.

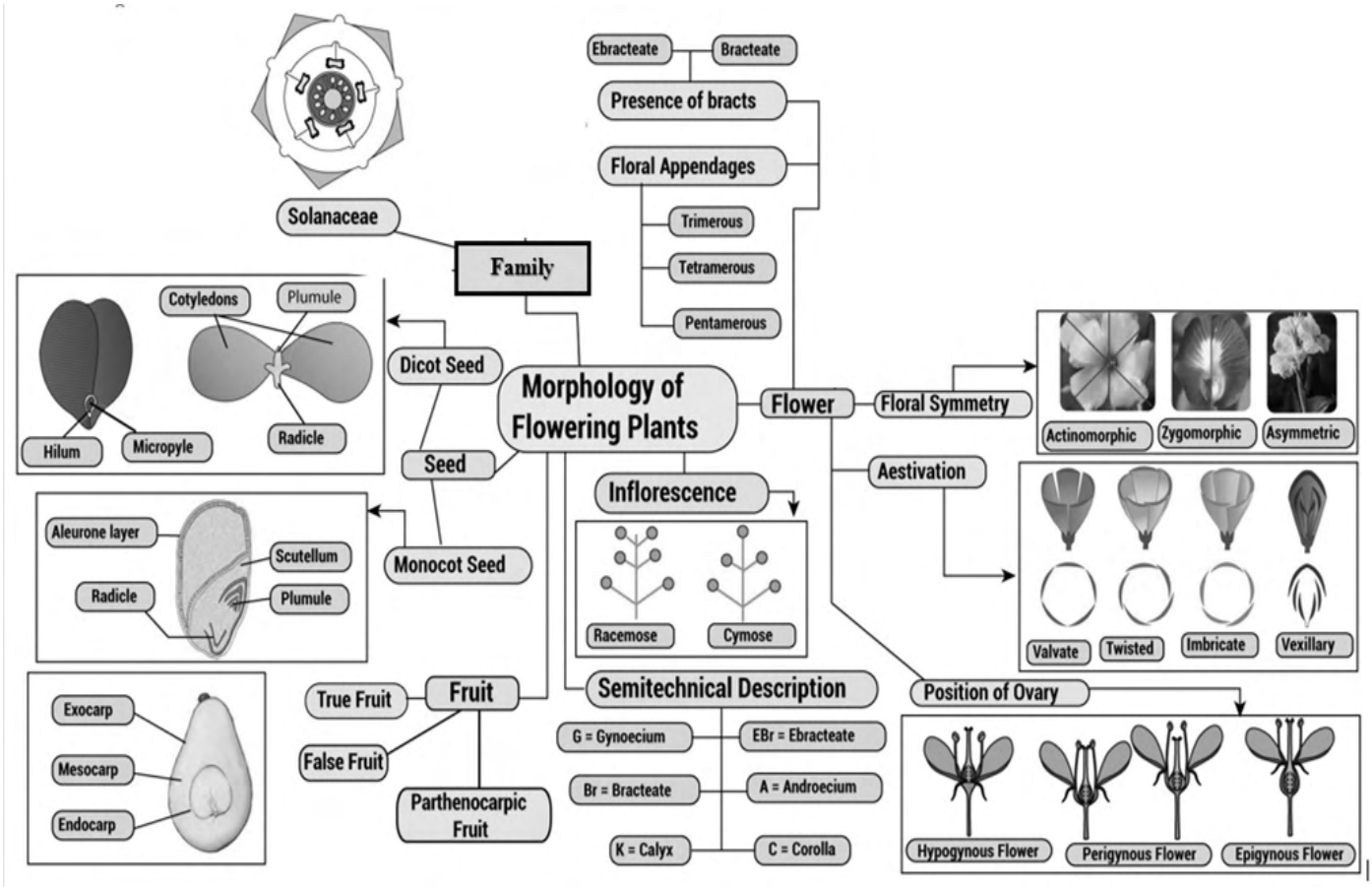
Answer the following questions related to birds.

1. Name a flightless bird.
2. Give any two features in which birds resemble with mammals.
3. Write two features in which birds resemble with reptiles.

Answers:

1. Ostrich(Struthio)
2. Both are warm blooded animals, both have four chambered heart.
3. The body of reptiles is covered by cornified scales, Birds have scales only on their hind limbs, Both are oviparous animals.(Except some snakes)

CONCEPT MAP



POINTS TO REMEMBER

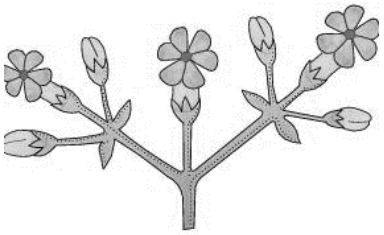
Inflorescence

Racemose Inflorescence

In this type of inflorescence, the flowers branch laterally on the floral axis. Here the floral axis keeps on growing and the flowers develop in an acropetal pattern.

Cymose Inflorescence

In this type of inflorescence, the flower is the terminating point of each floral axis. In Cymose inflorescence, flowers follow the basipetal pattern of growth.



Flowers

The flowers are the reproductive part of the plant. The arrangement of flowers on the floral axis is called inflorescence, which has two major parts called racemose which let the main axis continue to grow and cymose which terminates the main axis in a flow.

The flower consists of four different whorls:

- Calyx, the outermost.
- Corolla, composed of petals.
- Androecium, composed of stamens.
- Gynoecium, composed of one or more carpels.

The reproduction in plants occurs by the process of pollination. It is the process of transfer of pollen from the anther to the stigma of the same or different plants.

Functions of Flowers

The flower performs the following important functions:

1. They help in the process of reproduction.
2. They produce diaspores without fertilization.
3. The gametophytes develop inside the flower.
4. The flowers attract insects and birds which then act as a medium to transfer the pollen from the anther of one flower to the stigma of some other flower.
5. The ovary of the flower develops into a fruit that contains seed.

Fruits

The fruit is the characteristic feature of flowering plants, which is a ripened or mature ovary and the seed is what the ovules develop into after fertilization. The fruit that develops without fertilization is known as parthenocarpic.

Types of Fruits

There are three different types of fruits and are classified mainly based on their mode of development.

1. Simple— Developed from the monocarpellary ovary or multicarpellary syncarpous ovary. Examples of simple fruits.
2. Aggregate–Developed from the multicarpellary apocarpous ovary. Examples of aggregate fruits.

3. Composite–These are false fruits, developed from the entire inflorescence rather than from single flower. Examples of composite fruits include blackberries, Raspberries strawberries, etc.

The Seed

A seed is a basic part of a plant, which is found enclosed within the fruit. It is made up of a seed coat and an embryo. During the development of the fruit, the wall of the ovary becomes the pericarp. In some plants, the ovary wallsdry out completely, while in some it remains fleshy.

Types of Seeds

Based on the number of cotyledons, seeds are further classified into two types- dicotyledonous and monocotyledonous seeds.

1. Monocotyledonous— The embryo consists of an embryo axis and has only one cotyledon. The monocotyledonous is also known as monocot seeds. Grains including rice, millet, wheat and other plants like onions, corn, ginger banana, palm tree, are examples of monocot seeds.
2. Dicotyledonous— The embryo consists of an embryo axis and has two cotyledons. The dicotyledons are also known as dicots or dicot seeds. Legumes including beans, lentils, pea, peanuts, and tomato are examples of dicot seeds.

DESCRIPTION OF FAMILY SOLANACEAE

It is a large family, commonly called as the 'potato family'. It is widely distributed in tropics, subtropics and even temperate zones.

Vegetative Characters

Plants mostly herbs, shrubs and rarely small trees

Stem: herbaceous rarely woody, aerial; erect, cylindrical, branched, solid or hollow, hairy or glabrous, underground stem in potato (Solanum tuberosum)

Leaves: alternate, simple, rarely pinnately compound, exstipulate; venation reticulate

Floral Characters

Inflorescence : Solitary, axillary or cymose as in Solanum

Flower: bisexual, actinomorphic

Calyx: sepals five, united, persistent, valvate aestivation

Corolla: petals five, united; valvate aestivation

Androecium: stamens five, epipetalous

Gynoecium: bicarpellary, syncarpous; ovary superior, bilocular, placenta swollen with many ovules

Fruits: berry or capsule

Seeds: many, endospermous

Floral Formula: $\oplus \male \female K_{(5)}\ \overset{\frown}{C_{(5)}}\ A_5\ \underline{G}_{(2)}$

Economic Importance

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

QUESTION AND ANSWER

1. Roots that grow from any other part of the plant other than the radicle are called
(a) taproots(b) adventitious roots
(c) prop roots(d) epiphytic roots

ANS (b) adventitious roots

2. A large globular root that tapers sharply at the lower end is called
(a) fusiform(b) napiform(c) conicalANS(b) napiform

3. The roots that have swellings at regular intervals are called
(a) nodulose(b) fasciculated(c) moniliform(d) tuberousANS(c) moniliform

4, Massive aerial roots present in a Banyan tree is
(a) fibrous(b) respiratory(c) epiphytic(d) prop rootsANS d) prop roots

5. Plants growing in swamps have roots that grow vertically upwards like
conical spikes and have aerating pores. Such roots are called
(a) pneumatophores(b) mycorrhizal(c) conical(d) assimilatoryANS(a) pneumatophores

6. The roots of the parasitic plant Cuscuta are of
(a) climbing(b) prop or stilt(c) mycorrhizal(d) haustoriaANS(d) haustoria

7. A short, vertical underground stem that contains the food reserve is called
(a) rhizome(b) bulb(c) corm(d) tuberANS(c) corm

8. Ginger is an example of
(a) rhizome(b) bulb(c) corm(d) tuberANS(a) rhizome

9. A long green stem with long internodes growing horizontally on the soil surface is called
(a) runner(b) sucker(c) stolon(d) offsetANS(a) runner

10. A short, green, flattened branch resembling a leaf arising from the axil of a reduced scale leaf is called
(a) phylloclade(b) cladode(c) phyllode(d) stipuleANS (b) cladode

.11 What are Adventitious roots?

The roots developed from different parts of the plant other than radicle are called as the Adventitious roots.

12. Which is the edible part of the ginger plant?

Rhizome.

13 What is Venation?

Venation is the arrangement of veins in a leaf of a plant.

14.Which is the edible part in onion plant?

Fleshy scale leaves.

15.Where does woad come from?

16.Woad, also called as the Isatis tinctoria or the blue dye. It is a flowering plant of the family Brassicaceae known as Asp of Jerusalem. Woad is produced from the leaves of the plant.

17.Explain why maize grain is called as a fruit and not a seed?

Maize grain is usually called as a fruit and not a seed because they are borne or produced from the ripened ovary located within the grass Inflorescence.

18.Explain why sunflower is not considered as a flower?

Sunflower, a group of herbaceous plants from family Asteraceae and genus Helianthus are not considered as a flower because of it lacks either the male (Stamens) or the female organs (Pistils) or the gametes.

PREVIOUS YEAR QUESTIONS

Q1. Roots obtain oxygen from air in the soil for respiration. In the absence or deficiency of 02, root growth is restricted or completely stopped. How do the plants growing in marshlands or swamps obtain their 02 required for root respiration?
Ans: In some plants such as Rhizophora and Sonneratia (mangrove plant) growing in swampy areas near river mouths (saline marshy soil or halophytes), many roots come out of the ground and grow vertically upwards (negatively geotropic: against gravitational force). Such roots, called pneumatophores or breathing roots or respiratory roots, help to get oxygen for respiration.

Q3. In Opuntia the stem is modified into a flattened green structure to perform the function of leaves (i.e., photosynthesis). Cite some other examples of modifications of plant parts for the purpose of photosynthesis.
Ans: Some plants of arid regions modify their stems into flattened {Opuntia), or fleshy cylindrical {Euphorbia) structures. These modified stems of indefinite growth are called phylloclades. They contain chlorophyll and carry out photosynthesis.

Q3. Give two examples of roots that develop from different parts of the angiospermic plant other than the radicle.
Ans: The root that arise from parts of plant other than radicle are called adventitious roots. Pneumatophores—for respiration Stilt roots—for support Prop roots—for support

Q4. The essential functions of roots are anchorage and absorption of water and minerals in the terrestrial plant. What functions are associated with the roots of aquatic plants? How are roots of aquatic plants and terrestrial plants different?
Ans: The roots of aquatic plants help in balancing and anchorage. In terrestrial plants, functions of roots are anchorage and absorption of water and minerals.

Q5. A typical angiosperm flower consists of four floral parts. Give the names of the floral parts and their arrangements sequentially.
Ans: A typical flower has four different kinds of whorls arranged successively on the swollen end of the stalk or pedicel, called thalamus or receptacle. These are calyx, corolla, androecium and gynoecium. The calyx is the outermost whorl of the flower and the members are called sepals. Corolla

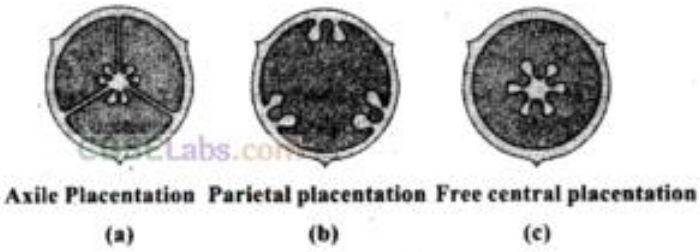
is the second outermost whorl composed of petals. Androecium is the second innermost whorl composed of stamens. Gynoecium is the innermost whorl which is female reproductive part of the flower and is made up of one or more carpels.

Q6. Reticulate venation is found in dicot leaves while in monocot leaves venation is of parallel type. Biology being a 'Science of exceptions', find out any exception to this generalization.
Ans: Smilax and Dioscorea are monocots having reticulate venation. Calophyllum and Eryngium are dicots having parallel venation.

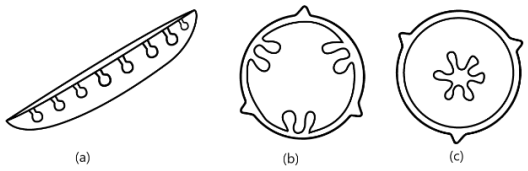
Q7. Mango and coconut are 'drupe' type of fruits. In mango fleshy mesocarp is edible. What is the edible part of coconut? What does milk of tender coconut represent?
Ans: Edible part of coconut is endosperm or seed. Milk of tender coconut represent free nuclear liquid endosperm.

Q8. How can you differentiate between free central and axile placentation?
Ans: When the ovules are borne on central axis and septa are absent, as in Dianthus and Primrose the placentation is called free central.
When the placenta is axial and the ovules are attached to it in a multilocular ovary, the placentation is said to be axile, as in China rose, tomato and lemon.

Q9. The arrangements of ovules within the ovary is known as placentation. What does the term placenta refer to? Name and draw various types of placentations in the flower as seen in T.S. or V.S.
Ans: The ovules are female reproductive structures and borne in the ovary of the flower. The number, structure, their position in the ovary varies in different plants. They also differ in mode of attachment with the ovary wall. At the point of attachment there is a cellular ridge or cushion of cells called placenta. The mode of attachment of ovule to the placenta is known as placentation which is of the following types: (a) Parietal (b) Marginal (c) Axile (d) Free central (e) Basal.



Q10. Observe the given figure showing various types of placentation. Identify the type of placentation. Give one example of each.



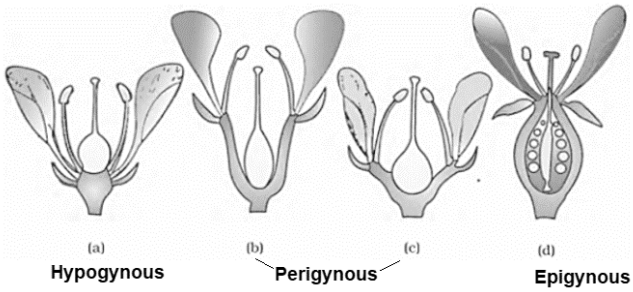
Various Types of Placentation

Ans: The type of placentation is: -

a. Marginal placentation: - Pea
b. Parietal placentation: - Argemone
c. Free central placentation: - Dianthus Primrose

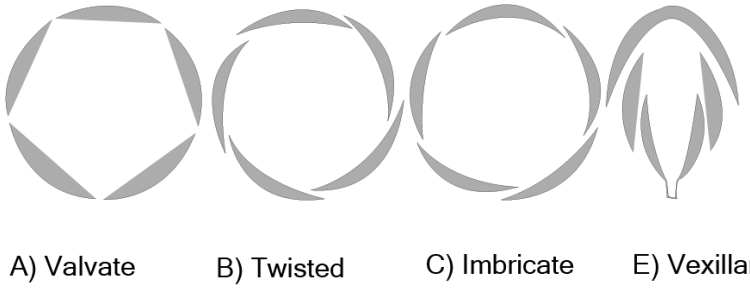
Q11. Describe the arrangement of floral members in relation to their insertion on the thalamus.
Ans: The position of the calyx, corolla, and androecium in reference to the ovary on the thalamus is used to classify flowers into three categories:

a) Hypogynous Flowers: The gynoecium is at the top of the flower while the rest of the whorls lie below it. Example: - Mustard, China rose, etc.
b) Perigynous Flowers: The gynoecium is in the centre while the rest of the whorls of the flower are situated on the rim of the thalamus. They all lie almost at the same level. The ovary is half inferior. Example: Plum and rose.
c) Epigynous Flowers: - The margins of the thalamus grow upwards enclosing the ovary completely. The rest of the whorls of the flower arise above the ovary. The ovary is inferior. Example: Guava, sunflower and Cucumber.



Classification of flowers based on position of floral parts on thalamus

Q12. What is aestivation? What are its different types and give examples?
Ans: Aestivation is the positional arrangement of sepals or petals in a floral bud. Different types of aestivations are: -
(a) Valvate Aestivation: - Petals or sepals meet each other at the edge. They are arranged without overlapping. Example: - Guava and mustard.
(b) Twisted Aestivation: - The overlapping of petals or sepals is done by one margin of each petal over the margin of adjacent petals. Example: - China Rose and cotton.
(c). Imbricate Aestivation: -The margins of sepals and petals overlap. They do not overlap in a specific direction. Example: - Cassia and Gulmohar.
(d).Vexillary Aestivation: - There are five petals. The largest petal overlaps the 2 lateral petals which successively overlap the 2 smallest anterior petals. Example: - Bean and pea.



Different Types of Aestivation

COMPETENCY BASED QUESTIONS

1. Omprakash used to go to vegetable market with his grandfather, a retired biology teacher.
Grandfather told Omprakash that chilies, brinjal and tomato belong to the same family of plants and

asked him to find out similarity in these plants. Read the above passage and answer the following questions:-

I. Identify the family to which these plants belong.

II. What are the characteristic features of the family?

III. What value is reflected in grandfather's behavior?

Ans 1.

i. Solanaceae

ii. Persistant Calyx, Obliquely Placed Ovary and Swollen Placenta

iii. Grandfather wanted to arouse interest of his grandson in biology

2. Pointing towards a sunflower plant, father asked Kailash, a biology student to show him flower of this plant. Kailash pluck flowering twig and pointed towards the big yellow structure at the tip of the twig. Father laughed and clarified that it is not a single flower but a group of several flowers arranged in a disc like structure. Read the above passage and answer the following questions:-

I. What is inflorescence?

I. it is an axis bearing a cluster of flowers in a particular manner

II. Define racemose and cymose inflorescence?

II. in recemose type of inflorescence, the main axis possess terminal bud which grows indefinitely giving rise to lateral and axillary flowers. In cymose type, the main axis terminates into a flowers and further growth takes place by lateral branches which arises below the terminal flower.

III. What message is delivered by father of Kailash.

.

III. Being a student of biology, one should observe things critically.

3. Ishwer was reading a chapter on function of different parts of a green plant. His mother asked him about the functions of roots. He replied that roots are meant for anchorage and absorbing water and minerals from soil. Then mother showed him radish, carrot and turnip and asked him about the additional functions that the roots perform. Read the above passage and answer the following questions:-

I. What is the special function of roots in above examples?

storage of food

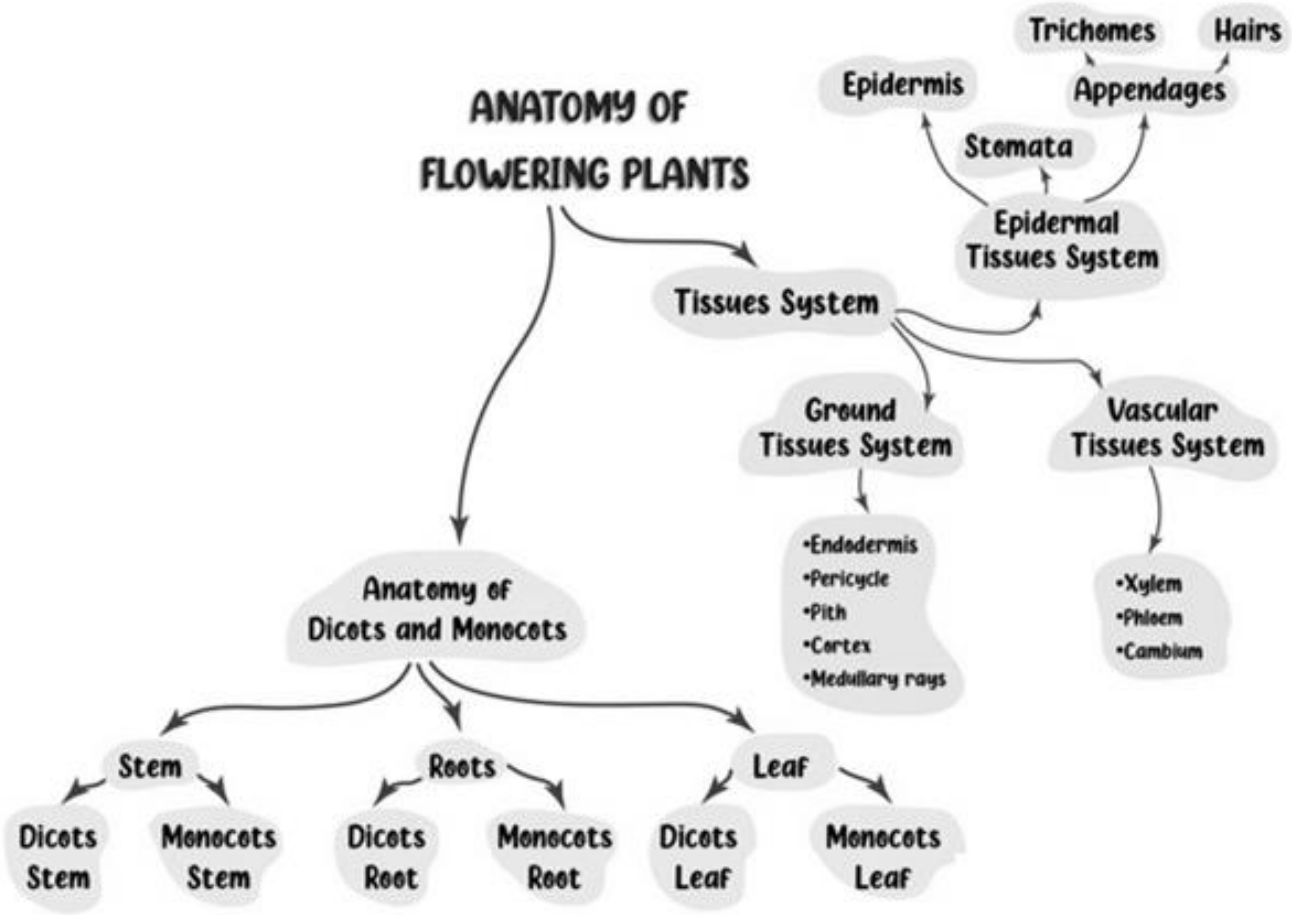
II. What other secondary functions roots are known to perform?

support (Stilt root), respiration (pneumatophores), photosynthesis (Trapa).

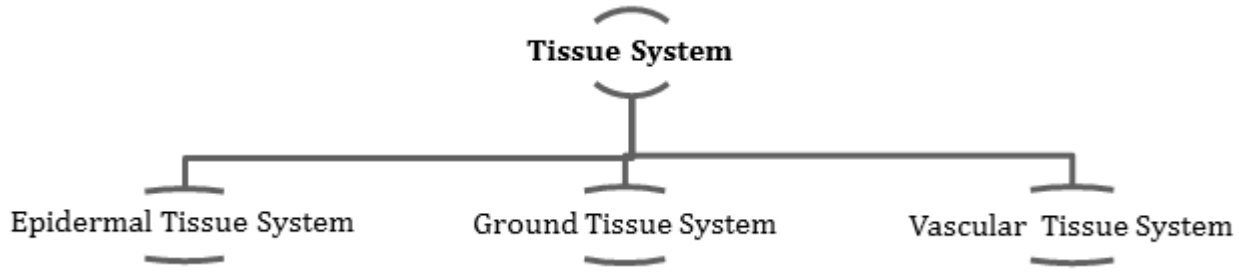
III. What value is displayed by his mother.

iii. She enriched Ishwar's knowledge about secondary functions of root.

CONCEPT MAP



POINTS TO REMEMBER



Epidermal Tissue System

- It comprises the outer covering of the plants, such as epidermis, cuticle, stomata, epidermal extensions; trichomes in stem and root hairs
- Stomata regulate gaseous exchange and water loss by transpiration
- Guard cells are bean-shaped in dicots and contain chloroplasts
- Grasses have a dumb-bell shaped guard cells
- Root hairs are unicellular
- Trichomes are multicellular

Stomatal apparatus

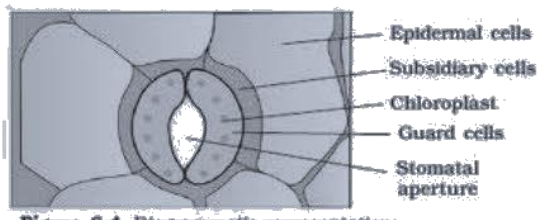
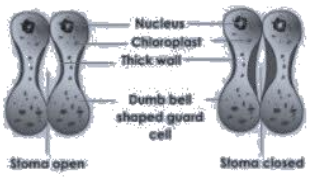


Figure 6.4 Diagrammatic representation: (a) stomata with bean-shaped guard cells

Stomatal aperture , guard cells , subsidiary cells



Dicots (Bean shaped) Monocots (Dumb-bell shaped)

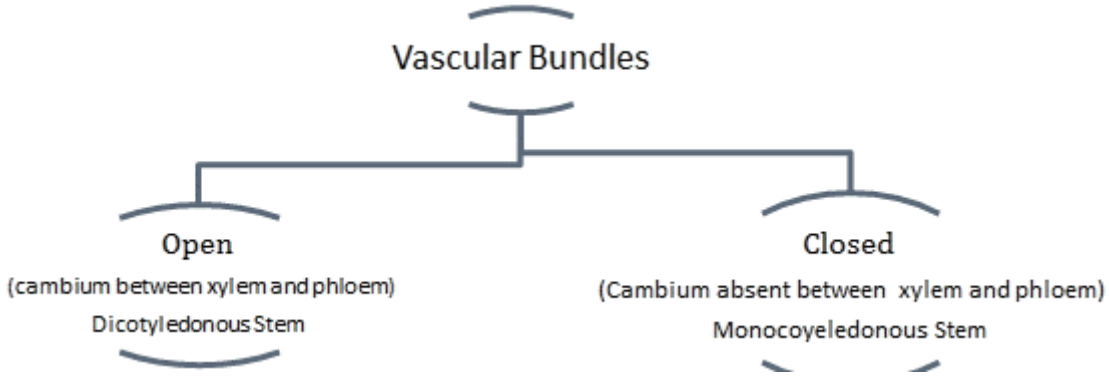
- Epidermis also contains a number of hairs. Root hairs are unicellular elongation of epidermal cells. Trichomes are present on stems, which are multicellular, branched or un-branched preventing water loss due to transpiration.

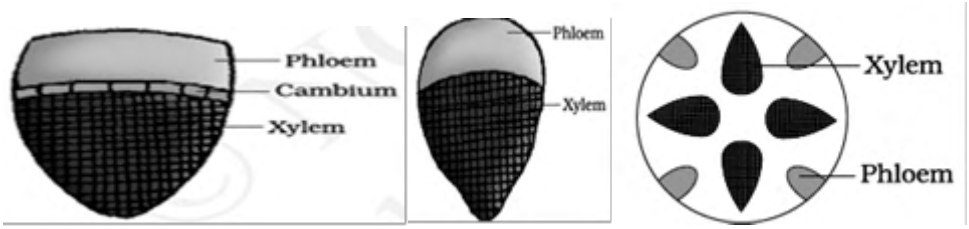
The ground Tissue System

- They form the major bulk of tissues between epidermal and vascular tissues, e.g. cortex, pericycle, pith
- It contains simple tissues
- Mesophyll of leaves is a ground tissue with chloroplast

The Vascular Tissue System

- It consists of complex tissues of xylem and phloem
- Dicots have cambium present between xylem and phloem of vascular bundle
- Cambium forms secondary vascular tissues
- Dicots have an open vascular bundle
- Monocots have a closed type of vascular bundle, i.e. cambium is absent
- Roots have a radial arrangement of vascular bundles, i.e. xylem and phloem are present alternatively
- Stem and leaves have a conjoint arrangement of vascular bundles, i.e. xylem and phloem are present at the same radius

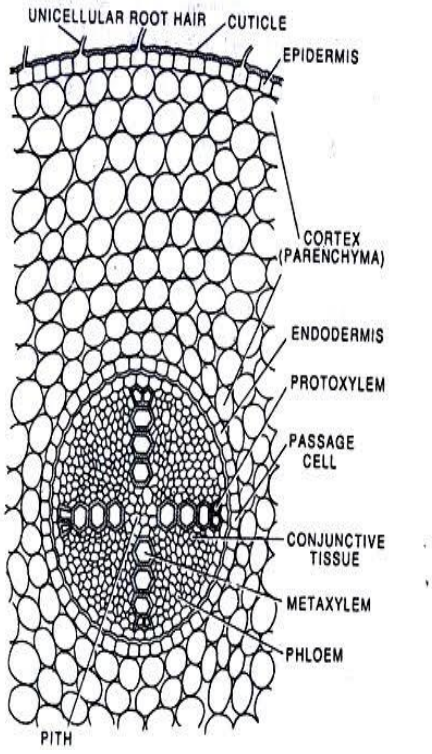




- When xylem and phloem within a vascular bundle are arranged in alternate manner on different radii, the arrangement are called radial as in roots. When xylem and phloem are situated at the same radius of vascular bundle, it is called conjoint as in stem and leaves.

Dicotyledonous Root

- Epiblema is the outermost layer, which contains root hair
- Several layers of cortex present, that ends with innermost layer endodermis, which contains waxy material called suberin forming Casparian strips
- Next is pericycle, which gives rise to lateral roots and vascular cambium
- Two to six vascular bundles are present
- Radial and exarch vascular bundles



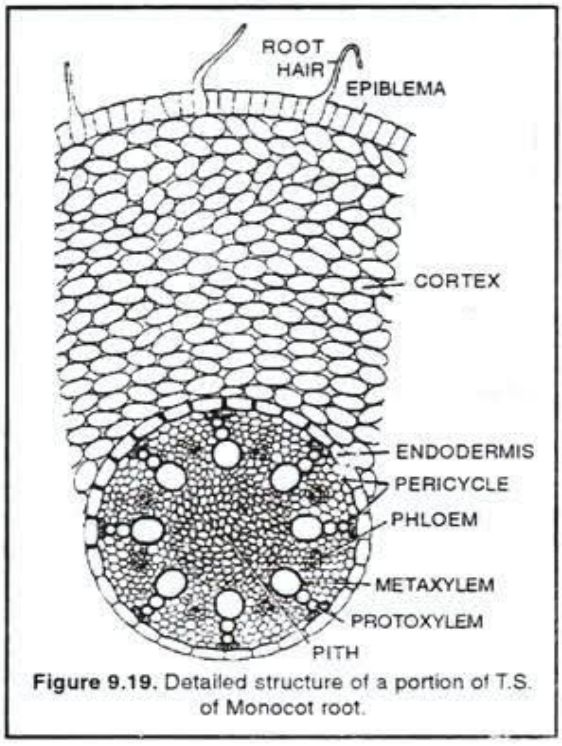


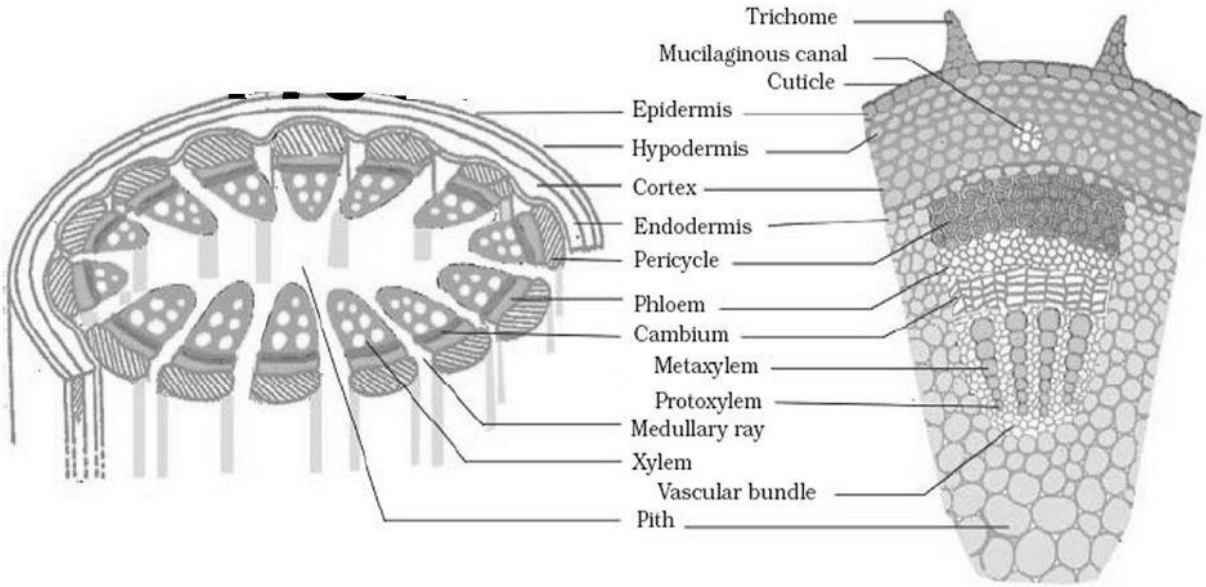
Figure 9.19. Detailed structure of a portion of T.S. of Monocot root.

Monocotyledonous Root

- The structure is similar to dicot root but polyarch xylem bundles are present
- Pith is large and no secondary growth

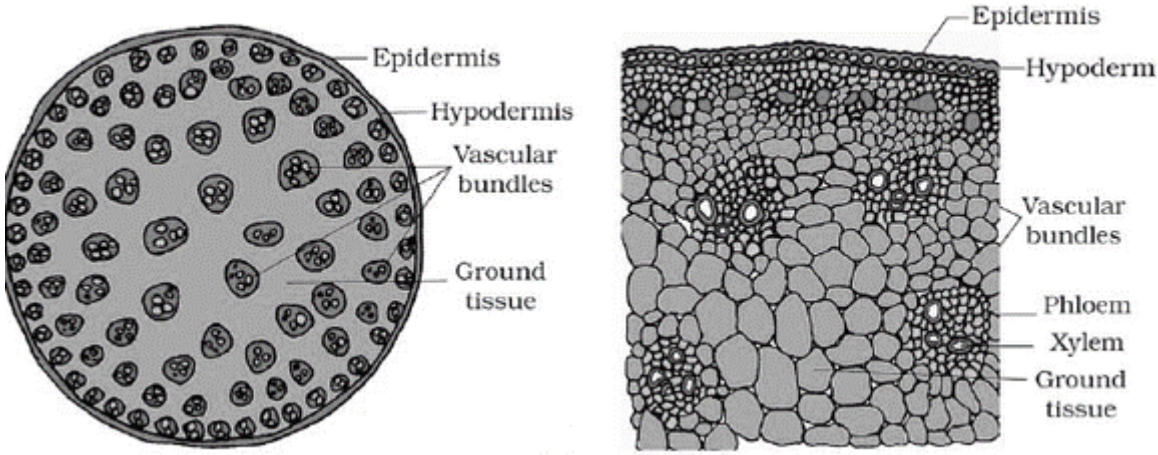
Dicotyledonous Stem

- The outermost layer is the epidermis with cuticle
- Trichomes and stomata may be present on the epidermis
- The cortex consists of three layers; outermost hypodermis (collenchymatous), middle parenchymatous cortical layer and the endodermis containing starch grains
- Below endodermis, pericycle and radially located medullary rays are present
- Vascular bundles are arranged as a ring
- Vascular bundles conjoint, open and with endarchprotoxylem



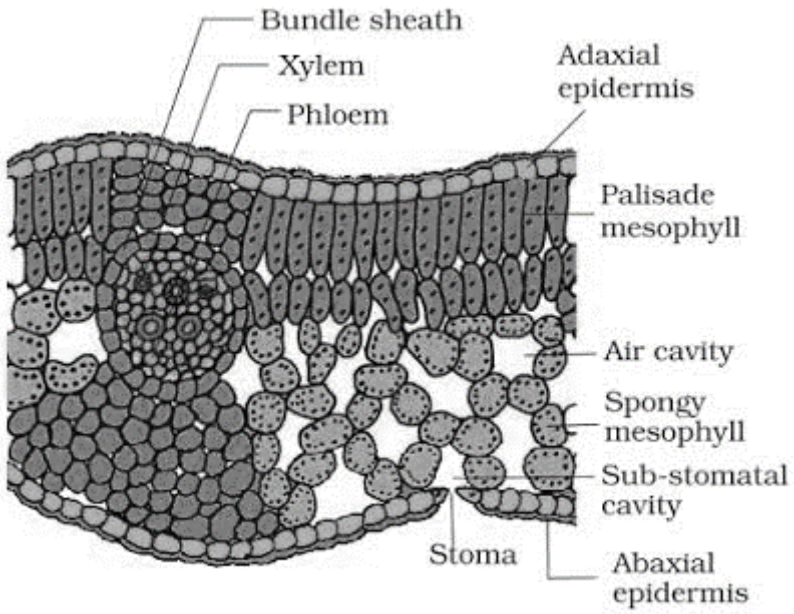
Monocotyledonous Stem

- Hypodermis is sclerenchymatous
- Vascular bundles are scattered, conjoint and closed



Dorsiventral (Dicotyledonous) Leaf

- Also known as dorsiventral leaf due to distinct dorsal and ventral side
- Reticulate venation
- The epidermis covers both the upper and lower surface
- There are more stomata present on the abaxial epidermis
- Mesophyll cells are parenchymatous and perform photosynthesis
- The mesophyll is made up of elongated palisade and oval or round spongy parenchyma cells
- Vascular bundles are surrounded by bundle sheath cells and present on veins and mid-rib



Isobilateral (Monocotyledonous) Leaf

- Also known as isobilateral as both sides are similar
- Parallel venation
- Stomata are equally distributed on both sides
- The mesophyll is not differentiated between palisade and spongy parenchyma cells
- Some cells of the epidermis are modified into large cells called bulliform cells in grasses, they help in minimising water loss
- Vascular bundles are of the same size

DIFFERENCE BETWEEN MONOCOT AND DICOT STEM

Dicot	Monocot
The ground tissue is differentiated as endodermis, cortex, pericycle, medullary rays, pith, etc.	The ground tissue is the same and is composed of a mass of similar cells.
The vascular bundles are formed as broken rings.	The vascular bundles are scattered irregularly around the ground tissue.
Phloem parenchyma is present.	Phloem parenchyma is absent.
Pith is well-developed.	Pith is not as well-developed in monocots (usually absent in most)
Epidermal hair may or may not exist.	Presence of epidermal hair.
Vascular bundles are less in number and are of uniform size.	There are numerous vascular bundles of different sizes.
The dicot stem does not have a bundle sheath on the outside of a vascular bundle.	The monocot stem has a sclerenchymatous bundle sheath on the outside of a vascular bundle.

The dicot stems have trichomes.	The monocot stems do not have trichomes.
The vascular bundles always remain open, due to the presence of cambium within phloem and xylem.	The vascular bundles are closed.

DIFFERENCE BETWEEN MONOCOT AND DICOT ROOT

Dicot Root	Monocot Root
Pericycle	
Gives rise to cork cambium, parts of the vascular cambium, and lateral roots	Gives rise to lateral roots only
Vascular Tissues	
Has a limited number of Xylem and Phloem	Has a higher number of Xylem and Phloem
Conjunctive tissue	
Parenchymatous	Sclerenchymatous
Secondary growth	
Secondary growth occurs	Secondary growth does not occur
Cambium	
Present and formed by the Conjunctive parenchyma	Absent
Xylem	
Usually tetrarch	Polyarch

DIFFERENCE BETWEEN MONOCOT AND DICOT LEAF

Properties	Monocot Leaf	Dicot Leaf
Venation	Monocot leaves have equal veins. They are parallel venation	Dicot leaves have veins that spread out from one vein-like web. They are reticulate venation
Stomata	The shape of the stomata of the Monocot leaves is a dumbbell shape.	The shape of the stomata of the Dicot leaves is Kidney-bean shaped.
Distribution of Stomata	Monocot leaves are amphistomatic. On both the lower and upper epidermis, the stomata are found.	Dicot leaves are Hypostomatic. Only on the bottom of the leaf, the stomata are found.
Mesophyll	Monocot leaves have one layered mesophyll.	Dicot leaves have two mesophylls- Spongy mesophyll and Palisade mesophyll. Under the Palisade mesophyll, Spongy mesophyll is located, whereas, beneath the upper epidermis leaves, Palisade mesophyll cells are located.
Intercellular spaces	Due to the compact arrangement of mesophyll cells, the intercellular space is small in the Monocot leaf.	Due to the existence of loosely packed mesophyll cells, the intercellular space is big in Dicot leaves.
Bulliform or Motor Cells	On the upper surface of the Monocot leaf, the bulliform cells are present. They are empty, big, and colorless, and their existence is found in the mid-vein region of the leaf.	In Dicot leaves, Motor cells are absent.
Vascular Bundles	In the Monocot leaf, many large and small size vascular bundles are present in equal patterns.	In dicot leaves, vascular bundles are generally big.
Bundle Sheath	Due to the existence of chloroplasts, monocot leaves may have one or two layers of bundle sheath that are formed of colored cells.	In dicot leaves, the bundle sheath is formed of colored cells and is generally one-layered.
Silica Deposition	On the wall of an epidermal cell, monocot leaves have a large deposition of silica.	On the wall of an epidermal cell, dicot leaves do not have a deposition of silica.

QUESTION AND ANSWER

1. When phloem is present on both sides of the xylem, the vascular bundle is said to be
(a) collateral (b) bicollateral(c) radial (d) conjoint
ANS: b) bicollateral
2. The living components of the xylem are
(a) tracheids (b) vessels (c) wood fibres (d) wood parenchyma
3. Companion cells are present alongside the
(a) xylem vessels (b) sieve cells (c) sieve tubes (d) tracheids
ANS: (c) sieve tubes
4. The conductive tissue present in gymnosperms consist of
(a) vessels (b) sieve tubes (c) tracheids(d) wood fibres
ANS: (c) tracheids

5. The xylem that is formed from procambium and has lignified cell walls is known as
(a) primary xylem (b) secondary phloem (c) protoxylem(d) metaxylem
ANS: (d) metaxylem
6. The phloem formed from vascular cambium is known as
(a) primary phloem (b) secondary phloem (c) protophloem (d) metaphloem
ANS:(b) secondary phloem
7. The Casparian rings are found in
(a) monocot root (b) dicot root (c) monocot stem (d) dicot stem
ANS(a) monocot root
8. The stele consists of
(a) only vascular bundles (b) vascular bundles, pericycle, pith, and medullary rays
(c) vascular bundles, pericycle, and path (d) vascular bundles and pith
ANS :(b) vascular bundles, pericycle, pith, and medullary rays
9. The vascular bundles of a dicot stem are
(a) closed, collateral and exarch (b) open, collateral, and exarch
(c) closed, collateral, and endarch(d) open, collateral, and endarch
ANS: (d) open, collateral, and endarch
10. You are given a fairly old piece of dicot stem and a dicot root. Which of the following anatomical structures will you use to distinguish between the two? (2014)
A. cortical cells B. protoxylemC. secondary phloem D. secondary xylem
ANS: B. protoxylem

Short question and answer

Question 1. What are treachery elements? Of what use are these to the plants?
Answer:
These are vessels and tracheid. They are conducting cells of the xylem. The xylem vessels have perforations in their end walls while perforations are absent in tracheid, they form a continuous channel through the root, stem and leaves for the conduction of water and minerals.
Question 2.
If you are provided with microscopic preparation of transverse sections of a meristematic tissue and permanent tissue, how would you distinguish them apart?
Answer:
Meristematic tissues are composed of cells that are always in a dividing stage and divide endlessly to form new cells. These cells exist in different shapes without any intercellular spaces. These cells are thin-walled, rich in protoplasm and active with large nuclei and without vacuoles.
Permanent tissues are derived from meristematic tissue and are composed of cells, which have lost the power of division. These cells have their definite shape, size and function. These cells may be thin-walled or thick-walled.
Question 3.
What are the three basic tissues systems in flowering plants? Name the tissues under each system.
Answer:
In flowering plants, the three basic tissue systems are:
(a) It comprises the epidermis which is protective in function. During secondary growth, it is replaced by periderm.
(b) Vascular tissue system It consists of xylem and phloem and is found in the stele. In the root, the vascular bundles are renal with exarch condition whereas, in the stem, these are collateral with each condition.
(c) Ground or Fundamental Tissue It includes all the tissues except dermal and vascular, as parenchyma and sclerenchyma. It is found mainly between the epidermis and vascular cylinder and is formed of thin-walled

cells with intercellular spaces in between them. Collenchyma is usually found to be thickened at the comers whereas currency nations are dead tissue and provide mechanical support.

Question 4. Describe briefly the various types of vascular bundles.

Answer:

These are of the following types:

1. Radial The bundles in which xylem and phloem are arranged on different adulterating with each other and form the separate bundles are called radial vascular bundles as in all roots.

2. Conjoint The xylem and phloem are situated at the same radius and form a vascular bundle together. These are divided into three types:

(a) Collateral: These are the bundles where xylem and phloem are arranged on some radius, xylem is located internally and phloem externally. These may be open when there is a patch of cambium in between the xylem and phloem e.g. Helianthus or closed when there is no cambium at all as seen in monocot stems

(b) Bicallatiral: In this vascular bundle, the phloem is found in two groups one outside the xylem elements and the other inner to them. These are always open and found in pumpkin.

(c) Concentric: The bundle in which either Phloemounds the phloem completely is known as concentric. This exists in two forms.

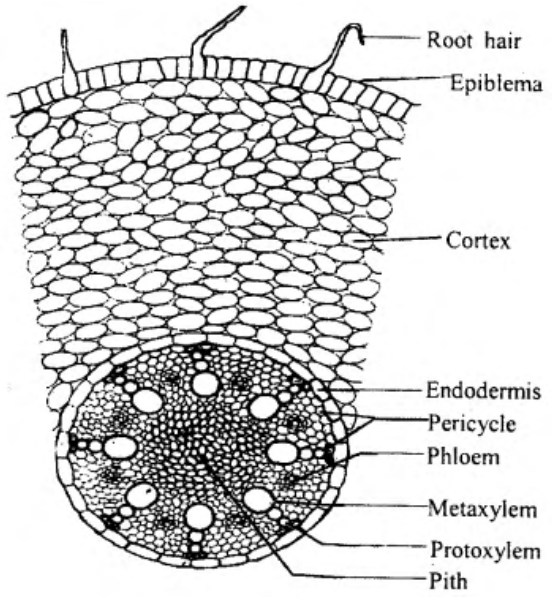
1. Anphicribral: The xylem lies at the centre and is surrounded by a ring of phloem, e.g., fern.
2. Amphivaial: The phloem lies at the centre and is surrounded by the xylem e.g. Dracaena.

Question 5.Describe briefly the internal structure of the monocot root with the help of a labelled diagram.

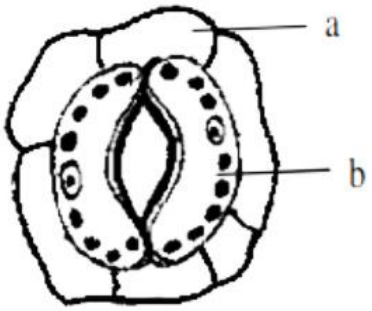
Answer:

A transverse section of the monocot root shows the following issues.

1. It is composed of a single layer of compactly arranged thin-walled cells without intercellular spaces and cuticle. It bears many unicellular root hair.
2. Cortex: It is present beneath the epidermis. It consists of 15-20 layers of parenchymatous cells with large intercellular spaces.
3. Endodermis: It is the innermost layer of the cortex. Its cells are barrel-shaped with Casparian strips on their anticlinal walls. The passage cells are seen just opposite the protoxylem ends.
4. Pericycle: It consists of a single layer of thin-walled parenchymatous cells.
5. Vascular bundle: The vascular bundles are radial and the xylem is exarch. The xylem and phloem bundles are always more than six.
6. Pith: It occupies the central portion of the stele and is made up of parenchymatous cells.
7. Conjunctive tissue: It consists of parenchymatous cells and is found between the xylem and phloem strands.



Question 6. Observe the figure and answer the following questions:
(i) Name parts (a)and(b)
(ii) Are those types of stomata observed in monocot or in dicot plants?
(iii) Which parts of the stomata constitute the stomata apparatus?



Ans:
(i) Part a is epidermal cell and part b is guard cell
(ii) These types of stomata are observed in dicot plants.
(iii) Stomata, aperture, guard cells, and the surrounding subsidiary cells are the constituents of the stomata apparatus.

Question 7. State the differences between the guard cells and epidermal cells. Which epidermal cell surrounds the guard cell?

Guard Cells	Epidermal Cells
Kidney-shaped.	Barrel-shaped.
Smaller in size.	Larger in size.
Contain chloroplast.	Do not contain chloroplast.
The cell wall is non-uniform and thick.	The cell wall is uniform and thin.

The epidermal cells surrounding the guard cells are called subsidiary cells.

Question 8. Difference between Dicot Root and Monocot Root?

Dicot Root	Monocot Root
Secondary growth is present	Secondary growth is absent
Cortex is very narrow	Cortex is very wide
Older root has a covering of cork.	Older root has a covering of exodermis
Xylem vessels are generally angular.	Xylem vessels are oval or rounded.
Examples– Beans, Peanuts, Pea, etc.	Examples– Banana, Palm, Maize, etc.

Question 9. Define the following terms:- Angiosperms, Monocotyledons and Dicotyledons.
Angiosperms: The flowering plants of the Kingdom Plantae are called the Angiosperms. They are the most diverse group of terrestrial plants. They are seed-producing plants.
Monocotyledons: The monocotyledons, also referred to as monocots. They are flowering plants or Angiosperms, which produce seeds containing only one cotyledon. Legumes are the best examples of monocotyledons.
Dicotyledons: The dicotyledons, also referred to as dicots. They are flowering plants or Angiosperms, which produce seeds containing two cotyledons. Grains are the best examples of dicotyledons.

Question 10. Give the differences between Dicot stem and monocot stem.

Dicot Stem	Monocot Stem
Vascular bundles are arranged in rings.	Vascular bundles are scattered.
Pith is present.	Pith is absent.
Medullary rays are present.	Medullary rays are absent.
The hypodermis is chlorenchymatous.	The hypodermis is sclerenchymatous.
Undergo silica deposition.	Do not undergo silica deposition.

Competency Based Questions
CASE 1
The epidermal tissue system forms the outer-most covering of the whole plant body and comprises epidermal cells, stomata and the epidermal appendages – the trichomes and hairs. The epidermis is the outermost layer of the primary plant body. It is made up of elongated, compactly arranged cells, which form a continuous layer. Epidermis is usually single layered. Epidermal cells are parenchymatous with a small amount of cytoplasm lining the cell wall and a large vacuole. The outside of the epidermis is often covered with a waxy thick layer called the cuticle which prevents the loss of water. Cuticle is absent in roots. Stomata are structures present in the epidermis of leaves. Stomata regulate the process of transpiration and gaseous exchange. Each stoma is composed of two bean shaped cells known as guard cells which enclose stomatal pore. In grasses, the guard cells are dumb-bell shaped. The outer walls of guard cells are thin and the inner walls are highly thickened. The guard cells possess chloroplasts and regulate the opening and closing of stomata. Sometimes, a few epidermal cells, in the vicinity of the guard cells become specialised in their shape and size and are known as subsidiary cells. The stomatal aperture, guard cells and the surrounding subsidiary cells are together called stomatal apparatus.
The cells of epidermis bear a number of hairs. The root hairs are unicellular elongations of the epidermal cells and help absorb water and minerals from the soil. On the stem the epidermal hairs are called trichomes. The trichomes in the shoot system are usually multicellular. They may be branched or unbranched and soft or stiff. They may even be secretory. The trichomes help in preventing water loss due to transpiration.
1.) Which of the following cell regulates the opening and closing of guard cell.
a.) Epidermal cellb.) Guard cell
c.) Subsidiary celld.) Trichomes ANS b.) Guard cell

2.) Which of the following components are known as epidermal appendages.
a.) Trichomesb.) Hairs

c.) Trichomes& Hairsd.) Stomata
ANS c.) Trichomes& Hairs

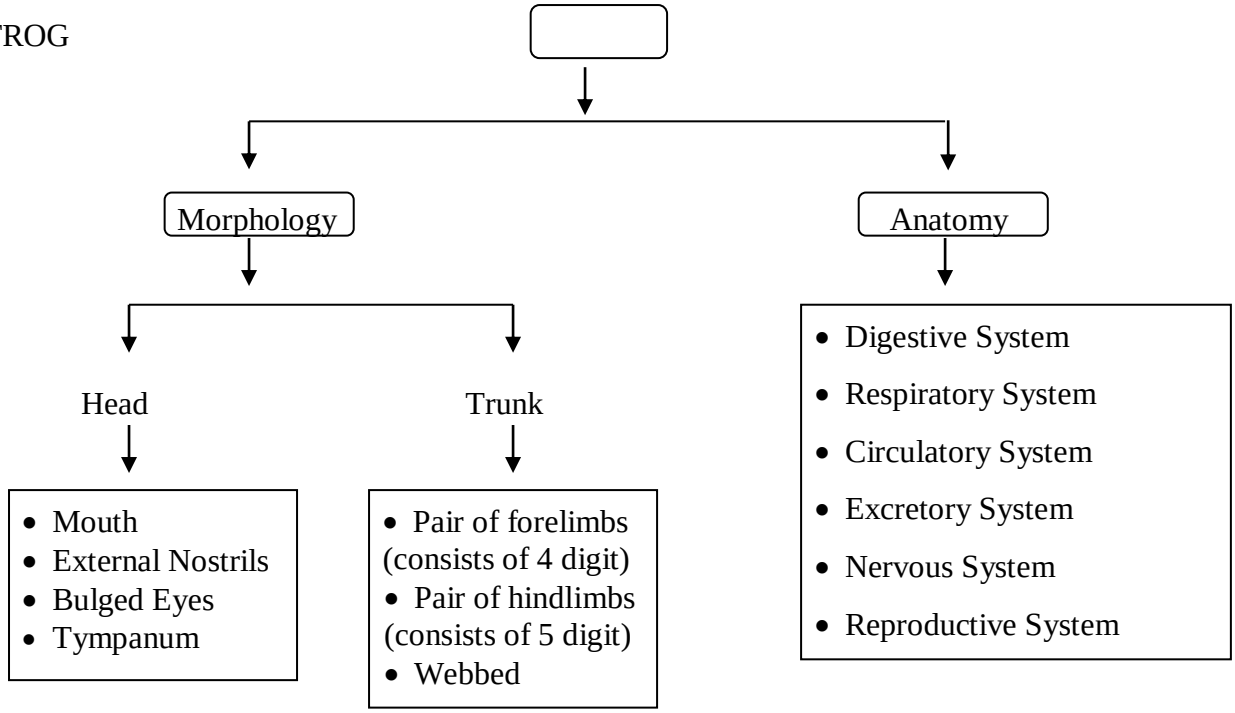
3.) Define cuticles and give its function.
Cuticle – The outside of the epidermis is often covered with a waxy thick layer called the cuticle.
Function of cuticle –prevents the loss of water.

4.) What is trichomes?
The cells of epidermis bear a number of hairs. Epidermal hairs present on the stem are called as trichomes.
5 Write short note on stomata?
Stomata are structures present in the epidermis of leaves. Stomata regulate the process of transpiration and gaseous exchange. Each stoma is composed of two bean shaped cells known as guard cells which enclose stomatal pore. In grasses, the guard cells are dumb-bell shaped. The outer walls of guard cells are thin and the inner walls are highly thickened. The guard cells possess chloroplasts and regulate the opening and closing of stomata. Sometimes, a few epidermal cells, in the vicinity of the guard cells become specialised in their shape and size and are known as subsidiary cells. The stomatal aperture, guard cells and the surrounding subsidiary cells are together called stomatal apparatus. (Draw diagram).

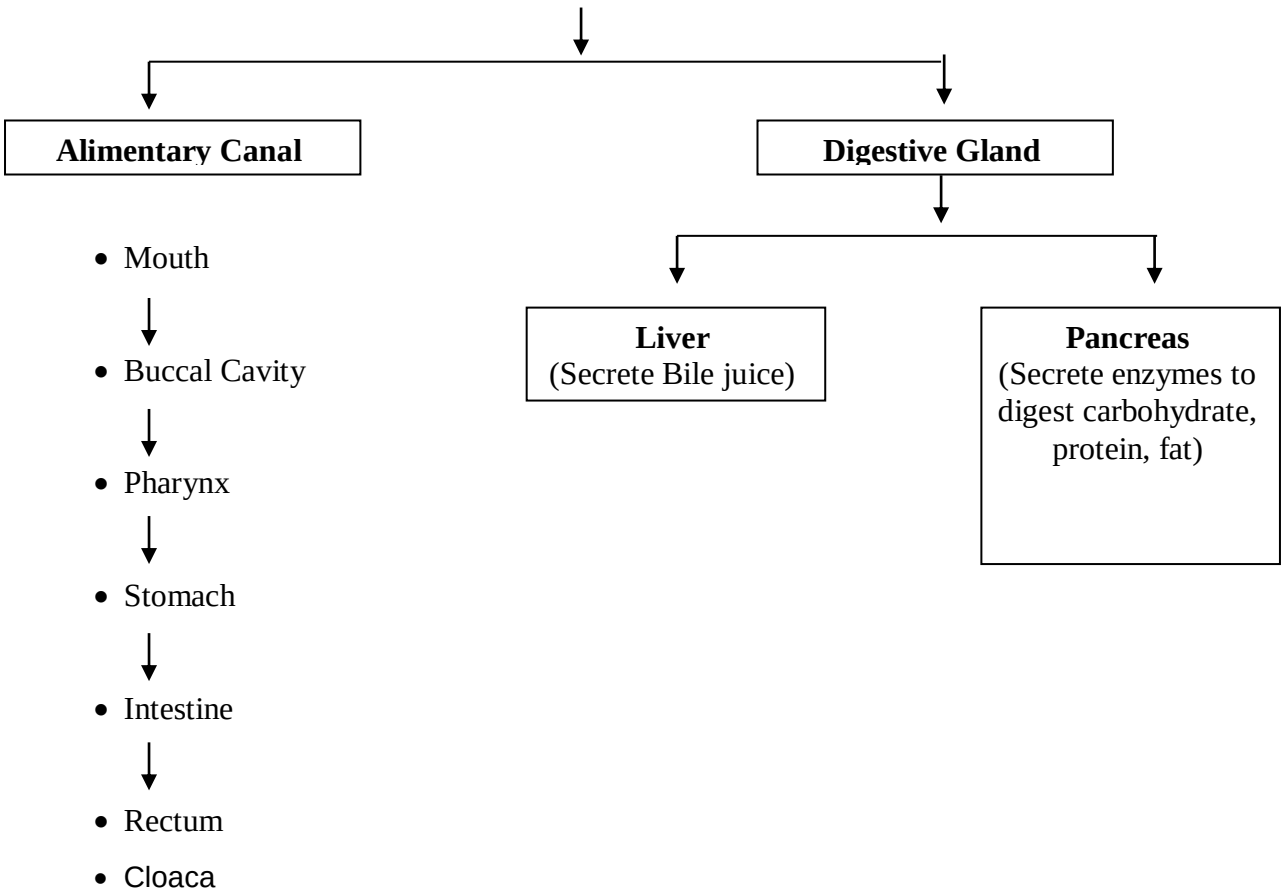
CHAPTER 7: STRUCTURAL ORGANIZATION IN ANIMALS

CONCEPT MAP

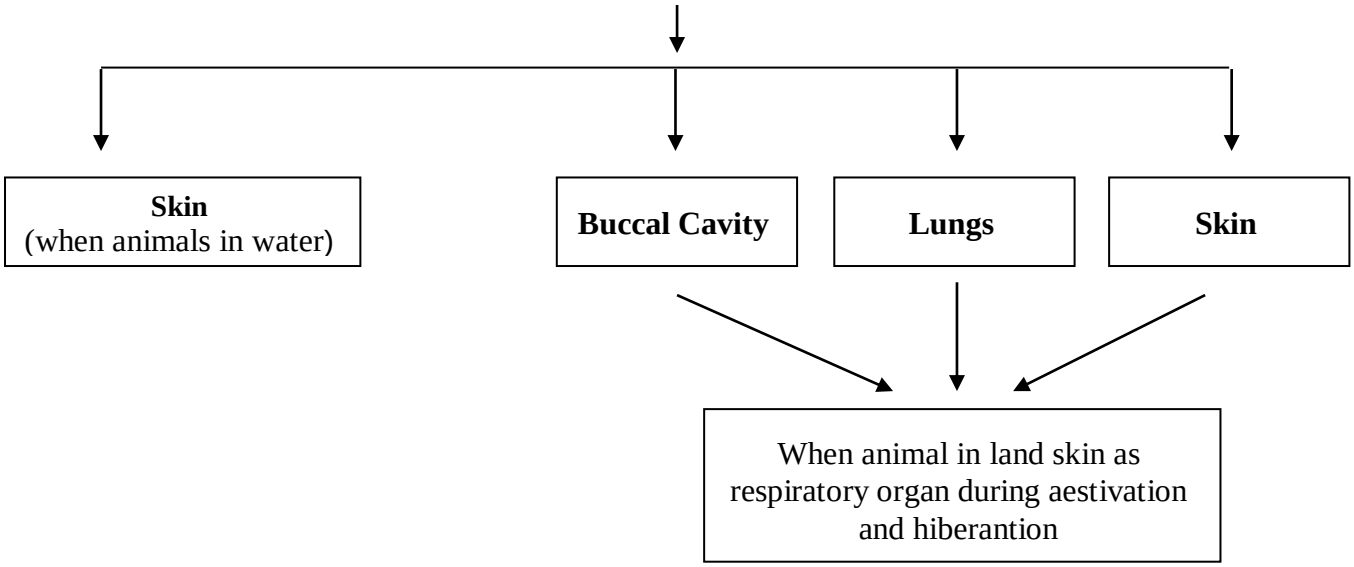
FROG



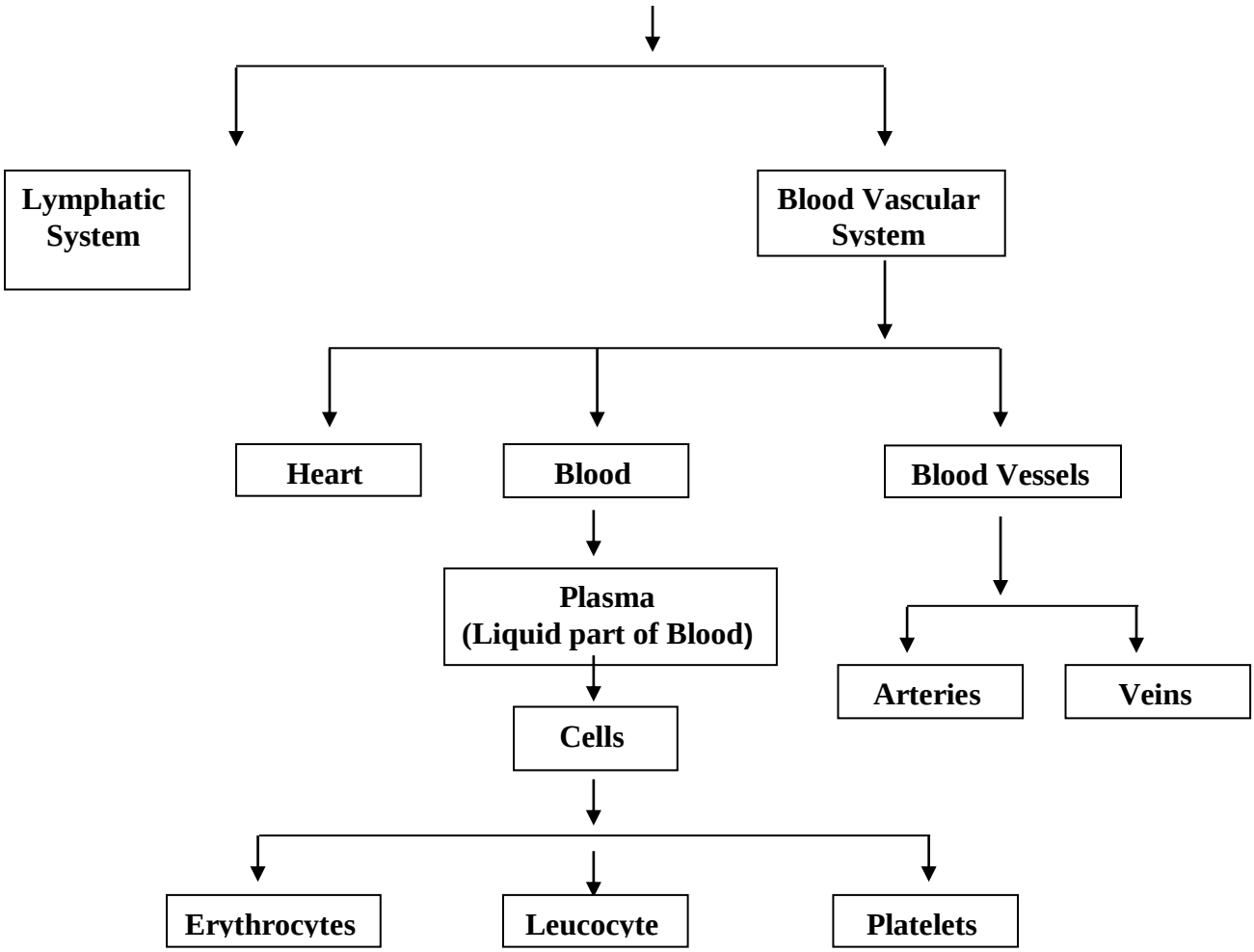
DIGESTIVE SYSTEM



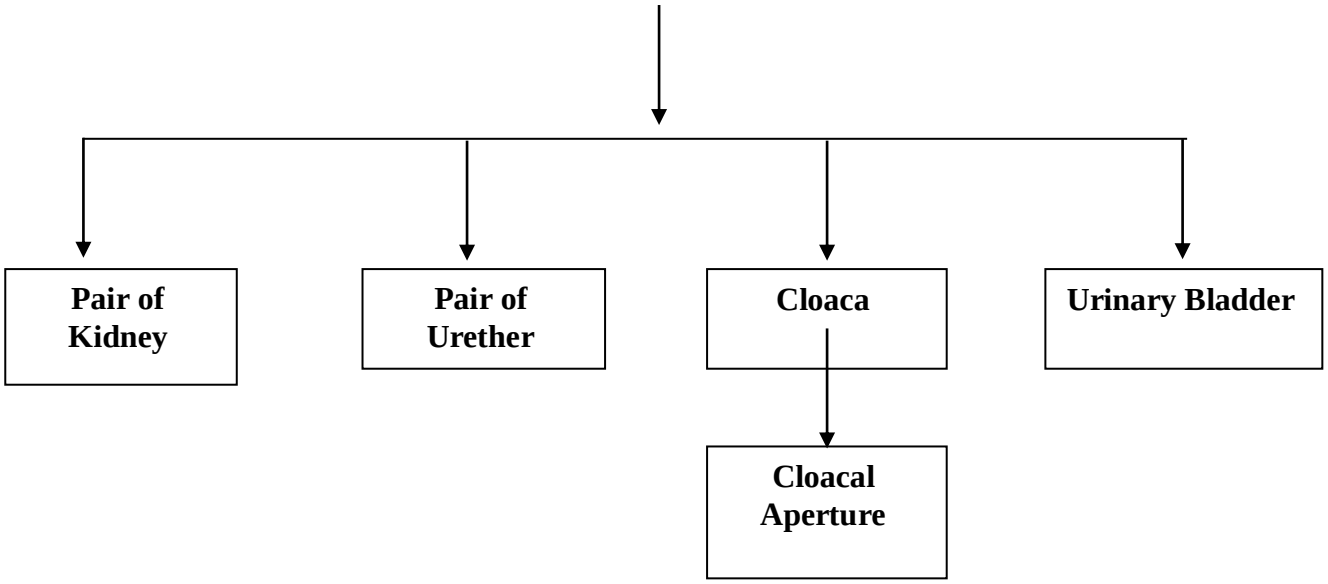
RESPIRATORY SYSTEM



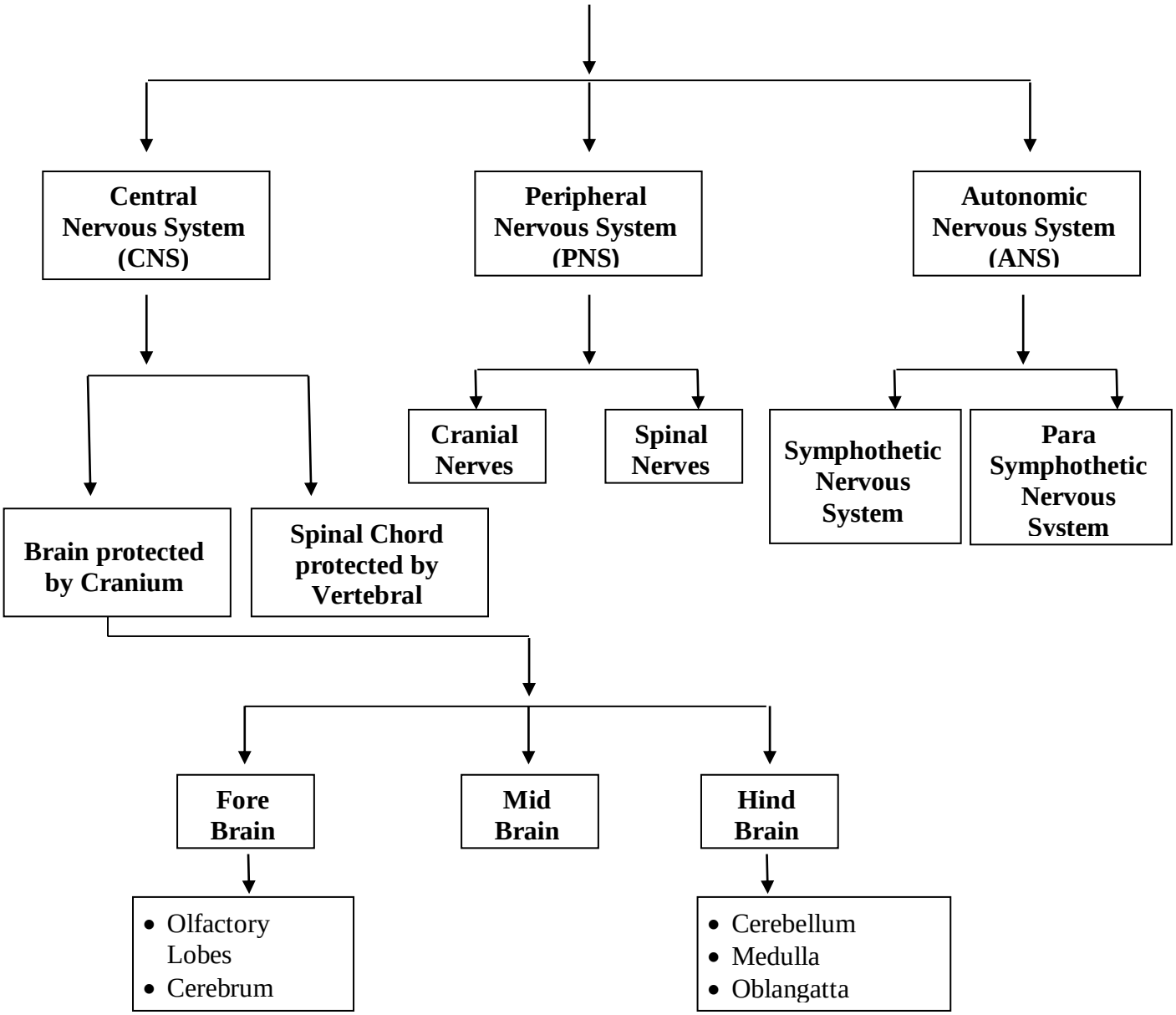
CIRCULATORY SYSTEM



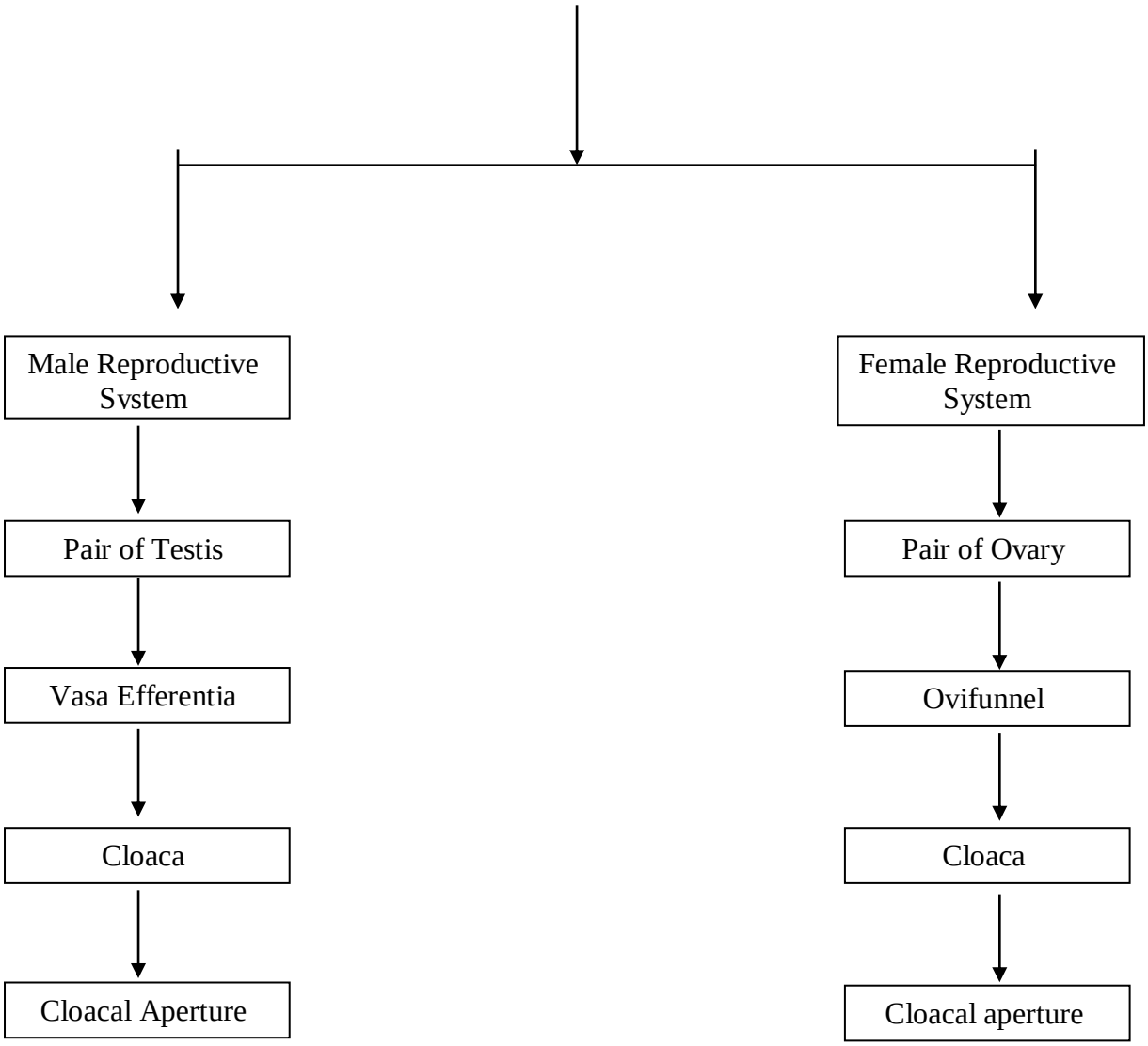
EXCRETARY SYSTEM



NERVOUS SYSTEM



REPRODUCTIVE SYSTEM



POINTS TO REMEMBER

SYSTEMATIC POSITION

Phylum : Chordata
Class : Amphibia
Genus : Rana
Species : tigrina ·

- Rana tigrina is the most common species in India.
- They are poikilotherms (cold blooded).
- They can change colour to hide them from their enemies (camouflage). This protective coloration is called mimicry.
- During summer and winter, they undergo aestivation (summer sleep) and hibernation (winter sleep) respectively to protect them from extreme heat and cold.

MORPHOLOGY OF FROG

- Body is divisible into head & trunk. Neck and tail absent.
- Skin is moist, smooth and slippery due to the mucus.
- Colour of dorsal side is olive green with dark irregular spots and ventral side is pale yellow.
- The frog never drinks water but absorb it through the skin.
- A mouth, paired nostrils and bulged eyes (covered by nictitating membrane) are present. On either side of eyes have a membranous tympanum (ear).
- The forelimbs (4 digits) and hind limbs (5 digits) help in swimming, walking, leaping and burrowing. The hind limbs are larger and muscular than fore limbs.
- Feet have webbed digits that help in swimming.
- Frogs exhibit sexual dimorphism. Male frogs have sound producing vocal sac and also a copulatory (nuptial) pad on the first digit of fore limbs which are absent in female frogs.

ANATOMY OF FROG - DIGESTIVE SYSTEM:

- Consists of alimentary canal and digestive glands.
- The alimentary canal is short because frogs are carnivores and hence the length of intestine is reduced.
- Mouth → buccal cavity → pharynx → oesophagus → stomach → intestine → rectum → cloaca.
- Liver secretes bile that is stored in gall bladder. Pancreas produces pancreatic juice containing digestive enzymes. –
- Food is captured by the bilobed tongue.
- Digestion: Gastric juice and HCl secreted from gastric wall digest the food. Partially digested food (chyme) is passed from stomach to the duodenum.
- Duodenum receives bile and pancreatic juices through a common bile duct.
- Bile emulsifies fat. Pancreatic juice digests carbohydrates and proteins. Digestion completes in the intestine.
- Finger-like villi and microvilli in intestine absorb digested food. The undigested solid waste moves into the rectum and passes out through cloaca.

RESPIRATORY SYSTEM:

- Skin acts as aquatic respiratory organ (cutaneous respiration). Dissolved oxygen in the water is exchanged through the skin by diffusion. During aestivation and hibernation respiration takes place through skin.
- On land, the buccal cavity, skin and lungs (pulmonary respiration) act as the respiratory organs.
- The lungs are a pair of elongated, pink coloured sac-like structures present in the thorax. Air enters through the nostrils into the buccal cavity and then to lungs.

CIRCULATORY SYSTEM:

- Closed type. Includes Blood vascular system (heart, blood vessels & blood) and lymphatic system (lymph, lymph channels & lymph nodes).

- Heart is 3-chambered, (two atria and one ventricle) and is covered by a membrane called pericardium. - A triangular structure called sinus venosus joins the right atrium. It receives blood through major veins (vena cava).
- The ventricle opens into a saclike conus arteriosus on the ventral side of the heart.
- The blood pumped from the muscular heart is carried to all parts of the body by the arteries (arterial system).
- The veins collect blood from different parts of body to the heart and form the venous system.
- Hepatic portal system (venous connection between liver and intestine) and renal portal system (between kidney and lower parts of the body) are present in frogs.
- Blood contains plasma and cells (RBC, WBC & platelets). RBCs are nucleated and contain haemoglobin.
- Blood transports nutrients, gases and water to tissues.

EXCRETORY SYSTEM:

- Includes kidneys (2), ureters (2), cloaca & urinary bladder.
- Kidneys are dark red and bean-shaped. Found posteriorly in the body cavity on both sides of vertebral column. Each kidney is formed of uriniferous tubules (nephrons).
- 2 ureters emerge from the kidneys. In male frogs, the ureters act as urinogenital duct which opens into cloaca. In females, ureters & oviduct open separately in cloaca.
- The thin-walled urinary bladder is present ventral to the rectum which also opens in the cloaca.
- The frog is a ureotelic animal (excretes urea). Nitrogenous wastes are carried by blood into the kidney where it is separated and excreted.

CONTROL AND CO-ORDINATION

ENDOCRINE SYSTEM:

- The endocrine glands secrete hormones.
- Endocrine glands: pituitary, thyroid, parathyroid, thymus, pineal body, pancreatic islets, adrenals & gonads.

NERVOUS SYSTEM:

- It includes Central nervous system (brain & spinal cord),
- Peripheral nervous system (cranial & spinal nerves)
- Autonomic nervous system (sympathetic & parasympathetic).
    - There are 10 pairs of cranial nerves arising from brain.
    - Brain is enclosed in a bony brain box (cranium).

- The brain is divided into
    - Fore-brain: Includes olfactory lobes, paired cerebral hemispheres and unpaired diencephalon.
    - Mid-brain: Includes a pair of optic lobes.
    - Hind-brain: Includes cerebellum & medulla oblongata. - Medulla oblongata passes out through the foramen magnum and continues into spinal cord, which is enclosed in the vertebral column.

- Sense organs include organs of
  - Sensory papillae: For touch
  - Taste buds: For taste
  - Nasal epithelium: For smell
  - Simple eyes: For vision. Paired and situated in orbit
  - Tympanum with internal ears: For hearing and balancing (equilibrium).

REPRODUCTIVE SYSTEM:

MALE REPRODUCTIVE SYSTEM:

- Male reproductive organs consist of a pair of yellowish ovoid testes, which are found adhered to the upper part of kidneys by a double fold of peritoneum (mesorchium).
- Vasa efferentia (10-12 in number) arise from testes. They enter the kidneys on their side and open into Bidder's canal. It communicates with urinogenital duct that comes out of the kidneys and opens into cloaca.
- The cloaca is a small, median chamber that is used to pass faecal matter, urine and sperms to the exterior.

FEMALE REPRODUCTIVE SYSTEM:

- The female reproductive organs include a pair of ovaries. The ovaries are situated near kidneys and there is no functional connection with kidneys.
- A pair of oviduct arising from the ovaries opens into the cloaca separately.
- A mature female can lay 2500 to 3000 ova at a time.
- Fertilisation is external and takes place in water.
- Development involves a larval stage called tadpole.
- Tadpole undergoes metamorphosis to form the adult.

ECONOMIC IMPORTANCE:

- Frogs are beneficial for mankind because they eat insects and protect the crop.
- Maintain ecological balance by serving as an important link of food chain and food web in the ecosystem.
- In some countries the muscular legs of frog are used as food by man.

<u>QUESTION AND ANSWER</u>

1. The organs used for respiration by a frog, when it is on land include

   a. Lungs b. Buccal Cavity c. skin d. All of these

   Answer: d

2. The medulla oblongata of the brain of a frog passes out as spinal cord through the opening in the skull, called

   a. foramen magnum b. foramen ovale
   c. foramen of Monro c. foramen of Magendie

   Answer: a

3. Cloaca is a median chamber that is used to pass

a. urine b. faecal matter c. sperms d. all of these
Answer: d

4. Vasa efferentia in frogs arise from 1 and open into 2

a. 1. testis 2. Bidder's canal
b. 1. testis 2. urethra
c. 1. kidneys 2. Bidder's canal
d. 1. kidneys 2. urethra

Answer: a

5. Which among the following are the sense organs of a frog?

a. Sensory papillae b. Ears
c. Nasal epithelium d. All of these

Answer: d

6. The forebrain of a frog includes

a. diencephalon b. olfactory lobes
c. cerebrum d. all of these

Answer: d

7. The number of cranial nerves in a frog is

a. 7 pairs b. 8 pairs c. 10 pairs d. 12 pairs

Answer: c

8. The ureters in a female frog open into

a. urinary bladder b. cloaca c. Bidder's canal d. Both a and c

Answer: b

9. The car is an organ for

a. hearing b. touch c. equilibrium d. both a and c

Answer: d

10. Write the scientific name of the common species of frog in India.

Answer: Rana tigrina

11. Name of two external divisions of the body of frogs

Answer: Head and trunk

12. How are the eyes of a frog protected, when the animal is in water?

Answer: The eyes are protected by the nictitating membrane

13. Name of the structure in the heart of a frog that receives blood from major veins. What name is given to the major veins?

Answer: - Sinus venosus
- Vena cavae

14. Where does the ventricle pump blood into, in a frog's heart?

Answer: Conus arteriosus

15. Name the two special venous connections found in the circulatory system of frogs

Answer: Hepatic portal system and renal portal system

Short Answers Type Questions

16. Frogs are not seen during extreme (hot) summer and extreme cold conditions (during winter). Give reason.

Answer: - Frogs are poikilotherms
- During extreme summer or winter they take shelter in deep burrows.
- They undergo aestivation (summer sleep) during summer and hibernation (winter sleep) during winter.

17. Describe the adaptations a frog has to escape from its predators.

Answer: - They have the ability to change the colour of the skin i.e., camouflage, when they are on land to escape from their enemies.

- This protective colouration is called mimicry too.

18. Mention the functions performed by the forelimbs and hindlimbs of frogs

Answer:

Forelimbs	Hindlimbs
- They are shorter and less muscular than hindlimbs. - They end in four digits. - Digits are not webbed - In male frogs, the first digit has a copulatory pad.	- They are larger and more muscular than forelimbs - They end in five digits - Digits are webbed. - There is no copulatory pad in the first digit

19. Mention the functions performed by the forelimbs and hindlimbs of frogs

Answer: Forelimbs and hindlimbs are used for walking, swimming, leaping and burrowing.

20. Frogs are diocious and sexually dimorphic. Write two features in which the male frogs can be distinguished from the female frogs, externally?

Answer: Male frogs can be distinguished from the female frogs by the presence of the following that are absent in the female frogs:

i. The sound producing vocal sacs.
ii. The copulatory pad on the first digit of the forelimbs.

21. What is cutaneaous respiration? When does a frog carry out cutaneous respiration?

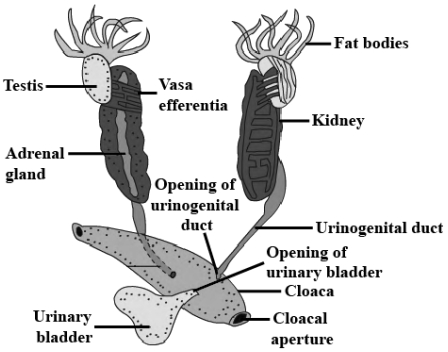
Answer: - Cutaneous respiration refers to the respiration by skin.
- A frog shows cutaneous respiration when in water and on land during hibernation and aestivation.

Long Answer Type Questions

22. How is digestion aided in the stomach and intestine in frogs?

Answer: - In the stomach, digestion is aided by the hydrochloric acid and the gastric juice secreted by the wall of the stomach.
- In the intestine (duodenum) digestion is aided by the bile secreted by the liver and pancreatic juice secreted by Pancreas.
- Bile emulsifies facts.
- Pancreatic juice has enzymes to digest proteins, fats and carbohydrates.

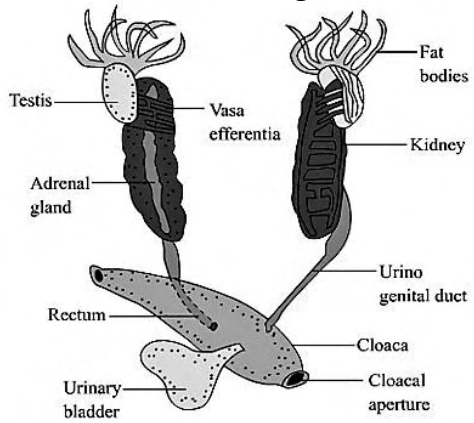
23. Draw a diagram of the reproductive system of a male frog and label six parts in it.



Competency / Case-Based / Passage - Based Integrated Questions:

24. The diagram of the reproductive system of a male frog is shown below

Observe the diagram and answer the questions that follow:



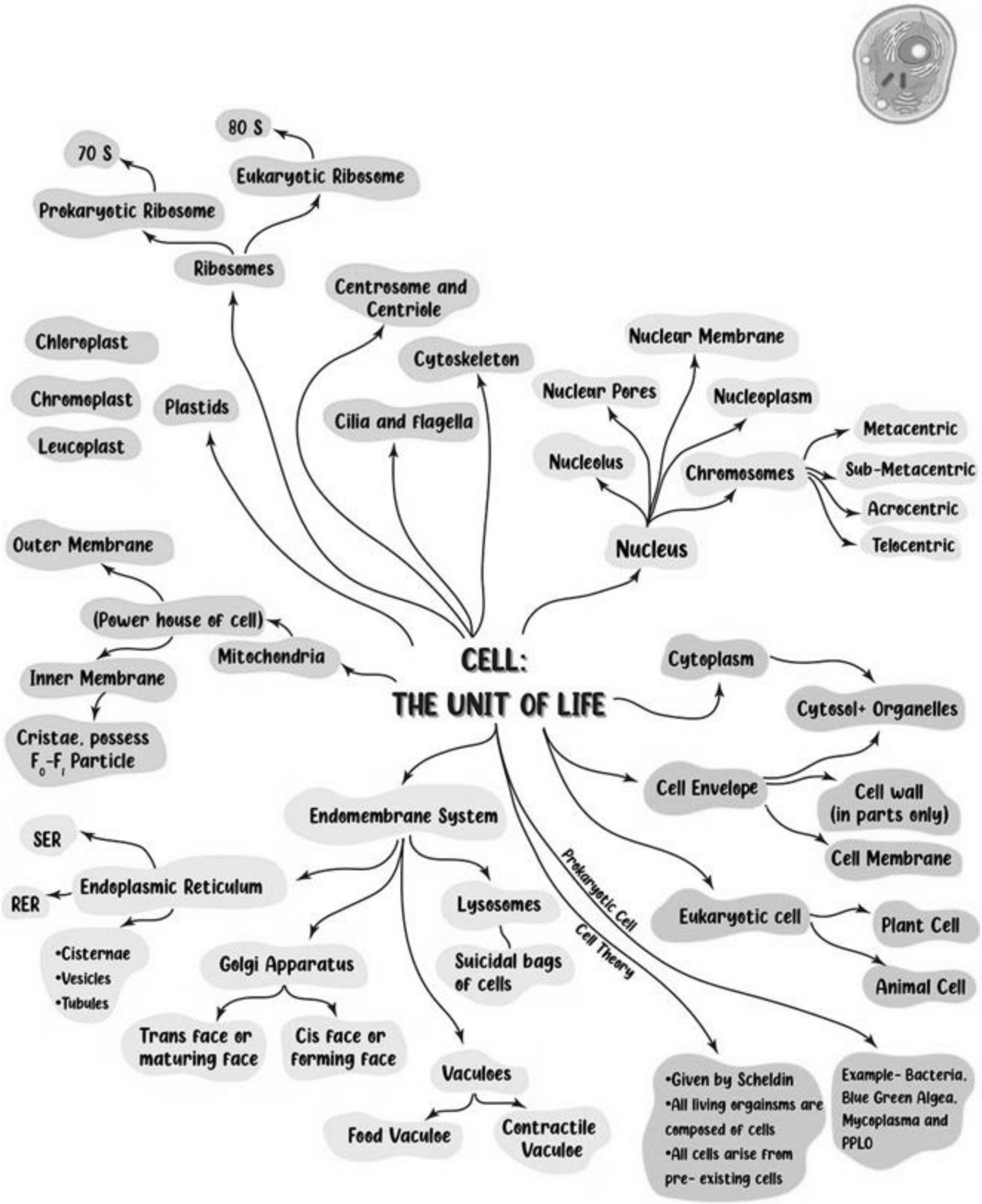
a. How are the testis adhered to the upper part of kidney?
b. Why are the ureters in a male frog called urinogenital ducts?
c. Where do the vasa efferentia arise from? How many of them are there? Where do they enter further and open into?
d. Where do the urinogenital ducts open into?

Answer: a. The testis are adhered to the upper part of kidney by a double fold of peritonium called mesorchium.
b. The Bidder's canal opens into the ureter and transfers the sperms; since the ureter carries urine as well as sperms, it is called urinogenital duct
c. Vasa efferentia arise from the testis.

- 10-12 vasa efferentia arise from a testis
- They enter the kidneys
- They open into Bidder's Canal

d. The urinogenital ducts open into the cloaca.

CONCEPT MAP


CELL:
THE UNIT OF LIFE
Ribosomes
80 S
70 S
Eukaryotic Ribosome
Prokaryotic Ribosome
Centrosome and Centriole
Cytoskeleton
Cilia and Flagella
Plastids
Chloroplast
Chromoplast
Leucoplast
Nucleus
Nuclear Membrane
Nuclear Pores
Nucleoplasm
Nucleolus
Chromosomes
Metacentric
Sub-Metacentric
Acrocentric
Telocentric
Mitochondria
(Power house of cell)
Outer Membrane
Inner Membrane
Cristae, possess F0-F1 Particle
Cytoplasm
Cytosol+ Organelles
Cell Envelope
Cell wall (in parts only)
Cell Membrane
Endomembrane System
Endoplasmic Reticulum
SER
RER
•Cisternae
•Vesicles
•Tubules
Golgi Apparatus
Trans face or maturing face
Cis face or forming face
Lysosomes
Suicidal bags of cells
Vaculoes
Food Vaculoe
Contractile Vaculoe
Prokaryotic Cell
Cell Theory
Eukaryotic cell
Plant Cell
Animal Cell
•Given by Scheldin
•All living orgainsms are composed of cells
•All cells arise from pre- existing cells
Example- Bacteria, Blue Green Algea, Mycoplasma and PPLO

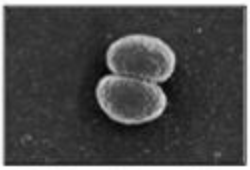
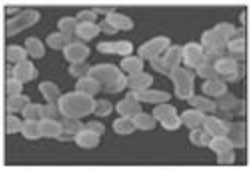
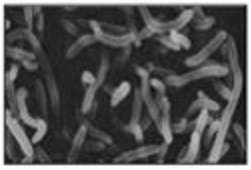
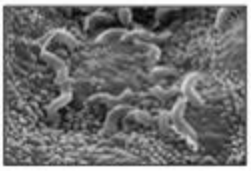
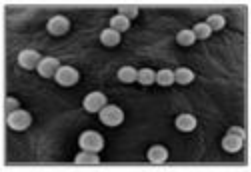
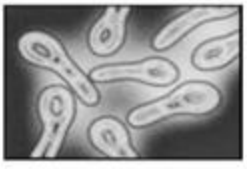
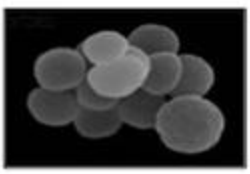
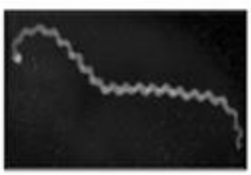
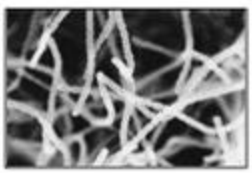
POINTS TO REMEMBER

CELL THEORY :

- Schieiden and Schwann together formulated the cell theory.
- They proposed that the body of animal and plant are composed of cells and product of cells.
- Rudolf Virchow (1855) he modified and gives the final shape to the cell theory.
    - All living organisms are composed of cells and products of cells.
    - All cells arise from pre-existing cells.

PROKARYOTIC CELLS :

- Represented by bacteria, blue-green algae, mycoplasma and PPLO.
- Smaller and multiply more rapidly than eukaryotic cells.
- Four basic shape of bacteria are
    - Bacillus (rod like)
    - Coccus (spherical)
    - Vibrio (comma shaped)
    - Sprillum (spiral)
- All prokaryotes have a cell wall surrounds the plasma membrane.
- There is no well-defined nucleus.
- Chromosome is single and circular, not enveloped by nuclear membrane.
- Presence of many small, circular, extra chromosomal and self-replicable DNA called plasmid.
- Plasmid provides unique characteristic to the bacteria.
- One of the characteristic is antibiotic resistant.
- No membrane bound cell organelles.
- A specialized differentiated form of cell membrane called mesosome is present.

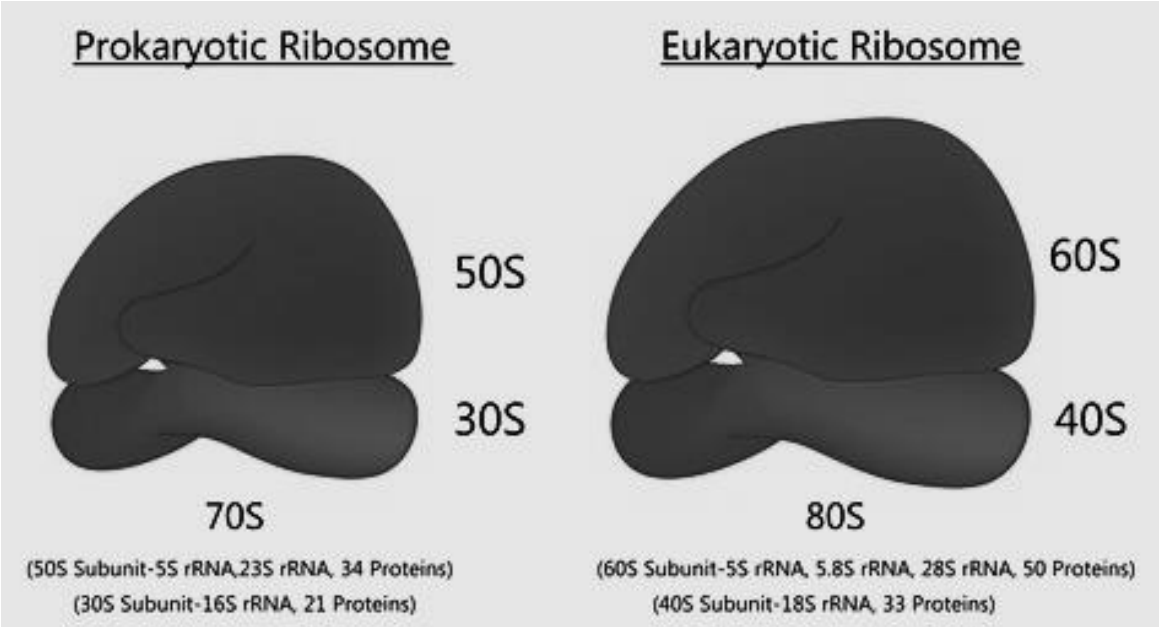
Circular	Rod-shaped	Curved Forms	Other Shapes
 Diplo- (in pairs)	 Coccobacilli (oval)	 Vibrio (curved rod)	 Helicobacter (helical)
 Strepto- (in chains)	 Streptobacilli	 Spirilla (coil)	 Corynebacter (club)
 Staphylo- (clusters)	 Mycobacteria	 Spirochete (spiral)	 Streptomyces

Cell envelope and its Modifications :

- Most prokaryotic cell have characteristic complex cell envelope.
- The cell envelops consists of tightly bound three layer structure;
    - The outermost glycocalyx.
    - Middle cell wall
    - Inner plasma membrane.
- According to the nature of the cell wall and behavior towards the stain developed by Gram, bacteria are Gram positive or Gram negative.
- Glycocalyx may for a loose sheath called slime layer.
- Glycocalyx may be thick and tough called the capsule.
- The cell wall determines the shape of the cell, strong structural support to prevent the bacterium from bursting and collapsing.
- Plasma membrane is semi-permeable in nature and interacts with outside world.
- A special membranous structure is the mesosome which is formed by extensions of plasma membrane into the cell.
    - These extensions are in the form of vesicles, tubules and lamellae.
    - They help in cell wall formation, DNA replication and distribution to the daughter cell.
    - They also help in respiration and secretion.
- Some bacteria have filamentous extensions called flagella.
- Bacterial flagellum has three parts – filament, hook and basal body.
- Pili are elongated tubular structures made of a special protein.
- Fimbriae are small bristle like fibres sprouting out of the cell. Play role in adhesion.

Ribosome and inclusion bodies :

- Ribosomes are associated with the plasma membrane of the cell.
- Each ribosome (70 S) has two sub units; smaller (30 S) and large (50 S).
- Ribosomes are the site of protein synthesis.
- Several ribosomes attached to a single mRNA to form a chain called polyribosome or polysome.
- Reserve materials are stored in the form of inclusion bodies.
- Phosphate granules, cyanophycean granules and glycogen granules are the inclusion bodies.



EUKARYOTIC CELL :

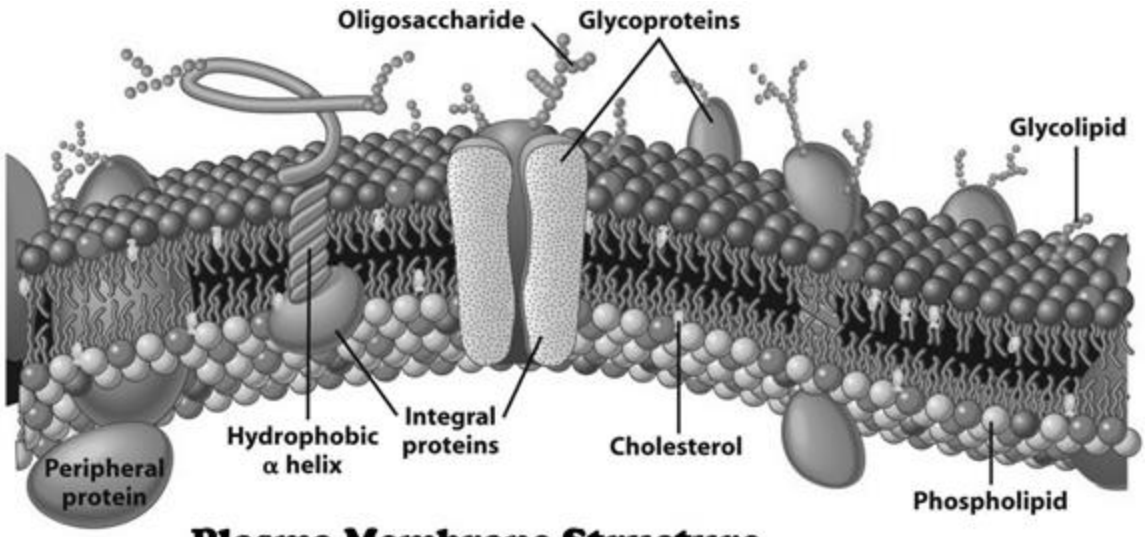
- Eukaryotes include all the Protists, plants, animals and fungi.
- Extensive compartmentalization due to membrane bound cell organelles.
- Possess an organized nucleus with nuclear envelope.
- Have a variety of complex locomotory and cytoskeletal structure.
- Genetic materials are organized into chromosomes.
- The plant cell possess cell walls, plastids and a large central vacuole, which are absent in animal cell.
- Animal cells have centrioles which absent in plant cells.

Cell membrane :

- The cell membrane composed of lipids that arranged in bilayer.
- Lipids are arranged within the membrane with the hydrophilic polar head towards the outer sides and the hydrophobic tails towards the inner part.
- Non polar tail of saturated hydrocarbons is protected from the aqueous environment.
- The lipid component of the membrane mainly consists of phophoglycerides.
- Cell membrane also possesses protein and carbohydrates.
- Ratio of protein and lipids varies from cell to cell.
- Human erythrocyte plasma membrane contains 52 % protein and 40 % lipids.
- Membrane protein may be integral or peripheral.
- Peripheral protein lie on the surface and integral proteins are partially or totally buried in the membrane.
- The improved model of the structure of plasma membrane was proposed by singer and Nicolson (1972) widely accepted as fluid mosaic model.
- According to this the quasi fluid nature of lipid enables the lateral movement of proteins within the overall bilayer.

Function :

- Passive transport.
  - Simple diffusion
  - Facilitated diffusion.
- Active transport.
- Phagocytosis
- Exocytosis.
- Pinocytosis.



Plasma Membrane Structure

Cell wall :

- A non-living rigid structure called cell wall present outside the plasma membrane of plant and fungal cell.
- Algae have a cell wall made of cellulose, galactans, mannans and minerals like calcium carbonate.
- Plant cell wall consists of cellulose, hemicelluloses, pectins and proteins.
- The cell wall of young plant is called primary cell wall.
- On maturity secondary cell wall formed inner to it.
- The middle lamella is a layer of calcium pectate which holds or glues the neighboring cells.
- The cell wall and middle lamella may traversed by plasmodesmata; the cytoplasmic connection between two adjacent cell.

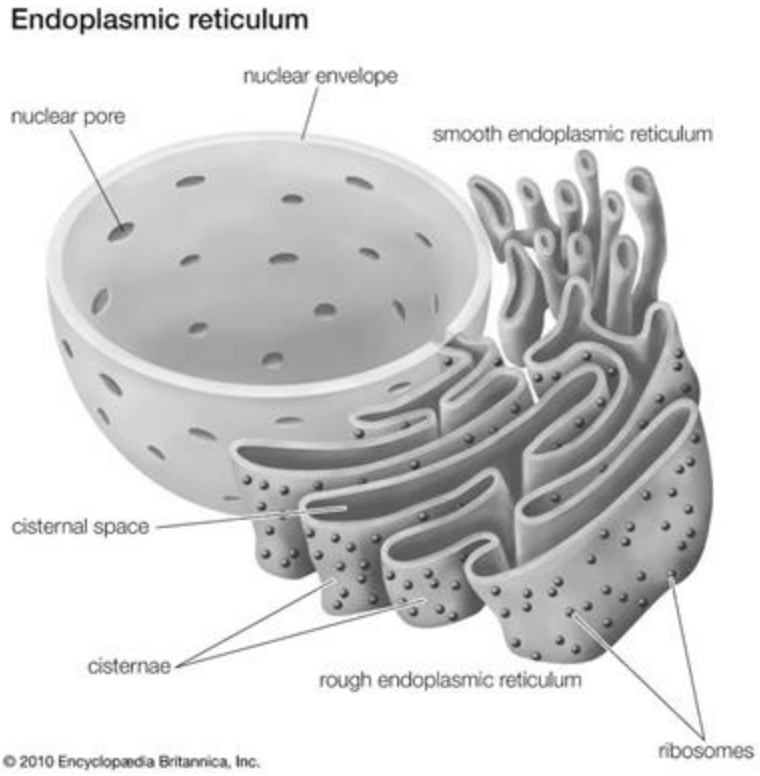
The endomembrane system :

Endoplasmic reticulum :

- Network or reticulum of tiny tubular structures scattered in the cytoplasm, called endoplasmic reticulum.
- It divides the intracellular space into two distinct compartments:
    - Luminal (inside the ER)
    - Extra luminal (cytoplasm).
- The ER shows ribosomes attached to their outer surface called Rough Endoplasmic reticulum (RER).
- Endoplasmic reticulum without ribosome called SER (smooth endoplasmic reticulum)

Function:

- RER present in the cell actively involved in protein synthesis.
- SER is the site for synthesis of lipid, glycogen and steroid hormones.

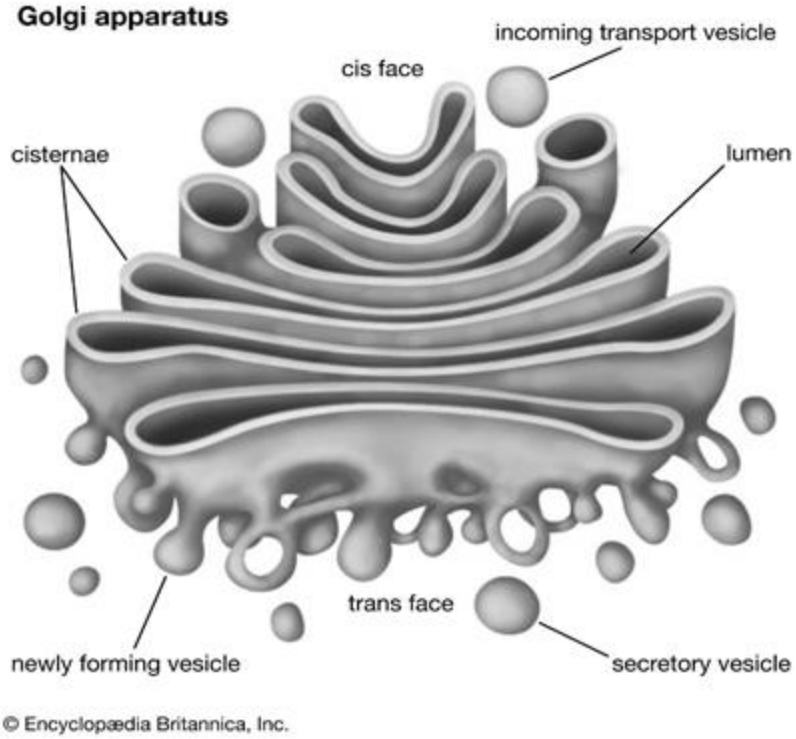


Golgi apparatus:

- Camillo Golgi (1898) first observed this organelle, and named after him.
- It consists of many flat, disc shaped sacs or cisternae.
- These are staked parallel to each other.
- The Golgi cisternae are concentrically arranged near the nucleus with distinct convex *cis*or the forming face and concave *trans*or the maturing face.

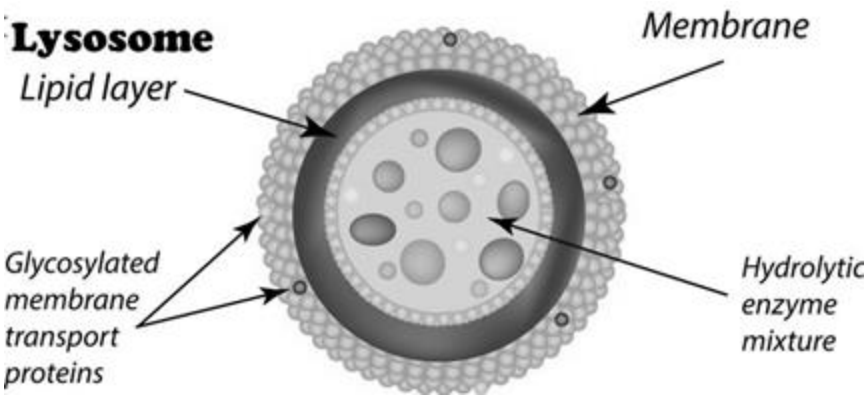
Function:

- Principally responsible for packing of materials to be delivered intra-cellular target or intercellular target.
- Materials are packed in the form of vesicles, from the ER fuse with the cis face of the Golgi apparatus and move towards the trans face.
- Important site for the formation of glycoprotein and glycolipids.



Lysosomes:

- Membrane bound vesicular structure.
- Formed by Golgi body.
- Rich in all type hydrolytic enzymes, optimally active in acidic pH.
- These enzymes are capable to digesting carbohydrates, proteins, lipids and nucleic acids.

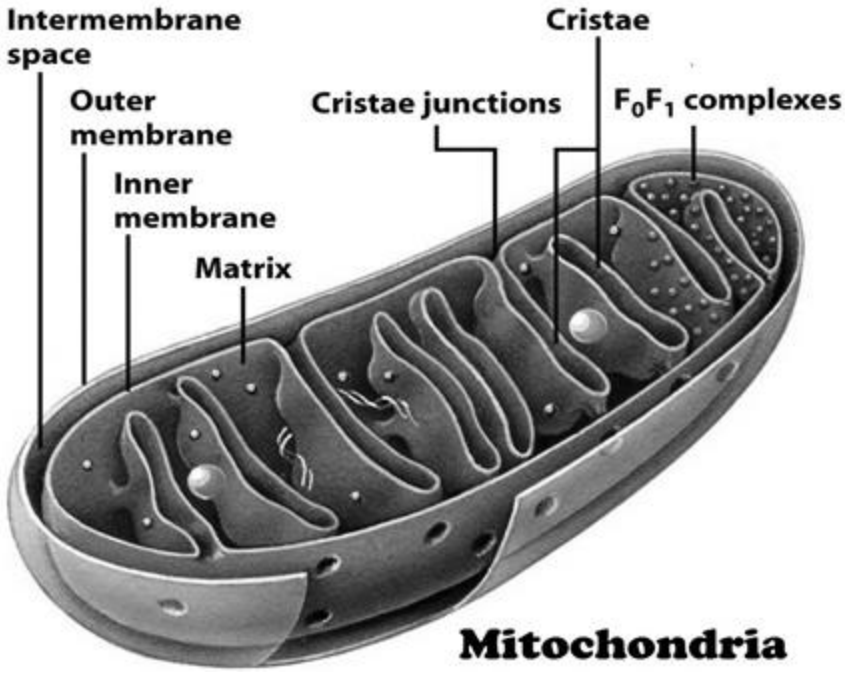


Vacuoles:

- The vacuole is the membrane-bound space found in the cytoplasm.
- It contains water, sap, excretory product.
- Vacuole is bounded by a single membrane called tonoplast.
- In plant cells the vacuole can occupy 90% of the volume.
- Tonoplast facilitates active transport of material from cytoplasm into the vacuole.
- In *Amoeba* the contractile vacuole is important for excretion and osmoregulation.
- In many protists, food vacuoles are formed by engulfing the food particles.

Mitochondria:

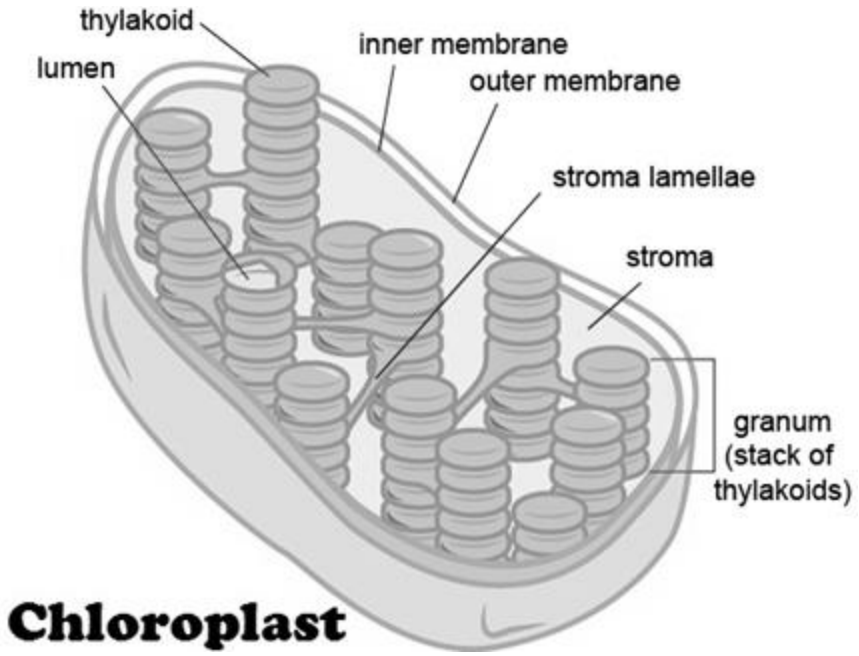
- The number of mitochondria varies according to the physiological activity of the cell.
- Each mitochondrion is a double membrane bound structure with outer and inner membrane, dividing its lumen into two aqueous compartments
    - Outer compartment.
    - Inner compartment.
- The inner compartment is called the matrix.
- The inner membrane forms a number of infoldings called the cristae towards the matrix.
- The cristae increase the surface area.
- Two membranes have their own specific enzymes associated with the mitochondrial function.
- Mitochondria are the site of aerobic respiration.
- They produce cellular energy in the form of ATP, hence called 'power house' of the cell.
- The matrix also possess single circular DNA molecule and a few RNA molecules, ribosomes (70S), they synthesize their own protein.
- Mitochondria divide by fission.



Plastids :

- Plastids are found in all plant cells and in Euglenoids.
- They bear some specific pigment, impart specific colour to the plants.
- Based on the type of pigments plastids can be classified into
    - Chloroplast.
    - Chromoplast
    - Leucoplast.

- The chloroplasts contain chlorophyll and carotenoid pigments, traps solar energy for photosynthesis.
- In the chromoplasts fat soluble carotenoid pigments like carotene, xanthophylls are present.
- The leucoplasts are colourless plastids of varied shapes and size with stored nutrients.
    - Amyloplast - store carbohydrates.
    - Elaioplasts – store oils and fats.
    - Aleuroplast – store proteins and minerals.
- Chloroplasts are found in the mesophyll cells of the leaves.
- These are oval, spherical, discoid or even ribbon like organelles.
- Chloroplast is a double membrane organelle.
- The space limited by inner membrane is called stroma.
- A number of organized flattened membranous sacs called thylakoid are present in the stroma.
- Thylakoids are arranged like stakes of coins to form grana.
- There are flat membranous tubules called the stroma lamellae connecting the thylakoids of the different grana.
- They thylakoids enclose a space called lumen.
- Chlorophyll pigments are located in the thylakoids.
- Chloroplast contains enzymes required for the synthesis of carbohydrates and proteins.
- Stroma contains small circular DNA and ribosomes.



Chloroplast

Ribosomes :

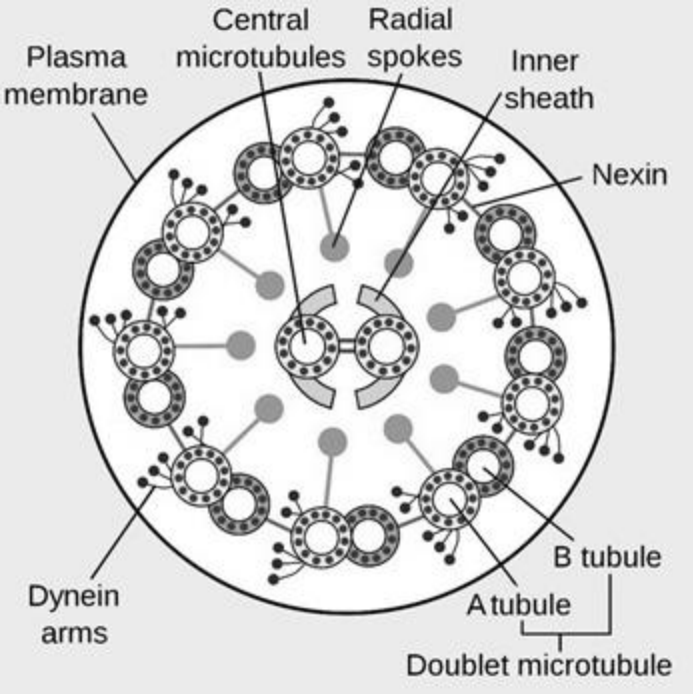
- Ribosomes are granular structure first observed by George Palade (1953).
- Composed of ribonucleic acid (RNA) and proteins.
- Non-membranous cell organelles.
- Eukaryotic ribosomes are 80S while the prokaryotic ribosomes are 70S.
- 'S' stands for sedimentation coefficient; measure of density and size.
- Both 70S and 80S ribosomes consists of two subunits.
- Primary function is protein synthesis hence called protein factory of the cell.

Cytoskeleton :

- An elaborate network of filamentous proteinaceous structures present in the cytoplasm is collectively known as cytoskeleton.
- Cytoskeleton involved in many function such as mechanical support, motility, maintenance of the shape of the cell.

Cilia and Flagella :

- Cilia and flagella are hair-like outgrowths of the cell membrane.
- Cilia are small help in the movement of cell or surrounding fluid.
- Flagella are longer and responsible for cell movement.
- Cilia and flagella covered by plasma membrane.
- Their core called axoneme, possess a number microtubules running parallel to the long axis.
- The axoneme usually has nine pairs of doublets of radially arranged peripheral microtubules and a pair of centrally located microtubules.
- The central tubules are connected by bridges and are also enclosed by a central sheath, which is connected to one of the tubules of each peripheral doublet by radial spoke.
- The peripheral doublets are also interconnected by linkers.
- Both cilia and flagella emerge from centrioles-like structure called basal bodies.



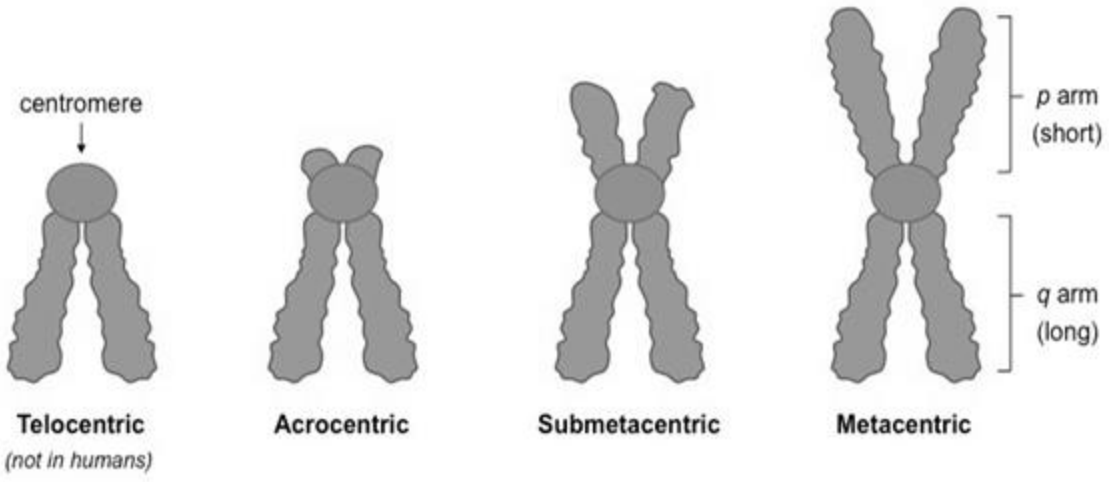
Centrosome and centrioles :

- Centrosome is an organelle usually containing two cylindrical structures called centrioles.
- They are surrounded by amorphous pericentriolar materials.
- Both centrioles in a Centrosome lie perpendicular to each other.
- Each centriole has an organization like the cartwheel.
- They are made of nine evenly spaced peripheral fibrils of tubulin.
- Each of the peripheral fibril is a triplet.
- The adjacent triplets are also linked to each others.
- The central part of the centriole is called hub.
- The hub connected to peripheral triplets by radial spokes.
- The centriole forms the basal body for cilia, flagella and form spindle fibres during cell division.

Nucleus :

- Nucleus as a cell organelle was first described by Robert Brown in 1831.
- Materials inside the nucleus was stained by Flemming and named as chromatin.
- The interphase nucleus has highly extended and elaborates nucleoprotein fibres called chromatin.

- The nucleus also contains nuclear matrix and one or two spherical bodies called nucleoli.
- Nuclear envelope consists of two membranes with perinuclear space (10- 50 nm).
- The outer membrane remains continuous with endoplasmic reticulum.
- Presence of nuclear pore due to fusion of two membranes.
- Nuclear pores allow the movement of RNA and protein in both directions.
- The nuclear matrix or nucleoplasm contains nucleolus and chromatin.
- Nucleolus is the site for active ribosomal RNA synthesis.
- During cell division the chromatins condensed to form chromosomes.
- Chromatin contains DNA and some basic proteins called histones, non-histone proteins and some RNA.
- A single human cell contains approximately two meter long thread of DNA in 46 chromosomes.
- Each chromosome essentially has a primary constriction or the centromere.
- On each side of centromere there is disc shaped structures called kinetochores.
- Based on the position of the centromere chromosomes are classified into four types:-
    - Metacentric: centromere at the middle with two equal arms.
    - Sub-Metacentric: one short arm and one long arm.
    - Acrocentric: with extremely short arm and a very long arm.
    - Telocentric: with terminal centromere.
- A few chromosomes have non-staining constrictions at a constant location. This gives the appearance of a small fragment called the satellite.



Question and Answers

Select and write one most appropriate option

1. Which structures perform the function of mitochondria in bacteria?
    (a) Nucleoid
    (b) Ribosomes
    (c) Cell wall
    (d) Mesosomes
    Answer - (d)

2. The organelles that are included in the endomembrane system are:
    (a) Golgi complex, Mitochondria, Ribosomes and Lysosomes
    (b) Golgi complex, Endoplasmic reticulus, Mitochondria and Lysosomes
    (c) Endoplasmic reticulum, Mitochondria, Ribosomes and Lysosomes
    (d) Endoplasmic reticulum, Golgi complex, Lysosomes and Vacuoles
    Answer - (d)

3. All prokaryotes have a cell wall surrounding the cell membrane except in
   (a) Mycoplasma
   (b) Bacillus
   (c) Vibrio
   (d) Blue green algae
   Answer - (a)
4. The plasma membrane consists mainly of
   (a) phospholipids embedded in a protein bilayer
   (b) proteins embedded in a phospholipid bilayer
   (c) proteins embedded in a polymer of glucose molecules
   (d) proteins embedded in a carbohydrate bilayer
   Answer - (b)
5. Choose incorrect match
   (a) Chloroplast - Thylakoid
   (b) Golgi bodies - Cristae
   (c) Mitochondria - Oxysome
   (d) Centriole - Microtubules
   Answer - (b)

6. What is a tonoplast?
   (a) Outer membrane of mitochondria
   (b) Inner membrane of chloroplast
   (c) Membrane boundary of the vacuole of plant cells
   (d) Cell membrane of a plant cell.
   Answer - (c)

Assertion_Reason Based Questions

Directions: In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as:
(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) If Assertion is true but Reason is false.
(d) If both Assertion and Reason are false.

7. Assertion: Rudolf Virchow modified the hypothesis of cell theory given by Schleiden and Schwann.
   Reason : Cell theory says that all cells arise from pre-existing cells.
   Answer – (b)
8. Assertion: The Golgi apparatus mainly performs the function of packaging materials.
   Reason: Materials to be packed in the form of vesicles from the ER fuse with trans face of the Golgi Apparatus
   Answer – (c)
9. Assertion : Plasmids are double-stranded extra chromosomal DNA.
   Reason : Plasmids are possessed by eukaryotic cells.
   Answer – (c)
10. Assertion: Lysosomes are capable of digesting carbohydrates, proteins, lipids and nucleic acids.
    Reason: Lysosomes are rich in hydrolytic enzymes like lipases, proteases and carbohydrases
    Answer – (a)

11. What does "S" stand for in the 70S and 80S ribosome?
"S" is the Svedberg's unit for sedimentation coefficient. It depicts the rate of sedimentation of a cell during ultracentrifugation. Heavier the cell structure, higher is the sedimentation coefficient.

12. Where is dynein present?
In microtubules of flagella

13. Briefly describe the cell theory.
Schleiden and Schwann together formulated the cell theory (1838-39). This theory, however, did not explain as to how new cells were formed. Rudolf Virchow (1855) first explained that cells divided and new cells are formed from pre-existing cells (Omnis cellula-e cellula). He modified the hypothesis of Schleiden and Schwann to give the cell theory a final shape. Cell theory as understood today is
(i) All living organisms are composed of cells and products of cells.
(ii) All cells arise from pre-existing cells.

14. What are the cell inclusions in a prokaryotic cell?
Cell inclusions in prokaryotic cells are granules or inclusion bodies. They lie freely in the cytoplasm. For example, phosphate granule; glycogen granules, sulphur granules, gas vacuole, poly-(ii) hydroxybutyrate. There may be metachromatic granules.

15. What is a mesosome in a prokaryotic cell? Mention the functions that it performs.
- Mesosome is a membranous structure in prokaryotic cell, which is formed by the extensions of the plasma membrane into the cell in form of vesicles, tubules and lamellae.
- Mesosomes are equal to mitochondria in eukaryotes, as they perform aerobic cellular respiration in prokaryotes.
- It helps in DNA replication and distribution of genetic material to daughter cells. Mesosomes also help in respiration, increase the surface area of the plasma membrane and enzymatic content and cell wall formation.

16. What are the main functions of the cell wall?
The main functions of the cell wall are:
- It gives a definite shape to the cell and protects the internal organelles.
- It provides a framework and lends support to the plasma membrane.
- It prevents the cell from desiccation.
- It counteracts physically the osmotic pressure produced by the cell contents.
- It helps in the transport of materials and metabolites in and out of the cell.

17. Write the functions of the following:
a. Centromere
b. Smooth ER
c. Centrioles
a. Centromere: Every chromosome essentially has a primary constriction or the centromere. Two sister chromatids are joined together at the centromere.
b. Smooth ER: The smooth endoplasmic reticulum is the major site for synthesis of lipid. In animal cells lipid-like steroidal hormones are synthesised in SER.
c. Centrioles: The centrioles form the basal body of cilia or flagella, and spindle fibres that give rise to spindle apparatus during cell division in animal cells.

18. Describe the functions of the three organelles, viz Golgi bodies, chloroplasts, and mitochondria.

(a) Functions of Golgi bodies:

- Carbohydrate synthesis of mucopolysaccharides
- Formation of acrosome
- Formation of the lysosome.
- Formation of the plasma membrane.
- Formation of the cell wall.
- Absorption of compounds.
- Production of hormones.
- Formation of pigments.
- Yolk deposition.

(b) Functions of chloroplast:

- Their main function is to trap the sun's energy and to convert it into the chemical energy of food by photosynthesis.
- Storage of starch,
- Chloroplasts in fruits and flowers change into chromoplasts.

(c) Functions of Mitochondria:

- Powerhouses the cell and stores energy as ATP.
- Several respiratory enzymes are found in mitochondria.
- DNA is also contained in mitochondria.
- They regulate the concentration of calcium ions in the cells.

19. Give an ultrastructure of mitochondria.

- Mitochondria, unless specifically stained, are not easily visible under the microscope.
- The number of mitochondria per cell is variable depending on the physiological activity of the cells.
- In terms of shape and size also, considerable degree of variability is observed.
- Typically it is sausage shaped or cylindrical having a diameter of 0.2-1.0 ft m (average 0.5 film) and length (1.0 -4.1 ft).
- Each mitochondrion is a double membrane-bound structure with the outer membrane and the inner membrane dividing its lumen distinctly into two aqueous compartments, i.e. the outer compartment and the inner compartment.
- The inner compartment is called the matrix. The outer membrane forms the continuous limiting boundary of the organelle.
- The inner membrane forms a number of infoldings called the cristae. The cristae increase the surface area.
- The two membranes have their own specific enzymes associated with the mitochondrial function. Mitochondria are the sites of aerobic respiration.
- They produce cellular energy in the form of ATP, hence they are called. "Power houses" of the cell.
- The matrix also possesses single circular DNA molecule, a few RNA molecules, ribosomes (70s) and the components required for the synthesis of proteins.
- The Mitochondria divide by fission.

20. Differentiate between Rough Endoplasmic Reticulum and Smooth Endoplasmic Reticulum.

Rough Endoplasmic Reticulum (RER)	Smooth Endoplasmic Reticulum (SER)
Ribosomes are attached to their surface.	Ribosomes are not attached to their surface.
Formed of cisternae and a few tubules.	Formed of vesicles and tubules.
It participates in the protein and enzyme synthesis.	Takes part in the synthesis of glycogen, lipids, and steroids.

May develop from the nuclear envelope.	May develop from RER.
It is internal.	It is peripheral.
It is connected to the nuclear envelope.	It is connected to the plasmalemma.
Lacks detoxification enzymes.	Contains detoxification enzymes.
Gives rise to lysosomes.	Gives rise to sphaerosomes.

Case Based Question

A chloroplast is a type of membrane-bound organelle known as a plastid that conducts photosynthesis mostly in plant and algal cells. The photosynthetic pigment chlorophyll captures the energy from sunlight, converts it, and stores it in the energy-storage molecules ATP and NADPH while freeing oxygen from water in the cells. The ATP and NADPH is then used to make organic molecules from carbon dioxide in a process known as the Calvin cycle. Chloroplasts carry out a number of other functions, including fatty acid synthesis, much amino acid synthesis, and the immune response in plants. The number of chloroplasts per cell varies from one, in unicellular algae, up to 100 in plants like *Arabidopsis* and wheat.

(i) The ground material in Chloroplast is

(a) Matrix (b) Stroma (c) Lamellae (d) Thylakoid

Answer - (b)

(ii) When green tomatoes fruits turn to red, then

(a) new chromoplasts are formed

(b) chloroplasts are disintegrated and get converted into chromoplasts

(c) chromoplasts are changed to chloroplasts

(d) none of these

Answer - (b)

(iii) In chloroplasts, the parallel layering of membranes is suited for

(a) maximum exposure of enzymes

(b) maximum light absorption

(c) minimum light absorption so cells can maintain their temperature

(d) all of these

Answer - (b)

(iv) Chlorophyll in chloroplasts is present in

(a) Stroma

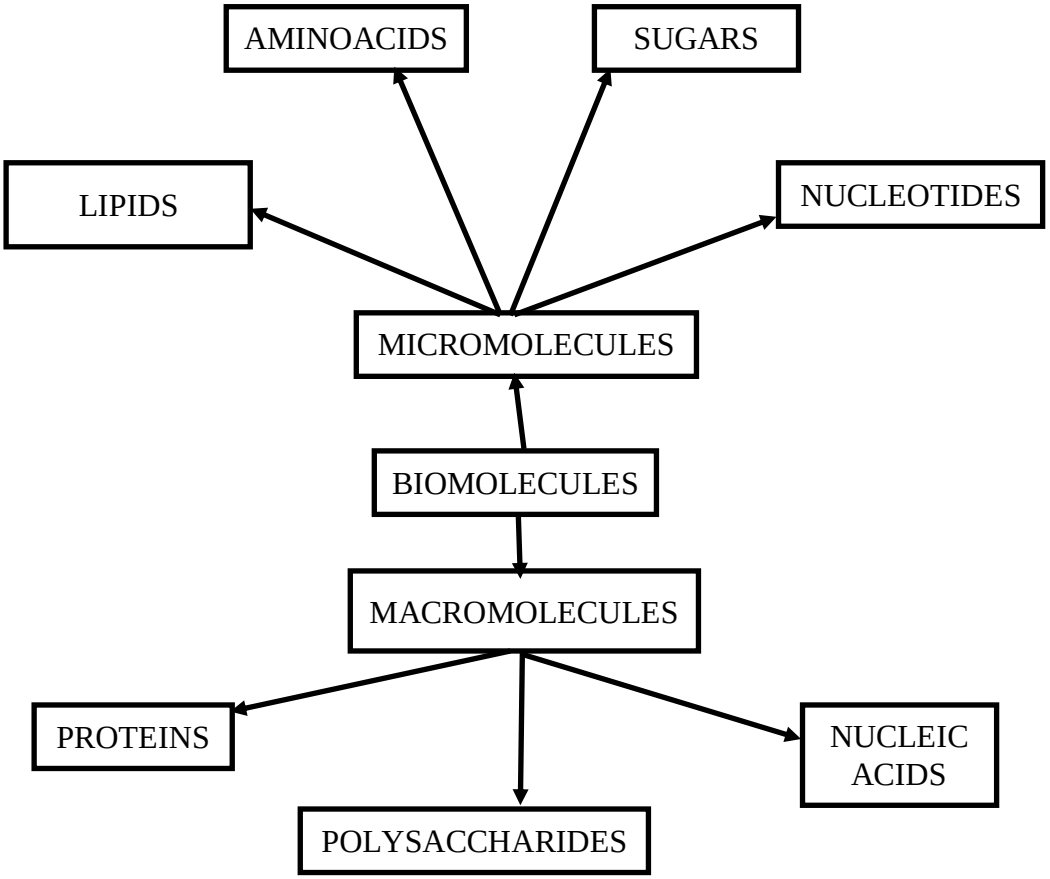
(b) outer membrane

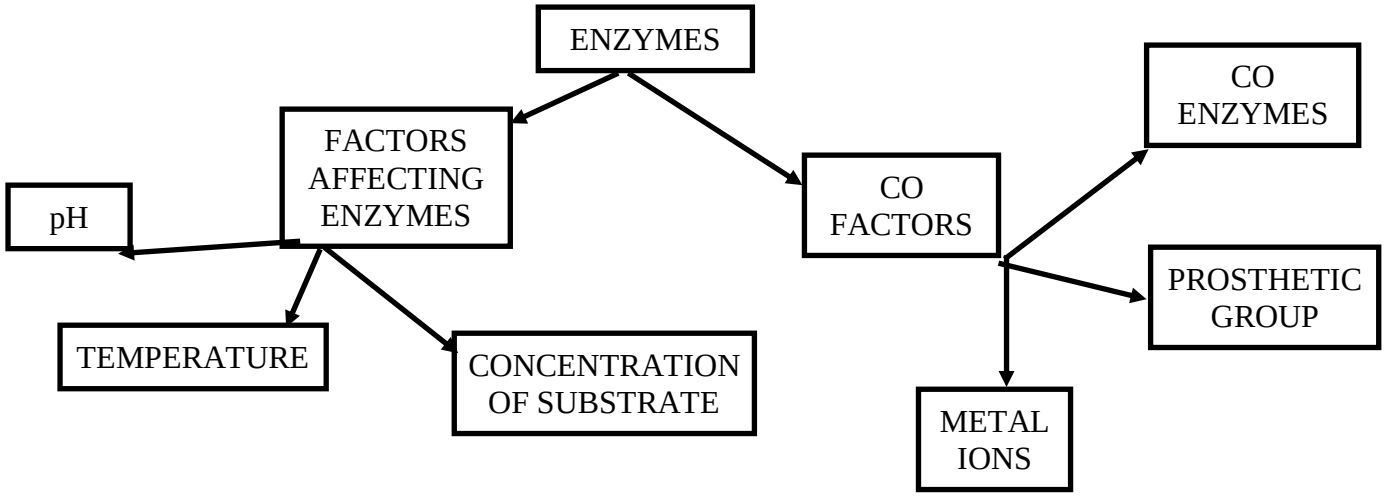
(c) inner membrane

(d) thylakoids

Answer - (d)

CONCEPT MAP


AMINOACIDS
SUGARS
LIPIDS
NUCLEOTIDES
MICROMOLECULES
BIOMOLECULES
MACROMOLECULES
PROTEINS
NUCLEIC ACIDS
POLYSACCHARIDES


ENZYMES
FACTORS AFFECTING ENZYMES
pH
TEMPERATURE
CONCENTRATION OF SUBSTRATE
CO FACTORS
CO ENZYMES
PROSTHETIC GROUP
METAL IONS

POINTS TO REMEMBER

Biomolecules are chemical compounds found in living organisms. They include organic and inorganic compounds.

ANALYSIS OF CHEMICAL COMPOSITION IN A TISSUE

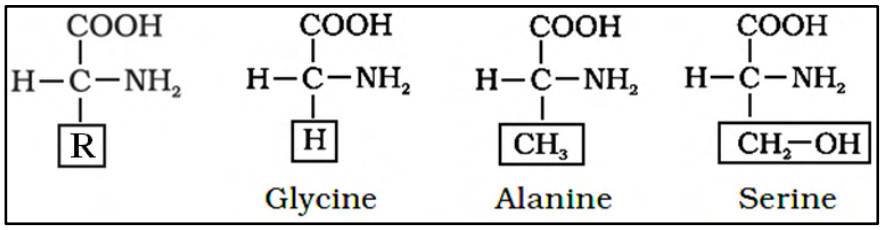
*Take a living tissue (a vegetable or piece of liver etc).
*Grind it in trichloroacetic acid (Cl_3CCOOH) using a mortar and a pestle to get a thick slurry.
*Strain this through a cheesecloth or cotton to get 2 fractions such as filtrate (acid-soluble pool) and the retentate (acid-insoluble fraction).
*The filtrate contains biomicromolecules (biomolecules having molecular weight less than 1000 Dalton). The retentate contains biomacromolecules (biomolecules having molecular weight higher than 1000 Dalton).
Analysis of inorganic compounds
*Weigh a living tissue and dry it to evaporate water.
*It is fully burnt to oxidize all the carbon compounds to gaseous form (CO_2 and water vapour).
*The remaining ash contains inorganic elements (Ca, Mg, Na, K etc.) and inorganic compounds (SO_4^{2-}, PO_4^{3-}, NaCl, $CaCO_3$ etc.).

BIOMICROMOLECULES (MICROMOLECULES OR BIOMOLECULES)

Molecular weight of biomicromolecules found in the acid soluble pool ranges from 18 to 800 Dalton (Da). The acid soluble pool represents the cytoplasmic composition.
They include amino acids, sugars, nitrogen bases, lipids etc.

1. AMINO ACIDS:

A typical amino acid is formed of an amino group ($-NH_2$), an acid group (-COOH), H & a



variable group (R). $-NH_2$ & –COOH are attached to the same carbon atom (α-carbon).

20 types of amino acids are used for protein synthesis. They include
*Acidic amino acids: e.g. Glutamic acid, Aspartic acid
*Basic amino acids: e.g. Lysine, Arginine
*Neutral amino acids: e.g. Valine
Some amino acids are aromatic. E.g. tyrosine, phenyl alanine and tryptophan.
Amino acids are 2 types:
*Essential amino acids: They cannot be synthesized by the body and should be supplied through diet. E.g. Lysine, leucine, isoleucine, tryptophan etc.
*Non-essential amino acids: They can be synthesized by the body. E.g. Glycine, alanine, serine, arginine etc.

Amino acids have ionizable nature. So structure of amino acids changes in solutions of different pH.

2. LIPIDS :

- Water insoluble.
- Contain C,H& O but number of oxygen atoms is less.

Types of lipids

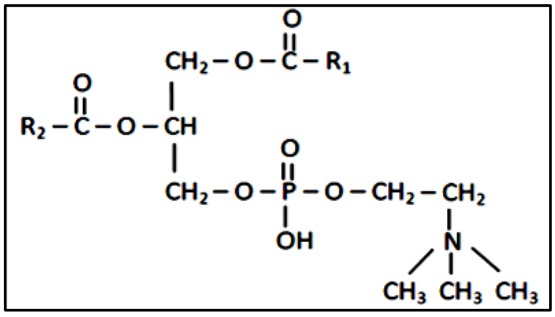
a. Simple lipids: These are formed of Fatty acids and alcohol such as glycerol.
*Fatty acids are organic acids with a hydrocarbon chain (R- group) ending in –COOH group. E.g. Palmitic acid has 16 carbons (CH_3 - $(CH_2)_{14}$ - COOH or $C_{15}H_{31}$-COOH) and Arachidonic acid has 20 Carbons.
*Fatty acids are 2 types:
*Saturated fatty acids: They have no double or triple bonds between carbon atoms. E.g. Palmitic acid, Stearic acid ($C_{17}H_{35}COOH$) etc.
*Unsaturated Fatty acids: They have one or more C=C bonds. E.g. Oleic acid ($C_{17}H_{33}COOH$), Arachidonic acid ($C_{19}H_{31}COOH$) etc.
Structure of glycerol (trihydroxy propane):

CH_2-OH
|
CH-OH
|
CH_2-OH

Fatty acids are esterified with glycerol through ester bond forming monoglycerides, diglycerides& triglycerides.

1 glycerol + 1 fatty acid = Monoglyceride
1 glycerol + 2 fatty acid = Diglyceride
1 glycerol + 3 fatty acid = Triglyceride

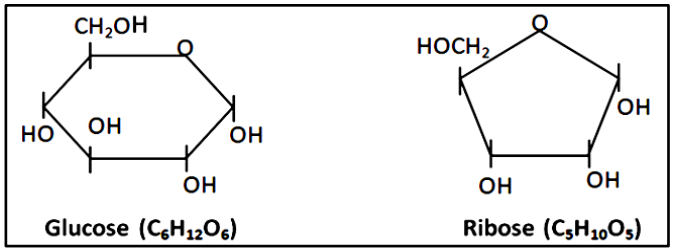
*Based on melting point, lipids (triglycerides) are 2 types:
(i)Fats: Higher melting point. (ii)Oils: Lower melting point.



b.Compound lipids: These are the esters of fatty acids and alcohol with additional groups. E.g. Phospholipids (fatty acids+ glycerol + phosphate). They are found in cell membranes. E.g. Lecithin.

c. Derived lipids: These are the products of hydrolysis of simple lipids and compound lipids. E.g. Cholesterol.

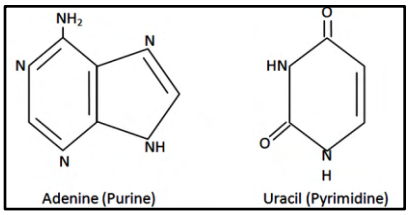
3. SUGARS (CARBOHYDRATES) :



Sugars are sweet and water soluble carbohydrates. They are formed of C, H and O in the ratio of 1:2:1.

4. NITROGEN BASES :

These are the nitrogen containing cyclic compounds found in nucleic acids. They are 2 types:



Nucleoside: Nitrogen base + Sugar

Adenine + sugar = Adenosine
Guanine + sugar = Guanosine
Cytosine + sugar = Cytidine
Thymine + sugar = Thymidine
Uracil + sugar = Uridine

Nucleotide: Nitrogen base + Sugar + phosphate
Adenine + sugar + phosphate = Adenylic acid
Guanine + sugar + phosphate = Guanylic acid
Cytosine + sugar + phosphate = Cytidylic acid
Thymine + sugar + phosphate = Thymidylic acid
Uracil + sugar + phosphate = Uridylic acid

Nucleotides are heterocyclic compounds.
Nucleic acids (DNA & RNA) are made up of nucleotides.

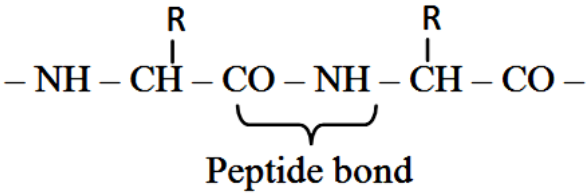
BIO-MACROMOLECULES (MACROMOLECULES)

These are biomolecules having molecular weight greater than 1000 Da. They include
*Proteins
*Polysaccharides
*Nucleic acids

Acid insoluble fraction (macromolecular fraction) includes macromolecules from cytoplasm and organelles.
Lipid is not strictly a macromolecule as its molecular weight does not exceed 800 Da. But it comes under acid insoluble fraction because many lipids are arranged into structures like cell membranes. When a tissue is grinded, cell membranes are broken and form water insoluble vesicles. They cannot be filtered along acid soluble fraction.

1. PROTEINS:

Proteins are heteropolymers of amino acids. They are polypeptides. i.e., linear chains of amino acids linked by p
Peptide bonds.
Peptide bond is formed when –COOH group of one amino acid reacts with $–NH_2$ group of next amino acid by releasing a molecule of water (dehydration).



Functions of protein:

- For growth and tissue repair.
- Transport nutrients across cell membranes (e.g. GLUT-4 enables glucose transport into cell).
- Acts as intercellular ground substance (e.g. collagen).
- Acts as antibodies to fight infectious organisms.
- Acts as receptors (e.g. receptors of smell, taste, hormones). Some are hormones (e.g. Insulin), enzymes (e.g. trypsin), pigments (e.g. hemoglobin) etc.

Most abundant protein in animal world: Collagen
Most abundant protein in the biosphere: Ribulosebiphosphate carboxylase - oxygenase (RuBisCO)

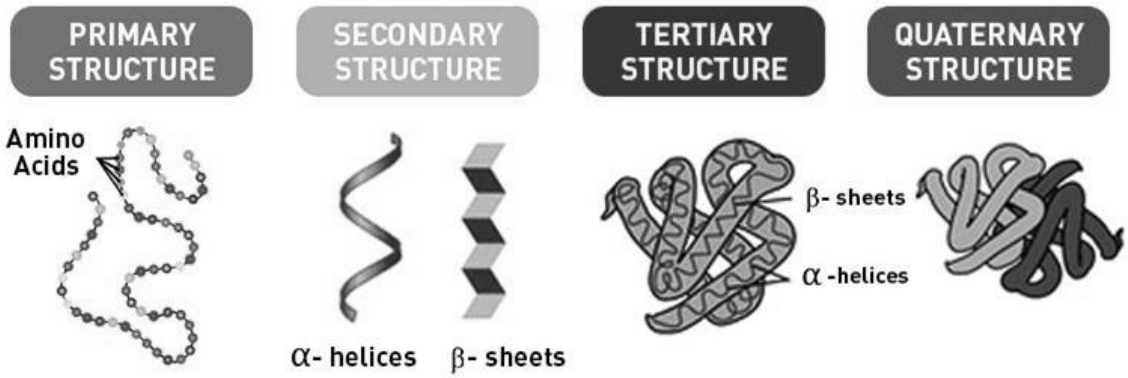
Structural levels of protein:

Primary structure: It describes the sequence of amino acids, i.e. the positional information in a protein. Left end of the chain has first amino acid (N-terminal amino acid). Right end has last amino acid (C-terminal amino acid).

Secondary structure: Here, one or more polypeptide chains are folded in the form of a helix. It has only right handed helices. E.g. Keratin, Fibroin (silk fibre).

Tertiary structure: Here, helical polypeptide chain is further folded like a hollow woolen ball. It gives 3-D view. Tertiary structure is necessary for many biological activities of proteins. E.g. Myoglobin, enzymes.

Quaternary structure: Here, more than one polypeptide chains form tertiary structure and each chain functions as subunits of protein. E.g. Haemoglobin. It has 4 subunits (2 α subunits and 2 β subunits).



2. POLYSACCHARIDES (COMPLEX CARBOHYDRATES)

These are polymers of sugars (monosaccharides). E.g.

Starch (polymer of glucose)

Cellulose (polymer of glucose) Homopolymers

Glycogen (polymer of glucose)

Inulin (polymer of fructose)

There are complex polysaccharides formed of amino- sugars (e.g., glucosamine, N-acetyl galactosamine etc.). Chitin is the homopolymer of N-acetyl glucosamine.

Seen in exoskeleton of arthropods and fungal cell wall.

Glycosidic bond in polysaccharides: It is the bond formed when individual monosaccharides are linked between 2 carbon atoms by dehydration.

Starch forms helical secondary structure.

Starch holds I_2 molecules in the helical portion giving blue colour.

Cellulose has no complex helices and so cannot hold I_2.

Diagrammatic representation of a portion of glycogen is given below:

3. NUCLEIC ACIDS (DNA & RNA)

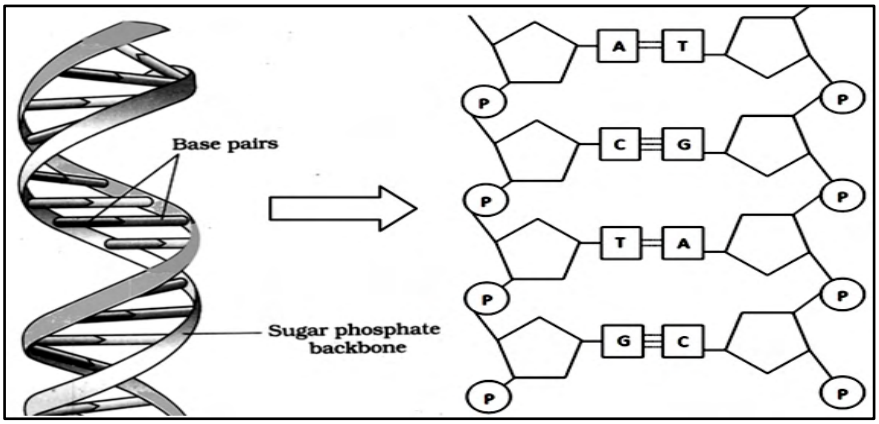
- Nucleic acids are heteropolymer of nucleotides. i.e., many nucleotides are linked to form polynucleotide.

Nucleic acids are 2 types: DNA (Deoxyribonucleic acid) and RNA (Ribonucleic acid).

Secondary structure of DNA (Watson - Crick Double Helix Model)

- DNA is different types such as A, B, C, D, E etc.

- DNA consists of 2 polynucleotide strands arranged antiparallely as a double helix.
- In DNA, a nucleotide consists of nitrogen base, deoxyribose sugar and phosphate group.
- Backbone (strands) of DNA is formed by the sugar- phosphate-sugar chain.
- Steps are formed of Nitrogen base pairs.
- Nitrogen bases include Adenine (A), Guanine (G), Thymine (T) and Cytosine (C). Uracil



absent.

- A pairs with T (A=T) by 2 hydrogen bonds. - G pairs with C (G≡C) by 3 hydrogen bonds.

- A phosphate molecule links the 3'-carbon atom of the sugar of one nucleotide to the 5'-carbon of the sugar of the succeeding nucleotide.

ENZYMES

Enzymes are biological catalysts which influence the speed of biochemical reactions.
"All enzymes are proteins but all proteins are not enzymes."
Enzymes are specific.i.e.each enzyme has its own substrate.

Ribozymes: Nucleic acids (RNA)that behave like enzymes.
Enzymes form tertiary structure (3D) with some crevices (pockets) called 'active site' into which the substrate fits.

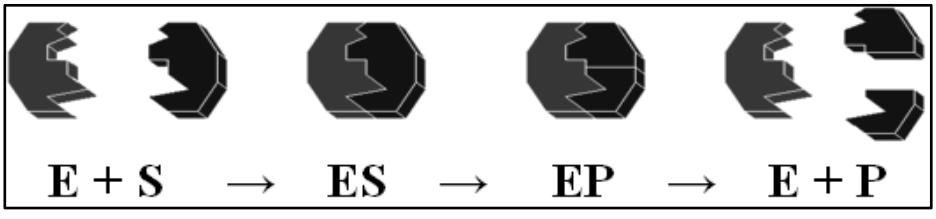
Carbonic anhydrase is the fastest enzyme. It accelerates the following reaction 10 million times.

$CO_2 + H_2O$ carbonic anhydrase H_2CO_3

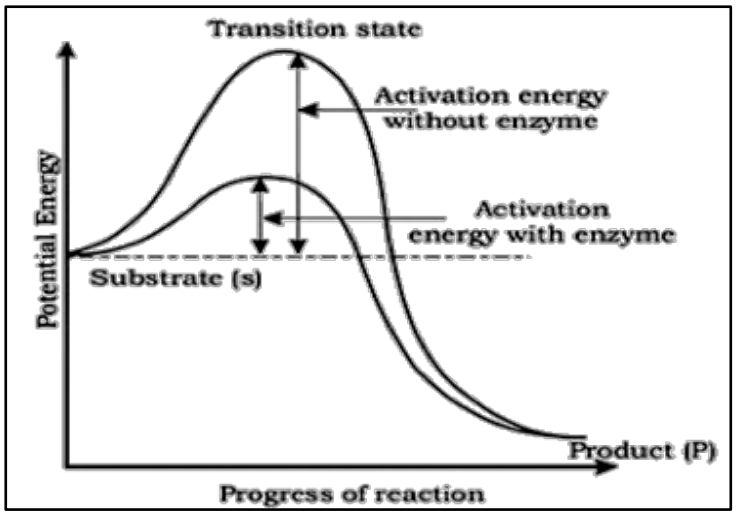
In the absence of enzyme, only 200 molecules of H_2CO_3 are formed in an hour. In the presence of carbonic anhydrase about 600,000 molecules are formed per second.
In a metabolic pathway, each step is catalysed by different enzymes.
E.g. In glycolysis [Glucose ($C_6H_{12}O_6$) → 2 Pyruvic acid ($C_3H_4O_3$)] ten different enzymes take part.

Nature of enzyme action (catalytic cycle)

Enzyme acts with substrate like a lock & key model action. It includes the following steps:
*The substrate binds to the active site of enzyme (E+S).
*This induces some changes in enzyme so that the substrate is tightly bound with active site of enzyme to form enzyme- substrate complex (ES).
*The active site breaks chemical bonds of substrate to form enzyme- product complex (EP).
*The enzyme releases the products and the free enzyme is ready to bind to other molecules of the substrate (E+P).
This pathway goes through some unstable transition state structures.



How do Enzymes Speed up a chemical Reaction?
(Concept of activation energy)



- Activation energy is the additional energy required to start a chemical reaction.

-In an exothermic or endothermic reaction, the substrate has to go through a much higher energy state. It is called transition state energy. Therefore, activation energy is the difference between average energy of substrate and transition state energy.

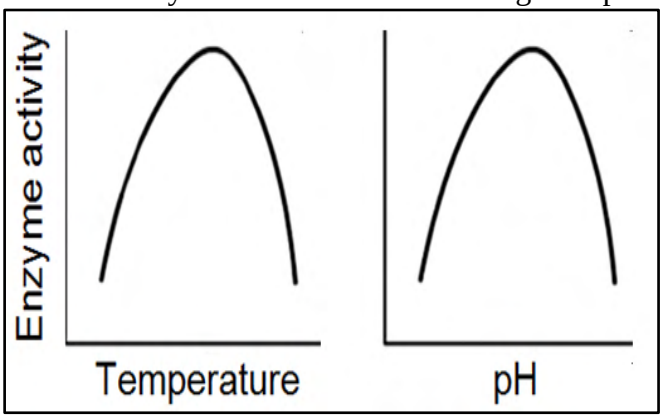
- If the product (P) is at a lower energy level than the substrate (S), the reaction is an exothermic reaction (spontaneous reaction). It requires no energy (by heating) in order to form the product.
- In a biochemical reaction, enzymes lower the activation energy. As a result, speed of the reaction increases.

Factors affecting enzyme activity

a) Temperature and pH :Enzymes show highest activity at optimum temperature &pH. Activity declines below and above optimum value. At low temperature, enzyme temporarily inactive.At high temperature, enzymes destroy because proteins are denatured by heat.

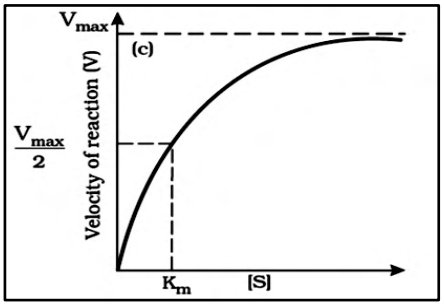
Inorganic catalysts work at high temperature & pressure. But enzymes get damaged at high temperature (> 40^0 C).

Thermophilic organisms have enzymes which are stable at high temperature (up to 80-90^0 C).



b) Concentration of substrate

With the increase in substrate concentration, the velocity of enzyme action rises at first and reaches a maximum velocity (Vmax). This is not exceeded by further rise in concentration because enzyme molecules are fewer than the substrate molecules i.e. No free enzyme molecules to bind with additional substrate molecules.



c) Presence of Inhibitor

- The binding of specific chemicals (inhibitor) shuts off the enzyme activity. This is called inhibition.

- The inhibitor closely similar to the substrate is called competitive inhibitor. It competes with the substrate for the binding site of the enzyme. As a result, the substrate cannot bind and the enzyme action declines.

E.g. Inhibition of succinic dehydrogenase by malonate which is similar to the substrate succinate.
Competitive inhibitors are used to control bacterial pathogens.

Classification and nomenclature of enzymes

* Oxido-reductases / Dehydrogenases: Catalyze oxido- reduction b/w two substrates.
S reduced + S' oxidized → S oxidized + S' reduced

*Transferases: Catalyze a transfer of a group (other than hydrogen).
S-G+S'→S'-G+S
*Hydrolases: Catalyze hydrolysis of ester, ether, peptide, glycosidic, C-C, C-halide or P-N bonds.
*Lyases: Catalyze removal of groups by mechanisms other than hydrolysis leaving double bonds.
X-C-C-Y → X-Y + C=C
* Isomerases:Catalyze inter-conversion of optical geometric or positional isomers.

* Ligases:Catalyzethelinkingof2compoundstogether. E.g. enzymes catalyzing joining of bonds like C-O, C-S, C- N, P-O etc.

Co-factors
*These are non-protein constituents bound to the enzyme to make the enzyme catalytically active.
*Apo-enzyme: Protein portion of the enzyme. Co-factor + Apoenzyme = Holoenzyme.
*When the co-factor is removed from the enzyme, its catalytic activity is lost.
Co-factors are 3 types:

Prosthetic group: Organic. Tightly bound to apoenzyme. E.g. Haem in peroxidase and catalase.
▪Co-enzymes: Organic. Loosely bound to apoenzyme. Many co-enzymes contain vitamins. E.g. NAD and NADP contain niacin.
▪Metal ions: They form co-ordination bonds with side chains at active site and one or more co- ordination bonds with the substrate.
E.g. Zn is a cofactor for Carboxypeptidase.

QUESTION AND ANSWER

Multiple Choice Questions:

1. An amino acid is essential because it is
(A)used in metabolic pathways (B) an enzyme(C) must be taken in food(D) being present in all plants.
Answer: (C) must be taken in food

2.Which one is the most abundant protein in the animal world?
(A) Collagen (B) Insulin (C) Trypsin (D) Haemoglobin
Answer:(A) Collagen

3.Example of a typical homopolysaccharide is
(A) Inulin (B) Suberin (C) Lignin (D) Starch
Answer: (D) Starch

4.The proteins associated with nucleic acids are
(A) albumins (B) globulins (C) histones (D) scleroproteins
Answer: (C) histones

5.The RNA contains a base uracil in place of
(A) adenine(B) guanine(C) cytosine (D) thymine
Answer: (D) thymine
6.One of the elements not found in living organisms either free or in form of compounds is
(A) Magnesium (B) Sodium (C) Iron (D) Silicon
Answer:(D) Silicon

7.Benedict test is conducted to confirm presence of
(A) Polysaccharide (B) Reducing sugar (C) Lipid (D) Protein
Answer:: (B) Reducing sugar

8.Quaternary structure of proteins have
(A) four subunits (B) either alpha or beta forms
(C) No relation to protein function (D) Depends on primary structure of individual polypeptides
Answer: (A) four subunits

9.If on one helix of DNA the base is cytosine the other helix could have
(A) guanine (B) adenine (C) thymine (D) uracil
Answer:: (A) guanine

10.Helical structure of protein is stabilized by
(A) Hydrogen bonds (B) Disulphide bonds (C) Peptide bonds (D) None of these

Answer: (A) Hydrogen bonds

Assertion & Reason Questions

1.Assertion: The exoskeleton of arthropods is made up of a complex polysaccharide called chitin
Reason: Plant cell walls are made up of Cellulose
(A). If both assertion and reason are true and reason is the correct explanation of assertion
(B). If both assertion and reason are true but reason is not the correct explanation of assertions
(C). If assertion is true but reason is false
(D). If both assertion and reason or false
Answer: B

2. Assertion: All enzymes are proteins
Reason: RNA molecules that possess catalytic activity are called ribozymes.
(A). If both assertion and reason are true and reason is the correct explanation of assertion
(B). If both assertion and reason are true but reason is not the correct explanation of assertions
(C). If assertion is true but reason is false
(D). If both assertion and reason or false
Answer: B

3. Assertion: Hydrolases are enzymes which catalyze the hydrolysis of ester, peptide, Glycosidic bonds.
Reason: Lyases are enzymes catalyzing the linking together of two compounds like joining of C-O, C-N, P-O etc. bonds
(A). If both assertion and reason are true and reason is the correct explanation of assertion
(B). If both assertion and reason are true but reason is not the correct explanation of assertions
(C). If assertion is true but reason is false
(D). If both assertion and reason or false
Answer: C

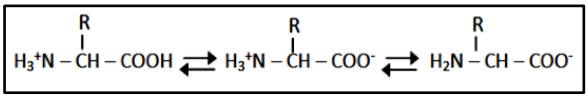
4. Assertion: Each enzyme has a substrate binding site in its molecule which forms highly reactive enzymes substrate complex.
Reason: The enzyme substrate complex is long lived and dissociates into its product and unchanged enzyme.
(A). If both assertion and reason are true and reason is the correct explanation of assertion
(B). If both assertion and reason are true but reason is not the correct explanation of assertions
(C). If assertion is true but reason is false
(D). If both assertion and reason or false
Answer: C
5. Assertion: The living state is an equilibrium steady state to be able to perform work.
Reason: Living process is a constant effort to prevent falling into non- equilibrium
(A).If both assertion and reason are true and reason is the correct explanation of assertion
(B). If both assertion and reason are true but reason is not the correct explanation of assertions
(C). If assertion is true but reason is false
(D). If both assertion and reason or false
Answer: D

Short Answer Questions

1.What are biomacromolecules ?
Ans.All the carbon compounds that we get from living tissues.
2. Why enzymes are called bio-catalysts ?
Ans.Enzymes are proteins that catalyze metabolic/chemical reactions inside the living being. Thatís why they are called biocatalysts.
3.Name an element found in proteins but not in lipids and carbohydrates.
Ans.Nitrogen.
4.What does an enzyme do in terms of energy requirement of a reaction ?
Ans.Lowers the activation energy of reaction.
5.What is the difference between RNA and DNA in terms of nitrogenous base ?
Ans.RNA has uracil instead of thymine.

Short Answer Questions

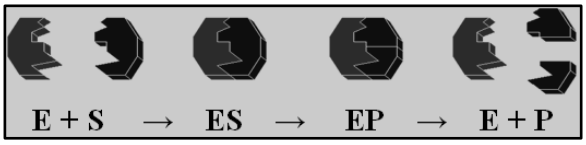
Why do starch give blue black colour with iodine ?
Ans.Starch form helical secondary structure which can hold I_2.
2.Amino acids exist as zwitter ions. Give its structure. Why is it formed ?
Ans.



Due to ionizable nature of $-NH_2$ and -COOH groups.
3. List the different types of lipids.
Ans.Lipids are of three types:-
(i) Simple lipids:- they are of alcohols or triglycerides containing fatty acid & glycerol.
(ii) Compound lipids:- They are simple lipids with a biologically active compound in them eg. glycolipids (carbohydrate lipid) lipoprotein (protein + lipids)
(iii) Derived lipids:- They are hydrolysed products of simple lipids such as fatty acids & alcohol.
4.Enlist three properties of enzymes?
Ans.(i) An enzyme is specific for a substrate &catalyses only a particular reaction. because of the specific shape of active site & substrate.
(ii) Every enzyme requires an optimum temperature for its functioning. (iii) The enzymes are sensitive to PH & each enzyme shows its maximum activity at a specific PH called optimum PH.
5.What is enzymatic competitive inhibition? Give one example?
Ans. Some chemicals prevent the enzyme to function, are known as inhibitors. Enzymatic competitive inhibition is done by the substrate which very closely resembles the substrate in its molecular structure.
Long Answer Questions

1.Describe the lock & key hypothesis of enzyme action?
Ans.According to Fischer's lock & key hypothesis of enzyme action:- if the right key fits in the right lock, the lock can be opened otherwise not. To explain the above in context with

enzyme action it is bedewed that molecules have specific geometric shapes. Proteins are able to act as enzyme because their shape provides space configuration into which other molecules can fit. The molecules which are acted upon by the enzymes are called substrates of the enzymes.



2. Differentiate between cofactors, coenzymes & prosthetic group.

Ans.COFACTORS: i) It is a non-protein substance or group that gets attached to an enzyme. ii) It is essential for functioning it may be organic or inorganic or metallic factor

COENZYMES: i) it is a non-protein group which is loosely attached to the open enzyme in a functional enzyme ii) NAD is coenzyme for dehydrogenase

PROSTHETIC GROUP: i) it is a non-protein part or group which gets attached to open enzyme. ii) Some prosthetic group have porphyrin of the cytochrome.

3. What are nucleic acids? Describe the structure of DNA.

Ans. Nucleic acids are found in acid soluble fraction of living tissue. They are linear polymers of deoxyribonucleotides or ribonucleotidesA nucleotide has 3 distinct components. DNA is a double stranded structure & each strand is a polymer of deoxyribonucleotide. The backbone of the nucleic acid is uniformly consisting of alternating pentose sugar & phosphate group. i) The steps composed of nitrogenous bases adenine guanine cytosine & thymine & hydrogen bonds hold two strands together. ii) Two strands are complementary to each other. iii) They run in an antiparallel manner. iv) It is genetic material in all organisms. v) It has the property to replicate vi) At one end of strand, 5-C of pentose sugar is free on other end; third carbon of pentose is free.

4.What is metabolism? Mention the role of enzymes is metabolism?

Ans. Metabolism is defined as the sum total of the living processes in the body. Enzymes direct metabolic pathways. Enzymes act as catalysts. Enzymes are highly specialized organic catalysts produced by living cell. Biochemical pathways refer to the reactions occurring in the cells in sequences. Enzymes guide the biochemical pathways along desired directions. They have active site. The substrate binds at active site of enzyme & form enzyme substrate complex.

Case Based Questions

1.Lipids form a heterogeneous group but all are made up of carbon hydrogen and oxygen. These are insoluble in water and soluble in organic solvents like acetone, ether, alcohol etc. The number of oxygen atoms is very small compared to carbon atoms. They need a large amount of oxygen for their oxidation to release energy. They could be simple lipids, compound lipids, and derived lipids. Simple lipids are esters of fatty acid and alcohol. Compound lipids are formed when simple lipids combine with another compounds for example glycolipids, phospholipids and lipoproteins. Derived lipids are of various types and important example being steroids.

(i) Lipids mainly consist of

(A) Carbon only (B) carbon hydrogen and nitrogen

(C) carbon hydrogen and oxygen (D) Hydrogen only

Answer: C) carbon hydrogen and oxygen

(ii) Among the given options non-polymeric molecule is

(A) Nucleic acids (B) proteins (C) Lipids (D) polysaccharides

Answer:(C) Lipids

(iii) An example of unsaturated fatty acid is

(A) oleic acid (B) stearic acid (C) Linoleic acid (D) both a and c

Answer: (D) both a and c

(iv) The number of carbon atoms as compared to oxygen atoms in lipids is

(A) same (B) much less (C) much more (D) none of these.

Answer: (A)same

2.Polysaccharides or the macro molecules consisting of long chains of sugar. Only carbohydrates they are not sweet and are insoluble in water. The two ends of the polysaccharide chain are called reducing and non-reducing ends. Based upon their monomeric units these are homo polysaccharides or heteropolysaccharides. Depending upon their location polysaccharides play multiple functions in living world few examples of polysaccharides include Cellulose, chitin, inulin etc.

(i) All the listed polysaccharides are homopolymers except

(A) Starch (B) glycogen (C) Chitin (D) Cellulose

Answer:C) Chitin

ii) Inulin is a polymer of

(A) glucose (B) fructose (C) glucose and sucrose (D) fructose and galactans

Answer: B) fructose

(iii)A polysaccharide found in the exoskeleton of crabs is

(A)Cellulose (B) pectin (C) murine (D) chitin

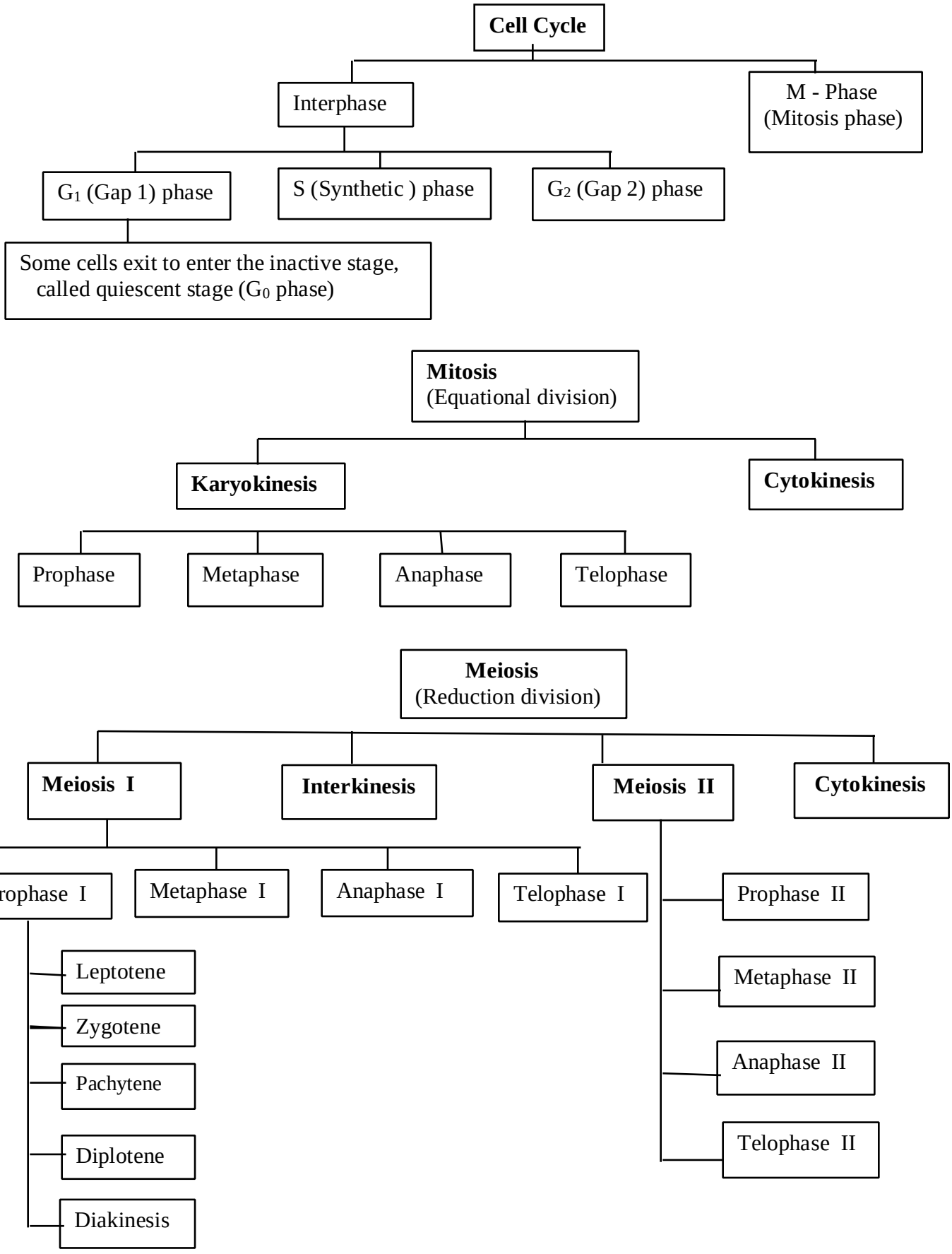
Answer: (D) chitin

(iv) The right end of the polysaccharide chain is called

(A) reducing end (B) non-reducing end (C) right end (D) none of these

Answer: (A) reducing end

CONCEPT MAP

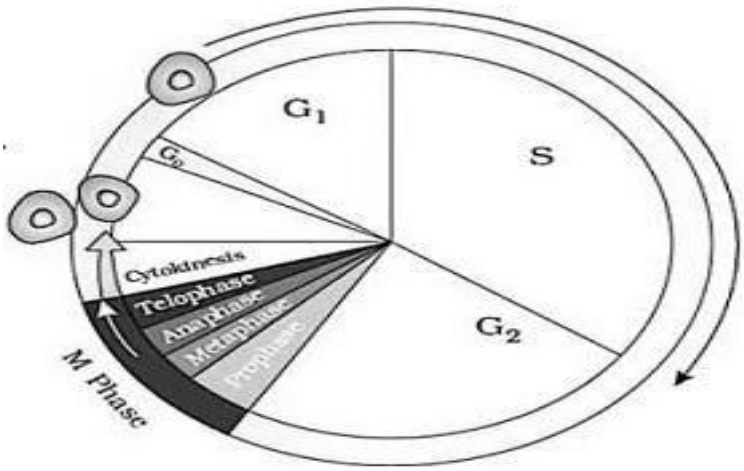

Cell Cycle
Interphase
M - Phase (Mitosis phase)
G1 (Gap 1) phase
S (Synthetic) phase
G2 (Gap 2) phase
Some cells exit to enter the inactive stage, called quiescent stage (G0 phase)
Mitosis (Equational division)
Karyokinesis
Cytokinesis
Prophase
Metaphase
Anaphase
Telophase
Meiosis (Reduction division)
Meiosis I
Interkinesis
Meiosis II
Cytokinesis
Prophase I
Metaphase I
Anaphase I
Telophase I
Leptotene
Zygotene
Pachytene
Diplotene
Diakinesis
Prophase II
Metaphase II
Anaphase II
Telophase II

POINTS TO REMEMBER

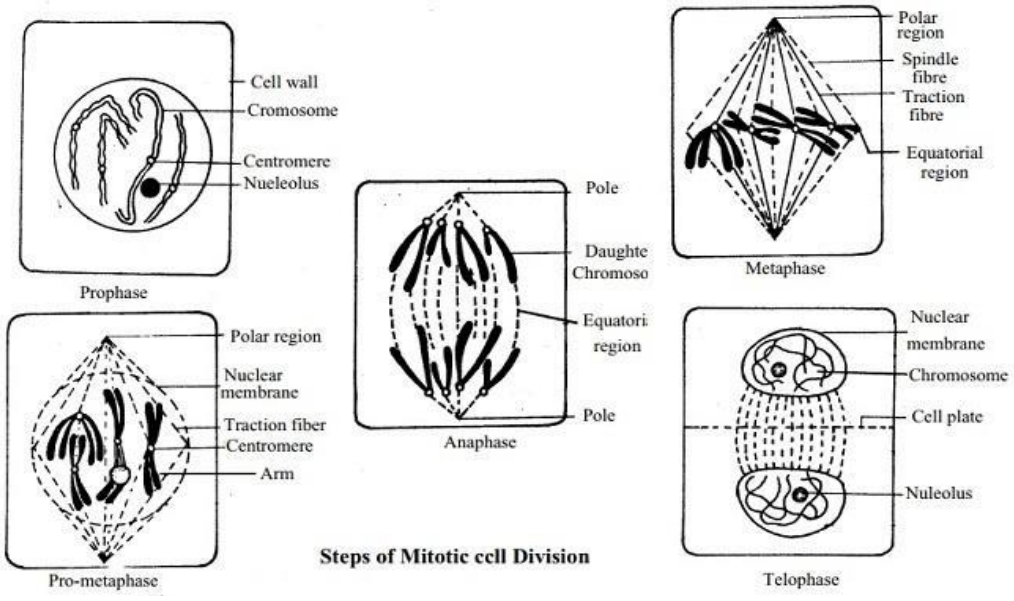
- The sequence of events by which a cell duplicates its genome, synthesizes the other constituents of cells and eventually divide into two daughter cells is called cell cycle.
- DNA synthesis occurs in one specific stage of cell division but distribution of chromosome in cells occur s in complex series of events during cell division.

Phases of Cell cycle

- Human cell divides once in approximately 24 hours, which may vary in different organisms.In yeasts it takes about 90 minutes to complete the cell division process.
  Cell cycle is divides into two basic phases.
  Interphase: It is the phase between two successive M phases.
  Interphase lasts for 95% of a cell cycle. This phase is called as resting phase but during this period the cells prepare itself for nuclear division by cell growth.
- G_1 phase represents the interval between mitosis and initiation of DNA replication.
- Cell is continuously active and grows in size.
- During synthesis phase, replication or synthesis of DNA takes place and amount of DNA gets double per cell.
- During G_2 phase, protein is synthesized which is used for mitosis.
- Inadult animals, some cells do not divide or may divide occationally. The cells that so not divide further and exits the G1 phase to enter an inactive stage is called Quiescent Stage (G_0) of cell cycle.
- In animals, mitotic division is present in only somatic diploid cells but in plants it is seen in both haploid and diploid cells.
- Mitotic cell division is also known as equationaldivision because the number of chromosome remain same in parental and progeny cells.
  M Phase: When the actual cell division or mitosis occur, it starts with karyokinesis (nuclear division) or separation of daughter chromosome and end with cytokinesis or division of cell matrix (cytoplasm division).
-



- Prophase is the first phase of mitosis followed by G_2 phase. It involves following events:
  - Initiation of condensation of chromosomal material
  - Movement of centrioles towards opposite poles of the cell.
  - At the end of prophase, endoplasmic reticulum, nuclear membrane, golgi complex disappears.
- Metaphase starts with complete disappearance of nuclear membrane. It is the most suitable stage for the study of morphology of chromosomes. It involves:
  - Condensation of chromosomal materials into compact and distinct chromosomes made up of two sister chromatids attached with spindle fibres. Small disc-shaped structures at the surface of centromeres known as kinetochores serve as the sites of attachement of spindle fibres.
  - Chromosomes arrange at centre of cell called metaphase plate.
- Anaphase involves the
  - Splitting of each chromosome at centromere into two sister chromatids.
  - Two chromatids start moving towards opposite poles.
- Telophase is the last stage of mitosis. It involves following events:
  - Chromosomes reach at opposite poles and loose its identity as discrete unit.
  - Nuclear membrane reassembles around the chromosome clusters.
  - Nucleolus, Golgi complex and ER reappear.
- Cytokinesis is the division of cytoplasm of a cell after Karyokinesis (division of chromosome) into two daughter cells. In animal cells, appearance of furrows in plasma membrane gradually deepens and joins to divide cytoplasm into two parts.
  In plants, cell wall formation starts at the centre and grows outwards to meet lateral walls. The formation of cell plate begins with formation of cell plate.



Steps of Mitotic ccll Division

- Significance of Mitosis
  - Mitosis produces diploid daughter cells with identical genetic complement.
  - It helps in repair of cells especially in lining of guts and blood cells.
  - Meristematic division in apical and lateral cambium results in continuous growth of plants.
  - It helps in growth of multicelluar organisms and maintain nucleo cytoplasmic ratio.
- Meiosis: It is a type of cell division that reduce the number of chromosome to half and results in the production of haploid daughter cells. It ensure the production of haploid phase in the life cycle of sexually reproducing organisms. It involves following events.
  - Two sequential cycles of nuclear and cell division called meiosis I and meiosis II but single cycle of DNA replication.
  - It involves pairing of homologous chromosome and their recombination.
  - Four haploid cells are formed at the end of meiosis II.
  - Prophase I of meiosis I is typically longer and involves five phases based on chromosomal behavior, i.e., Leptotene, Zygotene, Pachytene, Diplotene and Diakinesis.
- During Leptotene, the chromosome becomes distinct and visible under microscope. Compaction of chromoasome continues throughout the leptotene phase.
- During Zygotene stage, chromosomes start pairing together (synapsis). The paired chromosomes are called homologous chromosomes. Synaptonemal complex formed by a pair of homologous chromosome is called bivalent or a tetrad.
- During Pachytene stage, crossing over between non-sister chromatids of homologous chromosomes occurs for exchange of genetic material. The crossing over is enzyme mediated process which involves the enzyme recombinase.
- Diplotene is recognized by dissolution of synaptonemal complex and tendency of separation of bivalent except at the site of crossing over. RThis forms an X like structure called chiasmata.
- Diakinesis is marked by terminalisation of chiasmata. The nuclear membrane breaks and nucleolus disappear.
- In metaphase I, the bivalent chromosome align at equatorial plate and microtubules from the opposite pole of the spindle attach to the pair of homologous chromosomes.
- In anaphase I, homologous chromosome separate but sister chromatids remain attached at centromere.
- During Telophase I, nuclear membrane and nucleolus reappears and cytokinesis follows. This is called as dyad of the cells.
- The stage between two meiotic divisions is called interkinesis and it is short lived that follows Prophase II.

  Meiosis II
- It is initiated immediately after cytokinesis before chromosome gets elongated.
- In prophase II, nuclear membrane disappeasrs and chromosome becomes compact.
- At metaphase II stage, the chromosomes align at equator and microtubules attach with kinetochores of sister chromatids.

- Anaphase II start with splitting of centromere of each chromosome to move towards opposite poles. Meiosis ends with Telophase II, in which two groups of chromosomes get enclosed by nuclear membrane followed by cytokinesis to form tetrad of cells (four daughter cells).

Significance of meiosis:

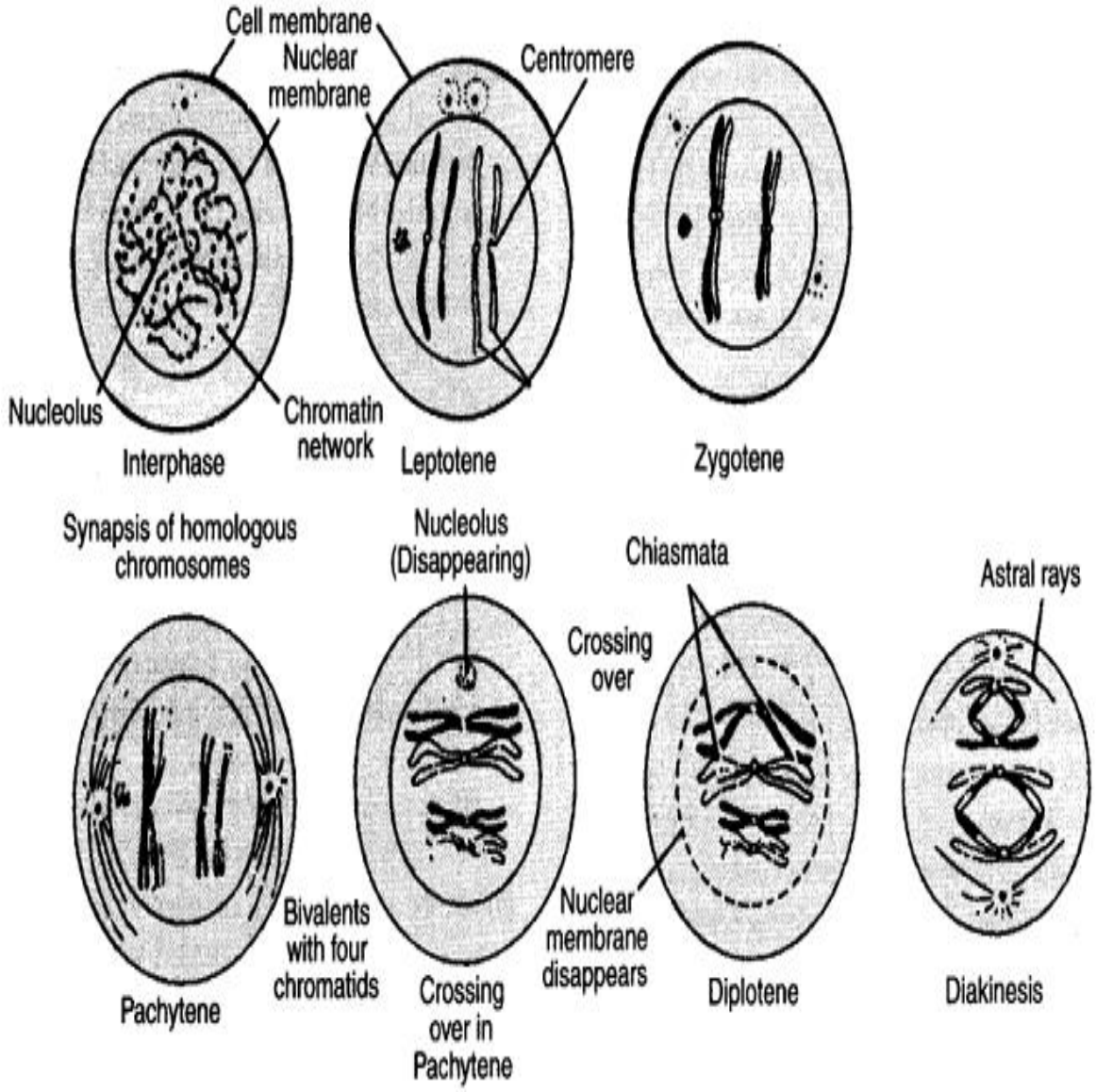
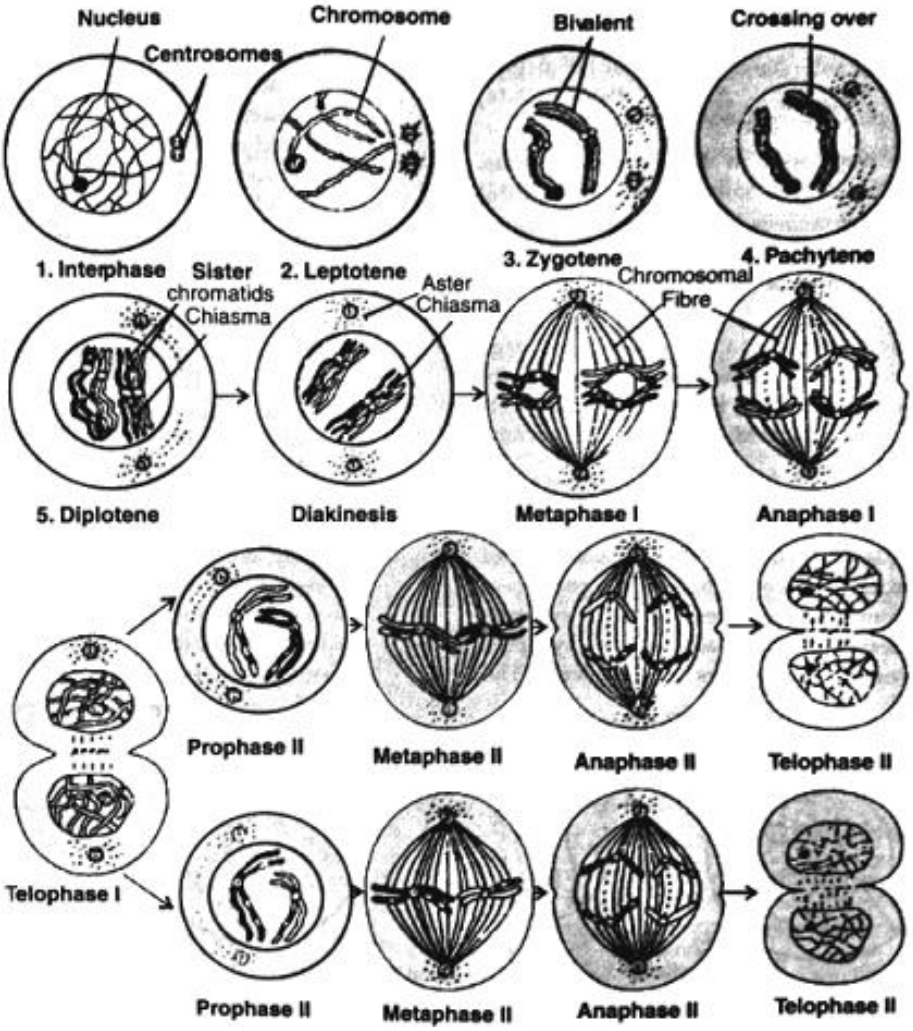


Fig. : Prophase I of meiosis I

- Meiosis forms gametes that are essential for sexual reproduction.
- Crossing over introduces new recombination of traits.
- Maintains the chromosome number of sexually reproducing organism.

QUESTION

1. Disso



(a) zygotene (b) pachytene (c) diplotene (d) diakinesis

Answer : a

2. A fruit fly has 8 chromosomes (2n) in each of its body cells. What would be the number of chromosomes after S phase of interphase in a cell?

(a) 4 (b) 8 (c) 16 (d) 32

Answer : 8

3. During karyokinesis, chromosomes exhibit the highest level of coiling at

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

Answer: b

4. During G_1 phase of cell division

(a) RNA and proteins are synthesised (b) cell grows in size

(c) decision for cell division occurs (d) all of these

Answer : a

5. During meiosis I, the chromosomes start pairing at

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

Answer : b

6. How many mitotic divisions are involved in the formation of 128 cells from a single cell?

(a) 7 (b) 14 (c) 28 (d) 64

Answer: a

7. The time gap between Meiosis I and Meiosis II is

(a) G_1 phase (b) interphase (c) G0 phase (d) interkinesis

Answer :d

8 When do the bivalent chromosomes appear clearly as tetrads during meiosis I

(a) Leptotene (b) Zygotene (c) Pachytene (d) Diplotene

Answer : b

Short questions & answers:

Q1.Who first described meiosis?

Answer: Strasburger

Q2.What is a genome?

Answer: It is a full set of DNA instructions or a single set of chromosomes in a cell.

Q3.What is meant by the non-disjunction of chromosomes?

Answer:Non-disjunction means failure in the separation of homologous chromosomes during anaphase.

Q4.Why is mitosis an equational division?

Answer:Mitosis is an equational division because the daughter cells get the same number of chromosomes from the parent.

Q5.What is crossing over?

Answer:The exchange of segments of chromatids of homologous chromosomes during meiosis is called crossing over.

Q6.Why is meiosis a reductional division?

Answer:Meiosis is a reductional division because it reduces the number of chromosomes from diploid number to haploid number in the daughter cells.

Q7.What are the two successive divisions in meiosis?

Answer:The first division is reductional followed by the second equational division.

Q8.Name the two phases of the cell cycle of a somatic cell.

Answer:.Interphase and M-phase or mitotic phase.

Q9.During which part of interphase active synthesis of RNA and proteins take place.

Answer: G. phase.

Q10.What amount of DNA is present in the cell during the G_2 phase?

Answer:Double the amount of DNA present in the original diploid cell.

Q11.What is a kinetochore?

Answer:A part of the chromosome for the attachment of chromosomal fibers..

Q12.Define Eumitosis.

Answer:Chromosomes are attached to the spindle by their centromere and this type of mitosis is called Eumitosis.

Q13.How many mitotic divisions will be required to produce 128 daughter cells from a single cell?

Answer:127.

Q14.What is the G1 phase of the interphase?

Answer:It is the first period of growth of the neatly formed undivided cells, during which the cell synthesizes a lot of RNA and proteins.

15.Why is mitosis an equationaldivision?.Mitosis is an equational division because the daughter cells have the same number of chromosomes and an equal amount of cytoplasm.

16..hy is meiosis necessary in sexually reproducing organisms?.Meiosis is necessary for sexually reproducing organisms because

1. It maintains the number of chromosomes constant in generation as meiosis is reductional division.
2. It causes variations among the progeny because crossing over takes place during meiosis. This variation is important for evolution.

Q17.What is the importance of mitosis?.Mitosis is important because

1. It maintains genetic stability through generations.
2. It helps in the growth of multicellular organisms.
3. Many plants and animals multiply by mitosis i.e., asexual repro-duction to regenerate the whole organism.
4. It helps to regenerate lost parts of an animal's body.
5. It helps in the regeneration of new cells in place of dead and worn-out cells.

Competency Based Questions

Case Study 1:

Anaphase – At the onset of anaphase, each chromosome arranged at the metaphase plate is split simultaneously and the two daughter chromatids, now referred to as daughter chromosomes of the future daughter nuclei, begin their migration towards the two opposite poles. As each chromosome moves away from the equatorial plate, the centromere of each chromosome remains directed towards the pole and hence at the leading edge, with the arms of the chromosome trailing behind. Thus, anaphase stage is characterised by the following key events:

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

Telophase –At the beginning of the final stage of karyokinesis, i.e., telophase, the chromosomes that have reached their respective poles de-condense and lose their individuality. The individual chromosomes can no longer be seen and each set of chromatin material tends to collect at each of the two poles. This is the stage which shows the following key events:

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

1.) Anaphase is characterised by _____
a) Separation of chromatids b) Condensation of chromatin
c) Splitting of Centromeres d) Both a and c

Answer: d) Both a and c

2.) In anaphase, chromatids migrates to _____

a) Centromeres b) Opposite poles
c) Similar poles d) Both b and c

Ans: b) Opposite poles

3.) Name the phase in which de-condensation of chromosomes takes place.

Ans: In telophase, the chromosomes reached their respective poles and de-condense. In this phase chromosomes lose their individuality.

4.) Enlist the characteristic events that takes place during the telophase.

Ans: Characteristic events that takes place during the telophase.

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

Nuclear envelope develops around the chromosome clusters at each pole forming two daughter nuclei.

Nucleolus, Golgi complex and ER reform

5.) Write the characteristic events that takes place in anaphase?

Ans: Anaphase stage is characterised by the following key events:

Centromeres split and chromatids separate.

Chromatids move to opposite poles.

CASE 2

The prokaryotic cells are represented by bacteria, blue-green algae, mycoplasma and PPLO (Pleuro Pneumonia like Organisms). They are generally smaller and multiply more rapidly than the eukaryotic cells. They may vary greatly in shape and size. The four basic shapes of bacteria are bacillus (rod like), coccus (spherical), vibrio (comma shaped) and spirillum (spiral).

The organisation of the prokaryotic cell is fundamentally similar even though prokaryotes exhibit a wide variety of shapes and functions. All prokaryotes have a cell wall surrounding the cell membrane except in mycoplasma. The fluid matrix filling the cell is the cytoplasm. There is no well-defined nucleus. The genetic material is basically naked, not enveloped by a nuclear membrane. In addition to the genomic DNA (the single chromosome/circular DNA), many bacteria have small circular DNA outside the genomic DNA. These smaller DNA are called plasmids. The plasmid DNA confers certain unique phenotypic characters to such bacteria. One such character is resistance to antibiotics. Nuclear membrane is found in eukaryotes. No organelles, like the ones in eukaryotes, are found in prokaryotic cells except for ribosomes. Prokaryotes have something unique in the form of inclusions. A specialised differentiated form of cell membrane called mesosome is the characteristic of prokaryotes. They are essentially infolding of cell membrane.

1.) _____ is the fluid matrix, which fills the prokaryotic cell.

a.) Cell sap b) Cytoplasm

c.) Water d.) Both a & b

2.) Identify incorrect statement

Statement 1 – In prokaryotic cell nucleus is absent.

Statement 2 – In prokaryotic cells genetic material appears naked.

Statement 3 – In prokaryotic cells genetic material not enveloped by a nuclear membrane.

Statement 4 – prokaryotic cells do not have a cell wall.

a.) Only 1 b) Only 4 c.) Both 2 & 3 d.) All of the above

3.) Give reason – why genetic material in prokaryotic cell is not enveloped in nuclear membrane?

4.) Define mesosome.

5.) Give the any two characteristic of prokaryotic cells.

6.) Enlist the shapes of bacteria are generally occurs.

Answer key

1.) b

2) b

3.) In prokaryotic cell well-defined nucleus is absent. Hence all genetic material appears naked and not enveloped by a nuclear membrane.

4.) Mesosome – A specialised differentiated form of cell membrane called mesosome is the characteristic of prokaryotes. They are essentially infoldings of cell membrane

5.) Characteristic of prokaryotic cells;

- There is no well-defined nucleus.
- The genetic material is basically naked, not enveloped by a nuclear membrane.
- Cellulose is the fluid matrix, which fills the prokaryotic cell.
- The prokaryotic cells are generally smaller and multiply more rapidly than the eukaryotic cells.
- All prokaryotes have a cell wall surrounding the cell membrane except in mycoplasma.

6.) The four basic shapes of bacteria are bacillus (rod like), coccus (spherical), vibrio (comma shaped) and spirillum (spiral).

Assertion And Reason Questions

In the following questions, a statement of assertion is followed by a statement of reason.
Mark the correct choice as:
(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) If Assertion is true but Reason is false.
(d) If both Assertion and Reason are false.

Q.1.Assertion : Interphase is resting stage.
Reason : The interphase cell is metabolically inactive.

Answer: (c) Previously interphase was called resting stage because there is no apparent activity related to cell division. The interphase cell is metabolically quite active. Interphase consist of three sub-phases (G1 , G2 and S). Synthesis of DNA occurs in S phase. G1 is the period between the end of mitosis and the start of S phase. G2 is the interval between S phase and start of mitosis. As the synthesis of DNA occurs in S phase so, it is considered as metabolically active phase.

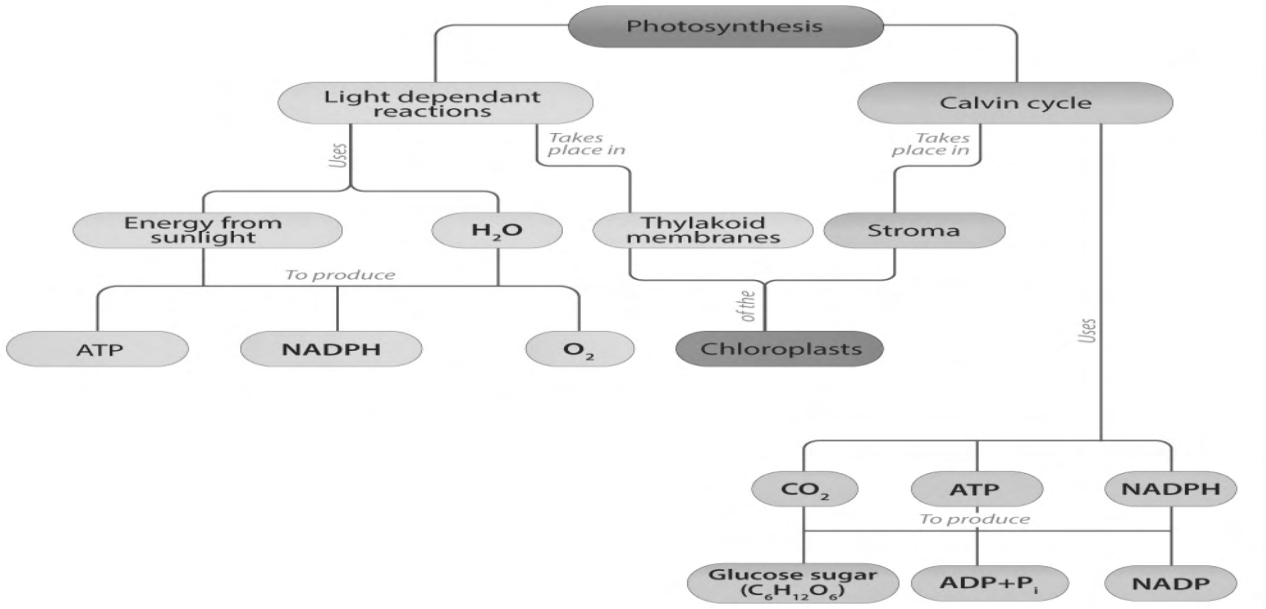
Q.2. Assertion: Histones are basic proteins of major importance in packaging of eukaryotic DNA. DNA and histones comprise chromatin, forming the bulk of eukaryotic chromosome.
Reason: Histones are 5 major types H_1, H_2A, H_2B, H_3 and H_4.

Answer: (b) Chromosome contains equal amounts of DNA and histone. The DNA and histone octamer forms a nucleosome. Histone is the protein found in eukaryotic chromosomes. There are 5 types of histone namely H1, H2A,H2B,H3 and H4.

Q.3. Assertion: DNA synthesis occurs in G1 and G2 periods of cell cycle.
Reason: During G1 and G2 phase, the DNA content become double.

Answer: (d) The synthesis of DNA occurs only in a restricted portion of the interphase during S period, which is preceded and followed by two "gap" periods of interphase (G1 and G2) in which there is no DNA synthesis. G1 is the period between the end of mitosis I and the start of DNA synthesis. S is the period of DNA synthesis and G2 is the interval between the end of DNA synthesis and the start of mitosis. During G1, a cell contains two times (4C) the amount of DNA present in the original diploid cell (2C). Following mitosis, the daughter cell again enter is the G1 period and have a DNA content equivalent to 2C.

CONCEPT MAP



POINTS TO REMEMBER

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

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

1. Photosynthesis is the basis of life on earth because it is the primary source of all food on earth and it is responsible for release of O_2 in the atmosphere.
2. Chlorophyll, light and CO2 is required for photosynthesis.
It occurs only in green part of leaves and in presence of light.

Early Experiments

1. Joseph Priestley in 1770, on the basis of his experiments showed the essential role of air in growth of green plants.
2. A mouse kept in closed space could get suffocated and die but if a mint plant is kept in bell jar neither candle will extinguish nor will the mouse die.
3. Priestley hypothesised: Plants restore to the air whatever breathing animals and burning candles remove

Mouse died

Mouse alive

2. Julius Von Sachs in 1854 shows that green part in plants produces glucose which is stored as starch. Starch is the first visible product of photosynthesis.

3. T.W.Engelmann (1843-1909) used prism to split light into its components and then illuminated Cladophora (an algae) placed in a suspension of aerobic bacteria.
He found that bacteria accumulated in blue and red light of the split spectrum.
He thus discovered the effect of different wavelength of light on photosynthesis (action spectrum).

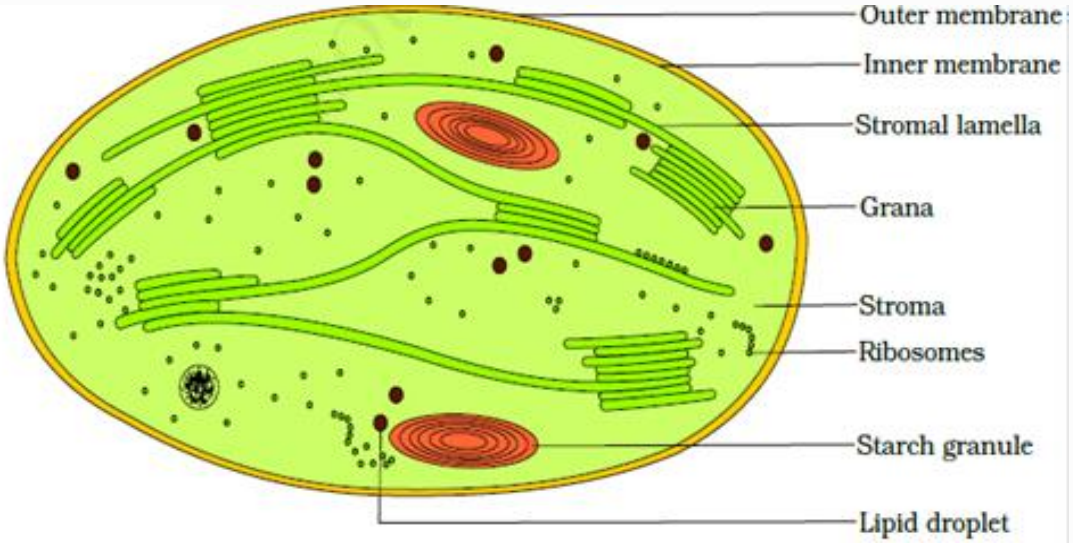
4. Cornelius Van Neil (1897-1985)
On the basis of studies with purple and green sulphur bacteria showed that photosynthesis is a light dependent reaction in which hydrogen from an oxidisable compound reduces CO_2 to form sugar.

$$2H_2A + CO_2 \xrightarrow{\text{Light}} 2A + CH_2O + H_2O$$

1. In green sulphur bacteria, when H_2S , instead of H_2O was used as hydrogen donor, no O_2 was evolved.
2. He inferred that O_2 evolved by green plants comes from H_2O but not from CO_2 as thought earlier.

Where Does Photosynthesis Takes Place?

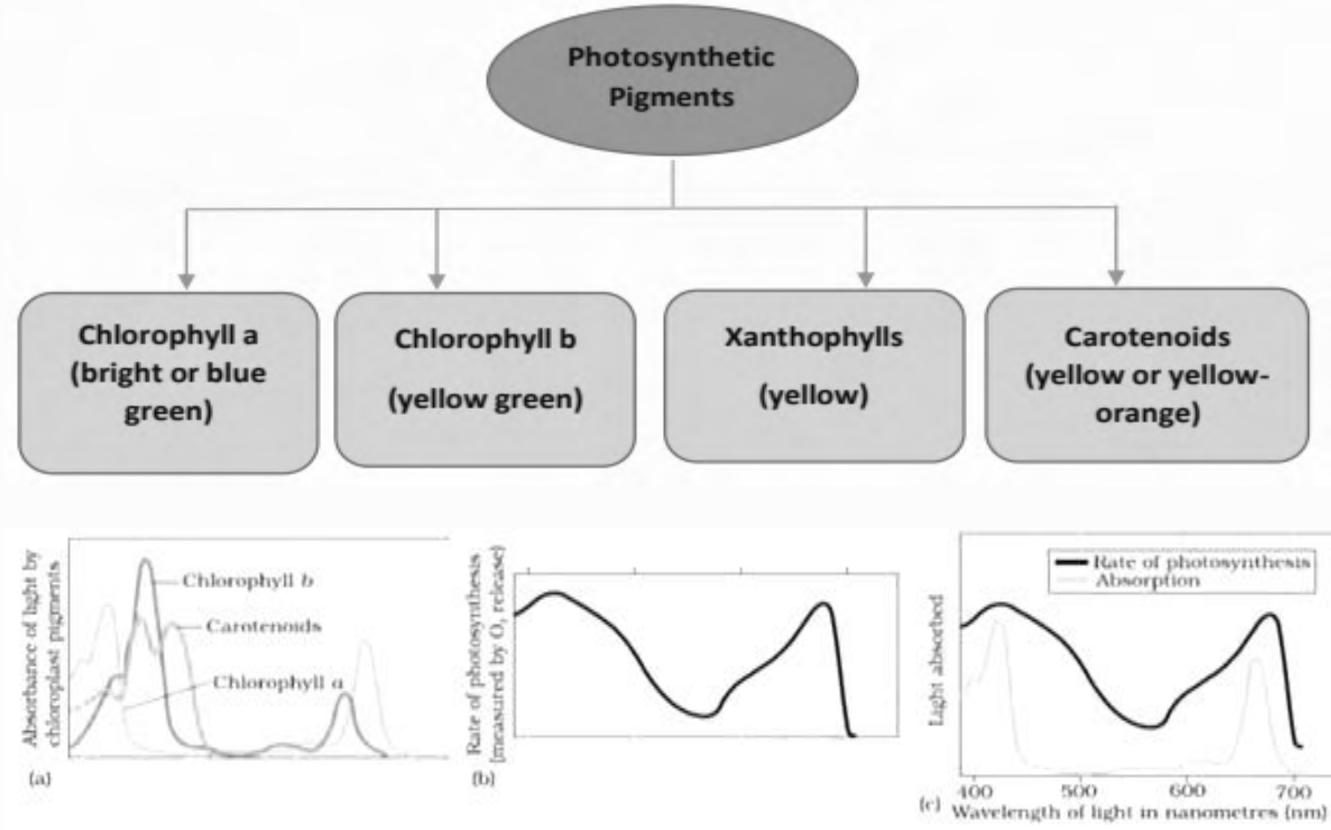
1. Chloroplasts are green plastids which function as the site of photosynthesis in eukaryotic photoautotrophs.
2. Inside the leaves, chloroplast is generally present in mesophyll cells along their walls.
3. Within the chloroplast there is a membranous system consisting of grana, the stroma lamellae and the fluid stroma.



4. The membrane system is responsible for synthesizing light energy for the synthesis of ATP and NADPH. In stroma enzymatic reactions incorporate CO_2 in plants leading to synthesis of sugar.
5. The reaction in which light energy is absorbed by grana to synthesis ATP and NADPH is called light reaction. The later part of photosynthesis in which CO_2 is reduced to sugar, light is not necessary and is called dark reaction.

Pigments involved in Photosynthesis –

Chromatographic separation of leaf pigments are as follows-

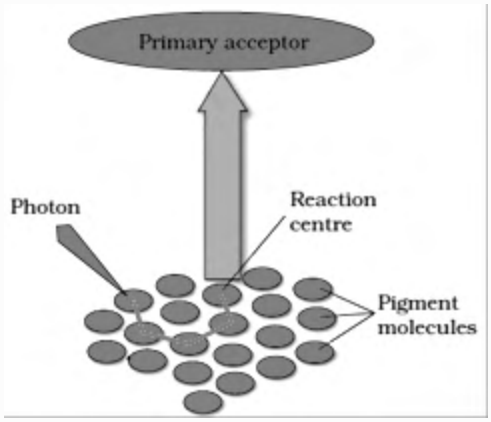


Maximum absorption by chlorophyll a occurs in blue and red regions having higher rate of photosynthesis. So, chlorophyll a is the chief pigment. Other thylakoid pigments like chlorophyll b, xanthophyll and carotenoids are called accessary pigments that absorb light and transfer energy to chlorophyll a and protect them from photo-oxidation.

Light reaction

a. Light reaction (photochemical phase) includes:

1. Light absorption
2. Water splitting
3. Oxygen release
4. Formation of high energy chemical intermediates (ATP and NADPH).
5. The pigments are organized into two discrete LHC (light harvesting complex) within photosystem I and photosystem II.
6. LHC are made up of hundreds of pigments molecules containing all pigments except chlorophyll a molecules in each PS.

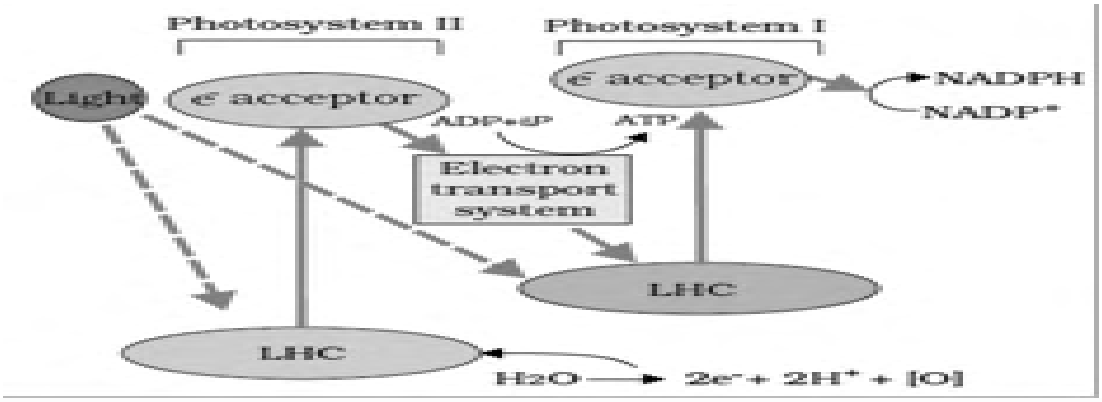


7. The pigments in photosystem I and photosystem II absorbs the lights of different wavelength, chlorophyll a molecule makes the reaction centre.

8. In PS I reaction centre has highest peak at 700nm, hence called P700.
9. And PS II reaction centre has highest peak at 680 nm, so called P680.

The Electron Transport System

1. In photosystem II the reaction centre chlorophyll a absorbs 680 nm wavelength of red light causing electrons to become excited and jump into an orbit farther from the atomic nucleus.
2. These electrons are picked by an electron acceptor which passes to electron transport system consisting of cytochromes.

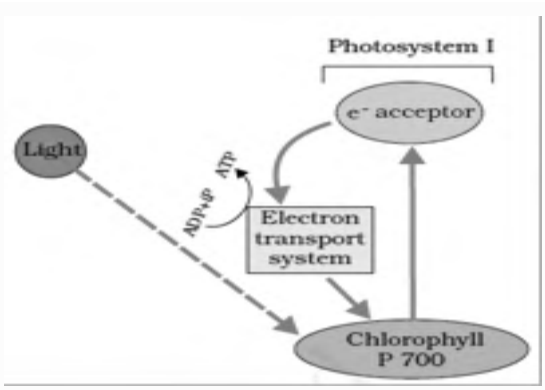


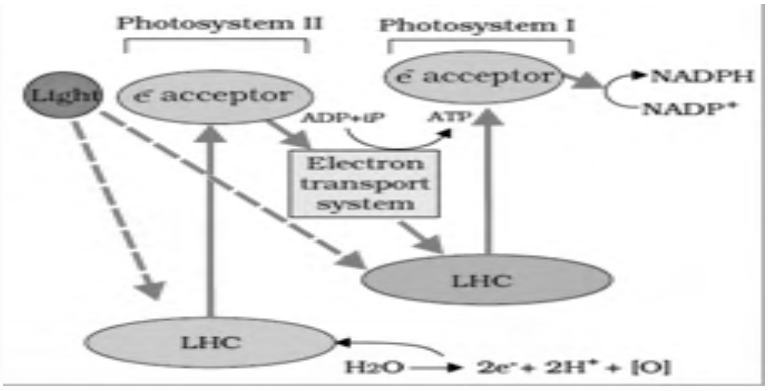
3. Electrons are passed down the electron transport chain and then to the pigment of PS I.
4. Electron in the PSI also get excited due to light of wavelength 700nm and are transferred to another accepter molecule having a greater redox potential.
5. When electron passes in downhill direction, energy is released. This is used to reduce NADP+ to NADPH. The whole scheme of transfer of electron is called Z-scheme due to its shape.
6. Photolysis of water release electrons that provide electron to PS II. Oxygen is also released during this process.

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

Difference between cyclic and non-cyclic photophosphorylation

Cyclic photophosphorylation	Non-cyclic photophosphorylation
1. It is performed by photosystem I independently. 2. Reaction centre is 700 3. An external source of electron is not required. 4. It synthesizes only ATP. 5. It occurs only in stromal or intergranal thylakoids.	1. It is performed by collaboration of both PS I and PS II. 2. Reaction centre is 680 3. The process requires an external electron donor. 4. It synthesizes ATP and NADH both. 5. It occurs in the granal thylakoids only.

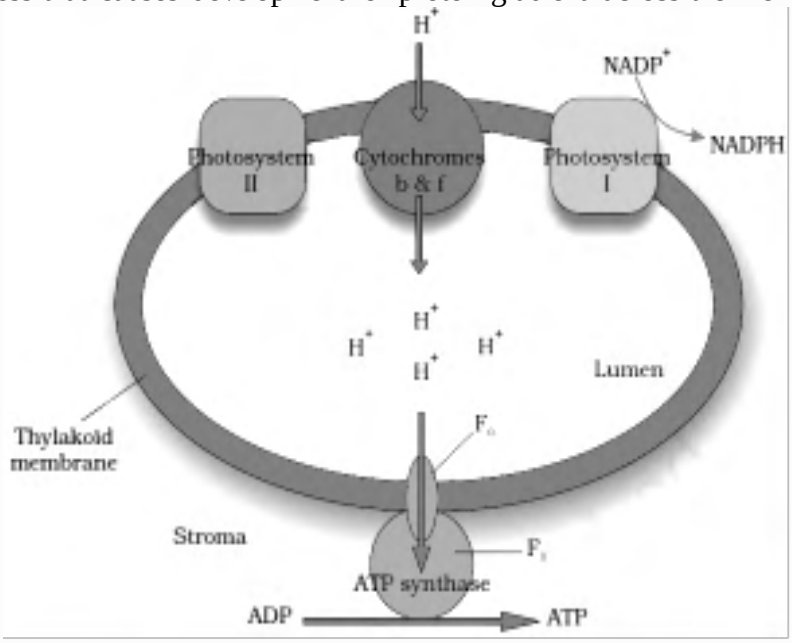




Chemiosmotic Hypothesis of ATP formotion

This hypothesis was proposed by Mitchell in 1961. ATP synthesis is linked to development of proton gradient across the membrane of thylakoid and mitochondria.

The process that causes development of proton gradient across the membrane is-



1. Splitting of water molecules occurs inside the thylakoid to produce hydrogen ion or proton.
2. As electron passes through the photosystems, protons are transported across the membrane because primary acceptor of electron is located towards the outer side the membrane.
3. The NADP reductase enzyme is located on the stroma side of the membrane. Along with electrons that come from the acceptor of electrons of PS I, protons are necessary for the reduction of NADP+ to NADPH+ H+ . These protons are also removed from the stroma.
4. a) Gradient is broken down due to movement of proton across the membrane to the stroma through trans-membrane channel of F0 of ATPase.
   b) One part of this enzyme is embedded in membrane to form trans-membrane channel.
   c) The other portion is called F1that protrudes on the outer surface of thylakoid membrane which makes the energy packed ATP.
5. ATP and NADPH produced due to movement of electron is used immediately to fix CO2 to form sugar.
6. The product of light reaction used to drive the process leading to synthesis of sugar are called biosynthetic phase of photosynthesis.

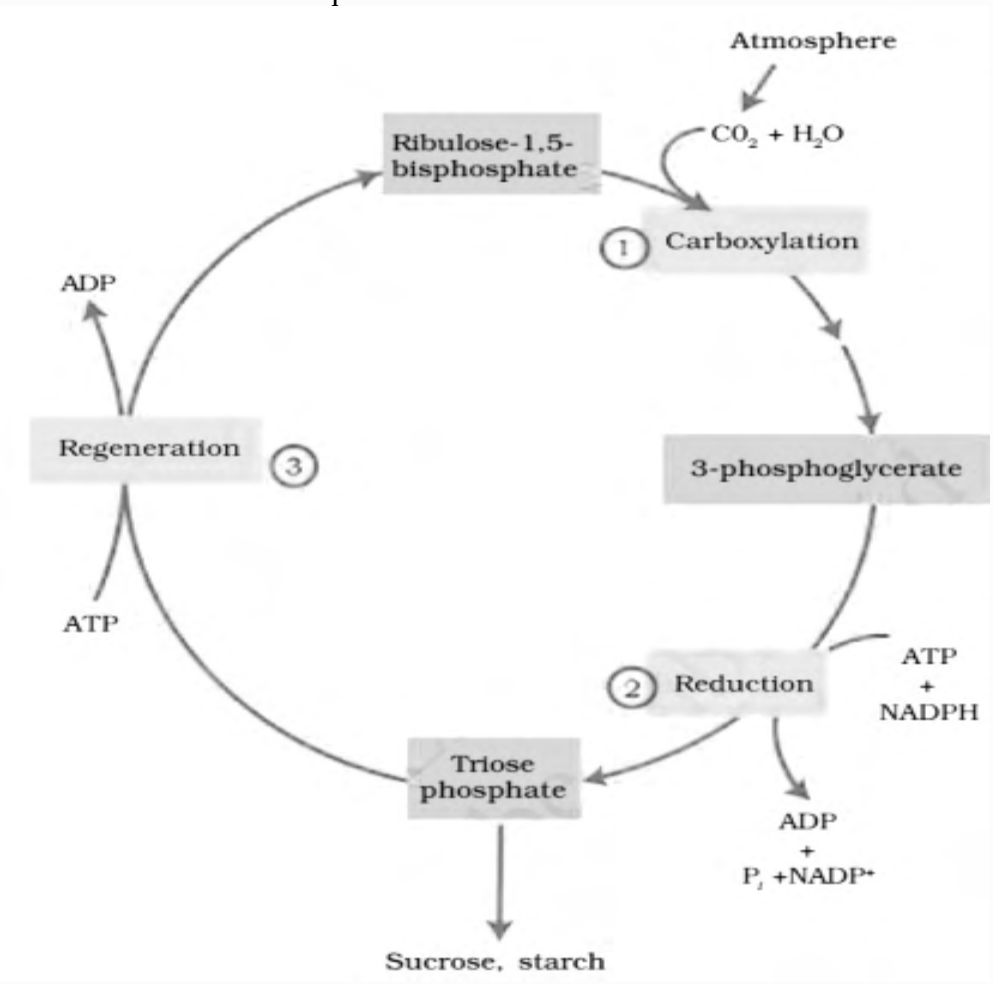
Calvin Cycle/C3 cycle/Reductive Pentose Sugar Phosphate Pathway

e Calvin pathway occurs in all photosynthetic plants; it does not matter whether they have C3 or C4 (or any other) pathways (Figure 13.8). For ease of understanding, the Calvin cycle can be described under three stages: carboxylation, reduction and regeneration.

1. Carboxylation is the fixation of CO_2 into 3-phosphoglyceric acid (3-PGA). Carboxylation of RuBP occurs in presence of enzyme RuBP carboxylase (RuBisCO) which results in the formation of two molecules of 3-PGA.

2. Reduction is series of reaction that leads to formation of glucose. Two molecules of ATP and two molecules of NADPH are required for reduction of one molecules of CO_2. Six turn of this cycle are required for removal of one molecule of Glucose molecules from pathway.

3. Regeneration is the generation of RuBP molecules for the continuation of cycle. This process require one molecules of ATP.



Calvin Cycle/ C3 Cycle

For every molecules of CO_2 entering the Calvin Cycle, 3 molecules of ATP and 2 molecules of NADPH is required. To make one molecules of glucose 6 turns of cycle is completed so total energy molecule required is

In	Out
Six CO_2 18 ATP 12 NADPH	One glucose 18 ADP 12 NADP

C4 pathway/Hatch Slack Pathway

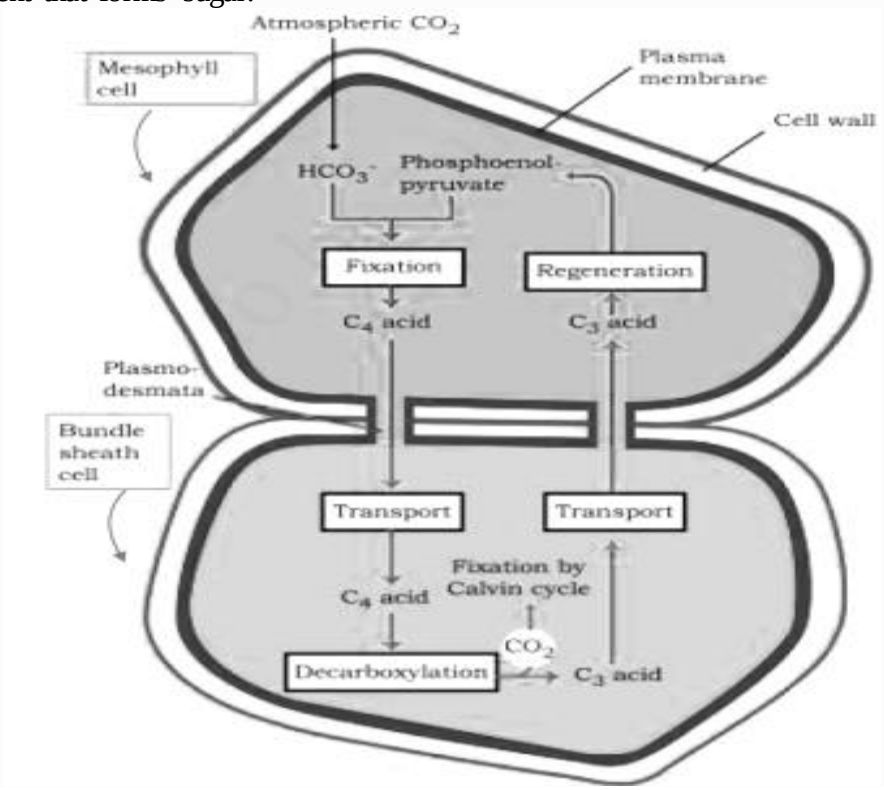
1. This pathway was worked out by Hatch and Slack (1965, 1967), mainly operational in plants growing in dry tropical region like Maize, Sugarcane, Sorghum etc.

2. In this pathway first stable product is a 4-carbon compound Oxaloacetic acid (AAO) so called as C_4 pathway. C_4 plants have Kranz Anatomy), characterized by large no of chloroplast, thick wall impervious to gases and absence of intercellular spaces.
3. The primary CO_2 acceptor is a 3-carbon molecule Phosphoenol Pyruvate present in mesophyll cells and enzyme involved is PEP carboxylase.

4. OAA formed in mesophyll cell forms 4-carbon compound like malic acid or aspartic acid which is transported to bundle sheath cells.

5. In bundle sheath cell, it is broken into CO_2 and a 3-carbon molecule. The 3-carbon molecule is returned back to mesophyll cells to form PEP.

6. The CO_2 molecules released in bundle sheath cells enters the Calvin cycle, where enzyme RuBisCO is present that forms sugar.



Photorespiration

1. This is the reaction where RuBP combines with CO2 to form 2 molecules of 3PGA, that is catalysed by RuBisCO
2. Photorespiration decreases the rate of photosynthesis when oxygen concentration is increased from 2-3% to 21%.

3. Presence of light and higher concentration of Oxygen results in the binding of RuBisCO enzyme with O_2 to form.

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

This pathway involves Chloroplast, Peroxisome and Mitochondria. Photorespiration do not occurs in C_4 plants.

C3 plants	C4 plants
1. The leaves do not have Kranz anatomy. 2. Photorespiration occurs. 3. RuBisCO is the first acceptor of CO2. 4. PGA is the first stable product. 5. Plants are adapted to all climates. 6. Mesophyll cells perform complete photosynthesis.	1. The leaves show Kranz anatomy in leaves. 2. Photorespiration does not occur. 3. PEP is the first acceptor of CO2. 4. OAA is the first stable product. 5. Plants are adapted to tropical climate. 6. Mesophyll cells perform only initial fixation.

Factors affecting photosynthesis

1. Light- as light intensity increases, the rate of photosynthesis also increases until light saturation point.
2. Carbon dioxide concentration– with increase in concentration of CO_2 rate of photosynthesis increase till the compensation point.
3. Temperature- it does not influence the rate of photosynthesis directly but at higher temperature enzyme activity is inhibited due to denaturation of enzymes which affect the dark reaction.
4. Water– due to increase in amount of water, rate of photosynthesis does not increase proportionally as after saturation no more water is required during photosynthesis.

Blackman's Law of Limiting Factors states:
If a chemical process is affected by more than one factor, then its rate will be determined by the factor which is nearest to its minimal value: it is the factor which directly affects the process if its quantity is changed.

QUESTION AND ANSWER

1)Photosynthesis is -
(a) A physical process
(b) A chemical process
(c) A physio-chemical process
(d) An energy wasting process
Ans.c

2 . Which-one is not an accessory photosynthetic pigment?
(a) Chl b (b) Xanthophyll (c) Carotene (d) Chl a
Ans. d

3. What is the function(s) of accessory pigments?
(a) They enable a wider range of wavelength of incoming light to be utilized for photosynthesis
(b) They absorb light and transfer the energy to reaction centre
(c) They protect reaction centre from photooxidation
(d)All
Answer. d

4.The light harvesting complex (LHC) is made up of-
(a) One molecule of Chl a
(b) Very few molecules of Chl·a
c)Hundreds of pigment molecules bound to proteins
d)Chla + chl c +protein +DNA

Answer .c

5.The term Kranz (wreath) of Kranz-anatomy of leaf c4 plant refers to arrangement of cells. These cells are cells of

(a) Mesophyll
(b) Spongy parenchyma
(c) Bundle sheath
(d) Both mesophyll and bundle sheath

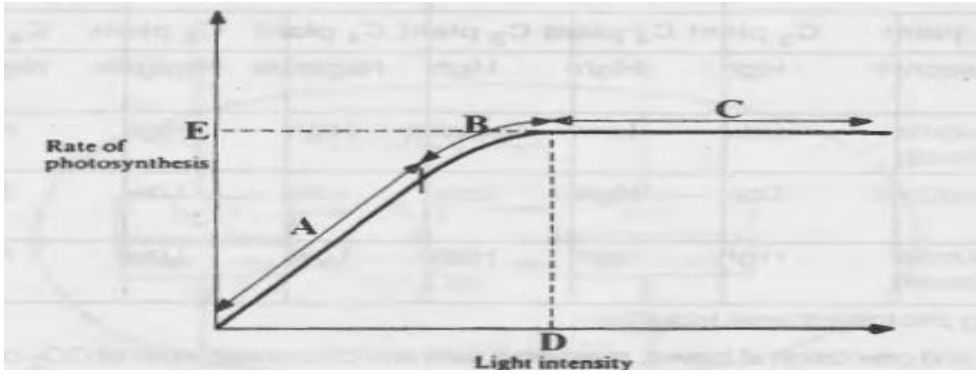
Answer. c

6. Photosynthetic yield depends upon -

(a) Duration of exposure to light
(b) Light intensity
(c) Light quality
(d)All

Answer.d

7.



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Column -1	Column - 2
I. Limiting factor in region A	1. Some factor other than light intensity is becoming the Jimjting factor
II. B represents to	2. Light is no longer limiting factor
Ill. C represents to	3. Light intensity
IV. D represents to	4. Maximum rate of photosynthesis
V. E represents to	5. Saturation point for light intensity

The correct option is -

(a) I - 1, II - 2, Ill - 3, IV - 4, V – 5
(b) I - 3, II - 1, Ill - 2, IV - 5, V - 4
(c) I - 4, II - 2, Ill - 5, IV - 3, V - 1
(d) I - 5, II - 4, Ill - 3, IV - 2, V -1

Answer.b

8. Mention the four important events/ processes associated with the photochemical phase or light reaction of photosynthesis

Ans. (i) Absorption of light
(ii) Splitting of water
(ii) Oxygen release
(iv) Formation of ATP and NADPH

9. $2H_2O \longrightarrow 2H^+ + O_2 + 4e^-$

On the basis of the above equation, answer the following questions:

(a)Where does this reaction take place in plants during photosynthesis?
(b) What is the significance of this reaction?

Answer. (a)This reaction occurs on the inner side of the thylakoid membrane, where PSII is located.

(b)Water is split into H+, oxygen and electrons , this is the step of oxygen release.

Case Study Based Questions

(I)Light quality, light intensity and the duration of exposure to light these light factors affects photosynthesis. There is a linear relationship between incident light and CO_2 fixation rates at low light intensities. At higher light intensities, gradually the rate does not show further increase as other factors become limiting. It is interesting to note is that light saturation occurs at 10 per cent of the full sunlight. Hence, except for plants in shade or in dense forests, light is rarely a limiting factor in nature. Increase in incident light beyond a point causes the breakdown of chlorophyll and a decrease in photosynthesis Carbon dioxide is the major limiting factor for photosynthesis. The concentration of CO_2 is very low in the atmosphere (between 0.03 and 0.04 per cent). Increase in concentration upto 0.05 per cent can cause an increase in CO_2 fixation rates; beyond this the levels can become damaging over longer periods.

1) As per law of limiting factors, If a chemical process is affected by more than one factor, then its rate will be determined by the factor which is _____.

a) Nearest to its minimal value
b) Nearest to its maximal value
c) Nearest to its optimal value
d) None of the above

2) In photosynthesis, increase in incident light beyond optimum level causes the _____

a) Breakdown of chlorophyll and increase in photosynthesis.
b) Activation of chlorophyll andincrease in photosynthesis.
c) Breakdown of chlorophyll and decrease in photosynthesis.
d) Breakdown of chlorophyll and decrease in photooxidation.

3.) What concentration of CO_2 is present in our atmosphere or surrounding?

4.) Give the Blackman's (1905) Law of Limiting Factors.

5.) How C3 and C4 plants respond to CO_2 concentration?

Answer

1) a

2) c

3) The concentration of CO_2 is very low in the atmosphere between 0.03 and 0.04 per cent.

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

5) The C3 and C4 plants respond differently to CO_2 concentrations. At low light conditions neither group responds to high CO_2 conditions. At high light intensities, both C3 and C4 plants show increase in the rates of photosynthesis. The fact that C3 plants respond to higher CO_2 concentration by showing increased rates of photosynthesis leading to higher productivity has been used for some greenhouse crops such as tomatoes and bell pepper. They are allowed to grow in carbon dioxide enriched atmosphere that leads to higher yields

Five marks questions

Q1. Where does Calvin cycle take place? Describe its three phases. (Draw the cycle also)
OR
Where does Calvin cycle take place in chloroplasts? Describe the three phases of Calvin cycle.
Ans. It occurs in the stroma of chloroplasts.
There are three stages:
- Carboxylation
- Reduction
- Regeneration.

1) Carboxylation:

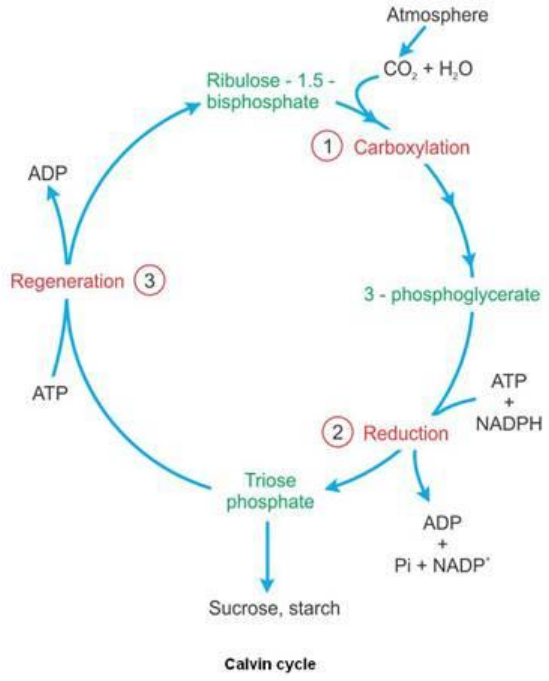
- Fixation of CO2 into a stable organic intermediate.
- CO2 is utilised for the carboxylation of RuBP.
- Catalysed by the enzyme RuBP carboxylase.
- Results in the formation of 2 molecules of 3PGA (3 Phospho Gylceric Acid)
- RuBP has oxygenation activity , so it is called RuBP carboxylase-oxygenase or RuBisCo.

• 2) Reduction:

- Utilisation of 2 molecules of ATP for Phosphorylation.
- Utilisation of 2 molecules of NADPH for reduction per CO2 molecule.
- Fixation of 6 molecules of CO2 and 6 turns of the cycle are required for the removal of one molecules of glucose from the pathway.

3) Regeneration

- Regeneration of CO2 acceptor molecule RuBP is needed.
- Regeneration requires one ATP for phosphorylation to form RuBP.

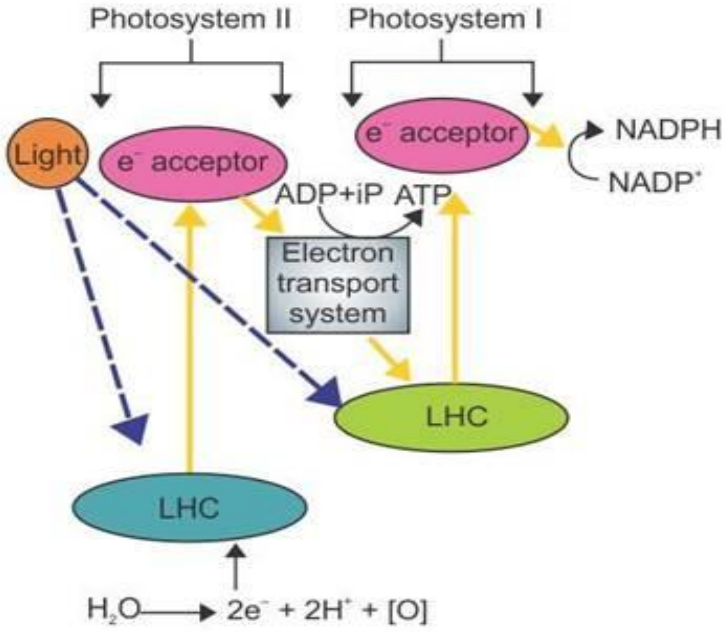


Calvin cycle

Q2.Explain non cyclic phosphorylation in plants. Why is this process called so?
Or
Where does non cyclic photophosphorylation take place?Describe this process. Why is this process called so?
Ans.Non cyclic photophosphorylation occurs in lamellae of grana.

- When the two photosystems work in a series, first PS II and then the PS I, non-cyclic photo-phosphorylation occurs.
- The two photosystems are connected through an electron transport chain- Z scheme.
- Both ATP and NADPH + H+ are synthesised by this kind of electron flow,
- The photophosphorylation process which results in the movement of the electrons in a non-cyclic manner for synthesizing ATP molecules using the energy from excited electrons provided by photosystem II is called non-cyclic photophosphorylation.
- This process is referred to as non- cyclic photophosphorylation because the lost electrons by P680 of Photosystem II are occupied by P700 of Photosystem I and are not reverted to P680. Here the complete movement of the electrons is in a unidirectional or in a non- cyclic manner.

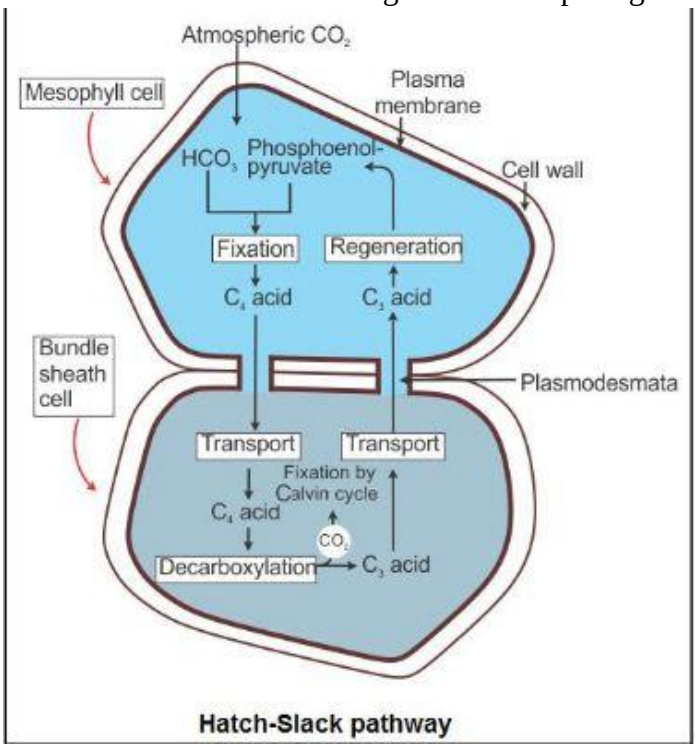
- During non-cyclic photophosphorylation, the electrons released by P700 are carried by primary acceptor and are finally passed on to NADP. Here, the electrons combine with the protons – H+ which is produced by splitting up of the water molecule and reduces NADP to NADPH2.



Non-cyclic photo-phosphorylation

Q3. Mention the steps involved in C4 pathway/Hatch and Slack pathway starting from atmospheric CO2 to its entry into the C3 cycle.

- Primary CO2 acceptor is a 3 carbon molecule (PEP) Phospho Enol Pyruvate.
- PEP is present in the mesophyll cells
- Enzyme- PEP carboxylase or PEPcase
- Mesophyll cells lack RuBisCo enzyme
- C4 acid OAA is formed in the 12esophyll cells
- Then forms 4 Carbon compounds like Malic Acid or Aspartic Acid.
- Then it is transported to the Bundle Sheath Cells.
- Bundle sheath cells, C4 acids are broken to release 3 carbon molecules (C3 acid)
- C3 acid is transported back to the mesophyll.
- C3 acid is converted to PEP again thus completing the cycle.



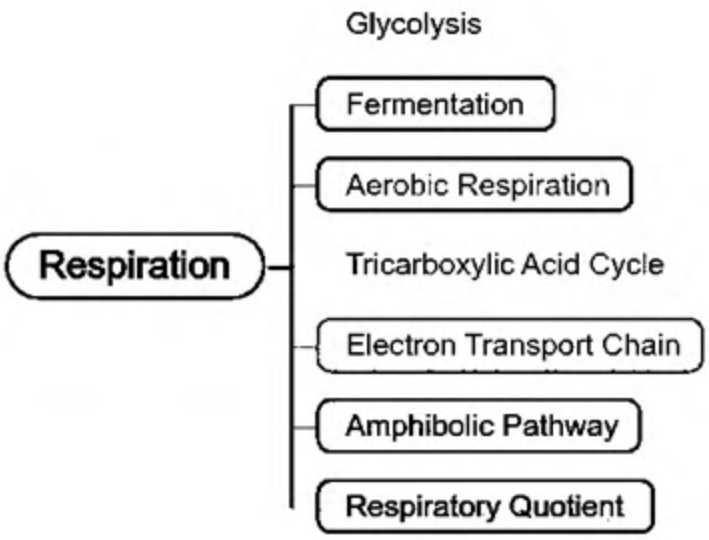
Hatch-Slack pathway

Q4.(i) Name the CO2 acceptor in the mesophyll cells of a C4 plant.
(ii)Name the pentose phosphate that fixes CO2 in a C3 plant.
(iii)Name the first stable compound formed in sugarcane plant during CO_2 fixation.
(iv)Expand PEP. Where is it produced in C4 plants? What is its role in biosynthetic process?

Ans.(i) PEP(Phospho Enol Pyruvate) is the CO2 acceptor in C4 plants
(ii)Ribulose 1,5 biphosphate
(iii)Oxalo acetic acid
(iv)a)Phospho Enol Pyruvate
b)It is produced in the mesophyll cells of leaves of C4 plants.
c) It is the primary acceptor of CO2 and is converted into OAA. Thus it helps in CO2 fixation in these plants. By this pathway , the CO2 concentration in the bundle sheath increases and photorespiration is prevented from occurring.

CHAPTER 14 – RESPIRATION IN PLANTS

CONCEPT MAP



POINTS TO REMEMBER

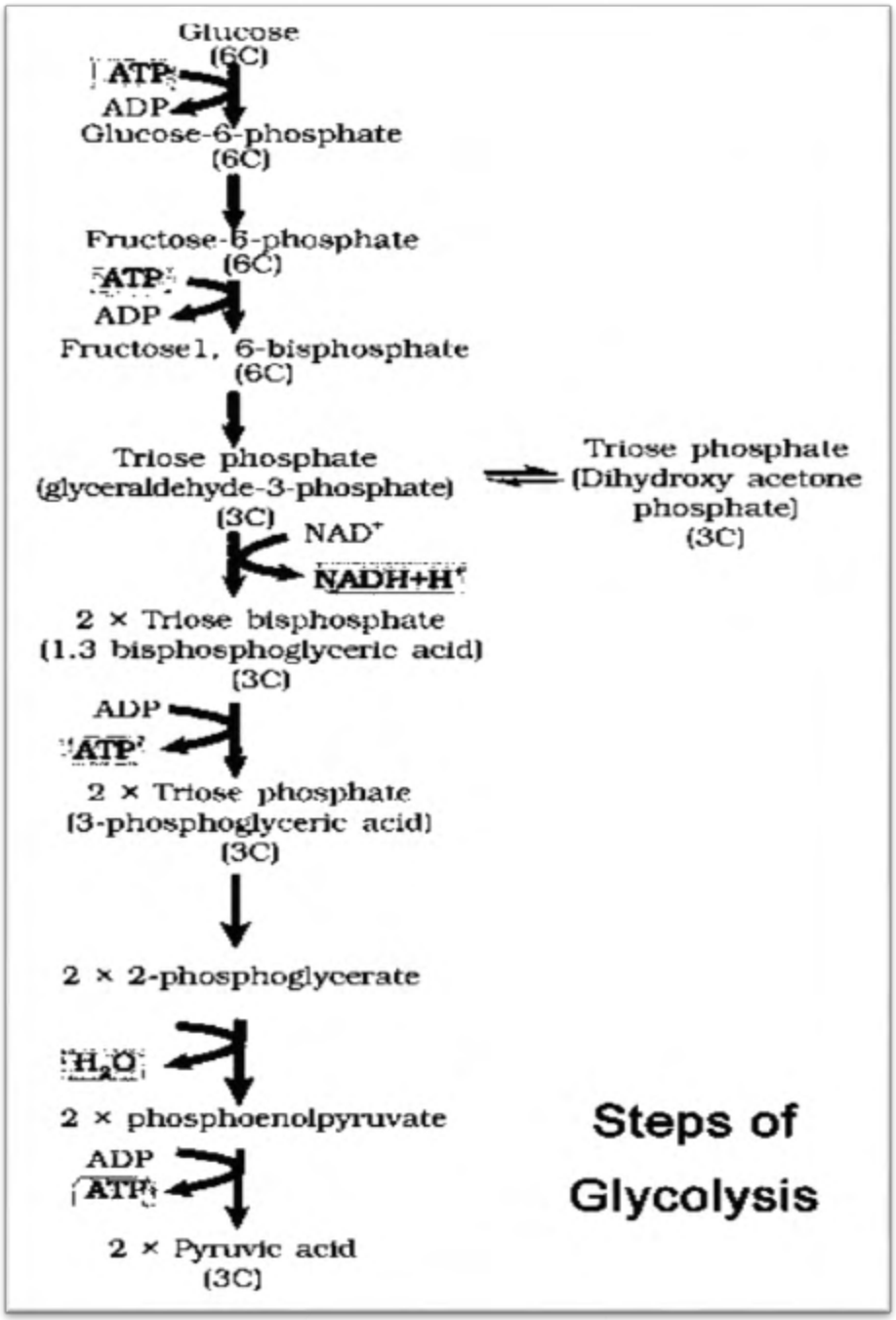
- All the energy required for life processes is obtained by oxidation of macromolecules called food.
- The breaking of the C-C bonds of complex compounds through oxidation within the living cells, leading to release of considerable amount of energy is called respiration.
- The compounds that are oxidised during this process are called respiratory substrates.
- Energy is released in a series of step-wise reactions controlled by enzymes and it is trapped as chemical energy in the form of ATP.
- Gaseous exchange in plants occurs by stomata and lenticels.
- The complete combustion of glucose is given as follows:
  $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ + Energy
- The breakdown of glucose to pyruvic acid is called glycolysis.
- The scheme of glycolysis was given by Gustav Embden, Otto Meyerhof and J. Parnas – often referred to as the EMP pathway.
- For the complete oxidation of glucose to CO_2 and H_2O, organisms adopt Kreb's cycle (aerobic respiration).
- In fermentation, the incomplete oxidation of glucose is achieved under anaerobic conditions by sets of reactions where pyruvic acid is converted to CO_2 and ethanol. The enzymes pyruvic acid decarboxylase and alcohol dehydrogenase catalyse these reactions.
- Aerobic respiration can be represented as follows:
- The acetyl CoA enters Tricarboxylic acid cycle commonly called Kreb's cycle after the scientist Hans Krebs who first elucidated it.
- The metabolic pathway through which the electron passes from one carrier to another is called the electron transport system (ETS) or Oxidative phosphorylation.
- Oxidation of one molecule of NADH gives 3 molecules of ATP whereas that of one molecule of $FADH_2$ gives 2 molecules of ATP.

- The respiratory pathway is an amphibolic pathway as it involves both anabolism and catabolism.
- Respiratory quotient (RQ)

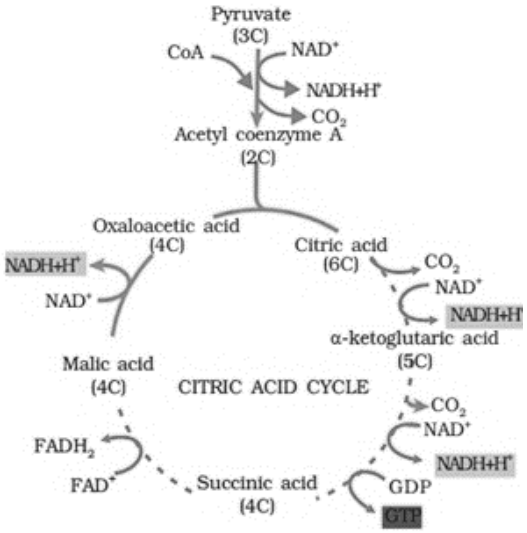
$$RQ = \frac{\text{Volume of } CO_2 \text{ evolved}}{\text{Volume of Oxygen consumed}}$$

- The respiratory quotient depends on the type of respiratory substrate used during respiration.

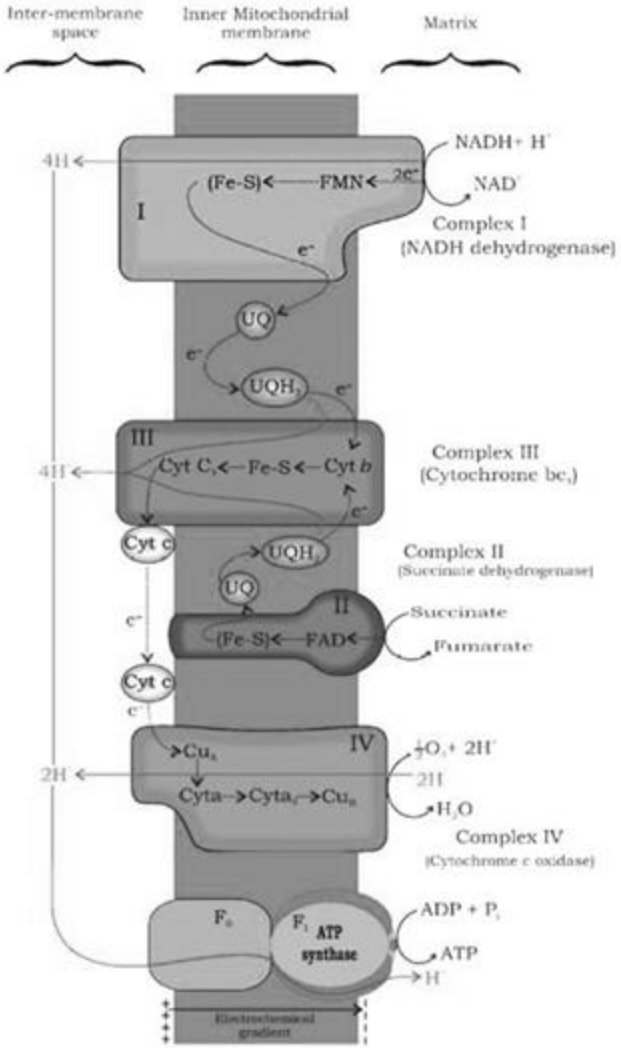
Diagrams:



Citric Acid Cycle



Electron Transport Chain



QUESTION AND ANSWER

I. Choose the correct answer:

1. The breakdown of glucose to pyruvic acid is called
   a) Glycolysis b) Gluconeogenesis
   c) Glycogenolysis d) Kreb's cycle
   Answer: a
2. The electron transport system is present in the
   a) Mitochondrial matrix b)Outer Mitochondrial Membrane
   c)Inner Mitochondrial Membrane d) Cytoplasm
   Answer: c
3. Amphibolic pathway involves
   a) Catabolism b) Anabolism
   c) Both (a) and (b) d) None of the above
   Answer: Both a and b
4. When carbohydrates are used as substrate and are completely oxidised, the Respiratory Quotient will be
   a) 0 b) 1
   c) -1 d) 2
   Ans: b
5. The overall goal of glycolysis, Kreb's cycle and the electron transport system is the formation of
   a) sugars b) ATP in small stepwise units
   c) ATP in one large oxidation reaction d) nucleic acids
   Ans: b
6. This biomolecule is common to a respiration-mediated breakdown of fats, carbohydrates and proteins .
   a) Acetyl CoA b) Pyruvic acid
   c) fructose 1, 6-bi phosphate d) Glucose-6-phosphate
   Ans: a
7. How many ATP molecules could maximally be generated from one molecule of glucose, if the complete oxidation of one mole of glucose to CO_2 and H_2O yields 686 kcal and the useful chemical energy available in the high energy phosphate bond of one mole of ATP is 12 kcal?
   a) 7 b) 30
   c) 2 d) 1
   Ans: a
8. During which stage in the complete oxidation of glucose is the greatest number of ATP molecules formed from ADP?

a) Electron transport chain b)Kreb's cycle

c) Glycolysis d) conversion of pyruvic acid to acetyl CoA

Ans: a

10. How many ATP molecules are produced by aerobic oxidation of one molecule of glucose?

a) 38 b) 34

c) 4 d) 2

Ans: a

Short Answer Questions:

1. Define glycolysis.

A: All living organisms retain the enzymatic machinery to partially oxidise glucose without the help of oxygen. This breakdown of glucose to pyruvic acid is called glycolysis.

3. Give the formula of respiratory quotient.

$$RQ = \frac{\text{Volume of } CO_2 \text{ evolved}}{\text{Volume of Oxygen consumed}}$$

4. What is the fate of pyruvate?

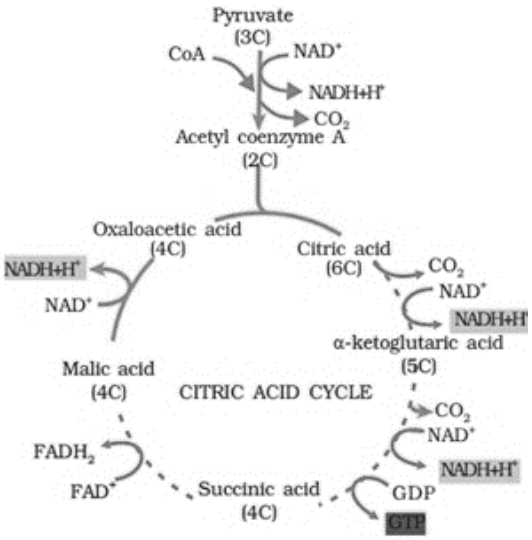
A. Different cells metabolize pyruvic acid produced by glycolysis in three different ways depending on need of the cell. Lactic acid fermentation, alcoholic fermentation, and aerobic respiration are the three fates of pyruvate.

5. Why is respiration an amphibolic process?

A. Respiration is an amphibolic process as it involves both anabolism and catabolism.

Long Answer Questions:

1. Draw the Citric Acid Cycle.



Competency based questions

1. Assertion: During the process of respiration, oxygen is utilised and carbon dioxide. water and energy is released as products.

   Reason: The combustion reaction does not require oxygen.

   a) If both assertion and reason are true and the reason is the correct explanation of the assertion.

   b) If both assertion and reason are true but reason is not the correct explanation of the assertion.

   c) If assertion is true but reason is false.

   d) If both assertion and reason are false.

   Ans: c) Assertion is true but reason is false.

2. Assertion: Kreb cycle occurs in cytoplasm.
   Reason: Enzymes for Kreb cycle are found in cytoplasm.

   a) Both assertion and reason are correct and reason is the correct explanation for assertion.

   b) Both assertion and reason are correct and reason is not the correct explanation for assertion.

   c) If assertion is true but the reason is false.

   d) If both assertion and reason are false.

   Ans: d) Both assertion and reason are false.

3 .Assertion: Fermentation is the incomplete oxidation of glucose.
   Reason: It occurs in aerobic conditions only.
   a) Both assertion and reason are correct and reason is the correct explanation for assertion.

   b) Both assertion and reason are correct and reason is not the correct explanation for assertion.

   c) If assertion is true but the reason is false.

   d) If both assertion and reason are false.

   Ans: c) Assertion is true but the reason is false.

4. Assertion: In eukaryotes, photosynthesis takes place within the chloroplasts.
   Reason: The breakdown of complex molecules to yield energy takes place in the cytoplasm and in the mitochondria
   a) Both assertion and reason are correct and reason is the correct explanation for assertion.

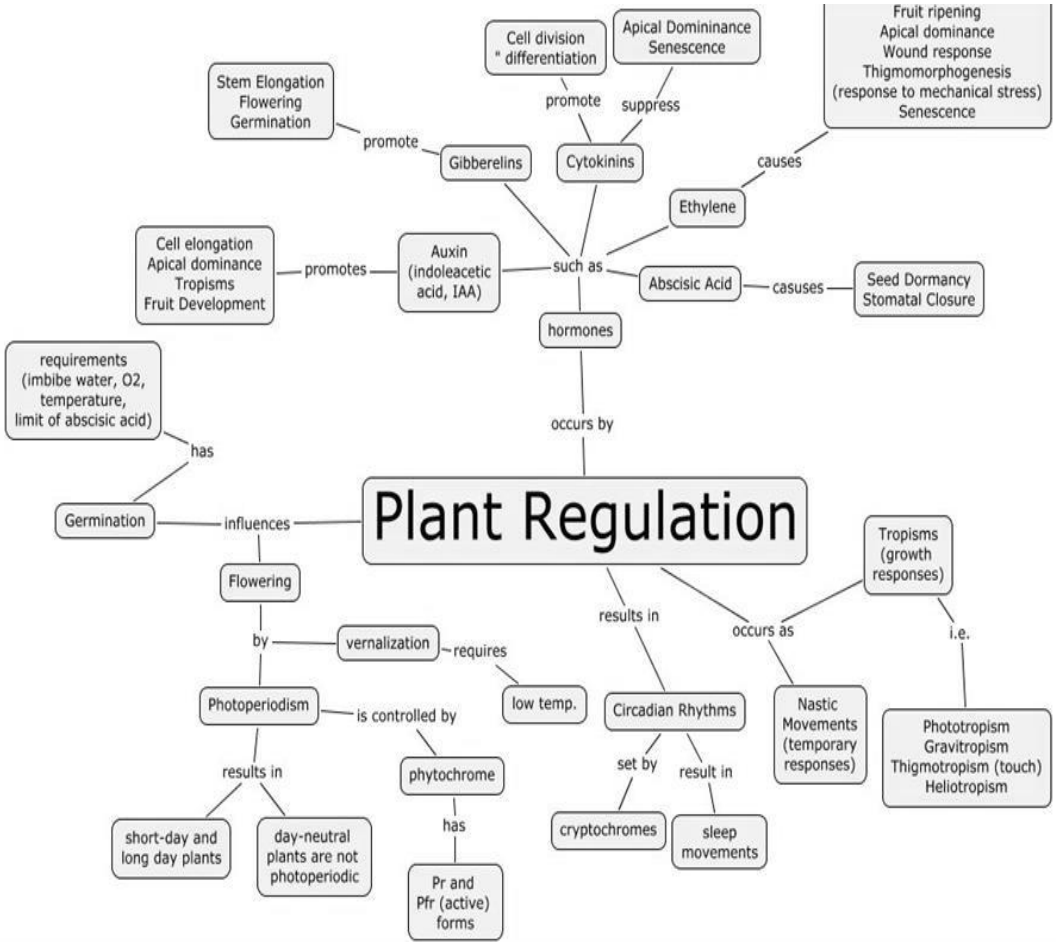
   b) Both assertion and reason are correct and reason is not the correct explanation for assertion.

   c) If assertion is true but the reason is false.

   d) If both assertion and reason are false.

   Ans: b) Both assertion and reason are correct and reason is not the correct explanation for assertion.

CONCEPT MAP



POINTS TO REMEMBER

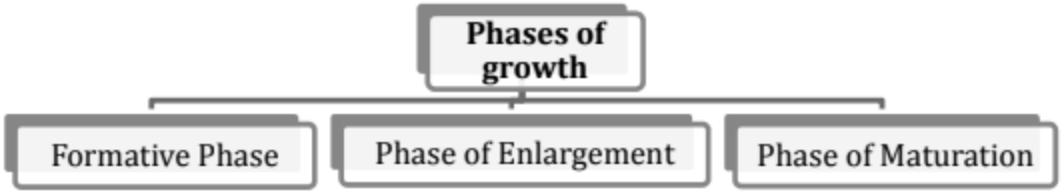
Development is the sum of two processes growth and differentiation. Intrinsic and extrinsic factors control the process of growth and development in plants.

Growth is a permanent or irreversible increase in dry weight, size, mass or volume of cell, organ or organism. It is internal or intrinsic in living beings.

· In plants growth is accomplished by Cell division, Increase in cell number and cell enlargement

Plant growth is generally indeterminate (capacity of unlimited growth throughout the life) Root apical meristem and shoot apical meristem are responsible for primary growth and elongation of plant body along the axis.

The parameter used to measure growth is increase in fresh weight, dry weight, length, area, and volume and cell number.



Formative phase is also called as the phase of cell formation or cell division. It occurs at root apex, shot apex and other region having meristematic tissue.

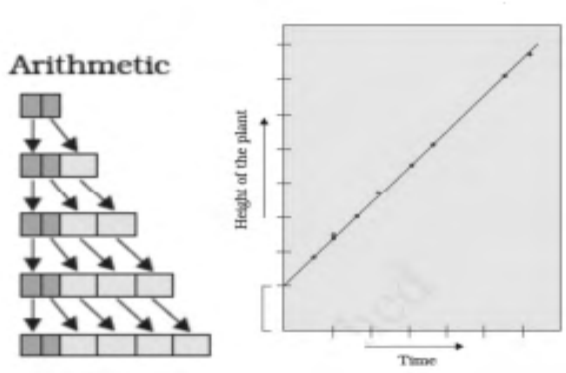
Phase of Enlargement- newly formed cells produced in formative phase undergo enlargement. Enlarging cells also develops vacuoles that further increase the volume of cell. Cell enlargement occurs in all direction with maximum elongation in conducting tissues and fibres.

Phase of maturation- the enlarged cells develops into special or particular type of cells by undergoing structural and physiological differentiation.

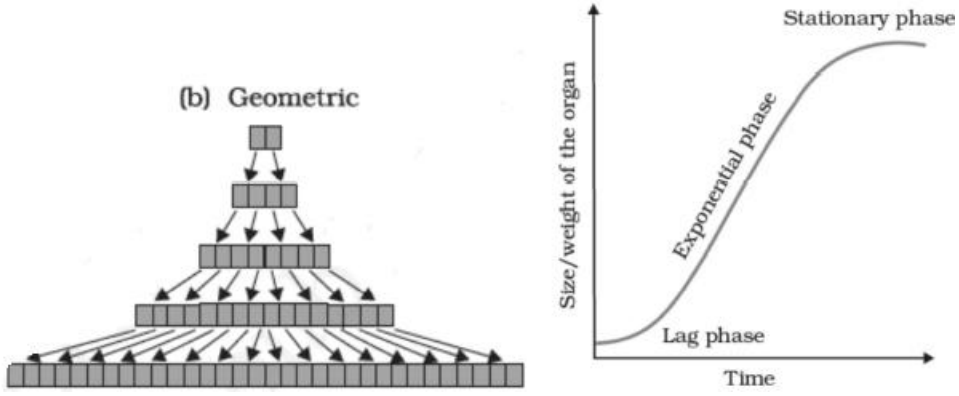
Growth Rate- increase in growth per unit time is called growth rate. Growth rate may be arithmetic or geometrical.

Arithmetic Growth- the rate of growth is constant and increase in growth occurs in arithmetic progression- 2,4,6,8 ……. It is found in root and shoot elongation.
$L_t = L_0 + rt$

Length after time = length at beginning + growth rate x time.



Geometric Growth- here initial growth is slow and increase rapidly thereafter. Every cell divides. The daughter cells grow and divide and the granddaughter cells that result into exponential growth.



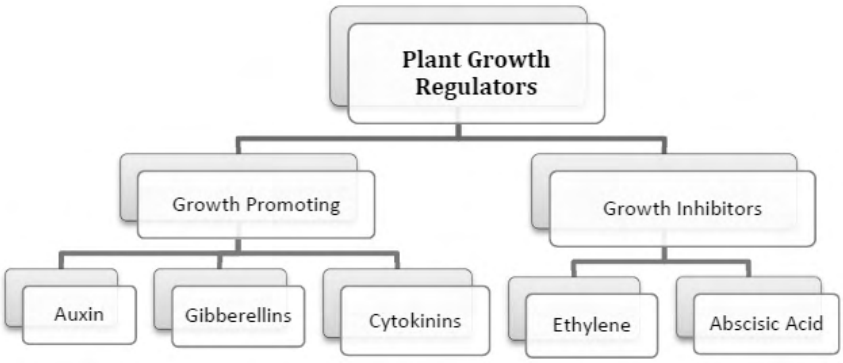
Geometrical growth is common in unicellular organisms when grows in nutrient rich medium.

Sigmoid growth curve consists of fast dividing exponential phase and stationary phase.

Quantitative comparison between the growth of living system can be made by

I. Measurement and comparison of total growth per unit time is called the absolute rate.
II. The growth of given system per unit time expressed on a common basis is called relative growth rate.

Plant Growth Regulators are simple molecules of diverse chemical composition which may be indole compounds, adenine derivatives or derivatives of carotenoids.



Auxin- was first isolated from human urine. It is commonly indole-3-acetic acid (IAA). It is generally produced at stem and root apex and migrate to site of action.

Function
a) Cell enlargement.
b) Apical dominance
c) Cell division
d) Inhibition of abscission
e) Induce Parthenocarpy

Gibberellins- are promontory PGR found in more than 100 forms named as GA1, GA2, GA3….GA100. The most common one is GA3 (Gibberellic Acid).

Function
a)Cell elongation.
b)Breaking of dormancy.
c)Early maturity
d)Seed germination.

Cytokinins- plant growth hormone basic in nature. Most common forms includes kinetin, zeatin They are mainly synthesized in roots.

Function-
a) Cell division and cell differentiation.
b) Essential for tissue culture.
c) Overcome apical dominance.
d) Promote nutrient metabolism.

Ethylene – it is a gaseous hormone which stimulates transverse or isodiametric growth but retards the longitudinal one.

Function-

a) Inhibition of longitudinal growth.
b) Fruit ripening
c) Senescence
d) Promote apical dominance

Abscisic Acid – it is also called stress hormone . It is mainly produced in chloroplast of leaves.

Function -
a) Bud dormancy
b) Leaf senescence
c) Induce Parthenocarpy
d) Seed development and maturation.

Condition for growth
· Necessary condition for growth includes water, oxygen and essential elements. Water is required for cell enlargement and maintaining turgidity. Water also provide medium for enzymatic conditions.
· Protoplasm formation requires water and micro and macronutrients and act as source of energy.
· Optimal temperature and other environmental conditions are also essential for growth of the plant.
· Cells produced by apical meristem become specialized to perform specific function. This act of maturation is called differentiation.
· The living differentiated cells that have lost ability of division can regain the capacity of division. This phenomenon is called dedifferentiation. For example inter fascicular cambium and cork cambium.
· Dedifferentiated cells mature and lose the capacity of cell division again to perform specific functions. This process is called redifferentiation.
Development
It is the sequence of events that occur in the life history of cell.

QUESTION AND ANSWER

1) Grass coleoptile tip bend towards source of light because

a) It likes the sun b) It is heavy
c) It needs darkness d) Due to some secretion from tip
Answer:d

2) Certain chemical substances having profound effect on growth, are called

a)Catalytic agents b)Phytohormones
c)Enzymes d)Compost
Answer: b

3) To prevent over – ripening, bananas should be

a)given a dip in ascorbic acid b) maintained at room temperature
c) refrigerated d) Warmed and chilled

Answer: c

4) Which growth hormone accelerates the malting process in brewing industry?

a) Auxins b) Gibberellins
c) Ethylene d) Cytokinins

Answer: b

5) Which plant growth regulator is the derivative of carotenoids?

a) Auxin b) Gibberelic acid
c) Cytokinin d) Abscisic acid

Answer:d

6) Typical plant growth shows _____ curve.

a) J-shaped b) S-shaped
c) I-shaped d) Parabolic

Answer:b

7) Growth is a consequence of which of the following?

a) Increase in the amount of protoplasm b) Increase in the amount of DNA
c) Increase in the amount of cytoplasm d) Increase in the amount of RNA

Answer: a

8) The equation "$L_t = L_0 + rt$" represents which growth?

a) arithmetic growth b) geometric growth
c) absolute growth d) relative growth
Answer:a

9) The term synergistic action of Hormones refer to

a) When two hormones act together and contribute to same function
b) When two hormones act together and bring about opposite effects
c) When one hormone affects more than one function
d) When many hormones bring about any one function
Answer:a

10) You are given a tissue with its potential for differentiation in an artificial culture. Which of the following pairs of hormones would you add to the medium to secure shoots as well as roots?

a) Auxin and Abscisic acid
b) Cytokinin and Auxin
c) IAA and Gibberellins
d) Gibberellins and Abscisic acid
Answer:b.

Short Answer type:

1) What is meant by Abscission? Which Hormone is involved?
   Premature fall of leaves and fruits. ABA
2) Name the Hormone acting antagonistic to ABA. From which microbe was it extracted?
   Gibberellins. The fungus Gibberella fujikuroi

3) What induces Ethylene formation in Plants?

Ripening of Fruits

4) How is Bioassay understood?
Technique to test the growth response of plants/plant parts to the growth regulator

5) A gardener finds some broad leaved dicot weeds growing in his lawn. What can be done to get rid of this efficiently?
Application of 2 4 D

6) Why is plant growth indefinite?
Plants have capacity of unlimited growth due to presence of meristems

7) What is respiratory climactic?
The PGR Ethylene increases the rate of respiration when the fruits are maturing. The term "respiratory climactic" refers to this increase in breathing rate.

8) Name the three stages of cellular growth
Cell division, Cell enlargement, Cell maturation

9) What is Dedifferentiation?
Already differentiated living cells recapture the ability to divide. Eg differentiation of Parenchyma to form cambium

10) How are Hormones translocated in plants ?
Vascular bundle tissues xylem and phloem help in the above process

Competency based questions

Directions: In the following questions, a statement of assertion is followed by a statement of reason.Mark the correct choice as:
(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) If Assertion is true but Reason is false.
(d) If both Assertion and Reason are false.

Q.1. Assertion: As a whole plant growth is indefinite.
Reason: Plants retain the capacity of continuous growth throughout their life.

Answer: (a)

Q.2. Assertion: Both at the root apex and the shoot apex, the constantly dividing cells show the meristematic phase of growth.
Reason: The cells of this region are rich in protoplasm and lacks nuclei.

Answer: (c)

Q.3. Assertion: The sum of growth and differentiation is development.
Reason: Development in plants is under the control of extrinstic factors only

Answer: (c)

Q.4. Assertion : Apical dominance is increased by removal of shoot tip.
Reason : Due to accumulation of auxin in lateral parts, growth is inhibited.

Answer: (d)

Q.5. Assertion: F.W. Went isolated auxin from the times of coleoptiles of wheat seedlings.
Reason: Ethylene delays the senescence.

Answer: (d)

Q.6. Assertion : Auxins help to prevent fruit and leaf drop at early stages.
Reason : Auxins promote the abscission of older mature leaves and fruits.

Answer: (b)

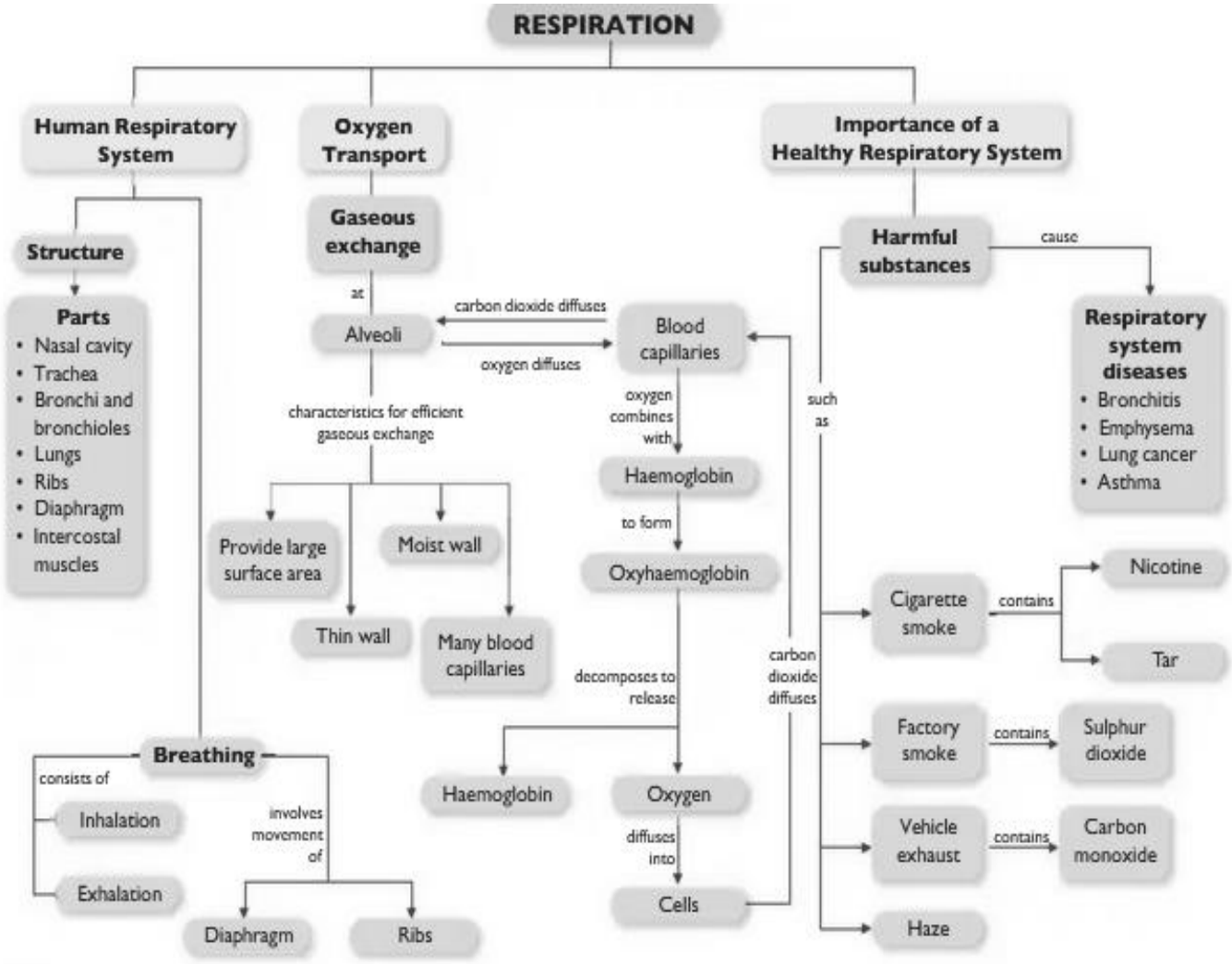
Q.7. Assertion: Auxin is used as herbicide
Reason: Auxin is used to kill monocotyledonous weeds, does not affect mature dicotyledonous plants.

Answer: (c)

Q.8. Assertion: Foolish seedling disease of rice seedlings was reported by E. Kurosawa
Reason: It is due to the ability of gibberellins to cause an increase in length of axis

Answer: (c)

CONCEPT MAP



POINTS TO REMEMBER

- Breathing: (External respiration) the process of exchange of O_2 from the atmosphere with CO_2 produced by the cells.

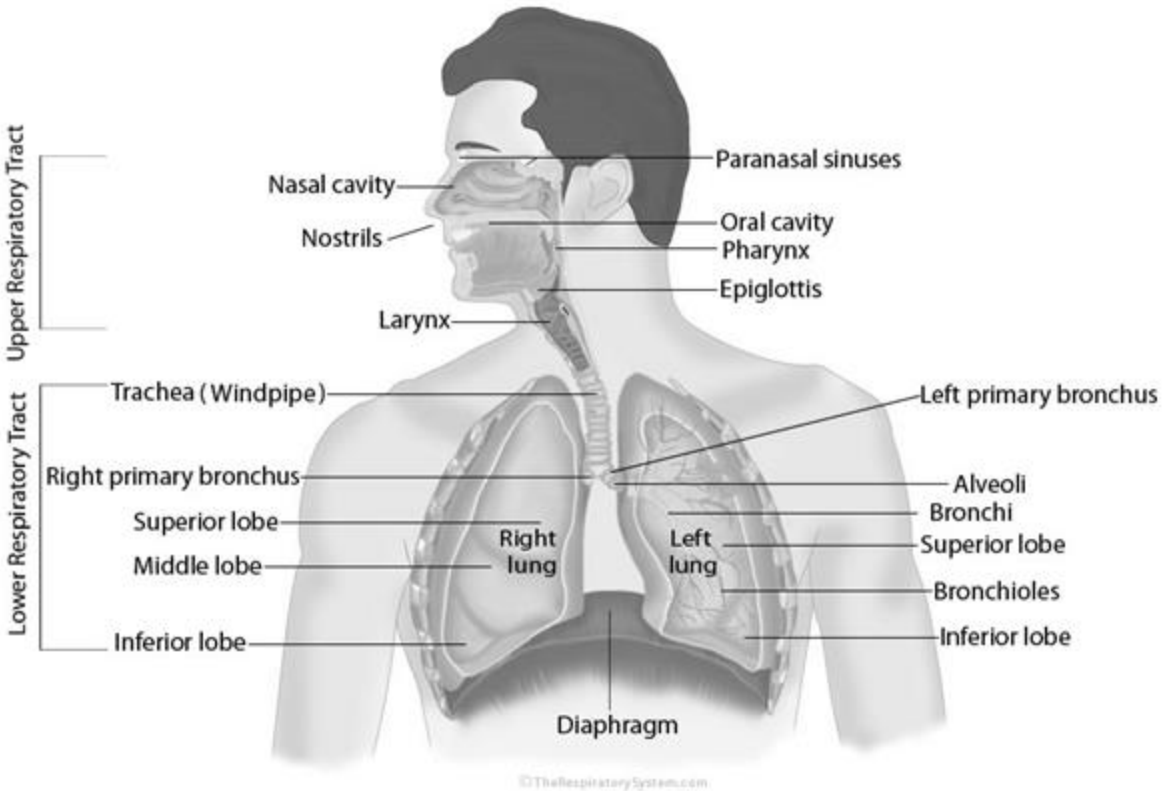
RESPIRATORY ORGANS :

- Direct respiration by diffusion from the environment – sponges, coelenterates, flat worms etc.
- Cutaneous or by skin – earthworm.
- Tracheal system – insects.
- Gills – aquatic arthropods mollusks
- Lungs – terrestrial forms.

HUMAN RESPIRATORY SYSTEM:

- External nostril opens into the nasal chamber through nasal passage.
- The nasal chamber opens into the nasopharynx.
- Nasopharynx opens through glottis of the larynx into the trachea.

- Larynx is a cartilaginous box which produce sound hence called sound box.
- Cartilaginous epiglottis covers the glottis during swallowing to prevent entry of food into trachea.
- Trachea is a straight tube extending up to themed-thoracic cavity, which divides into right and left primary bronchi at the level of 5th thoracic vertebra.
- Each bronchus undergoes repeated divisions to form the secondary and tertiary bronchi and bronchioles ending up in very thin terminal bronchioles.
- Trachea, primary, secondary and tertiary bronchi and initial bronchioles are supported by cartilaginous rings.
- Each terminal bronchiole gives rise to a number of very thin, irregular-walled and vascularised bags like structures called alveoli.
- The branching network of bronchi, bronchioles and alveoli comprises the lungs.
- There are two lungs which are covered by a double layered pleura, with pleural fluid in them.
- Lungs are situated in the thoracic chamber which is anatomically a air tight chamber.
- The thoracic chamber is formed –
    - Dorsally by vertebral column.
    - Ventrally by sternum.
    - Laterally by ribs.
    - On the lower side by dome shaped diaphragm.
- Respiration involves in following steps –
    - Breathing or pulmonary ventilation by which atmospheric air is drawn in and CO_2 rich alveolar air is released out.
    - Diffusion of gases (O_2 and CO_2) across alveolar membrane.
    - Transport of respiratory gases by blood.
    - Diffusion of O_2 and CO_2 between blood and tissues.
    - Utilization of O_2 by the cells for catabolic reactions and resultant release of CO_2.



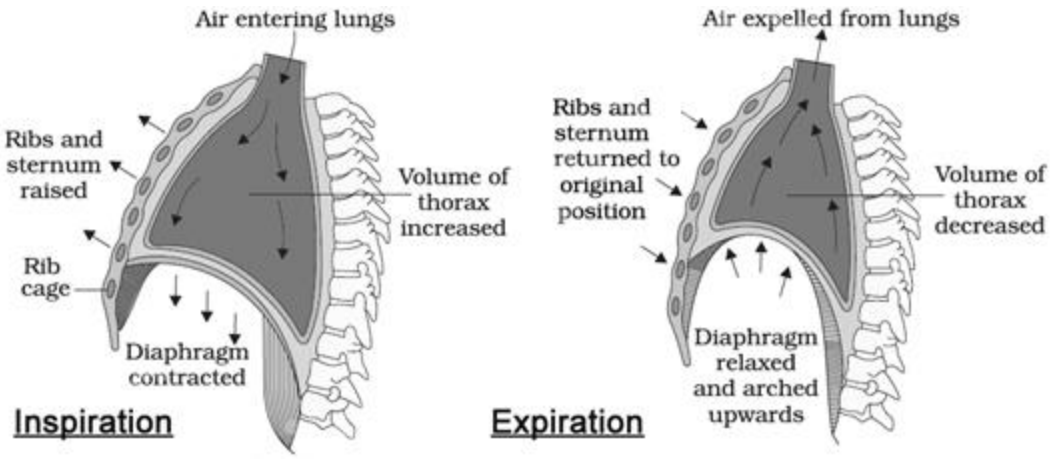
MECHANISM OF BREATHING :

Inspiration :

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

Expiration :

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



Respiratory Volumes and Capacities :

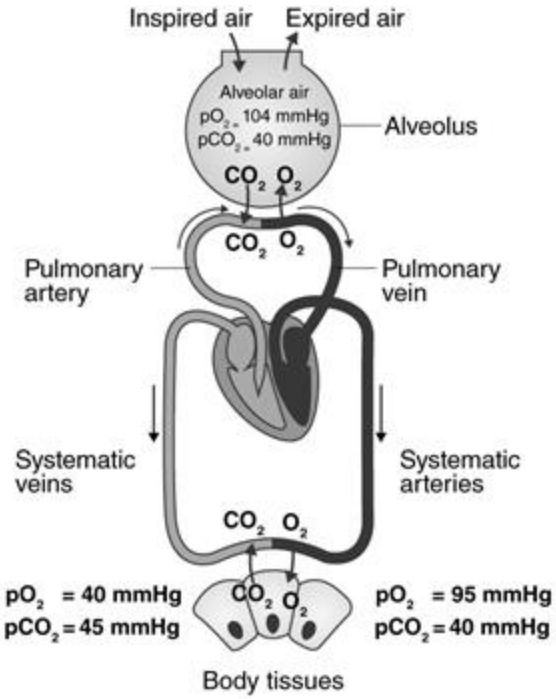
- Tidal volume: volume of air inspired or expired during a normal breathing. It is about 500 ml.
- Inspiratory reserve volume: Additional volume of air, a person inspire by a forceful inspiration. It is about 2500-3000 ml.
- Expiratory reserve volume: Additional volume of air, a person expires by a forceful expiration. It is about 1000-1100 ml.
- Residual volume: Volume of air remaining in the lungs even after a forceful expiration. It is about 1200 ml.
- Inspiratory capacity: it includes tidal volume and Inspiratory reserve volume.
- Expiratory capacity: it includes tidal volume and expiratory reserve volume.
- Functional residual capacity: This includes ERV+RV.
- Vital capacity: IRV + TV + ERV.
- Total lung capacity: RV + IRV + TV + ERV

	Measurement	Adult male average value	Adult female average value	Description
Respiratory volumes	Tidal volume (TV)	500 ml	500 ml	Amount of air inhaled or exhaled with each breath under resting conditions
	Inspiratory reserve volume (IRV)	3100 ml	1900 ml	Amount of air that can be forcefully inhaled after a normal tidal volume inhalation
	Expiratory reserve volume (ERV)	1200 ml	700 ml	Amount of air that can be forcefully exhaled after a normal tidal volume exhalation
	Residual volume (RV)	1200 ml	1100 ml	Amount of air remaining in the lungs after a forced exhalation
Respiratory capacities	Total lung capacity (TLC)	6000 ml	4200 ml	Maximum amount of air contained in lungs after a maximum inspiratory effort: TLC = TV + IRV + ERV + RV
	Vital capacity (VC)	4800 ml	3100 ml	Maximum amount of air that can be expired after a maximum inspiratory effort: VC = TV + IRV + ERV (should be 80% TLC)
	Inspiratory capacity (IC)	3600 ml	2400 ml	Maximum amount of air that can be inspired after a normal expiration: IC = TV + IRV
	Functional residual capacity (FRC)	2400 ml	1800 ml	Volume of air remaining in the lungs after a normal tidal volume expiration: FRC = ERV + RV

Summary of respiratory volumes and capacities for males and females

EXCHANGE OF GASES :

- Alveoli are the primary site of exchange of respiratory gases.
- Exchange of gases also takes place between blood and tissues.
- Exchange of O_2 and CO_2 take place in the pressure gradient, by simple diffusion.
- Pressure contributed by an individual gas in a mixture of gases is called the partial pressure and is represented by pO_2 for oxygen and pCO_2 for carbon dioxide.
- Diffusion of O_2
    - pO_2 in alveolar air = 104 mm Hg.
    - pO_2 in venous blood = 40 mm Hg.
    - O_2 diffuses from alveoli to venous blood.
- Diffusion of CO_2
    - pCO_2 is venous blood = 45 mm Hg.
    - pCO_2 is alveolar air = 40 mm Hg
    - CO_2 diffuses from venous blood to alveoli.
- Solubility of CO_2 is 20-25 times higher than that of O_2; the amount of CO_2 that can diffuse through the diffusion membrane per unit difference in partial pressure is much higher compared to that of O_2.
- Respiratory membrane is formed by;
    - Thin Squamous epithelium of the alveoli.
    - Endothelium of alveolar capillaries
    - Basement membrane between them.



TRANSPORT OF GASES :

- Blood is the medium of transport of O_2 and CO_2.
- About 97 per cent of O_2 is transported by RBCs in the blood.
- 3 per cent of O_2 is transported in the plasma in dissolved state.
- 20-25 per cent of CO_2 transported in the RBC in the form of carbamino-haemoglobin.
- 70 percent CO_2 carried as bicarbonate ion in plasma.
- 7 percent CO_2 transported in dissolved state in plasm.

Transport of Oxygen :

- Haemoglobin is red coloured pigment present in the RBC.
- O_2binds with hemoglobin reversibly to form oxy-hemoglobin.
- Each haemoglobin can binds maximum with four O_2 molecules.
- Binding of Oxygen with haemoglobin is primarily related with partial pressure of O_2.
- Partial pressure of CO_2, hydrogen ion concentration (pH) and temperature are the factors that influence this binding.
- A sigmoid curve is obtained when percentage of saturation of hemoglobin with O_2 is plotted against the partial pressure of O_2 (pO_2). This curve is called oxygen dissociation curve.
- Condition favourable for binding of Hemoglobin with O_2 at alveolar level;
    - High pO_2
    - Low H^+ ion concentration.
    - Low temperature.
- Condition favourable for dissociation of HbO_2 into Hb and O_2 at tissue level;
    - Low pO_2
    - High H^+ ion concentration.
    - High temperature.
- Every 100 ml of oxygenated blood can deliver around 5 ml of O_2 to the tissues under normal physiological conditions.

Transport of Carbon dioxide:

- 20-25 percent of CO_2 is carried out in the RBC by binding with the free amino group of haemoblobin by formation of carbamino-haemoglobin.

- When pCO_2 is high and pO_2 is low as in the tissues, more binding of CO_2 occurs whereas, when the pCO_2 is low and pO_2 is high as in the alveoli, dissociation of CO_2 from carbamino-haemoglobin takes place.
- 70 per cent of CO_2 transported in the form of HCO_3- in the plasma.
- CO_2 from the tissue diffused into the plasma and along with the water it forms carbonic acid which dissociated into HCO_3- and H^+. This reaction is catalysed by an enzyme called carbonic anhydrase present in the plasma membrane of RBC and plasma.

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

REGULATION OF RESPIRATION :

- Specialized centre present in the medulla region of the brain called respiratory rhythm centre is primarily responsible for regulation of breathing.
- Pneumotaxis centre of pons region of brain has moderate regulation.
- Neural signal from this centre can reduce the duration of inspiration and alter the rate of respiration.
- Chemosensitive area adjacent to rhythm centre is sensitive to CO_2 and H^+ ion.
- Receptors associated with aortic arch and carotid artery also can recognize changes in the CO_2 and H^+ concentration and send necessary signals to the rhythm centre for remedial actions.

DISORDERS OF REPIRATORY SYSTEM :

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

QUESTION AND ANSWERS

Select and write one most appropriate option

1. Hemoglobin that is bonded to carbon monoxide and therefore cannot transport oxygen, is called Answer - (a)
   (a) carboxyhemoglobin
   (b) methemoglobin
   (c) reduced hemoglobin
   (d) carbaminohemoglobin
2. CO_2 dissociates from carbaminohaemoglobin when Answer - (b)
   (a) pCO_2 is high and pO_2 is low
   (b) pO_2 is high and pCO_2 is low
   (c) pCO_2 and pO_2 are equal
   (d) None of the above
3. Mark the correct pair of muscles involved in the normal breathing in humans Answer - (d)
   (a)External and internal intercostal muscles
   (b)Diaphragm and abdominal muscles
   (c)Diaphragm and external intercostal muscles
   (d) Diaphragm and intercostal muscles
4. It is known that exposure to carbon monoxide is harmful to animals because Answer - (b)
   (a) It reduces CO_2 transport
   (b) It reduces O_2 transport
   (c) It increases CO_2 transport
   (d) It increases O_2 transport

5. Which of the following is entirely made of cartilage? Answer - (b)
   (a) Nasal septum
   (b) Larynx
   (c) Glottis
   (d) Trachea

Assertion_Reason Based Questions

Directions: In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as:
(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) If Assertion is true but Reason is false.
(d) If both Assertion and Reason are false.

6. Assertion : Vital capacity is higher in athletes than non-athletes.
   Reason : Vital capacity is about 3.5-4.5 litres in a normal adult person.
   Answer – (b)
7. Assertion : Symptoms of emphysema develops when a person living on plains ascends and stays on a mountain.
   Reason : Air pressure and partial pressure of oxygen falls with the rise in altitude.
   Answer – (a)
8. Assertion : If there is no air in trachea, it will not collapse.
   Reason : Trachea is having the cartilaginous ring
   Answer – (a)
9. Assertion: Carbonic anhydrase is present in the erythrocytes.
   Reason: In erythrocytes carbon dioxide combines with water and is transported.
   Answer – (a)
10. Assertion: The role of oxygen in the regulation of respiratory rhythm is quite insignificant.
    Reason: Increased pCO_2 and H^+ concentration inputs from chemoreceptors can activate respiratory rhythm centre to make necessary adjustments.
    Answer – (a)

11. A fluid-filled double membranous layer surrounds the lungs. Name it and mention its important function.
    Pleural fluid is found in between the two membranes of lung and it reduces the friction on the lung surface.

12. What is tidal volume?
    Tidal volume is the volume of air inspired or expired with each normal breath. This is about 500 mL in an adult person. It is composed of about 350 mL of alveolar volume and about 150 mL of dead space volume.

13. Define partial pressure of a gas.
    It is the pressure exerted in a mixture of gases and is equal to the total pressure of the mixture of gases divided by the percentage of that gas in a mixture. The atmospheric air pressure at sea level is 760mm of Hg. Oxygen forms 35% of the air.
    The partial pressure of oxygen is $760 \times 35/ 100 = 266$ mmHg.

14. Define oxygen dissociation curve.
    The relationship between the partial pressure of oxygen (pO_2) and percentage saturation of the haemoglobin with oxygen (O_2)is graphically illustrated by a curve called oxygen haemoglobin dissociation curve (also called oxygen dissociation curve). The oxygen haemoglobin dissociation curve shows sigmoidal pattern.

15. What is chloride shift? Write its significance during respiration.
    The chloride ions (Cl^-) inside RBC combine with potassium ion (K^+) to form potassium chloride (KCl), whereas hydrogen carbonate ions (HCO^-_3) in the plasma combine with Na' to form sodium hydrogen carbonate ($NaHCO_3$) Nearly 70% of carbon dioxide is transported from tissues to the lungs in this form. In response to chloride ions (Cl^-) diffuse from plasma into erythrocytes to maintain the ionic balance. This is called the chloride shift.

16. Diffusion of gases occurs in the alveolar region only and not in the other parts of respiratory system. Why?
    For efficient exchange of gases, respiratory surface must have certain characteristics such as (i) it must be thin, moist and permeable to respiratory gases (ii) it must have large surface area, (iii) it must be highly vascular. Only alveolar region has these characteristics. Thus, diffusion of gases occurs in this region only.

17. How is respiration regulated?
    Respiration is under both nervous and chemical regulation.

    - The respiratory centre in brain is composed of groups of neurons located in the medulla oblongata and pons varolii.
    - The respiratory centre regulates the rate and depth of the breathing.
    - Dorsal respiratory group of neurons are located in the dorsal portion of the medulla oblongata. This group of neurons mainly causes inspiration.
    - Ventral group of neurons are located in the ventrolateral part of the medulla oblongata. These can cause either inspiration or expiration.
    - Pneumotaxic centre is located in the dorsal part of pons varolii. It sends signals to all the neurons of dorsal respiratory group and only to inspiratory neurons of ventral respiratory group. Its job is primarily to limit inspiration.
    - Chemically, respiration is regulated by the large numbers of chemoreceptors located in the carotid bodies and in the aortic bodies.
    - Excess carbon dioxide or hydrogen ions mainly stimulate the respiratory centre of the brain and increases the inspiratory and expiratory-signals to the respiratory muscles.
    - Increased $C0_2$ lowers the pH resulting in acidosis. The role of oxygen in the regulation of respiratory rhythm is quite insignificant.

18. Explain the mechanism of Breathing

    The air that we breathe in and out of the lungs varies in its pressure. So basically when there is a fall in air pressure the alveolar spaces fall and the air enters the lungs (inspiration) and as the pressure of the alveoli within exceeds the atmospheric pressure, the air is blown from the lungs (expiration). The flow rate of air is in proportion to the magnitude of the pressure difference.

    The breathing mechanism involves two processes:

- Inspiration
- Expiration

Inspiration

In the process of inspiration, there would be a contraction of muscles attached to the ribs on the outer side which pulls out the ribs and results in the expansion of the chest cavity. Later, the diaphragm, contracts, moves downwards and expands the chest cavity resulting in the contraction of the abdominal muscles. The expansion of the chest cavity produces a partial vacuum which sucks air into the lungs and fills the expanded alveoli.

Mechanism of Inspiration

- The process of intake of atmospheric air is known as inspiration. It is an active process.
- When the volume of the thoracic cavity increases and the air pressure decreases, inspiration takes place.
- Contraction of external intercostal muscles increases the volume of the thoracic cavity.
- Contraction of the diaphragm further increases the size of the thoracic activity. Simultaneously, the lungs expand.
- With the expansion of the lungs, the air pressure inside the lungs decreases.
- The pressure equalizes and the atmospheric air rushes inside the lungs.

Expiration

The expiration process is considered once after the gaseous exchange occurs in the lungs and the air is expelled. This expulsion of air is called expiration. During this process, muscles attached to the ribs contract, the muscles of the diaphragm and the abdomen relax which leads to a decrease in the volume of the chest cavity and increases the pressure of the lungs, causing the air in the lungs to be pushed out through the nose.

Mechanism of Expiration

- The process of exhaling carbon dioxide is called expiration. It is a passive process.
- It occurs when the size of the thoracic activity decreases and the air pressure outside increases.
- Now the external intercostal muscles relax and the internal intercostal muscles contract.
- As a result, the ribs are pulled inwards and the size of the thoracic cavity is reduced.
- The diaphragm is relaxed and the lungs get compressed.
- Consequently, the pressure increases and the air is forced outside.

Case Based Question

Lungs are a pair of organs located within the chest, which help in breathing. In simple words, lungs remove carbon dioxide and bring oxygen to the blood. Lungs are the primary respiratory organs of animals. In spite of the functionality, the structure and capacities are different amongst various species. Different animals have different lung capacities based on the size of the body and the activities they perform. For example, the lung capacity of an elephant is greater than that of a human due to its large body size. Also, the lung capacity of animals like cheetahs and gazelles is very high because they require a large amount of oxygen for their muscles in order to run at very high speed.

A human lung has a capacity to hold a maximum of six litres of air. The device that is used to measure the volume of air involved is called a spirometer. It is a medical apparatus that is used to determine the amount of air you are able to breathe in and out and the time you take to completely exhale the air after you take a deep breath. Lung volume and lung capacity are used to measure air present in the lungs. Lung volume measures the amount of air present for a living being to inhale or exhale. On the other hand, lung capacity is the volume of air in the lungs upon the maximum effort of inspiration.

Lung Volumes and Capacities

The lung is the primary respiratory organ of animals. However, the structure and capacities are different amongst various species. For example, the structure of a dog's lungs is smaller than humans. Also, the lungs of a sparrow are different as they can fly. Lung volumes and capacities are two significant terms in the respiratory system. It is determined based on human breath, which is a full respiratory circle of one inspiration and expiration.

Lung Volume vs Lung Capacity

There is a stark difference between these two terms. The first one shows the quantity of air for a single function. For example, breathing in or out. The last one tells the maximum amount of air lungs can hold. For instance, it is the sum of two or more lung volumes.

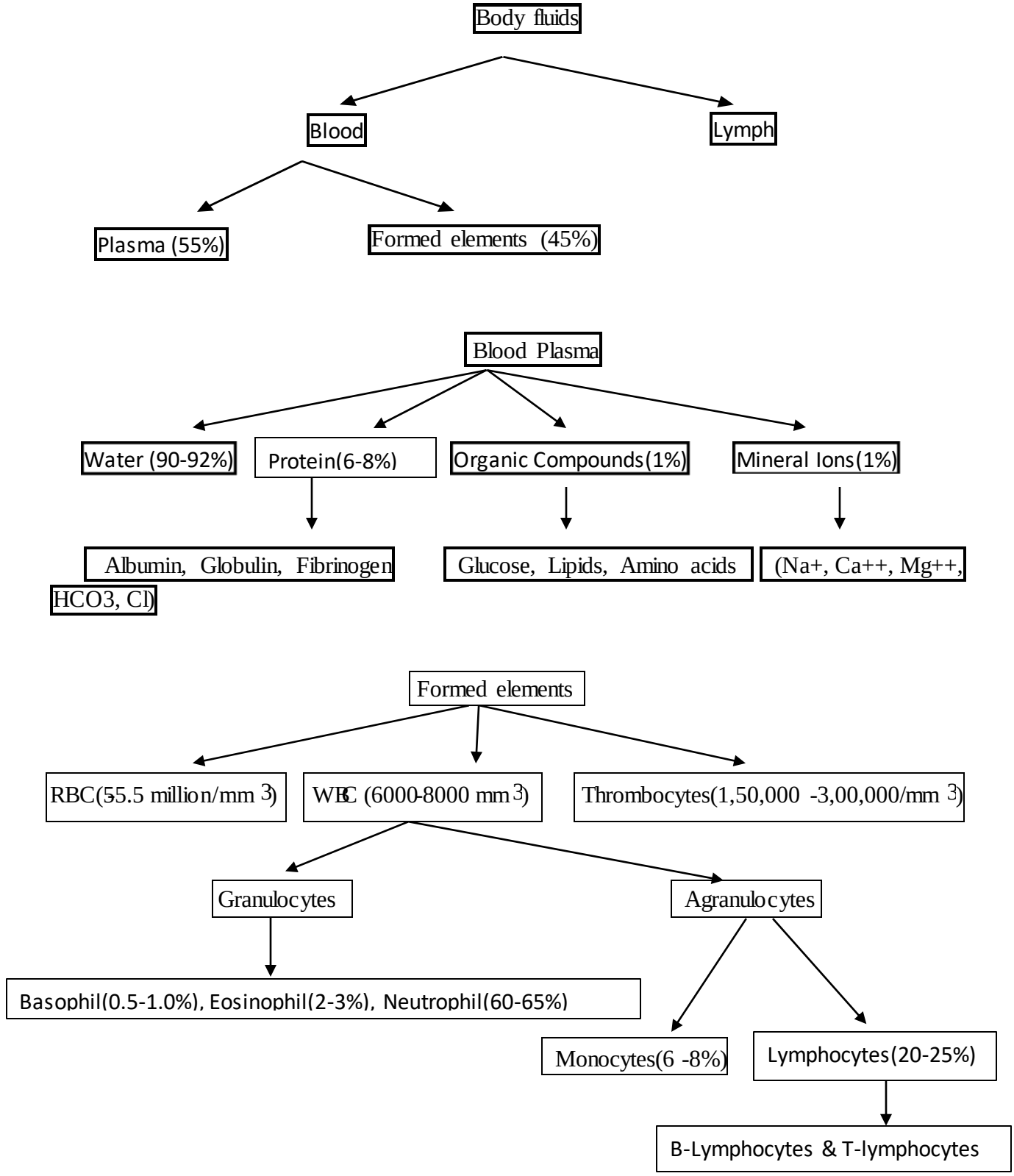
19. Mark the incorrect combination w.r.t. pulmonary capacities Answer - (c)
    (a) IC = TV + IRV
    (b) FRC = RV + ERV
    (c) VC = TLC + RV
    (d) EC = TV + ERV

20. The Total Lung Capacity (TLC) is the total volume of air accommodated in the lungs at the end of forced inspiration. This includes: Answer - (d)
    (a) RV; IC (Inspiratory Capacity); EC (Expiratory Capacity); and ERV
    (b) RV; ERV; IC and EC
    (c) RV; ERV; VC (Vital Capacity) and FRC (Functional Residual Capacity)
    (d) RV (Residual Volume); ERV (Expiratory Reserve Volume); TV (Tidal Volume); and IRV (Inspiratory Reserve Volume

21. Volume of air that will remain in the lungs after a normal expiration is Answer - (b)
    (a) Inspiratory capacity
    (b) Functional residual capacity
    (c) Vital capacity
    (d) Expiratory reserve volume

22. The maximum amount of air that a person can breathe out after a forced inspiration, under normal physiological conditions, would be about: Answer - (c)
    (a) 1600 ml
    (b) 2300 ml
    (c) 4500 ml
    (d) 5600 ml
    Or
    A healthy man can inspire or expire approximately _____ of air per breath normally
    (a) 1100 ml to 1200 ml
    (b) 1000 ml to 1100 ml
    (c) 500 ml
    (d) 6000 ml to 8000 ml

CONCEPT MAP


Body fluids
Blood
Lymph
Plasma (55%)
Formed elements (45%)
Blood Plasma
Water (90-92%)
Protein(6-8%)
Organic Compounds(1%)
Mineral Ions(1%)
Albumin, Globulin, Fibrinogen
Glucose, Lipids, Amino acids
(Na+, Ca++, Mg++, HCO3, Cl)
Formed elements
RBC(5-5.5 million/mm 3)
WBC (6000-8000 mm 3)
Thrombocytes(1,50,000 -3,00,000/mm 3)
Granulocytes
Agranulocytes
Basophil(0.5-1.0%), Eosinophil(2-3%), Neutrophil(60-65%)
Monocytes(6 -8%)
Lymphocytes(20-25%)
B-Lymphocytes & T-lymphocytes

POINTS TO REMEMBER

(i)Blood
(ii)Plasma
(iii)Formed Elements(RBC,WBC&Blood platelets)
(iv)Blood Groups(ABO group&Rh group)
(v)Blood Coagulation(or)Clotting
(vi)Lymph(or)Tissue fluid
(vii)Circulatory Pathways(Open and Closed)
(viii)Human circulatory system
(ix)Origin and conduction of human Heart beat
(x)Cardiac cycle
(xi)Electro Cardio Graph(ECG)
(xii)Double circulation(Pulmonary and Systemic circulations)
(xiii)Regulation of cardiac activity
(xiv)Disorders of the Circulatory Syste

Mechanism of Blood clotting (or)Coagulation;

Injured tissues plus blood platelets□release Thromboplastin(Throbokinase)

Thromboplastin plus Ca+ ions

Prothrombin ----------□Thrombin

Thrombin

Finbrinogen----------□Fibrin

Fibrin(Monomer)plus RBC----------□Blood Clot(or)Coagulum

Events during Heart beat ;

(i)Atria (right and left) and ventricles (right and left)relax(diastole)blood flows in to the atria

↓

(ii)Atria(right and left) contract (systole)forcing blood to ventricles

↓

(iii)Ventricles(right and left)contract(systole)blood from right ventricle flows in to pulmonary artery,thenfrom left ventricle in to dorsal aorta.

Electro Cardio Gram(ECG) ;

Each Peak in the ECG is identified with a letter from P to T(P,QRS complex and T)that corresponds to a specific electrical activity of the heart

↓

P-wave represents the electrical excitation (or)depolarization of the atria

↓

Contraction of both atria

↓

QRS Complex-depolarisation of the ventricles

↓

Ventricular contraction

↓

Shortly after Q-beginning of the systole

↓

T-wave represents return of the ventricles from excited to normal state(Repolarisation)

↓

The end of the T-wave marks the end of systole

Human blood circulation through Heart

Deoxygenated(or)impure blood

↓

Right Atrium

↓

Right Ventricle

↓

Pulmonary Artery(Trunk)

↓

Right and Left Lungs for purification

Oxygenated(or)pure blood

↓

Left Atrium

↓

Left Ventricle

↓

Dorsal Aorta

↓

Pure blood goes to different parts of the body

Pulmonary Circulation

blood from Right Ventricle

↓

ry Artery(or)Trunk

↓

Right and Left Lungs(blood purified)

Pure blood from right and left lungs

↓

2 right and 2 left Pulmonary veins

↓

Left Atrium

Systemic Circulation:

Dorsal Aorta(Pure blood)

↓

Arteries

↓

Arterioles

↓

Capillaries to the tissues

Impure blood from Venule

↓

venules

↓

Veins

↓

Vena Cava to the Right Atrium

Origin Conduction of Human Heart

SinoAtrialNode(SA Node)(Pace maker of the heart)

↓

AtrioVentricularNode(AVN)

↓

Atrio Ventricular Bundle(AV Bundle)

↓

Bundle of HIS

Right Bundle Branch → Purkinje Fibres

Left Bundle Branch → Purkinje Fibres

Diagrams

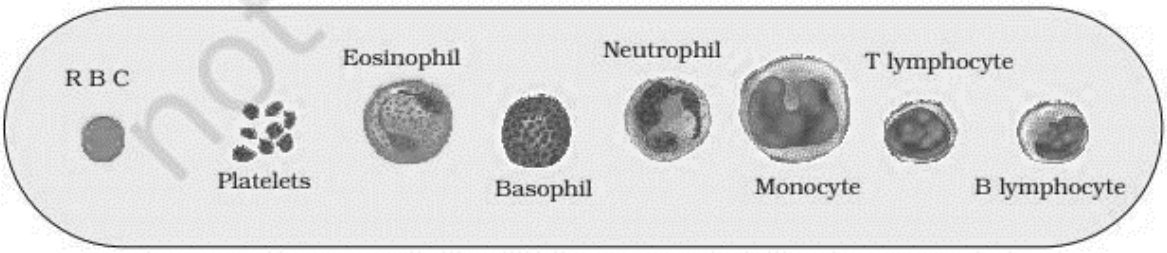


Figure 18.1 Diagrammatic representation of formed elements in blood

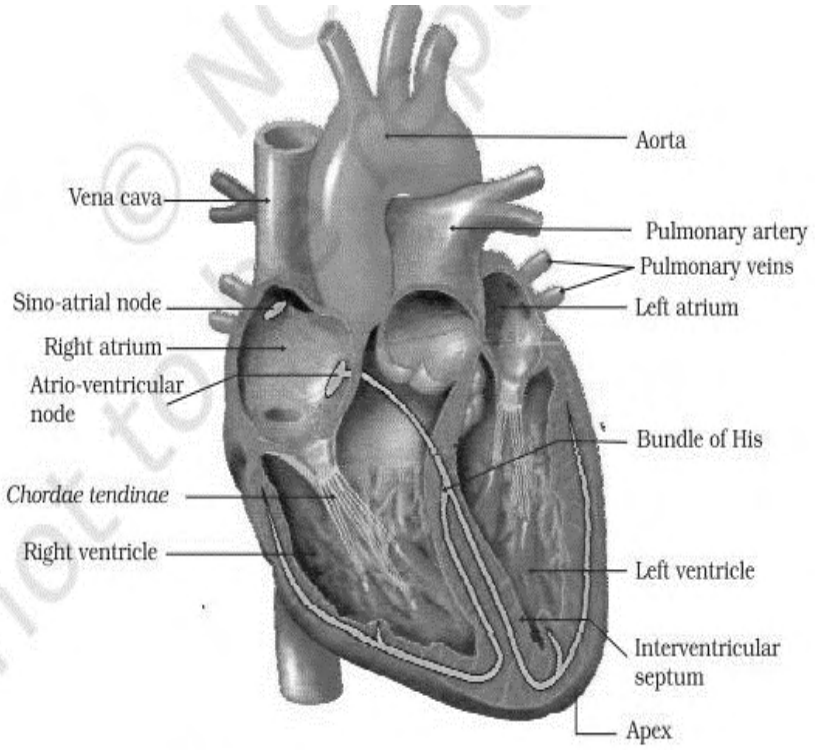


Figure 18.2 Section of a human heart

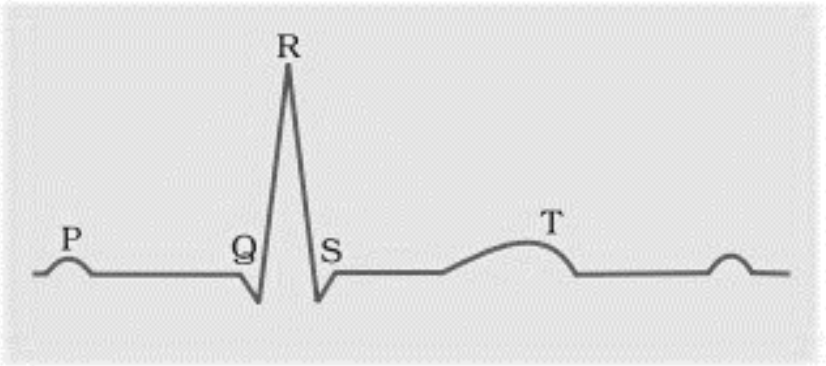


Figure 18.3 Diagrammatic presentation of a standard ECG

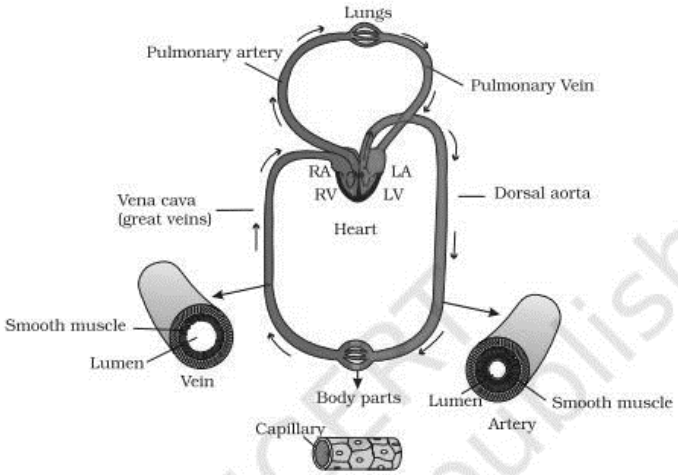


Figure 18.4 Schematic plan of blood circulation in human

Table of Blood groups and their Alleles

S.No	Blood groups	Alleles
1	A	I^AI^A, I^Ai
2	B	I^BI^B , I^Bi
3	AB	I^A I^B (or) I^B I^A
4	O	ii

Blood groups and Donor Compatibility:

		ab	b	a	o
	Recipient □ Donor ↓	O	A	B	AB
ab	O	-	-	-	-
b	A	+	-	+	-

a	B	+	+	-	-
o	AB	+	+	+	-

Blood groups and Donor Compatibility

S.No	Blood groups	Antigen on RBC's	Antibodies in plasma	Donors group	Recipient group
1	A	A	anti B	A,O	A,AB
2	B	B	anti A	B,O	B,AB
3	AB	AB	Nil	A,B,AB,O	AB
4	O	nil	anti A,B	O	A,B,AB,O

QUESTION AND ANSWER

I. Choose the best answer from the following statements (MCQ);

1. Blood is a kind of

(a)Fluid connective tissue (b)Liquid connective tissue

(c)Specialized connective tissue (d)All of the above

Answer-(d)

2.Leukopenia is a condition of

(a)Decrease in WBC production (b)Decrease in RBC production

(c)Increase in WBC production (d)Increase in RBC production

Answer(a)

3.HowErythroblastosisfoetalis(Haemolytic diseases of the new born) can be avoided?

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

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

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

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

Answer(b)

4.The other name of Lymph is

(a)Tissue Fluid (b)Middle man of the body

(c)Interstitial fluid (d)All of the above

Answer(d)

5.How fats are absorbed through the Lymph?

(a)Lacteals of intestinal villi (b)Chorionic villi

(c)Alveoli (d)Microvilli

Answer(a)

6.The venous heart is present in

(a)Amphibians (b)Fishes

(c)Reptiles (d)Birds and Mammals

Answer(b)

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

(a)AV Node (b)AV Bundle

(c)Bundle of HIS (d)SA Node

Answer(d)

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

(a)Cardiac cycle (b)Cardiac input

(c)Cardiac output (d)None of the above

Answer c

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

(a)End of systole (b)Beginning of systole

(c)End of diastole (d)Beginning of diastole

Answer a

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

(a)Kidney and liver (b)Brain and pancreas

(c)Lungs and spleen (d)Brain and kidney

Answer(d)

Short question and answers

1.Define Lymph(or)Interstitial fluid?

As the blood passes through the capillaries in tissues,some water along with many small water soluble substances move out in to the spaces between the cells of tissues leaving the larger proteins and most of the formed elements in the blood vessels.This fluid released out is called the Lymph (or)Tissue fluid.

2.How the Heart can be protected?

The Heart can be protected by a double walled sac like structure called Pericardium which contains pericardial fluidwhich act as a shock absorber and protects the heart from mechanical injury ,shock and reduces frictions.

3.How both atria and ventricles of the heart are separated?

By Interatrial septum and Interventricular septum

4.What is the function of the semilunar valves?

That allows the flow of blood only in one direction

5.Why SANode is called a Pacemaker of the heart?

Because it is responsible for initiating and maintaining the rhythmic contractile activity of the heart

6.Give a variation in the Heart chamber of some animals

(i)Fishes-2 chambered heart-single atrium and single ventricle

(ii)Amphibians and Reptiles-except Crocodiles-3 chambered heart-Right and left atrium and a single ventricle.

(iii)Birds,Mammals and Crocodiles-4 chambered heart-Right and left atrium and right and left ventricle

7..Differentiate open circulatory system with closed circulatory system

Open circulatory system-Examples-Arthropods and Molluscs in which blood pumped by the heart passes through the large vessels in to open spaces(or)body cavities called sinuses.

Closed circulatory system-Examples Annelids up to chordates ,the blood is pumped by the heart is always circulated through a closed network of blood vessels

8.How can you differentiate Arteries and Veins

Arteries-They are pink coloured, thick walled and more elastic, the tunica media is very thick .They carry pure (or)oxygenated blood except pulmonary artery(trunk),they do not have valves, and blood moves very fast due to high pressure

Veins-They are dark red coloured, thin walled and less elastic, the tunica media is very thin. They carry impure(or)deoxygenated blood except pulmonary vein ,they have valves ,and blood moves slow due to low pressure.

9. Differentiate Lubb and Dubb

Lubb-This is the first heart sound,It is the beginning of ventricular systole and it is long and dull sound ,It occurs due to the closure of bicuspid and tricuspid valves

Dubb-This is the second heart sound,It is the end of ventricular systole and it is short and sharp sound,it occurs due to the closure of semi lunar valves

10.Name the three secretions of Basophils and mention their function?

Histamine, Serotonin, and Heparin. They are involved in inflammatory reactions.

Long question and answer

1. Give a brief account of disorders of the human circulatory system

Disorders of the circulatory system are the following;

(i)High blood pressure(Hypertension)-It is the term for blood pressure that is higher than normal(120/80.where120mmHg (millimeters of mercury pressure)is the systolic(or)pumping pressure,and 80 mmHg is the diastolic (or)resting pressure.If repeated checks of blood pressure of an individual is 140/90(140 over90)or higher.It shows Hypertension

(ii)CAD(or)Coronary Artery Disease(or)Atherosclerosis)-affects the vessels that supply blood to the heart muscle.It is caused by deposits of calcium,fat,cholesterol and fibrous tissues which makes the lumen of arteries narrower.

(iii)Angina(or)Angina pectoris-a symptom of acute chest pain appears when no enough oxygen is reaching the heart muscle, It can occurs in men and women of any age but it is more common among the middle aged and elderly. It occurs due to conditions that affect the blood flow.

(iv)Heart failure-It means the state of heart when it is not pumping blood effectively enough to meet the needs of the body. It is some times called Congestive heart failure because congestion of the lungs is one of the main symptoms of this disease.

(v)cardiac arrest-when the heart stops beating

(vi)Heart attack-when the heart muscle is suddenly damaged by an unadequate blood supply.

Competency based questions

Formed elements of blood;

Erythrocytes, leucocytes and platelets are collectively called as formed elements of blood, and they constitute nearly 45% of the blood leucocytes are also known as White Blood Cells(WBC) as they are

colourless due to the lack of haemoglobin. Blood platelets are also called Thrombocytes helpful for blood clotting (or) blood coagulation

Answer the following questions;

1.Why spleen is called as the graveyard of RBC's?

.RBC's have an average lifespan of 120 days after which they are destroyed in the Spleen 2.Basophils

2.Histamine,Serotonin and Heparin are secreted from what type of blood cells?

Basophils

3.Mention the functions of Eosinophils

They resist infections associated with allergic reactions

4.What is the shape of the Nucleus of Eosinophils?

Horse Shoe shaped Nucleus

5.What are Megakaryocytes?

They are special cells in the bone marrow cell fragments to produce Platelets(or)Thrombocytes

6.Name a condition in which abnormal increase of RBC in human blood

Polycythemia

7.What is Leukaemia(or)Blood Cancer?

The abnormal increase in WBC production of human

8.The kidney shaped nucleus found in which kind of Agranulocytes?

Monocytes

9.Which cells are responsible for human responses of the body?

B-Lymphocytes(B-Cells) and T-Lymphocytes(T-Cells)

10.Name two mammals that have nucleus in their matureRBC's?

Camel and Llama

(b)No enough oxygen is reaching the heart muscle

(c)When the heart stops beating

(d)None of the above

Answer©When the heart stops beating

8.The Compatibility in Blood transfusion means

(a)Blood minus plasma matched (b)Blood plus plasma mismatched

(c)Blood should be mismatched (d)Blood should be matched

Answer(d)Blood should be matched

9.The 3 major proteins of blood plasma are

(a)Fibrinogen, globulin and albumin (b)Glutelin,fibrinogen and albumin

(c)Globulin, albumin and serotonin (d)Albumin, heparin and globulin

Answer(a)Fibrinogen, globulin and albumin

10.Serum is called as

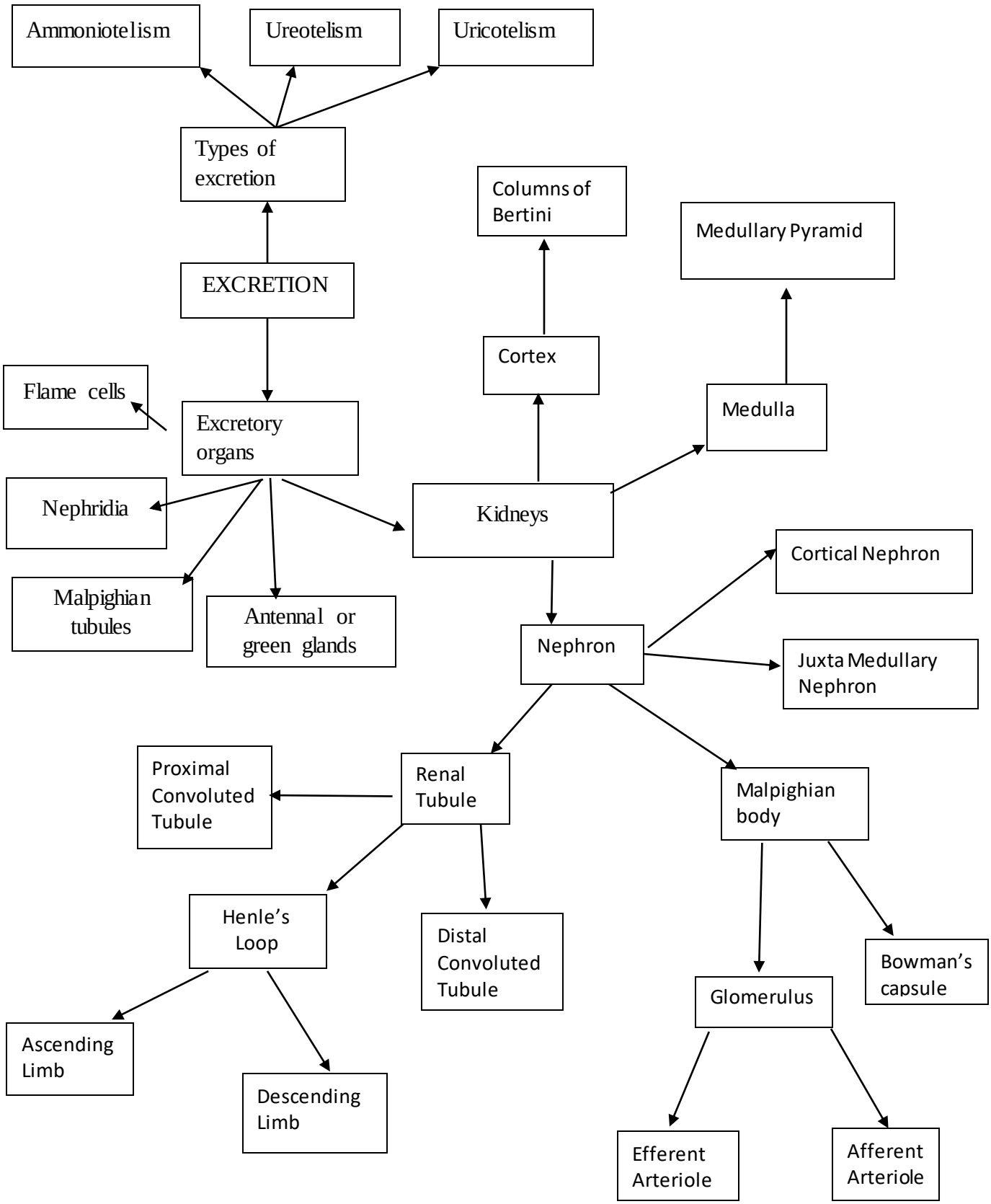
(a)Plasma without formed elements (b)Plasma without clotting factors

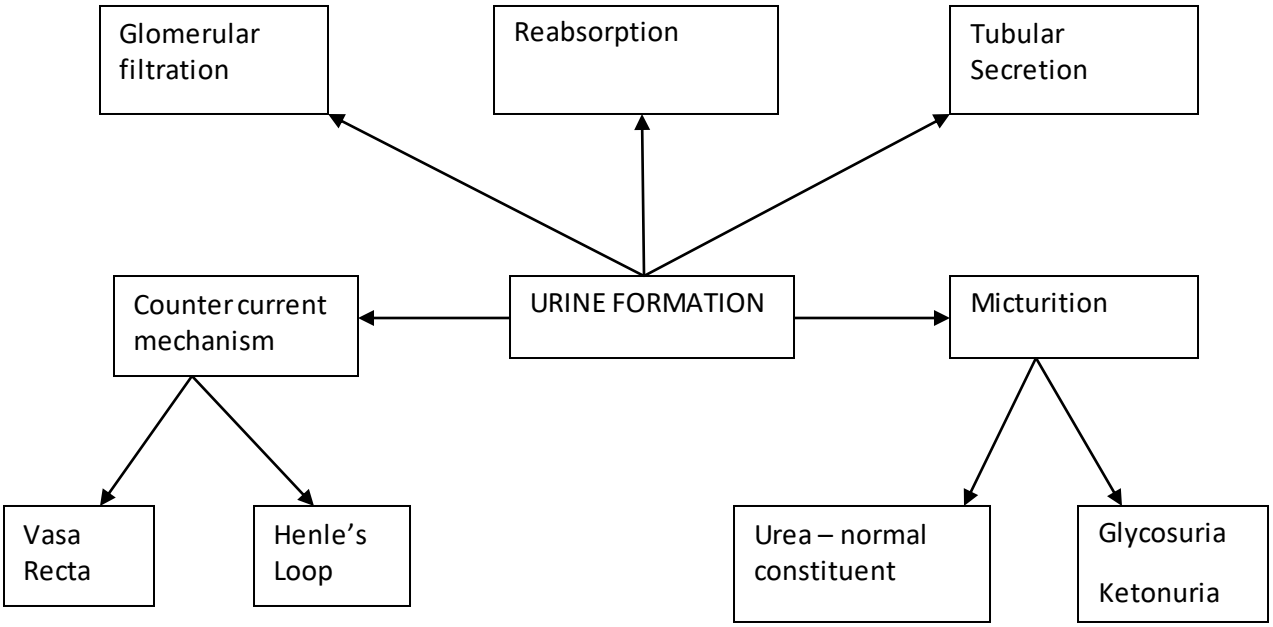
(c)Plasma plus clotting factors (d)Plasma plus formed elements

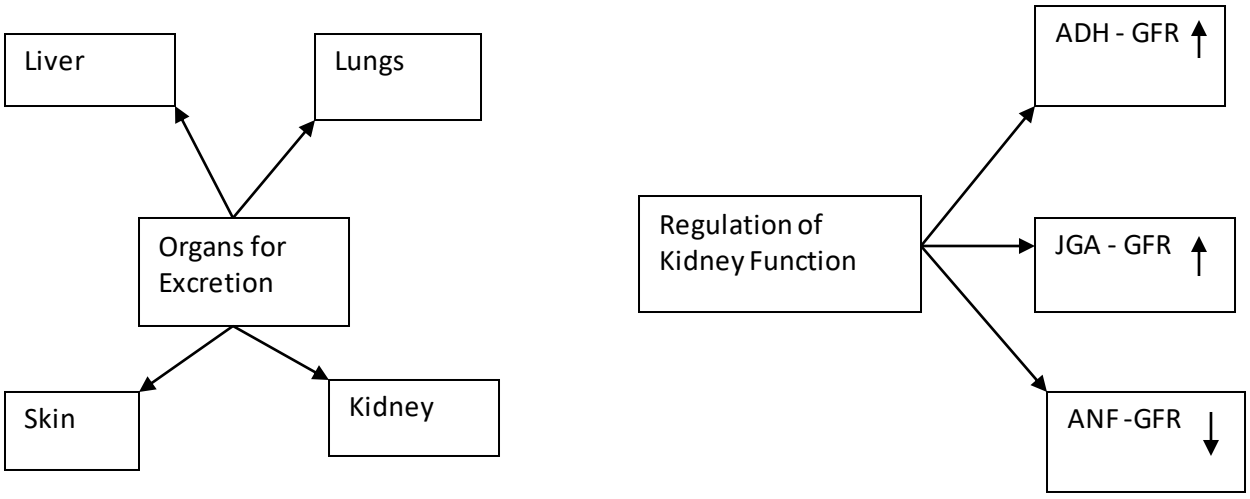
Answer(b)Plasma without clotting factor

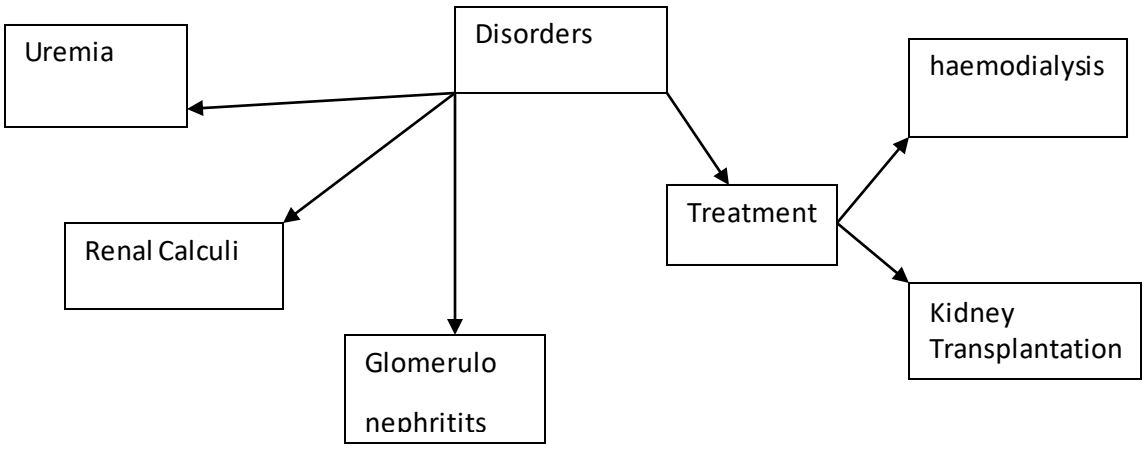
.

CONCEPT MAP


Ammoniotelism
Ureotelism
Uricotelism
Types of excretion
EXCRETION
Flame cells
Excretory organs
Nephridia
Malpighian tubules
Antennal or green glands
Columns of Bertini
Medullary Pyramid
Cortex
Medulla
Kidneys
Cortical Nephron
Nephron
Juxta Medullary Nephron
Proximal Convoluted Tubule
Renal Tubule
Malpighian body
Henle's Loop
Distal Convoluted Tubule
Bowman's capsule
Glomerulus
Ascending Limb
Descending Limb
Efferent Arteriole
Afferent Arteriole

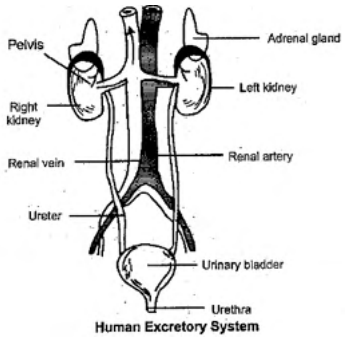

Glomerular filtration
Reabsorption
Tubular Secretion
URINE FORMATION
Counter current mechanism
Micturition
Vasa Recta
Henle's Loop
Urea – normal constituent
Glycosuria
Ketonuria


Liver
Lungs
Organs for Excretion
Skin
Kidney
Regulation of Kidney Function
ADH - GFR
JGA - GFR
ANF -GFR


Disorders
Uremia
Renal Calculi
Glomerulo nephritits
Treatment
haemodialysis
Kidney Transplantation

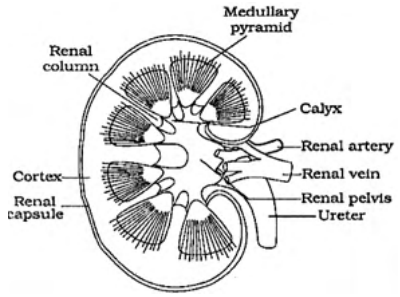
POINTS TO REMEMBER

- Excretion - Elimination of metabolic wastes like ammonia, urea, uric acid etc. from the tissues.
- Ammonotelism - Process of excretion of NH_3. NH_3 is highly toxic. So, excretion needs excess of water.
- Ureotelism - Process of excretion of urea. In liver, NH_3 is converted into less toxic urea. So, it needs only moderate quantity of water for excretion.
- Uricotelism - Process of excretion of uric acid. It is water insoluble & less toxic. So, water is not needed for excretion.
- Protonephridia (flame cells)- Excretory organs -In Flatworms.
- Nephridia - Excretory organs In Annelids.
- Malpighian tubules - Excretory organs: In Insects.
- Antennal or green glands - Excretory organs In Crustaceans
- Kidneys, ureters, urinary bladder & urethra - Parts of human excretory system



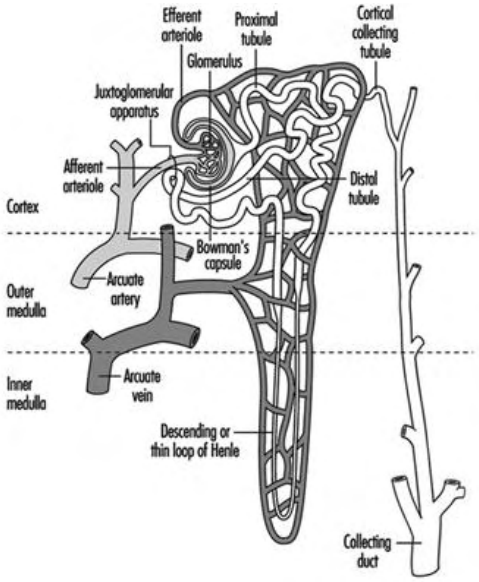
Human Excretory System

- Renal capsule - Kidney is enclosed in a tough, 3-layered fibrous renal capsule.
- Hilum - On the concave side of kidney, there is an opening through which blood vessels, nerves, lymphatic ducts and ureter enter the kidney.
- Renal pelvis - Hilum leads to funnel shaped cavity.
- Medullary pyramids - Medulla has few conical projections called renal pyramids projecting into the calyces.
- Columns of Bertini - Cortex extends in between the medullary pyramids as renal columns.

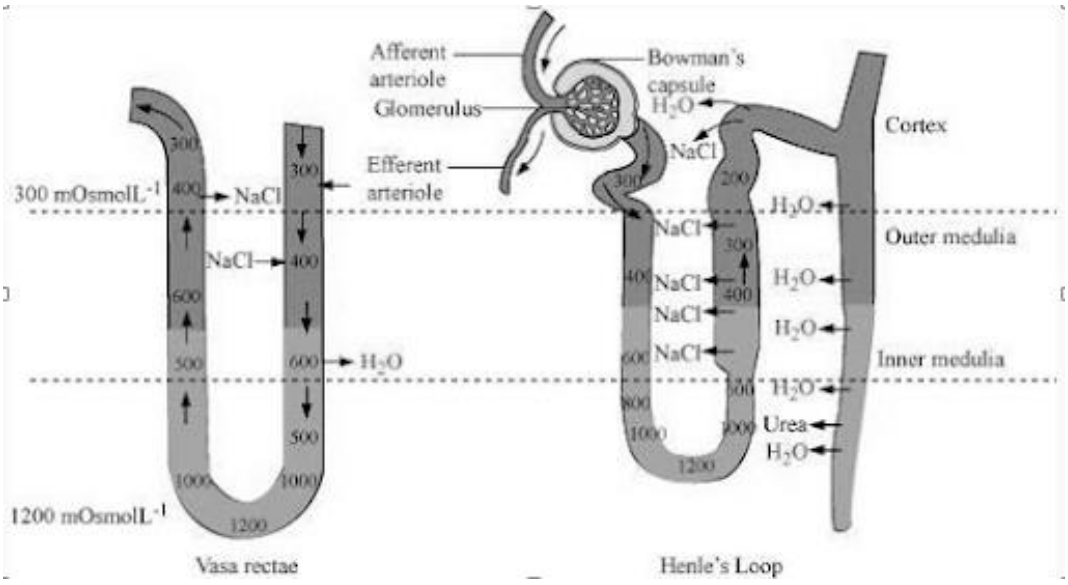


- Nephron - Nephrons are the structural & functional units of kidney.
- Glomerulus - A tuft of capillaries formed by afferent arteriole.
- Malpighian body - Glomerulus + Bowman's capsule.
- Renal tubule - Proximal convoluted tubule (PCT), Henle's loop & distal convoluted tubule (DCT).
- Peritubular capillaries - The efferent arteriole forms a fine capillary network around the renal tubule.
- Vasa recta - A minute vessel of this network runs parallel to Henle's loop form a 'U'

shaped.



- Cortical nephrons - The Henle's loop is short and extends only very little into the medulla. Vasa recta is absent or highly reduced.
- Juxtamedullary nephrons - Henle's loop is long and runs deep into medulla. Vasa recta present.
- Glomerular filtration - Filtration of blood through 3 layers, i.e. endothelium of glomerular blood vessels, epithelium of Bowman's capsule & a basement membrane between these 2 layers.
- Podocytes - The epithelial cells of Bowman's capsule called podocytes are arranged in an intricate manner so as to leave some minute spaces called filtration slits or slit pores
- Glomerular filtration rate (GFR)- The amount of the filtrate formed per minute. 125 ml/minute, i.e., 180 litres/day.
- Tubular Reabsorption - From the filtrate, glucose, amino acids, Na^+, etc. are reabsorbed actively and nitrogenous wastes are absorbed passively. Passive reabsorption of water occurs in the initial segments of the nephron
- Tubular Secretion - Cells of PCT & DCT maintain ionic (Na-K balance) and acid-base balance (pH) of body fluids by selective secretion of H^+, K^+ & NH_3 into the filtrate and absorption of HCO_3^- from it.
- Counter current pattern - Henle's loop & vasa recta help to concentrate the urine. The flow of filtrate in the 2 limbs of Henle's loop and the flow of blood through the 2 limbs of vasa recta are in opposite directions.



- Micturition - Release of urine.
- Micturition reflex - The neural mechanism causing micturition.
- Glycosuria - Presence of glucose in urine.
- Ketonuria - Presence of ketone bodies in urine.
- ADH (vasopressin) - Antidiuretic hormone ADH prevents diuresis , increases the glomerular blood flow.
- JGA - Juxta glomerular apparatus (Renin-Angiotensin mechanism) Increases glomerular blood pressure and thereby GFR.
- ANF - Atrial Natriuretic Factor ANF causes vasodilation
- Uremia - Accumulation of urea in blood which may lead to kidney failure.
- Renal calculi - Stone or insoluble mass of crystallized salts (oxalates, etc.) formed within the kidney.
- Glomerulonephritits - Inflammation of glomeruli .
- Hemodialysis - Urea is removed by hemodialysis.
- Heparin – anticoagulant .
- Kidney transplantation - A functioning kidney is taken from a donor.

QUESTION AND ANSWER

Q.No	Questions	Marks
	I– Multiple choice questions	
1	The following substances are the excretory products in animals. Choose the least toxic from among them. (a) Ammonia (b) Carbon dioxide (c) Urea (d) Uric acid. Answer: d	
2	The condition of accumulation of urea in the blood is termed as (a) Glycosuria (b) Ketonuria (c) Uremia (d) Renal calculi. Answer: c	
3	Dialyzing unit contains a fluid which is almost same as plasma except that it has (a) high glucose (b) No urea (c) high urea (d) high uric acid . Answer: b	
4	Diuresis is the condition in which (a) the excretory volume of urine increases (b) the excretory volume of urine decreases (c) the kidneys fail to excrete urine (d) the water balance of the body is disturbed. Answer: a	
5	Which of the following is an incorrect match ? (a) Bowman's capsule – Glomerular filtration (b) PCT – Absorption of	

sodium and potassium ions
(c) Henle's loop – Concentration of urine (d) DCT – Absorption of glucose . Answer: d

6 The basic functional unit of human kidney is
(a) Nephridia (b) Nephron (c) Neuron (d) Henle's loop.
Answer: b

7 The muscular tubes which take the urine from the kidneys to the bladder are
(a) Urinary bladders(b) Ureters(c) Urethras(d) Nephrons.
Answer: b

8 Nerves, blood vessels and ureter enters into the kidney through
(a) calyces (b) hilum(c) capsule(d) cortex.
Answer: b

9 pH of urine under healthy condition is
(a) neutral (b) slightly acidic (c) slightly alkaline (d) highly alkaline .
Answer: b

10 Which of the following components of blood does not enter into nephron ?
(a) water (b) urea (c) glucose (d) plasma protein.
Answer: d

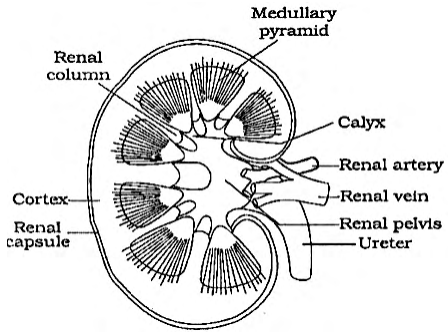
Short question and answers

11 What are ammonotelic animals? Give an example.
ANSWER: The animals which excrete nitrogenous wastes as ammonia are ed ammonotelic animals, e.g., certain fishes.

12 Differentiate between sweat and sebum.
ANSWER: Sweat produced by the sweat glands is a watery fluid containing NaCl, small amounts of urea, lactic acid, etc. Sebaceous glands eliminate certain substances like sterols, hydrocarbons and waxes through sebum. This secretion provides a protective oily covering for the skin.

13 Differentiate between ureotelism and Uricotelism.
ANSWER: Ureotelism -process of elimination of urea ,water moderately required for elimination.
Uricotelism – precess of elimination of uric acid ,much less water required for elimination.

14 Draw the L.S. of Kidney and label the parts given below .Pyramids, cortex, ureter, renal vein.



Answer

15 Give a brief account of the counter current mechanism.
ANSWER: The flow of filtrate in the two limbs of Henle's loop is in opposite directions and thus forms a counter current.
The flow of blood through the two limbs of vasa recta is also in a counter current pattern.

The proximity between the Henle's loop and vasa recta, as well as the counter current in them help in maintaining an increasing osmolarity towards the inner medullary interstitium,
NaCl is transported by the ascending limb of Henle's loop which is exchanged with the descending limb of vasa recta. NaCl is returned to the interstitium by the ascending portion of vasa recta.
This mechanism helps to maintain a concentration gradient in the medullary interstitium.
Presence of such interstitial gradient helps in an easy passage of water from the collecting tubule thereby concentrating the filtrate

16 Explain the following disorders of the excretory system:
i.Renal failure - correction
ii.Renal calculi
iii.Glomerulonephritis
ANSWER: Kidney transplantation is the ultimate method in the correction of acute renal failures (kidney failure).
Renal calculi: Stone or insoluble mass of crystallised salts (oxalates, etc.) formed within the kidney.
Glomerulonephritis: Inflammation of glomeruli of kidney

Competency Based Questions

17 Animals accumulate ammonia, urea, uric acid, carbon dioxide, water and ions like Na^+, K^+, Cl^-, phosphate, sulphate, etc., either by metabolic activities or by other means like excess ingestion. These substances have to be removed totally or partially. Ammonia, urea and uric acid are the major forms of nitrogenous wastes excreted by the animals. Ammonia is the most toxic form and requires large amount of water for its elimination, whereas uric acid, being the least toxic, can be removed with a minimum loss of water.
1. Why are many bony fishes, aquatic amphibians and aquatic insect ammonotelic in nature?
2. Terrestrial adaptation necessitated the production of lesser toxic nitrogenous wastes like urea and uric acid. Justify the statement.
3. Mammals, many terrestrial amphibians and marine fishes mainly excrete urea. How and where is it produced?
4. Mention two organisms which excrete nitrogenous wastes as uric acid.

Answer:

1. Ammonia, as it is readily soluble, is generally excreted by diffusion across body surfaces or through gill surfaces (in fish) as ammonium ions.
2. To conserve water
3. . Ammonia produced by metabolism is converted into urea in the liver of these animals
4. Reptiles, birds, land snails and insects

18 The functioning of the kidneys is efficiently monitored and regulated by hormonal feedback mechanisms involving the hypothalamus, JGA and to a certain extent, the heart. Osmoreceptors in the body are activated by changes in blood volume, body fluid volume and ionic concentration. An excessive loss of fluid from the body can activate these receptors which stimulate the hypothalamus to release antidiuretic hormone. 4
1. Explain the feedback mechanism of ADH to increase glomerular blood flow and thereby GFR.

2. Mention and explain the complex regulatory mechanism which is working complementary to ADH role.
3. Increase in blood flow to the heart is regulated by a mechanism to decrease the blood pressure. Explain the mode of action.

ANSWER:

1. ADH facilitates water reabsorption from latter parts of the tubule, thereby preventing diuresis. An increase in body fluid volume can switch off the osmoreceptors and suppress the ADH release to complete the feedback.
2. JG cells to release renin which converts angiotensinogen in blood to angiotensin I and further to angiotensin II. Angiotensin II, being a powerful vasoconstrictor, increases the glomerular blood pressure and thereby GFR. Renin-Angiotensin mechanism
3. An increase in blood flow to the atria of the heart can cause the release of Atrial Natriuretic Factor (ANF). ANF can cause vasodilation (dilation of blood vessels) and thereby decrease the blood pressure. ANF mechanism, therefore, acts as a check on the renin-angiotensin mechanism.

19 Malfunctioning of kidneys can lead to accumulation of urea in blood, a condition called uremia, which is highly harmful and may lead to kidney failure. In such patients, urea can be removed by a process called hemodialysis. During the process of haemodialysis, the blood drained from a convenient artery is pumped into a dialysing unit called artificial kidney which remove the nitrogenous wastes. This method is a boon for thousands of uremic patients all over the world.

1. What is meant by uremia?
2. What is heparin?
3. When the cleared blood is pumped back to the body which factor is added to it?
4. Explain the process of Haemodialysis.

Answer:

1. Malfunctioning of kidneys can lead to accumulation of urea in blood, a condition called uremia
2. anticoagulant like heparin
3. The cleared blood is pumped back to the body through a vein after adding anti-heparin to it
4. Blood drained from a convenient artery is pumped into a dialysing unit after adding an anticoagulant like heparin. The unit contains a coiled cellophane tube surrounded by a fluid (dialysing fluid) having the same composition as that of plasma except the nitrogenous wastes. The porous cellophane membrance of the tube allows the passage of molecules based on concentration gradient. As nitrogenous wastes are absent in the dialysing fluid, these substances freely move out, thereby clearing the blood.

20 Explain the function of the tubules in the reabsorption and secretion of substance with a diagram.

Answer : PCT - water , electrolyte absorption / secretion – NH_3, K^+ Henle's loop –descending –permeable to water , impermeable to electrolyte / ascending –impermeable to water /DCT –reabsorption of Na^+ and water , HCO_3^-, secretion – H^+ , K^+, NH_3 / collecting duct – water reabsorbed , urea , secretion of H^+, K^+ .

III - Assertion and Reason:

Directions: In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as:

(a) If both assertion and reason are true and reason is the correct explanation of assertion.

(b) If both assertion and reason are true but reason is not the correct explanation of assertion.

(c) If assertion is true but reason is false.

(d) If both assertion and reason are false.

21 Assertion : Liver is referred to as the primary excretory organ in vertebrates. Reason: Liver helps kidneys in the secretion of urine.
Answer : d

22 Assertion: During micturition , urine is prevented from flowing back into the ureter.
Reason: Urethral sphincters contract during micturition.
Answer: c

23 Assertion : The Henle's loop and vasa recta play a significant role in producing a concentrated urine.
Reason: The counter current arrangement of Henle's loop and vasa recta helps in this.
Answer : a

24 Assertion: Antidiuretic hormone controls the amount of water in the urine.
Reason: ADH determines the permeability of the collecting duct to water.
Answer: a

25 Assertion: Nephrons are of two types : cortical and juxtamedullary according to their position in the cortex.
Reason: Juxtamedullary nephrons have short loop of Henle while cortical nephrons have long loop of Henle.
Answer: c

26 Assertion : In the descending limb of loop of Henle the filtrate is hypotonic , while in ascending limb of loop of Henle , the filtrate is hypertonic.
Reason: Descending limb is impermeable to water while ascending limb is impermeable to Na^+.
Answer: d

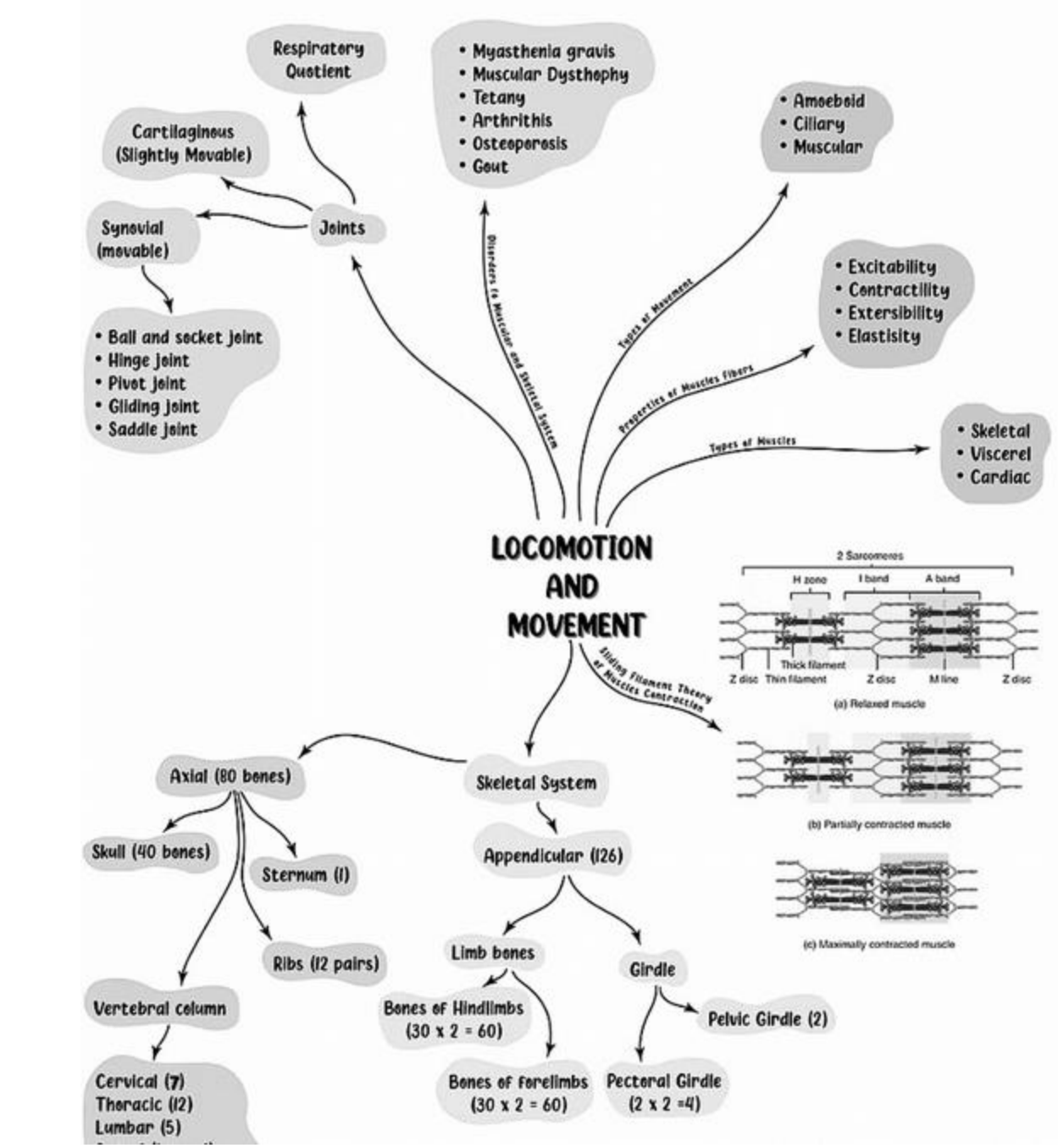
27 Assertion: Vasa recta is absent or highly reduced in cortical nephrons .
Reason: Cortical nephrons are mainly concerned with concentration of urine.1
Answer: c

28 Assertion : The kidneys have built in mechanisms for the regulation of GFR rate.
Reason: ADH and JGA help in regulation of GFR rate.
Answer: a

29 Assertion : Angiotensin II increases the glomerular blood pressure thereby GFR.
Reason: Angiotensin II activates the JG cells to release renin.
Answer : c

30 Assertion : Tubular secretion removes foreign bodies ,ions and molecules from the body .
Reason: As much as 99 percent of the material in the filtrate is reabsorbed from the body because of tubular secretion.
Answer : c

CONCEPT MAP



POINTS TO REMEMBER

Types of movements

Three types of Muscles

a. Skeletal

b. Visceral

c. Cardiac

Sarcomere

Structure of contractile proteins

Mechanism of muscle contraction

Skeletal system

a. Axial

b. Appendicular

Joints

Classification of joints

Disorders of muscular system

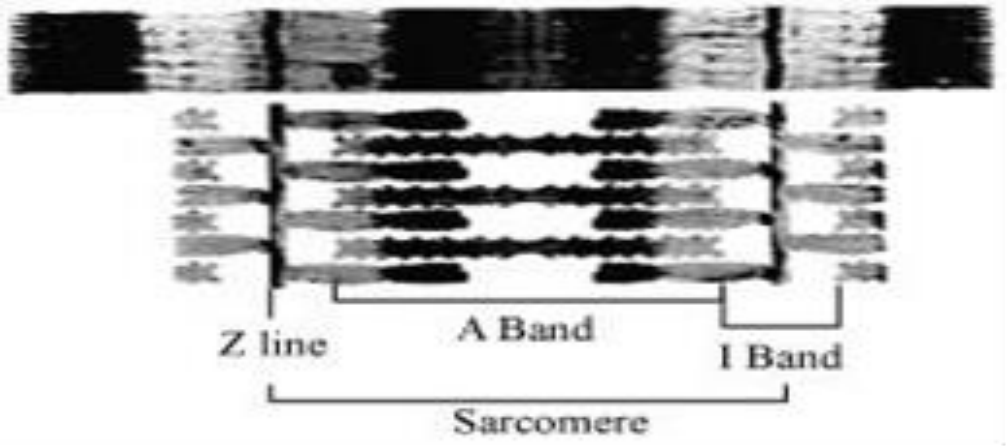
Disorders of skeletal system

Amoeboid	Ciliary	Muscular
Movement with the help of pseudopodia formed by cytoplasmic streaming	This movement occurs in most of our internal tubular organs lined by the ciliated epithelium.	This movement occurs because of the contractile property of muscles.
Examples: Movement of leucocyte, macrophages and cytoskeletal elements in our body.	Examples: Movement of cilia in trachea and movement of ova in the reproductive tract	Examples: Movement of our jaws, limbs, tongue, etc.

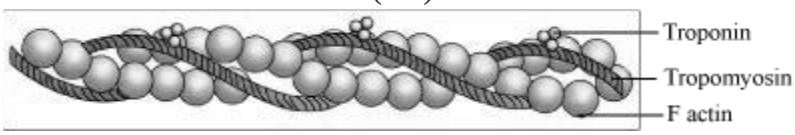
Skeletal muscles	Visceral muscles	Cardiac muscles
These have striped appearance under the microscope. Therefore, they are called Striated muscles.	These do not exhibit any striation. They are smooth muscles (non-striated).	These are also striated.
These are associated with the skeletal components of the body.	These are associated with the inner walls of the hollow visceral organs.	These are present in the heart.
These are under the voluntary control of the nervous system.	These are involuntary muscles.	These are involuntary muscles.
Involved in locomotory actions and changes in body posture	Involved in actions such as transportation of food through the alimentary canal, etc.	Involved in the conduction of cardiac impulses

Red muscle fibre	White muscle fibre
Myoglobin content is higher in them, making them red in colour.	Lesser myoglobin content makes them white in colour.
They contain plenty of mitochondria	They contain fewer mitochondria.
They are aerobic muscles since large amount of oxygen is stored in them.	They are anaerobic muscles.

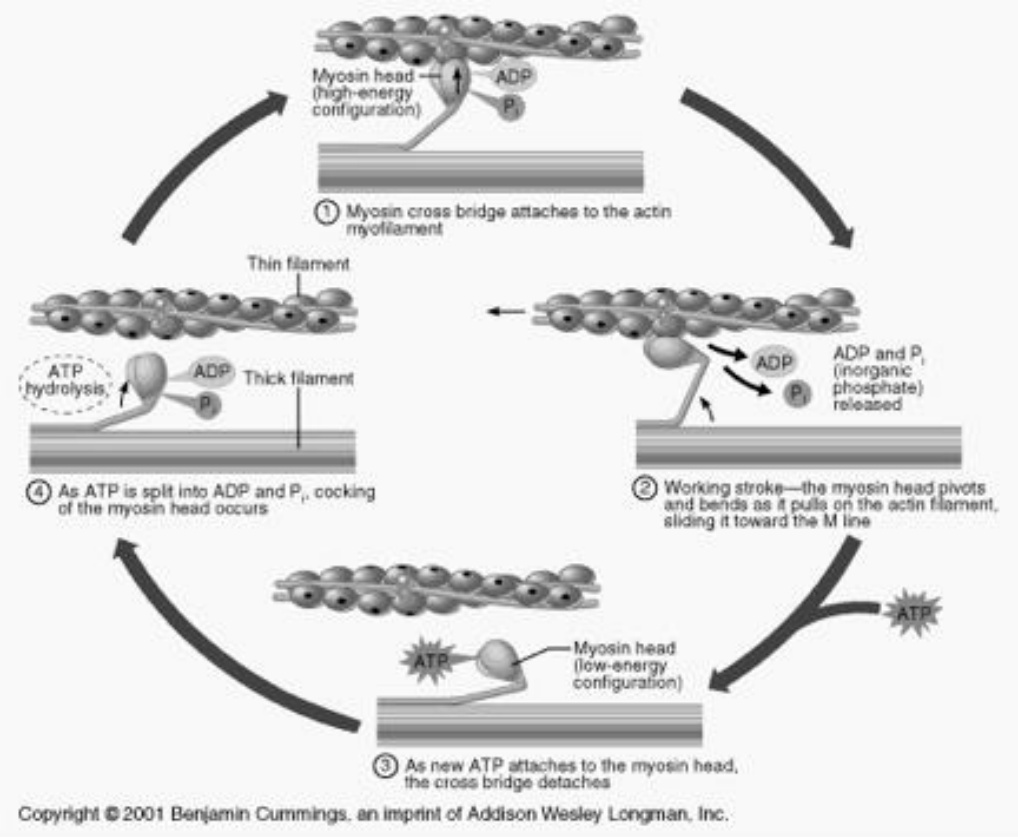
A Sarcomere



An Actin (thin) filament

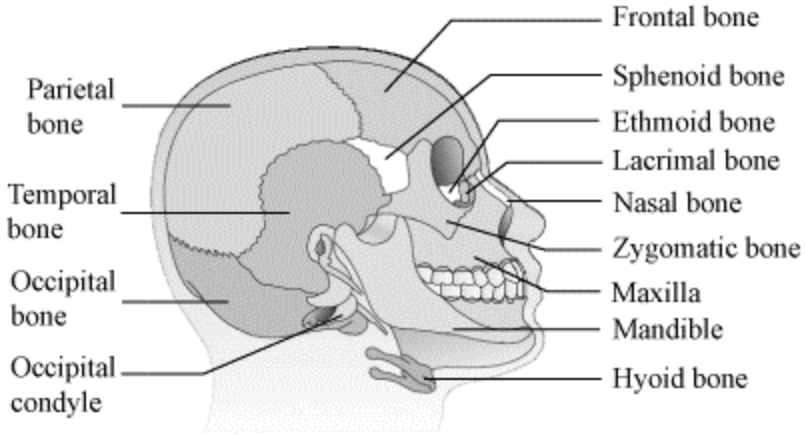


Sliding Filament theory



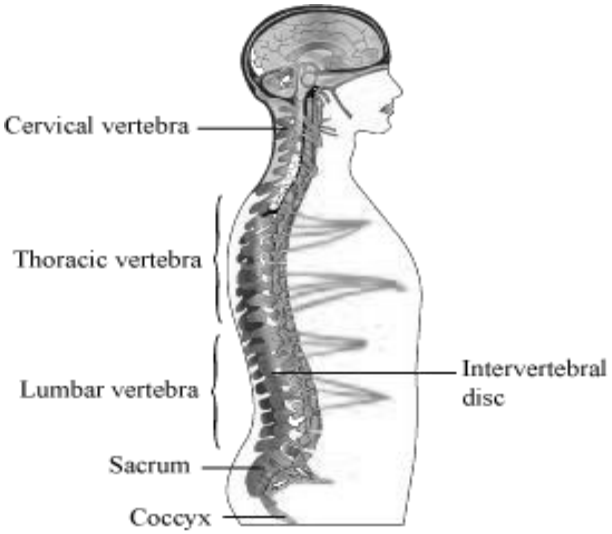
The mechanism for muscle contraction

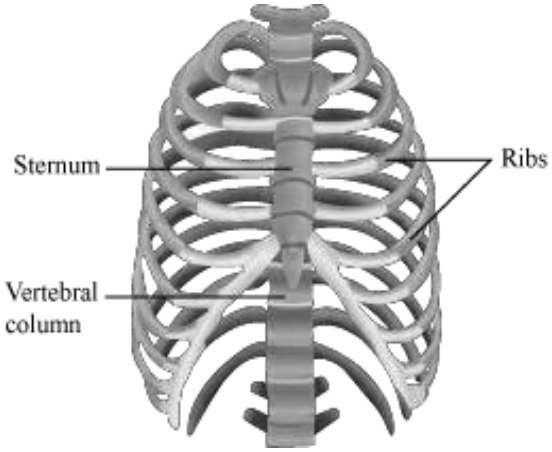
Human skull



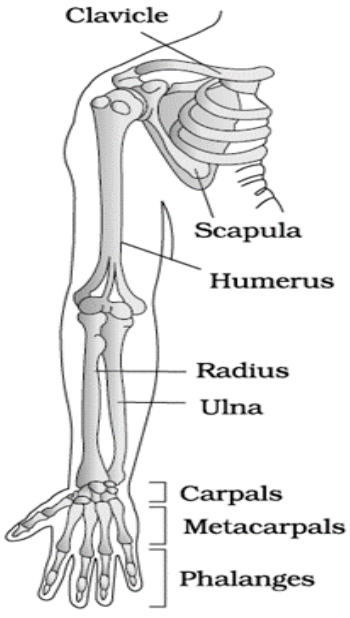
Vertebral Column

Rib Cage

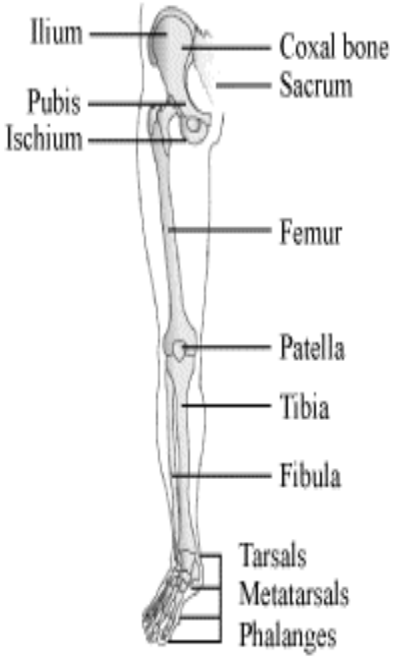




Pectoral Girdle and upper arm



Pelvic Girdle and lower limb bones



QUESTION AND ANSWER

1. Who shows amoeboid movement?
   a) Amoeba b) leucocytes c) macrophage d) all a,b,c
   Ans d) all a,b,c
2. Which muscle does not fatigue and possesses abundant blood supply during life span?
   a) Skeletal muscle b) smooth muscle c) cardiac muscle d) both b and c
   Ans: d) both b and c
3. Which muscle possesses multinucleus condition(Syncytium)?
   a)Skeletal muscle b) smooth muscle c) cardiac muscle d) none of the above
   Ans: a) skeletal muscle
4. In which muscle, amount of myoglobin is high?
   a) Red muscle b) white muscle c) Non-striated muscle a) both a and b
   Ans: a) red muscle
5. How many bones is the skull made up of?
   a) 23 b)22 c)21 d)20
   Ans: b) 22
6. Who makes the floor of the buccal cavity?
   a) Hyoid bone b) vomer c) mandible d) frontal
   Ans. a) Hyoid bone

One Mark Questions

1. What is a tendon?
   A A tissue that connects bone to muscle
2. Which type of movable joint makes the hip joint?
   A Ball and socket joint
3. Name the heaviest and longest bone in the human body?
   A. Mandible(Jaw) and Femur (Thigh bone)
4. Name the functional contractile unit of muscle.
   A Sarcomere
5. What is arthritis?
   A. Inflammation of joints

Two Marks Questions

1. . What makes the synovial joints freely movable? List any four types of synovial joints.

Ans. Synovial fluid. Ball and socket joint, hinge joint, pivot joint and gliding joint.

2. Name the four special properties of muscles.
   Ans. excitability, contractility, extensibility and elasticity
3. Define a joint.

Ans: joints are points of contact between bones or between bones and cartilages. Force generated by the muscles is used to carry out movement through joints, where the joint acts as fulcrum.

4.What is osteoporosis? Name two factors which are responsible for osteoporosis.

Ans. It is a age related disorder characterised by decreased bone mass and increased chances of

fractures. Decreased levels of oestrogen is a common cause.

5. What are floating ribs? How many of them are there?

Ans: These ribs are not connected ventrally to the body eg. 11^{th} and 12^{th} pair of ribs

Three Marks Questions

1. Differentiate between Endoskeleton and Exoskeleton.
   Ans: Endoskeleton is found inside the body, composed of bones and cartilage eg. Vertenrates
   Exoskeleton is the outermost covering of the animals eg. Insects, prawn, crab, snail etc
2. Define fascia.
   Ans. Each organised skeletal muscle in our body is made up of a number of muscle bundles or fascicles held together by a common collagenous connective tissue layer called fascia.
3. List any three disorders of the muscular system.
   Ans. Myasthenia gravis, muscular dystrophy, tetany
4. Name any three disorders of bones.
   Ans. Arthritis, osteoporosis and gout
5. What is a neuro muscular junction?
   Ans. The junction between a motor neuron and the sarcolemma of the muscle fibre is called the neuromuscular junction or motor end plate.

Five Marks Questions

1. Explain sliding filament theory of muscle contraction.

Mechanism of Muscle Contraction – Sliding Filament Theory

- Muscle contraction is initiated by the signal sent by the CNS.

- Neural signal, on reaching the neuromuscular junction, releases a neurotransmitter (acetylcholine) that generates action potential in the sarcolemma.

- Action potential spreads through the muscle fibre and causes release of calcium ions in the sarcoplasm.

- These calcium ions bind with troponin subunits. Hence, the masking of the active sites of myosin is removed.
- Exposed active sites on actin now binds with the myosin head to form a cross bridge.
- Cross bridge formation pulls the attached actin filament towards the centre of A band. The Z line attached to the actin is also pulled in, leading to muscle contraction.

- Myosin releases ADP + Pi, and relaxes. A new ATP binds and the cross bridge is broken.

ATP is again hydrolysed by the myosin head, and cycle of cross bridge formation and breakage is repeated, causing further sliding.

- Process continues till calcium ions are pumped back and actin filaments are masked again. The Z lines return to their original position and the muscle relaxes.

2. Describe the various kinds of joint in human body. According to mobility giving one example of each.

Joints

- Points of contact between bones or between bones and cartilages
- Joints act as fulcrum used to carry out movement by force generated through muscles.
- Classification of joints depending upon structure:

Fibrous joints	Cartilaginous joints	Synovial joints
Bones fuse end to end with the help of dense fibrous connective tissues.	Bones are joined together with the help of cartilages.	Bones are not joined together directly, but fluid-filled synovial cavity is present between articulating surfaces of two bones.
Do not allow any movement	Permit limited movement	Show maximum movement
Example − Skull bones fuse end to end with the help of dense fibrous connective tissues called sutures to form cranium.	Example − Joints between adjacent vertebrae	Example − Ball and socket joint

Types of Synovial joints

- Synovial joint − five types:

- Ball and socket joint

Allows free movement
Found between humerus and pectoral girdle, femur and acetabulum

- Hinge joint

Allows movement in one plane
Example: knee joint, elbow joint

- Pivot joint

One bone rotates over other. Found between atlas and axis

- Gliding joint

Allows only gliding and sliding movement
Found between carpals and wrist

- Saddle joint

This type of joints allows back and forth and side to side motion, but only limited rotation. Found between carpal and metacarpal of thumb

Case Based Questions:

Skeletal system consists of a framework of bones and a few cartilages. This system has a significant role in movement shown by the body. Bone and cartilage are specialised connective tissues. The former has a very hard matrix due to calcium salts in it and the latter has slightly pliable matrix due to chondroitin salts. In human beings, this system is made up of 206 bones and a few cartilages. It is grouped into two principal divisions – the axial and the appendicular skeleton.

Axial skeleton comprises 80 bones distributed along the main axis of the body. The skull, vertebral column, sternum and ribs constitute axial skeleton. The skull is composed of two sets of bones – cranial and facial, that totals to 22 bones. Cranial bones are 8 in number. They form the hard protective outer covering, cranium for the brain. The facial region is made up of 14 skeletal elements which form the front part of the skull

1.) Which of the following is the connective tissue has pliable matrix?

a) Bone b) Blood c) Cartilages d) All of the above

Ans: c) Cartilage

2.) Human skull is composed of _____

a) Cranial bones b) Facial bones c) Pliable matrix d) both a and b

Ans. d) both a and b

3.the vertebral formula of human beings is

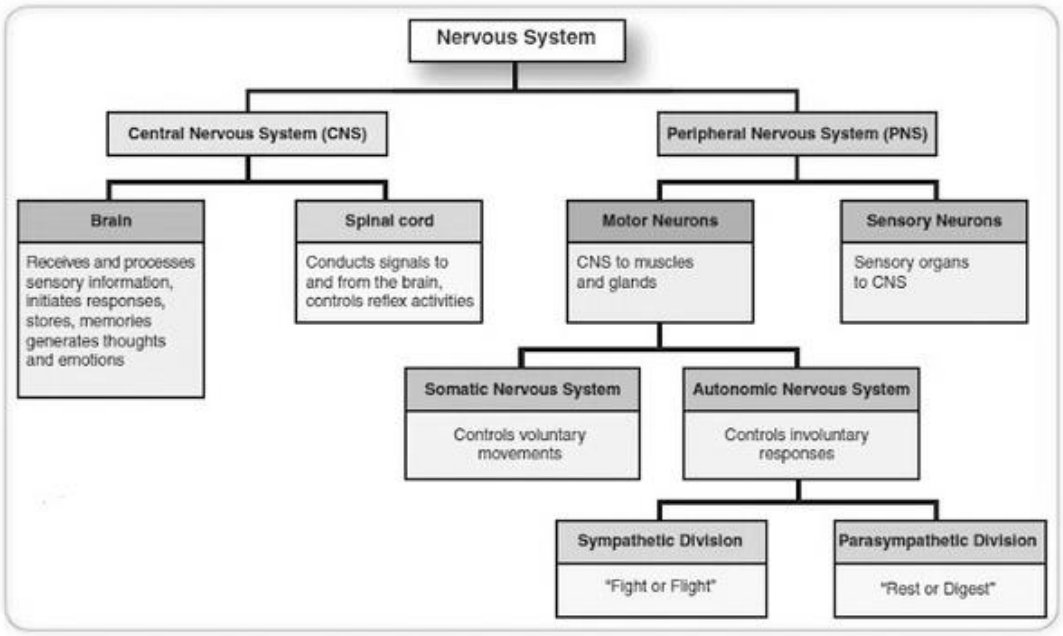
a) C7, T12,L5,S1,C1 b) C8, T12,L5,S1,C1

c) C7, T11,L5,S1,C1 d) C7, T12,L4,S1,C1

Ans: a) C7, T12,L5,S1,C1

3. The total number of bones in axial skeleton is
   a) 90 b)80 c)85 d)88
   Ans: b) 80
   4. Inter vertebral disc is found in the vertebral column of
   a) Birds b) reptiles c) amphibians d) mammals
   b) Ans. d) mammals
   5.Ribs are attached to the
   a) scapula b) sternum c) clavicle d) ileum
   Ans. b) sternum

CONCEPT MAP



POINTS TO REMEMBER

Coordination is the process through which two or more organ interact and complement the function of each other.

NEURAL SYSTEM: Provide an organized network of point to point connections for quick co-ordination. The endocrine system provide chemical integration through hormones.

NEURAL SYSTEM The neural system of all Animals is composed of specialized cells called as Neuron which can detect, receive and transmit different kinds of stimuli.

*In Hydra the neural system is composed of network of neurons.

*In insects it consists of brain and a number of ganglia.

HUMAN NEURAL SYSTEM:

A. Central nervous system (CNS)

* It includes brain and spinal cord.

*Site of information and processing and control.

B. Peripheral nervous system (PNS)

* Comprises of all nerves of the body which associates with CNS

* The peripheral neural system: The nerve fibres of PNS are of two types:

1. Afferent fibres: Transmit impulse from tissues / Organs to the CNS

2. Efferent fibres: Transmit regulatory impulse from CNS to the concerned peripheral tissue organs.

PNS is divided in to two division:

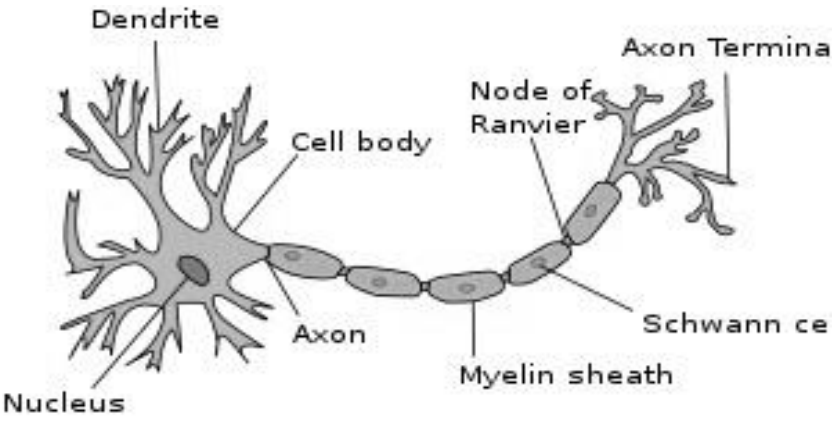
A. Somatic neural system: Relays impulse from CNS to skeletal muscles.

B. Autonomic neural system: Transmits impulse from CNS to the involuntary organs and smooth muscles of the body.

The autonomic neural system is classified in to: Sympathetic neural system and parasympathetic neural system.

NEURON: A Neuron is a microscopic structure composed of three major parts:

1. Cell body
2. Dendrite
3. Axon



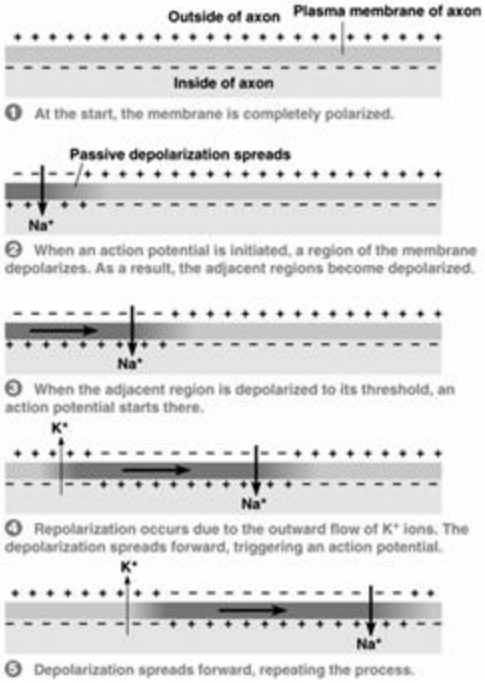
*Cell body: It consists of cytoplasm with cell organelles and certain glandular bodies called Nissl's granules.
* Short fibres which branch repeatedly and project out of the cell body and also contain Nissl's granules called as Dendrites.
*Transmit impulse towards the cell body.
*The axon is a long fibre, the distal end of which is branched.
* Synaptic Knob: Each branch terminates as a bulb like structure called as synaptic knob which contains synaptic vesicles and chemical neurotransmitters.
*The axon transmits the nerve impulse away from the cell body to a synapse.

NEURONS:
Neurons are of three types they are:

1. Unipolar neuron : With only one axon. They are found in the embryonic stage.
2. Bipolar neuron : With one axon and one dendrite. They are found in the retina of eyes.
3. Multipolar neuron : Cell body with one axon and two or more Dendrites. They are found in Cerebral Cortex.

AXONS:
1.Myelinated : Fibres are enveloped with Schwann cells to form myelin sheets around the axon.
2.Unmyelinated : Fibres are enveloped by Schwann cells that do not form myelin sheets around the axon.
NODES OF RANVIER:
The gap between two adjacent myelin sheets.

GENERATION AND CONDUCTION OF NERVE IMPULSE:



- Different types of ion channels are present on neural membrane.
- When the Neuron is not conducting impulse such that resting, the axonal membrane is more permeable to K+ ions and impermeable to Na+ ions.
- The membrane is impermeable to negatively charged protein present in the axoplasm.
- The axoplasm inside the axon contain high concentration of K+ and negatively charged protein and low concentration of Na+ ions.
- The fluid outside the axon contain high concentration of Na+ ions and thus forms a concentration gradient.
- Ionic gradient across the resting membrane is maintained by an active transport of ion by Sodium- Potassium pump.
- This will develop positive charge outside the axonal membrane and negative charge on the inner side. Therefore, is polarised.

RESTING POTENTIAL:

- The electric potential across the resting membrane is called as resting potential.
- When stimulus is applied at site A, the membrane becomes permeable to Na + ions to create outer surface negatively charged and inner membrane positively charged that create action potential or nerve impulse.
- Nerve impulse from A moves to B in the inner surface and B to A in the outer surface.
- This process is repeated several times to transmit the impulse.

TRANSMISSION OF IMPULSE :

- A nerve impulse is transmitted from one Neuron to one another through the junction called Synapses.
- A synapses is formed by the membranes of pre-synaptic neuron and a post- synaptic neuron which may or may not be separated by a gap called synaptic cleft.
- There are two types of synapse:

1. Electrical synapse:
   - Electrical synapse, the membrane of pre and post synaptic neuron are in close proximity.
   - Electrical current can flow directly from one Neuron in to another neuron across these synapse.
   - Impulse transmission across an electrical synapse is always fewer.
2. Chemical synapse:
   - The membrane of pre and post synaptic neurons are separated by a fluid filled space called as synaptic cleft.
   - Chemicals called neurotransmitters are involved in the transmission of impulse at these synapses.
   - When an impulse arrives at the axon terminal, it stimulates the movement of synaptic vesicles towards the membrane, where they fuse with plasma membrane and release their neurotransmitters in the synaptic cleft.
   - The released neurotransmitters bind to their specific receptors, present on the post- synaptic membrane.
   - These binding opens ion channels allowing the entry of ions which can generate a new potential in the post synaptic neuron.

CENTRAL NERVOUS SYSTEM :

- The brain is the central information processing organ of our body.
- It acts a command and control system.
- The human brain is well protected by the skull.

- Inside the skull the brain is protected by the cranial menaces consisting of an outer layer ---Duramater a very thin middle layer ---Arachnoid membrane and an inner layer--- Piamater which in contact with brain tissues.

Brain can be divided in to three parts :

- Fore brain
- Mid brain
- Hind brain

FORE BRAIN :

- Consists of cerebrum, thalamus and hypothalamus.
- Cerebrum is divided in to left and right Cerebral hemispheres which are covered by Cerebral Cortex.
- The hemispheres are connected by a tract of nerve fibre called corpus collosum.
- Cerebral Cortex contains sensory neurons, motor neuron and associated area.
- Control complex functions like memory and communication.
- Cerebrum wraps around a structure called thalamus. It is the major coordinating centre for sensory and motor signalling.

Hypothalamus :

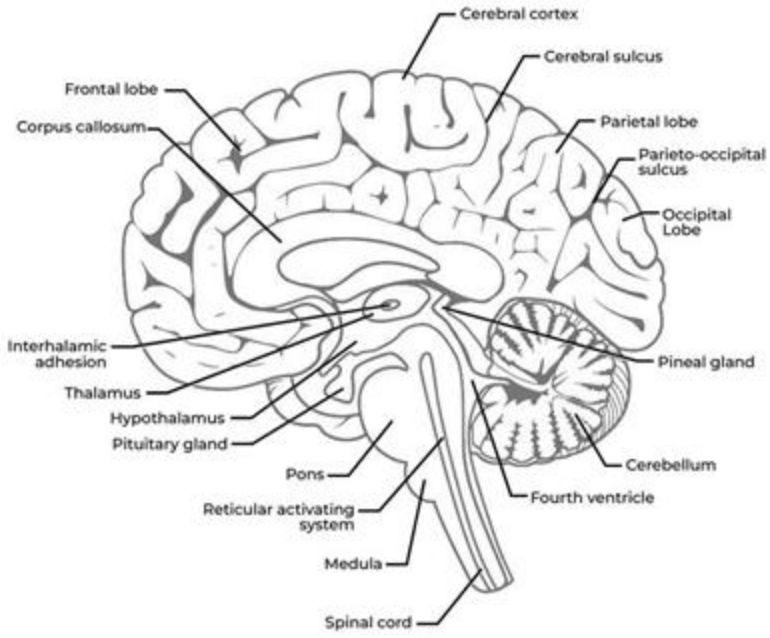
* Lies at the base of the thalamus.
* It controls body temperature and it creates the urge for eating and drinking.
* It contains a group of neurosecretory cells, which secrete hormone.
* Limbic system in involved in controlling the sexual behaviour and expression of emotional reactions.

MID BRAIN :

- It is located in between the thalamus and hypothalamus of fore brain and Pons of hind brain.
- The dorsal portion of mid brain consists mainly of four round swelling called Corpora quadrigemina.

HIND BRAIN :

- It consists of Pons, medulla oblongata and Cerebellum.
- PONS: Consists of fibre tracts that interconnect different regions of the brain.
- MEDULLA: It contains centres which control respiration, Cardiovascular and reflex action.



QUESTION AND ANSWERS:

Choose the correct option:

1) The resting membrane potential is established primarily due to: Answer: (b)
   (a) Sodium-potassium pump
   (b) Efflux of potassium
   (c) Influx of sodium
   (d) Influx of chloride

2) The thalamus and the hypothalamus are located in the _____ Answer: (d)
   (a) Brain stem
   (b) Cerebrum
   (c) Cerebellum
   (d) Diencephalon

3) At a neuromuscular junction, synaptic vesicles discharge _____. Answer: (a)
   (a) Acetylcholine
   (b) Epinephrine
   (c) Adrenaline
   (d) None of these

4) Which layer is in contact with brain tissues? Answer: (a)
   (a) Piamater
   (b) Arachnoid
   (c) Duramater
   (d) Piamater and Arachnoid

5) Cerebellum is concerned with Answer: (a)
   (a) Co-ordination of muscular movement
   (b) Memory
   (c) Vision
   (d) Reflex action

6) The gray matter differs from white matter in the :- Answer: (d)
   (a) Absence of axons
   (b) Absence of nurilemma
   (c) Presence of myelin sheath
   (d) Absence of myelin sheath

7) Number of cranial nerves in human: Answer: (a)
   (a) 12 Cranial Nerves
   (b) 24 Cranial Nerves
   (c) 11 Cranial Nerves
   (d) 29 Cranial Nerves

Assertion_Reason Based Questions

Directions: In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as:
(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(c) If Assertion is true but Reason is false.

(d) If both Assertion and Reason are false.

8) Assertion : The imbalance in concentration of Na+, K+ and proteins generates resting potential.
Reason : To maintain the unequal distribution of Na+ & K+, the neurons use electrical energy.
Answer: (c)

9) Assertion: Medulla contains centres which control respiration, cardiovascular reflexes and gastric secretions.
Reason: Medulla contains several neurosecretory cells which secrete hormones.
Answer: (c)

10) Assertion : The presynaptic neuron transmits an impulse (action potential) across the synaptic cleft to the postsynaptic neuron.
Reason : For the transmission of impulses at synapse, chemicals called neurotransmitters are responsible.
Answer: (b)

11) Assertion : Nerve conduction is the one way conduction.
Reason : Nerve impulse is transmitted from dendrite terminals to axon terminals.
Answer: (c)

12) Which part of the human brain is the most developed?
Cerebrum

13) What is a synapse?
It is the junction between axon terminals of a neuron and dendrites or the cell body of another neuron. There is a narrow fluid-filled space, called Synaptic Cleft separating axon terminals and dendrites at the synaptic junction. So, the two-neurons forming synapse does not form actual continuity between the neurons.

14) Name the structures involved in fhe protection of the brain.
- The human brain is well protected by the skull.
- Inside the skull, the brain is covered by cranial meninges consisting of an outer layer called dura mater, a very thin middle layer called arachnoid and an inner layer (which is in contact with the brain tissue) called pia mater.
- Piamater is a vascular membrane which is richly supplied with blood capillaries.
- Space between the duramater and arachnoid is called subdural space. Space between the arachnoid and pia mater is called subarachnoid space.
- Subarachnoid space is filled with the cerebrospinal fluid (CSF) which acts as a cushion for CNS from shocks.

15) Explain the role of Na^+ in the generation of action potential.
The action potential is largely determined by Na^+ ions. The action potential results from the following sequential events:
(i) Disturbance caused to the membrane of a nerve fibre by a stimulus results in leakage of Na^+ into the nerve fibre.
(ii) Entry of Na^+ lowers the trans-membrane potential difference.
(iii) Decrease in potential difference makes the membrane more permeable to Na^+ than to K^+ ions so that more Na^+ enter the fibre than K^+ leave it.
(iv) Accumulation of Na^+ in the nerve fibre initiates depolarisation (action potential), making the axonic contents positively charged relative to the extracellular fluid.
(v) With continued addition of Na^+ the potential reaches zero and then plus 40-50 millivolts. This is the peak of action potential.

(vi) Permeability of a depolarised membrane to Na^+ then rapidly drops, there are now as many Na^+ on the inside of the membrane as on the outside.

16) Explain the following process of transmission of a nerve impulse across a chemical synapse

Transmission of a nerve impulse across a chemical synapse:

- At a chemical synapse, the membranes of the pre- and post- synaptic neurons are separated by a fluid- filled space called synaptic cleft.
- Chemicals called neurotransmitters are involved in the transmission of impulses at these synapses.
- The axon terminals contain vesicles filled with these neurotransmitters.
- When an impulse (action potential) arrives at the axon terminal, it stimulates the movement of the synaptic vesicles towards the membrane where they fuse with the plasma membrane and burst to release their neurotransmitters in the synaptic cleft.
- The released neurotransmitters bind to their specific receptors, present on the post-synaptic membrane.
- This binding opens ion channels allowing the entry of ions which can generate a new potential in the post-synaptic neuron.
- The new potential developed may be either excitatory or inhibitory.

17) Briefly describe the structure of Brain

The brain acts as control and command system of the body. It is protected by skull and is covered by three meninges. It is divisible into three main regions: forebrain, midbrain and hindbrain.

(i) Forebrain – It consists of three regions:

(a) Olfactory lobes: These are a pair of very small, solid club-shaped bodies which are widely separated from each
other. They are fully covered by cerebral hemispheres.

(b) Cerebrum – It is the largest and most complex of all the parts of human brain. A deep cleft divides the cerebrum into right and left cerebral hemispheres, connected by myelinated fibres, the corpus callosum.

(c) Diencephalon – It encloses a slit-like cavity, the third ventricle. The thin roof of this cavity is known as the epithalamus, the thick right and left sides as the thalami, and floor as the hypothalamus.

(ii) Midbrain – It is located between thalamus/ hypothalamus of forebrain and pons of hindbrain. Its upper surface has two pairs of rounded protrusious called corpora quadrigemina and two bundles of fibres called crura cerebri.

(iii) Hindbrain – It consists of:

(a) Cerebellum – The second largest part of the human brain is the cerebellum. It consists of two lateral cerebellar hemispheres and central worm-shaped part, the vermis. The cerebellum has its grey matter on the outside, comprising three layers of cells and fibres. It also has Golgi cells, basket cells and granule cells.

(b) Pons varolii – An oval mass, called the pons varolii, lies above the medulla oblongata. It consists mainly of nerve fibres which interconnect different regions of the brain.

(c) Medulla oblongata – It extends from the pons varolii above and is continuous with the spinal cord below. The mid brain, pons varolii and medulla oblongata are collectively called brain stem.

Case Based Question:

The brain is a complex organ that controls thought, memory, emotion, touch, motor skills, vision, breathing, temperature, hunger and every process that regulates our body. Together, the brain and

spinal cord that extends from it make up the central nervous system, or CNS. Weighing about 3 pounds in the average adult, the brain is about 60% fat. The remaining 40% is a combination of water, protein, carbohydrates and salts. The brain itself is a not a muscle. It contains blood vessels and nerves, including neurons and glial cells. The brain sends and receives chemical and electrical signals throughout the body. Different signals control different processes, and your brain interprets each. Some make you feel tired, for example, while others make you feel pain.

Some messages are kept within the brain, while others are relayed through the spine and across the body's vast network of nerves to distant extremities. To do this, the central nervous system relies on billions of neurons (nerve cells).

18) An injury sustained by the Hypothalamus is most likely to interrupt Answer: (c)
(a) Coordination during locomotion
(b) Short term memory
(c) Regulation of body temperature
(d) Executive function like decision making

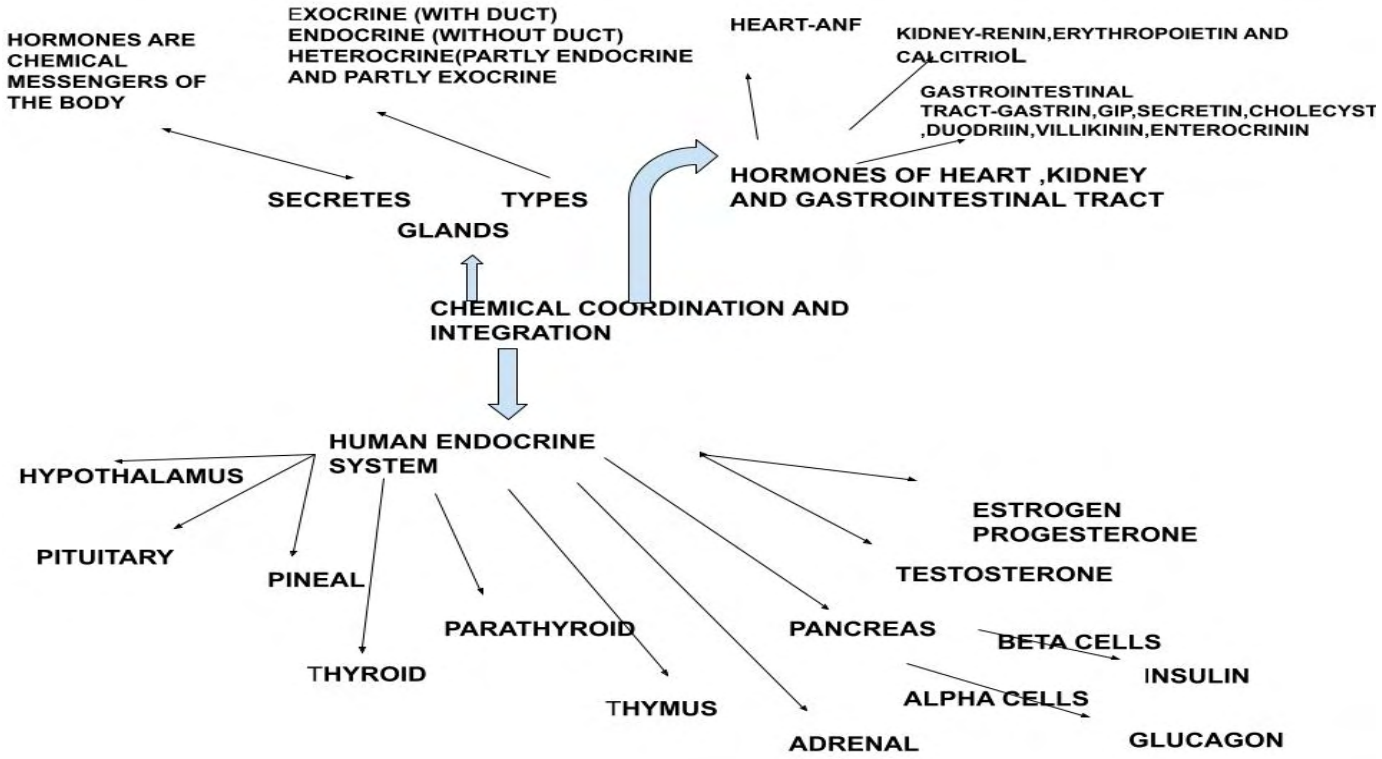
19) This statement is not associated with Midbrain Answer: (a)
(a) The central portion of the midbrain is composed of mainly four, round swellings known as corpora quadrigemina.
(b) Located between the thalamus of the forebrain and pons of the hindbrain.
(c) The canal called the cerebral aqueduct passes through the midbrain.
(d) Hindbrain and midbrain constitute the brain stem

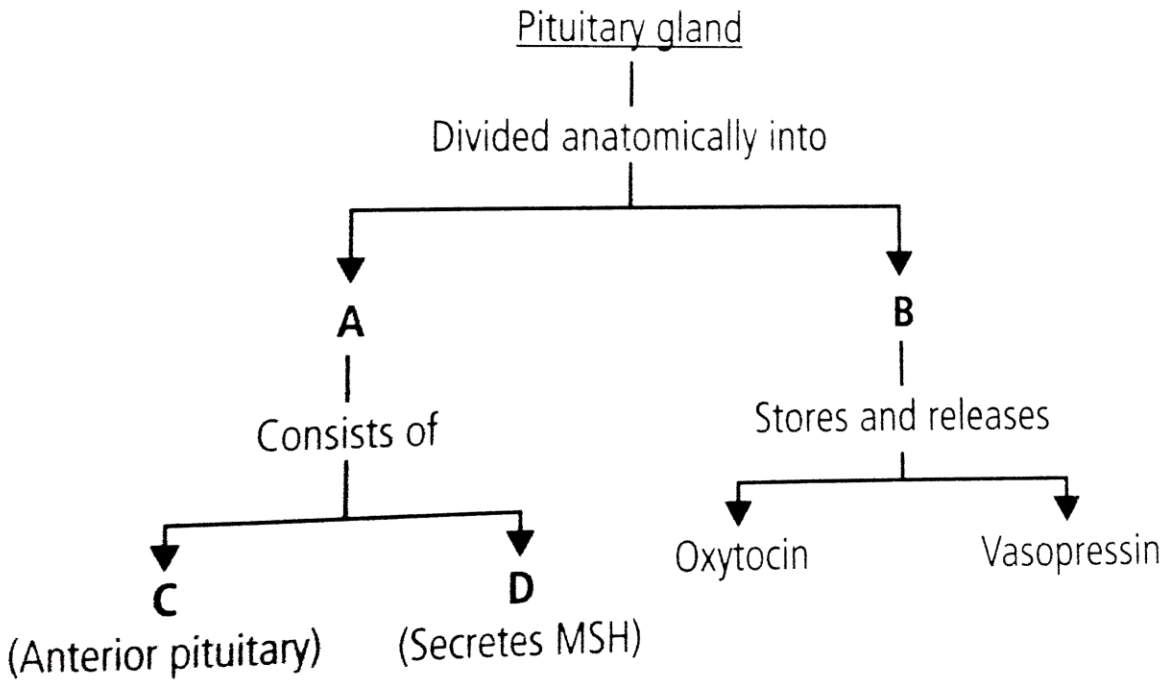
20) What connects two hemispheres of the brain? Answer: (c)
(a) Pons
(b) Pia matter
(c) Corpus callosum
(d) Diencephalon

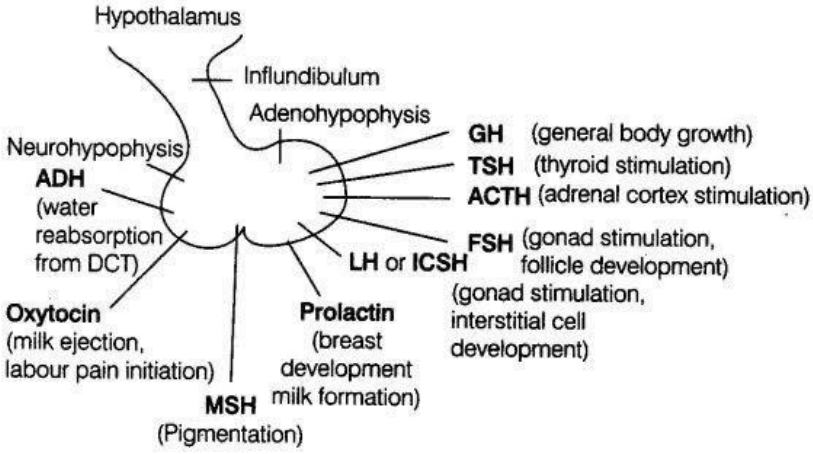
21) Which part of the brain controls higher mental activities like reasoning? Answer: (b)
(a) Temporal lobe
(b) Frontal lobe
(c) Medulla oblongata
(d) Cerebellum

22) The autonomic nervous system Answer: (c)
(a) enables us to act on the external environment
(b) transmits motor information to the brain
(c) regulates the internal environment
(d) is located within the brain

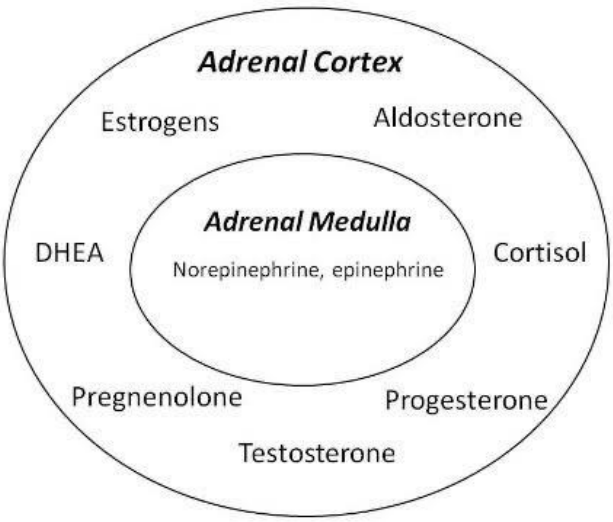
CONCEPT MAP


HORMONES ARE CHEMICAL MESSENGERS OF THE BODY
EXOCRINE (WITH DUCT)
ENDOCRINE (WITHOUT DUCT)
HETEROCRINE(PARTLY ENDOCRINE AND PARTLY EXOCRINE
HEART-ANF
KIDNEY-RENIN,ERYTHROPOIETIN AND CALCITRIOL
GASTROINTESTINAL TRACT-GASTRIN,GIP,SECRETIN,CHOLECYST ,DUODRIIN,VILLIKININ,ENTEROCRININ
SECRETES
TYPES
GLANDS
HORMONES OF HEART ,KIDNEY AND GASTROINTESTINAL TRACT
CHEMICAL COORDINATION AND INTEGRATION
HUMAN ENDOCRINE SYSTEM
HYPOTHALAMUS
PITUITARY
PINEAL
THYROID
PARATHYROID
THYMUS
ADRENAL
PANCREAS
BETA CELLS
INSULIN
ALPHA CELLS
GLUCAGON
ESTROGEN
PROGESTERONE
TESTOSTERONE

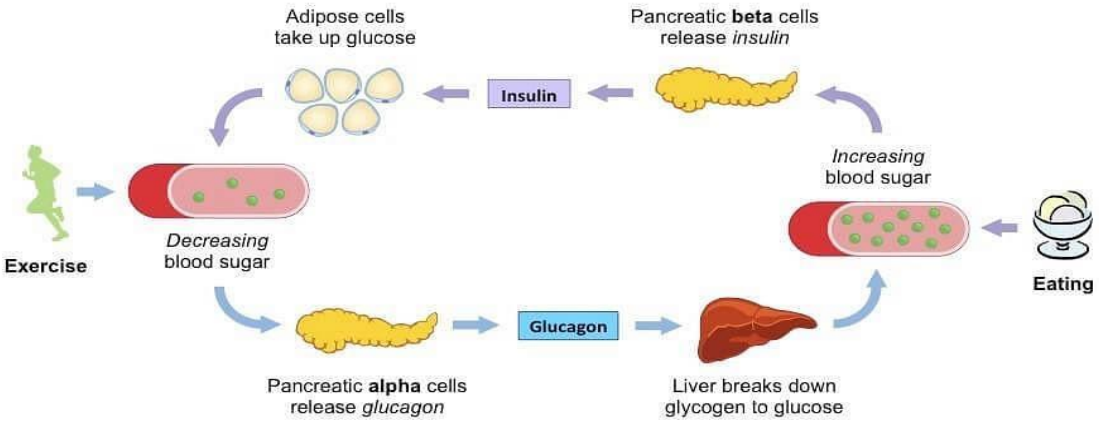

Pituitary gland
Divided anatomically into
A
B
Consists of
Stores and releases
C
(Anterior pituitary)
D
(Secretes MSH)
Oxytocin
Vasopressin



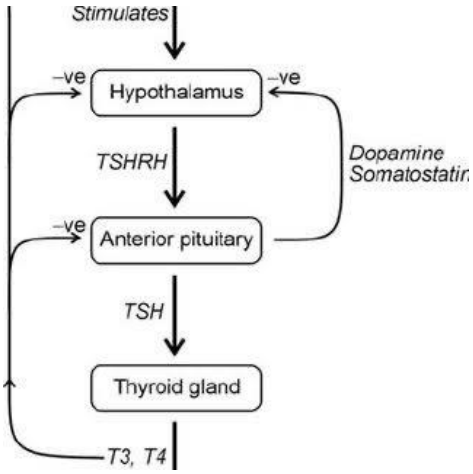
[redacted] Pituitary hormone and their major effects



[redacted] Hormones of Adrenal Glands



Hypothalamus pituitary action



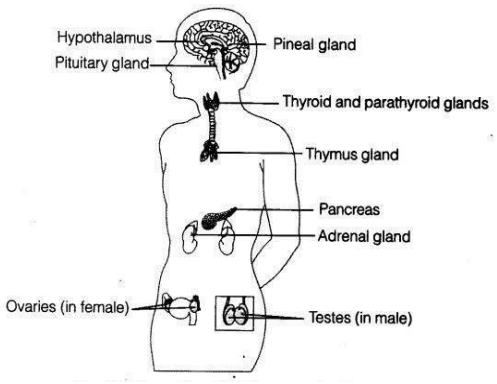
Thyroid gland feedback mechanism

POINTS TO REMEMBER

ENDROCRINE GLANDS AND HORMONES

Endocrine system

- It includes endocrine glands and their secretions(hormones)
- Since the endocrine glands do not have ducts,they are called ductless glands
- Hormones are non-nutrient chemicals that act as intercellular messengers and are
- produced in trace amounts .

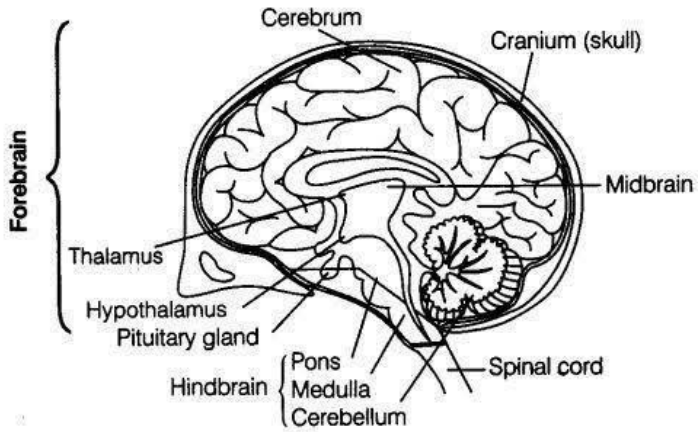


Endocrine glands

- Hypothalamus
- Pituitary gland
- Pineal gland
- Thyroid gland
- Parathyroid gland
- Thymus gland
- Adrenal gland

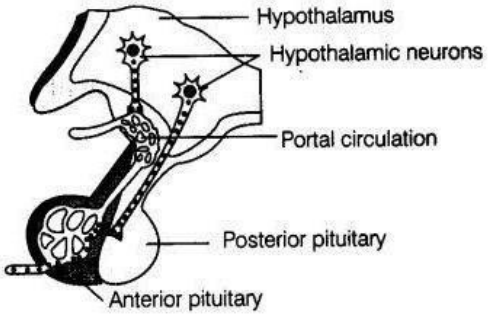
- Pancreas
- Gonads -Testes and Ovaries

1. HYPOTHALAMUS



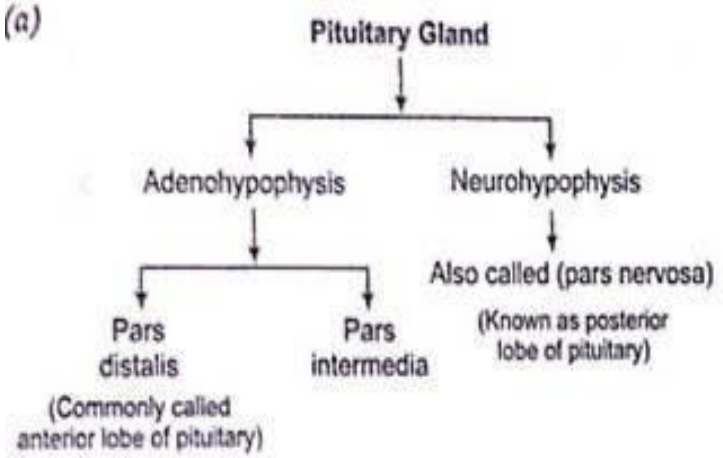
- Neurosecretory cells (nuclei) of hypothalamus secrete the following types of hormones.

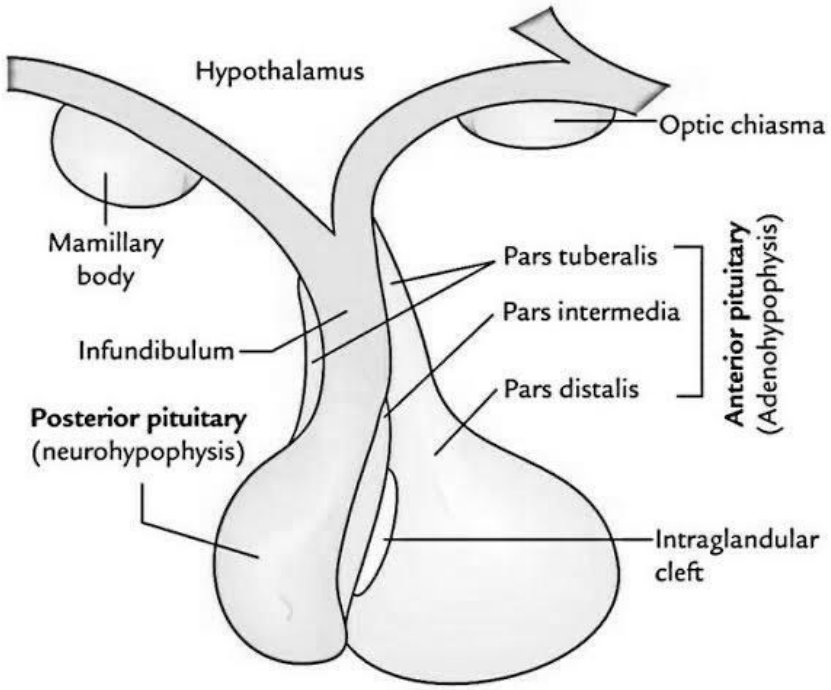
a. Releasing hormones. Stimulate secretion of pituitary hormones.E.g.gonadotropin releasing hormone (GnRH) stimulates release of gonadotropin from pituitary.
b. Inhibiting hormones. Inhibit secretion of pituitary hormones.E.g.Somatostatin inhibits release of growth hormone from pituitary.
c. Oxytocin and Vasopressin.These are transported axonally and stored in pituitary.



2. PITUITARY GLAND

- It is located in a bony cavity called sella tursica.
- It is attached to hypothalamus by a stalk.
- Parts of Pituitary





ADENOHYPOPHYSIS (Anterior pituitary)

1. Pars distalis in (Anterior pituitary)

It produces the following hormones:

- Somatotropin or Growth hormone(GH)
- Prolactin (PRL)
- Thyroid stimulating hormone (TSH)
- Adrenocorticotrophic hormone(ACTH)
- Follicle stimulating hormone (FSH)
- Luteinizing hormone(LH)

1. Somatotropin or Growth hormone(GH)

- For body growth.
- Over- secretion of GH causes Gigantism (abnormal growth).
- Hyposecretion of GH causes Dwarfism(stunted growth)

- Over-secretion of GH in adults (mainly in middle age) causes Acromegaly. (severe disfigurement especially of face). It leads to serious complication and premature death.
- Early diagnosis of the disease is difficult. It may be undetected for many years.

2. Prolactin (PRL).Regulates growth of mammary glands and milk production.
3. Thyroid stimulating hormone (TSH): Stimulating secretion of thyroid hormone from thyroid gland.
4. Adrenocorticotrophic hormone (ACTH): Stimulates the synthesis and secretion of steroid hormones (glucocorticoids) from adrenal cortex.
5. Follicle stimulating hormone (FSH):

1. Stimulates gonadal activity
2. In males ,FSH & androgens regulate sperm formation (spermatogenesis)
3. In females, FSH stimulates the growth and development of the ovarian follicles.

6. Luteinizing hormone (LH)

1. Stimulates gonadal activity
2. In males, it stimulates the synthesis of and secretion of androgens from testis.
3. In females, it induces ovulation and maintains the corpus luteum.

2. Pars Intermedia

- In human, it is almost merged with pars distalis.
- It produces Melanocyte stimulating hormone (MSH).
- MSH acts on melanocytes to regulate skin pigmentation.

b. NEUROHYPOPHYSIS

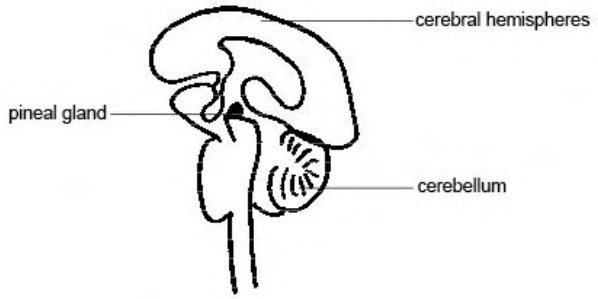
- It stores Oxytocin &Vasopressin(hormones of hypothalamus)

Oxytocin

- Contracts the smooth muscles.
- In females, it stimulates contraction of uterus at the time of child birth,and milk ejection from the mammary gland.

Vasopressin or Anti-diuretic hormone (ADH)

- Stimulates reabsorption of water and electrolytes by DCT of kidney and thereby reduces dieresis.(loss of water through urine).
- Deficiency of ADH results in diminished ability of the kidneys to conserve water leading to water loss and dehydration .This is called Diabetes insipidus.



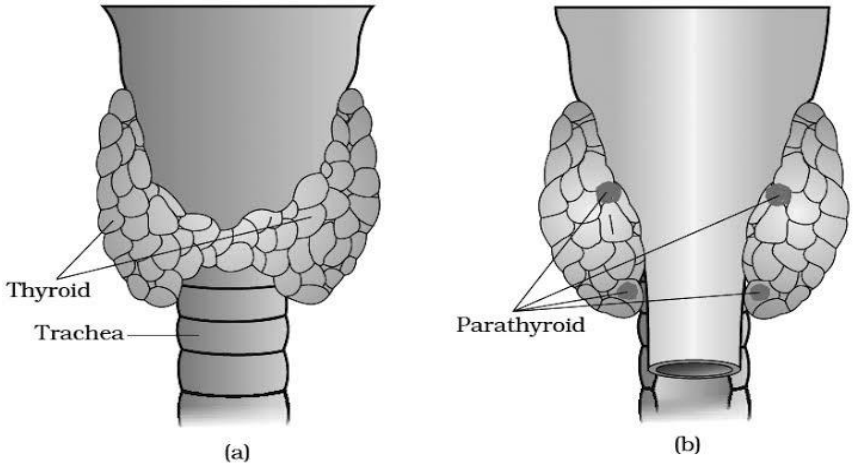
3. PINEAL GLAND

- Smallest endocrine gland.
- Located on dorsal side of forebrain.
- It secretes melatonin.

Functions of melatonin.

- Regulates diurnal (24- hour) rhythm of body.E.g. Sleep - wake cycle,body temperature etc.
- Influences metabolism, pigmentation & menstrual cycle.
- Influences our defence capability.

4. THYROID GLAND



- Largest endocrine gland.
- It includes 2 lobes located on either side of the trachea.
- The lobes are interconnected with isthmus(a connective tissue)
- Thyroid gland is composed of follicles & stroma tissues.

Follicular cells secrete the following hormones:

1. Thyroxin(tetraiodothyronineT_4)& Triiodothyronine (T_3)
2. Thyrocalcitonin(TCT)

1. Thyroxin(tetraiodothyronineT_4)& Triiodothyronine (T_3)

Functions:

- Regulation of basal metabolic rate(BMR)
- Physical, mental& sexual development.
- Support RBC formation
- Control metabolism of carbohydrates,proteins &fats
- Maintain water and electrolyte balance.

2. Thyrocalcitonin(TCT)

- A protein hormone
- It regulates (lowers) the blood calcium levels.

Iodine is essential for normal hormone synthesis in thyroid.

Hypothyroidism (Goitre)

- Enlargement of thyroid gland due to deficiency of iodine.
- In adult women,it causes irregular menstrual cycle
- Hypothyroidism during pregnancy affects the baby causing stunted growth(cretinism), mental retardation,low intelligence quotient,abnormal skin,deaf - mutism etc.

Hyperthyroidism

- Abnormal increase of thyroid hormones resulting in adverse effects on the physiology activities.
- It is caused due to development o the nodules or the cancer of thyroid gland.
- Exophthalmic goitre (Grave's disease)

It is a form of Hyperthyroidism.

Symptoms:Enlargement of thyroid gland,protrusion of eyeballs,increased BMR and weight loss.

5. PARATHYROID GLAND

- These are 4 glands present on backside of the thyroid gland,one pair each in the two lobes of thyroid gland..
- They secrete Parathyroid hormone (PTH)- a peptide hormone.

Functions of parathyroid hormone (PTH)

- Increase Ca^{2+} level in blood (hypercalcaemic hormone)
- Stimulates the bone resorption (demineralisation).
- Stimulates the reabsorption of Ca^{2+} by renal tubules and increases Ca^{2+} absorption from the digested food .Along with TCT ,it helps in calcium balance in the body.

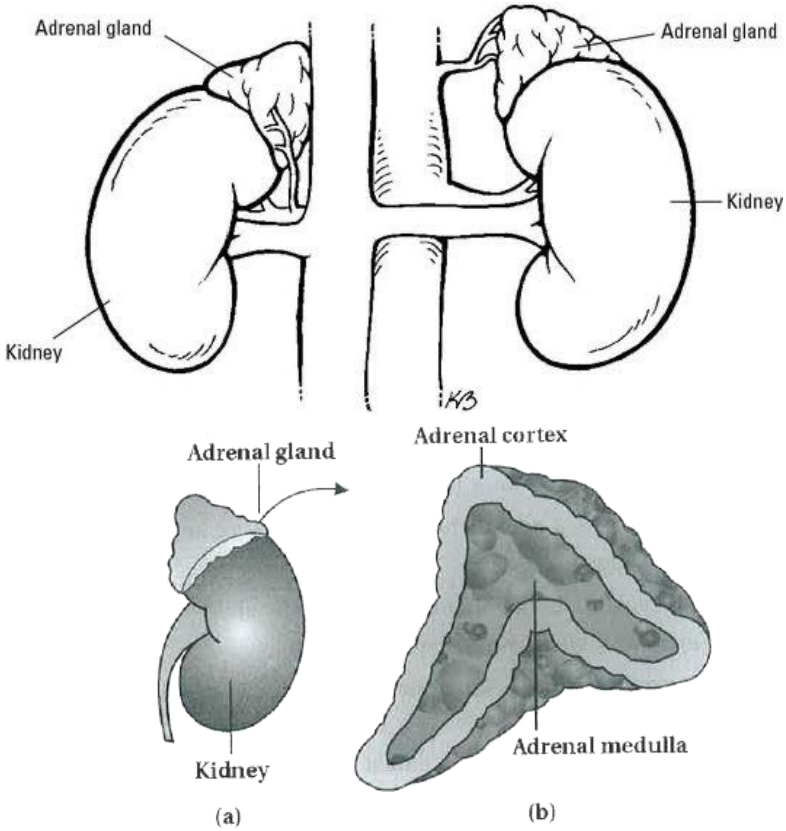
6. Thymus Gland

- A bilobed gland located between lungs behind sternum on the ventral side of aorta.
- It secretes Thymosins (peptide hormones)

Functions of thymosins

- Differentiation of T-Lymphocytes, which provide cell mediated immunity.
- Promote antibody production for humoral immunity.
- Thymus is degenerated in old individuals .So production of thymosins decreases .As result, immune responses of old persons become weak.

7. ADRENAL GLAND.



Diagrammatic representation of : (a) Adrenal gland on kidney (b) Section showing two parts of adrenal gland

- It has 2parts :
- Adrenal cortex (outer part)
- Adrenal medulla(inner part)

Adrenal Cortex

- It has3 layers
- Inner zona reticularis is
- Middle zona fasciculata
- Outer zona glomerulosa
- It produces corticoid hormones such as

1. Glucocorticoids(mainly cortisol)
2. Mineralcorticoids(mainly aldosterone)
3. Androgenic corticoids

1. Glucorticoids

- Involved in carbohydrate metabolism
- Stimulate gluconeogenesis, lipolysis and proteolysis.
- Inhibit cellular uptake and utilisation of amino acids.
- Maintain cardiovascular system and kidney functions.
- Cortisol stimulates RBC production.
- Produces anti-inflammatory reactions and suppress and immune response.

2. Mineralocorticoids

- Regulate the water, electrolytic balance,osmotic pressure and blood pressure.
- Aldosterone stimulates reabsorption of Na^+ and water from renaltubules and excretion of K^+ and phosphate ions.

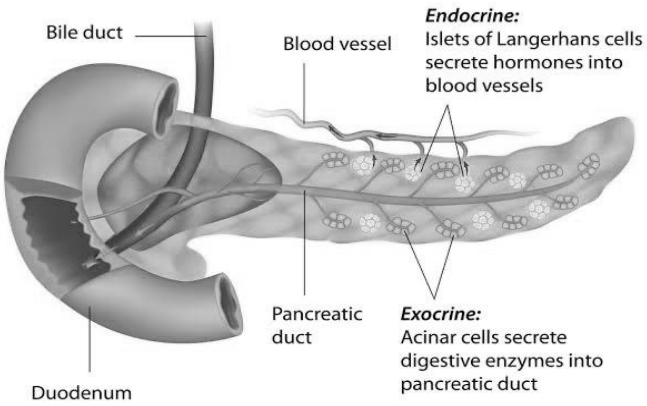
- Androgenic corticoids: For growth of axial hair, pubic hair and facial hair during puberty.

Deficiency of corticoids hormones affects carbohydrate metabolism.It causes acute weakness and fatigue.This condition is calledAddison's disease.

ADRENAL MEDULLA

- Produces catecholamine hormones such as Adrenaline(epinephrine)&Noradrenaline(norepinephrine)
- They are rapidly secreted in response to stress emergency situations so called emergency situations so called emergency hormones (hormones of Fight or Flight)
- These increase alertness,papillary dilation ,piloerection,sweating,heartbeat,heart contraction and respiratory rate.Stimulate glycogenolysis to increase glucose in blood .Also stimulate lipolysis and proteolysis.

8. PANCREAS (ISLETS OF LANGERHANS)



1. A composite (heterocrine) gland i.e exocrine and endocrine
2. Islets of Langerhans are the endocrine part.There are about 1-2 million Islets(1-2% of pancreatic tissue)
3. Alpha cells and beta cells in the islets secrete peptide hormones such as Glucagon and Insulin respectively.They maintain Glucose homeostasis in blood.

Glucagon: Hyperglycemic factor.It

1. Acts on hepatocytes and stimulates glycogenolysis resulting in an increased blood sugar(Hyperglycemia)
2. Stimulates gluconeogenesis.
3. Reduces the cellular glucose uptake and utilisation.

Insulin:Hypoglyemic factor.It

- Acts on hepatocytes and adipocytes to enhance cellular glucose uptake and utilisation.So, glucose from blood rapidly moves to hepatocytes and adipocytes. Thus,blood glucose level decreases(hypoglycemia).
- Stimulates glycogenesis (glucose converts to glycogen).

Prolonged hyperglycemia leads to Diabetes mellitus (loss of glucose through urine and formation of harmful compounds like ketone bodies).Treatment is insulin therapy.

9. TESTIS(MALE GONAD)

- It is the male primary sex organ and an endocrine gland.
- A pair of testis is present in the scrotal sac.
- It is formed of Seminiferous tubules and interstitial (stroma) tissues.

- Leydig(interstitial) cells in the inter-tubularspaces produce hormones called androgens(mainly testosterone).

Functions of androgens:

- Regulate development,maturation and functions of the accessory sex organs.
- Spermatogenesis (sperm production)
- Stimulate sexual behaviour (libido), growth of muscles, hairs ,aggressiveness,low pitch voice etc.
- Help in anabolism of protein and carbohydrate.

10. OVARY(FEMALE GONAD)

- It is the female primary sex organ.
- A pair of ovaries is located in the abdomen.
- It produces one ovum during each menstrual cycle.
- Ovary is formed of ovarian follicles and stromal tissues.
- Ovarian follicles produce Estrogen (steroid hormone).
- After ovulation ,ruptured follicle forms a structure called Corpus luteum.It secretes progesterone(a steroid hormone)

Functions o Estrogen.

- Growth and activities of female secondary sex organs.
- Development of ovarian follicles& mammary glands.
- Female secondary sex characters (e.g.High pitch voice) and Sexual behaviour.

Functions of Progesterone:

- It supports pregnancy.
- It acts on mammary glands to stimulate formation of alveoli (sac to store milk) and milk secretion.

HORMONES OF HEART,KIDNEY& GASTROINTESTINAL TRACT.

1. Atrial wall of heart:Produce a peptide hormone called Atrial natriuretic factor(ANF).When BP increases ,ANF causes dilation of blood vessels to reduce the BP.
2. JGS of Kidney:Produces Erythropoietin(peptide hormone).Stimulates erythropoiesis(Formation of RBC).
3. Gastro-intestinal tract:Produce peptide hormones.E.g.

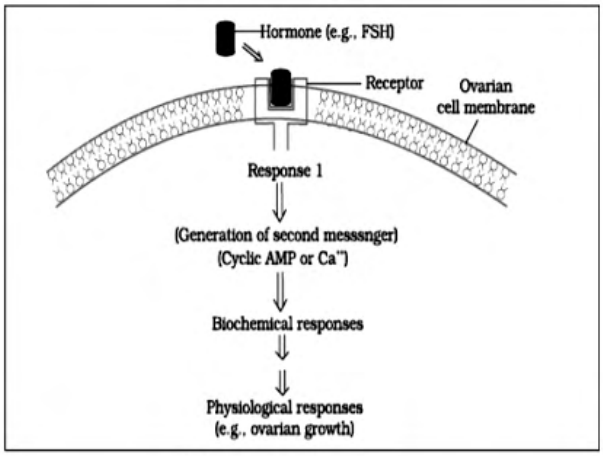
- Gastrin:Stimulates gastric glands to secrete HCl and Pepsinogen.
- Secretin:Stimulates exocrine pancreas to secrete water and bicarbonate ions.
- Cholecystokinin (CCK).Stimulates secretion of bile from gall bladder and pancreatic enzymes from pancreas.
- Gastric inhibitory peptide (GIP): Inhibits gastric secretion.

Several other non-endocrine tissues secrete hormones called growth factors.These are essential for the normal growth of tissues and their repairing or regeneration.

Based on the chemical nature,hormones are various types:

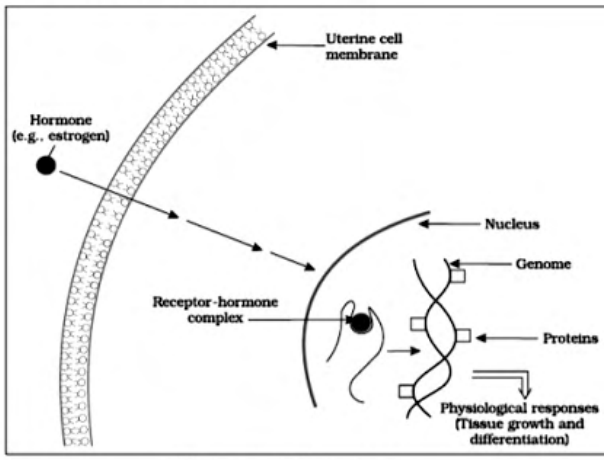
- Peptide, polypeptide, protein hormone:Insulin,glucagon ,pituitary hormones,hypothalamic hormones etc.
- steroids:Cortisols mtestosterone,estradiol&progesterone
- Iodothyronines(thyroid hormones)
- Amino-acid derivatives:Adrenaline ,nor-adrenaline etcintracellular

MECHANISM OF HORMONE ACTION



(a) Protein hormone

Diagramatic representation of the mechanism of hormone action :



(b) Steroid hormone

- Hormones produce their effects by binding to the specific proteins (hormone receptors) located in target tissues.
- A hormone binds to its specific receptor to formhomone- receptor complex.
- It leads to biochemical changes in target tissue and thereby regulates metabolism and physiological functions.

Hormone receptors are 2 typres:

- Membrane- bound receptors:Some hormones(e.g.protein hormone , FSH) interact with membrane - bound receptors(do not enter the target cell).It generates second messengers(e.g.cyclic AMP ,IP_3
- It in turn regulates cellular metabolism and causes physiological effects.
- Intercellular receptors (mostly nuclear receptors.): Some hormones (e.g, steroid hormones,iodothyronines)interact with intercellular receptors.They mostly regulate gene expression ,or chromosome function by the interaction of hormone-receptor complex with the genome.
- Cumulative biochemical actions result in physiological and developmental effects,

QUESTION AND ANSWER

Q1_____ controls the concentration of urine
a)ADH b)Oxytocin
c) ACTH d) None of the above
Answer a.

Q2 Children who have damaged thymus may result in_____
a)Loss of an antibody-mediated immunity b)Reduction in stem cell production
c)Deafness d)Loss of cell-mediated immunity

Answer d.

Q3 A group of hormones called _____ are released due cortex
a)Glucose b)Glucocorticoid
c) Glucagon d) None of the above
Answer b

Q4 Adrenocorticotropic hormones stimulate the adrenal cortex to produce _____
a)Testosterone b)Aldosterone
c) Cortisol d) None of the above
Answer c

Q5.Deficiency of this element causes the thyroid gland to swell up
a)Calcium b)Iodine
c)phosphorous d)None of the above
Answer b.
Q6 _____ are synthetic steroid hormones that resembles testosterone
a)Aldosterone b)Anabolic Steroids
c) Both (1) and (2) d) None of the above
Answer b.

Q7. The hormone that participates in metabolizing calcium and phosphorous are called _____
a)Glucagon b)Calcitonin
c) Glycogen d) None of the above
Answer. b

Q8. _____ is a chemical substance that is released by an organism that can affect the behaviour of another individual of the same species.
a)Pheromone b)Androgen
c) Testosterone d)All of the above
Answer a.

Q9. The deficiency of adrenal cortex hormones can lead to _____
a)Dwarfism b)GERD

c)Addison's Disease d)Acromegaly
Answer c.

Q10. If too much growth hormone is released during the growth period, it can cause _____
a)Acromegaly b)Crohn's Disease
c) Gigantism d) None of the above
Answer c.

Q11. Endemic goitre relates to
a)Increased Pancrease function b)Increased Thyroid function
c) Decreased Thyroid function d) Decreased Pancreatic function
Answer c

Q12. _____ secretes glucagon hormone
a)Thyroid gland b)Pituitary gland
c)Liver d)Pancreas
Answer d

Q13. Name the hormone that is responsible for milk secretion after parturition.
a)Insulin b)Prolactin
c)Lactogen d)None of the above
Answer b

Q14._____ is a hormone predominantly made by the adipose cells and enterocytes in the small intestine
a)Estrogen b)Calcitonin
c)Leptin d)Adrenaline

Answer c.

Q15. _____ is produced by the alpha cells of the pancreas
a)Calcitonin b)Glucagon
c) Insulin d)None of the above

Answer b

Q16. _____ is a hormone that plays a major role in social bonding, the period before and after childbirth, and sexual reproduction
a)Oxytocin b)Osteocalcin
c) Renin d) None of the above

Answer a.

Q17. Which of the following is an emergency hormone?
(a) Norepinephrine (b) Androgen
(c) Cortisol (d) FSH

Answer a

Q18. Match the columns.
1. PRL – A. Pigmentation of skin
2. LH – B. Steriod hormones
3. ACTH – C. Formation of milk
4. MSH – D. Gonadal activity
(a) 1-C, 2-D, 3-B, 4-A
(b) 1-C, 2-D, 3A, 4-B
(c) 1-D, 2-C, 3-B, 4-A
(d) 1-B, 2-C, 3-D, 4-A

Answer a.

Q20. In adults, insufficient thyroxine can lead to _____.
(a) Goitre (b) Tetany
(c) Cretinism (d) Myxedema

Answer d.

Q21. In the body, both the blood sodium and potassium levels are regulated by _____.
(a) Pheromones (b) Aldosterone
(c) Cortisol (d) Androgens

Answer b.

Q22.Which of the following acts on bones?
(a) Melatonin (b) Triiodothyronine
(c) GH (d) Parathyroid

Answer d.

Q23. Endemic goitre is a state of
(a) Increased thyroid function (b) Normal thyroid function
(c) Decreased thyroid function (d) Moderate thyroid function

Answer c.

Q24.. PTH is called as hypercalcemic hormone because it leads to the
(a) Absorption of $CaCO_3$ from the digested food (b) reabsorption of water from renal tubules
(c) Increasing blood calcium levels (d) maintenance ion balance in blood

Answer c.

Q25. Which of the following conditions is not linked to deficiency of thyroid hormones?
(a)cretinism (b)Goitre
(c)Myxedema (d)Exophthalmia

Answer d

VERY SHORT ANSWERED QUESTIONS

Q1. List the endocrine gland that is absent in males and the one absent in the female.
A.1. A pair of testes are present in the scrotal sac in males that performs functions of the endocrine gland as well as acts as a sex organ. This gland is absent in females as they possess a pair of ovaries situated in the abdomen. It produces progesterone and estrogen and is absent in males.

Q.2. Which amongst the two adrenocortical layers, zona reticularis, and zona glomerulosa lies outside wrapping the other?
A.2. The zona glomerulosa envelops the zona reticularis.

Q.3. Define erythropoiesis. Name the hormone that triggers it.
A.3. The process of formation of RBC is known as erythropoiesis. The peptide hormone erythropoietin produced from the juxtaglomerular cells of the kidney triggers the erythropoiesis.

Q.4. Which is the only hormone that is secreted by the pars intermedia of the pituitary gland?
A.4. Melanocyte Stimulating Hormone (MSH).

Q.5. Which is the endocrine gland that secretes calcitonin? What role does this hormone play?
A.5. It is produced by the parafollicular cells of the thyroid gland. It restricts excess Ca^{2+} and phosphate in the plasma by lowering mobilization from bones. Its deficiency causes osteoporosis or loss of bone density.

Q.6. Which hormone aids in cell-mediated immunity?
A.6. Thymosins play a significant role in the differentiation and development of T-lymphocytes that provide cell-mediated immunity.

Q.7. State if true or false
a) The gastrointestinal tract, heart, and kidney also produces hormones
b) Pars distalis produces six trophic hormones
A.7.
a)The gastrointestinal tract, heart, and kidney also produce hormones – True.
b) Pars distalis produces six trophic hormones – True.

Q.8.Which hormone is responsible for normal sleep cycle?
A8. There are a variety of hormones, which are responsible for sleep-wake cycles. This hormone includes– cortisol, melatonin, prolactin and thyroid-stimulating hormone- TSH.

Q.9. Name the endocrine gland that secretes cortisol hormone?
A.9.Adrenal gland.

Q.10.Name the endocrine gland, which is present only in females?
A.10. Ovaries are present only in females.

Q11.What is an endocrine gland?
A.11. The gland without duct, which secretes hormones, is called the endocrine gland.

Q12. What are hormones?
A.12. The endocrine glands secrete chemical substances which affect various body activities in target organs, by reaching there through blood.

Q13.Expand the term BMR.
A.13. Basal Metabolic Rate.

Q14. Which hormone is responsible for the metamorphosis of tadpoles into adult frogs?
A.14.The hormone thyroxine secreted by the thyroid gland is responsible for the metamorphosis of tadpoles into adult frogs.

Q15. What is castration?
A.15.The surgical removal of the testis is called castration.

Short Answer Type Questions
Q.1. State the significance of luteinizing hormones in males and females.
A.1. The luteinizing hormone in males triggers the production and secretion of hormones known as androgens from testes. Along with Follicle Stimulating Hormone (FSH), androgens control the spermatogenesis. The LH in females causes ovulation of the Graafian follicles and maintains the corpus luteum, developed from the traces of the Graafian follicles after ovulation that produces progesterone.

Q.2. Write about the importance of the second messenger in hormone action.
A.2. The hormones that do not enter the target cells, communicate with specific receptors situated on the surfaces of the target cell membranes and produces second messengers on the

plasma membrane(inner side). In turn, the second messenger performs all the functions related to hormones.

Q.3. Which is the steroid that controls inflammatory responses? Name its source and its other functions.
A.3. Glucocorticoids. They are secreted by the adrenal cortex. They trigger gluconeogenesis, proteolysis, and lipolysis and hinder the cellular uptake and utilization of amino acids.

Q.4. Why do old people have a weak immunity system?
A.4. The thymus gland is situated on the dorsal side of the heart and the aorta and is a lobular structure. Derived from the embryo's endoderm, the thymus produces the thymosin hormone that triggers the development of WBCs which produce immunity. In older individuals, the thymus degenerates thus causing a decreased thymosin secretion. Hence their immune system becomes weak.

Q.5. How does hypothyroidism affect the maturation and development of a growing baby, generally seen during pregnancy?
A.5. During pregnancy, hypothyroidism causes defective maturation and development of the fetus, that induces a stunted growth, low Intelligence Quotient(IQ), mental retardation, deaf-mutism, abnormal skin, etc.

Q.6. Differentiate between hyperthyroidism and hypothyroidism.
A.6. Hyperthyroidism is the over secretion of thyroid hormone and occurs due to the cancer of the thyroid gland whereas hypothyroidism is the low secretion of the thyroxine hormone

Q7.Work out the contrast between diabetes Mellitus and diabetes insipidus.

A.7.Diabetes mellitus and diabetes insipidus

Diabetes mellitus (i) It is due to failure of insulin secretion.
(ii) The blood sugar is abnormally high and the glucose appears in the urine.
(iii) There are high blood cholesterol and ketone body formation.

Diabetes insipidus
(i) It is due to the failure of secretion of vasopressin.
ii) The blood sugar is normal and no glucose appears in the urine.
iii) There is no such phenomenon.

Q8.Name the hormones, their source glands and their mode of functioning to achieve calcium homeostasis in the human body.
A8. TCT secreted by the parafollicular cells of thyroid and the parathyroid hormone (PTH) secreted by parathyroid glands are involved in achieving calcium homeostasis in humans. TCT is secreted when the calcium levels in the blood becomes high, it is a hypocalcemic hormone that reduces the calcium level in blood.

PTH is secreted when the calcium levels of blood become low;it increases the calcium level by reabsorption of bone,reabsorption of calcium from renal tubules and from digested food.

Q9.Differentiate the action of insulin and glucagon

A9.Insulin

(1) It is secreted by beta cells of islet of Langerhans of the pancreas.
(2) It converts soluble glucose into insoluble glycogen.
Glucagon
(1) It is secreted by alpha cells of islet of Langerhans of the pancreas
2) It converts glycogen into glucose.

Q10.Name and state briefly the functions of the hormones secreted by the adrenal cortex.
A10. The hormones secreted by the adrenal cortex are:

- Glucocorticoids: These regulate the metabolism of carbohydrates, fats, and proteins.
- Mineralocorticoids: These maintain the sodium, potassium level in the blood.
- Sex corticoids: These stimulate the development of external sex characters hormonene male patterns of body hair distribution. Androstenedione and dehydroepiandrosterone are sex corticoids.

Q11.Why do you suppose the brain goes to the trouble of synthesizing releasing hormones, rather than simply directing the production of the pituitary hormones immediately?

A11..Hormones secreted by the posterior lobe of the pituitary gland are actually synthesized by the neurons in the hypothalamus and stored in their axon ends in the posterior lobe for release, when required.

The pituitary was called the Master endocrine gland, because of the number of hormones it produces and the control it exercises over other endocrine glands. However, it itself is under control of the releasing hormones secreted by the hypothalamus of the brain. Thus there is a chain of disorders, the hypothalamus directs the pituitary output, which controls the secretion of hormones by other endocrine glands.

Q11.The immune response of old becomes weak. Which endocrine gland is responsible for this? Name the hormone secreted by this gland and state the role of hormone in maintaining the immune system?
A11. Thymus gland is responsible for this

- It secretes hormone thymosin.
- Thymosins play a major role in the differentiation of T-lymphocytes that provide cell mediated immunity.
- They also stimulates the production of antibodies,which provide humoral immunity

Q12.Differentiate between glycogenesis and glycogenolysis and the hormone involved in them.
A12.

Glycogenesis	Glycogenolysis
• It is the process of formation of glycogen from glucose	• It is the process of breakdown of glycogen
• It is stimulated by insulin	• It is stimulated by glucagon,cortisol and adrenalin
• It results in hypoglycemia	• It results in hyperglycemia

LONG ANSWER TYPE QUESTIONS

Q.1. A milkman's cow refuses to give milk. On being fondled by the calf, the cow produced enough milk. Explain the significance of the endocrine gland and the pathway related to this response.

A.1. A neuroendocrine reflex is created when calf suckling occurs that causes an increase in the oxytocin from the neurohypophysis. Here the neurons produce the oxytocin precursor and bundle it into vesicles. The level of oxytocin in the blood gets concentrated within a minute or two after the stimulation which causes smooth muscle contraction of the udder causing milk to flow. An intra-udder hormone that functions like oxytocin would do a similar function. Following is a summarization. Suckling stimulus → Hypothalamus → Neurohypophysis → Oxytocin → Udder → Flow of milk.

Q.2. A urine sample contained increased content of glucose and ketone bodies. Answer the questions below basis this observation.

a) Name the hormone and gland associated with this condition.

b) On which cells do these hormones act?

c) Name the condition. How can it be rectified?

A.2. a) Insulin hormone and Pancreas gland.

b) It acts on the β-cells of islets of Langerhans present in the pancreas

c) Prolonged hyperglycemia causes diabetes mellitus that is linked to loss of glucose via urine and accumulation of harmful compounds called as ketone bodies. Insulin therapy can be successfully used to treat Diabetic patients.

Q.3. Describe the importance of hormones and endocrine glands responsible for regulating the Calcium Homeostasis.

A.3. The hormones and endocrine glands that regulate calcium homeostasis are thyroid and parathyroid glands and their related hormones which are Parathyroid hormone (PTH) and calcitonin. The endoderm of the embryo develops the parathyroid glands and has two types of cells – oxyphil cells and chief cells. The chief cells secrete the parathyroid hormone (PTH) which is involved in controlling phosphate and calcium stability between other tissues and blood. From bones, it causes the secretion of calcium into the blood. PTH causes an increase in the reabsorption of calcium by the organs of the body such as kidneys and intestine. The thyroid gland is the largest endocrine gland that is situated prefrontal to the thyroid cartilage of the larynx in the neck. It regulates the calcium homeostasis and releases thyrocalcitonin hormone which is produced by the 'C' cells. The hormone is secreted when the calcium concentration in blood is high. They lower the calcium level by suppressing the release of calcium ions from the bones. Hence calcitonin has a contrary effect on calcium in comparison to the parathyroid hormone.

Q.4. Explain why hypothalamus is a super master endocrine gland.

A.4 The hypothalamus controls an array of functions. It has many groups of neurosecretory cells known as nuclei that produce hormones. These hormones maintain the secretion and synthesis of pituitary hormones. The hormones produced by the hypothalamus are – the

releasing hormones and the inhibiting hormones. The releasing hormones trigger the secretion of pituitary hormones and the inhibiting hormones hinder the secretions of the pituitary hormones. Through a portal circulatory system, the hormones arrive at the pituitary gland and check the functions of the anterior pituitary. Hypothalamus directly regulates the posterior pituitary. It also synthesizes two hormones – vasopressin and oxytocin which are further conveyed to the posterior pituitary.

CASE STUDY QUESTIONS

CASE 1

The pituitary gland is located in a bony cavity called sellatursica and is attached to hypothalamus by a stalk. It is divided anatomically into an adenohypophysis and a neurohypophysis. Adenohypophysis consists of two portions, pars distalis and pars intermedia. The pars distalis region of pituitary, commonly called anterior pituitary, produces growth hormone (GH), prolactin (PRL), thyroid stimulating hormone (TSH), adrenocorticotrophic hormone (ACTH), luteinizing hormone (LH) and follicle stimulating hormone (FSH). Pars intermedia secretes only one hormone called melanocyte stimulating hormone (MSH). However, in humans, the pars intermedia is almost merged with pars distalis. Neurohypophysis (pars nervosa) also known as posterior pituitary, stores and releases two hormones called oxytocin and vasopressin, which are actually synthesised by the hypothalamus and are transported axonally to neurohypophysis.

Over-secretion of GH stimulates abnormal growth of the body leading to gigantism and low secretion of GH results in stunted growth resulting in pituitary dwarfism. Excess secretion of growth hormone in adults especially in middle age can result in severe disfigurement (especially of the face) called Acromegaly. Prolactin regulates the growth of the mammary glands and formation of milk in them. TSH stimulates the synthesis and secretion of thyroid hormones from the thyroid gland. ACTH stimulates the synthesis and secretion of steroid hormones called glucocorticoids from the adrenal cortex. LH and FSH stimulate gonadal activity and hence are called gonadotrophins.

After ovulation. FSH stimulates growth and development of the ovarian follicles in females. MSH acts on the melanocytes (melanin containing cells) and regulates pigmentation of the skin. Oxytocin acts on the smooth muscles of our body and stimulates their contraction. In females, it stimulates a vigorous contraction of uterus at the time of child birth, and milk ejection from the mammary gland. Vasopressin acts mainly at the kidney and stimulates resorption of water and electrolytes by the distal tubules and thereby reduces loss of water through urine (diuresis). Hence, it is also called as anti-diuretic hormone (ADH). An impairment affecting synthesis or release of ADH results in a diminished ability of the kidney to conserve water leading to water loss and dehydration. This condition is known as Diabetes Insipidus.

`1.) _____ are the hormones secreted by Pars intermedia.

a) Adrenocorticotrophic hormone

b) Melanocyte stimulating hormone

c) Luteinizing hormone

d) Follicle stimulating hormone

2.) Growth and functioning of the mammary glands is regulated and controlled by the

a) Glucocorticoids Hormone

b) Stimulating hormone

c) Prolactin hormones

d) Luteinizing hormone

3.) Name the hormones which acts on the smooth muscles of our body and stimulates their contraction.

4.) Write short note on the hormone which stimulates resorption of water and reduces loss of water.

5.) What are the adverse effect of over secretion of GH on human body?

Answer key

1) b

2) c

3) Oxytocin acts on the smooth muscles of our body and stimulates their contraction.

4) Vasopressin is hormone stimulates resorption of water and reduces loss of water. It acts mainly at the kidney and stimulates resorption of water and electrolytes by the distal tubules and thereby reduces loss of water through urine (diuresis). Hence, it is also called as anti-diuretic hormone (ADH).

5) Over-secretion of GH stimulates abnormal growth of the body leading to gigantism. Excess secretion of growth hormone in adults especially in middle age can result in severe disfigurement especially of the face.

CASE 2

The thyroid gland is composed of two lobes which are located on either side of the trachea. Both the lobes are interconnected with a thin flap of connective tissue called isthmus. The thyroid gland is composed of follicles and stromal tissues. Each thyroid follicle is composed of follicular cells, enclosing a cavity. These follicular cells synthesise two hormones, tetraiodothyronine or thyroxine (T4) and triiodothyronine (T3). Iodine is essential for the normal rate of hormone synthesis in the thyroid. Deficiency of iodine in our diet results in hypothyroidism and enlargement of the thyroid gland, commonly called goitre. Hypothyroidism during pregnancy causes defective development and maturation of the growing baby leading to stunted growth (cretinism), mental retardation, low intelligence quotient, abnormal skin, deaf-mutism, etc. In adult women, hypothyroidism may cause menstrual cycle to become irregular. Due to cancer of the thyroid gland or due to development of nodules of the thyroid glands, the rate of synthesis and secretion of the thyroid hormones is increased to abnormal high levels leading to a condition called hyperthyroidism which adversely affects the body physiology.

Exopthalmic goitre is a form of hyperthyroidism, characterised by enlargement of the thyroid gland, protrusion of the eyeballs, increased basal metabolic rate, and weight loss, also called Graves' disease. Thyroid hormones play an important role in the regulation of the basal metabolic rate. These hormones also support the process of red blood cell formation. Thyroid hormones control the metabolism of carbohydrates, proteins and fats. Maintenance of water

and electrolyte balance is also influenced by thyroid hormones. Thyroid gland also secretes a protein hormone called thyrocalcitonin (TCT) which regulates the blood calcium levels.

1.) _____ Protein hormone secreted by thyroid gland regulates the blood calcium levels along with PTH.

a) thyromelatonin

b) thyrocalcitonin

c) thyrocalciumtonin

d) thyrocarbotonin

2.) Cretinism is referred as,

a) Stunted growth due to deficiency of iodine

b) Stunted growth due to deficiency of thyroid hormones

c) Mental retardation due to deficiency of iodine

d) Deaf-mutism due to deficiency of iodine

3.) Explain how the both lobes of thyroid gland are interconnected?

4.) Give the composition of thyroid follicle and their function?

5.) What are adverse effect of iodine deficiency on human body?

Answer key

1) b

2) a

3) Thyroid gland is composed of two lobes these lobes are interconnected with a thin flap of connective tissue called isthmus.

4) Thyroid follicle is made up of follicular cells.

5) Function – Follicular cells synthesise two hormones named as Tetraiodothyronine/Thyroxine (T4) and Triiodothyronine (T3).

6) Iodine is essential for the optimum level of thyroid hormones secretion. Deficiency of iodine in our diet results in hypothyroidism and enlargement of the thyroid gland, commonly known as goitre. Deficiency of iodine during pregnancy causes defective development and maturation of the growing baby leading to stunted growth (cretinism), mental retardation, low intelligence quotient, abnormal skin, deaf-mutism, etc. In adult women, deficiency of iodine may cause menstrual cycle to become irregular.

ASSERTION AND REASON QUESTIONS

1.) Assertion: The hormone Gonadotrophin releasing hormone (GnRH) stimulates the synthesis and release of gonadotrophins

Reason: The hormone Gonadotrophin is produced by pituitary gland

a.) Both Assertion and Reason are correct and Reason is the correct explanation for Assertion.

b.) Both Assertion and Reason are correct and Reason is not the correct explanation for Assertion.

c.) If assertion is true but the reason is false.

d.) If both assertion and reason are false.

Answer c

2) Assertion: Androgens act on the central neural system and influence the male sexual behaviours.

Reason: These hormones produce anabolic (synthetic) effects on protein and carbohydrate metabolism.

a.) Both Assertion and Reason are correct and Reason is the correct explanation for Assertion.

b.) Both Assertion and Reason are correct and Reason is not the correct explanation for Assertion.

c.) If assertion is true but the reason is false.

d.) If both assertion and reason are false.

Answer b

3) Assertion: Adrenaline and noradrenaline are rapidly secreted in response to stress of any kind and during emergency situations

Reason: due to this reason called emergency hormones or hormones of Fight or Flight.

a.) Both Assertion and Reason are correct and Reason is the correct explanation for Assertion.

b.) Both Assertion and Reason are correct and Reason is not the correct explanation for Assertion.

c.) If assertion is true but the reason is false.

d.) If both assertion and reason are false.

Answer a

4) Assertion: Hormones with membrane-bound receptors normally do not enter the target cell.

Reason: these hormones regulate cellular metabolism by production of secondary messengers

a.) Both Assertion and Reason are correct and Reason is the correct explanation for Assertion.

b.) Both Assertion and Reason are correct and Reason is not the correct explanation for Assertion.

c.) If assertion is true but the reason is false.

d.) If both assertion and reason are false.

Answer a

SAMPLE QUESTION PAPER Time : 3 Hrs.

Class : XI Marks : 70

Blue Print

UNITS	L.No.	VSA (1)	SA-I (2)	SA-II (3)	CBQ (4)	LA (5)	TOTAL MARKS
I. Diversity in the Living World	1	1	1				3
	2	1		1			4
	3	1		1			4
	4	1		1			4
	TOTAL	4(4)	1(2)	3(9)	0	0	8(15)
II. Structural Organisation in Plants and Animals	5	2					2
	6	1		1			4
	7	1		1			4
	TOTAL	4(4)	0	2(6)	0	0	6(10)
III. Structure and Functions	8	1	1	OR			3
	9	1	1	1		OR	6
	10	1				1	6
	TOTAL	3(3)	2(4)	1(3)		1(5)	7(15)
IV. Plant Physiology	13					1	5
	14				1	OR	4
	15	1	1				3
	TOTAL	1(1)	1(2)	0	1(4)	1(5)	4(12)
V. Human Physiology	17	1	OR				1
	18	1				OR	1
	19	1		1			4
	20	1	1				3
	21					1	5
	22				1		4
	TOTAL	4(4)	1(2)	1(3)	1(4)	1(5)	8(18)
FINAL	TOTAL	16(16)	5(10)	7(21)	2(8)	3(15)	33(70)

KENDRIYA VIDYALAYA SANGATHAN - CHENNAI REGION

Class XI

Biology (044)

SAMPLE QUESTION PAPER 1 2022-23

Maximum Marks: 70

Time: 90 Minutes

General Instructions:

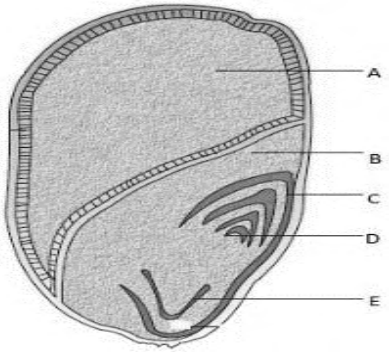
(i) All questions are compulsory.

(ii) The question paper has five sections and 33 questions. All questions are compulsory.

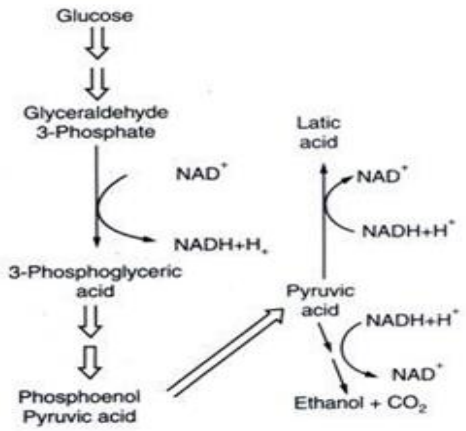
(iii) Section–A has 16 questions of 1 mark each; Section–B has 5 questions of 2 marks each; Section–C has 7 questions of 3 marks each; Section– D has 2 case-based questions of 4 marks each; and Section–E has 3 questions of 5 marks each.

(iv) There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.

(v) Wherever necessary, neat and properly labeled diagrams should be drawn.

Q. No.	SECTION - A
1	Which of the following does not come under taxon? (a) Species(b) Kingdom (c) Division(d) Key
2	The asexual spores are not found, vegetative reproduction occurs by fragmentation and sexual organs are absent. Identify the class of fungi. (a) Phycomycetes (b) Ascomycetes (c) Basidiomycetes (d) Deuteromycetes
3	Iodine is found in (a) Spirogyra(b) Laminaria (c) Polysiphonia(d) Chlorella
4	Phylum that doesn't have a true coelom is (a) Platyhelminthes(b) Annelida (c) Echinoderms(d) Arthropoda
5	 Label the parts of a monocot seed. (a) A.Endosperm, B. Scutellum, C. Radicle, D. Coleoptile, E. Plumule (b) A.Endosperm, B. Coleoptile, C. Scutellum, D. Radicle, E. Plumule (c) A.Endosperm, B. Scutellum, C. Coleoptile, D. Radicle, E. Plumule (d) A.Endosperm, B. Scutellum, C. Coleoptile, D. Plumule, E. Radicle
6	The term phyllotaxy is used to describe the (a) type of ovary in a plant b) mode of arrangement of leaves (c) type of roots(d) arrangement of sepals and petals
7	Closed vascular bundles lack (a) pith(b) xylem (c) cambiumd) xylem vessels
8	Tendons connect the following: (a) bone to boneb) muscle to muscle (c) cartilage to muscle(d) bone to muscle

9	Middle lamella is made up of _____. (a) calcium sulphideb) calcium pectate (c) calcium carbonated) calcium chloride
10	With reference to enzymes, which one of the following statements is true? (a) Apoenzyme = Holoenzyme + Coenzyme (b) Holoenzyme = Apoenzyme + Coenzyme (c) Coenzyme = Apoenzyme + Holoenzyme (d) Holoenzyme = Coenzyme – Apoenzyme
11	Choose the correct sequence. A. Pachytene B. Zygotene C. Leptotene D. Diakinesis E. Diplotene (a) C, B, A, D, E (b) C, A, B, E, D (c) C, B, A, E, D (d) D, B, C, E, A
12	Mobilization of stored food in germinating seeds is triggered by (a) auxins (b) cytokinins (c) gibberellins(d) ethylene
	Question No. 13 to 16 consist of two statements – Assertion (A) and Reason (R). Answer these questions by selecting the appropriate option given below: A. Both A and R are true and R is the correct explanation of A. B. Both A and R are true and R is not the correct explanation of A. C. A is true but R is false. D. Both A and R are False.
13	Assertion: Haemoglobin is an oxygen carrier. Reason: Oxygen binds to NH_2 of haemoglobin.
14	Assertion: Thrombocytes play an important role in blood coagulation. Reason: They are produced by the fragmentation of megakaryocytes.
15	Assertion: The epithelial cells of PCT have a brush border. Reason: Luminal surfaces of the epithelial cells are provided with microvilli.
16	Assertion: Rheumatoid arthritis is a viral disease. Reason: It is commonly known as ‘wear and tear’ arthritis
	SECTION B
17	State universal rules of nomenclature.
18	Classify the chromosomes based on the positions of centromeres.
19	What is meant by tertiary structure of proteins?
20	How is arithmetic growth different from geometric growth?
21	How do you distinguish between a skeletal muscle and a cardiac muscle? OR Diffusion of gases occurs in the alveolar region only and not in other parts of the respiratory system. Why?

	SECTION – C
22	i) What are heterocysts? ii) What is a viroid? iii) What are aplanospores?
23	In which plant will you look for Mycorrhiza and coralloid roots? Also explain what these terms mean.
24	Give three major differences between chordates and non-chordates.
25	Draw a neat labelled diagram of a dorsiventral leaf.
26	Frogs can respire on land and in water. Describe the different methods used by them for respiration.
27	Enumerate the different classes of enzymes. OR Draw a neat, labelled structure of chloroplast.
28	Aquatic animals are generally ammonotelic in nature whereas terrestrial forms are not. Comment.
	SECTION - D
29	 In fermentation, say by yeast, the incomplete oxidation of glucose is achieved under anaerobic conditions by sets of reactions where pyruvic acid is converted to CO2 and ethanol. The enzymes, pyruvic acid decarboxylase and alcohol dehydrogenase catalyse these reactions. Other organisms like some bacteria produce lactic acid from pyruvic acid. In animal cells also, like muscles during exercise, when oxygen is inadequate for cellular respiration pyruvic acid is reduced to lactic acid by lactate dehydrogenase. The reducing agent is NADH+H+ which is reoxidised to NAD+ in both the processes. In both lactic acid and alcohol fermentation not much energy is released; less than seven per cent of the energy in glucose is released and not all of it is trapped as high energy bonds of ATP. Also, the processes are hazardous – either acid or alcohol is produced. Yeasts poison themselves to death when the concentration of alcohol reaches about 13 per cent. In eukaryotes these steps take place within the mitochondria and this requires O2. Aerobic respiration is the process that leads to a complete oxidation of organic substances in the presence of oxygen, and releases CO2, water and a large amount of energy present in the substrate. This type of respiration is most common in higher organisms.

	1.) Under _____ condition incomplete oxidation of respiratory substrate takes place. a) Aerobic b) Anaerobic c) Aerobic and anaerobic d) None of the above 2.) In fermentation process, a) pyruvic acid is converted to O2 and ethanol b) pyruvic acid is converted to CO2 and ethylene c) pyruvic acid is converted to CO2 and ethanol d) pyruvic acid is converted to CO2 and ethephon 3.) Name the enzyme which facilitates the reactions where pyruvic acid is converted to CO2 and ethanol. 4.) Name the process which leads to a complete oxidation of organic substances in presence of oxygen.
30	The thyroid gland is composed of two lobes which are located on either side of the trachea. Both the lobes are interconnected with a thin flap of connective tissue called isthmus. The thyroid gland is composed of follicles and stromal tissues. Each thyroid follicle is composed of follicular cells, enclosing a cavity. These follicular cells synthesize two hormones, tetraiodothyronine or thyroxine (T4) and triiodothyronine (T3). Iodine is essential for the normal rate of hormone synthesis in the thyroid. Deficiency of iodine in our diet results in hypothyroidism and enlargement of the thyroid gland, commonly called goitre. Hypothyroidism during pregnancy causes defective development and maturation of the growing baby leading to stunted growth (cretinism), mental retardation, low intelligence quotient, abnormal skin, deaf-mutism, etc. In adult women, hypothyroidism may cause the menstrual cycle to become irregular. Due to cancer of the thyroid gland or due to development of nodules of the thyroid glands, the rate of synthesis and secretion of the thyroid hormones is increased to abnormally high levels leading to a condition called hyperthyroidism which adversely affects the body physiology. Exophthalmic goitre is a form of hyperthyroidism, characterised by enlargement of the thyroid gland, protrusion of the eyeballs, increased basal metabolic rate, and weight loss, also called Graves' disease. Thyroid hormones play an important role in the regulation of the basal metabolic rate. These hormones also support the process of red blood cell formation. Thyroid hormones control the metabolism of carbohydrates, proteins and fats. Maintenance of water and electrolyte balance is also influenced by thyroid hormones. Thyroid gland also secretes a protein hormone called thyrocalcitonin (TCT) which regulates the blood calcium levels. i.) _____ Protein hormone secreted by thyroid gland regulates the blood calcium levels along with PTH. a) thyromelatonin b) thyrocalcitonin

	c) thyrocalciumtonin d) thyrocarbotonin ii.) cretinism is referred as, a) stunted growth due to deficiency of iodine b) stunted growth due to deficiency of thyroid hormones c) mental retardation due to deficiency of iodine d) deaf-mutism due to deficiency of iodine iii.) Explain how the both lobes of the thyroid gland are interconnected? iv.) Give the composition of thyroid follicle and their function?
	SECTION E
31	Write briefly, the significance of mitosis and meiosis in multicellular organisms. OR Describe Watson and Crick's model of DNA structure.
32	List the salient features of the Calvin cycle. Why are the plants having this cycle called C_3 plants? OR Give the schematic representation of the overall view of Krebs cycle. Where does it take place?
33	Name the parts of the human forebrain indicating their respective functions. OR Explain the different types of blood groups and donor compatibility by making a table.

KENDRIYA VIDYALAYA SANGATHAN - CHENNAI REGION

Class XI
Biology (044)

SAMPLE QUESTION PAPE 1 2022-23
SCORING KEY

Maximum Marks: 70
Time: 90 Minutes

Q. No.	SECTION - A
1	(d) Key
2	(c) Basidiomycetes
3	(b) Laminaria
4	(a) Platyhelminthes
5	(d) A.Endosperm, B. Scutellum, C. Coleoptile, D. Plumule, E. Radicle,
6	(b) mode of arrangement of leaves
7	(c) cambium

<table>
<tr><td>8</td><td>(d) bone to muscle</td></tr>
<tr><td>9</td><td>(b) calcium pectate</td></tr>
<tr><td>10</td><td>(b) Holoenzyme = Apoenzyme + Coenzyme</td></tr>
<tr><td>11</td><td>(c) C, B, A, E, D</td></tr>
<tr><td>12</td><td>(c) gibberellins</td></tr>
<tr><td>13</td><td>C. A is true but R is false.</td></tr>
<tr><td>14</td><td>B. Both A and R are true and R is not the correct explanation of A.</td></tr>
<tr><td>15</td><td>A. Both A and R are true and R is the correct explanation of A.</td></tr>
<tr><td>16</td><td>D. Both A and R are False.</td></tr>
<tr><td></td><td>SECTION – B</td></tr>
<tr><td>17</td><td>1. Written in italics
2. First word is genus and the second is species epithet.
3. When handwritten should be underlined separately
4. Generic name starts with a capital letter and specific name with a small letter.</td></tr>
<tr><td>18</td><td>Telocentric, Acrocentric, Submetacentric, Metacentric= ½ x 4</td></tr>
<tr><td>19</td><td>Three-dimensional compact structure=1
Hydrophobic side chains held interior and hydrophilic groups held outside=1</td></tr>
<tr><td>20</td><td>In arithmetic growth following mitotic cell division, only one daughter cell continues to divide while the other differentiates and matures=1
In geometric growth, a sigmoid curve is obtained depicting lag, log and stationary phases.=1</td></tr>
<tr><td>21</td><td>
<table>
<tr><th>Skeletal muscle</th><th>Cardiac muscle</th></tr>
<tr><td>1. Voluntary
2. Unbranched
3. Multinucleated
4. Intercalated discs absent</td><td>1. Involuntary
2. Branched
3. One or two nuclei
4. Intercalated discs present</td></tr>
<tr><td colspan="2">OR
1. The differences in partial pressure across the respiratory membrane are substantial
2. The distances involved in gas exchange are small
3. The gases are lipid soluble
4. The total surface area is large
5. Blood flow and air flow are coordinated (Any 4)</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td></td><td>SECTION – C</td></tr>
<tr><td>22</td><td>i) Heterocysts are specialised nitrogen fixing cells in some cyanobacteria.
ii) Viroids are agents of infectious disease in plants. They lack a capsid.
iii) Aplanospores are non-motile spores.</td></tr>
<tr><td>23</td><td>Mycorrhiza is an association between fungus and roots of higher plants like Pinus=1
Coral like roots are irregular and branched=1
They are present in Cycas=1</td></tr>
<tr><td>24</td><td><table><tr><th>Chordates</th><th>Non-chordates</th></tr><tr><td>1. Notochord present at some stage or replaced by backbone
2. Gut ventral to nerve chord
3. Pharyngeal gill slits present at some stage of life</td><td>1. Notochord or backbone absent
2. Gut dorsal to nerve chord
3. Pharyngeal gill slits absent.</td></tr></table></td></tr>
<tr><td>25</td><td>Diagram=1
Any 4 correct labelling=2</td></tr>
<tr><td>26</td><td>In water, skin acts as aquatic respiratory organ, cutaneous respiration=1 ½
On land, buccal cavity, skin and lungs act as respiratory organs, pulmonary respiration= 1 ½</td></tr>
<tr><td>27</td><td>1. Oxidoreductase
2. Transferases
3. Hydrolases
4. Lyases
5. Isomerases
6. Ligases
OR
Diagram =1
Any 4 labelling=2</td></tr>
<tr><td>28</td><td>Excretion of ammonia requires large amount of water=1
Terrestrial animals do not get sufficient amount of water=1
They are either ureotelic or uricotelic =1</td></tr>
<tr><td></td><td>SECTION - D</td></tr>
<tr><td>29</td><td>1.) b
2.) c
3.) Pyruvic acid decarboxylase and Alcohol dehydrogenase catalyse the reactions where pyruvic acid is converted to CO2 and ethanol.
4.) Aerobic respiration is the process that leads to a complete oxidation of organic substances in the presence of oxygen and releases carbon dioxide, water and a large amount</td></tr>
</table>

	of energy present in the organic substance
	1) b 2) a 3) Thyroid gland is composed of two lobes. These lobes are interconnected with a thin flap of connective tissue called isthmus. 4) Thyroid follicle is made up of follicular cells.
	SECTION E
31	Significance of mitosis =2 Growth and repair, reproduction in unicellular organisms (any 2) Significance of meiosis =3 Maintains same chromosome number, maintains stability of species, variations due crossing over, OR Diagram of DNA = 1 Description = 4 Double stranded helix, sugar and phosphate backbone, nitrogenous bases, base specific hydrogen bonds
32	i) It was studied by Calvin in a unicellular green alga *Chlorella* by using $C^{14}O_2$ with the help of autoradiography =1 ½ ii) Three types of reactions namely carboxylation, reduction and regeneration occur= 1 ½ iii) There is utilization of 18 ATP and 12 NADPH molecules for 6 CO_2 molecules=1 iv) The fixation of 6 molecules of CO_2 and 6 turns of the cycle are needed for the production of one molecule of glucose=1 OR Kreb's cycle diagram = 4 Mitochondrial matrix =1
33	

Part of forebrain	Functions	Marks
Olfactory region	Smell	1
Cerebrum	Thinking, intelligence, memory ability to learn from experience etc	2
Diencephalon	Heat, cold and pain Control centre of autonomic nervous system	1
Hypothalamus	Regulate body temp. appetite, emotions, metabolism etc	1
OR		
ABO blood grouping		3
Donor compatibility table		2

KENDRIYA VIDYALAYA CHENNAI REGION

Sample Question Paper 2 2022-23

CLASS XI BIOLOGY

Maximum Marks: Time: 3 hours

General Instructions:

(i) All questions are compulsory.

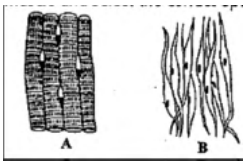
(ii) The question paper has five sections and 33 questions. All questions are compulsory.

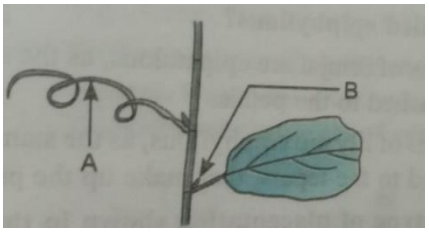
(iii) Section–A has 16 questions of 1 mark each; Section–B has 5 questions of 2 marks each; Section–C has 7 questions of 3 marks each; Section– D has 2 case-based questions of 4 marks each; and Section–E has 3 questions of 5 marks each.

(iv) There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.

Wherever necessary, neat and properly labeled diagrams should be drawn

	SECTION A	
Q No	Question	Marks
1	The taxonomic unit Phylum in the classification of animals is equivalent to which hierarchical level in classification of plants? (a)Class (b) Order (c) Division (d) Family	1
2	The edible part in mango is (a) Epicarp (b) tegmen (c)mesocarp (d) endocarp	1
3	The type of cells, which line the inner surface of fallopian tubes and bronchioles is a) Simple squamous epithelial cells b) Ciliated epithelial cells b) Simple cuboidal epithelial cells d) Stratified squamous epithelial cells	1
4	Match the following (i)Cristae (a) Flat membranous sacs in stroma (ii)Cisternae (b)Infoldings in mitochondria (iii)Thylakoids c) Disc shaped sacs in Golgi apparatus	1
5	In which phase meiosis is Synaptonemal complex formed? a)Zygotene of Prophase I (b) Pachytene of Prophase I c)Pachytene of Prophase II (d)Diakinesis of Prophase I	1
6	The number of ATP and $NADPH_2$ molecules required for fixing one molecule of CO_2 in Calvin cycle is a a)1 ATP, 2 $NADPH_2$ (b)2 ATP, 3 $NADPH_2$ c)3 ATP, 2 $NADPH_2$ (d) 2 ATP, 2 $NADPH_2$	1
7	Mark the odd one in the following Oxaloacetic acid, citric acid, succinic acid, pyruvic acid	1
8	To increase sugar production in sugarcanes, they are sprayed with a)IAA (b) cytokinin c)Gibberellin (d) ethylene	1

9	What will be the P O_2 and p CO_2 in the atmospheric air compared to those in the alveolar air? (i)P O_2 lesser P CO_2 higher (ii)P O_2 higher P CO_2 lesser (iii)P O_2 higher P CO_2 higher (iv)P O_2 lesser P CO_2 lesser	1
10	Angiotensinogen is a protein produced and secreted by a) Juxtaglomerular (JG) cells B)Macula dense cells b) Endothelium of blood vessels c) Liver cells	1
11	A sarcomere consists of A band in the centre and halves of two I bands on its two sides/ends: True/ False	1
`12	Deficiency of parathormone produces muscle cramps (tetany) due to a) Enhanced levels of Na+ in blood b) Lowered levels of blood glucose c) Enhanced levels of blood Ca^{2+} d) Lowered levels of blood Ca^{2+}	1
	Question No. 13 to 16 consist of two statements – Assertion (A) and Reason (R). Answer these questions by selecting the appropriate option given below: A. Both A and R are true and R is the correct explanation of A. B. Both A and R are true and R is not the correct explanation of A. C. A is true but R is false. D. A is False but R is true.	
13	Assertion: Pancreas is a heterocrine gland. Reason: Pancreas consists of exocrine as well as endocrine tissues.	1
14	Assertion: Haemoglobin is a quaternary protein. Reason: It consists of 4 amino acid units	1
15	Assertion: Action spectrum of photosynthesis compares well with the absorption spectrum of chlorophyll. Reason: Chlorophyll is the only pigment which can absorb and convert light energy into chemical energy	1
16	Assertion: The urinary bladder has a well-developed, 3 layered detrusor muscle in its wall. Reason: Bladder gradually contracts to drive urine out during micturition.	1
	SECTION B	
17	Name the aggregation formed by slime moulds during favourable conditions. What happens to it during the following unfavourable conditions	2
18	a)Name the kind of tissue found at the shoot tip b) Name the only living cells/ components of xylem	2
19	 Identify A and B and write one point of difference between them	2
20	Mention the two steps in glycolysis, where ATP is consumed	2
21	Describe the incomplete double circulation with an example	2

	SECTION C	
22	Give the characters of the phylum to which this organism belongs to (any six) 	3
23	a)Name the part shown at (A) and (B) in the diagram  b) Explain the following term: (i)Actinomorphic flower(ii)Syncarpous	3
24	(a)Name the stage of cell cycle at which each of the following events occur: (i) Chromosomes are moved to spindle equator (ii) Centromere splits and chromatids separate (b)What are chiasmata? What is their significance	3
25	Explain cyclic photophosphorylation along with its pathway	3
26	(i)Name the causative agent of 'bakane'disease in rice seedlings (ii)Name the stress hormone sound in plants (iii)Name the PGR that increase yield of sugarcane	3
27	(i)List two factors which affect the rate of diffusion of a gas (ii) What is the term given to the maximum volume of air, a person can breathe in after a forceful expiration (iii)What is one of the major causes of emphysema?	3
28	(i)Why is the cerebral cortex referred to as grey matter too? (ii)Mention any two functions of the association areas of cerebral cortex. (iii)Why does cerebellum have a very convoluted surface?	3
	SECTION D	
	Q.no 29 and 30 are case based questions. Each question has subparts with internal choice in one subpart.	
29.	The conifer forests of the world cover huge areas of land and provide the largest terrestrial carbon sink. Conifers are also valued economically; their softwood is used for the production of timber, they are used to cultivate pine nuts, and the berries of the juniper bush are used to flavour gin. As in all other vascular plants, gymnosperms have a sporophyte dominant life cycle (the sporophyte is the diploid multicellular stage, which comprises the body of the plant, i.e., a leafy tree). The gametophyte phase is relatively short, and sees gametes produced on the reproductive organs.	

	1(i) For a plant species to be 'dioecious', it must: (a) Reproduce asexually (b) Have both male and female organs (c) Have separate male and female individuals (d)Not reproduce (ii) Which division of the gymnosperms is most commonly used to create paper? (a) Conifers (b) Cycads (c) Gnetophyta (d) Gingkophyta (iii) What role does the cone have in the gymnosperm life cycle? (a)It is the seed (b)It is the male gametophyte (c) It is the reproductive body (d) It feeds the embryo (iv)Conifers are adapted to tolerate extreme environmental conditions because of- (a) broad hardy leaves. (b) superficial stomata. (c) thick cuticle (d) presence of vessels. OR (v)Cycas and Adiantum resemble each other in having: (a) seeds (b) motile sperms (c) cambium (d) vessels	4
30	Lipids form a heterogeneous group but all are made up of carbon hydrogen and oxygen. These are insoluble in water and soluble in organic solvents like acetone, ether, alcohol etc. The number of oxygen atoms is very small compared to carbon atoms. They need a large amount of oxygen for their oxidation to release energy. They could be simple lipids, compound lipids, and derived lipids. Simple lipids are esters of fatty acid and alcohol. Compound lipids are formed when simple lipids combine with another compounds for example glycolipids, phospholipids and lipoproteins. Derived lipids are of various types and important example being steroids. i) Lipids mainly consist of A) Carbon only B) carbon hydrogen and nitrogen C) carbon hydrogen and oxygen D) Hydrogen only ii) Among the given options non-polymeric molecule is A) Nucleic acids B) proteins C) Lipids D) polysaccharides iii) An example of unsaturated fatty acid is A) oleic acid B) stearic acid C) Linoleic acid D) both a and c iv) The number of carbon atoms as compared to oxygen atoms in lipids is A) same B) much less C) much more D) none of these. OR v) Steroids are an example of A) derived lipids B) conjugated lipids C) simple lipids D) lipo protein	
	SECTION E	

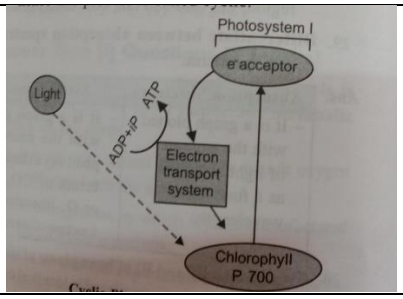
31	a) List four points of difference between virus and viroids b) What is meant by contagium vivum fluidum.Who gave this idea? c) Name the groups of organisms included in the phylum Chrysophyta OR (a)Give a comparative account of the nature of cell wall and the characteristic of flagella among three classes of algae (b)Differentiate between Thallophytes and Bryophytes	5
32	Who proposed the fluid mosaic model of plasma membrane? Describe the fluid mosaic model of plasma membrane with the help of a labelled diagram. OR a) Where are ribsosomes present in a prokaryotic cell?What is their function?Differentiate between RER and SER b) What are plasmodesmata? What is their function	5
33	(i)In old age people suffer from stiffness and inflammation in joints. What is this condition called?What is the cause of osteoporosis? (ii)Explain the sliding filament theory of the mechanism of muscle contraction OR a) Differentiate between Skeletal muscles and visceral muscles b) Explain the role of calcium ions and ATP in muscle contraction	5

SAMPLE PAPER 2

ANSWER KEY

	SECTION -A
Q No	Answer
1	C
2	c
3	b
4	1-b ii-c iii-a
5	a
6	c
7	Pyruvic acid
8	c. Gibberellin
9	ii. P O_2 higher P CO_2 lesser
10	(a)Juxtaglomerular (JG) cells
11	True
`12	d
13	A
14	C
15	B
16	A

	Section B
17	Plasmodium (1) Unfavourablesonditions form fruiting bodies that bears spores at their tips(2)
18	(a)Meristematic tissue(1) (b)Xylem parenchyma(1)
19	A-Cardiac muscle (½ Marks) B- Smooth muscle (½ Marks) One difference- 1 mark
20	(i_Conversion of glucose into pyruvic acid (ii)Convresion of fructose 6 phosphate into fructose 1,6- biphosphate. (1+1)
21	Atria of the heart receives oxygenated and deoxygenated blood separately but the two get mixed up in ventricle which pumps out mixed blood. Eg. Amphibians.
	Section- C
22	6 * ½ =3
23	a)A-Tendril (½) B- Axillary bud(½) b) (i)cut into two equal parts along any radial plane passing through the centre (1) (ii)Syncarpous: If carpels are fused.(1)
24	(a)(i)Metaphase(1) (ii)Anaphase of mitosis and anaphase II of meiosis(1) (b) X shaped structures formed at the point of crossing over. They represent the sites of cross overs and hence exchange of genetic material or recombination(½ + ½)
25	(i) Occurs In stroma lamella (ii) Involves only PS I (iii) When the photons activate P700 (PS1) , it emits pair of electrons. (iv) These electrons with high potential energy are captured by a primary acceptor and re transported down an electron transport chain consisting of ferredoxin, plastoquinone, cytochrome complex and plastocyanin. (v) At each step of electron transfer, the electrons lose some amount of energy (vi) This energy is used to pump H+ across the thylakoid membrane (vii) The energy liberated when the protons diffuse across the thylakoid membrane is used for the formation of ATP. (viii) The degenerised electrons come back to P700 and hence this process is called cyclic .



26 (i)Gibberellafujikuroi (1)
(ii)Abscisic acid (1)
(iii)Gibberellins (1)

27 (i)Thickness, solubility (½ + ½)
(ii)Vital Capacity(1m)
(iii)Cigarette smoking(1)

28 (i)Contains cell bodies of the neurons, which give a greyish appearance
(ii)Intersensory association, memory , communication (1M)
(iii)To provide accomodation for a large number of neurons.

Section D

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

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

Section E

31 (A) Difference

Viroids	Virus
1. Lack a protein coat	1. Have a protein coat
2. They are short segments of free RNA, that is infectious	2.Genetic material is RNA or DNA
3. Smaller than viruses	3.Comparatively larger
4. RNA is of low molecular weight	4.RNA is of high molecular weight

(b)Infectious living fluid, MW Beijerinek (2M)
c)Diatoms and desmids
OR
a)

	Cell Wall	Nature of Flagella
Chlorophyceae	Cellulose	2-8 equal. Apical
Phaeophyceae	Cellulose and algin	2 unequal , lateral
Rhodophyceae	Cellulose, pectin and poly sulphate esters	Absent

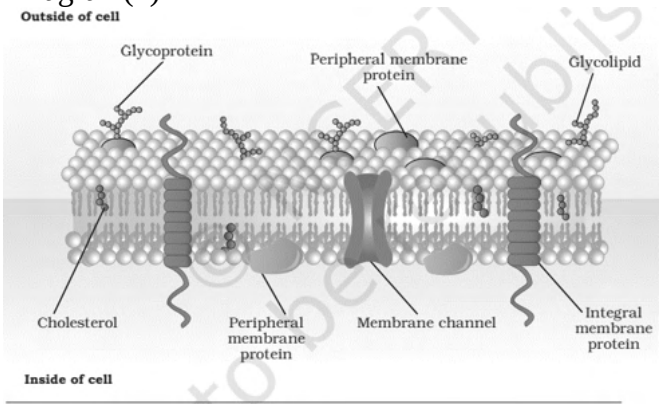
b)

Thallophytes	Bryophytes

	1. Aquatic, freshwater or marine	1. Land plants , living in damp and shady places
	2. Sex organs are unicellular and do not have a protective covering	2. Sex organs are multicellular and have a protective covering.
	3. Sporophyte is absent and zygote is the only diploid phase	3. Zygote develops into an embryo and then into a diploid sporophyte
	4. Have a thalloid body	4. Root like , stem like parts present.

32

Singer and Nicolson(1M)
Proper explanation(2M)
The model suggests plasma membrane to be lipid bilayer surrounding the cell with mosaic of globular proteins. Composition of lipid and protein varies in different cells, for example, human erythrocyte membrane contains approximately 52 per cent protein and 40 per cent lipids. Lipid bilayer makes the cell boundary in a quasifluid state and it is dynamic in nature. Due to the fluid nature, lipids and proteins can freely diffuse laterally across the membrane. Phospholipids (the major membrane lipid) is composed of hydrophilic head facing the exterior and long hydrophobic tail of hydrocarbon chains occupying the interior of a lipid bilayer. Two different types of proteins have been identified in the plasma membrane based on their location and association i.e., peripheral and integral membrane proteins. Peripheral membrane proteins are mainly involved in cell signalling and these are superficially attached to lipid bilayer. Integral membrane proteins are partially or fully buried in the plasma membrane. Transmembrane proteins are the most abundant type of integral membrane protein.
Well labelled Diagram(2)



OR

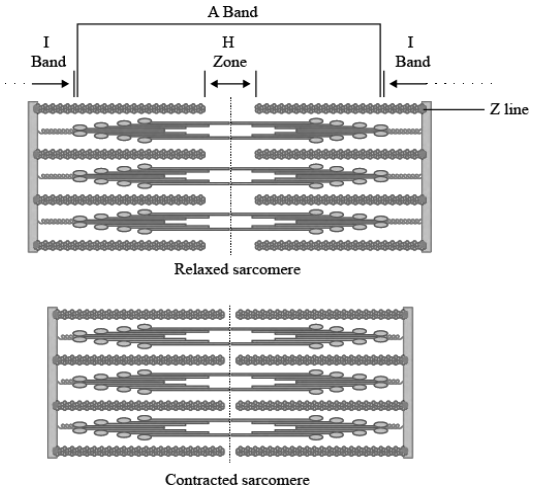
3+2
a)Ribosomes are present on Endoplasmic Reticulum(1M)
Synthesis Protein(1M)
RER- Endoplasmic Reticulum that contains Ribsomes
SER- Endoplasmic Reticulum that does not contain Ribosomes(1M)
b)
Plasmodesmata - cytoplasmic bridges that transverse the primary cell wall and middle lamella and connect the adjacent cell. They form transport channels between adjacent cells(2M)

33

(i)arthritis(1)Decreased level of estrogen causes osteoporosis(1)
(ii)Proper Explanation(3)
The sliding filament theory explains the process of muscle contraction during which the thin filaments slide over the thick filaments, which shortens the myofibril.

Each muscle fibre has an alternate light and dark band, which contains a special contractile protein, called actin and myosin respectively. Actin is a thin contractile protein present in the light band and is known as the I-band, whereas myosin is a thick contractile protein present in the dark band and is known as the A-band. There is an elastic fibre called z line that bisects each I-band. The thin filament is firmly anchored to the z line. The central part of the thick filament that is not overlapped by the thin filament is known as the H-zone.

During muscle contraction, the myosin heads or cross bridges come in close contact with the thin filaments. As a result, the thin filaments are pulled towards the middle of the sarcomere. The Z line attached to the actin filaments is also pulled leading to the shortening of the sarcomere. Hence, the length of the band remains constant as its original length and the I-band shortens and the H-zone disappears.



OR

Difference between Skeletal and Visceral muscles(3M)

Skeletal Muscles	Visceral Muscles
1. Found attached to the skeletal elements	1. They are found in the wall of visceral organs.
2. They are voluntary in function	2.They are involuntary
3. Striations are prominent	3.Striations are absent

Role of calcium ions(2M)
Role of calcium in muscle contraction:
During muscle contraction, microfilaments move over thick filaments.
A transmitter sent out by the nervous system via a motor neuron causes muscle movement.

	Chemicals called neurotransmitters are released when a neural signal is applied to a neuromuscular junction and an excitatory is formed in the sarcolemma. Like the signal travels through the muscle fiber, calcium ions are released in the sarcoplasm. Calcium then activates myosin by shackling to troponin on the cytoskeleton.

Sample Question Paper 3 2022-23
CLASS XI BIOLOGY

Maximum Marks: 70 Time 3 hours

General Instructions:

*All questions are compulsory.

*The question paper has five sections and 33 questions. All questions are compulsory.

*Section–A has 16 questions of 1 mark each; Section–B has 5 questions of 2 marks each; Section– C has 7 questions of 3 marks each; Section– D has 2 case-based questions of 4 marks each; and Section–E has 3 questions of 5 marks each.

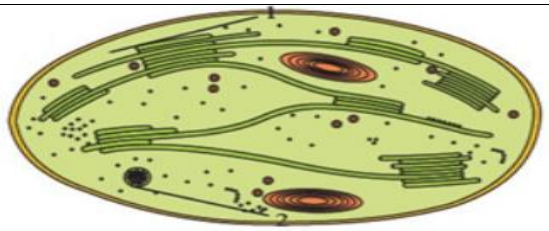
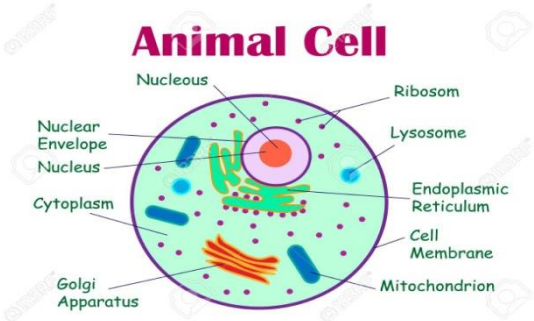
*There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.

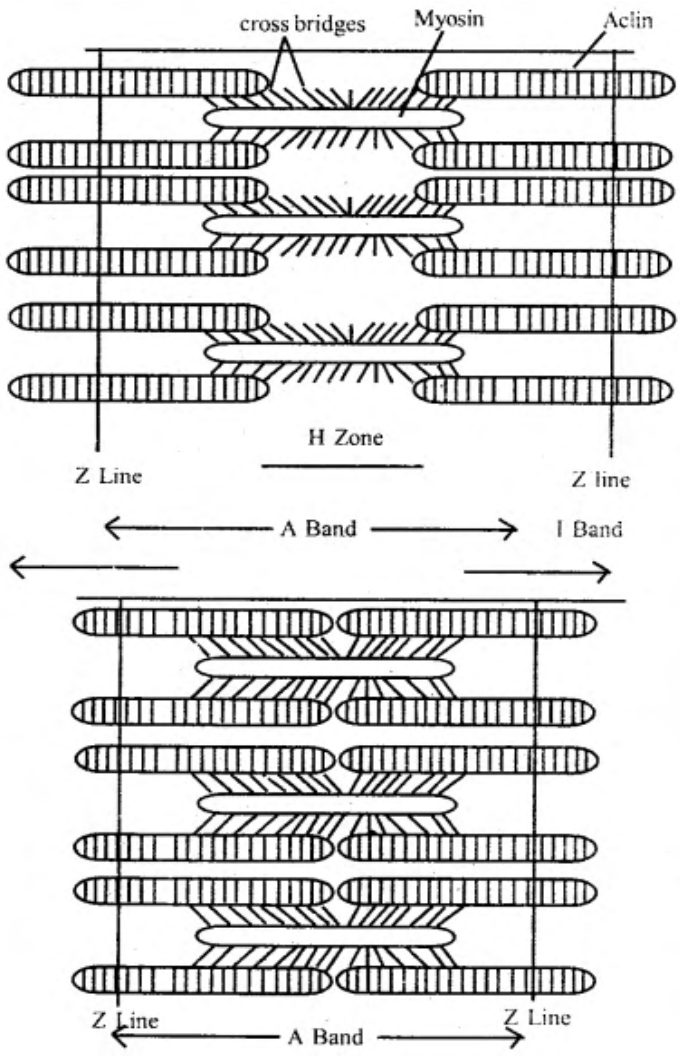
*Wherever necessary, neat and properly labeled diagrams should be drawn

1.	Binomial nomenclature was given by a. Linnaeus b.Hugo de Vries c.John Ray d Huxley	1
2	2. The morphological nature of the edible part of a coconut is a. Cotyledon b. Perisperm c. Pericarp d. Endosperm	1
3	Antibodies are chemically _____. a. Fats b. Foreign pathogens c. Actin d. Protein	1
4	Which of the following are not membrane-bound ORGANELL? a) Ribosomes b) Mesosomes c) Vacuoles d) Lysosomes	1

5	The longest stage in the cell cycle is a)Interphase b)Anaphase c)Metaphase d)None of the above	1
6	The end product of the Calvin cycle (a) RuBP (b) PGAL (c) PGA (d) ADP + NAD	1
7	Malacophily means (a) pollination by wind (b) pollination by water (c) pollination by snails (d) pollination by animals	1
8	Typical plant growth shows (a) J-shaped curve (b) S-shaped curve (c) I-shaped curve (d) Parabolic curve	1
9	In brain, respiratory control centre lies in (a) pons (b) medulla oblongata (c) hypothalamus (d) cerebrum	1
10	Kidneys are located in (a) thoracic cavity (b) abdominal cavity (c) body cavity (d) pelvic cavity	1
11	Match the columns. A. Hinge Joint – 1. Carpals B. Saddle Joint – 2. Knee C. Pivot Joint – 3. Thumb D. Gliding Joint – 4. Vertebra (a) A-4, B-3, C-1, D-2 (b) A-3, B-1, C-2, D-4 (c) A-2, B-3, C-4, D-1 (d) A-3, B-1, C-4, D-2	1

12	Which is an emergency hormone? (a) Norepinephrine (b) Androgen (c) Cortisol (d) FSH	1
	Question No. 13 to 16 consist of two statements – Assertion (A) and Reason (R). Answer these questions by selecting the appropriate option given below: A. Both A and R are true and R is the correct explanation of A. B. Both A and R are true and R is not the correct explanation of A. C. A is true but R is false. D. A is False but R is true.	
13	Assertion : Specialization of cells is advantageous for the organisms. Reason : It increases the operational efficiency of an organism.	1
14	Assertion : Cell growth is a continuous process in terms of cytoplasmic increase. Reason : DNA synthesis occurs only during two specific stages in the cell cycle.	1
15	Assertion : Stomata are absent in submerged hydrophytes. Reason : Respiration occurs by means of air chambers in submerged plants.	1
16	Assertion: Both ammonia and urea are excreted by earthworms. Reason: Excretion in earthworm depends on the environment.	1
	SECTION B(2 MARKS)	
17	What do you understand by 'phycobiont' and 'mycobiont'?	2
18	Why are phloem and xylem, complex tissues?	2
19.	Mention the cellular components of blood.	2
20	On what factor the respiratory quotient depends?	2
21	Write about three valves in the heart	2
	SECTION C (3 MARKS)	
22	. Distinguish between the Chordates and Non-Chordates	3
23	. What do you mean by phyllotaxy?	3
24	What is the significance of meiosis.	3

25	 a) Is this composition present in a plant cell or animal cell? b) Can it be inherited by the offspring? How? c) Write the metabolic processes that are occurring at the places marked as (1) and (2) in the figure	3
26	What are Plant growth regulators?	3
27	List the following steps in a sequential manner for the completion of the respiration process. a) Diffusion of oxygen and CO_2 across the alveolar membrane b) Transportation of gases by blood c) Utilization of oxygen for catabolic reactions by the cells and hence the resultant release of CO_2 d) Pulmonary ventilation through which atmospheric air is drawn in and carbon dioxide-rich alveolar air is given out e) Diffusion of oxygen and carbon dioxide between tissues and blood	3
28	How could it affect a person's CNS if he is attacked by a blow on the back of the neck?	3
	SECTION D (5 MARKS)	
29	What do you mean by double fertilization and triple fusion? (OR) Write the economic importance of gymnosperms	5
30	Which of these structures is responsible for  	

30	(a) Manufacture of lipids and steroids (b) Release of energy (c) Manufacture of hormones and digestive enzymes (d) Production of spindle fi;bres in cell division (e) Endo and exocytosis (OR) Draw the types of chromosomes based on the position of centromere	5
31	Describe the significance of Ca^{2+} ions in the contraction of muscles. (OR)  How thick and thin filaments are arranged in a muscle fibre?What is the relationship between actin and myosin filaments in stretched and contracted states	5
	CASE BASED QUESTIONS	

32	Algae are a diverse group of aquatic organisms that have the ability to conduct photosynthesis, they are unicellular or multicellular and undifferentiated organisms that occur in a variety of forms and sizes . Algae belong to a polygenetic group. Based on the pigment , composition and reserved food material, algae has been divided into three major classes, viz. chlorophyceae , phaeophyceae and Rhodophyceae. The members of these classes also differ in cell wall composition, stored food material , body structure , mode of reproduction , etc. (1) A representative organism of class Rhodophyceae is (a) Spirogyra (b) fucus (c) Polysphonia (d)Chlorella (2) Multicellular saline forms are found in (a) Rhodophyceae (b) Chlorophyceae (c) Phaeophyceae (d) All the above 3) Stored food material in class – Phaeophyceae is (a) mannitol and laminarin (b) floridean starch (c) pyrenoids (d) All of the above (4) Cell wall of Porphyra (red algae) contains (a) cellulose (b) pectins (c) Poly sulphate esters (d) all of these	4
33	The detailed structure of the membrane was studied only after the advent of the electron microscope in the 1950s. Meanwhile, chemical studies on the cell membrane, especially in human red blood cells (RBCs), enabled the scientists to deduce the possible structure of the plasma membrane. These studies showed that the cell membrane is composed of lipids, proteins and carbohydrates. 1. Which component of the plasma membrane is arranged as a bilayer? 1. Nucleic acid 2. Lipid 3. Protein 4. Carbohydrate 2. The lipid component of the membrane mainly consists of _____. 1. Phosphoglycerides 2. Amino 3. acids 4. Glycoproteins 2. What percentage of the membrane of human erythrocytes consists of proteins? 1. 40 2. 70 3. 52 4. 66 2. Depending on the ease of extraction, membrane proteins can be of _____ types. 1. Three 2. Two 3. Four 4. Five	4

ANSWER KEY

CLASS XI BIOLOGY

Maximum Marks: 70 Time: 3 hours

	SECTION A	
1	(a) Carolus Linnaeus	1
2	(d) Endosperm	1
3	(d)Proteins	1
4	(a) Ribosomes	1
5	.(a) Interphase	1
6	(a) RuBP	1
7	(c)Pollination by snails	1
8	(b) S shaped curve	1
9	(b)Medulla Oblangata	1
10	(b) Abdominal cavity	1
11	(c) A-2,B-3, C-4,D-1	1
12	(a) Norepinephrine	1
13	A	1
14	C	1
15	B	1
16	A	1
	SECTION B (2 MARKS)	
17	The algal component of the lichens is known as phycobiont, while the fungal component is known as mycobiont. (1) Both the algae and the fungi live in symbiotic association with each other. The algae prepare food for the fungi and the fungi, in turn, provides shelter and absorbs nutrients from the soil.(1)	1 + 1
18	. Xylem and phloem are made up of more than one type of cells. Xylem conducts water and minerals and provides support to the plant. It is made up of tracheids, xylem parenchyma, and xylem fibres. (1) Phloem conducts food materials to various parts of the plant. It comprises of sieve tubes, phloem parenchyma, companion cells, and phloem fibres. (1)	1 + 1
19	Blood contains the following components: (4X1/2) • Plasma • Red Blood Cells • White Blood Cells • Platelets	4 X 1 / 2
20	The ratio of the volume of CO_2 evolved to the volume of O_2 consumed in respiration is called the respiratory quotient (1)	1 + 1

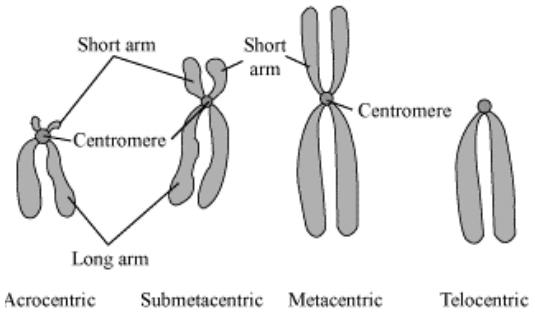
	$RQ = \frac{\text{Volume of } CO_2 \text{ evolved}}{\text{Volume of } O_2 \text{ consumed}}$ (a) RQ (the respiratory quotient) depends upon the type of respiratory substrate used during respiration. This is different for different substrates.(1)	
21	(a)Tricuspid valve: The valve present at the right atrioventricular aperture formed of three flaps. (b) Bicuspid valves: The valve present at the left atrioventricular aperture, formed of two flaps, also called the mitral valve. (c) Semi-lunar valve: Two sets of half-moon shaped valves, present at openings of pulmonary aorta and aorta, present here to check backflow of blood	1 + 1
	SECTION C(3 MARKS)	
22		3

Chordates	Non-Chordates
1. Notochord present.	1. Notochord absent.
2. Central nervous system is dorsal, hollow, and single.	2. Central nervous system is ventral solid and double
3. Pharynx perforated by gill slices	3. Gill slits are absent.
4. Heart is ventral.	4. Heart is dorsal.
5. A post-anal (tail) is present.	5. Past-anal tail is absent.

(Any 3 points)

23	The pattern of arrangement of leaves on the stem or branch is termed phyllotaxy.(1) It is usually of three types: (2)	1 + 2

	(a) Alternate: A single leaf arises at each node in an alternate manner, as in a china rose. (b) Opposite: A pair of leaves arise at each node and lie opposite to each other as in calotropis and guava plants. (c) Whorled: When more than two leaves arise at a node and form a whorl, as in Alstonia.	
24	(a) Sexual reproduction: Maintains a number of chromosomes constant. Characteristic of a species from generation to generation.(1 ½) (b) Genetic variation: Through crossing over, it produces variations of genetic characters of the progeny essential for evolution. (1 ½)	1 1 / 2 + 1 1 / 2
25	It is a chloroplast, green in colour, found in plant cells(1) b) Because of the presence of extranuclear DNA, it has the potential to self-replicate.(1) c) At site 1 – Dark reactions of photosynthesis takes place at the stroma of the chloroplasts. At 2 – It is the structure of extracellular DNA that is responsible for replication of chloroplasts when necessary in the photosynthesizing cells.(1)	1 + 1 + 1
26	Plant growth regulators also referred to as phytohormones or plant hormones. (1)They are a group of organic compounds, which functions by controlling and modifying the physiological processes like the growth, development, and movement of plants(2)	1 + 2
27.	. Pulmonary ventilation through which atmospheric air is drawn in and carbon dioxide-rich alveolar air is given out a) Diffusion of oxygen and CO_2 across the alveolar membrane b) Transportation of gases by blood e) Diffusion of oxygen and CO_2 between tissues and blood c) Utilization of oxygen for catabolic reactions by the cells and hence the resultant release of CO2	1 + 1 + 1
28.	It would lead to an impairment of cognitive abilities or dysfunctionalities physically. (1)Furthermore, it can also cause disturbance of emotional or behavioural functioning. (1)Cervical damages can lead to tetraplegia(1)	1 + 1 + 1
	SECTION D(5 MARKS)	
29.	In this process, one male gamete fertilizes the egg and forms a diploid zygote. The other male gametes fuse with the two polar nuclei forming a triploid zygote that develops into the endosperm. This is known as double fertilization. The three	5

	haploid nuclei fuse to form endosperm. It is known as triple fusion. (OR) Algae, the natural substance can be used as a food source, fodder, fish farming, and as fertilizer. It also plays a key role in alkaline reclaiming and can be used as a soil binding agent as well as can be used in a variety of commercial products.	
30	(a) Smooth endoplasmic reticulum (b) Mitochondria (c) Ribosomes (d) Centrioles (e) Plasma membrane OR  	5
31	Calcium plays a key role in the muscle contraction process. During contraction of muscles, from the motor endplate, an action potential passes over the sarcolemma and further into the T-tubules and sarcoplasmic reticulum and triggers it to produce Ca^{2+} ions into the sarcoplasm. The binding of calcium ions to the troponin causes its shape and position to change which in turn modifies the position and shape of tropomyosin that binds the troponin. This shift presents the active sites on the molecule, F-actin which prompts the myosin cross-bridges to bind to these active sites .(OR) Each striated muscle contains thin actin and thick myosin filaments. These filaments are longitudinally arranged inside light I bands and dark A bands respectively. The actin and myosin filaments remain cross-linked with each other in the myofibril. Sarcomeres are the rows of functional unit in each myofibril, each extending from the dark Z- line of the next I band. Each sarcomere thus comprises of A band in the middle with 2 half I band on its two sides. From each Z line, the actin filaments through half of the I band intermingles with the ends of myosin filaments in the A band. The myofibril is surrounded at each I band by the tubules and cisternae of sarcoplasmic reticulum and at each junction of A and I bands by a TI tubule communicating with the cell exterior, which is shown in the figure. The relationship between actin (thin filament) and myosin (thick filament).	5

	CASE BASED QUESTIONS(4 MARKS)	
32	1. c 2. a 3. a 4. d	4
33	a) 2)lipid b) 1)Phosphoglycerides c) 3)52 d) 2) 2	4
