SUPPORT MATERIAL FOR BIOLOGY

CLASS XI

C.S DAV PUBLIC SCHOOL BIOLOGY

DEPARTMENT PREPARED SUPPORT

MATERIALS

Chapter-1
THE LIVING WORLD

POINTS TO REMEMBER

Characteristics of Living Organisms : Growth, reproduction, metabolism, cellular organisation, consciousness (ability to sense environment), self-rep- licating and self regulation.

- Reproduction and growth are NOT defining properties.
- Metabolism, cellular organisation and consciousness are defining properties.

Biodiversity : Term used to refer to the number of varieties of plant and animals on earth.

Need for classification : To organise the vast number of plants and animals into categories that could be named, remembered, studied and understood.

Rules for Nomenclature : • Latinised names are used.

- First word is genus, second word is species name.
- Printed in italics; if handwritten then underline separately.
- First word starts with capital letter while species name written in small letter.

ICBN : International Code of Botanical Nomenclature (for giving scientific name to plants.)

ICZN : International Code of Zoological Nomenclature (for giving scientific name to animals.)

Taxonomy : Study of principles and procedures of classification.

Binomial Nomenclature : Given by Carolus Linnaeus. Each scientific name has two components - Generic name + Specific epithet.

Systematics : It deals with classification of organisms based on their diversities and relationships among them. Term was proposed by Carlous Linnaeus who wrote 'Systema Naturae'.

Taxonomic Hierarchy : Arrangement of various steps (categories or taxa or ranks) of classification.

Species → Genus → Family → Order → Class → Phylum (for animals) / Division (for plants) Kingdom →

Species : All the members that can interbreed among themselves and can produce fertile offsprings are the members of same species. This is the biological concept of species proposed by Mayr.

Three Domains of Life : Proposed by Carl Woese in 1990 who also proposed the six kingdom classification for living organisms. The three Domains are Archaea, Bacteria and Eukarya.

Domains
- Archaea → Archaebacteria
- Eubacteria → Monera
- Eukaryota →
  - Protista
  - Mycota
  - Plantae
  - Animalia

Herbarium Storehouse of dried, pressed and preserved plant specimen on sheets.

Botanical Garden Collection of living plants for reference.

Taxonomical aids Zoological Park (Places where wild animals are kept in protected environment.)

- Keys (Used for identification of plant and animals on the basis of similarities and dissimilarities.)
- Flora (Index to plant species found in a particular area.)
- Manuals (Provide information for identification of name of species in an area.)
- Monograph (Contain information on one taxon.)

QUESTIONS

Very Short Answer Questions (1 mark each)

1. Define species.
2. What is systematics ?
3. Give the names of two famous botanical gardens.

Short Answer Questions-II (2 marks each)

4. What is the basis of modern taxonomical studies ?

5. **Why growth and reproduction cannot be taken as defining property of all living organisms** ?

6. How is a taxon (pl. taxa) defined ?

Short Answer Questions-I (3 marks each)

7. What is the difference between Botanical Garden and Herbarium ?

8. Keys are analytical in nature and are helpful in identification and classification of organisms.How ?

9. Define : (a) Genus (b) Family (c) Order

Long Answer Questions (5 marks each)

10. What are the universal rules of nomenclature ? What does 'Linn.' refer to in *Mangifera indica* Linn. ?

11. Illustrate taxonomical hierarchy with suitable examples from plant and animal species.

ANSWERS

Very Short Answers (1 mark each)

1. Members that can interbreed to produce fertile offspring.

2. Systematic arrangement which also takes into account evolutionary relationships between organisms.

3. Kew (England) and National Botanical Research Institute (Lucknow), Indian Botanical Garden (Howrah).

Short Answers-II (2 marks each)

4. External and internal structure, structure of cell, development process and ecological information.

5. • Non-living things can also increase in mass by accumulation of material on surface.

• Many organisms do not reproduce (*e.g.,* mules, sterile worker bees).

6. Each category in a taxonomical hierarchy represents a rank and is called taxon.

Short Answers-I (3 marks each)

7. Botanical Garden : Collection of living plants.

Herbarium : Collection of dried, pressed and preserved plant specimens on sheets.

8. Refer page no. 13 NCERT, Text Book of Biology for Class XI.

9. Genus : Group of related species; Family : Group of related genera; Order : Group of related families.

Long Answers (5 marks)

10. Refer page no. 7, NCERT, Text Book of Biology for Class XI.

'Linn.' indicates that the species was first described by Linnaeus.

11. Refer table 1.1, page no. 11, NCERT, Text Book of Biology for Class XI.

Chapter-2
BIOLOGICAL CLASSIFICATION

POINTS TO REMEMBER

SYSTEMS OF CLASSIFICATION

• Earliest Classification was given by Aristotle. Divided plants into herbs, shrubs and trees.

Animals into those with RBC's and those who do not have it.

•**Two kingdom classification :** Given by Carolous Linnaeus – Plant kingdom and Animal kingdom.

• **Five kingdom classification :** By R. H. Whittaker. Monera, Protista, Fungi, Plantae and Animalia are the five kingdoms.

Kingdom Monera :

• Has bacteria a sole member.

• Bacteria can have shapes like : Coccus (spheri cal), Bacillus (rod-shaped), Vibrio (comma shaped) and sprillum (spiral shaped).

• Bacteria found almost everywhere and can be Photosynthetic autotrophs, Chemosynthetic au totrophs or Heterotrophs.

Bacteria

Archaebacteria : • Halophiles (salt-loving)

• Thermoacidophiles (in hot springs)

• Methanogens (in marsh and in gut of ruminant animals. Produce methane gas.)

Eubacteria :

• Photosynthetic autotrophs like Cyanobacteria. Some like Anabaena have specialised cells called **heterocysts** for nitrogen fixation.

• **Chemosynthetic autotrophs :** Oxidise various inorganic substances like nitrates/nitrites, ammonia and use released energy for their ATP production.

• **Heterotrophic bacteria :** Decomposes, help in making curd, production of antibi otics, N_2 fixation, cause diseases like chol era, typhoid.

Mycoplasma : Completely lack cell wall. Smallest living cells. Can survive without oxygen. Pathogenic in animals and plants.

Kingdom Prostita

(All single celled eukaryotes)

• Forms a link between plants, animals and fungi.

(i) Chrysophytes (Has diatoms and golden algae)

• Cell walls have silica and cell walls overlap to fit together like a soap box.

• Their accumulation forms 'Diatomaceous Earth'.

• Used in polishing, filtration of oils and syrups.

(ii) Dinoflagellates : • Marine, photosynthetic, cell wall has cellulose.

• Two flagella – one longitudinal and other transversely in a furrow between wall plates.

(iii) Euglenoids : • Have protein rich layer 'pellicle' which makes body flexible.

• Photosynthetic in presence of sunlight but become heterotrophs if they do not get sunlight.

(iv) Slime Moulds : • Saprophytic protists

• Form aggregates to form plasmodium grows on decaying twigs and leaves.

• Spores have true walls which are extremely resistant and survive for many years.

(v) Protozoans :

Amoeboid : Catch prey using pseudopodia, *e.g.,* Amoeba.

Flagellated : More flagella. Cause disease like sleeping sickness *e.g., Trypanosoma*.

Ciliated : Have cilia to move food into gullet and help in locomotion. *e.g., Paramecium.*

Sporozoans : Have infective spore like stage in life cycle, *e.g., Plasmodium* which causes Malaria.

KINGDOM FUNGI

- Non chlorophyllous hyphae
- Network of hyphae called mycelium
- Cell wall of chitin and polysaccharides
- Grow in warm and humid places
- Saprophytic, parasitic, symbiotic (Lichen)

e.g., ***Puccinia*** (rust causing), ***Penicillium.***

CLASSES OF FUNGI

(i) Phycomycetes :

- grow on decaying wood
- Mycelium septate
- Spores produced endogenously
- Asexual reproduction by Zoospores or Aplanospores

e.g., ***Rhizopus, Albugo.***

(ii) Ascomycetes :

- Also known as 'sac fungi'
- Mycelium branched and septate
- Spores : Asexual spores are called conidia produced exogenously on the conidiophores.

Sexual spores are called ascospores produced endog enously in ascus produced inside fruiting body called Ascocarp.

e.g., ***Aspergillus, Neurospora.***

(iii) Basidiomycetes

- Mycelium septate.
- Asexual spores generally are not found.
- Vegetative reproduction by fragmentation.
- Sexual reproduction by fusion of vegetative or somatic cells to form basidium produced in basidiocarp.
- Basidium produced four basidiospores after meiosis.

e.g., ***Agaricus, Ustilago.***

(iv) Deuteromycetes

- Called as 'Fungi Imperfecti' as sexual form (per fect stage) is not known for them.
- Once sexual form is discovered the member is moved to Ascomycetes or Basidiomycetes.

• Mycelium is septate and branched.

• Are saprophytic, parasitic or decomposers.

e.g., ***Alternaria, Colletotrichum.***

Viruses : • They did not find a place in classification. Take over the machin ery of host cell on entering it but as such they have inert crystalline structure. So, difficult to call them **living or non-living.**

• Pasteur gave the term 'Virus' *i.e.*, poisonous fluid.

• D. J. Ivanowsky found out that certain microbes caused Tobacco Mosaic Disease in tobacco plant.

• M. W. Beijerinek called fluid as 'Contagium vivum fluidum' as extracts of infected plants of tobacco could cause infection in healthy plants.

• W. M. Stanely showed viruses could be crystallised to form crystals of protein which are inert outside their specific host.

Structure of Virus :

• Its a nucleoprotein made up of protein called Capsid. Capsid is made up of capsomeres arranged in halical or polygeometric forms. Have either DNA or RNA as genetic material which may be single or double stranded.

• Usually plant viruses have single stranded RNA; bacteriophages have double stranded DNA and animal viruses have single or double stranded RNA or double stranded DNA.

Diseases caused : Mumps, Small pox, AIDS etc.

Viroids : • Infectious agent, free RNA (lack protein coat)

• RNA has low molecular weight.

• Causes potato spindle tuber disease.

• Discovered by T. O. Diener.

• **Lichens :** • Symbiotic association between algal component (Phycobiont) and fungal component (mycobiont). Algae provide food. Fungi provide shelter and absorb nutrients for alga.

• Good pollution indicators as they do not grow in polluted areas.

QUESTIONS

Very Short Answer Questions (1 mark each)

1. ***Nostoc*** and ***Anabaena*** have specialised cells called hetercysts. What is the function of these cells ?
2. Which group comprises of single celled eukaryotes only ?
3. Which organisms are the chief producers in oceans ?
4. Name the fungus which causes disease in wheat (i) rust (ii) Smut.
5. Which Ascomycetes has been used extensively in biochemical and genetic work ?

Short Answer Questions-II (2 marks each)

6. How are bacteria classified on basis of their shapes ?
7. What is the mode of reproduction in bacteria ?
8. Why are red tides caused and why are they harmful ?
9. Viruses and viroids differ in structure and the diseases they cause. How ?
10. Which class of kingdom fungi has both unicellular as well as multicellular members ? When is a fungus called coprophilous ?

Short Answer Questions-I (3 marks each)

11. Who gave five kingdom classification ? What was the criteria used by him ?
12. What are the steps in the sexual cycle in kingdom fungi ?
13. Some symbiotic organisms are very good pollution indicators and composed of a chlorophyllous and a non-chlorophyllous member. Describe them.

Long Answer Questions (5 marks each)

14. Some primitive relatives of animals live as predators or parasites and are divided into four major groups. Elaborate.
15. Differentiate between various classes of kingdom Fungi on the basis of their (i) Mycelium, (ii) Types of spores and (iii) Type of fruiting body. Also give two examples for each class.

ANSWERS

Very Short Answers (1 mark)

1. Help in nitrogen fixation.

2. Kingdom Protista.

3. Diatoms

4. (i) *Puccinia,* (ii) *Ustilago*

5. *Neurospora*

Short Answers-II (2 marks each)

6. Bacillus (rod-shaped), Coccus (spherical), Vibrium (comma shaped) and Spirillum (spiral shaped).

7. Mainly by fission; Production of spores in unfavourable conditions. Sexual reproduction by DNA transfer.

8. Rapid multiplication of dinoflagellates like *Gonyaulax*. Harmful as they release toxins which kill marine animals.

9. Refer 'Points to Remember'

10. Ascomycetes : Yeast (Unicellular), *Penicillium* (Multicellular), Coprophilous means fungi which grow on dung.

Short Answers-I (3 marks each)

11. R. H. Whittakar. Criteria for classification : Cell structure, thallus organisation, mode of nutrition, reproduction and phylogenetic relationships.

12. The steps are (i) Plasmogamy : fusion of protoplasm of two motile or non-motile gametes.

(ii) Kayogamy : fusion of two nuclei.

(iii) Zygotic Meiosis to form haploid spores.

(iv) Dikaryophase in ascomycetes and basidiomycetes where before karyo gamy two nuclei per cell (dikaryon) are found.

13. Lichens. Refer 'Points to Remember'

Long Answers (5 marks each)

14. Protozoans. Refer page no. 21-22, NCERT Text Book of Biology for Class XI Biology.

15. Refer NCERT Text Book of Biology for Class XI, page no. 23-24.

■

Chapter-3

PLANT KINGDOM

POINTS TO REMEMBER

CLASSIFICATION :

- **Artificial System of Classification**
  - Based on a few characteristics.
  - *e.g.,* By Carolous Linnaeus, based on androecium structure
- **Natural System of Classification**
  - Based on natural affinities among organisms
  - Included external as well as internal features
  - *e.g.,* By George Bentham and J. D. Hooker
- **Phylogenetic System of Classification**
  - Based on evolutionary relationships between the various organisms
  - *e.g.,* By Hutchinson

Numerical Taxonomy :
- Carried out using computers
- Based on all observable characteristics
- Data processed after assigning number and codes to all the characters.

Advantage : Each character gets equal importance and a number of characters can be considered.

Cytotaxonomy :
- Based on cytological information.
- Gives importance to chromosome number, structure and behaviour.

Chemataxonomy :
- Based on chemical constituents of the plants.

Importance of Algae :
- At least half of the total carbon dioxide fixation on earth carried out by them.
- Increase oxygen level in the environment.
- Many species like ***Laminaria, Sargassum*** etc. are used as food.

• Agar obtained from ***Gelidium*** and ***Gracilaria*** is used in ice-creams and jellies.

• Algin obtained from brown algae are carrageon from red algae used commercially.

• ***Chlorella*** and ***Spirullina*** are unicellular algae, rich in protein and used even by space travellers.

Algae divided into 3 classes :

• Algae are unicellular like ***Chlamydomonas***, colonial like ***Volvox*** or fila mentous like ***Spirogyra***.

• Are simple, thalloid, autotrophic and occur in water, soil, wood etc.

• Help in carbon dioxide fixation by carrying out photosynthesis and have immense economic importance.

(i) Chlorophyceae

• Green algae. Main pigment is chlorophyll 'a' and 'b'.

• Cell wall has inner layer of cellulose and outer layer of pectose.

• Has pyrenoids made up of starch and proteins.

e.g., ***Chlamydomona, Volvox, Spirogyra.***

(ii) Phaeophyceae

• Brown algae due to main pigments chlorophyll 'a', 'c' and fucoxanthin.

• Cell wall has cellulose and lignin or gelantinous coating of algin.

• Has mannitol and laminarin as reserve food material.

• Body divisible into holdfast, stipe and frond.

• *e.g.*, ***Ectocarpus, Fucus, Laminaria.***

(iii) Rhodophyceae

• Red algae due to pigments chlorophyll 'a', 'd' and *r*-phycoerythrin.

• Found on surface as well as great depths in oceans.

• Cell wall as cellulose.

• Reserve food material is floridean starch.

• *e.g.*, ***Polysiphonia, Porphyra, Gelidium.***

REPRODUCTION IN ALGAE

Vegetative reproduction : by fragmentation

Asexual Reproduction : Flagellated zoospores in Chlorophyceae

Biflagellated zoospores in Phaeophyceae

By non-motile spores in Rhodophyceae.

Sexual Reproduction : Isogamous, anisogamous or oogamous in Chlorophyceae and Phaeophyceae.

By non-motile gametes in Rhodophyceae.

BRYOPHYTES : 'Amphibians of plant kingdom'

- Occur in damp, humid places.
- Lack true roots, stem or leaves.
- Main plant body is haploid.
- **Economic Importance :** Food for herbaceous animals.

Sphagnum in form of peat is used as fuel and also used for trans-shipment of living material as it has water holding capacity, prevent soil erosion, along with lichens are first colonisers on barren rocks.

• Is divided into two classes Liverworts (thalloid body, dorsiventral, *e.g.*, ***Marchantia*)** and Mosses (have two stages in gametophyte – creeping, green, branched, filamentous protonema stage and the leafy stage having spirally arranged leaves *e.g.*, ***Funaria***.

REPRODUCTION IN BRYOPHYTES

• Vegetative reproduction by fragmentation.

• Asexual reproduction by gemmae formed in gemma cups.

• Sexual reproduction **:** By fusion of antherozoids produced in antheridium and egg cell produced in archegonium. This results in formation of zygote which develops into a sporophytic structure differentiated into foot, seta and capsule. Spores produced in a capsule germinate to form free-living gametophyte.

PTERIDOPHYTES :

• Main plant body is sporophyte which is differentiated into true stem and leaves.

• Leaves may be small (microsporophyll) as in ***Selaginella*** or large (macrophyll) as in ferns.

• Sporangia having spores are subtended by leaf-like appendages called sporophylls. (Sporophylls may be arranged to form strobili or cones.)

• In Sporangia, the spore mother cells give rise to spores after meiosis.

• Spores germinate to form haploid gametophytic structure called **prothallus** which is free living, small, multicellular and photosynthetic.

• Prothallus bears antheridia and archegonia which bear antherozoids and egg cell respectively which on fertilisation form zygote. Zygote produces multicellular, well differentiated sporophyte.

• The four classes are : Psilopsida (*Psilotum*), Lycopsida (*Selaginella*), Sphenopsida (*Equisetum*) and Pteropsida (*Pteris*).

HETEROSPORY : Two kinds of spores *i.e.,* large (macro) and small (micro) spores are produced. *e.g., Selaginella* and *Salvinia.*

SEED HABIT : The development of zygote into young embryos takes place within the female gametophyte which is retained on parent sporophyte. This is an important step in evolution and is found in ***Selaginella*** and ***Salvinia*** among the pteridophytes.

GYMNOSPERMS : • Have naked seeds as the ovules are not enclosed by any ovary wall and remain exposed.

• Male cone has microsporophylls which bear microsporangia having microspores which develop into reduced gametophyte called pollen grain.

• Female cone has megasporophylls which bear megasporongia having megaspores which are enclosed within the megasporangium (Nucellus). One megaspore develops into female gametophyte bearing two or more archegonia.

• Pollen grains carried in air currents reach ovules, form pollen tube which reach archegonia and release male gametes which fertilise egg cell and form zygote which produce embryos. Ovules develop into seeds which are not covered.

ANGIOSPERMS : • Called flowering plants and have seeds enclosed in fruits.

• Divided into two classes – Dicotyledons (have two cotyledons) and Monocotyledons (have one cotyledon).

• **Smallest angiosperm :** *Wolfia*

• **Large tree :** *Eucalyptus*

• Stamen has filament and anther. Anthers bear pollen grains. Pollen grains have two male gametes.

• Pistil has stigma, style and ovary. Ovary has ovule in which female gametophyte (embry sac) develops.

• Embryo sac has 7 cells and 8 nuclei. One egg cell, 2 synergids, 3 antipodals and two polar nuclei which fuse to form secondary nucleus.

• Pollen grain is carried by wind, water etc. reaches to stigma and produces pollen tube which enters embryo sac.

• **Double fertilisation :** One male gamete fuses with egg cell to form zygote which develops into embryo.

Other male gamete fuses with secondary nucleus which forms triploid primary endosperm nucleus (PEN). PEN develops into endosperm which nourishes the developing embryo.

• Ovules develop into seeds and ovaries into fruits.

Alternation of generation : Haploid gametophytic and spore producing sporophytic generation alternate with each other in this process.

Haplontic : Gametophytic phase dominant. *e.g.*, ***Chlamydomonas***

Diplontic : Sporophytic phase dominant. *e.g.,* Angiosperms and Gymnosperms

Haplo-Diplontic : Intermediate like stage where gametophytic and sporophytic stage partially dominate at different stages. *e.g.,* Bryophytes and Pteridophytes.

Exceptions : *Ectocarpus, Polysipnonia* are Haplo-diplontic algae.

Fucus is diplontic alga.

QUESTIONS

Very Short Answer Questions (1 mark each)

1. What is a pyrenoid body ?
2. Define gemma.
3. Which group of plants is regarded as first terestrial plants ? Why ?
4. Which organism is regarded as one of the tallest tree species ?
5. The gametes and spores of phaeophyceae have a distinct morphology. Give its name.
6. Which substance has structural similarity to floridean starch ?

7. Name the organisms which exhibit heterospory can can exhibit seed habit.

Short Answer Questions-I (2 marks each)

8. *Sphagnum* has a lot of economic importance. Justify.
9. Gymnosperms can show polyembroyony. Why do you think so?
10. How is leafy stage formed in mosses ? How is it different from protonema ?

Short Answer Questions-II (2 marks each)

11. The leaves in gymnosperms are adapted to withstand xerophytic conditions. Justify.
12. The gametophytes of bryophytes and pteridophytes are different from that of gymnosperms. How ?
13. Roots in some gymnosperms have fungal or algal association. Give examples, their names and role in the plants.

Long Answer Questions (5 marks each)

14. Pteridophytes and Gymnosperms have haplo-diplontic life cycle. Explain.
15. Draw the life cycle of an angiosperm along with a brief note on double fertilisation.

ANSWERS

Very Short Answers (1 mark)

1. Proteinaceous body usually surrounded by starch found in algae.

2. Gemma are green, multicellular, asexual buds which develop in receptacles called as gemma cups.

3. Pteridophytes. As the possess vascular tissues - xylem and phloem.

4. *Sequoia*

5. Pyriform (pear-shaped), bear two laterally attached flagella.

6. Amylopectin and glycogen.

7. *Selaginella* and *Salvinia.*

Short Answers-I (2 marks)

8. Provide peat used as fuel; used as packing material for trans-shipment of living material.

9. Have two or more archegonia so polymebryony can occur.

10. Leafy stage develops from secondary protonema as a lateral bud. Protonema is creeping, green, branched frequently filamentous stage whereas leafy stage is upright with spirally arranged leaves.

Short Answers-II (2 marks)

11. Gymnosperms like conifers have : needle shaped leaves to reduce surface area, thick cuticle and sunken stomata to reduce water loss.

12. Male and female gametophyte have free existence in bryophytes and pteridophytes but not in Gymnosperms.

13. *Pinus* has fungal association to form mycorrhiza which helps in absorption of water and minerals.

Cycas has cyanobacteria in its roots which forms coralloid roots and helps in nitrogen fixation.

Long Answers (5 marks)

14. Refer page no. 43, NCERT, Text Book of Biology for Class XI

15. Refer Figure 3.6, page no. 41, NCERT, Text Book of Biology for Class XI.

Chapter-4

ANIMAL KINGDOM

POINTS TO REMEMBER

Circulatory System : Open type : Blood pumped out through heart. Cells and tissues are directly bathed in it.

Closed type : Blood is circulated through vessels.

Symmetry : • Asymmetrical : Cannot be divided into equal halves through median plane. *e.g.,* Sponges.

• **Radial symmetry :** Any plane passing through cental axis can divide organism into equal halves. *e.g., Hydra.*

• **Bilateral symmetry :** Only one plane can divide the organism into equal halves. *e.g.,* Annelids and Arthropods.

CLASSIFICATION ON BASIS OF GERMINAL LAYERS :

Diploblastic : Cells arranged in two embryonic layers *i.e.* external ectoderm and internal endoderm. (Mesoglea may be present in between ectoderm and endoderm) *e.g.,* Coelentrates. (Cnidarians)

Triploblastic : Three layers present in developing embryo *i.e.,* ectoderm, endoderm and mesoderm. *e.g.,* Chordates.

Coelom (Body cavity which is lined by mesoderm)

Coelomates : Have coelom *e.g.,* Annelids, Chordates etc.

Pseudocoelomates : No true coelem as mesoderm is present in scattered pouches between ectoderm and endoderm. *e.g.,* Aschelminthes.

Acoelomates : Body cavity is absent. *e.g.* Platyhelminthes.

Metamerism : If body is externally and internally divided into segments with serial repetition of atleast some organs then phenomenon is called metamerism. *e.g.,* Earthworm.

Notochord : Rod-like structure formed during embryonic development on the dorsal side. It is mesodermally derived. *e.g.,* Chordates.

PHYLUM PORIFERA : • Also called sponges.

• Are usually marine and asymmetrical.

• Have cellular level of organisation.

• Food gathering, respiratory exchange and removal of wastes occurs through water canal system. Digestion intracellular.

• Ostia (minute pores on body), spongocoel (body cavity) and osculum help in water transport. They are lined by choanocytes (collar cells).

• Body wall has spicules and spongin fibres.

• Animals are hermaphrodite. Fertilisation internal. Development is indirect (*i.e.,* has a larval stage distinct from adult stage) *e.g.,* ***Sycon, Euspongia.***

PHYLUM COELENTERATA : • Also called Cnidarians.

• Are usually marine and radially symmetrical.

• Have tissue level of organisation

• Are diploblastic

• Food gathering, anchorage and defends occurs through cnidoblasts present on tentacles.

• Digestion extracellular and intracellular.

• Have gastro-vascular cavity and an opening, hypostome.

• Body wall composed of calcium carbonate.

• Exhibit two body forms : polyp and medusa *e.g.,* **Hydra,*Aurelia.***

• Alternation of generation between body forms called Metagenesis occurs in ***Obelia*** where Medusa $\underset{\text{Asexually}}{\overset{\text{sexually}}{\rightleftharpoons}}$ Polyp.

• *e.g.,* ***Physalia, Adamsia.***

PHYLUM CTENOPHORA : • Also called as sea walnuts or combjellies.

• Are exclusively marine, radially symmetrical.

• Have tissue level organisation, are diploblastic.

• Digestion both extra and intracellular.

• Body has eight external rows of ciliated comb plates for locomotion.

• Show Bioluminescence (living organism emit light).

• Only sexual reproduction occurs. External fertilisation. Indirect develop ment. *e.g.,* ***Ctenoplana.***

PHYLUM PLATYHELMINTHES : • Also called as 'flat worms'.

• Have dorsoventrally flattened body. Are endoparasites in animals.

• Are bilaterally symmetrical, triploblastic, acoelomate.

• Absorb nutrients through body surface.

• Parasite forms have hooks and suckers.

• 'Flame cells' help in osmoregulation and excretion.

• Fertilisation internal. Many larval stages. ***Planaria*** has high regeneration capacity.

e.g., ***Taenia, Fasciola.***

PHYLUM ASCHELMINTHES : • Also called 'round worms'.

• May be free living, parasitic, aquatic or terrestrial.

• Are bilaterally symmetrical, triploblastic, pseudocoelomate.

• Alimentary canal complete (has muscular pharynx), wastes removed through excretory pore.

• Sexes separate. Shows dimophism.

• Females longer than males.

• Fertilisation internal. Development direct or indirect.

e.g., ***Ascaris, Wuchereria.***

PHYLUM ANNELIDA : • Are aquatic or terrestrial, free-living or parasitic.

• Are bilaterally symmetrical, triploblastic, organ-system level of organisation and metamerically segmented body.

• Have longitudinal and circular muscles for locomotion.

• ***Nereis*** (dioecious and aquatic annelid) has lateral appendages called parapodia for swimming.

• Have nephridia for osmoregulation and excretion.

• *e.g.*, Earthworm (*Pheretima*) and Leech **(*Hirudinaria*)** which are hermaphrodites **(*i.e.*, monoecious).**

PHYLUM ARTHROPODA : • Largest phylum of Animalia.

• Are bilaterally symmetrical, triploblastic and organ system level of organisation, coelomate.

• Body divisible into head, thorax, abdomen and has a chitinous exoskeleton. Jointed appendages are present.

• Respiration by gills, book gills, lungs or trached system. Excretion through malpighian tubules.

• Sensory organs : Antennae, eyes; Organs of balance : Statocysts.

• Fertilisation internal. Development is indirect or direct. Are mostly oviparous.

e.g., ***Apis, Bombyx, Anopheles, Locusta, Limulus.***

14. PHYLUM MOLLUSCA : • Second largest phylum of Animalia.

• Are bilaterally symmetrical, triploblastic and organ system level of organisation, coelomate.

• Body divisible into head, muscular foot and visceral hump and is covered by calcareous shell. It is unsegmented over visceral hump.

• Mantle : Soft and spony layer of skin; Mantle cavity : Space between visceral hump and mantle.

• Respiration and excretion by feather like gills in mantle cavity.

• Head has sensory tentacles. Radula-file like rasping organ for feeding.

• Are oviparous, dioecious, have indirect development.

e.g., ***Pila, Pinctada, Octopus.***

PHYLUM ECHINODERMATA : • Are spiny bodied organisms.

• Are exclusively marine, radially symmetrical in adult but bilaterally symmetrical in larval stage. Organ system level of organisation.

• Digestive system complete. Mouth ventral, Anus on dorsal side.

• Food gathering, respiration, locomotion carried out by water vascular system.

• Excretory system is absent.

• Fertilisation external. Development indirect (free swimming larva)

• *e.g.,* ***Asterias, Cucumaria.***

PHYLUM HEMICHORDATA : • Has small worm-like organisms.

• Was earlier placed as sub-phylum of Phylum Chordata.

• Bilaterally symmetrical, triploblastic and coelomate.

• Body cylindrical, has proboscis, collar and trunk.

• Respiration by gills, excretion by proboscis gland.

• Sexes separate, external fertilisation, indirect development.

e.g., ***Balanoglossus***

PHYLUM CHORDATA • Presence of Notochord

• Have dorsal hollow nerve chord.

• Have paired pharyngeal gill slits.

• Heart is ventral.

• Post anal tail present.

(i) SUB-PHYLA UROCHORDATA

• Notochord present only in larval tail.

e.g., ***Ascidia, Sepia.***

(ii) SUB-PHYLA CEPHALOCHORDATA

• Notochord extends from head to tail.

e.g., ***Ambhioxus.***

(iii) SUB-PHYLA VERTEBRATA

• Have notochord only during embryonic period.

• Notochord gets replaced by bony or cartilaginous vertebral column.

• Have ventral muscular heart, paired appendages and kidneys for excretion and osmoregulation.

SUB-PHYLUM VERTEBRATA

(a) AGNATHA (Lock Jaw) : Class : Cyclostomata

• Have sucking and circular mouth without jaws.

• Live as ectoparasites on some fishes.

• No scales, no paired fins.

• Cranium and vertebral column is cartilaginous.

• Migrate to fresh water for spawning and die after spawning.

• Larva returns to ocean after metamorphosis.

e.g., ***Petromyzon.***

(b) GNATHOSTOMATA (Bear Jaws)

SUPER-CLASS : PISCES

1. Class : Chondrichthyes

- Have cartilagenous endoskeleton.
- Mouth ventral.
- Gill slits without operculum
- Skin has placoid scales.
- Usually oviparous, fertilisation internal.
- No air bladder, so swim constantly to avoid sinking.
- Teeth are backwardly directed, modified placoid scales.
- Notochord is persistent throughout life. Males have claspers on pelvicfins.
- *e.g.,* ***Torpedo, Trygon, Scoliodon.***

2. Class : Osteichthyes

- Have bony endoskeleton.
- Mouth is usually terminal.
- Four pairs of gill slits covered by operculum.
- Skin has cycloid/ctenoid scales.
- Usually viviparous, fertilisation external.
- Have air bladder which regulates buoyancy.
- *e.g.,* ***Hippocampus, Labeo, Catla, Betta.***

SUB-PHYLUM VERTEBRATA : GNATHOSTOMATA

SUPER CLASS : TETRAPODA

1. Class : Amphibia

- Can live in aquatic as well as terrestrial habitats.
- Body divisible into head and trunk.
- Skin moist. No scales.
- Tympanum represents ear.
- Cloaca is the common chamber where alimentary, urinary and repro ductive tracts open.

- Respiration by gills, lungs or skin.
- Heart is 3-chambered.
- Oviparous. Indirect development.
- *e.g.,* ***Bufo, Rana, Hyla.***

2. Class : Reptilia

- Creep or crawl to locomote.
- Body has dry and cornified skin and epidermal scales or scutes.
- Tympanum represents ear.
- Limbs when present are two pairs.
- Snakes and lizards shed scales as skin cast.
- Heart 3-chambered but 4-chambered in crocodiles.
- Oviparous. Direct development.
- *e.g.,* ***Testudo, Naja, Vipera, Calotes.***

3. Class : Aves

- Presence of feathers and beak.
- Forelimbs are modified into wings.
- Hind limbs have scales.
- No glands on skin except oil gland at base of tail.
- Endoskeleton bony with air cavities (pneumatic) and hollow bones to assist in flight.
- Air sacs are connected to lungs to supplement respiration.
- Oviparous. Direct development.
- *e.g.,* ***Columba Struthio.***

4. Class : Mammalia

- Have mammary glands to nourish young ones.
- Have two pairs of limbs.
- Skin has hairs.
- External ears or pinna present.
- Different types of teeth in jaw.
- Viviparous. Direct development.
- *e.g.,* ***Rattus, Canis Elephas, Equus.*** Oviparous mammal is ***Ornithorhynchus.***‘’

QUESTIONS

Very Short Answer Questions (1 mark each)

1. What is mesogloea ? Where is it found ?
2. When is the development of an organism called as Indirect ?
3. Why are corals important ?
4. What is the difference between class Amphibia and class Reptilia in respect of their skin ?
5. Which phylum consists of organisms with cellular level of organisation ?
6. Name the arthropod which is a (i) Living fossil, (ii) Gregarious pest.
7. Which organ helps in excretion in (i) Arthropods, (ii) Hemichordates ?

Short Answer Questions-II (2 marks each)

8. Distinguish between poikilothermous and homoiothermous organisms.
9. Define metagenesis with a suitable example.
10. List the characteristic features of class Mammalia.

Short Answer Questions-I (3 marks each)

11. What is the difference between organisms on the basis of the coelom ? Give examples for each.
12. Compare the water transport (vascular) system of poriferans and the echinoderms.
13. What are the features of class Aves which help them in flying ?

Long Answer Questions (5 marks each)

14. Distinguish between the chordates and non-chordates.
15. Differentiate between class Chondrichthyes and class Osteichthyes.

ANSWERS

Very Short Answers (1 mark)

1. Undifferentiated layer present between ectoderm and endoderm. It is found in Coelenterates.

2. Have a larval stage morphologically distinct from adult.

3. Have skeleton composed of calcium carbonate which gets deposited and can lead to formation of land forms. *e.g.*, Lakshadweep (a coral island).

4. **Class Amphibia :** Have moist skin without scales.

   Class Reptilia : Have dry cornified skin with scales.

5. Phylum Porifera.

6. (i) ***Limulus*** (King crab), (ii) ***Locusta*** (Locust)

7. (i) Malpighian tubules, (ii) Proboscis gland.

Short Answers-II (2 marks)

8. **Poikilothermous** (cold blooded) : Lack ability to regulate their body temperature.

   Homoiothermous (warm blooded) : Can regulate body temperature.

9. Refer 'Points to Remember',

10. Refer 'Points to Remember',

Short Answers-I (3 marks)

11. Refer 'Points to Remember',

12. Refer 'Points to Remember', NCERT, Text Book of Biology for Class XI.

13. Wings, bones long and hollow with air cavities, air sacs connected to lungs to supplement respiration.

Long Answers (5 marks)

14. Refer Table 4.1, page 55, NCERT, Text Book of Biology for Class XI.

15. Refer 'Points to Remember',

Chapter-5

MORPHOLOGY OF FLOWERING PLANTS

POINTS TO REMEMBER

Morphology : The study of various external features of the organism is known as morphology.

Adaptation : Any alteration in the structure or function of an organism or any of its part that results from natural selection and by which the organism becomes better fitted to survive and multiply in its environment.

The Root : The root is underground part of the plant and develops from elongation of radicle of the embryo.

Various types of root

Tap root	Fibrous root	Adventitious root
Originates from radicle.	Originates from base of the stem.	Originates from parts of the plant other than radicle.
Dicotyledonous plants, *e.g.*, gram, pea, mango.	Monocotyledonous plants, *e.g.*, wheat, paddy, grasses.	Banyan tree (Prop roots) Maize (Still roots) Rhizophora (Respiratory roots)

Root Cap : The root is covered at the apex by the thumble-like structure which protects the tender apical part.

Regions of the root :

1. Region of meristematic activity : Cells of this region have the capability to divide.

2. Region of elongation : Cells of this region are elongated and enlarged.

3. Region of Maturation : This region has differentiated and matured cells. Some of the epidermal cells of this region form thread-like roothairs.

Modifications of Root :

Roots are modified for support, storage of food, respiration.

- **For support :** Prop roots in banyan tree, stilt roots in maize and sugarcane.
- **For respiration :** pneumatophores in *Rhizophora* (Mangrove).
- **For storage of food :** Fusiform (radish), Napiform (turnip), Conical (carrot).

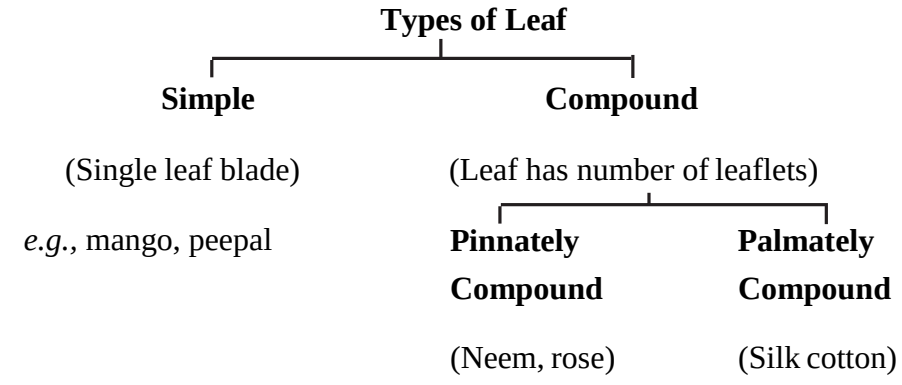
The Stem : Stem is the aerial part of the plant and develops from plumule of the embryo. It bears nodes and internodes.

Modifications of Stem :

In some plants the stems are modified to perform the function of storage of food, support, protection and vegetative propagation.

- **For food storage :** Rhizome (ginger), Tuber (potato), Bulb (onion), Corm (colocasia).
- **For support :** Stem tendrils of watermelon, grapvine, cucumber.
- **For protection :** Axillary buds of stem of citrus, *Bougainvillea* get modified into pointed thorns. They protect the plants from animals.
- **For vegetative propagation :** Underground stems of grass, strawberry, lateral branches of mint and jasmine.
- **For assimilation of food :** Flattened stem of opuntia contains chlorophyll and performs photosynthesis.

The Leaf : Developes from shoot apical meristem, flattened, green structure, manufacture the food by photosynthesis. It has bud in axil. A typical leaf has leaf base, petiole and lamina.



Venation : The arrangement of veins and veinlets in the lamina of leaf.

Types of Venation :

1. Reticulate : Veinlets form a network as in leaves of dicotyledonous plants (China rose, peepal).

2. Parallel : Veins are parallel to each other as in leaves of monocotyledonous plants (grass, maize, sugarcane).

Phyllotaxy : The pattern of arrangement of leaves on the stem or branch.

Types of phyllotaxy

Alternate	**Opposite**	**Whorled**
(Single leaf at a node)	(Two leaves at a node)	(More than two leaves in a whorl at a node)
e.g., China rose, Mustard	*e.g., Calotropis*, guava	*e.g.,* Nerium, devil tree

Modifications of Leaves :

- Tendrils : (Climbing) – Sweet wild pea
- Spines : (Protection) – *Aloe, Opuntia, Argemone*
- Piture : (Nutrition) – *Nepenthes*
- Hook : (Support) – Cat's nail

Inflorescence : The arrangement of flowers on the floral axis.

Main types of Inflorescence :

1. **Racemose :** Radish, Mustard, *Amaranthus.*

2. **Cymose :** Cotton, Jasmine, *Calotropis.*

3. **Special type :** Ficus, *Salvia, Euphorbia.*

The Flower : A flower is modified shoot. It is a reproductive unit in angiosperms. Flowers may be unisexual or bisexual, bracteate or ebractiate. Some features of flower are as given below :

Symmetry of flower	**On the basis of no. of floral appendages**	**On the basis of position of calyx, corolla, androecium with respect of ovary**
Actinomorphic (radial symmetry)	Trimerous	Hypogynous (superior ovary)
Zygomorphic (bilateral symmetry)	Tetramerous	Perigynous (half inferior ovary)
Asymmetric (irregular)	Pentamerous	Epigynous (inferior ovary)

Parts of flower :

1. **Calyx :** Sepals, green in colour, leaf like.
2. **Corolla :** Petals, usually brightly coloured to attract insects for pollination.

3. Androecium : Stamens (filament, anther), male organ and produce pollen grains. Stamens may be epipetalous (attach to petals) or epiphyloous (attach to perianth). Stamens may be monoadelphous (united into one bundle), diadelphous (two bundles) or polyadelphous (more than two bundles).

4. Gynoecium : Made up of one or more carpels, female reproductive part, consists of stigma, style and ovary, ovary bears one or more ovules. Carpels may be apocarpous (free) or syncarpous (united). After fertilisation, ovules develop into seeds and ovary into fruit.

Gamosepalous	–	(Sepals united)
Polyseptalous	–	(Sepals free)
Gamopetalous	–	(Petals united)
Polypetalous	–	(Petals free)

Perianth : If calyx and corolla are not distinguishable, they are called perianth.

Aestivation : The mode of arrangement of sepals or petals in floral bud.

Types of aestivation :

1. Valvate : Sepals or petals do not overlap the sepal or petal at margins.

2. Twisted : Sepals or petals overlap the next sepal or petal.

3. Imbricate : The margins of sepals or petals overlap one another but not in any definite direction.

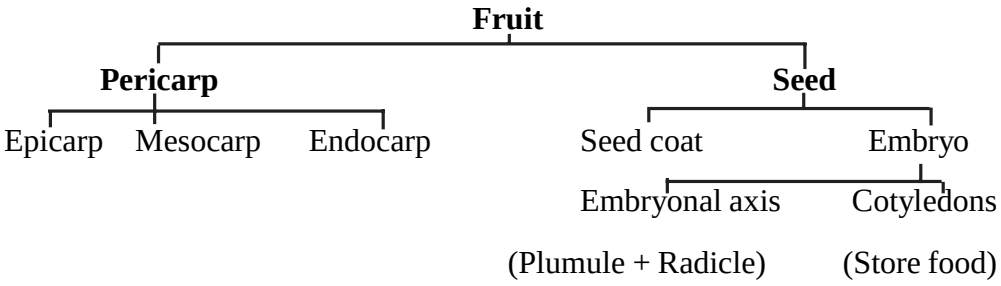
4. Vexillary : The largest petal overlaps the two lateral petals which in turn overlap two smallest anterior petals.

Placentation : The arrangement of ovules within the ovary.

Types of Placentation :

1. **Marginal :** Placenta forms a ridge along the ventral suture of ovary.
2. **Axile :** Margins of carpels fuse to form central axis.
3. **Parietal :** Ovules develop on inner wall of ovary.
4. **Free central :** Ovules borne on central axis, lacking septa.
5. **Basal :** Placenta develop at the base of ovary.

The fruit : After fertilisation, the mature ovary develops into fruit. The parthenocarpic fruits are formed from ovary without fertilisation.



QUESTIONS

Very Short Answer Questions (1 mark each)

1. Which part of opuntia is modified to form spines ?
2. Name one plant in which leaf is pinnately compound.
3. In mangroves, pneumatophores are the modified adventitious roots. How are these roots helpful to the plant ?
4. Which part of mango fruit is edible ?
5. Why do various plants have different type of phyllotaxy?
6. State the main function of leaf tendril.
7. Which plant family represent the following floral formula :

$$+ \ ♀ P_{3+3} A_{3+3} \underline{G}_{(3)}$$

8. The endosperm is formed as a result of double fertilisation (triple fusion). What is its function ?
9. Which type of venation do you observe in dicot leaf ?
10. In pea flower, the aestivation in corolla is known as vexillary. Give reason.

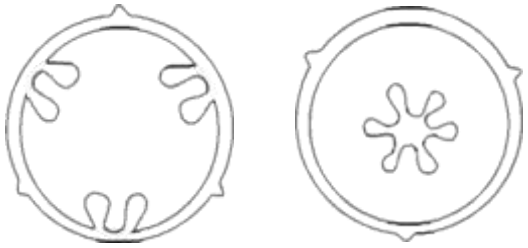
Short Answer Questions-II (2 marks each)

11. Flower is a modified shoot. Justify.
12. Name the type of root for the following :
    (a) Roots performing the function of photosynthesis.
    (b) Roots come above the surface of the soil to absorb air.
    (c) The pillar like roots developed from lateral branches for providing mechanical support.
    (d) Roots coming out of the lower nodes of the stem and provide the support to the plant.

13. Fill up the blank spaces (a), (b), (c) and (d) in the table given below :

Type of flower	Position of calyx, corolla and androecium in respect of the ovary on thalamus	Type of ovary
Hypogynous	.....(a).....	Superior
Perigynous	On the rim of the thalamus almost at the same level of ovary.	.....(b).....
.....(c).....	.....(d).....	Inferior

14. Provide the scientific terms for the following :
    (i) The leaf without a petiole (stalk)
    (ii) The flat and expanded portion of a leaf
    (iii) Orderly arrangement of leaves on the node
    (iv) Lateral appendages on either side of the leaf
15. Observe the given figure showing various types of placentation. Identify the type of plancentation. Give one example of each.



Short Answer Questions-I (3 marks each)

16. 'Potato is a stem and sweet potato is a root.' Justify the statement on the basis of external features.
17. Draw the structure of monocotyledonous seed and label the following parts in it. Aleurone layer, Endosperm, Coleoptile, Coleorhiza, Plumule, Radicle.
18. Define aestivation. Which type of aestivation is found in China rose, Calotropis, Gulmohar and pea.
19. Explain the different types of phyllotaxy. Give one example of each type.

20. Differentiate between :

    (a) Actinomorphic flower and Zygomorphic flower

    (b) Apocarpous ovary and Syncarpous ovary

    (c) Racemose inflorescence and Cymose inflorescene

Long Answer Questions (5 marks each)

21. Describe various stem modifications associated with food storage, climbing and protection.

22. Give the distinguishing morphological features of gynoecium of family Fabaceace, Solanaceae and Liliaceae. Draw floral diagrams of Fabaceae and Solanaceae.

ANSWERS

1. In Optunia leaves are modified into spines.
2. Neem, Rose, Acacia.
3. Pneumatophores in mangroves help in respiration.
4. The edible part in mango fruit is mesocarp.
5. For proper exposure of leaves to get sunlight.
6. The leaf tendrils help the plant for climbing.
7. Liliaceae
8. Endosperm stores the food.
9. Reticulate venation.
10. In peas, there are five petals. The largest one (standard) overlaps the two lateral petals (wings) which in turn overlap the two smallest anterior petals (keel).

Short Answers-II (2 marks)

11. The flower is considered to be a modified shoot because the internodes in a flower are highly condensed and the appendages such as sepals, petals, stamens and carpels (pistil) are generally large in number.
12. (a) Assimilatory roots (b) Respiratory roots

    (c) Prop roots (d) Stilt roots
13. (a) Floral parts are situated below the ovary.

    (b) Half inferior

    (c) Epigynous

    (d) Floral parts are situated above the ovary.

14. (i) Sessible
(ii) Lamina
(iii) Phyllotaxy
(v) Stipules

15. (a) Parietal placentation – Mustard, *Argemone*
(b) Free central plancentation – *Dianthus, Primose*

Short Answers-I (3 marks)

16. Potato is the swollen tip of an underground stem branch (stolon). It has nodes (eyes) which consist of one or more buds subtended by a leaf scar. Adventitious roots also arise during sprouting. On the other hand sweet potato is a swollen adventitious root (tuberous root). It has no nodes, internodes and buds like a stem.

17. Refer Figure 5.19, page 77, NCERT Text Book of Biology for Class XI.

18. The mode of arrangement of sepals or petals in a floral bud is known as aestivation.

China rose – twisted	*Calotropis* – valvate
Gulmohar – imbricate	Pea – vexillary

19.

Type of phyllotaxy	**Examples**
(i) Alternate	China rose, mustard
(ii) Opposite	*Calotropis*, guava
(iii) Whorld	Nerium, *Alstonia*

20.

(a) Actinomorphic Flower	**Zygomorphic flower**
(1) Two equal halves are formed by any vertical division passing through the centre.	Two equal halves are produced only by one vertical division.
(2) It has a radial symmetry.	It has a bilateral symmetry.
(b) Apocarpous Ovary	**Syncarpous Ovary**
(1) The flower has several free carpels (ovary).	The flower has fused carpels.
(2) On maturity it forms fruitlet of aggregate type.	On maturity it forms a single fruit.

(c) Racemose Inflorescence	**Cymose Inflorescence**
(1) The main axis has unlimited growth.	The main axis has a limited growth.
(2) Flowers are arranged acropetally *i.e.*, the lower flowers are younger.	Flowers are arranged basipetally *i.e.*, the lower flowers are older.

Long Answers (5 marks)

21. Stem Modifications :

• **For food storage :** Ginger (Rhizome), potato (Tuber), Onion (Bulb), *Colocasia* (Corm).

• **For climbing (support) :** Stem tendril (cucumber, grapevine, watermelon)

• **For protection :** Thorn (*Bougainvillea*, Citrus, *Duranta*)

Description : Refer page 68, NCERT, Text Book of Biology for Class XI.

22. Gynoecium :

Family Fabaceae : Ovary superior, monocarpellary, unilocular with many ovules, style single.

Family Solonaceae : Ovary superior, bicarpellary, syncarpous, bilocular, placenta swollen with many ovules.

Family Liliaceae : Ovary superior, tricarpellary syncarpous, trilocular with many ovules, axile placentation.

Floral diagram :

Fabaceae : Figure 5.21 (f), page 79, NCERT, Text Book of Biology for Class XI.

Solanaceae : Figure 5.22 (f), page 80, NCERT, Text Book of Biology for Class XI.

■

Chapter-6

ANATOMY OF FLOWERING PLANTS

POINTS TO REMEMBER

Anatomy : Anatomy is the study of internal structure of organisms. Plant anatomy includes organisation and structure of tissues.

Tissue : A group of similar cells alongwith intercellular substance which perform a specific function.

Meristematic tissues : The meristematic tissue is made up of the cells which have the capability to divide. Meristems in plants are restricted to a specialised regions and responsible to the growth of plants.

Meristems

Apical meristem	Intercalary meristem	Lateral meristem
• Occurs at the tips of roots and shoots	• Occurs between mature tissue	• Occurs in the mature regions of roots and shoots
• Primary meristem	• Primary meristem	• Secondary meristem
• Increase the length of plant	• Capable of forming branch and flower	• Appears later than primary meristem and responsible for secondary growth

Axillary bud : The buds which are present in the axils of leaves and are responsible for forming branches or flowers.

Permanent tissues : The permanent tissues are derived from meristematic tissue and are composed of cells, which have lost the ability to divide.

Types of Permanent Tissue

Simple: Parenchyma, Collenchyma, Sclerenchyma

Complex: Xylem, Phloem

Parenchyma : Thin walled cells, with intercellular spaces, cell wall is made up of cellulose. It performs the function like photosynthesis, storage, secretion.

Collenchyma : It is formed of living, closely packed isodimetric cells. It's cells are thickened at the corners due to deposition of cellulose and pectin. It provides mechanic support to the growing parts of the plant.

Sclerenchyma : It is formed of dead cells with thick and lignified walls. They have two types of cells : fibres and sclereids.

Xylem : Xylem consists of tracheids, vessels, xylem fibres and xylem parenchyma. It conducts water and minerals from roots to other parts of plant.

Protoxylem : The first formed primary xylem elements.

Metaxylem : The later formed primary xylem.

Endarch : Protoxylem lies towards the centre and metaxylem towards the periphery of the organ.

Phloem : Phloem consists of sieve tube elements, companion cells, phloem fibres and phloem parenchyma. Phloem transports the food material from leaves to various parts of the plant.

Protophloem : First formed phloem with narrow sieve tubes.

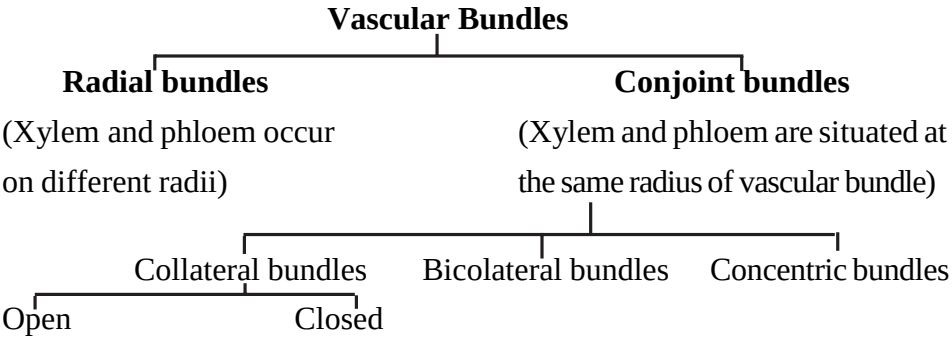
Metaxylem : Later formed phloem with bigger sieve tubes.

The Tissue System :

1. Epidermal tissue system : It includes cuticle, epidermis, epidermal hairs, root hairs, trichomes and stomata.

2. The ground tissue system : It is made up of parenchyma, collenchyma, sclerenchyma. In dicot stems and roots the ground tissue is divided into hypodermis cortex, endodermis, pericycle, medullary rays and pith.

3. The vascular tissue system : It includes vascular bundles which are made up of xylem and phloem.



Anatomy of Root

Dicot Root	Monocot Root
1. Cortex is comparatively narrow.	1. Cortex is very wide.
2. Endodermis is less thickened casparian stripes are more prominent.	2. Endodermal cells are highly thickened Casparian strips are visible only in young roots.
3. The xylem and phloem bundles varies from 2 to 5.	3. Xylem and phloem are more than 6 (polyarch).
4. Pith is absent or very small.	4. Well developed pith is present.
5. Secondary growth takes place with the help of vascular cambium and cork cambium	5. Secondary growth is absent.

Anatomy of Stem

Dicot Stem	Monocot Stem
1. The ground tissue is differentiated into cortex, endodermis, pericy and pith.	1. The ground tissue is made up of similar cells.
2. The vascular bundles are arranged in a ring.	2. The vascular bundles are scat tered throughout the ground tissue.
3. Vascular bundles are open, without bundle sheath and wedge-shaped outline.	3. Vascular bundles are closed, surrounded by sclerenchymatous bundle sheath, oval or rounded in shape.
4. The stem shows secondary growth due to presence of cambium between xylem and phloem.	4. Secondary growth is absent.
5. Stomata have kidney-shaped guard cells.	5. Stomata have dumb bell-shaped guard cells.

Secondary growth in dicot stem : An increase in the girth (diameter) in plants. Vascular cambium and cork cambium (lateral meristems) are involved in secondary growth.

1. Formation of cambial ring : Intrafascicular cambium + interfascicular cambium.
2. Formation of secondary xylem and secondary phloem from cambial ring.
3. Formation of spring wood and autumn wood.

4. Development of cork cambium (phellogen)

Cork Cambium — Cork (phellem) - From outer cells
Sec. cortex (phelloderm) - From inner cells

(Phellogen + Phellem + Phelloderm) = Periderm

Secondary growth in dicot roots : Secondary growth in dicot root occurs with the activity of secondary meristems (vascular cambium). This cambium is produced in the stele and cortex, and results in increasing the girth of dicot roots.

Anatomy of Leaf

Dorsiventral (Dicot) Leaf	Isobilateral (monocot) Leaf
1. Stomata are absent or less abundant on the upper side.	1. The stomata are equally distributed on both sides.
2. Mesophyll is differentiated into two partsupper palisade parenchyma and lower spongy parenchyma.	2. Mesophyll is undifferentitated.
3. Bundle sheath is single layered and formed of colourless cells.	3. Bundle sheath may be single or double layered.
4. Hypodermis of the mid-rib region is collen-chymatous.	4. Hypodermis of the mid-rib region is sclerenchymatous.

QUESTIONS

Very Short Answer Questions (1 mark each)

1. Name the tissue represented by the jute fibres used for making the ropes.

2. Which kind of roots have polyarch vascular bundles ?

3. What is heart wood ?

4. State the role of pith in stem.

5. Where are bulliform cells found in leaves ?

6. Which meristem does produce growth in length ?

7. What forms the cambial ring in a dicot stem during the secondary growth ?

8. Name the anatomical layer in the root from which the lateral branches of root originate.

9. Which tissue of the leaf contains chloroplast ?

10. A plant tissue when stained, showed the presence of hemicellulose and pectin in cell wall of its cells. Name the tissue.

Short Answer Question-II (2 marks each)

11. Why is cambium considered to be lateral meristem ?

12. Give any four differences between tracheids and vessels.

13. How are open vascular bundles differ from closed vascular bundles ?

14. What are trichomes ? State their functions.

15. Given below are the various types of tissue and their functions. Which out of these is not a matching pair and why :

(a) Collenchyma : provides mechanical support to the growing parts of plant.

(b) Sclerenchyma : photosynthesis, storage and secretion.

(c) Chlorenchyma : perform the function of photosynthesis.

(d) Xylem : conduction of water and minerals.

Short Answer Question-I (3 marks each)

16. If you are provided with microscopic preparation of transverse section of a meristemic tissue and permanent tissue, how would you distinguish them ?

17. Differentiate between arenchyma and collenchyma on the basis of their structure and function.

18. Are there any tissue elements of phloem which are comparable to those of xylem ? Explain.

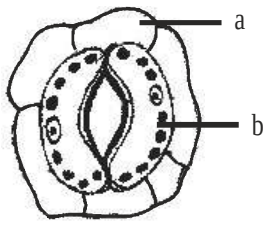
19. Palm is a monocotyledonous plant, yet it increases in girth. How is it possible ?

20. Observe the figure and answer the following questions :

(i) Name parts (a) and (b).

(ii) Are these types of stomata observed in monocot or in dicot plants ?

(iii) Which parts of stomata constitute the stomatal apparatus ?



Long Answer Questions (5 marks each)

21. (i) What are meristems?

(ii) Name the various kinds of meristems in plants.

(iii) State the location and function of meristems.

22. (i) Suppose you are examining a cross section of a stem under compound microscope, how would you determine whether it is monocot stem or dicot stem ?

(ii) Write the characterstics of collenchyma.

23. What is secondary growth in plants ? Describe various steps of secondary growth in dicot stem with the help of diagrams.

ANSWERS

Very Short Answers (1 mark)

1. Sclerenchyma.

2. Monocotyledonous roots.

3. The hard central region of tree trunk made up of xylem vessels.

4. Pith stores the food material.

5. Bulliform cells are found in the upper epidermis of monocot leaves.

6. Primary meristem.

7. Fascicular and intrafascicular strips of meristem.

8. Pericycle of mature zone.

9. Mesophyll tissue.

10. Chollenchyma.

Short Answers-II (2 marks)

11. The cambium is considered as a lateral meristem because it occurs along the lateral sides of the stem and roots and appear later than primary meristem. Cells of this meristem divide periclinally and increase the thickness of the plant body.

12.

Tracheid	Vessel
1. A tracheid is formed from a single cell.	1. A vessel is made of a number of cells.
2. The ends are rounded or transverse.	2. The ends are generally oblique and tapering.
3. They are comparatively narrower.	3. They are comparatively wider.
4. The lumen is narrower.	4. The lumen is wide.

13. Open Vascular bundles : These vascular bundles contain a strip of cambium in between phloem and xylem. Open vascular bundles are collateral and bicollateral.

Closed Vascular bundles : Intrafascicular cambium is absent. Closed vascular bundles can be collateral or concentric.

14. Trichomes are multicellular epidermal hairs on the stem, seeds or fruits.

Trichomes help in protection, dispersal of fruits and seeds and reduction in water loss.

15. (b) Sclerenchyma : photosynthesis, storage and secretion is not a matching pair. The function of sclerenchyma is to provide mechanical support to organs.

Short Answers-I (3 marks)

16. Meristematic tissues are composed of cells that have the capability to divide. These cells are exist in different shapes without intercellular space. Cells are thin walled, rich in protoplasm, without vacuoles.

Permanent tissues are derived from meristematic tissue and are composed of cells have their definite shape, size and function. These cells may be thin walled (living) or thick walled (dead).

17.

Arenchyma	Collenchyma
(a) Parenchymatous tissue containing space large air space.	(a) Tissue contains deposits of cellulose and large pectin7 at the corner of cells.
(b) Thin walled cells, isodiametric in shape with intercellular space.	(b) Consists of oval and polygonal cells without intercellular space.
(c) Provides buoyancy to the plant.	(c) Provides elasticity and mechanical strength.

18. (a) The sieve elements of phloem is comparable to the vessel of the xylem because both lack nucleus.

(b) Phloem fibre is similar to the xylem fibre because both provide tensile strength to the tissue.

(c) Phloem parenchyma and xylem parenchyma is the living components of phloem and xylem respectively.

19. A palm tree is monotcotyledonous plant, hence do not have primary cambium in the vascular bundles of stem. However, with age the tree grows in diameter. A secondary cambium may be formed in the hypodermal region of the stem. The later forms the conjuctive tissue and patches of meristematic cells. The activity of meristematic cells results in the formation of secondary vascular bundles.

20. (i) a : epidermal cell

b : guard cell

(ii) In dicot plants.

(iii) The stomatal apparatus includes the stomatal aperture, guard cells and the surrounding subsidiary cells.

Long Answers (5 marks)

21. (i), (ii) and (iii) : Refer 'Points to remember'

22. (i) and (ii) : Refer. 'Points to remember'

23. • **Secondary growth :** Refer notes.

• **Steps of secondary growth :** Refer page 94-97, NCERT, Text Book of Biology for Class XI.

• Figure 6.9, page 95 NCERT, Text Book of Biology for Class XI.

Chapter-7

STRUCTURAL ORGANISATION IN ANIMALS

POINTS TO REMEMBER

Tissue : A group of similar cells along with intercellular substances which perform a specific function.

Simple epithelium : is composed of a single layer of cells resting on a basement membrane.

Compound epithelium : consists of two or more cell layers and has protective function.

Areolar tissue : is a type of loose connective tissue present beneath the skin.

Adipose tissue : is a type of loose connective tissue which has cells specialised to store fats.

Neuroglia : A delicate connective tissue which supports and binds together the nerve tissue in the Central Nervous Tissue.

Malpighian tubules : Yellow coloured thin, filamentous tubules present at the junction of midgut and hindgut in cockroach; helps in excretion.

Uricotelic : Animals which excrete nitrogenous waste in the form of uric acid.

Tight junctions : Plasma membranes of adjacent cells are fused at intervals. They help to stop substances from leaking across a tissue.

Adhering junctions : Perform cementing function to keep neighbouring cells together.

Gap junction : Facilitate the cells to communicate with each other by connecting the cytoplasm of adjoining cells for rapid transfer of ions, small molecules and sometimes big molecules.

Animal Tissues

Epithelial | Connective | Muscular | Neural

Epithelial Tissue

Simple : • Composed of single layer of cells.

• Functions as lining for body cavities, ducts and tubes.

1. Squamous
   - single thin layer of flattened cells.
   - found in walls of blood vessels, air sacs of lungs.
2. Cuboidal
   - single layer of cube like cells.
   - found in ducts of glands and tubular parts of nephron.
3. Columnar
   - single layer of tall and slender cells.
   - free surface may have microvilli.
   - found in living of stomach and intestine.
4. Ciliated
   - columnar or cuboidal cells with cilia.
   - move particles or mucus in specific direction, in bronchioles, fallopian tubes.

Compound

- Made of more than one layer of cells.
- Provide protection against chemical and mechanical stresses.
- Cover dry surface of skin, moist cavity, pharynx, inner lining of ducts of salivary glands and pancreatic ducts.

Glandular epithelium

Exocrine glands	**Endocrine glands**
• secrete mucus, saliva, oil, milk, digestive enzymes.	• secrete harmones.
• products released through ducts.	• secrete directly into the fluid bathing the gland.

Connective tissue : Link and support other tissues / organs of the body.

CONNECTIVE TISSUE

Loose Connective Tissue

(has cells and fibres loosely arranged in semi-fluid ground substance)

(i) Areolar Tissue :

- present beneath the skin.
- contains fibroblasts, macrophages and mast cells.
- serves as a support framework for epithelium.

(ii) Adipase Tissue :

- located beneath the skin.
- cells are specialised to store fats.

Dense Connective Tissue

Fibres and fibroblasts are compactly packed.

(i) Dense Regular

- Collagen fibres present in rows.
- Tendons attach skeletal muscle to bone.
- Ligaments attach bone to bone.

(ii) Dense Irregular

- Has collagen fibres and fibroblasts oriented differently.
- This tissue is present in the skin.

Specialised Connective Tissue

(i)	Cartilage	made up of chondrocytes and collegen fibres.
(ii)	Bones	Ground substance is rich in calcium salts and collegen fibres Osteocytes are present in lacunae
(iii)	Blood	Fluid connective tissue, consists of plasma and blood cells

Muscle Tissue

Consists of long, highly contractile cells called fibres; bring about movement and locomotion.

(i) Skeletal Muscle

- Consists of long cylindrical, multinucleated fibres.
- Closely attached to skeletal bones.
- Striated.

(ii) Smooth Muscles

- Consists of spindle like, uninucleated fibres.
- Do not show striations.
- Wall of internal organs such as blood vessels, stomach and intestine.

(iii) Cardiac Muscles

- Short, cylindrical, uninucleated fibres.
- Occur in the heart wall.
- Intercalated discs for communication.

Neural Tissue

- Neurons are the functional unit and are excitable cells.
- Neuroglia cells make up more than half the volume of neural tissue. They protect and support neurons.

Cockroach – *Periplaneta americana*

is a terrestrial, nocturnal, omnivorous, unisexual, oviparous insect. Body covered by a chitinous, hard exoskeleton of hard plates called sclerites.

Head : Triangular, formed by fusion of 6 segments. Bears a pair of antennae, compound eyes. Mouth parts consists of labrum (upper lip), a pair of mandibles, a pair of maxillae, labium (lower lip), hypopharynx (acts as tongue).

Thorax : 3 segments; prothorax, mesothorax and metathorax. Bears 2 pairs of wings :

Forewings : tegmina (mesothoracic).

Hindwings : transparent, membranous (metathoracic) and 3 pairs of legs in thoracic segments.

Abdomen : 10 segments. Bears a pair of long, segmented **anal cerci** in both sexes and a pair of short, unjoined **anal styles** in males only.

Also has anus and genital aperture at the hind end. Genital aperture surrounded by external genitalia called **gonapophysis or phallomere.**

Anatomy : Study of the morphology of internal organs.

Alimentary canal : Divided into foregut, midgut and hindgut.

Mouth → Pharynx → Oesophagus → Crop (stores food) → Gizzard (grinding of food) → Hepatic caeca (at junction of fore and midgut; secretes digestive juice) → Hindgut (ileum, colon, rectum) → Anus.

Blood vascular system : Open type, visceral organs bathed in haemolymph (colourless plasma and haemocytes).

Heart consists of enlongated mascular tube and differentiated into funnel-shaped chambers with ostia on either side. Blood from sinuses enters heart through ostia and is pumped anteriorly to sinuses again. Blood colourless (haemolymph).

Repiratory system : Network of trachea which open through 10 spiracles. Spiracles regulated by sphincters. Oxygen delivered directly to cells. Excretion and osmoregulation by Malpighian tubules; uricotelic (Uric acid as excretory product).

Nervous system : Consists of series of fused segmentally arranged ganglia joined by paired longitudinally connectives on the ventral side. three ganglia in thorax, six in abdomen. Brain represented by supra-oesophageal ganglion.

Reproductive system :

Male – Pair of testes (4th-6th segments) $\rightarrow$ vas deferens $\rightarrow$ ejaculatory duct $\rightarrow$ male gonophore.

Glands – Seminal vesicle (stores sperms), mushroom shaped gland (6th-7th segment).

Female reproductive system :

A pair of ovaries (with 8 ovarian tubules) $\rightarrow$ Oviduct $\rightarrow$ Genital chamber.

Sperms transferred through spermatophores. Fertilised eggs encased in capsules called oothecae; development of *P. americana* paurometabolous (incomplete metamorphosis). Nymph grows by moulting 13 times to reach adult form.

Interaction with man

- Pests as destroy food and contaminate it.
- Can transmit a variety of bacterial diseases (Vector).

QUESTIONS

Very Short Answer Questions (1 mark each)

1. Name the tissue which contains Haversian canals.

2. Mention two special properties of nervous tissues.

3. Name the large cells present in adipose tissue.

4. Name the cells responsible for clotting of blood.

5. What are exocrine glands ?

Short Answer Questions-II (2 marks each)

6. What is the function of ciliated epithelium ? Where do we find this epithelium ?

7. What are the two types of fibres of connective tissues ? Distinguish between the two.

8. To which tissue do the following belong to :

(a) Osteocytes (b) Chondrocytes

(c) Neuroglia (d) Intercalated discs

9. Give the location of hepatic caecae in cockroach ? What is their function ?

10. Name the locomotory appendages of cockroach on the basis of external morphology.

Short Answer Questions-I (3 marks each)

11. Differentiate between skeletal and smooth muscles.

12. Differentiate between male and female cockroach on the basis of external morphology.

13. (a) What is open circulatory system ?

(b) Explain the respiratory system of cockroach.

14. (a) Give the common name of *Periplaneta americana.*

(b) How many spermathecae found in cockroach ?

(c) What is the position of ovaries in cockroach ?

(d) How many segments are present in the abdomen of cockroach ?

(e) Where do you find malpighian tubules ?

(f) What is mosaic vision ?

Long Answer Questions (5 marks each)

15. (a) What is compound epithelium ? What are their main function ?

(b) Where do we find areolar tissue ?

(c) How is adhering junction different from gap junction ?

ANSWERS

Very Short Answers (1 mark)

1. Mammalian bone.

2. Excitability and conductivity.

3. Adipocytes.

4. Blood platelets.

5. Glands which discharge their secretions into ducts.

Short Answers-II (2 marks)

6. Refer 'Points to Remember'.

7. White and yellow fibres. White fibres are thin, wavy, unbranched, inelastic, occur in bundles and formed of protein collagen. Yellow fibres are thick, straight, elastic, branched, occuring singly, formed of protein elastin.

8. (a) Bone tissue (b) Cartilage

(c) Neural tissue (d) Cardiac muscle

9. Refer 'Points to Remember'.

10. Three pairs of legs and 2 pairs of wings.

Short Answers-I (3 marks)

11. Refer 'Points to Remember'.

12. Refer 'Points to Remember'.

13. Refer 'Points to Remember'.

14. (a) American coackroach.

(b) One pair, present in 6^{th} segment.

(c) Between 2^{nd} and 6^{th} abdominal terga.

(d) 10 segments.

(e) At the beginning of ileum in cockroach.

(f) Vision where several images of an object are formed by compound eye. Helps detect movement of objects very efficiently.

Long Answers (5 marks)

15. Refer 'Points to Remember'.

Chapter-8

CELL : THE UNIT OF LIFE

POINTS TO REMEMBER

Gram positive bacteria : Bacteria that take up gram stain.

Gram negative bacteria : Bacteria that do not take up gram stain.

Prokaryotic cells : Cells which lack a well defined nucleus and membrane bound cell organelles. *e.g.*, bacteria, cyanobacteria, mycoplasma.

Eukaryotic cells : Cells which have a well defined nucleus and membrane bound cell organelles. *e.g.*, all protists, plants, animals and fungi cells.

Passive transport : Transport of molecules across a membrane along the concentration gradient, *i.e.,* from higher to lower concentration without the consumption of energy.

Active transport : Transport of molecules against concentrataion gradient, *i.e.,* from lower to higher concentration with the consumption of energy (ATP).

Polyribosome/polysome : A chain like structure formed when several ribosome are attached to a single mRNA.

PPLO : Pleuro Pneumonia Like Organisms.

Cell : Cell is the structural and functional unit of life. Cell Theory was formulated by Scheleiden and Schwann and was modified by Rudolf virchow states :

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

(b) All cells arise from pre-existing cells.

Prokaryotic cells

Genetic material is not enveloped by nuclear envelope. Many bacteria contain extra chromosomal DNA – plasmids.

Cell Envelope

Prokaryotic cells have a chemically complex cell envelope which consists of a tightly bound 3 layered structure *i.e.,* outermost **glycocalyx** followed by **cell wall** and then **plasma membrane.**

A specialised structure – **mesosome** is formed by the extension of plasma

membrane into the cell. Mesosomes help in cell wall formation, DNA replication and distribution to daughter cells, respiration, secretion process, to increase surface area of plasma-membrane and enzymatic content.

Bacterial cells may be motile or non-motile. Motile bacterias have **flagella** composed of three parts – filament, hook and basal body. Pili and fimbriae are surface structures which do not play any role in motality. These structures help the bacteria to attach with rocks and the host tissues.

70S ribosomes are associated with plasma membrane and is made of two subunits – 50S and 30S. Ribosomes are site of protein synthesis.

Eukaryotic cells

Possess an organized nucleus with nuclear envelope and have a variety of complex locomotory and cytoskeletal structures.

Cell Membrane

Singer and Nicolson (1972) gave 'Fluid mosaic model'. According to this the quasi-fluid nature of lipid enables lateral movement of proteins within the overall bilayer.

Functions : Selectively permeable.

Cell Wall is a non-living rigid structure which gives shape to the cell and protects cell from mechanical damage and infection, helps in cell-to-cell interaction and provides barrier to undesirable macromolecules.

Cell wall of algae is made of cellulose, galactans, mannans and minerals like calcium carbonate. Plant cell wall consists of cellulose, hemicellulose, pectins and proteins.

Middle lamella is made of calcium pectate which holds neighbouring cells together.

Plasmodesmata connect the cytoplasm of neighbouring cells.

Endoplasmic Recticulum (ER)

Consists of network of tiny tubular structures. ER divides the intracellular space into two distinct compartments – luminal (inside ER) and extra luminal (cytoplasm).

(i) Rough Endoplasmic Reticulum (RER) :

- Ribosomes attached to outer surface.
- Involved in protein synthesis and secretion.

(ii) Smooth Endoplasmic Reticulum (SER) :

- Lack ribosomes.
- Site for synthesis of lipid.

Golgi apparatus :

Consists of cisternae stacked parallel to each other. Two faces of the organelle are convex **cis** or forming face and concave **trans** or maturing face.

Functions : Performs packaging of materials, to be delivered either to the intra-cellar targets or secreted outside the cell. Important site of formation of glycoproteins and glycolipids.

Lysosomes :

Membrane bound vesicular structures formed by the process of packaging in the golgi apparatus. Contain hydrolysing enzymes (lipases, proteases, carbohyrases) which are active in acidic pH. Also called 'Suicidal Bag'.

Function : Intracellular digestion.

Vacuoles :

Membrane bound space found in the cytoplasm. Contain water, sap, excretory product, etc.

Function : In plants **tonoplast** (single membrane of vacuole) faciliates transport of ions and other substances.

Contractile vacuole for excretion in ***Amoeba*** and food vacuoles formed in protistis for digestion of food.

Mitochondria :

Double membrane structure. Outer membrane smooth and inner membrane forms a number of infoldings called cristae.

Function : Sites of aerobic respiration. Called 'power houses' of cell as produce cellular energy in the form of ATP. Matrix possesses single circular DNA molecule, a few RNA molecules, ribosomes (70S). It divides by fission.

Plastids :

Found in plant cells and in euglenoides. Chloroplasts, chromoplasts and leucoplasts are 3 types of plastids depending on pigments contained.

Chloroplasts are double membraned structure. Space limited by inner membrane is called **stroma.** Flattened membranous sacs called **thylakoids** in stroma. Chlorophyll pigments are present in thylakoids.

Function : Site of photosynthesis.

Ribosomes

Compased of RNA and proteins; without membrane. Eucaryotic ribosomes are 80S.

Function : Site of protein synthesis.

Cilia and Flagella

Cilia are small structures which work like oar, which help in movement.

Flagella are longer and responsible for cell movement. They are covered with plasma membrane. Core is called **axoneme** which has 9 + 2 arrangement.

Centrosome and Centrioles

Centrosome contains two cylindrical structures called centrioles. Surrounded by amorphous pericentriolar material. Has 9 + 0 arrangement. Centrioles form the basal body of cilia or flagella and spindle fibres for cell division in animal cells.

Nucleus : With double membrane; nuclear pores; has chromatin, nuclear matrix and nucleoli (site for rRNA synthesis).

Chromatin : DNA + non histone proteins.

Chromosomes (on basis of position of centromere) :

Metacentric : Middle centromere.

Sub-metacentric : Centromere nearer to one end of chromosome.

Acrocentric : Centromere situated close to its end.

Telocentric : Has terminal centromere.

Satellite : Some chromosomes have non-staining secondary constrictions at a constant location, which gives the appearance of small fragment called satellite.

QUESTIONS

Very Short Answer Questions (1 markeach)

1. Name the parts of bacterial flagella.

2. What do elaioplasts and aleuroplasts store ?

3. Who first saw and described a live cell ?

4. Which is the largest single cell ?

5. Who first explained that new cells arose from pre-existing cells ?

6. What is the composition of plasma membrane of human erythrocyte.

Short Answer Questions-II (2 marks each)

7. What are nuclear pores ? State their function.

8. State the cell theory.

9. Differentiate between active and passive transport.

10. Differentiate between RER and SER.

11. List the functions of golgi apparatus.

12. List the functions of mesosome.

Short Answer Questions-I (3 marks each)

13. Explain the Fluid Mosaic Model. Also represent it diagrammatically.

14. Differentiate between a prokaryotic and eukaryotic cell.

15. (a) Give the characteristic features of the genetic material of bacteria.

(b) What is plasmid ? What is its importance ?

16. Give the structural details of an eukaryotic nucleus along with its diagram.

Long Answer Questions (5 marks each)

17. (a) Give the structural details of mitochondria.

(b) Draw its diagram.

(c) Why is it called 'powerhouse of the cell' ?

18. (a) Diagrammatically represent the types of chromosomes based on the position of centromere.

(b) What does chromatin contain ?

(c) What is perinuclear space ?

ANSWERS/HINTS/REFERENCES

Very Short Answers (1 mark)

1. Filament, hook, basal body.

2. Elaioplasts : fats and oils.

Aleuroplasts : proteins.

3. Anton Von Leeuwenhoek

4. Egg of ostrich.

5. Rudolf Virchow.

6. 52% protein, 40% lipids.

Short Answers-II (2 marks)

7. Minute pores present in the nuclear envelope; provide passage for movement of RNA and proteins between nucleus and cytoplasm.

8. Refer notes.

9. Refer notes.

10. Refer notes.

11. Refer notes.

12. Refer notes.

Short Answers-I (3 marks)

13. Refer page no. 131-132, NCERT, Text Book of Biology for Class XI.

14. Differences in nucleus/chromosomes/mesosome/membrane bound cell organelles/ribosomes/compartments in cell.

15. Refer page no. 128, NCERT, Text Book of Biology for Class XI.

16. Refer page no. 138, NCERT, Text Book of Biology for Class XI.

Long Answers (5 marks)

17. Refer page no. 134-135, NCERT, Text Book of Biology for Class XI.

18. Refer page no. 138-139, NCERT, Text Book of Biology for Class XI.

Chapter-9

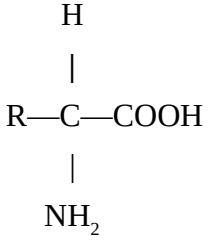
BIOMOLECULES

POINTS TO REMEMBER

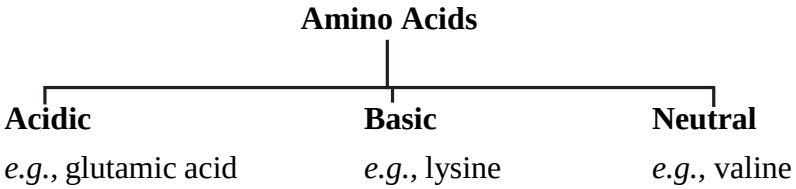
Biomolecules : All the carbon compounds that we get from living tissues.

Micromolecules : Molecules which have molecular weights less than one thousand dalton.

Amino acids : Organic compounds containing an amino group and one carboxyl group (acid group) and both these groups are attached to the same carbon atom called **α carbon**.



- Twenty types of amino acids.
- Based on number of amino and carboxyl groups, amino acids can be :

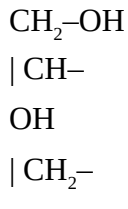


Lipids :

- Water insoluble, containing C, H, O.
- Fats on hydrolysis yield fatty acids.
- Fatty acid has a carboxyl group attached to an R group (contains 1 to 19 carbons).
- **Fatty Acids : Saturated :** With single bonds in carbon chain. *e.g.,* Palmitic acid, butyric acid.

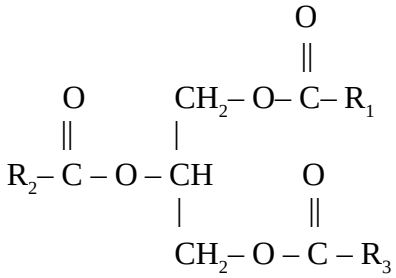
  Unsaturated : With one or more double bonds. *e.g.,* oleic acid, linoleic acid.

• **Glycerol :** A simple lipid, is trihydroxypropane.



• Some lipids have fatty acids esterified with glycerol.

• They can be monoglycerides, diglycerides and triglycerides.



Triglyceride (R_1, R_2, R_3 are fatty acids.)

• **Phospholipids** are compound lipids with phosphorus and a phosphorylated organic compound *e.g.,* Lecithin.

Nitrogen bases

Carbon compounds with heterocyclic rings)

Purine : Adenine, Guanine. **Pyrimidine :** Cytosine, Uracil, Thymine.

Nucleoside : Nitrogenous base + Sugar *e.g.,* Adenosine, guanosine.

Nucleotide : Nitrogenous base + Sugar + Phosphate group. *e.g.,* Adenylic acid, thymidylic acid.

Nucleic acid : Polymer of nucleotides - DNA and RNA.

Biomacromolecules : Biomolecules with molecular weights in the range of ten thousand daltons and above; found in acid insoluble fraction.

Lipids are not strictly macromolecules as their molecular weights do not exceed 800 Da but form a part of the acid insoluble pool.

Proteins :

- Are polymers of aminoacids linked by peptide bond.
- Is a heteropolymer.
- For functions of proteins refer Table 9.5, Page no. 147, NCERT, Text Book of Biology for Class XI.

Structure of Proteins

(a) **Primary structure :** Is found in the form of linear sequence of amino acids. First amino acid is called N-terminal amino acid and last amino acid is called C-terminal amino acid.

(b) **Secondary structure :** Polypeptide chain undergoes folding or coiling which is stabilized by hydrogen bonding. Right handed helices are observed. *e.g.,* fibrous protein in hair, nails.

(c) **Tertiary structure :** Long protein chain is folded upon itself like a hollow wollen ball. Gives a 3-dimensional view of protein, *e.g.,* myosin.

(d) **Quaternary structure :** Two or more polypeptides with their foldings and coilings are arranged with respect to each other. *e.g.,* Human haemoglobin molecule has 4 peptide chains - 2a and 2b subunits.

Peptide bond : Formed between the carboxyl (-COOH) group of one amino acid and the amino ($-NH_2$) group of the next amino acid with the elimination of water moeity.

Polysaccharides : Are long chain of sugars.

(a) **Starch :** Store house of energy in plant tissues. Forms helical secondary structures.

(b) **Cellulose :** Polymer of glucose.

(c) **Glycogen :** Is a branched homopolymer, found as storage polysaccharide in animals.

(d) **Insulin :** Is a polymer of fructose.

(e) **Chitin :** Chemically modified sugar (amino-sugars) N-acetyl galactosamine. Form exoskeleton of arthropods.

Anabolic pathways : Lead to formation of more complex structure from a simpler structure with the consumption of energy. *e.g.,* Protein from amino acids.

Catabolic pathway : Lead to formation of simpler structure from a complex structure. *e.g.*, Glucose $\rightarrow$ Lactic Acid.

Enzymes : Are biocatalysts.

- Almost all enzymes are proteins.
- **Ribozomes** - Nucleic acids that behave like enzymes.
- Has primary, secondary and tertiary structure.
- Active site of an enzyme is a crevice or pocket into which substrate fits.
- Enzymes get damaged at high temperatures.
- Enzymes isolated from thermophilic organisms (live under high temperatures) are thermostable.
- Enzymes accelerate the reactions many folds.
- Enzymes lower the activation energy of reactions. (Fig. 9.6, Page no. 156, NCERT Text Book of Biology for Class XI).
- $E + S \rightleftharpoons ES \rightarrow EP \rightarrow E + P$

  where E = Enzyme, S = Substrate, P = Product.

Factors affecting enzyme activity :

(a) **Temperature :** Show highest activity at optimum temperature. Activity declines above and below the optimum value.

(b) **pH :** Enzymes function in a narrow range of pH. Highest activity at optimum pH. (Fig. 9.7, Page no. 157, NCERT, Text Book of Biology for Class XI)

(c) **Concentration of substrate :** The velocity of enzymatic reaction rises with increase in substrate concentration till it reaches maximum velocity (V_{max}). Further increase of substrate does not increase the rate of reaction as no free enzyme molecules are available to find with additional substrate.

Enzyme inhibition : When the binding of a chemical shuts off enzyme activity, the process is called inhibition and chemical is called **inhibitor.**

Competitive inhibition : Inhibitor closely resembles the substrate in its molecular structure and inhibits the enzyme activity. *E.g.,* inhibition of succinic dehydrogenase by malonate.

Classification of enzymes :

Oxidoreductase/dehydrogenases : Catalyse oxidoreduction between 2 substrates.

Transferases : Catalyse transfer of a group between a pair of substrates.

Hydrolases : Catalyse hydrolysis of ester, ether, peptide, glycosidic, C-C, P-N bonds.

Lyases : Catalyse removal of groups from substrates by mechanisms other than hydrolysis.

Isomerases : Catalyse inter-conversion of optical, geometric or positional isomers.

Ligases : Catalyse linking together of 2 compounds.

Cofactors : Non-protein constituents found to the enzyme to make it catalytically active. Protein portion of enzyme is called **apoenzyme.**

Cofactors : • Prosthetic groups : Are organic compounds tightly bound to apoenzyme. *E.g.,* haem in peroxydase and catalase.

• **Co-enzymes :** Organic compounds which has transient association with enzyme. *E.g.,* NAD, NADP.

• **Metal ions :** Required for enzyme activity. Form coordination bond with side chains at active site and with substrate. *E.g.,* zinc is a co-factor for enzyme carboxypeptidase.

18. Nucleic acids : Deoxyribonucleic acid (DNA) and ribonucleic acid (RNA).

DNA structure (Watson and Crick Model) : DNA is a right handed, double helix of two polynucleotide chains, having a major and minor groove. The two chains are antiparallel, and held together by hydrogen bonds (two between A and T and three between C and G). The backbone is formed by sugar-phosphate-sugar chain. The nitrogen bases are projected more or less perpendicular to this backbone and face inside.

QUESTIONS

Very Short Answer Questions (1 mark each)

1. Why do generally oils remain in liquid state even in winters ?

2. Name an element found in proteins but not in lipids and carbohydrates.

3. What is the difference between RNA and DNA in terms of nitrogenous base ?

4. What does an enzyme do in terms of energy requirement of a reaction ?

5. What is the function of ATP in cell metabolism ?

6. Name the protein which form the intercellular ground substance.

Short Answer Questions-II (2 marks each)

7. Why are aminoacids also known as substituted methane ?

8. Amino acids exist as zwitter ions. Give its structure. Why is it formed ?

9. Why do starch give blue black colour with iodine ?

10. Why are starch and glycogen more suitable than glucose as a storage product ?

11. What would happed when salivary amylase which acts on starch in mouth, enter stomach ?

Short Answer Questions-I (3 marks each)

12. Explain the structure of proteins.

13. (a) What is an enzyme ?

(b) Give an example of co-enzyme.

(c) Distinguish between apoenzyme and co-enzyme.

14. Explain Watson-Crick model on DNA structure.

15. Explain peptide bond, glycosidic bond and phophodiester bond.

16. Explain competitive inhibition along with an example.

Long Answer Questions (5 marks each)

17. List the 6 classes of enzymes alongwith their functions.

ANSWERS

Very Short Answers (1 mark)

1. Oils are unsaturated lipids, hence have lower melting points.

2. Nitrogen.

3. RNA has uracil instead of thymine.

4. Lowers the activation energy of reaction.

5. Are the energy currency of cell.

6. Collagen.

Short Answers-II (2 marks)

7. The α-carbon has 4 substituted groups occupying the 4 valency positions : -H, -COOH, -NH_2 and -R group.

8.

$$H^+_3 - CH(R) - COO^-$$

Ionizable nature of $-NH_2$ and –COOH groups.

9. Starch forms helical secondary structures which can hold I_2.

10. Occupy lesser space as less bulky and can hydrolysed to glucose when required.

11. Action of amylase stops in stomach as it cannot act in an acidic medium.

Short Answers-I (3 marks)

12. Refer 'Points to Remember'.

13. (a) Are biocatalysts.

(b) NADP, NAD

(c) The enzymes which work only in the presence of co-factors as known as apoenzymes.

An organic non-protein cofactor which is easily separable from the apoenzyme is called co-enzyme.

14. Refer 'Points to Remember'.

15. Refer Page no. 151, NCERT, Text Book of Biology for Class XI.

16. Refer 'Points to Remember'.

Long Answers (5 marks)

17. Refer Page no. 158., NCERT, Text Book of Biology for Class XI.

■

Chapter-10

CELL CYCLE AND CELL DIVISION

POINTS TO REMEMBER

Cell cycle : The sequence of events by which a cell duplicates its genome, synthesis the other constitutents of the cell and eventually divides into two daughter cells.

Phases of cell cycle :

Interphase :

- **G_1 Phase :** Cell metabolically active and grows continuously.
- **S Phase :** DNA synthesis occurs, DNA content increases from 2C to 4C. but the number of chromosomes remains some (2N).
- **G_2 Phase :** Proteins are synthesised in preparation for mitosis while cell growth continues.

M Phase (Mitosis Phase) : Starts with nuclear division, corresponding to separation of daughter chromosomes (karyokinesis) and usually ends with division of cytoplasm (cytokinesis).

Quiescent stage (G_0) : Cells that do not divide and exit G_1 phase to enter an inactive stage called G_0. Cells at this stage remain metabolically active but do not proliferate.

MITOSIS

Prophase : (i) Replicated chromosomes, each consisting of 2 chromatids, condense and become visible.

(ii) Microtubules are assembled into mitotic spindle.

(iii) Nucleolus and nuclear envelope disappear.

(iv) Centriole moves to opposite poles.

Metaphase : (i) Spindle fibres attached to kinetochores (small disc-shaped structures at the surface of centromers) of chromosomes.

(ii) Chromosomes line up at the equator of the spindle to form metaphase plate.

Anaphase : (i) Centromeres split and chromatids separate.

(ii) Chromatids move to opposite poles.

Telophase : (i) Chromosomes cluster at opposite poles.

(ii) Nuclear envelope assembles around chromosome cluster.

(iii) Nucleolus, golgi complex, ER reform.

Cytokinesis : Is the divison of protoplast of a cell into two daughter cells after Karyokinesis (nuclear division).

Animal cytokinesis : Appearance of furrow in plasma membrane which deepens and joins in the centre dividing cell cytoplasm into two.

Plant cytokinesis : Formation of new cell wall begins with the formation of a simple precursor – **cell plate** which represents the middle lamella between the walls of two adjacent cells.

Significance of Mitosis :

1. Growth – addition of cells.
2. Maintenance of surface/volume ratio.
3. Maintenance of chromosome number.
4. Regeneration.
5. Reproduction in unicellular organism.
6. Repair and wound healing.

Meiosis :

- Specialised kind of cell division that reduces the chromosome number by half, resulting in formation of 4 haploid daughter cells.
- Occurs during gametogenesis in plants and animals.
- Involves two sequential cycles of nuclear and cell division called Meiosis I and Meiosis II.
- Interphase occurs prior to meiosis which is similar to interphase of mitosis except the S phase is prolonged.
- 4 haploid daughter cells are formed.

Meiosis I

Prophase I : Subdivided into 5 phases.

Leptotene :

- Chromosomes make their as single stranded structures.
- Compaction of chromosomes continues.

Zygotene :

- Homologous chromosomes start pairing and this process of association is called **synapsis.**
- Chromosomal synapsis is accompanied by formation of synaptonemal complex.
- Complex formed by a pair of synapsed homologous chromosomes is called bivalent or tetrad.

Pachytene : Crossing over occurs between non-sister chromatids of homologous chromosomes.

Diplotene : Dissolution of synaptonemal complex occurs and the recombined chromosomes separate from each other except at the sites of crossing over. These X-shaped structures are called **chaismata.**

Diakinesis : • Terminalisation of chaismata.

- Chromosomes are fully condensed and meiotic spindles assembled.
- Nucleolus disappear and nuclear envelope breaks down.

Metaphase I : • Bivalent chromosomes align on the equatorial plate.

- Microtubules from opposite poles of the spindle attach to the pair of homologous chromosomes.

Anaphase I : Homologous chromosomes separate while chromatids remain associated at their centromeres.

Telophase I :

- Nuclear membrane and nucleolus reappear.
- Cytokinesis follows (diad of cells).

Interkinesis : Stage between two meiotic divisions. (meiosis I and meiosis II)

Meiosis II

Prophase II

- Nuclear membrane disappears.
- Chromosomes become compact.

Metaphase II

- Chromosomes align at the equator.
- Microtubules from opposite poles of spindle get attached to kinetochores of sister chromatids.

Anaphase II

- Simultaneous splitting of the centromere of each chromosome, allowing them to move towards opposite poles of the cell.

Telophase II

- Two groups of chromosomes get enclosed by a nuclear envelope.
- Cytokinesis follows resulting in the formation of tetrad of cells *i.e.*, 4 haploid cells.

Significance of Meiosis

1. Formation of gametes : In sexually reproducing organisms.

2. Genetic variability

3. Maintenance of chromosomal number : By reducing the chromosome number in gametes. Chromosomal number is restored by fertilisation of gametes.

QUESTIONS

Very Short Answer Questions (1 mark each)

1. What are kinetochores ?

2. What is interkinesis ?

3. Why is mitosis called equational division ?

4. Name the stage of meiosis during which synaptonemal complex is formed.

5. What is G_0 phase of cell cycle ?

Short Answer Questions-II (2 marks each)

6. Differentiate between cytokinesis of plant and animal cell.

7. What is chaismata ? State its significance.

8. What happens during S phase of interphase ?

9. Distinguish between metaphase of mitosis and metaphase I of meiosis.

Short Answer Questions-I (3 marks each)

10. Differentiate between mitosis and meiosis.

11. List the significance of mitosis.

12. Describe the following :

(a) Synapase

(b) Bivalent

(c) Leptotene

Long Answer Questions (5 marks each)

13. With the help of labelled diagram, explain the following :

(a) Diplotene

(b) Anaphase of mitosis

(c) Prophase I

14. What is cell cycle ? Explain the events occuring in this cycle.

ANSWERS

Very Short Answers (1 mark)

1. Small disc-shaped structure at the surface of the centromeres.

2. The stage between two meiotic divisions.

3. The chromosome number in daughter cells is equal to that of the parent cell.

4. Zygotene.

5. Cells which enter a stage where they are metabolically active but no longer proliferate.

Short Answers-II (2 marks)

6. Refer 'Points to Remember'.

7. Refer 'Points to Remember'.

8. Refer 'Points to Remember'.

9.

Metaphase	Metaphase I
(a) Chromosome align along the equator of the cell. (b) Figure 10.2 (b) page 165, Text Book of Biology for Class XI.	Bivalent chromosomes arrange along the equatorial plane Figure 10.3, meta phase I page 169, NCERT Text Book of Biology for Class XI.

Short Answers-II (2 marks)

10. Refer 'Points to Remember'.

11. Refer 'Points to Remember'.

12. Refer 'Points to Remember'.

Short Answers-II (2 marks)

13. Refer 'Points to Remember'.

14. Refer 'Points to Remember'.

Chapter-11

TRANSPORT IN PLANTS

POINTS TO REMEMBER

Translocation : Transport of substances in plants over longer distances through the vascular tissue (Xylem and Phloem) is called translocation.

Means of transport : The transport of material into and out of the cells is carried out by a number of methods. These are diffusion, faciliated diffusion and active transport.

Diffusion : Diffusion occurs from region of higher concentration to region of lower concentration across the permeable membrane. It is passive and slow process. No energy expenditure takes place.

Facilitated diffusion : The diffusion of hydrophilic substances along the concentration gradient through fixed membrane transport protein without involving energy expenditure is called facilitated diffusion. For this the membrane possess aquarporins and ion channels. No energy is utilized in this process.

Methods of Facilitated Diffusion

Symport	**Antiport**	**Uniport**
(Two molecules cross the membrane in the same direction at the same time.)	(Two molecules move in opposite direction at the same time.)	(Single molecule moves across membrane independent of other molecules.

Active transport : Active transport is carried by the movable carrier proteins (pumps) of membrane. Active transport uses energy to pump molecules against a concentration gradient from a low concentration to high concentration (uphill-transport). It is faster than passive transport.

Water potential : The chemical potential of water is called water potential. It is denoted by Ψ_W (Psi) and measured in pascals (Pa). The water potential of a cell is affected by solute potential (Ψ_s) and pressure potential (Ψ_p).

$$\Psi_W = \Psi_s + \Psi_p$$

Water potential of pure water at standard temperature which is not under any pressure is taken to be zero (by convention).

Osomosis : Osmosis is movement of solvent or water molecules from the region of their higher diffusion pressure or free energy to the region of their lower diffusion pressure or free energy across a semi-permeable membrane.

Water molecules move from higher water potential to lower water potential until equilibrium is reached.

Plasmolysis : Process of shrinkage of protoplasm in a cell due to exosmosis in hypertonic solution.

Casparian strip : It is the tangential as well as radial walls of endodermal cells having the deposition of water impermeable suberin.

Imbibition : Imbibition is the phenonmenon of adsorption of water or any other liquid by the solid particles of a substance without forming a solution.

Some examples of Imbibition :

(i) If a dry piece of wood is placed in water, it swells and increases in its volume.

(ii) If dry gum or pieces of agar-agar are placed in water, they swell and their volume increases.

(iii) When seeds are placed in water they swell up.

Mass flow : Mass flow is the movement of substances (water, minerals and food) in bulk from one point to another as a result of pressure differences between two points.

Transport of water in plants : Water is absorbed by root hairs, then water moves upto xylem by two pathways – apoplast and symplast pathway.

The transport of water to the tops of trees occurs through xylem vessels. The forces of adhesion and cohesion maintain a thin and unbroken columns of water in the capillaries of xylem vessels through which it travesl upward. Water is mainly pulled by transpiration from leaves.

(Cohesion-tension-transpiration pull Model)

Root pressure : A hydrostatic pressure existing in roots which pushes the water up in xylem vessels.

Guttation : The water loss in its liquid phase at night and early morning through special openings of vein near the tip of leaves.

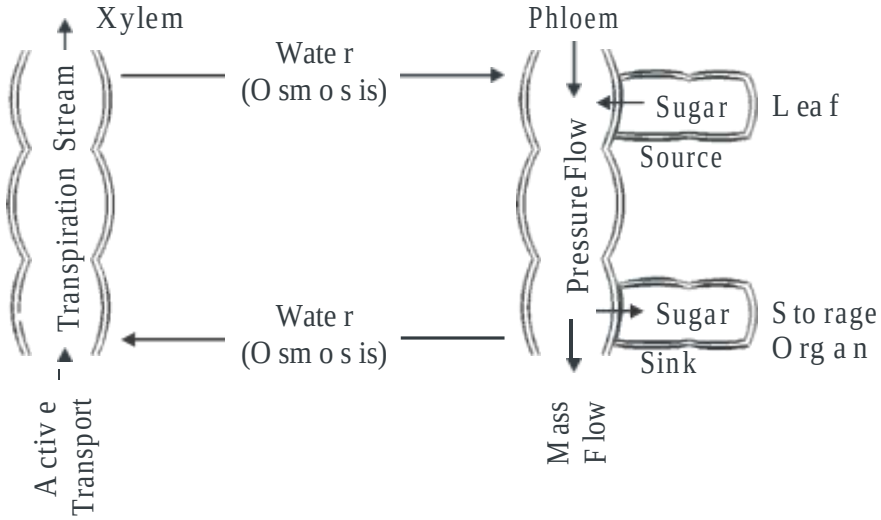
Transpiration : The loss of water through stomata of leaves and other aerial parts of plants in form of water vapour.

Factors affecting transpiration : Temperature, light, humidity, wind speed, number and distribution of stomata, water status of plant.

Uptake and transport of mineral nutrients : Ions are absorbed by the roots by passive and active transport. The active uptake of ions require ATP energy. Specific proteins in membranes of root hair cells actively pump ions from the soil into the cytoplasm of epidermal cells and then xylem. The further transport of ions to all parts of the plant is carried through the transpiration stream.

The Pressure or Mass Flow Hypothesis : The glucose is prepared at the source by the process of photosynthesis and is converted to sucrose (sugar). This sugar is then moved into sieve tube cells by active transport. It produces hypertonic condition in phloem. Water in the adjacent xylem moves into phloem by osmosis. Due to osmotic (turgor) pressure, the phloem sap moves to the areas of lower pressure.

At the sink, osmostic pressure is decreased. The incoming sugar is actively transported out of the phloem and removed as complex carbohydrates (sucrose). As the sugar is removed, the osmotic pressure decreases, the water moves out of the phloem and returns to the xylem.



QUESTIONS

Very Short Answer Questions (1 mark each)

1. Which part of the root is related with the absorption of water ?

2. What makes the raisins to swell up when kept in water ?

3. Define water potential.

4. What will happen to water potential when a solute is added to water ?

5. A plant cell when kept in a solution got plasmolysed. What was the nature of the solution ?

6. Mention two ways of absorption of water in plants.

7. Which form of sugar is transported through phloem ?

8. Give one example of imbibition.

9. A flowering plant is planted in an earthen pot and irrigated. Urea is added to make the plant grow faster, but after some time the plant dies. Give its possible reason.

10. Why is energy required to develop root pressure ?

Short Answer Questions-II (2 marks each)

11. A well watered potted herbaceous plant shows wilting in the afternoon of a dry sunny day. Give reason.

12. Do different species of plants growing in the same soil show the same rate of transpiration of a particular time ? Justify your answer.

13. What is casparian strip ? Write its significance in plants.

14. Xylem transport is unidirectional and phloem transport bi-directional. Why ?

15. How is transpiration different from guttation ? Give two points.

Short Answer Questions-I (3 marks each)

16. When any dry plant material or seeds are kept in water, they swell up.

(a) Name the phenomenon involved in this change.

(b) Define this phenomenon.

(c) Give two conditions essential for the phenomenon to occur.

17. Plants show temporary and permanent wilting. Differentiate between the two. Do any of them indicate the water status of the soil ?

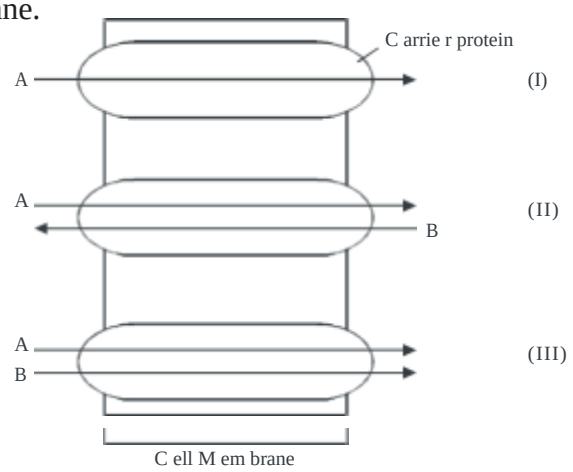
18. What is mycorrhiza ? How is the mycorrhizal association helpful in absorption of water and minerals in plants ?

19. Observe the given figure and give the answers of the following :

(a) Identify the process occuring in (I), (II) and (III).

(b) Differentiate between the process II and III.

(c) How many types of aquaporins form the water channels in the cell membrane.



20. Give the scientific term for the following statements/processes :

(a) Movement of water in roots through the cell wall exclusively.

(b) The positive hydrostatic pressure developed inside the cell or cell wall.

(c) A solution having relatively less concentration.

(d) Loss of water vapour from the aerial parts of the plants in the form of water vapour.

(e) Movement of a molecule across a membrane independent of other molecule.

(f) Water loss in its liquid phase through the special openings of veins near the tip of leaves of many herbaceous plants.

Long Answer Questions (5 marks each)

21. Minerals are present in the soil in sufficient amount. Do plants need to adjust the types of solutes that reach the xylem ? Which molecules help to adjust this ? How do plants regulate the type and quantity of solutes that reach xylem.

22. How do plants absorb water ? Explain transpiration pull model in this regard.

23. (a) Describe the pressure flow hypothesis of translocation of sugar in plants.

(b) Explain the mechanism of closing and opening of stomata.

ANSWERS

Very Short Answers (1 mark)

1. Root hairs.

2. Endosmosis.

3. Water potential is the potential energy of water.

4. Water potential will decrease.

5. Hypertonic.

6. Apoplast and symplast pathway.

7. Sucrose.

8. Swelling of seed when put in water/moist soil.

9. Due to exosmosis.

10. Every activity requires energy. Root pressure develops due to activity to living cell.

Short Answers-II (2 marks)

11. During noon the rate of transpiration becomes higher than the rate of water absorption by plant. It causes loss of turgity or wilting.

12. Rate of transpiration is not same because transpiration is affected by numbers and distribution of stomata.

13. Refer page 185, NCERT, Text Book of Biology for Class XI

14. Refer page 190, NCERT, Text Book of Biology for Class XI

15.

Transpiration	Guttation
(i) Loss of water by a plant in form of vapours.	(i) The loss of liquid droplets from the plant.
(ii) Occurs through the general surface of leaves (stomata) and the young stems.	(ii) Occurs at the margins and the tips of the leaves.

Short Answers-I (3 marks)

16. (a) Imbibition.

(b) Refer to Points to Remember.

(c) Condition necessary to imbibition.

(i) Water potential gradient between the absorbent and the liquid imbibed.

(ii) Affinity between the adsorbent and the liquid.

17.

Temporary wilting	Permanent wilting
(i) Plant recovers from temporary wilting after sometime.	(i) Automatic recovery is not possible. It may recover if water is provided soon.
(ii) Much damage is not caused.	(ii) Much damage is caused.
(iii) It commonly occurs during mid-day only.	(iii) It occurs throughout day and night.

When wilting is permanent, water present in soil is largely in unavailable form. The soil contains 10-15% water depending upon its texture.

18. Refer page 185, NCERT, Text Book of Biology for Class XI.

19. (a) (i) Uniport (ii) Antiport (iii) Symport

(b) Refer 'Points to Remember'.

(c) 8 types of aquaporins.

20. (a) Apoplast pathway

(b) Turgor pressure

(c) Hypotonic

(d) Transpiration

(e) Uniport

(f) Guttation

Long Answers (5 marks)

21. Refer page 189, NCERT, Text Book of Biology for Class XI.

22. Refer page 186-187, NCERT, Text Book of Biology for Class XI.

23. (a) Refer points toemember.

(b) Refer page 191, NCERT, Text Book of Biology for Class XI.

■

Chapter-12

MINERAL NUTRITION

POINTS TO REMEMBER

Autotroph : An organism that synthesize its required nutrients from simple and inorganic substances.

Heterotroph : An organism that cannot synthesise its own nutrients and depend on others.

Necrosis : Death of cells and tissues.

Biological nitrogen fixation : Conversion of atmospheric into organic compounds by living organisms.

Nitrification : Conversion of ammonia (NH_3) into nitrite and then to nitrate.

Denitrification : A process of conversion of nitrate into nitrous oxide and nitrogen gas (N_2).

Leg-hemoglobin : Pinkish pigment found in the root nodules of legumes. It acts as oxygen scavenger and protects the nitrogenase.

Flux : The movement of ions is called flux.

Necrosis : Death of tissues particularly leaf tissue due to deficiency of Ca, Mg, Cu, K.

Mineral Nutrition : Plants require minerall elements for their growth and development. The utilization of various absorbed ions by a plant for growth and development is called **mineral nutrition** of the plant.

Hydroponics : Soil-less culture of plants, where roots are immersed in nutrient solution without soil is called hydroponics. The result obtained from hydroponics may be used to determine deficiency symptoms of essential elements.

Essential Elements

Macronutrients	Micro-nutrients
Macronutrients are present in plant tissues in concentrations of 1 to 10 mg per gram of dry matter.	Micro-nutrients are needed in very low amounts : 0.1 mg per gram of dry matter.
C, H, O, N, P, K, S, Ca, Mg.	Fe, Mn, Cu, Mo, Zn, B, Cl, Si.

Chlorosis : Yellowing of leaves due to loss of chlorophyll.

Active Transport : Absorption occuring at the expense of metabolic energy.

Passive Transport : Absorption of minerals with concentration gradient by the process of diffusion without the expense of metabolic energy.

Role of Minerals Elements in Plants

MACRO-NUTRIENTS

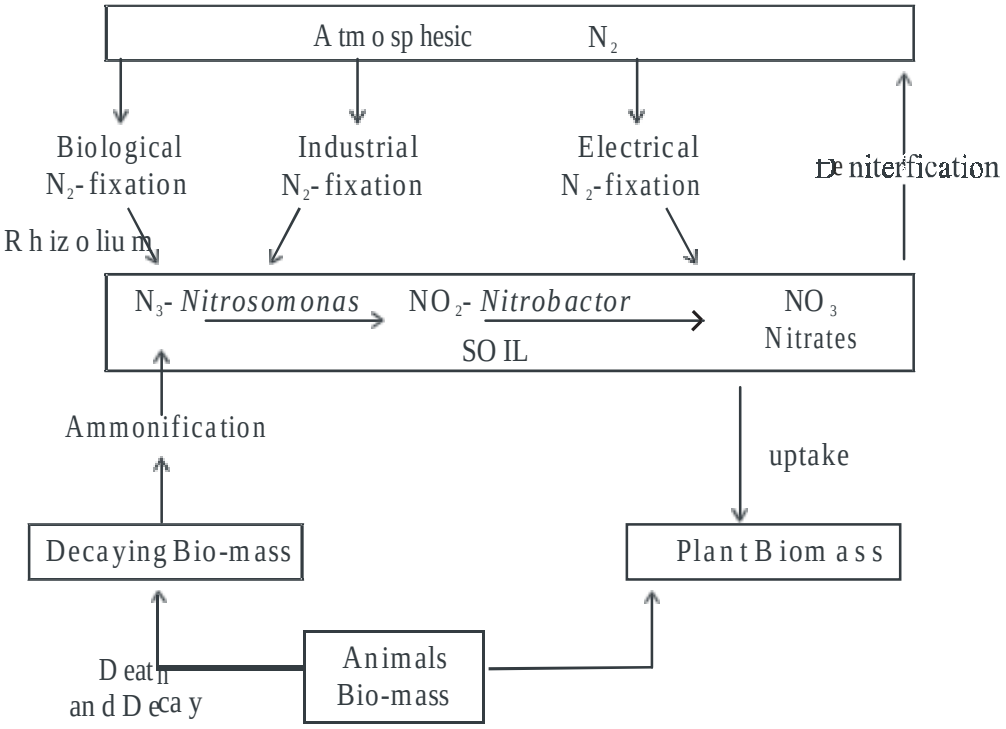
Element	Obtained as	Functions	Deficiency symptoms
Nitrogen (N)	Mainly as NO_3^- some as NO_2^- or NH_4^+.	Constituent of proteins, nucleic acids, vitamins and hormones.	Stunted growth. Chlorosis
Phosphorus (P)	Phosphate ions ($H_2PO_4^-$ or HPO_4^{2-})	Constituent of cell membrane. Required for the synthesis of nucleic acids, nucleotides, ATP NAD and NADP and for phosphorylation reactions.	Poor growth of plant. Leaves dull green.
Potasium (K)	K^+	Helps to maintain an anion-cation balance in cells. Involved in protein synthesis, in opening and closing of stomata; activation of enzymes; maintenance of turgidity of cells.	Stunted growth; yellow edges of leaves; mottled appearance of leaves. Premature death.
Calcium (Ca)	Ca^{++}	Required in formation of mitotic spindle; involved in normal functioning of cell membranes; activates certain enzymes; as calcium pectate in middle lamella of the cell wall.	Stunted growth, chlorosis of young leaves.

Magnesium (Mg)	Mg^{++}	Activates enzymes in phosphate metabolism, constituent of chloro-phyll; maintains ribosome structure.	Chlorosis
Sulphur (S)	SO_4^{++}	Constituent of amino-acids. Crysteine and methionine and proteins, co-enzymes, vitamins and ferredoxin.	Chlorosis

MICRO-NUTRIENTS

Element	Obtained as	Functions	Deficiency symptoms
Iron (Fe)	Fe^{+++}	Constituent of Ferredoxin and cytochrome; needed for synthesis of chlorophyll.	Chlorosis
Manganese (Mn)	Mn^{+++}	Activates certain enzymes involved in photosynthesis, respiration and nitrogen metabolism.	Chlorosis, grey spots on leaves.
Zinc (Zn)	Zn^{++}	Activates various enzymes like carbo-xylases. Required for synthesis of auxins.	Malformation of leaves. Dieback of shoots.
Copper (Cu)	Cu^{+++}	Activates certain enzymes.	
Boron (B)	BO_3^- or $B_4O_7^{2-}$	Required for uptake of water and Ca, for membrane functioning, pollen germination, cell elongation carbohydrate translocation.	Death of stem and root apex.
Molybdenum (Mo)	MoO_2^{2+} (molybdate)	Activates certain enzymes in nitrogen metabolism.	
Chlorine (Cl)	Cl^-	Maintains solute concentration along with Na^+ & K^+; maintain anioncation balance in cells; essential for oxygen evolution in photosynthesis.	

Nitrogen Cycle :



QUESTIONS

Very Short Answer Questions (1 mark each)

1. Name one symbiotic nitrogen-fixing bacteria.

2. Give two examples of photosynthetic micro-organisms, which also fix atmospheric nitrogen.

3. Name two organisms each which fix nitrogen asymbiotically and symbiotically.

4. Name the substance that imparts pink colour to the root nodule of a leguminous plant and also mention its role.

5. What is the term used for mineral deficiency symptom in plants in which leaves became yellow in different pattern ?

Short Answer Questions-II (2 marks each)

6. Differentiate between two types of absorption of minerals in plants from soil.

7. Name the following :

(a) Bacteria which converts ammonia into nitrite.

(b) Bacteria which oxidises nitrite into nitrate.

8. How does Leghemoglobin protect the enzyme nitrogenase ?

Short Answer Questions-I (3 marks each)

9. Write the deficiency symptoms of the following three elements :

(a) Phosphorus

(b) Magnesium

(c) Potassium

10. Describe the following three deficiency symptoms and co-relate them with concerned mineral deficiency :

(a) Chlorosis

(b) Necrosis

(d) Stunted plant growth

11. Explain the steps in biological nitrogen fixation in brief.

12. Describe the two main processes of synthesis of amino acids from Ammonium ion (NH_4^+) in plants.

Long Answers (5 marks each)

13. Describe all the steps of nitrogen cycle in nature.

14. Describe with diagrams how root nodules are formed in leguminous plants.

ANSWERS

Very Short Answers (1 mark)

1. *Rhizobium*

2. *Anabaena, Nostoc*

3. Asymbiotically – *Azotobacter, Bacillus polymyxa*

Symbiotically – *Rhizobium*, *Anabaena.*

4. Leghemoglobin. It is an oxygen scavenger, which protects the enzyme nitrogenase.

5. Necrosis.

Short Answers-II (2 marks)

6. Refer to NCERT Book, Page no. 200 (12.3).

7. (i) Nitrifying Bacteria – *Nitrosomonas.*

(ii) Nitrifying Bacteria – *Nitrobacter*

8. Refer to page no. 203.

Short Answers-I (3 marks)

9. Refer to 'Points to Remember'.

10. Refer to 'Points to Remember'.

11. Refer to Page no. 201.

12. Refer to Page no. 204.

Long Answers (5 marks)

13. Refer to Page no. 201.

14. Refer to Page no. 203.

Chapter-13

PHOTOSYNTHESIS IN HIGHER PLANTS

POINTS TO REMEMBER

Photosynthesis : Photosynthesis is an enzyme regulated anabolic process of manufacture of organic compounds inside the chlorophyll containing cells from carbon dioxide and water with the help of sunlight as a source of energy.

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

Historical Perspective

Joseph Priestley (1770) : Showed that plants have the ability to take up CO_2 from atmosphere and release O_2.

Jan Ingenhousz (1779) : Release of O_2 by plants was possible only in sunlight and only by the green parts of plants.

Theodore de Saussure (1804) : Water is an essential requirement for photosynthesis to occur.

Julius Von Sachs (1854) : Green parts in plant produce glucose which is stored as starch.

S. W. Engelmann (1888) : The effect of different wavelength of light on photosynthesis and plotted the first action spectrum of photosynthesis.

C. B. Van Niel (1931) : Photosynthesis is essentially a light dependent reaction in which hydrogen from an oxidisable compound reduces CO_2 to form sugar. He gave a simplified chemical equation of photosynthesis.

Hill (1937) : Evolution of oxygen occurs in light reaction.

Calvin (1954-55) : Traced the pathway of carbon fixation.

Hatch and Slack (1965) : Discovered C_4 pathway of CO_2 fixation.

Site for photosynthesis : Photosynthesis takes place only in green parts of the plant, mostly in leaves. Within a leaf, photosynthesis occurs in mesophyll cells which contain the chloroplasts. Chloroplasts are the actual sites for photosynthesis. The thylakoids in chloroplast contain most of pigments required for capturing solar energy to initiate photosynthesis. The membrane system (grana)

is responsible for trapping the light energy and for the synthesis of ATP and NADPH. Biosynthetic phase (dark reaction) is carried in stroma.

Pigments involved in photosynthesis :

Chlorophyll a : (Bright or blue green in chromatograph). Major pigment, act as reaction centre, involved in trapping and converting light into chemical energy.

Chlorophyll b : (Yellow green)

Xanthophyll : (Yellow)

Carotenoids : (Yellow to yellow-orange)

In the blue and red regions of spectrum shows higher rate of photosynthesis.

Light Harvesting Complexes (LHC) : The light harvesting complexes are made up of hundreds of pigment molecules bound to protein within the photosystem I (PSI) and photosystem II (PSII). Each photosystem has all the pigments except one molecule of chlorophyll 'a' forming a light harvesting system (antennae). The reaction centre (chlorophyll a) is different in both the photosystems.

Photosystem I (PSI) : Chlorophyll 'a' has an absorption peak at 700 nm (P700).

Photosystem II (PSII) : Chlorophyll 'a' has absorption peak at 680 nm (P680).

Process of photosynthesis : It includes two phases - Photochemical phase and biosynthetic phase.

(i) Photochemical phase (Light reaction) : This phase includes - light absorption, splitting of water, oxygen release and formation of ATP and NADPH.

(ii) Biosynthetic phase (Dark reaction) : It is light independent phase, synthesis of food material (sugars).

Photophosphorylation : The process of formation of high-energy chemicals (ATP and NADPH).

Cyclic photophosphorylation : Two photosystems work in series – First PSII and then PSI. These two photosystems are connected through an electron transport chain (Z. Scheme). Both ATP and NADPH + H^+ are synthesised by this process. PSI and PSII are found in lamellae of grana, hence this process is carried here.

Non-cyclic photophosphorylation : Only PSI works, the electron circulates within the photosystem. It happens in the stroma lamellae (possible location) because in this region PSII and NADP rectase enzyme are absent. Hence only ATP molecules are synthesised.

The electron transport (Z-Scheme) : In PS II, reaction centre (chlo. a) absorbs 680 nm wavelength of red light which make the electrons to become excited. These electrons are taken up by the electron acceptor that passes them to an electron transport system (ETS) consisting of cytochromes. The movement of electron is down hill. Then, the electron pass to PSI and move down hill further.

The splitting of water : It is linked to PS II. Water splits into H^+, O and electrons.

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

Chemiosmotic Hypothesis : Chemiosmotic hypothesis explain the mechanism of ATP synthesis in chloroplast. In photosynthesis, ATP synthesis is linked to development of a proton gradient across a membrane. The electrons are accumulated inside of membrane of thylakoids (in lumen). ATPase has a channel that allows diffusion of protons back across the membrane. This releases energy to activate ATPase enzyme that catalyses the formation of ATP.

Biosynthetic phase in C_3 plants :

ATP and NADH, the products of light reaction are used in synthesis of food. The first CO_2 fixation product in C_3 plant is 3-phosphoglyceric acid or PGA. The CO_2 acceptor molecule is RuBP (ribulose bisphosphate). The cyclic path of sugar formation is called Calvin cycle on the name of Melvin Calvin, the discoverer of this pathway. Calvin cycle proceeds in three stages :

(1) **Carboxylation :** CO_2 combines with ribulose 1, 5 bisphosphate to form 3 PGA in the presence of RuBisCo enzyme.

(2) **Reduction :** Carbohydrate is formed at the expense of ATP and NADPH.

(3) **Regeneration :** The CO_2 acceptor ribulose 1, 5-bisphosphate is formed again .

6 turns of Calvin cycles and 18 ATP molecules are required to synthesize one molecule of glucose.

The C_4 pathway : C_4 plants have special type of leaf anatomy, they tolerate higher temperatures. In this pathway, oxaloacetic acid (OAA) is the first stable product formed. It is 4 carbon atoms compound, hence called C_4 pathway (Hatch and Slack Cycle). The leaf has two types of cells : mesophyll cells and Bundle sheath cells (Kranz anatomy). Initially CO_2 is taken up by phosphoenol pyruvate (PEP) in mesophyll cells and changed to oxaloacetic acid (OAA) in the presence of PEP carboxylase. Oxaloacetate is reduced to maltate/asparate that reach into bundle sheath cells.

The oxidation of maltate/asparate occurs with the release of O_2 and formation of pyruvate (3C). In high CO_2 concentration RuBisCo functions as carboxylase and not as oxygenase, the photosynthetic losses are prevented. RuBP operates now under Calvin cycle and pyruvate transported back to mesophyll cells and changed into phosphoenol pyruvate to keep the cycle continue.

Photosrespiration : The light induced respiration in green plants is called photorespiration. In C_3 plants some O_2 binds with RuBisCo and hence CO_2 fixation is decreased. In this process RuBP instead of being converted to 2 molecules of PGA binds with O_2 to form one molecule of PGA and phosphoglycolate.

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 nearest to its minimal value. It is the factor which directly affects the process if its quantity is changed.

Factors affecting photosynthesis :

1. Light
2. Carbondioxide
3. Temperature
4. Water

QUESTIONS

Very Short Answer Questions (1 mark each)

1. Name two photosynthetic pigments belonging to Caretenoids.

2. How many molecules of ATP are required for synthesis of one molecule of glucose in C_3 and C_4 pathways ?

3. What part of sunlight is most suitable for photosynthesis ?

4. Which one of the photosystems can carry on photophosphorylation independently ?

5. Name two plants that can carry out photosynthesis at night.

6. Under what conditions the affinity of RuBP carboxylase for carbon dioxide and for oxygen increase ?

7. Name the scientist who proposed the C_4 pathway.

8. Where does carbon fixation occur in chloroplast ?

9. Which compound acts as CO_2 acceptor in Calvin cycle ?

10. Name the end products of light reaction.

Short Answer Questions-II (2 marks each)

11. Why does the rate of photosynthesis decline in the presence of continuous light ?

12. Why do green plants start evolving carbon dioxide instead of oxygen on a hot sunny day ?

13. Fill in the space, left blank in the given table to bring the difference between C_3 and C_4 plants :

S. No.	Characterisitcs	C_3 plants	C_4 plants
1.	Cell type	One type (mesophyll)	.....(a).....
2.	CO_2 acceptor	.....(b).....	Phosphoenol pyruvate (PEP)
3.	First CO_2 fixation product	3-PGA	.....(c).....
4.	Optimum temperature	.....(d).....	30º C to 45º C

14. State two functions of accesory pigments found in thylakoids.

15. Why do C_4 plants are more expensive than C_3 plants ?

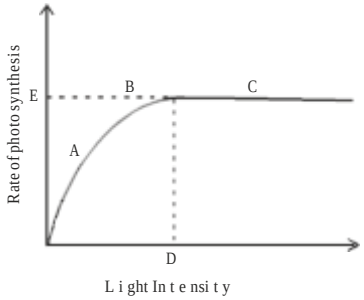
Short Answer Questions-I (3 marks each)

16. The figure shows the effect of light on the rate of photosynthesis. Based on the graph, answer the following questions :

(i) At which point(s) A, B or C in the curve, light is a limiting factor ?

(ii) What could be the limiting factor(s) in region A ?

(iii) What do region C and D represent on the curve ?

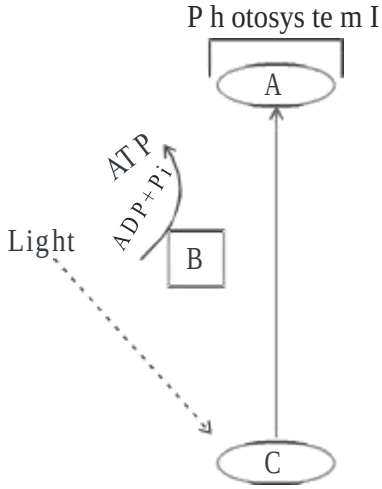


17. When and why does photorespiration take place in plants ? How does this process result in a loss to the plant ?

18. What are the steps that are common to C_3 and C_4 photosynthesis ?

19. Two potted plants were kept in an oxygen free environment in transparent containers, one in total darkness and the other in sunlight. Which one of the two is likely to survive more ? Justify your answer by giving the reason.

20. (a) In the diagram shown below label A, B and C. What type of phosphorylation is possible in this ?



(b) Give any two points of difference between cyclic and non-cyclic photophosphorylation.

Long Answer Questions (5 marks each)

21. Describe C_4 pathway in a paddy plant. How is this pathway an adaptive advantage to the plant ?

22. Explain the process of biosynthetic plase of photosynthesis occuring in chloroplast.

23. (a) Give steps of ATP synthesis in chloroplasts through chemiosmosis.

(b) Schematically represent non-cyclic photophosphoryaltion in plants.

ANSWERS

Very Short Answers (1 mark)

1. Carotene and Xanthophyll.

2. In C_3 pathway = 18 ATP molecules

In C_4 pathway = 30 ATP molecules

3. Blue and red regions of the light spectrum are the most effective in photosynthesis.

4. PS-I.

5. Opuntia, Chenopodium, Bougainvillea.

6. In temperature and oxygen concentration.

7. Hatch and Slack.

8. Carbon fixation takes place in stroma.

9. Ribulose 1, 5 bisphosphate.

10. ATP, $NADPH_2$ and O_2.

Short Answers-II (2 marks)

11. Increase in incident light beyond a point causes the breakdown of chlorophyll.

12. On a hot sunny day, enzyme RuBP carboxylase becomes active and its affinity for CO_2 decreases and for O_2 increases. Consequently more and more photosynthetically fixed carbon is lost by photorespiration.

13. (a) Two types cells : mesophyll and bundle sheath.

(b) RuBP

(c) OOA (oxaloacetic acid)

(d) 20ºC-25ºC

14. (a) Absorption of light and transfer of energy to chlorophyll 'a'.

(b) Protect chlorophyll 'a' from photo oxidation.

15. Because they require more energy (30 ATPs) in synthesizing one glucose molecule as compared to C_3 - 18ATPs.

Short Answers-I (3 marks)

16. (i) 'B'

(ii) CO_2 and temperature

(iii) 'C' represents to constant rate of photosynthesis, 'D' is the light saturation intensity at which rate of photosynthesis is maximum.

17. Refer Page no. 220, NCERT, Text Book Biology for class XI.

18. Hints :

(a) Photolysis of H_2O and photophosphorylation occurs in both C_3 and C_4 plants.

(b) In both, dark reaction occurs in stroma.

(c) Calvin cycle results in the formation of starch in both the plants.

(d) During dark reaction both types of plants undergo the phases of carboxylation and regeneration.

19. Hints :

• The plant in sunlight will survive for longer period.

• Light is essential for photosynthesis.

20. (a) (A) e^- acceptor

(B) Electron transport system

(C) Chlorophyll P700

(b) Refer Page no. 212, NCERT Text Book of Biology for Class XI.

Long Answers (5 marks)

21. Refer Page no. 218, NCERT Text Book of Biology for Class XI.

22. Refer Page no. 216, NCERT Text Book of Biology for Class XI.

Hint : Three stages of Calvin cycle : Carboxylation, reduction and regeneration.

23. (a) Refer Page no. 213 (Chemiosmotic Hypothesis), NCERT Text Book of Biology for Class XI.

(b) Refer Fig. 13.5 (Z-Scheme of light reaction), NCERT Text Book of Biology for Class XI.

Chapter-14

RESPIRATION IN PLANTS

POINTS TO REMEMBER

Aerobic respiration : Complete oxidation of organic food in presence of oxygen thereby producing CO_2, water and energy.

Anaerobic respiration : Incomplete breakdown of organic food to liberate energy in the absence of oxygen.

ATPSynthetase : An enzyme complex that catalyses synthesis of ATP during oxidative phospho-relation.

Biological oxidation : Oxidation in a series of reaction inside a cell.

Cytochromes : A group of iron containing compounds of electron transport system present in inner wall of mitochondria.

Dehydrogenase : Enzyme that catalyses removal of H atom from the substrate.

Electron acceptor : Organic compound which recieve electrons produced during oxidation-reduction reactions.

Electron transport : Movement of electron from substrate to oxygen through respiratory chain during respiration.

Fermentation : Breakdown of organic substance that takes place in certain microbe like yeast under anaerobic condition with the production of CO_2 and ethanol.

Glycosis : Enzymatic breakdown of glucose into pyruvic acid that occurs in the cytoplasm.

Oxidative phosphorylation : Process of formation of ATP from ADP and Pi using the energy from proton gradient.

Respiration : Biochemical oxidation food to release energy.

Respiratory Quotient : The ratio of the volume of CO_2 produced to the volume of oxygen consumed.

Proton gradient : Difference in proton concentration across the tissue membrane.

Mitochondrial matrix : The ground material of mitochondria in which

pyruvic acid undergoes aerobic oxidation through Kreb's cycle.

Abbreviations

ATP	–	Adenosine tri phosphate
ADP	–	Adenosine di phosphate
NAD	–	Nicotinamide Adenine dinucleotide
NADP	–	Nicotinamide Adenine dinucleotide Phosphate
NADH	–	Reduced Nicotinamide Adenine dinucleotide
PGA	–	Phosphoglyceric acid
PGAL	–	Phospho glyceraldehyde
FAD	–	Flavin adenine dinucleotide
ETS	–	Electron transport system
ETC	–	Electron transport chain
TCA	–	Tricarboxylic acid
OAA	–	Oxalo acetic acid
FMN	–	Flavin mono nucleotide
PPP	–	Pentose phosphate pathway

AEROBIC RESPIRATION

The overall mechanism of aerobic respiration can be studied under the following steps :

(A) Glycolysis (EMP pathway)

(B) Oxidative Decarboxylation

(C) Kreb's cycle (TCA-cycle)

(D) Oxidative phosphorylation

Glycolysis : The term has originated from the Greek word, *glycos* = glucose, *lysis* = splitting or breakdown means breakdown of glucose molecule.

- It is also called Embeden-Meyerhof-Paranus pathway. (EMP pathway)
- It is common in both aerobic and anaerobic respiration.
- It takes place outside the mitochondria, in the cytoplasm.
- One molecule of glucose (Hexose sugar) ultimately produces two molecules of pyruvic acid through glycolysis.

- During this process 4 molecules of ATP are produced while 2 molecules of ATP are utilised. Thus net gain of ATP is of 2 molecules.

Oxidative decarboxylation : Pyruvic acid is converted into Acetyle CoA in presence of pyruvate dehydrogenase complex.

$$\underset{CH_3COCOOH}{\text{Pyruvic acid}} \xrightarrow[\text{Pyruvate dehydrogenase}]{Mg^{2+}} \text{Acetyle CoA}$$

$$CH_3COCOOH + CoA + NAD \rightarrow CH_3Co.CoA + CO_2 + NADH + H^+$$

Tri Carboxylic Acid Cycle (Kreb's cycle) or Citric acid Cycle : This cycle starts with condensation of acetyle group with oxaloacitic acid and water to yield citric acid which undergoes a series of reactions.

- It is aerobic and takes place in mitochondrial matrix.
- Each pyruvic acid molecule produces 4 NADH + H^+, one $FADH_2$, one ATP.
- One glucose molecule has been broken down to release CO_2 and eight molecules of NADH + H^+, two molecules of $FADH_2$ and 2 molecules of ATP.

Electron transport system and oxidative phosphorylation : The metabolic pathway through which the electron passes from one carrier to another, is called Electron transport system and it is present in the inner mitochondrial membrane.

ETS comprises of the following :

(i) NAD and NADH + H^+

(ii) FAD and $FADH_2$

(iii) UQ

(iv) Cyt b, Cyt c_1, Cyt c, Cyt a and Cyt a_3.

Oxygen acts as final hydrogen acceptor. Oxidative phosphorylation takes place in elementary particles present on the inner membrane of cristae of mitochondria. Synthesis of ATP from ADP and Pi using energy from proton gradient is called oxidative phosphorylation. In this process O_2 is the ultimate electron acceptor and it get reduced to water.

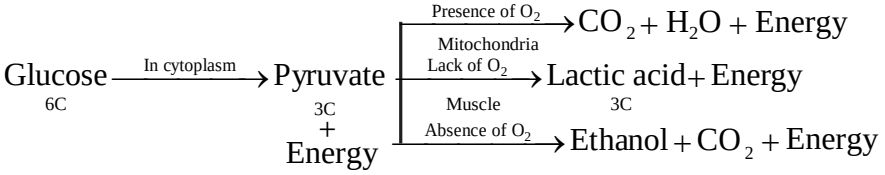
Total ATP Production

Process	Total ATP produced
1. Glycolysis	$2ATP + 2NADH_2 (6ATP) = 8ATP$
2. Oxidative decarboxylation	$2NADH_2 (6ATP) = 6ATP$
3. Kreb's Cycle	$2GTP (2ATP) + 6NADH_2 (18ATP) + 2FADH_2 (4ATP) = 24ATP$

Energy production in prokaryotes during aerobic respiration = 38 ATP

Energy production in eukaryotes during aerobic respiration = 38 – 2 = 36 ATP

(2ATP are used up in transporting 2 molecule of pyruvic acid in mitochondria.)



QUESTIONS

Very Short Answer Questions (1 mark each)

1. Name the molecule which is terminal acceptor of electron.

2. How many ATP molecules are produced from a molecule of glucose on it complet oxidation in eukaryotes ?

3. Where does ETC found in eukaryotic cell ?

4. Name the enzyme which convert sugar into glucose and fructose.

5. How many molecules of ATP are produced by the oxidation of one molecule of $FADH_2$?

6. Why do the person with sufficient white fibres get fatigued in a short period ?

7. Write the name of end product of glycolysis.

8. Name the first product formed in Kerb's cycle.

Short Answer Questions-II (2 marks each)

9. Differentiate between aerobic respiration and anaerobic respiration.

10. Mention two steps of glycolysis in which ATP is utilised.

11. Why does anaerobic respiration produces less energy than aerobic respiration ?

12. Define Respiratory Quotient. What is its value for fat and protein ?

13. Distinguish between glycolysis and fermentation.

14. What are respiratory substrates ? Name the most common respiratory substrate.

Short Answer Questions-I (3 marks each)

15. Give the schematic representation of an overall view of TCA cycle.

16. Where does electron transport system oparative in mitochondria ? Explain the system giving the role of oxygen ?

17. Give a brief account of ATP molecules produced in aerobic respiration in eukaryotes.

18. Discuss The respiratory pathway is an amphibolic pathway.

Long Answer Questions (5 marks each)

19. What is glycolysis ? Where does glycolysis takes place in a cell ? Give schematic representation of glycolysis.

ANSWERS

Very Short Answers (1 marks)

1. Oxygen.

2. 36 ATP.

3. Mitochondrial membrane.

4. Invertase.

5. 2 ATP molecules.

6. due to formation of Lactic acid.

7. Pyruvic acid.

8. Citric acid.

Short Answers-II (2 marks)

9. Refer NCERT Book Chapter 14 (14.3 and 14.4).

10. (i) ATP molecules are formed by direct transfer of Pi to ADP.

(ii) By oxidation of NADH.

11. Refer NCERT Book Chapter 14, Page 230.

12. Refer NCERT Book Page no. 236.

13. Refer NCERT Book Page no. 229 and page no. 230.

14. Refer NCERT Book Page no. 227.

Short Answers-I (3 marks)

15. Refer NCERT Book, Fig. 14.3 Page no. 232.

16. Refer NCERT Book Page no. 232 and page no. 233.

17. Refer notes.

18. Refer NCERT Book Page no. 235.

Long Answers (5 marks)

19. Refer NCERT Book Page no. 228 and page no. 229.

Chapter-15

PLANT GROWTH AND DEVELOPMENT

POINTS TO REMEMBER

Abscission : Shedding of plant organs like leaves, flowers and fruits etc. from the mature plant.

Apical dominance : Suppression of the growth of lateral buds in presence of apical bud.

Dormancy : A period of suspended activity and growth usually associated with low metabolic rate.

Photoperiodism : Response of plant to the relative length of day and night period to induce flowering.

Phytochrome : A pigment, which control the light dependent developmental process.

Phytohormone : Chemicals secreted by plants in minute quantities which influence the physiological activities.

Senescene : The last phase of growth when metabolic activities decrease.

Vernalisation : A method of promoting flowering by exposing the young plant to low temperature.

Growth : An irreversible permanent increase in size of an organ or its parts or even of an individual.

Abbreviations

IAA	Indole acetic acid
NAA	Naphthalene acetic acid
ABA	Abscissic acid
IBA	Indole-3 butyric acid
2.4D	2.4 dichlorophenoxy acetic acid
PGR	Plant growth regulator

Measurement of growth : Plant growth can be measured by a variety of parameters like increase in fresh weight, dry weight, length, area, volume and cell number.

Phases of growth : The period of growth is generally divided into three phases, namely, meristamatic, elongation and maturation.

(i) Meristematic zone : New cell produced by metotic division at root-tip and shoot tip thereby show increase in size. Cells are rich in protoplasm and nuclei.

(ii) Elongation zone : Zone of elongation lies just behind the meristematic zone and concerned with enlargement of cells.

(iii) Maturation zone : The portion lies proximal to the phase of elongation. The cells of this zone attain their maximum size in terms of wall thickning and protoplasmic modification.

Growth rate : The increased growth per unit time is termed as growth rate. The growth rate shows an increase that may be arithmetic or geometrical.

Growth	Mathematical expression	Curve
In Arithematic growth : Only one daughter cell continues to divide mitotically while other differentiates and matures.	$L_t = L_0 + rt$ L_t = Length at time t L_0 = Length at time zero r = growth rate	Linear curve
In geometrical growth : The initial growth is slow (lag phase) and increase rapidly thereafter at an exponential rate (log phase). • Both the progeny cells divide mitotically and continue to do so. However, with limited nutrient supply, the growth slow down leading to stationary phase.	$W_1 = W_0 e_{rt}$ W_1 = Final size W_0 = Initial size r = growth rate t = time of growth e = base of natural logarithms	Sigmoid or S-curve

Differentiation : A biochemical or morphological change in meristemic cell (at root apex and shoot apex) to differentiate into permanent cell is called differentiation.

Dedifferentiation : The phenomenon of regeneration of permanent tissue to become meristematic is called dedifferentiation.

Redifferentiation : Meristems/tissue are able to produces new cells that once again lose the capacity to divide but mature to perform specific functions.

PHYTO HORMONE OR PLANT GROWTH-REGULATOR

Growth promoting hormones : These are involved in growth promoting activities such as cell division, cell enlargement, flowering, fruiting and seed formation. *e.g.,* Auxin, gibberellins, cytokinins.

Growth inhibitor : Involved in growth inhibiting activities such as dormancy and abscission. *e.g.,* Abscisic acid and Ethylene.

Hormones	Functions
Auxins	Apical dominance, cell elongation, prevent premature leaf and fruit falling, initiate rooting in stem cutting, as weedicide, induce parthenocarpy.
Gibberellins	Delay senescence, speed up malting process, increase in length of axis (grape stalk), increase in length of stem (sugarcane), bolting in beet, cabbages and many plants with rosette habit.
Cytokinins	Promote cell division, induce cell enlargment, reduce apical dominance, induce growth in auxilary bud, chlorophyll preservation, lateral shoot growth, adventitious root formation.
Ethylene	Promotes senescence and abscission of leaf and fruits, promotes ripening of fruits, break seed and bud dormancy, initiate germination in peanut, sprouting of potato tuber, promotes root growth and root hair formation.
Abscisic acid	Inhibit seed germination, stimulate clouser of stomata, increase tolerance to various stress, induce dormancy in seed and bud, promotes ageing of leaf (senescence).