

**Biology (CODE-044)**  
**COURSE STRUCTURE**  
**CLASS XI (2013-14)**  
**(Theory)**

Time : 3 hours

Maximum Marks : 70

**1. Weightage of Contents / Subject Units**

<i>Units</i>	<i>Content</i>	<i>No. of Periods</i>	<i>Marks</i>
I	Diversity of living organisms	23	07
II	Structural Organisation in Plants and Animals	22	12
III	Structure and Functions	35	15
IV	Plant Physiology	40	18
V	Human Physiology	40	18
	<b>Total</b>	<b>160</b>	<b>70</b>

**Note :** The questions paper will include a Section on Open Case studies based-questions on two case studies of 7 marks each form the syllabus, a total of 14 marks. The case studies will be supplied to students in advance. These case studies are designed to test the analytical and higher order thinking skills of students.

**Unit I: Diversity of Living Organism**

**23 Periods**

What is living? Biodiversity; Need for classification; three domains of life, taxonomy and systematics; concept of species and taxonomical hierarchy, Binomial nomenclature; tools for study of taxonomy museums, zoological parks, herbaria, botanical gardens.

Five kingdom classification; Salient features and classification of Monera, Protista and Fung into major groups: Lichens, Viruses and Viroids. Salient features and classification of plants into major groups. Algae, Bryophyta, Pteridophyta, Gymnospermae and Angiospermae (three to five salient and distinguishing features and at least two examples of each category); Angiosperms- classification upto class, characteristic features and example.

Salient features and classification fo animals non chordate up to phyla level and chordates up to class level (three to five salient features and at least two examples of each category).

(No live animals or specimen should be displayed).

## Unit 2: Structural Organisation in Animals and Plants

22 Periods

Morphology and modifications : Tissues; anatomy and functions of different parts of flowering plants; root, stem leaf, inflorescence, flower, fruit and seed (to be dealt along with the relevant practical of the Practical syllabus)

Animal tissues: Morphology, anatomy and functions of different systems (digestive, circulatory, respiratory, nervous and reproductive) of an insect (cockroach), (a brief account only)

## Unit 3: Cell Structure and Function

35 Periods

Cell theory and cell as the basic unit of life: Structure of prokaryotic and eukaryotic cells; Plant cell and animal cell; Cell envelope, cell membrane, cell wall; Cell organelles - structure and function; endomembrane system, endoplasmic reticulum, Golgi bodies, lysosomes, vacuoles; mitochondria, ribosomes, plastids, microbodies, cytoskeleton, cilia, flagella, centrioles (ultrastructure and function); nucleus, nuclear membrane, chromatin, nucleolus. Chemical constituents of living cells, biomolecules, structure and function of proteins, carbohydrates, lipids, nucleic acids, enzymes, types, properties, enzyme action.

Cell division : Cell cycle, mitosis, meiosis and their significance.

## Unit 4: Plant Physiology

40 Periods

**Transport in plants;** Movement of water, gases and nutrients, cell to cell transport, Diffusion, facilitated diffusion, active transport, plant-water relations, Imbibition, water potential, Osmosis, plasmolysis, long distance transport of water- Absorption, apoplast, symplast, transpiration pull, root pressure and guttation, transpiration, opening and closing of stomata, Uptake and translocation of mineral nutrients- Transport of food, phloem transport, mass flow hypothesis, diffusion of gases.

**Mineral nutrition :** Essential minerals, macro-and micronutrients and their role, deficiency symptoms; mineral toxicity, elementary idea of hydroponics as a method to study mineral nutrition, nitrogen metabolism, nitrogen cycle, biological nitrogen fixation.

**Photosynthesis:** Photosynthesis as a mean of autotrophic nutrition, site of photosynthesis, pigments involved in photosynthesis (elementary idea), photochemical and biosynthesis phases of photosynthesis; cyclic and non cyclic photophosphorylation; chemiosmotic hypothesis; photorespiration; C3 and C4 pathways; factors affecting photosynthesis.



**Respiration** : Exchange of gases; cellular respiration - glycolysis, fermentation (anaerobic), TCA cycle and electron transport system (aerobic); energy relations- number of ATP molecules generated; amphibolic pathways; respiratory quotient.

**Plant growth and development** : Seed germination; phases of plant growth and plant growth rate; conditions of growth; differentiation, dedifferentiation and redifferentiation; sequence of developmental processes in a plant cell; growth regulators - auxin, gibberellin, cytokinin, ethylene, ABA; seed dormancy; vernalisation, photoperiodism.

## **Unit 5: Human Physiology**

40 Periods

**Digestion and absorption** : Alimentary canal and digestive glands, role of digestive enzymes and gastrointestinal hormones; Peristalsis, digestion, absorption and assimilation of proteins, carbohydrates and fats; calorific values of proteins, carbohydrates and fats; egesting; nutritional and digestive disorders- PEM, indigestion, constipation, vomiting, jaundice, diarrhoea.

**Breathing and Respiration** : Respiratory organs in animals (recall only), Respiratory system in humans; mechanism of breathing and its regulation in humans - exchange of gases, transport of gases and regulation of respiration, respiratory volume, disorders related to respiration- asthma, emphysema, occupational respiratory disorders.

**Body fluids and circulation** : Composition of blood; blood groups, coagulation of blood; composition of lymph and its function; human circulatory system- Structure of human heart and blood vessels; cardiac cycle, cardiac output, ECG; double circulation; regulation of cardiac activity; disorders of circulatory system- hypertension, coronary artery disease, angina pectoris, heart failure.

**Excretory products and their elimination:** Modes of excretion- ammonotelism, ureotelism, uricotelism; human excretory system - structure and function, urine formation, osmoregulation; regulation of kidney function- renin-angiotensin, atrial natriuretic factor, ADH and diabetes insipidus; role of other organs in excretion; disorders; - uraemia, renal failure, renal calculi, nephritis; dialysis and artificial kidney.

**Locomotion and movement** : Types of movement - ciliary, flagellar, muscular; skeletal muscle- contractile proteins and muscle contraction; skeletal system and its function; joints, disorders of muscular and skeletal system- myasthenia gravis, tetany, muscular dystrophy structure and functions of eye and ear.

**Neural control and coordination :** Neuron and nerves; Nervous system in humans- central nervous system, peripheral nervous system and visceral nervous system, generation and conduction of nerve impulse; reflex action; sensory perception; sense organs; elementary structure and function of eye and ear.

**Chemical coordination and regulation:** Endocrine glands and hormones; human endocrine system- hypothalamus, pituitary, pineal, thyroid, parathyroid, adrenal, pancreas, gonads; mechanism of hormone action (elementary Idea), role of hormones as messengers and regulators; hypo- and hyperactivity and related disorders; dwarfism, acromegaly, cretinism, goiter, exophthalmic goiter, diabetes, Addison's disease.

**Note :** Diseases related to all the human physiological systems to be taught in brief.

### **PRACTICALS**

<b>Evaluation Scheme</b>	<b>Maximum Marks : 30</b>
One Major Experiment	5 Marks
One Minor Experiment	4 Marks
Slide Preparation	5 Marks
Spotting	7 Marks
Practical Record + Viva Voce	4 Marks
Project Record + Viva Voce	5 Marks
<b>Total</b>	<b>30Marks</b>

#### **A. List of Experiments**

60 Periods

1. Study and describe three locally available common flowering plants, one from each of the families Solanaceae, Fabaceae and Liliaceae including dissection and display of floral whorls, anther and ovary to show number of chambers, Types of root (Tap and adventitious), stem (herbaceous and woody); leaf (arrangement, shape, venation, simple and compound).
2. Preparation and study of T.S of dicot and monocot roots and stems (primary).
3. Study of osmosis by potato osmometer.
4. Study of plasmolysis in epidermal peels (e.g. Rhoexo leaves).
5. Study of distribution of stomata in the upper and lower surface of leaves.
6. Comparative study of the rates of transpiration in the upper and lower surface of leaves.
7. Test for the presence of sugar, starch, proteins and fats. To detect these in suitable plant and animal materials.
8. Separation of plant pigments through paper chromatography.
9. Study of the rate of respiration in flower buds/leaf tissue and germinating

seeds.

10. Test for presence of urea in urine.
11. Detect the presence of sugar in urine.
12. Detect the presence of albumin in urine.
13. Detect the presence of bile salts in urine.

**B. Study / observation of the following (spotting)**

1. Study of the parts of a compound microscope.
2. Study of the specimens/slides/models and identification with reasons Bacteria, Oscillatory, Spirogyra, Rhizopus, mushroom, yeast, liverwort, moss, fern, pine, one monocotyledonous plant and one dicotyledonous plant and one lichen.
3. Study of virtual specimens/ slides/ models and identification with reasons, Amoeba, Hydra, liverfluke, Ascais, leech, earthworm, prawn, silkworm, honeybee, snail, starfish, shark, rohu, frog, lizard, pigeon and rabbit.
4. Study of tissues and diversity in shapes and sizes of plant and animal cells (palisade cells, guard cells, parenchyma, collenchyma, sclerenchma, xylem, phloem, squamous epithelium, muscle fibers and ammalian blood smear) through temporary/permanent slides.
5. Study of motosis in onion root tip cells and animals cells (grasshopper) from permanent slides.
6. Study of different modifications in root, stem, and leaves.
7. Study and identification of different types of inflorescence (cymose and racemose)
8. Study of imbibition in seeds/raisins.
9. Observation and comments on the experimental set up for showing:
  - a) Anaerobic respiration
  - b) Phototropism
  - c) Effect of apical bud removal
  - d) Suction due to transpiration
10. Study of human skeleton and different types of joints with the help of virtual images/models only.
11. Study of external morphology of cockroach through virtual images/models.

**Prescribed Books:**

1. Biology Part I, Class XI, Published by NCERT
2. Biology Part II, Class XI, Published by NCERT.

**BIOLOGY (CODE - 044)**  
**QUESTION PAPER DESIGN**  
**Class - XI (2013-14)**

Time 3 Hours

Max. Marks 70)

S. No.	Typology of Questions	Very Short Answer (VSA) (1 mark)	Short Answer-I (SA-I) (2 marks)	Short Answer- II (SA-II) (3 marks)	Value based question (VBQ) (4 marks)	Long Answer (L.A.) (5 marks)	Total Marks	% Weigh- tage
1.	Remembering- (Knowledge based Simple recall questions, to know specific facts, terms, concepts, principles, or theories, Identify, define, or recite, information)	2	1	1	-	-	7	10%
2.	Understanding- (Comprehension - To be familiar with meaning and to understand conceptually, interpret, compare, contrast, explain, paraphrase information)	-	2	4	-	1	21	30%
3.	Application (Use abstract information in concrete situation, to apply knowledge to new situations, Use given content to interpret a situation, provide an example, or solve a problem)	-	2	4	-	1	21	30%
4.	High Order Thinking Skills (Analysis & Synthesis- Classify, compare, contrast or differentiate between different pieces of information, Organize and/ or integrate unique pieces of information from a variety of sources)	2	-	1	-	1	10	14%
5.	Evaluation and Multi-Disciplinary- (Appraise, judge, and / or worth of a decision or outcome, or to predict outcomes based on values)	1	-	2	1	-	11	16%
	<b>TOTAL</b>	5x1= 5	5x2= 10	12x3= 36	4x1= 4	5x3=15	70 (26)	100%

**Note:** The question paper will include a section on Open Case Studies based-questions on two case studies of 7 marks each from the syllabus, a total of 14 marks. The case studies will be supplied to students in advance. These case studies are designed to test the analytical and higher order thinking skills of students.

### QUESTION WISE BREAK UP

Type of Question(s)	Mark(s) per Question	Total No. of Questions	Total Marks
VSA	1	5	05
SA-I	2	5	10
SA-II	3	12	36
VBQ	4	1	04
LA	5	3	15
Total		26	70

1. Internal Choice : There is no overall choice in the paper. However, there is an internal choice in one question of 2 marks weightage, one question of 3 marks weightage and all the three questions of 5 marks weightage.
2. The above template is only a sample. Suitable internal variations may be made for generating similar templates keeping the overall weightage to different form of questions and typology of questions same.

## Chapter-1

# THE LIVING WORLD

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### POINTS TO REMEMBER

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**Characteristics of Living Organisms :** Growth, reproduction, metabolism, cellular organisation, consciousness (ability to sense environment), self-replicating 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 variety 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.)

**Taxa :** Each category (i.e. unit) classification is called as a taxon.

**Taxonomy :** Study of principles and procedures of classification.

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

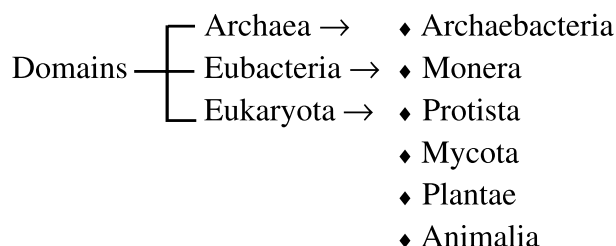
**Systematics :** It deals with classification of organisms based on their diversities and relationships among them. Term was proposed by Carolus Linnaeus who wrote 'Systema Naturae'.

**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.



**Herbarium** Store house of dried, pressed and preserved plant specimen on sheets.

**Botanical Garden :** Collection of living plants for reference.\*\*

\*\***Examples :** Kew (England), National Botanical Research Institute (Lucknow), Indian Botanical Garden, Howrah.

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

- ◆ Keys (Used for identification of plants 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.
12. Define classification what is the significance of classification? What is the six kingdom classification?

<b>ANSWERS</b>
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**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.
12. Grouping organisms on the basis of their similarities and differences.  
Significance:- Aids in study, better understanding, predicting the features of the group known.  
Refer 'Points to Remember' for six kingdom classification.

## Chapter-2

# BIOLOGICAL CLASSIFICATION

### POINTS TO REMEMBER

#### SYSTEMS OF CLASSIFICATION

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

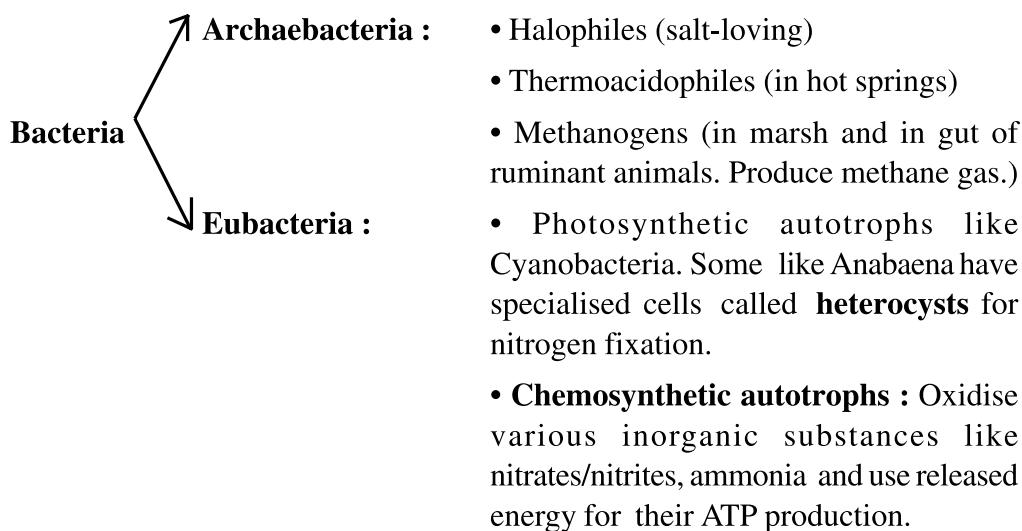
Animals into those with RBC's and those who do not have it.

- **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 as sole members.
- Bacteria can have shapes like : Coccus (spherical), Bacillus (rod-shaped), Vibrio (comma shaped) and sprillum (spiral shaped).
- Bacteria found almost everywhere and can be Photosynthetic autotrophs, Chemosynthetic autotrophs or Heterotrophs.



- **Heterotrophic bacteria** : Decomposes, help in making curd, production of antibiotics, N<sub>2</sub> fixation, cause diseases like cholera, typhoid.

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

### **Kingdom PROTISTA**

(Comprises of 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.
- **Example** : *Gonyaulax multiples* rapidly, make sea appear red (red tides) and produce toxins to kill marine animals.

**(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.
- **Example** : *Euglena*

**(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** : Have one or 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
  - Hyphae which have multinucleate cytoplasm are called coenocytic hyphae
  - Cell wall of chitin and polysaccharides
  - Grow in warm and humid places
  - Saprophytic, parasitic, symbiotic (Lichen)
- e.g., Puccinia* (rust causing), *Penicillium*, Yeast is a unicellular fungus.

### CLASSES OF FUNGI

- (i) **Phycomycetes :**
- grow on decaying wood
  - Mycelium aseptate
  - Spores produced endogenously
  - Asexual reproduction by Zoospores or Aplanospores
  - Zygosporangia are formed by the fusion of gametes.
- 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 endogenously in ascus, produced inside fruiting body called Ascocarp.
- e.g., Aspergillus, Neurospora.*
- (iii) **Basidiomycetes**
- Mycelium septate.
  - Generally asexual spores are not found.
  - Vegetative reproduction by fragmentation.
  - Sexual reproduction by fusion of vegetative or somatic cells to form basidium produced in basidiocarp.
  - Basidium produces four basidiospores after meiosis.
- e.g., Agaricus, Ustilago.*
- (iv) **Deuteromycetes**
- Called as ‘Fungi Imperfecti’ as sexual form (perfect 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 machinery of host cell on entering it and become living but as such they have inert crystalline structure appear non-living. 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. Beijerinck called fluid as ‘Contagium vivum fluidum’ as extracts of infected plants of tobacco could cause infection in healthy plants.
  - W. M. Stanley showed viruses could be crystallised to form crystals of protein which are inert outside their specific host.

- Structure of Virus :**
- It is a nucleoprotein made up of protein coat called Capsid. Capsid is made up of capsomeres arranged in helical 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 provides food. Fungi provides 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 heterocysts. 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 the 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 for such classification ?
12. What are the modes of nutrition in 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.
13. Describe sexual reproduction in fungi.



## 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. Whittaker. Criteria for classification : Cell structure, thallus organisation, mode of nutrition, reproduction and phylogenetic relationships.
12. Saprophytes, Parasites, Symbionts- Lichens & Mycorrhizae
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
15. Refer NCERT Text Book of Biology for Class XI, page no. 23-24.
16. Refer NCERT Text Book of Biology for class XI Page 23. (Plasmogamy, Karyogamy, Meiosis in zygote, Dikaryophase)  
The steps are (i) Plasmogamy : fusion of protoplasm of two motile or non-motile gametes.  
(ii) Karyogamy : fusion of two nuclei.  
(iii) Zygotic Meiosis to form haploid spores.  
(iv) Dikaryophase in ascomycetes and basidiomycetes where before karyogamy two nuclei per cell (dikaryon) are found.

## Chapter-3

# PLANT KINGDOM

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### POINTS TO REMEMBER

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#### CLASSIFICATION :

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

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

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

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

- Chemotaxonomy :**
- 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* which is used in ice-creams and jellies.
- Algin obtained from brown algae and carrageen from red algae used commercially.
- *Chlorella* and *Spirulina* 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 filamentous 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., *Chlamydomonas*, *Volvox*, *Spirogyra*.

**(ii) Phaeophyceae**

- Brown algae are brown coloured due to main pigments chlorophyll 'a', 'c' and fucoxanthin.
- Cell wall has cellulose and lignin or gelatinous 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 are red coloured 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, prevents 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 (Protonema).

## 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 megasporangia 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** : *Wolffia*
- **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 (embryo 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 insects 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*, *Polysiphonia* 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 terrestrial 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 and seed habit.

**Short Answer Questions- II (2 marks each)**

8. *Sphagnum* has a lot of economic importance. Justify.

9. Gymnosperms can show polyembryony. Why do you think so ?

10. How is leafy stage formed in mosses ? How is it different from protonema ?

**Short Answer Questions-I (3 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. Draw the life cycle of an angiosperm along with a brief note on double fertilisation.

15. Explain alternation of generation in plants.

**ANSWERS**

**Very Short Answers (1 mark each)**

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 they 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-II (2 marks each)**

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



9. Have two or more archegonia, so polyembryony 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-I (3 marks each)

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 each)

14. Refer Figure 3.6, page no. 41, NCERT, Text Book of Biology for Class XI.
15. Refer 'Points to Remember' and Page No. 42, NCERT, Text book of Biology for class XI.

## Chapter-4

# ANIMAL KINGDOM

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### POINTS TO REMEMBER

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**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 central 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, mesoderm and endoderm *e.g.*, Chordates.

**Coelom** (Body cavity which is lined by mesoderm)

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

**Pseudocoelomates :** No true coelom 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 mesoderally 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 defense 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  $\xrightarrow{\text{sexually}}$  Polyp.  
 $\xleftarrow{\text{Asexually}}$
- *e.g.*, ***Physalia, Adamsia***.

**PHYLUM CTENOPHORA :** • Also called as sea walnuts or comb jellies.

- 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 development. *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 dimorphism.
- 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 tracheal 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 and is unsegmented.
- Mantle : Soft and spongy 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., Amphioxus.*

**(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 (Lack 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 cartilagenous.
- 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 pelvic fins.
- *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 reproductive 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 each)

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 each)

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 each)

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 each)

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 form and relative position of different organs of the organism is known as morphology. It may be further divided into internal & external morphology.

**External Morphology :** It deals with external forms like shape, size, colour, structure and relative position of different organs.

**Internal Morphology :** Further divided into anatomy & histology,

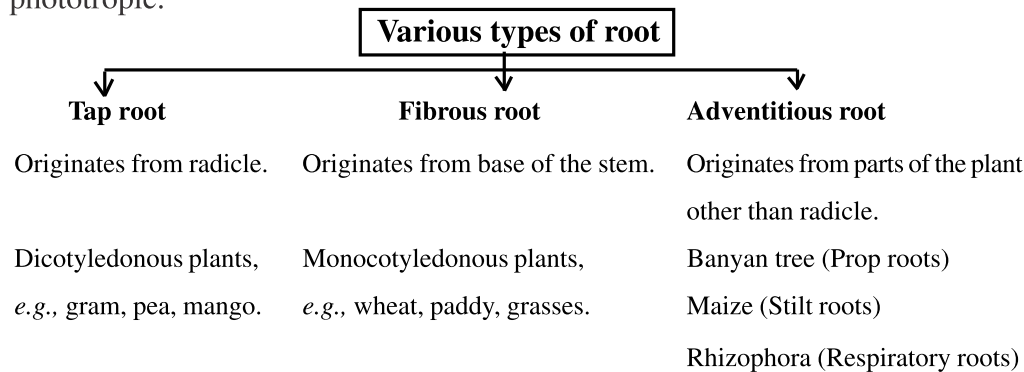
**Anatomy :** It deals with the study of internal structure exposed after direction and opening of various parts of an organ.

**Histology:** The study of tissues, their composition and structure.

**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.

**Characteristics:** It lies inside the soil, chlorophyll is absent, absence of nodes and internodes, leaves and buds, geotropism & hydro-tropic and negative phototropic.



**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.

Some of the epidermal cells of this region form thread-like root hairs.

**Modifications of Root :**

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

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

**3. Region of Maturation :** This region has differentiated and matured cells.

- **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).

**Functions of stem:** Exposure of leaves, conduction of water and minerals, translocation of food, exposure of flowers and fruits.

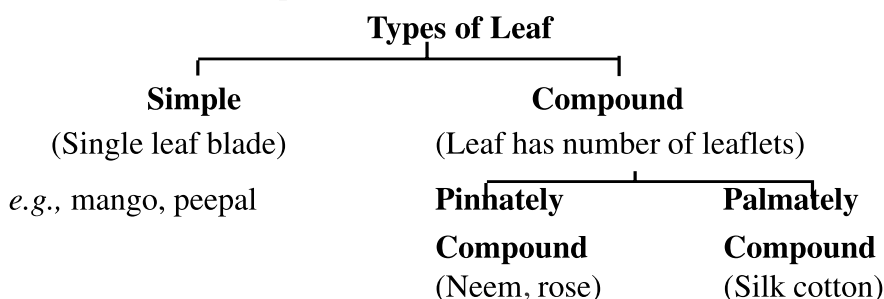
**The Stem :** Stem is the aerial part of the plant and develops from plumule of the embryo. It bears nodes and internodes.

**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, grapevine, 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 :** Develops 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. In some leguminous plants the leaf base may become swollen which is called as pulvinus



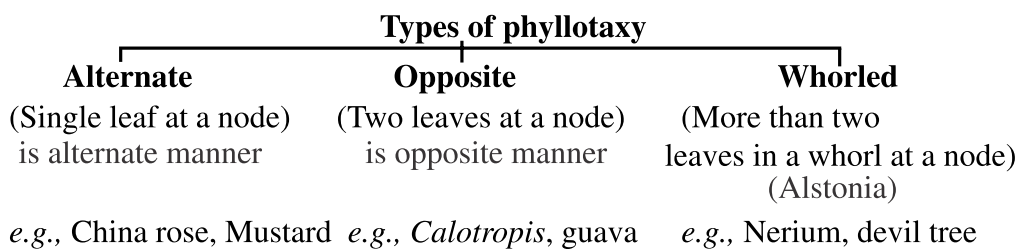
**Venation** : The arrangement of veins and veinlets in the lamina of leaf.

**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.



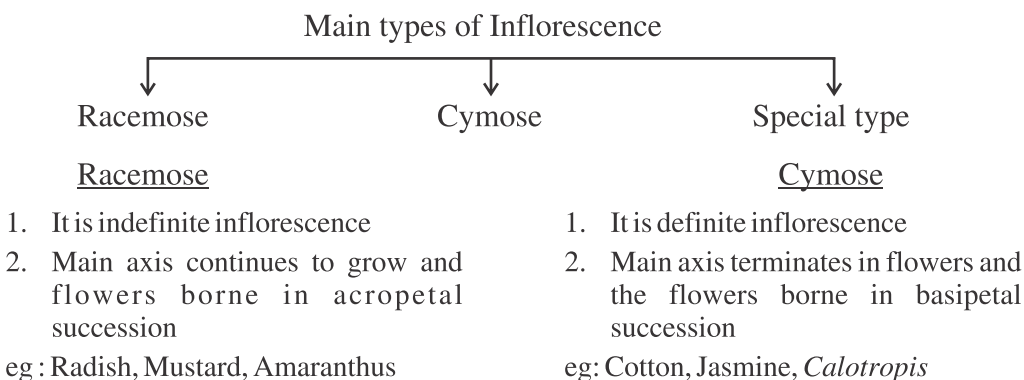
**Functions of Leaf**

photosynthesis, gaseous exchange, transpiration, protection of buds and conduction.

**Modifications of Leaves :**

Type	Function	Example
• Tendrils :	(Climbing) –	Sweet wild pea
• Spines :	(Protection) –	<i>Aloe, Opuntia, Argemone</i>
• Pitcher :	(Nutrition) –	<i>Nepenthes</i>
• Hook :	(Support) –	Cat's nail

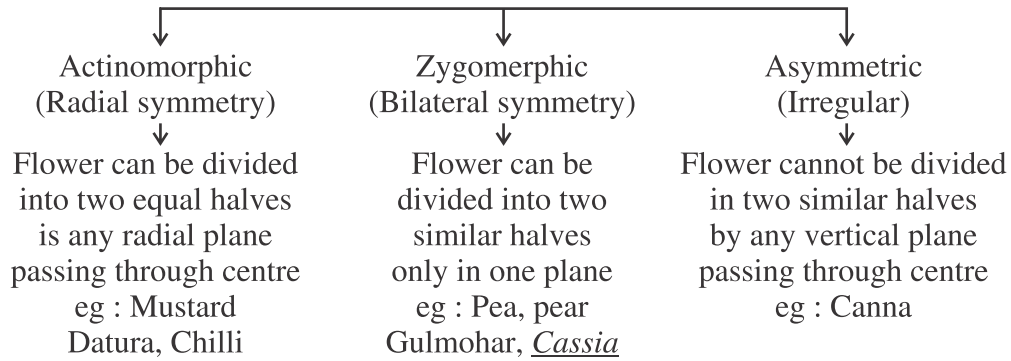
**Inflorescence** : The arrangement of flowers on the floral axis.



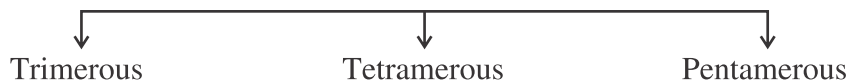
**Special type** - Ficus, Salvia, Euphorbia

**Flower** - Modified shoot meant for reproduction

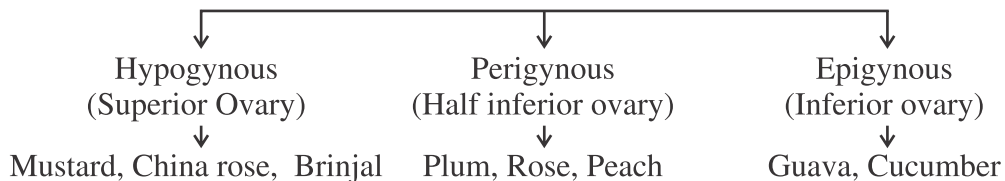
On the basis of symmetry flower can be :-



On the basis of floral appearance flower can be :-



On the basis of position of Calyx, Corolla and androecium in respect of ovary, flower can be:-



### 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 epiphyllous (attach to perianth). Stamens may be monadelphous (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.

<b>Gamosepalous</b>	–	(Sepals united)
<b>Polyseptalous</b>	–	(Sepals free)
<b>Gamopetalous</b>	–	(Petals united)
<b>Polypetalous</b>	–	(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** :

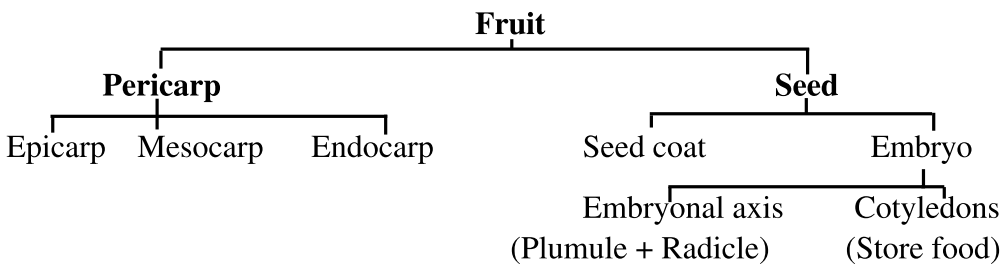
1. **Valvate** : Sepals or petals do not overlap the sepal or petal at margins. *e.g.*, *Calotropis*
2. **Twisted** : Sepals or petals overlap the next sepal or petal. *e.g.*, China rose, Cotton
3. **Imbricate** : The margins of sepals or petals overlap one another but not in any definite direction. *e.g.*, *Cassia*, Gulmohar
4. **Vexillary** : The largest petal overlaps the two lateral petals which in turn overlap two smallest anterior petals. *e.g.*, Bean

**Placentation** : The arrangement of ovules within the ovary.

Types of Placentation :

1. **Marginal** : Placenta forms a ridge along the ventral suture of ovary. *e.g.*, Pea
2. **Axile** : Margins of carpels fuse to form central axis. *e.g.*, China rose, Tomato
3. **Parietal** : Ovules develop on inner wall of ovary. *e.g.*, Mustard, *Argemone*
4. **Free central** : Ovules borne on central axis, lacking septa. *e.g.*, *Dianthus*, *Primrose*
5. **Basal** : Placenta develop at the base of ovary. *e.g.*, Sunflower, Marigold

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



Seed Coat  $\left\{ \begin{array}{l} \text{Testa (Outer layer)} \\ \text{Tegmen (Inner Layer)} \end{array} \right.$

**Monocotyledonous seed** - Endosperm bulky and stores food, proteinaceous layer - Aleurone layer is present. Seed has single large cotyledon- scutellum.

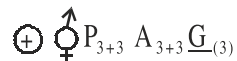
Plumule is enclosed in Coleoptile and Radicle is enclosed in Coleorrhiza.



## 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 in Ginger and Onion are 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 :



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.
11. What is the name given to the cotyledon in case of Monocots
12. Name the part modified for food storage in the following (a) carrot (b) Radish (c) Potato (d) Dahlia (e) Turmeric (f) Sweet potato

### Short Answer Questions-II (2 marks each)

13. Flower is a modified shoot. Justify.
14. 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.
15. Identify the type of tendrils found in the following plants:-
  - (a) Cucumber      (b) Pea      (c) Grape vines      (d) Water Melon

16. 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

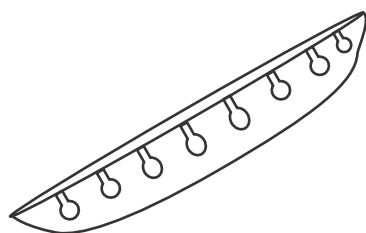
17. Provide the scientific terms for the following :

- (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.

18. Differentiate between peduncle and Pedicel

**Short Answer Questions - I (3 marks each)**

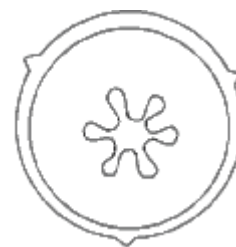
19. Observe the given figure showing various types of placentation. Identify the type of placentation. Give one example of each.



(a)



(b)



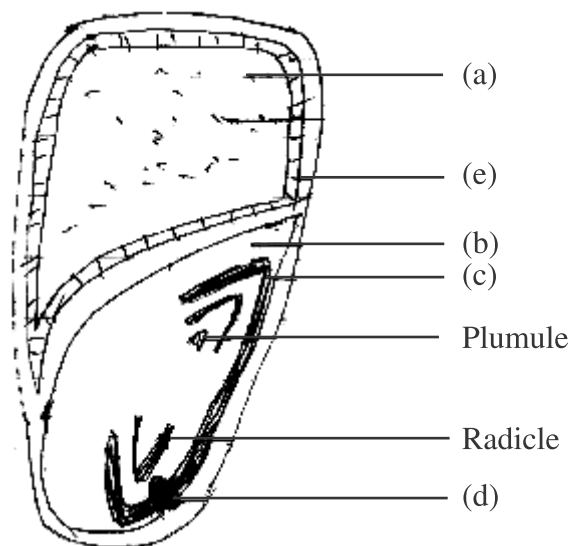
(c)

20. 'Potato is a stem and sweet potato is a root.' Justify the statement on the basis of external features.

21. Define aestivation. Which type of aestivation is found in China rose, Calotropis Gulmohar and pea.

22. Explain the different types of phyllotaxy. Give one example of each type.

23. Differentiate between :
- Actinomorphic flower and Zygomorphic flower
  - Apocarpous ovary and Syncarpous ovary
  - Racemose inflorescence and Cymose inflorescence
24. In the given structure of a Monocotyledonous seed label the parts a, b, c, d, e. Give the function of part 'a'



25. Maize grain usually called as a fruit and not a seed. Why?

**Long Answer Questions (5 marks each)**

- Describe various stem modifications associated with food storage, climbing and protection.
- Give the distinguishing morphological features of gynoecium of family Fabaceae, Solanaceae and Liliaceae. Draw floral diagrams of Fabaceae and Solanaceae.

## ANSWERS

### Very Short Answers (1 mark each)

1. Leaves
2. Neem, Rose, Acacia.
3. Pneumatophores in mangroves help in respiration.
4. **Ginger**- Rhizome & **Onion** - bulb
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).
11. Secutellum.
12. (a and b ) Fleshy tap root      (c) Stem tuber      (d) root tuber  
(e) Rhizome      (f) Fleshy root tuber

### Short Answers-II (2 marks)

13. The flower is considered to be a modified shoot because the internodes in flower are highly condensed and the appendages such as sepals, petals, stamens and carpels (pistil) are generally large in number.
14. (a) Assimilatory roots      (b) Respiratory roots  
(c) Prop roots      (d) Stilt roots
15. (a) Stem tendril      (b) leaf tendril  
(c) & (d) both stem tendrils
16. (a) Floral parts are situated below the ovary.  
(b) Half inferior  
(c) Epigynous  
(d) Floral parts are situated above the ovary.
17. (i) Sessile  
(ii) Lamina  
(iii) Phyllotaxy  
(v) Stipules

**Short Answer-I (3 marks each)**

18. **Peduncle** is the axis of inflorescence which generally bears a number of flowers

**Pedicel** is the stalk of the flower which bears a single flower.

**Short Answer - I (3 marks each)**

19. (a) Marginal placentation – Pea

(b) Parietal placentation – Mustard, *Argemone*

(c) Free central placentation – *Dianthus*, *Primrose*

20. 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.

21. 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

22. **Type of phyllotaxy**

**Examples**

(i) Alternate

China rose, mustard

(ii) Opposite

*Calotropis*, guava

(iii) Whorled

Nerium, *Alstonia*

23. (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.<sup>38</sup>      Flowers are arranged basipetally *i.e.*,  
the lower flowers are older.
24. (a) Endosperm (b) Scutellum (c) Coleoptile (d) Coleorrhiza  
(e) Aleurone layer  
Function of (a) - Provide nutrition.
25. Maize grain is a single seeded fruit in which the seed covering or testa is fused with pericarp or fruit wall. A micropyle is not found but base of style is present.

**Long Answers (5 marks each)**

26. **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.

27. **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

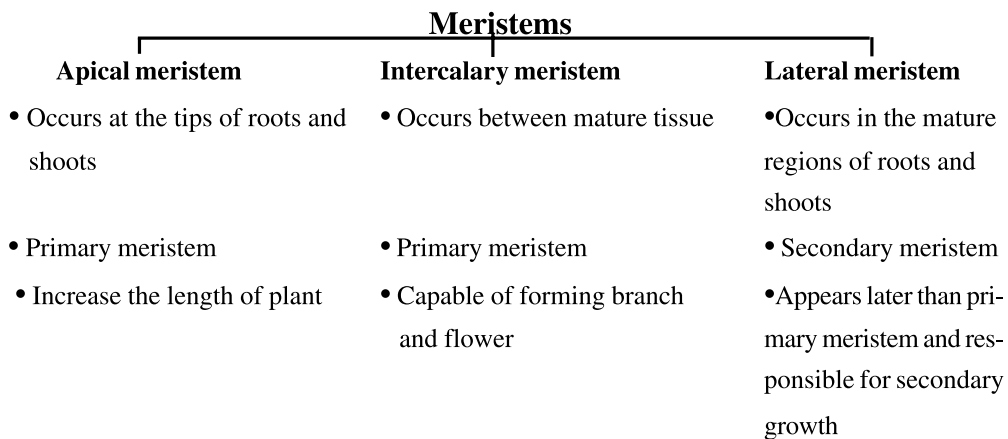
## ANATOMY OF FLOWERING PLANTS

### POINTS TO REMEMBER

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

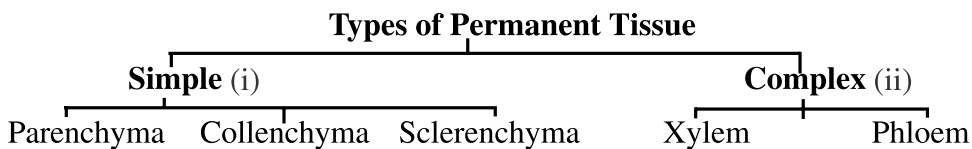
There are two types of tissues (i) Meristematic (ii) Permanent

**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.



**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.



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

- (i) Formed of only one type of structurally and functionally similar mature cells having a common origin. They are homogeneous.
- (ii) They are heterogeneous, formed of two or more types of mature cells of common origin.

**Collenchyma** : It is formed of living, closely packed isodiametric cells. It's cells are thickened at the corners due to deposition of cellulose and pectin. It provides mechanical 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.

Metaphloem : Later formed phloem with bigger sieve tubes.

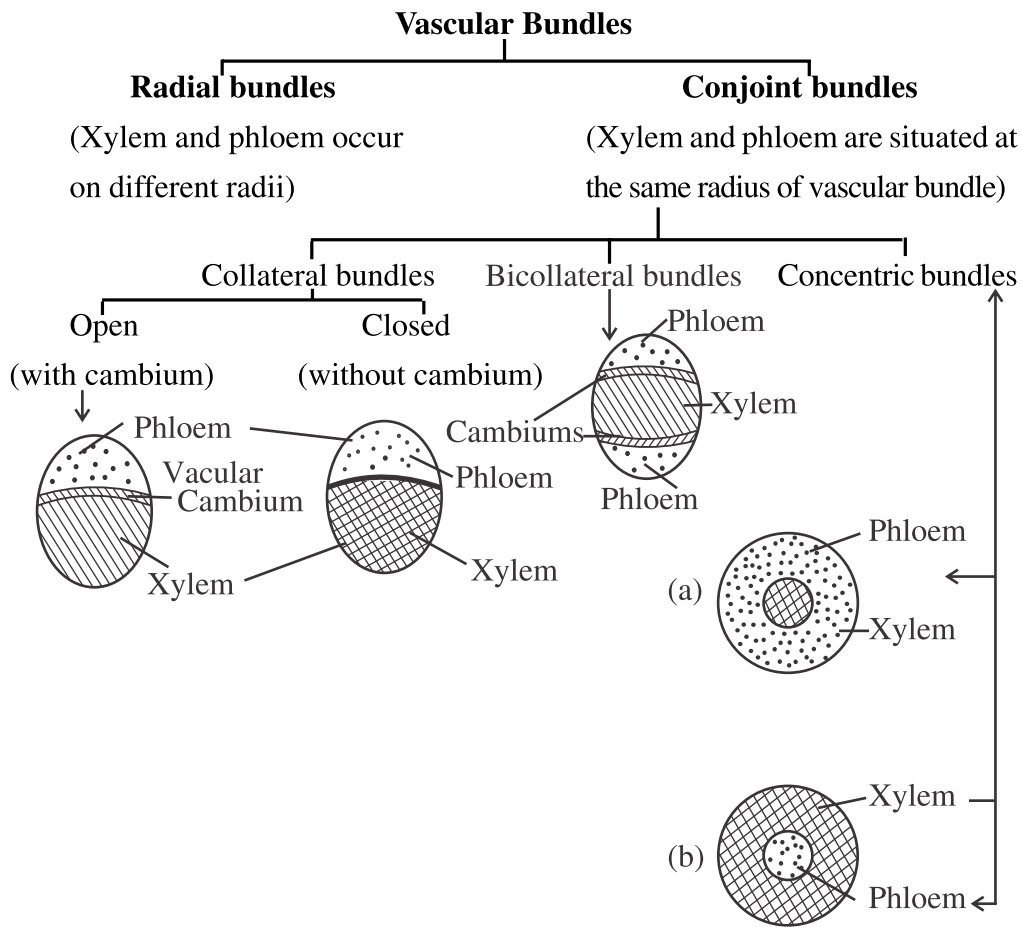
### **The Tissue System :**

**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 (both monocots and dicots) 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

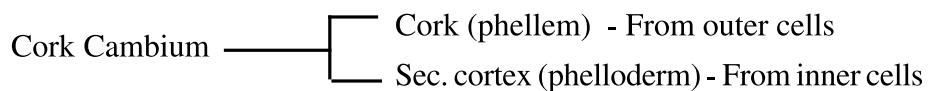
<b>Dicot Root</b>	<b>Monocot Root</b>
1. Cortex is comparatively narrow.	1. Cortex is very wide.
2. Endodermis is less thickened casparian strips are more prominent.	2. Endodermal cells are highly thickened Casparian strips are visible only in young roots.
3. The xylem and phloem bundles varies from 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
<ol style="list-style-type: none"> <li>1. The ground tissue is differentiated into cortex, endodermis, pericycle and pith.</li> <li>2. The vascular bundles are arranged in a ring.</li> <li>3. Vascular bundles are open, without bundle sheath and wedge-shaped outline.</li> <li>4. The stem shows secondary growth due to presence of cambium between xylem and phloem.</li> <li>5. Stomata have kidney-shaped guard cells.</li> </ol>	<ol style="list-style-type: none"> <li>1. The ground tissue is made up of similar cells.</li> <li>2. The vascular bundles are scattered throughout the ground tissue.</li> <li>3. Vascular bundles are closed, surrounded by sclerenchymatous bundle sheath, oval or rounded in shape.</li> <li>4. Secondary growth is absent.</li> <li>5. Stomata have dumb bell-shaped guard cells.</li> </ol>

**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)



(Phellogen + Phellem + Phellogen) = 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

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

### Spring Wood

- 1) Also called early wood.
- 2) Cambium is active
- 3) Xylary elements more
- 4) Vessels with wide cavities
- 5) Light in colour, low density.

### Autumn Wood

- 1) Also called late wood
- 2) Cambium less active
- 3) Xylary elements less
- 4) Vessels narrow
- 5) Dark, high density.

### Heartwood

- 1) Central or innermost region of stem which is hard, durable and resistant to attack of Microorganisms and insects.
- 2) Not involved in conduction of water.

### Sapwood

- 1) Peripheral region of stem, light in colour
- 2) Involved in conduction of water and mineral

**Lenticels** - Produced when phellogen cuts off parenchymatous cells on outer side. These cells rupture the epidermis forming lens shaped openings called lenticels.

**Function** - Permit exchange of gases

## 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.
11. Write the function of phloem parenchyma.
12. What constitutes the cambial ring?
13. Name the cells which make the leaves curl in plants during water stress.
14. Give the function of lenticels.
15. The vascular bundles are surrounded by a thick layer of cells. What is the name of the cells?
16. Where are casparian strips found?
17. Give the function of companion cells.

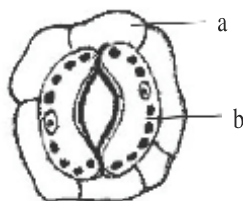
**Short answer type Questions:-**

**(2 marks each)**

18. Why is cambium considered to be lateral meristem ?
19. Give any four differences between tracheids and vessels.
20. How are open vascular bundles differ from closed vascular bundles ?
21. What are trichomes ? State their functions.
22. 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.
23. In which part of the plant you would see the following:
  - (a) Radial vascular bundle
  - (b) Well developed pith

**Short Answer Question-I (3 marks each)**

24. Give the points of difference between lenticels and stomata.
25. Even being a monocotyledonous plant the Palm increases in girth. Why and how does it take place?
26. Differentiate between endarch and exarch conditions
27. If you are provided with microscopic preparation of transverse section of a meristemic tissue and permanent tissue, how would you distinguish them ?
28. Differentiate between aerenchyma and collenchyma on the basis of their structure and function.
29. Are there any tissue elements of phloem which are comparable to those of xylem ? Explain.
30. Palm is a monocotyledonous plant, yet it increases in girth. How is it possible?
31. 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)**

32. (i) What are meristems ?
  - (ii) Name the various kinds of meristems in plants.
  - (iii) State the location and functions of meristems.
33. (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 characteristics of collenchyma.
34. 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 each)

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.
11. Lateral conduction of food and supply of water from xylem.
12. Cambial ring is formed by fusion of interfascicular and intrafascicular cambium strips.
13. Bulli form or motor cells.
14. Permit exchange of gases
15. Bundle sheath cells
16. Endodermis
17. Maintain pressure gradient in Sieve tubes

### Short Answers-II (2 marks each)

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

19.	<b>Tracheid</b>	<b>Vessel</b>
	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.

**20. 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.

**21.** 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.

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

**23.** (a) Root (b) monocot root

#### **Short Answers-I (3 marks each)**

**24 Lenticels :** Found in old stems & roots in the cork tissues containing a number of complimentary cells and they are permanently opened pores.

**Stomata :** Found in leaves and young stems in the epidermis and have two guard cells. They open and close in response to turgidity of their guard cells.

**25.** Palms possess residual meristem below their leaf primordial, which adds ground parenchyma and vascular bundles. The ground parenchyma can also undergo further divisions even after the completion of elongation.

**26. Endarch condition**

1 Protoxylem towards pith and metaxylem towards periphery

2. Found in Stem

**Exarch condition**

1. Protoxylem towards periphery and metaxylem towards pith

2. Found in root.

**27. Meristematic tissues** are composed of cells that have the capability to divide. These cells 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).

28.	<b>Arenchyma</b>	<b>Collenchyma</b>
	(a) Parenchymatous tissue containing large air space.	(a) Tissue contains deposits of cellulose and large pectin 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.

29. (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.
30. A palm tree is monocotyledonous 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 conjunctive tissue and patches of meristematic cells. The activity of meristematic cells results in the formation of secondary vascular bundles.
31. (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 each)

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



34. • **Secondary growth** : Refer 'Points to remember).
- **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

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#### POINTS TO REMEMBER

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**Tissue:** A group of one or more types of cells along with intercellular substance which perform one or more specific functions:-

**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.

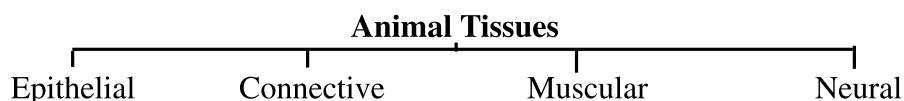
**Uricotelic :** Animals which excrete nitrogenous waste in the form of uric acid.

**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.

<b>Types of Fundamental Animal Tissues</b>			
<b>S.No.</b>	<b>Type</b>	<b>Location</b>	<b>Functions</b>
1.	Epithelial Tissues	Free Surfaces	Protection, Secretion, Excretion, bsorption, Sensory and reproduction
2.	Connective Tissues	Inside body its organs, other tissues and below skin.	Holding or binding, support, transport and circulation, protection and storage.
3.	Muscular Tissues	Inside movable parts	Movements and locomotion.
4.	Nervous Tissues	Central Peripheral and every organ	Communication and control.



### **Epithelial Tissue**

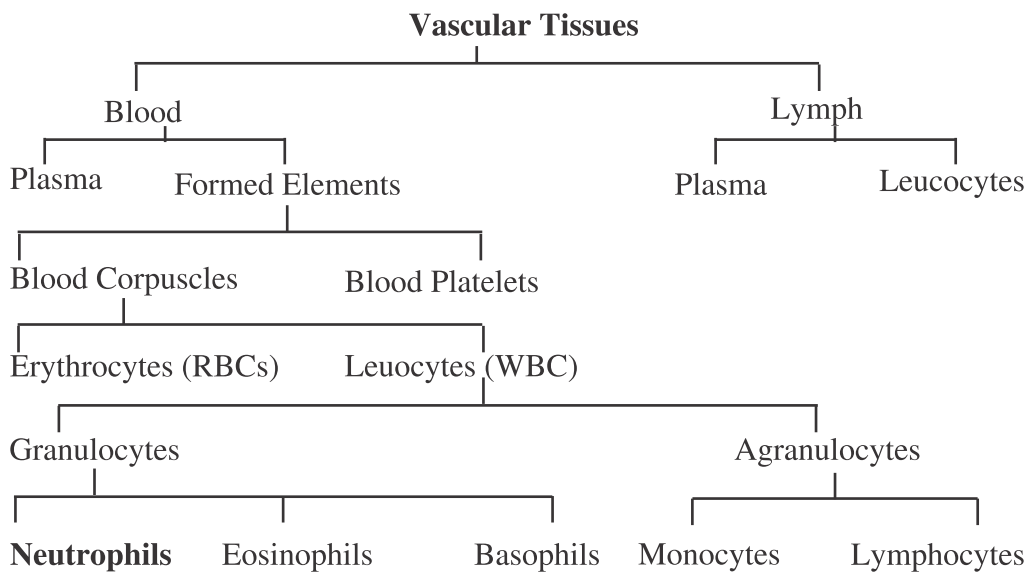
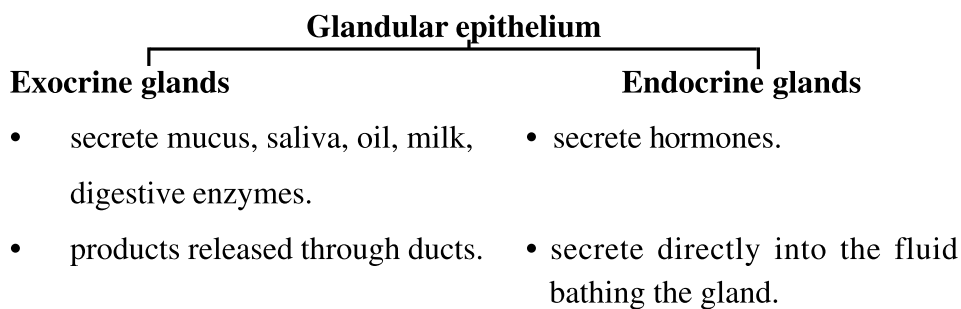
**Simple :** • Composed of single layer of cells.

• 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.

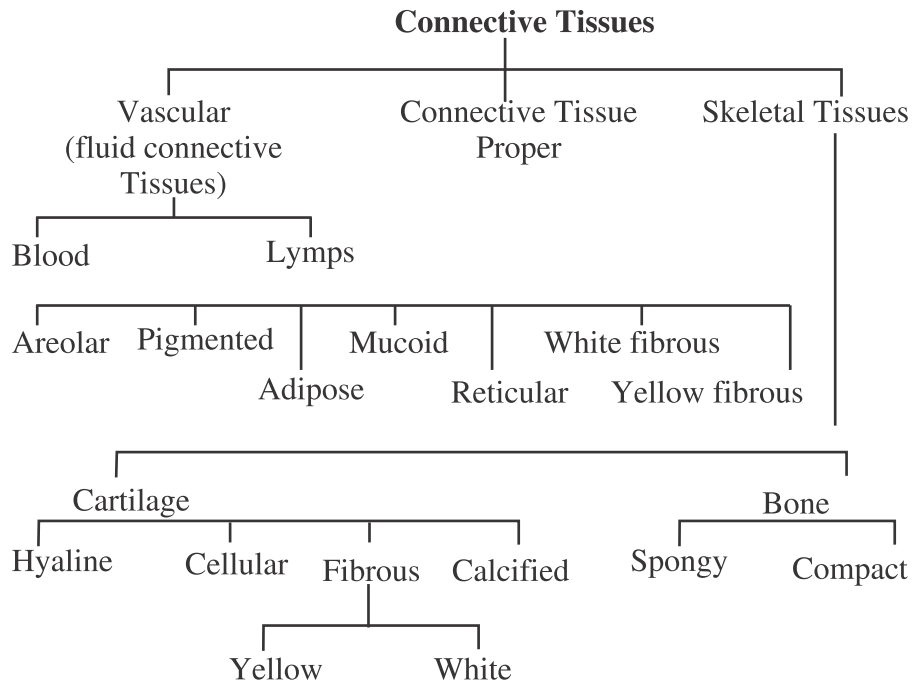
## Compound

- 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.



**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) Adipose 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 collagen fibres.
- (ii) Bones        Ground substance is rich in calcium salts and collagen 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***

Cockroach 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)

3 pairs of legs in thoracic segments. (one pair in each thoracic segment.)

**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**.

Male Cockroach

Female Cockroach

1. Abdomen long and narrow

1. Abdomen short and broad

2. All nine sterna visible

2. Seven sterna visible. (7th sternum fused with 8th and 9th sterna)

3. Anal style present

3. Anal style absent

**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 caecae (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 elongated muscular 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 is colourless (haemolymph).

**Respiratory 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 reproductive system : Pair of testes (4th-6th segments) → vas deferens → ejaculatory duct → male gonophore.

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

**Female reproductive system :**

A pair of ovaries (with 8 ovarian tubules) → Oviduct → 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 ?
6. Differentiate between tendon and ligament.
7. Where are RBC's formed?
8. A muscular fiber having no striations and tapers at both ends. Name it.
9. Mention the site of sclerite present in cockroach.
10. Name the mouth part of cockroach which is comparable to our tongue.

**Short Answer Questions-II (2 marks each)**

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



12. What are the two types of fibres of connective tissues ? Distinguish between the two.
13. To which tissue do the following belong to :
  - (a) Osteocytes
  - (b) Chondrocytes
  - (c) Neuroglia
  - (d) Intercalated discs
14. Give the location of hepatic caecae in cockroach ? What is their function ?
15. Name the locomotory appendages of cockroach on the basis of external morphology.

Short Answer Questions-I (3 marks each)

16. Differentiate between skeletal and smooth muscles.
17. Differentiate between male and female cockroach on the basis of external morphology.
18. (a) What is open circulatory system ?  
(b) Explain the respiratory system of cockroach.
19. (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 ?
20. Name the different cell junctions found in tissues.
21. Mention the special features of eye in cockroach.
22. Write the appropriate type of tissue in column B accounting to the functions mentioned in column A.
 

Column A	Column B
a. Linking and supporting frame work	.....
b. Protective covering	.....
c. Secretion and absorption	.....

**Long Answer Questions (5 marks each)**

23. (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 ?
24. Make a neat and well labelled diagram showing alimentary canal of cockroach



19. (a) American Cockroach.  
(b) One pair, present in 6th segment.  
(c) Between 2<sup>nd</sup> and 6<sup>th</sup> 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 to detect movement of objects very efficiently.
20. (i) Gap junctions                      (ii) Tight junctions  
(iii) Adhering junctions  
(a) Desmosomes.                      (b) Hemidermosomes  
(c) Terminal bars
21. See text in NCERT at page No. 114  
(i) Situated at dorsal surface of head.  
(ii) Each eye consists of about 2000 hexagon ommatidia.  
(iii) It can receive several images of an object.  
(iv) This kind of vision is known as mosaic vision.  
(v) It is more sensitivity but less resolution.
22. (a) Connective tissue  
(b) Stratified epithelium  
(c) Columnar epithelium

**Long Answers (5 marks each)**

23. Refer 'Points to Remember'.
24. Refer Fig 7.16 NCERT Text Book of Biology class-XI

## 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. (ATP). *eg.* diffusion (of neutral solute), Osmosis.

**Active transport :** Transport of molecules against concentration gradient, *i.e.*, from lower to higher concentration with the consumption of energy (ATP). *eg.* Na<sup>+</sup>/K<sup>+</sup> pump

**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 cell theory 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**.

Nucleoid - represents the genetic material of prakaryotes which consists of a

single, circular, double stranded naked DNA

**Plasmid** - Self replicating, extra chromosomal segments of double stranded, circular, naked DNA. Contains genes like antibiotic resistance.

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 bacteria have **flagella** composed of three parts – filament, hook and basal body. Pili and fimbriae are surface structures which do not play any role in motility. 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.

*e.g.*, Na<sup>+</sup>/K<sup>+</sup> pump

**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 Reticulum (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-cellular 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, carbohydrases) 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) facilitates transport of ions and other substances.

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

Mitochondria :

Double membraned 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 binary 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** are present in stroma. Chlorophyll pigments are present in thylakoids.

**Function :** Site of photosynthesis.

## Ribosomes

Composed 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 mark each)

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.
7. Eukaryotic ribosomes are 80S. What does 'S' stand for)
8. What is the function of cytoskeleton in a cell?

Short Answer Questions-II (2 marks each)

9. What are nuclear pores ? State their function.
10. State the cell theory.
11. Differentiate between active and passive transport.
12. Differentiate between RER and SER.
13. List the functions of golgi apparatus.
14. List the functions of mesosome.
15. Differentiate between the electron microscopic structure of cilia/flagella and centriole.
16. Give the specific terms for the following
  - a) Cluster of ribosomes found in cytoplasm
  - b) Extensive infolding to the inner membrane of mitochondria.
  - c) Stacks of closely packed thylakoids
  - d) Stalked particles on the inner membrane of mitochondria.
17. a) What is the function of inclusion bodies in prokaryotic cells?
  - b) Where are they present?
  - c) Give two examples of inclusion bodies.

**Short Answer Questions-I (3 marks each)**

18. Explain the 'Fluid Mosaic Model'. Also represent it diagrammatically.



19. Differentiate between a prokaryotic and eukaryotic cell.
20. (a) Give the characteristic features of the genetic material of bacteria.  
(b) What are plasmids ? What is its importance ?
21. Give the structural details of an eukaryotic nucleus along with its diagram.

**Long Answer Questions (5 marks each)**

22. (a) Give the structural details of mitochondria.  
(b) Draw its diagram.  
(c) Why is it called 'powerhouse of the cell' ?
23. (a) Diagrammatically represent the types of chromosomes based on the position of centromere.  
(b) What does chromatin contain ?  
(c) What is perinuclear space ?

**ANSWERS**

**Very Short Answers (1 mark each)**

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% proteins, 40% lipids.
7. Sedimentation coefficient
8. Mechanical support, motility, maintenance of shape of cell.

**Short Answers-II (2 marks each)**

9. Minute pores present in the nuclear envelope; provide passage for movement of RNA and proteins between nucleus and cytoplasm.
10. Refer 'Points to Remember'.
11. Refer 'Points to Remember'.
12. Refer 'Points to Remember'.
13. Refer 'Points to Remember'.

14. Refer 'Points to Remember'.

15. Flagella/Cilia	Centriole
i) Possess (9+2) pattern of axoneme microtubules enclosed by a membrane	: Possess (9+0) pattern, membrane less organelle
ii) Each tubule is a doublet	: Each tubule is a triplet

16. a) Polyribosome/Polysome

b) Cristae

c) Grana

d) Fo-F<sub>1</sub> particles

17. a) Reserve materials are stored.

b) They are free in the cytoplasm

c) *e.g.*, Phosphate granules, cyanophycean granules, glycogen granules.

**Short Answers-I (3 marks each)**

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

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

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

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

**Long Answers (5 marks each)**

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

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

## Chapter-9

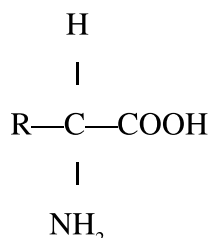
### BIOMOLECULES

#### POINTS TO REMEMBER

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

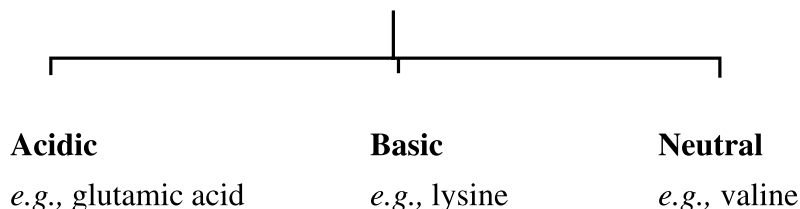
**Micromolecules** : Molecules which have molecular weights less than one thousand dalton.

**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  **$\alpha$  carbon**.



- Twenty types of amino acids.
- Based on number of amino and carboxyl groups, amino acids can be :
- Phenylalanine, Tryptophan and Tyrosine are aromatic (give smell) amino acids.

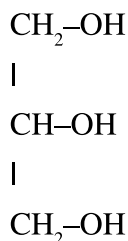
#### Amino Acids



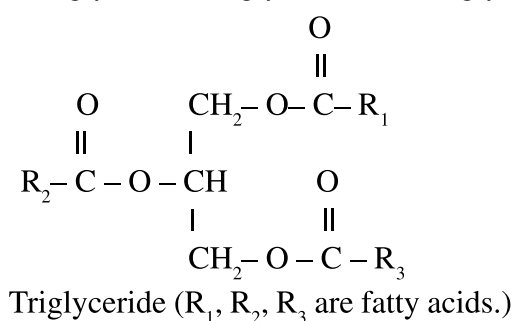
#### Lipids :

- 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 trihydroxy propane.



- Some lipids have fatty acids esterified with glycerol.
- They can be monoglycerides, diglycerides and triglycerides.



- **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**

- 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.
- 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.
- Tertiary structure :** Long protein chain is folded upon itself like a hollow wollen ball. Gives a 3-dimensional view of protein, *e.g.*, myosin.
- 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 - 2  $\alpha$  and 2  $\beta$  subunits.

**Polysaccharides :** Are long chain of sugars.

- Starch :** Store house of energy in plant tissues. Forms helical secondary structures.
- Cellulose :** Polymer of glucose.
- Glycogen :** Is a branched homopolymer, found as storage polysaccharide in animals.
- Insulin :** Is a polymer of fructose.
- 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.

Bonds linking monomers in a polymer

**Peptide bond** – formed between the carboxyl ( $-\text{COOH}$ ) group of one amino acid and the amino ( $-\text{NH}_2$ ) group of the next amino acid with the elimination of water moiety.

**Glycosidic bond** – bond formed between two carbon atoms of two adjacent monosaccharides.

**Phosphodiester bond** - bond formed in nucleic acids where in a phosphate moiety links the 3-carbon of one sugar of one nucleotide to the 5' - carbon of the sugar of the succeeding nucleotide.

**Enzymes** : Are biocatalysts.

- Almost all enzymes are proteins.
- Ribozymes - 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).
- $\text{E} + \text{S} \rightleftharpoons \text{ES} \rightarrow \text{EP} \rightarrow \text{E} + \text{P}$   
where E = Enzyme, S = Substrate, P = Product.

**Factors affecting enzyme activity :**

- Temperature** : Show highest activity at optimum temperature. Activity declines above and below the optimum value.
- 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)
- 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 bind 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. (Actual substrate is succinic acid)

Classification of enzymes :

1. **Oxidoreductase/dehydrogenases** : Catalyse oxidoreduction between 2 substrates.
2. **Transferases** : Catalyse transfer of a group between a pair of substrates.
3. **Hydrolases** : Catalyse hydrolysis of ester, ether, peptide, glycosidic, C-C, P-N bonds.
4. **Lyases** : Catalyse removal of groups from substrates by mechanisms other than hydrolysis. Leave double bonds.
5. **Isomerases** : Catalyse inter-conversion of optical, geometric or positional isomers.
6. **Ligases** : Catalyse linking together of 2 compounds.

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

1. **Cofactors** : • **Prosthetic groups** : are organic compounds tightly bound to apoenzyme. *e.g.*, haem in perox, dase and catalase.
2. • **Co-enzymes** : Organic compounds which has transient association with enzyme. *e.g.*, NAD, NADP. (Contain vitamin Niacin)
3. • **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.

**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. The pitch is  $34\text{\AA}$ . At each step of ascent, the strand

turns  $36^\circ$ . The rise per base pair is  $3.4\text{Å}$ , so one full turn involves ten base pairs.

## QUESTIONS

### Very Short Answer Questions (1 mark each)

1. Why do oils generally 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 amino acids 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 happen when salivary amylase which acts on starch in mouth and in stomach ?
12. Differentiate between homopolysaccharides and heteropolysaccharides
13. Why do physicians recommend vegetable oils rich in polyunsaturated fat for persons suffering from cardiovascular diseases?
14. Why does the shelf life of fruits and vegetables increase in a refrigerator?

### Short Answer Questions-I (3 marks each)

15. Explain the structure of proteins.
16. (a) What is an enzyme ?  
(b) Give an example of co-enzyme.  
(c) Distinguish between apoenzyme and co-enzyme.
17. Explain Watson-Crick model on DNA structure.
18. Explain peptide bond, glycosidic bond and phosphodiester bond.
19. Explain competitive inhibition along with an example.

### Long Answer Questions (5 marks each)

20. List the 6 classes of enzymes along with their functions.



## ANSWERS

Very Short Answers (1 mark each)

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 each)

7. The  $\alpha$ -carbon has 4 substituted groups occupying the 4 valency positions : - H, -COOH, -NH<sub>2</sub> and -R group.



Due to ionizable nature of -NH<sub>2</sub> and -COOH groups.

9. Starch forms helical secondary structures which can hold I<sub>2</sub>.
10. Occupy lesser space as less bulky and can hydrolysed to glucose when required.
11. In mouth, salivary amylase changes starch into maltose. Action of amylase stops in stomach as it cannot act in an acidic medium.
12. 

Homopolysaccharides	Heteropolysaccharides
a) Constituted of single type of monosaccharide units	Constituted by two or more type of monosaccharide unit and their derivatives
b) e.g., starch, glycogen, cellulose	e.g., Peptidoglycans, chitin
13. Polyunsaturated oils contain fatty acids having one or more double bonds which does not clog arteries due to high proportion of polyunsaturated fatty acids
14. Low temperature prevents growth of food spoiling micro organisms and also inhibits the action of enzymes present in the food, because enzymes are inactivated at low temperature.

Short Answers-I (3 marks each)

15. Refer 'Points to Remember'.

16. (a) Are biocatalysts.

(b) NADP, NAD

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

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

17. Refer 'Points to Remember'.

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

19. Refer 'Points to Remember'.

**Long Answers (5 marks each)**

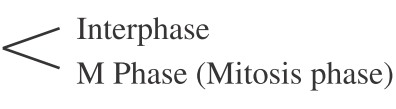
20. Refer Page no. 158., NCERT, Text Book of Biology for Class XI.

# Chapter-10

## CELL CYCLE AND CELL DIVISION

### POINTS TO REMEMBER

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

**Phases of cell cycle :** 

**Interphase :**

- **G<sub>1</sub> 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 same (2N).
- **G<sub>2</sub> 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<sub>0</sub>) :** Cells that do not divide and exit G<sub>1</sub> phase to enter an inactive stage called G<sub>0</sub>. 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 centromeres) 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 division 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. Maintain Nucleo - cytoplasmic ratio
3. Maintenance of chromosome number.
4. Regeneration.
5. Reproduction in unicellular organisms.
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 appearance 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 **chiasmata**.

**Diakinesis** : • Terminalisation of chiasmata.

- 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 ?
6. Where does mitosis take place in plants and animals?

### Short Answer Questions-II (2 marks each)

7. Differentiate between cytokinesis of plant and animal cell.
8. What is chiasmata ? State its significance.
9. Differentiate between chromatin and chromatid.

10. Give the terms for the following :
- The period between 2 successive mitotic divisions
  - Cell division in which chromosome number is halved.
  - Phase in cell cycle where DNA is synthesised
  - Division of nuclear material.
11. What happens during S phase of interphase ?
12. Distinguish between metaphase of mitosis and metaphase I of meiosis.
13. What will be the DNA content of a cell at  $G_1$ , after S and  $G_2$  if the content after M phase is  $2C$ .

**Short Answer Questions-I (3 marks each)**

14. Differentiate between mitosis and meiosis.
15. List the significance of mitosis.
16. Describe the following :
- Synapase
  - Bivalent
  - Leptotene

**Long Answer Questions (5 marks each)**

17. With the help of labelled diagram, explain the following :
- Diplozene
  - Anaphase of mitosis
  - Prophase I
18. What is cell cycle ? Explain the events occurring in this cycle.

**ANSWERS**

**Very Short Answers (1 mark each)**

- Small disc-shaped structure at the surface of the centromeres.
- The stage between two meiotic divisions.
- The chromosome number in daughter cells is equal to that of the parent cell.
- Zygotene.
- Cells which enter a stage where they are metabolically active but no

longer proliferate.

6. Plants – Meristematic tissue; Animals - somatic cells.

**Short Answers-II (2 marks each)**

7. Refer 'Points to Remember'.

8. Refer 'Points to Remember'.

**9. Chromatin**

a) Diffuse, deep staining hereditary material

b) Metabolically inert

**Chromatid**

longitudinally split half of a chromosome, light staining hereditary material

Metabolically active

10. a) Interphase  
b) Meiosis  
c) S phase  
d) Karyokinesis

11. Refer 'Points to Remember'.

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

**Short Answers-I (3 marks each)**

13.  $G_1 - 2C$ ,  $S_1 - 4C$ ,  $G_2 - 4C$

14. Refer 'Points to Remember'.

15. Refer 'Points to Remember'.

16. Refer 'Points to Remember'.

**Long Answers (5 marks each)**

17. Refer 'Points to Remember'.

18. Refer 'Points to Remember'.



# Chapter-11

## TRANSPORT IN PLANTS

### POINTS TO REMEMBER

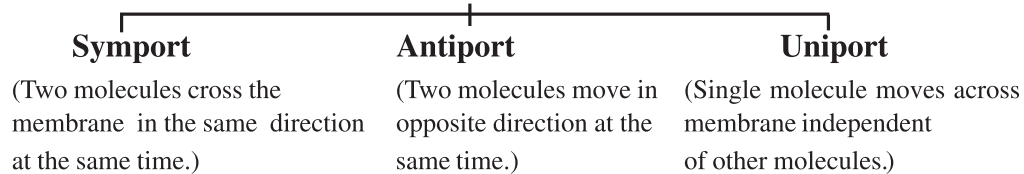
**Translocation :** Transport of substances in plants over longer distances through the vascular tissue (Xylem and Phloem) is called translocation. The transport of water and mineral in Xylem is unidirectional while transport of organic and mineral nutrients in phloem is multi-directional.

**Means of transport :** The transport of material into and out of the cells is carried out by a number of methods. These are diffusion, facilitated 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 aquaporins and ion channels. No ATP energy is utilized in this process.

#### Methods of Facilitated Diffusion



**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.

#### Different Transport Mechanisms

S. No.	Property	Simple Diffusion	Facilitated Transport	Active Transport
1.	Required Special membrane protein	No	Yes	Yes
2.	Uphill transport	No	No	Yes
3.	Requires ATP Energy	No	No	Yes

**Turgor Pressure** : Due to osmotic entry of water the protoplasm of a plant cell presses the cell wall towards the outside with a force, it is called Turgor Pressure.

**Diffusion Pressure** : The pressure exerted by the tendency of the particles to diffuse from the area of higher concentration to lower concentration. It is directly proportional to the concentration of particles of diffusing substance.

**Osmosis** : 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 protoplast in a cell due to exosmosis in hypertonic solution. If a plasmolysed cell is placed in water or a hypotonic solution it becomes turgid.

**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 phenomenon of adsorption of water or any other liquid by the solid particles of a substance process imbibition the size of adsorbant is increased without forming a solution. In causing it to increase in volume.

**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.

**Conditions essential for imbibition**

1. Water potential gradient between the surface of the adsorbant and the imbibed liquid.
2. affinity between the adsorbant and the imbibed liquid.

**Transport of water in plants** : Water is absorbed by root hairs by diffusion 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 travel 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. These openings are called hydathode.

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

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

**Endosmosis :** When a cell is placed in hypotonic solution or pure water then inflow of water takes place into the cell. Due to it the volume of cell increases. It creates the turgor pressure.

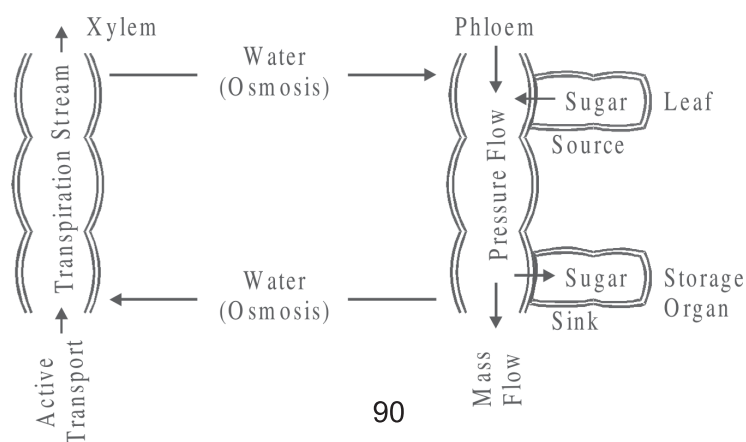
**Exomosis :** When a cell is placed in hypertonic solution, the with-drawl of water from the cell takes place into outside solution it decrease the volume of cell.

**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 water stream. Older dying leaves export much of their mineral content to younger leaves. Elements phosphorous, sulphur, nitrogen and potassium are most readily mobilised.

**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.

**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, osmotic 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.



**Mycorrhiza :** A mycorrhiza is a symbiotic association of a fungus with a root system. The fungal hyphae absorb mineral ions and water from the soil, and provide them to the roots of plant, in turn the roots provide sugars and nitrogen containing compounds to the mycorrhizae.

## 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. Casparian strip is made of a substance which is impervious to water. Name this substance.
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 by root hairs 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 ?
11. Correct the statements.
  - (a) Imbibition is a special type of diffusion when water is absorbed by living cell.
  - (b) Most of water flow in the roots occurs via symplast.
  - (c) Cell shrink in hypotonic solution and swell in hypertonic solution.

### Short Answer Questions-II (2 marks each)

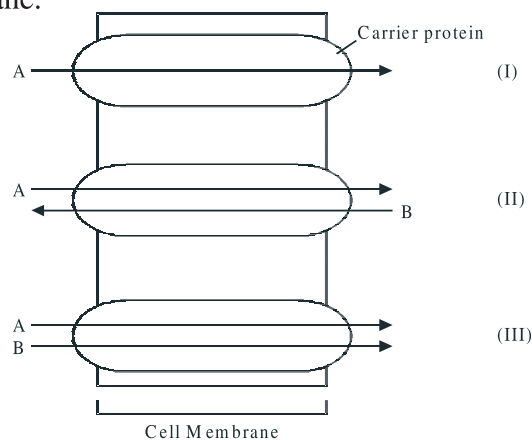
12. A well watered potted herbaceous plant shows wilting in the afternoon of a dry sunny day. Give reason.
13. Do different species of plants growing in the same soil show the same rate of transpiration of a particular time ? Justify your answer.
14. What is casparian strip ? Write its significance in plants.
15. Xylem transport is unidirectional and phloem transport bi-directional Why ?
16. How is transpiration different from guttation ? Give two points.
17. Suggest two methods to increase the life of cut plants in a vase.
18. Write the chemical composition of xylem and phloem sap.

Short Answer Questions-I (3 marks each)

19. When any dry plant material or seeds is/are kept in water, they swell up.
- Name the phenomenon involved in this change.
  - Define this phenomenon.
  - Give two conditions essential for the phenomenon to occur.
20. Differentiate between temporary and permanent wilting. Do any of them indicate the water status of the soil ?
21. Observe the diagram and answer the following :



- Which of these guard cells show a higher water content, A or B?
  - Are these types of guard cells found in monocots or dicots?
  - Name the element which plays an important role in the opening and closing of stomata.
22. What is mycorrhiza ? How is the mycorrhizal association helpful in absorption of water and minerals in plants ?
23. Observe the given figure and give the answers of the following :
- Identify the process occurring in (I), (II) and (III).
  - Differentiate between the process II and III.
  - How many types of aquaporins form the water channels in the cell membrane.



24. Give the scientific term for the following statements/processes :
- (a) Movement of water in roots exclusively. through the cell wall
  - (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 vapours.
  - (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)**

25. 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.
26. How do plants absorb water ? Explain transpiration pull model in this regard.
27. (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 each)**

- 1. Root hairs.
- 2. Endosmosis.
- 3. Suberin
- 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 ie water comes out the plant.

10. Every activity requires energy. Root pressure develops due to activity of living cell.
11. (a) Osmosis is a special type of diffusion when water is absorbed by living cells.  
 (b) Most of the water flow in the roots occurs via the apoplast.  
 (c) Cells shrink in hypertonic solution and swell in a hypotonic solution.

**Short Answers-II (2 marks each)**

12. During noon, the rate of transpiration becomes higher than the rate of water absorption by plant. It causes loss of turgidity and leads to wilting.
13. Rate of transpiration is not same because transpiration is affected by numbers and distribution of stomata, and their opening.
14. Refer page 185, NCERT, Text Book of Biology for Class XI
15. Refer page 190, NCERT, Text Book of Biology for Class XI

16.

<b>Transpiration</b>	<b>Guttation</b>
(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.

17. (a) By adding cytokinin into water of the vase.  
 (b) Preventing entry of air in the cut plants by immediately immersing the cut end in water.
18. Xylem Sap - Water, traces of all minerals.  
 Phloem sap - 5-10% sucrose, 1% amino acids, traces of bound minerals, hormones, other organic substances and rest is water.

**Short Answers-I (3 marks each)**

19. (a) Imbibition.  
 (b) Refer to 'Points to Remember.'  
 (c) Condition necessary to imbibition.  
 (i) Water potential gradient between the absorbant and the liquid imbibed.  
 (ii) Affinity between the adsorbant and the liquid imbibed.

20.	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 unavailable form. The soil contains 10-15% water depending upon its texture.

21. (a) A

(b) Dicots

(c)  $K^+$  (Potassium ions)

22. Refer points to remember

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

(b) Refer 'Points to Remember'.

(c) 8 types of aquaporins.

24. (a) Apoplast pathway

(b) Turgor pressure

(c) Hypotonic

(d) Transpiration

(e) Uniport

(f) Guttation

**Long Answers (5 marks each)**

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

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

27. (a) Refer points to remember.

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



# Chapter-12

## MINERAL NUTRITION

### POINTS TO REMEMBER

**Autotroph** : An organism that synthesizes its required nutrients from simple and inorganic substances. Example - plants, blue green algae (cyanobacteria)

**Heterotroph** : An organism that cannot synthesize its own nutrients and depend on others. Example - Bacteria, protists, members of animalia

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

**Nitrification** : Conversion of ammonia ( $\text{NH}_3$ ) into nitrite and then to nitrate.

**Denitrification** : A process of conversion of nitrate into nitrous oxide and nitrogen gas ( $\text{N}_2$ ).

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

**Flux** : The movement of ions is called flux. Influx is inward movement of ions into the cells and efflux is the outward movement of ions.

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

**Mineral Nutrition** : Plants require mineral 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

Macronutrients are present in plant tissues in concentrations of more than  $10 \text{ m mole Kg}^{-1}$  of dry matter.

C, H, O, N, P, K, S, Ca, Mg.

##### Micro-nutrients

Micro-nutrients are needed in very low amounts : less than  $10 \text{ m mole Kg}^{-1}$  matter.

Fe, Mn, Cu, Mo, Zn, B, Cl, Si.

Chlorosis : Yellowing of leaves due to loss of chlorophyll.

Active Transport : Absorption occurring 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 $\text{NO}_3^-$ some as $\text{NO}_2^-$ or $\text{NH}_4^+$ .	Constituent of proteins, nucleic acids, vitamins and hormones.	Stunted growth. Chlorosis, dormancy of casual buds.
Phosphorus (P)	Phosphate ions ( $\text{H}_2\text{PO}_4^-$ or $\text{HPO}_4^{2-}$ )	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, delay in seed germination purple or red spots on leaves, premature leaf fall.
Potassium (K)	$\text{K}^+$	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 leaves edges of leaves; mottled appearance of leaves. Premature death.
Calcium (Ca)	$\text{Ca}^{2+}$	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)	$\text{Mg}^{2+}$	Activates enzymes in phosphate metabolism, constituent of chlorophyll; maintains ribosome structure.	Chlorosis between the leaf veins necrotic purple colours spots on older leaf
Sulphur (S)	$\text{SO}_4^-$	Constituent of two amino-acids- Crysteine and methionine and proteins, coenzymes, vitamins and ferredoxin.	Chlorosis of younger leaves, stunted growth

### MICRO-NUTRIENTS

Element	Obtained as	Functions	Deficiency symptoms
Iron (Fe)	Fe <sup>3+</sup>	Constituent of Ferredoxin and cytochrome; needed for synthesis of chlorophyll.	Chlorosis of leaves
Manganese (Mn)	Mn <sup>2+</sup>	Activates certain enzymes involved in photosynthesis, respiration and nitrogen metabolism.	Chlorosis, grey spots on leaves.
Zinc (Zn)	Zn <sup>2+</sup>	Activates various enzymes like carboxylases. Required for synthesis of auxins.	Malformation of leaves. Stunted growth, inter-veinal chlorosis in leaves. Necrosis of the tip of young leaves, die back of shoot.
Copper (Cu)	Cu <sup>2+</sup>	Activates certain enzymes. Essential for overall metabolism	Death of stem and root apex. loss of a foical dominance, abscission of flowers, small size of fruits
Boron (B)	BO <sub>3</sub> <sup>3-</sup> , B <sub>4</sub> O <sub>7</sub> <sup>2-</sup>	Required for uptake of water and Ca, for membrane functioning, pollen germination, cell elongation carbohydrate translocation.	
Molybdenum (Mo)	M <sub>6</sub> O <sub>2</sub> <sup>2+</sup> (molybdate ions)	Activates certain enzymes in nitrogen metabolism.	Nitrogen deficiency inter-veinal chlorosis retardation of growth
Chlorine (Cl)	Cl <sup>-</sup>	Maintains solute concentration along with Na <sup>+</sup> & K <sup>+</sup> ; maintain anion-cation balance in cells; essential for oxygen evolution in photosynthesis.	Wilted leaves, stunted root growth and reduced fruiting.

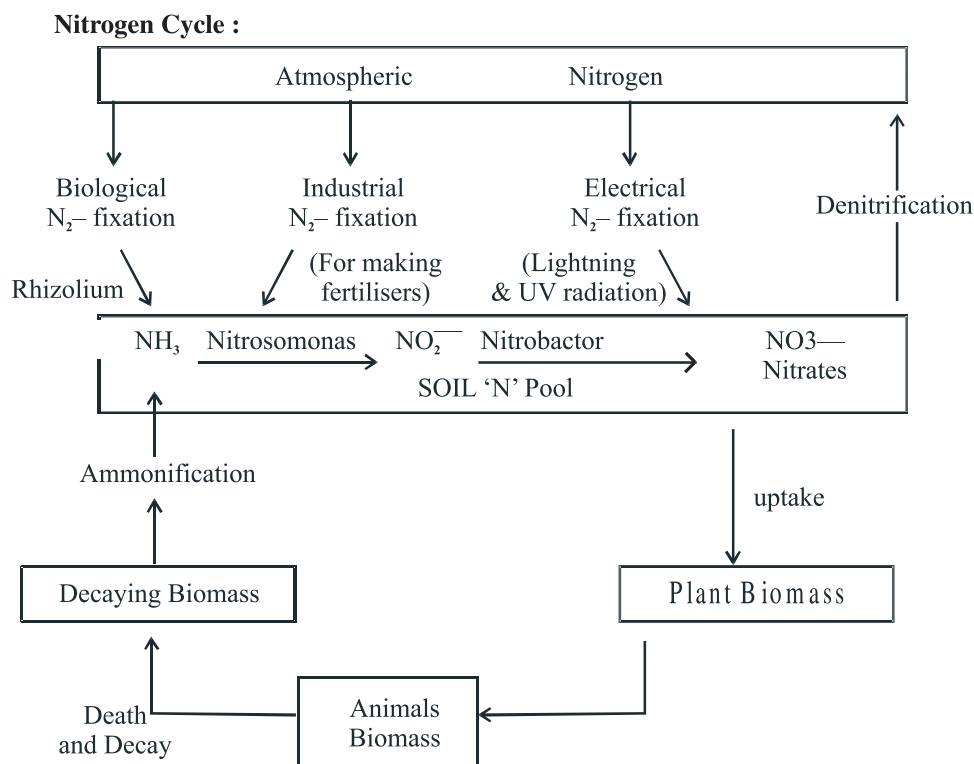
Role of microbes in nitrogen cycle :

Rhizobium, Azotobacter, Rhodospirillum : Fix atmospheric nitrogen

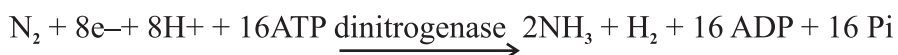
Nitrosomonas and / or Nitrococcus :- Conversion of ammonia to nitrite

Nitrobacter : Conversion of nitrite into nitrate.

Pseudomonas and Thiobacillus : reduce nitrate into nitrogen.



Enzyme nitrogenase : The enzyme nitrogenase is a Mo-Fe protein and catalysis the conversion of atmospheric nitrogen to ammonia (First stable product of nitrogen fixation)



Steps of nodule formation :

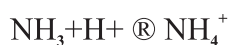
- Rhizobium bacteria present in soil contract a susceptible root hair.
- Infection of the root hair cause it to curl.
- An infection thread is produced carrying the bacteria into the cortex of the root.
- The bacteria get modified into rod-shaped bacteroids and cause inner cortical and pericycle cells to divide.
- Division and growth of cortical and pericycle cells lead to nodule formation.

(Refer Figure 12.4, page 203 NCERT Text Book).

Fate of Ammonia :

Ammonium ions ( $\text{NH}_4^+$ ) are used to synthesize amino acids in plants. It can be taken place by two main ways.

- (i) Reductive amination : ammonia reacts with  $\alpha$ -ketoglutaric acid and forms glutamic acid. This reaction is catalysed by enzyme glutamic dehydrogenase.
- (ii) Transamination : Other aminoacides are formed by the transfer of amino group ( $\text{NH}_2$ ) mainly from glutamic acid to the keto group of a ketoacid. The enzyme trans-aminase catalyses these reactions.



### 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. Which substance 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 become yellow in different pattern ?
6. Define hydroponics.
7. Give the name of an insectivores angiosperm plant.
8. Give the name of one non-symbiotic nitrogen fixing prokaryote
9. Name the green house gas produced in rice fields.

Short Answer Questions-II (2 marks each)

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

11. Name the following :
  - (a) Bacteria which converts ammonia into nitrite.
  - (b) Bacteria which oxidises nitrite into nitrate.
12. How does Leghemoglobin protect the enzyme nitrogenase ?
13. Name the enzyme found in root nodules for  $N_2$  fixation? Name the pink coloured pigment required for its functioning.

Short Answer Questions-I (3 marks each)

14. Write the deficiency symptoms of the following three elements :
  - (a) Phosphorus
  - (b) Magnesium
  - (c) Potassium
15. Describe the following three deficiency symptoms and co-relate them with concerned mineral deficiency :
  - (a) Chlorosis
  - (b) Necrosis
  - (d) Stunted plant growth
16. Explain the steps in biological nitrogen fixation in brief.
17. Describe the two main processes of synthesis of amino acids from Ammonium ion ( $NH_4^+$ ) in plants.

Long Answers (5 marks each)

18. Describe all the steps of nitrogen cycle in nature.
19. Describe with diagrams how root nodules are formed in leguminous plants.

### ANSWERS

Very Short Answers (1 mark each)

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.
6. The technique of growing plants in a nutrient solution without soil is called hydroponics.
7. Nepenthes (Pitcher plant)

8. Azoto bacter
9. Methane (CH<sub>4</sub>)

Short Answers-II (2 marks each)

10. Refer to NCERT Book, Page no. 200 (12.3).
11. (i) Nitrifying Bacteria – Nitrosomonas.  
(ii) Nitrifying Bacteria – Nitrobacter
12. Refer to page no. 203.
13. Enzyme-Nitrogenase  
Pink coloured pigment-Leghaemoglobin

Short Answers-I (3 marks each)

14. Refer to 'Points to Remember'.
15. Refer to 'Points to Remember'.
16. Refer to Page no. 201.
17. Refer to Page no. 204.

Long Answers (5 marks each)

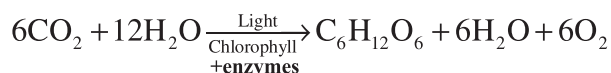
18. Refer to Page no. 201.
19. Refer to Page no. 203.

## 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.



#### Historical Perspective

**Joseph Priestley (1770) :** Showed that plants have the ability to take up  $\text{CO}_2$  from atmosphere and release  $\text{O}_2$ .

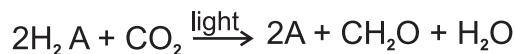
**Jan Ingenhousz (1779) :** Release of  $\text{O}_2$  by plants was possible only in sunlight and only by the green parts of plants.

**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.

**T. 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  $\text{CO}_2$  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  $\text{C}_4$  pathway of  $\text{CO}_2$  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.

**Importance of Photosynthesis** - (1) Synthesis of organic compounds (2) Change of radiant energy into chemical energy (3) Useful products are obtained from plants gums, oils, timber fire wood, resins rubber, fibers and drugs etc. (4) Balance the percentage of O<sub>2</sub> and CO<sub>2</sub> in atmosphere (5) Fossil fuels like coal, natural gas and petroleum have been formed inside the earth indirectly as a product of photosynthesis.

#### **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. It is called universal photo-synthetic pigment.

**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). (Calvin cycle)

**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<sup>+</sup> are synthesised by this process. PSI and PSII are found in lamellae of grana, hence this process is carried here. (Fig. 13.6)

**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 reductase enzyme are absent. Hence only ATP molecules are synthesised.

**The electron transport (Z-Scheme)** : In PS II, reaction centre (chlorophyll 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. (Fig. 13.5)

**The splitting of water** : It is linked to PS II. Water splits into H<sup>+</sup>, O and electrons.



**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. (Fig. 13.7)

Biosynthetic phase in C<sub>3</sub> plants :

ATP and NADPH, the products of light reaction are used in synthesis of food. The first CO<sub>2</sub> fixation product in C<sub>3</sub> plant is 3-phosphoglyceric acid or PGA. The CO<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> acceptor ribulose 1, 5-bisphosphate is formed again .

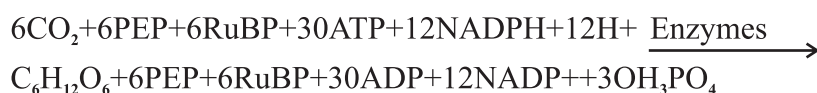
6 turns of Calvin cycles and 18 ATP molecules are required to synthesize one molecule of glucose. (Fig. 13.8)



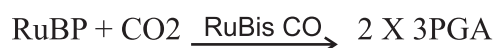
Input		Output
6CO <sub>2</sub>	-	One Glucose
18 ATP	-	18 ADP
12NADPH	-	12 NADP

**The C<sub>4</sub> pathway :** C<sub>4</sub> plants such as maize, sorghum, sugarcane 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<sub>4</sub> pathway (Hatch and Slack Cycle). The leaf has two types of cells : mesophyll cells and Bundle sheath cells (Kranz anatomy). Initially CO<sub>2</sub> 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 malate/aspartate that reach into bundle sheath cells.

The oxidation of malate/aspartate occurs with the release of O<sub>2</sub> and formation of pyruvate (3C). In high CO<sub>2</sub> concentration RuBisCo functions as carboxylase and not as oxygenase, hence 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. (Fig. 13.9)



**Photorespiration :** The light induced respiration in green plants is called photorespiration. In C<sub>3</sub> plants some O<sub>2</sub> binds with RuBisCo and hence CO<sub>2</sub> fixation is decreased. In this process RuBP instead of being converted to 2 molecules of PGA binds with O<sub>2</sub> 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 : Rate of photo synthesis increases at low light intensities. At high

intensities of light beyond a point the rate of CO<sub>2</sub> fixation decreases. Longer hours of light duration favour more photosynthesis rate.

2. Carbon dioxide : Increase in CO<sub>2</sub> concentration causes increase in CO<sub>2</sub> fixation
3. Temperature : The rate of photosynthesis at optimum temperature is high. It is 20°C-25°C For C<sub>3</sub> plants and 30-45°C for C<sub>4</sub> plants
4. Water : Water is one of the reactant in photosynthesis, but it effects the rate of CO<sub>2</sub> fixation. Low water content causes the stomata to close and reduces the CO<sub>2</sub> availability.

### QUESTIONS

#### Very Short Answer Questions (1 mark each)

1. Name two photosynthetic pigments belonging to Carotenoids.
2. How many molecules of ATP are required for synthesis of one molecule of glucose in C<sub>3</sub> and C<sub>4</sub> 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. Name the enzyme which is found abundantly in the world.
7. Name the scientist who proposed the C<sub>4</sub> pathway.
8. Where does carbon fixation occur in chloroplast ?
9. Which compound acts as CO<sub>2</sub> acceptor in Calvin cycle ?
10. Name the end products of light reaction.
11. Does the photosynthesis occur in moon light?

#### Short Answer Questions-II (2 marks each)

12. Why does the rate of photosynthesis decline in the presence of continuous light ?
13. Why do green plants start evolving carbon dioxide instead of oxygen on a hot sunny day ?
14. Fill in the space, left blank in the given table to bring the difference between C<sub>3</sub> and C<sub>4</sub> plants :

S. No.	Characterisitics	C <sub>3</sub> plants	C <sub>4</sub> plants
1.	Cell type	mesophyll	...(a)... and mesophyll
2.	CO <sub>2</sub> acceptor	.....(b).....	Phosphoenol pyruvate (PEP)
3.	First CO <sub>2</sub> fixation product	3-PGA	.....(c).....
4.	Optimum temperature	.....(d).....	30° C to 45° C

15. State two functions of accessory pigments found in thylakoids.

16. Why do C<sub>4</sub> plants are more expensive than C<sub>3</sub> plants ?

17. What is limiting factor? State the law of Limiting factors.

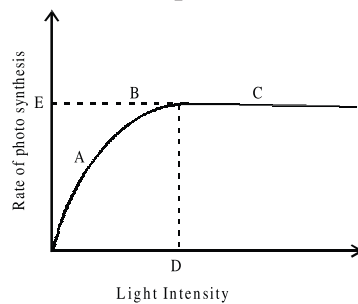
#### Short Answer Questions-I (3 marks each)

18. 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 ?

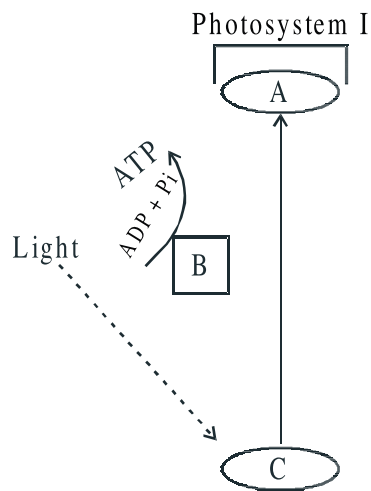


19. When and why does photorespiration take place in plants ? How does this process result in a loss to the plant ?

20. What are the steps that are common to C<sub>3</sub> and C<sub>4</sub> photosynthesis ?

21. 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.

22. (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.

23. Name the pigment found in tomato, carrots, chillies etc. which gives red colour to them. Is it a Photosynthetic pigment?

#### Long Answer Questions (5 marks each)

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

25. Explain the process of biosynthetic phase of photosynthesis occurring in chloroplast.

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

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

### ANSWERS

#### Very Short Answers (1 mark each)

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. RuBisCO.

7. Hatch and Slack.
8. Carbon fixation takes place in stroma.
9. Ribulose 1, 5 bisphosphate.
10. ATP, NADPH and O<sub>2</sub>.
11. No, the moonlight is unable to perform light reactions of photosynthesis (ATP+NADPH Synthesis).

**Short Answers-II** (2 marks each)

12. Increase in incident light beyond a point causes the breakdown of chlorophyll.
13. On a hot sunny day, enzyme RuBP carboxylase becomes active and its affinity for CO<sub>2</sub> decreases and for O<sub>2</sub> increases. Consequently more and more photosynthetically fixed carbon is lost by photorespiration.
14. (a) Bundle sheath  
(b) RuBP  
(c) OAA (oxaloacetic acid)  
(d) 20°C-25°C
15. (a) Absorption of light and transfer of energy to chlorophyll 'a'.  
(b) Protect chlorophyll 'a' from photooxidation.
16. Because they require more energy (30 ATPs) in synthesizing one glucose molecule as compared to C<sub>3</sub> - (18ATPs.)
17. Limiting Factor - A factor which is deficient to such an extent that increase in its concentration directly increase the rate of the process.  
(For the law of limiting factors see text in NCERT Book.) Page 222

**Short Answers-I** (3 marks each)

18. (i) 'B'  
(ii) CO<sub>2</sub> and temperature  
(iii) 'C' represents to constant rate of photosynthesis, 'D' is the light saturation intensity at which rate of photosynthesis is maximum.
19. Refer Page no. 220, NCERT, Text Book Biology for class XI.

**20. 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.

**21. Hints :**

- The plant in sunlight will survive for longer period.
- Light is essential for photosynthesis.

**22. (a)** (A)  $e^-$  acceptor

(B) Electron transport system

(C) Chlorophyll P700

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

**23. Carotenoid :** It is an accessory photosynthetic pigment which takes part in harvesting light energy only if chlorophyll is present.

**Long Answers (5 marks each)**

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

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

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

**26. (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

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### POINTS TO REMEMBER

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**Aerobic respiration :** Complete oxidation of organic food in presence of oxygen thereby producing CO<sub>2</sub>, water and energy.

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

**ATP Synthetase :** 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<sub>2</sub> and ethanol.

**Glycolysis :** 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<sub>2</sub> 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.

Electron Transport Chains (ETC)- A series of co-enzymes and electron/carriers where electrons can pass along increasing redox potential losing a bit of energy at every step of transfer.

#### 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 ( <b>Cycle</b> )
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.

#### Steps for Glycolysis- (EMP Pathway)

1. Phosphorylation of glucose
2. Formation of fructose 6- phosphate
3. Second phosphorylation
4. Lysis (splitting)
5. Isomerisation of DiHAP
6. Oxidation
7. Substrate Level ATP synthesis
8. Isomerisation or Rearrangement
9. Dehydration
10. Substrate Level ATP Synthesis and formation of Pyruvate.

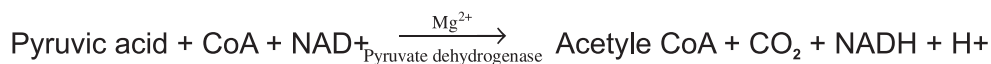
- It is also called Embden-Meyerhof-Paranus pathway. (EMP pathway)
- It is common in both aerobic and anaerobic respiration.
- It takes place outside the mitochondria, in the cytoplasm.
- One molecule of glucose (Hexose sugar) ultimately produces two molecules of pyruvic acid through glycolysis.
- During this process 4 molecules of ATP are produced while 2 molecules of ATP are utilised. Thus net gain of ATP is of 2 molecules.

#### Input and Output of glycolysis

S. No.	Input	Output
1.	Glucose (6-C)- 1 molecule	Pyruvate (3-C) 2 molecules
2.	2 ATP	2 ADP
3.	4 ADP + 2 Pi	4 ATP + 2H <sub>2</sub> O
4.	2 NAD <sup>+</sup>	2 NADH (+ H <sup>+</sup> )

Net out put ..... 2 Pyruvate + 2ATP + 2NADH (+ H<sup>+</sup>) OR 2 Pyruvate + 8 ATP

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



The Acetyl CoA enters in TCA cycle.

**Tri Carboxylic Acid Cycle (Kreb's cycle) or Citric acid Cycle :** This cycle starts with condensation of acetyl group with oxaloacetic 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<sup>+</sup>, one FADH<sub>2</sub>, one ATP.
- One glucose molecule has been broken down to release CO<sub>2</sub> and eight molecules of NADH + H<sup>+</sup>, two molecules of FADH<sub>2</sub> 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<sup>+</sup>
- (ii) FAD and FADH<sub>2</sub>
- (iii) UQ (Ubiquinone)
- (iv) Cyt b, Cyt c<sub>1</sub>, Cyt c, Cyt a and Cyt a<sub>3</sub>.

Oxygen acts as final hydrogen acceptor. The oxidation of NADH<sub>2</sub> or FADH<sub>2</sub> occurs by transfer of their electrons to a series of electron acceptors and finally they combine with oxygen to form water and ATP. The oxidation of each molecule of NADH<sub>2</sub> and FADH<sub>2</sub> give rise to 3 ATP and 2 ATP molecules respectively.

**Compensation Point :** It is the value of a factor at which the rate of photosynthesis controlled by it is just equal to the rate of respiration and photo respiration so that there is no net exchange of gases between the photo synthetic organ and the environment.

At compensation point the photosynthetic tissue manufacture only such amount of food which of sufficient for it to remain alive. No food is supplied to rest of the plant. Therefore net photosynthesis it zero.

#### **Oxidative Phosphorylation :**

The synthesis of ATP from ADP and inorganic phosphate using energy from proton gradient is called oxidative phosphorylation. This takes place in elementary particles present on the inner membrane of cristae of mitochondria. This process in mitochondria is catalysed by ATP synthetase (complex V). This complex has two major components F<sub>0</sub> and F<sub>1</sub>. F<sub>0</sub> acts a channel for proton and F<sub>1</sub> acts as an ATP synthetase.

#### **Total ATP Production**

<b>Process</b>	<b>Total ATP produced</b>
1. Glycolysis	2ATP + 2NADH <sub>2</sub> (6ATP) = 8ATP
2. Oxidative decarboxylation	2NADH <sub>2</sub> (6ATP) = 6ATP
3. Kreb's Cycle	2GTP (2ATP) + 6NADH <sub>2</sub> (18ATP) + 2FADH <sub>2</sub> (4ATP) = 24ATP

Energy production in prokaryotes during aerobic respiration = 38 ATP

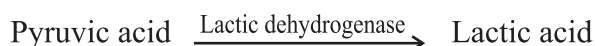
Energy production in eukaryotes during aerobic respiration = 38 – 2 = 36 ATP

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

Fermentation : It is the process of anaerobic respiration which occurs in yeast and some bacteria. Fermentation involves incomplete oxidation of food into ethanol and carbon-di-oxide. It results in the production of 2 ATP molecules.



Anaerobic respiration in muscles : During strenuous exercise a person feels pain and fatigue in his muscles. This is due to accumulation of lactic acid in muscles. When oxygen inadequate pyruvic acid is reduced to lactic acid in presence of enzyme-lactic dehydrogenase



During rest, lactic acid is reconverted to pyruvic acid.

Respiratory pathway as an Amphibolic pathway

During the process of cellular respiration Carbohydrates, fats and proteins are broken down to release energy and hence respiration is a catabolic process/catabolic pathway. From this pathway many compounds are withdrawn for synthesis of substrates. Here some anabolic processes are –

- Acetyl CoA is withdrawn for the synthesis of fat
- Respiratory intermediates at many places are linked for formation of proteins.

Because respiratory pathway is involved in both catabolism and anabolism, it is better to consider the respiratory pathway as an amphibolic pathway

## 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 its complete oxidation in eukaryotes ?
3. Where is ETC found in a eukaryotic cell ?
4. Name the enzyme which converts sugar into glucose and fructose.
5. How many molecules of ATP are produced by the oxidation of one molecule of  $\text{FADH}_2$  ?
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 Krebs's cycle.

**Short Answer Questions-II (2 marks each)**

9. Define the term 'Respiratory substrate'.
10. Which intermediate undergoes lysis in glycolysis?
11. Write the other two names of Krebs cycle.
12. Name the acceptor molecule of Krebs cycle.
13. Name the substrate entrant of Krebs cycle.
14. Name the first chemical produced in Krebs cycle.
15. What is Electron Transport Chain ? (ETC)
16. Differentiate between aerobic respiration and anaerobic respiration.
17. Mention two steps of glycolysis in which ATP is utilised.
18. Why does anaerobic respiration produces less energy than aerobic respiration ?
19. Define Respiratory Quotient. What is its value for fat and protein ?
20. Distinguish between glycolysis and fermentation.
21. What are respiratory substrates ? Name the most common respiratory substrate.

**Short Answer Questions-I (3 marks each)**

22. Give the schematic representation of an overall view of TCA cycle.
23. Where does electron transport system operative in mitochondria ? Explain the system giving the role of oxygen ?
24. Give a brief account of ATP molecules produced in aerobic respiration in eukaryotes.
25. Discuss The respiratory pathway is an amphibolic pathway.
26. Expand ETC, ETS and TCA.

**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 mark each)**

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.
9. The organic substances which is catabolised or broken down enzymatically in cellular respiration for releasing energy.
10. Fructose 1,6- biphosphate.
11. (i) Citric acid cycle      (ii) Tricarboxylic acid cycle
12. Oxaloacetate
13. Acetyl Co-A
14. Citrate
15. See text (Points to remember)

**Short Answers-II (2 marks each)**

16. Refer NCERT Text Book Chapter 14 (14.3 and 14.4).
17. (i) ATP molecules are formed by direct transfer of Pi to ADP.  
(ii) By oxidation of NADH.
18. Refer NCERT Text Book Chapter 14, Page 230.
19. Refer NCERT Text Book Page no. 236.
20. Refer NCERT Text Book Page no. 229 and page no. 230.
21. Refer NCERT Text Book Page no. 227.

**Short Answers-I (3 marks each)**

22. Refer NCERT Text Book, Fig. 14.3 Page no. 232.
23. Refer NCERT Text Book Page no. 232 and page no. 233.
24. Refer notes.
25. Refer NCERT Text Book Page no. 235.
26. See text (abbreviations).

**Long Answers (5 marks each)**

27. Refer NCERT Text Book Page no. 228 and page no. 229.

## Chapter-15

### PLANT GROWTH AND DEVELOPMENT

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#### POINTS TO REMEMBER

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**Seed Germination :** The seed germinates only when favourable conditions for growth exists in the environment. In absence of favourable conditions it goes into a period of suspended growth or rest, called dormancy.

**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. Some seeds undergo a period of dormancy and can germinate only after dormancy period gets over.

**Phytochrome :** A pigment, found in plants which control the light dependent developmental process.

**Phytohormone :** Chemicals secreted by plants in minute quantities which influence the physiological activities.

**Senescence :** 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, volume and weight of an organ or its parts or even of an individual.

**Quiescence :** Non germination of a viable seed due to non-availability of proper environmental conditions.

**Vivipary :** It is the germination of seed while its is still attached to the parent plant and is nourished by it. eg. Rhizophora and Sonneratia. As the germinating seed forms a seedling. It fall down into the mud due to increase in weights. In the mud, lateral roots develops for anchorage.



### 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

Seed Dormancy	Quiescence
It is the condition of seed when it is unable to germinate in spite of the availability of all environmental conditions suitable for germination.	The condition of a seed when it is unable to germinate because the condition for germination are not available.

**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, meristematic, elongation and maturation.

**(i) Meristematic zone :** New cell produced by mitotic 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 thickening 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
<b>In Arithmetic growth :</b> Only one daughter cell continues to divide mitotically while other differentiates and matures.	$L_t = L_0 + rt$ $L_t = \text{Length at time } t$ $L_0 = \text{Length at time zero}$ $r = \text{growth rate}$	Linear curve

<p><b>In geometrical growth :</b> The initial growth is slow (lag phase) and increase rapidly thereafter at an exponential rate (log phase).</p> <ul style="list-style-type: none"> <li>• Both the progeny cells divide mitotically and continue to do so. However, with limited nutrient supply, the growth slow down leading to stationary phase.</li> </ul>	$W_1 = W_0 e^{rt}$	Sigmoid or S-curve
	$W_1 =$ Final size	
	$W_0 =$ Initial size	
	$r =$ growth rate	
	$t =$ time of growth	
	$e =$ base of natural logarithms	

**Relative Growth :** The growth per unit time as percentage of initial size.

$$\text{RGR} = \frac{\text{Growth per unit time}}{\text{Initial size}} \times 100$$

**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 produce new cells that once again lose the capacity to divide but mature to perform specific functions.

**Conditions or factors influencing Growth**

1. Nutrition
2. Availability of water
3. Temperature
4. Oxygen
5. Light
6. Gravity
7. Stress factors like minerals, water or temperature etc.

**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 eg. (Indole 3- Acetic Acid 2, 4-D and 2, 4, 5-T etc.)	Apical dominance, cell elongation, prevent premature leaf and fruit falling, initiate rooting in stem cutting, as weedicide, induce parthenocarpy.

Gibberellins eg. $\left( \begin{array}{l} \text{GA}_3 \text{ (C}_{19}\text{H}_{22}\text{O}_6 \\ \text{GA}_4, \text{GA}_7, \text{GA}_{19} \text{ and} \\ \text{GA}_{20} \text{ etc.} \end{array} \right)$	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 eg. $\left( \begin{array}{l} \text{Zeatin (trans 6-purine} \\ \text{DMAA- Dimethylallyl} \\ \text{adenine and Isopentyl} \\ \text{adenine (IP) etc.} \end{array} \right)$	Promote cell division, induce cell enlargement, reduce apical dominance, induce growth in axillary bud, chlorophyll preservation, lateral shoot growth, adventitious root formation.
Ethylene ( $\text{H}_2\text{C}=\text{CH}_2$ )	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.
Absciscic acid (ABA) eg. $\left( \begin{array}{l} \text{Abscisin II} \\ \text{Dormin} \end{array} \right)$	Inhibit seed germination, stimulate closure of stomata, increase tolerance to various stress, induce dormancy in seed and bud, promotes ageing of leaf (senescence).
$\text{KMnO}_4$	can delay the ripening of stored fruits as it absorbs the ethylene.

Photoperiodism : The response of plant to the relative length of day and night period to induce flowering is called photoperiodism there are three basic categories of flowering plants.

- A) Short day Plants – The plants, which need short day light period for flowering than the critical length eg. Soyabean.
- B) Long day plants – The plants, which need long day, light period for flowering than a critical length. eg. spinach
- C) Day neutral Plants – Those plants flower through out the year and these are not affected by day length of the photoperiod.

eg. Tomato

## QUESTIONS

### Very Short Answer Questions (1 mark each)

1. Write the cause of 'Bakane' disease of rice.
2. Name the plant hormone which was first isolated from human urine.
3. Name the only gaseous plant hormone.
4. How does abscisic acid acts as stress hormone in drought condition ?
5. A farmer observed some broad-leaved weeds in a wheat crop farm. Which plant hormone would you suggest remove them ?
6. **Name the plant growth regulators you should use to (a) Increase the yield of sugarcane (b) Promote lateral growth (c) Cause sprouting of potato tuber (d) Inhibit seed germination.**
7. Why do lateral buds start developing into branches when apical bud is removed ?
8. Flowering in certain plant occur only when they are exposed to low temperature for a few weeks. Name this phenomenon.
9. Name the hormone released from over-ripe apples that affects all other apples in a small wooden box.

### Short Answer Questions-II (2 marks each)

10. How will you induce lateral branching in a plant which normally does not produce them ? Give reason.
11. What induces ethylene formation in plants ? Give any two different action of ethylene on plants.
12. What is meant by abscission ? Name the phytohormone involved in it.
13. What is meant by apical dominance ? Which hormone control it ?
14. Differentiate between photoperiodism and vernalisation.
15. **Name a hormone which is :  
(a) gaseous in nature (b) responsible for photo tropism (c) used for killing dicot weeds (d) Induces flowering in long day plants.**

**Short Answer Questions I (3 marks each)**

16. A primary root grows from 5 cm to 19 cm in a week. Calculate the growth rate and relative growth over the period.
17. Where are the following hormones synthesised in plants (a) IAA (b) Gibberellins (c) Cytokinins.
18. What would be expected to happen if :
- (a) GA<sub>3</sub> is applied to rice seedling.
  - (b) a rotten fruit get mixed with unripe fruits.
  - (c) you forget to add cytokinin to the culture medium.
19. Which growth hormone is responsible for the following :
- (a) induce rooting in a twig
  - (b) quick ripening of a fruit
  - (c) delay leaf senescence
  - (d) 'bolt' a rosette plant
  - (e) induce immediate stomatal closure in leaves (f) Induce growth in axillary buds
20. Define differentiation, dedifferentiation and redifferentiation.
21. Where are auxins generally produced in a plant ? Name any one naturally occurring plant auxin and any one synthetic auxin.
22. Define growth rate. Name two types of growth. Give the shape of curve for these growth.
23. Mention various parameter taken into consideration for measuring the growth.

**Long Answer Questions (5 marks each)**

24. Inlist the five categories of phytohormone. Write atleast two uses of each.

**ANSWERS**

**Very Short Answers (1 mark each)**

1. Gibberella fujikuroi.
2. Auxin
3. Ethylene

4. ABA causes rapid closure of stomata, preventing loss of water by transpiration.
5. 2,4-D
6. (a) Gibberellin (b) Cytokinin  
(c) Ethylene (d) Abscisic acid
7. Due to inhibit activity of Auxin lateral growth starts.
8. Vernalisation
9. Ethylene

**Short Answers-II (2 marks each)**

10. When apical bud is removed, lateral branches are produced. Removal of apical bud effect the auxin is destroyed inducing the lateral buds to grow rapidly.
11. Refer NCERT Book Page no. 250.
12. • Premature fall of leaf and fruit is called abscission.  
• Abscisic acid
13. Refer NCERT Text Book Page no. 250.
14. Refer NCERT Text Book Page no. 252.
15. (a) Ethylene ( $C_2H_4$ ) (b) Auxin (c) 2, 4-D (d) Gibberellin
16. (a) Growth =  $19 - 5 = 14$  cm, Period = 7 days  
 Growth rate =  $\frac{14}{7} = 2$  cm/day  
 (b) Initial growth =  $\frac{7}{5}$  cm  
 Growth rate per day =  $\frac{19 - 5}{7} = 2$  cm  
 Relative growth rate =  $\frac{2}{5} \times 100 = 40\%$
17. (a) 1AA = Shoot apex  
(b) Gibberellin – young leaves of buds, root tips  
(c) Cytokinins – Root apical meristan

**Short Answers-I (3 marks each)**

18. (a) Hyper elongation of internodes of rice seedlings will occur.  
(b) Unripe fruits will lead to early ripening and ultimately it will result in rotting.  
(c) Short but formation will not occur.
19. Refer NCERT Book.
20. Refer NCERT Text Book Page no. 245.
21. Refer NCERT Text Book Page no. 248.
22. Refer NCERT Text Book Page no. 242 and 243.
23. Refer NCERT Text Book Page no. 241.

**Long Answers (5 marks each)**

24. Refer NCERT Text Book Page no. 247-250.

# Chapter-16

## DIGESTION AND ABSORPTION

### POINTS TO REMEMBER

**Digestion :** The process in alimentary canal by which the complex food is converted mechanically and biochemically into simple substances suitable for absorption and assimilation.

**Food :** A substance which on taken and digested in the body provides materials for growth, repair, energy, reproduction, resistance from disease or regulation of body processes.

**Thecodont :** The teeth embedded in the sockets of the jaw bone. *e.g.*, in mammals.

**Diphyodont :** The teeth formed twice in life time *e.g.*, in mammals.

**Heterodont :** An adult human has 32 permanent teeth which are of four different types.

<b>Dental formula of man :</b>	$32 = 2 \times$	I	C	PM	M	
		2	1	2	3	Lower Jaw
		2	1	2	3	Upper Jaw

**Peristalsis :** The involuntary movement of the gut by which the food bolus is pushed forward.

**Deglutition :** The process of swallowing of food bolus. It is partly voluntary and partly involuntary.

**Ruminants :** The herbivours animals (*e.g.*, cow, buffalo etc.) which have symbiotic bacteria in the rumen of their stomach which synthesize enzymes to hydrolyse cellulose into short chains fatty acids.

**Diarrhoea :** The abnormal frequent discharge of semisolid or fluid faecal matter from the bowel.

**Vomitting :** The ejection of stomach contents through the mouth, caused by antiperistalsis.

**Dysentery :** Frequent watery stools often with blood and mucus and with pain, fever and causes dehydration.



**Chyme** : The semifluid mass into which food is converted by gastric secretion and which passes from the stomach into the small intestine.

Hepatic - Anything associated with liver is given a prefix 'hepatic'.

Gastric - Anything associated with stomach is given a prefix 'gastric'.

Proenzyme - The inactive forms of enzymes.

Sphincter - A flap like structure at various junctions of the alimentary canal which facilitates one way traffic in the alimentary canal.

Bolus - The masticated food mixed with saliva.

Goblet cells : The cells of intestinal mucosal epithelium which secrete mucus.

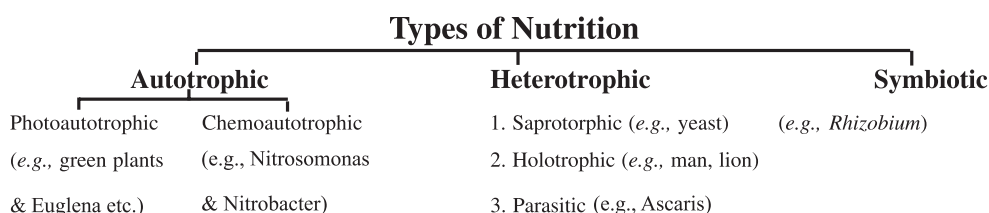
Glisson's capsule : The connective tissue sheath which covers the hepatic lobules of liver.

Hepatic lobules : The structural and functional units of liver containing hepatic cells which are arranged in the form of cords.

Sphincter of Oddi : The sphincter which guard the opening of common hepato-pancreatic duct.

Villi : The small finger-like folding in the innermost layer of the alimentary canal which increase the absorption surface area.

PEM : Protein Energy Malnutrition.



**Basic steps of Holozoic Nutrition :**

- (1) **Ingestion** : Intake of food.
- (2) **Digestion** : Breaking down of complex organic food materials into simpler, smaller soluble molecules.
- (3) **Absorption and assimilation** : Absorption of digested food into blood or lymph and its use in the body cells for synthesis of complex components.
- (4) **Egestion** : Elimination of undigested food as faeces.

### Digestive glands :

- (A) Salivary glands (found in mouth). Three types are : (i) Parotid, (Cheek)  
(ii) (Below the tongue) Sublingual, (iii) Submaxillary or sub-mandibular  
(lower jaw)

Secrete saliva which contains ptyalin (Salivary Amylase)

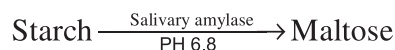
**(B) Pancreas :** Secretes pancreatic juice.

**(C) Liver :** Secretes bile.

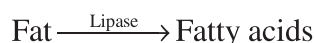
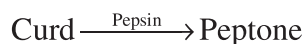
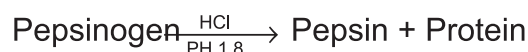
**(D) Gastric glands :** Secretes gastric juice.

**(E) Intestinal glands :** Secretes intestinal juice or succus entericus.

**Digestion in mouth :** Saliva contains enzyme Ptyalin. (Salivary Amylase)



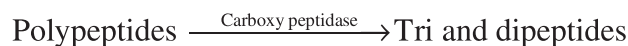
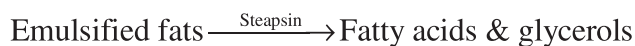
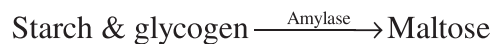
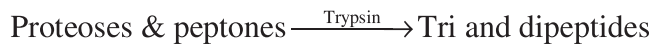
**Digestion in stomach :** Gastric juice contains HCl and enzymes pepsin, rennin and gastric lipase.



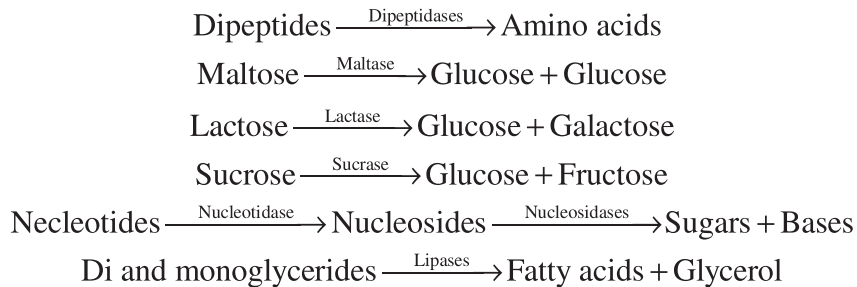
**Digestion in small intestine :** Liver secretes bile.



Pancreatic juice contains trypsin.



### Functions of succus entericus :



### QUESTIONS

#### Very Short Answer Questions (1 mark each)

1. What do you mean by the term malnutrition ?
2. Name the hardest substance in the body.
3. What is a lacteal ?
4. Name the small projections, found on the upper surface of tongue.
5. Mention the function of epiglottis.
6. Write the names of major parts of stomach.
7. Name the enzyme that digest fats. Mention the end products of fat digestion.
8. In which part of alimentary canal does absorption of water, simple sugars and alcohol takes place ?
9. Why are proteases generally released in inactive form ?
10. Trypsinogen is an inactive enzyme of pancreatic juice. An enzyme, enterokinase, activates it. Which tissue/cell secrete the enzyme ? How is it activated ?
11. What is the role of insulin ?

#### Short Answer Questions-II (2 marks each)

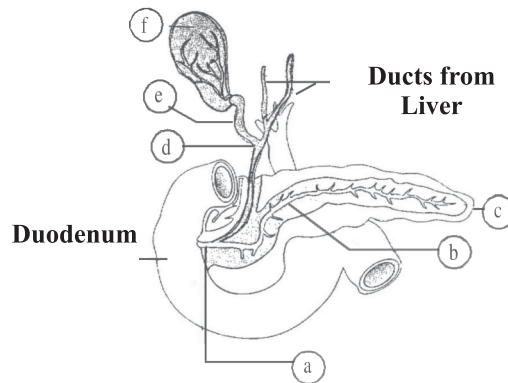
12. What is emulsification ? Where and how does it occur ?
13. Name three parts of large intestine. Which vestigial organ arises from the first part of it ?
14. Name the gland which perform/acts as exocrine and endocrine. Also name the products which are secreted by it.
15. The wall of alimentary canal is made up of four layers. Give the names of these four layers.

16. In which part of the digestive system the absorption of following substances takes place ?

- (a) Certain drugs (b) Glucose, fructose and fatty acids  
(c) Water, some minerals and drugs (d) Simple sugar and alcohol

Short Answer Questions-I (3 marks each)

17. In the following diagram of duct system of liver, gall bladder and pancreas, label a, b, c, d, e and f:



18. Give a diagrammatic representation of transverse section of gut.

19. Draw the sketch of anatomical regions of human stomach and label any four parts in it.

20. How does the nervous system control the activities of gastro-in-testinal tract?

Long Answer Questions (5 marks each)

21. Draw a labelled figure of digestive system of human.

22. Give a summary of cause and symptoms of following disorders of digestive system :

- (a) Jaundice (b) Vomiting  
(c) Diarrhoea (d) Constipation  
(e) Indigestion

## ANSWERS

Very Short Answers (1 mark)

1. The state of health due to improper intake of food or nutrients. It covers both undernutrition as well as overnutrition.
2. Enamel
3. Lymph vessel found in villi.
4. Papillae

5. Prevention the entry of food into the glottis.
6. Cardiac, fundic, pyloric.
7. Lipase, fatty acids and glycerol.
8. Stomach
9. If released in active form, they will start digesting the membranes and muscular walls of the alimentary canal.
10. Intestinal mucosa.



11. Metabolism of sugar

#### Short Answers Questions-II (2 marks)

12. The process of breakdown of large fat droplets into smaller ones. It occurs in small intestine. It is brought about by bile salts through reduction of surface tension of large fat droplets.
13. Caecum, colon and rectum. Vermiform appendix.
14. Pancreas. Exocrine secretion is pancreatic juice containing enzymes and exocrine secretions are hormones : insulin and glucagon.
15. Serosa, muscularis, submucosa and mucosa.
16. (a) Mouth (b) Small intestine (c) Large intestine (d) Stomach

#### Short Answers Questions-I (3 marks)

17. Refer Fig. 16.6, Page no. 261 (NCERT Text Book , Class XI Biology).
18. Refer Fig. 16.4, Page no. 260 (NCERT Text Book , Class XI Biology).
19. Refer Fig. 16.3, Page no. 259 (NCERT Text Book, Class XI Biology).
20. Refer page 264 (NCERT Text Book, Class XI- Biology)

#### Long Answers (5 marks)

21. Refer Fig. 16.1, Page no. 258 (NCERT Text Book, Class XI Biology).
22. Refer Page no. 265-266 (NCERT Text Book, Class XI Biology).

## Chapter-17

### BREATHING AND EXCHANGE OF GASES

#### POINTS TO REMEMBER

**Breathing :** (External respiration) The process of exchange of O<sub>2</sub> from the atmosphere with CO<sub>2</sub> produced by the cells.

**Inspiration :** Oxygen from fresh air taken by lungs and diffuses into the blood.

**Expiration :** CO<sub>2</sub> given up by venous blood in the lungs is sent out to exterior.

**Respiration :** The sum total of physical and chemical processes by which oxygen and carbohydrates (main food nutrient) etc are assimilated into the system and the oxidation products like carbon dioxide and water are given off.

**Diaphragm :** A muscular, membranous partition separating the thoracic cavity from the abdominal cavity.

**Partial Pressure :** The pressure contributed by an individual gas in a mixture of gases. It is represented as pO<sub>2</sub> for oxygen and pCO<sub>2</sub> for carbondioxide.

**Pharynx :** The tube or cavity which connects the mouth and nasal passages with oesophagus. It has three parts (i) Nasopharynx (anterior part) (ii) Oropharynx (middle part) and (iii) Laryngopharynx (posterior part which continues to larynx)

**Adam's Apple :** The projection formed by the thyroid cartilage and surrounds the larynx at the front of the neck.

**Tidal volume (TV) :** volume of air during normal respiration (500 mL.)

**Inspiratory Reserve Volume (IRV) :** Additional volume of air inspired by a forcible inspiration. 2500 mL to 3000 mL.

**Expiratory Reserve Volume (ERV) :** Additional volume of air, a person can expire by a forcible volume (RV) volume of air remaining in the lungs even after a forcible expiration (1100 mL to 1200 mL)

**PULMONARY CAPACITIES :** Use in clinical diagnosis.

Inspiratory capacity (IC) = (TV + IRV)

Expiratory Capacity (E.C) = (TV + ERV)

Functional Residual Capacity (FRC) = (ERV + RV)

Vital Capacity (VC) = ( ERV + TV + IRV ) or the maximum volume of air a person can breathe out after a forced inspiration.

Total Lung Capacity : It includes RV, ERV,TV and IRV or vital capacity + residual volume.

Pulmonary – Anything associated with the lungs is given the prefix ‘pulmonary’

Steps involved in respiration –

- (i) Breathing or pulmonary ventilation (intake of atmospheric air and releasing out CO<sub>2</sub> rich alveolar air)
- (ii) Diffusion of gases (O<sub>2</sub> and CO<sub>2</sub>) across alveolar membrane.
- (iii) Transport of gases by the blood
- (iv) Diffusion of O<sub>2</sub> and CO<sub>2</sub> between blood and tissues.
- (v) Utilisation of O<sub>2</sub> by the cells for catabolic reactions and resultant release of CO<sub>2</sub>.

### MECHANISM OF BREATHING

Inspiration :

If the pressure within the lungs (intrapulmonary pressure) is less than the atmospheric pressure, ie there is negative pressure in the lungs with respect to the atmospheric pressure.

- The contraction of diaphragm increases the volume of thoracic chamber in the antero-posterior axis.
- The contraction of external intercostal muscles lifts up the ribs and the sternum causing an increase in the volume of thoracic chamber in the dorso ventral axis.
- It causes an increase in pulmonary volume decrease the intra-pulmonary pressure to less than the atmospheric pressure.
- It forces the air out side to move in to the lungs, i.e, inspiration.

Expiration :

Relaxation of diaphragm and sternum to their normal positions and reduce the thoracic and pulmonary volume.

- It increases in intrapulmonary pressure slightly above the atmospheric pressure.
- It causes the expulsion of air from the lungs, i.e, expiration.

Inspiration	Expiration
<b>Contraction of diaphragm and external intercostal muscles</b> ↓ <b>Increase in the volume of thoracic chamber</b> ↓ <b>Lungs expand</b> ↓ <b>Pressure inside the lungs fall</b> ↓ <b>Air rushes in</b>	<b>Relaxation of diaphragm and sternum</b> ↓ <b>Decrease in the volume of thoracic chamber</b> ↓ <b>Lungs contract</b> ↓ <b>Pressure inside the lungs increase</b> ↓ <b>Air rushes out</b>

### Respiratory Tract :

A pair of external nostrils → nasal chamber through nasal passage → nasopharynx → glottis → larynx → trachea → Left and right primary bronchi → secondary and tertiary bronchi → bronchioles → vascularised bag like structures (alveoli) or air-sacs. Each lung is covered with double layered membrane known as pleura with pleural fluid between them.

### Respiratory organs in animals :

- (i) **General body surface** - Protozoans, annelids
- (ii) **Gills** - Fishes, tadpole stage of frog and many other aquatic animals.
- (iii) **Air bladder** - Bony fishes (Lung fishes)
- (iv) **Tracheae or Tracheal Tube** - Insects and a few other arthropods.
- (v) **Lungs** - All land vertebrates (amphibians, reptiles, aves and mammal)

**Intercostal muscles :** The muscles present between the ribs.

### Physiology of Respiration :

(a) **Exchange of gases** - Diffusion of gases takes place from the region of higher partial pressure to lower (lesser) partial pressure)

- (i)  $pO_2$  in alveolar air = 104 mm Hg.  
 $pO_2$  in venous blood = 40 mm Hg.  
 $O_2$  diffuses from alveoli to venous blood.

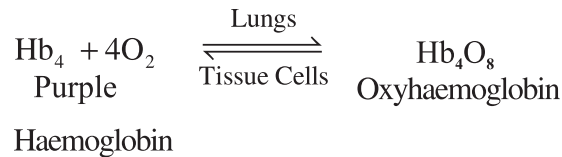


(ii)  $p\text{CO}_2$  in venous blood = 45 mm Hg.

$p\text{CO}_2$  in alveolar air = 40 mm Hg

$\text{CO}_2$  diffuses from venous blood to aveoli

(b) **Transport of  $\text{O}_2$  by the blood** - about 10% of  $\text{CO}_2$  forms caronic acid with water of plasma.



(c) **Transport of  $\text{CO}_2$  in the blood :-**



about 20% of  $\text{CO}_2$  is transported by combining with free amino group of Haemoglobin, in RBC.

70% of  $\text{CO}_2$  is transported as bicarbonates of sodium ( $\text{NaHCO}_3$ ) and potassium ( $\text{KHCO}_3$ )

### QUESTIONS

Very Short Answer Questions (1 mark each)

1. Name the organ in human respiratory system which produces sound.
2. How many oxygen molecules can be carried out by one haemoglobin molecule.
3. Give the name and function of a fluid filled double membranous layer which surrounds the lungs.
4. Which organ of our respiratory system acts as primary site of exchange of gases?
5. Cigarette smoking causes emphysema. give reason.
6. Name the principle of exchange of gases.
7. What is the role of oxyhaemoglobin after releasing molecular oxygen in the tissues?
8. Name the muscles which fascilitate breathing.
9. How is the entry of food prevented in the respiratory tract?
10. About 97% of  $\text{O}_2$  is transported by RBCs in the blood. How does the remaining 3% of  $\text{O}_2$  transported?

Short Answer Questions-II (2 marks each)

11. Draw a labelled diagram of a section of an alveolus with a pulmonary capillary.
12. Following is the table showing partial pressure (in mm Hg) of oxygen and carbondioxide) at different parts involved in diffusion in comparison to those in atmosphere. Fill in the blanks - a, b, c and d.

Respiratory gases	Atmospheric air	Alveoli	Blood (Deoxygenated)	Blood (Oxygenated)	Tissue
O <sub>2</sub>	Ⓐ	104	40	Ⓓ	40
CO <sub>2</sub>	0.3	Ⓑ	Ⓒ	40	45

13. Name the organs of respiration in the following organisms.  
a) Flatworms b) Birds c) Frog d) Cockroach
14. What are occupational respiratory disorders? What are their harmful effects? What precautions should a person take to prevent such disorders?

Short Answer Questions-I (3 marks each)

15. Explain the role of neural system in regulation of respiration in human.
16. Explain the neural control of respiration in human.

Long Answer Questions (5 marks each)

17. With the help of labelled diagram explain the structure of human respiratory system.
18. Explain the mechanism of breathing with the help of labelled diagram involving both stages - inspiration and expiration.
19. Explain the process of exchange of gases with the help of a diagrammatic representation in human respiratory system.

ANSWERS

Very Short Answers (1 mark each)

1. Larynx (Sound box)
2. Four molecules
3. Pleuron. It reduces the friction and keeps the two pleura together and the lungs inflated.
4. Alveoli of lungs.
5. Cigarette smoking damages alveolar walls due to alveolar sacs remaining filled with air leading to decreased respiratory surface for exchange of gases.
6. Diffusion.

7. Amino group of reduced haemoglobin combines with CO<sub>2</sub> forming carbaminohaemoglobin to transport CO<sub>2</sub>.
8. External and internal intercostal muscles, situated between ribs.
9. During swallowing a cartilaginous flap like structure called epiglottis covers the glottis and prevents the entry of food into respiratory tract.
10. In simple solution form through plasma.

Short Answers -II (2 marks each)

11. Refer fig 17.4, page 273 (NCERT Text Book Class XI Biology)
12. Refer Table 17.1 page 272 (NCERT Text Book Class XI Biology)
13. a) Body surface b) lungs c) skin and lungs d) Network of trachea
14. Refer page 276 (NCERT Text Book Class XI Biology)

Short Answers Questions-I (3 marks each)

15. Refer page 275 (17.5) (NCERT Text Book Class XI-Biology)
16. Refer content 17.5 regulation of respiration on page no. 275 (NCERT Text Book XI-Biology)

Long Answer (5 marks each)

17. Refer content 17.1.1 page 29, diagrams 17.1, page 29 (NCERT Text Book Class XI Biology)
18. Refer content 17.2 and fig 17.2 page No. 270-271 (NCERT Text Book Class XI Biology)
20. Refer content 17.3 and fig. 17.3 on page 272 - 273 (NCERT Text Book Class XI - Biology)

## Chapter -18

### BODY FLUIDS AND CIRCULATION

#### POINTS TO REMEMBER

**Blood :** A special connective tissue that circulates in principal vascular system of man and other vertebrates consisting of fluid matrix, plasma and formed elements.

**Plasma :** The liquid part of blood or lymph which is straw coloured, viscous fluid and contains about 90-92% of water and 6-8% proteins.

**Lymph :** A clear yellowish, slightly alkaline, coagulable fluid, containing white blood cells in a liquid resembling blood plasma.

**Heart Beat :** The rhythmic contraction and relaxation of the heart, which includes one systole (contraction phase) and one diastole (relaxation phase) of the heart. Heart beat count of healthy person is 72 times per minute.

**Cardiac output :** The amount of blood pumped by heart per minute is called cardiac or heart output. The value of cardiac output of a normal person is about  $72 \times 70 = 5040$  mL or about 5L per minute.

**Electrocardiograph :** (ECG) The machine used to record electrocardiogram.

**Electrocardiogram ECG :** The graphic record of the electric current produced by the excitation of the cardiac muscles. It is composed of a 'P' wave, 'QRS' wave (complex) and 'T' wave (Refer fig. 18.3, page 286 (for a standard ECG) (NCERT class XI - Biology)

#### Human Blood Corpuscles

Name and Number/ Percentage	Structure	Life Span and Formation	Function
(A) <u>Erythrocytes</u> <u>RBCs</u> - 4.5 to 5.5 million per cubic millimetre of blood	Red colour Circular, biconcave denucleated, elastic, lack of cell organelles like ER, ribosomes, mitochondria etc.	Formed from birth onwards by red bone marrow Life - 120 days excess RBCs are stored in spleen	Transport of oxygen and some amount of carbon dioxide through haemoglobin

(B) Leucocytes (WBCs) 5000-8000 per cubic mm of blood	Colourless, rounded or irregular, nucleated 12 to 20mm wide, life 1-4 days	Formed in red bone marrow, Lymph nodes, spleen and thymus	Acts as soldiers scavenger and some help in healing
(i) Agranulocytes			
(a) Lymphocytes 20-45% of leucocytes	Large rounded nucleus, 6-10 mm	Lymph nodes, spleen, thymus red bone marrow, life few days to months or even years	Non Phagocytic secrete antibodies
(b) Monocytes 6-8% leucocytes	Largest of all (12-15 mm) bean shaped nucleus	Red Bone marrow, life 10-20 hours	phagocytic, very motiles engulf germs
(ii) Granulocytes			
(a) Eosinophils 2-3% of leucocytes	bilobed nucleus, granules in cytoplasm	Red Bone marrow, life 4 to 8 hrs in blood	play role in immunity nonphagocytic
(b) Basophils 0-5% of leucocytes	Three lobed nucleus (s-shaped)	Red Bone marrow, life 4 to 8 hours in blood	release heparin and histamine
(c) Neutrophils 60-65% of leucocytes	Many lobed nucleus fine granules	Red Bone marrow, life 4 to 8 hours in blood	phogocytic, engulf germ and dead cells
(C) Platelets thrombocytes 1,50,000 - 3,50,000 mm <sup>3</sup> of blood	Colourless, rounded or oval, or irregular non-nucleated fragments	Red Bone marrow worn out ones phagocytized in blood	help in blood clotting

Refer fig. 18.1, page 279 (NECRT Text Book Class XI - Biology)

**Blood Pressure** - The resistance offered by the lumen of the artery to the flow of Blood.

**Cardiac Cycle** : The rhythmic contraction and delation of different parts of heart in one beat.

**Hypertension** : The condition when blood pressure is more than normal

**Systole** : Construction of heart muscles

**Diastole** : Dilation of heart muscles.

## Lymph

The colourless mobile fluid connective tissue drains into the lymphatic capillaries from the intercellular spaces.

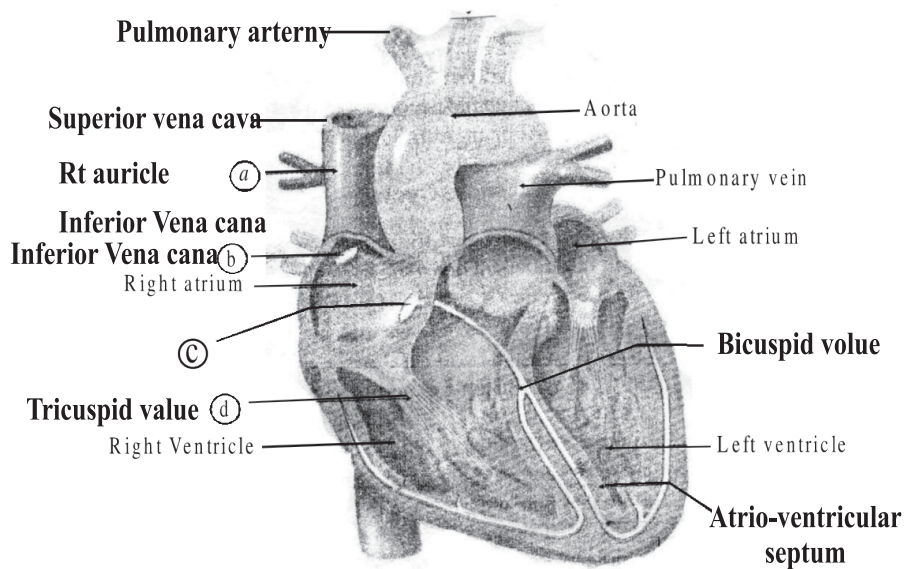
**Composition** :

It is composed of fluid matrix, plasma, white blood corpuscles or leucocytes.

**Functions** :

- (i) It drains excess tissue fluid from extra cellular spaces back into the blood.
- (ii) It contain lymphocytes and antibodies.
- (iii) It transports digested fats.

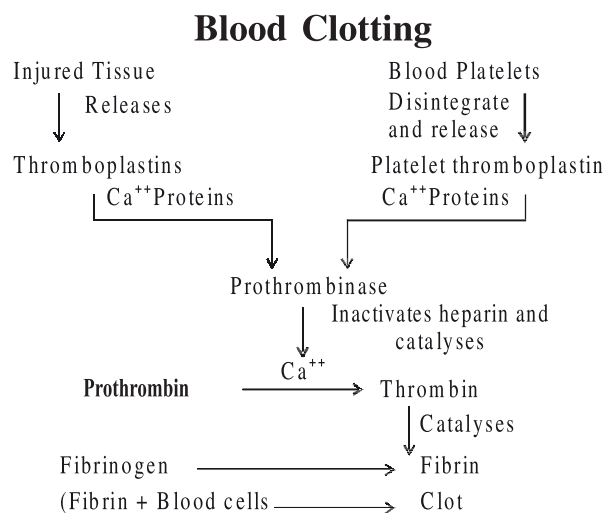
## Human Heart



- It is the mesodermally derived organ situated in thoracic cavity in between the two lungs. Protected by pericardium.
- Four chambers - two (left and right) atria, and two ventricles (left and right)
- Inner- atrial septum separates the two atria and inter ventricular septum separates the two ventricles, while the atria & ventricles are separated by atrioventricular septum.
- The valves between right atrium and right ventricle is tricuspid while between left atrium and ventricle is bicuspid or mitral valve.
- The openings of the right and the left ventricles into the pulmonary artery and the aorta are guarded by semilunar valves.
- The valves allow the flow of blood only in one direction, i.e., from atria to ventricles and from ventricles to pulmonary artery or aorta.

## Functions of Blood

Transport of food, respiratory gases (O<sub>2</sub> and CO<sub>2</sub>), hormones, metabolic intermediates, waste products, supply of raw materials, regulation of water balance, regulation of pH and body temperature, and provides immunity.



## Blood Groups

Blood Group	Antigen (on the Surface of R.B.Cs)	Anti body (In plasma)	Possible recipients having blood group	Possible donors having blood group	Remarks
A	A	Anti B	A, AB	O, A	–
B	B	Anti A	B, AB	O, B,	–
AB	A and B	None	AB	O, A, B, AB	Universal recipients
O	None	Anti A and anti B	O, A, B, AB	O	Donor

### **Rh (Rhesus) Group :**

Discovered by Landsteiner and Wiener in 1940. The antigen found on the surface of RBCs. The presence of this antigen is termed as Rh - positive (Rh+) and its absence as (Rh–). It plays a crucial role in child's birth born out of a marriage between Rh– woman and Rh+ man, causing to produce anti Rh antibodies.

→ **SAN (Sino - artrial node) :** A patch of tissues present in the right upper corner of the right atrium, acts as pacemaker due to having a unique property of self excitation.

→ **AVN (Atrio Ventricular Node) :** A mass of tissues seen in the lower left corner of the right atrium close to the atrio-ventricular septum. Fresh wave of contraction generated here, passes over both the ventricles simultaneously along the bundle of his.

### **Heart Valves**

**Tricuspid Valve :** The valves formed of three muscular flaps or cups, which guard the opening between the right atrium and the right ventricle.

### **Bicuspid Valve (Mitral Valve) :**

The valves which guard the opening between the left atrium and the left ventricle, made up of two flaps.

**Semilunar Valves :** The valves present at the opening of the right and the left ventricles and allow the entry of blood into pulmonary artery and the aorta respectively.

**Reading of ECG :** 'P' Wave represents the electrical excitation (or depolarisation) of the atria and leads to the contraction of both the atria.

**'QRS' complex :** represents the depolarisation of the ventricles, which initiates the ventricular contraction.

**'T' Wave :** represents the return of the ventricles from excited to normal state (repolarisation). The end of T-wave marks the end of systole.



**Double circulation :** The passage of same blood twice through heart in order to complete one cycle. eg.

- (i) The blood pumped by the right ventricle (deoxygenated blood) is transported through pulmonary artery to lungs where CO<sub>2</sub> is exchanged with O<sub>2</sub> through diffusion and returns back to the heart through pulmonary vein.
- (ii) The oxygenated blood from left ventricle is transported through aorta to different body parts (cells and tissues) where O<sub>2</sub> is exchanged with CO<sub>2</sub> through diffusion and then returned back to the heart through vena-cava.

### Disorders of circulatory System

**Hypertension (High Blood Pressure) :** It results from narrowing of arterial lumen and reduced elasticity of arterial walls in old age. It can cause rupturing of capillaries. It is a silent killer.

**Coronary Artery Disease :** (CAD) Atherosclerosis The supply of the blood to heart muscles is affected. It is caused by deposits of Calcium, fat, cholesterol and fibrous tissues to make the lumen of arteries narrower.

**Angina Pectoris :** Caused due to arteriosclerosis, when not enough oxygen is reaching the heart muscle due to which the person experiences acute chest pain.

**Heart attack :** Caused when the heart muscle is suddenly damaged by an inadequate blood supply.

**Cardiac arrest :** The state in which the heart stops beating.

**Arteriosclerosis :** The state of hardening of arteries and arterioles due to thickening of the fibrous tissue and consequent loss of elasticity. It causes hypertension.

### QUESTIONS

Very Short Answer Questions (1 mark each)

1. Name the instrument used for measuring blood pressure.
2. What is a pace-maker?
3. Why is the SA node called pace-maker of the heart?
4. Write the full form of SA node.
5. What is lymph node?
6. A cardiologist observed an enlarged QRS wave in the ECG of a patient. What does it indicate?
7. Name the enzyme that catalyses the formation of carbonic acid in erythrocytes.
8. What is systemic circulation?

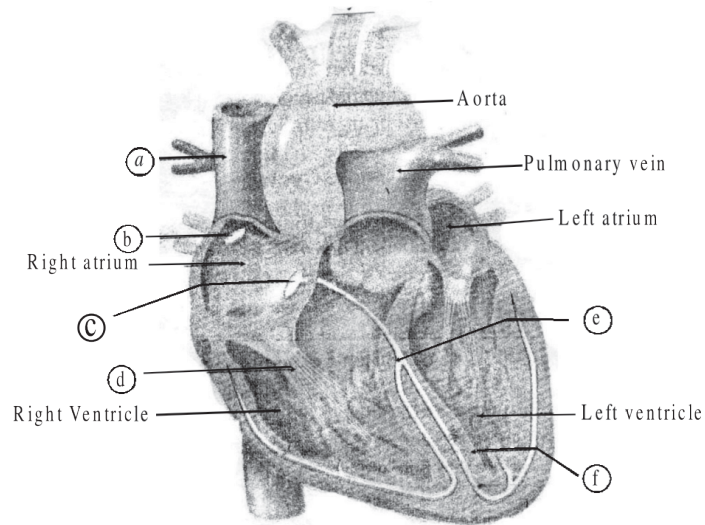
9. Give two examples of extra-cellular fluids.
10. What name is given to the blood vessels which generally bring blood to an organ?
11. Which adrenal hormone accelerates the heart beat under normal conditions.
12. Name the blood vessel that carries blood from the intestine to liver.
13. Define cardiac cycle.
14. Name the protein found in RBCs.
15. What happens to a person suffering from haemophilia

Short Answer Questions-II (2 marks each)

16. Explain when and how the two sounds of heart are produced ?
17. Define joint diastole. What are the constituents of the conducting system of human heart?
18. Give the names of various types of formed elements present in the blood.

Short Answer Questions-I (3 marks each)

19. Draw a diagram showing schematic plan of blood circulation in human.
20. In the following diagram of section of a human heart, label a, b, c, d, e and f.



21. What is lymph? Describe its circulation in brief.
22. What is stroke volume? What is its relation with cardiac output?
23. A person suffering from fever is advised to take blood test. What may happen to his WBC count and why?

Long Answer Questions (5 marks each)

24. Draw a diagram to show the internal structure of human heart. Label any two heart chambers, any two heart valves and chordae tendinae in it.
25. Describe the structure of human heart.
26. What is cardiac cycle? Describe the event that occurs during it.
27. Explain Rh grouping and its incompatibility in humans.

### ANSWERS

#### Very Short Answers (1 mark each)

1. Sphygmomanometer.
2. A patch of modified heart muscle that initiates a wave of contraction.
3. SA node being self excitatory, initiates a wave of contraction in the heart.
4. Sinu Auricular Node (pace-maker)
5. A lymph node is specialised structure in lymphatic vessel concerned with the filtration of foreign bodies by the lymphocytes.
6. QRS wave denotes ventricular contraction of heart which may be normal or abnormal.
7. Carbonic anhydrase.
8. The kind of blood circulation that is concerned with the supply of oxygenated blood from the left ventricle to all body parts and return of oxygenated blood to the right atrium of heart.
9. Interstitial fluid and blood plasma.
10. Afferent blood vessel.
11. Noradrenalin.
12. Hepatic portal vein.
13. A regular sequence of three events (i) auricular systole (ii) ventricular systole and  
(iii) Joint diastole during the completion of one heart beat.
14. Haemoglobin
15. The person suffering from haemophilia lacks clotting factors in blood, which result the defective clotting mechanism. In case of injury the person is at a risk of blood loss.

#### **Short Answers-II (2 marks each)**

16. (i) 'Lubb' the first sound which is low pitched, is caused by the closure of bicuspid and tricuspid valves.  
(ii) 'Dup' the second sound which is high pitched, is caused by the closure of semilunar valves.
17. In a cardiac cycle when both atria and ventricles are in a diastole and are relaxed simultaneously is called a joint diastole.  
Conducting system constitutes : SA node ® AV node ® Bundle of His ® Purkinje fibres.
18. Erythrocytes, Lymphocytes, monocytes, neutrophils, eosinophils, basophils and platelets.

**Short Answers-I (3 marks each)**

19. Refer fig. 18.4, page 287 (NCERT Text Book Class XI - Biology)
20. Refer fig. 18.2, page 283 (NCERT Text Book Class XI - Biology)
21. Refer content 18.2, page 282 (NCERT Text Book Class XI - Biology)
22. During one cardiac cycle or one heart beat the volume of blood pumped by the heart is called stroke volume. This is normally 70 mL.  
In one minute the heart beats about 72 times and the amount of blood pumped per minute is called cardiac output. This is usually 4900 mL. or 5 litres.
23. The WBC count of this person may show an increase from the normal range. As pathogens may be present in his body, so the body is producing more WBCs to fight against those pathogens. WBC count is a good tool to assess the presence of infection in a sick person.

Long Answer (5 marks)

24. Refer fig. 18.2, page 283 (NCERT Text Book Class XI - Biology)
25. Refer content 18.3.1, page 283 (NCERT Text Book Class XI - Biology)
26. Refer content 18.3.2, page 284 (NCERT Text Book Class XI - Biology)
27. Refer content 18.1.3.2, page 281 (NCERT Text Book Class XI - Biology)

## Chapter -19

# EXCRETORY PRODUCTS AND THEIR ELIMINATION

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### POINTS TO REMEMBER

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#### **Ammonotelism :**

The animals which excrete ammonia are called ammonotelic and excretion of ammonia is known as ammonotelism eg Amoeba, sycon, hydra, liver fluke, tape-worm, Leech, Prawn, bony fishes etc.

#### **Ureotelism :**

Excretion of urea is known as ureotelism and the animals which excrete urea are ureotelic animals eg. mammals, many terrestrial amphibians and marine fishes and sting rays etc.

#### **Uricotelism :**

Excretion of uric-acid is known as uricotelism and the animals are called uricotelic eg. most insects, land snails, lizards, snakes and birds.

#### **Nephrons :**

The structural and functional unit of kidneys. Each kidney contains about one million of nephrons.

#### **Structure of Nephron :**

A nephron consists of Glomerulus, Bowman's capsule, PCT (Proximal convoluted tubule). JG A (Juxtaglomerular Apparatus) and the collecting duct. (Refer fig., 19.3, page 292 (NCERT Text Book of Biology for Class XI)

#### **Structure of Kidney :**

Size 10-12 cm in length, 5-7 cm in width, 2-3 cm thick, average weight about 120-170 g

- The blood vessels, ureter and nerves enter in the kidney through hilum (a notch).
- The outer layer is a tough capsule.
- The outer zone of Kidney is cortex and the inner is medulla.

- The medulla is divided into few conical masses (medullary pyramids) projecting into calyces.
- The cortex extends between medullary pyramids called columns of Bertini.  
Refer figure 19.2, page 292 (NCERT - Class XI Biology)

### **Glomerular Filtration :**

The filtration of blood in glomerulus, about 1100-1200 ml of blood is filtered by the kidney per minute.

### **Glomerular Filtration Rate (GFR) :**

The amount of filtrate formed by the kidney per minute. In a healthy individual it is about 125 ml/minute, ie 180 litres per day.

### **Types of Nephrons :**

(i) **Juxtamedullary Nephron** - about 15% of total nephrons, Glomeruli are found in inner region of cortex, large in size, long loop of Henle and found deep in medulla, associated with vasa recta, control plasma volume when water supply is short.

(ii) **Cortical Nephron** - About 25% of total nephron mainly lie in renal cortex, glomeruli found in outer cortex, short loop of Henle, extends very little in medulla. They do not have vasa recta.

### **Functions of Tubules :**

(i) **PCT** - absorption of all essential nutrients and 70-80% of electrolytes and water, helps to maintain the pH and ionic balance of body fluids by selective secretion of  $H^+$ , ammonia and  $K^+$  into filtrate.

(ii) **Henle's Loop** - reabsorption in this segment is minimum, it plays a significant role in maintenance of higher molarity of medullary interstitial fluid.

(iii) **DCT** - conditional reabsorption of  $Na^+$  and water takes place here, reabsorption of  $HCO_3^-$  and selective secretion of  $H^+$  and  $K^+$  and ammonia to maintain the pH and sodium-potassium balance in blood.

(iv) **Collecting duct** - Large amount of water is absorbed from this region to produce concentrated urine, it plays a role in maintenance of pH and ionic balance of blood by selective secretion of  $H^+$  and  $K^+$  ions.

### **Mechanism of concentration of the Filtrate (Countercurrent Mechanism) :**

Refer fig 19.6 page 296 (NCERT - Class XI Biology)

- This mechanism is said to be countercurrent mechanism because the out flow (in the ascending limb) runs parallel to and in the opposite direction of the inflow (in the descending limb).
- NaCl is transported by the ascending limb of Henle's loop which is exchanged with the descending limb of **vasa-recta**.
- NaCl is returned to the interstitium by the ascending portion of **vasa recta**.
- Henle's loop and **vasa-recta** as well as the counter current in them help to maintain an increasing osmolarity towards the inner medullary interstitium ie from 300 mOsmol/L in cortex to about 1200 mOsmol/L in inner medulla.
- Small amount of urea enter the thin segment of ascending limb of Henle's loop which is transported back to the interstitium by the collecting tubule.
- This mechanism helps to maintain a concentration gradient in the medullary tubule interstitium.
- It helps in an easy passage of water from the collecting tubule to concentrate the filtrate i.e. urine.

#### **Micturition :**

The expulsion of urine from the urinary bladder. It is a reflex process but can be controlled voluntarily to some extent in grown up children and adults.

- The CNS (Central Nervous System) sends the signal which cause the stretching of the urinary bladder when it gets filled with urine.
- In response, the stretch receptors on the walls of the bladder sends signals to the CNS.
- The CNS passes on motor message to initiate the contraction of smooth muscles of the bladder and simultaneous relaxation of the urethral sphincter causing the release of urine.
- An adult human excretes on an average 1 to 1.5 litres of urine per day.
- On an average 25-30 gram of urea is excreted out per day.

#### **Role of other organs in excretion :**

- **Lungs** - removes  $\text{CO}_2$  (18L/day) and water.
- **Liver** - secretes bilirubin, biliverdin etc. helps to eliminate these substances alongwith cholesterol, vitamins, drugs and degraded steroid hormones through digestive wastes.

- **Sweat and sebaceous glands** - These glands of skin help to eliminate small amount of urea, NaCl and lactic acid etc. through sweat while sebaceous glands help to eliminate some substances like steroids, hydrocarbons and waxes through sebum.
- **Saliva** - It can help to eliminate small amount of nitrogenous wastes.

#### **Disorders of Excretory system :**

- **Uremia** - The accumulation of urea in blood due to malfunctioning of kidney.
- **Hemodialysis** - The process of removal of urea from the blood artificially. In this process the blood from an artery is passed into dialysing unit after adding an anticoagulant like heparin. The blood passes through coiled cellophane tube surrounding by dialysing fluid. The nitrogenous wastes from the concentration gradient and the blood becomes clear. This blood is pumped back to the body through vein after adding anti-heparin to it.
- **Renal calculi** - The formation of insoluble mass of crystallised salts (oxalates or phosphates of calcium).
- **Glomerulonephritis** - Inflammation of glomeruli of kidney.

### QUESTIONS

#### **Very Short Answer Questions (1 mark each)**

1. Which gland **secretes** sebum?
2. One part of loop of Henle is impermeable to water. Name it.
3. Besides water, name any two constituents of human sweat.
4. Explain the function of vasa rectae.
5. Name two types of nephrons found in human kidney.
6. Define GFR (Glomerular Filtration Rate)
7. The mechanism of concentration of filtrate is also known as counter current mechanism. Justify the statement.
8. What is micturition?
9. Write the function of enzyme 'renin' produced by kidney.
10. Name the excretory product of (i) reptiles (ii) Prawns.

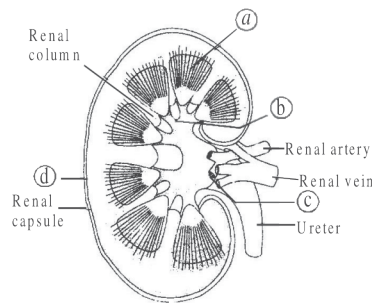


**Short Answer Questions-II (2 marks each)**

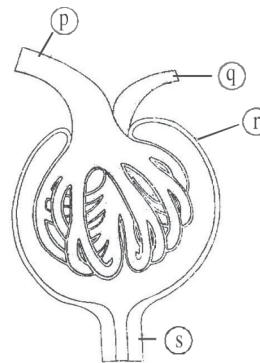
11. Mark the odd ones in each of the following -

- (a) Renal pelvis, medullary pyramid, renal cortex, ureter.
- (b) Afferent arteriole, Henle's loop, vasa recta, efferent arteriole.
- (c) Glomerular filtration, antidiuretic hormone, hypertonic urine, collecting duct.
- (d) Proximal convoluted tubule, distal convoluted tubule, Henle's loop renal corpuscle.

12. In the following diagram of longitudinal section of kidney (Fig.-1) identify and label a, b, c and d respectively.



(Fig.-1)



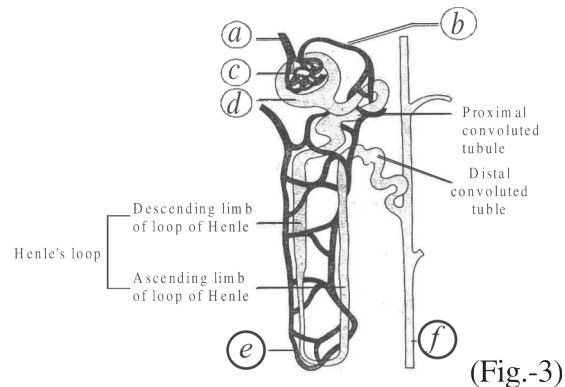
(Fig.-2)

13. In the diagram (Fig-2) showing malpighian body (renal corpuscle) identify and label p, q, r, s.

14. Name two metabolic disorders which can be diagnosed by the analysis of urine.

**Short Answer Questions-I (3 marks each)**

15. In the following diagram (Fig.-3) showing structure of a nephron label a, b, c, d, e and f.



(Fig.-3)

16. Describe the hormonal feed back circuit in controlling the renal functions.
17. Give three points of difference between rennin and Renin.
18. What are Ammonotelic, ureotelic and Uricotelic animals.? Give on example of each type of these.

**Long Answer Questions (5 marks each)**

19. Draw a labelled diagram of human uninary system and write one function of of each adrenal gland, ureter, urinary bladder kidney and urethra.
20. Describe how urine is formed in the nephron through filtration reabsorption and secretion.

**OR**

Explain the steps involved in the process of urine formation.

21. Distinsguish between (i) Uricotelism and Ureotelism (ii) Sebum and sweat (iii) Proximal and distal convoluted tubules (iv) Ascending and descending limbs of Henle's loop (v) Cortical and Medullary nephrons.
22. Explain the function of different tubules of nephron.

**OR**

Explain the process of reabsorption and secretion of major substances at different parts of nephron with the help of schematic diagram.

**ANSWERS**

**Very Short Answers (1 mark each)**

1. Sebaceous glands (wax - glands)
2. Ascending limb
3. Sodium chloride, lactic acid, glucose (any two).
4. It helps to retain reabsorbed ions and urea in the interstitial fluid of the medulla, to maintain its high osmotic pressure.
5. (i) Juxta medullary nephron (ii) Cortical nephron
6. The amount of filtrate formed by the kidney per minute.
7. (in the ascending limb) the out flow runs parallel to and in the opposite direction of the inflow in the descending limb.

8. The act of passing out urine from urinary bladder.
9. Renin is used to convert angiotensinogen to angiotensin.
10. (i) Uric acid (ii) Ammonia

**Short Answers -II (2 marks each)**

11. (a) Ureter (b) Henle's loop (c) Glomerular filtration (d) Renal Corpuscle.
12. Refer fig 19.2, page 292 (NCERT Class XI - Biology)
13. Refer fig. 19.4, page 293 (NCERT class XI - Biology)
14. Glycosuria, Ketonuria

**Short Answers -I (3 marks each)**

15. Refer fig. 19.3, page 292, (NCERT class XI - Biology)
16. Refer content 19.5, page 297 (NCERT class XI - Biology).

<b>Rennin</b>	<b>Renin</b>
17. (i) It is a proteolytic enzyme (ii) It helps in the digestion of milk protein caesin (iii) It is secreted as an inactive form Prorennin which is activated to rennin by HCl. (iv) Its secretion is stimulated by food.	(i) It is a hormone that acts as an enzyme. (ii) It converts the protein angiotensinogen into angiotensin (iii) It is secreted as renin (iv) Its secretion is stimulated by a reduction of $\text{Na}^+$ level in tissue fluid. (----- any three)

18. Refer content given in the begining of the capter or NCERT Text Book page 290 class XI - Biology

**Long Answer (5 marks each)**

19. Refer fig 19.1, page 291 and content 19.1 (NCERT Text Book page Class XI - Biology)
20. Refer content given in the chapter or 19.2, page 293 (NCERT Text Book page Class XI - Biology)
21. Refer the content given in the chapter or NCERT Text Book Class - XI Biology at pages 290, 298 (19.7), 292 and 293 respectively.
22. Refer content 19.3 and content 19.5 at page 294-295 (NCERT Text Book Class XI - Biology)

## Chapter-20

### LOCOMOTION AND MOVEMENT

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#### POINTS TO REMEMBER

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**Arthritis :** an inflammatory joint disease characterised by inflammation of joints.

**Coccyx :** tail bone formed by fusion of four coccygeal vertebrae in man.

**Dicondylic Skull :** A Skull with two occipital condyles.

**Endo Skeleton :** A skeleton present inside the body.

**Fascicule :** Bundles of muscles fibres held together by connective tissue.

**Fascia :** Collagenous connective tissue layer that surrounds muscle bundles.

**Floating ribs :** The ribs that remain free anteriorly. **(last 2 pairs)**

**False ribs :** The ribs whose sternal part are join to sternal part of a true rib.

**Myoglobin :** A red coloured pigment present in sarcoplasm of muscle.

**Sarcomere** A portion of myofibril between two successive 'Z' lines.

**Sarcocolema :** The plasma membrane of a muscle.

**Gout :** Inflammation of joints due to accumulation of uric acid crystal.

**Suture :** immovable joints between skull bones.

**Synovial joints :** Freely movable joints between limb bones.

**Patella :** A sesamoid bone acting as kneecap

**Intervertebral disc :** Fibro carti lagenous pad present between the vertebrae **that** act as shock absorbers.

L.M.M. : Light meromyosin

HMM : Heavy meromyosin

### **Types of Movement :**

**1. Amoeboid movement :** These movement takes place in phagocytes where leucocytes and macrophages migrate through tissue. It is affected by pseudopodia formed by the streaming of protoplasm (as in amoeba)

**2. Ciliary movement :** These movement occurs in internal organs which are lined by ciliary epithelium.

**3. Muscular Movement :** This movement involve the muscle fibers, which have the ability to contract and relax.

**Properties of Muscle :** (i) Excitability                      (ii) Contractility  
(iii) Extensibility                      (iv) Elasticity

### **Types of Muscles :**

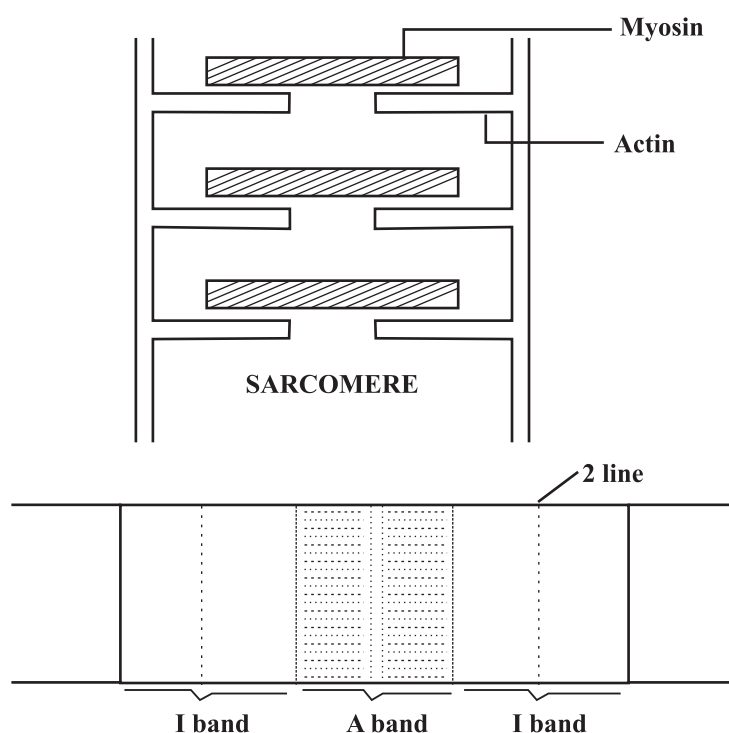
- (a) **Skeletal muscles or striated muscles** - These involved in locomotion and change of body postures. These are also known as voluntary muscles.
- (b) **Visceral muscles or smooth muscles** - These are located in inner wall of hollow visceral organ, smooth in appearance and their activity are not under control of nervous system.
- (c) **Cardiac muscles** - The muscles of heart, involuntary in nature, striated and branched, These are uninucleated.

### **Structure of myofibril :**

- Each myofibril consist of alternate dark and light band.
- Dark band - contain myosin protein and is called A-band or Anisotropic band.
- Light band - Contain actin protein and is called I Band or Isotropic band.

- I Band is bisected by an elastic fiber called 'Z' line. Actin filament (thin filament) are firmly attached to the 'Z' lines.
- Myosin filament (thick filament) in the 'A' Band are also held together in the middle of 'I' Band by thin fibrous membrane called 'M' line.
- The portion between two successive 'Z' lines is considered as functional unit of contraction and is called a sarcomere.

### STRUCTURE OF ACTIN AND MYOSIN FLAMENT



1. Actin filament : An actin filament is made of two 'F' actins which are helically wound to each other. Two filaments of tropo myosin protien also run close to 'F' actins throughout its lenth. A complex protien Troponin is distributed at regular intervals on tropomyosin which mask the actin binding site for myosin
2. Myosin filament : Each myosin filament is a polymer of meromyosin. Each meromyosin has two components – a globular head with a short arm and a tail. Head is made of heavy moromyosin while tain is made of light meromyosin. The head with its short arm project outward at regular distance and angle from each other and is known as cross arm. The head has an active site for actin and binding site for ATP.

Red muscle fibres :

- There are red in colour due to presence of high content of myoglobin.
- These contain plenty of mitochondria
- Sarcoplasmic reticulum is less in these fibres.

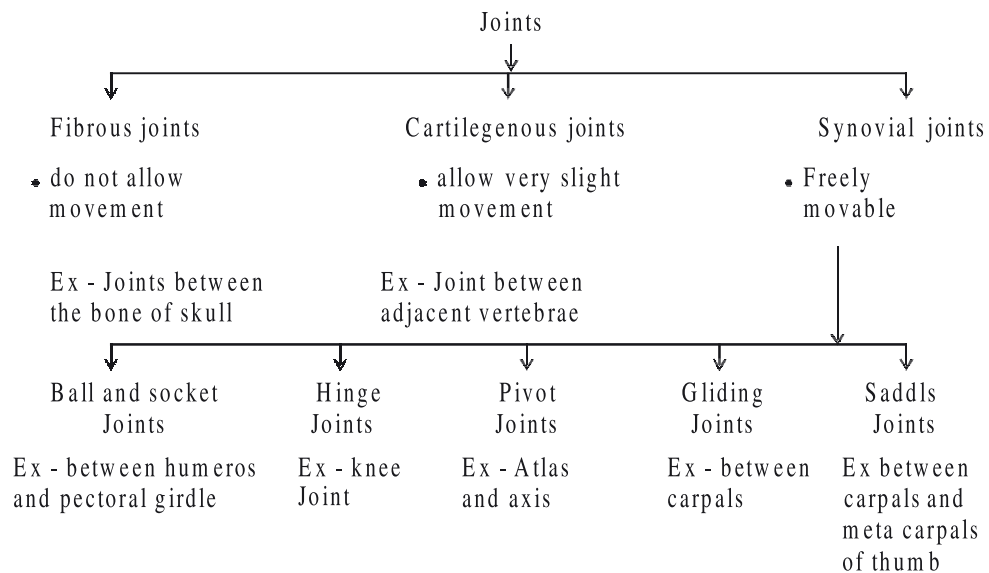
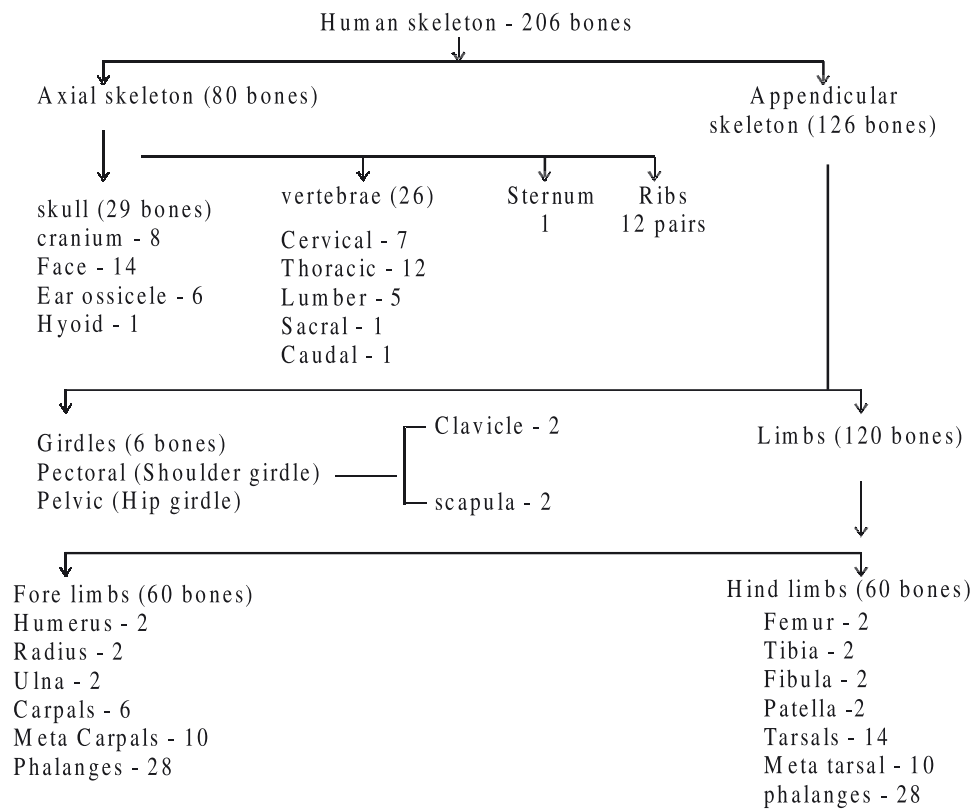
White muscle fibres :

- These are pale or whitish due to presence of less content of myoglobin.
- These contain fewer mitochondria
- Sarcoplasmic reticulum is more/high

**Mechanism of Muscle contraction :** Sliding filament theory.

The contraction of muscle fiber takes place by the sliding of actin (thin filament) on myosin (thick filament).

- Muscle contraction is initiated by a signal sent by the CNS via a motor neuron.
- Impulse from motor nerve stimulates a muscle fiber at neuro muscular junctions.
- Neurotransmitter releases here which generates an action potential in sarcolemma.
- These causes release of  $Ca^{++}$  into sarcoplasm. These  $Ca^{++}$  binds with troponin, thereby remove masking of active site.
- Myosin head binds to exposed active site on actin to form a cross bridge, utilising energy from ATP hydrolysis.
- This pulls the actin filament towards the centre of 'A' band.
- 'Z' lines also pulled inward thereby causing a shortening of sarcomere i.e. contraction.
- 'I' band get reduced, whereas the 'A' band retain the length.
- During relaxation, the cross bridge between the actin and myosin break.  $Ca^{++}$  pumped back to sarcoplasmic cisternae. Actin filament slide out of 'A' band and length of 'I' band increases. This returns the muscle to its original state.





## QUESTIONS

### Very Short Answer Questions (1 mark each)

1. How many bones are present in each limb?
2. Why do skeletal muscle show striation?
3. Name last two pairs of ribs.
4. Write the name of chemical that causes fatigue in the muscles.
6. What lubricate the freely movable joints at the shoulder?
7. Name of longest bone of human body.
8. Give the first vertebra.
9. Define a sarcomere.
10. Name the cup shaped bone that constitutes the knee cap.

### Short Answer Questions-II (2 marks each)

11. Write any two differences between cardiac muscle and skeletal muscle.
12. Distinguish between red fibre and white fiber.
13. Name the two types of girdles found in human body and write their role.
14. State the role of calcium ions and ATP in muscle contraction.
15. Name the bones of fore limb (hand) of human body. Give their number in each limb.

### Short Answer Questions-I (3 marks each)

16. What makes the synovial joints freely movable? List any four types of synovial joints.
17. Name the category of bones forming the ribcage. How are these articulated to each other to form the cage?
18. How are actin and myosin filaments arranged in a muscle fibre?
19. Mention the factor which is responsible for the following :
  - (i) Tetany
  - (ii) Gout
  - (iii) osteoporosis

### Long Answer Questions (5 marks each)

20. Explain the important steps of sliding filament theory of muscle contraction.

## ANSWERS

### Very Short Answers (1 mark)

1. 30 bones.
2. Due to distribution pattern of actin and myosin protein.
3. Floating ribs.
4. Actin and myosin
5. Lactic acid
6. Synovial fluid
7. Femur
8. Atlas
9. A portion of myofibril between two successive 'Z' lines.
10. Knee cap

### Short Answers -II (2 marks)

11. Refer NCERT Text book Class XI Page 303.
12. Refer Points to remember
13. Refer NCERT Text book Class XI Page 311.
14. Refer NCERT Text book Class XI Page 307 and 308.
15. Refer Points to remember

### Short Answers -I (3 marks)

16. Refer NCERT Text book Page 312. Class XI
17. Refer NCERT Text book Page 310. Class XI
18. Refer NCERT Text book Page 305. Class XI
19. Refer NCERT Text book Page 312. Class XI

### Long Answer (5 marks)

20. Refer Points to remember

## Chapter-21

### NEURAL CONTROL AND COORDINATION

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#### POINTS TO REMEMBER

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**Action potential :** A sudden change in the electrical charges in the plasma membrane of a nerve fibre.

**Aqueous humour :** The thin watery fluid that occupy space between lens and cornea in eye.

**Blind spot :** A spot on retina which is free from rods and cones and lack the ability for vision.

**Cerebrospinal fluid :** An alkaline fluid present in between inner two layer of meninges.

**Cerebellum :** A part of hind brain that controls the balance and posture of the body.

**Cochlea :** A spirally coiled part of internal ear which is responsible for hearing.

**Corpus callosum :** A curved thick bundle of nerve fibres that joins two cerebral hemisphere.

**Depolarisation :** A condition when polarity of the plasma membrane of nerve fibre is reversed.

**Endolymph :** The fluid filled within membranous labyrinth.

**Ecustachian tube :** A tube which connect ear cavity with the pharynx.

**Fovea :** A area of highest vision on the retina which contain only cones.

**Meninges :** Three sheets of covering of connective tissue wrapping the brain.

**Grey Matter :** This shows many convolutions which increase the amount of vital nerve tissue.

**Medula oblongata :** Posterior most part of the brain which is continuous with spinal cord and control respiration, heart rate, swallowing, vomiting.

**Pons :** Thick bundles of fibres on the ventral side of brain below cerebellum.

**Foramen magnum :** A big aperture in the skull posteriorly through which spinal cord emerges out.

**Spinal cord :** A tubular structure connected with medulla oblongata of brain and situated in the neural canal of the vertebral column, covered by meninges.

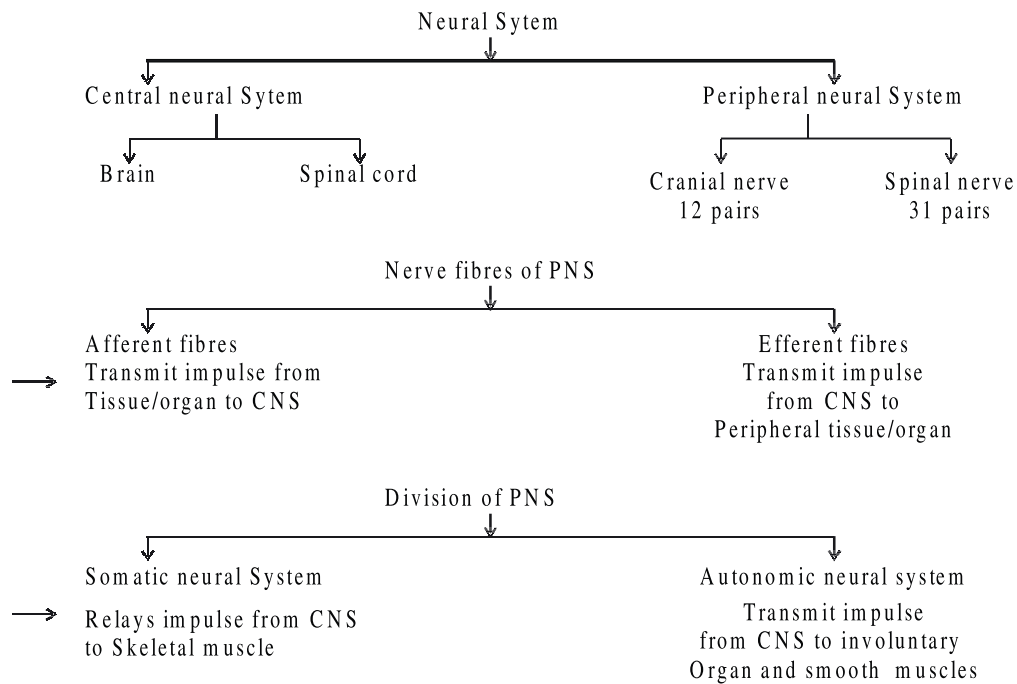
**Synaptic cleft :** A narrow fluid filled space which separates two membranes of the two neurons at the synapse.

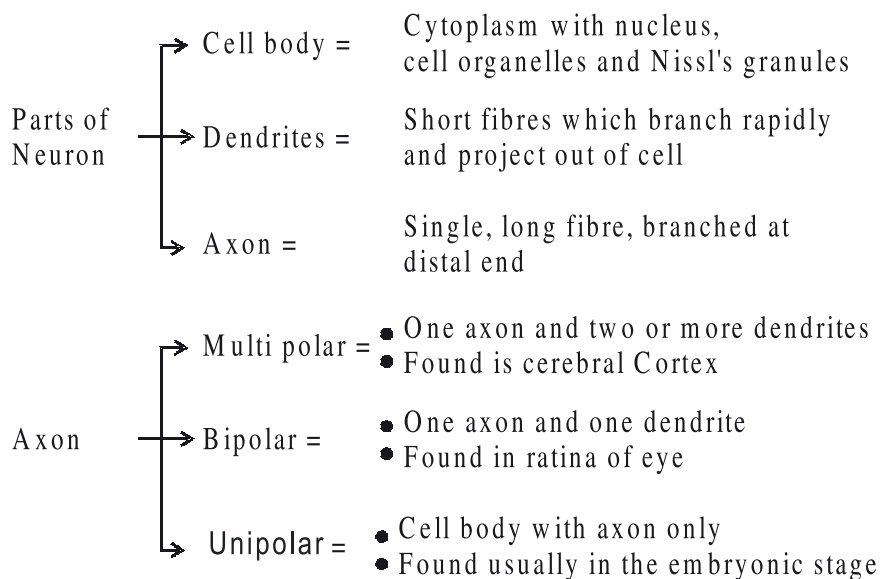
**Synaptic vesicles :** These are membrane bound vesicles in the axoplasm of the axon terminal and these store neurotransmitter.

**Neurotransmitter :** These are chemicals stored in synaptic vesicles, diffuse to reach the membrane of next neuron for its stimulation.

**Synapse :** A physiological junction between axon of one neuron and dendrite of next neuron.

- CNS – Central neural system
- PNS – Peripheral neural system
- ANS – Autonomic neural system





### Conduction of nerve impulse along axon

#### Polarised membrane/Resting Potential

In resting phase when neuron is not conducting an impulse, the axonal membrane is called polarised. This is due to difference in concentration of ions across the axonal membrane.

- At Rest :**
- Axoplasm inside the axon contain high conc. of  $K^+$  and low conc. of  $Na^+$ .
  - The fluid outside the axon contain low conc. of  $K^+$  and high conc. of  $Na^+$ .

As a result the outer surface of axonal membrane is positively charged and inner surface is negatively charged. The electric potential difference across the resting plasma membrane is called resting potential.

**Action Potential :** When a nerve fibre is stimulated, the permeability of membrane to  $Na^+$  is greatly increased at the point of stimulus (rapid influx of  $Na^+$ ) and hence polarity of membrane is reversed and now membrane is said to be depolarised. The electric potential difference across the plasma membrane at that site is called action potential, which infact termed as nerve impulse.

Depolarisation is very rapid, so that conduction of nerve impulse along the entire length of axon occurs in fractions of second.

## Transmission of Impulses at Synapse

(i) **At electrical synapses** : Here the membrane of pre and post-synaptic neuron are in very close proximity. Electric current can flow directly from one neuron into other across these synapses, like impulse conduction along a single axon.

(ii) **At chemical synapses** : Here the membrane of pre and post-synaptic neuron are separated by fluid filled space called synaptic cleft. Neurotransmitter are involved here.

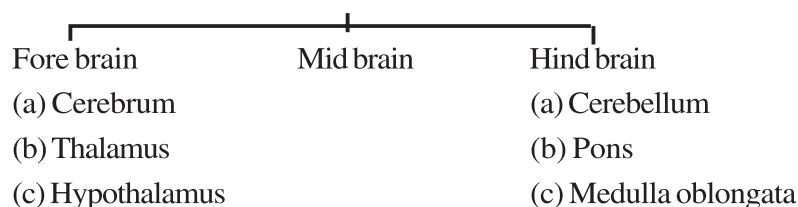
When an impulse arrives at the axon terminal, it stimulates the movement of the synaptic vesicles towards membrane and they fuse with the plasma membrane and release their neurotransmitter in the synaptic cleft. These chemicals bind to specific receptors, present on the post-synaptic membrane. Their binding opens ion channels and allow the entry of ion which generate new potential in post synaptic neuron.

Human brain : Human brain is the major portion of central neural system. Which is well protected by the skull.

The brain is surrounded by three cranial meninges—

- i) Duramater – outer layer
- ii) Arachnoid – middle layer
- iii) Piamater – Inner layer—remain in contact with brain

### Parts of Brain



### Functions of parts of brain :

**Cerebrum** : Centre of intelligence, memory and imagination, reasoning, judgement, expression of will power.

**Thalamus** : Acts as relay centre to receive and transmit general sensation of pain, touch and temperature.

**Hypothalamus** : Centre for regulation of body temperature, urge for eating and drinking.

**Mid brain** : Responsible to coordinate visual reflexes and auditory reflexes.

**Cerebellum** : Maintains posture and equilibrium of the body as well as coordinates and regulates voluntary movement.

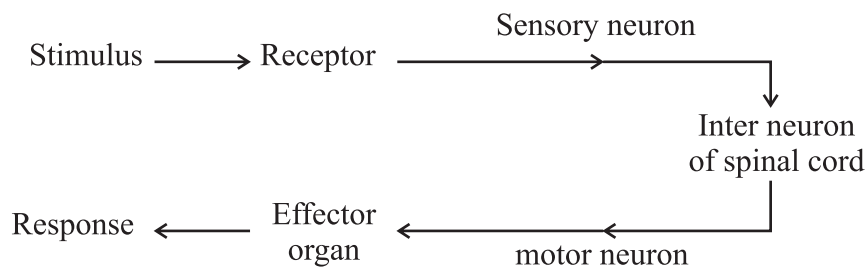
**Pons varoli :** Relays impulses between medulla oblongata and cerebral hemisphere and between the hemisphere of cerebrum and cerebellum.

**Medulla oblongata :** Centre that control heart beat, breathing, swallowing, salivation, sneezing, vomiting and coughing.

**Reflex action :** It is a spontaneous, autonomic and mechanical response to a stimulus that occurs at the level of spinal cord, with involvement of brain.

**Reflex arc :** The flow of nerve impulse along the specific pathway during reflex action. It consist of–

- a) A receptor
- b) An Afferent neuron (sensory neuron)
- c) An interneuron
- d) An efferent neuron (motor neuron)
- e) An effector organ



### Organ of Sight – Eye

Layer	Component	Function
1. External layer	Sclera	Protects and maintain shape of the eye ball.
	Cornea	Absorb O <sub>2</sub> from the air, helps to focus light rays.
2. Middle layer	Choroid	Absorb light and prevent light from being reflected within the eye ball.
	Ciliary body	Holds lens, regulate shape of the lens.
	Iris	Control amount of light entering.
3. Inner layer	Retina	Vision in dim light, colour vision, vision in bright light.

### Organ of Hearing – Ear

Portion of the ear	Component	Function
1. External ear	Pinna	Collect sound waves.
	External auditory canal	Direct sound waves toward ear drum, ear wax prevents the entry of foreign bodies.
2. Middle ear	Tympanic membrane	Acts as resonator that reproduces the vibration of sound.
	Ear ossicles	Transmit sound waves to internal ear.
	Eustachian tube	Helps in equalising the pressure of either side of ear drum.
3. Internal ear	Cochlea	Hearing.
	Vestibular apparatus	Balancing of body.

### QUESTIONS

#### Very Short Answer Questions (1 mark each)

1. Name the fluid present in membranous labyrinth.
2. Name the area of retina where only cones are densely packed.
3. Name the inner most meninges of the brain.
4. To which part of the brain communication and memory are associated ?
5. Name the bundle of fibres that connect two cerebral hemisphere in human being.
6. Name the photo pigment present in the rod cells.
7. Why can impulses flow only in one direction ?
8. Where is hypothalamus located in the brain ?

#### Short Answer Questions- (2 marks each)

9. Distinguish between electrical synapses and chemical synapses.
10. What is iris ? Give the function of iris.
11. What is organ of corti ? Where is it located ?
12. Differentiate between cerebrum and cerebellum.



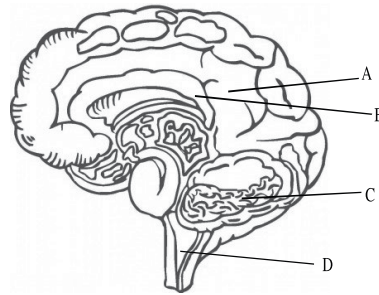
13. Fill in the blanks in the different columns A to D :

Part/Organ	Function
Pinna	.....(A).....
.....(B).....	Equalise the pressure on either side of ear drum.
Cone cells	.....(C).....
.....(D).....	Regulate amount of light to pass into the eye.

14. Why are grey matter and white matter contained in human nervous system named so ?

**Short Answer Questions (3 marks each)**

15. Observe the diagram given right and answer the following questions :



- (i) Label the parts A and B.
- (ii) Give the function of C and D.
- (iii) Name the layers which wrap this organ.

16. What is a synapse ? How does the nerve impulse cross the chemical synapse ?

17. Give the function of the following :

- (i) Cerebrum      (ii) Hypothalamus      (iii) Mid brain

18. What is meant by reflex action ? Name the components of a reflex arc in correct sequence from receptor upto effector. Support your answer by a diagram.

19. Draw a diagram of V. S. of human eye and label the following :

Iris, Ratina, Cornea, Blind spot, Ciliary body and Vitreous chamber.

**Long Answer Questions (5 marks each)**

20. Describe in detail, how conduction of nerve impulse takes place through a nerve fibre.



## Chapter-22

# CHEMICAL COORDINATION AND INTEGRATION

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### POINTS TO REMEMBER

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**Endocrine glands :** These are ductless glands which secrete hormones directly into the blood stream.

**Hormones :** Non-nutrient chemicals, synthesised in trace amounts, acts as intracellular messengers and are specific in their action.

**Hypothalamus :**

- It is basal part of diencephalon.
- Has neurosecretory cells called nuclei which produce hormones to regulate the synthesis and secretion of pituitary gland hormones.
- Two types of hormones released are :

**Releasing hormones :** Stimulate secretion of pituitary hormones, *e.g.*, Gonadotropin releasing hormone stimulates pituitary gland to synthesise gonadotrophins.

**Inhibiting hormones :** Inhibit secretions of pituitary hormones, *e.g.*, Somatostatin inhibits secretion of growth hormone.

**Pituitary Gland :**

- Located in bony cavity called as sella tursica.
- Attached to hypothalamus by a stalk.
- Divided anatomically into : Adenohypophysis and Neurohypophysis.
- Hormones released from hypothalamic neurons reach anterior pituitary through portal system.
- Direct neural regulation by hypothalamus occurs in posterior pituitary.

**1. PITUITARY GLAND :**

**Adenohypophysis :**

**Pars intermedia :** Produces only one hormone melanocyte stimulating hormone.

**Pars distalis :** • **Growth hormone (GH) :** Oversecretion leads to gigantism and low secretion causes dwarfism.

- **Prolactin (PRL) :** Growth of mammary glands and formation of milk in them.
- **Thyroid stimulating hormone (TSH) :** Stimulates synthesis and secretion of thyroid hormones from thyroid gland.
- **Adrenocorticotrophic hormone (ACTH) :** Stimulates synthesis and secretion of steroid hormones called glucocorticoids from adrenal cortex.
- **Luteinizing hormone (LH) :** Synthesis and secretion of hormones called androgens in males, and helps in ovulation and maintenance of corpus luteum in females.
- **Follicle stimulating hormone (FSH) :** Regulate spermatogenesis in males, and growth and development of ovarian follicles in females.

#### **Neurohypophysis : Pars Nervosa :**

- **Oxytocin** helps in contraction of uterus during child birth and milk ejection from mammary gland in females.
- **Vasopressin :** Acts on kidney and stimulates reabsorption of water and electrolytes by distal tubules to reduce water loss through urine. It is also called as Anti Diuretic Hormone (ADH).

#### **2. PINEAL GLAND :**

- Located on dorsal side of forebrain.
- Secretes melatonin to regulate 24-hour rhythm, sleep-wake cycle, menstrual cycle, pigmentation etc.

#### **3. THYROID GLAND :**

- Has two lobes on either side of trachea interconnected by isthmus (connective tissue).
- Composed of follicles and stromal tissues.
- Follicular cells synthesise thyroxine ( $T_4$ ) and triiodothyronine ( $T_3$ ).
- Iodine is necessary for normal functioning in of thyroid.
- **Goitre (Hypothyrodism) :** Enlargement of thyroid gland. Hypothyrodism may lead to mental retardation and stunted growth (cretinism) in the baby if it occurs during pregnancy.
- **Hyperthyroidism :** Occurs due to cancer or due to development of nodules in thyroid glands. Effects body physiology as abnormal high levels of thyroid hormones is synthesised.



- Glucocorticoids :**
- Involved in carbohydrate metabolism.
  - Stimulates gluconeogenesis, lipolysis and proteolysis.
  - *e.g.*, Cortisol which is also involved in cardio-vascular and kidney functions.
  - It also suppresses immune response and stimulates RBC production.

- Mineralocorticoids :**
- Regulate balance of water and electrolytes in body.
  - *e.g.*, Aldosterone which also helps in reabsorption of  $\text{Na}^+$  and water excretion of  $\text{K}^+$  and phosphate ions from renal tubules.

## 7. PANCREAS :

- Has both exocrine and endocrine function.
- Contains about 1-2 million islets of langerhans which has glucagon secreting  $\alpha$ -cells and insulin secreting  $\beta$ -cells.
- **Glucagon :** Peptide hormone, stimulates glycogenolysis by acting on liver cells. Also, stimulates gluconeogenesis. Hence called hyperglycemic hormone.
- **Insulin :** Peptide hormone, acts on hepatocytes and adipocytes to enhance cellular glucose uptake, stimulates conversion of glucose to glycogen (glycogenesis), so decreases blood glucose level called hypoglycemic hormone.
- Deficiency of insulin causes diabetes mellitus in which loss of glucose occurs through urine.

## 8. TESTIS :

- A pair of testis composed of seminiferous tubules and interstitial cells is present in the scrotal sac of males.
- Leydig cells (interstitial cells) produce androgens (mainly testosterone) which regulate development and maturation of male accessory sex organs, formation of secondary sex characters and play stimulatory role in spermatogenesis. Male sexual behaviour (libido) is influenced by androgens.

(i) **OVARY :** A pair of ovaries which produce one ovum in each menstrual cycle are present in abdomen in females.

- Ovary composed of ovarians follicles and stromal tissue.
- Estrogen synthesised by growing ovarian follicles helps in stimulation of growth of female secondary sex organs, female behaviour, mammary gland development and female secondary sex characters.
- Ruptured follicle forms corpus luteum which secretes progesterone. Progesterone supports pregnancy and stimulates alveoli formation and milk secretion in mammary glands.

### **Hormones secreted by tissues which are not endocrine glands :**

(a) **Heart** : Atrial wall secretes Atrial Natriuretic factor (ANF) which decreases blood pressure by dilation of the blood vessels.

(b) **Kidney** : Juxtaglomerular cells secretes erythropoietin which stimulates erythropoiesis (RBC formation).

(c) **Gastro-intestinal tract** : It secretes four peptide hormones.

- **Gastrin** : Acts on gastric glands and stimulates secretion of hydrochloric acid and pepsinogen.

- **Secretin** : Acts on pancreas and stimulates secretion of water and bicarbonate ions.

- **Cholecystinin (CCK)** : Acts on pancreas and gall bladder to stimulate secretion of pancreatic juice and bile juice respectively.

**Gastric inhibitory peptide (GIP)** : Inhibits gastric secretion and motility.

**Mechanism of hormone action** : By hormone receptors of two kinds, *i.e.*,

(a) **Located on membrane of target cell**

- These are membrane bound receptors.
- Form hormone receptor complex .

↓

Leads to biochemical changes in tissue.

↓

Release of second messengers like (cyclic AMP,  $IP_3$ ,  $Ca^{2+}$  etc.) which regulate cellular metabolism.

**(b) Located inside the target cell**

- These are intracellular receptors.
- Hormones (steroid hormones, iodothyronines etc.) interact with them and cause physiological and developmental effects of regulating gene expression.

**QUESTIONS**

**Very Short Answer Questions (1 mark each)**

1. Which two systems coordinate and regulate physiological functions of our body ?
2. What is the role of melanocyte stimulating hormone ?
3. Name the hormones which act antagonistically in order to regulate calcium levels in the blood.
4. Give the names of any one glucocorticoid and one mineralocorticoid.
5. How does atrial natriuretic factor decreases blood pressure ?
6. Which structure is formed from ruptured follicle in females ? What is its role ?
7. Immunity of old persons becomes very weak. Give reason.

**Short Answer Questions-II (2 marks each)**

8. What happens if a person suffers from prolonged hyperglycemia ?
9. What are the two modes through which the hypothalamus causes the release of hormones by pituitary gland ?
10. Androgens regulate the development, maturation and other important functions in human male. List them.

**Short Answer Questions-I (3 marks each)**

11. Define hormone and classify them on basis of their chemical nature.
12. How do oxytocin, progesterone and estrogen differ from each other ?
13. What are the disorders caused and the effects produced due to malfunctioning/ improper secretion from thyroid gland ?

**Long Answer Questions (5 marks each)**

14. 'The master gland regulates a number of physiological functions in our body.' Give reasons and explain.
15. Explain the mechanism of hormone action which helps in various physiological and development effect ? Also, define the role of second messenger in this process.



## ANSWERS

### **Very Short Answers (1 mark each)**

1. Neural system and endocrine system.
2. Acts on melanocytes and regulates pigmentation of skin.
3. Thyrocalcitonin (TCT) and parathyroid hormone (PTH).
4. Glucocorticoid - Cortisol; Mineralocorticoid - Aldosterone.
5. By dilation of the blood vessels.
6. Corpus luteum which secretes progesterone.
7. Thymus gland degenerates with age.

### **Short Answers Questions-II**

8. Gets affected by diabetes mellitus which causes loss of glucose through urine and formation of harmful ketone bodies.
9. Through hypothalamic neurons control anterior pituitary gland. Through neural regulation controls posterior pituitary gland.
10. Refer Points to Remember.

### **Short Answers Questions-II (2 marks each)**

11. Refer Points to Remember and page no. 338, NCERT, Text Book of Biology for class XI.
12. Oxytocin causes milk ejection and contraction of uterus at time of child birth.  
Progesterone-causes milk secretion and maintains pregnancy.  
Estrogen : Refer Points to Remember.
13. Refer Points to Remember.

### **Long Answers (5 marks each)**

14. Explain the role of pituitary gland + Refer Points to Remember.
15. Refer Points to Remember+ NCERT, Text Book of Biology for Class XI.