UNIT
12
Plant Anatomy and Plant Physiology

POINTS TO REMEMBER

Photosynthesis : Green Plants are capable of synthesizing glucose from CO_2 and H_2O in the presence of light.

$$6CO_2 + 12H_2O \xrightarrow[\text{Chlorophyl}]{\text{Sunlight}} C_6H_{12}O_6 + 6H_2O + 6O_2 \uparrow$$

Light reaction : It takes place in grana of chloroplast.

Dark reaction : It takes place in stroma of chloroplast.

Accessory Pigments : Chlorophyll. b. and carotenoids.

Primary Pigment : Chlorophyll. a also called reaction centre

Aerobic respiration : Takes place in the presence of oxygens.

Anaerobic respiration : $C_6H_{12}O_6 \rightarrow 2CO_2 + 2C_2H_5OH + \text{Energy(ATP)}$

Respiratory quotient : Respiratory quotient = $\frac{\text{Volume of } CO_2 \text{ liberated}}{\text{Volume of } O_2 \text{ consumed}}$

Cellular respiration : Biochemical process occurs within cells where the food is oxidized to obtain energy.

Mitochondria : It is called as power houses of the cell or ATP factory of the cell.

Tissues : Tissue is a group of similar or dissimilar cells having a common origin and performing similar functions.

Xylem : Xylem conducts water to different parts of the plant.

Phloem : Phloem conducts food materials to different parts of the plant.

Radial Vascular bundles : Xylem and Phloem within the vascular bundles are placed in different radii alternating with each other.

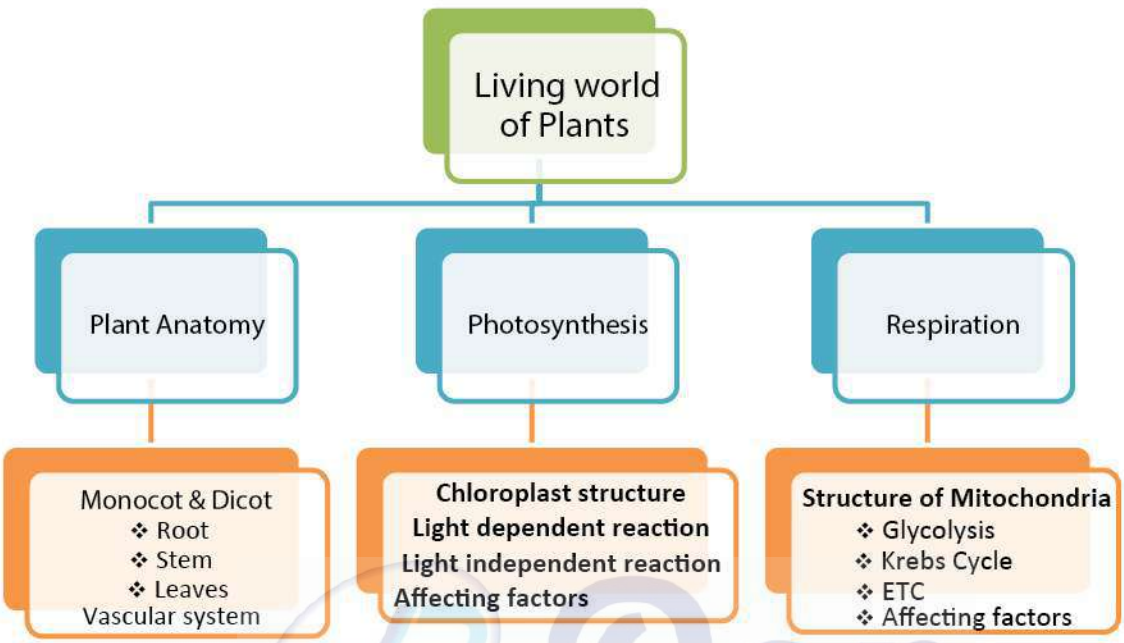
Conjoint bundles : Xylem and Phloem lie on the same radius.

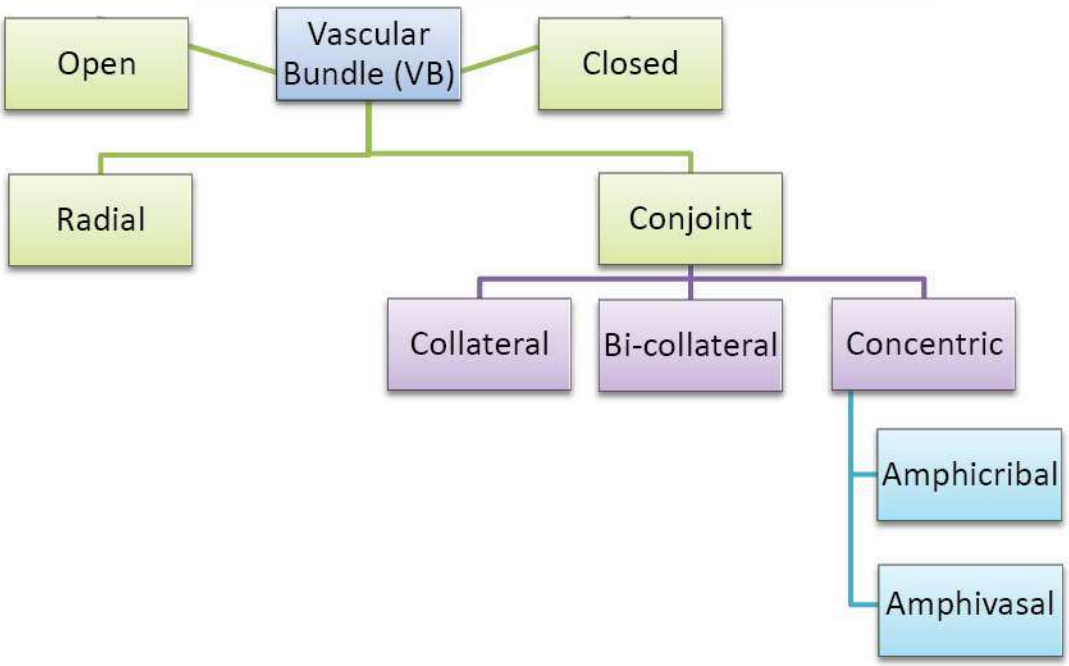
Collateral : Xylem lies towards the centre and phloem lies towards the periphery.

Bicollateral : Phloem is present on both the inner and outer sides of xylem

Open : When cambium is present between xylem and phloem in collateral bundles, it is called open.

MIND MAP





Closed	: Collateral bundles without cambium in between xylem and phloem is called closed.
Amphivasal	: Xylem completely surrounds the phloem.
Amphicribal	: Phloem completely surrounds the xylem.
Endarch	: Protoxylem lies towards the centre and metaxylem towards the periphery.
Exarch	: Metaxylem towards the centre and protoxylem lies towards the periphery.
Epiblema	: Outermost layer of the root also called as the rhizodermis.
Oxysomes	: The inner mitochondrial membrane bear minute tennis racket shaped particles called oxysomes or F1 particles.

Abbreviations:

TCA	–	Tri carboxylic Acid Cycle.
ETC	–	Electron Transport chain.
ATP	–	Adenosine Triphosphate
ADP	–	Adenosine Diphosphate
NAD	–	Nicotinamide Adenine Dinucleotide
NADP	–	Nicotinamide Adenine Dinucleotide Phoisphate

Scientists and Inventions:

- Nehemish Grew is known as the father of Plant Anatomy.
- Sachs in 1875 classified the tissue system in plants into three types.
- Light dependent photosynthesis was discovered by Robin Hill in 1939.
- Melvin Calvin, an American biochemist, discovered the chemical pathway for photosynthesis. He was awarded the Nobel Prize in the year 1961.
- C.N. Rao, who was conferred Bharat Ratna, is now working on artificial photosynthesis.
- The mitochondria were first discovered by Kolliker in 1857.

Tabulation

Tissue System	Components	Functions
Dermal Tissue System	Epidermis and Periderm (in older stems and roots)	Protection Prevention of water loss
Ground Tissue System	Parenchyma tissue Collenchyma tissue Sclerenchyma tissue	Photosynthesis Food storage Regeneration Support Protection
Vascular Tissue System	Vascular tissues - Xylem tissue - Phloem tissue	Transport of water and minerals Transport of food

Textbook Evaluation

I. Choose the most suitable answer from the given four alternatives and write the option code and corresponding answer:

1. **Casparian strips are present in the _____ of the root.**
   a) cortex b) pith
   c) pericycle d) endodermis

2. **The endarch condition is the characteristic feature of**
   a) Root b) Stem
   c) Leaves d) flower

3. **The xylem and phloem arranged side by side on same radius is called _____.**
   a) Radial b) Amphivasal
   c) Conjoint d) None of these

4. **Which is formed during anaerobic respiration?**
   a) Carbohydrate b) Ethyl alcohol
   c) Acetyl CoA d) Pyruvate

5. **Krebs cycle takes place in** ★★
   a) chloroplast b) mitochondrial matrix
   c) stomata d) inner mitochondrial membrane

6. **Oxygen is produced at what point during photosynthesis?**
   a) When ATP is converted to ADP
   b) When CO_2 is fixed
   c) When H_2O is splitted
   d) All of these

Ans:

1.	d)	endodermis	4.	b)	Ethyl alcohol
2.	b)	Stem	5.	b)	Mitochondrial matrix
3.	c)	Conjoint	6.	c)	When H_2O is splitted

II. Fill in the blanks

1. **Cortex lies between _____.**
2. **Xylem and phloem occurring on the same radius constitute a vascular bundle called _____.**
3. **Glycolysis takes place in _____.** ★★
4. **The source of oxygen liberated in photosynthesis is _____.**
5. **_____ is ATP factory of the cells.** ★★

Ans:

1.	Epidermis and Endodermis	2.	conjoint vascular bundles
3.	Cytoplasm	4.	H_2O
5.	Mitochondria		

III. State whether the statements are true or false. Correct the false statement

1. Phloem tissue is involved in the transport of water in plants. **False**

Xylem tissue is involved in the transport of water in plants.

2. The waxy protective covering of a plant is called cuticle. **True**

3. In monocot stem cambium is present in between xylem and phloem. **False**

In monocot stem cambium is **not** present in between xylem and phloem.

4. Palisade parenchyma cells occur below upper epidermis in dicot root. **False**

Palisade parenchyma cells occur below upper epidermis in **dicot leaf**.

5. Mesophyll contains chlorophyll. **True**

6. Anaerobic respiration produces more ATP than aerobic respiration. **False**

Anaerobic respiration produces **less** ATP than aerobic respiration.

IV. Match the following

1. **Column I** **Column II**

1. Amphicribal	-	a) Dracaena	(c)
2. Cambium	-	b) Translocation of food	(d)
3. Amphivasal	-	c) Fern	(a)
4. Xylem	-	d) Secondary growth	(e)
5. Phloem	-	e) Conduction of water	(b)

V. Answer in a sentence

1. What is collateral vascular bundle? ★ ★

When xylem lies towards the **centre** and **phloem** lies towards the **periphery**, it is called collateral vascular bundle.

2. Where does the carbon that is used in photosynthesis come from?

The carbon that plants need for photosynthesis comes from **carbon dioxide**, or CO_2 that's present in our atmosphere.

3. What is the common step in aerobic and anerobic pathway?

Glycolysis is the common step in both aerobic and anaerobic pathway.

4. Name the phenomenon by which carbohydrates are fermented to release ethyl alcohol. ★

Anaerobic respiration is a process by which carbohydrates are converted into ethyl alcohol.

VI. Short answer questions

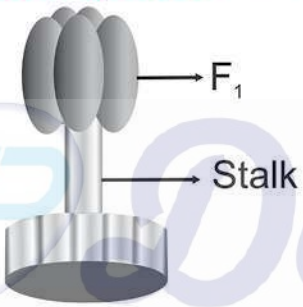
1. Give an account on vascular bundle of dicot stem.

- A large number of vascular bundles are present in **dicot stem.**
- They are arranged in the form of a **ring** around the pith.
- Vascular bundles are **conjoint, collateral, endarch** and **open**.

2. Write a short note on mesophyll.

- The tissue present between the **upper** and the **lower epidermis** is called mesophyll.
- Mesophyll cells contain chloroplasts.
- In dicot leaf, the mesophyll is differentiated into **palisade** parenchyma and **spongy** parenchyma.
- Palisade cells do not have intercellular spaces and take active part in photosynthesis. Whereas, spongy parenchyma cells have large **intercellular spaces** and helps in **gaseous exchange.**

3. Draw and label the structure of oxysomes. ✶ ✶ ✶



Structure of Oxysomes

4. Name the three basic tissues system in flowering plants. ✶

- Dermal or Epidermal tissue system
- Ground tissue system
- Vascular tissue system

5. What is photosynthesis? Where in a cell does it occur? ✶ ✶

- Photosynthesis is a process by which autotrophic organisms like green plants, algal and chlorophyll containing bacteria utilize the energy from **sunlight** using CO_2 and H_2O to synthesize their own food.
- It occurs in the chloroplasts of the cell.

6. What is respiratory quotient? ✶ ✶

- Respiratory quotient (R.Q) is the ratio of **volume** of **carbon dioxide** liberated and the **volume** of **oxygen** consumed during respiration.
- $$\mathbf{RQ = \frac{Volume\ of\ CO_2\ liberated}{Volume\ of\ O_2\ consumed}}$$

7. Why should the light dependent reaction occur before the light independent reaction?

- During light independent reaction CO_2 is reduced to carbohydrate by **ATP** and **$NADPH_2$** which are generated during light dependent reaction.
- So light dependent reaction should occur before the light independent reaction.

8. Write the reaction for photosynthesis. ✶

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

Carbon dioxide + Water ⟶ Glucose + Water + Oxygen

VII. Long answer questions

1. Differentiate the following. ✶ ✶ ✶

a) Monocot root and Dicot root

S.No.	Tissues	Dicot Root	Monocot Root
1.	Number of Xylem	Tetrach	Polyarch
2.	Cambium	Present (During secondary growth only)	Absent
3.	Secondary Growth	Present	Absent
4.	Pith	Absent	Present

b) Aerobic and Anaerobic respiration

Basis for Comparison	Aerobic respiration	Anaerobic respiration
It occurs in	The cytoplasm and mitochondria.	Cytoplasm only.
Final product	Carbon dioxide, water and energy	Carbon dioxide, Lactic acid (animal cells), ethanol (plant cell) and energy
It requires	Oxygen and glucose to produce energy.	It does not require oxygen but uses glucose to produce energy
Number of ATP released	38 ATP.	2 ATP.

2. Describe and name three stages of cellular respiration that aerobic organisms use to obtain energy from glucose. ✶ ✶

- The 3 stages of aerobic respiration are Glycolysis, Krebs cycle and Electron Transport Chain.

Glycolysis:

- Glycolysis takes place in the **cytoplasm** of the cell.
- It is the breakdown of **one** molecule of **glucose** (6 carbon) into **two** molecules of **pyruvic acid** (3 carbon).

Krebs cycle:

- This cycle occurs in the **mitochondrial** matrix.
- At the end of glycolysis **2** molecules of **pyruvic acid** enter into mitochondria.
- Oxidation of **pyruvic acid into CO_2** and water takes place.
- It is also called **Tricarboxylic Acid Cycle.**

Electron Transport Chain:

- **$NADH_2$** and **$FADH_2$** molecules formed during glycolysis and Krebs cycle are oxidised to **NAD^+** and **FAD^+** to release energy through electrons.

- These electrons move through the **electron transport chain** and release energy.
- This energy is used by **ADP** to synthesize **ATP**.
- This is called **oxidative phosphorylation.**
- In this process O_2 gets reduced to **water**.
- $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + ATP$

3. How does the light dependent reaction differ from the light independent reaction? What are the end product and reactants in each? Where does each reaction occur within the chloroplast? ✱

a) Difference between Light dependent and Light independent reactions:

S.No.	Light dependent Reaction	Light Independent Reaction
1.	It requires sunlight.	It does not require sunlight.
2.	It takes place in the thylakoid membrane (grana) of the chloroplast.	It takes place in the stroma of the chloroplast.
3.	These reactions use light energy to make ATP and $NADPH_2$.	These reactions use the energy derived from light dependent reactions to form glucose.

b) Reactants and End products:

S.No.	Reactions	Reactants	End products
1.	Light dependent	Photosynthetic pigment, light, H_2O	ATP, $NADPH_2$, $O_2\uparrow$, H_2O
2.	Light independent	CO_2, ATP, $NADPH_2$	Glucose

c) Place of occurrence:

- **Light Dependent** : Thylakoid membrane (grana) of the chloroplast.
- **Light Independent** : Stroma of the chloroplast

VIII. Higher Order Thinking Skills (HOTS)

1. The reactions of photosynthesis make up a biochemical pathway.

(A) What are the reactants and products for both light and dark reactions?

(B) Explain how the biochemical pathway of photosynthesis recycles many of its own reactions and identify the recycled reactants.

(A) The light-dependent reactions require light and water and produce ATP and $NADPH_2$. The light-independent reactions require carbon dioxide and this CO_2 is reduced to carbohydrates.

(B) During photosynthesis, two important processes are taking place:

- The light reactions and the dark reactions (Calvin cycle).
- The light reactions use light to synthesize **ATP** and **$NADPH_2$.**
- The Calvin cycle uses these reactants to produce sugar from additional CO_2 molecule.
- This cycle then produces NAP^+, ADP + Pi (Inorganic phosphate) which is used in the light reactions, with H_2O molecules, to produce ATP and $NADPH_2$ again.

2. Where do the light dependent reaction and the Calvin cycle occur in the chloroplast?

The light-dependent reactions occur in the **thylakoids** (grana) and the light independent reactions (Calvin cycle) occur in the **stroma**.

Additional Questions

I. Choose the most suitable answer from the given four alternatives and write the option code and corresponding answer:

1. _____ is parenchymatous with profuse intercellular spaces in monocot stem.
a) Hypodermis b) Ground tissue c) Vascular bundles d) Cortex

2. Single layered without hair
a) Endodermis b) Epidermis c) Hypodermis d) Pericycle

3. Bulliform or motor cells are present on ✶
a) Root b) Stem
c) Isobilateral leaf d) Dorsiventral leaf

4. Bulliform cells differ from other cells in being
a) small and thick walled b) small and thin walled
c) large and thick walled d) large and thin walled

5. The endarch condition is characteristic of
a) root b) stem c) leaves d) petiole

6. Passage cells are present in
a) cortex b) pericycle c) pith d) endodermis

7. Innermost layer of cortex is
a) pericycle b) endodermis c) cortex d) peristerm

8. Starch sheath is
a) endodermis of stem b) outer cortex
c) inner cortex d) covering of vascular bundle

9. Endodermis is not differentiated in ✶
a) monocot root b) dicot root c) monocot stem d) dicot stem

10. Open vascular bundles are those in which
a) the protoxylem lies towards the pith
b) there is no cambium
c) cambium is present between xylem and phloem
d) phloem is found on both outer and inner sides of xylem

11. Stele consists of ✶
a) Endodermis, pericycle, vascular bundle and pith
b) pericycle, vascular bundle and pith
c) Vascular bundle and pith
d) Vascular bundles only

12. **Which of these characters does/do not apply to the vascular bundle of monocot stem?**
    I. Conjoint II. Collateral III. Open IV. Endarch
    a) I and II only b) II and III only c) III and IV only d) III only

13. **Epidermal hairs are not present in**
    a) Monocot stem b) Monocot root
    c) Dicot stem d) Dicot root

14. **Cell organelles responsible for preparation and storage of food:**
    a) Mitochondria b) Plastids c) Lysosomes d) Ribosomes

15. **Fuel Produced by using the technology Artificial photosynthesis is _____**
    a) Oxygen b) Nitrogen c) Hydrogen d) Methane

16. **Proteins which forms channel for the passage of molecules through the outer mitochondrial membrane is _____** ★★
    a) porin molecules b) cristal c) oxysomes d) matrix

17. **The common step in both aerobic and anaerobic respiration is _____**
    a) Krebs cycle b) Electron Transport chain
    c) Oxidation d) Glycolysis

18. **The chemical pathway of photosynthesis was discovered by**
    a) C.N. Rao b) Melvin Calvin
    c) Sachs. d) Robin Hill

19. **Power house of the cell _____**
    a) Mitochondria b) Leucoplast c) Chromopalast d) Chloroplast

Ans:

1.	b)	Ground tissue	11.	b)	pericycle, vascular bundle and pith
2.	b)	Epidermis	12.	d)	III only
3.	c)	Isobilateral leaf	13.	a)	Monocot stem
4.	d)	Large and thin walled	14.	b)	Plastids
5.	b)	Stem	15.	c)	Hydrogen
6.	d)	Endodermis	16.	a)	porin molecules
7.	b)	Endodermis	17.	d)	Glycolysis
8.	a)	endodermis of stem	18.	b)	Melvin Calvin
9.	c)	Monocot stem	19.	a)	Mitochondria
10.	c)	cambium is present between xylem and phloem			

II. Fill in the blanks

1. **_____ increases the inner surface area of the mitochondrial membrane.**
2. **Conjunctive tissue is made of _____ cells in dicot root.**
3. **_____ is a ground tissue that is present between both epidermal layers in leaf.**

4. Vascular bundles are skull shaped in _____.
5. Roots possess _____ xylem.
6. Light reactions takes place in the _____ of chloroplast.
7. _____ are orange coloured plastids. ✶
8. Number of vascular bundles are many in _____.
9. Phloem is present on both outer and inner side of xylem in _____ vascular bundle.
10. Vascular bundles are conjoint, collateral and closed in _____.
11. Each vascular bundle is surrounded by parenchymatous bundle sheath _____.
12. Thylakoids are arranged in the form of dics stacked one above the other called as _____.
13. Vascular bundles are tetrach in _____. ✶ ✶
14. Vascular bundles are arranged in the form of a ring around the pith in _____.
15. Each vascular bundle is surrounded by sclerenchymatous bundle sheath _____.
16. Chlorophyll b and carotenoids are called _____ pigments. ✶ ✶
17. Calvin cycle is carried out in the _____ of light.
18. Protoxylem lacuna is present in _____ (monocot stem, monocot root)
19. _____ helps the cells to maintain normal concentration of calcium ions.
20. Photosynthetic pigments are found in _____
21. Inner mitochondrial membrane gives rise to finger-like projections called _____.
22. Minute tennis rocket shaped particles called _____ are present in the inner mitochondrial membrane.

Ans:

1.	cristae	2.	parenchyma
3.	Mesophyll	4.	Monocot stem
5.	exdarch	6.	Grana
7.	Chromoplast	8.	monocot stem
9.	bicollateral	10.	Dorsiventral leaf (or) dicot leaf
11.	in leaf	12.	grana
13.	dicot root	14.	dicot stem
15.	Monocot stem	16.	accessory pigments
17.	absence	18.	monocot stem
19.	Mitochondria	20.	Thylakoids
21.	cristae	22.	oxysomes

III. State whether the statements are true or false. Correct the false statement

1. **X or Y shaped vessels are present in monocot root.** ✱ **False**
   X or Y shaped vessels are present in **monocot stem.**
2. **Parenchyma cells which are responsible for the gaseous exchange in mesophyll of leaf is spongy parenchyma.** **True**
3. **Medullary rays are present in Monocot stem.** **False**
   Medullary rays are present in **Dicot stem.**
4. **Secondary growth is present in Monocot stem.** **False**
   Secondary growth is present in **Dicot stem**.
5. **Leucoplasts are colourless plastids.** ✱ **True**
6. **Glucose is converted to ethanol in the presence of oxygen.** **False**
   Glucose is converted to ethanol in the **absence** of oxygen.

IV. Assertion and Reason

a) Both if assertion and reason are true and reason is the correct explanation of assertion
b) Both if assertion and reason are true and reason is not the correct explanation of assertion
c) If assertion is true and reason is false
d) Both if assertion and reason are false

1. **Assertion:** A cell cannot get its energy directly from glucose.
   Reason: The energy released from glucose during respiration is used to make ATP.
   Ans: a) Both if assertion and reason are true and reason is the correct explanation of assertion.
2. **Assertion:** Carbondioxide is reduced to carbohydrates during light reactions.
   Reason: With the help of ATP and $NADPH_2$ formed in the light reactions, carbohydrates are formed.
   Ans: a) Both if assertion and reason are true and reason is the correct explanation of assertion.
3. **Assertion:** Xylem is exarch and tetrarch in dicot root.
   Reason: Protoxylem lies towards the centre in dicot root.
   Ans: b) Both if assertion and reason are true and reason is not the correct explanation of assertion.
4. **Assertion:** Collenchyma forms the hypodermis of dicot stems.
   Reason: Flexibility of dicot stems is because of collenchyma cells.
   Ans: a) Both if assertion and reason are true and reason is the correct explanation of assertion.
5. **Assertion:** In collateral vascular bundles, phloem is situated towards the inner side.
   Reason: In monocot stem, cambium is present.
   Ans: d) Both if assertion and reason are false.

6. **Assertion:** Spongy parenchyma helps in gaseous exchange in dorsiventral leaf.
Reason: Bulliform cells are present in the epidermis of dorsiventral leaf.

Ans: c) If assertion is true and reason is false.

V. Match the following

1.

Column I		Column II ★	
1) Krebs cycle	-	a) Suberin	(c)
2) Anaerobic	-	b) Oxidative phosphorylation	(d)
3) Isobilateral	-	c) Tricarboxylic acid cycle	(e)
4) Casparian strips	-	d) Ethanol	(a)
5) ETC	-	e) Bulliform	(b)

2.

Column I		Column II	
1) Pericycle	-	a) Bulliform cells	(b)
2) Large and thin walled cells	-	b) Lateral roots originate from this layer in upper epidermis	(a)
3) Casparian strips	-	c) Mesophyll tissue of dicot leaf	(d)
4) Spongy parenchyma	-	d) Suberin deposition in the radial walls of endodermis	(c)

VI. Answer in a sentence

1. What is bicollateral vascular bundle?

When phloem is present on **both sides** of the xylem, it is called bicollateral vascular bundle.

2. What are radial bundles? ★

When xylem and phloem are present in **different radii** alternating with each other, it is called radial bundles.

3. What is amphivasal vascular bundle?

When **xylem surrounds the phloem** it is called amphivasal vascular bundle.

4. What is amphicribal vascular bundle?

When **phloem surrounds the xylem** it is called amphicribal vascular bundle.

5. What is endarch vascular bundle? ★

When **protoxylem** lies towards the **centre** and **metaxylem** lies towards the **periphery** it is said to be endarch.

6. What is exarch vascular bundle?

When **protoxylem** lies towards the **periphery and metaxylem** lies towards the **centre** it is said to be exarch.

7. Name the three types of plastids.

Chloroplast, Chromoplast and Leucoplast are the three types of plastids.

8. Who classified the tissue system in plants into three types?

Sachs (1875) classified the tissue system in plants into three types.

9. Which is called as reaction centre? Why?

Chlorollphyll.a. – It traps solar energy.

10. Where does the light dependent reaction take place during photosynthesis?

The light dependent reaction takes place in the **thykaroid membranes** of chloroplast.

11. What are the other names of Calvin cycle?

C_3 cycle or calcium-Benson-Basharm cycle or pentose phophate cycle.

12. Define cellular respiration. ★★

- Biochemical process occurs **within cells** where the food is oxidized to obtain energy is known as cellular respiration.
- Cellular respiration is a **biochemical pathway** by which cells regain energy from the chemical bonds of food molecules and provide energy for essential process of life.

VII. Short answer questions

1. Write a short note on plastids.

- Plastids are **double membrane** bound organelles found in plants and some algae.
- They are responsible for the **preparation** and **storage** of **food**.
- There are three types of plastids.

  Chloroplast – **green colour** plastid
  Chromoplast – **yellow** or **orange** coloured plastid
  Leucoplast – **colourless** plastid

2. Write short note on the functions of chloroplast. ★★

- Photosynthesis
- Storage of starch
- Synthesis of fatty acids
- Storage of lipids

3. Write notes on photosynthetic pigments.

- Pigments involved in **photosynthesis** are called photosynthetic pigments.
- They are of two classes. **Primary** and **accessory** pigments.
- Primary pigment traps the **solar energy** and converts it into **electrical** and **chemical energy.** Hence, it is called the **reaction centre.**
- Pigments such as **chlorophyll b** and **carotenoids** are called accessory pigments.
- Reaction centre (chlorophyll a) and accessory pigments are called photosystems.

4. What are oxysomes? Give the functions of oxysomes.

- **Cristae of mitochondria** bear minute regularly spaced tennis rocket shaped particles are called oxysomes.
- They involve in **ATP** synthesis.

5. How does a cell get its energy?

- A cell **cannot** get energy directly from glucose.
- During **cellular respiration** glucose is oxidized to release energy.
- This energy is trapped by **ADP** to synthesize **ATP** which the energy currency of the sell.
- The cell **consumes** this energy when it needs.

6. Which is the power house of cells? Why?

- Mitochondria.
- It produces a large number of **ATP** molecules.

VIII. Long answer questions

1. Write a note on structure of chloroplast.

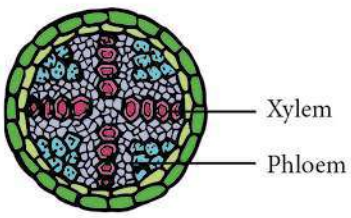
- Chloroplasts are **green plastids** containing green pigment called **chlorophyll**.
- Chloroplasts are oval shaped organelles having a **diameter** of **2-10 micrometer** and a **thickness** of **1.2 micrometer**.
- The outer and inner membranes of the envelope are **separated** by **intermembrane space.**
- Matrix present **inside** the membrane is called **stroma**. It contains DNA, ribosomes and other molecules required for **protein synthesis.**
- Disc like **membranous sacs** present in the chloroplast are called **thylakoids**. These thylakoids are stacked one above the other called as **grana**.
- These are **interconnected** to each other by membranous lamellae called **Fret channels**.

2. Write notes on the structure of Mitochondria.

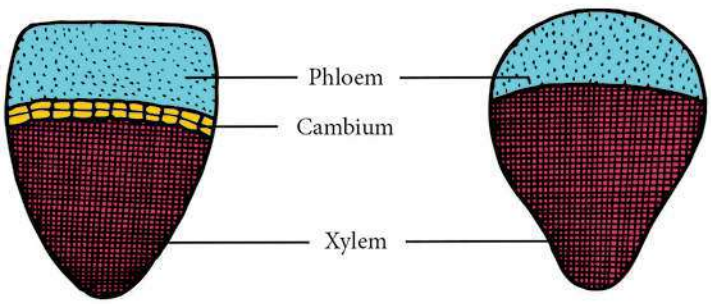
It consists of two membranes called inner and outer membrane.

- Outer membrane is **smooth and permeable** to molecules.
- It contains enzymes, proteins and lipids.
- It has porin molecules (proteins) which form **channels** for passage of molecules through it.
- Inner mitochondrial membrane is **semi-permeable** and regulates the passage of materials in and out of Mitochondria.
- It is rich in enzymes and carrier proteins. It consists of **80% proteins** and **lipids**.

3. Draw and label the parts of different types of vascular bundles.

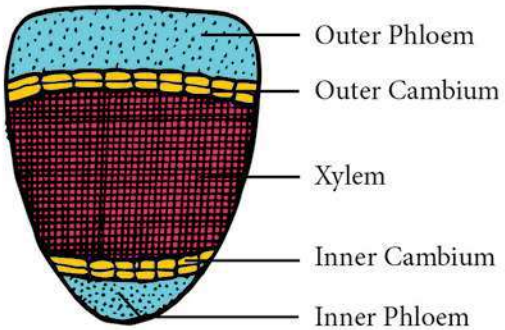


Radial

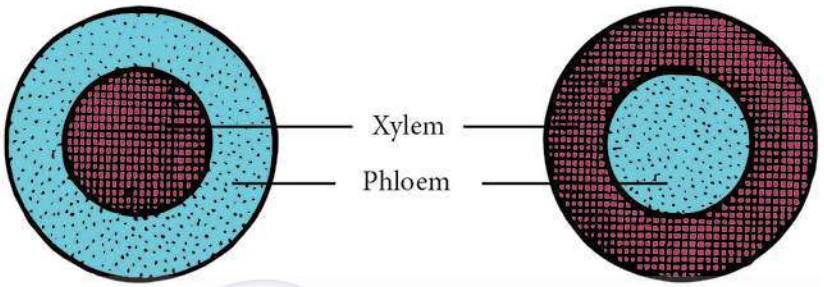


Conjoint, collateral and open

Conjoint, collateral and closed



Conjoint, Bicollateral



Concentric and Amphicribral

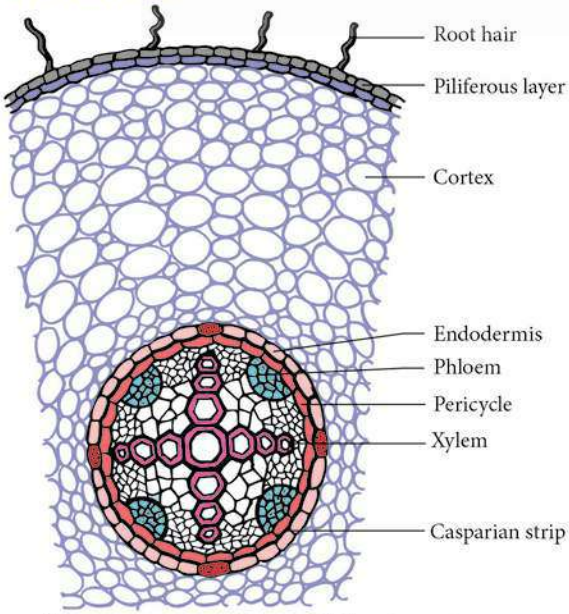
Concentric and Amphivasal

4. Observe the diagram and answer the following questions

i) Mention the type of transverse section.

ii) Describe the vascular bundle.

i) 1. Dicot root



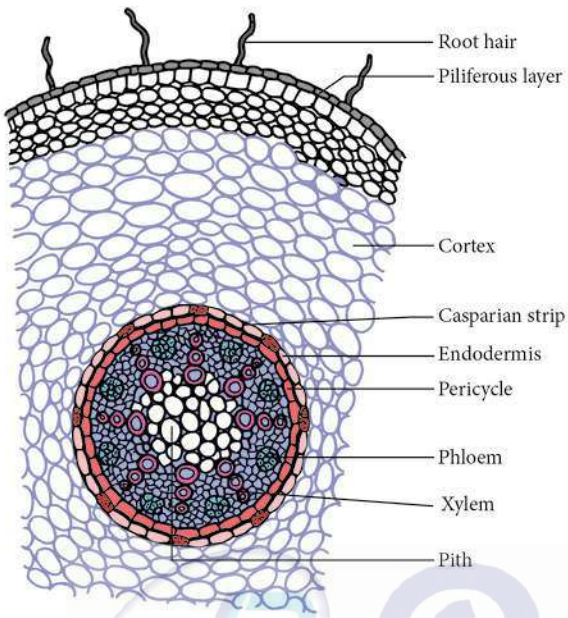
Transverse section of Dicot root

Transverse section of a Dicot root:

- Vascular bundle is radial.
- Xylem is exarch and tetrach.

- The tissue present between xylem and phloem is called conjunctive tissue.
- In dicot root, it is made up of parenchyma.
- Young root contains pith whereas in old root pith is absent.

2. Monocot root

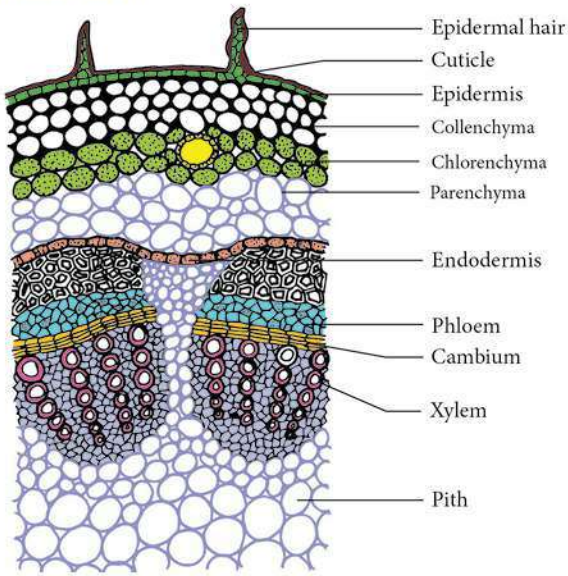


Transverse section of Monocot root

Transverse section of a Monocot root:

- **Vascular tissues:** It consists of many patches of xylem and phloem arranged radially.
- The xylem is exarch and polyarch.
- The conjunctive tissue is made up of sclerenchyma.
- It is present at the center.
- It is made up of parenchyma cells with intercellular spaces.

3. Dicot stem

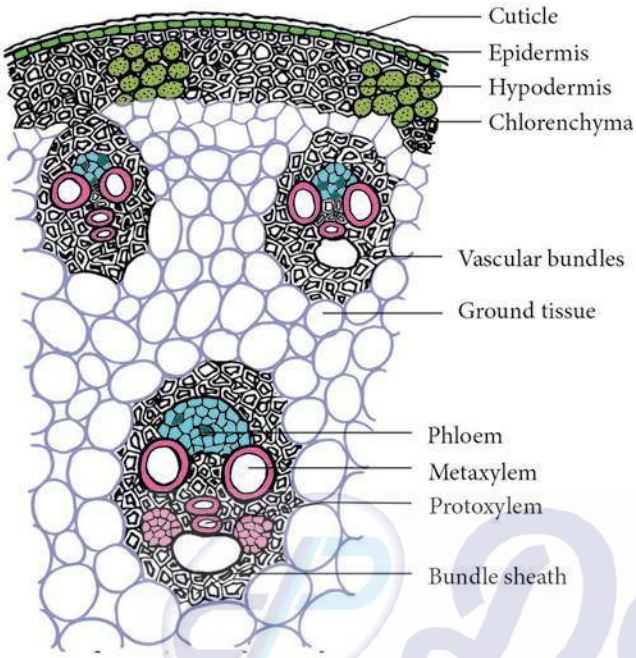


Transverse section of Dicot stem

Transverse section of a Dicot stem

- Vascular bundles are conjoint, collateral, endarch and open.
- They are arranged in the form of a ring around the pith.
- Pith is a large central parenchymatous zone with intercellular spaces.

4. Monocot stem



Transverse section of monocot stem

Transverse section of a Monocot stem

- Vascular bundles are skull shaped and scattered in the ground tissue.
- Vascular bundles are conjoint, collateral, endarch and closed.
- Each vascular bundle is surrounded by few layers of sclerenchyma cells called bundle sheath.

ii) Vascular bundles:

- Large number of vascular bundles are present, some of which are small and some are large.
- Each vascular bundle is surrounded by parenchymatous bundle sheath.
- Vascular bundles are conjoint, collateral and closed.
- Xylem is present towards upper epidermis and phloem towards lower epidermis.

(a) Xylem:

- It consists of metaxylem and protoxylem. Xylem vessels are arranged in V or Y shape.
- In mature vascular bundle, the lower most protoxylem disintegrates and form a cavity. This is called protoxylem lacuna.

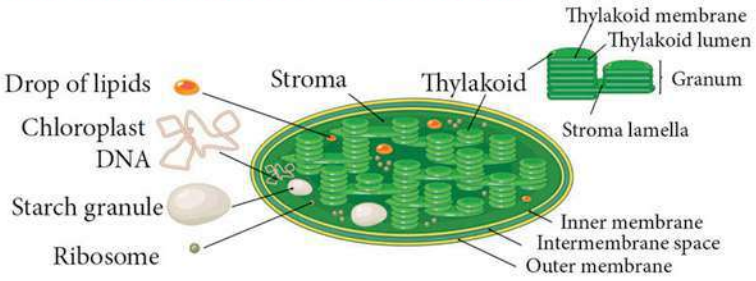
(b) Phloem:

- It consists of sieve tube elements and companion cells.
- Phloem parenchyma, and phloem fibers are absent.

(c) Pith:

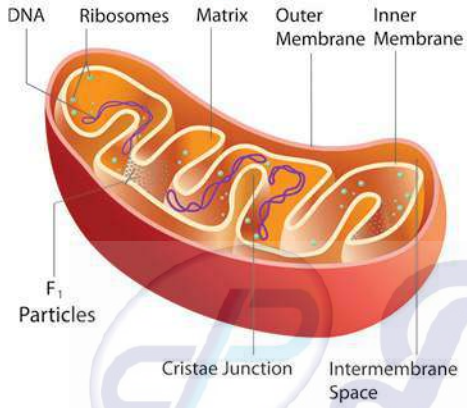
- Pith is not differentiated in monocot stems.

5. Draw and label the parts of Chloroplast.



Ultrastructure of chloroplast

6. Draw and label the parts of Mitochondria.



Structure of mitochondria

7. Differences between Dicot and Monocot Stem.

S. No.	Tissues	Dicot Stem	Monocot Stem
1	Hypodermis	Collenchymatous	Sclerenchymatous
2	Ground tissue	Differentiated into cortex, endodermis, pericycle and pith	Undifferentiated
3	Vascular bundles	i) Less in number ii) Uniform in size iii) Arranged in a ring iv) Open v) Bundle sheath absent	(i) Numerous (ii) Smaller near periphery, bigger in the centre (iii) Scattered (iv) Closed (v) Bundle sheath present
4	Secondary growth	Present	Mostly absent
5	Pith	Present	Absent
6	Medullary rays	Present	Absent

Unit Test - 12

Plant Anatomy and Plant Physiology

Time : 1 hr **Marks : 30**

I. Choose the most suitable answer and write the code with the corresponding answer. 5 × 1 = 5

1. The endarch condition is the charateristic feature of
   a) root b) Stem c) Leaves d) flower
2. The xylem and phloem arranged side by side on same radius is called _____.
   a) radial b) Amphivasal c) Conjoint d) None of these
3. _____ is parenchymatous with profuse intercellular spaces in monocot stem.
   a) Hypodermis b) Ground tissue c) Vascular bundles d) cortex
4. Single layered without hair
   a) Endodermis b) Epidermis c) Hypodermis d) Pericycle
5. Starch sheath is
   a) endodermis of stem b) Outer cortex
   c) Inner cortex d) covering of vascular bundle

II. Answer the following questions in one or two lines. 5 × 2 = 10

1. Write a short note on mesophyll.
2. Draw and label the structure of oxysomes.
3. What is respiratory quotient?
4. Write short note on the functions of chloroplast.
5. Write notes on photosynthetic pigments.

III. Answer the following questions in brief. 2 × 4 = 8

1. i) What is collateral vascular bundle?
   ii) Draw and label the structure of oxysomes.
2. i) Write a short note on mesophyll.
   ii) What is the common step in aerobic and anaerobic pathway?

IV. Answer the following questions in detail. 1 × 7 = 7

1. i) Write a notes on xylem and phloem.
   ii) Draw the transverse section of Dicot stem and label its parts.