

SAMPLE CONTENT

PERFECT

BIOLOGY



**Vol.
I**

Based on New Paper Pattern and Latest Textbook

Phenotypic variations:

Phenotypic variations observed within populations may be caused due to genetic differences between individuals, or due to differences in environmental factors, or by interaction between genetics and the environmental factors.



Std. XII Sci.

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PERFECT

BIOLOGY (Vol. I)

Std. XII Sci.

Salient Features

- ☞ Written as per Latest Board Paper Pattern
- ☞ Subtopic-wise segregation for powerful concept building
- ☞ Complete coverage of Textual Exercise Questions and Intext Questions
- ☞ Includes relevant board questions from March 2009 to March 2020
- ☞ Extensive coverage of New Type of Questions
- ☞ ‘Apply Your Knowledge’ section to test application of concepts
- ☞ ‘Quick Review’ at the end of every chapter facilitates quick revision
- ☞ ‘Competitive Corner’ presents questions from prominent competitive examinations
- ☞ About the Chapter, Reading Between the Lines, Enrich Your Knowledge, Gyan Guru, Connections, Cautions, NCERT Corner are designed to impart holistic education
- ☞ Marks provided to the Questions as per relevant weightage wherever deemed necessary
- ☞ Topic Test at the end of each chapter for self-assessment
- ☞ Video/PDF links provided via QR codes for boosting conceptual retention
- ☞ QR Code to access the Model Question Paper along with Solution and Reduced Syllabus as per Board Notification
- ☞ Includes Board Question Paper of March 2022 with solution through QR code

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PREFACE

Perfect Biology Vol. I, Std. XII Sci. is intended for every Maharashtra State Board aspirant of Std. XII, Science. The scope, sequence, and level of the book are designed to match the new textbook issued by the Maharashtra State board.

At this crucial juncture in their lives, when the students are grappling with the pressures of cracking a career-defining board examination, we wanted to create a book that not only develops the necessary knowledge, tools, and skills required to excel in the examination, but also enables students to appreciate the beauty of the subject and piques their curiosity.

We believe that students respond favourably to meaningful content, if it is presented in a way that is easy to read and understand, rather than being mired down with facts and information. Consequently, we have always placed the highest priority on writing clear and lucid explanations of fundamental concepts. Moreover, special care has been taken to ensure that the topics are presented in a logical order. The coherent Question/Answer approach helps students expand their horizon of understanding of the concepts.

The primary purpose of this book is to assist the students in preparing for the board examination. However, this is closely linked to other goals: to exemplify how important and how incredibly interesting Biology is, and to help the student become an expert thinker and problem solver.

Every chapter in this book begins with a brief introduction of the topic to capture students' imagination and stimulate their appetite for the topic. The scope of the book extends beyond the State Board examination as it also offers a plethora of Multiple Choice Questions (MCQs) in order to familiarize the students with the pattern of competitive examinations.

In addition, the Topic-Test has been carefully crafted to focus on concepts, thus providing the students with a quick opportunity for self-assessment and giving them an increased appreciation of chapter-preparedness. Relevant questions of Board Examination from March 2009 to March 2020 are provided so that students would get an idea about the types of questions that are asked in Board Examinations. '**Model Question Paper**' along with solution based on updated Board Paper Pattern provided through QR Code would help students to assess their preparedness for final Board Examination.

We believe that the study of Biology helps in the understanding of many fascinating and important phenomena. In this vein, we have put an effort to relate Biology to real-world events in order to show students that Biology is a vibrant, constantly evolving science that has relevance in our modern world. We hope this book becomes a valuable tool for you and helps you to understand the concepts of Biology.

*Our **Perfect Biology Vol. I, Std. XII Sci.** adheres to our vision and achieves several goals: **building concepts, recapitulation, self-study, self-assessment and student engagement**-all while encouraging students towards cognitive thinking.*

- Publisher

Edition: Fourth

The journey to create a complete book is strewn with triumphs, failures and near misses. If you think we've nearly missed something or want to applaud us for our triumphs, we'd love to hear from you.

Please write to us on: mail@targetpublications.org

Disclaimer

This reference book is transformative work based on textbook Biology; Reprint: 2021 published by the Maharashtra State Bureau of Textbook Production and Curriculum Research, Pune. We the publishers are making this reference book which constitutes as fair use of textual contents which are transformed by adding and elaborating, with a view to simplify the same to enable the students to understand, memorize and reproduce the same in examinations.

This work is purely inspired upon the course work as prescribed by the Maharashtra State Bureau of Textbook Production and Curriculum Research, Pune. Every care has been taken in the publication of this reference book by the Authors while creating the contents. The Authors and the Publishers shall not be responsible for any loss or damages caused to any person on account of errors or omissions which might have crept in or disagreement of any third party on the point of view expressed in the reference book.

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KEY FEATURES

'About the Chapter' is a short introduction designed to stimulate students' appetite for the topic.

About the chapter

Reading between the lines

Reading between the lines provides elaboration or missing fragments of the concept which is essential for complete understanding of the concept.

NCERT Corner covers information from NCERT textbook relevant to topic.

NCERT Corner

Connection

Connections enable students to interlink concepts covered in different chapters.

Caution helps students to clarify the differences between two related words or concepts.

Caution

Diagrams in Hand-drawn Format

Diagrams in Hand-drawn format are easy to memorize, save time and efforts of the students.

QR code provides:

- i. Access to a video/PDF in order to boost understanding of a concept or activity
- ii. Model Paper with Solution
- iii. Reduced Syllabus as per Board Notification
- iv. Solution to Board Question Paper of March 2022

QR Codes

Enrich Your Knowledge

Enrich Your Knowledge presents fascinating information about the concept covered.

Continued...

KEY FEATURES

Gyan Guru illustrates real life applications or examples related to the concept discussed.

**GG-Gyan
Guru**

**Apply
Your
Knowledge**

Apply Your Knowledge includes challenging questions.

Quick review includes tables/ flow charts to summarize the key points in a chapter.

**Quick
Review**

**Competitive
Corner**

Competitive Corner presents latest questions from prominent [NEET (UG), NEET (Odisha), MHT CET] competitive exams based entirely on the syllabus covered in the chapter.

Includes selective Board questions from March 2009 to March 2020

**Board
Questions**

PAPER PATTERN

- There will be one single theory paper of 70 Marks and practical examination of 30 Marks in Biology.
- Duration of theory paper will be 3 hours.

Section A: (18 Marks)

This section will contain Multiple Choice Questions and Very Short Answer (VSA) type of questions.

There will be 10 MCQs and 8 VSA type of questions, each carrying **One** mark.

Students will have to attempt all the questions.

Section B: (16 Marks)

This section will contain 12 Short Answer (SA-I) type of questions, each carrying **Two** marks.

Students will have to attempt any 8 questions.

Section C: (24 Marks)

This section will contain 12 Short Answer (SA-II) type of questions, each carrying **Three** marks.

Students will have to attempt any 8 questions.

Section D: (12 Marks)

This section will contain 5 Long Answer (LA) type of questions, each carrying **Four** marks.

Students will have to attempt any 3 questions.

Distribution of Marks According to the Type of Questions

Type of Questions		
MCQ	1 Mark each	10 Marks
VSA	1 Mark each	8 Marks
SA - I	2 Marks each	16 Marks
SA - II	3 Marks each	24 Marks
LA	4 Marks each	12 Marks

CONTENTS

Chapter No.	Chapter Name	Marks without option	Marks with option	Page No.
1	Reproduction in Lower and Higher Plants	6	8	1
2	Reproduction in Lower and Higher Animals	6	8	30
3	Inheritance and Variation	4	6	74
4	Molecular Basis of Inheritance	4	6	111
5	Origin and Evolution of Life	4	6	147
6	Plant Water Relation	5	7	181
7	Plant Growth and Mineral Nutrition	5	7	207
8	Respiration and Circulation	7	10	237
	Board Question Paper March 2022 with solution through QR code			288
•	Scan the given Q.R. Code to access the Reduced Syllabus.			
•	Scan the given Q.R. Code to download the Model Question Paper with Solution.			

[Reference: Maharashtra State Board of Secondary and Higher Secondary Education, Pune - 04]

- Note:**
- * mark represents Textual question.
 - # mark represents Intext question.
 -  symbol represents textual questions that need external reference for an answer.
 - This Reference Book is based on the Entire Textbook (Complete Syllabus) of Biology Prescribed by Maharashtra State Board.  symbol represents the content that belongs to the Reduced Syllabus as per the State Board Notification.
 - Table provided at the beginning of the chapter facilitates students to find out Textual Exercise Questions in Target Notes.
 - Chapters 9 to 15 are a part of Perfect Biology Vol. II, Std. XII (Sci.)

Scan the adjacent QR Code to know more about our **“Model Question Papers with solutions”** book for Std. XII (Sci.) and Gear up yourself to score more in the XII Board Examination.

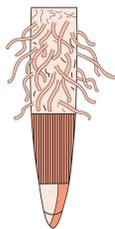


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6

Plant Water Relation



About the chapter...

This chapter is all about the water requirement of the plant, roots involved in water absorption, mechanism of absorption and transport of water and minerals in the plants, along with the importance of transpiration for the plant.

This chapter carries a weightage of 7 marks with options and 5 marks without options in the board examination.

CONTENTS AND CONCEPTS

- 6.0 Introduction
- 6.1 Properties of water
- 6.2 Water absorbing organ
- 6.3 Water available to roots for absorption
- R 6.4 Absorption of water by roots from soil
- R 6.5 Water Potential (Ψ)
- R 6.6 Plasmolysis
- R 6.7 Path of water across the root (i.e. from epiblema upto xylem in the stelar region)
- R 6.8 Mechanism of absorption of water
- R 6.9 Translocation of water
- R 6.10 Transport of mineral ions
- R 6.11 Transport of food
- R 6.12 Transpiration
- R 6.13 Structure of stomatal apparatus

TEXTBOOK EXERCISE QUESTIONS

Textbook Exercise Question No.	Target Notes			Textbook Exercise Question No.	Target Notes		
	Subtopic No.	Question No.	Page No.		Subtopic No.	Question No.	Page No.
Q.1 Multiple choice questions				Q.3 Answer the following questions			
1	6.3	2	203	8	6.13	86	199
2	6.9	18	204	9	6.7	40	189
3	6.4	8	204	Q.4 Long Answer Questions			
4	6.13	22	204	1	6.2	7	183
5	6.4	19	204	2	6.7	39	188
6	6.4	11	204	3	6.9	55	192
7	6.4	6	203	4	6.13	85	199
8	6.7	3	203	5	6.10	59	193
9	6.12	23	204				
10	6.4	10	204				
Q.2 Very short answer type questions							
1	6.4	24	186				
2	6.6	34	188				
3	6.5	32	188				
4	6.6	37	188				
5	6.9	52	192				
6	6.9	57	193				
7	6.13	84	199				

Page no. **182** to **190** are purposely left blank.

To see complete chapter buy **Target Notes** or **Target E-Notes**



READING BETWEEN THE LINES

**In passive absorption,**

- When the leaf loses water due to transpiration, it develops water deficit or suction pressure.
- To overcome this deficit, it draws water from the petiole.
- The petiole in turn draws water from the stem and the stem draws from the root.
- The suction force is thus transmitted from veins to root hair.

In Active absorption,

- When water enters the root hair cell by osmosis, it becomes fully turgid and its D.P.D. becomes zero.
- Inner cortical cell possess higher D.P.D. therefore water moves into this cell by osmosis. Consequently the inner cortical cell becomes turgid and its D.P.D. becomes zero.
- Water from this cell moves to the next inner cell. Hence, each cell becomes alternately turgid and flaccid and water moves from cell to cell in cortex.
- Metabolic energy is required to maintain high O.P. Hence, the process is called active absorption.

Q.47. Explain in detail osmotic and non-osmotic absorption. [3/4 marks]

Ans: Active absorption of water can be of two types: Osmotic and non-osmotic absorption.

i. Osmotic absorption:

- Atkins and Priestly (1922) proposed that water is absorbed from soil into xylem of the root according to the osmotic gradient.
- To create osmotic conditions, there is an expenditure of energy. But such absorption does not directly require an expenditure of energy.
- A gradient of DPD develops from cell of epiblema to pericycle due to activity of living cells of root.
- As the process is continuous, a hydrostatic pressure, called root pressure is developed in root cells.
- This root pressure forces water from pericycle to xylem and then upwards to the stem.

ii. Non-osmotic absorption:

- Kramer and Thimann (1959) proposed non-osmotic absorption theory.
- Sometimes, water is absorbed from soil against the concentration gradient.

- Such absorption requires an expenditure of energy released during respiration.
- Poor supply of oxygen retards water absorption.
- Moreover low temperature retards water uptake because of decrease in the rate of respiration.
- Use of metabolic inhibitors also retards the rate of respiration and thus the water uptake.

6.9 Translocation of water

Q.48. Define ascent of sap. [1Mark]

Ans: The transport of water with dissolved minerals from root to other aerial parts like stem and leaves, against the gravity, is called translocation or ascent of sap.

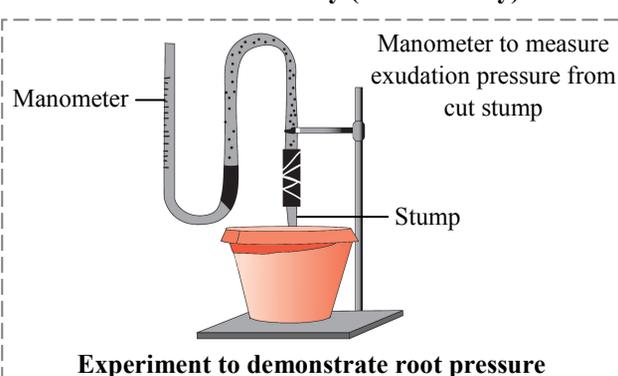
***Q.49. Discuss theories of water translocation. [3 marks]**

Ans: Theories of water translocation:

- Various theories have been put forth to explain the mechanism of translocation of water. These theories include Vital force theory, Relay pump theory, Physical force theory, Root pressure theory, etc.
- Root Pressure Theory (Vital Theory):** This theory was proposed by J. Priestley. According to this theory, the activity of living cells of root is responsible for translocation of water.
- Capillarity theory (physical force theory):** This theory was put forth by Boehm in (1863). According to this theory, physical forces and dead cells are responsible for ascent of sap.
- Cohesion- tension theory (Transpiration pull theory):** This theory was put forth by Dixon and Jolly (1894). This is presently widely accepted theory explaining ascent of sap in plants. This theory is based on two principles i.e. Cohesion and adhesion, and transpiration pull.

Q.50. Draw figure of experimental set up to demonstrate root pressure and explain root pressure theory in detail. [4 marks]

Ans: Root Pressure Theory (Vital Theory):





- i. This theory was proposed by **J. Priestley**.
- ii. According to this theory, the **activity of living cells** of root is responsible for translocation of water.
- iii. When a stem of potted plant is cut few inches above the soil by a sharp knife, xylem sap is seen flowing out/ oozing out through the cut end. This exudation is a good proof for the existence of root pressure.
- iv. As water absorption by roots is constant and continuous process, a hydrostatic pressure is developed in the living cells of root cortex. This is termed as root pressure (coined by S. Hales).
- v. It is due to root pressure water along with dissolved minerals is not only forced into xylem but it is also conducted upwards against the gravity.
- vi. Root pressure seems to be largely an osmotic phenomenon and its development is an active process.
- vii. The value of root pressure is **+1 to +2 bars** which is enough to pump water to a height of 10 to 20 meters.
- viii. The factors like oxygen, moisture, temperature of soil, salt contents, etc. influence the root pressure.

Q.51. Root pressure is not the sole mechanism explaining the ascent of sap in all plants of varying heights. Give reason. [2/3 marks]

OR

Write limitations of root pressure theory.

Ans: Although, ascent of sap takes place due to root pressure, there are certain limitations to root pressure theory:

- i. It is not applicable to plants taller than 20 meters.
- ii. Ascent of sap can also occur even in the absence of root system.
- iii. Root pressure value is almost nearly zero in taller gymnosperm trees.
- iv. In actively transpiring plants, no root pressure is developed.
- v. Xylem sap under normal condition is under tension i.e. it shows negative hydrostatic pressure or high osmotic pressure.

Thus, root pressure is not the sole mechanism explaining the ascent of sap in all plants of varying heights.

***Q.52. Which type of plants have negative root pressure? [1Mark]**

Ans: The plants in which transpiration occurs rapidly especially during midsummer shows negative root pressure.

***Q.53. Explain capillarity theory of water translocation. [3 marks]**

Ans: Capillarity theory of water translocation:

- i. This theory was put forth by Boehm in 1863.
- ii. According to this theory, physical forces and dead cells are responsible for ascent of sap. For e.g. Wick dipped in an oil lamp, shows capillarity due to which oil is raised upwards; Capillarity is responsible for the conduction of water in a straw upto a certain height, depending upon the diameter of the straw.
- iii. Capillarity is because of surface tension, and forces of cohesion (attraction between like molecules) and adhesion (attraction between unlike molecules).
- iv. Xylem vessel/ tracheid with its lumen can be compared to the straw.
- v. Water column exist because of combined cohesive and adhesive forces of water and xylem wall, due to capillarity.
- vi. Due to capillarity, water is raised or conducted upwards against the gravity, to few centimetres only.

Q.54. Write objections/ Limitations of capillarity theory: [2 marks]

Ans: Objections/ Limitations of capillarity theory:

- i. Capillary tube (xylem) must be continuously and completely hollow from one end to the other end but tracheids in the xylem show closed end-walls.
- ii. The lower end of capillary tube i.e. xylem must be in direct contact with soil water. However, there exists a barrier of root cortex between xylem and soil water.
- iii. Narrower the capillary tube, greater is the height to which water column is raised. Thus, taller trees should show xylem vessels with very narrow bore (diameter). However, in nature the tall trees show xylem vessels having wider bore.

***Q.55. Explain cohesion theory for translocation of water. [4 marks]**

Ans: Cohesion theory (Transpiration pull theory) for translocation of water:

- i. This theory was put forth by Dixon and Jolly (1894).
- ii. This is presently widely accepted theory explaining ascent of sap in plants.
- iii. It is based on two principles i.e. Cohesion and adhesion, and transpiration pull.
- iv. **Cohesion and adhesion:**
 - a. A strong force of attraction between water molecules is called **cohesive force**.



- b. A strong force of attraction between water molecules and lignified wall of xylem vessel is called **adhesive force**.
- c. Due to combined cohesive and adhesive forces a continuous water column is developed (formed) in the xylem from root upto the tip of the topmost leaf in the plant.
- v. **Transpiration pull:**
- a. The transpiration pull developed in the leaf vessel is transmitted down to root and thus accounts for the ascent of sap.
- b. Excess water is lost in the form of vapour, mainly through the stomata found on leaf.
- c. This water loss increases D.P.D. of mesophyll cells. These cells withdraw water ultimately from xylem in the leaf.
- d. In other words, due to continuous transpiration, a gradient of suction pressure (i.e. D.P.D.) is developed right from guard cells up to the xylem in the leaf. This will create a tension (called negative pull or transpiration pull) in the xylem.
- e. Consequently, water column is pulled out of xylem. Thus, water is pulled upwards passively against the gravity leading to the ascent of sap.

Q.56. Write objections/ limitations of cohesion theory for translocation of water. [2 marks]

Ans:

- i. For transpiration pull to operate, water column should be unbroken and continuous. However, due to temperature fluctuations during day and night, gas bubbles may enter in water column breaking the continuity.
- ii. This mechanism assumes that tracheids are more efficient than the vessels, as their end walls support water column. However, vessels are more evolved than tracheids and are more efficient.
- iii. If plant leaves are smeared with vaseline in order to stop transpiration, even then ascent of sap occurs.
- iv. Ascent of sap also occurs in deciduous plants that have shed all of their leaves.

***Q.57. In which conditions transpiration pull will be affected? [1Mark]**

Ans: Refer Q.56 (i)

6.10 Transport of mineral ions

Q.58. Which are the readily mobilized ions in plants? [1 Mark]

Ans: Ions like phosphorus, sulphur, nitrogen and potassium are readily mobilized ions in plants.

***Q.59. Explain the active absorption of minerals.**

[2/3 marks]

Ans: Active Absorption:

- i. Uptake of mineral ions against concentration gradient is called active absorption.
- ii. Such movement requires an expenditure of energy by the absorbing cell. This energy is derived from respiration and is supplied through ATP.
- iii. The rate of active absorption of minerals depends upon respiration.
- iv. When the roots are deprived of oxygen, they show a sudden drop in active absorption of minerals. The mineral ions accumulated in the root hair pass into the cortex and finally reach the xylem.
- v. The minerals in the xylem are then carried along with water to other parts of the plant along the transpiration stream and are subsequently assimilated into organic molecules and then redistributed to other parts of the plant through the phloem.



Connections

In chapter 7, you will study about passive and active absorption of minerals in detail.

Q.60. 'Soil would not be the only source for mineral uptake'. Justify the statement. [2 marks]

Ans: Soil serves as main source for minerals; however it is not the only source for mineral uptake. It is because;

- i. Mineral ions can be remobilized within the parts of the plant.
- ii. Older parts (like leaves in deciduous plants) export their ions to younger leaves before the fall.
- iii. Thus ions like phosphorus, sulphur, nitrogen and potassium are readily mobilized; however ions like calcium from structural components are not remobilized.

***Q.61. Write on macro and micro nutrients required for plant growth. [2 marks]**

Ans: On the basis of required quantity, nutrients can be classified as:

- i. **Macronutrients:** Some minerals like C, H, O, P, N, S, Mg, K, Ca required in large quantity for normal growth of plant, are called macro elements. Macronutrients are required in large quantity. They mainly play the nutritive and structural roles.



- ii. **Micronutrients:** Some minerals like Cu, Mo, Mn, Cl, Bo, Zn required in small quantity for growth of plant, are called micro elements. Micronutrients are required in traces because they function in the catalytic role as co-factors.



Connections

In chapter 7, you will study micronutrients and macronutrients in detail.

***Q.62. Enlist macronutrients and micronutrients required for plant growth. [1Mark]**

Ans: Refer Q.61

Q.63. Match the columns: [2 marks]

	Column I		Column II
(A)	Macronutrient	1.	N and Zn
(B)	Micronutrient	2.	Mn and Cu
		3.	Mg and K

Ans: (A) – 3 (B) – 2

Q.64. Internet my friend (Textbook page no. 127)

- The general roles of minerals in the life of plants.
- The role of essential minerals in the day to day life of plants.

Ans:

- Minerals are essential for healthy growth of a plant.
 - Mineral are required for different plant processes like chlorophyll formation, cell wall formation, photosynthesis, flowering, opening and closing of stomata, etc.
 - Many enzymes need mineral ions as activators or co-factors to catalyse chemical reactions.
- Essential minerals are those that are indispensable without which plants cannot complete their life cycle. The deficiency of such mineral elements develops some deficiency symptoms.
Essential mineral elements are usually classified as macronutrients or micronutrients, according to their relative concentration in plant tissue.

[Note: Students are expected to search on internet about role of minerals in the life of plants and role of essential minerals in the day to day life of plants]

Q.65. State true or false and justify your answer: 'Xylem transports only inorganic and phloem transports only organic molecules.'

[2 marks]

Ans:

- The given statement, 'Xylem transports only inorganic and phloem transports only organic molecules' is **false**.
- Analysis of xylem exudate shows that some nitrogen travels as inorganic ions whereas much of it is carried in the organic form like amino acids and related compounds.
- Small amount of inorganic molecules of phosphorus and sulphur are also carried.
- Some exchange of materials also occurs between xylem and phloem.

Q.66. Do you know? (Textbook page no. 127)

[3 marks]

- Different modes of passive absorption and active absorption of minerals in plants.
- Carrier concept of active absorption.

Ans:

- Passive absorption of minerals can take place by direct **ion-exchange**, **in-direct ion-exchange**, **mass flow** and **Donnan equilibrium**.
 - Active absorption of minerals can take place by using **Carrier** (transport occurs by a special carrier protein) and **Cytochrome Pump** (transport occurs by electrochemical gradient generated by electron transport). According to cytochrome pump theory, only anions are absorbed actively (requires energy) and cations are absorbed passively (does not require energy).
- Carrier concept of active absorption:** According to this theory, plasma membrane is impermeable to some ions. Absorption of these ions is facilitated by some special proteins present on plasma membrane; such proteins are called carrier proteins. Carrier proteins combine with ions to form carrier-ion-complex which can move across plasma membrane. When carrier-ion-complex reaches inner surface of plasma membrane, it releases ion into lumen of cell. This carrier-ion-complex again moves towards outer surface of plasma membrane to accept new ion.



Connections

In chapter 7, you will study about **Donnan equilibrium** and **Carrier hypothesis** theory in detail.

**6.11 Transport of food**

Q.67. What is translocation of food? Explain the path of translocation. [3 marks]

Ans:

- The movement of food from the **source** (the part where food is synthesized i.e. the leaf) to **sink** (the part where food is utilized) is called as translocation of food.
- Food needs to be translocated to longer distances in higher plants. Hence plants must have adequate channels for the transport of food.
- Sieve tubes and vessels are structurally suited for longitudinal (vertical) translocation.
- The ringing experiment, structure and distribution of phloem, chemical analysis of phloem sap and use of isotope ^{14}C , clearly point out that the phloem tissue is primarily responsible for flow of food in longitudinal downward direction.
- The transport of food occurs in vertical and lateral direction.
- The horizontal (lateral) translocation occurs from phloem to pith or phloem to cortex via medullary rays in the stem.
- Food is always translocated in the form of sucrose (soluble form) and always along the concentration gradient from source to sink.

[Note: Radial translocation is the lateral movement of organic solute. It occurs from the cells of pith to the cells of cortex and epidermis. The radial translocation occurs through the medullary rays.]

NCERT Corner

- The source and sink may be reversed depending on the season, or the plant's needs.
- Sugar stored in roots can be mobilized to become a source of food in the early spring when the buds of trees act as sink. These buds required energy for growth and development of the photosynthetic apparatus.
- Since the source-sink relationship is variable, the direction of movement in the phloem can be upwards or downwards, i.e., bi-directional.

Q.68. Explain why xylem transport is unidirectional and phloem transport bi-directional. [NCERT] [2 marks]

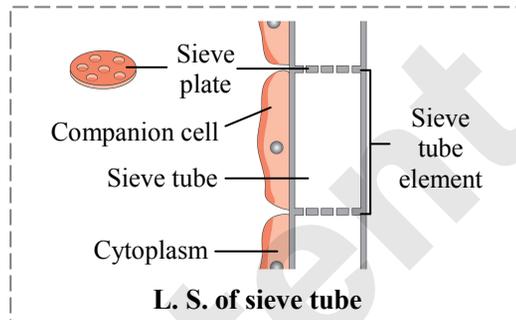
Ans:

- The transport of water in the xylem takes place only from the roots to the leaves. Therefore, the movement of water and minerals in the xylem is unidirectional.

- Movement of food occurs through phloem from source to sink. The source and sink may be reversed depending on the season, or the plant's needs. Thus transport of food through phloem is bidirectional.

Q.69. Draw neat and labelled diagram of L.S. of sieve tube. [2 marks]

Ans:



Q.70. Explain in detail vertical and lateral translocation of food. [3 marks]

Ans: The translocation of food occurs in **vertical** and **lateral** direction.

i. Vertical translocation:

- In vertical (longitudinal) transport, food is translocated in downward direction from leaves (source) to stem and root (sink).
- It also occurs in upward direction during germination of seed, bulbils, corm, etc.
- Upward translocation also occurs from leaves to growing point of stem, to developing flowers and fruits situated near the ends of the branches of stem.

ii. Lateral translocation:

- It occurs horizontally/laterally across the root and stem.
- When food is translocated from phloem to pith, it is called **radial translocation** and from phloem to cortex, it is called **tangential translocation**.

[Note: Radial translocation is the lateral movement of organic solute. It occurs from the cells of pith to the cells of cortex and epidermis. The radial translocation occurs through the medullary rays.]

Q.71. Enlist the different theories/mechanisms put forth to explain sugar transport through phloem. [3/4 marks]

Explain the most convincing theory amongst them.

Ans:

- Different mechanisms/ theories like diffusion, activated diffusion, protoplasmic streaming, electro-osmosis, Munch's pressure-flow, etc. are put forth to explain sugar transport through phloem.



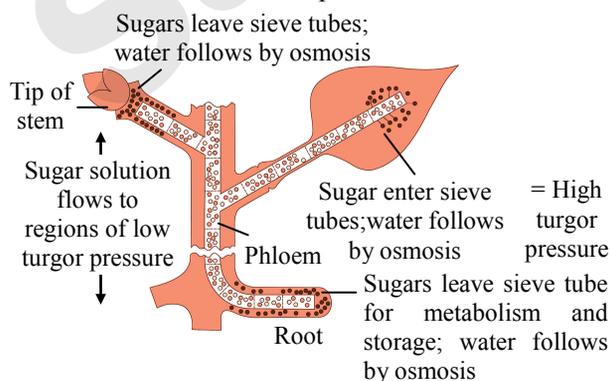
- ii. The most convincing theory amongst them is Munch's pressure flow theory or mass flow hypothesis.
- iii. **Munch's pressure flow theory/Mass flow hypothesis:**
 - a. Ernst Munch proposed that photosynthetic cell synthesizes glucose. Hence, its osmotic concentration increases.
 - b. Due to endosmosis water is absorbed from surrounding cells and xylem. Due to which cell becomes turgid.
 - c. Due to increase in turgor pressure, sugar from photosynthetic cell is forced ultimately into the sieve tube of the vein. This is called **loading of vein**.
 - d. At the sink end, root cell utilizes sugar and also polymerizes excess sugar into the starch. Its osmotic concentration is lowered. Exosmosis occurs.
 - e. Water in the root cell is lost to surrounding cells, thereby decreasing the turgidity of cell. As a result turgor pressure is lowered.
 - f. Hence, a turgor pressure gradient is developed from sieve tube in the leaf to the root cell.
 - g. Consequently, food is translocated along the concentration gradient, passively. This is called **unloading of vein**.
 - h. At the sink end sugar is used and excess water exudes into the xylem.

Q.72. What are the limitations of Munch's pressure flow theory? [2 marks]

- Ans: Limitations of Munch's pressure flow theory:**
- i. Munch's pressure flow theory does not explain bidirectional transport of food.
 - ii. According to Munch, pressure flow is purely a physical process.

NCERT Corner

Accepted mechanism for translocation of sugars from source to sink via the phloem.



Diagrammatic representation of mass flow in a plant

Glucose (Prepared by leaves (**source**) during photosynthesis)

↓
Converted to

Sucrose

↓
Moves to

Companion cells

↓
Sugar is transported by active transport to

Phloem sieve tube cells

↓
Entry of sucrose makes phloem environment hypertonic thereby allowing influx of water into phloem from nearby xylem by osmosis.

↓
As a result, osmotic pressure builds up in phloem which causes phloem sap to move from the source to the areas with lower osmotic pressure (i.e. towards **sink**) by active transport.

↓
At sink, sucrose is converted to complex carbohydrates (Cellulose or starch) and actively transported out of the phloem.

↓
Due to loss of solute from phloem, a high water potential is created.

↓
As a result, water passes out of phloem and returns eventually to xylem.

ENRICH YOUR KNOWLEDGE



Ring-girdle experiment: (An experiment which proves that phloem transports food is known as girdling)

- i. Ring of the bark (upto the phloem layer) is removed.
- ii. After a few weeks, the bark above the ring swells, while the root dies.
- iii. As the phloem gets removed, the transport of food down the plant is not possible. Thus, the food is transported only up to the ringed region, which causes the swelling.
- iv. Due to unavailability of food, the lower plant starves and dies eventually. Thus, it is proved that phloem is the food transporting vessel.

**6.12 Transpiration**

Q.73. Define guttation. Name the structure involved in this process. [2 marks]

Ans:

- The loss of water in the form of liquid is called guttation.
- It occurs through special structures called water stomata or **hydathodes**.

Q.74. Define transpiration. Name the three sites that are mainly involved in this process. [2 marks]

Ans:

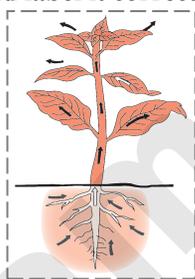
- The loss of water in the form of vapour is called transpiration that occurs through leaves, stem, flowers and fruits.
- Transpiration occurs through three main sites - **cuticle, stomata and lenticels**.

Q.75. Distinguish between Guttation and Transpiration [NCERT] [2 marks]

Ans: Guttation and Transpiration

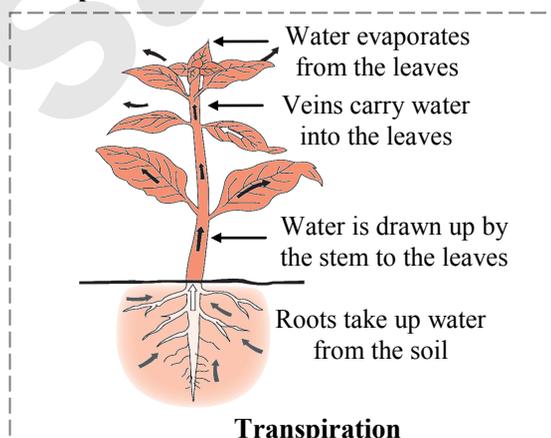
No.	Guttation	Transpiration
i.	It is water loss in the form of liquid.	It is water loss in the form of water vapours.
ii.	It occurs through hydathodes.	It occurs through cuticle, stomata and lenticels.

Q.76. Identify the process represented in the given figure and label it correctly. [3 marks]



Ans:

- The given figure represents the process of **transpiration**.



Q.77. Explain in detail three types transpiration. [4 marks]

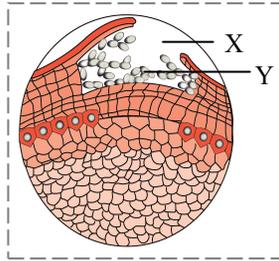
[4 marks]

Ans:

- Three types transpiration are **cuticular, stomatal and lenticular**.
- Cuticular transpiration:**
 - Cuticle is a layer of waxy substance- cutin, present on outer surface of epidermal cells of leaves and stem.
 - Cuticular transpiration occurs by simple diffusion and contributes 8-10% of the total transpiration.
 - Cuticular transpiration occurs throughout the day and its rate is inversely proportional to thickness of cuticle.
- Lenticular transpiration:**
 - Lenticels are small raised structures composed of loosely arranged complementary cells.
 - Each lenticel is a porous tissue consisting of cells with large intercellular spaces in the periderm of the secondarily thickened organs and the bark of woody stems and roots of dicotyledonous flowering plants.
 - Lenticels are present in bark of old stem and pericarp of woody fruits but are absent in leaves.
 - Lenticular transpiration contributes only about 0.1-1.0% of total transpiration.
 - Rate of lenticular transpiration is very slow.
 - It also occurs throughout the day.
- Stomatal transpiration:**
 - Each stoma is a minute aperture formed of two guard cells and accessory cells.
 - Stomata are located in the epidermis of young stem and leaves.
 - Leaves generally show more number of stomata on the lower surface.
 - Depending upon distribution of stomata on leaves, leaves are categorized into three types namely epistomatic- on upper epidermis (Hydrophytes e.g. Lotus), hypostomatic- on lower epidermis (Xerophytes e.g. *Nerium*) and amphistomatic- on both surfaces (Mesophytes e.g. Grass).
 - Stomatal transpiration occurs only during daytime. (Exception: Desert plants).
 - 90 to 93% of total transpiration occurs through stomata and that too during day time only.



Q.78. Identify label X and Y in the given figure of structure of lenticel and write how it helps in transpiration.



[2 marks]

Ans:

i. In the given figure of structure of lenticel:

X: Lenticular pore

Y: Loose complementary cells

ii. Lenticular transpiration: Refer Q.77 (iii)

Q.79. Define the following terms: [2 marks]

i. Stomatal Frequency

ii. Stomatal index (I)

Ans:

i. Stomatal Frequency: The number of stomata per unit area of leaf is called stomatal frequency.

ii. Stomatal index (I): The correlation between the number of stomata and number of epidermal cells per unit area is called stomatal index (I).



GG - Gyan Guru

Porometer

Porometer is an instrument used for measuring the area of the stomatal openings of a leaf.

In porometer, stomatal conductance of leaf is measured. Stomatal conductance is the measure of the rate of passage of carbon dioxide or water vapor through the stomata of a leaf.

Q.80. Activity (Textbook page no. 131)

Prepare stomatal frequency chart for any six angiospermic plants in your area.

Plant name	Details

Ans: Stomatal frequency: Refer Q.79 (i)

Formula to calculate stomatal frequency:

Number of stomata per field / Area of field.

[Note: Students are expected to perform this activity on their own]

[Note: Students can scan the adjacent QR code to watch video about preparation of slide of leaf peel to calculate stomatal frequency]



Q.81. Match the columns:

[3 marks]

i.

	Column I		Column II
(A)	Lenticular transpiration	1.	90 to 93%
(B)	Cuticular transpiration	2.	8-10%
(C)	Stomatal transpiration	3.	0.1-1.0%

ii.

	Column I		Column II
(A)	Epistomatic leaves	1.	Xerophytes
(B)	Hypostomatic leaves	2.	Hydrophytes
(C)	Amphistomatic leaves	3.	Mesophytes

Ans: i. (A)-3, (B)-2, (C)-1

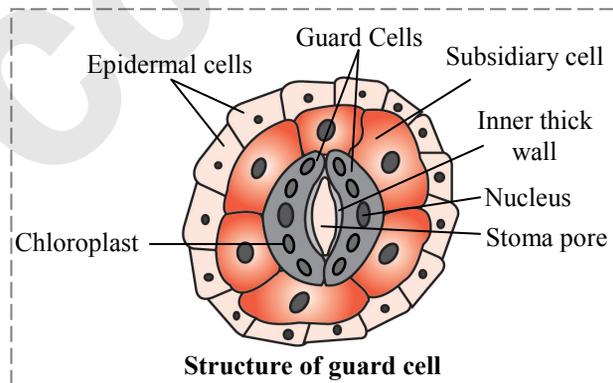
ii. (A)-2, (B)-1, (C)-3

6.13 Structure of stomatal apparatus

Q.82. Draw neat and labelled diagram and describe the structure of stomatal apparatus.

[4 marks]

Ans:



i. Typical stomatal apparatus consists of two guard cells, stoma and accessory cells.

ii. Guard cells:

a. Guard cell is a type of epidermal tissue which may be called as modified, epidermal parenchyma cell.

b. Guard cells are kidney shaped in dicotyledons and dumbbell-shaped in grasses (monocotyledons).

c. Guard cells are living, nucleated cells with unevenly thick walls.

d. Inner wall (wall facing stoma) of guard cells is thick and inelastic, and its lateral (outer) wall is thin and elastic.

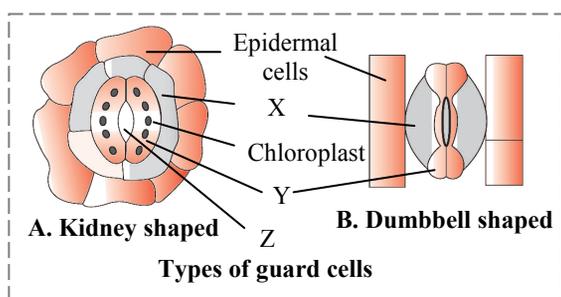
e. Guard cells contain few chloroplasts which are capable of poor photosynthesis.

f. Guard cells have ability to change their size and form due to which stoma opens (widens) or closes (narrows).



- iii. **Stoma:**
- Stoma is a minute, elliptical pore bounded by two kidney/dumbbell shaped guard cells.
 - Excess of water is lost in the form of vapour through the stoma.
- iv. **Accessory cells:**
- These are specialized epidermal cells surrounding the guard cells.
 - Their number is variable and they are the reservoirs of K^+ ions. These are also called **subsidiary cells**.

Q.83. Identify the label 'X', 'Y' and 'Z' in given figure of stomata showing two types of guard cells. [2/3 marks]



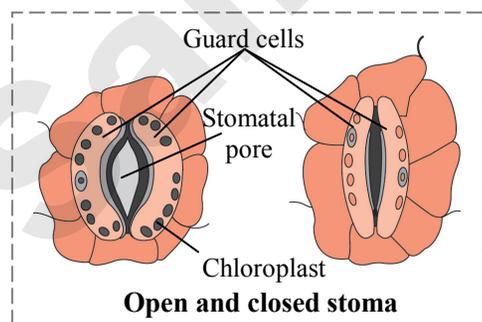
Ans: In given figure of stomata showing two types of guard cells:
 X: Subsidiary cells;
 Y: Guard cells
 Z: Stomatal aperture

***Q.84. Mention the shape of guard cells in *Cyperus*. [1 mark]**

Ans: In *Cyperus*, both kidney shaped and dumbbell shaped guard cells are present.

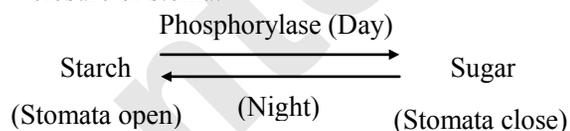
***Q.85. Write mechanism of opening and closing of stoma. [4 marks]**

Ans: Mechanism of opening and closing of stoma:



- Opening and closing of stoma is controlled by turgor of guard cells.
- During day time, guard cells become turgid due to endosmosis.
- Thus turgor pressure is exerted on the thin walls of guard cells.

- Being elastic and thin, lateral walls are stretched out.
- Due to kidney or dumb-bell like shape, inner thick walls are pulled apart to open (widen) the stoma.
- During night time, guard cells become flaccid due to exosmosis.
- Flaccidity closes the stoma almost completely.
- Endosmosis and exosmosis occur due to diurnal changes in osmotic potential of guard cells.
- ix. According to **starch-sugar inter-conversion theory** (Steward 1964), during day time, enzyme phosphorylase converts starch to sugar, thus increasing osmotic potential of guard cells causing entry of water, thereby guard cells are stretched and stoma widens. The reverse reaction occurs at night bringing about the closure of stoma.



[Note: (Day) \rightarrow Starch \rightarrow Sugar \rightarrow Stomata open
 (Night) \rightarrow Sugar \rightarrow Starch \rightarrow Stomata close]

- According to **theory of proton transport** (Levitt-1974), stomatal movement occurs due to transport of protons H^+ and K^+ ions. During daytime, starch is converted into malic acid. Malic acid dissociates to form malate ions and protons. Protons are transported to subsidiary cells and K^+ ions are imported from them. Potassium malate is formed that increases osmolarity and causes endosmosis. Uptake of K^+ ions is always accompanied with Cl^- ions. At night, uptake of K^+ and Cl^- ions is prevented by abscisic acid, changing the permeability of guard cells. Due to this guard cells become hypotonic and thereby become flaccid.

***Q.86. Why do diurnal changes occur in osmotic potential of guard cells? [2 marks]**

Ans:

- According to Steward, diurnal changes occur in osmotic potential of guard cells due to starch-sugar inter-conversion.
- Whereas according to Levitt active transport of potassium ions into the guard cells and out of them causes diurnal changes in osmotic potential of guard cells.
- Endosmosis and exosmosis occur due to diurnal changes in osmotic potential of guard cells.



***Q.87. What is transpiration? Describe mechanism of opening and closing of stomata. [4 marks]**

Ans:

- i. **Transpiration:** Refer Q.74 (i)
- ii. **Mechanism of opening and closing of stomata:** Refer Q.85

Q.88. Write significance of Transpiration. [2 marks]

Ans: Significance of Transpiration:

- i. It removes excess of water.
- ii. It helps in the passive absorption of water and minerals from soil.
- iii. It helps in the ascent of sap.
- iv. As stomata are open, gaseous exchange required for photosynthesis and respiration is facilitated.
- v. It maintains turgor of the cells.
- vi. Transpiration helps in reducing the temperature of leaf and in imparting cooling effect.

Q.89. Write disadvantage of transpiration. [1mark]

Ans: Excessive transpiration leads to wilting and injury in the plant. It may also lead to the death of the plant.

***Q.90. What is transpiration ? Explain role of transpiration. [3 marks]**

Ans:

- i. **Transpiration:** Refer Q.74 (i)
- ii. **Role of transpiration:** Refer Q.88

***Q.91. What is significance of transpiration? Explain root pressure theory and its limitations. [4 marks]**

Ans:

- i. **Significance of transpiration:** Refer Q.88
- ii. **Root pressure theory and its limitations:** Refer Q.50, and Q.51

***Q.92. Why transpiration is called necessary evil? [2/3 marks]**

Ans: Curtis (1926) regarded transpiration as 'a necessary evil', because;

- i. For stomatal transpiration to occur, stoma must remain open, during day time.
- ii. When stomata are open then only the gaseous exchange needed for respiration and photosynthesis, will take place.
- iii. If stomatal transpiration stops, it will directly affect productivity of plant through the loss of photosynthetic and respiratory activity.
- iv. Hence for productivity, stomata must remain open.
- v. Transpiration is necessary evil because water is lost in the process, but transpiration helps in water absorption and transportation in plants, as well as it is essential for imparting cooling effect to the plant.

NCERT Corner

Factors affecting transpiration:

External factors: Temperature, Light, Humidity, Wind speed, Altitude, Amount of water in soil, Atmospheric pressure

Internal factors: Water status of the plant, Total number of stomata, Distribution of stomata, Number of open stomata, Canopy structure, Thickness of cuticle

***Q.93. Define and or explain the terms:**

[1 mark Each]

- | | |
|---------------------|-------------------------|
| i. Osmosis | ii. Diffusion |
| iii. Plasmolysis | iv. Imbibition |
| v. Guttation | vi. Transpiration |
| vii. Ascent of sap | viii. Active absorption |
| ix. DPD | x. Turgor pressure |
| xi. Water potential | xii. Wall pressure |
| xiii. Root pressure | |

Ans:

- i. **Osmosis:** Refer Q.19
- ii. **Diffusion:** Refer Q.12
- iii. **Plasmolysis:** Refer Q.35
- iv. **Imbibition:** Refer Q.10
- v. **Guttation:** Refer Q.73
- vi. **Transpiration:** Refer Q.74
- vii. **Ascent of sap:** Refer Q.48
- viii. **Active absorption:** Refer Q.46(iii)
- ix. **DPD:** Refer Q.14
- x. **Turgor pressure:** Refer Q.23(i)
- xi. **Water potential:** Refer Q.31
- xii. **Wall pressure:** Refer Q.23(ii)
- xiii. **Root pressure:** Refer Q.42

PRACTICAL / PROJECT

***Q.94. Prepare power point presentation for different types of transpiration.**

Ans: Refer Q.77

[Note: Students are expected to collect more information about different types of transpiration]

APPLY YOUR KNOWLEDGE

Q.95.

- i. **What would be the effect on osmotic pressure after addition of 25 mg of sodium chloride in 100ml of pure water?**
- ii. **The diffusion pressure of pure water is theoretically 1236 atm. If 25 mg of sugar is added to 150 ml of pure water. What would be the effect on diffusion pressure?**



iii. With reference to the DPD of a plant cell, what would happen when OP has equal value as that of TP (WP)? [3 marks]

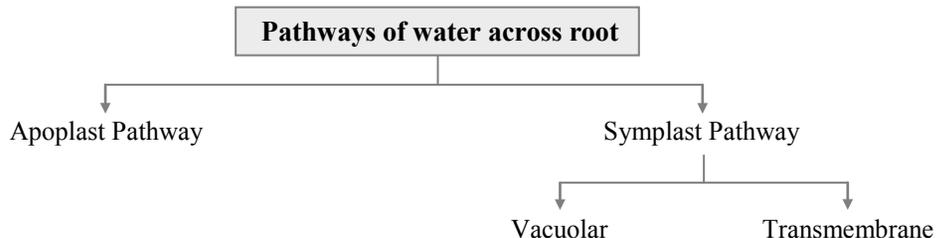
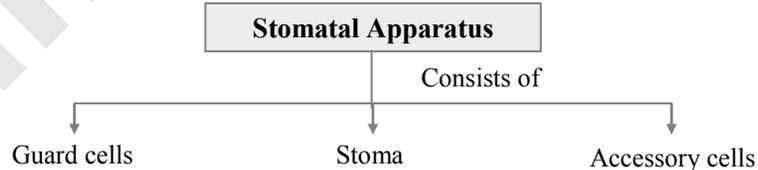
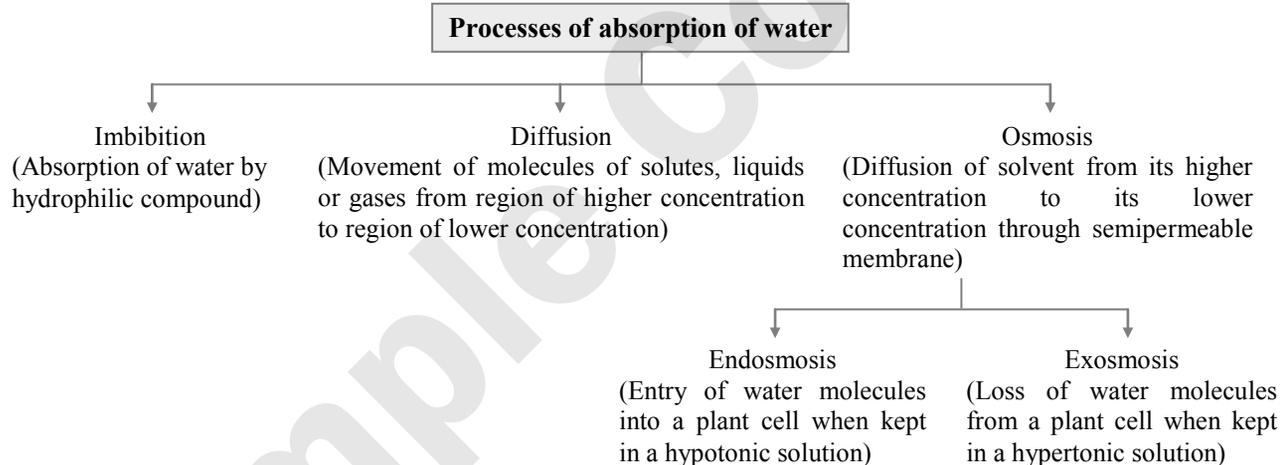
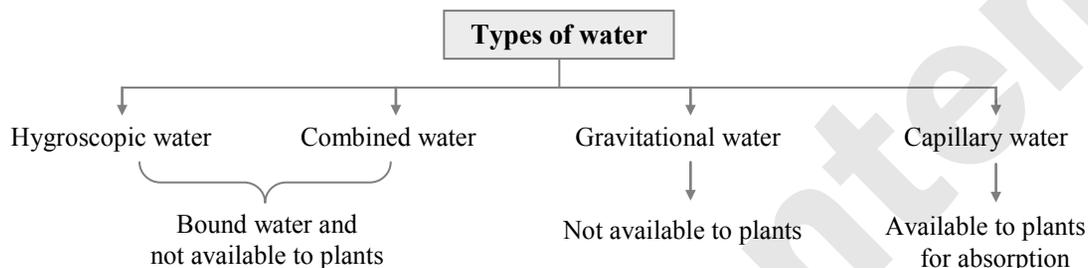
Ans:

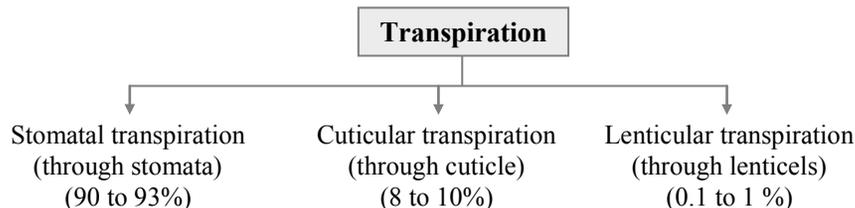
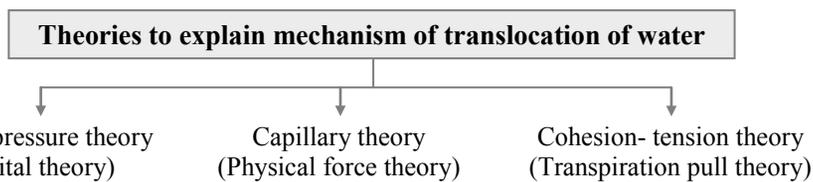
i. When any solute is added to pure water the osmotic pressure of water increases. Therefore, when 25 mg of sodium chloride is added in 100ml of pure water the osmotic pressure would increase.

ii. The diffusion pressure decreases when a solute is added to pure water. Therefore, when we add 25 mg of sugar to 150 ml of pure water its diffusion pressure decreases.

iii. When the value of osmotic pressure (OP) is equal to turgor pressure (TP) then the diffusion pressure deficit (DPD) is zero. The entry of water into the plant cell is prevented.

QUICK REVIEW





EXERCISE

6.1 Properties of water

1. What are the properties of water? **[3 Marks]**

Ans: Refer Q.2

6.2 Water absorbing organ

2. Which are the four regions of a typical root?

[1 Mark]

Ans: Refer Q.5

3. Name the region of a root which possesses root hair.

[1 Mark]

Ans: Refer Q.5

6.3 Water available to roots for absorption

4. i. Which are the four types of water?
ii. Which type of water is available for plants to absorb?

[2 Marks]

Ans: i. Refer Q.8 ii. Refer Q.8 (iv)

R 6.4 Absorption of water by roots from soil

5. Explain the term Imbibition. **[2 Marks]**

Ans: Refer Q.10

6. Give examples of Imbibition. **[1 Mark]**

Ans: Refer Q.10 (vi), Q.11 (i)

7. What is DPD? **[1 Mark]**

Ans: Refer Q.14

8. Name the types of solutions based on concentration and osmotic diffusion.

[1 Mark]

Ans: Refer Q.21

9. Define turgor pressure and wall pressure.

[2 Marks]

Ans: Refer Q.23 (i, ii)

10. Why is osmosis important to plants? **[2 Marks]**

Ans: Refer Q.28

R 6.5 Water Potential (Ψ)

11. Write a short note on water potential. **[2 Marks]**

Ans: Refer Q.31

12. What is the unit to measure water potential?

[1 Mark]

Ans: Refer Q.31 (iii)

R 6.6 Plasmolysis

13. What is turgor pressure of plasmolysed cell?

[1 Mark]

Ans: Refer Q.36 (i)

14. Define Plasmolysis.

[1 Mark]

Ans: Refer Q.35 (i)

R 6.7 Path of water across the root (i.e. from epiblema upto xylem)

15. Which are the two pathways of water across the roots? **[1 Mark]**

Ans: Refer Q.39 (x, xi, xii)

16. Draw neat and labelled diagram of pathways for water uptake by the root. **[2 Marks]**

Ans: Refer Q.39 (Diagram)

17. Define root pressure. **[1 Mark]**

Ans: Refer Q.42 (i)

R 6.8 Mechanism of absorption of water

18. Explain in detail passive and active absorption of water. **[3/4 marks]**

Ans: Refer Q.46

19. Write a short note on osmotic absorption.

[2 Marks]

Ans: Refer Q.47 (i)

**R 6.9 Translocation of water**

20. Who put forth the cohesion tension theory?
[1 Mark]
Ans: Refer Q.49 (iv)
21. Explain in detail root pressure theory.
[2/3 marks]
Ans: Refer Q.50
22. Write limitations of root pressure theory.
[2/3 marks]
Ans: Refer Q.51
23. Write objections of capillarity theory. **[2 marks]**
Ans: Refer Q.54
24. Describe transpiration pull model of water transport in plants. **[NCERT] [2/3 Marks]**
Ans: Refer Q.55

R 6.10 Transport of mineral ions

25. Write about active absorption of minerals.
[2 Marks]
Ans: Refer Q.59
26. Enlist micronutrients and macronutrients in plants.
[1/2 Marks]
Ans: Refer Q.61

R 6.11 Transport of food

27. Explain the pressure flow hypothesis of translocation of sugar in plants.
[NCERT] [2 Marks]
Ans: Refer Q.71 (iii)
28. Explain the Munch's pressure flow theory/Mass flow hypothesis.
[3/4 marks]
Ans: Refer Q.71
29. Explain the terms source and sink with respect to transport of food in plants. **[2 Marks]**
Ans: Refer Q.67 (i)

R 6.12 Transpiration

30. Define guttation. **[1 Mark]**
Ans: Refer Q.73 (i)
31. Which are the three types of transpiration?
[1 Mark]
Ans: Refer Q.77 (i)
32. Write a short note on stomatal transpiration.
[2 Marks]
Ans: Refer Q.77 (iv)

R 6.13 Structure of stomatal apparatus

33. With the help of neat and labelled diagram explain the stomatal apparatus. **[3 Marks]**
Ans: Refer Q.82
34. What is stoma? Write its function. **[2 Marks]**
Ans: Refer Q.82 (iii)
35. Explain in detail mechanism of opening and closing of stomata. **[4 marks]**
Ans: Refer Q.85
36. Transpiration is called as necessary evil. Give reason. **[2/3 marks]**
Ans: Refer Q.92
37. What causes the opening and closing of guard cells of stomata during transpiration?
[NCERT] [2 marks]
Ans: Refer Q.85

MULTIPLE CHOICE QUESTIONS

- [1 Mark Each]**
1. Productivity of plant is mainly affected by the non-availability of
(A) sunlight (B) water
(C) fertilizers (D) micronutrients
- *2. In soil, water available for absorption by root is
(A) gravitational water
(B) capillary water
(C) hygroscopic water
(D) combined water
- *3. Water absorption takes place through
(A) lateral roots (B) root cap
(C) root hair (D) primary root
4. Plants absorb water from the
(A) aerial parts of a plants
(B) rhizosphere
(C) water stomata
(D) all four regions of a root
5. Which of the following is the first step in water absorption?
(A) Imbibition
(B) Active Absorption
(C) Passive absorption
(D) Osmosis
- *6. During rainy season wooden doors warp and become difficult to open or to close because of
(A) plasmolysis (B) imbibition
(C) osmosis (D) diffusion



7. Diffusion is significant in plants in
 (A) absorption of minerals
 (B) exchange of gases
 (C) absorption of water
 (D) all of these
- *8. Water movement between the cells is due to
 (A) T. P.
 (B) W. P.
 (C) DPD
 (D) incipient plasmolysis
- R 9. Osmotic movement of water is on the basis of _____.
 (A) free energy (B) entropy
 (C) translocation (D) imbibition
- *10. Osmosis is a property of
 (A) solute (B) solvent
 (C) solution (D) membrane
- *11. Which of the following type of solution has lower level of solutes than the solution?
 (A) Isotonic (B) Hypotonic
 (C) Hypertonic (D) Anisotonic
- R 12. In a fully turgid cell, DPD is
 (A) always one
 (B) zero
 (C) always negative
 (D) both (B) and (C)
- R 13. In a flaccid cell, if T.P. is zero then
 (A) DPD is equal to O.P
 (B) DPD is greater than O.P
 (C) O.P is greater than DPD
 (D) DPD is also zero
- R 14. Select the incorrect statement from the following.
 (A) DPD is termed as water potential.
 (B) O. P is termed as osmotic potential.
 (C) T. P. has always positive value.
 (D) Water potential of pure water is always negative.
- R 15. Plasmolysis occurs in plant cells when outer solution is
 (A) isotonic (B) hypertonic
 (C) hypotonic (D) mesotonic
- R 16. In symplast pathway, water passes across
 (A) Cell wall
 (B) intercellular spaces
 (C) plasmodesmata
 (D) both (A) and (B)
- R 17. Select the incorrect statement with respect to passive absorption of water.
 (A) No ATP is utilized.
 (B) The rate of respiration is not affected.
 (C) There is expenditure of energy generated through respiratory activity of cells.
 (D) Occurs during day time when transpiration is in progress.
- *18. The most widely accepted theory for ascent of sap is
 (A) capillarity theory
 (B) root pressure theory
 (C) diffusion
 (D) transpiration pull theory
- *19. Surface tension is due to
 (A) diffusion (B) osmosis
 (C) gravitational force (D) cohesion
- R 20. Which of the following component is not remobilized in plant?
 (A) Phosphorous (B) Sulphur
 (C) Calcium (D) Nitrogen
- R 21. Movement of food material from leaves to other parts of the plant takes place through
 (A) xylem (B) phloem
 (C) both (A) and (B) (D) meristems
- *22. In guard cells, when sugar is converted into starch, the stomatal pore
 (A) closes almost completely
 (B) opens partially
 (C) opens fully
 (D) remains unchanged
- R 23. Due to low atmospheric pressure the rate of transpiration will
 (A) increase (B) decrease rapidly
 (C) decrease slowly (D) remain unaffected
- R 24. Guttation takes place through special glands called
 (A) xylem (B) water stomata
 (C) hydathodes (D) both (B) and (C)
- R 25. Maximum transpiration occurs through
 (A) stomata (B) cuticle
 (C) lenticels (D) bark
- R 26. In grasses, guard cells are
 (A) kidney shaped (B) dumbbell shaped
 (C) spherical shaped (D) oval shaped
- R 27. Opening and closing of stomata is mainly due to the
 (A) hormonal change in guard cells
 (B) change in turgor pressure of guard cells
 (C) gaseous exchange
 (D) respiration



28. In fully opened stomata, guard cells are
 (A) plasmolysed (B) shrunken
 (C) turgid (D) flaccid

ANSWERS TO MULTIPLE CHOICE QUESTIONS

1. (B) 2. (B) 3. (C) 4. (B)
 5. (A) 6. (B) 7. (D) 8. (C)
 9. (A) 10. (B) 11. (B) 12. (B)
 13. (A) 14. (D) 15. (B) 16. (C)
 17. (C) 18. (D) 19. (D) 20. (C)
 21. (B) 22. (A) 23. (A) 24. (D)
 25. (A) 26. (B) 27. (B) 28. (C)

COMPETITIVE CORNER

1. Xylem translocates [NEET (UG) 2019]
 (A) Water, mineral salts and some organic nitrogen only
(B) Water, mineral salts, some organic nitrogen and hormones
 (C) Water only
 (D) Water and mineral salts only

2. What will be the direction of flow of water when a plant cell is placed in a hypotonic solution? [NEET Odisha 2019]
 (A) No flow of water in any direction
 (B) Water will flow in both directions
 (C) Water will flow out of the cell
(D) Water will flow into the cell

Hint: If a plant cell is placed in hypotonic solution then water will flow into the cell as water moves from high water potential to low water potential.

3. The main difference between active and passive transport across cell membrane is [NEET Odisha 2019]
 (A) active transport occurs more rapidly than passive transport.
 (B) passive transport is non-selective whereas active transport is selective.
(C) passive transport requires a concentration gradient across a biological membrane whereas active transport requires energy to move solutes.
 (D) passive transport is confined to anionic carrier proteins whereas active transport is confined to cationic channel proteins.

4. The process responsible for facilitating loss of water in liquid form the tip of grass blades at night and in early morning is:

[NEET (UG) P-I 2020]

- (A) Root pressure**
 (B) Imbibition
 (C) Plasmolysis
 (D) Transpiration

5. Match List-I with List-II. [NEET (UG) 2021]

List – I		List – II	
(a)	Cohesion	(i)	More attraction in liquid Phase
(b)	Adhesion	(ii)	Mutual attraction among water molecules
(c)	Surface Tension	(iii)	Water lose in liquid phase
(d)	Guttation	(iv)	Attraction towards polar surfaces

Choose the correct answer from the options given below.

- (a) (b) (c) (d)
 (A) (ii) (i) (iv) (iii)
(B) (ii) (iv) (i) (iii)
 (C) (iv) (iii) (ii) (i)
 (D) (iii) (i) (iv) (ii)

Hint: In active transport, materials are transported across a biological membrane with the help of a carrier protein and ATP whereas, in passive transport, substances move along the concentration gradient, i.e., from its higher concentration to its lower concentration.

**SECTION A****Q.1. Select and write the correct answer:****[04]**

- i. Wooden doors swell up and get stuck up during rainy season due to
(A) Endosmosis (B) exosmosis (C) imbibition (D) capillarity
- ii. _____ % of total transpiration occurs through lenticels.
(A) 10-15 (B) 90-93 (C) 0.1-1 (D) 8-10
- iii. Solution outside a cell has higher concentration of solutes than cell sap. Then, the solution is
(A) isotonic (B) hypertonic (C) hypotonic (D) acidic
- iv. Which of the following correctly represents the formula for calculating DPD?
(A) $DPD = OP - TP$ (B) $DPD = OP \times TP$ (C) $DPD = OP/TP$ (D) $DPD = OP/TP \times 100$

Q.2. Answer the following:**[03]**

- i. Define guttation.
- ii. Name the three processes that occur sequentially during absorption of water by roots from soil.
- iii. What is osmotic pressure?

SECTION B**Attempt any Four:****[08]**

- Q.3. Write any four significance of transpiration.
- Q.4. Write a short note on facilitated diffusion.
- Q.5. Write any four limitations of root pressure theory.
- Q.6. Draw neat and labelled diagram of root tip.
- Q.7. Define following terms:
i. Ascent of sap ii. Symplast pathway
- Q.8. i. Name the plant in which both kidney shaped and dumbbell shaped stomata are present.
ii. Match the columns:

	Column I		Column II
a.	Epistomatic leaves	p.	Grass
b.	Amphistomatic leaves	q.	Lotus
		r.	<i>Nerium</i>

SECTION C**Attempt any Two:****[06]**

- Q.9. Explain the three types of solutions based on concentration and osmotic diffusion.
- Q.10. Who regarded transpiration as necessary evil and why?
- Q.11. Draw neat and labelled diagram of diffusion of water into plant cell across the plasma membrane and write the significance of diffusion in plants.

SECTION D**Attempt any One:****[04]**

- Q.12. With the help of neat and labelled diagram explain the path of water across the root.
- Q.13. With the help of neat and labelled diagram describe the structure of stomatal apparatus.

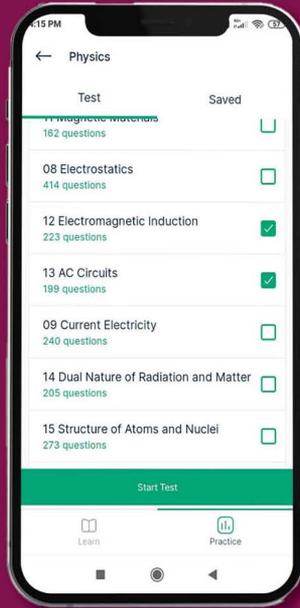
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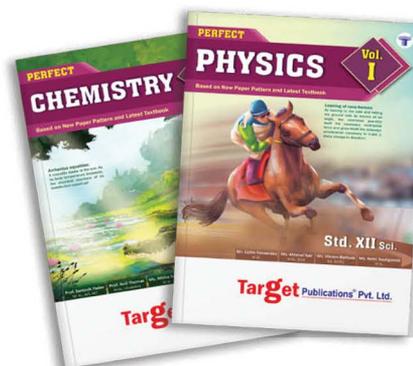
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