

## TEACHER'S GUIDE

**BIOLOGY**            **2. Form: S3**

### UNIT 2: TRANSPORT OF MATERIALS IN PLANTS

#### Introduction

If plants and animals are to survive then they must have evolved ways to transport the **nutrients** to all of their **tissues**.

The nutrients they use to live and to grow come from their **environment**.

**In plants** the main nutrients are **carbon dioxide** from the air and **minerals** from the soil. They use these to make the substances they need to maintain themselves. In **green plants** the carbon dioxide is taken from the air through their **leaves**. The **minerals** they need are taken up through their **roots**, as is **water** which is also essential for life.

**Animals** take in food through their **mouths** or, in very small organisms, they may be absorbed through their **skin**.

The challenge for plants is to evolve ways to transport their nutrients from the surface of the plant to cells in the middle of the plant that also need to be nourished. Animals also must have systems for moving the food they take in to their stomachs or through their skin (for small organisms) to the rest of their bodies. They must also have ways to transport waste products out of their bodies.

Very small organisms use a method called **diffusion** to move materials. Nutrients that are dissolved or suspended in water are **absorbed** through their skins. Once they have been taken in to the plant or animal, they gradually **percolate** or diffuse through their tissues

towards the cells in the middle. The problem is that the **rate of diffusion** of substances through the tissues may be slow, so it only works well with small organisms like **protozoa**, single-celled plants and jellyfish. Bigger organisms cannot be kept alive by diffusion alone, because the cells that are further away from the source of nutrients would die. So **size is a limiting factor**, if the organism depends only on diffusion as its means of transporting nutrients.

Larger organisms need more complex systems to transport nutrients around their bodies. In the case of mammals, for example, they have a heart and blood vessels that allow fluids containing nutrients to be transported quickly and efficiently.

### **BRIEF DESCRIPTION OF UNIT OF TEACHER SUPPORT MATERIAL:**

This unit deals with;

- (c) Structure of root hairs and stem.
- (d) Movement of water, minerals, salts and manufactured food through a transport system.
- (e) Structure and functions of the root hairs, stem and roots in relation to transport
- (f) Diffusion, osmosis, and plant cell relation: plasmolysis. Flaccidity and turgidity.
- (g) Active transport
- (h) Opening and closing of stomata
- (i) Transpiration and factors affecting transpiration.
- (j) Translocation
- (k) Storage organs and food nutrients.

### **SUMMARISE THE MAIN CONTENT AND CONCEPTS THAT THE TEACHER SHOULD EMPHASISE IN TEACHING THE SUB-TOPIC:**

- (l) Transverse section of root, and stem.
- (m) Simple structure of xylem and phloem and relationship between structure and function.

- (n) Movement of water and solutes from soil to leaves.
- (o) Diffusion, osmosis: Experiments on diffusion and osmosis.
- (p) Transpiration and factors affecting it.

**LIST ITEMS OF TEACHING/LEARNING MATERIALS:**

(Worksheet, stimulus activity, experiments, items of evidence, statistics, texts, pictures, diagrams, graphs)

Chart with transverse section of a stem and root, xylem and phloem.

- (q) Knife/razor blade/scapel.
- (r) Microscope, microscopes slide and cover slips.
- (s) Simple potometer, polyethene bag.
- (t) Stain e.g. iodine.
- (u) Anhydrous copper II sulphate/blue cobalt chloride paper.
- (v) Locally available storage organs (cassava, potatoes, sugar cane etc.)
- (w)Text books stain e.g. iodine
- (x) Common salt
- (y) Prepared slides of the stem, root, and stomata.
- (z) Animation of diffusion molecules from an area of high concentration to low concentration.

**Worksheet for practical /experimental activity.**

**Aim:**

To show that a plant transpires.

Materials and apparatus.

- (aa)Potted plant or attached shoot
- (bb)Polythene bag
- (cc)Thread/rubber bands
- (dd)Cobalt chloride paper,/anhydrous copper II sulphate

**Procedure**

Cover a branch or shoot with a polythene bag. Tie around the stem with a string or rubber band firmly. (See diagram below)

Place the set up under sunlight and leave for 2 hours.

Remove the polythene bag and collect the liquid that may have gathered in the bag water.

Test the liquid with anhydrous copper II sulphate/cobalt chloride paper

**Observation:**

A colourless liquid collects in the bag.

The white anhydrous powder copper II sulphate powder turns blue/blue cobalt chloride paper pink/ in the control experiment there is no water.

**Conclusion;**

A plant gives off water in form of vapour

**Learners' activity.**

- (ee)a) Why isn't the pot enclosed?
- b) Why is the polythene bag tied firmly?

**Answers to learner's activity.**

- a) To ensure that any moisture that is collected is lost from aerial parts but not from the soil.
- (ff) To prevent moisture from the atmosphere getting into the polythene bag.

**Evaluation questions.**

- (gg) Which of the following tissues conducts water and also provides mechanical support to a plant
- (hh) Phloem
- (ii) Xylem

(jj) Cambium

(kk)Cortex

(ll) The figure below shows a transverse section of a dicot stem. Study it and answer the questions that follow.

a) Name the parts labeled P to U.

b) State the functions of each of the parts labeled S and T.

(mm)State two differences between diffusion and osmosis

**Answers to evaluation questions**

1. B

2. a)

P – Cortex

Q - Pith

R - Cambium

S – Xylem

T - Phloem

U – Epidermis

b) S – Conducts water and mineral salts up the plant

T – Conducts manufactured food from leaves to other parts of a plant.

3.

<b>DIFFUSION</b>	<b>OSMOSIS</b>
Solutes move from high concentration to low concentration	Water moves from high to low concentration
Membranes not involved	Semi-permeable membrane involved

## **Worksheet for practical activity /Experiment II**

### **Aim:**

To demonstrate osmosis in living tissues.

### **Materials/ and apparatus.**

Concentrated solution of salt/sugar, potato/unripe paw paw.

Water, basins/ trough/sauce pan, knife

### **Procedure:**

Peel two potatoes to expose the living tissue.

Scoop them to form a cup as shown below.

Place concentrated solution of salt/sugar in cups A and water in cup B.

Mark the levels in the potato cups.

Place the potato cups into Petri dishes of water.

Mark the levels of water in the Petri dishes.

Observe the levels in the Petri dishes and the cups after 6- 24 hours.

### **Observations**

Level of the solution rises in cup A while the level of water in the Petri dish falls.

Level of water in cup B and the Petri dish does not change.

### **Conclusion;**

Osmosis takes place in living tissues.

**TEACHER'S GUIDE** Include essential teacher information on separate pages: topic notes, learning objectives, organisational advice and tips, answers to student exercises, advice on assessment/evaluation, marking and exam preparation, suggested follow-up and extension work, useful textbook references and other resources).

### **References:**

(nn)Beckett B.S (1982) Biology: A modern introduction (2<sup>nd</sup> Edition) London, Oxford

- University Press.
- (oo)Hayward. G. Semakadde I and Ochiro. E. (2002) Macmillan secondary Biology, London, Macmillan.
- (pp)Mackean .D.G (1973) Introduction to Biology. London, Evans Brothers, UK.
- (qq)Stone R. H and cozens A, B (2002). New Tropical Biology 3<sup>rd</sup> edition. London (UK) Longman

**Useful tips:**

The teacher should ensure that control experiments are set up in order to obtain results. Involve students in suggesting control experiments.

**SAMPLE EXAMINATION QUESTIONS**

**SECTION A: OBJECTIVES**

- (rr) Which of the following processes for movement of molecules **in** and **out** of cells specifically refers to water molecules?
- A. Diffusion
  - B. Active transport.
  - C. Osmosis
  - D. Phagocytes
- (ss) Which of the following processes requires energy?
- E. Translocation.
  - F. Diffusion
  - G. Osmosis
  - H. Active transport.
- (tt) In which underground organ does cassava store starch?
- I. Stem tuber.
  - J. Root tuber

K. Rhizome

L. Corn

**SECTION B: STRUCTURED QUESTION**

(uu)The table below shows the distribution of stomata on the leaves of plants A and B, which live in different habitats. Study the table and answer the questions that follow:

<b>Leaf</b>	<b>No. of stomata on upper surface</b>	<b>No. of stomata on lower surface</b>
A	150	02
B	35	100

(vv)Name the habitat for each leaf.

Leaf A.....

Leaf B.....

(2 marks)

(ww)

i. State the difference in the distribution of stomata in plants A and B.

.....  
.....  
.....  
.....

(1 1/2 marks)

ii. Give reasons for the difference stated in b (i) above.

.....  
.....  
.....  
.....  
.....  
.....

.....  
( 3 marks)

(xx)Give the advantages of transpiration to a plant.

.....  
.....  
.....

(2 marks )

(yy)State any two adaptations of plants that enable them to survive in desert areas.

.....  
.....  
.....  
.....

(2 marks)

**SECTION C: ESSAY/LONG ANSWER QUESTION.**

- 1. a) How does water move from the soil to xylem of a root? (7 marks)
- b) Give the adaptations of root hairs to absorption of water. (2 marks)
- c) Name four environmental factors that affect the rate of transpiration

**ANSWERS TO SAMPLE QUESTIONS.**

***SECTION A***

- 1. C
- 2. D
- 3. B

**SECTION B**

- 1. a) Leaf A - Water  
    Leaf B – Well-watered soil/land.

b)

(zz)The leaves of plant A have more stomata on the upper than the lower surface whereas the leaves of B have more stomata on the lower than the upper

surface.

(aaa) Plant A has more water available to it than plant B. A needs to lose excess water. B needs to conserve water. In A the stomata are exposed to direct sunlight, promoting rapid evaporation. In B the stomata are sheltered from direct sunlight, thus less evaporation.

c) - Cools the plant.

-Enables absorption of water and mineral salts.

-Enables upward movement of water and mineral salts (any two points)

d) - Thick cuticle on leaves to reduce water loss

(bbb) Leaves modified to spines to reduce water loss.

(ccc) Leaves have small surface area to reduce water loss.

(ddd) Extensive superficial root system to absorb water over a large area.

(eee) Deep roots absorb water from deeper layers of soil.

(fff) Succulent stems or leaves for storage of water.

(ggg) Stomata opening at night and closing during the day to reduce water loss.

(hhh) Stomata sunken in pits to reduce water loss. (any two points)

## SECTION C

1.

(iii) Root hairs absorb water from the soil by osmosis because the sap in the root hair is more concentrated than the soil solution. The sap of the root hair cell becomes less concentrated than that of the neighboring cortical cell, which in turn draws in water from it by osmosis. Water moves in the same way across the cortex up the xylem vessel. It then diffuses into the xylem vessel.

(jjj) Root hairs are thin and long to increase the surface area for absorption

Root hairs are numerous, further increasing the surface area of absorption

(kkk) **Temperature:** High temperatures favour high rates of transpiration while low temperatures favour low rates.

**Relative humidity:** the rate of transpiration is high at low relative humidity and low at high relative humidity.

**Light intensity:** At high light intensity the rate of transpiration is high. At low

light intensity the rate is low

**Wind:** The rate of transpiration is higher in windy conditions than in still air.

**Atmospheric pressure:** The rate of transpiration is higher at low atmospheric pressure.

### **Glossary:**

**Xylem:** Tissue that conducts water and mineral salts from the roots to the leaves.

**Phloem:** Tissue that conduct food materials from the leaves to the other parts of a plant

**Semi-permeable membrane: /selectively**

Is one that allows only solvent molecules to pass through while preventing the passage of solute molecules.

**Flaccid:** Describes a cell that has lost its turgidity and is relatively soft due to loss of water.

**Plasmolysis:** The loss of water from a plant cell to the extent that the protoplasm pulls away from the cell wall. Continued plasmolysis leads to wilting.

**Transpiration:** Is loss of water vapour from aerial parts of a plant to the atmosphere.  
Occurs mainly through the leaves.

**Cohesive force:** Is force of attraction between like molecules or molecules of the same substance.

**Adhesive force:** Is force of attraction between unlike molecules or molecules of different substances.

**Translocation:** Is movement of minerals and chemicals compounds within a plant  
It involves movement of water and mineral salts through the xylem and manufactured food through the phloem.

**Turgor:** Is a condition in a plant cell when its vacuole is distended with water pushing the protoplasm against the cell wall.