Transport in plants and the role of heterotrophs

Lesson plan and teacher's notes · Form 2 Biology · 1 period of 40 minutes

School	(write school name)	**Teacher**	(write name)
Date	(date)	**Class**	Form 2
Subject	Biology	**Enrolment**	Boys ___ Girls ___ Total ___
Time	40 minutes	**Topic**	Transport in plants and the role of heterotrophs

Learners explain why heterotrophic nutrition matters to organisms and the environment, name the xylem and phloem and say what each carries, describe transpiration and the factors that affect its rate, and give plant features that reduce water loss. Examples come from rotting maize leaves on a farm near Feira, a cow grazing and a washed shirt drying.

Specific outcomes

By the end of the lesson, learners should be able to:

1. Explain why heterotrophic nutrition is important to organisms and the environment
2. Name the tissues that carry materials in a plant and say what each one carries
3. Describe transpiration and the factors that affect its rate
4. Give plant adaptations that reduce water loss

Prior knowledge

- Plants make food in their leaves
- Leaves, stems and roots are parts of a plant
- Evaporation of water from wet surfaces

Teaching and learning materials

- a washed cloth or shirt
- chalk and board
- leaves with a waxy surface if available
- exercise books

References

Ministry of Education (CDC) Form 2 Biology syllabus and module; 25Schools learners' note: Transport in plants and the role of heterotrophs.

Lesson development

Stage and time	Teacher activities	Learner activities
Introduction **5 min**	Ask what happens to leaves that fall on the ground and what a cow gets from the grass it eats. Tell learners that plants also have a system that moves materials to every part.	Suggest answers and copy the lesson title and key words.
Development: heterotrophic nutrition **8 min**	Define heterotrophic nutrition. Explain that fungi and bacteria break down dead plants and animals, stop dead matter piling up and return nutrients to the soil.	Copy the definition and give one example from home or the community.
Development: xylem and phloem **10 min**	Explain transport in plants as the movement of water, minerals and manufactured food to all parts of the plant. Draw the two tissues and label what each carries.	Copy the diagram and label the xylem and the phloem.
Development: transpiration **14 min**	Define transpiration. Work the shirt example on the board, then teach the factors that affect the rate and the features that reduce water loss.	List the four factors and the three plant features, and explain the shirt example.
Conclusion **3 min**	Ask which tissue carries water and which carries food. Set the homework.	Answer orally and copy the homework.

Teacher's content notes

Read these before the lesson. They are what you need to know, not what to copy onto the board.

Why heterotrophic nutrition matters

Heterotrophic organisms get nutrients and energy by feeding on plants, animals or other organic matter. This supports their growth and survival. Fungi and bacteria are heterotrophs that break down dead plants and animals. This stops dead matter from piling up and recycles nutrients back into the soil, where they support plant growth and keep the environment in balance. You can see this at home or in the community when leaves and food waste decompose, and when animals feed.

The transport system in plants

Transport in plants is the movement of water, minerals and manufactured food to all parts of the plant. In dicot and monocot plants this is done by two special tissues, the xylem and the phloem. The xylem carries water and minerals from the roots to the leaves. The phloem carries the food made in the leaves to the other parts of the plant.

Transpiration

Transpiration is the evaporation of water from the leaves. As water leaves, it pulls more water upward from the roots. This helps the movement of water and nutrients, cools the plant and keeps minerals flowing for growth.

Factors and adaptations

The rate of transpiration is affected by temperature, wind, humidity and light. Plants have features that reduce water loss, such as a thick cuticle, small leaves and sunken stomata. The cuticle is the waxy covering on a leaf that helps to reduce water loss.

Questions to ask during the lesson

Question	Expected answer
A learner sees leaves rotting on the ground and a cow grazing in the same field near the school. (a) What do we call getting food and energy by feeding on plants, animals or other organic matter. (b) Which organisms break down the dead leaves. (c) Why is this useful to the soil.	(a) Heterotrophic nutrition. (b) Fungi and bacteria. (c) It stops dead matter piling up and recycles nutrients back into the soil.
A teacher cuts a plant stem and tells learners that it has two special tissues for carrying materials. (a) Name the two tissues. (b) What does the xylem carry. (c) What does the phloem carry.	(a) Xylem and phloem. (b) Water and minerals from the roots to the leaves. (c) Food made in the leaves, to other parts of the plant.
A learner in Lusaka sees that a washed shirt dries faster on a hot, windy day and wonders how this links to plants. (a) What is transpiration. (b) Why does the shirt dry faster. (c) What does this tell you about temperature and wind.	(a) The evaporation of water from the leaves, which pulls more water up from the roots. (b) Water evaporates faster when it is hot and windy. (c) Both increase the rate of transpiration.
A farmer grows a plant in a very hot place and wants it to lose less water. (a) Name the four factors that affect the rate of transpiration. (b) Give two features that reduce water loss. (c) What is the cuticle.	(a) Temperature, wind, humidity and light. (b) Any two of a thick cuticle, small leaves, sunken stomata. (c) The waxy covering on a leaf that helps to reduce water loss.

Worked examples for the board

Example 1: the washed shirt

Why does a washed shirt dry faster on a hot, windy day, and how does this link to transpiration? Water evaporates faster when it is hot and windy. Transpiration is the evaporation of water from leaves. So temperature and wind both increase the rate of transpiration.

Example 2: rotting leaves in a field

Fallen leaves and food waste decompose. Fungi and bacteria are heterotrophs that break down the dead matter. This stops it piling up and recycles nutrients back into the soil, where they support plant growth.

Example 3: xylem and phloem

The xylem carries water and minerals from the roots to the leaves. The phloem carries the food made in the leaves to the other parts of the plant. So water travels up to the leaves in the xylem, and food made in the leaves travels to other parts in the phloem.

Board plan

Write the title and key words. Left: heterotrophs and what they do for the environment. Centre: a table comparing xylem and phloem. Right: transpiration with the four factors and the three features that reduce water loss.

Tissue	What it carries	Direction in the note
Xylem	Water and minerals	From the roots to the leaves
Phloem	Food made in the leaves	To other parts of the plant

Xylem and phloem compared

Mistakes to expect

Learners often think	Put it right
The phloem carries water from the roots.	The xylem carries water and minerals from the roots to the leaves. The phloem carries food made in the leaves to other parts of the plant.
Rotting leaves just disappear and do nothing for the soil.	Fungi and bacteria break down dead matter and recycle nutrients back into the soil, where they support plant growth.
Transpiration is the plant taking in water through its leaves.	Transpiration is the evaporation of water from the leaves, which pulls more water up from the roots.
Only temperature affects the rate of transpiration.	Temperature, wind, humidity and light all affect the rate.

Differentiation

Learners who struggle

Give learners a two-column table with xylem and phloem and let them write what each carries. For transpiration, give them the four factors as a list and let them match each to a situation, such as a hot windy day.

Learners who finish early

Ask learners who finish early to explain how a thick cuticle, small leaves and sunken stomata help a plant that grows in a hot place, and to link the shirt example to transpiration.

Hearing or visual impairment

For learners with visual impairment, let them feel a waxy leaf and a rough leaf and describe the cuticle aloud. For learners with hearing impairment, write each key word and what it means on the board before you explain it.

No projector, no printing

Use a wet cloth hung in the sun, in the shade and in the wind to show evaporation. Draw the xylem and phloem on the board with chalk.

If time is short

Teach the xylem and phloem and define transpiration with the washed shirt example. Leave the part on heterotrophs and the plant adaptations for the next lesson.

Evaluation

Question or task	A correct answer shows
A farmer near Feira notices that fallen maize leaves and old fruit in her field slowly disappear and the soil becomes richer. (a) Which living things cause this. (b) Explain why this is important for the plants she grows next season. (c) Say what happens to the nutrients in the dead matter.	(a) Fungi and bacteria, which are heterotrophs. (b) They break down dead matter and return nutrients to the soil, which supports plant growth. (c) They are recycled back into the soil.
Two bean plants are placed outside, one in a still, humid spot and one in a hot, windy spot. After a day the plant in the hot, windy spot has lost more water. (a) Which plant has the higher rate of transpiration. (b) Explain using the factors that affect transpiration. (c) Name one feature that could help the plant reduce water loss.	(a) The plant in the hot, windy spot. (b) Higher temperature and wind increase evaporation, while humid air slows it. (c) A thick cuticle, small leaves or sunken stomata.
A learner at a school in Luangwa cuts a stem and is asked which tissue carries what. (a) Name the tissue that carries water and minerals. (b) Name the tissue that carries food made in the leaves. (c) Say where the water is carried to.	(a) Xylem. (b) Phloem. (c) From the roots to the leaves.

Homework

A girl in a village hangs two washed shirts, one in the shade on a still day and one in the sun in the wind. (a) Which shirt dries faster. (b) Explain how this links to transpiration. (c) Name two factors from the note that change the rate of transpiration.

Extra practice with answers

Question	Answer
1. A farmer near Feira notices that fallen maize leaves and old fruit in her field slowly disappear and the soil becomes richer. (a) Which living things cause this. (b) Explain why this is important for the plants she grows next season. (c) Say what happens to the nutrients in the dead matter.	(a) Fungi and bacteria, which are heterotrophs. (b) They break down dead matter and return nutrients to the soil, which supports plant growth. (c) They are recycled back into the soil.
2. Two bean plants are placed outside, one in a still, humid spot and one in a hot, windy spot. After a day the plant in the hot, windy spot has lost more water. (a) Which plant has the higher rate of transpiration. (b) Explain using the factors that affect transpiration. (c) Name one feature that coul	(a) The plant in the hot, windy spot. (b) Higher temperature and wind increase evaporation, while humid air slows it. (c) A thick cuticle, small leaves or sunken stomata.

3. A learner at a school in Luangwa draws a plant and is asked to label what travels in each tissue. (a) Which tissue carries water and minerals from the roots to the leaves. (b) What does the phloem carry. (c) What is transport in plants.	(a) The xylem. (b) Food made in the leaves, to other parts of the plant. (c) The movement of water, minerals and manufactured food to all parts of the plant.
4. A teacher asks learners to explain why a plant with a thick waxy cover on its leaves keeps its water in a dry place. (a) Name the waxy covering. (b) Say what it does. (c) Give two other features that reduce water loss.	(a) The cuticle. (b) It helps to reduce water loss. (c) Small leaves and sunken stomata.

Answers to the learners' check-yourself questions

1. Name the tissue that carries water and minerals from the roots to the leaves.
   Xylem.
2. What does the phloem carry?
   Food made in the leaves, to other parts of the plant.
3. What is transpiration?
   The evaporation of water from the leaves, which pulls more water up from the roots.
4. List four factors that affect the rate of transpiration.
   Temperature, wind, humidity and light.
5. Give two plant features that reduce water loss.
   Any two of a thick cuticle, small leaves, sunken stomata.
6. A farmer near Feira notices that fallen maize leaves and old fruit in her field slowly disappear and the soil becomes richer. (a) Which living things cause this? (b) Explain why this is important for the plants she grows next season. (c) Say what happens to the nutrients in the dead matter.
   (a) Fungi and bacteria, which are heterotrophs. (b) They break down dead matter and return nutrients to the soil, which supports plant growth. (c) They are recycled back into the soil.
7. Two bean plants are placed in the sun, one in a still, humid spot and one in a hot, windy spot. After a day the second plant has lost more water. (a) Which plant has the higher rate of transpiration? (b) Explain why using the factors that affect transpiration. (c) Name one feature that could help th
   (a) The plant in the hot, windy spot. (b) Higher temperature and wind increase evaporation, while humid air slows it. (c) A thick cuticle, small leaves or sunken stomata.

Teacher's reflection

What went well:

What I will change next time:

Learners who need follow-up: