IGCSE BIOLOGY • EXERCISE SHEET

8.1 Xylem and phloem

Name: _____ Class: _____ Date: _____ **Total: 27 marks**

KEY WORDS xylem 木质部 • phloem 韧皮部 • sucrose 蔗糖 • mineral ions 矿物质离子 • vascular bundles 维管束

Objective

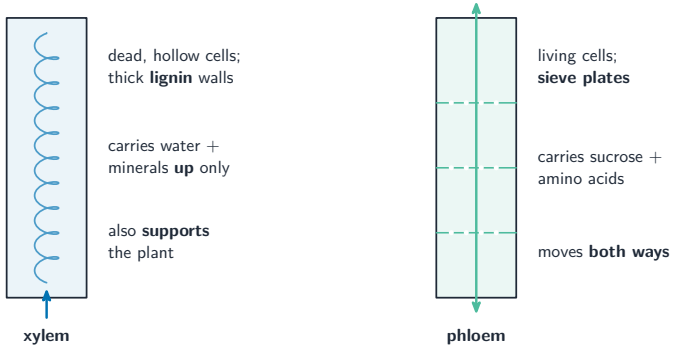
Build the skills to answer exam questions on **xylem and phloem** 木质部与韧皮部 — what each carries, where they are, and how xylem is adapted.

You must be able to:

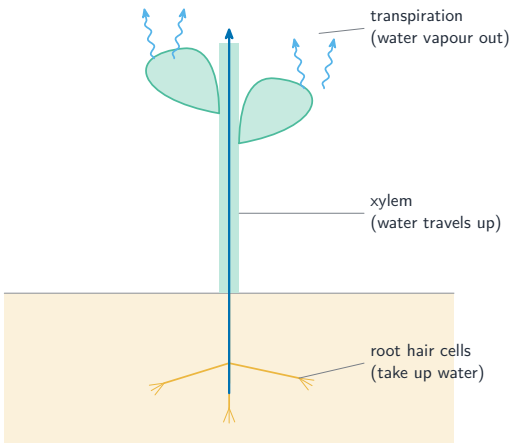
- state what xylem and phloem transport, and the direction
- describe the structure of xylem (dead, lignified tubes)
- locate xylem and phloem in a vascular bundle

1 Worked examples

■ The two transport tissues



Xylem: water + mineral ions, upward, + support. Phloem: sucrose + amino acids



Xylem and phloem run through the plant

- **xylem cells:** dead and hollow, with thick **lignin** walls; joined end to end into one pipe.

■ Two tissues, four contrasts

	xylem 木质部	phloem 韧皮部
carries	water and mineral ions	sucrose and amino acids
direction	**upwards only**, roots → leaves	**both ways**, source → sink
cells	dead, hollow, no end walls; lignified	living sieve tube elements with perforated sieve plates, plus companion cells
process	passive — pulled by transpiration	active — needs energy from the companion cells

Learn "source and sink", because that is what makes phloem two-way. A **source** is where sucrose is made or released — a photosynthesising leaf in summer, a storage organ in spring. A **sink** is where it is used or stored — a growing root tip, a developing fruit. The direction of flow depends on which organ is which **at that time of year**, so the same tuber is a sink in summer and a source in spring.

Why xylem is built as it is. The cells are **dead and hollow with no end walls**, forming a continuous tube of the lowest possible resistance; **lignin** in the walls keeps the vessel from collapsing under the tension of the transpiration pull, and waterproofs it.

Locating them in a diagram is a common one-mark question: in a root the xylem

is in the **centre** (in a star shape) with phloem between the arms; in a stem the vascular bundles are in a **ring** with xylem on the **inside** and phloem on the **outside**; in a leaf they are in the midrib and veins, xylem again on top.

Worked example. A ring of bark is removed all the way round a tree trunk. Explain why sugar accumulates above the ring and the roots eventually die.

1. The bark carries the phloem; removing it cuts the phloem but leaves the xylem, which is deeper in.
2. Sucrose made in the leaves is translocated down the phloem, so it accumulates just above the cut.
3. No sucrose can reach the roots, so they have no supply of glucose for respiration and die.
4. Water still reaches the leaves at first, because the xylem is intact — which is why the tree does not wilt immediately.

2 Practice

2.1 State what the xylem transports. [1]

2.2 State what the phloem transports. [1]

2.3 State one substance carried by xylem and one carried by phloem. [2]

2.4 Explain why xylem cells are dead and lignified. [2]

2.5 State what is meant by a source and a sink in translocation. [2]

3 Exam-style questions

3.1 Xylem vessels are well adapted to carry water because they are: [1]

A B
C D

A living cells full of cytoplasm
B dead, hollow tubes with lignin walls
C thin-walled and branched
D packed with chloroplasts

3.2 Xylem and phloem run through the plant.

(a) State the additional role of xylem (besides transport). [1]

(b) Explain how the structure of xylem suits carrying water. [2]

3.3 The diagram shows a transverse section through a plant stem, with the vascular bundles labelled.

(a) State where the xylem and the phloem are found in a stem, relative to each other. [2]

(b) Complete the table comparing xylem and phloem. [4]

Feature	Xylem	Phloem
substances carried		
direction of transport		
living or dead cells		
end walls		

(c) Explain why translocation in the phloem can occur in two directions but transport in the xylem cannot. [3]

(d) A complete ring of bark is removed from around a tree trunk. Explain why sugars build up above the ring, and why the roots eventually die. [4]

(e) Explain why the leaves do not wilt immediately after the bark is removed. [2]