Exercise walk-through

Structure of transport tissues ▪ 7.1

eXercise

You must be able to

- describe the distribution of xylem and phloem in stems, roots and leaves
- relate the structure of xylem vessels, sieve tubes and companion cells to their functions
- draw plan diagrams and use magnification calculations

Method — Where xylem and phloem are

- **stem** — vascular bundles in a ring near the edge; xylem on the inside of each bundle.
- **root** — xylem in a central star, phloem between the arms.
- **leaf** — both in the veins.

Method — Where xylem and phloem are

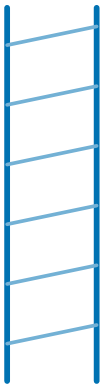
stem: bundles in a ring root: xylem in a central star

Method — Structure suited to function

- **xylem vessels 导管** — dead, empty cells joined end to end with no end walls (one open tube); walls thickened with **lignin 木质素**. So water flows fast and the lignin gives support.
- **sieve tubes 筛管** — living cells with **sieve plates 筛板** (holes for sap); lose most contents and the nucleus.
- **companion cells 伴胞** — keep the nucleus and many **mitochondria 线粒体**; do the living work and load sugars.

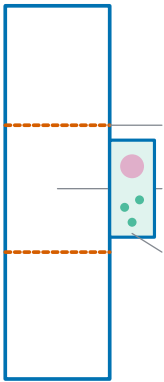
Method — Structure suited to function

xylem vessel



dead, empty cells;
thick lignified walls;
no end walls $\longrightarrow$
one open pipe

phloem



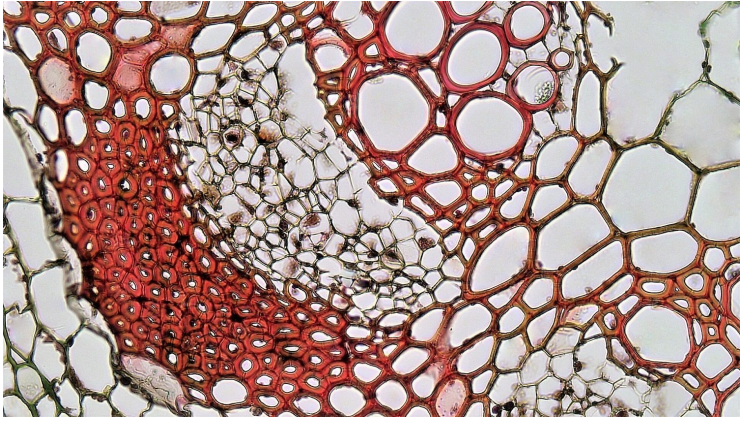
sieve plate (holes)

sieve tube (no nucleus)

companion cell
(nucleus, mitochondria)

Method — Drawing plan diagrams

Draw only the **outlines** of the tissue regions (not single cells), in correct proportions, with clear unbroken lines.



Practice 2.1 ▪ 2 marks

State one structural feature of a xylem vessel and explain how it suits the vessel's function.

Solution 2.1

Method: Structure suited to function

Worked steps

e.g. lignified walls → give strength/support and waterproofing; *or* no end walls/empty → continuous open tube for fast water flow B1 B1 *feature*, *link*.

Practice 2.2 ▪ 2 marks

State **two** ways a companion cell differs from a mature sieve tube.

Solution 2.2

Method: Structure suited to function

Worked steps

any two: companion cell keeps its nucleus (sieve tube loses it); companion cell has many mitochondria; companion cell retains most cytoplasm B1 *each, max 2.*

Exam-style 3.1 ▪ 1 mark

Which feature is found in xylem vessels but **not** in phloem sieve tubes?

A living cytoplasm

B sieve plates

C lignified walls and no contents

D companion cells

Solution 3.1

Method: Structure suited to function

A living cytoplasm

B sieve plates

C lignified walls and no contents ✓

D companion cells

Worked steps

C. Only xylem vessels have lignified walls and no living contents.

Exam-style 3.2 ▪ 1 mark

In a transverse section of a root, the xylem is found:

A in a ring near the edge

B in the centre, often in a star shape

C only in the veins

D outside the phloem

Solution 3.2

Method: Drawing plan diagrams

A in a ring near the edge

B in the centre, often in a star shape ✓

C only in the veins

D outside the phloem

Worked steps

B. In the root, xylem is central, often star-shaped.

Exam-style 3.3 ▪ 2 marks

A xylem vessel is drawn 40 mm wide. The real width of the vessel is 50 µm.
(a) Calculate the magnification of the drawing.
(b) Explain why a xylem vessel having no cell contents and no end walls is an advantage.

Solution 3.3

Method: Structure suited to function

Worked steps

(a) 40 mm $= 40\,000$ µm M1; magnification $= \dfrac{40\,000}{50} = \times 800$ A1.

(b) no contents and no end walls make one continuous open tube M1, so water flows quickly with little resistance A1.

Exam-style 3.4 ▪ 4 marks

Relate the structure of phloem sieve tubes and companion cells to their function in transport.

Solution 3.4

Method: Structure suited to function

Worked steps

sieve tubes have sieve plates with pores so sap flows through B1; they lose most contents/nucleus to leave room for flow B1; companion cells keep a nucleus and many mitochondria B1 to provide ATP and load sugars into the sieve tube B1.