

Exercise walk-through

7.1

Structure of transport tissues

A-Level Biology

The two transport tissues

xylem

water and minerals up
from the roots; dead ligni-
fied vessels; also support

phloem

sugars in either direction; living
sieve tubes with companion cells

What each tissue carries, and where

Xylem

Xylem carries water and dissolved **mineral ions** **up** from the roots. Dead, hollow, lignified – no contents to get in the way.

Phloem

Assimilates such as **sucrose** and **amino acids** travel from a **source** to a **sink** – in either direction.

Sieve tube

To leave room for flow, a sieve tube cell loses most of its contents and has **no nucleus**.

Companion cell

So its companion cell does the living for it: it keeps its nucleus and has many **mitochondria** to power loading.

In a **transverse section** of a **dicotyledonous plant**, xylem and phloem sit together in vascular bundles – a ring in the stem, a star in the root.

Worked example – which way does water move?

A plant cell with a water potential of -800 kPa is placed in a solution of -500 kPa. What happens?

- water moves from **higher** (less negative) to **lower** water potential
- the solution is -500 , the cell -800 , so the solution is higher
- water moves **into the cell**
- the cell becomes turgid; **hydrostatic pressure** rises until ψ inside matches outside

Water potential is **always negative or zero**, so “higher” means *closer to zero*. Reading the numbers as ordinary magnitudes reverses the answer.

Reading a transverse section

In a **transverse section** of a **dicotyledonous** stem the **vascular bundles** sit in a ring, each with **xylem** toward the inside and **phloem** toward the outside.

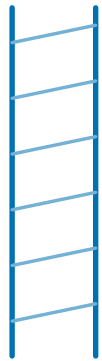
- xylem carries **water and minerals**, upward only
- phloem carries **assimilates** – mostly sugars – to wherever they are needed

A **plan diagram** shows the *outlines of the tissues* and no individual cells. Drawing single cells on a plan diagram loses the mark.

In translocation a **source** is where the assimilate is made or released – a photosynthesising leaf – and a **sink** is where it is used or stored.

Xylem vessels and phloem sieve tubes

xylem vessel



dead, empty cells;
thick lignified walls;
no end walls →
one open pipe

phloem



sieve plate (holes)
sieve tube (no nucleus)
companion cell
(nucleus, mitochondria)

- **xylem vessels** – dead, hollow, **lignin** -strengthened pipes
- **sieve tubes** – living, with **sieve plates** & a **companion cell**

Structure suits the job.

Exercises 2.1-2.2

2.1 State one structural feature of a xylem vessel and explain how it suits the vessel's function. [2]

2.2 State **two** ways a companion cell differs from a mature sieve tube. [2]

Exercises 2.1·2.2

2.1 State one structural feature of a xylem vessel and explain how it suits the vessel's function. [2]

2.1

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

2.2 State **two** ways a companion cell differs from a mature sieve tube. [2]

2.2

- any two: companion cell keeps its nucleus (sieve tube loses it); companion cell has many mitochondria; companion cell retains most cytoplasm

Exercises 3.1-3.2

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

[1]

☐

A living cytoplasm

B sieve plates

C lignified walls and no contents

D companion cells

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

[1]

☐

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

Exercises 3.1-3.2

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

[1]

☐

A living cytoplasm

B sieve plates

C lignified walls and no contents

D companion cells

3.1 C

- Only xylem vessels have lignified walls and no living contents

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

[1]

☐

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

3.2 B

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

Exercise 3.3 (a)

3.3 A xylem vessel is drawn 40 mm wide. The real width of the vessel is 50 μm .

(a) Calculate the magnification of the drawing.

[2]

Exercise 3.3 (a)

3.3 A xylem vessel is drawn 40 mm wide. The real width of the vessel is 50 μm .

(a) Calculate the magnification of the drawing.

[2]

(a)

- $40 \text{ mm} = 40\,000 \text{ } \mu\text{m}; \text{ magnification} = \frac{40\,000}{50} = \times 800$

Exercise 3.3 (b)

3.3 A xylem vessel is drawn 40 mm wide. The real width of the vessel is 50 μm .

(b) Explain why a xylem vessel having no cell contents and no end walls is an advantage.[2]

Exercise 3.3 (b)

3.3 A xylem vessel is drawn 40 mm wide. The real width of the vessel is 50 μm .

(b) Explain why a xylem vessel having no cell contents and no end walls is an advantage.[2]

(b)

- no contents and no end walls make one continuous open tube, so water flows quickly with little resistance

Exercise 3.4

3.4 Relate the structure of phloem sieve tubes and companion cells to their function in transport. [4]

Exercise 3.4

3.4 Relate the structure of phloem sieve tubes and companion cells to their function in transport. [4]

3.4

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