

Exercise walk-through

7.2

Transport mechanisms

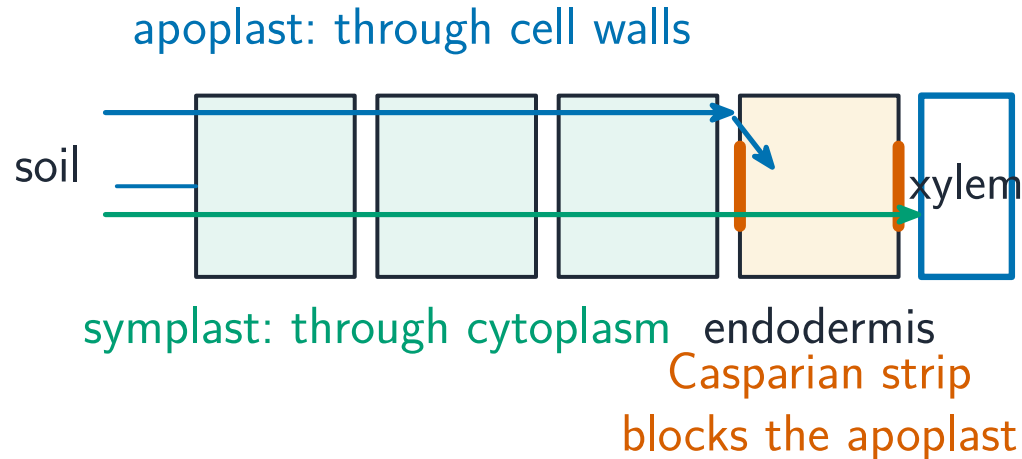
A-Level Biology

Water across the root

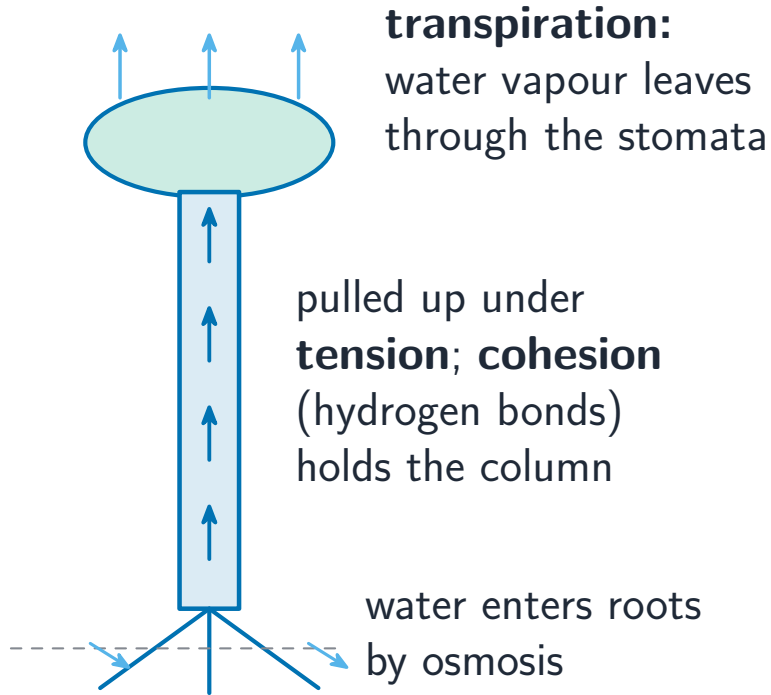
Water enters a **root hair cell** by osmosis, then crosses by:

- **apoplast** – through the walls (fast)
- **symplast** – through the cytoplasm

The **Casparian strip** blocks the apoplast, so the plant controls entry.



Transpiration



Transpiration : water evaporates inside the leaf and diffuses out of the **stomata** .

This pulls a continuous water column up the xylem – held together by **cohesion** (hydrogen bonds) under **tension** .

Transpiration, in the order it happens

Evaporation

Water *evaporates* from the wet cell surfaces inside the leaf – this step is **evaporation**.

Diffusion out

The **water vapour** then **diffuses** out through the **stomata** into the **atmosphere**.

The pull

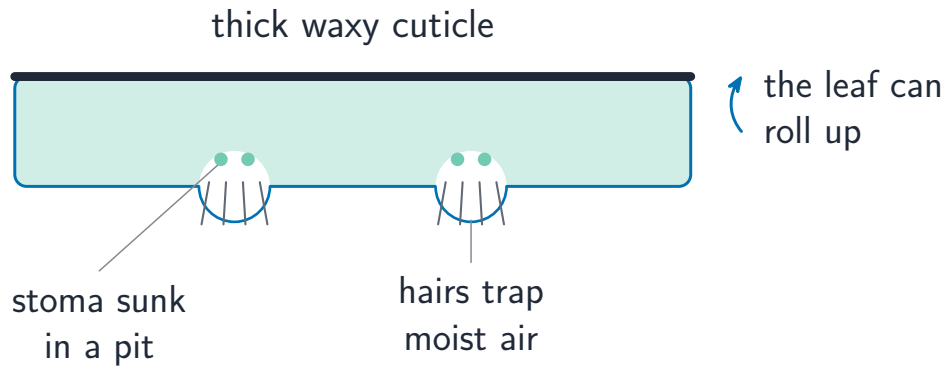
That loss lowers the water potential at the top of the column, and cohesion drags the whole thread of water up the xylem.

Transpiration is the loss

Transpiration is the loss of water vapour from a plant – evaporation and diffusion together, not one of them.

The plant spends water to gain carbon dioxide. Every xerophyte adaptation is a way of paying less for the same gas.

Xerophytes



A **xerophyte** is adapted to live where water is scarce. Its leaves cut water loss with:

- a thick waxy **cuticle**
- **sunken stomata** & trapped moist air
- leaves that roll up

Exercises 2.1-2.2

2.1 State the difference between the apoplast and symplast pathways. [2]

2.2 Define a **source** and a **sink** in translocation. [2]

Exercises 2.1·2.2

2.1 State the difference between the apoplast and symplast pathways. [2]

2.1

- apoplast – water moves through the cell walls and spaces; symplast – water moves through the cytoplasm from cell to cell via plasmodesmata

2.2 Define a **source** and a **sink** in translocation. [2]

2.2

- source – where the assimilate is made/released (e.g. a leaf); sink – where it is used or stored (e.g. a root)

Exercises 3.1-3.2

3.1 What is the role of the Casparian strip?

[1]

☐

A to carry water up the xylem

B to block the apoplast pathway so water passes through cell membranes

C to load sucrose into the phloem

D to store water in the root

3.2 Which property of water, caused by hydrogen bonding, allows a continuous column to be pulled up the xylem?

[1]

☐

A adhesion to air

B cohesion between water molecules

C high density

D low specific heat capacity

Exercises 3.1·3.2

3.1 What is the role of the Casparian strip?

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A to carry water up the xylem

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3.1 B

- The Casparian strip blocks the apoplast, forcing water through the cell membranes

3.2 Which property of water, caused by hydrogen bonding, allows a continuous column to be pulled up the xylem?

[1]

☐

A adhesion to air

B cohesion between water molecules

C high density

D low specific heat capacity

3.2 B

- Cohesion between water molecules holds the column together under tension

Exercise 3.3 (a)

3.3 A potometer measures water uptake. In 10 minutes the meniscus moves 60 mm along a tube of cross-sectional area 2.0 mm^2 .

(a) Calculate the volume of water taken up, in mm^3 .

[2]

Exercise 3.3 (a)

3.3 A potometer measures water uptake. In 10 minutes the meniscus moves 60 mm along a tube of cross-sectional area 2.0 mm^2 .

(a) Calculate the volume of water taken up, in mm^3 . [2]

(a)

- volume $V = l \times A = 60 \text{ mm} \times 2.0 \text{ mm}^2 = 120 \text{ mm}^3$

Exercise 3.3 (b)

3.3 A potometer measures water uptake. In 10 minutes the meniscus moves 60 mm along a tube of cross-sectional area 2.0 mm^2 .

(b) Calculate the rate of water uptake, in mm^3 per minute.

[1]

Exercise 3.3 (b)

3.3 A potometer measures water uptake. In 10 minutes the meniscus moves 60 mm along a tube of cross-sectional area 2.0 mm^2 .

(b) Calculate the rate of water uptake, in mm^3 per minute.

[1]

(b)

- $\text{rate} = 120/10 = 12 \text{ mm}^3 \text{ min}^{-1}$

Exercise 3.4

3.4 Explain how sucrose is loaded into the phloem at a source and how this drives mass flow. [4]

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3.4

- companion cells use proton pumps to pump H^+ out, then cotransporters bring sucrose in with H^+ – active transport; this lowers the water potential in the sieve tube so water enters by osmosis, raising the hydrostatic pressure; sap then flows down the pressure gradient to the sink (mass flow)