

Transport in plants

Revision notes · Root hair cells, xylem and phloem, transpiration and the stomata, and translocation of sucrose.

For Edexcel GCSE Biology 1BIO and Combined Science 1SC0. **Triple only** is not in Combined Science. **Higher tier** is only on the Higher paper.

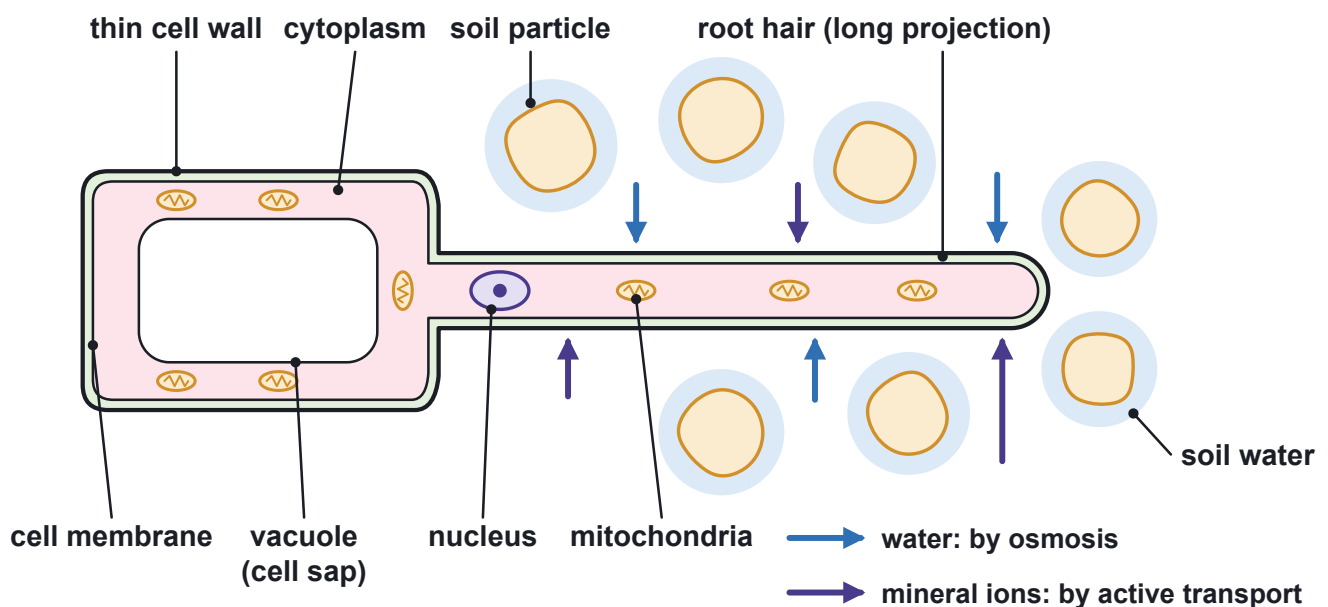
Transport in plants Spec 6.7-6.10

Root hair cells Spec 6.7

Root hair cells are found near the tips of roots. They take in **water** and **mineral ions** from the soil. Their structure is adapted for this job.

Adaptations of a root hair cell	
Adaptation	How it helps
A long, thin projection (the root hair)	Gives a large surface area for absorbing water and mineral ions
A thin cell wall	A short distance for water and mineral ions to cross
Many mitochondria	Release energy by respiration for the active transport of mineral ions into the cell
Cell sap more concentrated than the soil water	Water moves into the cell by osmosis

Mineral ions, such as nitrate ions, are usually at a lower concentration in the soil water than inside the cell. They are taken in by **active transport**, which needs energy from respiration.



A root hair cell: water enters by **osmosis**; mineral ions enter by **active transport** using energy from the mitochondria.

Exam tip: For an 'explain' question, link each adaptation to a function: 'the root hair gives a large surface area, so more water can be absorbed'.

Xylem and phloem Spec 6.8

Xylem and phloem are the two transport tissues in a plant. They run together through the roots, stem and leaves.

Xylem

The xylem carries **water and mineral ions** from the roots to the rest of the plant. It is made of **lignified dead cells**.

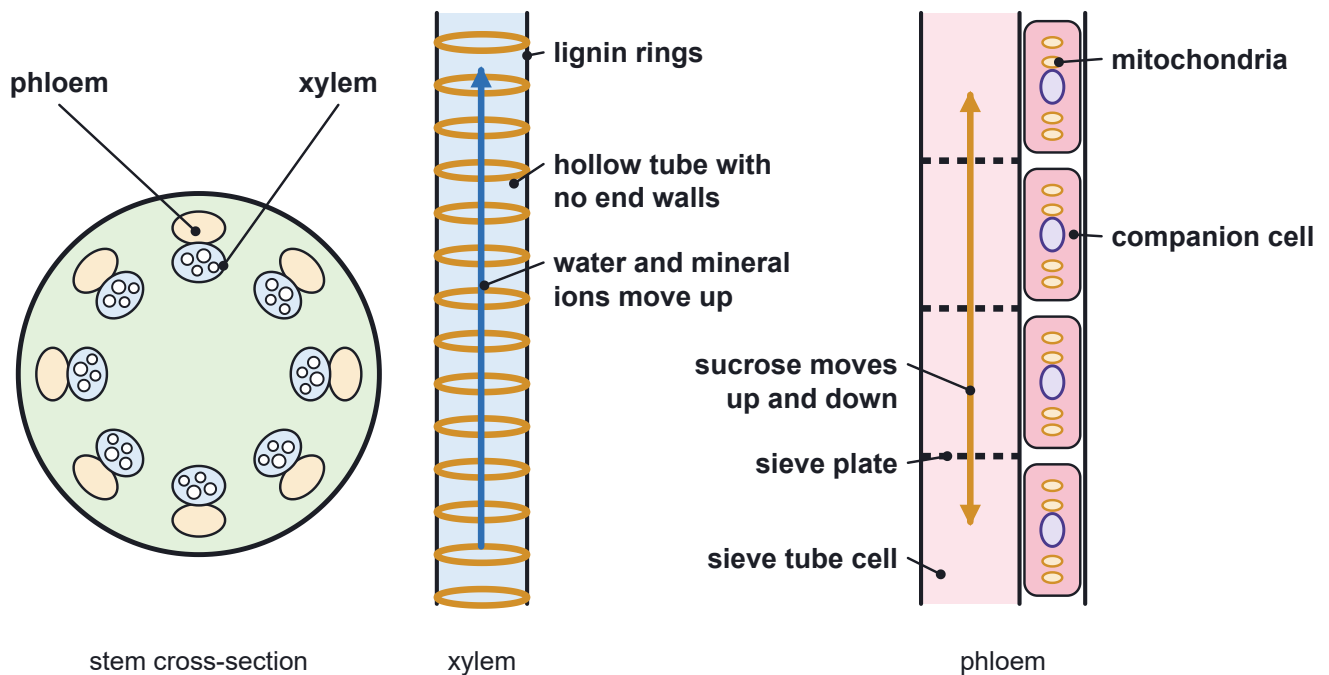
- The cells are dead, with no cytoplasm or nucleus, and the end walls between them have broken down, so they form a continuous hollow tube. Water can flow through easily.
- The walls are strengthened with lignin, which is strong and waterproof. This stops the tubes from collapsing and supports the plant.

Phloem

The phloem carries **sucrose** around the plant. It is made of **living cells** that use energy to transport sucrose.

- Sieve tube cells are joined end to end. The end walls have holes (sieve plates), so dissolved sucrose can pass from cell to cell.
- Companion cells are next to the sieve tube cells. They have many mitochondria to release the energy that is needed for the transport of sucrose.

Xylem and phloem compared		
	Xylem	Phloem
Substances carried	Water and mineral ions	Sucrose (dissolved in water)
Cells	Dead	Living
Cell walls	Thickened with lignin	Cellulose, with holes in the end walls (sieve plates)
Energy needed for transport	No	Yes



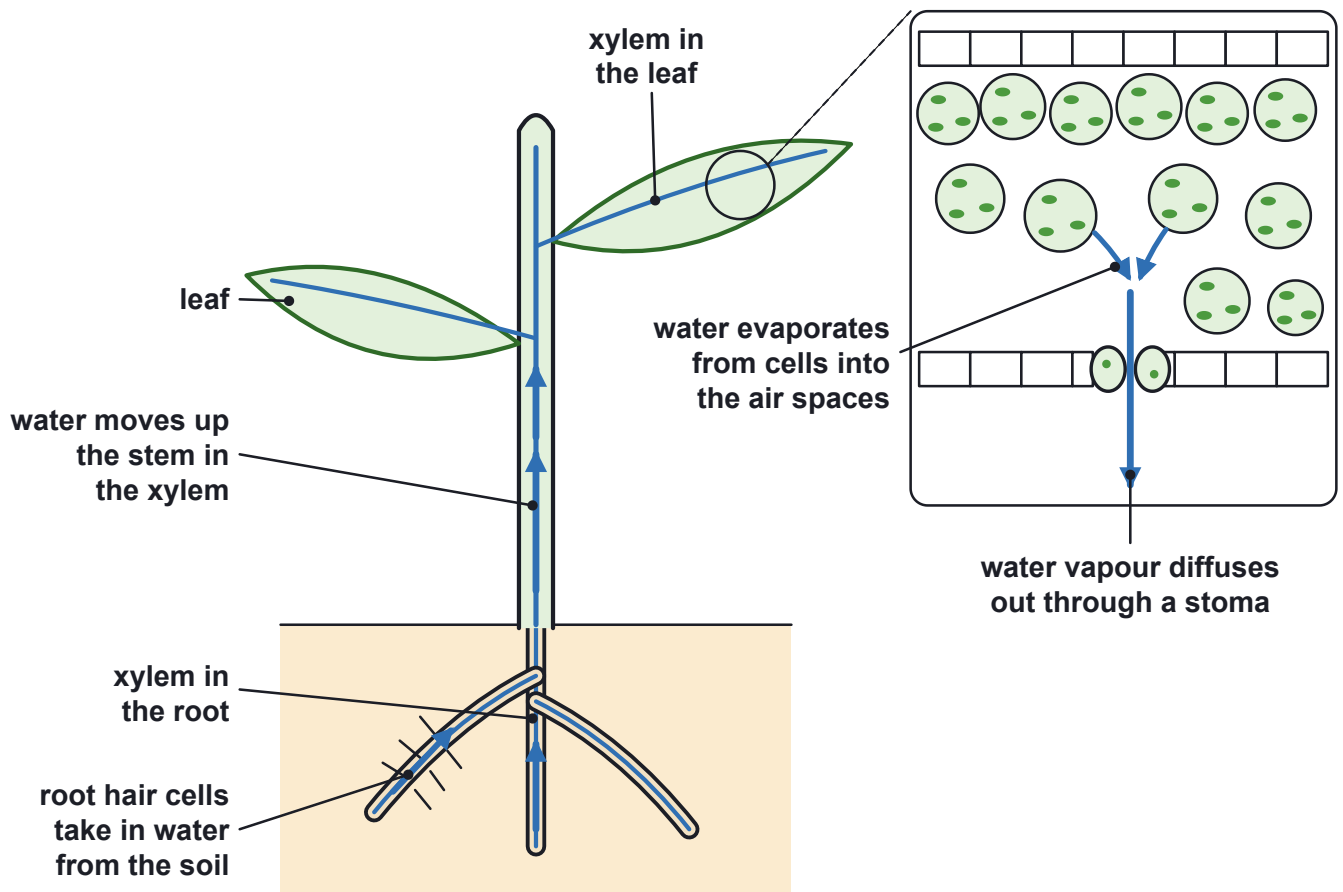
Xylem: **dead, hollow, lignified** tubes carrying water up. Phloem: **living** sieve tube cells and companion cells carrying sucrose both ways.

Common mistake: Do not mix the two up. Xylem = water and mineral ions, dead cells. Phloem = sucrose, living cells.

Transpiration and stomata Spec 6.9

Transpiration is the loss of water vapour from a plant, mainly through the stomata in the leaves. It pulls a continuous stream of water, called the **transpiration stream**, through the plant. This is how water and mineral ions are transported from the roots to the leaves.

1. Water is absorbed from the soil by the root hair cells.
2. Water and dissolved mineral ions move up through the xylem to the leaves.
3. Water evaporates from the surface of the cells inside the leaf, into the air spaces.
4. Water vapour diffuses out of the leaf through the stomata, into the air.

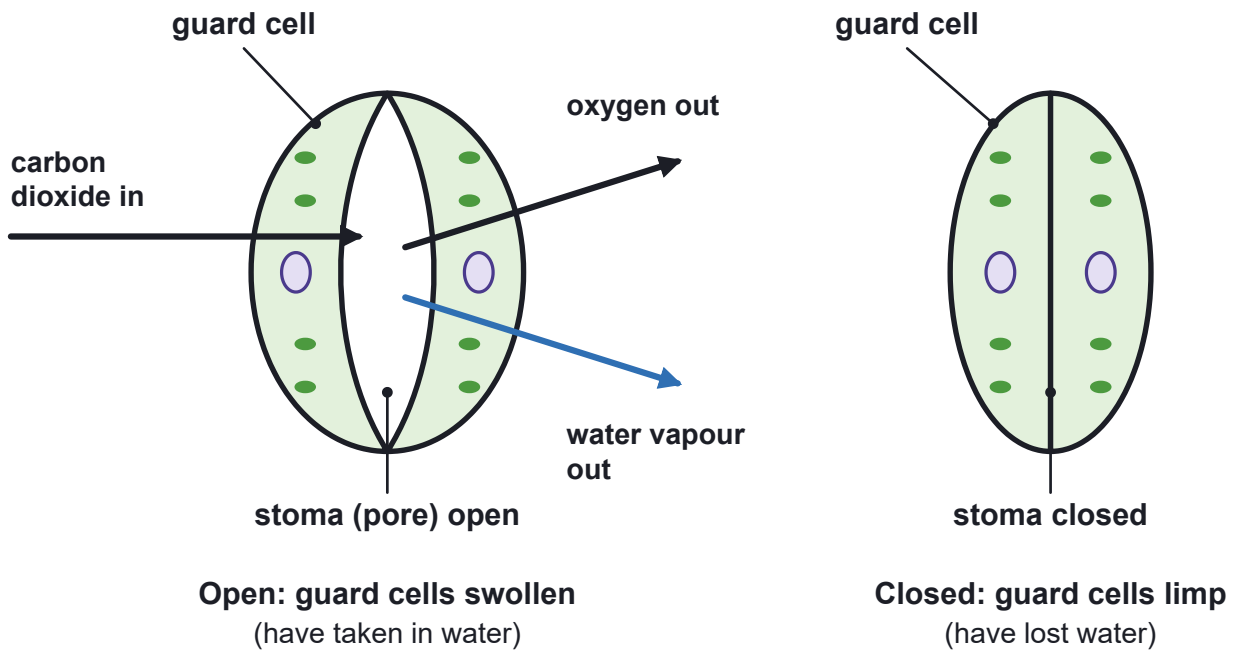


The transpiration stream: water moves up the **xylem**, **evaporates** into the air spaces and **diffuses** out through the stomata.

Stomata

Stomata are tiny pores, found mainly on the underside of a leaf. Each stoma is surrounded by two **guard cells** which control whether the stoma is open or closed.

- Open stomata let carbon dioxide diffuse into the leaf for photosynthesis, and let oxygen and water vapour diffuse out.
- When the guard cells take in water they swell and the stoma opens.
- When the guard cells lose water they become limp and the stoma closes. This reduces the amount of water lost by transpiration, for example when the plant is short of water.



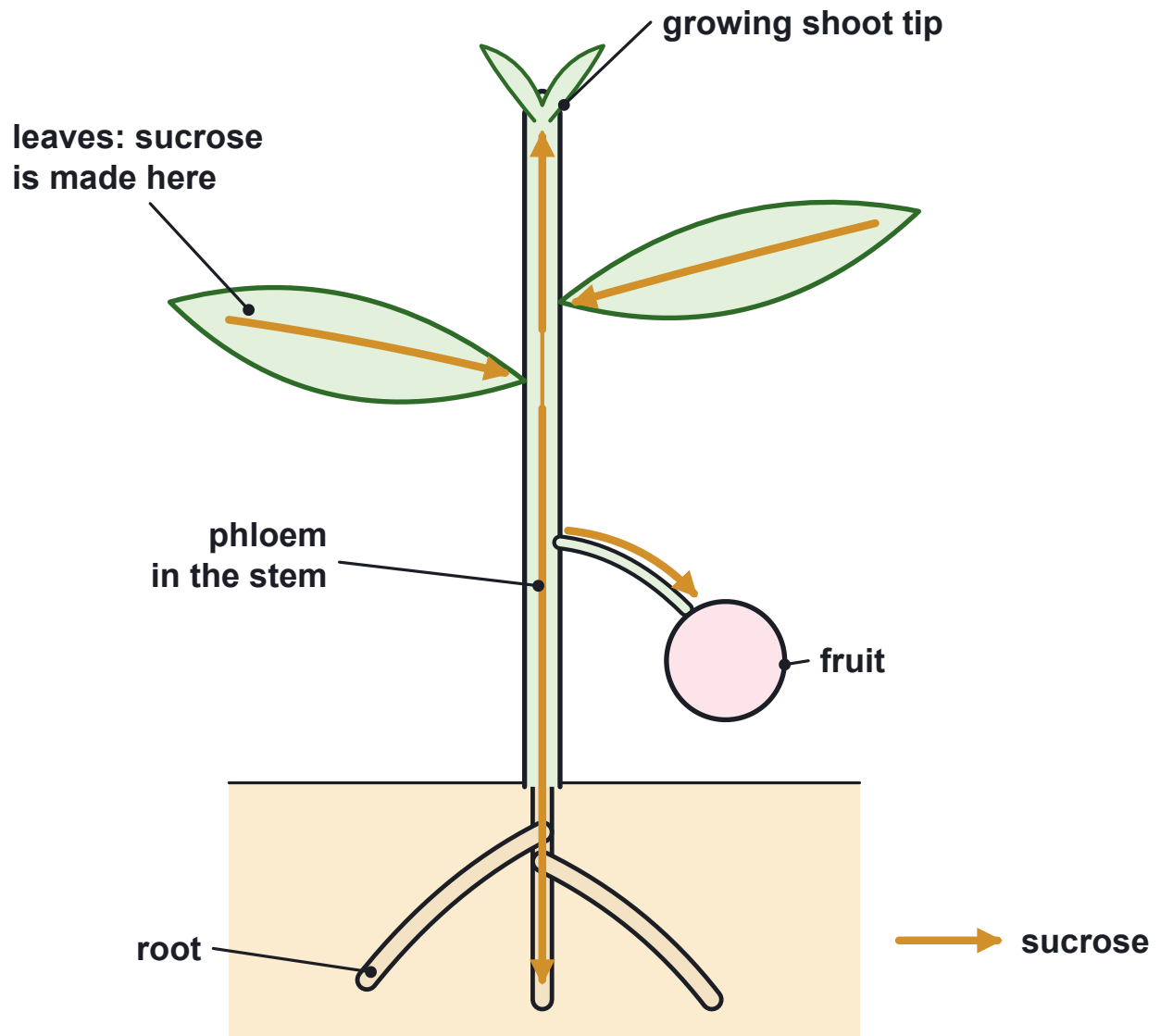
Guard cells that take in water swell and **open** the stoma; guard cells that lose water go limp and **close** it.

Exam tip: Water is lost from the leaf by evaporation and then diffusion. Do not say that water 'escapes' or 'leaks'. Use the terms evaporates and diffuses.

Translocation Spec 6.10

Translocation is the transport of **sucrose** around the plant. Sucrose is made from the glucose produced in photosynthesis, and it is carried dissolved in water in the **phloem**.

- Sucrose moves from the leaves, where it is made, to the parts of the plant that use it or store it, such as growing shoot tips, roots, flowers and fruits.
- It can move up and down the plant, depending on where it is needed.
- Translocation needs energy, which is released by respiration in the living cells of the phloem.



Translocation: sucrose moves in the **phloem** from the leaves to where it is used or stored, **up and down** the plant.

Exam tip: Contrast it with transpiration: translocation moves sucrose in the phloem and uses energy. Transpiration moves water in the xylem and does not use energy from the plant's cells.

Quick check

1. Give two adaptations of a root hair cell.
2. Why is xylem made of lignified dead cells?
3. What is transpiration?
4. What is translocation?

Quick check answers

Transport in plants

- 1 . Any two of: a long, thin projection for a large surface area; many mitochondria for active transport; a thin cell wall.
- 2 . Dead cells with no end walls form a continuous hollow tube for water, and lignin strengthens the walls.
- 3 . The loss of water vapour from the leaves, which pulls water through the plant.
- 4 . The transport of sucrose around the plant in the phloem.