

Transport in plants revision notes

Plants move water and mineral ions in the xylem and the products of photosynthesis in the phloem. This topic covers where these tissues are, how root hair cells take in water, the route water takes to the leaves, and how water is lost by transpiration.

For Cambridge IGCSE Combined Science 0653, **Supplement** is Extended content, only examined on Papers 2 and 4.

1 Xylem and phloem **Spec B8.1**

Xylem and phloem **Spec B8.1.1**

Plants have two transport tissues. Together they make up the vascular tissue, which runs from the roots through the stem and into the leaves.

Functions of xylem and phloem

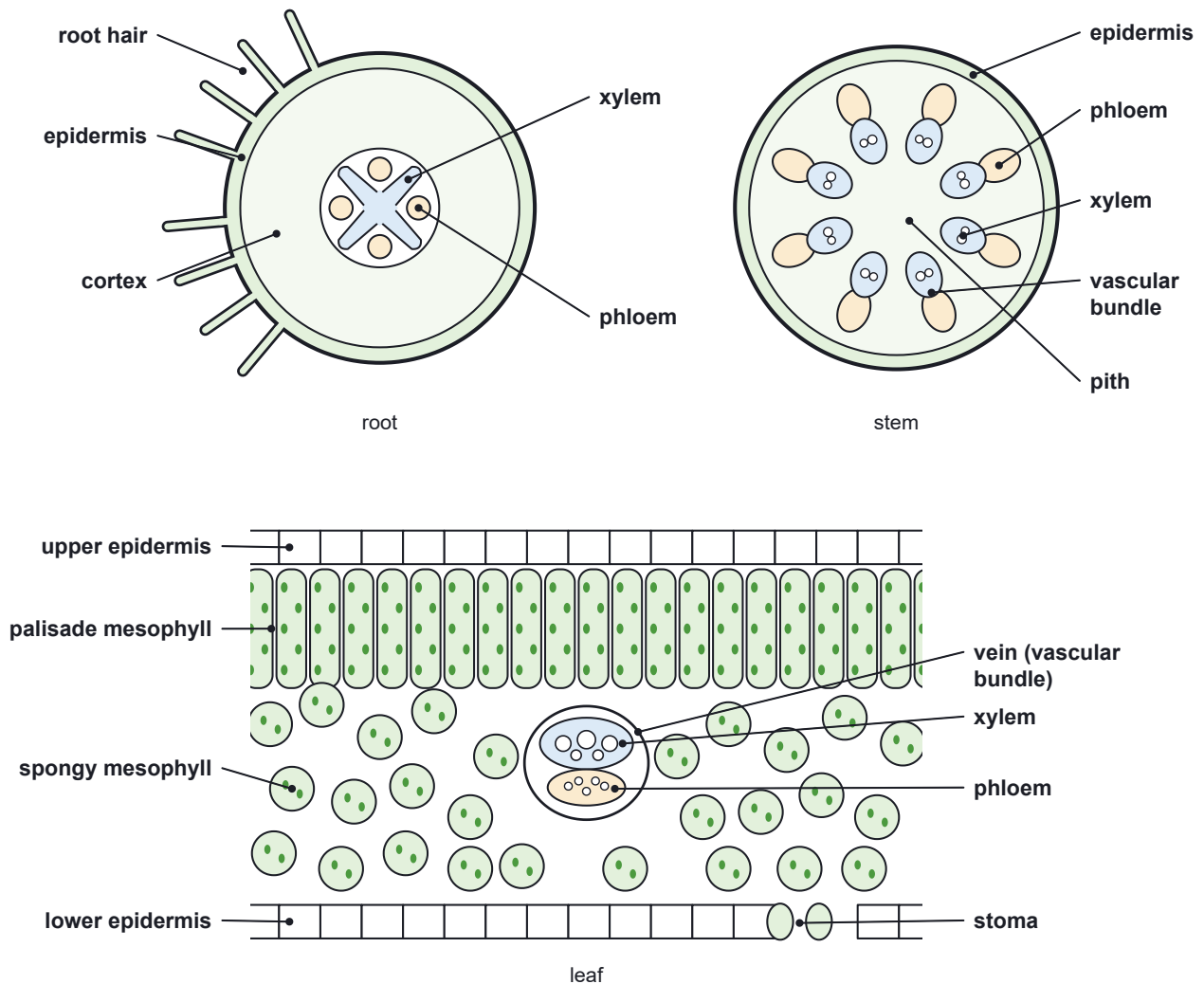
Tissue	Function
Xylem	transport of water and mineral ions (from the roots upwards), and support for the plant
Phloem	transport of sucrose and amino acids

Xylem and phloem in roots, stems and leaves **Spec B8.1.2**

You must be able to find xylem and phloem in sections of the roots, stems and leaves of a non-woody dicotyledonous plant. In all three organs they are found together, in groups called **vascular bundles** (veins in the leaf).

Position of xylem and phloem

Organ	Where the vascular tissue is	Xylem and phloem
Root	in the centre of the root	xylem in the middle, often in an X or star shape, with phloem between the arms of the X
Stem	vascular bundles in a ring near the outside of the stem	in each bundle, xylem is on the inside and phloem on the outside
Leaf	in the midrib and the veins	in each vein, xylem is on the upper side and phloem on the lower side



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Root: xylem in the centre. Stem: bundles with **phloem outside, xylem inside**. Leaf vein: **xylem above phloem**.

To identify the tissues in a photograph, find the vascular bundle or vein first, then use its position to decide which tissue is which.

Common mistake: Do not mix up the order in the stem. Phloem is on the outside of each bundle and xylem is on the inside.

Quick check

1. What does phloem transport?
2. What are the two functions of xylem?
3. In a stem, which tissue is on the outside of a vascular bundle?

2 Water uptake Spec B8.2

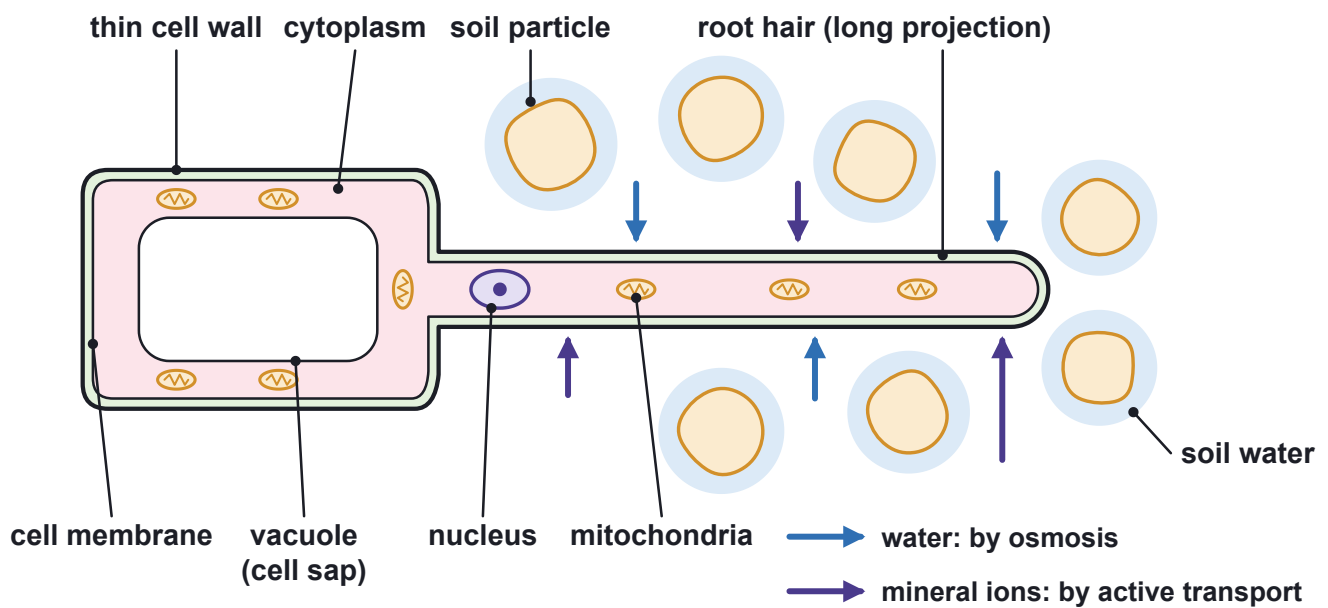
Root hair cells and the pathway of water Spec B8.2.1, B8.2.2, B8.2.3

Root hair cells

A **root hair cell** is a cell in the outer layer of the root that has a long, thin extension called the root hair. Its functions are to absorb water from the soil and to absorb mineral ions from the soil.

Supplement

The root hair gives the cell a **large surface area**, which increases the uptake of water and mineral ions.



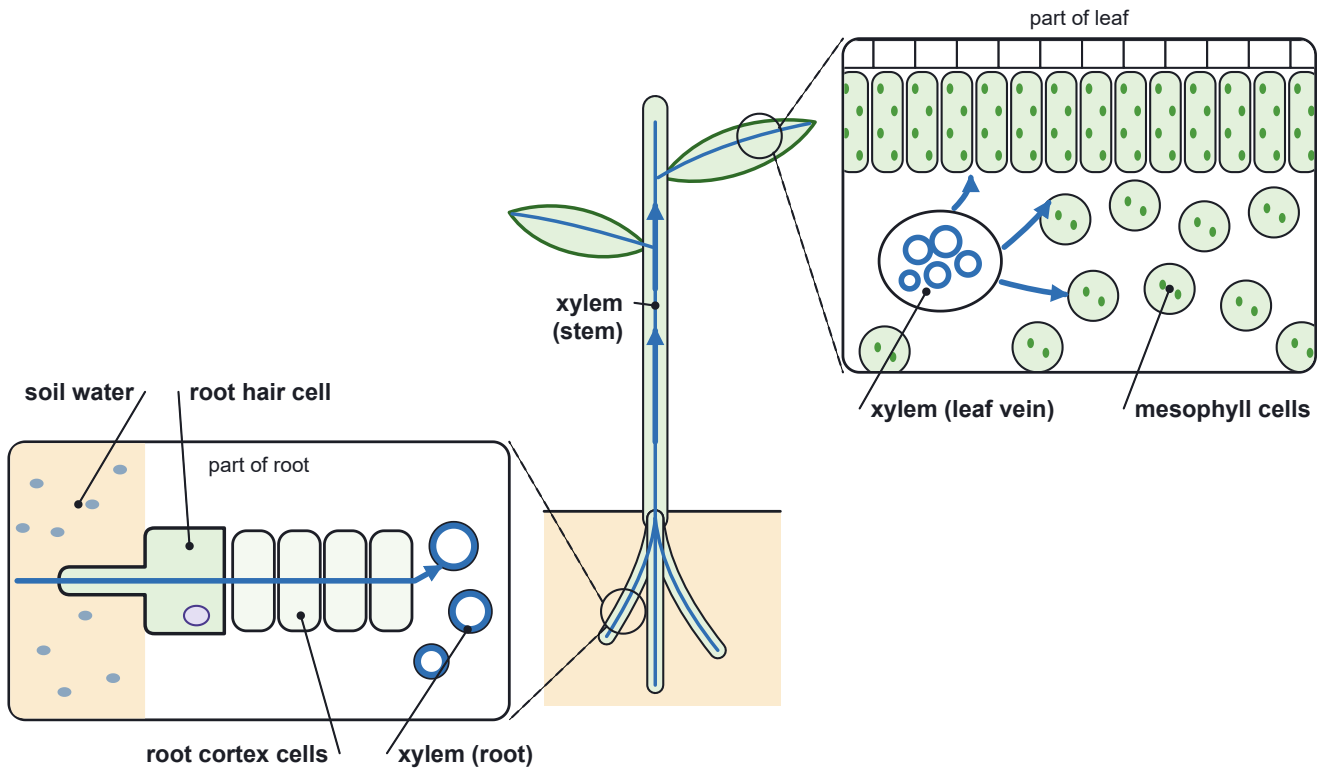
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A root hair cell. Its long extension gives a large surface area for absorbing water and mineral ions.

The pathway of water

Water takes the same route from the soil to the air. You need to be able to outline it.

1. Water enters the **root hair cells** from the soil.
2. It passes through the **root cortex cells**.
3. It enters the xylem and moves up the root and stem.
4. It leaves the xylem in the leaf and reaches the **mesophyll cells**.



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Water moves from the soil into the **root hair cells**, across the **root cortex cells**, up the **xylem** and into the **mesophyll cells**.

Exam tip: Give the cells in the right order: root hair cells, root cortex cells, xylem, mesophyll cells.

Writing 'roots to leaves' alone will not score.

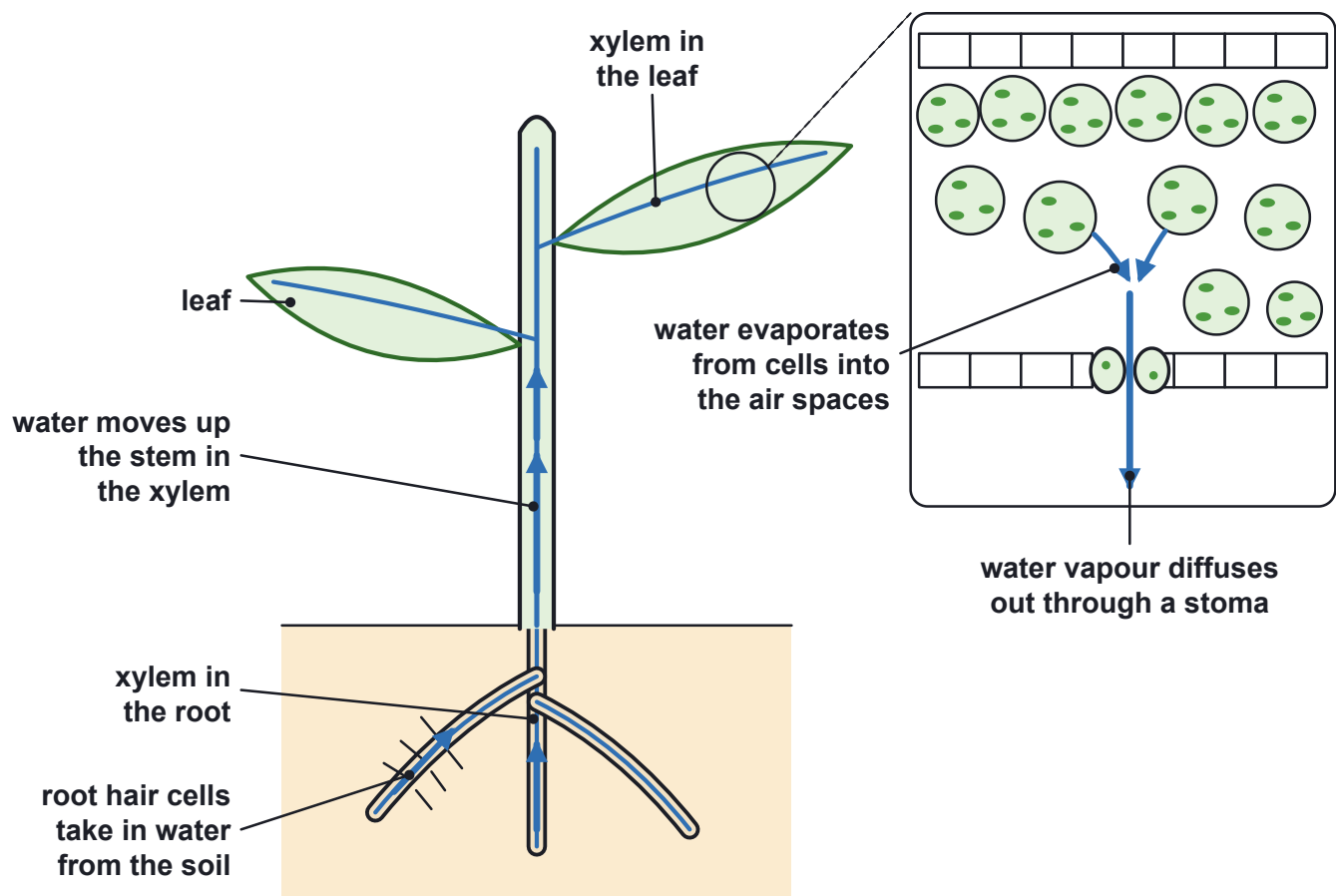
Quick check

1. What do root hair cells absorb?
2. **Supplement** Why does a root hair increase uptake?
3. Give the pathway of water in order.

3 Transpiration Spec B8.3

Transpiration Spec B8.3.1

Transpiration is the loss of water vapour from leaves.



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In the leaf, water evaporates from the mesophyll cells and the vapour diffuses out through the stomata.

Factors affecting the rate of transpiration Spec B8.3.2 Supplement

The rate of transpiration changes with the conditions around the plant. You must be able to describe the effects of **temperature** and **wind speed**.

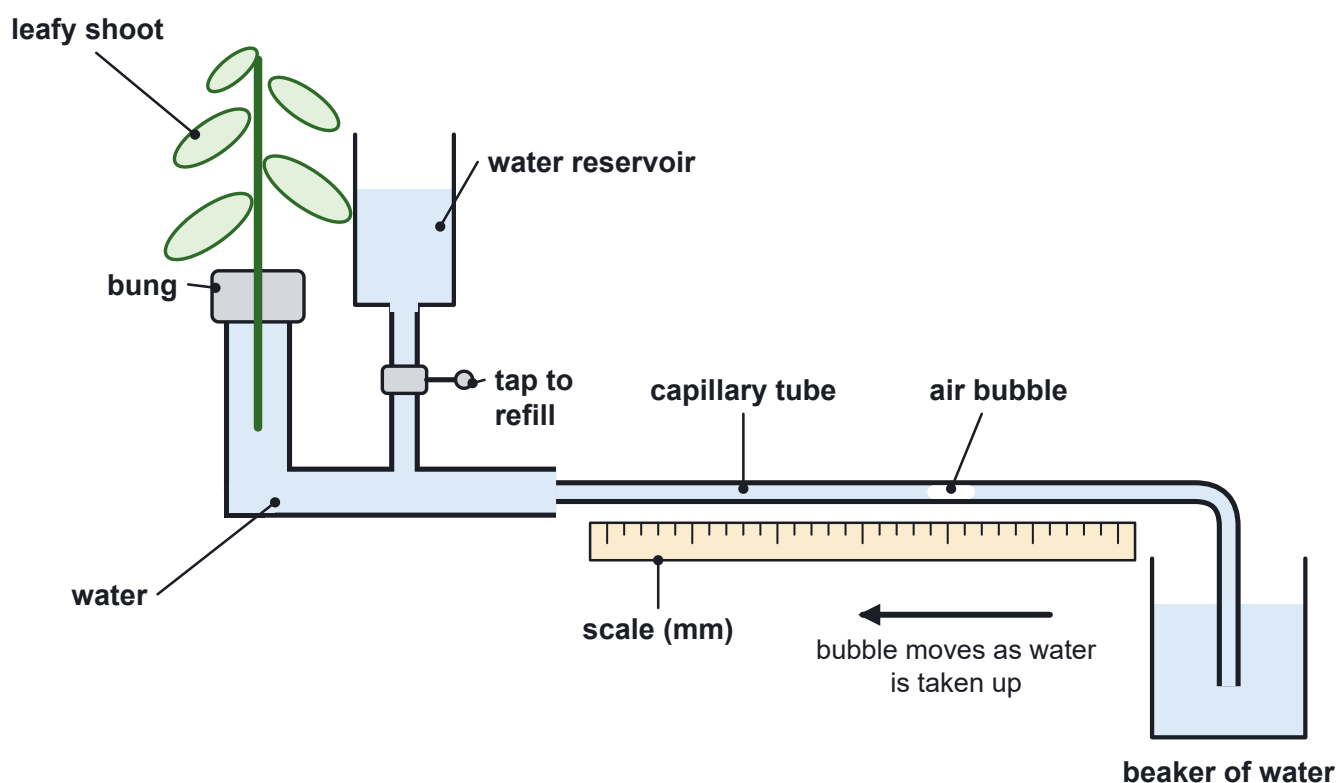
Effect of environmental factors on the rate of transpiration	
Factor	Effect on rate
Temperature	higher temperature gives a faster rate
Wind speed	higher wind speed gives a faster rate

Measuring the rate: the potometer

A **potometer** measures how much water a cut shoot takes up. Most of the water taken up is lost by transpiration, so water uptake is used as an estimate of the rate of transpiration. As the shoot takes up water, an air bubble in the capillary tube moves along a scale.

1. Cut a leafy shoot under water and fit it into the potometer, keeping the apparatus full of water with no air bubbles.
2. Introduce an air bubble into the capillary tube and note its starting position.

3. Change one factor, for example place a fan at different distances to vary wind speed, or use rooms or water baths at different temperatures.
4. Measure the distance moved by the bubble in a set time.
5. Repeat and calculate a mean. Keep everything else the same.



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As the shoot takes up water, the **air bubble** moves along the scale.

rate of water uptake = distance moved by bubble ÷ time

Calculating a rate

In a potometer, the air bubble moved 45 mm in 15 minutes. Calculate the rate of water uptake in mm / min.

1. rate = distance ÷ time

2. rate = $45 \div 15$

Answer: 3 mm / min

Practical skill: Name the independent variable (for example wind speed), the dependent variable (distance moved by the bubble in a set time) and at least two controlled variables (such as the same shoot, temperature and light). Repeat the experiment for reliability.

Quick check

1. Define transpiration.
2. **Supplement** Name two factors that increase the rate of transpiration when they increase.

Quick check answers

Xylem and phloem

- 1 . Sucrose and amino acids.
- 2 . Transport of water and mineral ions, and support.
- 3 . Phloem.

Water uptake

- 1 . Water and mineral ions.
- 2 . It gives the cell a large surface area.
- 3 . Root hair cells, root cortex cells, xylem, mesophyll cells.

Transpiration

- 1 . The loss of water vapour from leaves.
- 2 . Temperature and wind speed.