

Leaves, water uptake and extreme environments

Revision notes • The factors that affect the rate of water uptake and transpiration, measuring it with a potometer, and transpiration rate calculations.

For Edexcel GCSE Combined Science 1SC0. **Higher tier** is only on the Higher paper.

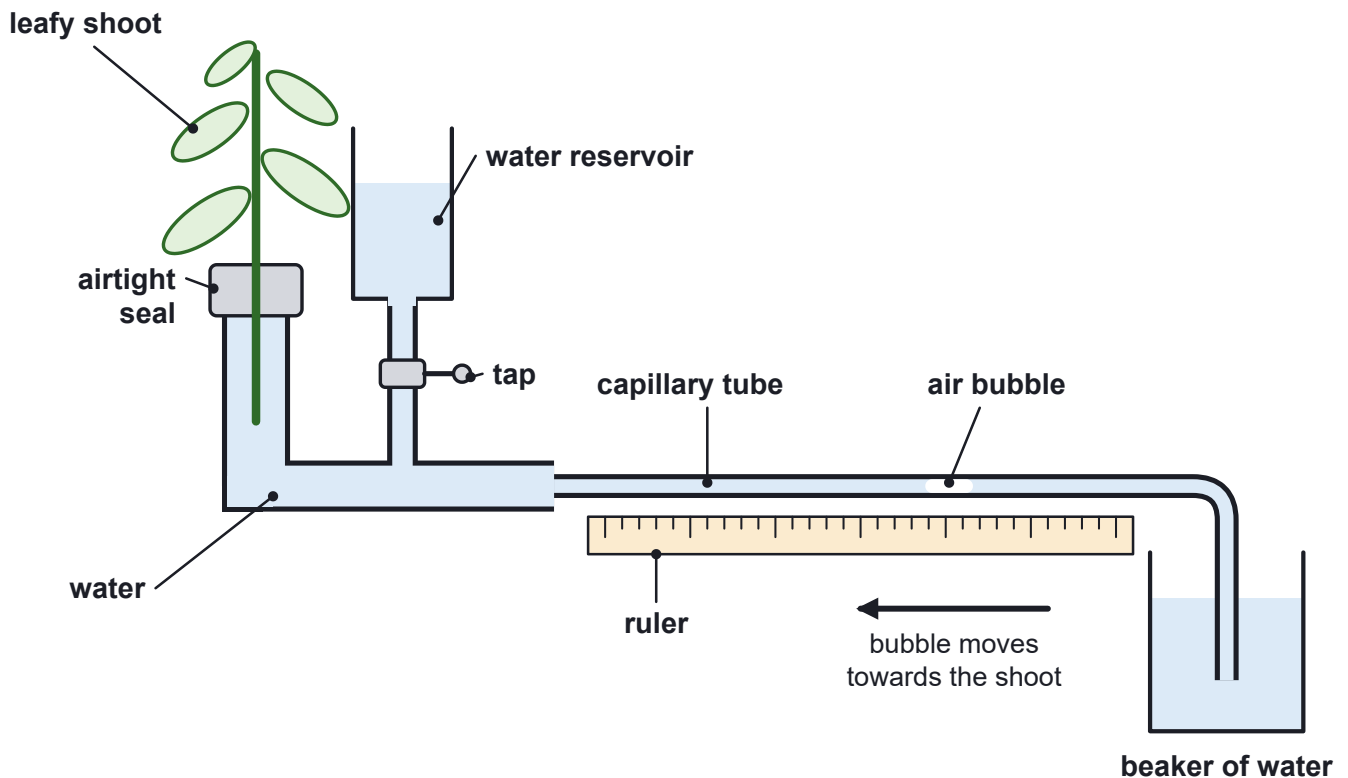
Leaves, water uptake and extreme environments Spec 6.11B-6.14B

Factors affecting water uptake Spec 6.12

The rate at which a plant takes up water depends on the rate of transpiration. When more water is lost from the leaves, more is pulled up through the xylem. Three environmental factors affect it.

Effect of environmental factors on water uptake		
Factor	Effect on water uptake	Explanation
Light intensity	Higher light intensity increases the rate	Stomata open in the light, so more water vapour can diffuse out of the leaf. Low light or darkness makes the stomata close.
Air movement	More air movement increases the rate	Moving air carries away water vapour from around the stomata. This keeps a steep concentration gradient, so water vapour diffuses out faster.
Temperature	Higher temperature increases the rate	Water evaporates from the cells faster, and water vapour particles move faster, so diffusion out of the leaf is faster.

A **potometer** is used to measure the rate of water uptake of a leafy shoot. As the shoot takes up water, an air bubble moves along a capillary tube. The distance moved in a set time is a measure of the rate. You can compare the rate in different conditions, for example with and without a fan, or in the light and in the shade.



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A potometer: the **distance the bubble moves** in a set time measures the rate of water uptake.

Common mistake: Say what happens and why. 'The rate goes up' is not enough. Add 'because the stomata are open' or 'because the water vapour is carried away, keeping a steep concentration gradient'.

Rate calculations for transpiration Spec 6.13

A rate tells you how much something changes in a unit of time. For water uptake or transpiration you can use the distance moved by a bubble in a potometer, the volume of water lost, or the change in mass of a plant.

rate = change in quantity ÷ time taken

percentage change = (change in mass ÷ original mass) × 100

Rate of water uptake

In a potometer, an air bubble moved 31 mm, 28 mm and 34 mm in three repeats of 10 minutes each. Calculate the mean rate of water uptake in mm per minute.

1. Mean distance = $(31 + 28 + 34) \div 3 = 93 \div 3 = 31$ mm.
2. Rate = distance ÷ time = $31 \div 10 = 3.1$ mm per minute.

Answer: 3.1 mm per minute

Percentage loss of mass

A leafy shoot had a mass of 25.0 g at the start of an investigation and 23.0 g at the end. Calculate the percentage loss of mass.

1. Loss of mass = $25.0 - 23.0 = 2.0$ g.
2. Percentage loss = $2.0 \div 25.0 \times 100 = 8\%$.

Answer: 8%

Maths skill: Always include the unit with a rate, for example mm per minute or cm³ per hour. Calculate a mean first if you are given repeats.

Quick check

1. What does a potometer measure?
2. Why does moving air increase the rate of transpiration?
3. A bubble in a potometer moves 24 mm in 8 minutes. What is the rate?
4. Why does a higher temperature increase the rate of water uptake?

Quick check answers

Leaves, water uptake and extreme environments

- 1 . The rate of water uptake of a leafy shoot.
- 2 . It carries away water vapour, keeping a steep concentration gradient so water vapour diffuses out faster.
- 3 . $24 \div 8 = 3$ mm per minute.
- 4 . Water evaporates from the leaf cells faster and water vapour diffuses out faster, so more water is pulled up the xylem.