Core practical 10: Transpiration

2.58B Core practical: Investigate the role of environmental factors in determining the rate of transpiration from a leafy shoot

Links to the specification content

2.54	Describe the role of xylem in transporting water and mineral ions from the roots to other parts of the plant
2.55B	**Understand how water is absorbed by root hair cells**
2.56B	**Understand that transpiration is the evaporation of water from the surface of a plant**
2.57B	**Understand how the rate of transpiration is affected by changes in humidity, wind speed, temperature and light intensity**

Introducing the practical

This investigation uses a potometer to measure the rate of water uptake and therefore deduce water loss or transpiration from a leafy shoot. A simple bubble potometer consists of a straight length of capillary tube attached to a plastic collar into which the cut end of a leafy shoot is inserted. Commercially produced potometers are not required but you could show one to the students if you have one.

The students will need help to set up the potometer ensuring that the shoot fits snugly into the collar and that there are no leaks or bubbles in the tube. A bucket filled with water that enables the potometer to be immersed vertically will help to remove unwanted bubbles.

When set up, the bottom of the capillary tube can be placed in a beaker of water. It can then be lifted out until a small air bubble appears then replaced in the beaker to 'seal' the bubble.

Once set up the students can measure the transpiration rate as distance the bubble travels in one minute. They should take a number of readings and calculate a mean rate.

If the students are careful they can use the plastic collar to squeeze out the bubble from the bottom of the capillary tube when it gets too high up the capillary tube. They can then lift the tube out of the beaker and allow a new bubble to form, replace the tube in the water and carry on with their readings. This will save a lot of time, as the apparatus will not need to be dismantled.

Each potometer can be used to collect readings in normal air, windy conditions (e.g. using a hairdryer on cold), increased temperature, increased humidity (e.g. using a clear plastic bag), darkness and finally with half of the leaves removed.

Students could decide how they could vary conditions. Class data can be collected and a discussion should ensue on how we can combine data from different shoots and potometers.

Transpiration

Questions you could ask to enhance learning and focus your students on important aspects of the practical:

Skills that are covered in the practical:

- Identify independent, dependent and control variables
- Devise and plan investigations, using scientific knowledge and understanding when selecting appropriate techniques
- Selecting appropriate apparatus
- Observing and recording changes
- Producing appropriate results tables
- Analyse and interpret data to draw conclusions that are consistent with the evidence
- Communicate the findings from experimental activities, using appropriate technical language, relevant calculations and graphs
- Assess the reliability of an experimental activity
- Evaluate data and methods taking into account factors that affect accuracy and validity.

Maths skills:

1C Use ratios, fractions, percentages, powers and roots

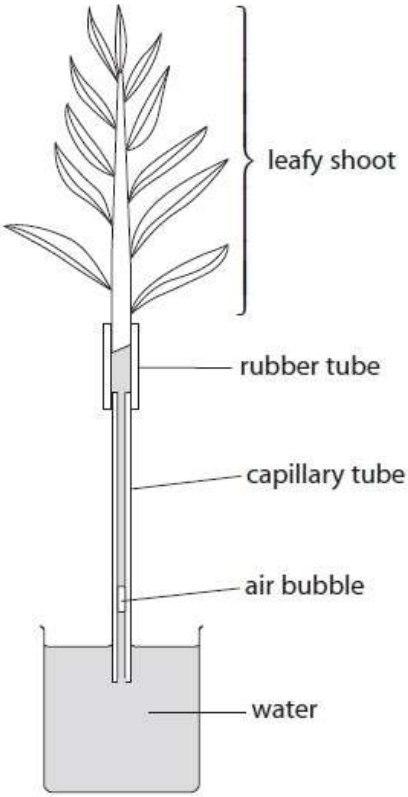
2A Use an appropriate number of significant figures

2B Understand and find the arithmetic mean (average) of class data

2C Construct and interpret bar charts

Exam questions

Steven wanted to measure the rate of water loss from a leafy shoot. He set up this apparatus in normal laboratory conditions.



(a) Name the apparatus Steven used. **(1)**

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(b) Name the process by which a plant loses water. **(1)**

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(c) Describe how Steven should set up the apparatus and how he should then use it to estimate the rate of water loss from the leafy shoot. **(4)**

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(d) Steven carried out three further experiments. He used the same plant, but changed one condition in each experiment.

The table shows the percentage change in rate of water loss for each condition when compared to Steven's original experiment.

Condition	Percentage change in rate of water loss (%)
wind increased	+23
Light intensity reduced	-40
half of the leaves removed	-48

Explain the change in water loss when

(i) wind was increased. **(2)**

(ii) light intensity was reduced. **(1)**

(iii) half of the leaves were removed. **(2)**

(e) Suggest how Steven could increase the wind around the leafy shoot. **(1)**

(Total for question = 12 marks)