**Measuring rate of water uptake by a plant shoot using a potometer**

The objectives of this activity are:

* to obtain estimates for the rate of transpiration from a plant shoot in different conditions
* to establish how different factors affect the rate of transpiration
* to evaluate the potometer as a piece of apparatus for measuring transpiration.

### Procedure

SAFETY:

If the sap from the plants irritates your skin, let your teacher know.

Take care if you cut the plant shoot yourself.

Take care when assembling and handling the glass potometer: it is easy to break the long glass tubes and cut yourself with the broken ends.

Make sure you know how to deal with breakages.

### Investigation

1. Check the apparatus is set up as in the diagram.
2. Leave undisturbed for 5 minutes or until the shoot equilibrates to the conditions.
3. Starting about 2 cm from the free end of the capillary tubing, mark the tubing at 1 cm intervals using the ruler and marker pen. Make as many marks as possible (at least 6).
4. Introduce a bubble into the capillary tubing by lifting the whole potometer upwards. To do this, loosen the screw on the boss and slide the boss up the clamp stand so that the capillary tube comes out of the water in the beaker. Retighten the screw on the boss.
5. Gently blot the end of the capillary tube with a piece of paper towel and an air bubble should appear in the capillary tube.
6. Loosen the screw on the boss and lower the potometer, so that the capillary tube just goes back into the water in the beaker. Retighten the screw on the boss.
7. There are two ways of taking measurements:

* Start the stop clock when the bubble of air touches the first marked line. Stop the clock when the bubble has travelled a fixed distance (2 or 3 cm) and touches the appropriate marked line.

OR:

* Start the stop clock when the bubble of air touches the first marked line. Allow the bubble to travel upwards for a fixed period of time (depending on the rate of movement, this could be 10 or 30 seconds or longer) and mark how far the bubble has moved with a different coloured pen. Measure the distance between the first mark and this second coloured mark.

1. Calculate the rate of movement of the air bubble (and hence rate of transpiration) using the formula given here. SI units are cm/s.

Distance moved by the air bubble

Time taken for the air bubble to move that distance

1. Change a factor that might affect how quickly the plant loses water by transpiration.

1. Repeat from d to i.

**QUESTIONS**

1. Draw a graph of your results.
2. Describe the shape of your graph and note any anomalies or inconsistencies.
3. Explain in biological terms what your graph shows.
4. The apparatus measures the uptake of water. What could happen to the water once it enters the plant shoot?
5. Suggest some ways you could improve this procedure.

**ANSWERS**

1. Independent variable should be on the x-axis, dependent variable on the y-axis.
2. Depends on graph. Transpiration will be increased by increasing wind speed, and reduced by reducing surface area.
3. Terms could include: proportional, inversely proportional. Anomalies could be highlighted and explained.
4. In biological terms, increasing wind speed carries away more water vapour from near the leaf surface and increases the rate of diffusion of water vapour out of the stomata. This reduces the humidity in the intercellular space in the spongy mesophyll and increases the rate of evaporation from the cell surface. This in turn draws water from one cell to another through the leaf and up the stem.
5. In the shoot, the water could stay in the cells, or be used in photosynthesis and assimilated into carbohydrate, or it could be passed on up the xylem to the leaf tissue.
6. Practice would make this more reliable as it is quite a tricky set of apparatus to handle. Setting up a controllable chamber – with consistent air currents and variably humidity/ temperature would make results more accurate.