GCSE

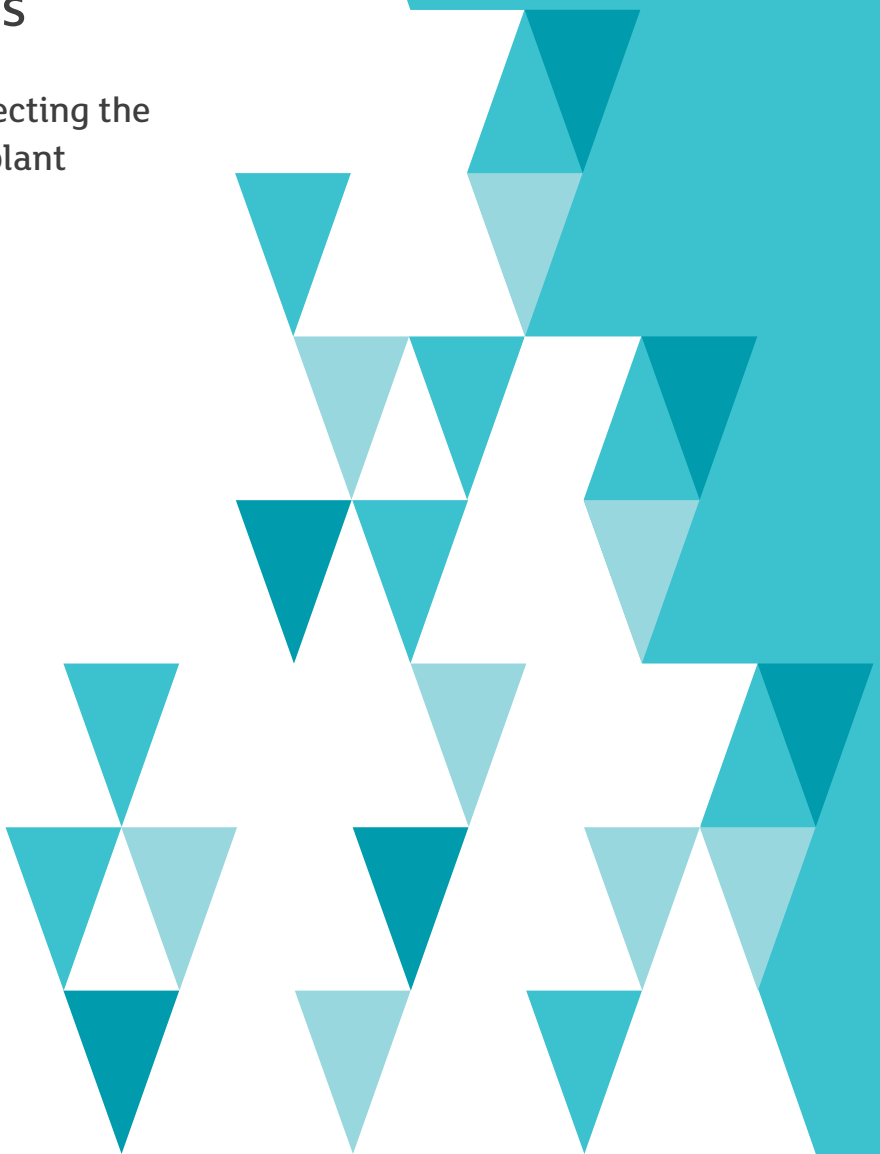
Rewarding Learning

CCEA GCSE TEACHER GUIDANCE

Biology Practical Manual

Unit 3: Practical Skills

2.2 Investigate the factors affecting the rate of water uptake by a plant



For first teaching from September 2017

Practical 2.2

Use a potometer (either a bubble or weight potometer and/or washing line method) to investigate the factors affecting the rate of water uptake by a plant.

Transpiration refers to the loss of water from a plant by evaporation. The movement of water through a plant from the roots, through the stem and leaves and then out to the surface of the leaf through the stomata where it can be removed by evaporation, is called the transpiration stream.

The continuous movement of water through a plant is important for a number of reasons:

- Photosynthesis – It ensures that there is a constant supply of water to the leaves where it is used in photosynthesis
- Transport of minerals – Any dissolved minerals can be moved through the plant to where they may be needed
- Support – The movement of water into cells by osmosis provides support

A potometer measures water loss from leaves.

A bubble potometer measures the rate of water loss from a plant by transpiration.

A weight photometer measures the amount of water lost by a plant through transpiration.

The washing line method is used to prove that most water loss occurs from the lower surface of the leaf.

Using a bubble potometer

Apparatus

- bubble potometer
- vaseline
- cutting from a leafy plant. (privet, busy lizzie or geranium all work well)
- stopwatch

Method

1. Cut the shoot under water to prevent air bubbles entering the xylem of the stem and ensure the cut is diagonal to increase the surface area available for water uptake.
2. Place the cutting in the potometer and seal with vaseline to ensure no air enters the system.
3. Dry the leaves with kitchen paper or blotting paper. This will create a concentration gradient between the inside and outside of the leaves.
4. Reset the bubble to zero using the tap at the reservoir.
5. Record the position of the bubble along the scale after 20 minutes.
6. Reset the bubble and repeat under different conditions:
   a. with a heat lamp shining on the leaf
   b. with a fan blowing air around the leaf
   c. with a lamp and a fan

Results

Record the results in a suitable table.

A sample table is shown.

	Bubble position at the start	**After 20mins**	**Total distance travelled/cm**
Normal			
Lamp			
Fan			
Lamp and Fan			

Conclusion

The faster the water evaporates from the surface of the leaf, the faster the water is pulled through the plant. This is shown by the movement of the bubble as the water is pulled through the potometer and up the leaf.

Additional Investigations:

SURFACE AREA: remove some leaves from the cutting and repeat.
LIGHT INTENSITY: Light vary distance of the lamp from the plant.
WIND SPEED: Set the fan at different speeds or different distances from the plant.

Using the weighing method

Apparatus

- electronic balance
- volumetric flask or measuring cylinder
- plant cutting
- oil
- water

Method

1. Pour water into the measuring cylinder and record the volume.
2. Place the cutting into the water.
3. Pour a layer of oil onto the water to prevent evaporation from the surface.
4. Place the measuring cylinder and its contents onto the electronic balance.
5. Record the mass.
6. Leave in the classroom.
7. Record the mass at time intervals.
8. Repeat under different conditions:
    a. Place a lamp next to the equipment.
    b. Place a fan next to the equipment.
    c. Place both a lamp and a fan next to the equipment.

Results

Record your results in a suitable table.

A sample table is shown.

	Mass at start/g	**Mass after 3hrs/g**	**Difference/g in mass**
Normal conditions			
Lamp			
Fan			
Lamp and fan			

Conclusion

Over time water in the measuring cylinder will be pulled through the plant to the leaves where it will evaporate. So the overall amount of water in the cylinder will decrease. This will be shown as a decrease in weight.

The additional investigations outlined on the previous page can be carried out using this equipment.

The washing line method

Apparatus

- 'washing line'/string hung between 2 points
- leaves (laurel leaves, geranium leaves)
- vaseline

Method

1. Hang the leaves at intervals along the line.
2. Leaf 1 is left untouched.
3. Leaf 2 has vaseline smeared on the top surface.
4. Leaf 3 has vaseline smeared on the bottom surface.
5. Leaf 4 has vaseline smeared on both surfaces.
6. Record the appearance of each leaf after 24 hours.

Results

Record the appearance of the leaves in a suitable table.

A sample table is shown.

Conditions	**Appearance at the start**	**Appearance after 24hrs**
Normal		
Vaseline on top surface		
Vaseline on bottom surface		
Vaseline on both surfaces		

Conclusion

The leaf will wilt as water is lost. The leaf that loses the most water will wilt the most.