Plant tissue: measure osmosis

Question: how does external sucrose concentration affect the percentage change in potato mass? Living cell membranes provide the partially permeable barrier.

1. COLLECT COMPARABLE MEASUREMENTS

A. PREPARE Cut equal-diameter, equal-length cylinders from the same potato. Remove skin, gently blot and record each initial mass.

B. IMMERSE Use a range of labelled sucrose concentrations, including distilled water. Keep tissue size, solution volume, temperature and immersion time constant.

C. REWEIGH Remove, blot consistently without squeezing and record final mass. Use several independent cylinders per concentration; calculate individual percentage changes, then a mean.

2. CALCULATE PERCENTAGE CHANGE

$$\text{Percentage change} = \frac{\text{final mass - initial mass}}{\text{initial mass}} \times 100$$

Illustrative example: 2.00 g to 2.20 g gives (0.20 ÷ 2.00) × 100 = +10%.

3. INTERPRET THE SIGN

Positive change	Net water entry; external water potential is higher.
Negative change	Net water loss; external water potential is lower.
About zero change	Little net water movement under these conditions.

Plot mean percentage change against sucrose concentration. The zero-change intercept estimates a solution with similar water potential to the tissue; it does not directly measure the sugar concentration inside the cells.

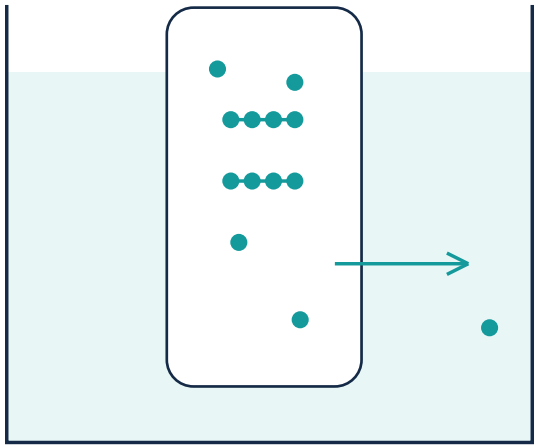
Plant-tissue method: AQA GCSE Biology practical handbook, osmosis activity.
Osmosis and partially permeable membranes: OpenStax Biology 2e, section 5.2.

Scope: Cambridge Biology 9700 syllabus, section 4.2, outcome 2, p. 21.

Dialysis tubing: test permeability

A non-living membrane model separates two solutions. Detecting glucose outside a bag initially containing starch and glucose tests solute diffusion, not osmosis.

1. FOLLOW THE SOLUTE



Rinse the bag exterior before immersion.

Bag: starch + glucose

Small dots: glucose can diffuse out.

Chains: starch is retained by suitable tubing.

Surrounding water starts without either solute.

2. TEST BEFORE AND AFTER

Soak the tubing, fill and seal it securely. Rinse its exterior to remove contamination. Sample the surrounding water at the start and after a fixed interval. Use separate clean pipettes and equal sample volumes; keep temperature, volumes and tubing area constant.

3. EXPECTED EVIDENCE OUTSIDE THE BAG

Glucose: Benedict's reagent with a hot water bath changes from blue to a coloured precipitate if enough reducing sugar is present.

Starch: iodine should remain yellow-brown, not turn blue-black. A positive starch test suggests leakage or contamination.

The model has pores, not a phospholipid bilayer or active transport proteins. Permeability depends on the tubing used. Mass change alone may reflect both water and solute transfer; do not automatically label it pure osmosis.

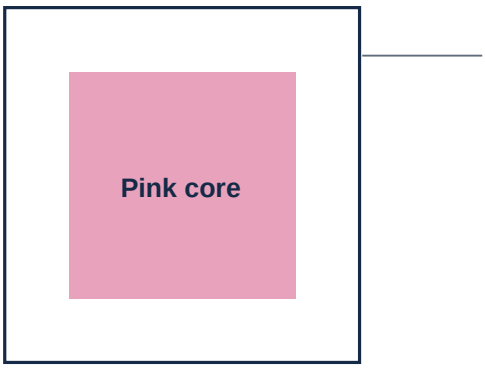
Model and solute tests: Practical Biology, Evaluating Visking tubing as a model for a gut.
Passive transport principles: OpenStax Biology 2e, section 5.2.

Scope: Cambridge Biology 9700 syllabus, section 4.2, outcome 2, p. 21.

Agar: make diffusion visible

A coloured reaction front can reveal penetration into a gel. Agar is non-living and has no cell-surface membrane, so colour change alone is not evidence of osmosis.

1. LOOK INSIDE THE BLOCK



Colourless outer region: acid has entered and neutralised the alkali.

Pink core: the indicator still shows alkaline conditions.

Cut-face view; the whole block was initially pink.

2. MEASURE PENETRATION AFTER A SET TIME

Use teacher-prepared alkaline agar containing phenolphthalein and immerse equal-sized blocks in dilute acid. Compare different exposure times, using a fresh block for each time point. Remove, rinse promptly and cut through the centre. Measure the depth of the colourless region with a ruler.

3. KEEP THE TEST FAIR

Keep block dimensions, agar composition, acid concentration, acid volume, temperature and mixing consistent. Repeat each exposure time. Record units and variation between repeats. The colour boundary tracks diffusion plus neutralisation, not the exact position of every acid particle.

Worked example: section width = 20 mm; pink core width = 12 mm.
Depth from each side = (20 - 12) ÷ 2 = 4 mm.
This assumes similar penetration from both faces.

Safety: use eye protection, teacher-approved dilute reagents and a cutting tile. Handle blades and hot water baths carefully. Do not eat laboratory materials.

Agar method and indicator front: Practical Biology, Effect of size on uptake by diffusion.
Practical scope: Cambridge Biology 9700; examples here are teaching models.

Scope: Cambridge Biology 9700 syllabus, section 4.2, outcome 2, p. 21.