Find the point of no net change

Immerse comparable plant tissue samples in a series of solutions. The solution producing no overall mass change gives an estimate of the tissue water potential.

1. WATER MOVES DOWN A WATER-POTENTIAL GRADIENT

Water potential (ψ) describes the tendency of water to move relative to pure water. Across a partially permeable membrane, net movement is from higher to lower water potential. Pure water at atmospheric pressure has ψ = 0 kPa; adding solute makes solution ψ more negative.

2. PREDICT THE MASS CHANGE

SOLUTION ψ HIGHER THAN TISSUE ψ

Net water entry → mass increases

Example: -200 kPa outside; initially -600 kPa in tissue.

SOLUTION ψ LOWER THAN TISSUE ψ

Net water loss → mass decreases

Example: -1000 kPa outside; initially -600 kPa in tissue.

SOLUTION ψ EQUAL TO TISSUE ψ

No net water transfer → mass stays similar

Water molecules still cross in both directions.

3. READ NEGATIVE NUMBERS CORRECTLY

-200 kPa is higher than -600 kPa. Water therefore moves from -200 towards -600 kPa, not the other way round. These are initial comparisons: water entry or loss changes the cells' water potential.

4. WATER POTENTIAL IS NOT JUST SOLUTE CONCENTRATION

Pressure inside living plant cells also affects water potential. A no-change result does not prove that the solution and cell sap have the same solute concentration.

Water-potential principles: OpenStax Biology 2e, section 30.5.
Practical context: SAPS, Measuring the water potential of a potato cell.

Scope: Cambridge Biology 9700 syllabus, section 4.2, outcome 5, p. 22.

Measure a fair percentage change

Use potato cylinders or another suitable plant tissue. Record each sample separately so its final mass is compared with its own initial mass.

1. A CONTROLLED MASS-CHANGE METHOD

A. PREPARE

Label a range of sucrose solutions. Include concentrations expected to produce both mass gain and mass loss. Use known solution water potentials or a suitable conversion table at the test temperature.

B. STANDARDISE

Cut equal-diameter, equal-length cylinders without skin from comparable tissue. Blot gently and weigh each one. Randomly allocate independent samples to each solution, with at least three per condition.

C. IMMERSE

Keep solution volume, temperature and immersion time constant. Fully cover each sample; use enough solution to minimise concentration changes. Cover containers to reduce evaporation.

D. REWEIGH

Remove at the set time. Blot consistently, without squeezing, and weigh promptly. Calculate each percentage change, then the mean for each solution and the spread of repeats.

2. WORKED EXAMPLE: INITIAL 2.50 g; FINAL 2.65 g

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

$$[(2.65 - 2.50) \div 2.50] \times 100 = +6.0\%$$

Positive = gain; negative = loss. Divide by the initial mass, not the final mass. Percentage change allows comparison of slightly different starting masses.

Controls do not become unnecessary when percentages are used. Keep tissue dimensions and source comparable. Safety: cut on a tile, handle blades and cork borers carefully, and do not eat laboratory tissue.

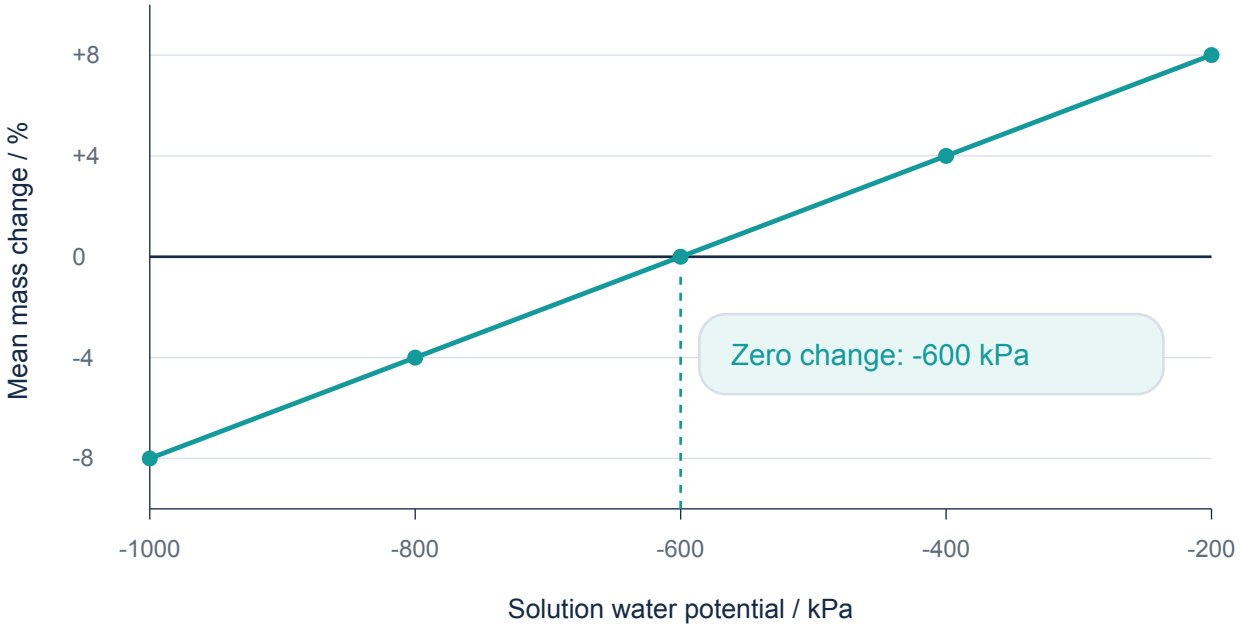
Mass-change approach: SAPS, Measuring the water potential of a potato cell.
Blotting, repeats and graphing: Practical Biology, Osmosis in chipped potatoes.

Scope: Cambridge Biology 9700 syllabus, section 4.2, outcome 5, p. 22.

Use the zero-change intercept

Illustrative data, not measured results. Here the x-axis already gives solution water potential, so the intercept can be read directly in kPa.

1. MEAN PERCENTAGE MASS CHANGE AGAINST SOLUTION ψ



The plotted values are means for illustration; real repeats would show variation.

2. ESTIMATE, DO NOT OVERCLAIM

Draw a suitable best-fit line or curve, allowing for the trend and variation. Read the x-value where it crosses 0% mass change. Here tissue ψ is about -600 kPa (= -0.60 MPa). If zero lies between tested values, interpolate.

3. IMPROVE THE ESTIMATE

Test more closely spaced solutions around the intercept and repeat. Standardise blotting and check balance resolution. Tissue damage, biological variation, evaporation and too short an immersion can shift the result.

If the x-axis is sucrose concentration, the intercept gives a concentration first. Convert using valid water-potential data at the same temperature; mol dm^{-3} is not kPa. Zero change means no detectable net gain or loss, not that osmosis has stopped.

Estimating the no-change point: SAPS and Practical Biology potato investigations.

Scope: Cambridge Biology 9700 syllabus, section 4.2, outcome 5, p. 22.