Water potential

International Baccalaureate · IB Diploma · Biology · HL

Scope and prerequisites

This handout covers selected HL topics for the course first assessed in 2025; it is not the whole syllabus.

Prerequisites: read the stated quantities and units, and use arithmetic and the model conditions below.

The examples are original and fictional: they are not real measurements or real student investigations.

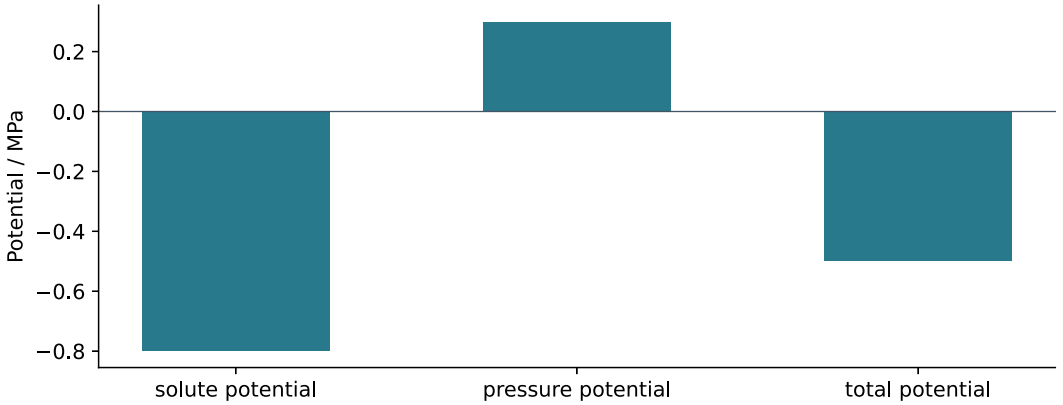
Water potential : include solute and pressure effects

What would explain this observation?

- A plant cell can stop gaining net water even while its contents contain solute. The cell wall permits pressure to build, altering the **water-potential** balance.

Build the model

- Water potential describes the tendency of water to move relative to a chosen reference, with pressure units.
- In the simplified cell model, water potential equals solute potential plus **pressure potential** .
- Dissolved solute lowers solute potential; positive pressure can raise water potential.
- Net water movement through a water-permeable membrane is from higher to lower water potential.
- water potential: A pressure-equivalent measure of the tendency of water to move relative to a reference.
- pressure potential: The pressure contribution to water potential in the stated model.



Water potential = solute + pressure potential: −0.8 + 0.3 = −0.5 MPa

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Choose evidence that can test it

- Compare the complete water potentials of the two sides rather than solute concentrations alone.
- A turgid cell can have the same total water potential as its surroundings despite unequal solute potential.
- At equilibrium there is no net transfer, but water molecules can continue moving in both directions.

In the lab: Use provided potential values and labelled plant-cell models. State the reference and units before adding components. For school tissue investigations, control temperature, tissue dimensions, time and blotting, and estimate a zero-change point from repeated measurements. Do not claim the mass method separately measures cell pressure without further evidence.

Work from known quantities

- Known: a cell has solute potential −0.8 MPa and pressure potential +0.3 MPa, so total potential is −0.5 MPa.
- Surrounding solution is −0.2 MPa.
- Water tends to enter the cell because −0.2 is higher than −0.5.
- If the cell components change to −0.8 and +0.6 MPa, its total is −0.2 MPa, matching the surroundings in this simplified model.

Your turn: Solute potential is −0.7 MPa and pressure potential is +0.4 MPa. Find total water potential.

Check the conclusion and its limits

- More negative is lower, not higher.
- The additive cell model has stated boundaries and does not require pretending that every real tissue has one uniform value.
- Loss of turgor and cell-wall support differ from a rigid wall directly controlling solute concentration.

Not true: Solute concentration alone always determines water movement in a turgid plant cell. In a turgid cell the wall pushes back: pressure potential opposes the solute effect, and movement depends on the SUM. Solute concentration alone decides only when pressure potential is zero.

Key:

- Water potential describes the tendency of water to move relative to a chosen reference, with pressure units.
- Compare the complete water potentials of the two sides rather than solute concentrations alone.
- Watch for: more negative is lower, not higher.

Write from a water potential of -0.7 megapascals

- Solute potential is -0.9 MPa and pressure potential is +0.2 MPa. The surrounding solution is -0.4 MPa.
- Find the cell's water potential and the direction of net water movement.