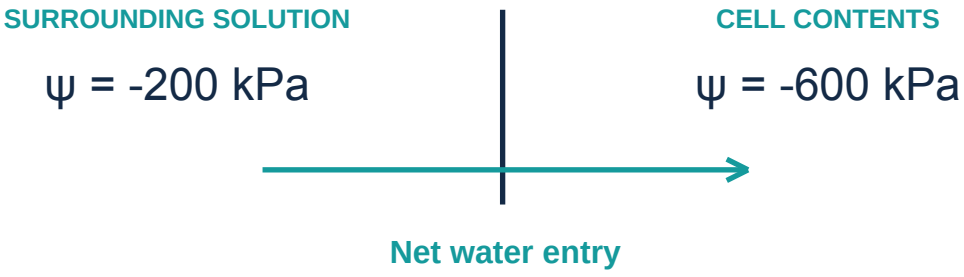
# Same rule, different cell outcomes

Compare water potential first. Then use the presence or absence of a cell wall to explain what happens to the cell.

## 1. OSMOSIS: NET WATER MOVEMENT

Water moves from higher to lower water potential (ψ) through a partially permeable membrane. This is passive: osmosis itself does not require ATP. Water molecules move both ways; the gradient determines the net direction.

## 2. AN INITIAL WATER-POTENTIAL COMPARISON




Vertical line = partially permeable cell surface membrane.

## 3. HIGHER MEANS LESS NEGATIVE

-200 kPa is higher than -600 kPa. Replacing the surrounding solution with -1000 kPa reverses the initial net direction: water leaves the cell. Compare the signed numbers, not just 200 and 600.

## 4. EQUILIBRIUM IS DYNAMIC

At equal water potentials there is no net water movement, but molecules still cross the membrane in both directions. Water entry or loss changes cell conditions, so the initial gradient need not persist.

For this syllabus outcome, separate solute-potential and pressure-potential calculations are not required.

Water-potential comparisons: OpenStax Biology 2e, section 30.5.

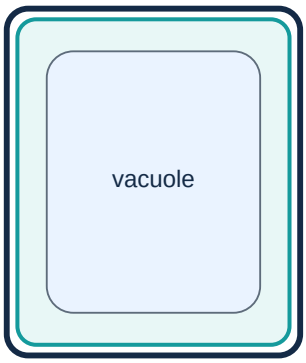
Scope: Cambridge Biology 9700 syllabus, section 4.2, outcome 6, p. 22.

# Plant cells: the wall changes the result

Water crosses membranes, while the cell wall provides mechanical support. These schematic cells have the same wall dimensions; internal volumes differ.

## 1. COMPARE THREE PLANT-CELL STATES

### A. TURGID

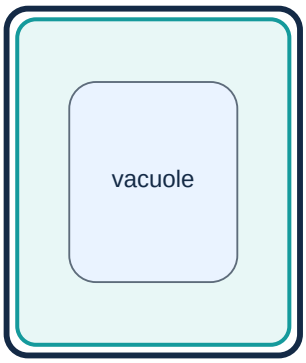



Water entry

Vacuole expands

Firm, supported cell

### B. FLACCID

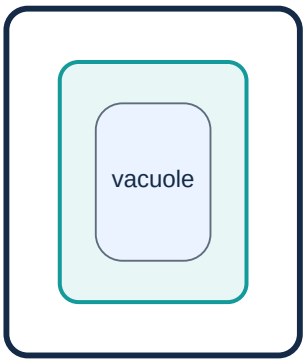



Turgor lost

Less firm cell

No clear wall separation

### C. PLASMOLYSED




Further water loss

Vacuole shrinks

Membrane pulls inward

Navy = wall; teal = surface membrane; blue = vacuole.

## 2. WHY A TURGID CELL DOES NOT KEEP SWELLING

As water enters, the vacuole enlarges and the contents press against the wall. The wall resists expansion. A healthy cell normally becomes turgid rather than bursting, and net entry ceases when water potentials balance.

## 3. FLACCID IS NOT THE SAME AS PLASMOLYSED

A flaccid cell has lost turgor. In plasmolysis, the protoplast (living contents enclosed by the surface membrane) visibly separates from the wall. The wall remains in place; the gap contains external solution, not air.

Under a microscope, compare epidermal cells in water and a concentrated salt solution. Restoring water can reverse plasmolysis if cells remain viable. Follow the teacher's method and handle slides carefully.

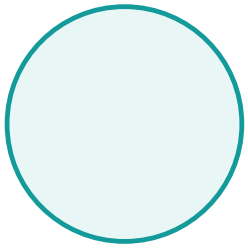
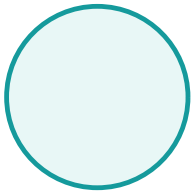
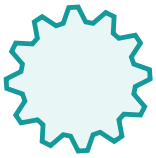
Observation and reversal: Practical Biology, Osmosis, plasmolysis and turgor.
Cell-wall support: OpenStax Biology 2e, section 30.5.

Scope: Cambridge Biology 9700 syllabus, section 4.2, outcome 6, p. 22.

# Animal cells: no supporting wall

Red blood cells provide a familiar example. The sketches below compare their responses; they are simplified outlines, not detailed cell anatomy.

## 1. COMPARE THE SURROUNDING SOLUTION WITH THE CELL

| HIGHER ψ | EQUAL ψ | LOWER ψ |
|---|---|---|
|  |  |  |
| Net water entry | No net water movement | Net water loss |
| Swells; may lyse | Stable volume | Shrinks / crenates |
| Haemolysis in red cells | Molecules still move | Membrane stays around cell |

## 2. SAME WATER MOVEMENT, DIFFERENT STRUCTURE

An animal cell lacks the resisting cellulose wall of a plant cell. Excess water entry can rupture its surface membrane (lysis). Water loss reduces its volume; the shrivelled appearance of red blood cells is called crenation.

## 3. A QUICK COMPARISON

| NET WATER | PLANT CELL | ANIMAL CELL |
|---|---|---|
| Enters | Becomes turgid | Swells; may burst |
| Leaves | Flaccid; may plasmolyse | Shrinks |

Use "plasmolysis" for separation from a cell wall, not for a shrunken animal cell. Explain a response in order: relative water potential → net osmosis direction → change in cell volume → structural outcome.

Animal-cell responses and tonicity: OpenStax Biology 2e, section 5.2.

Scope: Cambridge Biology 9700 syllabus, section 4.2, outcome 6, p. 22.