NAME _____ CLASS _____ DATE _____

IB BIOLOGY · D2.3

Water potential

Notes to fill in alongside the guide. Each numbered block matches a chapter of the guide, and of the lesson slides. Write in the gaps, answer the cues, annotate the figures, and sum up each section in your own words.

BY THE END YOU CAN

- [ ] Explain how water dissolves ions and polar molecules, by attraction to its charges and by hydrogen bonds D2.3.1
- [ ] Say which way water moves between two solutions in terms of solute concentration, using hypotonic, isotonic and hypertonic D2.3.2
- [ ] Predict the net movement of water into or out of a cell, and explain why there is dynamic equilibrium in an isotonic solution D2.3.3
- [ ] Measure changes in the mass and length of plant tissue in a range of solutions, and use the data, its standard deviation and standard error to find the isotonic concentration D2.3.4
- [ ] Describe what water movement does to cells without a wall, and how contractile vacuoles and isotonic tissue fluid protect them D2.3.5
- [ ] Explain turgor pressure in a hypotonic medium and plasmolysis in a hypertonic one D2.3.6
- [ ] Explain why intravenous fluids and the solutions for organs awaiting transplant are isotonic D2.3.7
- [ ] Describe water potential as the potential energy of water per unit volume, measured relative to pure water D2.3.8
- [ ] Explain why water moves from higher to lower water potential D2.3.9
- [ ] Use ψ = ψs + ψp for cells with walls, with negative solute potentials and pressure potentials that are usually positive D2.3.10
- [ ] Explain the changes in plant tissue bathed in hypotonic and hypertonic solutions in terms of solute and pressure potentials D2.3.11

01 Why so much dissolves in water D2.3.1

CUES

Predict: Which way do the water molecules round a dissolved K+ ion face?

What is meant by solvation?

What is meant by hydrogen bonds?

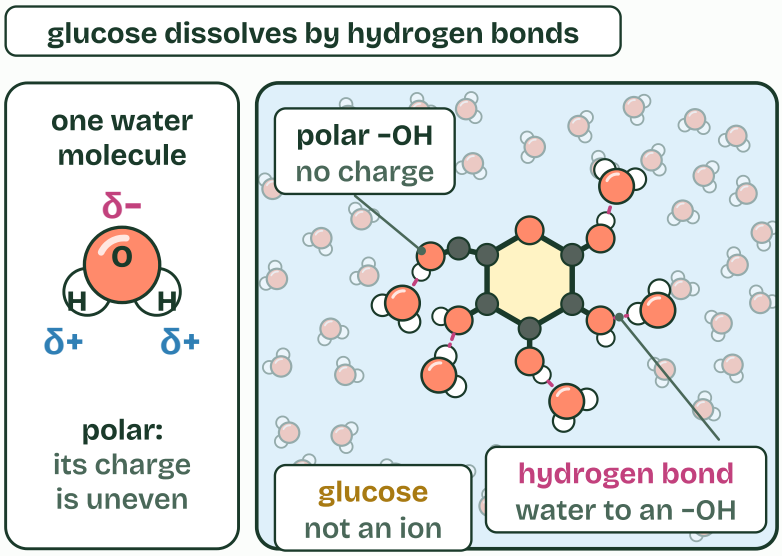
NOTES

1. Each ion ends up wrapped in a shell of water molecules: this is _____.
2. Polar molecules dissolve too, not by charge alone but by forming _____ with water.
3. Water is polar: _____.
4. A _____, Na^+: the water molecules turn their δ− oxygens towards it.
5. A _____, Cl^-: now the δ+ hydrogens face the ion.
6. _____ has no charge, but its polar –OH groups form hydrogen bonds with water.

Your own notes

ANNOTATE THE FIGURE

Number the 3 steps on the figure and note what happens at each: 1 sodium ion; 2 chloride ion; 3 Glucose.



SPOT THE MISTAKE

What do students often get wrong about solvation with water as the solvent? Write the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 01 in two or three sentences of your own.

02 Water goes where the solute is

D2.3.2 D2.3.3

CUES

Predict: A cell's cytoplasm is more concentrated than the solution around it. Which is true?

What is meant by osmosis?

What is meant by hypertonic?

What is meant by hypotonic?

What is meant by isotonic?

NOTES

1 _____ is the net movement of water across a partially permeable membrane, which lets water through but not the solute.

2 The net movement is from the _____ concentrated solution to the _____ concentrated one.

3 The more concentrated one is _____, the less concentrated one _____, and two with the same concentration are _____.

4 In an isotonic solution water still crosses, but as fast each way: a _____, with no net change.

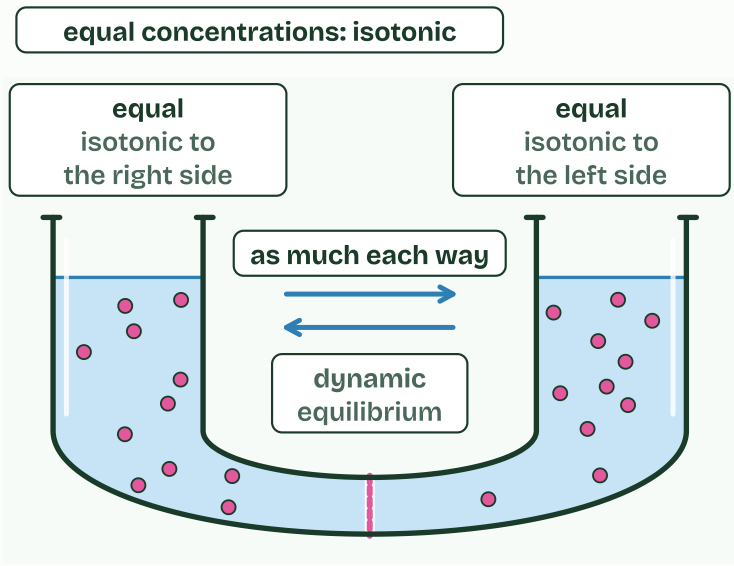
5 _____ outside: the cell gains water. Hypertonic outside: it loses water.

6 _____: water still moves, equally both ways.

Your own notes

ANNOTATE THE FIGURE

Number the 4 steps on the figure and note what happens at each: 1 partially permeable membrane; 2 both ways; 3 net; 4 isotonic.



SPOT THE MISTAKE

What do students often get wrong about water movement from less concentrated to more concentrated solutions Water movement by osmosis into or out of cells? Write the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 02 in two or three sentences of your own.

03 Cores in sugar

D2.3.4

CUES

Predict: Cores soaked in pure water gain 15% of their mass, but no more however long they are left. Why do they stop?

What is meant by standard deviation?

What is meant by standard error?

NOTES

1 The cores start at different masses, so work out each one's _____: (final − initial) ÷ initial × 100.

2 Where the line crosses zero, the tissue neither gains nor loses water: that concentration is _____ with its cells, which is how you find their solute concentration.

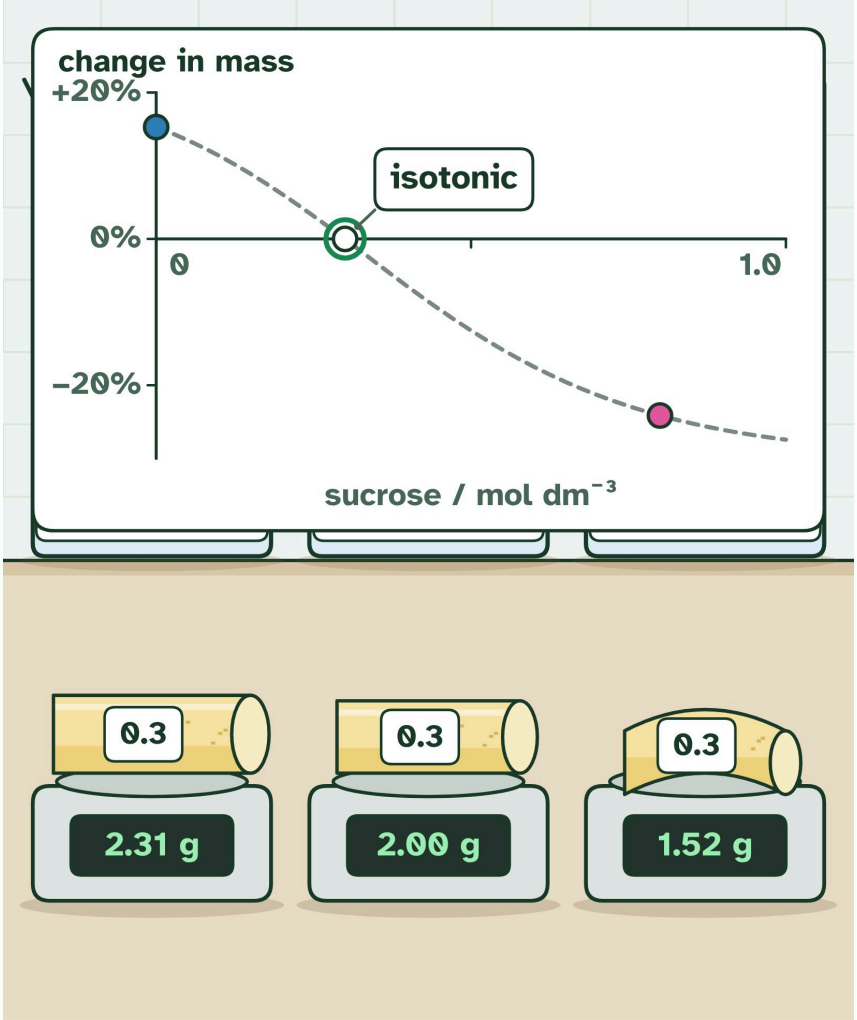
3 Repeats let you work out the _____ of each set, and from it the _____ of the mean, shown as error bars.

4 Hypotonic: _____.

Your own notes

ANNOTATE THE FIGURE

Annotate this still from the animation (Into the beaker): what is happening, and why?



SPOT THE MISTAKE

What do students often get wrong about changes due to water movement in plant tissue bathed in hypotonic and those bathed in hypertonic solutions? Write the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 03 in two or three sentences of your own.

04 No wall, no limit

D2.3.5

CUES

Predict: A Paramecium is moved from pond water into a solution isotonic with its cytoplasm. What happens to its contractile vacuole?

What is meant by crenation?

What is meant by contractile vacuole?

NOTES

1 In a hypotonic solution they take in water and swell, and with nothing to stop them they can _____; red blood cells in pure water do so within seconds.

2 In a hypertonic solution they lose water and shrink, and a red blood cell's surface puckers into points: _____.

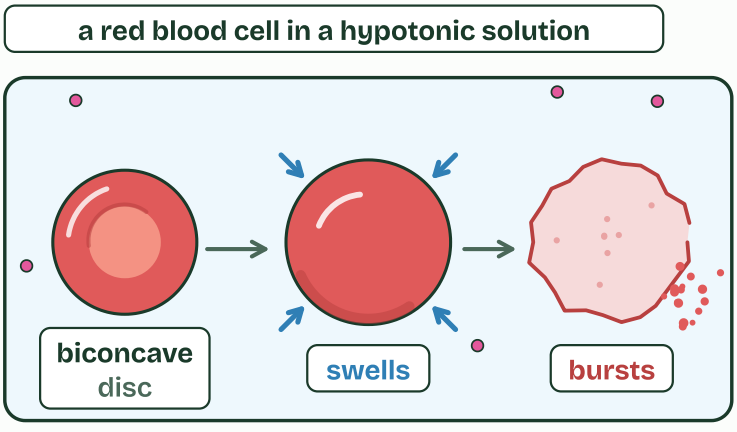
3 Freshwater single-celled organisms such as *Paramecium* live in a hypotonic world: water enters all the time, and a _____ collects it and pumps it out, using ATP.

4 Freshwater protists pump out the water with a _____.

Your own notes

ANNOTATE THE FIGURE

The figure shows it as Hypotonic, Isotonic, Hypertonic and Pond water. Note what changes each time.



SPOT THE MISTAKE

What do students often get wrong about effects of water movement on cells that lack a cell wall? Write the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 04 in two or three sentences of your own.

05 The wall pushes back

D2.3.6

CUES

Predict: Lettuce leaves left in a bowl of salty dressing go limp. Why?

What is meant by turgor pressure?

What is meant by plasmolysis?

NOTES

1 The wall is strong and hardly stretches, so it presses back. That pressure, _____, stops more water entering long before the cell could burst.

2 In an isotonic solution the cell is _____: the membrane just touches the wall, with no pressure.

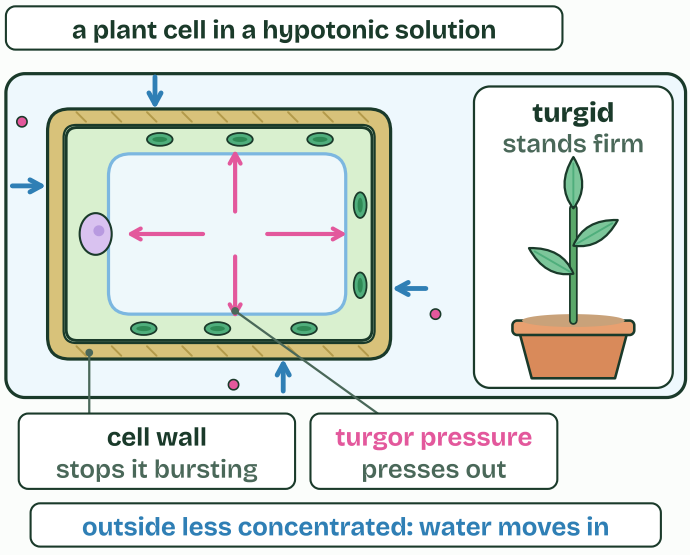
3 In a hypertonic solution water leaves, the vacuole and cytoplasm shrink, and the membrane pulls away from the wall: _____.

4 Isotonic: flaccid, no _____.

Your own notes

ANNOTATE THE FIGURE

The figure shows it as Hypotonic, Isotonic and Hypertonic. Note what changes each time.



SPOT THE MISTAKE

What do students often get wrong about effects of water movement on cells with a cell wall? Write the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 05 in two or three sentences of your own.

06 Keeping cells as they are

D2.3.7

CUES

Predict: What would happen if a large volume of pure water were run into a patient's vein?

NOTES

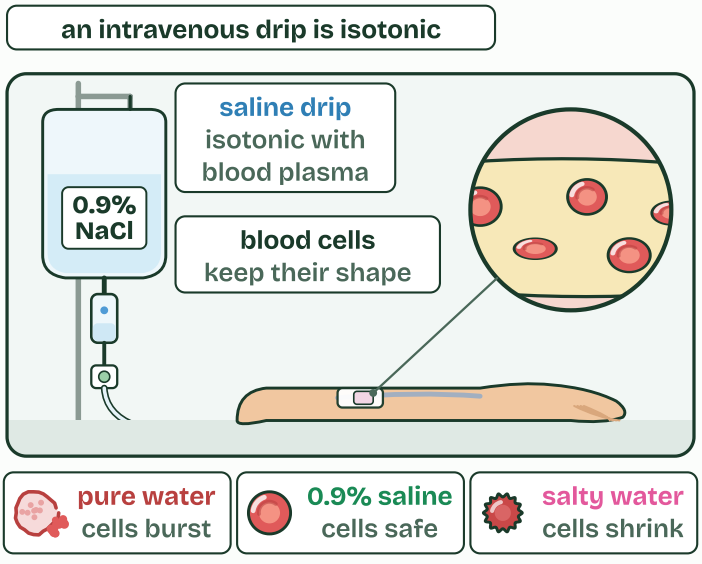
1 Fluid put into a patient's vein runs straight into the blood, so it must be isotonic with the blood cells. _____ such as normal saline, 0.9% sodium chloride, replace lost water and salts without making red blood cells swell and burst, as pure water would, or shrink, as a strong salt solution would.

2 An _____, such as a kidney, is taken out of the donor and kept until the patient is ready, sometimes for many hours.

Your own notes

ANNOTATE THE FIGURE

The figure shows it as Intravenous drip and Donor organ. Note what changes each time.



SPOT THE MISTAKE

What do students often get wrong about medical applications of isotonic solutions? Write the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 06 in two or three sentences of your own.

07 Water runs downhill

D2.3.8 HL D2.3.9 HL

CUES

Predict: Cell A has a water potential of −400 kPa and cell B, next to it, −650 kPa. Which way does water move?

What is meant by water potential?

NOTES

1 _____, ψ (the Greek letter psi), is the potential energy of water per unit volume: how free the water is to move.

2 _____: potential energy of water per unit volume, in kPa.

3 The reference: _____ at atmospheric pressure and 20 °C has ψ = 0.

4 Dissolve solutes in it and its water potential falls below zero: _____.

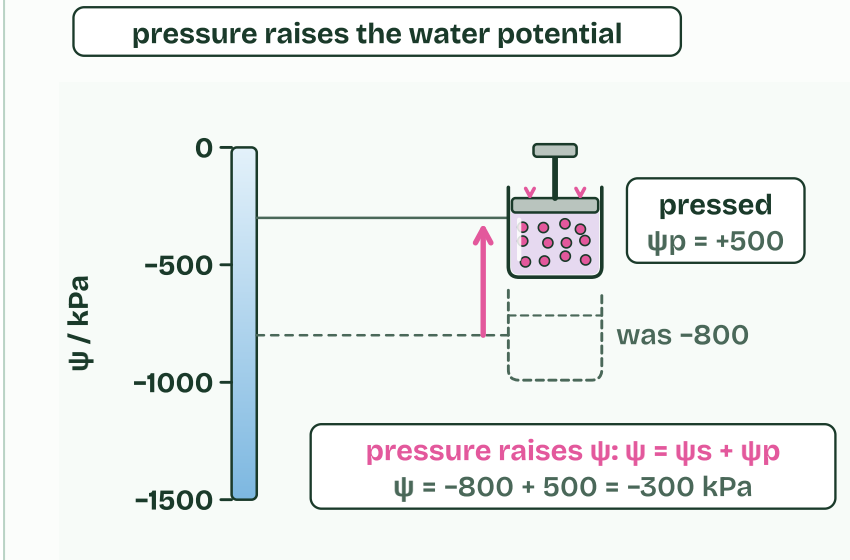
5 Water moves _____, from higher water potential to lower.

6 Pressure on a solution _____ its water potential.

Your own notes

ANNOTATE THE FIGURE

Number the 4 steps on the figure and note what happens at each: 1 pure water; 2 negative; 3 downhill; 4 raises.



SPOT THE MISTAKE

What do students often get wrong about water potential as the potential energy of water per unit volume Movement of water from higher to lower water potential? Write the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 07 in two or three sentences of your own.

08 ψ = ψs + ψp

D2.3.10 HL D2.3.11 HL

CUES

Predict: A cell has ψs = −900 kPa and ψp = +300 kPa. It is put in a solution with ψ = −750 kPa. Which way does water move?

What is meant by solute potential?

What is meant by pressure potential?

NOTES

1 The _____, ψ_s, is zero for pure water and negative for any solution: the more solute, the more negative.

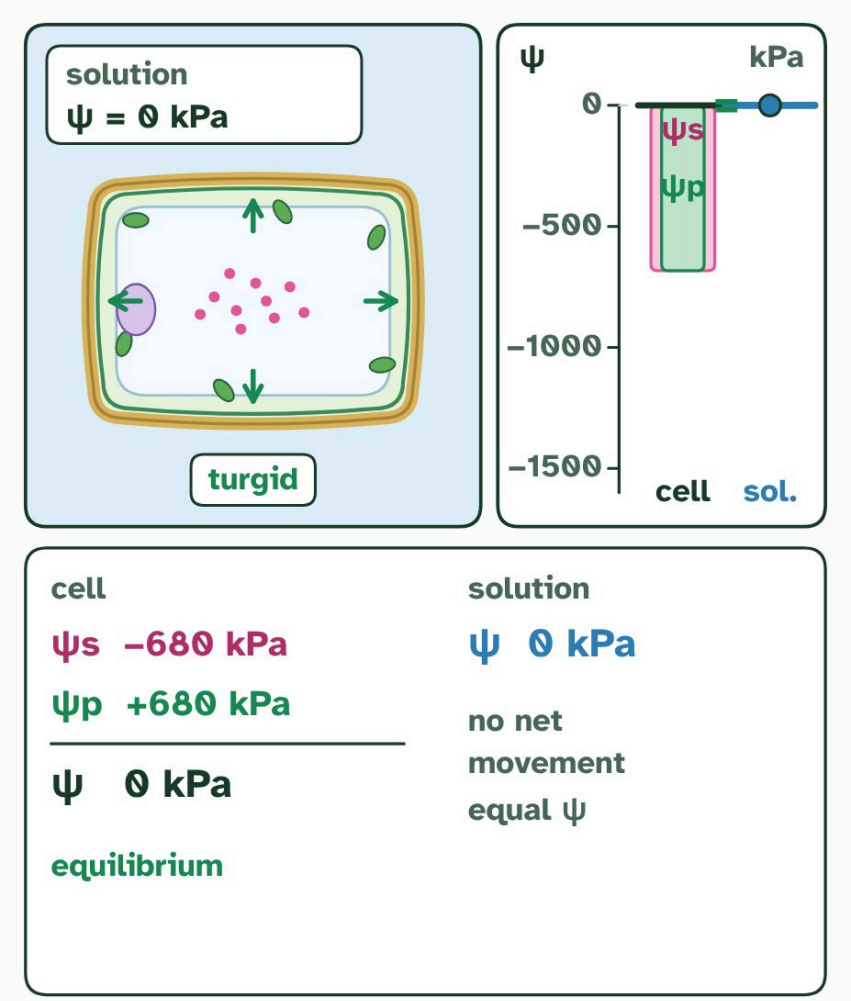
2 The _____, ψ_p, is the pressure of the cell's contents on its wall.

3 Together: _____ _____ _____ _____.

Your own notes

ANNOTATE THE FIGURE

Annotate this still from the animation (Water potential calculator): what is happening, and why?



SPOT THE MISTAKE

What do students often get wrong about contributions of solute potential and pressure potential to the water potential of cells with walls Water potential and water movements in plant tissue? Write the mistake, then put it right.

The mistake

Put it right

SUMMARY

Sum up section 08 in two or three sentences of your own.

Check yourself

The check for this guide is online: a fresh paper of past-paper style questions from the exam bank on D2.3 each time, marked as you go, and saved to your Exam practice progress when you are signed in. Scan the code, or type the link.

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How this was made. The course structure, the activities and the teaching choices come from my own classroom, my presentations and my years of teaching IB and AP Biology. I use Claude, an AI, to help write and build the interactive guides, lesson plans, slides and practice questions, and to draw the diagrams and code the interactives. I direct the work and review it against the IB and AP specifications before it goes live.