NAME _____ CLASS _____ DATE _____

AP BIOLOGY · 2.7

Tonicity and 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 which way water moves by osmosis between solutions, using hypotonic, isotonic and hypertonic 2.7.A
- [ ] Predict what hypotonic and hypertonic surroundings do to cells with and without a wall, including turgor and plasmolysis 2.7.A
- [ ] Explain how organisms osmoregulate, with contractile vacuoles and central vacuoles as examples, and why medical fluids are isotonic 2.7.A
- [ ] Explain that water moves from higher to lower water potential, and use Ψ = Ψp + Ψs 2.7.B
- [ ] Calculate solute potential with Ψs = −iCRT, and use it to predict water movement 2.7.B

01 Water goes where the solute is

2.7.A

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 tonicity?

What is meant by hypertonic?

What is meant by hypotonic?

What is meant by isotonic?

NOTES

1 _____ is the diffusion of water across a selectively permeable membrane, one that lets water through but not the solute.

2 The net movement is from _____ solute concentration to _____.

3 _____ compares two solutions by their solutes.

4 The one with more solute is _____, the one with less is _____, and two with the same concentration are _____.

5 Say what is hypertonic _____ what: a solution can be hypertonic to a red blood cell and hypotonic to a seawater fish's cells.

6 _____: net water movement from lower to higher solute concentration.

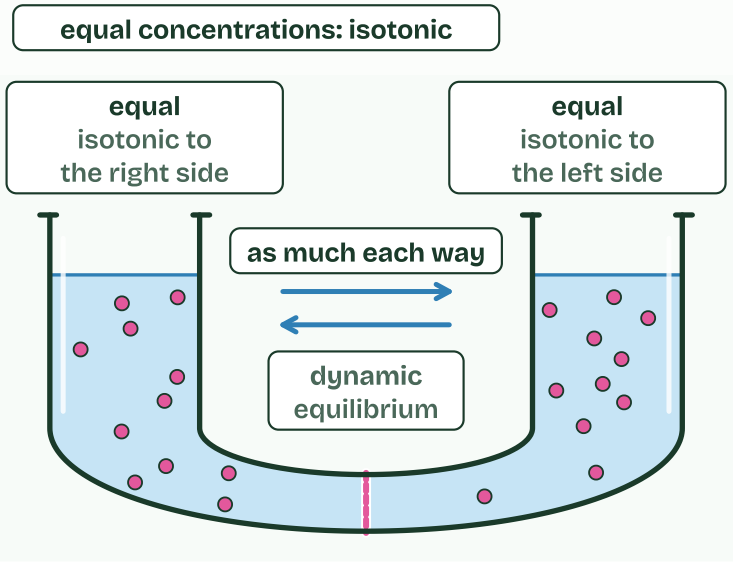
7 _____: more solute. Hypotonic: less. Isotonic: the same.

8 _____: 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

A student writes: "The cell is hypertonic." Spot 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 Cores in sugar

2.7.A

CUES

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

NOTES

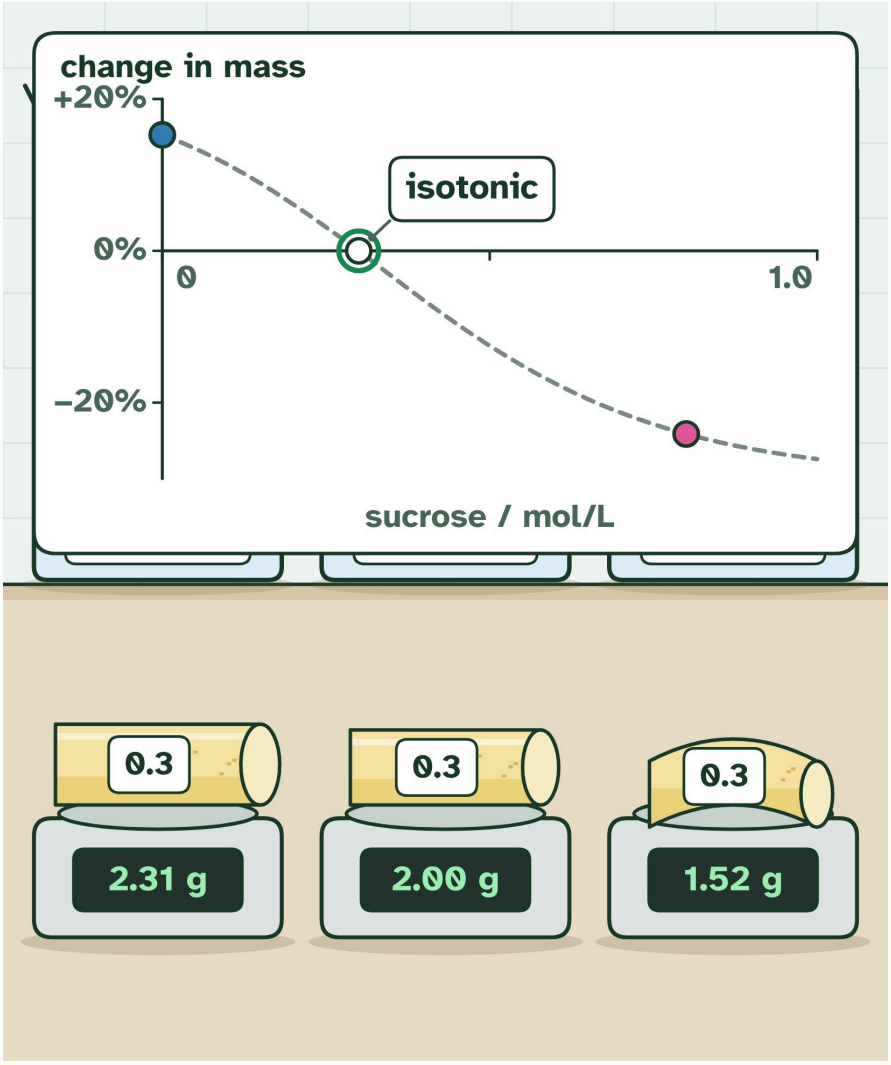
1 The cores start at different masses, so compare their _____: (final − initial) ÷ initial × 100.

2 Hypotonic solution: _____.

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 tonicity and osmoregulation? 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 No wall, no limit

2.7.A

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 contractile vacuole?

What is meant by osmoregulation?

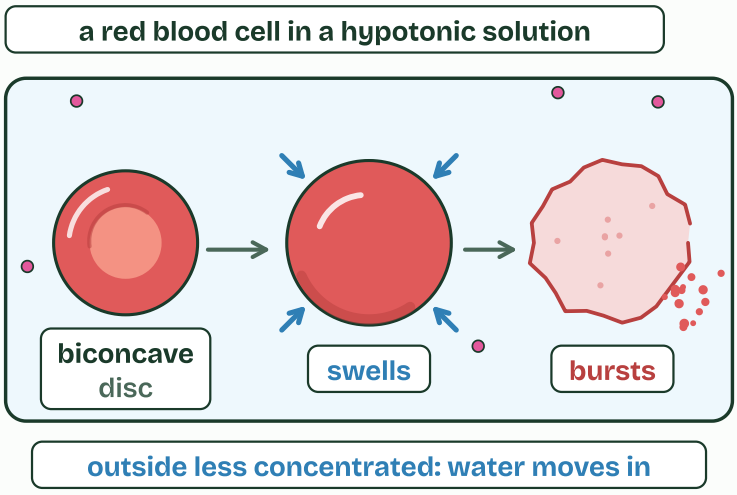
NOTES

1. In a hypotonic solution they take in water and swell, and with nothing to stop them they can _____, burst; red blood cells in pure water do so within seconds.
2. A _____ collects it and expels it, using ATP.
3. This is _____: keeping water and solutes in balance whatever the surroundings.
4. A _____ expels the water that enters a freshwater protist.
5. _____ keeps an organism's water and solutes in balance.

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 tonicity and osmoregulation? 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 The wall pushes back

2.7.A

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 In a hypotonic solution water enters, the large _____ swells, and the membrane presses against the wall.

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

3 A plant cell is healthiest this way, _____, and turgid cells pressing on each other hold stems and leaves up.

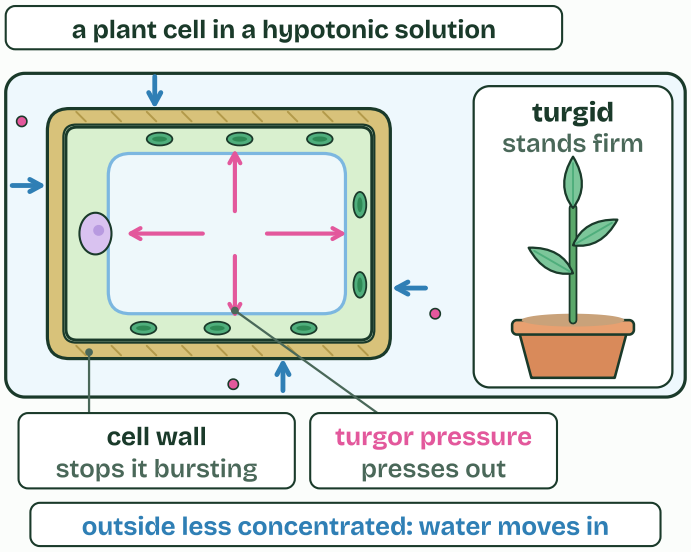
4 In an isotonic solution the cell is _____: the membrane just touches the wall, with no pressure.

5 In a hypertonic solution water leaves, the vacuole shrinks, and the membrane pulls away from the wall: _____.

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 tonicity and osmoregulation? 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 Keeping cells as they are

2.7.A

CUES

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

NOTES

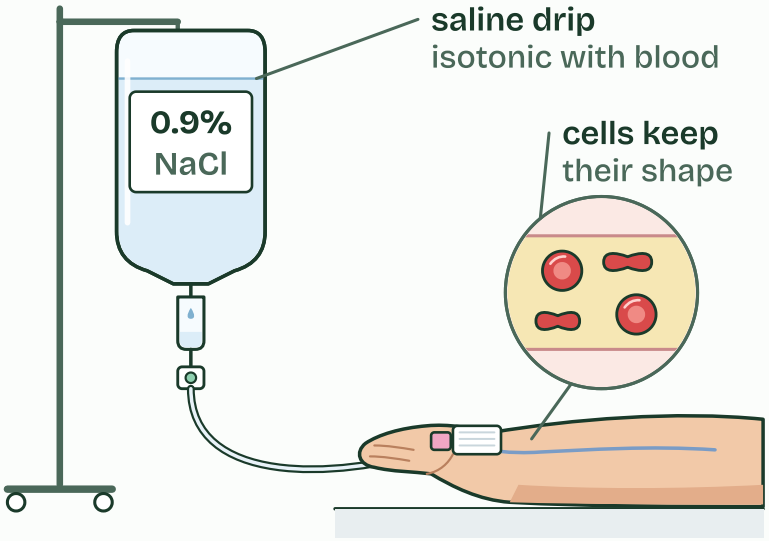
1 Fluid put into a patient's vein runs straight into the blood, so it must be isotonic with the blood cells. _____ such as normal saline, 0.9% sodium chloride, replace lost water and salts without making red blood cells swell and lyse, as pure water would, or shrivel, as a strong salt solution would.

2 An _____, such as a kidney, is 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 tonicity and osmoregulation? 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 Water runs downhill

2.7.B

CUES

Predict: Cell A has a water potential of −4 bars and cell B, next to it, −6.5 bars. Which way does water move?

What is meant by water potential?

NOTES

1 _____, Ψ (the Greek letter psi), measures how free water is to move.

2 Pure water in an open container is the reference, Ψ = 0, and it is measured in units of pressure: in AP Biology, _____.

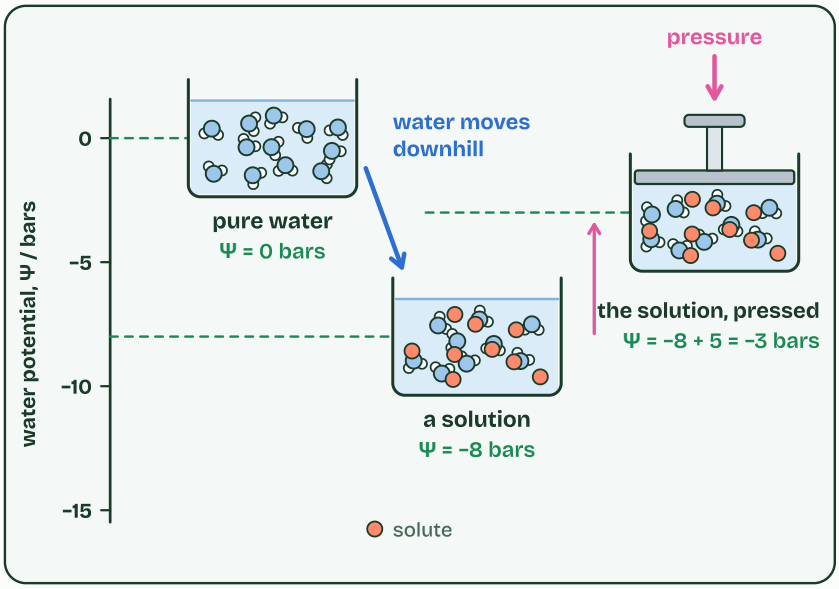
3 Read the scale carefully: −8 bars is _____ than −3 bars.

4 _____, Ψ: pure water is 0; measured in bars.

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 tonicity and osmoregulation? 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 $\Psi = \Psi p + \Psi s$

2.7.B

CUES

Predict: A cell has $\Psi s = -9$ bars and $\Psi p = +3$ bars. It is put in a solution with $\Psi = -7.5$ bars. 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.

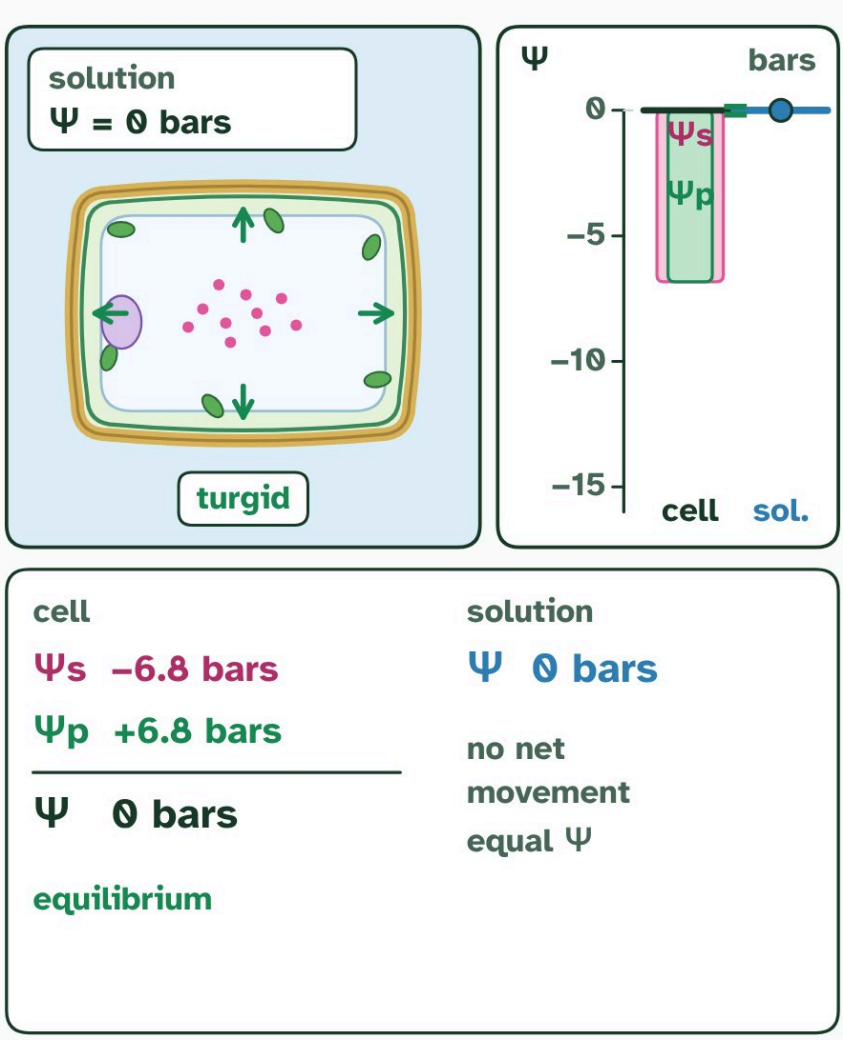
2 The _____, Ψ_p, is zero in an open container and positive in a turgid cell pressing on its wall.

3 Together: _____ _____ _____ _____.

Your own notes

ANNOTATE THE FIGURE

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



SPOT THE MISTAKE

What do students often get wrong about tonicity and osmoregulation? 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 Ψs = −iCRT

2.7.B

CUES

Predict: What is the solute potential of 0.1 M NaCl at 27 °C?

NOTES

1 The AP equation sheet gives _____ _____ _____, where _____ is the ionization constant, _____ the molar concentration, _____ the pressure constant, 0.0831 L·bar/(mol·K), and _____ the temperature in kelvin (°C + 273).

2 Open container: _____.

3 Solute potential from the equation sheet: _____. Here 0.20 M sucrose at 22 °C gives Ψs = −4.90 bars.

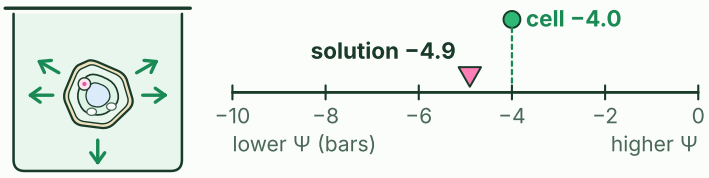
Your own notes

ANNOTATE THE FIGURE

Number the 2 steps on the figure and note what happens at each.

0.20 M sucrose at 22 °C, in an open beaker

i	1 (sucrose does not ionize)
C	0.20 mol/L
R	0.0831 L·bar/(mol·K)
T	22 + 273 = 295 K
Ψs	−iCRT = −(1)(0.20)(0.0831)(295) = −4.90 bars
Ψ	Ψp + Ψs = 0.0 + (−4.90) = −4.90 bars



Water moves from higher Ψ to lower Ψ.

SPOT THE MISTAKE

What do students often get wrong about tonicity and osmoregulation? 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 2.7 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.