Which way the water goes

60 minutes • 2.7.A • Chapters 1, 2, 3, 4 • The dry lab

Osmosis, hypotonic, isotonic and hypertonic solutions, potato cores in sucrose and the isotonic point, and cells with and without a wall

BY THE END, STUDENTS 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

TIMING

0–5	5 min	**Do now: the raisin**
5–13	8 min	**Water goes where the solute is**
13–43	30 min	**Cores in sugar**
43–53	10 min	**With and without a wall**
53–60	7 min	**Exit**
	60 min	**One lesson**

STARTER

5 min

Do now: the raisin

A raisin left overnight in water, and one in strong syrup, or photos of them. Pairs write what happened to each and where the water went.

ON THE BOARD, FROM THE GUIDE

Open the guide on the projector at each chapter (the links work in this PDF). Every figure plays from its own buttons, and the lesson's slides have the same figures, step by step, in the order of this plan.

01 Water goes where the solute is

CHAPTER 01 IN THE SLIDES

Step through the figure (4 steps, the arrow keys on a projector). Stop on each caption and ask what changed before you go on.

1. Two solutions, split by a **partially permeable membrane**. The solute cannot cross.
2. Water crosses **both ways**, but more crosses into the more concentrated side.
3. The **net** movement raises the level on the more concentrated side.
4. Equal concentrations, **isotonic**: water still crosses, as much each way.

> **Predict box:** A cell's cytoplasm is more concentrated than the solution around it. Which is true? Hands up or mini whiteboards first.
>
> **Answer B: The solution is hypotonic to the cell, so there is a net movement of water into the cell**

02 Cores in sugar

CHAPTER 02 IN THE SLIDES

Play the animation, Into the beaker. It loops; pause it on each moment below and ask what is happening (in the lesson slides it is a video).

1. Three cores cut from one potato, 2.00 g each. Its cells hold solutes at about **0.3 mol/L**, written on each core.
2. In 0.0 more water enters than leaves: the outside is **hypotonic**. In 0.8 more leaves: **hypertonic**.
3. Close up: in 0.0 the cells are **turgid**, pressed against their walls. In 0.8 they are **plasmolysed**.
4. Plasmolysed: the membrane has pulled away from the wall, and the outside solution fills the gap.
5. Out, blotted and weighed. The core in 0.8 has lost water and is floppy.
6. Water moves by osmosis toward the more concentrated solution. The line crosses 0% at the **isotonic** concentration. (Sizes are drawn bigger than life.)

> **Predict box:** Potato cores soaked in pure water gain 15% of their mass, then no more however long they are left. Why do they stop? Hands up or mini whiteboards first.
>
> **Answer B: The cell walls push back on the swelling cells, and that pressure stops any more net water entering**

03 No wall, no limit

CHAPTER 03 IN THE SLIDES

Switch the figure through Hypotonic, Isotonic, Hypertonic and Pond water, and have the class say what will change before each.

> **Predict box:** A *Paramecium* is moved from pond water into a solution isotonic with its cytoplasm. What happens to its contractile vacuole? Hands up or mini whiteboards first.
>
> **Answer B: It fills and empties much more slowly, because water no longer enters the cell by osmosis**

04 The wall pushes back

CHAPTER 04 IN THE SLIDES

Switch the figure through Hypotonic, Isotonic and Hypertonic, and have the class say what will change before each.

> **Predict box:** Lettuce leaves left in a bowl of salty dressing go limp. Why? Hands up or mini whiteboards first.
>
> **Answer B: The dressing is hypertonic to the cells, so they lose water, turgor pressure falls and they plasmolyze**

THE LESSON

8 min

Water goes where the solute is

Chapter 1's figure step by step. Define hypotonic, isotonic and hypertonic, always as a pair: hypertonic to what? Mini whiteboards: three quick pairs of solutions, students say which way the water goes.

30 min

Cores in sugar

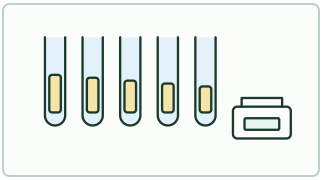
Potato cores for real, or the dry lab on the Lab tab (activity below): six sucrose solutions, five cores each, percentage change in mass, a graph and the isotonic point read where the line crosses zero. Groups compare potato, sweet potato and carrot.

10 min

With and without a wall

Chapter 3's and chapter 4's figures side by side, switched through the three solutions. Ask why a red blood cell bursts in pure water and a potato cell does not, then chapter 3's predict box on *Paramecium*.

ACTIVITIES



DRY LAB

Cores in sugar

Cut cores from a potato with a cork borer and trim them to the same length. Blot, weigh and record each one, then put five cores in each of six sucrose solutions from 0.0 to 1.0 M for at least 30 minutes. Blot them again, reweigh, and work out the percentage change in mass. Graph the means against concentration and read the isotonic point where the line crosses zero. The dry lab on the Lab tab runs three tissues and a mystery set in a few minutes.

Needs: potatoes (and sweet potato or carrot), a cork borer, a tile and knife, a ruler, a balance to 0.01 g, paper towels, sucrose solutions 0.0 to 1.0 M, labeled test tubes or cups.

PLENARY

7 min

Exit

On paper: "Potato cores gained mass in 0.1 M sucrose and lost mass in 0.4 M. Explain both results in terms of tonicity" (3 points).

WHAT STUDENTS GET WRONG

"Water moves to where there is less water." Say it in solutes: water moves to the side with more solute.

"The cell is hypertonic." Tonicity compares two solutions: hypertonic to what?

"Water stops moving in an isotonic solution." It moves both ways equally; the net movement is zero.

"Plant cells burst in pure water." The wall pushes back; the cell becomes turgid.

STRETCH AND SUPPORT

Stretch: a saltwater fish and a freshwater fish both keep their blood at about the same concentration. Explain which way water moves in each and what each must do about it.

Support: a pair of beakers to annotate: shade the side with more solute, then draw the water's arrow toward it.

For revision: students can drill this unit's key terms on Cramly.

IN THE GUIDE

1 Water goes where the solute is
2 Cores in sugar
3 No wall, no limit
4 The wall pushes back
Lab Dry lab: Cores in sugar
All The whole guide, with the figures that play
PPTX This lesson's slides, in the order of this plan

EXAM PRACTICE

Check yourself

Set it for homework: a fresh paper of exam-bank questions on 2.7 each time, marked as students go and saved to their Exam practice when they are signed in.

biologybybradford.com/exam-maker/sit?program=ap&units=U2&ced=2.7&paper=quiz&marks=15&src=ep

PRACTISE AND REVISE

BUILD FOR YOUR CLASS

- Tarsia puzzle, dominoes and picture reveal on Unit 2, built from its key terms and ready to print
- A pub quiz with rounds on Unit 2, to present or run with no projector
- The Cell Factory Lockdown escape room, or an escape room built from the question bank on Unit 2

ALREADY ON THE SITE FOR UNIT 2

- Lesson: Tonicity & Water Potential
- Lab: The Endomembrane System
- Quiz: Tonicity, Osmoregulation & Transport Mechanisms
- Exam questions: Unit 2 in the exam maker, a paper with scoring guidelines

CARD SETS ON SPLYCR

Open a set to host it as a class game, or make a copy to edit.

- Unit 2: Cell Structure and Function (part 1)
- Unit 2: Cell Structure and Function (part 2)
- Unit 2: Cell Structure and Function (part 3)

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.