

Exercise walk-through

3.2

Osmosis

IGCSE Biology

Osmosis in the words the Supplement uses

Water potential

Osmosis is the net movement of water from a region of **higher water potential** (a dilute solution – more water) to one of lower water potential, through a partially permeable membrane.

Turgor pressure

Water entering a plant cell presses outward on the cell wall; that outward push is the **turgor pressure**, and it holds a soft plant upright.

When it is lost

In a concentrated solution water leaves, the cell becomes **flaccid**, and eventually the membrane pulls away from the wall (**plasmolysis**).

Testing it

Investigate with **dialysis tubing** – an artificial partially permeable membrane – or with cylinders cut from a potato.

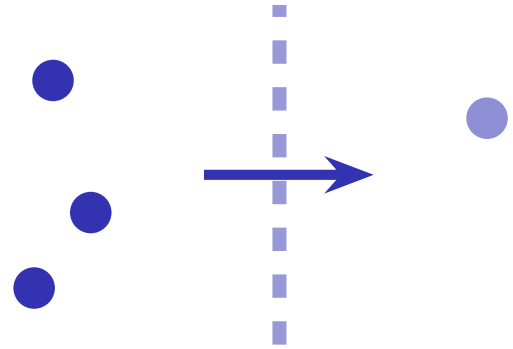
The cell wall is what makes turgor possible: an animal cell in the same solution simply bursts.

Exam tips

- Always write **net** movement: particles move both ways, but the overall flow is down the gradient (for diffusion and osmosis).
- Osmosis moves **water only**, and **only** through a partially permeable membrane. Diffusion can move many kinds of particle.
- Only **active transport** uses energy from respiration, and only it goes **against** the gradient.
- For the potato or plant experiment: water in → turgid, longer and heavier; water out → flaccid, shorter and lighter; equal concentration → no change.
- A larger surface area, higher temperature, steeper concentration gradient and shorter distance all make diffusion faster.

Check yourself

- 1 Which way do particles diffuse along a gradient?
- 2 What substance moves in osmosis?
- 3 What does a plant cell become in pure water?
- 4 Which process needs energy from respiration?



Answers 1. high to low concentration 2. water 3. turgid (firm) 4. active transport

Exercises 2.1-2.3

2.1 Define osmosis.

[2]

2.2 State what happens to a plant cell placed in pure water.

[1]

2.3 Define osmosis, using the term water potential.

[3]

Exercises 2.1-2.3

2.1 Define osmosis.

[2]

2.1

- net movement of water from **higher** to **lower water potential**
 - through a **partially permeable membrane**
-

2.2 State what happens to a plant cell placed in pure water.

[1]

2.2

- water moves in by osmosis and the cell becomes **turgid**
-

2.3 Define osmosis, using the term water potential.

[3]

2.3

- net movement of **water molecules**
- from higher to lower **water potential**
- through a **partially permeable membrane**

Exercises 2.4·2.5

2.4 Explain why a plant cell in pure water becomes turgid but does not burst. [2]

2.5 Explain why the potato cylinders must be blotted before weighing. [2]

Exercises 2.4·2.5

2.4 Explain why a plant cell in pure water becomes turgid but does not burst. [2]

2.4

- water enters and the vacuole swells, pushing the contents against the wall
 - the **cell wall** is strong, so the cell becomes **turgid** instead of bursting
-

2.5 Explain why the potato cylinders must be blotted before weighing. [2]

2.5

- surface water would be included in the mass
- that would make the change look **larger** than the water moved by osmosis

Exercise 3.1

3.1 A plant cell in a concentrated sugar solution becomes:

[1]

☐

A turgid

B flaccid (loses water)

C larger

D unchanged

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[1]

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B flaccid (loses water)

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D unchanged

3.1 B

- in a concentrated solution water **leaves** the cell, so it becomes **flaccid**
- A and C are in dilute solution; D is false

Exercise 3.2 (a)

3.2 Potato cylinders are placed in different sugar solutions and their mass measured.

(a) State what happens to the mass of a cylinder in pure water, and why. [2]

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(a)

- the mass **increases**
- because water moves **into** the cells by osmosis

Exercise 3.2 (b)

3.2 Potato cylinders are placed in different sugar solutions and their mass measured.

(b) State what you would observe for a cylinder in a very concentrated solution. [1]

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(b)

- it **loses mass** / becomes shorter and floppy

Exercise 3.3

3.3 Explain why turgid cells help support a plant.

[2]

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[2]

3.3

- turgid cells **press out** on the cell walls
- this firmness **holds the plant up straight**

Exercise 3.4 (a)

3.4 A student places identical potato cylinders in sucrose solutions of different concentrations for one hour, then blots and re-weighs them.

Sucrose concentration / mol dm^{-3}	0.0	0.2	0.4	0.6
Initial mass / g	5.00	5.00	5.00	5.00
Final mass / g	5.55	5.20	4.75	4.40

(a) Calculate the percentage change in mass for the 0.0 and the 0.6 solutions.

[3]

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(a)

$$\text{percentage change} = \frac{\text{final} - \text{initial}}{\text{initial}} \times 100 = \frac{5.55 \text{ g} - 5.00 \text{ g}}{5.00 \text{ g}} \times 100 = +\mathbf{11.0\%}$$

$$\text{percentage change} = \frac{\text{final} - \text{initial}}{\text{initial}} \times 100 = \frac{4.40 \text{ g} - 5.00 \text{ g}}{5.00 \text{ g}} \times 100 = -\mathbf{12.0\%}$$

Exercise 3.4 (b)

3.4 A student places identical potato cylinders in sucrose solutions of different concentrations for one hour, then blots and re-weighs them.

Sucrose concentration / mol dm^{-3}	0.0	0.2	0.4	0.6
Initial mass / g	5.00	5.00	5.00	5.00
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(b) Explain, in terms of water potential, the result for the 0.0 solution.

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[3]

(b)

- pure water has a **higher water potential** than the cell sap
- water moves **in** by osmosis, down the gradient
- the cylinder **gains mass**

Exercise 3.4 (c)

3.4 A student places identical potato cylinders in sucrose solutions of different concentrations for one hour, then blots and re-weighs them.

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(c) Estimate the concentration at which there would be no change in mass, and state what that tells you about the cells. [2]

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(c)

- no change at about 0.3 mol dm^{-3} (between 0.2 and 0.4)
- the external solution then has the **same water potential** as the cell sap

Exercise 3.4 (d)

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(d)

- contents **shrunk** and pulled away from the wall
- membrane no longer pressed against it
- the cell is **plasmolysed**

Exercise 3.4 (e)

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(e)

- an animal cell has **no cell wall**, so the membrane **bursts**
- a plant cell's strong wall resists, so it only becomes **turgid**

Exercise 3.4 (f)

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(f) State two variables the student must control for the comparison to be valid.

[2]

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(f)

- any **two** of: temperature / volume of solution / time / size and source of the cylinders