

Transport in cells

Revision notes · Diffusion, osmosis and active transport, the core practical on osmosis in potatoes, and calculating percentage change in mass.

For Edexcel GCSE Biology 1BI0 and Combined Science 1SC0. **Triple only** is not in Combined Science. **Higher tier** is only on the Higher paper.

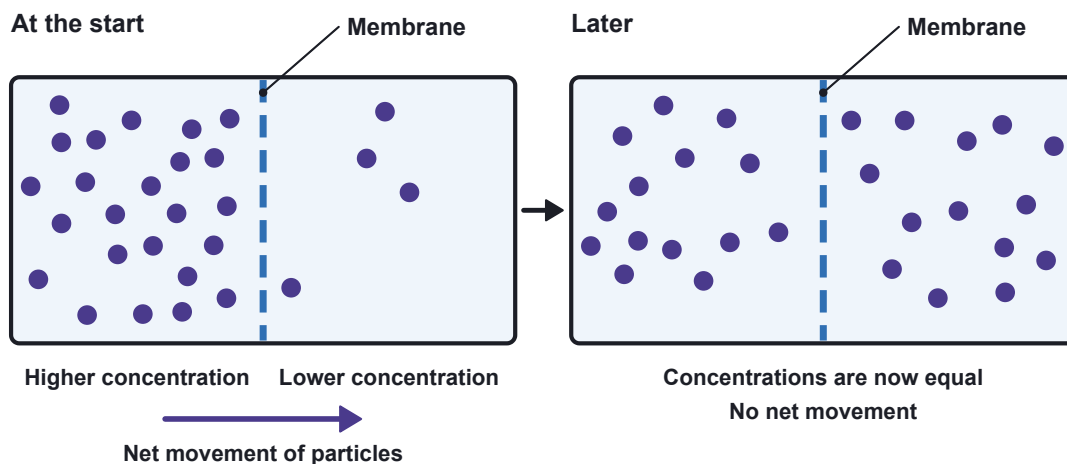
Transport in cells Spec 1.15-1.17

Diffusion Spec 1.15

Diffusion is the net movement of particles from an area of higher concentration to an area of lower concentration. The particles move **down a concentration gradient**. It is a passive process, so it does not need energy from respiration.

Oxygen, carbon dioxide and dissolved substances can diffuse into and out of cells through the cell membrane. The rate of diffusion is higher when:

- the concentration gradient is steeper, because there is a bigger difference in concentration
- the temperature is higher, because particles have more kinetic energy and move faster
- the surface area is larger, because more particles can cross at once

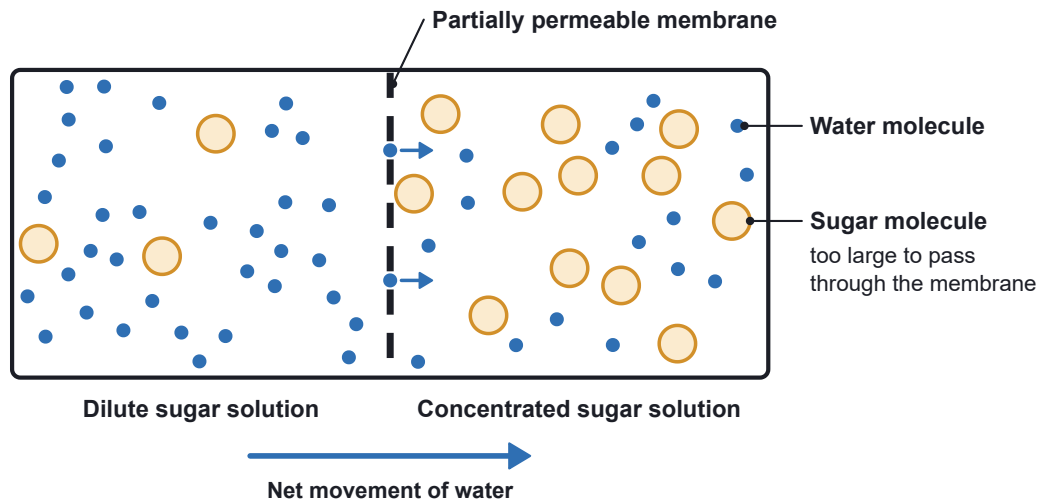


Diffusion: net movement of particles **down a concentration gradient** until the concentrations are equal.

Osmosis Spec 1.15

Osmosis is the diffusion of water from a dilute solution to a more concentrated solution through a **partially permeable membrane**. A partially permeable membrane lets small molecules such as water through, but not larger molecules.

Osmosis is a passive process. It does not need energy from respiration.



Osmosis: water moves from the **dilute** solution to the **concentrated** solution through a partially permeable membrane.

Common mistake: Osmosis is only about water. Do not write that 'particles' move by osmosis, and do not forget the partially permeable membrane.

Active transport Spec 1.15

Active transport is the movement of substances from a more dilute solution to a more concentrated solution, which is **against a concentration gradient**. It needs **energy from respiration**.

Active transport allows cells to take in substances they need even when they are in short supply outside the cell. For example, root hair cells take in mineral ions from the soil when the concentration of the ions is higher inside the cell than in the soil.

Three ways substances move into and out of cells

	What moves	Direction	Energy from respiration?
Diffusion	Particles, such as oxygen and carbon dioxide	High to low concentration	No
Osmosis	Water only, through a partially permeable membrane	Dilute to concentrated solution	No
Active transport	Substances such as mineral ions	Low to high concentration, against the gradient	Yes

Core practical: osmosis in potatoes Spec 1.16

Potato cells gain or lose water by osmosis depending on the concentration of the solution around them. You can measure this as a change in mass.

Core practical: Blot each cylinder dry before you weigh it. Wet cylinders have extra mass that is not from osmosis.

1. Use a cork borer to cut cylinders from one potato, and trim them to the same length.
2. Measure and record the mass of each cylinder.
3. Put each cylinder in a different concentration of sugar (or salt) solution, including pure water, using the same volume of solution each time.
4. Leave them for the same length of time at the same temperature.
5. Remove the cylinders, blot them dry with paper towel and measure their final mass.

6. Calculate the percentage change in mass for each cylinder and plot a graph of percentage change against concentration.

Result	Explanation
Mass increases	The solution is more dilute than the cell contents, so water moves into the potato by osmosis
Mass decreases	The solution is more concentrated than the cell contents, so water moves out of the potato by osmosis
No change in mass	The solution has the same concentration as the cell contents, so there is no net movement of water

Where the graph line crosses the x-axis (0% change), the concentration of the solution equals the concentration of the potato cell contents. Control the potato, the size of the cylinders, the volume of the solution, the time and the temperature. Repeat the experiment and calculate a mean. Cut on a tile away from your fingers, because cork borers and scalpels are sharp.

Percentage gain and loss of mass Spec 1.17

Different cylinders may start with slightly different masses, so you compare them using the percentage change in mass.

$$\text{percentage change} = (\text{final mass} - \text{initial mass}) \div \text{initial mass} \times 100$$

A positive answer is a percentage **gain**. A negative answer is a percentage **loss**.

Percentage change in mass

A potato cylinder has a mass of 3.00 g. After 30 minutes in a salt solution its mass is 2.55 g. Calculate the percentage change in mass.

1. change in mass = $2.55 - 3.00 = -0.45$ g
2. $-0.45 \div 3.00 = -0.15$
3. $-0.15 \times 100 = -15\%$

Answer: -15% (a loss of 15%)

Maths skill: Divide by the initial mass, not the final mass. Keep the minus sign if the mass decreased.

Quick check

1. Define diffusion.
2. Define osmosis.
3. What does active transport need that diffusion does not?
4. A potato cylinder gains mass in a solution. What does this tell you about the solution?
5. Write the equation for percentage change in mass.

Quick check answers

Transport in cells

1. The net movement of particles from a region of higher concentration to a region of lower concentration.
2. The diffusion of water from a dilute solution to a more concentrated solution through a partially permeable membrane.
3. Energy from respiration.
4. It is more dilute than the cell contents.
5. $(\text{final mass} - \text{initial mass}) \div \text{initial mass} \times 100$.