CAIE Biology IGCSE

3: Movement Into and Out of Cells

Notes

(Content in **bold** is for Extended students only)

The **cell membrane** and **cell wall** control what substances enter and exit the cell. Molecules such as glucose and proteins move into the cell for use in **metabolic reactions** and **storage**. Whereas **waste products** such as carbon dioxide and lactic acid are transported out into the blood to be excreted from the body.

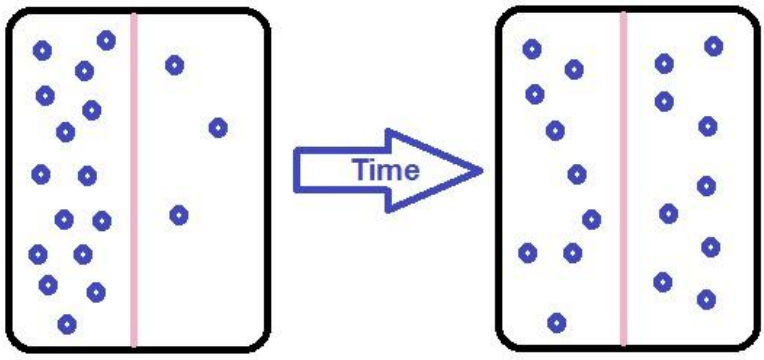
Diffusion

Diffusion is the **net movement** of particles from an **area of high concentration to an area of low concentration** down the **concentration gradient,** as a result of their random movement. The energy for diffusion comes from the **kinetic energy** of the molecules and ions.

Solutes and gases, such as carbon dioxide and oxygen, are able to diffuse in and out of cells across the cell membrane. This is important as these substances are crucial to **metabolic reactions** which occur within the cell, for example respiration and photosynthesis. Without them, the processes would not occur, and the cell would die.

Factors affecting rate of diffusion:

- **Surface area** - As the surface area increases, the rate of diffusion increases. This is because there is more space available for the substances to diffuse through.
- **Temperature** - As temperature increases, the rate of diffusion increases. This is because the molecules gain kinetic energy and thus move faster.
- **Concentration gradient** - As the concentration gradient increases, rate of diffusion increases.
- **Diffusion distance** - A greater diffusion distance slows the rate of diffusion as molecules must travel further.



Osmosis

Osmosis is the **net movement** of water molecules through a **partially permeable membrane**.

Key terms:

- **Turgid - cells are described as turgid when they are swollen due to a high-water content.**
- **Turgor pressure - The pressure on the cell wall from the cell membrane pushing upon it. This is a result of the cell becoming turgid as water moves into the cell via osmosis.**
- **Flaccid - Occurs when water moves out of the cell via osmosis. The cell shrinks but the cell membrane does not peel away from the cell wall. If more water leaves the cell, it becomes plasmolyzed.**
- **Plasmolysis - Occurs when there is too little water in cells. In plant cells, the cell membrane peels away from the cell wall.**

Water moves in and out of cells through the cell membrane via osmosis. Water is important to **provide support** for the cell structure through maintaining the **turgor pressure**. Plants are supported by the **pressure** of water inside the cells pressing outwards on the cell wall. Water also provides a **medium in which metabolic reactions occur.** Water has a high specific heat capacity, thus acting as a temperature buffer. This is important as it **maintains the optimum temperature for enzyme reactions**. Water also acts as a solvent in organisms which is important for digestion, excretion and transport.

Osmosis can also be described as the net movement of water molecules from a region of higher water potential (dilute solution) to a region of lower water potential (concentrated solution), through a partially permeable membrane. When the cell is more concentrated than the surrounding cells, water molecules diffuse into the cell via osmosis**, making it turgid.** When it is less concentrated than the surrounding cells, water molecules will leave the cell**, making it flaccid and leading to plasmolysis.** This effect can be investigated by placing cells in solutions of different concentrations.

Osmosis can be investigated via **dialysis tubing**. Dialysis tubing is an artificial **partially permeable membrane** made from cellulose. It has small pores which allow the entry of small molecules and prevents the entry of larger molecules. To demonstrate osmosis, dialysis tubing can be filled with concentrated sucrose solution. The tubing should then be placed in a beaker filled with distilled water. Water will move from the beaker(an area of **higher water potential**) to the tubing (an area of **lower water potential**).

Osmosis regulates water balance in both plant and animal cells. Water uptake in plants occurs due to the water potential gradient between the soil and root hair cells. Water moves from the soil (region of higher water potential) into the root hair cells (region of lower water potential) via osmosis. This water uptake is essential for plant growth and survival, as it is used in photosynthesis.

Active transport

Active transport is the movement of molecules **against a concentration** gradient using **energy from respiration**. Molecules are actively transported through a cell membrane from **regions of low concentrations to regions of higher concentration**.

Carrier proteins:
Carrier proteins facilitate active transport. They are embedded in the cell membrane and allow passage through it. Molecules from the side with lower concentration bind to the carrier protein. The carrier protein then changes shape using energy from respiration. This forces the molecule to move through the membrane to the side with high concentration, where it is released.

Examples of active transport:

- **Uptake of ions by root hair cells - plants take up ions such as nitrates and magnesium from the soil via root hair cells. The concentration of ions in the root hair cell is greater than the concentration of ions in the soil. Energy from respiration is therefore used to transport ions into the cell against the concentration gradient.**

- **Uptake of glucose - glucose is taken up in the small intestine and kidney tubules. Glucose moves against the concentration gradient through carrier proteins.**