AQA
TRANSPORT ACROSS THE CELL MEMBRANE NOTES

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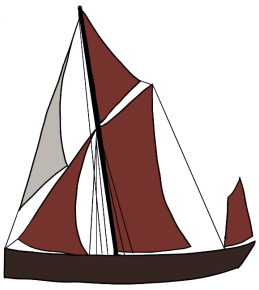

2021

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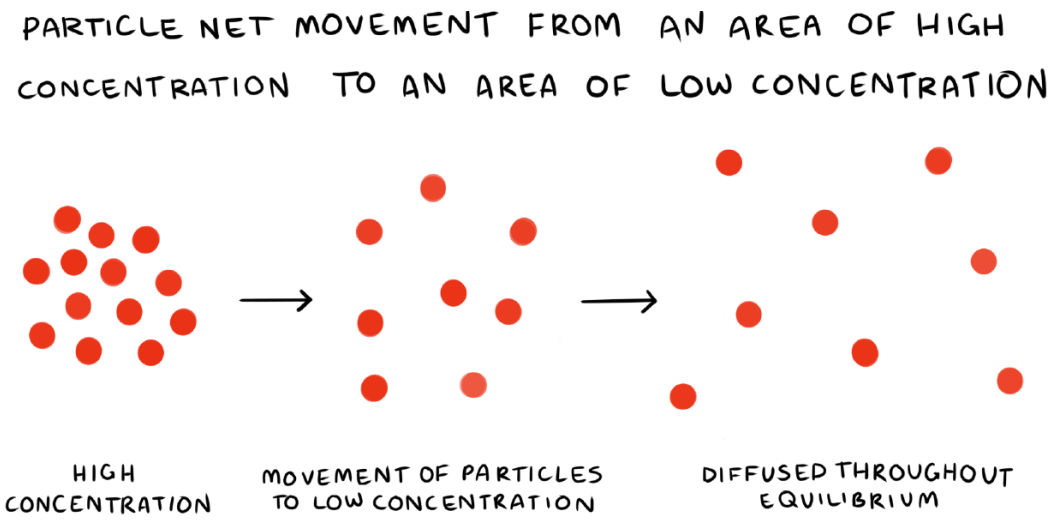
AQA Transport Across the Membrane Notes

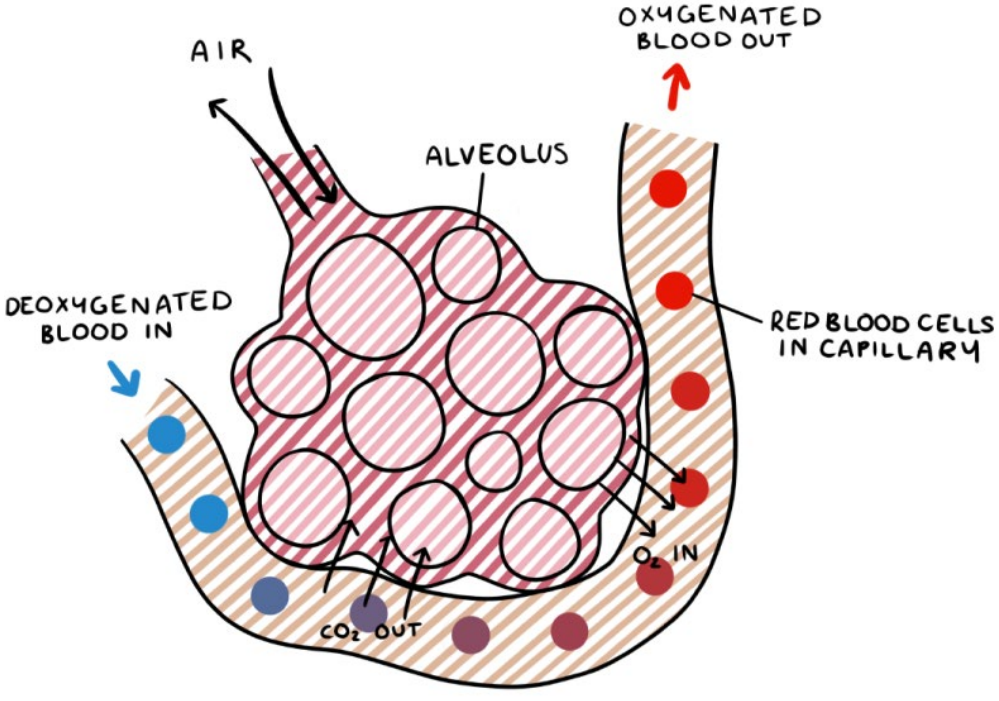
In order for chemical reactions to take place inside a cell, substances must be able to cross the cell membrane and enter the cell. There are three methods that are used to cross the membrane diffusion, osmosis and active transport. Let's look at each in turn.

***Diffusion*:** the net passive movement of particles (atoms, ions or molecules) from a region in which they are in higher concentration to a region of lower concentration moving down their concentration gradient.



Some examples of diffusion in biology are:

- Gas exchange at the alveoli — oxygen from air to blood, carbon dioxide from blood to air.
- Gas exchange for photosynthesis — carbon dioxide from air to leaf, oxygen from leaf to air.
- Gas exchange for respiration — oxygen from blood to tissue cells, carbon dioxide from the tissue cells to the blood.



Factors that affect the rate of diffusion

As diffusion is a passive process its rate is affected by physical conditions. The rate of diffusion can be **increased** by having:

- ***A short distance*** – diffusion occurs faster when a layer is one cell thick compared to a layer that is three cells thick. The thinner it is the faster the substance can move through.
- ***A large surface area*** – a larger surface area through which diffusion can happen increases the diffusion rate.
- ***A large concentration difference*** – a greater difference in the high and low concentrations increases the diffusion rate.
- ***A high temperature:*** increases the kinetic energy allowing particles to move faster.

Osmosis

Osmosis is a special example of diffusion.

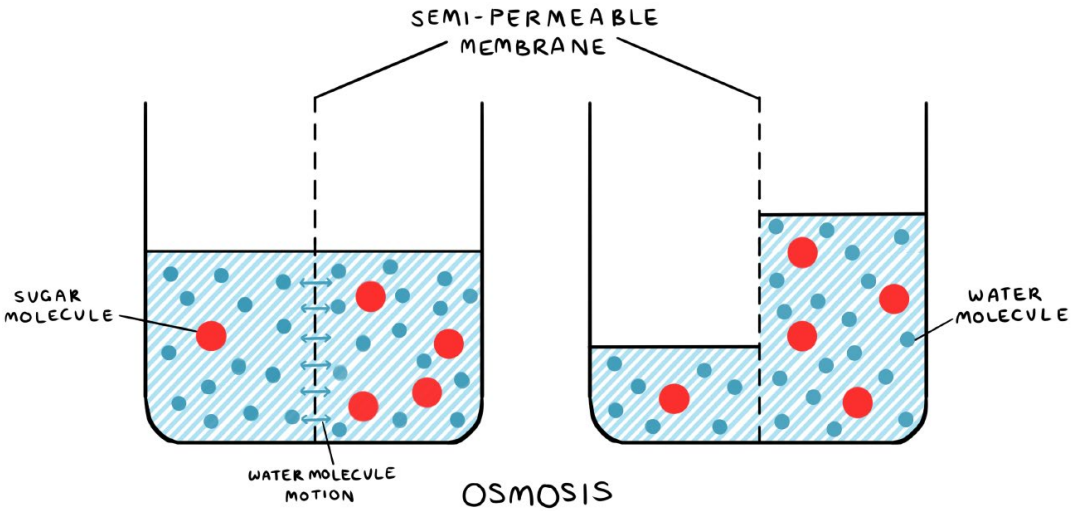
Osmosis: the movement of water through a partially permeable membrane from an area of higher water concentration to an area of lower water concentration – down the water potential gradient.

A partially permeable membrane is a barrier that permits the passage of some substances but not others; it allows the passage of the solvent molecules but not some of the larger solute molecules.

Cell membranes are described as **selectively permeable** because not only do they allow the passage of water but also allow the passage of certain solutes.

Some examples of osmosis are:

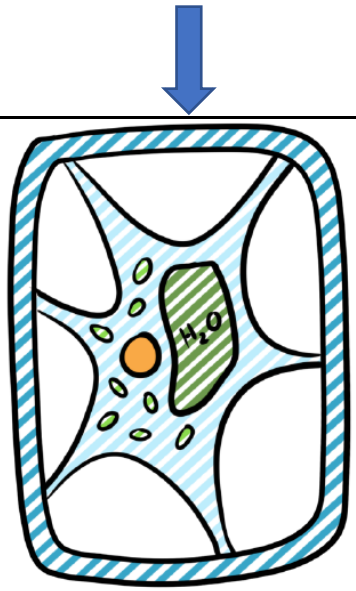
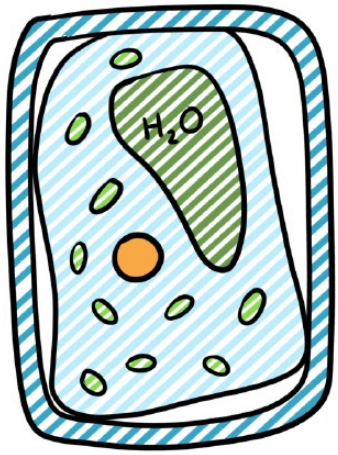
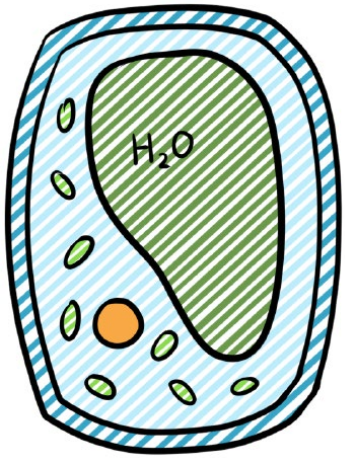
- Absorption of water by plant roots.
- Absorption of water by the alimentary canal — stomach, small intestine and the colon.



Special note: When the concentration of water is the same on both sides of the membrane, the movement of water molecules will be the same in both directions. There will be no **net** movement of water molecules.

Osmosis in Cells

Plant cells have a strong cellulose cell wall on the outside of the cell membrane. This supports the cell and **stops it bursting when it gains water by osmosis**.

Osmosis in Plant Cells		
Low water concentration outside of the cell	Equal water concentrations inside & outside of the cell	High water concentration outside the cell
		
Plasmolysed	**Flaccid**	**Turgid**
More water moves from the cell into the surroundings.	The same amount of water moves in and out of the cell.	More water moves from the surroundings into the cell.

Or put more simply…

Plasmolysed = **very little water in the cell.**

Flaccid = **normal amount of water in the cell.**

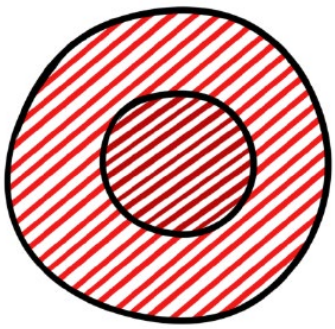
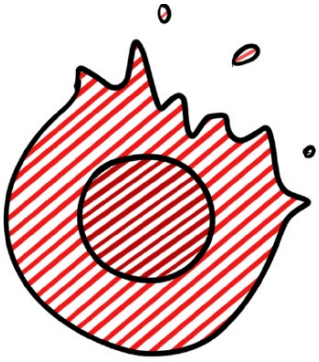
Turgid = **more than normal amount of water in the cell.**

I hope that helps 😊

AQA Transport Across the Membrane Notes

Animal Cells

Animal cells do <u>not have a cell wall</u>. They change size and shape when put into solutions that are at a different concentration to the cell contents.

Osmosis in Animal Cells		
Low water concentration outside of the cell	Equal water concentrations inside & outside of the cell	High water concentration outside the cell
↓	↓	↓
		
<u>Crenated</u>	**Normal**	**<u>Haemolysis/lysis</u>**
More water moves from the cell into the surroundings.	The same amount of water moves in and out of the cell.	More water moves from the surroundings into the cell.

Or put more simply…

Crenated = **very little water in the cell – cell shrinks.**

Normal = **normal amount of water in the cell.**

Haemolysis/lysis = **too much water in the cell – <u>cell bursts.</u>**

Again I hope that helps 😊

Calculating Percentage Change in Mass

We could be asked to calculate the percentage change in mass caused by osmosis. This form of question normally deals with the core practical involving potato cores/ cylinders.

The percentage change in mass can be calculated using the following equation:

$$\boldsymbol{Percentage\ change\ in\ mass = \frac{final\ mass - original\ mass}{original\ mass} \times 100}$$

Take the following examples:

1. A cylinder of potato has a mass of 5 g before it is placed into a concentrated solution and 3.5 g when it was removed.

$$Percentage\ change\ in\ mass = \frac{3.5 - 5}{5} \times 100$$

$$Percentage\ change\ in\ mass = -30\%$$

The **negative sign** shows that it has **lost** mass by osmosis.

2. A cylinder of potato has a mass of 4 g before it is placed into a dilute solution and 4.75 g when it was removed.

$$Percentage\ change\ in\ mass = \frac{4.75 - 4}{4} \times 100$$

$$Percentage\ change\ in\ mass = +18.75\%$$

The **positive sign** shows that it has **gained** mass by osmosis.

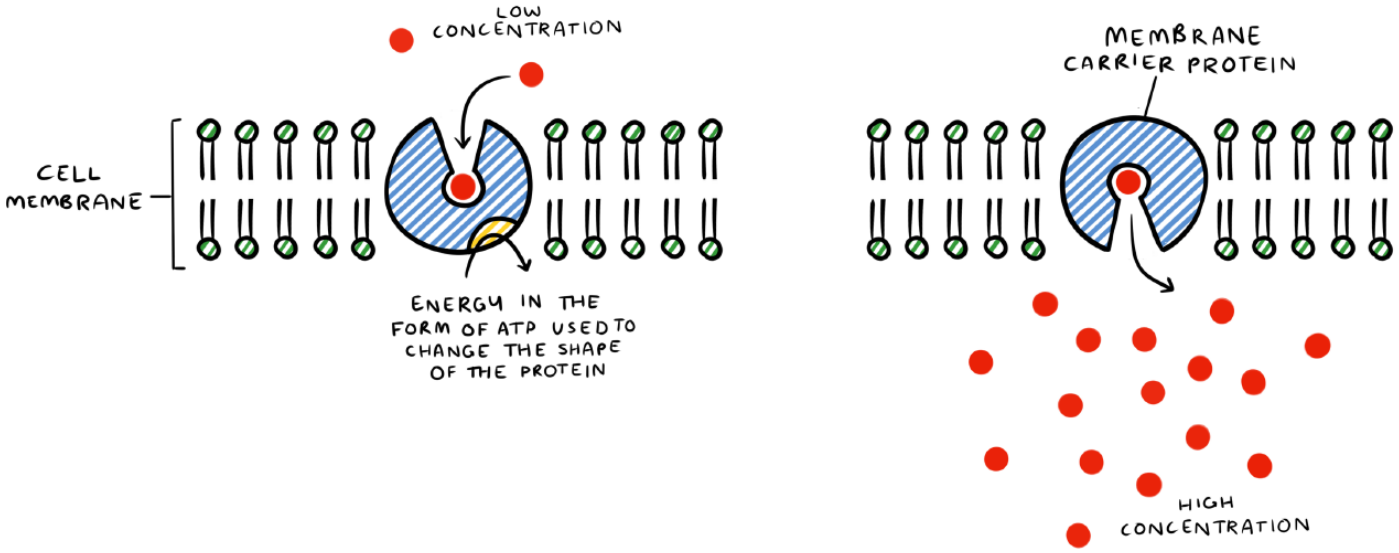
Active Transport

Active transport: the movement of a substance across a cell membrane **against its concentration gradient**, moving from **lower concentration to higher concentration** using energy in the form of adenosine triphosphate (ATP). Special proteins within the cell membrane act as specific protein 'carriers'.

The energy for active transport comes from ATP generated by respiration (in mitochondria).

Examples of Active Transport:

- Re-absorption of glucose, amino acids and salts by the proximal convoluted tubule of the nephron in the kidney.
- Sodium/potassium pump in cell membranes (especially nerve cells)



Summary			
	Diffusion	**Osmosis**	**Active transport**
Down a concentration gradient	✓	✓	X
Against a concentration gradient	X	X	✓
Energy needed	X	X	✓
Substance moved	Dissolved solutes	Water	Dissolved solutes
Notes	Gases and dissolved gases also diffuse	Partially permeable membrane needed	Carrier protein needed