

Unit 3 Movement in and out of cells

Diffusion

- Diffusion is the net movement of particles or ions of a high concentration to a low concentration down a concentration gradient
- Particles in a liquid or gas spread out from regions of high concentration to areas of a low concentration until evenly spread
- The difference between the concentration of molecules is called a concentration gradient
- The steeper the concentration gradient, the faster the diffusion takes place
- The movement of molecules by diffusion across the cell membrane is a passive movement as cells do not need to use energy to move the molecules

Factors that affect diffusion

- The distance the molecules have to travel- cell membranes are very thin
- The concentration gradient- cells maintain a steep concentration gradient
- The surface area- the larger the surface area, the more diffusion takes place
- The temperature- molecules move faster and collide more often as the temperature increases, diffusion is faster at warmer temperatures
- The size of the cell- as the cell gets bigger, its surface-to-volume ratio decreases, making diffusion less efficient

Gases vs Liquids

- Diffusion through air is 300 000 times faster than through water
- In mammals the gas exchange surface is formed of the alveoli in the lungs
- There are many alveoli to give a very large area of gas exchange
- In plants, gas exchange occurs inside the leaves
- The spongy mesophyll cells provide a large surface area for the exchange of gases
- There are air spaces between the cells

Water as a solvent

- Solute + Solvent = Solution
- Solute: what dissolves in the solvent
- Solvent: the liquid in which the solute dissolves
- Water is known as a universal solvent
- 75% of cytoplasm is water
- Water is needed for transportation in plants and animals
- Water is needed for digestion and excretion
- Most chemical reactions occur in water

Osmosis

- Osmosis is a special type of diffusion. It is the diffusion of free water molecules from a high concentration of free water molecules to a low concentration through a partially permeable membrane

Water Potential

- The ability of water to move via osmosis
- Water potential is caused by the amount of free water molecules available to move. So water molecules will always move from a high to a low water potential
- A dilute solution has a high water potential
- A concentrated solution has a low water potential
- Water potential is influenced by the amount of water available and the pressure exerted on water in plant cells by the cell wall
- Osmosis is measured using an osmometer

Osmosis in plant and animal cells

Turgidity

- Vacuoles store sugars and salts in a solution which creates a concentration gradient
- Plant cells have partially permeable membranes, allowing water to diffuse into the cell
- As the water diffuses into the cell, the cell swells up
- Water pushes against the cell wall creating turgor pressure
- A cell full to the point of bursting is known as turgid
- Plant cells will not burst due to a cell wall
- Many cells in the stem of the plant are supported by turgor pressure
- Wilted plants lose turgidity due to water shortage

Plasmolysis

- Placing a cell in a concentrated salt/sugar solution results in:
 - i. Water moving out via osmosis, vacuole shrinks and becomes limp
 - ii. Said to become flaccid
 - iii. If more water leaves the cell it will become plasmolysed, cytoplasm begins to move away from the cell wall
- Only plant cells can become plasmolysed

Active Transport

- Active transport is the movement of ions and molecules in or out of a cell through the cell membrane against a concentration gradient, using energy released during the respiration
- Active transport moves substances against a concentration gradient
- Movement involves the use of ATP from aerobic respiration to supply energy
- Structural changes in the carrier protein result in the movement through the membrane
- Active transport enables root hair cells to take up ions and epithelial cells of the villi to take up glucose
- Root hair cells and epithelial cells of villi have adapted for active transport by having many carrier proteins in their cell membranes and a high rate of respiration to provide energy
- Active transport relies upon respiration to take up ions or molecules against a concentration gradient. Any factor that affects the rate of respiration will also affect the rate of active transport. So a lack of oxygen will reduce respiration rate and active transport.
- An increase in temperature would increase the rate of respiration, up to a point, so would also have the same effects on active transport. The presence of poisons such as cyanide can stop, so active transport would stop altogether.