WJEC (Wales) Biology GCSE

Topic 1.1: Cells and Movement across Membranes

Notes

('Higher Tier only' in **bold**)

Cells

Animal and plant cells

Both plant and animal cells contain the following organelles:

- Cytoplasm - fluid component (contains organelles, enzymes, etc.), site of most cellular reactions.
- Nucleus - stores genetic information in the form of DNA, controls cellular activities.
- Cell membrane - controls the entry and exit of materials into and out of the cell.
- Mitochondria - site of later stages of aerobic respiration in which energy is released.

Plant cells contain some organelles that animal cells do not:

- Cell wall - made from cellulose, provides strength, prevents the cell bursting when water enters by osmosis.
- Vacuole - contains cell sap (a solution of salts, sugars and organic acids), supports the cell, maintaining its turgidity.
- Chloroplasts - site of photosynthesis, contain photosynthetic pigments e.g. chlorophyll.

Microscopy

Term	Definition
Magnification	Number of times bigger an image appears compared to the size of the specimen
Resolution	Smallest distance between two objects that can be distinguished

Animal and plant cells can be observed using a light microscope. A beam of light is passed through a specimen. It travels through the eyepiece lens, allowing the specimen to be observed.

The development of microscopes has enabled scientists to increase their understanding of cells. Greater magnifications and resolutions allow small sub-cellular structures (e.g. mitochondria) to be observed in detail. This enables scientists to develop more accurate explanations about how cell structure relates to function.

Cell differentiation

Cell differentiation produces specialised cells with specific functions e.g. red blood cells, sperm cells. Some genes are switched on or off, determining cell type.

Once a cell differentiates, it cannot divide to make an unspecialised cell, nor a cell which has a different specialised function.

Organisation

Term	Definition	Examples
Tissue	A group of similar cells which work together to perform a specific function	Muscle tissue Xylem tissue
Organ	A group of tissues that work together to perform a specific function	Brain Heart
Organ system	A collection of organs that work together to perform a specific function	Digestive system Nervous system
Organism	An animal or plant that is able to function independently	Human Sunflower

Movement across cell membranes

Cell membranes are selectively permeable enabling the passage of some substances through them. There are three methods of transport across cell membranes:

- Diffusion
- Osmosis
- Active transport

Diffusion

Diffusion is the net movement of molecules from an area of high concentration to an area of low concentration down a concentration gradient. This is a passive process and does not require energy. Small molecules (e.g. O_2 and CO_2) move across membranes by diffusion.

Factors affecting the rate of diffusion include:

- Temperature - the higher the temperature, the more kinetic energy possessed by molecules and the faster the rate of diffusion.

- Concentration gradient - the steeper the concentration gradient, the faster the rate of diffusion.

Visking tubing (permeable, plastic tubing) can be used as a model of living material to investigate the rate of diffusion.

Osmosis

Osmosis is the net movement of water molecules from an area of high water (low solute) concentration to an area of low water (high solute) concentration across a partially permeable membrane. It is a form of diffusion.

Active transport

Active transport is the movement of molecules across a cell membrane from an area of low concentration to an area of high concentration, against the concentration gradient, using energy.

Examples include the uptake of mineral ions from the soil into root hair cells and the uptake of glucose into the bloodstream in the small intestine.

Enzymes

Enzymes increase the rate of a reaction without being permanently altered themselves. They are biological catalysts and are crucial to living organisms (enable cellular reactions to take place at lower temperatures).

Enzymes are proteins made up of a chain of amino acids. The order of amino acids determines how the amino acid chain folds and its structure. Its function is determined by the shape of the enzyme.

The region of an enzyme to which a substrate molecule binds is called the active site. The active site shape is specific to the substrate molecule. Each enzyme is complementary to only one type of substrate (described as having a 'high specificity').

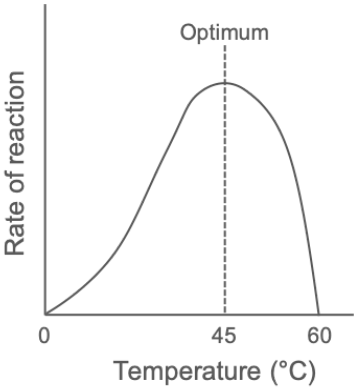
- Substrate collides with the active site of an enzyme
- Substrate binds, enzyme-substrate complex forms
- Substrate converted to products
- Products are released from the active site. The active site is now free to bind to another substrate

This is the 'lock and key' hypothesis.

Factors affecting the rate of enzyme-controlled reactions

Many different factors affect the rate of enzyme activity:

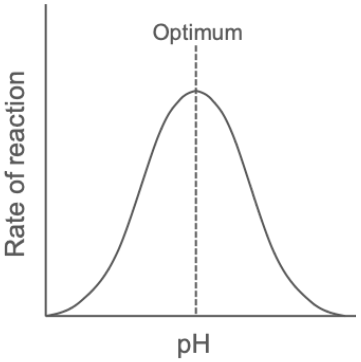
Temperature



- Temperature increases
- Molecules have more KE
- Movement of molecules increases
- Probability of a successful collision increases
- More enzyme-substrate complexes form
- Rate of reaction increases

- Temperature increases above the optimum
- Increased vibrations break bonds in enzyme's structure
- Active site changes shape, enzyme is denatured
- No more enzyme-substrate complexes can form
- Rate of reaction decreases

pH



- Enzymes have an optimum pH
- pH shifts from the optimum
- Bonds in the enzyme's structure are altered
- Active site changes shape, enzyme is denatured
- Rate of reaction decreases