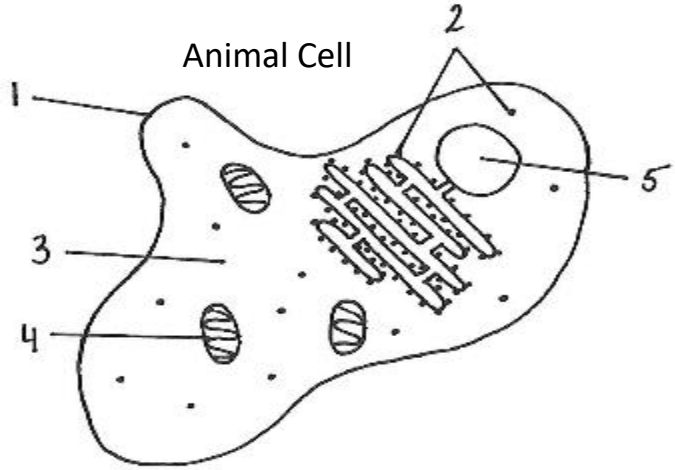
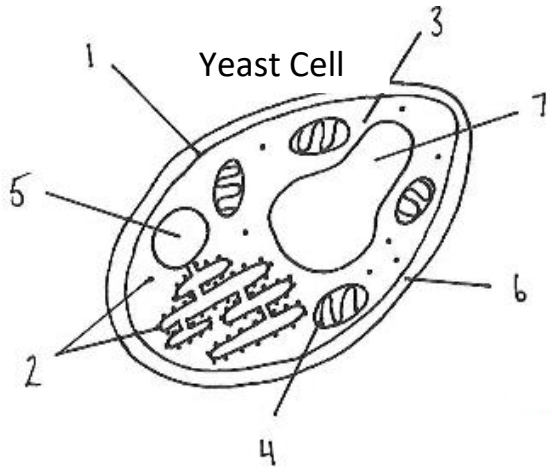
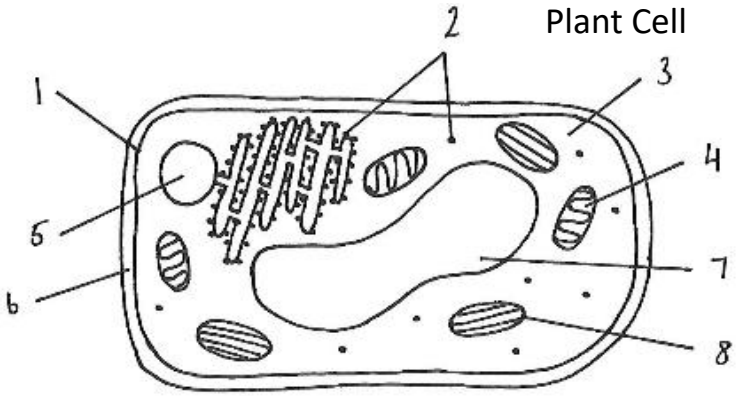
National 5 Cell Biology Summary Notes

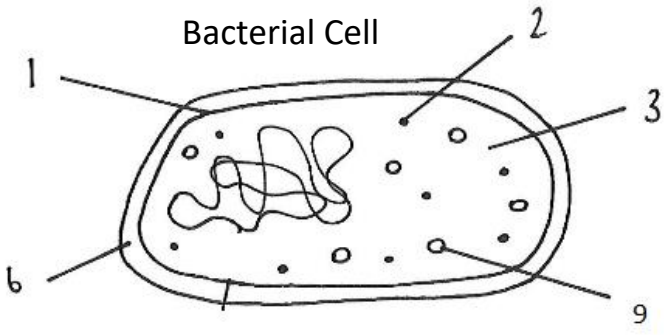
Cell Structure

All living things are made up of **cells**. There are 4 main types of cell: animal, plant, yeast and bacterial cells. Cells are made up of **organelles**.



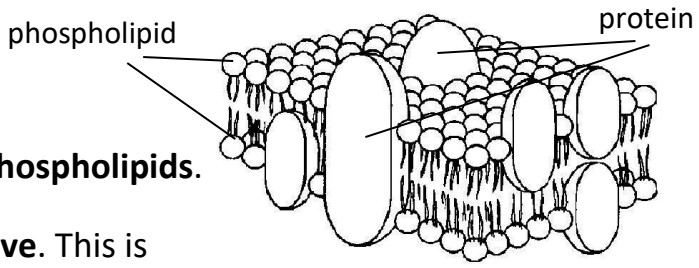






Number	Organelle	Function of Organelle	Type of cell found in
1	Cell membrane	Controls entry and exit of materials in the cell	All
2	Ribosome	Site of protein synthesis	All
3	Cytoplasm	Site of chemical reactions	All
4	Mitochondria	Site of aerobic respiration	Animal, plant, yeast
5	Nucleus	Controls the cell's activities	Animal, plant, yeast
6	Cell wall	Support the cell. Made of cellulose in plant cells and a different material in yeast and bacterial cells.	Plant, yeast, bacterial
7	Vacuole	Contains cell sap	Plant, yeast
8	Chloroplast	Site of photosynthesis	Plant
9	Plasmid	Small ring of DNA	Bacterial

We use a **microscope** to look at cells. We add a **stain** to the microscope slides so we can see the cell organelles clearly.



Transport Across Cell Membranes

The cell membrane is made up of **proteins** and **phospholipids**.

Transport across the cell membrane can be **passive**. This is where molecules move down a concentration gradient and no energy is required.

There are two types:

1) **Diffusion** - the movement of **molecules** down a concentration gradient from a **higher to a lower concentration**. No energy is needed. It is important to allow cells to gain glucose and oxygen for respiration and remove carbon dioxide into the blood.
2) **Osmosis** -the movement of **water** molecules from a **higher water concentration to a lower water concentration** through a **selectively permeable membrane**. No energy is needed.

Type of cell	Type of solution	Effect of solution on the cell
Animal	High water/dilute	Cell **bursts**
	Low water/concentrated	Cell **shrinks**
Plant	High water/dilute	Cell becomes **turgid** – cell swells and contents push against the cell wall
	Low water/concentrated	Cell becomes **plasmolysed** – cell contents shrink and pull away from the cell wall

Transport can also be active. **Active transport** requires energy for membrane proteins to move molecules and ions against the concentration gradient.

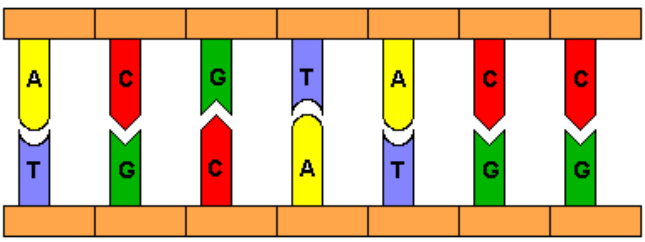
DNA and the Production of Proteins

DNA carries the genetic information for making proteins and therefore determines your characteristics eg. hair and eye colour. DNA is made up of genes. A **gene** codes for a particular protein.

DNA is made up of **2 strands**. The strands are twisted into a **double helix shape**. There are four bases in DNA – **adenine, thymine, guanine** and **cytosine**.

The following are the base pairs of DNA:

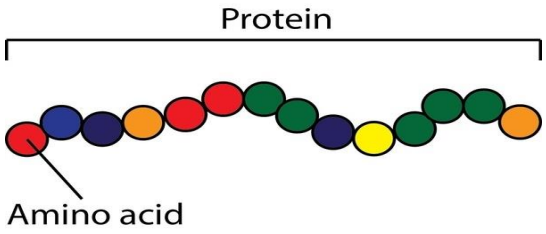
- Adenine – thymine
- Guanine – cytosine



Proteins are made of **amino acids**. There are different types of amino acids. Different amino acids will join together in different orders and make different proteins.

Since proteins are made at a ribosome, a copy of the gene needed to make the protein must be made. **mRNA (messenger RNA)** is the name given to the molecule which carries a complementary copy of the genetic code from the DNA, in the nucleus, to a ribosome, where the protein is assembled from amino acids.

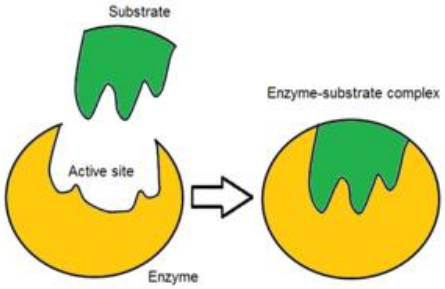
The sequence of amino acids in a protein is determined by the sequence of bases in the DNA.



<u>Proteins</u>

There are many different types of proteins.

- Antibodies – defend the body from disease causing microbes
- Hormones – chemical messengers
- Receptors – allow specific hormones to bind to cells
- Structural – make of the cell membrane
- Enzymes – speed up chemical reactions

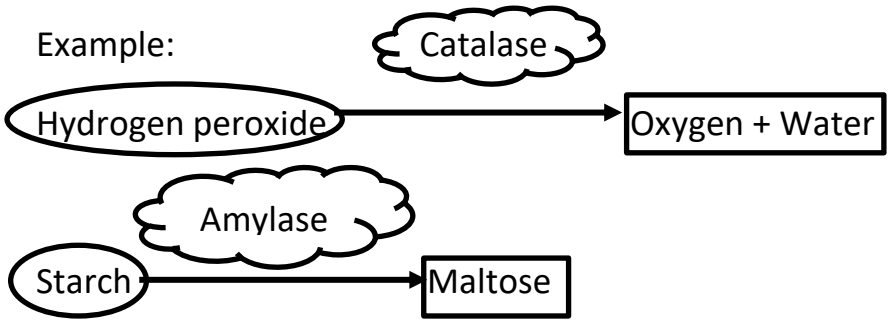


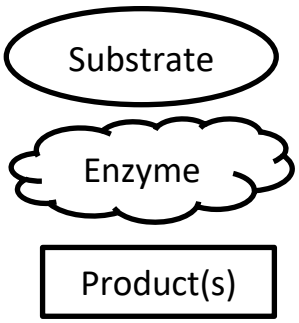
Enzymes are biological **catalysts**. They **speed up chemical reactions** and are **unchanged** after it. They are made of protein and are found in all living cells.

An enzyme has an **active site** which has a shape complementary to only one substrate – the enzyme is **specific** to one substrate. There are two types of enzyme reaction.

1) **Degradation** – break down of large molecules into smaller molecules.

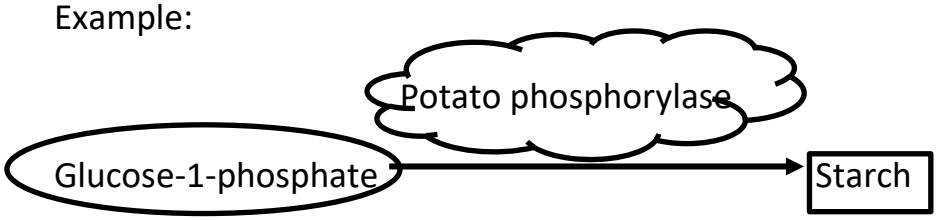
Example:





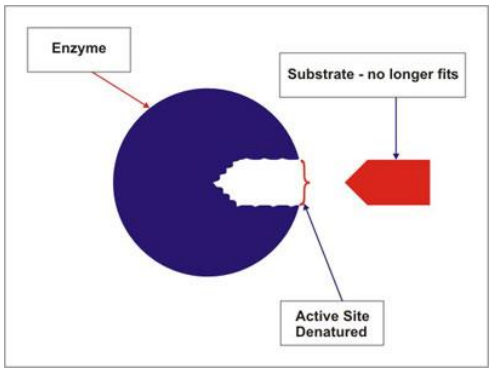
2) **Synthesis** – build up of large molecules from smaller molecules.

Example:



The condition at which an enzyme is at its most active is called the **optimum** condition.

Enzymes, and other proteins, can be affected by **temperature** and **pH**. Enzymes can be **denatured**. This is when the shape of the active site changes and will no longer fit the substrate. This will affect the rate of reaction.



Genetic Engineering

Genetic information can be transferred from one cell to another by **genetic engineering.** The stages of genetic engineering are:

1. identify section of DNA that contains required gene from source chromosome
2. extract required gene from the chromosome
3. extract plasmid from bacterial cell
4. insert required gene into bacterial plasmid
5. insert plasmid into host bacterial cell to produce a genetically modified (GM) organism.
6. Bacterial cell will produce protein coded for by inserted gene

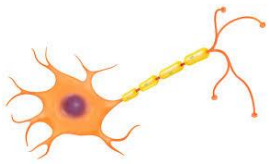
Enzymes are used in this process. Genetic engineering is used to produce human proteins such as insulin and human growth hormone.

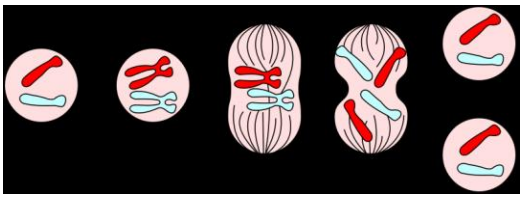
Respiration

The chemical energy stored in glucose must be released by all cells through a series of enzyme-controlled reactions called **respiration**.

The energy released from the breakdown of glucose is used to generate ATP – a molecule containing energy. The energy transferred by ATP can be used for cellular activities such as:

- Cell division
- Muscle cell contraction
- Protein synthesis
- Transmission of nerve impulses





Glucose is broken down to **two molecules of pyruvate**, releasing enough energy to yield **two molecules of ATP**. Further breakdown depends upon if oxygen is present or not.

If oxygen is present:

Aerobic respiration takes place, and each pyruvate is broken down to **carbon dioxide** and **water**, releasing enough energy to yield a **large number of ATP molecules.**

If oxygen is absent, the process of **fermentation** takes place. The products of fermentation are different between animal and plant/yeast cells.

If oxygen is absent in an animal cell:

The pyruvate molecules (from the glucose being broken down) are converted to **lactate**.

If oxygen is absent in plant/yeast cells:

The pyruvate molecules (from the glucose being broken down) are converted to **carbon dioxide and ethanol**.

The breakdown of each glucose molecule via the fermentation pathway yields only the **initial two molecules of ATP.**

Respiration begins in the cytoplasm. The process of aerobic respiration is completed in the mitochondria whereas fermentation is completed in the cytoplasm.

The higher the energy requirement of a cell the greater the number of mitochondria present in that cell. Example: Sperm cells need a lot of mitochondria so they can swim to the egg.

Summary Word Equations:

Aerobic Respiration:

Glucose + Oxygen → Carbon dioxide + Water + Energy

Fermentation in Animal Cells:

Glucose → Lactate + Energy

Fermentation is Plant/Yeast Cells:

Glucose → Carbon dioxide + Ethanol + Energy