

CAIE Biology A-level

Topic 1: Cell Structure

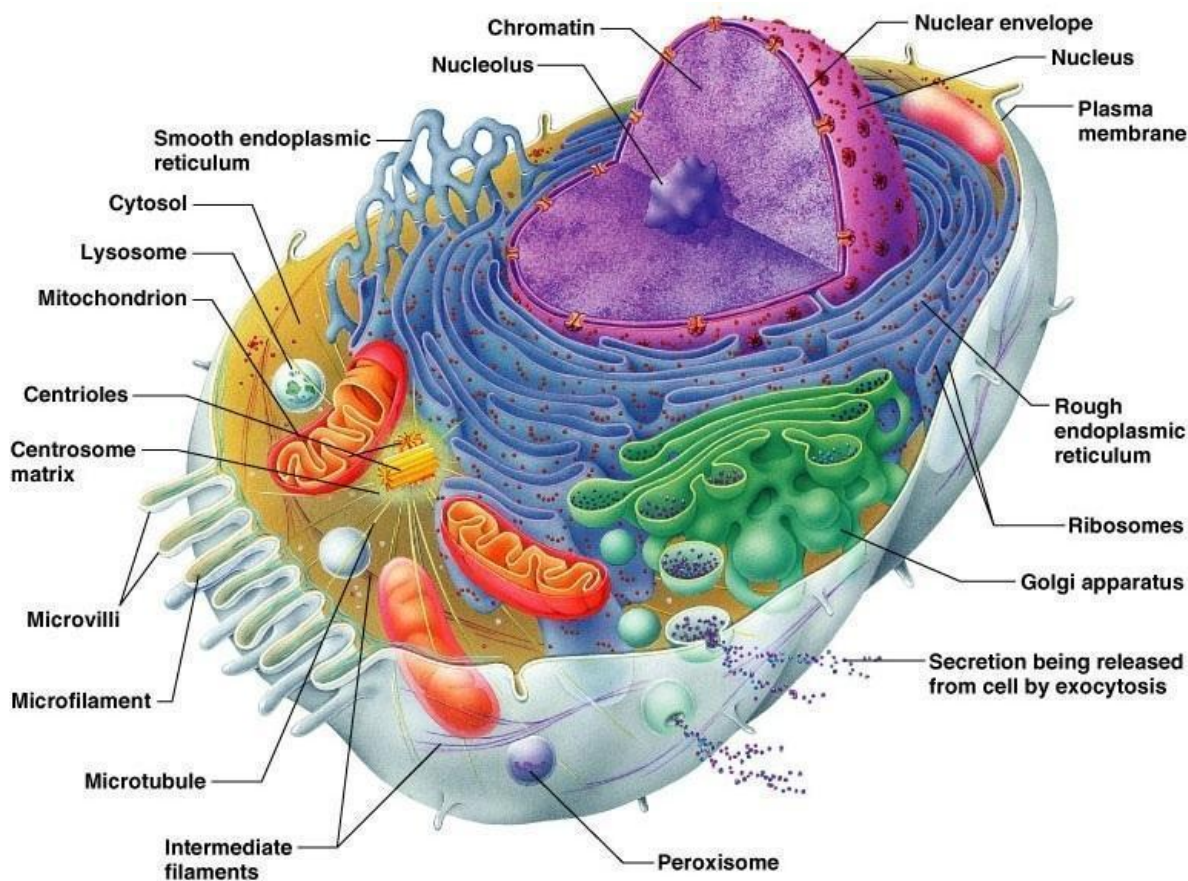
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All living organisms are made of cells, there are several different types of cells, some of them sharing some common features. Human are made up of **eukaryotic cells**. All eukaryotic cells contain a nucleus and membrane bound organelles. A more detailed structure of cells called the **ultrastructure** can be obtained by using a microscope.

Ultrastructure of eukaryotic cells:



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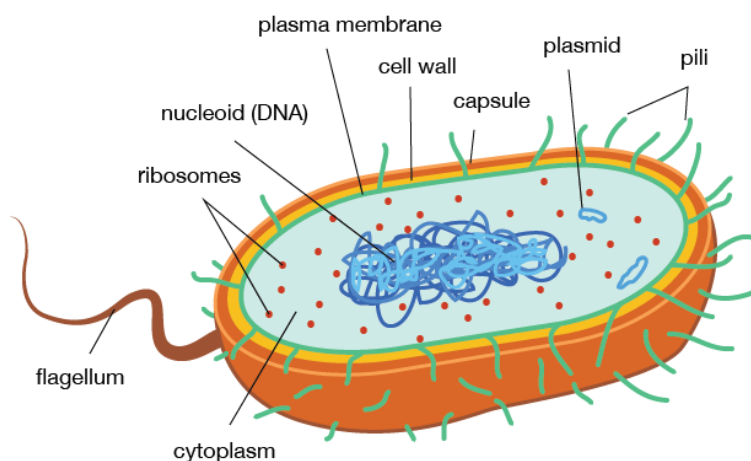
- **Nucleus** surrounded by a **double membrane called the envelope** containing **pores** which enable molecules to enter and leave the nucleus, the nucleus also contains **chromatin** and a **nucleolus** which is the site of ribosome production.
- **Rough endoplasmic reticulum** which is a **series of flattened sacs** enclosed by a membrane with ribosomes on the surface. RER **folds and processes proteins** made on the ribosomes.
- **Smooth endoplasmic reticulum** is a system of **membrane bound sacs**. SER **produces and processes lipids**.
- **Golgi apparatus** is a series of **fluid filled, flattened & curved sacs** with vesicles surrounding the edges. The Golgi apparatus **processes and packages proteins and lipids**. It also **produces lysosomes**.
- **Mitochondria** are usually **oval shaped, bound by a double membrane called the envelope**. The inner membrane is folded to form projections called **cristae** with **matrix** on the inside containing all the enzymes needed for **respiration**.



- **Centrioles** are **hollow cylinders** containing a ring of **microtubules** arranged at right angles to each other. Centrioles are involved in **cell division**. *Please note: Centrioles only exist in some species of lower plants (e.g. algal cells except red algae, some fern cells, male gametes of charophytes, bryophytes, ginkgo, cycads, seedless vascular plants, and moss cells).*
- **Ribosomes** are **composed of two sub units** and are **the site of protein production**
- **Lysosome** is a vesicle containing **digestive enzymes** bound by a **single membrane**.
- **The cell surface membrane** surrounds the cell and **controls what enters and exits**.
- The **vacuole** is a fluid-filled sac present in plant cells, surrounded by a membrane called the **tonoplast**. It contains mineral salts, sugars, amino acids, waste substances and pigments. Its role is to colour the cell to **attract pollinating insects**, act as a **temporary food store** and **provide support through turgidity**.
- The **cell wall** (plant cells) is made of **cellulose microfibrils**. Its role is to **strengthen** the cell and **prevent bursting** due to osmosis.
- **Plasmodesmata** are small channels that pass through the cell wall of adjoining plant cells to **allow communication** between cells.

Prokaryotic cells such as bacteria contain:

- **Cell wall** – Rigid outer covering made of **peptidoglycan**
- **Capsule** – Protective slimy layer which helps the cell to **retain moisture** and **adhere** to surfaces
- **Plasmid** –Circular piece of DNA
- **Flagellum**- a tail like structure which **rotates to move the cell**
- **Pili**- Hair-like structures which attach to other bacterial cells
- **Ribosomes**- Site of **protein production**
- **Mesosomes**- Infoldings of the inner membrane which **contain enzymes required for respiration**



Prokaryotic cells are **unicellular** and are typically **1–5µm in diameter**, which is much smaller than eukaryotic cells. They **do not contain membrane bound organelles** or a nucleus, and their **ribosomes are smaller (70S)** than ribosomes in the cytoplasm of eukaryotic cells (80S).

Viruses:

Viruses are **non-living** structures which consist of **nucleic acid** (either DNA or RNA) enclosed in a protective protein coat called the **capsid**, sometimes covered with a lipid layer called the **envelope**.



Microscopy

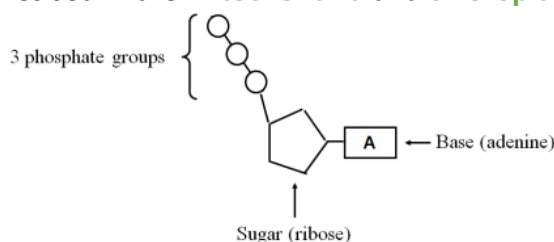
Microscopy is the most important technique used in biology as it enables us to see and examine organisms and structures which cannot be seen with the naked eye. **Magnification** is an indicator of how much bigger the microscope image is than the actual object whereas **resolution** is the smallest interval measurable by a microscope. **Magnification can be calculated by dividing the size of the image by the size of real object.**

There are two types of microscopes:

- **Light microscopes**- these are good for observing samples in a lab as they are **cheap** and **portable**. They have a **lower magnification and resolution** than electron microscopes, however.
- **Electron microscopes**- these are **good for examining organelles in high detail**. They have a **high magnification and resolution**, but samples must be placed in a **vacuum** and prepared first. This technique can be very **expensive**.

ATP

Adenosine triphosphate is a nucleotide derivative and consists of **ribose, adenine and three phosphate groups**. It is synthesised in the **mitochondria** and **chloroplasts** of cells.



- **Energy is released when ATP is hydrolysed** to form **ADP and a phosphate molecule**. This process is catalysed by **ATP hydrolase**.
- The **inorganic phosphate can be used to phosphorylate other compounds**, as a result making them more reactive.
- **Condensation of ADP and inorganic phosphate catalysed by ATP synthase produces ATP** during photosynthesis and respiration.

