

CAIE Biology A-level

Topic 1: Cell Structure

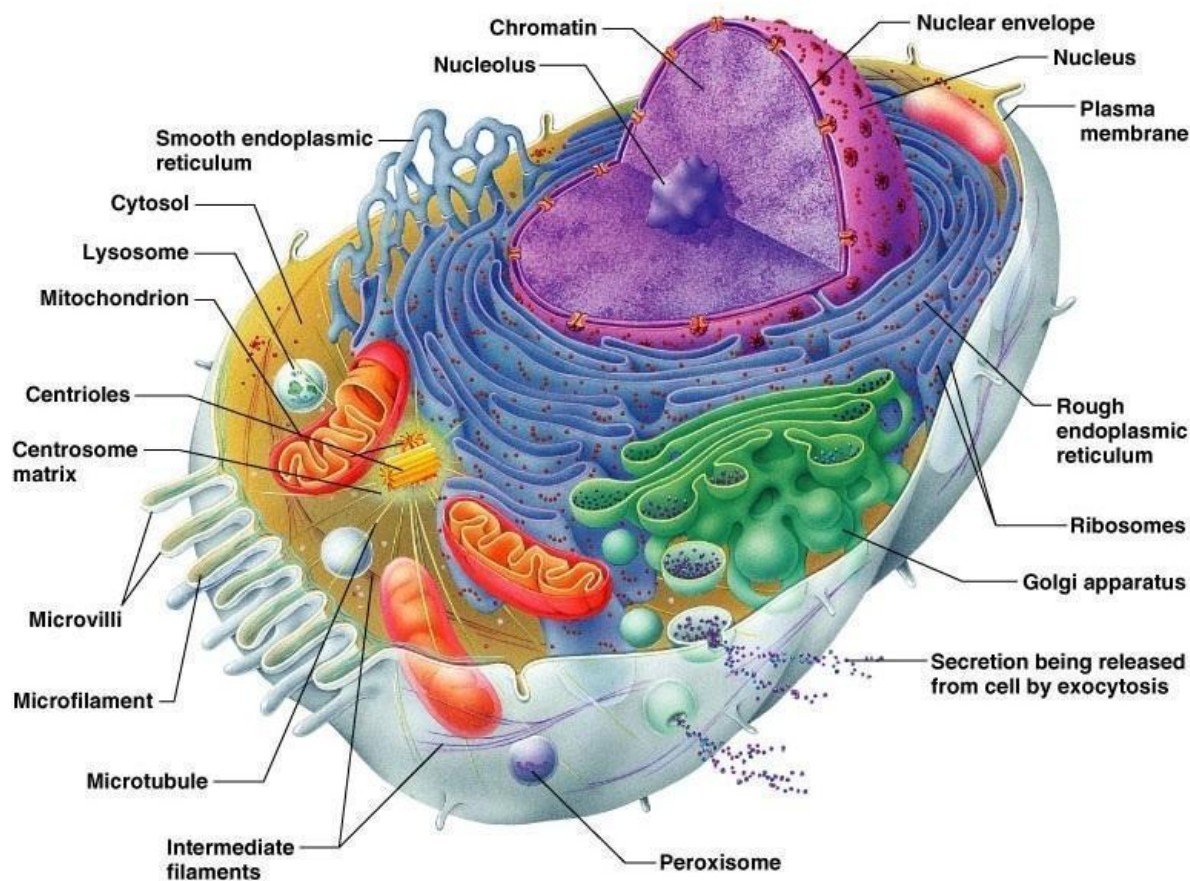
Notes

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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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Animals and plant cells both contain:

- **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 **crisetae** with **matrix** on the inside containing all the enzymes needed for **respiration**.



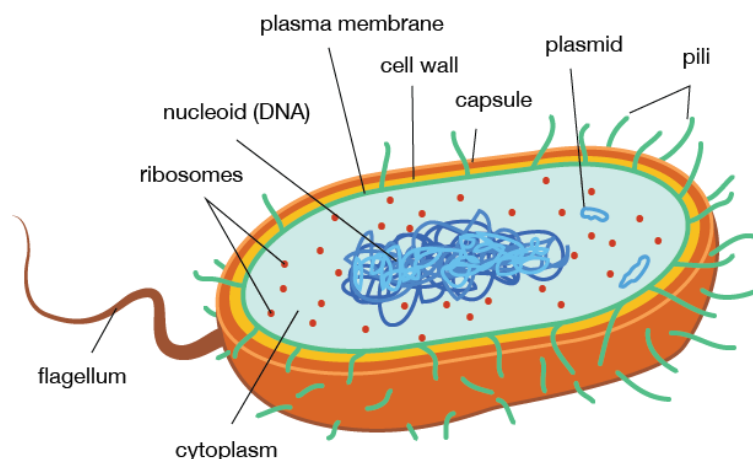
- **Centrioles are hollow cylinders** containing a ring of **microtubules** arranged at right angles to each other. Centrioles are involved in **cell division**. *Please note: Centrioles only exist in some species of lower plants (e.g. algal cells except red algae, some fern cells, male gametes of charophytes, bryophytes, ginkgo, cycads, seedless vascular plants, and moss cells).*
- **Ribosomes are composed of two subunits** 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**.
- Some animal cells may contain **cilia** on their surface membrane. These are **small hair-like structures** composed of **microtubules** in a **'9+2' formation**. This allows movement of cilia therefore allowing **movement of substances along the surface of the cell**.
- **Microvilli** are **finger-like projections of the cell membrane** which increases the cell's surface area. They line organs like the small intestine to maximise nutrient absorption.

The following are only in plant cells:

- 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.
- The **chloroplasts** are **small flat organelles**. They are surrounded by a **double membrane**. It also contains **thylakoid membranes** which are **stacked up to form grana** and are linked together by **lamellae**. Chloroplasts are the **site of photosynthesis**.
- **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 phospholipid layer called **the envelope**.

Prokaryotic cells	Eukaryotic cells
Circular DNA	Linear DNA
No nucleus so DNA is freely floating in the cytoplasm	Contains a nucleus so DNA is inside it
Polysaccharide cell wall	No cell wall (animals) Peptidoglycan cell wall (plants) Chitin cell wall (fungi)
Doesn't contain membrane-bound organelles	Many membrane-bound organelles
Smaller ribosomes (70S)	Larger ribosomes (80S)

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 the real object.**

Sample preparation

Fixation - use chemicals to preserve the live specimen keeping it in its natural state.

Dehydration - use ethanol to remove water from the specimen

Staining - use stains to colour the specimen. different types of tissue will pick up different stains which helps create a contrast and allows you to differentiate between different organelles.

Mounting - mount onto a microscope slide making sure there is a coverslip placed on top.



There are two types of microscopes:

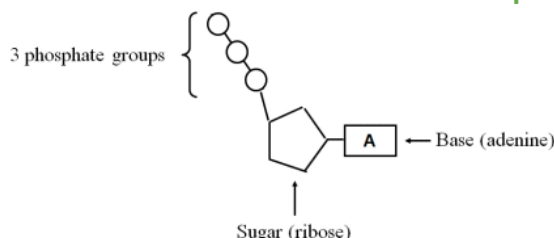
- **Light microscopes**- these are good for observing samples in a lab as they are **cheap** and **portable**. They have a **lower magnification and resolution** than electron microscopes, however.
- **Electron microscopes**- these are **good for examining organelles in high detail**. They have a **high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

Rules for scientific drawings

- Ensure you are using a **sharp pencil**
- Draw **continuous lines**
- Use **plain white paper**
- Make sure the drawing takes up **as much of the paper as possible**
- **No shading**
- Label lines **shouldn't cross over** each other
- Label lines should be **straight** and drawn with a **ruler**
- Label lines should **not have arrow heads**
- Include a **title** for the drawing
- State the **magnification**

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.

