

Cell structure

A-Level Biology 9700 · Topic 1 revision notes

Everything from the 3 lessons of this topic on a few pages: the key idea of each lesson, the diagram to remember, the points to learn and the traps examiners set. Read it, cover it, test yourself.

1. Microscopes, magnification and resolution

2. Animal and plant cells

3. Prokaryotic cells and viruses

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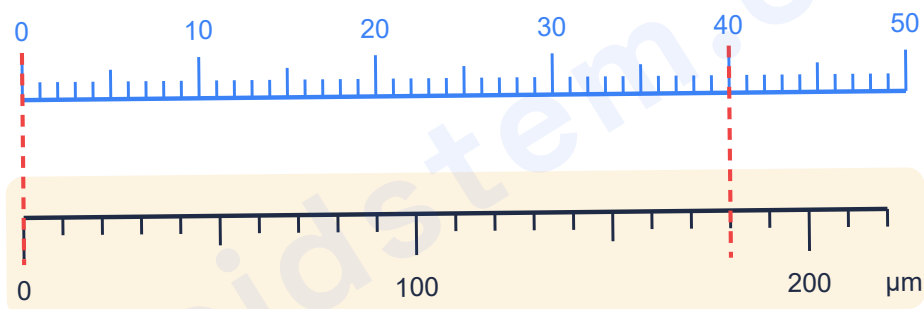
1 Microscopes, magnification and resolution

Syllabus 1.1

Magnification is how many times larger the image is than the real object: $\text{magnification} = \text{image size} \div \text{actual size}$, with both in the **same unit** ($1 \text{ mm} = 1000 \mu\text{m}$, $1 \mu\text{m} = 1000 \text{ nm}$).

Resolution is the smallest distance between two points that can still be seen as separate. It is limited by wavelength: a light microscope resolves about **200 nm**, an electron microscope about **0.5 nm**, so only the electron microscope shows organelle detail. To measure with a light microscope, calibrate the **eyepiece graticule** against a **stage micrometer** for each objective.

eyepiece graticule (arbitrary divisions)



stage micrometer (1 small division = $10 \mu\text{m}$)

at $\times 40$: 40 graticule divisions line up with $180 \mu\text{m}$

$$1 \text{ graticule division} = 180 \div 40 = 4.5 \mu\text{m}$$

change the objective and you must calibrate again

Fig. 1: calibrating an eyepiece graticule against a stage micrometer with the $\times 40$ objective

Magnification is size; resolution is detail.

- ✓ $M = I \div A$ with I and A in the same unit.
- ✓ $1 \text{ mm} = 1000 \text{ } \mu\text{m}$; $1 \text{ } \mu\text{m} = 1000 \text{ nm}$.
- ✓ **Graticule:** calibrate against the stage micrometer for each objective.
- ✓ **Resolution:** light 200 nm , electrons about 0.5 nm .

Watch out!

Increasing the magnification does **not** improve the resolution. Beyond about $\times 1500$ a light microscope just gives a larger blur, because two points closer than 200 nm still merge. Define both terms separately: magnification is about size, resolution is about detail.

Convert before you divide. The most common slip is dividing a length in mm by a length in μm , which puts the answer out by a factor of 1000 . Write both measurements in μm first, and check the answer is a sensible size for that structure.

2 Animal and plant cells

Syllabus 1.2

All living organisms are made of cells, the **basic units of life**. A eukaryotic cell has a **nucleus** and many **membrane-bound organelles**, each with its own function. Proteins for secretion are made on **80S ribosomes** on the rough ER, modified in the **Golgi body** and released by exocytosis. **Mitochondria** and **chloroplasts** have a double membrane, their own small **circular DNA** and **70S ribosomes**. Plant cells add a cellulose **cell wall**, **chloroplasts**, a **large permanent vacuole** and **plasmodesmata**; animal cells have **centrioles**. Cells use **ATP** from respiration for every energy-requiring process.

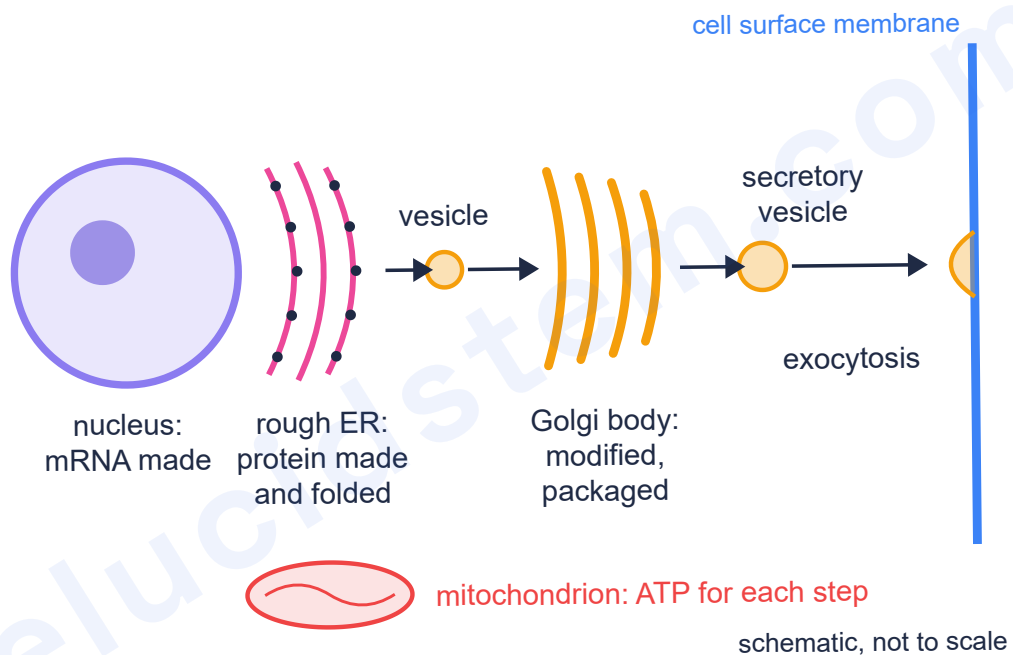


Fig. 1: organelles working together to make and secrete a protein

Structure, then function.

- ✓ **Protein route:** rough ER, vesicle, Golgi body, secretory vesicle, exocytosis.
- ✓ **Double membrane:** nucleus, mitochondrion, chloroplast.
- ✓ **Ribosomes:** 80S in cytoplasm, 70S in mitochondria and chloroplasts.
- ✓ **Plant only:** wall, chloroplasts, large vacuole, plasmodesmata.

Watch out!

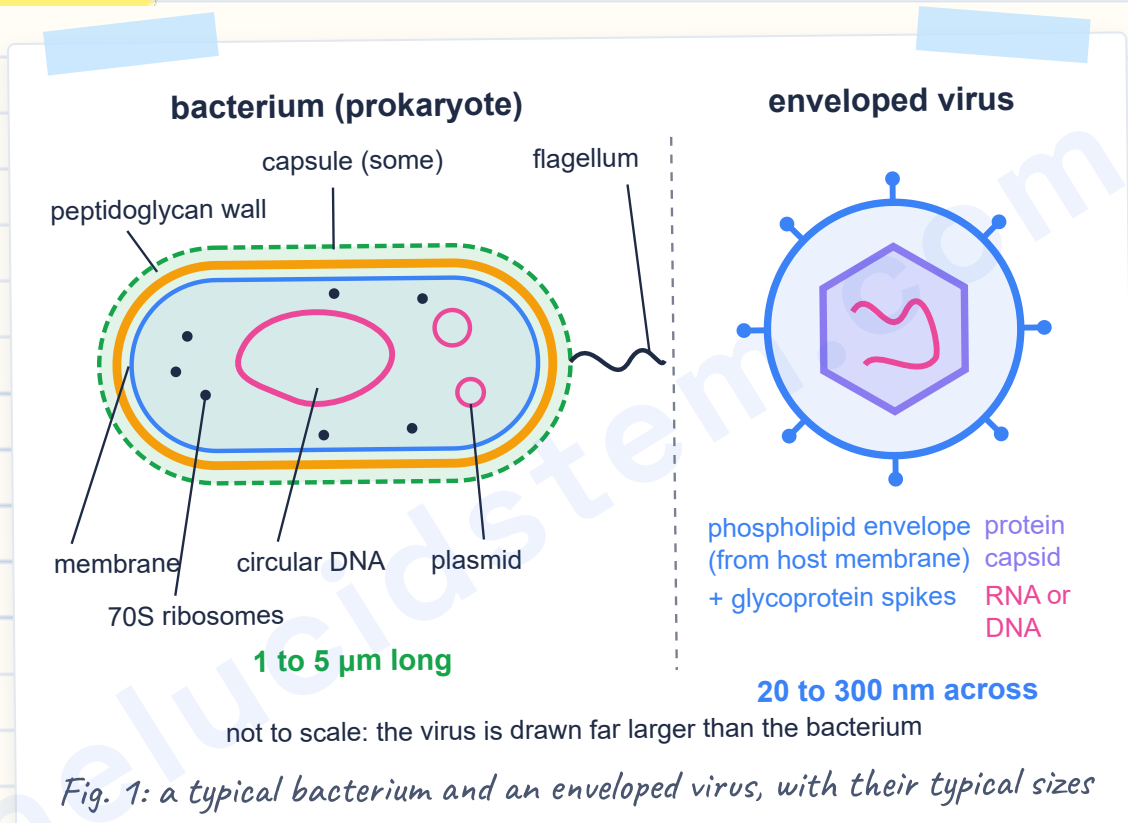
Do not confuse **cilia** and **microvilli**. Cilia are longer, contain microtubules and move; microvilli are much smaller folds that only increase surface area. And ribosomes have **no membrane**: they are not membrane-bound organelles.

ATP does not “make” energy and is not a long-term store. It transfers energy from respiration to the processes that need it, and each molecule is recycled within seconds of being made.

3 Prokaryotic cells and viruses

Syllabus 1.2

A **prokaryotic cell**, such as a bacterium, is **unicellular** and usually **1 to 5 μm** across. It has a **peptidoglycan** (murein) cell wall, **circular DNA** free in the cytoplasm with no histones, **70S ribosomes**, and **no organelles surrounded by double membranes**: no nucleus, mitochondria or chloroplasts. A **virus** is **non-cellular**: a core of nucleic acid, either **DNA or RNA**, inside a **protein capsid**, and in some viruses an outer **envelope of phospholipids** taken from the host cell. Viruses can only reproduce inside a host cell.



Wall, DNA, ribosomes, membranes.

- ✓ **Wall:** peptidoglycan in bacteria, cellulose in plants.
- ✓ **DNA:** circular and naked in prokaryotes; linear with histones in eukaryotes.
- ✓ **Ribosomes:** 70S in prokaryotes, 80S in eukaryotic cytoplasm.
- ✓ **Virus:** DNA or RNA + protein capsid (+ envelope in some).

Watch out!

Prokaryotes **do** have a cell surface membrane, cytoplasm and ribosomes: they lack only the membrane-bound organelles. And their cell wall is **peptidoglycan**, never cellulose. Writing "bacteria have no ribosomes" or "a cellulose wall" loses the mark.

Never describe a virus as a "cell" or as a type of bacterium. A virus is 10 to 100 times smaller than a bacterium, has no cytoplasm or ribosomes, and is not affected by antibiotics, which target bacterial structures such as the peptidoglycan wall and 70S ribosomes.