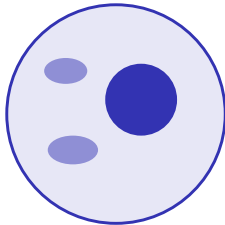


Organisation of the Organism

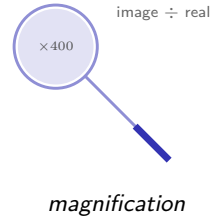
IGCSE Biology ■ Topic 2

IGCSE Biology



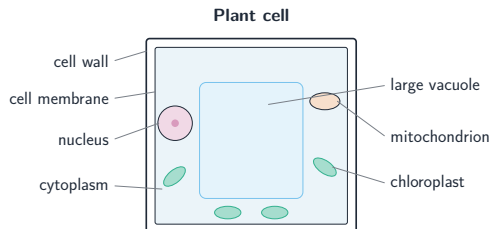
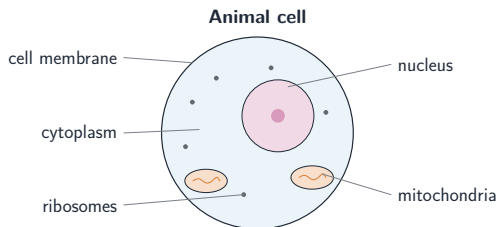
What we will cover

- 1 Animal & plant cells
- 2 Bacterial cells
- 3 What each part does
- 4 Specialised cells
- 5 Levels of organisation
- 6 Magnification



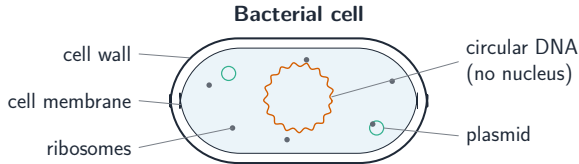


Animal and plant cells



Both share membrane, **cytoplasm** , **nucleus** , **mitochondria** & ribosomes. A plant cell adds a **cell wall** , a large **vacuole** & **chloroplasts** .

Bacterial cells



- **No nucleus**: the DNA is one circular loop, loose in the cytoplasm.
- Small extra rings of DNA, the **plasmids**, sit beside it.
- It still has a cell wall, a cell membrane, cytoplasm and ribosomes.
- It has **no** mitochondria and **no** chloroplasts.

What makes a bacterium different

A prokaryote

A bacterium is a **prokaryote** : its cell has **no** nucleus. The DNA sits free in the cytoplasm as a circular loop.

What it still has

Cell wall, cell membrane, cytoplasm and ribosomes – and often **plasmids** , small extra rings of DNA.

What it lacks

No mitochondria, no chloroplasts, no nucleus – so all its chemistry happens in the cytoplasm or at the membrane.

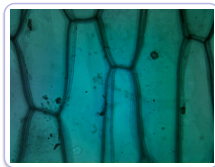
Where cells come from

All new cells are made by the **division** of cells that already exist – which is as true of a bacterium as of you.

Plasmids are why bacteria are the workhorse of genetic engineering: a gene can be carried in on a ring of DNA.

The parts every cell has

- **membrane** – controls what enters/leaves
- **cytoplasm** – a jelly-like liquid where many reactions happen
- **nucleus** – controls the cell; holds DNA
- **ribosomes** – make **proteins**
- **mitochondria** – where **respiration** releases energy



Plant cells show walls and vacuoles

What each cell structure does

chloroplasts

contain **chlorophyll** , the green substance that **traps light** for **photosynthesis**

cell wall

cellulose; supports the plant cell and stops it bursting

vacuole

filled with **cell sap** ; keeps the cell firm

nucleus

holds the **genetic material** and controls the cell's activities

mitochondria

where aerobic respiration releases energy

cell membrane

controls what enters and leaves the cell

The three a plant cell has and an animal cell does not are **cell wall**, **chloroplasts** and a **permanent vacuole**. That comparison is asked almost every year.

Specialised cells

A **specialised cell** 's shape suits its job:

- **red blood cell** – no nucleus, holds more O_2
- **root hair cell** – long, big surface
- **neurone** – very long, carries impulses



red blood cell
(carries oxygen)



root hair cell
(absorbs water)



nerve cell
(carries impulses)

Specialised cells, and the feature that fits each job

ciliated cells	move mucus along the trachea and bronchi – tiny hairs (cilia) sweep it upward
palisade mesophyll	photosynthesis – packed with chloroplasts, near the top of the leaf where the light is
root hair cells	absorb water and ions – a long extension gives a large surface area
neurones	carry electrical impulses – very long , to reach far across the body
red blood cells	carry oxygen – no nucleus, so there is more room for haemoglobin
sperm and egg cells	reproduction – the sperm can swim, the egg stores food. Both are gametes

Always answer in two halves: the **job**, then the **feature that suits it**. Naming the cell alone earns nothing.

Two specialised cells, read as shape-for-job

Root hair cells

For the **absorption** of water and minerals from the soil: a long thin “hair” gives a large surface area.

Palisade mesophyll cells

Palisade mesophyll cells do the photosynthesis: packed with chloroplasts and placed near the **top** of the leaf, where the light is.

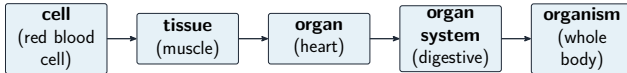
The rule

Every specialised cell is a shape that answers a job. Name the feature, then the job, then why the feature helps.

“It has a large surface area” is half an answer. Finish it: *so more water is absorbed per second.*



Levels of organisation



cell → **tissue** → **organ** →
organ system → **organism** .
e.g. muscle (tissue), heart
(organ), digestive system.

From cell to organism

cell

the smallest part that can carry out the **life processes**

tissue

a group of cells with **similar structure** working together – muscle tissue, xylem

organ

several different tissues working together to do a job – the heart, or a leaf

organ system

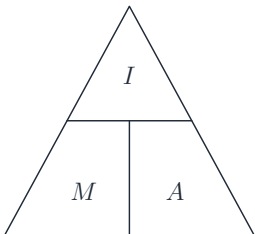
several organs working together – the **digestive system**, which breaks down food

organism

all the organ systems together

The word that separates tissue from organ is **different**: one tissue is one kind of cell, an organ is several kinds of tissue.

Magnification



I = image size

M = magnification

A = actual size

$$M = \frac{I}{A}$$

cover a letter to get its formula

$$\text{magnification} = \frac{\text{image size}}{\text{actual size}}$$

Example ($\times 250$)

image 5.00 mm $\rightarrow$ actual
 $= 5.00/250 = 0.02 \text{ mm} =$
 $20 \mu\text{m}$

image = size in the drawing; actual = real
 size of the **specimen** . 1 mm = 1000 μm .

Cover the quantity you want in the triangle to read off its formula

The size of cells: magnification



A light microscope, used to look at cells

Changing units (Supplement)

Cells are often measured in **micrometres** (μm), which are smaller than millimetres (mm):

$$1 \text{ mm} = 1000 \mu\text{m}, \quad 1 \mu\text{m} = 0.001 \text{ mm}$$

- mm $\rightarrow$ μm : **multiply** by 1000
- μm $\rightarrow$ mm: **divide** by 1000

A cell is drawn 60 mm wide and its real width is 30 μm . Find the magnification.

- Make the units match first: image = 60 mm = $60 \times 1000 = 60\,000 \mu\text{m}$.
- magnification = image $\div$ actual = $60\,000 \div 30 = \times 2000$.
- Forget to convert and $60 \div 30$ gives $\times 2$ – a thousand times too small.

Converting to one unit before dividing is the single most common mistake in this topic.

Exam tips

- A plant cell has a cell wall, a large vacuole and chloroplasts; an animal cell has none of these. Both have a nucleus, cytoplasm, cell membrane, mitochondria and ribosomes.
- A cell with **no nucleus** but with plasmids and a loop of DNA is a bacterium.
- For magnification, cover the quantity you want: $\text{magnification} = \text{image} \div \text{actual}$; $\text{actual} = \text{image} \div \text{magnification}$.
- Always convert to the same unit before you calculate. Remember $1 \text{ mm} = 1000 \mu\text{m}$.
- For a specialised cell, link its job to the one feature that suits it (for example a red blood cell has no nucleus, so it can hold more oxygen).



Topic 2 – key takeaways

1

Plant extras

cell wall, vacuole & chloroplasts

2

Bacteria

no nucleus; a DNA loop & plasmids

3

Organisation

cell to tissue to organ to organism

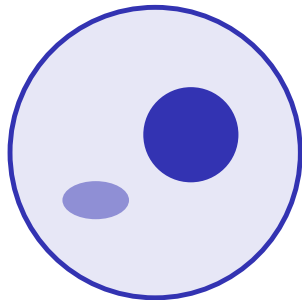
4

Magnification

image / actual; same unit first

Check yourself

- 1 Which three parts does a plant cell have but an animal cell not?
- 2 What holds a bacterium's DNA?
- 3 Where in a cell does respiration happen?
- 4 A $\times 100$ image is 4 mm – what is the actual size?



Answers 1. cell wall, vacuole, chloroplasts 2. a single loop of DNA (no nucleus)
3. the mitochondria 4. 0.04 mm