IGCSE BIOLOGY 0610 · CHAPTER 2 NOTES · ~9 MIN READ

Cells & organisation

What is inside animal, plant and bacterial cells and what each part does, how specialised cells are built for their jobs, the levels of organisation — and how to calculate magnification.

Animal & plant cells | Bacteria | Specialised cells | Tissues & organs | Magnification

AS
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No tag = **Core** (everyone) EXTENDED Extended only highlight = comes up again and again

Test yourself at the end

IN 30 SECONDS

- **Cells** are the basic units of life. Animal cells have a nucleus, cytoplasm, cell membrane, mitochondria and ribosomes. Plant cells also have a **cell wall, chloroplasts and a vacuole**.
- **Bacteria** are cells with **no nucleus**: their DNA is a circular loop, and they have a cell wall.
- Specialised cells have a **structure that fits their function**. Cells → tissues → organs → organ systems → organism.
- **Magnification = image size ÷ actual size** (both in the same units).

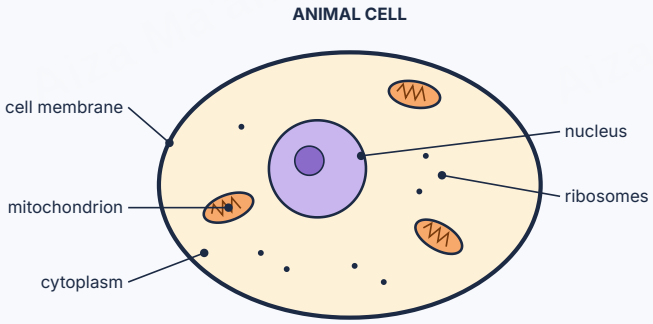
BY THE END YOU CAN

- Describe the structure and function of the parts of animal, plant and bacterial cells.
- Relate the structure of specialised cells to their functions.
- Order the levels of organisation: cell, tissue, organ, organ system, organism.
- Calculate magnification, image size and actual size.
- Convert between mm and µm. EXT

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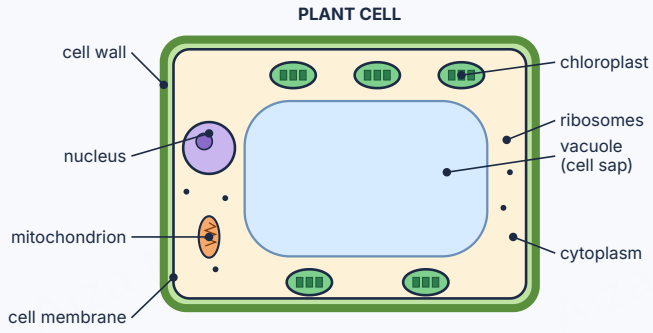
1 Cell structure

Animal and plant cells



no cell wall · no chloroplasts · no large permanent vacuole

An animal cell: no cell wall, no chloroplasts, no large permanent vacuole.



cellulose wall · chloroplasts · large permanent vacuole

A plant cell: cell wall, chloroplasts and a large permanent vacuole.

Cell membrane — a thin layer that **controls what enters and leaves** the cell.

Cytoplasm — a jelly-like fluid where most **chemical reactions** happen.

Nucleus — contains the **chromosomes** (DNA) and **controls the activities** of the cell.

Mitochondria — where **aerobic respiration** takes place, releasing energy.

Ribosomes — tiny structures where **proteins are made** (protein synthesis).

Cell wall — made of **cellulose** in plants. It gives **strength and support** and stops the cell bursting.

Chloroplasts — contain **chlorophyll**, which absorbs light for **photosynthesis**.

Vacuole — a space full of **cell sap**. It keeps the cell firm (turgid) and stores substances.

COMMON MISTAKE

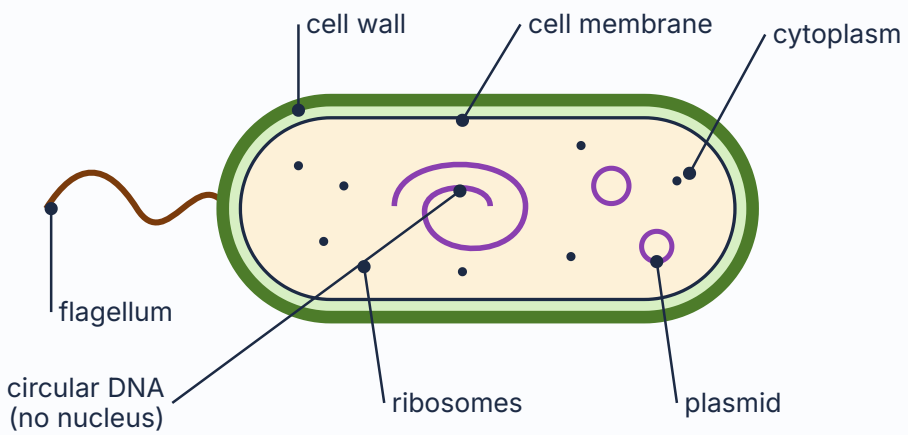
"Plant cells have a cell wall instead of a cell membrane." Plant cells have **both**. The membrane is **inside** the cell wall.

COMMON MISTAKE

"Cell walls control what enters the cell." Cellulose walls are **fully permeable**. The **cell membrane** controls what passes.

Bacterial cells

BACTERIAL CELL (a prokaryote)



no nucleus · no mitochondria · no chloroplasts

A bacterium is a prokaryote. It has no nucleus.

- A **cell wall**, cell membrane, cytoplasm and **ribosomes** — like other cells.
- **Circular DNA** loose in the cytoplasm (no nucleus) and often small rings of DNA called **plasmids**.
- No mitochondria and no chloroplasts. Some have a **flagellum** for swimming.

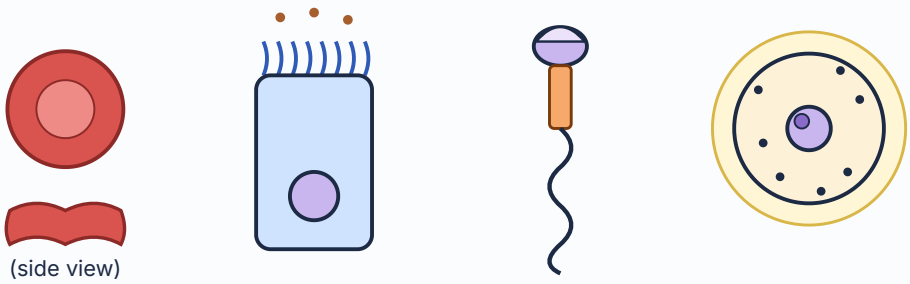
Structure	Animal cell	Plant cell	Bacterial cell
nucleus	yes	yes	no (circular DNA instead)
cell wall	no	cellulose	yes (not cellulose)
chloroplasts	no	yes	no
mitochondria	yes	yes	no
ribosomes	yes	yes	yes
large vacuole	no	yes	no

EXAM TIP

New cells only come from **existing cells dividing**. Cells never form from non-living matter. (Cell division is covered in Inheritance, variation & selection.)

2 Specialised cells

Structure fits function



(side view)

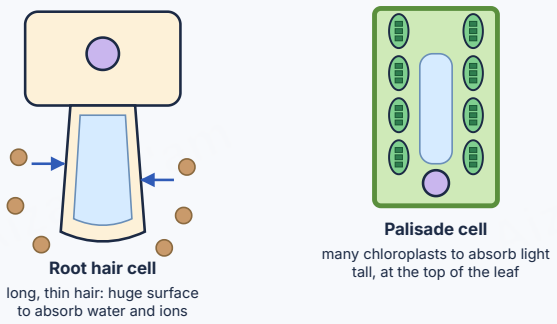
Red blood cell
biconcave disc = large surface area; no nucleus: more room for haemoglobin

Ciliated cell
cilia sweep mucus and trapped dirt up and away from the lungs

Sperm cell
tail swims to egg mitochondria give energy; acrosome enzymes enter egg

Egg cell
large: food store in cytoplasm; jelly coat blocks extra sperm

Four specialised animal cells. Each has features that help it do one job.



Two specialised plant cells: the root hair cell and the palisade cell.

Specialised cell — a cell that has a **structure adapted to its function**.

Cell	Job	Adaptations
ciliated cell	moves mucus along the airways	**cilia** (tiny hairs) that beat in waves; lines the trachea and bronchi
root hair cell	absorbs water and mineral ions	**long, thin hair** gives a large surface area; thin wall
palisade mesophyll cell	photosynthesis	**many chloroplasts**; tall and packed at the top of the leaf
neurone (nerve cell)	carries electrical impulses	very **long axon**, branched ends (dendrites)
red blood cell	carries oxygen	**biconcave disc**, **no nucleus**, full of haemoglobin
sperm cell	fertilises the egg	**tail** to swim; **mitochondria** for energy; enzymes in the head
egg cell	becomes the embryo	**large**, food store in the cytoplasm; jelly coat blocks extra sperm

- A neurone is shown in Coordination & response.
- **Gametes** (sperm and egg) are **haploid**: they carry **half** the normal number of chromosomes. See Reproduction.
- A **red blood cell** has no nucleus, which leaves more room for haemoglobin. A biconcave shape gives a **large surface area** for taking up oxygen.

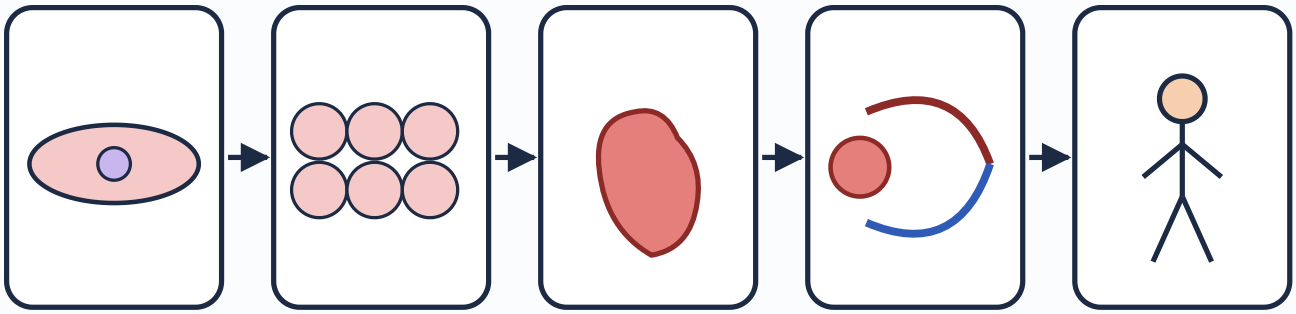
EXAM TIP

When a question says "explain how the cell is adapted", write **feature + how it helps**: "root hair cell has a long thin extension, which gives a large surface area for absorbing water."

COMMON MISTAKE

Learning "palisade cells have chloroplasts" with no reason. Add: **so they absorb more light for photosynthesis**.

Levels of organisation



cell	tissue	organ	organ system	organism
a muscle cell	muscle tissue	the heart	circulatory system	a human

cells → tissues → organs → organ systems → organism

From a single cell to a whole organism.

Tissue — a group of **similar cells** working together to do the same job (muscle tissue, xylem).

Organ — a structure made of **different tissues** that carries out a particular job (heart, stomach, leaf).

Organ system — a group of **organs** with related functions (digestive system, circulatory system).

Organism — a **living thing** made of organ systems working together.

- The **stomach** is an organ made of muscle tissue, glandular tissue (makes enzymes) and epithelial tissue (lines the surface).
- A **leaf** is a plant organ made of epidermis, palisade tissue, spongy tissue and xylem and phloem.

MEMORY TRICK

Cats **T**ake **O**ver **S**mall **O**ffices = **C**ell → **T**issue → **O**rgan → **S**ystem → **O**rganism.

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3 Size and magnification

Units

Each step down the units = ×1000



ant ≈ 3 mm
pinhead ≈ 1 mm

animal cell ≈ 20 µm
bacterium ≈ 2 µm

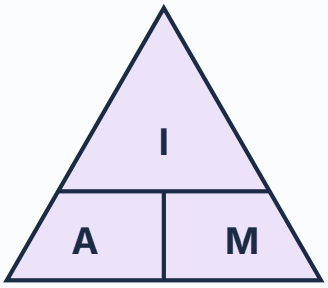
virus ≈ 100 nm
DNA width ≈ 2 nm

1 mm = 1000 µm · 1 µm = 1000 nm

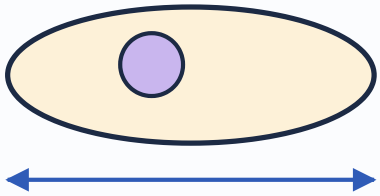
Each step down the units multiplies by 1000.

- **1 mm = 1000 µm** (micrometres), and 1 µm = 1000 nm. EXT You must be able to convert between mm and µm.
- To convert **mm → µm**, multiply by 1000. To convert **µm → mm**, divide by 1000.
- A typical animal cell is about **20 µm** (0.02 mm). A bacterium is about 2 µm. A virus is about 100 nm.

Calculating magnification



cover what you want:
M = I ÷ A
I = A × M
A = I ÷ M



I = 36 mm (measured on the drawing)

actual width A = 0.06 mm (a 60 µm cell)

M = I ÷ A = 36 ÷ 0.06 = ×600

Same units first! Convert, then divide.

The magnification triangle. Cover the quantity you want and read off the formula.

magnification = image size ÷ actual size

both sizes must be in the **same units**

image size = actual size × magnification

or actual size = image size ÷ magnification

WORKED EXAMPLE

A drawing of a cell is 36 mm long. The real cell is 0.06 mm long. Calculate the magnification.

1. magnification = image size ÷ actual size
2. same units already: 36 mm and 0.06 mm
3. **36 ÷ 0.06 = ×600**

WORKED EXAMPLE

A photograph of a cell is 45 mm wide. The magnification is ×300. What is the actual width in µm?

1. actual size = image size ÷ magnification
2. 45 ÷ 300 = 0.15 mm
3. **0.15 mm × 1000 = 150 µm**

WORKED EXAMPLE

EXT **A scale bar on a micrograph is 20 mm long and represents 10 µm. A cell on the micrograph is 60 mm wide. Find the actual width of the cell.**

1. convert the bar to µm: 20 mm = 20 000 µm
2. magnification = 20 000 ÷ 10 = ×2000
3. actual width = 60 mm ÷ 2000 = 0.03 mm
4. **0.03 × 1000 = 30 µm**

EXAM TIP

A neat method: **write both sizes in the same unit first** (usually mm or µm), then divide. Always include **units** in the answer, but magnification itself has no unit (write ×600).

COMMON MISTAKE

Forgetting to convert. 36 mm ÷ 60 µm is **not** 0.6. Convert 60 µm = 0.06 mm first, then 36 ÷ 0.06 = 600.

COMMON MISTAKE

Measuring the drawing in cm and the actual size in mm, then dividing without converting.

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4 Test yourself

Test yourself — cover the answers first

QUICK CHECK

1. Name the part of the cell where aerobic respiration happens.
2. Which part of a plant cell contains chlorophyll?
3. What is the cell wall of a plant made of?
4. Give two ways a bacterial cell differs from an animal cell.
5. Which structure controls what enters and leaves the cell?
6. Put in order from smallest: organ, cell, organism, tissue, organ system.
7. State the formula for magnification.
8. EXT Convert 0.045 mm to µm.

EXAM-STYLE

9. Describe two ways a root hair cell is adapted for its function. [2]
10. Explain why red blood cells have no nucleus. [2]
11. A student draws a plant cell 24 mm long. The magnification is ×120. Calculate the actual length in µm. [3]
12. EXT Compare the structure of a plant cell and a bacterial cell. [3]

Show answers

1. mitochondria
2. chloroplasts
3. cellulose
4. no nucleus; has a cell wall; circular DNA/plasmids
5. cell membrane
6. cell, tissue, organ, organ system, organism
7. magnification = image size ÷ actual size
8. 45 µm
9. long, thin extension gives a large surface area
   thin cell wall so water enters quickly (or: no chloroplasts, large vacuole)
10. more room for haemoglobin
    so they carry more oxygen
11. 24 ÷ 120
    = 0.2 mm
    = 200 µm
12. both have cell walls, membranes, cytoplasm and ribosomes
    plant cell has a nucleus, bacterium has circular DNA free in the cytoplasm
    plant cell has chloroplasts, mitochondria and a vacuole; the bacterium does not

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