

Organisation of the organism revision notes

All living things are made of cells, so this topic starts with what is inside plant, animal and bacterial cells and what each part does. It then shows how cells are specialised and built up into tissues, organs, organ systems and organisms. Finally you learn to calculate magnification and the actual size of specimens, converting between millimetres and micrometres.

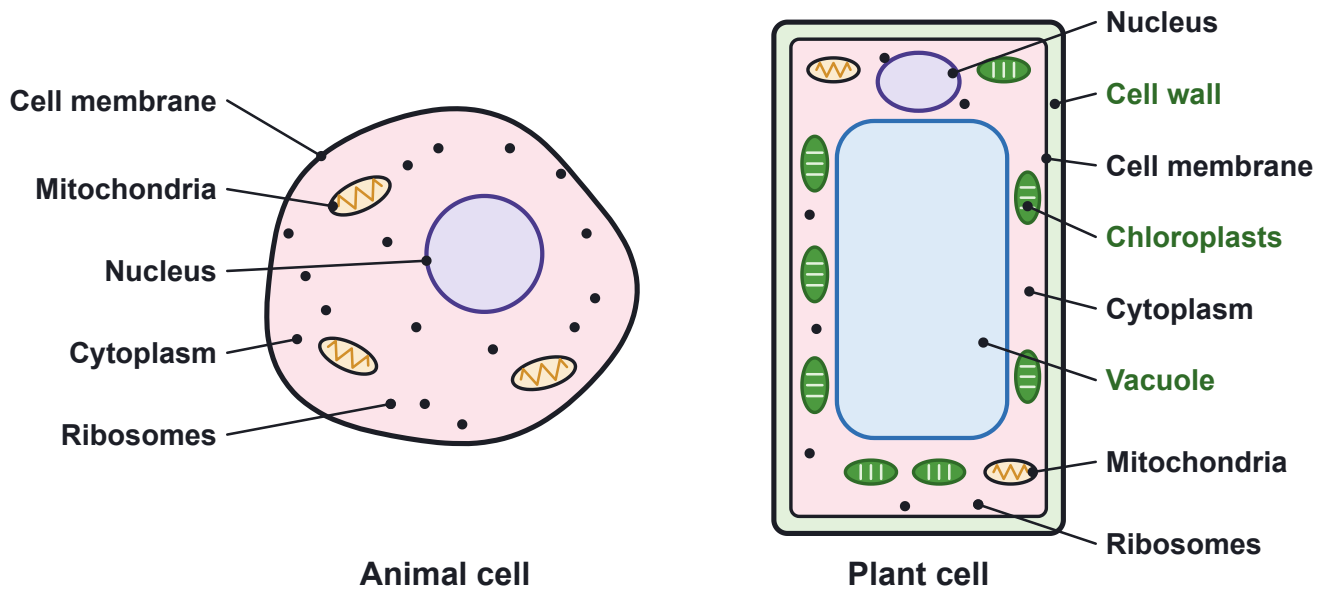
For Cambridge IGCSE Combined Science 0653. **Supplement** is Extended content, only examined on Papers 2 and 4.

1 Cell structure Spec B2.1

Plant and animal cells Spec B2.1.1, B2.1.3, B2.1.4

Plant and animal cells share many structures. Both have a cell membrane, cytoplasm, a nucleus, ribosomes and mitochondria. Plant cells also have a **cell wall**, **chloroplasts** (in the parts of the plant exposed to light) and a large **vacuole** containing cell sap (a solution of sugars and salts).

Structures in plant and animal cells, and what they do			
Structure	Function	Animal cell	Plant cell
Cell membrane	Controls the movement of substances into and out of the cell	Yes	Yes
Cytoplasm	Where most chemical reactions happen	Yes	Yes
Nucleus	Contains the genetic material (DNA) and controls the activities of the cell	Yes	Yes
Ribosomes	Make proteins (protein synthesis)	Yes	Yes
Mitochondria	Where aerobic respiration takes place, releasing energy	Yes	Yes
Cell wall	Made of cellulose; strengthens the cell and supports it	No	Yes
Chloroplasts	Contain chlorophyll, which absorbs light energy for photosynthesis	No	Yes (in cells exposed to light)
Vacuole	Contains cell sap; helps keep the cell firm	Small vacuoles only, if any	Yes, one large vacuole



☐ **Green labels: found in plant cells only, not animal cells**

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Plant cells have everything an animal cell has, plus a cell wall, chloroplasts and a large vacuole.

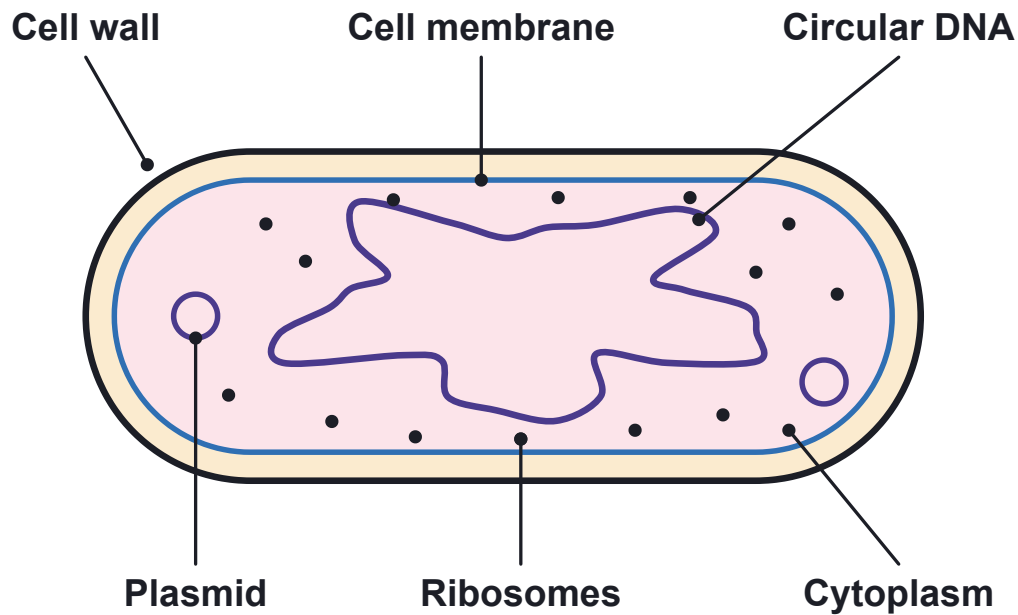
Common mistake: The cell wall is not the same as the cell membrane. The wall is a tough, fully permeable outer layer in plant cells. The membrane is thin, is found in every cell and controls what enters and leaves.

Exam tip: To compare, name a structure that both have, then a structure only one has. Saying 'plant cells have a cell wall, animal cells do not' earns the mark. Saying 'plant cells have more' does not.

Bacterial cells Spec B2.1.2, B2.1.3, B2.1.4

A bacterial cell is much simpler than a plant or animal cell. It has no nucleus. Its genetic material is a single loop of **circular DNA** that lies free in the cytoplasm. Bacteria may also have one or more small rings of extra DNA called **plasmids**.

Structures in a bacterial cell	
Structure	Function
Cell wall	Surrounds the cell and gives it strength and shape (not made of cellulose)
Cell membrane	Controls the movement of substances into and out of the cell
Cytoplasm	Where chemical reactions happen
Ribosomes	Make proteins (protein synthesis)
Circular DNA	Contains the genetic material; controls the activities of the cell
Plasmids	Small rings of extra DNA that carry a few additional genes



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A bacterial cell has no nucleus: its **circular DNA** lies free in the cytoplasm.

Exam tip: Write 'circular DNA free in the cytoplasm' rather than 'no DNA'. Bacteria do have DNA. What they lack is a nucleus to hold it.

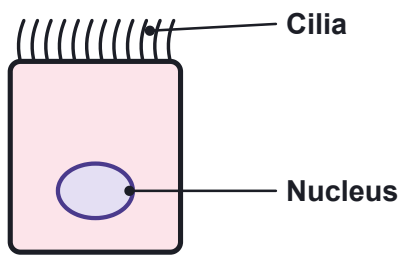
Specialised cells Spec B2.1.6 Supplement

In many organisms, cells become **specialised**. A specialised cell has a specific function. Its shape and contents are suited to doing that job.

Specialised cells and their functions		
Cell	Function	Feature that helps
Root hair cell	Absorption	Long extension gives a large surface area for uptake of water and mineral ions
Palisade mesophyll cell	Photosynthesis	Contains many chloroplasts
Red blood cell	Transport of oxygen	Contains haemoglobin, which carries oxygen

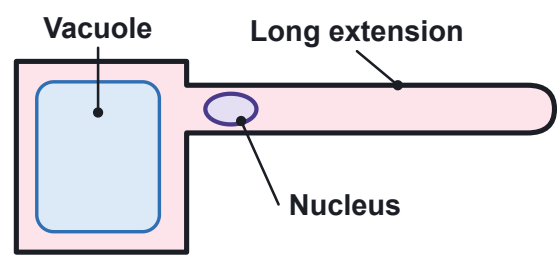
Ciliated cell

Movement of mucus in the trachea and bronchi



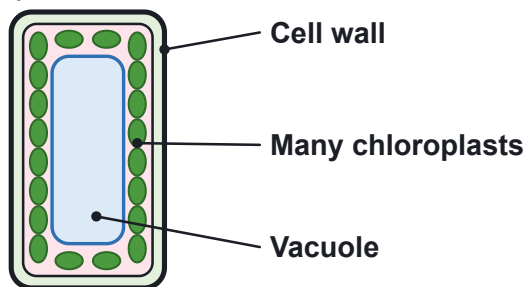
Root hair cell

Absorption



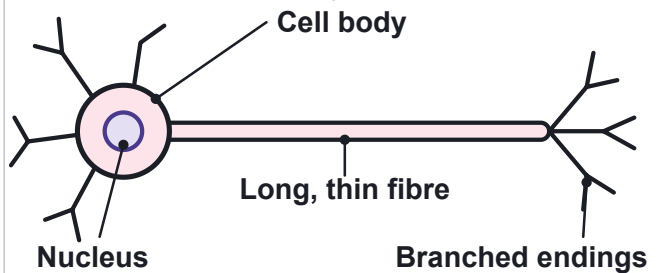
Palisade mesophyll cell

Photosynthesis



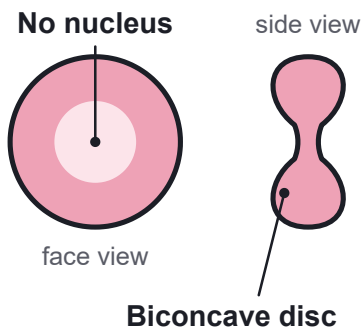
Neurone

Conduction of electrical impulses



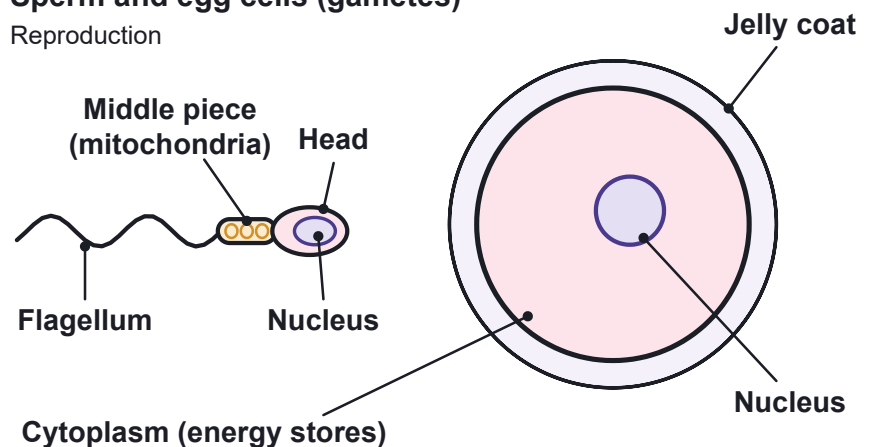
Red blood cell

Transport of oxygen



Sperm and egg cells (gametes)

Reproduction



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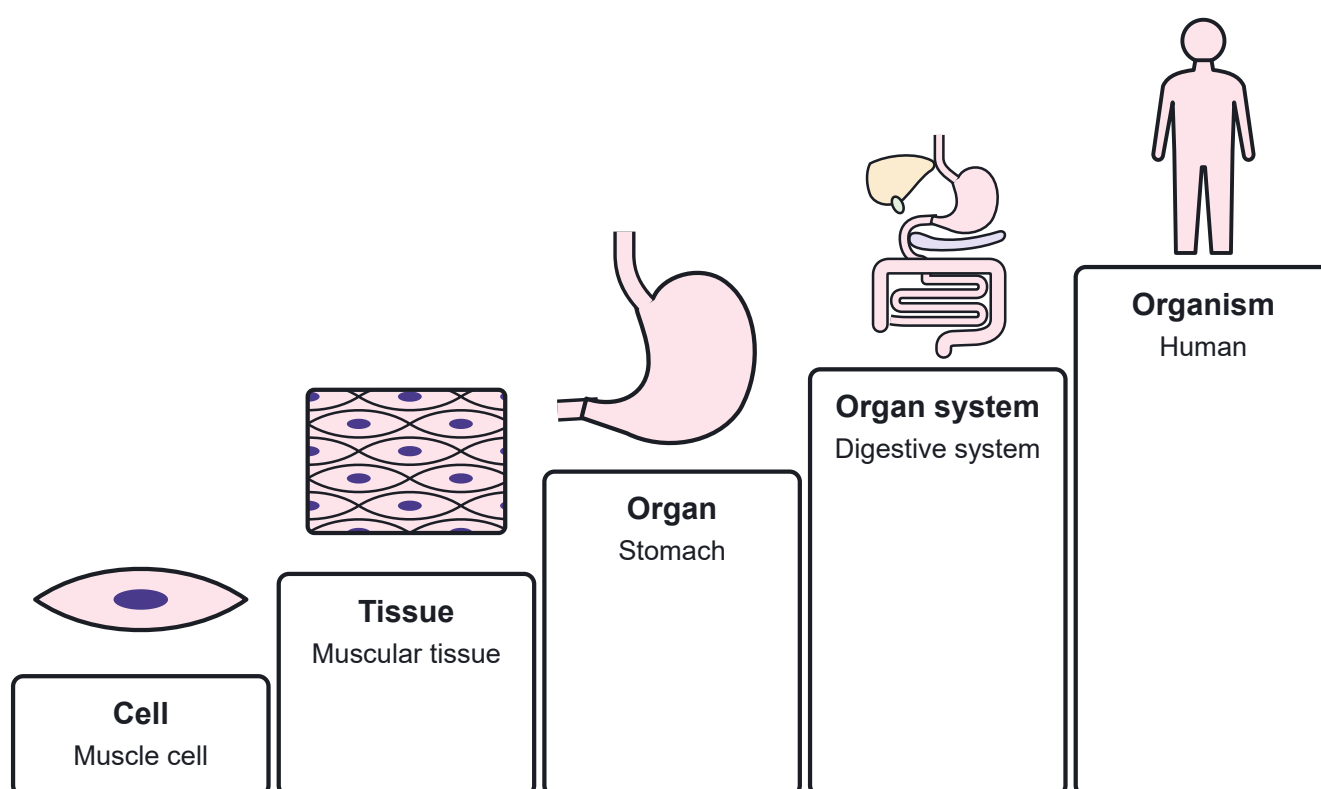
Each specialised cell is labelled with its **function**. Cells are not drawn to the same scale.

Exam tip: You need three specialised cells and their functions: **root hair cells** for absorption, **palisade mesophyll cells** for photosynthesis and **red blood cells** for the transport of oxygen. The diagram also shows cells that Combined Science does not ask about.

Cells, tissues, organs and organ systems Spec B2.1.5

Living things are built up in levels: **cell**, **tissue**, **organ**, **organ system** and **organism**. Each level is made from the one below it.

Cell	The basic unit of living things; cells are the building blocks of all organisms.
Tissue	A group of cells with similar structures, working together to perform a shared function.
Organ	A structure made up of a group of tissues, working together to perform specific functions.
Organ system	A group of organs with related functions, working together to perform body functions.
Organism	A whole living thing. It may be a single cell (e.g. a bacterium) or many cells organised into tissues, organs and organ systems that work together.



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Each level is made from the one below: cell → tissue → organ → organ system → organism.

Exam tip: Give an example with each definition. Animal: muscle cells make muscle tissue; the stomach is an organ; the digestive system is an organ system; a human is an organism. Plant: palisade mesophyll cells make palisade mesophyll tissue; the leaf is an organ.

Quick check

1. Name three structures found in plant cells but not in animal cells.
2. Where is the DNA in a bacterial cell?
3. **Supplement** Which specialised cell transports oxygen?
4. Put in order, smallest first: organ, cell, organism, tissue, organ system.

2 Size of specimens Spec B2.2

Magnification and actual size Spec B2.2.1, B2.2.2, B2.2.3

Many biological specimens are too small to see clearly. A microscope makes an **image** that is larger than the **actual size** of the specimen. The **magnification** tells you how many times larger.

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

Rearranged: $\text{actual size} = \text{image size} \div \text{magnification}$, and $\text{image size} = \text{actual size} \times \text{magnification}$. Measure the image with a ruler, in millimetres. Magnification has no units.

Calculating magnification

A drawing of a cell is 36 mm wide. The actual width of the cell is 0.12 mm. Calculate the magnification.

1. Both sizes are in mm, so no conversion is needed.
2. $\text{magnification} = \text{image size} \div \text{actual size} = 36 \div 0.12 = 300$.

Answer: $\times 300$

Calculating actual size

A photograph of a plant cell is magnified $\times 400$. The cell in the photograph is 20 mm long. Calculate the actual length of the cell in mm.

1. Rearrange: $\text{actual size} = \text{image size} \div \text{magnification}$.
2. $\text{actual size} = 20 \div 400 = 0.05 \text{ mm}$.

Answer: 0.05 mm

Supplement

Converting between mm and μm

Supplement

The unit for very small things is the **micrometre (μm)**. There are 1000 μm in 1 mm. To change mm to μm , multiply by 1000. To change μm to mm, divide by 1000.

Supplement

Converting units

A cell has an actual width of 0.04 mm. Give this in μm . A nucleus is 8 μm wide. Give this in mm.

1. mm to μm : $0.04 \times 1000 = 40 \mu\text{m}$.
2. μm to mm: $8 \div 1000 = 0.008 \text{ mm}$.

Answer: 40 μm ; 0.008 mm

Maths skill: Image size and actual size must be in the same unit (mm) before you divide. Magnification has no units; write $\times 300$, not 300 mm.

Practical skill: To find the magnification of your drawing, measure the same feature (e.g. the widest part) on the drawing and on the specimen, both in mm, then divide drawing length by specimen length. Draw a clear, continuous outline with no shading, and label with ruled lines.

Quick check

1. State the magnification formula.
2. A cell has an image size of 30 mm and an actual size of 0.1 mm. What is the magnification?
3. **Supplement** How many micrometres are in 1 millimetre?
4. **Supplement** Convert 0.5 mm to μm .

Quick check answers

Cell structure

1. Cell wall, chloroplasts and a large vacuole.
2. Circular DNA, free in the cytoplasm; there is no nucleus.
3. The red blood cell.
4. Cell, tissue, organ, organ system, organism.

Size of specimens

1. Magnification = image size $\div$ actual size.
2. $\times 300$.
3. 1000 μm .
4. 500 μm .