# Exercise walk-through

## Cell structure ▪ 2.1

eXercise

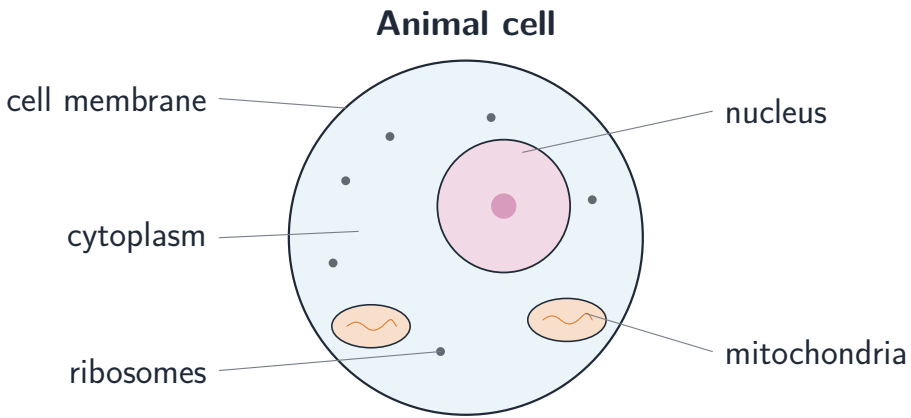
# You must be able to

- state which structures are in plant, animal and bacterial cells
- give the function of each structure
- link a specialised cell to its feature, and order the levels of organisation

# Method — Comparing cells

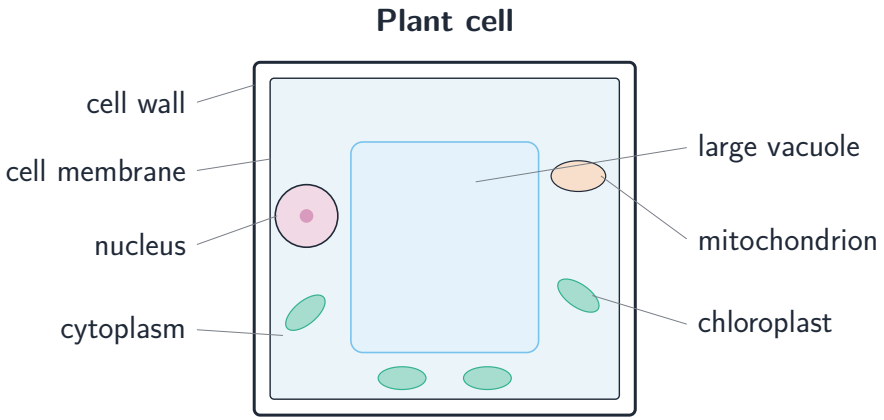
- **bacterium:** no nucleus (a loop of DNA), plus plasmids; no mitochondria.
- **levels:** cell → tissue → organ → organ system → organism.

# Method — Comparing cells




*A labelled animal cell*

# Method — Comparing cells




*A labelled plant cell with cell wall, vacuole, chloroplasts*

# Method — Reading a cell, and calculating its size

**Plant against animal.** Both have a cell membrane, cytoplasm, a nucleus, mitochondria and ribosomes. Only the plant cell adds a **cell wall** 细胞壁 of cellulose, which gives the fixed shape; a **large permanent vacuole** 液泡 full of cell sap; and **chloroplasts** 叶绿体 containing chlorophyll. A **bacterial cell** 细菌细胞 has a cell wall but no nucleus: its DNA is a single loop, with extra small rings called **plasmids** 质粒, and it has no mitochondria or chloroplasts.

**What each structure does.** Nucleus: holds the DNA and controls the cell's activities. Cytoplasm: where the reactions happen. Cell membrane: controls what enters and leaves. Mitochondria: aerobic respiration, releasing energy. Ribosomes: protein synthesis. Chloroplast: photosynthesis. Vacuole: stores cell sap and keeps the cell firm.

**Specialised cells** have a shape that fits the job: a red blood cell has no nucleus, so it carries more haemoglobin; a root hair cell has a long extension, giving a large surface

## Method — Reading a cell, and calculating its size

area for absorbing water; a nerve cell is long, to carry impulses a long way; a xylem vessel is a hollow dead tube with no end walls, so water flows freely.

**The magnification calculation** is asked in almost every paper:

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

**Worked example.** A cell drawing is $60$ mm across and the real cell is $0.03$ mm. Find the magnification.

1. Put both lengths in the **same unit**: both are already in mm.
2. magnification $= \dfrac{60}{0.03} = 2000.$
3. Write it as $\times 2000$, with no unit.

## Method — Reading a cell, and calculating its size

Going the other way, actual size $= \dfrac{\text{image size}}{\text{magnification}}$. Remember $1$ mm $= 1000$ $\mu$m: converting first is where most marks are lost.

## Practice 2.1 ▪ 3 marks

A student looks at two cells under a microscope. Cell A has a fixed rectangular shape and a large space in the middle; cell B has no fixed shape. Identify which is the plant cell, and name two structures that let you tell.

# Solution 2.1

Method: Reading a cell, and calculating its size

**Worked steps**

Cell A is the plant cell B1; any two of: a cell wall, which gives the fixed rectangular shape; a large permanent vacuole, which is the space in the middle; chloroplasts B1 B1.

## Practice 2.2 ▪ 1 mark

State the function of mitochondria.

# Solution 2.2

**Worked steps**

where respiration happens to release energy B1.

## Practice 2.3 ▪ 2 marks

State the function of the nucleus and of the cell membrane.

# Solution 2.3

**Worked steps**

Nucleus: holds the DNA and controls the cell's activities B1; cell membrane: controls which substances enter and leave the cell B1.

## Practice 2.4 ▪ 2 marks

A drawing of a cell is $45$ mm long. The real cell is $0.15$ mm long. Calculate the magnification.

# Solution 2.4

Method: Reading a cell, and calculating its size

**Worked steps**

$$\frac{45}{0.15} \quad \text{M1} \quad = \times 300 \quad \text{A1}.$$

## Practice 2.5 ▪ 2 marks

Explain how a root hair cell is adapted to its function.

# Solution 2.5

Method: Reading a cell, and calculating its size

**Worked steps**

It has a long, narrow extension B1, which gives a large surface area for absorbing water and mineral ions from the soil B1.

## Exam-style 3.1 ▪ 1 mark

A cell has no nucleus, but has a cell wall, a loop of DNA and plasmids. It is a:

**A** plant cell

**B** animal cell

**C** bacterial cell

**D** red blood cell

# Solution 3.1

**A** plant cell

**B** animal cell

**C** bacterial cell ✓

**D** red blood cell

**Worked steps**

**C**. No nucleus + plasmids + a DNA loop → a bacterial cell.

## Exam-style 3.2 ▪ 1 mark

A red blood cell is a specialised cell.
(a) State its job.
(b) Explain how having no nucleus suits this job.

# Solution 3.2

Method: Reading a cell, and calculating its size

**Worked steps**

(a) to transport oxygen **B1**.
(b) with no nucleus there is more room for haemoglobin **M1**, so it can carry more oxygen **A1**.

## Exam-style 3.3 ▪ 2 marks

Put these in order from smallest to largest: organ, cell, organism, tissue, organ system.

# Solution 3.3

Method: Comparing cells

**Worked steps**

cell → tissue → organ → organ system → organism **M1** **A1** *mostly correct, fully correct.*

# Exam-style 3.4 ▪ 2 marks

The diagram in a textbook shows a palisade mesophyll cell from a leaf. The drawing is $80$ mm tall and the cell is really $0.10$ mm tall.
(a) Calculate the magnification of the drawing.
(b) The same drawing shows a chloroplast $4$ mm across. Calculate the real width of the chloroplast, in micrometres.
(c) Complete the table by naming the structure that carries out each function.

| **Function** | **Structure** |
|---|---|
| controls what enters and leaves the cell | |
| site of aerobic respiration | |
| absorbs light energy for photosynthesis | |
| gives the plant cell its fixed shape | |

## Exam-style 3.4 ▪ 2 marks

(d) A bacterial cell is examined. Identify two structures present in the palisade cell that the bacterial cell does not have, and name the structure that carries the bacterial cell's genetic material.
(e) Explain how the palisade cell's position and its number of chloroplasts suit its function.

# Solution 3.4

Method: Reading a cell, and calculating its size

**Worked steps**

(a) $\frac{80}{0.10}$ M1 $= \times 800$ A1.

(b) Actual size $= \frac{4}{800}$ M1 $= 0.005$ mm A1; $0.005 \times 1000 = 5$ $\mu$m A1.

(c) Cell membrane B1; mitochondrion B1; chloroplast B1; cell wall B1.

(d) Any two of: a nucleus, mitochondria, chloroplasts, a permanent vacuole B1 B1; the bacterial cell's genetic material is a single loop of DNA, with extra rings called plasmids B1.

## Solution 3.4

(e) It sits near the top of the leaf, where the light is strongest **B1**, and it contains many chloroplasts, so it absorbs as much light as possible for photosynthesis **B1**.