

2.1 Cell structure

Name: _____ Class: _____ Date: _____

Total: 30 marks

KEY WORDS plant 植物 • cells 细胞 • organ 器官 • cell wall 细胞壁 • organism 生物体

Objective

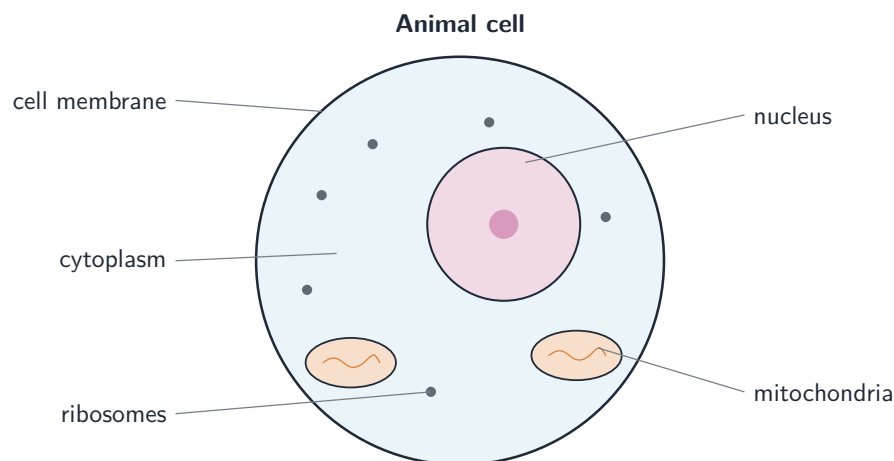
Build the skills to answer exam questions on **cell structure** 细胞结构 — comparing plant, animal and bacterial cells, the function of each structure, and **specialised cells** 特化细胞.

You must be able to:

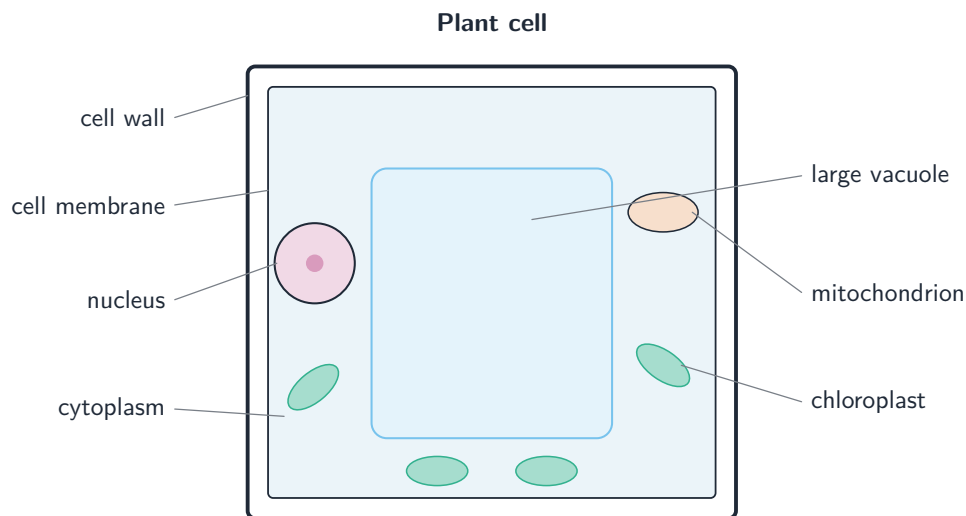
- state which structures are in plant, animal and bacterial cells
- give the function of each structure
- link a specialised cell to its feature, and order the levels of organisation

1 Worked examples

■ Comparing cells



Animal cell: membrane, cytoplasm, nucleus, mitochondria, ribosomes



A plant cell also has a cell wall, a large vacuole and chloroplasts

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

■ 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 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. $\text{magnification} = \frac{60}{0.03} = 2000$.
3. Write it as $\times 2000$, with no unit.

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

2 Practice

2.1 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. [3]

2.2 State the function of mitochondria. [1]

2.3 State the function of the nucleus and of the cell membrane. [2]

2.4 A drawing of a cell is 45 mm long. The real cell is 0.15 mm long. Calculate the magnification. [2]

2.5 Explain how a root hair cell is adapted to its function. [2]

3 Exam-style questions

3.1 A cell has no nucleus, but has a cell wall, a loop of DNA and plasmids. It is a: [1]

- A plant cell
- B animal cell
- C bacterial cell

- **D** red blood cell

3.2 A red blood cell is a specialised cell.

(a) State its job. [1]

(b) Explain how having no nucleus suits this job. [2]

3.3 Put these in order from smallest to largest: organ, cell, organism, tissue, organ system. [2]

3.4 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. [2]

(b) The same drawing shows a chloroplast 4 mm across. Calculate the real width of the chloroplast, in micrometres. [3]

(c) Complete the table by naming the structure that carries out each function. [4]

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	

(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. [3]

(e) Explain how the palisade cell's position and its number of chloroplasts suit its function. [2]

Solutions

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

2.2 where respiration happens to release energy.

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

3.2 (a) to transport oxygen.

(b) with no nucleus there is more room for haemoglobin, so it can carry more oxygen.

3.3 cell → tissue → organ → organ system → organism.

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

2.4 $\frac{45}{0.15} = \times 300$.

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

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

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

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

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

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