Organisation of the organism

IGCSE Biology

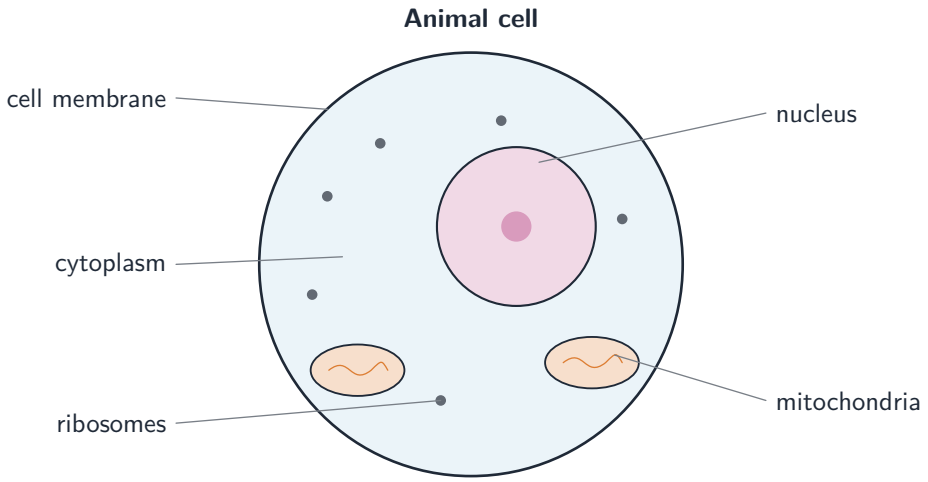
Cells: the building blocks of life

Every living thing is made of **cells** 细胞. A cell is the smallest part that can carry out the life processes. In this topic you compare a **plant** 植物 cell, an **animal** 动物 cell and the cell of a **bacterium** 细菌. All new cells are made by the **division** 分裂 of cells that already exist.

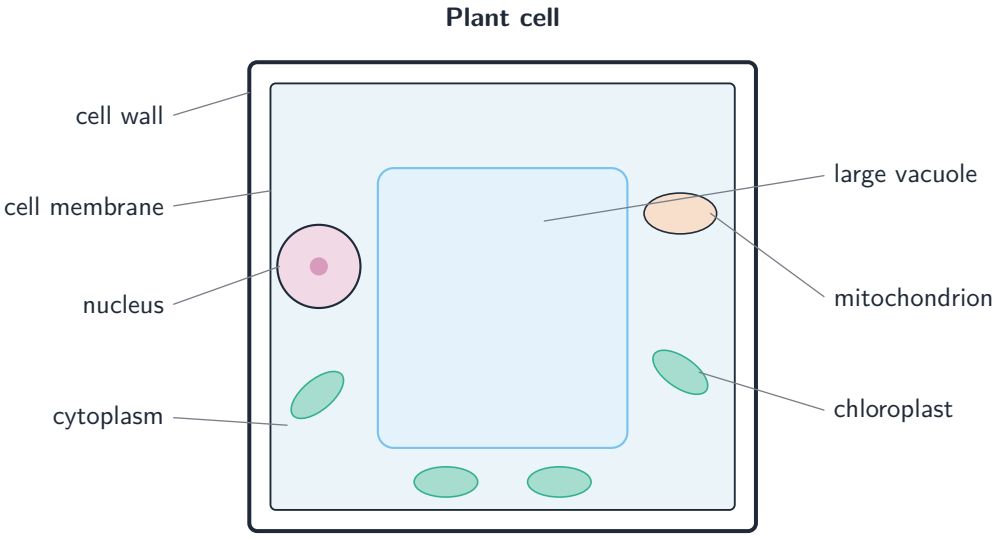
Which structures are in each cell?

Structure	Animal cell	Plant cell	Bacterial cell
cell membrane 细胞膜	yes	yes	yes
cytoplasm 细胞质	yes	yes	yes
ribosomes 核糖体	yes	yes	yes
nucleus 细胞核	yes	yes	no —has a loop of DNA instead
mitochondria 线粒体	yes	yes	no
cell wall 细胞壁	no	yes	yes (different material)
chloroplasts 叶绿体	no	yes (only in green parts)	no
large **vacuole** 液泡	no	yes	no
plasmids	no	no	yes

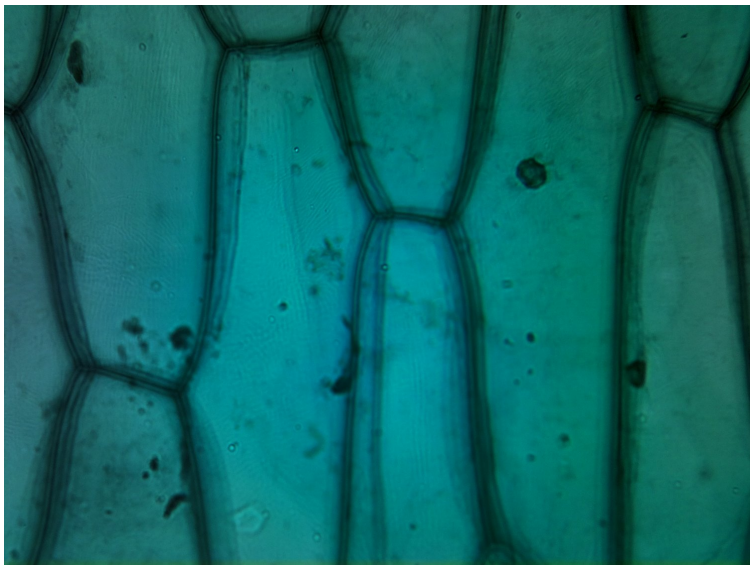
So plant and animal cells share five structures: cell membrane, cytoplasm, ribosomes, nucleus and mitochondria. A plant cell has three extra structures: a cell wall, a large vacuole and (in green parts) chloroplasts.



An animal cell: membrane, cytoplasm, nucleus, mitochondria and ribosomes



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



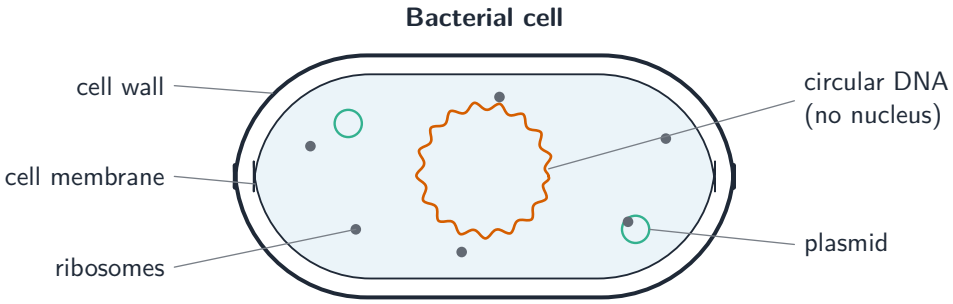
Onion epidermis cells under a light microscope —each cell has a clear cell wall

What each structure does

- **Cell membrane** —controls which substances enter and leave the cell.
- **Cytoplasm** —a jelly-like liquid where many chemical reactions happen.
- **Nucleus** —controls the cell's activities and holds the **genetic material** 遗传物质.
- **Ribosomes** —where **proteins** 蛋白质 are made.
- **Mitochondria** —where **respiration** 呼吸作用 happens to release **energy** 能量.
- **Cell wall** —made of **cellulose** 纤维素; it gives a plant cell strength and a fixed shape.
- **Chloroplasts** —contain **chlorophyll** 叶绿素, a green substance that traps light for **photosynthesis** 光合作用.
- **Large vacuole** —filled with **cell sap** 细胞液; it helps keep the plant cell firm.

Bacterial cells

A **bacterium** is a **prokaryote** 原核生物—its cell has **no** nucleus. Instead its DNA is a single loop (a ring), loose in the cytoplasm. Bacteria also have small extra rings of DNA called **plasmids** 质粒. A bacterial cell has a cell wall and cell membrane, cytoplasm and ribosomes, but no mitochondria and no chloroplasts.



A bacterial cell has no nucleus —its DNA is a single loop, plus small plasmids

Specialised cells

Most cells are **specialised cells** 特化细胞—their shape and parts suit one special job.

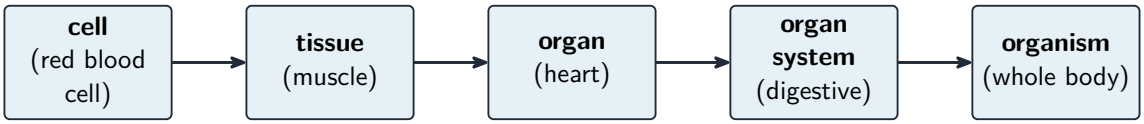
Cell	Job	How its shape helps
ciliated cells 纤毛细胞	move **mucus** 黏液 along the **trachea** 气管 and **bronchi** 支气管	tiny hairs (cilia) on top sweep the mucus along
root hair cells 根毛细胞	**absorption** 吸收 of water and minerals from the soil	a long, thin "hair" gives a large surface
palisade mesophyll cells 栅栏叶肉细胞	photosynthesis	packed with chloroplasts, near the top of the leaf
neurones 神经元	carry **electrical impulses** 电脉冲	very long, to reach far across the body
red blood cells 红细胞	transport **oxygen** 氧气	no nucleus and a dish shape, to carry more oxygen
sperm 精子 and **egg cells** 卵细胞	reproduction	the sperm can swim; the egg cell stores food

Sperm and egg cells are the sex cells, called **gametes** 配子.

Levels of organisation

An **organism** 生物体 made of many cells is built up in levels, from small to large:

- **cell** —the smallest unit of life (for example a red blood cell).
- **tissue** 组织—a group of similar cells that work together (for example **muscle** 肌肉).
- **organ** 器官—several different tissues that work together to do a job (for example the heart, or a leaf).
- **organ system** 器官系统—several organs that work together (for example the **digestive system** 消化系统, which breaks down food).
- **organism** —all the organ systems together make one whole living thing.



From a single cell up to the whole organism

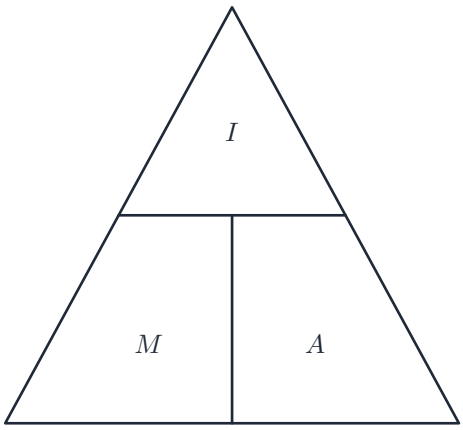
The size of cells: magnification

Cells are tiny, so you look at them under a **microscope** 显微镜, which makes them appear much larger. How many times larger the image is, is called the **magnification** 放大倍数.

A light microscope, used to look at cells

Image: GcG(jawp), Public domain (commons.wikimedia.org)

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



I = image size
M = magnification
A = actual size

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

cover a letter to get its formula

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

- **image size** = the size in the drawing or photo.
- **actual size** = the real size of the **specimen** 标本.

Magnification has **no unit** —it is just a number, for example ×250. You can rearrange the formula:

$$\text{actual size} = \frac{\text{image size}}{\text{magnification}}, \qquad \text{image size} = \text{actual size} \times \text{magnification}$$

Worked example. A structure is shown at a magnification of 250. Its image size is 5.00 mm. So the actual size = 5.00 ÷ 250 = 0.02 mm. Always put both sizes in the **same unit** before you divide.

Changing units (Supplement)

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

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

So 0.02 mm = 20 m. To change mm into m, multiply by 1000. To change m into mm, divide by 1000.

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: magnification = image ÷ actual; actual = image ÷ magnification.
- Always convert to the same unit before you calculate. Remember 1 mm = 1000 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).