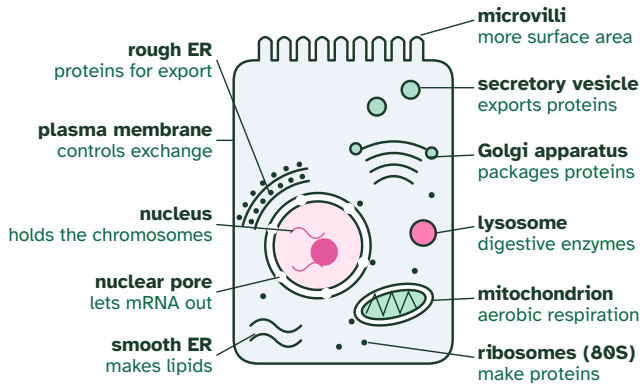
What every *cell* is built from

What to know, what to draw and what to say. Nothing else.

THE ONE IDEA

Every cell is DNA in watery cytoplasm inside a lipid membrane. Eukaryotes add a nucleus and compartments.



Annotate like this. Each part named, with its function under it.

A2.2.6 START HERE

The *eukaryote*: a cell of compartments

- Membranes **divide the cytoplasm into compartments**, so reactions that would clash are kept apart. Eukaryote ribosomes are **80S**.
- **Nucleus:** chromosomes of DNA wound round **histones**, inside a **double membrane with pores**.
- **Membrane-bound organelles:** mitochondria, rough and smooth ER, the Golgi apparatus, and vesicles and vacuoles, including lysosomes.
- **Cytoskeleton:** microtubules and microfilaments hold the shape and move things about.

A2.2.1

Cells, the unit of *life*

- **Cell theory:** all living things are made of **one or more cells**; the cell is the smallest unit that is alive; cells come only from cells.
- **Deduction:** a new organism is predicted to be **made of cells**.

A2.2.4

What *every* cell has

- **DNA:** the genetic material, copied when the cell divides.
- **Cytoplasm: mostly water**, so substances dissolve and react.
- **Plasma membrane: lipids** do not dissolve, so it holds the inside apart.

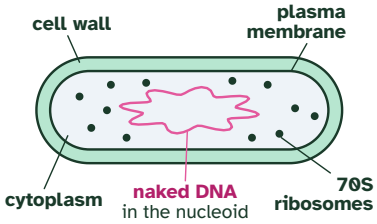
A2.2.5

The *prokaryote*

- **No nucleus**. Learn a Gram-positive bacterium: *Bacillus* or *Staphylococcus*.
- A thick **cell wall** of peptidoglycan keeps the shape and stops bursting; inside it, the membrane and cytoplasm.
- **Naked DNA** in a loop; **70S ribosomes**; no membrane-bound organelles.
- Prokaryote structure varies, but you need no details of how.

1 to 5 µm
long, for most

70S
smaller ribosomes



A2.2.5 and 6 COMPARE IN PAIRS

Prokaryote against *eukaryote*

FEATURE	PROKARYOTE	EUKARYOTE
Nucleus	None: DNA in the nucleoid	One, in a double membrane
Ribosomes	70S	80S
DNA	Naked loop	Chromosomes with histones
Organelles	No membrane-bound ones	Many membrane-bound
Size	1 to 5 µm	10 to 100 µm

Pink letters: the order to learn them in.

Remember: *Never Ride Dragons Over Seas*

A2.2.2 SKILLS

Mount, focus, *measure*

- **Mount:** thin cells in water or a stain (iodine for plant, methylene blue for cheek cells); coverslip lowered at an angle.
- **Focus: coarse focus** first; at high power **fine focus** only.
- **Measure:** calibrate the **eyepiece graticule** on a stage micrometer for each objective; photograph, add a **scale bar**.

QUANTITATIVE OBSERVATION

I Am Magnified

I Image what you measure	**A** Actual image ÷ magnification	**M** Magnification image ÷ actual

A2.2.3

Seeing *smaller*

LIVING CELLS, COLOUR
Light microscope
Resolves about 0.2 µm.

DEAD, THIN SPECIMENS
Electron microscope
Resolves about 1 nm: far finer detail.

- **Freeze fracture:** frozen cells split along the middle of membranes, showing their proteins.
- **Cryo-EM:** frozen protein copies, imaged from all angles, give its **3D structure**.
- **Fluorescent stains** light up one part of a living cell; **immunofluorescence** puts the dye on an antibody.

How cells *differ*, and where eukaryotes came from

A2.2.8 SPOT THE DIFFERENCE

Plant, fungus, *animal*

FEATURE	PLANT	FUNGUS	ANIMAL
Cell wall	**Cellulose**	**Chitin**	**None**
Vacuole	Large **sap vacuole** keeps it firm	Often large.	Small and temporary.
Plastids	**Chloroplasts**, amyloplasts	None: fungi feed on others.	None.
Centrioles, cilia, flagella	None in flowering plants.	None in most fungi.	Centrioles; cilia or a flagellum.

A2.2.7

One cell, *every* job

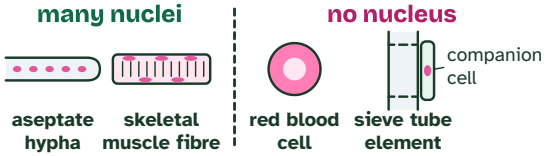
- One cell does every job of life: know *Paramecium* and *Chlamydomonas*.

MANY **Metabolism** All its reactions.	HUNGRY **Homeostasis** Expels water.	NEWTS **Nutrition** Eats or makes food.	MUNCH **Movement** Cilia or flagella.
EGGS **Excretion** Loses CO_2.	GRUBS **Growth** Gets bigger.	ROOTS **Response** Swims to light.	RICE **Reproduction** Divides in two.

A2.2.9

Cells that break the *rules*

- **Many nuclei:** **aseptate fungal hyphae** (no cross walls) and **skeletal muscle fibres** (fused cells).
- **No nucleus:** mammalian **red blood cells** and phloem **sieve tube elements**.



A2.2.10 and 11 SKILLS

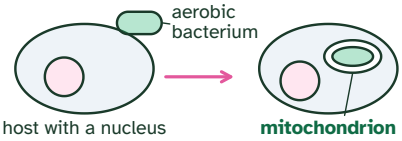
Reading *micrographs*

- **Identify:** no nucleus, a **prokaryote**; a wall and a large vacuole, a plant; neither, an animal.
- **Know by shape** in grey EMs: nucleoid, walls, nucleus, chromosomes, mitochondria, chloroplasts, sap vacuole, Golgi, both ERs, ribosomes, microvilli.
- **Draw:** pencil, clean lines, no shading, ruled labels; **annotate with functions**.

A2.2.12 HIGHER LEVEL

Origin by *endosymbiosis*

- The first eukaryote had a **nucleus** and reproduced sexually. An engulfed aerobic bacterium became the **mitochondrion**; later a cyanobacterium, the **chloroplast**.
- **Evidence:** **70S ribosomes**, naked circular DNA, two membranes, own division.



A2.2.13 and 14 HIGHER LEVEL

Many-celled *life*

- **Differentiation**: different **patterns of gene expression**, often set off by the surroundings.
- Multicellularity **evolved many times**: plants, animals, many fungi and algae.
- Gains: a **larger body**, **specialised cells**.



WATCH OUT

Six mistakes that *cost marks*

- ✕ **The nucleoid is not a nucleus.** It is the region where the DNA lies, with no membrane round it.
- ✕ **Prokaryotes do have ribosomes.** What they lack are membrane-bound organelles.
- ✕ **Electron microscopes win on resolution, not magnification.** A blur made bigger is still a blur.
- ✕ **Convert units before you divide:** 1 mm = 1000 µm. Magnification has no units.
- ✕ **Excretion is not egestion.** Excretion removes waste made by metabolism, such as CO_2.
- ✕ **Not every cell has a wall.** Animal cells have none.

COVER THE SHEET

Can you *answer these?*

1. State cell theory and the three structures every cell has.
2. Calculate the magnification: 5 µm drawn as 25 mm.
3. Outline one advantage of immunofluorescence.
4. Draw a Gram-positive bacterium and label five parts.
5. Distinguish prokaryote from eukaryote cells in five ways.
6. List the eight functions of life.
7. Compare the cell walls of plants, fungi and animals.
8. State two cells with many nuclei and two with none.
9. Annotate a drawn mitochondrion with its function.
10. Outline the evidence for endosymbiosis. HL
11. Explain how cells with the same genes differentiate. HL

IN THE EXAM

Compare in matched pairs ("70S in prokaryotes, 80S in eukaryotes"), never two lists; in a magnification sum, **convert units first**.

GO FURTHER

Animated figures, a dry lab and a marked Check are in the full guide online.