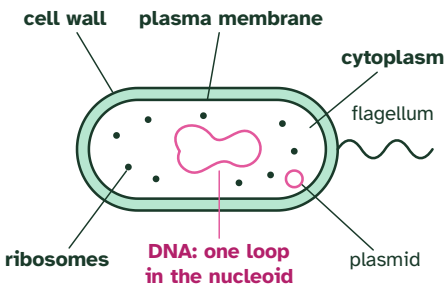
AP BIOLOGY | UNIT 2 | TOPICS 2.1, 2.2 | REVISION ON TWO PAGES

The parts of a *cell*

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

THE ONE IDEA

Every cell shares four parts. Eukaryotes add membrane-bound organelles, each built for its job. Cells stay small to keep surface high for their volume.



A bacterium. One open space: every reaction shares it, which works because the cell is tiny.

2.1.A START HERE

Every cell, the same *four parts*

- **Prokaryotes** (bacteria and archaea) are small, with **no membrane-bound organelles**. **Eukaryotes** (animals, plants, fungi, protists) are usually ten times wider and divided into compartments.
- A prokaryote's DNA is one loop in the **nucleoid**, a region of cytoplasm with no membrane around it. Most have a cell wall (peptidoglycan in bacteria); many have plasmids, some a flagellum.
- Every cell has the same four parts, with the same genetic code: evidence that all cells share a **common ancestor**.

IN EVERY CELL EVER FOUND

M Membrane controls what crosses	**C** Cytoplasm mostly water; fills the cell	**D** DNA carries the instructions	**R** Ribosomes read them to make proteins

2.1.A IN ALL LIFE

Ribosomes

- Made of **rRNA and protein**, in two subunits, with no membrane. They read mRNA and join amino acids in order: they **make proteins**.
- All life has them, working so alike that they must be inherited from **one common ancestor**.
- They are assembled in the nucleus, at the **nucleolus**, not in the ER.

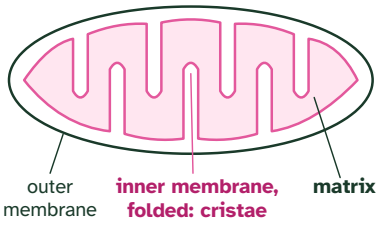
Free in the cytoplasm
Make proteins that stay in the cytoplasm.

Bound on the rough ER
Make proteins for membranes, for lysosomes or for export.

2.1.A USES ENERGY

The *mitochondrion*

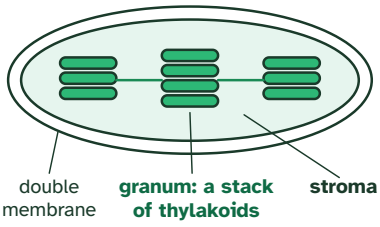
- Double membrane: a smooth outer one and an inner one **folded into cristae**.
- The **Krebs cycle** runs in the matrix. The **electron transport chain** and **ATP synthase** sit in the inner membrane.
- Folding gives **more surface area**, so more of both fit in and the cell makes more ATP.



2.1.A CAPTURES ENERGY

The *chloroplast*

- In plants and photosynthetic algae. A double membrane around a fluid, the **stroma**.
- **Thylakoid** membranes hold chlorophyll and electron transport proteins: the **light-dependent reactions** happen in the grana.
- The **Calvin cycle** fixes carbon dioxide into sugar in the **stroma**.



2.1.A EACH WITH ITS OWN JOB

A eukaryotic cell, *room by room*

ORGANELLE	WHAT IT LOOKS LIKE	WHAT IT DOES
Nucleus	A double membrane with pores.	Holds the DNA, the cell's instructions.
Rough ER	Membrane sacs studded with ribosomes.	Makes proteins and sends them on to the Golgi.
Smooth ER	Membrane with no ribosomes.	Makes lipids and breaks down toxins: liver cells have a lot.
Golgi complex	A stack of flattened sacs.	Folds and modifies proteins, then sorts them into vesicles.
Lysosome	A sac of hydrolytic enzymes.	Breaks down worn-out parts and what the cell takes in; apoptosis.
Vacuole	A membrane sac.	Stores water, food or waste.

2.1.A BOTH EUKARYOTIC

Plant cell, *animal* cell

	PLANT CELL	ANIMAL CELL
Cell wall	**Cellulose**	None: cytoskeleton holds shape.
Vacuole	**One, large**	Often many, small.
Chloroplasts	**Yes**	None.
Lysosomes	The vacuole does much of that job.	**Common**
Centrioles	None.	**Yes**

Both: nucleus, ER, Golgi, mitochondria, ribosomes, plasma membrane.

2.1.A SHADES OF GRAY, NO LABELS

Name it from a *micrograph*

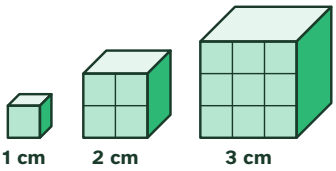
STRUCTURE	WHAT TO LOOK FOR
Nucleus	Largest round body: double membrane, pores.
Mitochondrion	Small, with a folded inner membrane.
Chloroplast	An oval with stacks of membrane inside.
Rough ER	Parallel sacs dotted with ribosomes.
Golgi	A curved stack with vesicles, no dots.

Wall, no nucleus: prokaryote. Wall, vacuole, chloroplasts: plant.

2.2.A

Why cells *stay small*

- Everything a cell exchanges crosses its membrane, so **supply** depends on **surface area**. **Demand** depends on **volume**.
- As a cell grows, volume rises faster than surface area, so the **surface area-to-volume ratio falls**.
- A large cell has too little membrane for its volume and a middle far from any surface. So cells stay small, and **divide** rather than keep growing.



SA = $6s^2$, V = s^3, so SA:V = 6 ÷ s

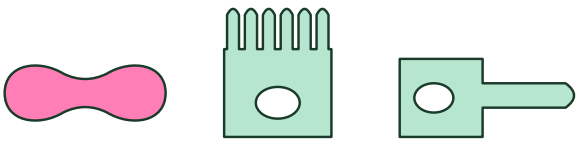
SIDE, CM	SA, CM²	V, CM³	SA:V
1	6	1	**6**
2	24	8	**3**
3	54	27	**2**

Sphere, cylinder and box formulas are on the AP formula sheet.

2.2.A

More surface: *flatten, fold, fringe*

- Cells that exchange a lot raise their surface area. **Flattening:** a red blood cell is a thin disc, so no hemoglobin is far from the surface.
- **Microvilli**, tiny fingers of membrane, multiply the area for absorption in the small intestine and kidney. A **root hair** does it for water and minerals.
- SA:V also sets heat exchange: a small animal **loses heat fast** for its size. Large animals need lungs, guts and blood to bring exchange surfaces close to every cell.



red blood cell
flattened disc

gut cell
microvilli

root hair cell
long extension

WATCH OUT

Five mistakes that *cost points*

- ✕ **Prokaryotes do have DNA.** It is a loop in the nucleoid, with no membrane around it.
- ✕ **The Golgi does not make proteins.** Ribosomes make them; the Golgi modifies and ships them.
- ✕ **Plant cells have mitochondria too.** Chloroplasts make sugar; mitochondria turn it into ATP.
- ✕ **A bigger cell has more surface area, not less.** It is the area for each unit of volume that falls.
- ✕ **Microvilli are not cilia.** They do not beat: they only add surface.

COVER THE SHEET

Can you *answer these?*

1. Identify the four structures every cell has.
2. Explain why ribosomes are evidence of common ancestry.
3. Describe one difference between rough and smooth ER.
4. Explain how cristae let a cell make more ATP.
5. Identify where the Calvin cycle runs in a chloroplast.
6. Describe three ways plant and animal cells differ.
7. Calculate SA:V for a cube of side 4 cm.
8. Predict which cools faster for its size: mouse or elephant.

IN THE EXAM

Link structure to function: name the feature (folded inner membrane), say what it adds (surface area), then what that allows (more ATP synthase, more ATP).

GO FURTHER

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