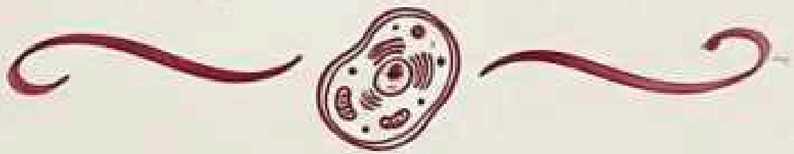
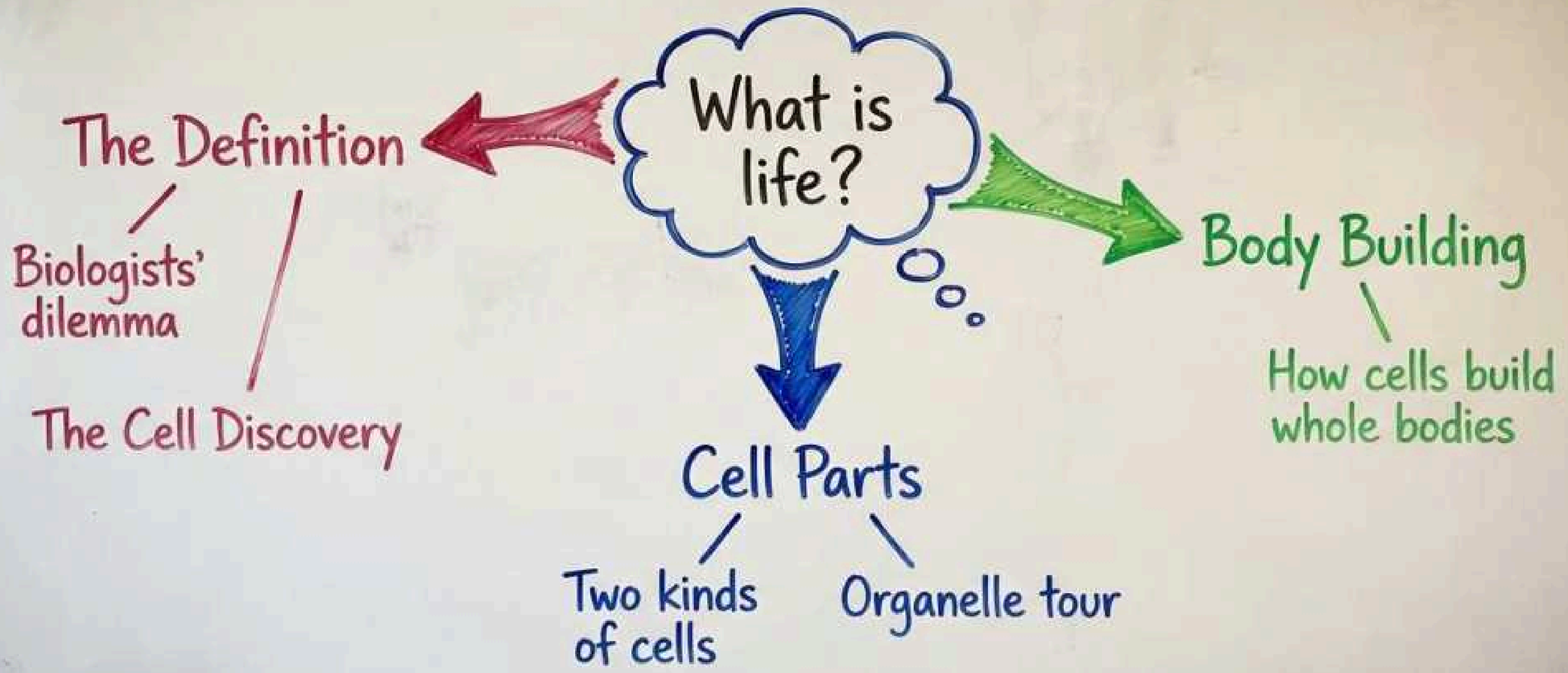
BIO 101 B:
What Is Life? The Cell
Lecture 1

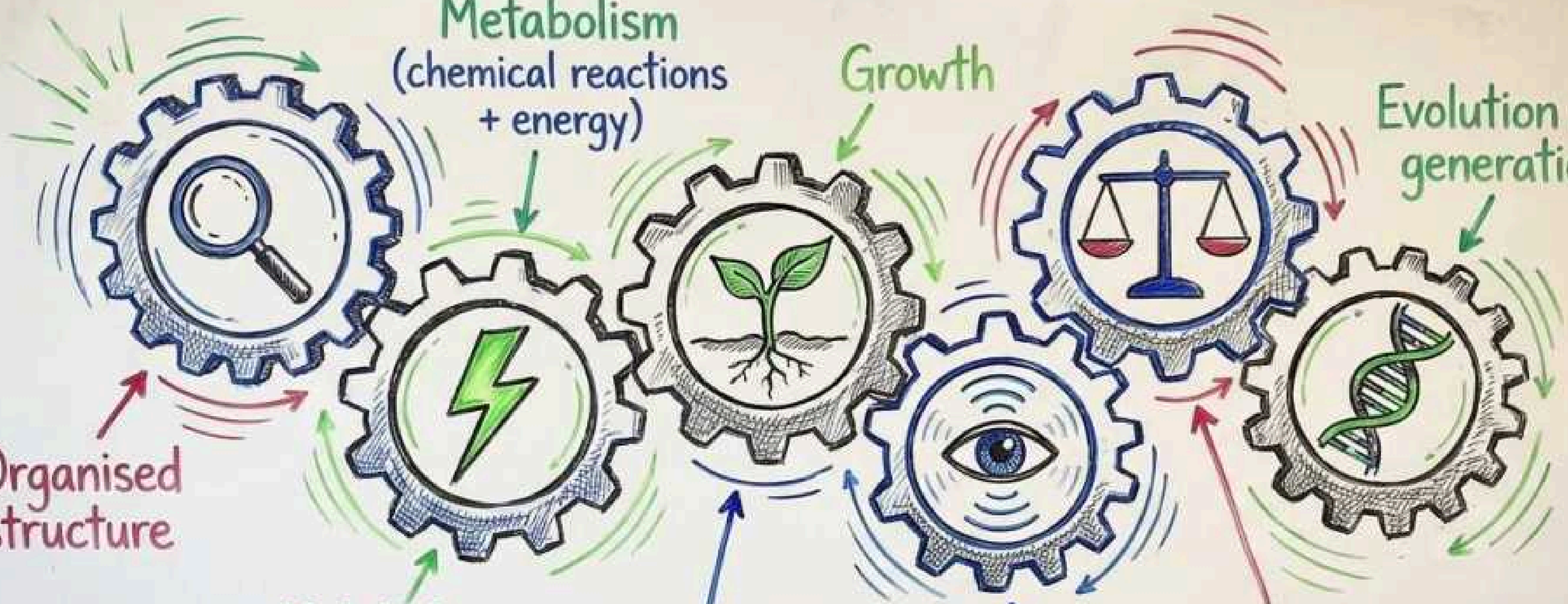


¶ 1.2


What is life?
The Definition
Biologists' dilemma
The Cell Discovery
Body Building
How cells build whole bodies
Cell Parts
Two kinds of cells
Organelle tour

The Checklist of Life

¶ 1.3

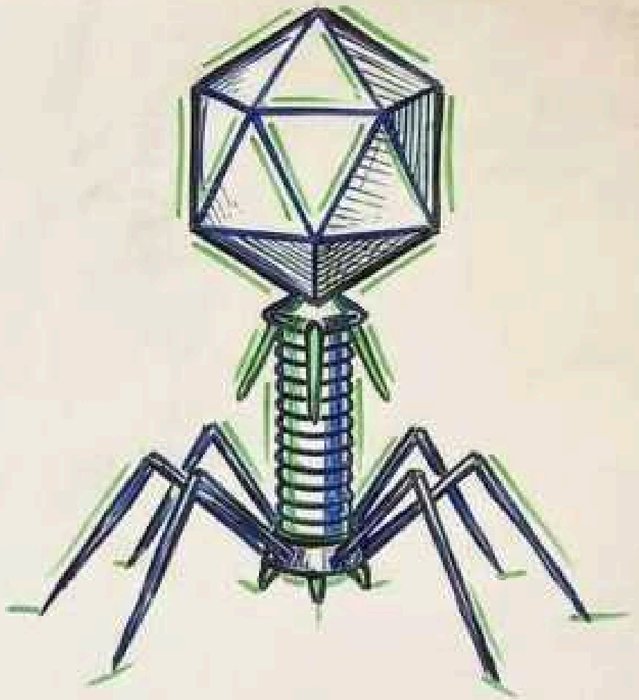


Edge Cases: When the Checklist Fails

¶ 1.4



Grows, uses fuel, and spreads.
Yet, NOT alive.



Has genes and evolves.
Yet, cannot reproduce without a host cell.

Viruses are treated as borderline.
The debate is fair.

Life is a Process, Not a Substance

¶ 1.5

No single atom here is alive.

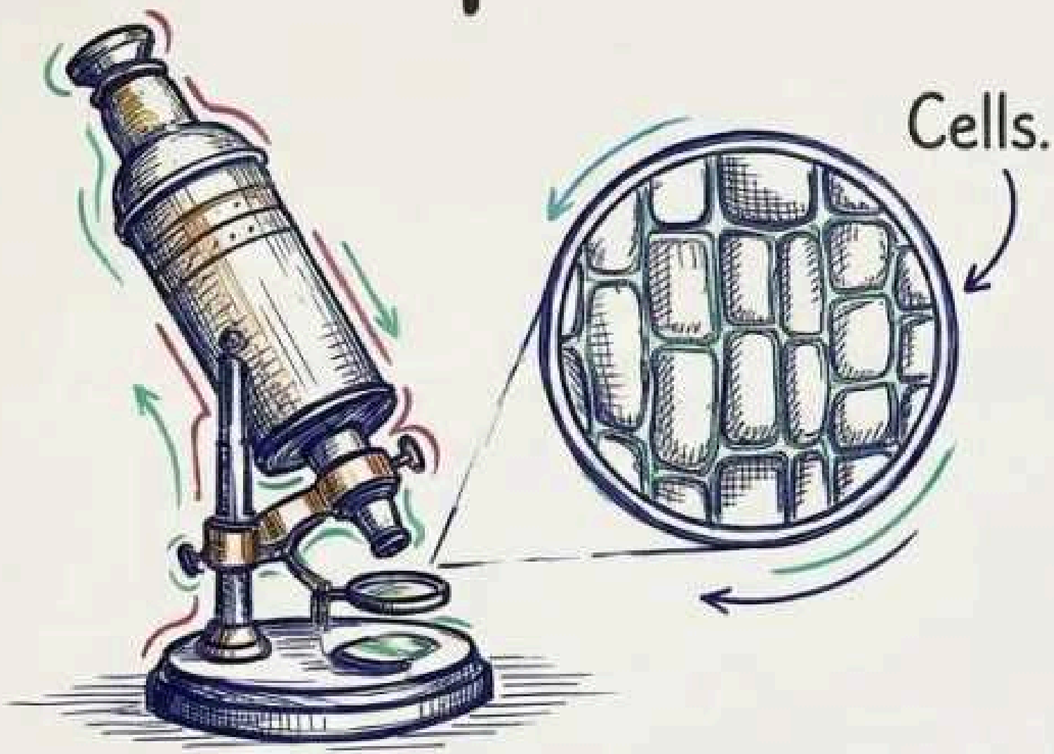


When activity stops, the same atoms remain.

Organised activity & constant chemistry keep it going.

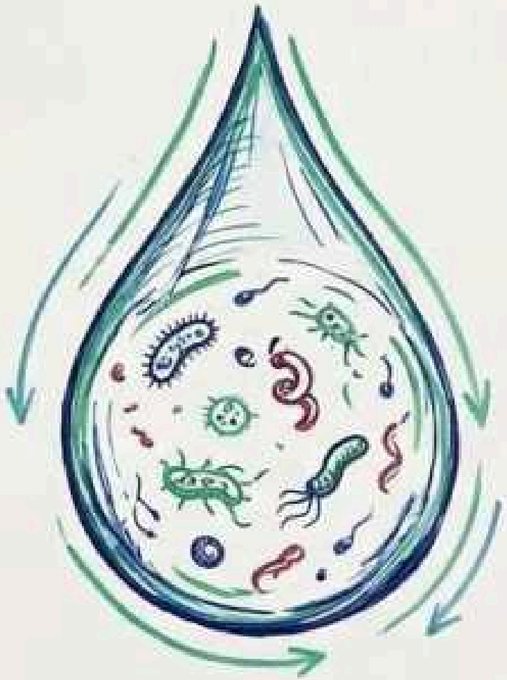
$$\sum (\text{Organised Activity}) = \text{Life}$$

1665



Robert Hooke examines cork
→ coins the term 'Cells'.

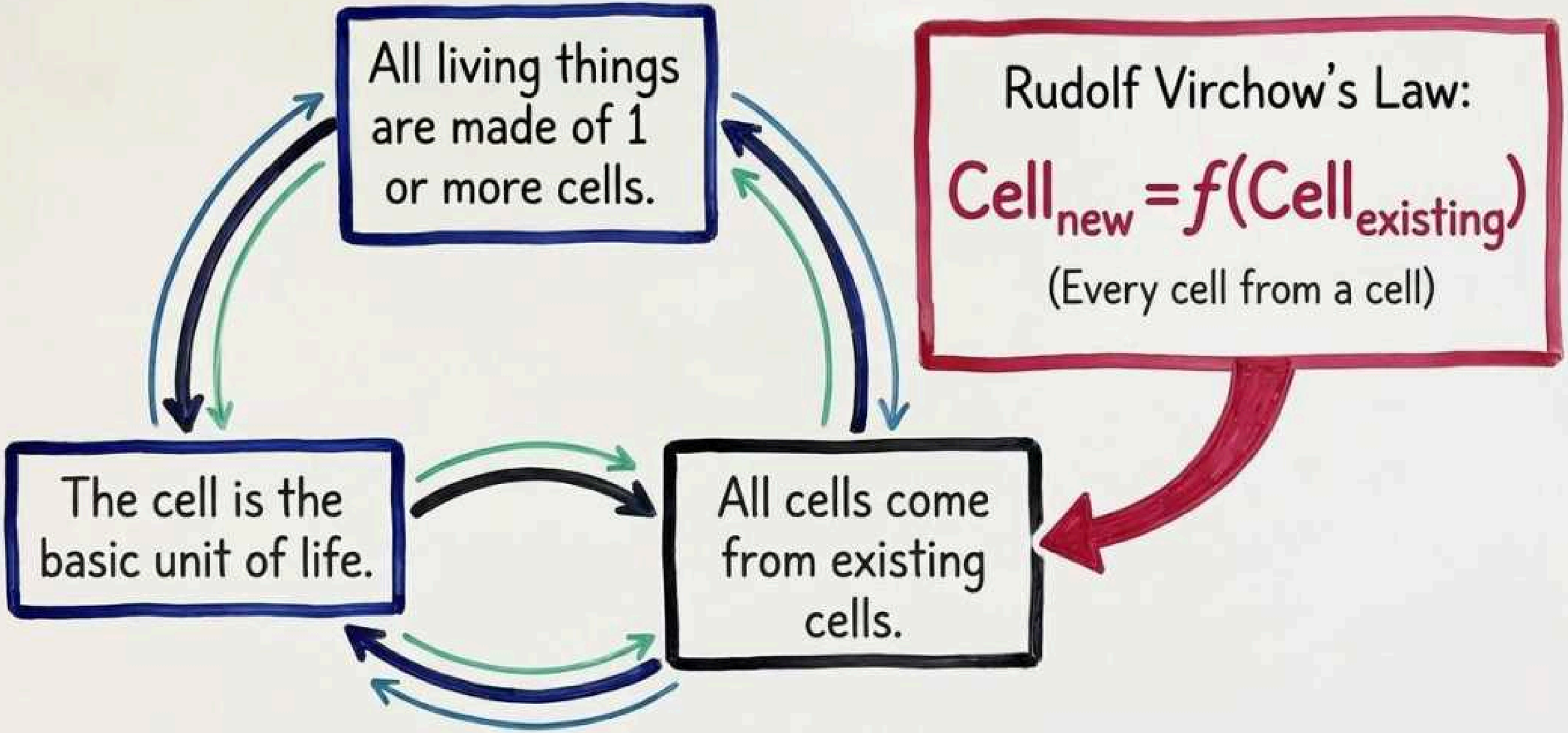
Late 1600s



Antonie van Leeuwenhoek observes
living microbes in pond water.

The Cell Theory (19th Century)

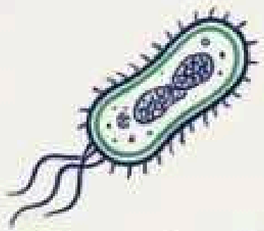
¶1.7



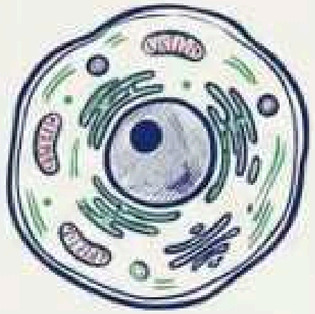
¶ 1.8

$$37 \times 10^{12}$$

Estimated cells
in a human body.



Typical
bacterium



Most typical
cells

micro

macro

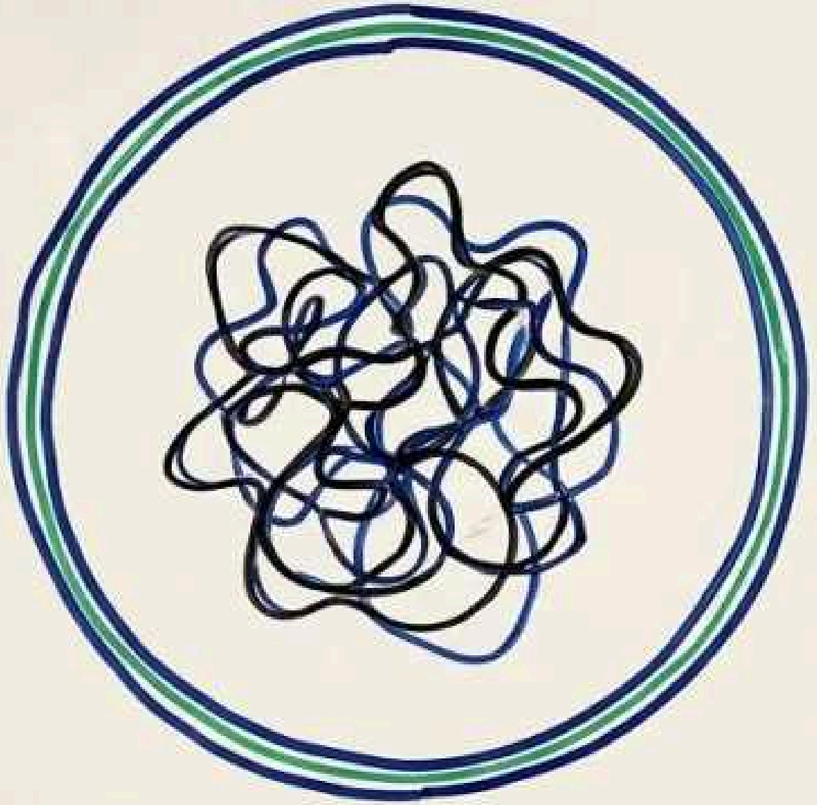
1 μm
(thousandth of a mm)

10 μm

100 μm

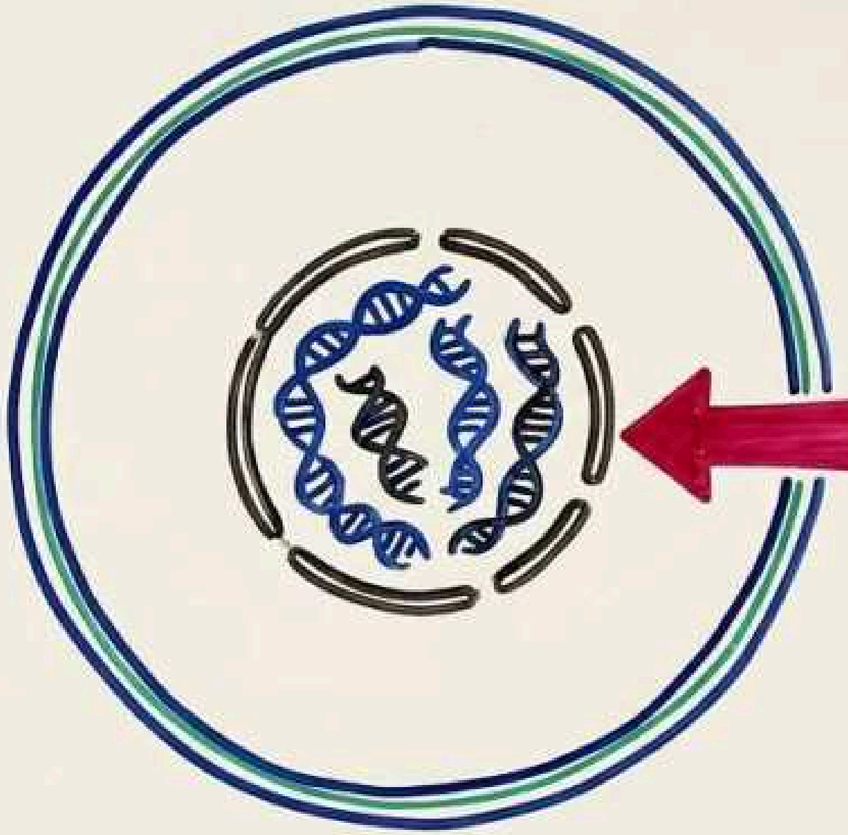
Two Basic Designs

¶ 1.9



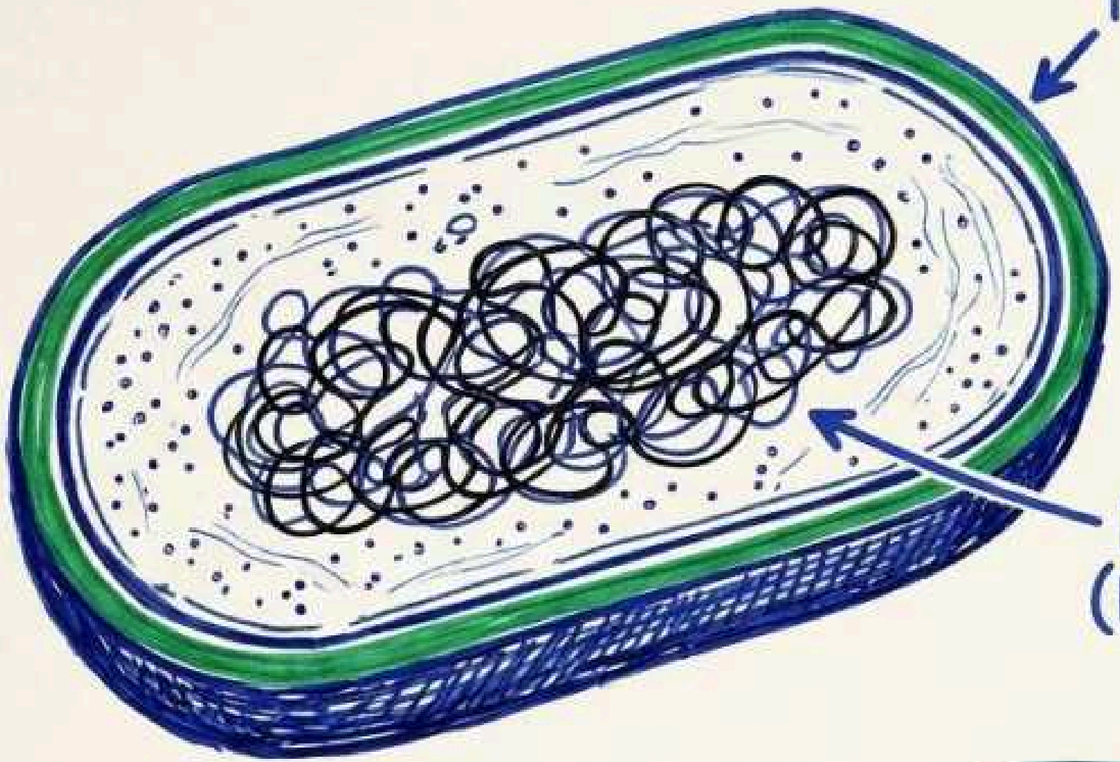
Prokaryotic Cell
(No nucleus)

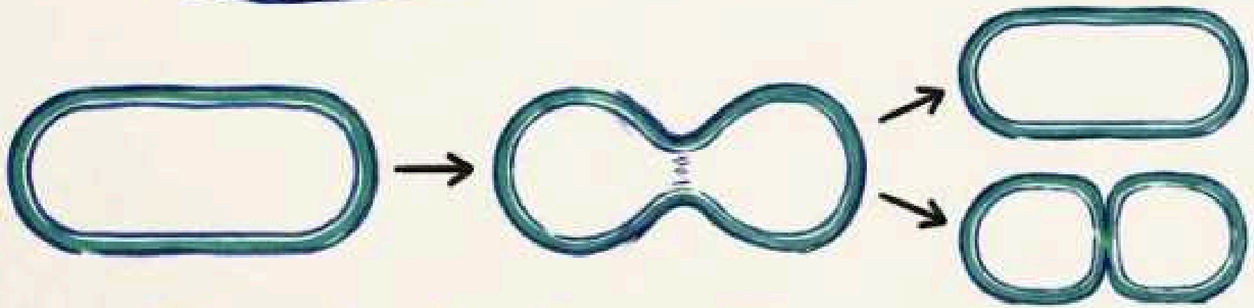
Bacteria / Archaea



Eukaryotic Cell

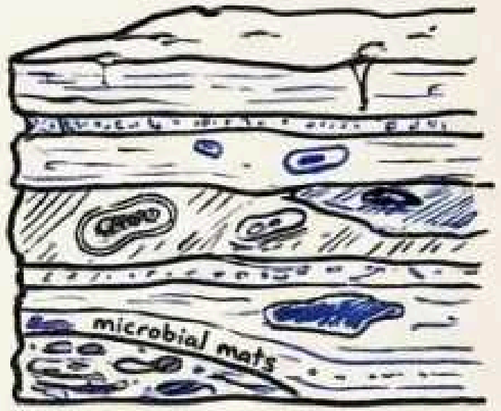
Animals, plants, fungi, protists



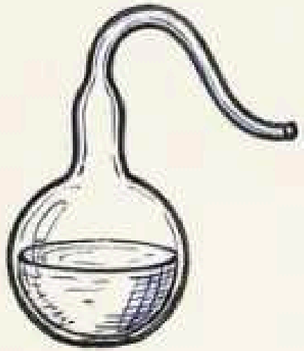


Reproduction by splitting in two.

3.5×10^9
Years Ago

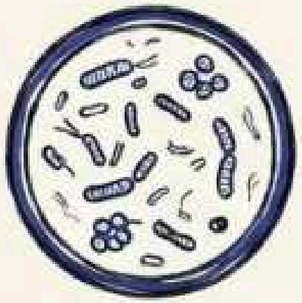


Fossil evidence of the earliest prokaryotes.



1860s:

Pasteur: Microbes cause fermentation; life doesn't arise from nothing in a sterile flask.



Koch: Links particular microbes to particular diseases.

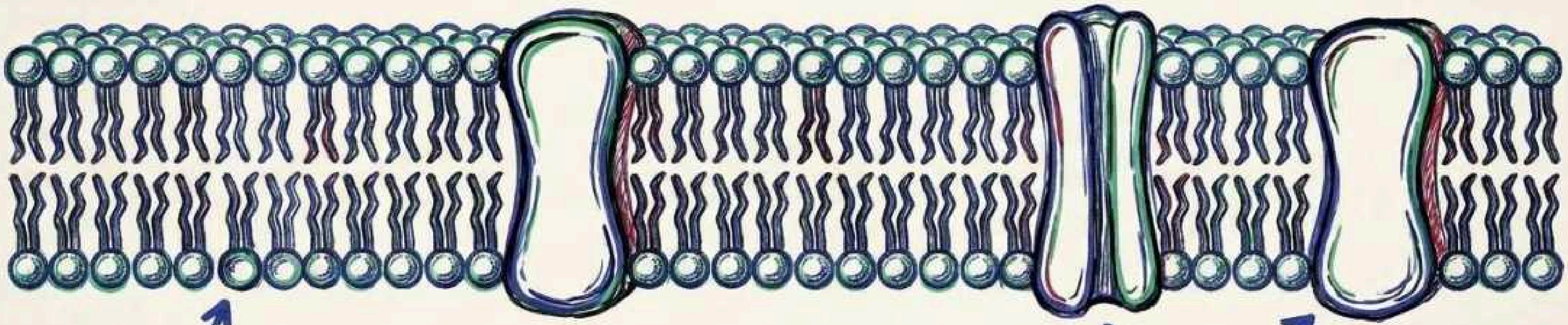


Result: Sterilisation, Vaccines, Antibiotics

Medicine changed by taking small cells seriously.

The Plasma Membrane

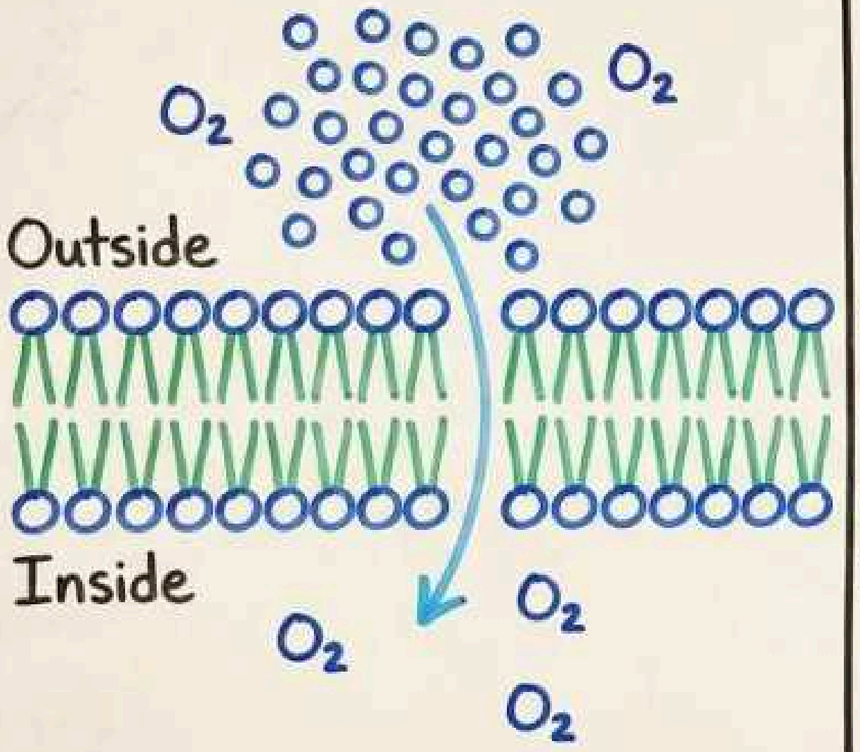
¶ 1.12



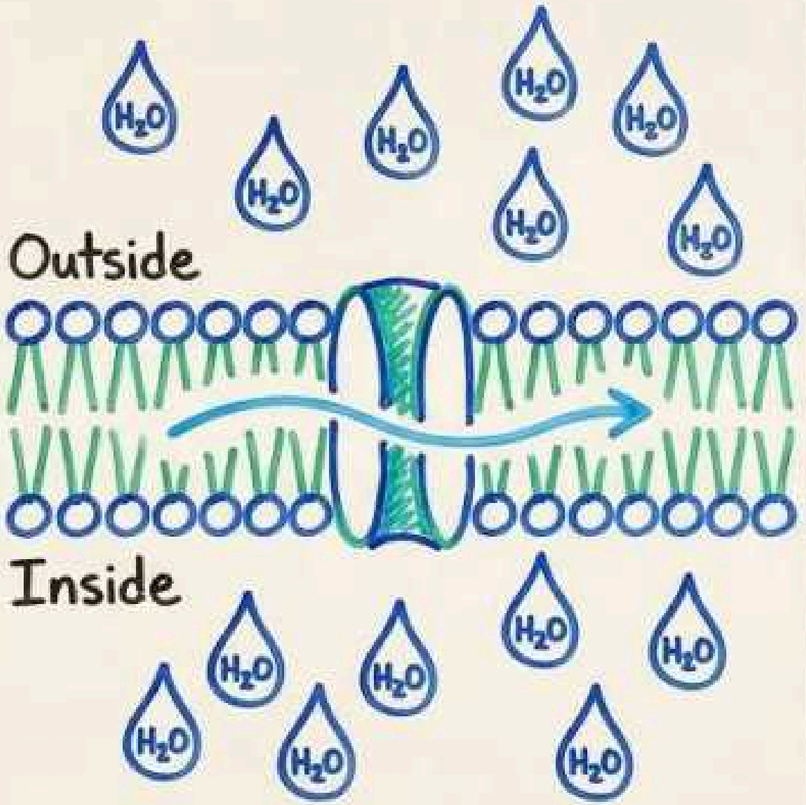
Phospholipids
- Head (Likes Water)
- Two Tails (Avoids Water / Tucked Inside)

Embedded Proteins → Act as Gates, Channels, and Signals

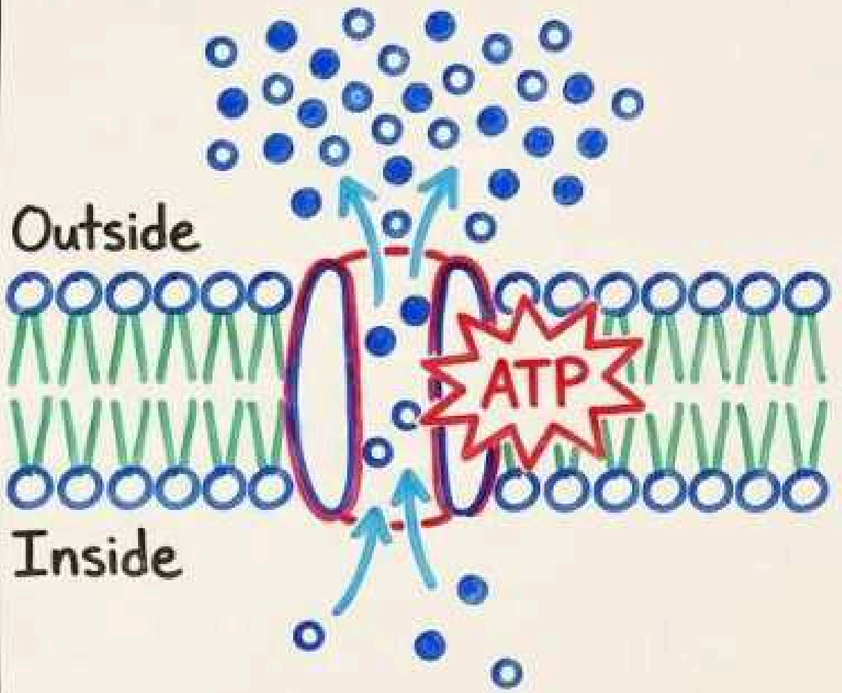
Diffusion



Osmosis



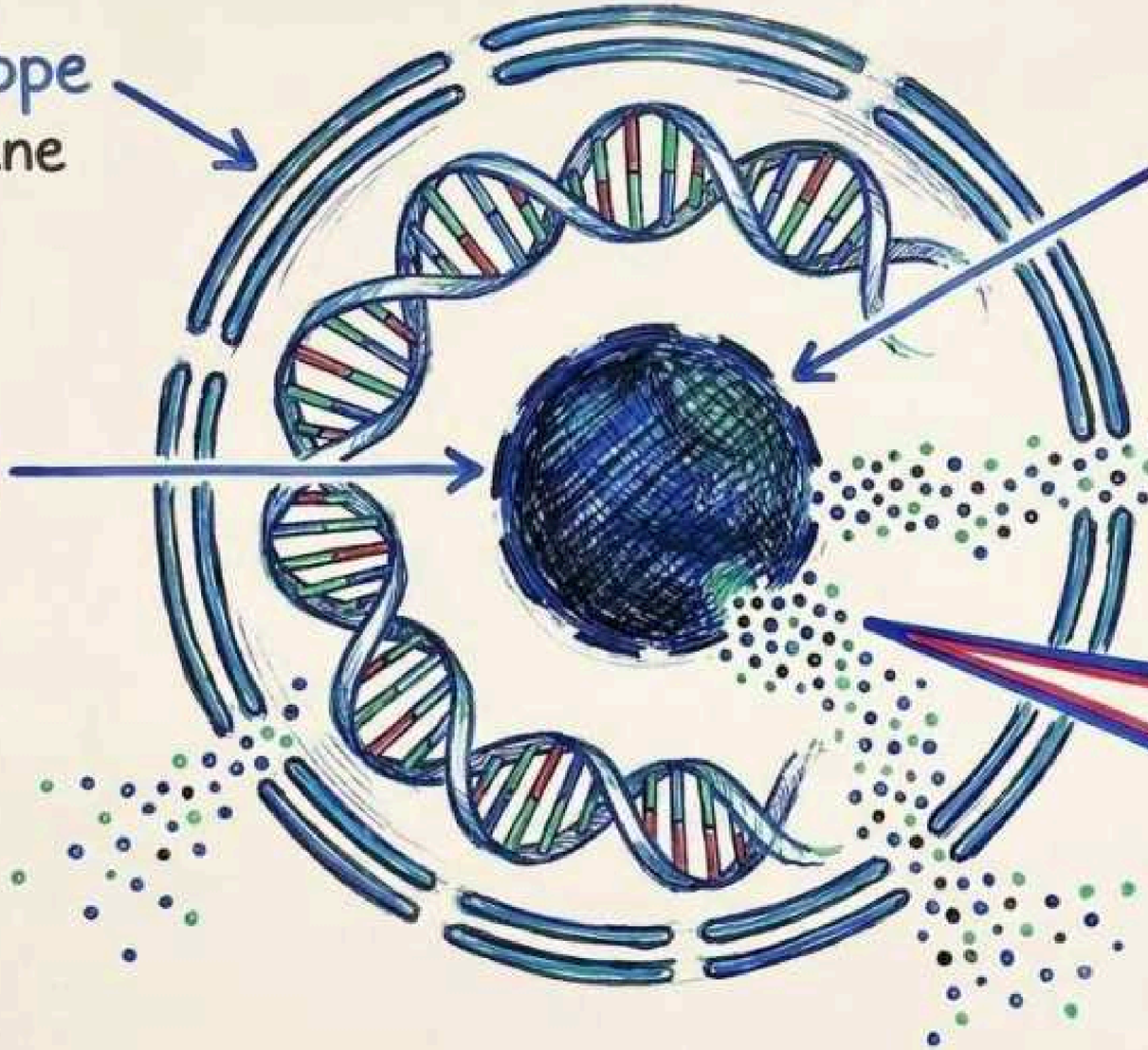
Active Transport



Costs the cell energy to move materials against the crowd.

¶ 1.14

The Control Centre



Nuclear Envelope
(Double membrane with pores)

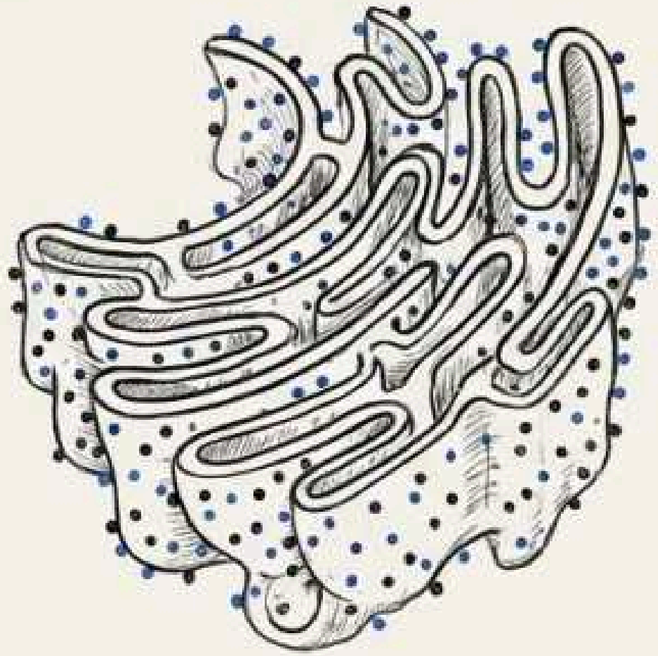
Nucleolus
(Dense spot)

DNA

Ribosomes built here
→ Tiny machines that assemble proteins
(Found in EVERY kind of cell).

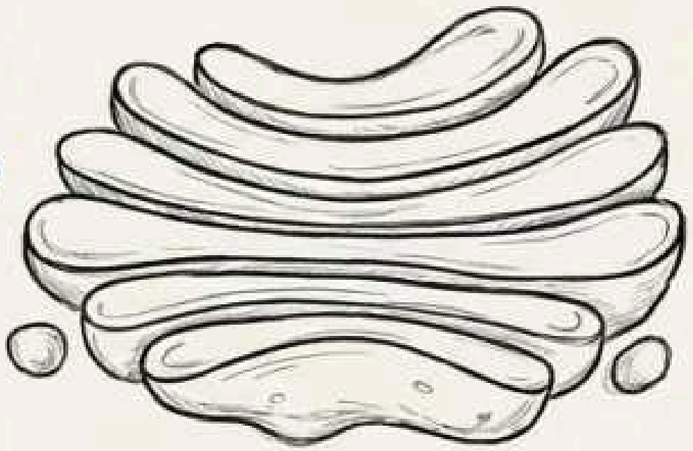
The Protein Assembly Line (For Export)

Rough Endoplasmic Reticulum



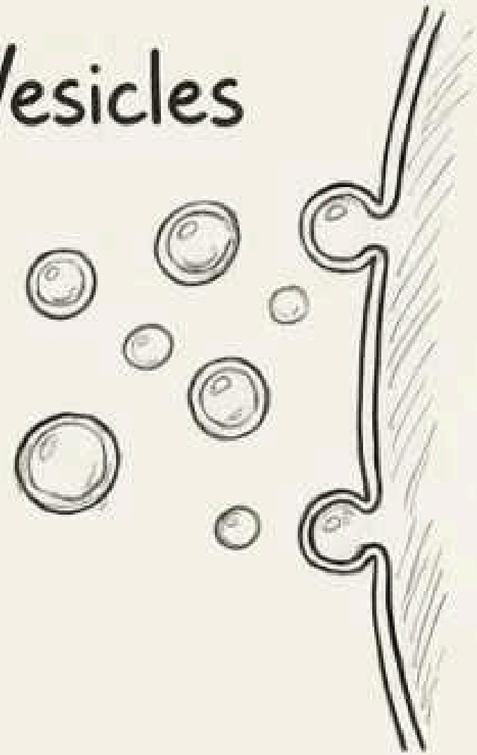
Studded with ribosomes.
Makes and folds proteins.

Golgi Apparatus



Sorts, tags, and packages products.

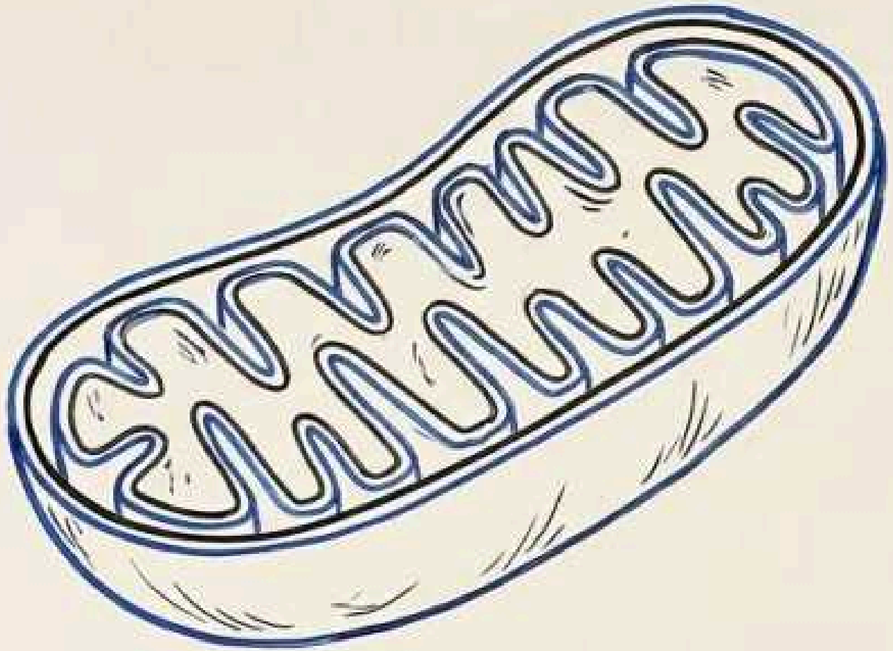
Vesicles

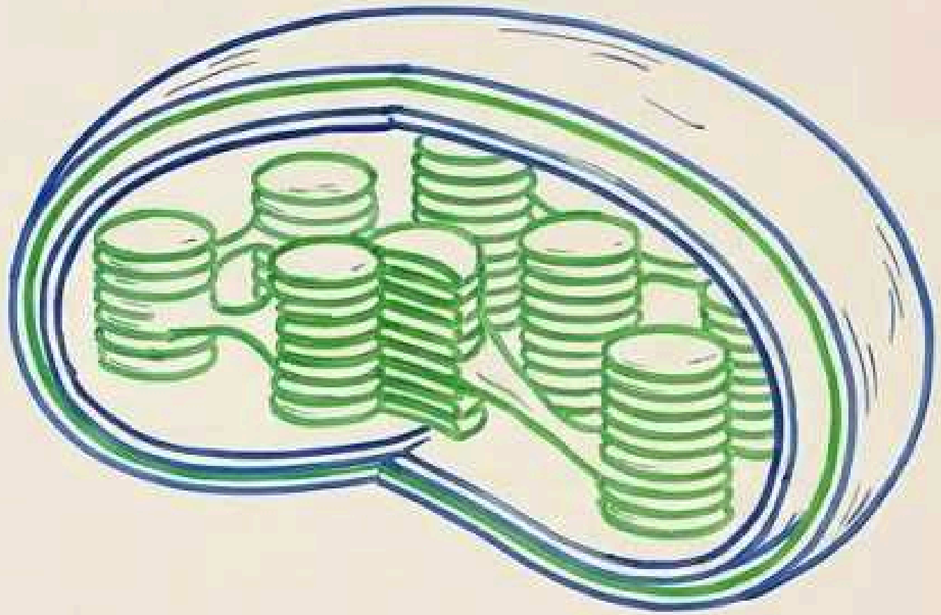


Small bubbles that carry finished products to the membrane or other parts.

The Power Plants (Organelles)

¶ 1.16





Food + O_2 → ATP

ATP = The cell's energy currency.

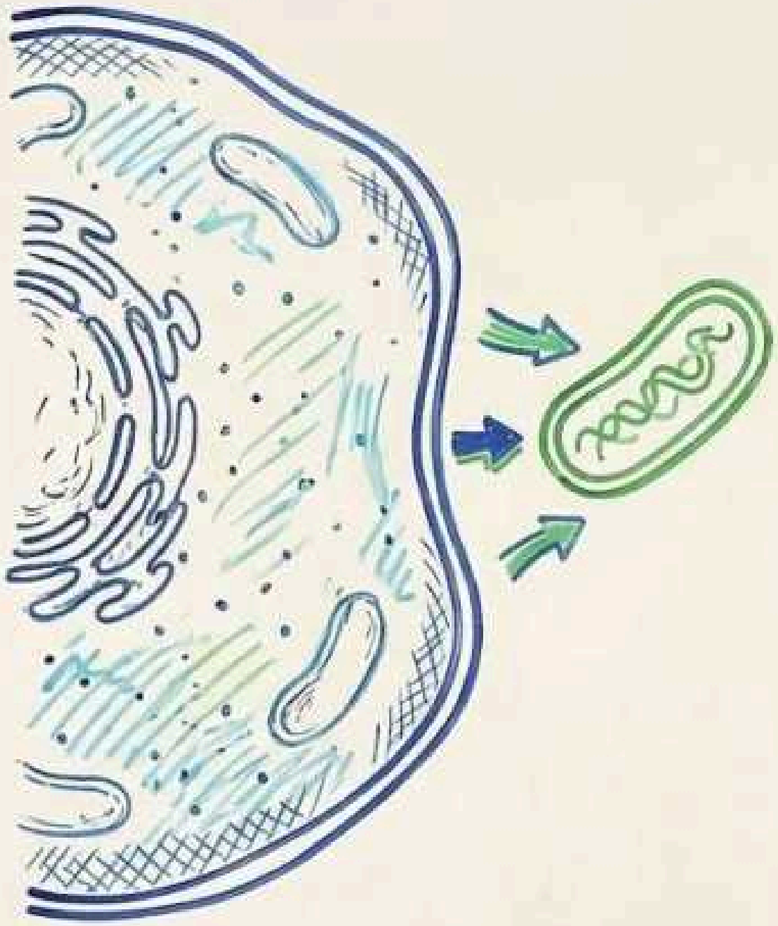
Sunlight + CO_2 → Sugar

(Plant Cells Only)

Organelle = A specialised part inside a cell.

Theory of Endosymbiosis (Lynn Margulis)

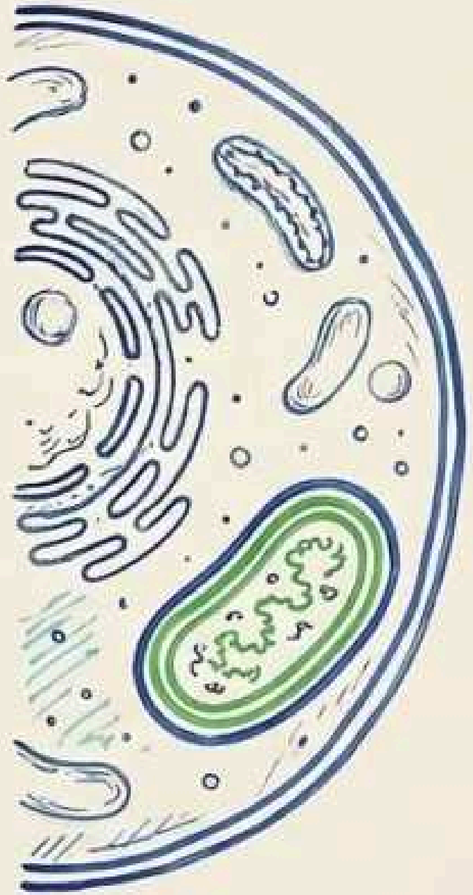
¶ 1.17



Step 1 (Left)



Step 2 (Middle)

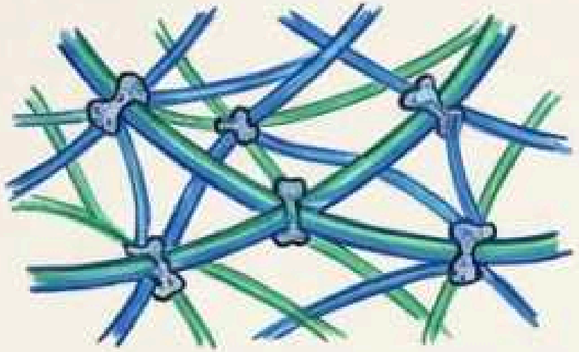


Step 3 (Right)

- ☒ Own small loops of DNA
- ☒ Bacterial size
- ☒ Double membranes

Shared Eukaryotic Features

¶ 1.18

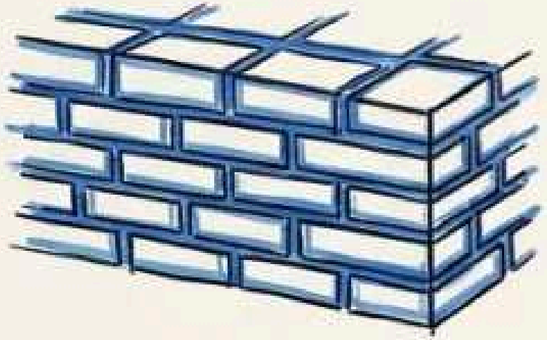


Cytoskeleton:
Protein fibres for shape/movement.

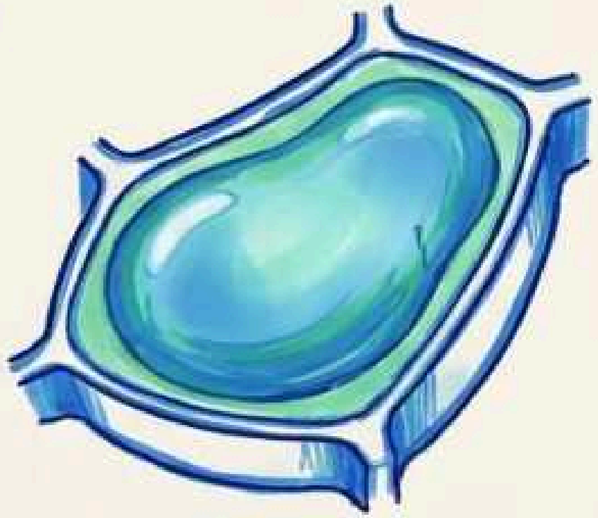


Lysosomes:
Digest waste.

Plant Cell Exclusives



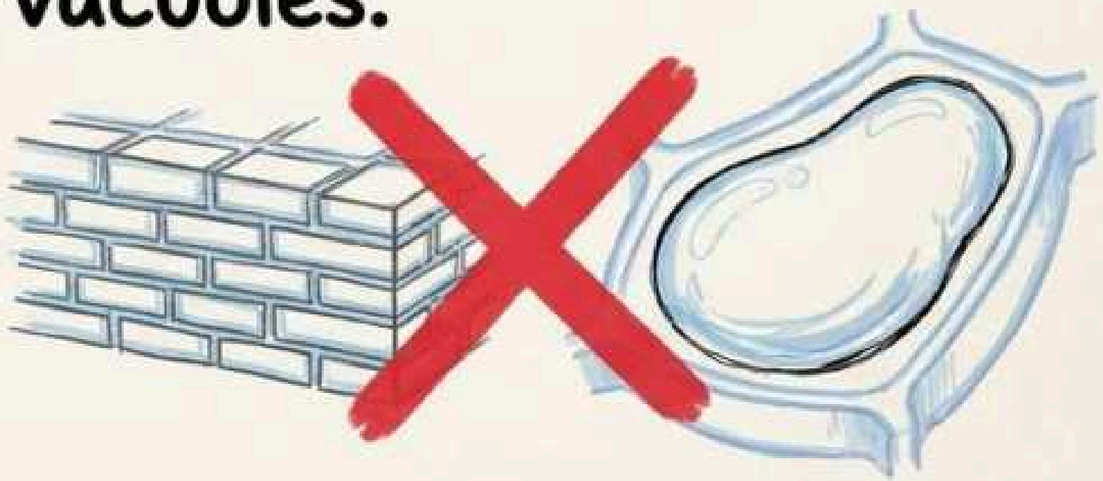
Rigid Cell Wall



Large Central Vacuole (stores water)

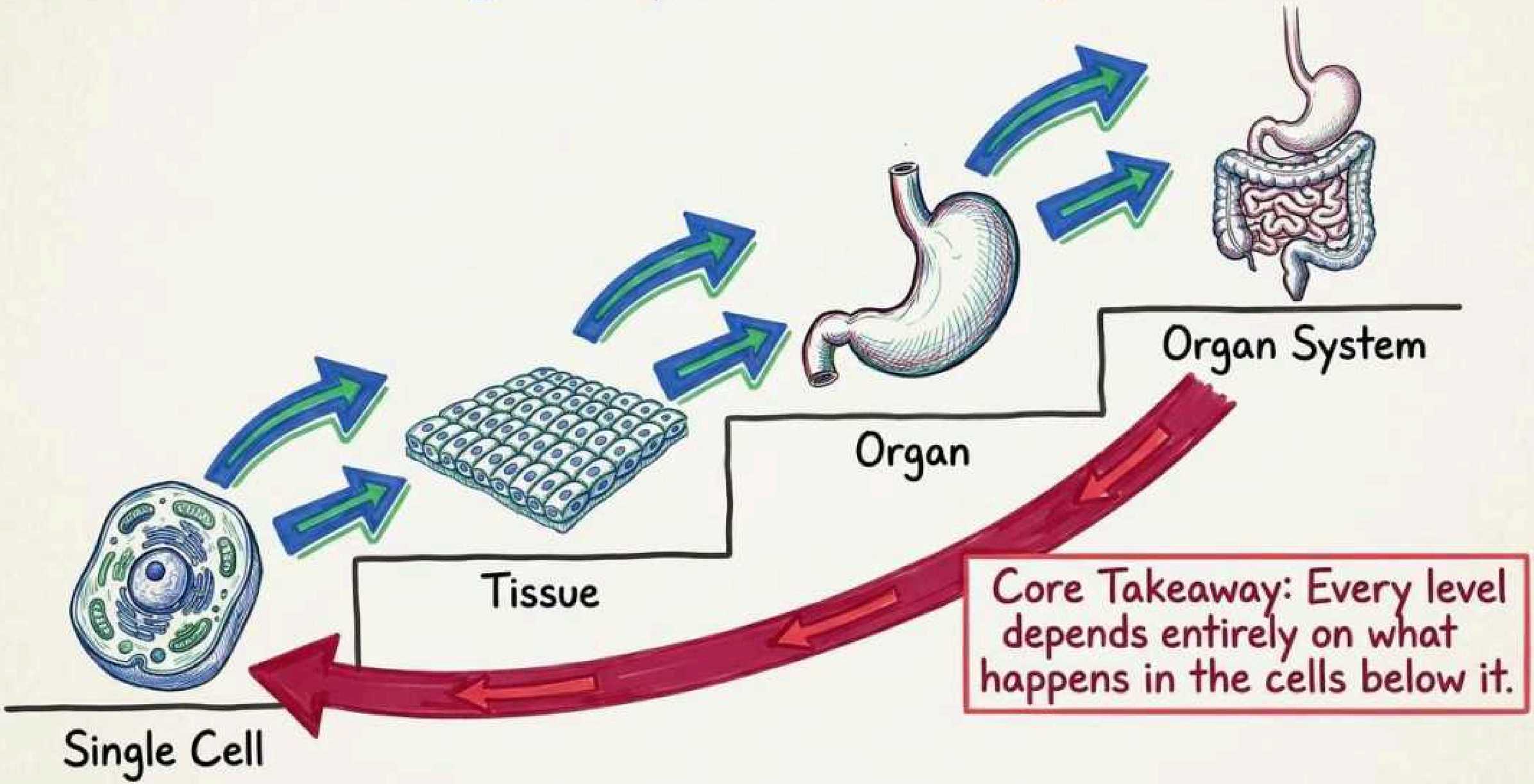
Animal Cell Note

Animal cells have neither rigid walls nor large central vacuoles.



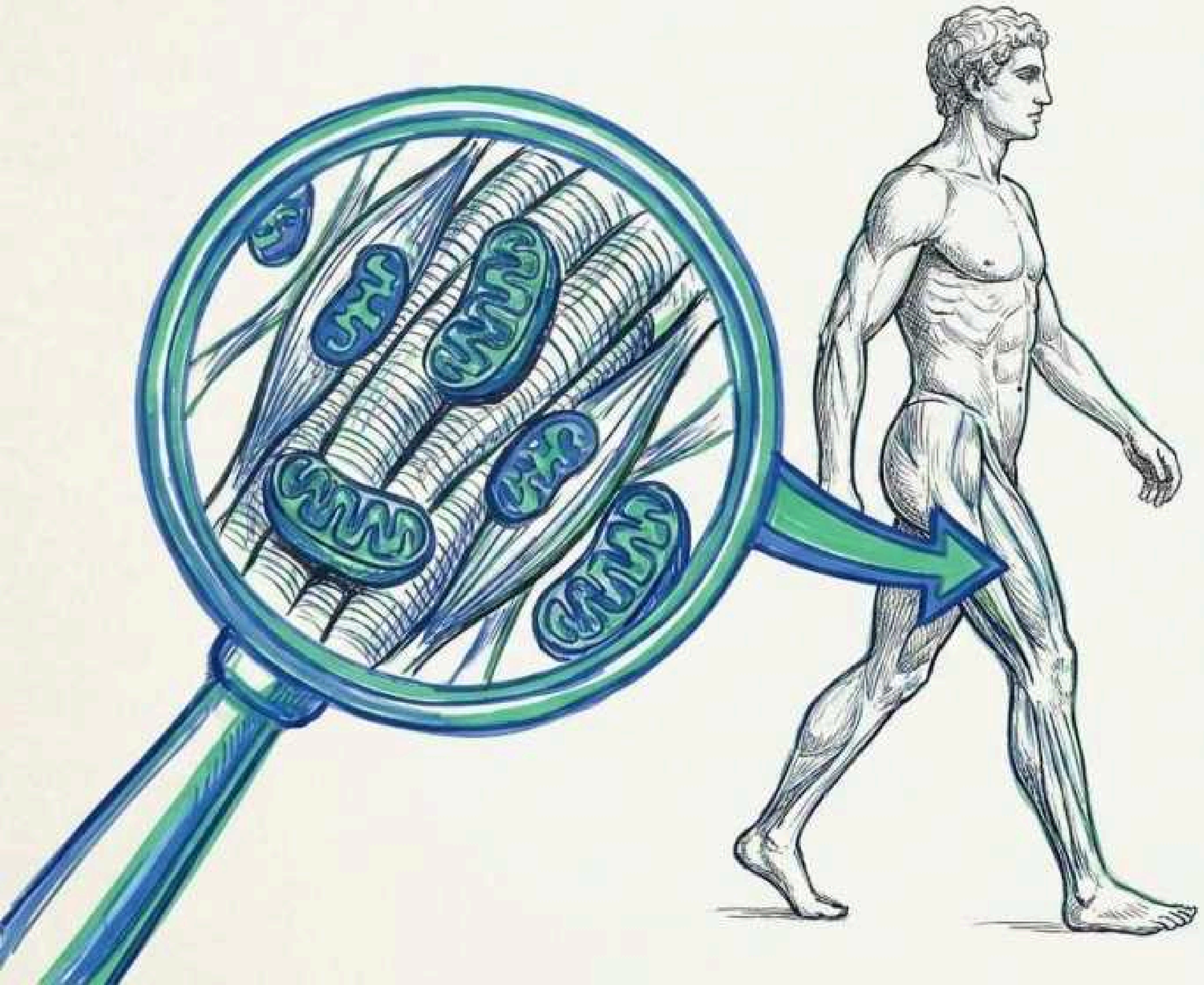
Building a Body (Multicellular Organisms)

¶ 1.19



Lecture Takeaway & Homework

¶ 1.20



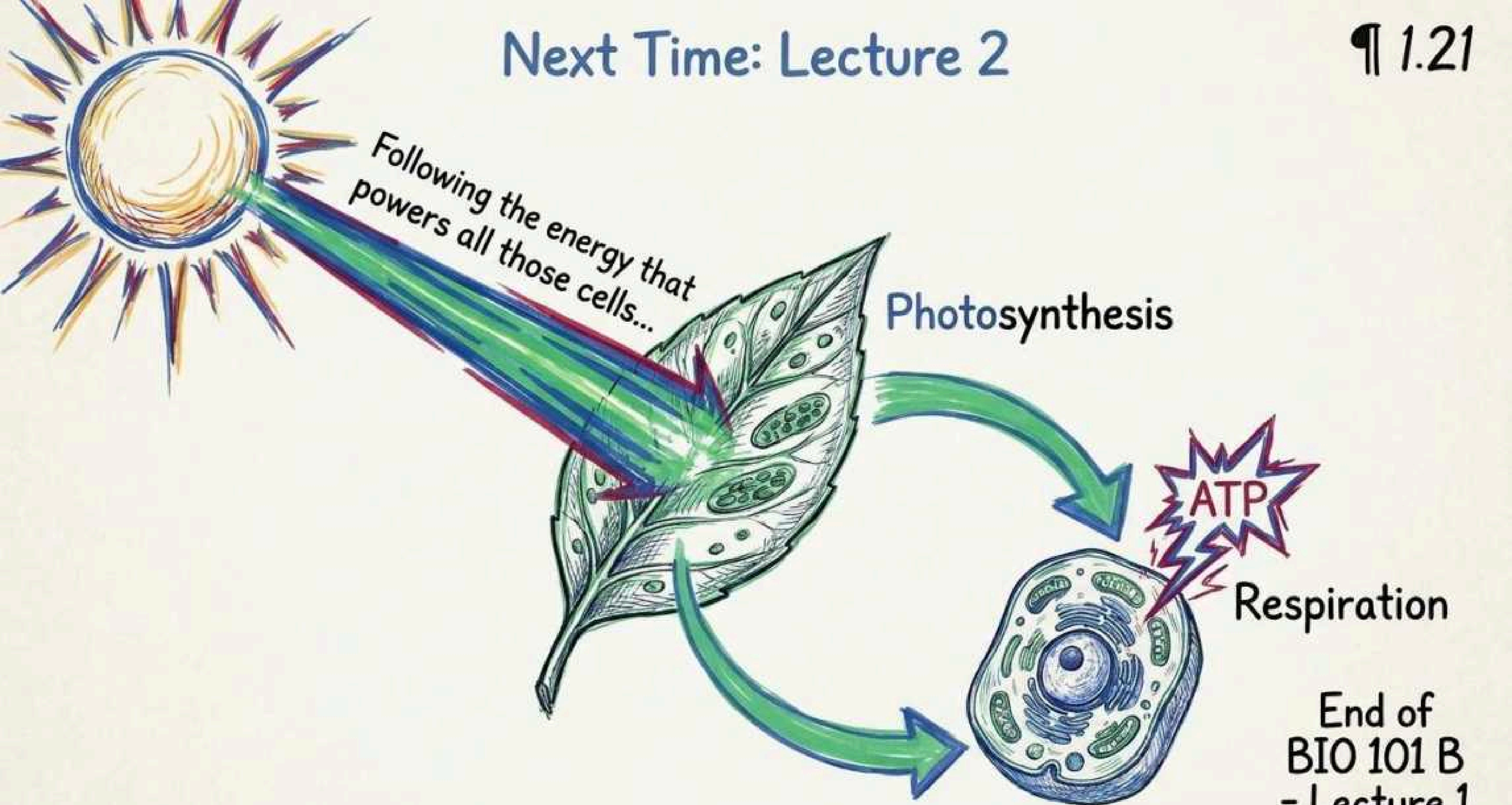
Thought Exercise:

Pick an action from today (e.g., walking, eating, reading).

What are the cells in your body doing to make it possible?

Requirement: Name at least 2 kinds of cells + 1 organelle your action depends on.

Next Time: Lecture 2



End of BIO 101 B - Lecture 1