A2.2

Cell & Microscope

Light Microscope

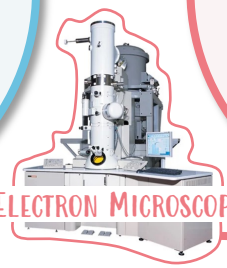
But dyes can be used to show color

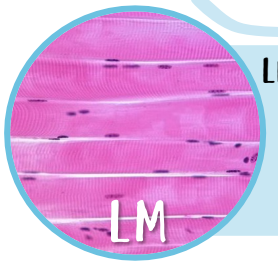
- Has no color
- Use light to view object
- × 2000
- 200nm resolution
- Inexpensive
- Examine living organisms
- Easy specimen preparation

Electron Microscope

But dyes can be used to show color

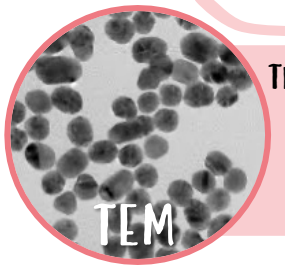
- Has no color
- Use electron beams
- × 500,000
- 1nm resolution
- Expensive
- Can't examine living organisms
- Complex specimen preparation





Light Microscopy

Uses fluorescent stains (dye) for color



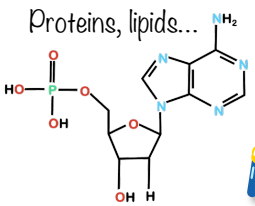
Transmission EM

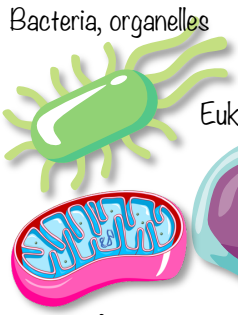
Inner structures can be viewed

Scanning EM

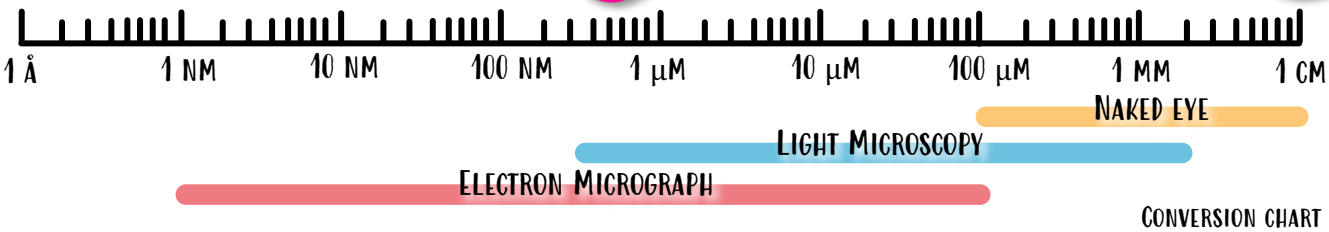
No inner structure
3D outer view

Cell Size...



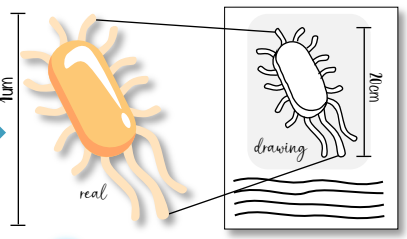


Smallest object visible by human eye



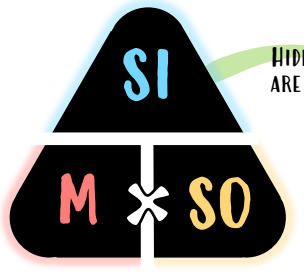
Magnification

$$Magnification = \frac{Size\ of\ image}{Size\ of\ object}$$



Conversion Chart

	1 m	
÷ 100		×100
	100 cm	
÷ 10		×10
	1000 mm	
÷ 1000		×1000
	1, 000, 000 um	
÷ 1000		×1000
	1, 000, 000, 000 nm	



Hide the one you are looking for!

$$Magnification = \frac{Size\ of\ image}{Size\ of\ object}$$

$$Magnification = \frac{200,000um}{1um}$$

Make sure to have same units(here um)

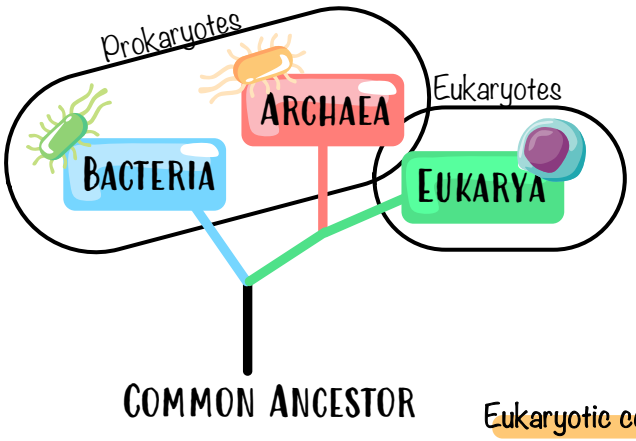
$$Magnification = 200,000$$

The bacteria has been magnified 200,000 times its size to create a 20cm large drawing of it!

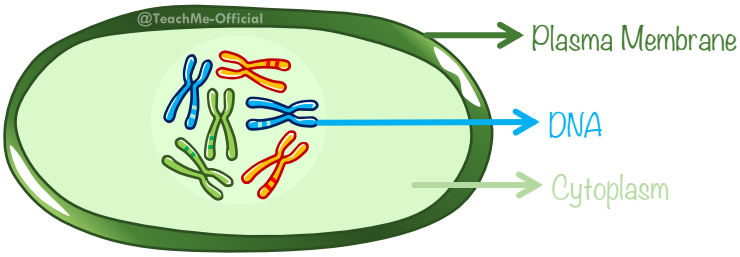
Teach Me

Eukaryotes

NORMAL | NUCLEUS

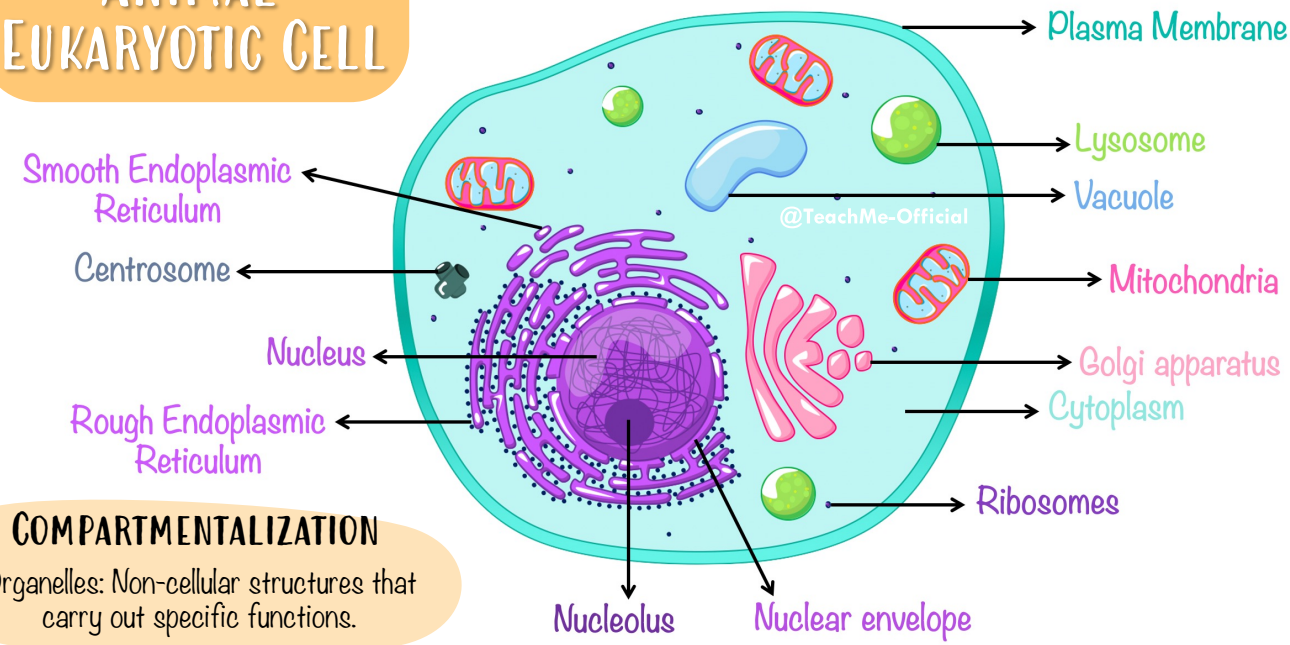


COMMON FEATURES TO ALL CELLS



Eukaryotic cells are found in: Animals + Plants + Fungi + Protozoa + Algae

ANIMAL EUKARYOTIC CELL

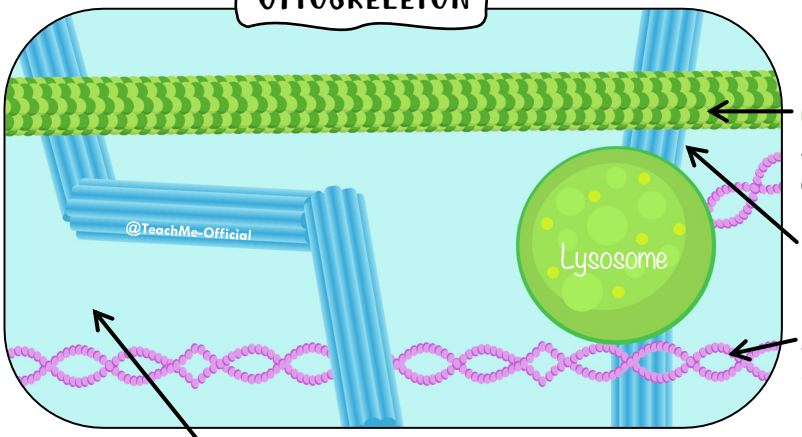


COMPARTMENTALIZATION

Organelles: Non-cellular structures that carry out specific functions.

Allows different chemical reactions to be separated

CYTOSKELETON



(Prokaryotes don't have cytoskeleton)

Microtubules – Shape & support the cell. Also function as movement paths or tracks through the cell for some organelles.

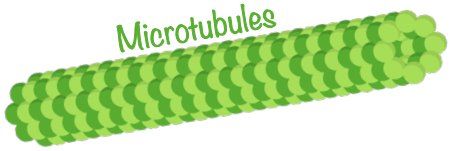
Intermediate filaments – reinforce cell shape as well as anchoring some organelles.

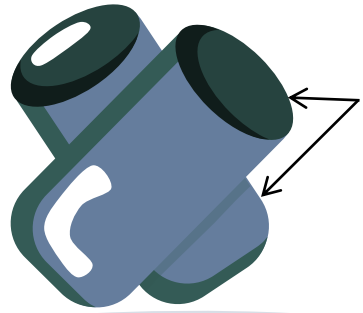
Actin Filaments (microfilaments) - cell division and cell movement (Eg. Contractions in muscle cells).

Cytoplasm (Cytosol + organelles) – the region where organelles are found, the fluid portion of the cell is called the **cytosol**.

CENTROSOME

Location - Close to the nucleus





A **centrosome** consists of a pair of centrioles – involved in the assembly of **microtubules**.

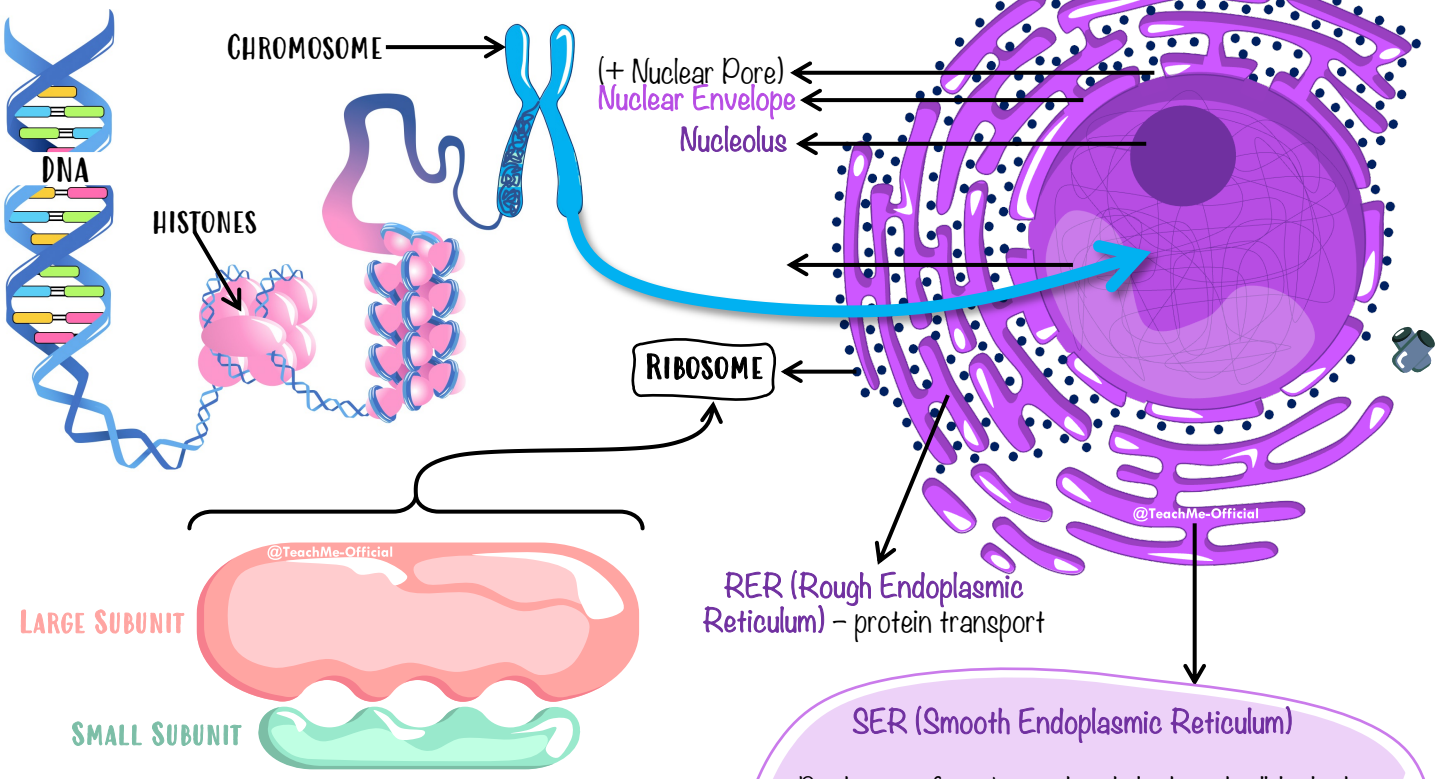
→ For structure and movement, important for cell division

Basal bodies are structures related to the centrosomes and are responsible for the formation of microtubules associated to cilia or flagella.

Centrioles do not exist in plant and fungal cells (instead have centrosome like regions).

THE NUCLEUS

Nucleus - Site where DNA resides & site of ribosome synthesis.



RER (Rough Endoplasmic Reticulum) – protein transport

Ribosome – may be free or bound (RER). Used for protein synthesis.

70S (Prokaryotic) or **80S** (Eukaryotic)

(called Svedberg units)

SER (Smooth Endoplasmic Reticulum)

Production of membrane phospholipids and cellular lipids.

Production of sex hormones (testosterone and estrogen).

Transportation of lipid-based compounds.

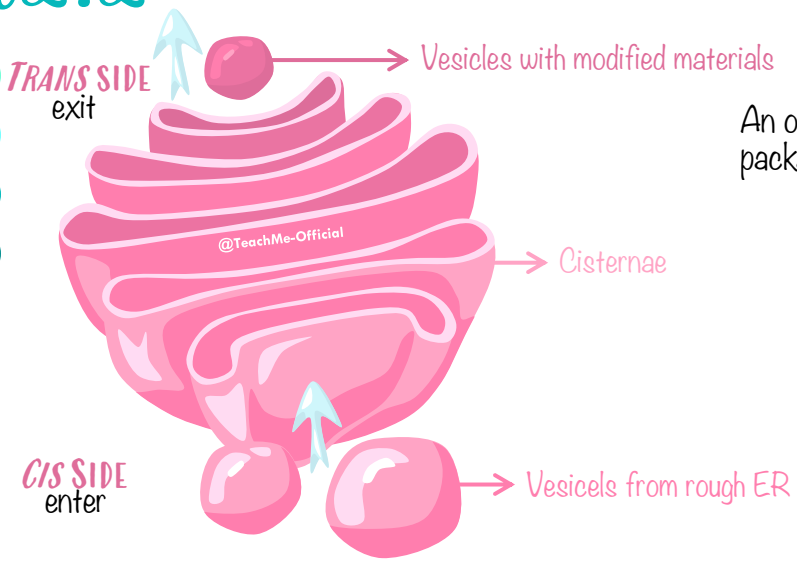
Detoxification of drugs in the *liver*.

Helping *liver* to release glucose into the bloodstream when needed.

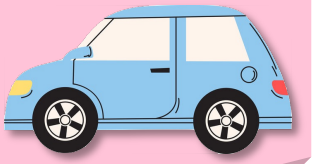
Storage of calcium ions in *muscle* cells. Muscle contraction.

GOLGI APPARATUS

An organelle which manages the collection, modifying, packaging and distribution of vesicles (transport vehicles).



BIG BRAIN TIP
Vesicle = Vehicle

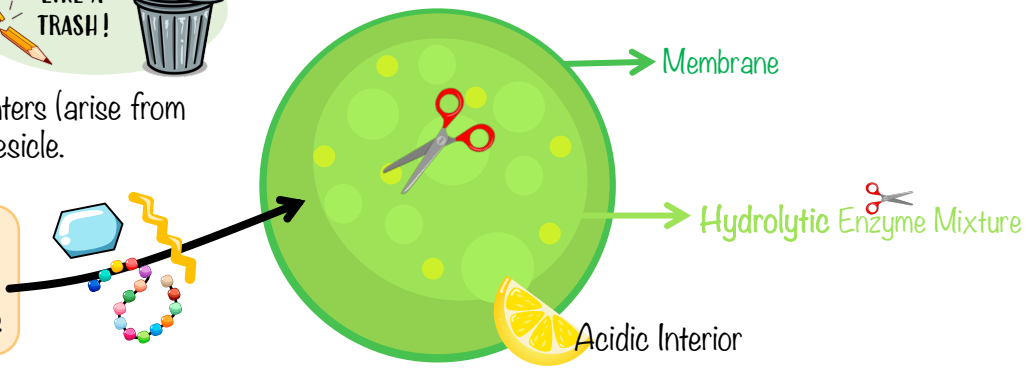


Vesicles - something that holds things and transport them

LYSOSOME

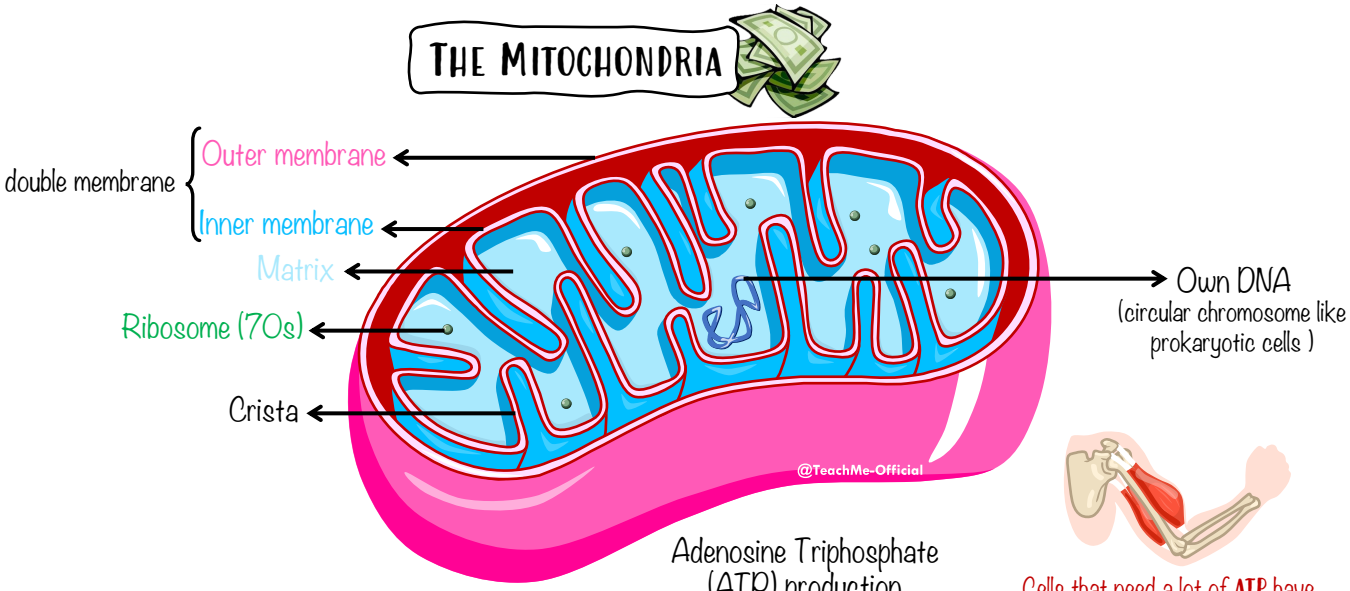
The intracellular digestive centers (arise from Golgi Apparatus), a type of vesicle.

Breakdown (hydrolysis) of proteins, lipids, carbohydrates, nucleic acids and old organelles



They can be brought into the cell by **PHAGOCYTOSIS** (a type of endocytosis)

THE MITOCHONDRIA

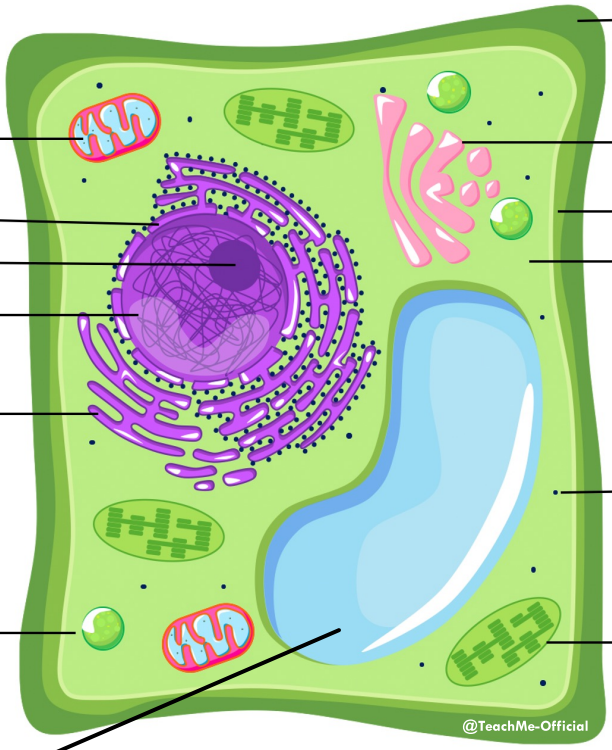


Adenosine Triphosphate (ATP) production

Aka. Energy!

Cells that need a lot of **ATP** have more mitochondria!
For example muscle cells

Plant Eukaryotic Cell



Cell Wall

Mitochondria

Golgi apparatus

Nuclear Envelope

Plasma membrane

Nucleolus

Cytoplasm

Nucleus

Endoplasmic Reticulum

Ribosomes

Lysosome

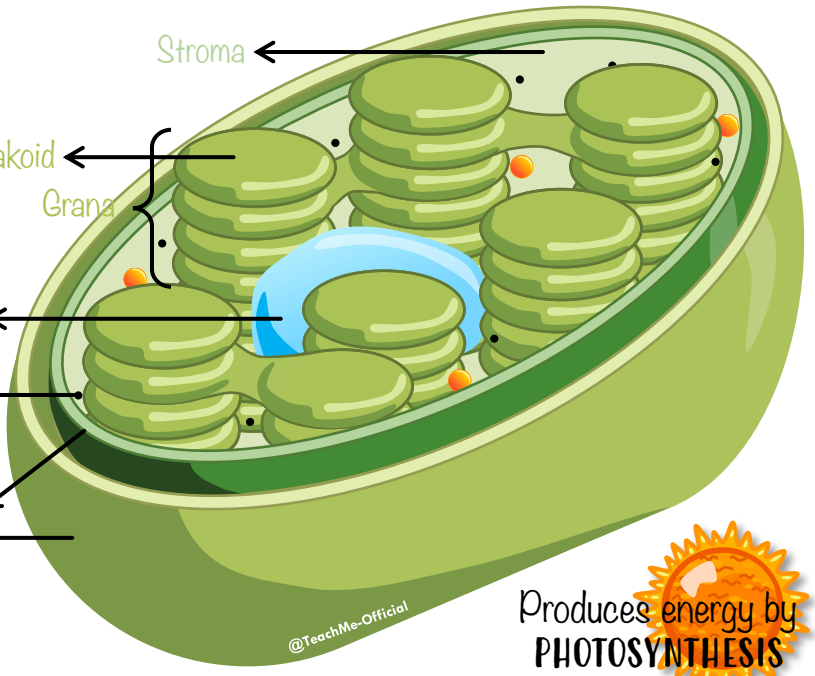
CHLOROPLAST

VACUOLE

(Made by Golgi)

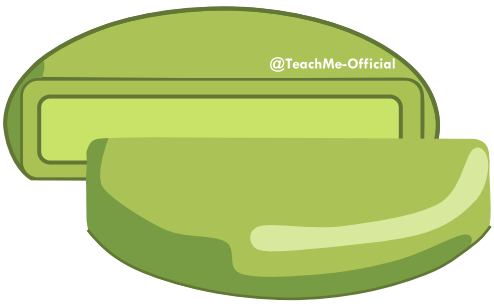
Plants > Animals
(large) (small)

Store potential food, waste, toxins & water



Have their own DNA (circular chromosome like prokaryotic cells)

* NOT ILLUSTRATED



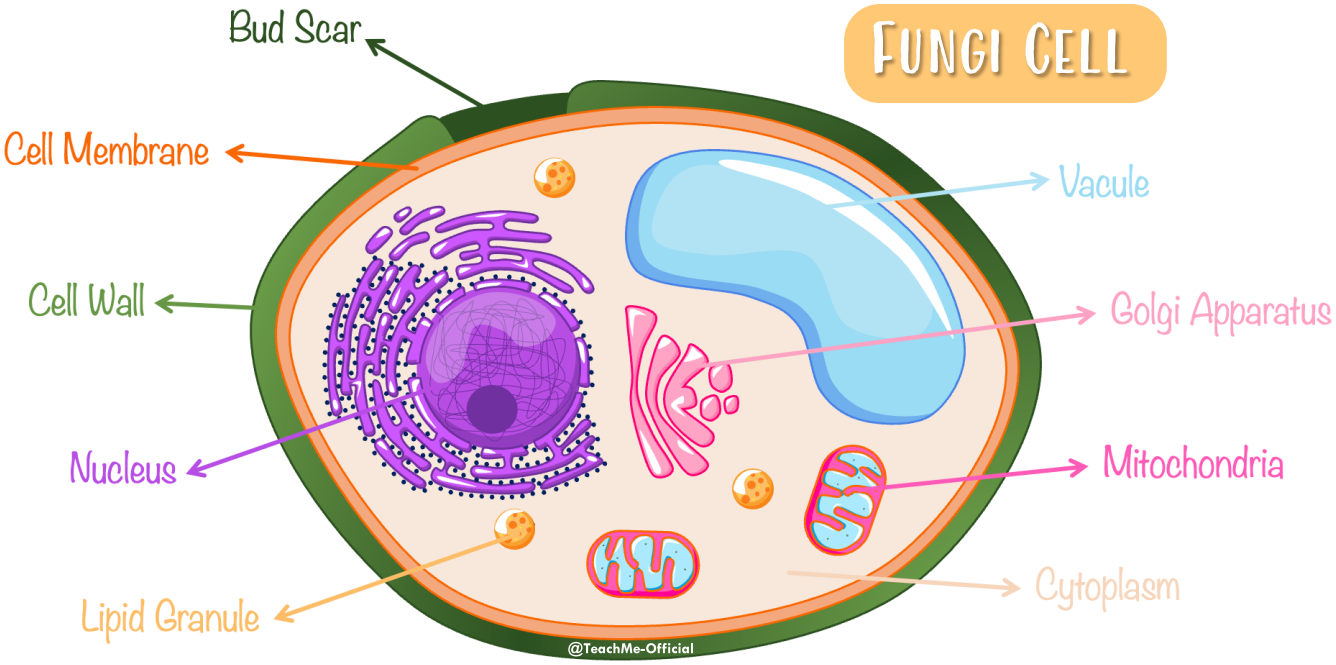
Produces energy by PHOTOSYNTHESIS

A real chloroplast

Summary functions for eukaryotic cells

Cell component	Function
Cytoplasm	Jelly-like substance that the organelles float in. It also contains enzymes that can help make reactions happen.
Cytoskeleton	Network of fibres. Maintain shape. Anchoring some organelles. Aiding cellular movements. Movement of organelles within a cell. Include actin filaments, intermediate filaments and microtubules.
Rough ER	This is the endoplasmic reticulum where ribosomes are attached to. This is the site of protein synthesis. As proteins are synthesized, they collect in the spaces between the membranes (known as cisternae). From here the proteins can be transported to other parts of the cell such as the Golgi Apparatus.
Smooth ER	The purpose depends on the cell within which it is located. In liver: Break down toxins. In ovary: Steroid hormone production (testosterone and oestradiol). Other: It can also produce phospholipids, that can help in membrane formation. Storage of calcium ions in muscle cells needed for contraction. Transportation of lipid-based compounds. Helping the liver to release glucose into the bloodstream when needed.
Nucleus	Contains the cells chromosomes or genetic code. This is the place of the instruction manual to our body. The nucleolus is the site of ribosome production.
Lysosome	This is the trash can of the cell (digestive centres). This is where cell components are broken down. It contains hydrolytic enzymes to do the breaking down. They arise from the Golgi apparatus. They are vesicles (sacs). Bounded by a single membrane. Phagocytosis (type of endocytosis).
Ribosomes – 80S	Where proteins are made. Could be free in the cytoplasm. Or on the surface of the ER.
Golgi apparatus	This organelle processes proteins made in the RER, collecting, packaging and modifying them. Finally releasing them in vesicles to other parts of the cell or outside of the cell. Consists of flattened sacs called cisternae. Cis side (near RER) and discharge on the trans side. Especially present in glandular cells.
Plasma Membrane	Allow and restrict the movement of substances in and out of the cell.
Mitochondria	The powerhouse of the cell. Where ATP (energy) is made during aerobic respiration.
Chloroplast (Plants only)	The site of photosynthesis Using light to make energy.
Cell Wall (Plants only)	It surrounds the cells. Helps maintain the cell structure and prevent it from bursting. Made of "peptidoglycan".
Vacuole (Plants only)	This area contains water and salts. Important of nutrient and water supply. Also, a very important structural component. Keeps the cell turgid and firm. Formed from the Golgi apparatus. Can store food, waste, toxins and water
Centrosome	In animal cells it consists of a pair of centrioles. These are involved in the assembly of microtubules. Important for cell movement and cell division. Plant/ fungal cells do not have centrioles: they have centrosome-like regions.

Fungi Cell



Whats their purpose?

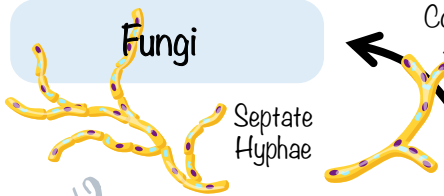
Decomposing organic matter (recycling)
Source of food
Medicine

Some examples

Plant	Animal	Fungal
Has Chloroplast	NO Chloroplast	NO Chloroplast
Has cell wall (cellulose) (rigid)	NO cell wall (flexible)	Has cell wall (chitin). Somewhat flexible. Vary shape.
Large vacuole present (central)	Small & numerous vacuole (rare)	Small & numerous vacuole (rare)
Stores starch	Stores glycogen	Stores glycogen
No cilia, flagella or basal bodies	May have cilia or flagella, with associated basal bodies	May have cilia or flagella, but do not have associated basal bodies
Possess centrosomes but no centrioles	Possess both centrosomes and centrioles	Possess centrosomes but no centrioles

Atypical Eukaryotes

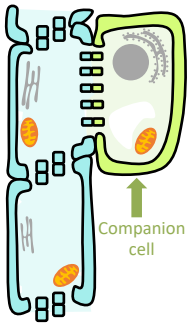
Fungi



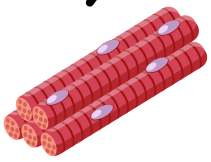
WHY? Many nuclei
No compartmentalization

Phloem Sieve Tube

WHY? Dependent on companion cells

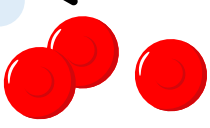


Skeletal Muscle Cell



Many nuclei
Composed of muscle fibers much larger than a single cell
WHY?

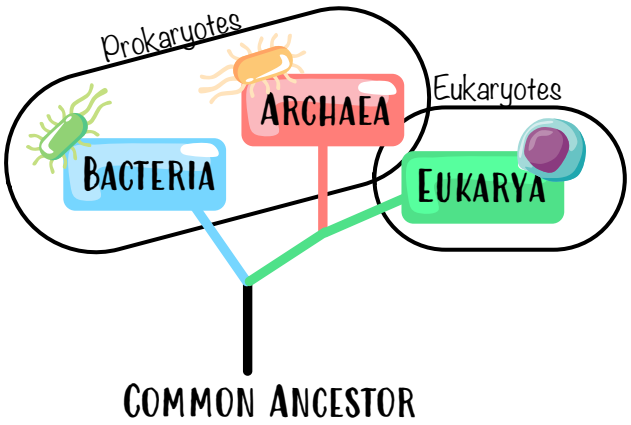
Red blood cells



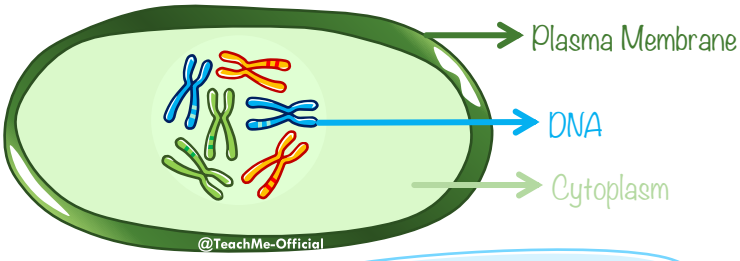
WHY? No nuclei

Prokaryotes

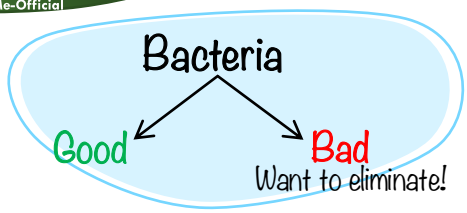
BEFORE NUCLEUS



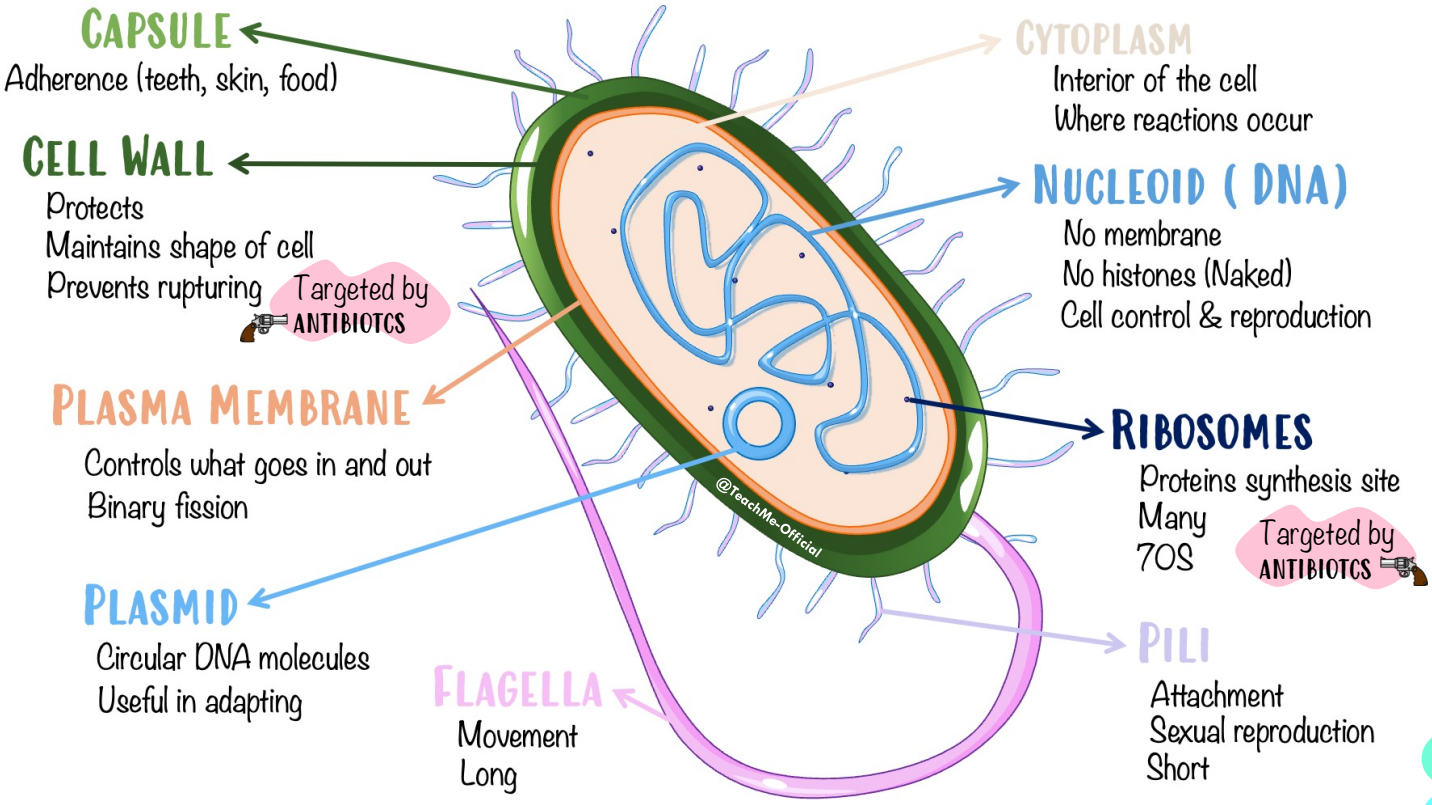
COMMON FEATURES TO ALL CELLS



Prokaryotic cells are found in: Bacteria and Archea



PROKARYOTIC CELL



CAPSULE
Adherence (teeth, skin, food)

CELL WALL
Protects
Maintains shape of cell
Prevents rupturing
Targeted by ANTIBIOTCS

PLASMA MEMBRANE
Controls what goes in and out
Binary fission

PLASMID
Circular DNA molecules
Useful in adapting

FLAGELLA
Movement
Long

CYTOPLASM
Interior of the cell
Where reactions occur

NUCLEOID (DNA)
No membrane
No histones (Naked)
Cell control & reproduction

RIBOSOMES
Proteins synthesis site
Many 70S
Targeted by ANTIBIOTCS

PILI
Attachment
Sexual reproduction
Short

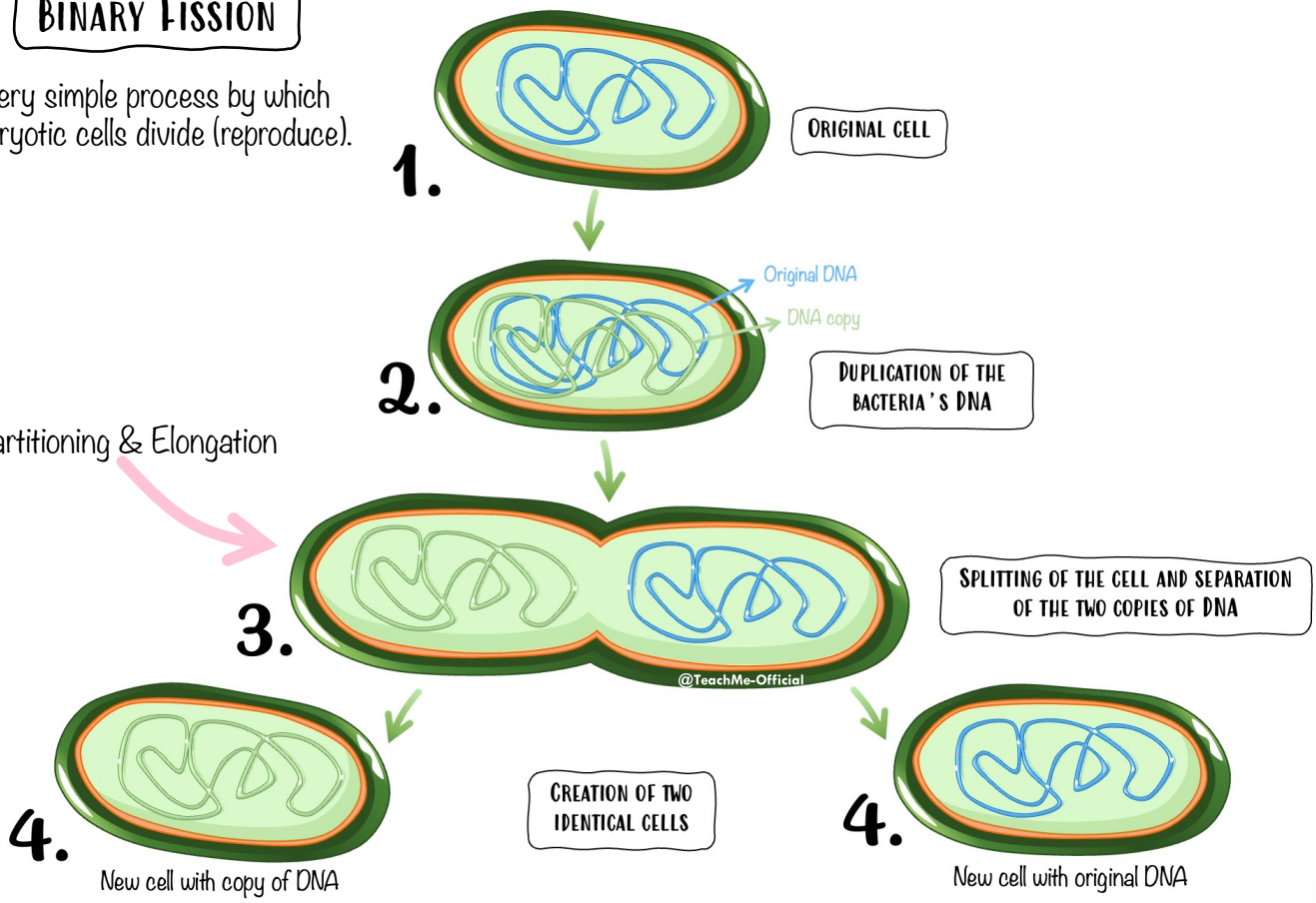
NO COMPARTMENTALIZATION!

Summary functions for prokaryotic cells

Cell component	Function
Cytoplasm	The interior of the cell. The fluid part is called cytosol. No compartmentalization.
Flagella	SOME prokaryotes have it. Made for movement. Anchored to cell well and plasma membrane.
Pili	For attachment, and communication. Can also help to exchange genetic material between cells (sexual reproduction).
Naked DNA – Nucleoid	The DNA or chromosomes are found in here. The genetic code. No nuclear envelope (nothing surrounding the DNA, no membrane). Not associated with histones.
Ribosomes – 70S	Where proteins are made. Composed of two subunits, protein and rRNA.
Plasmid	Extra DNA. It replicates (duplicates) independently of the nucleoid DNA. It can be passed from one cell to another. Helps in survival. Small, circular DNA molecules.
Plasma Membrane	Allow and restrict the movement of substances in and out of the cell. Control movement of substances in and out of the cell. Also plays a role in binary fission.
Cell Wall	It surrounds the cells. Helps maintain the cell structure and prevent it from bursting (protect). Made of "peptidoglycan" (carbohydrate-protein complex)
Capsule	Helps for survival of the cell. Useful for adherence. To places like the teeth, skin, and food. Some bacteria have this additional layer.

Binary Fission

A very simple process by which prokaryotic cells divide (reproduce).

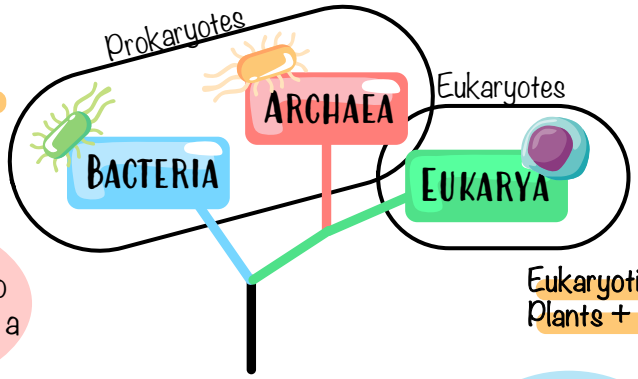


A2.2

Prokaryotes vs. Eukaryotes

BEFORE NUCLEUS — NORMAL NUCLEUS

Prokaryotic cells are found in: Bacteria and Archea



Remember, humans are eukaryotic:

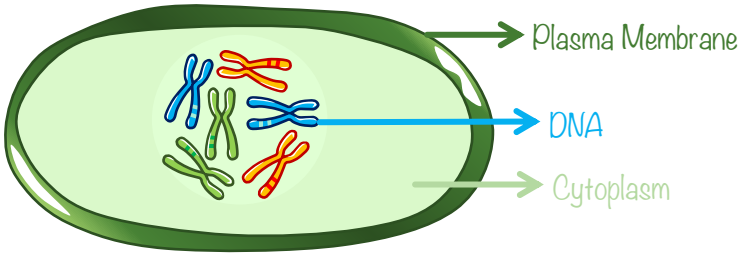
EU = YOU!

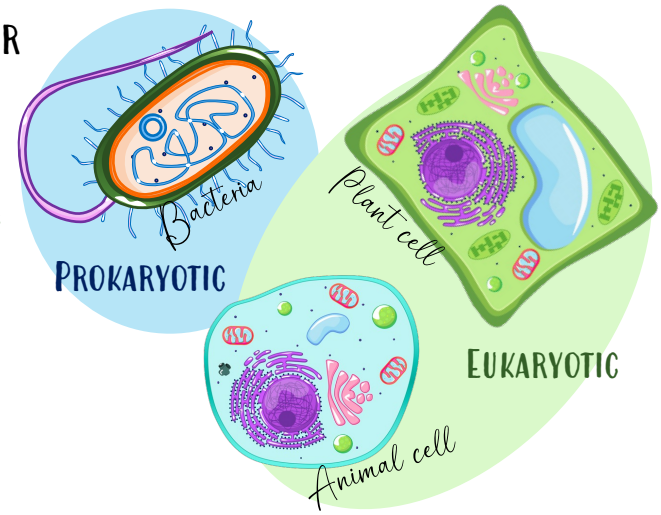
WHY DO WE CARE?

We want to find a way to destroy bacteria AND find a way to save ourselves

Eukaryotic cells are found in: Animals + Plants + Fungi + Protozoa + Algae

COMMON FEATURES TO ALL CELLS





Summary differences

STRUCTURE	PROKARYOTIC CELL	EUKARYOTIC CELL
COMPARTMENTALIZATION	No	Yes
SIZE	Smaller (<10um)	Larger (>10um)
NUCLEUS	No nucleus No nuclear envelope No nucleolus	Nucleus present Surrounded by nuclear envelope Containing chromosomes and nucleolus
CHROMOSOMES	DNA present Not associated with histone proteins (Naked) Circular plasmids may be present	DNA arranged in long strands Associated with histone proteins.
MITOCHONDRIA	No	Yes (usually)
CHLOROPLASTS	No	Yes (plants)
ENDOPLASMIC RETICULUM	No	Yes (usually)
RIBOSOMES	Relatively small 70S	Relatively large 80S
CELL WALL	Yes (made of peptidoglycan)	Yes (plant cells) Made of cellulose
FLAGELLA	Some have flagella	Sometimes present

Unicellular Organisms

Whether unicellular or multicellular all cells can perform the 7 functions of life:

The 7 functions of Life

- **HOMEOSTASIS** – Maintenance of a constant internal environment.
- **METABOLISM** – The sum of all the chemical reactions that occur within an organism.
- **RESPONSE** – As the environment changes, the organism adapts.
- **GROWTH** – The development of an organism.
- **REPRODUCTION** – The ability to produce offspring.
- **EXCRETION** – The ability to release materials not needed or harmful into the surrounding environment.
- **NUTRITION** – The ability to acquire the energy and materials needed to maintain life.

HOW TO REMEMBER?

HI MR. GREN!

notes