

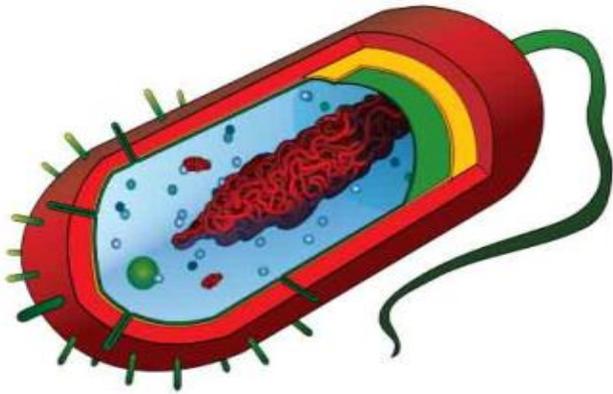


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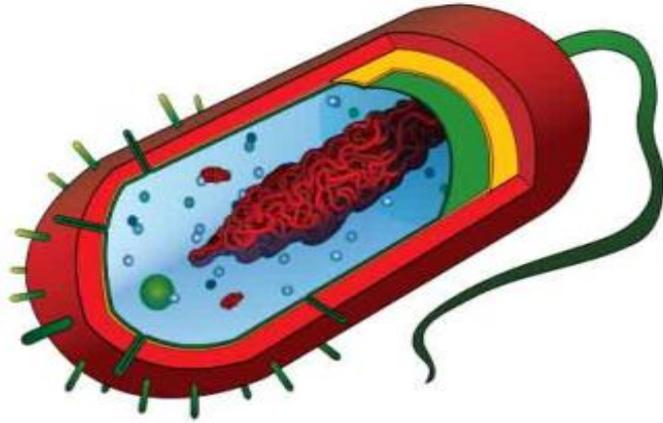
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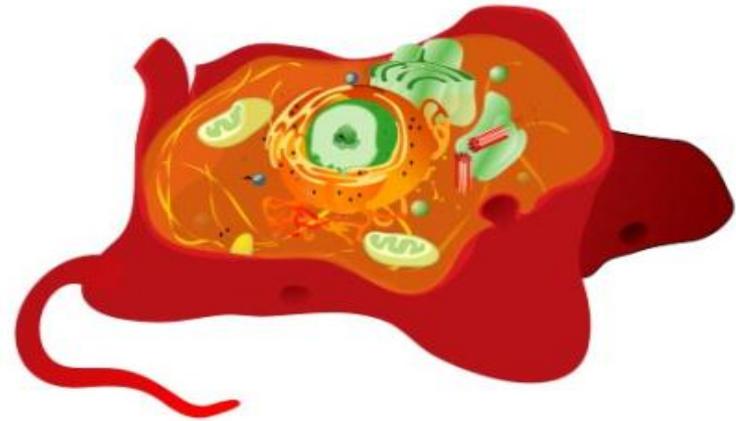
Biological Cell Structure & Function



Two Basic Types of Cells



Prokaryotic
Cells



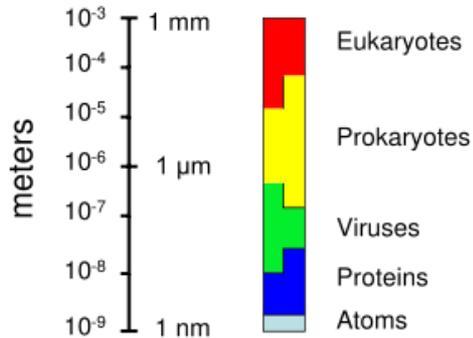
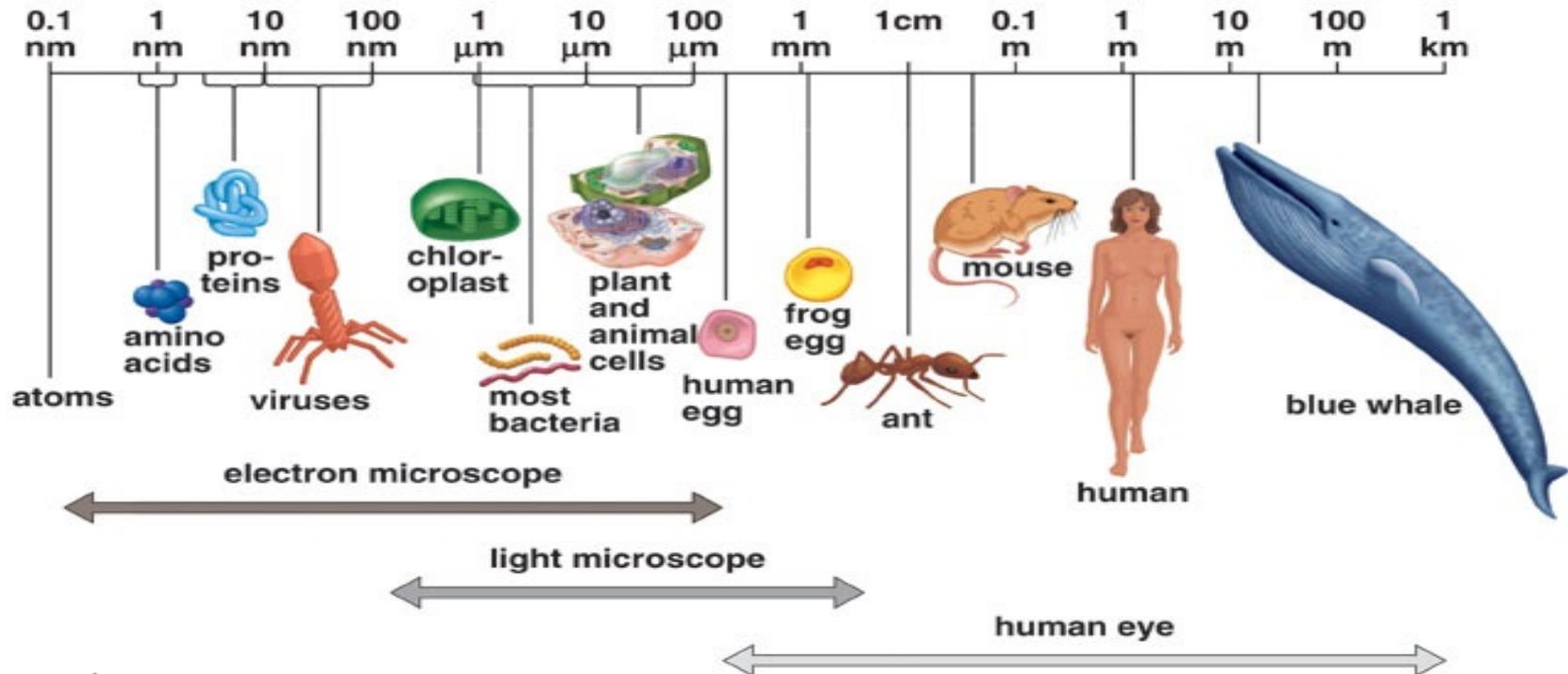
Eukaryotic
Cells

Cells:

- are the building blocks of life!
- All living things are made of one or more cells.
- only come from other cells.
- are , really small. [How small are they?](#)
- small because of surface to volume ratio

WATCH THIS!
[Introduction to
Cell Video](#)

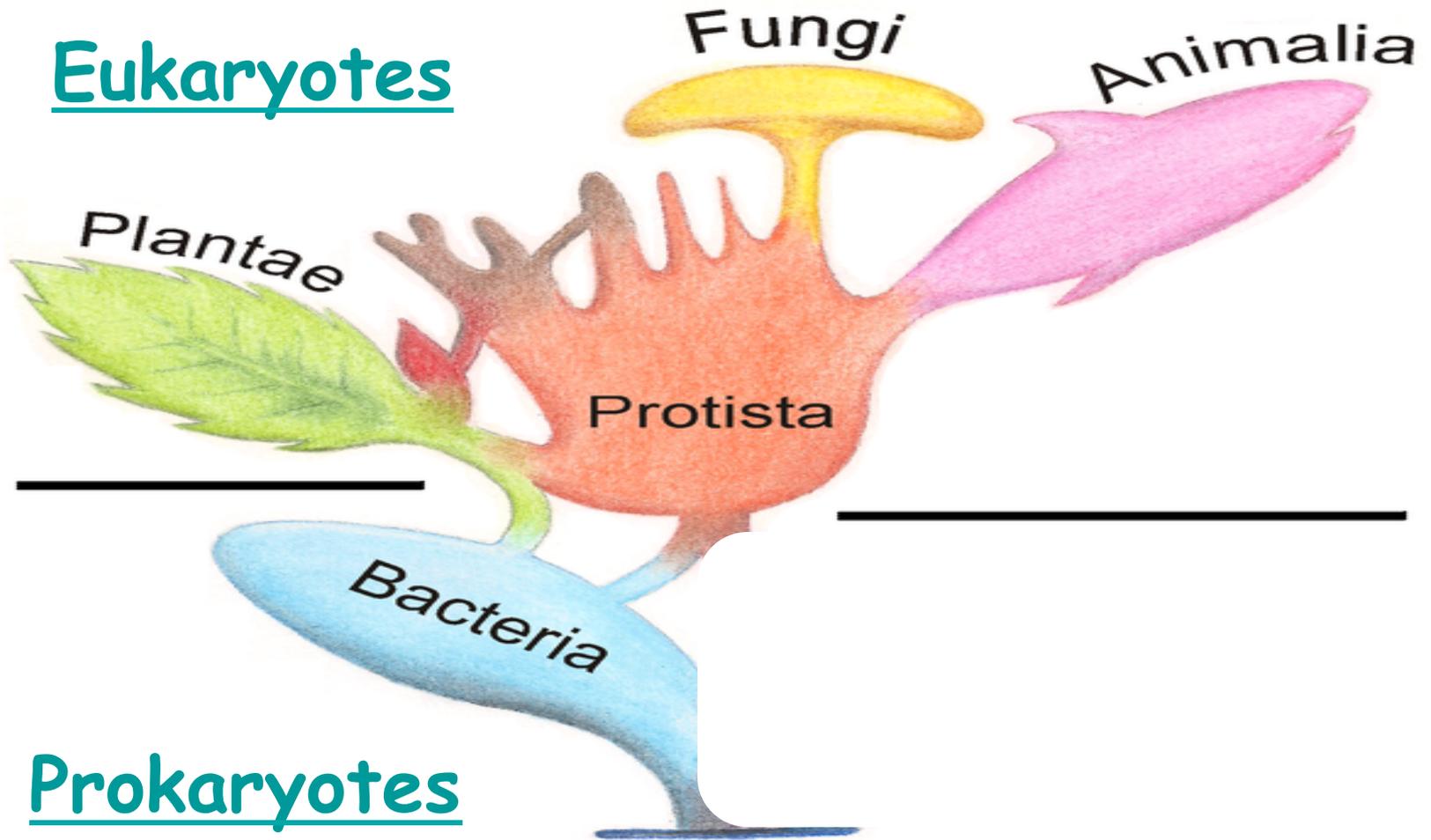
Size of Living Things



$1 \text{ m} = 100 \text{ cm} = 1,000 \text{ mm} = 1,000,000 \mu\text{m} = 1,000,000,000 \text{ nm}$
 $1 \text{ mm} = 1000 \mu\text{m} = 1,000,000 \text{ nm}$
 $1 \mu\text{m} = 1000 \text{ nm}$

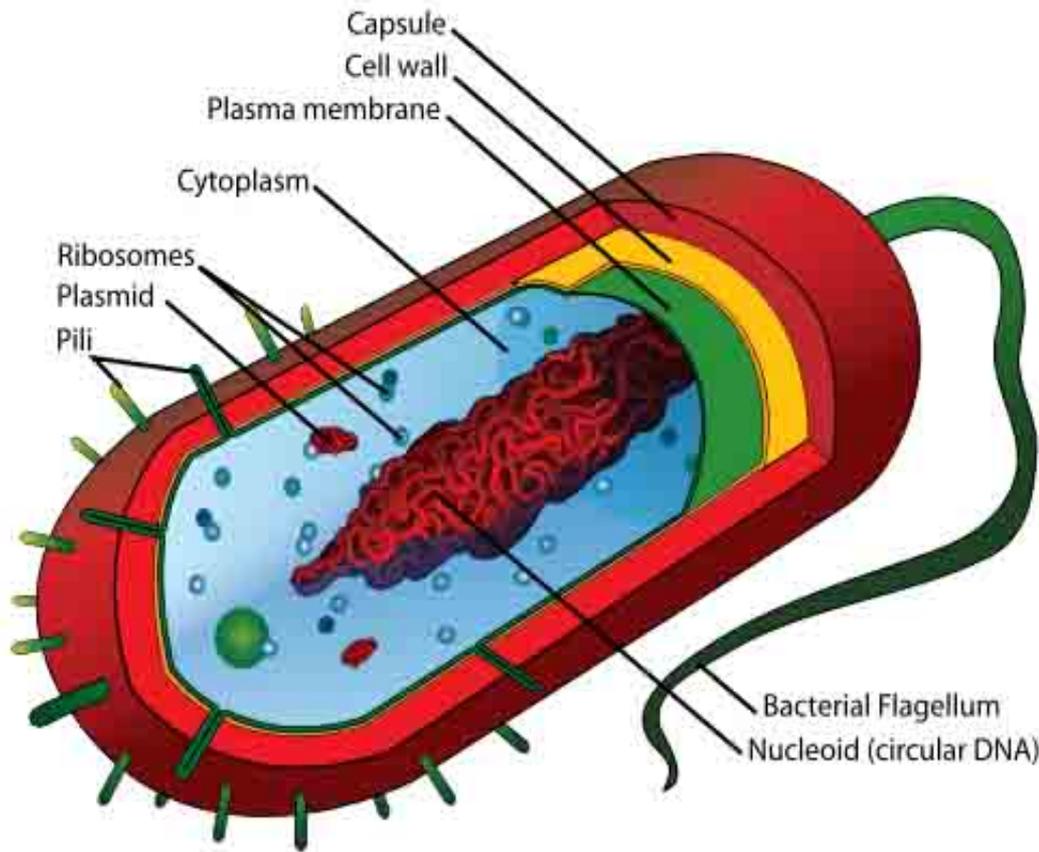
Click link for an interactive
["Size of Microscopic Things"](#)
 animation on Cells Alive.

Old School 5 Kingdom classification of organisms

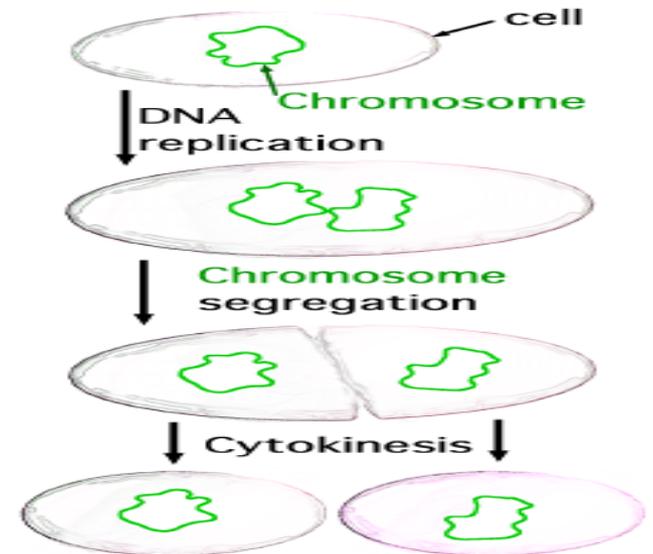


Prokaryotes (Bacteria)

Tell me about Prokaryotes...



Binary Fission



Check out these quick animated lessons on binary fission:

(Please watch both, as each provides different and useful information.)

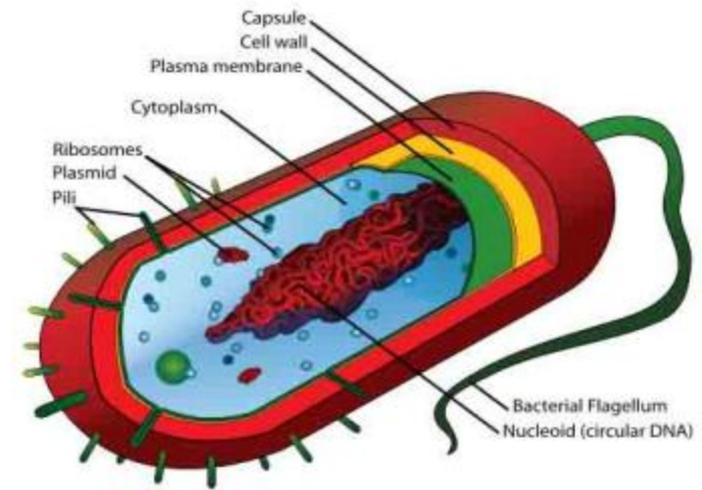
[Binary Fission Animation](#)
from ClassZone

[Binary Fission Animation](#)
From McGraw-Hill

Bacterial Genetics

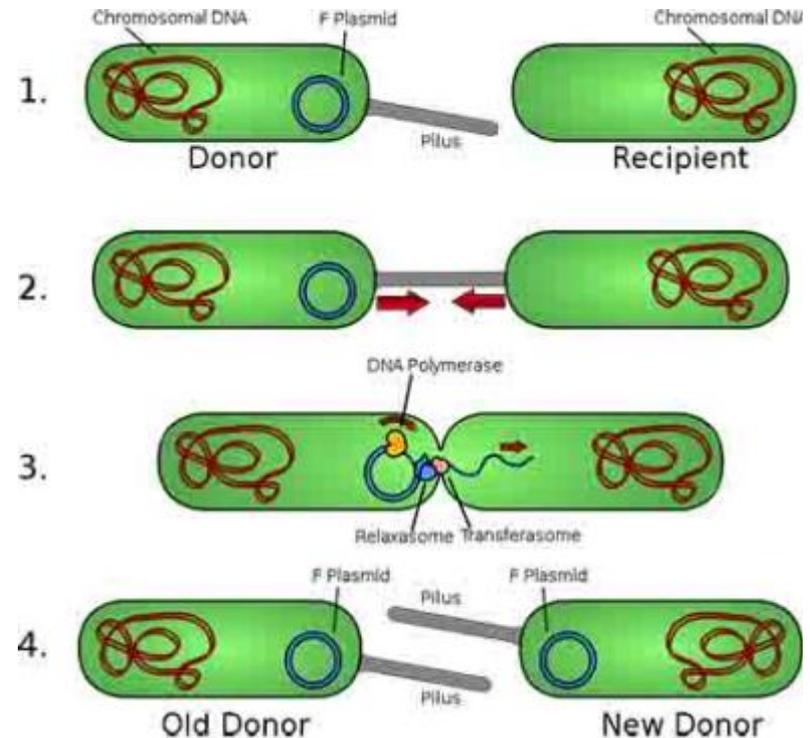
Nucleoid

- Region of cytoplasm where prokaryote's **genome** (**DNA**) is located.
- Usually a singular, circular chromosome.



Plasmid

- Small extra piece of chromosome/genetic material.
- 5 - 100 genes
- Not critical to everyday functions.
- Can provide genetic information to promote:
 - Antibiotic resistance
 - Virulence factors
(molecules produced by pathogen that specifically influence host's function to allow the pathogen to thrive)
 - Promote **conjugation**
(transfer of genetic material between bacteria through cell-to-cell contact)

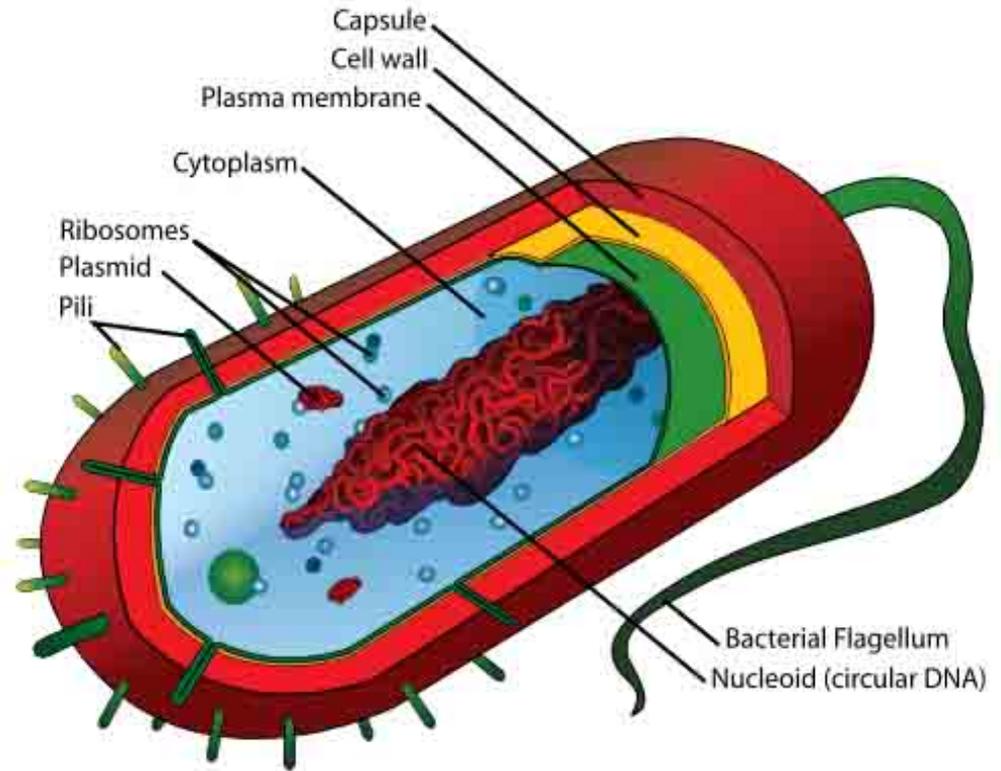


Prokaryotes

Bacteria

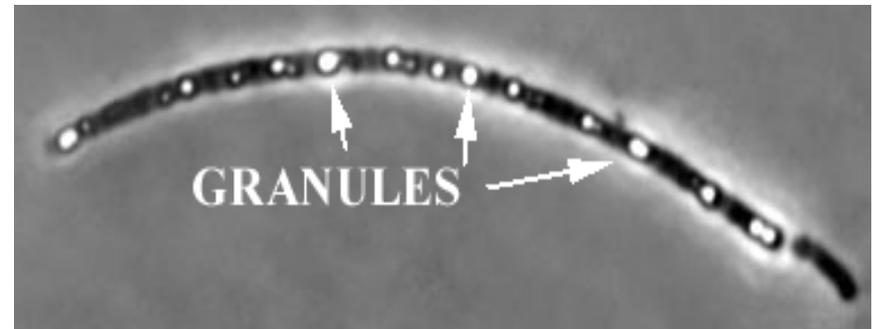
Cytoplasm

- Also known as proto-plasm.
- Gel-like matrix of water, [enzymes](#), nutrients, wastes, and gases and contains cell structures.
- Location of growth, metabolism, and [replication](#).



Granules

- Bacteria's way of storing nutrients.
- Staining of some granules aids in identification.

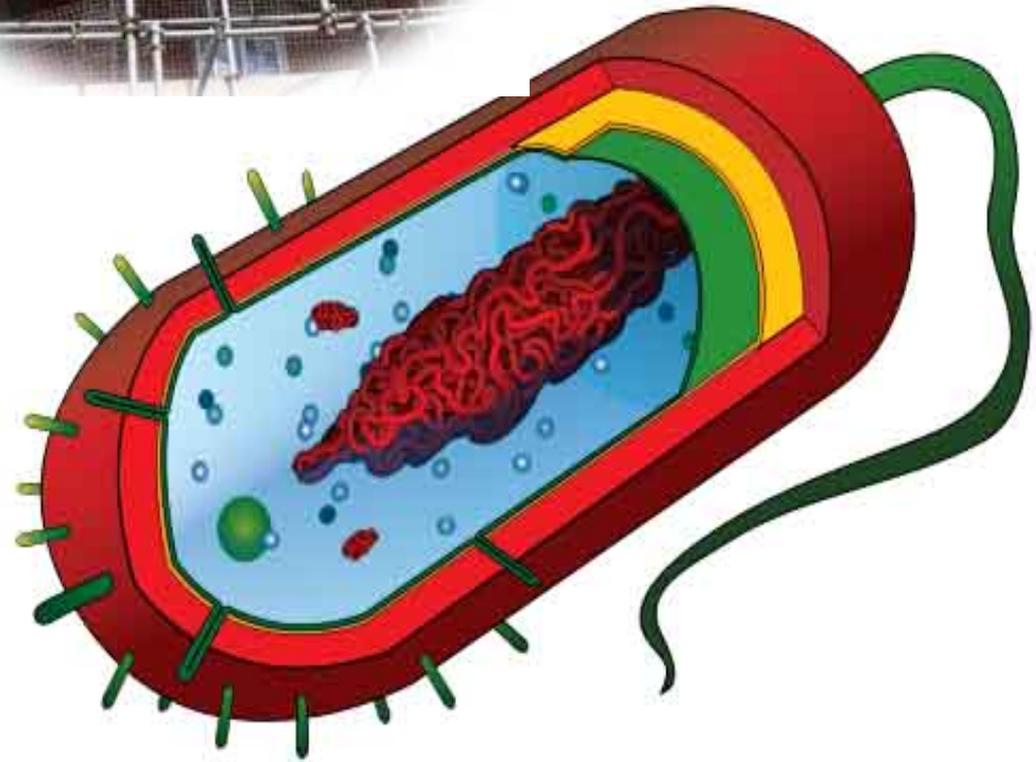


Prokaryotes

Bacteria

Cytoskeleton

- Cellular "scaffolding" or "skeleton" within the cytoplasm.
- Major advance in prokaryotic [cell biology](#) in the last decade has been discovery of the [prokaryotic](#) cytoskeleton.
- Up until recently, thought to be a feature only of [eukaryotic](#) cells.

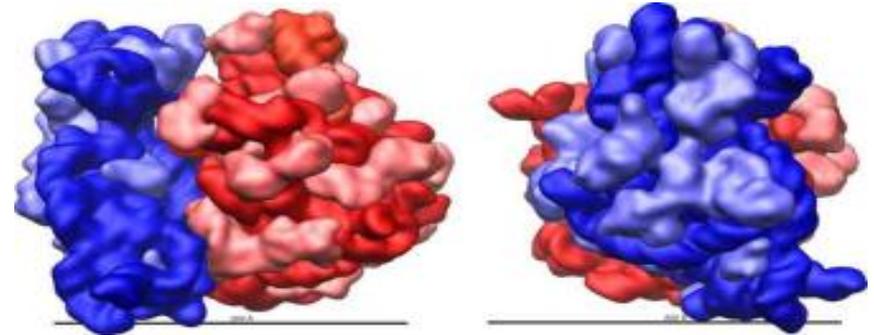


Prokaryotes

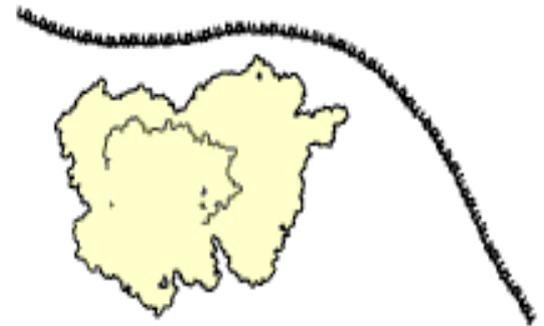
Bacteria

Ribosomes

- Found within cytoplasm or attached to plasma membrane.
- Made of protein & rRNA.
- Composed of two subunits.
- Cell may contain thousands .
- **Q:** *What do ribosomes do?*
- **Q:** *What's the relationship between the job that the ribosomes do and the genetic instructions (nucleic acids) of the cell?*



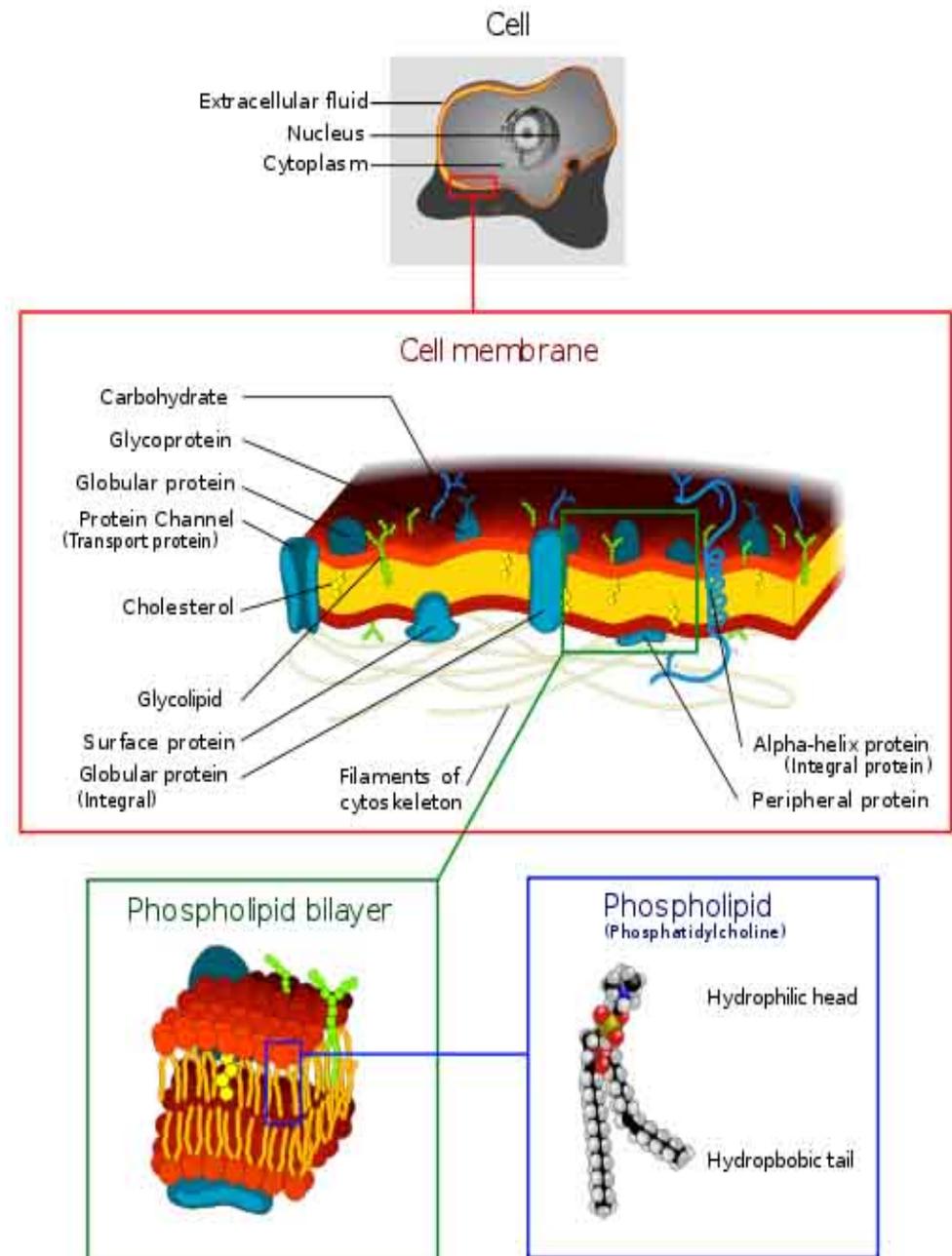
[Click here](#) for animation of ribosome building a protein.



Prokaryotes

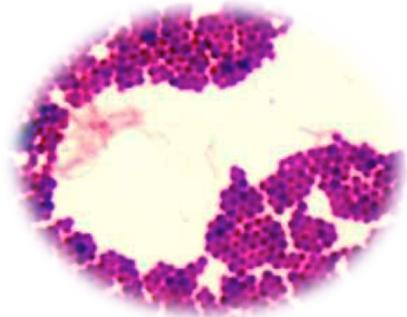
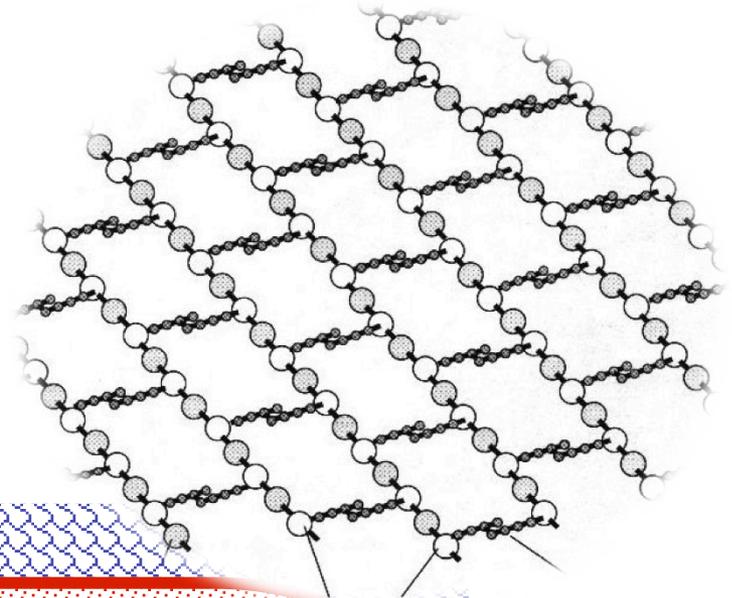
Plasma Membrane

- Separates the cell from its environment.
- Phospholipid molecules oriented so that **hydrophilic water-loving** heads directed outward and **hydrophobic water-hating** tails directed inward.
- Proteins embedded in two layers of lipids (lipid bilayer).
- Membrane is **semi-permeable**.
Q: What does that mean?

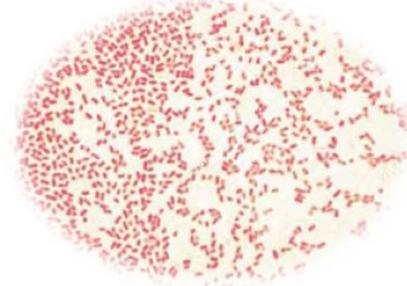


Bacterial Cell Wall

- **Peptidoglycan** is a huge polymer of interlocking chains of alternating sugar monomers held together with peptide bridges.
- Provides rigid support while freely permeable to solutes.
- Two main types of bacteria cell wall.



Gram-positive



Gram-negative

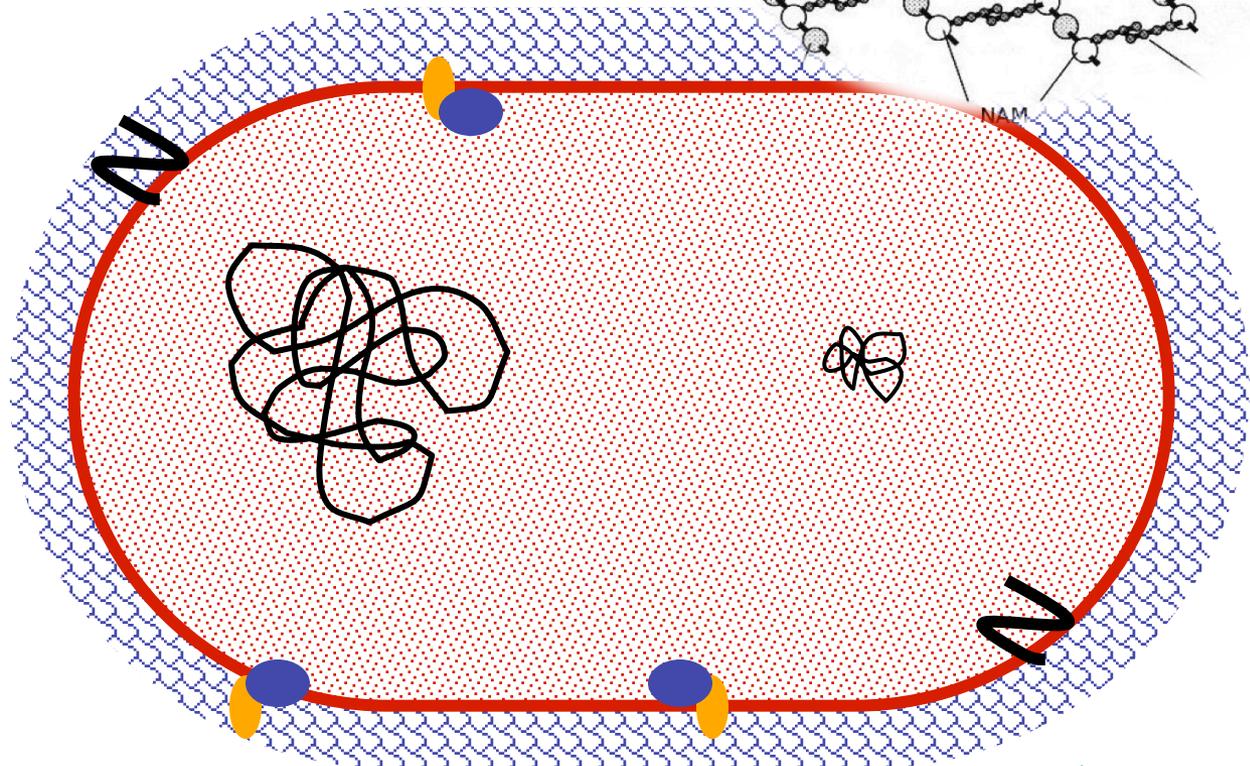


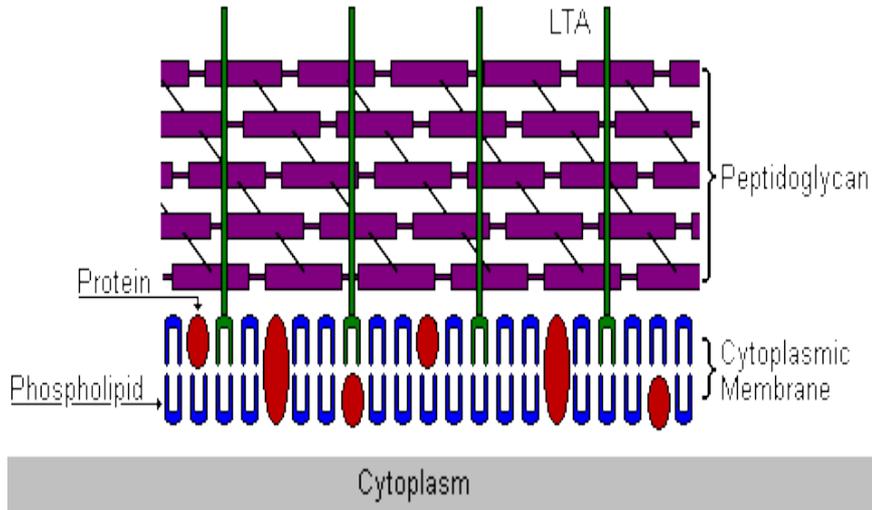
Image: [Bonding structure peptidoglycan](#),

Mouagip; Gram-positive and Gram-negative bacteria @ 100xTM

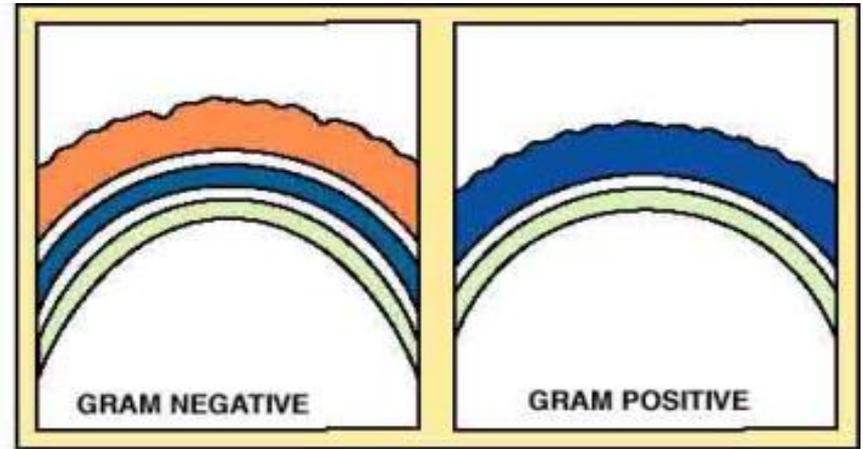
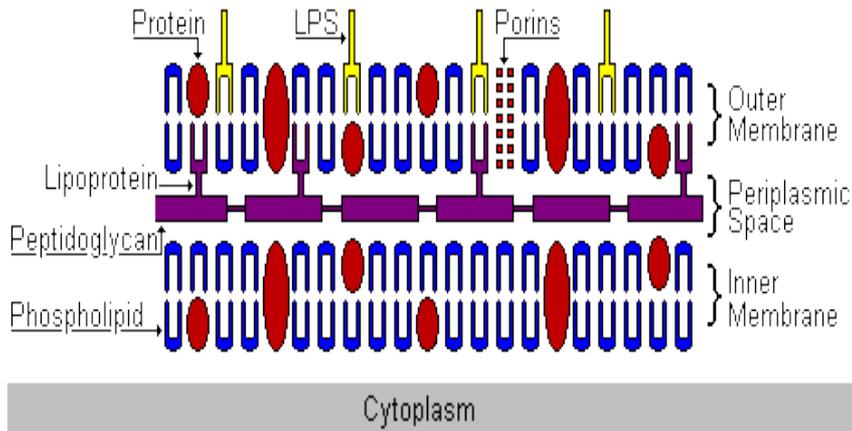
Bacterial Cell Wall

Gram-Positive & Gram-Negative

Gram-positive Cell Wall



Gram-negative Cell Wall



Q: Why are these differences in bacterial cell wall structure important?



Bacterial Endospores

- Dormant, tough, non-reproductive structure produced by small number of bacteria.
- Resistant to radiation, desiccation, lysozyme, temperature, starvation, and chemical disinfectants.
- Endospores are commonly found in soil and water, where they may survive for very long periods of time.

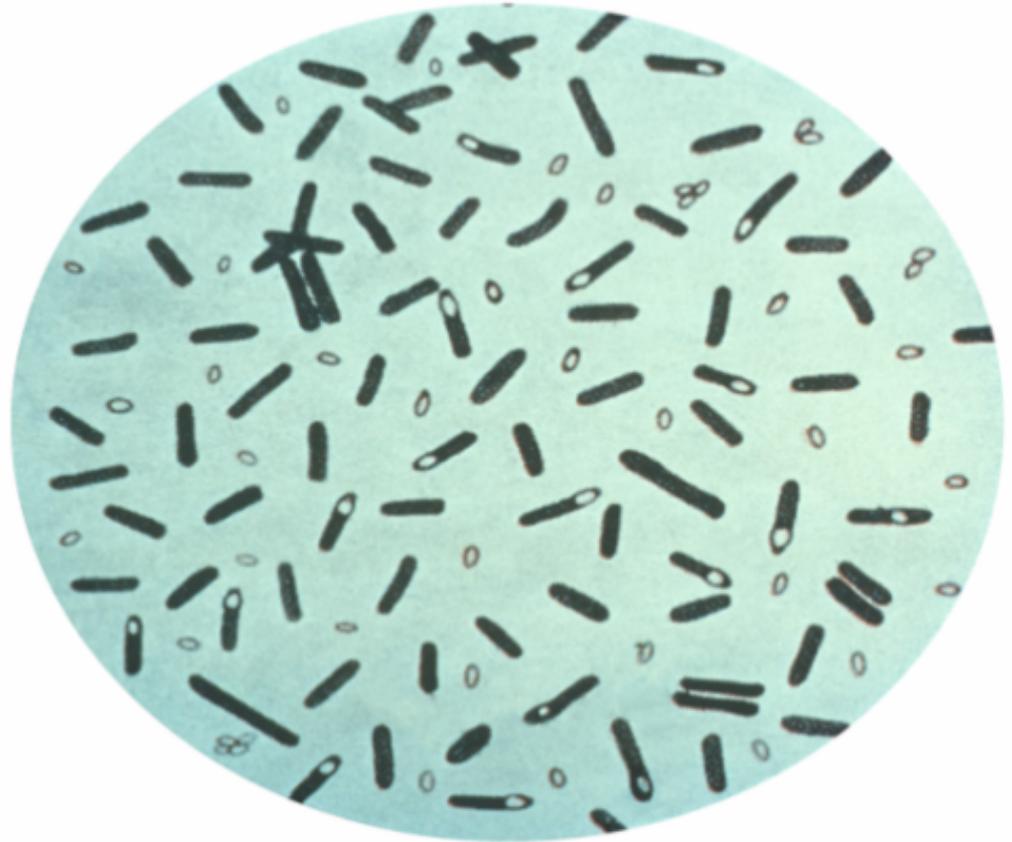


Image: *Bacillus subtilis*, SPO Science Image Library; , *Clostridium botulinum*, [PHIL](#) #2107

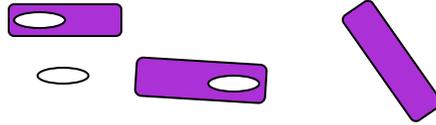
Bacterial Genus : Clostridium

GRAM-POSITIVE

Obligate anaerobes

bacillus-shaped

endospore producer



- The members of this genus have a couple of bacterial "superpowers" that make them particularly tough pathogens.
- They produce endospores
- Also produce a variety of toxins, some of which are fatal.
 - *Clostridium tetani* = agent of tetanus
 - *C. botulinum* = agent of botulism
 - *C. perfringens* = one of the agents of gas gangrene
 - *C. difficile* = part of natural intestinal flora, but resistant strains can proliferate and cause pseudomembranous colitis.



Prokaryotes

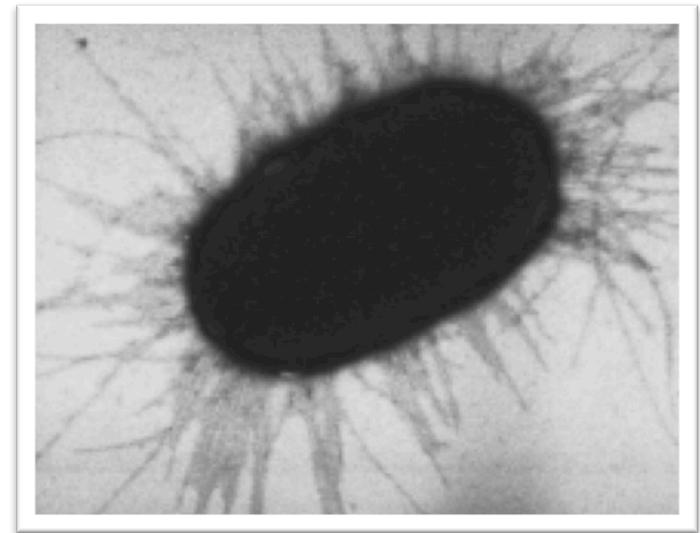
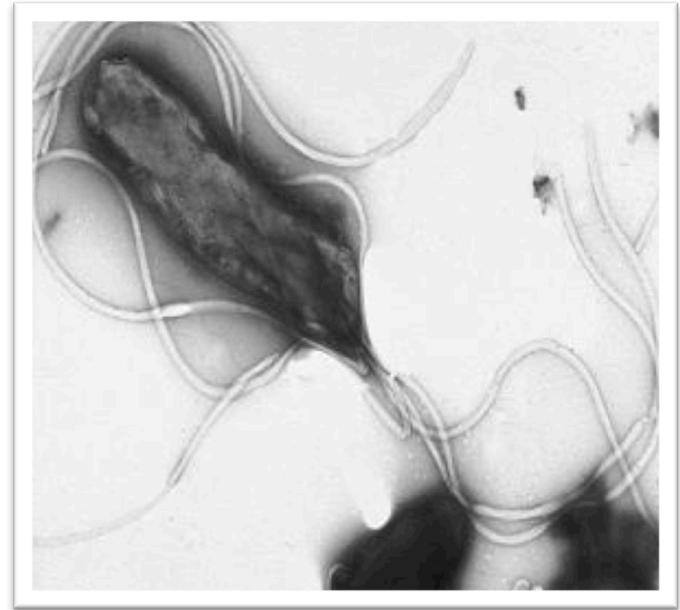
Surface Appendages

- Some **prokaryotes** have distinct appendages that allow them to move about or adhere to solid surfaces.
- Consist of delicate stands of **proteins**.

A couple example of prokaryotic surface appendages:

- **flagella**: Long, thin extensions that allow some bacteria to move about freely in aqueous environments. (singular: flagellum)
- **fimbriae**: Most **Gram-negative** bacteria have these short, fine appendages surrounding the cell. **Gram+** bacteria don't have.

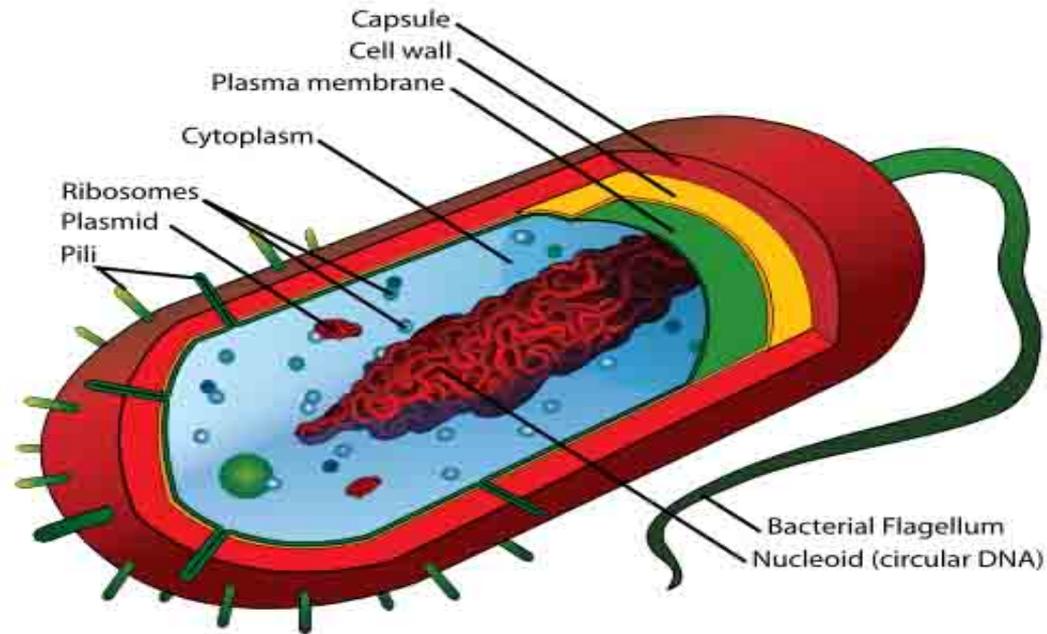
Help bacteria stick to solid surfaces. Major factor in virulence. (singular: fimbria)



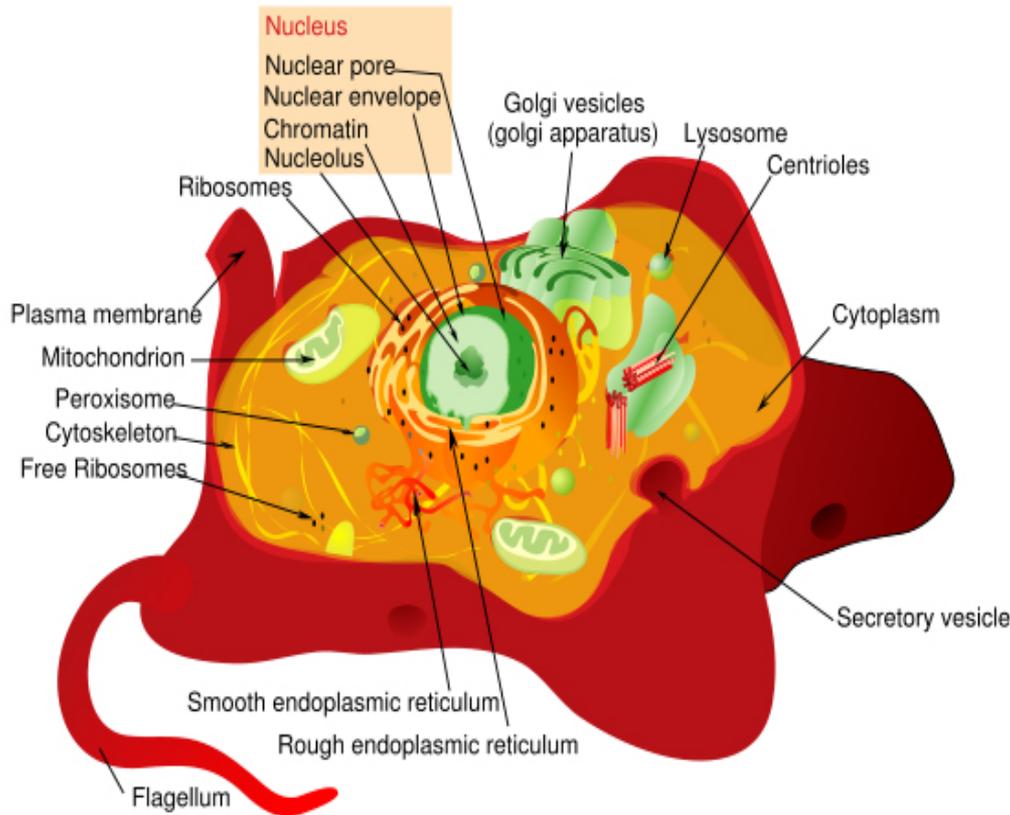
REVIEW!

Here's are two excellent interactive lessons:

1. [Prokaryote Cell Structure](#) from Cells Alive
2. [Interactive Cell Structure](#) from Wiley

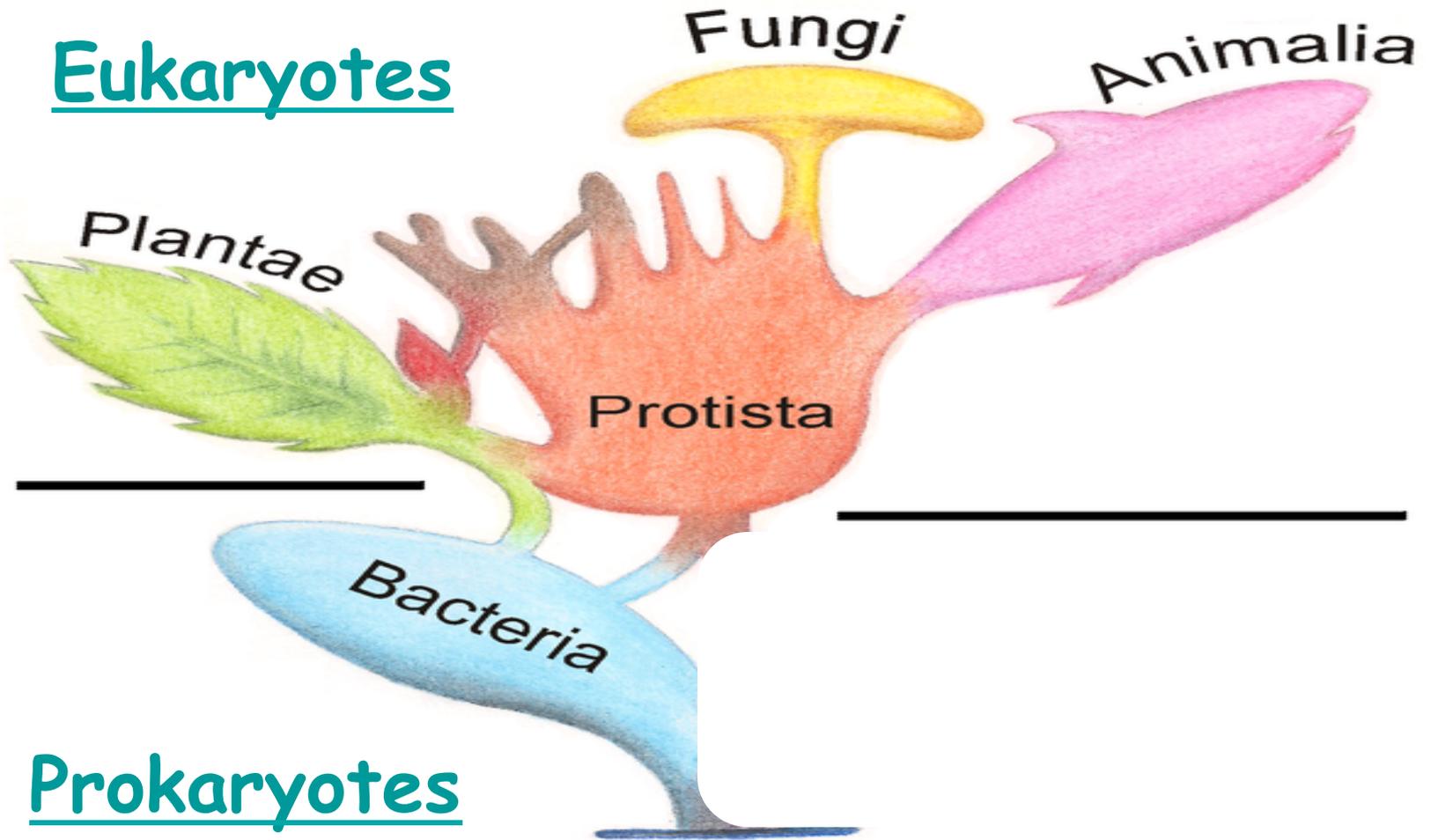


Eukaryotic Cells



- Eu = "true", karyon = "nucleus"
- Genetic material contained in a nuclear membrane.
- Membrane bound organelles.
- Include animal, plant, fungi, algae cells as well as other microscopic eukaryotes.
- Evolved from prokaryotic cells.

Old School 5 Kingdom classification of organisms

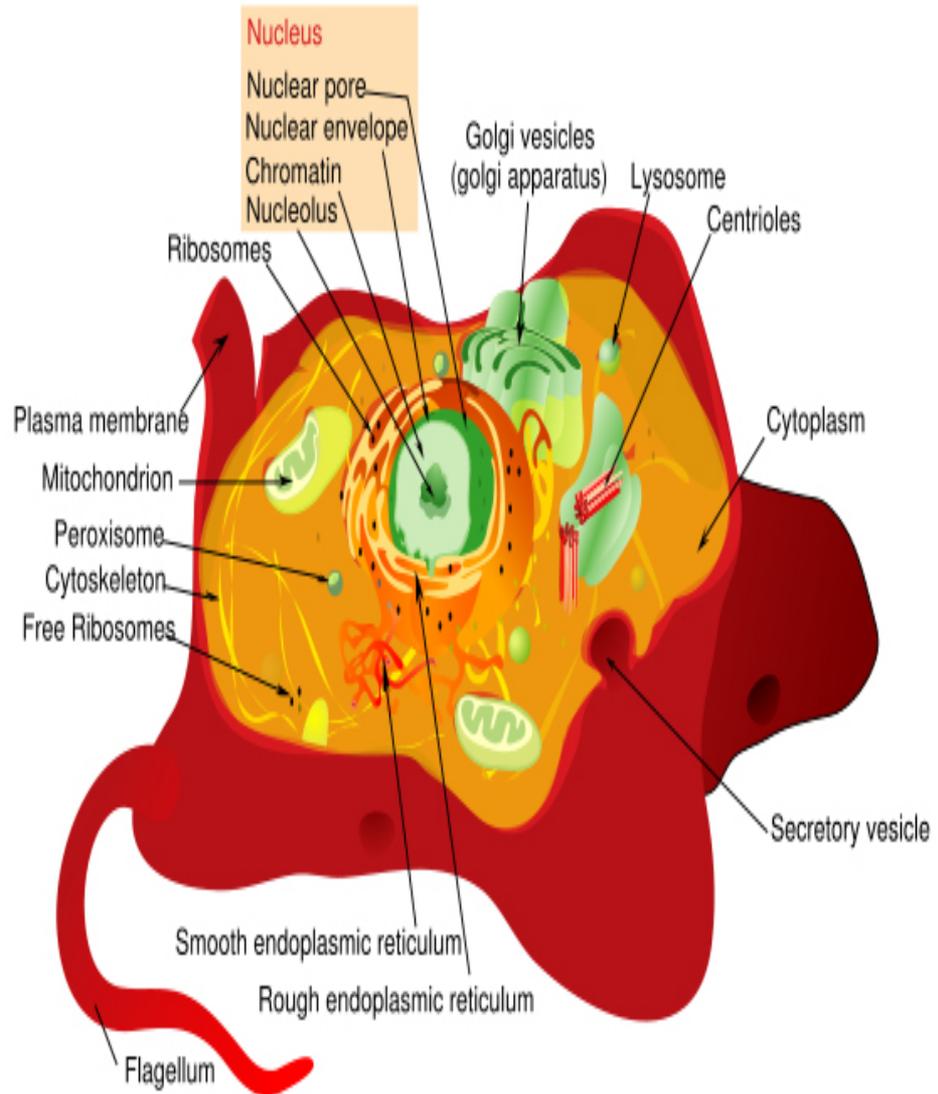


Cytoplasm

Nicknames: The Matrix,
Molecular Chowder

- Fills the space between the plasma membrane and the nuclear membrane
- A water-like substance that fills cells.
- Consists of **cytosol** and **cellular organelles** except for the cell nucleus.
- **cytosol** is made up of water, salts, organic molecules and many enzymes that catalyze reactions.

Q: Eukaryotes? Prokaryotes? Both?

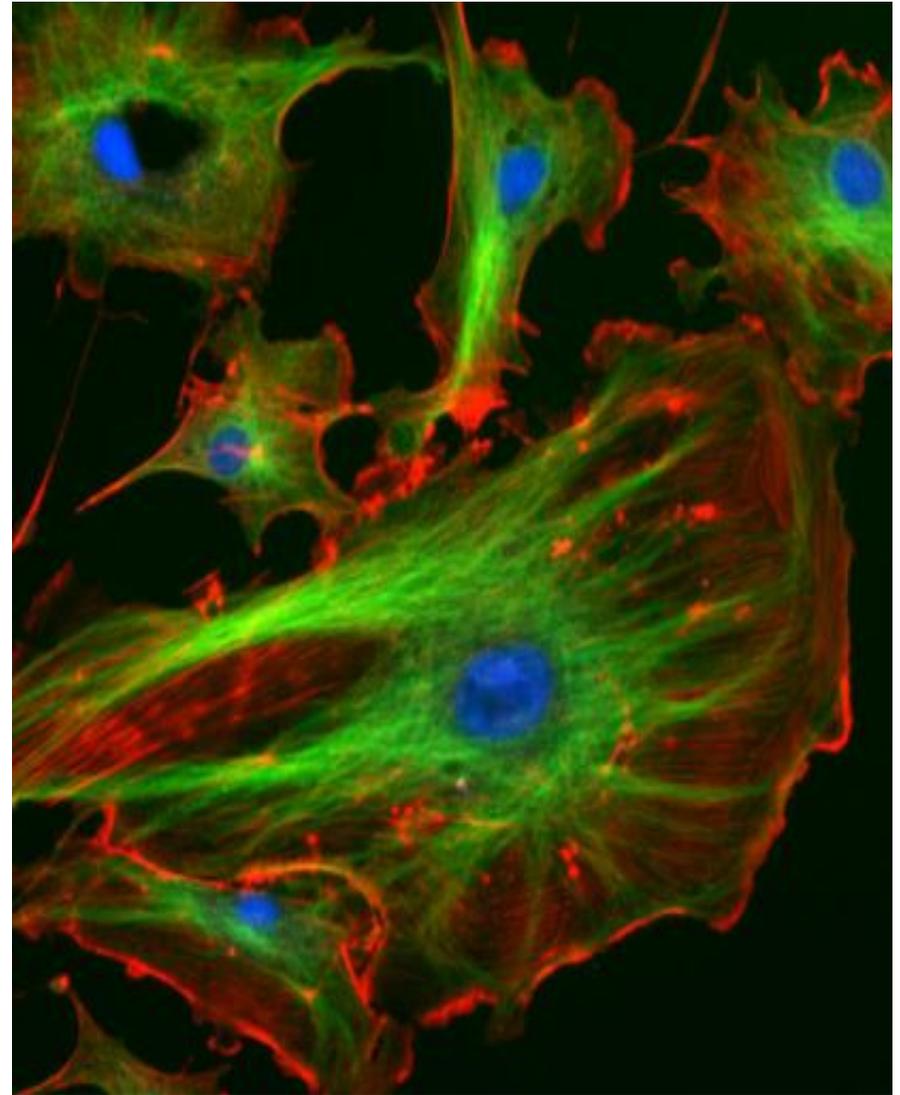


Cytoskeleton

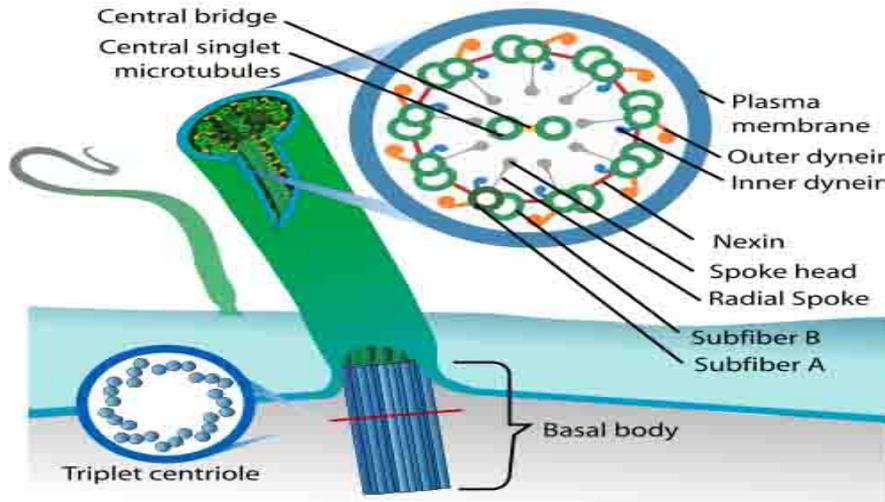
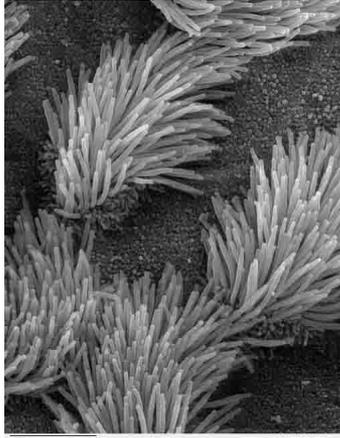
Nicknames: Scaffolding,
Highways

- Maintains cell shape.
- Protects the cell.
- Enables some cell movement (using structures such as flagella and cilia).
- Plays important roles in intracellular transport (*the movement of vesicles and organelles*).
- Plays important role in [cell division](#).

Q: Eukaryotes? Prokaryotes? Both?

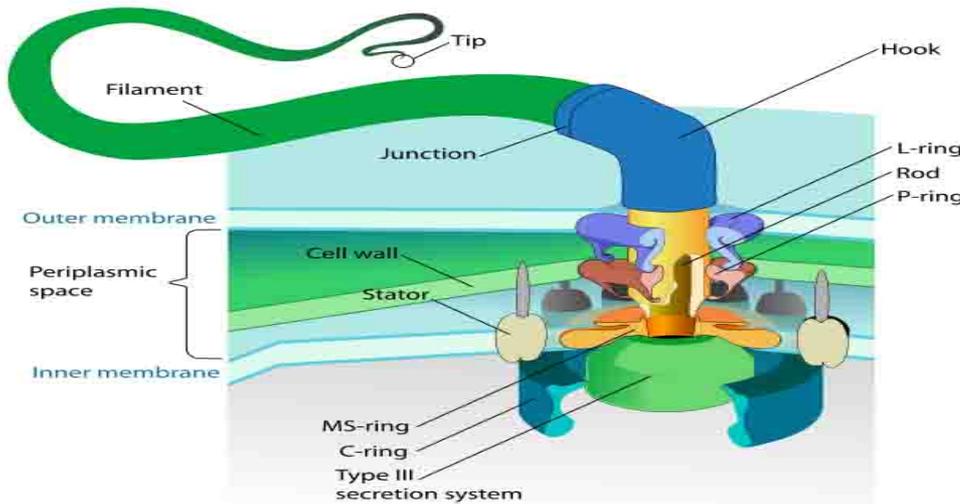


Surface Appendages: **Cilia & Flagella**



External appendages from cell membrane.

Aid in locomotion of the cell or movement of materials around cell.



Cytoskeleton on inside, plasma membrane on outside.

Network of protein fibers running throughout the cytoplasm that give a cell its shape & provide a basis for movement.

CYTOSKELETON: Microfilaments, Intermediate Filaments & Microtubules

1. Microfilaments

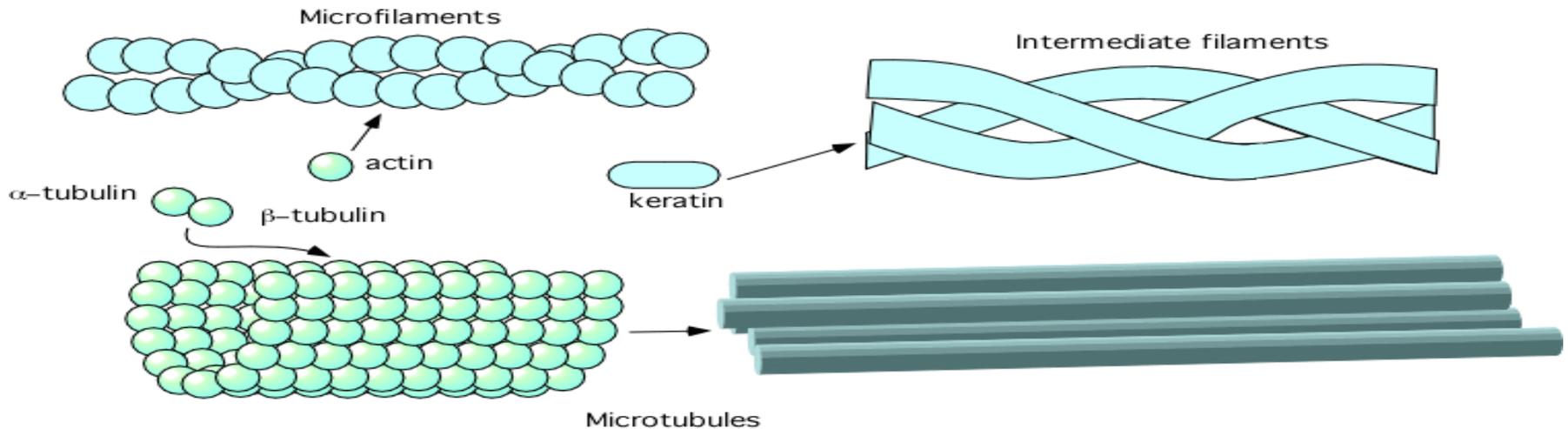
Two intertwined strands of actin protein.

2. Intermediate Filaments

Fibrous proteins supercoiled into thick cables.

3. Microtubules

- Hollow tubes of tubulin
- Cell shape, cell movement, chromosome movement during division
- "Highways" along which the organelles travel and are conveyed.
- Microtubules may work alone, or join with other proteins to form more complex structures called **cilia**, **flagella** or **centrioles**.

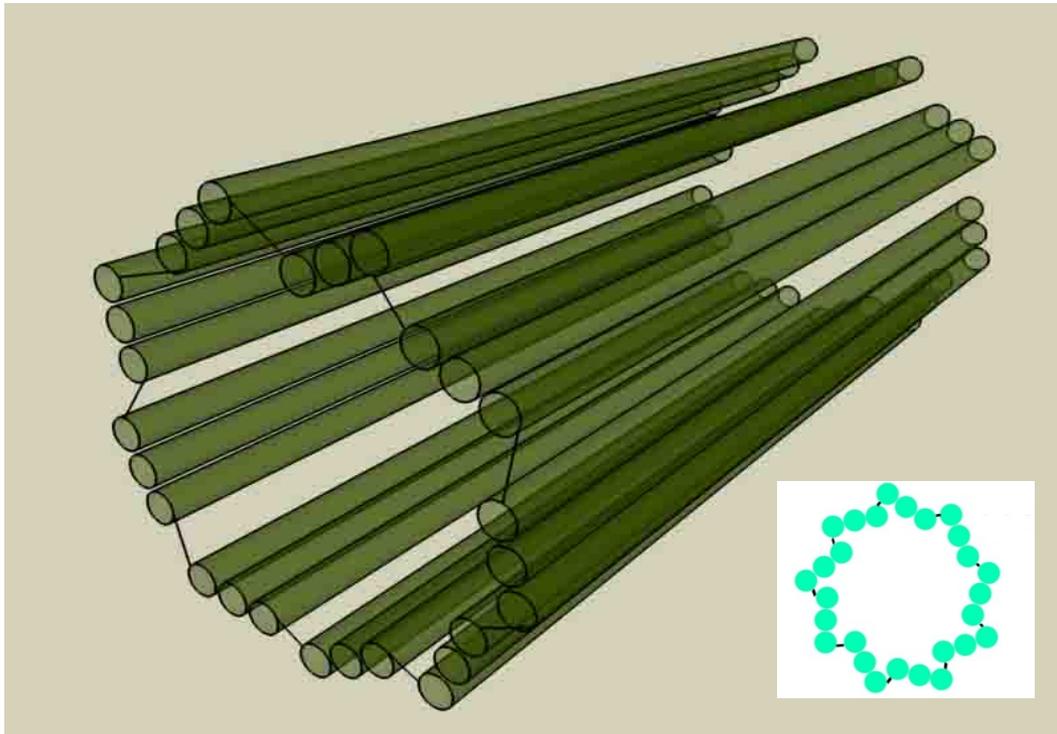


CYTOSKELETON: Centrioles & Centrosomes

The **centrosome**, also called the "microtubule organizing center", is an area in the cell where microtubules are produced.

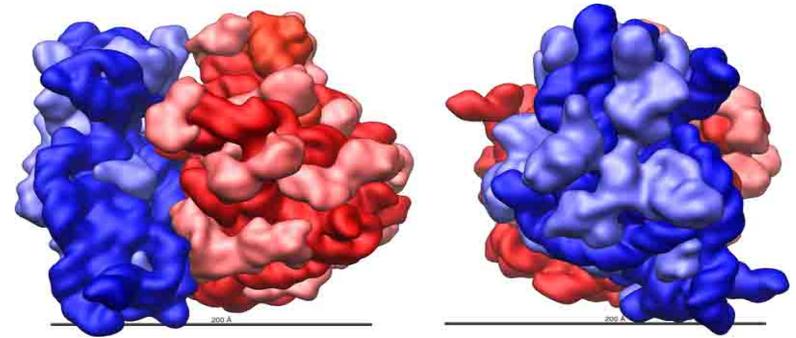
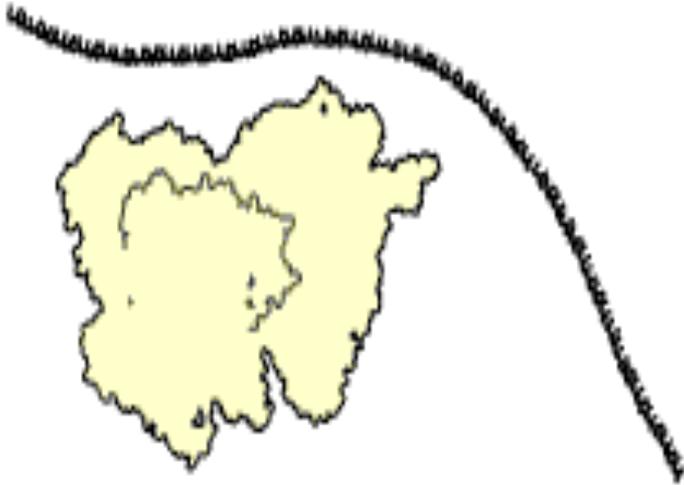
Within the cells of animals are a pair of **centriole**, made of nine sets of triplet microtubules.

Microtubules > Centriole > Centrosome



Ribosomes

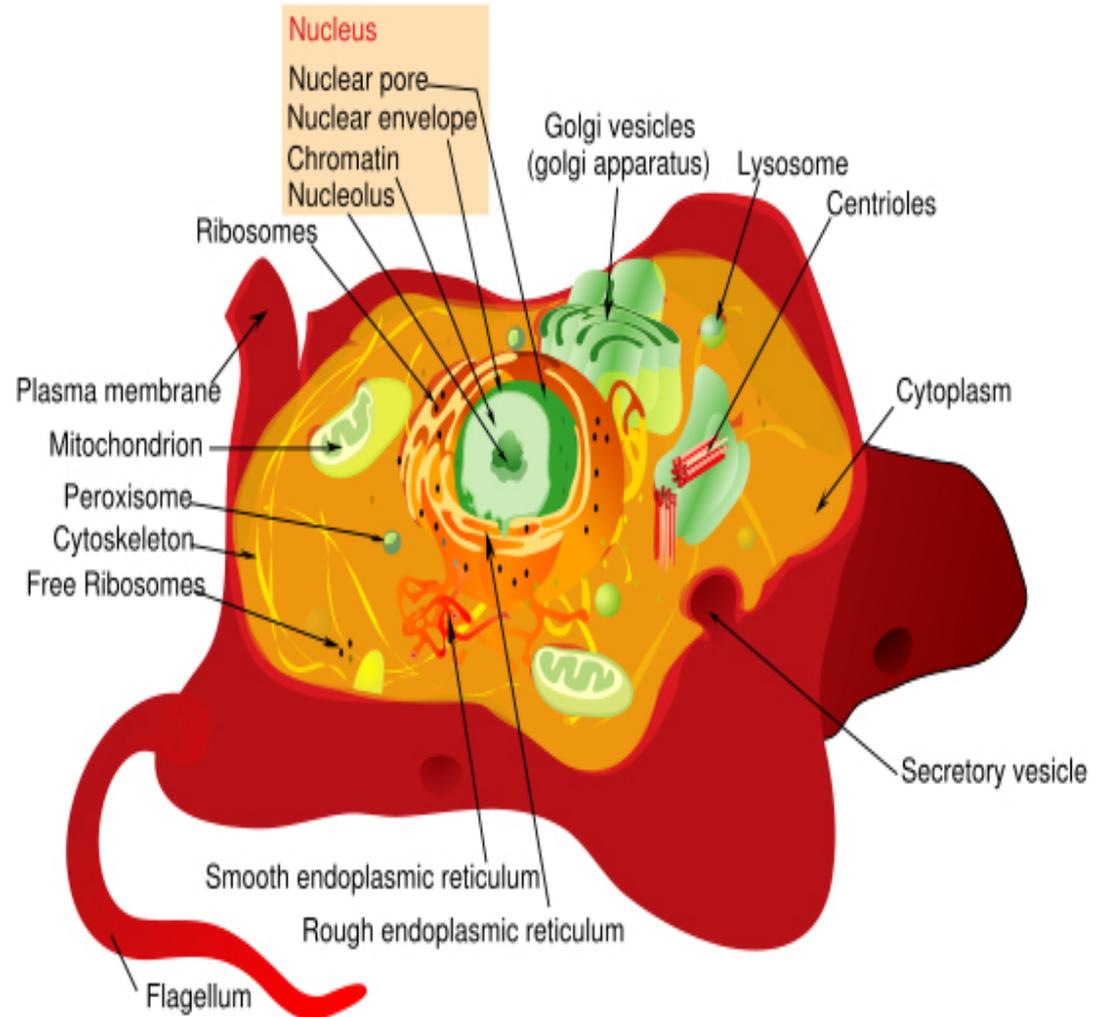
[Click here](#) for animation of ribosome building a protein.



- **Q:** What do ribosomes do?
- **Q:** What are they made of?
- Can be found alone in the cytoplasm, in groups called **polyribosomes**, or attached to the endoplasmic reticulum.
- **Q:** Eukaryotes? Prokaryotes? Both?

Membrane-bound Organelles

- Eukaryotic cells have many organelles.
- Prokaryotes only have ribosomes, which are not bound by a membrane.
- Membrane-bound eukaryotic organelles organize functions within the cell.



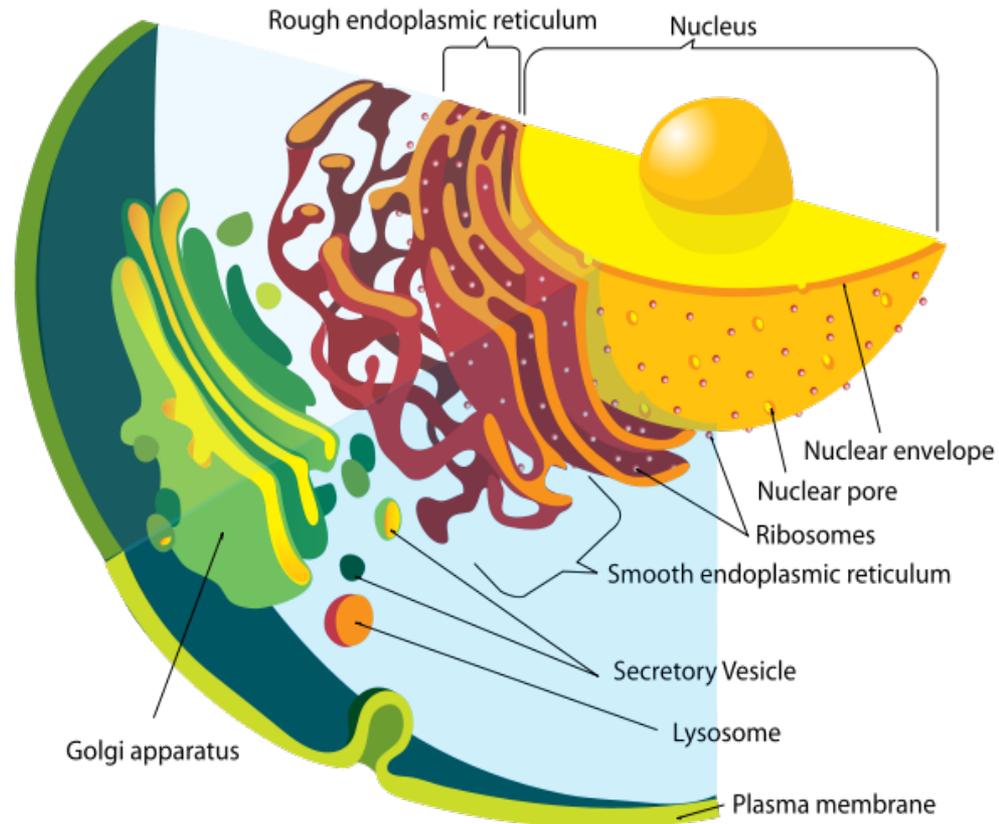
System of internal membranes within [eukaryotic cells](#) that divide the cell into compartments, or organelles.

Transport system, for moving molecules, into, out of, and through interior of cell, as well as interactive surfaces for lipid and protein synthesis.

Membranes of the [endomembrane system](#) are made of a lipid bilayer, with proteins.

The **Endomembrane System** consists of:

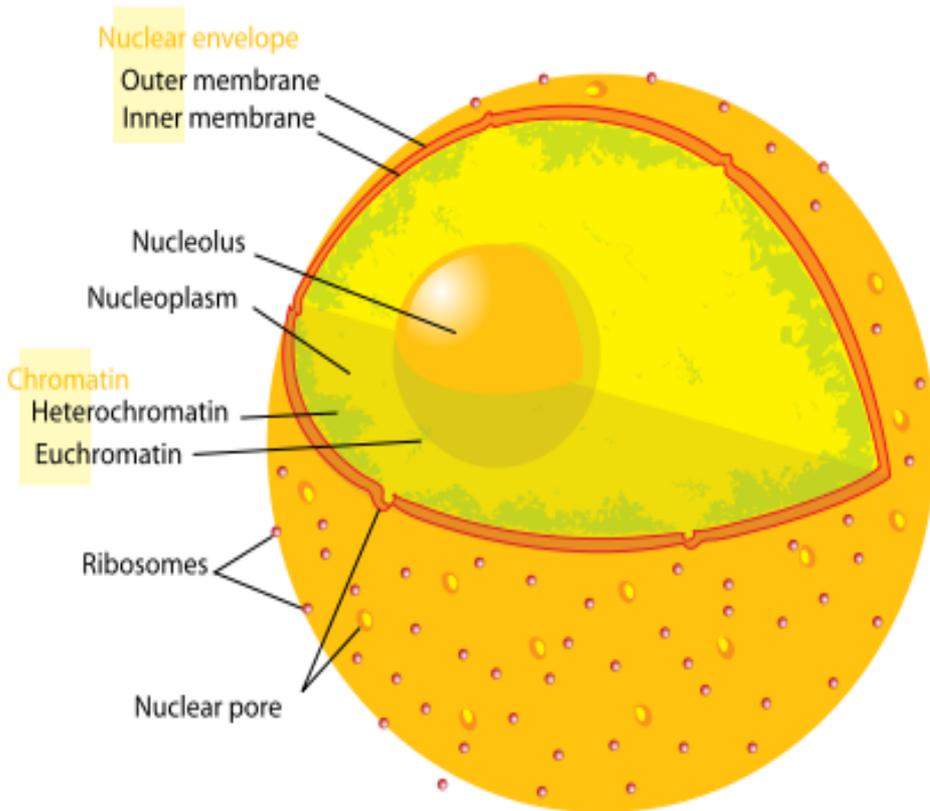
1. nucleus
2. endoplasmic reticulum
3. Golgi apparatus
4. vesicles
5. lysosomes
- 6... **Q**: What other membranous part of the cell should also be included in this list?





ENDOMEMBRANE SYSTEM ORGANELLES:

Nucleus



Nickname: Control Center

- Separates the genetic material (DNA) from the rest of the cell.
- DNA, the genetic material, is a blueprint, or code for making proteins.
- **nuclear membrane** is the double membrane structure that separates nucleus from cytoplasm.

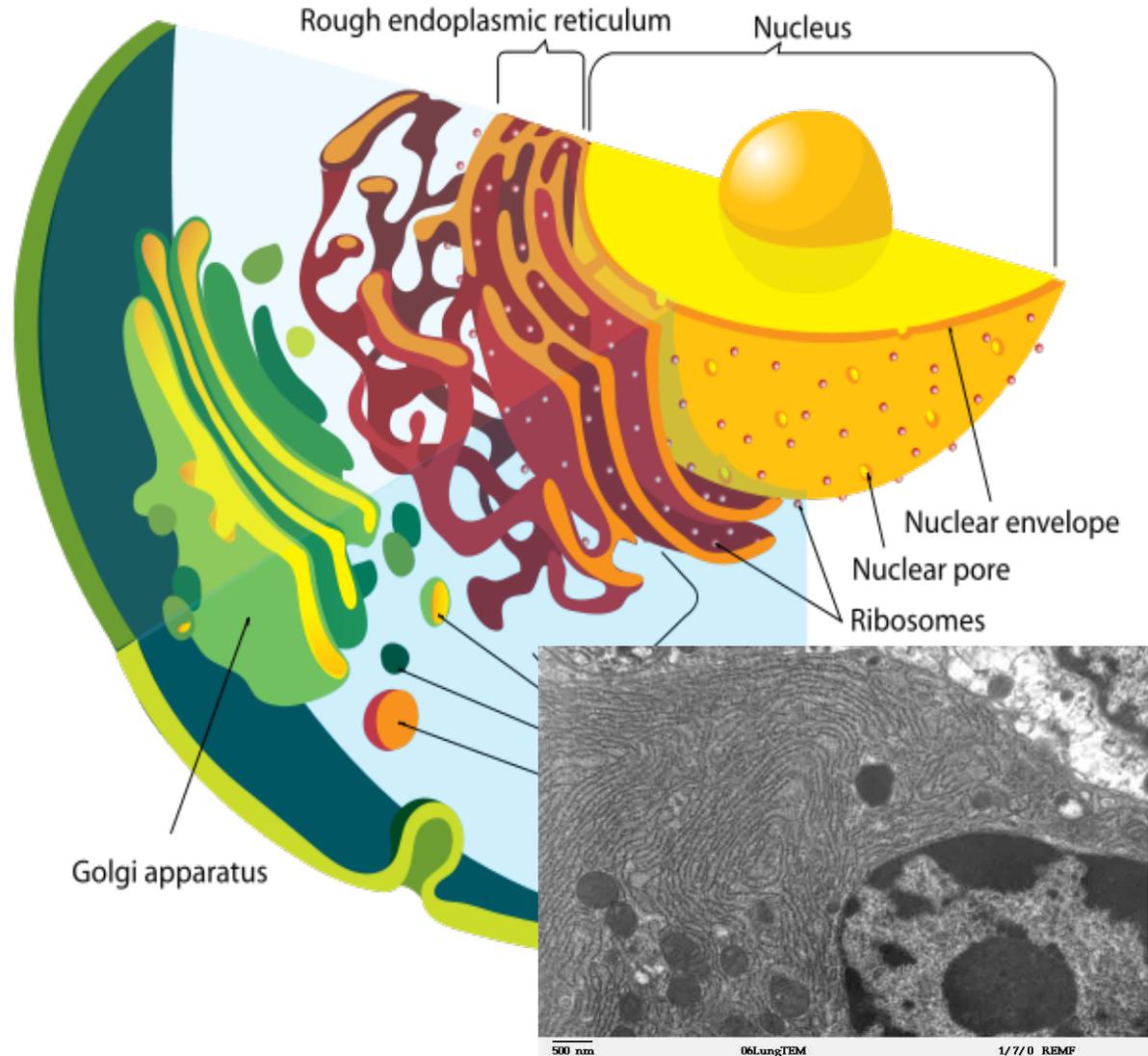
ENDOMEMBRANE SYSTEM ORGANELLES:

Endoplasmic Reticulum

Nickname:

Production Factory
(makes proteins and lipids)

- System of membranous channels and vesicles.
- Internal production & delivery system of the cell.
- **Rough ER** is studded with ribosomes. Site of protein synthesis and processing.
- **Smooth ER** lacks ribosomes. Site of synthesis of phospholipids and packaging of proteins into vesicles.



Images: [Endomembrane system](#) diagram, M. Ruiz, [ER photomicrograph](#), Louisa Howard.

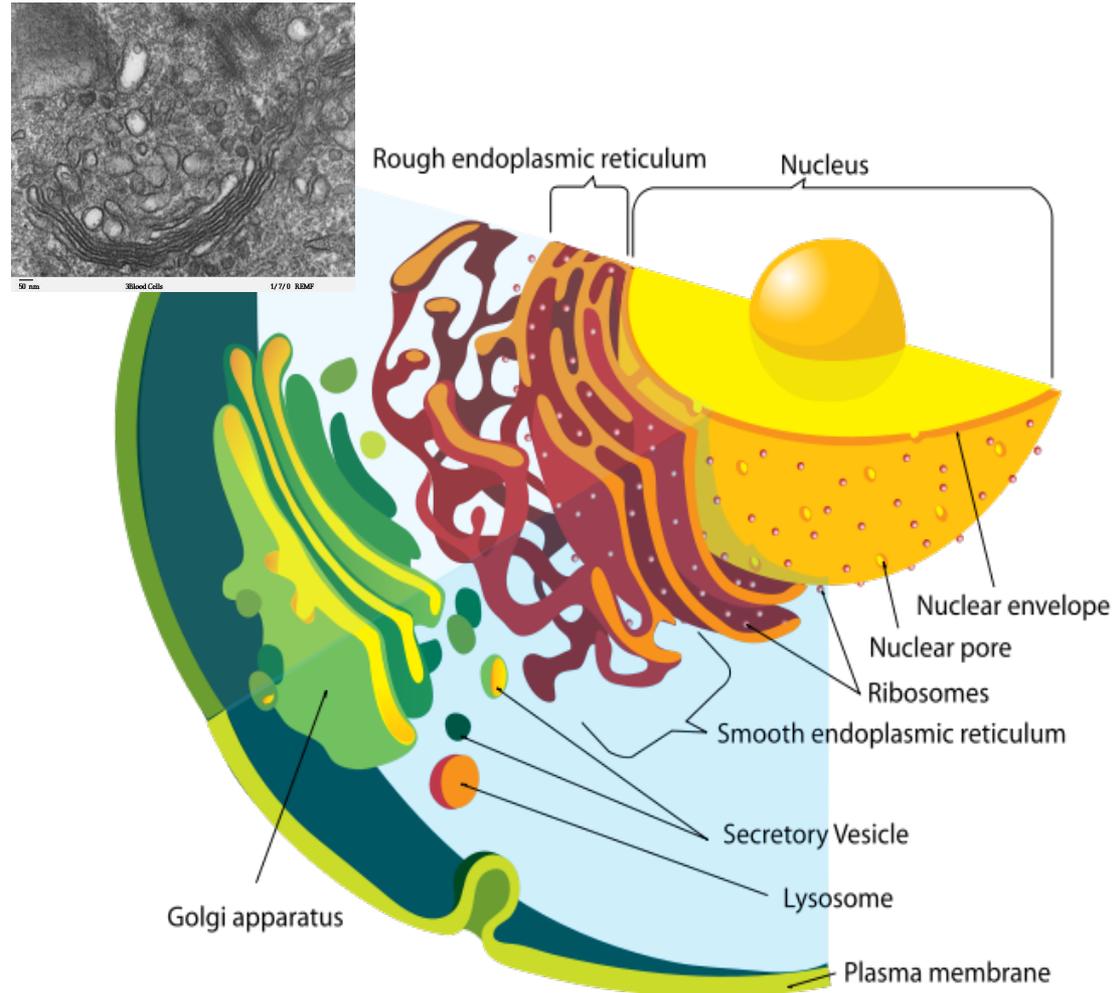
ENDOMEMBRANE SYSTEM ORGANELLES :

Golgi apparatus

Nickname:

Assembly Factory

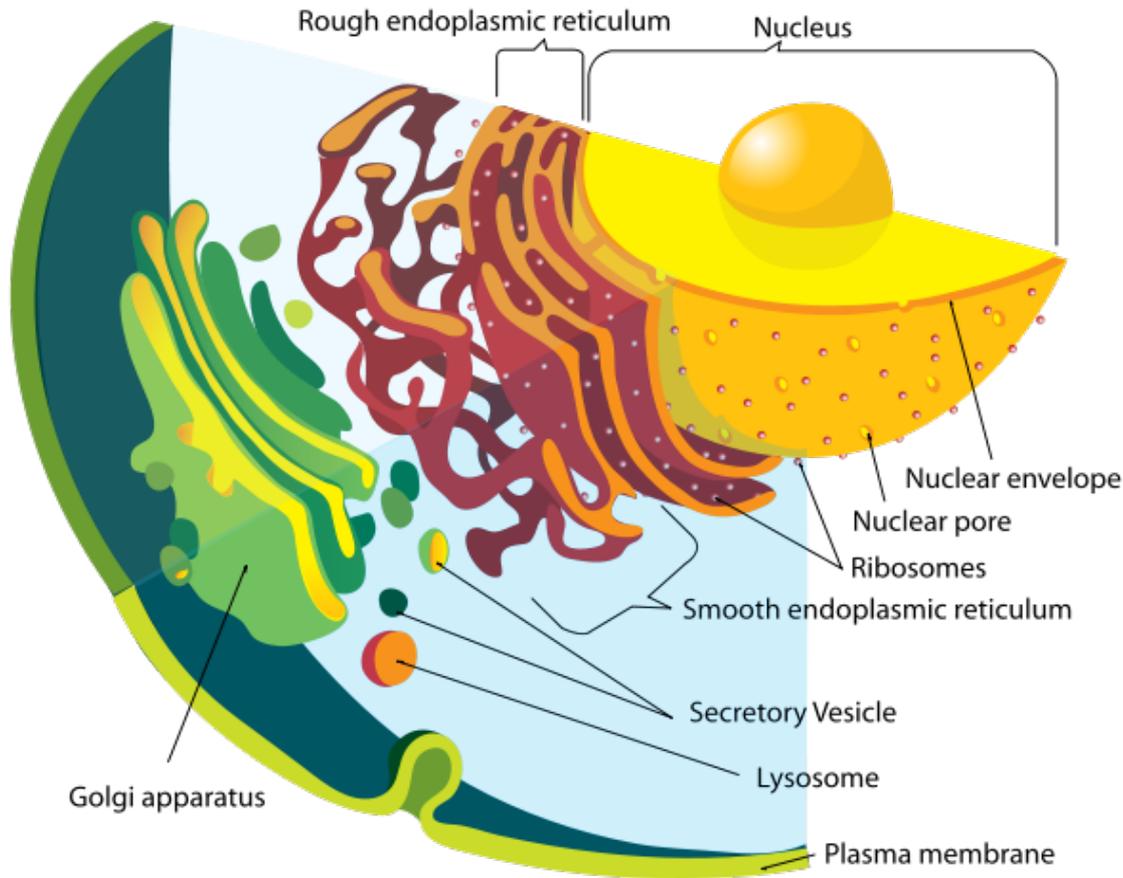
- Takes simple molecules and puts them together into more complex macromolecules.
- Packages, modifies, and transports materials to different location inside/outside of the cell.
- Consists of a stack of curved saccules.
- Receives [protein](#) and also [lipid](#)-filled vesicles from the ER, packages, processes, and distributes them *within the cell* or for *export out of the cell* (*secretion*).
- Also encloses digestive [enzymes](#) into membranes to form **lysosomes**.



Images: [Endomembrane system](#) diagram, M. Ruiz, [Golgi apparatus photomicrograph](#), Louisa Howard.

ENDOMEMBRANE SYSTEM ORGANELLES:

Vesicles



Nickname: The Trucks

- Store, transport, or digest cellular products and waste.
- Small compartments separated from the cytosol by at least one lipid bilayer.
- Made in Golgi apparatus, ER, or from parts of the plasma membrane.
- Vesicles form while taking in (**endocytosis**) or discharging (**exocytosis**) materials.
- **REVIEW:** Animation on [endocytosis & exocytosis](#)



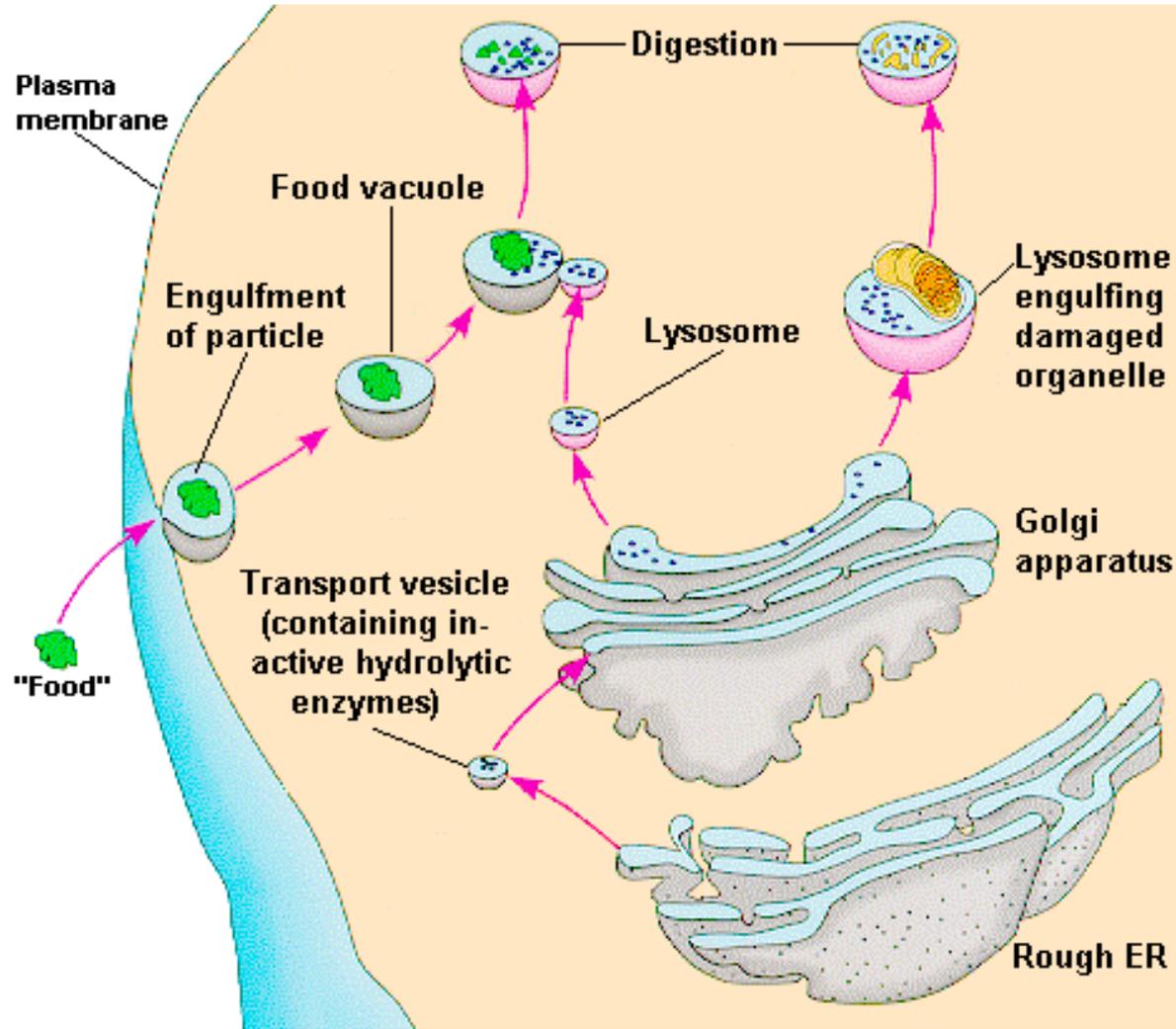
ENDOMEMBRANE SYSTEM ORGANELLES:

Lysosomes

Nickname:

Recycling Trucks

- Break down food into particles and also destroy old cellular components.
- **Q: Which organelle produces lysosomes?**
- Contain hydrolytic enzymes and are involved in intracellular digestion.



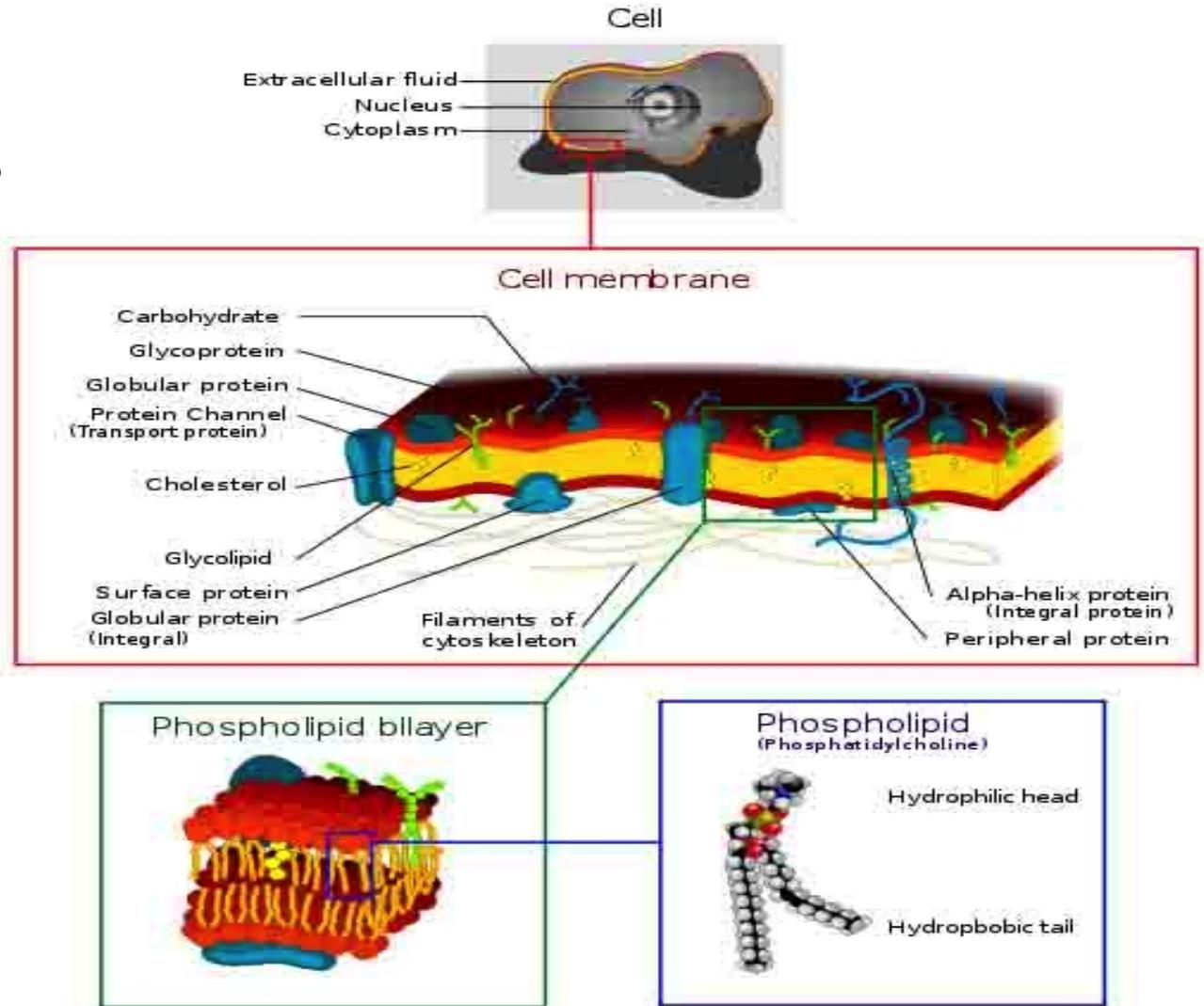


ENDOMEMBRANE SYSTEM ORGANELLES:

Plasma Membrane

Q: What is it made of?

Q: What is its function?



Organelles: Energy-Related

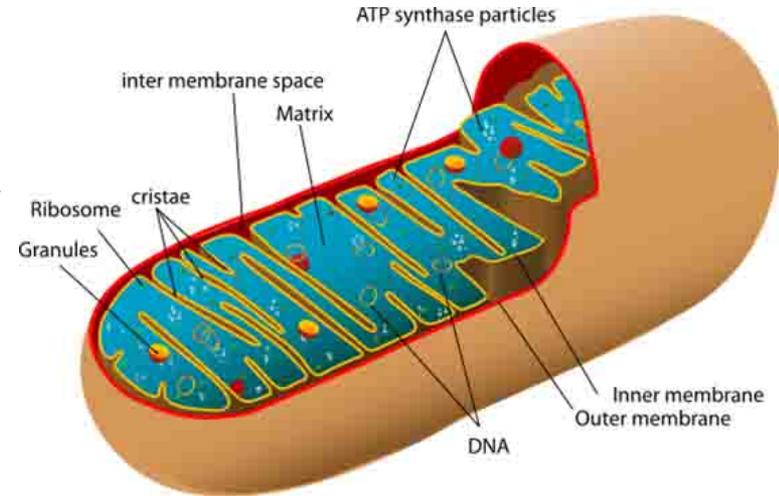
Mitochondria

&

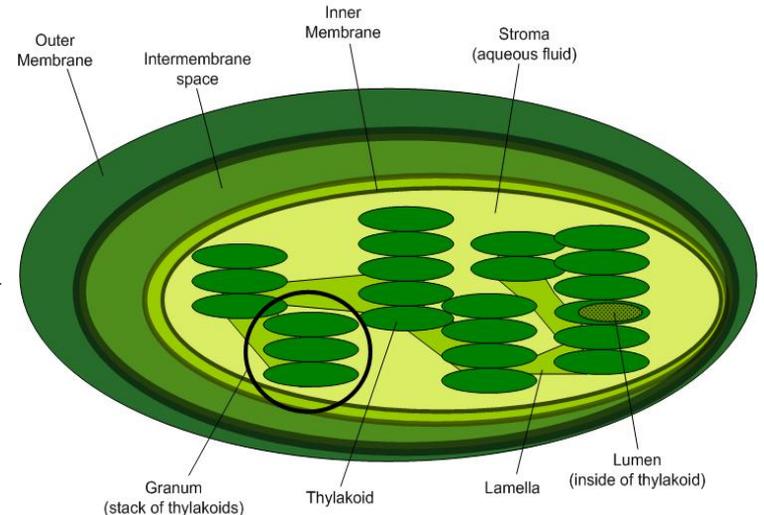
Chloroplast

- Both organelles house energy in the form of [ATP](#).
- Both ancestrally were independent cells that formed a symbiotic relationship with other cells.
- **Q: Eukaryotes? Prokaryotes? Both?**

Found in nearly all eukaryotes



Found in plants & algae & some microbes



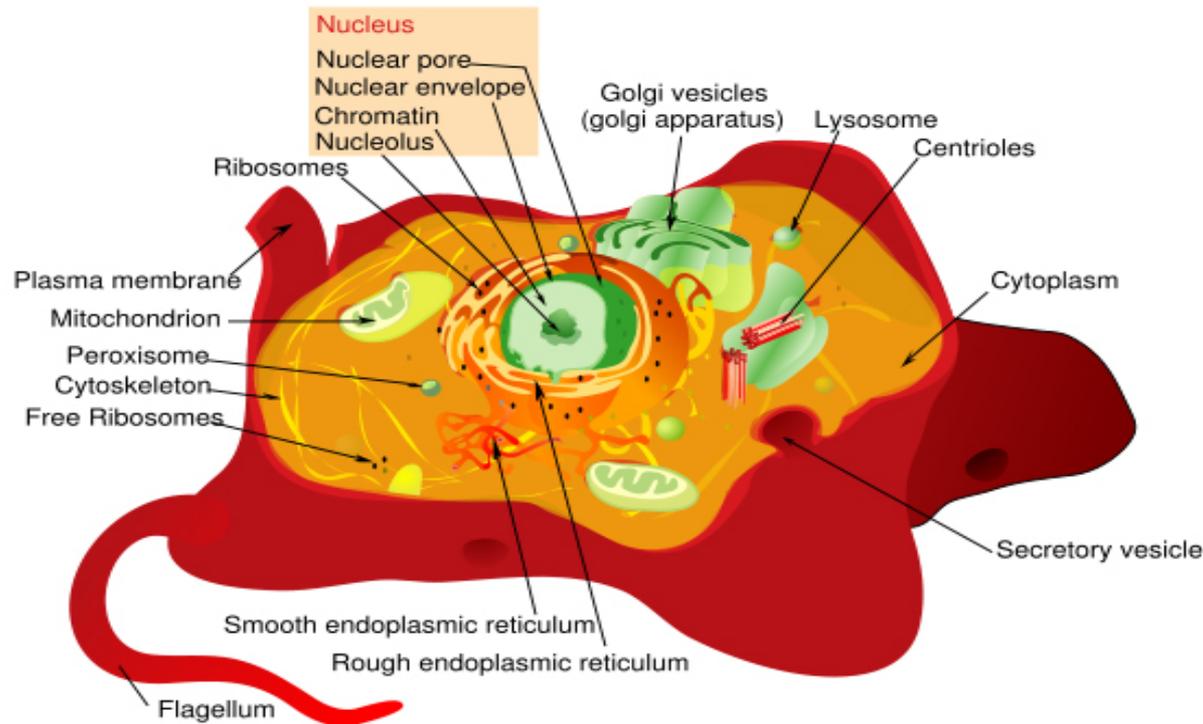
Images:

[Mitochondrion diagram](#) M. Ruiz;

REVIEW!

Here's are two excellent interactive lessons:

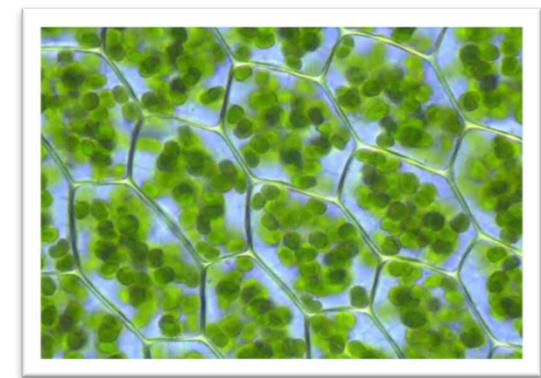
1. [Eukaryotic Cell Structure](#) from Cells Alive
2. [Interactive Cell Structure](#) from Wiley



Now let's
learn about
additional
structures
found in
Plant Cells



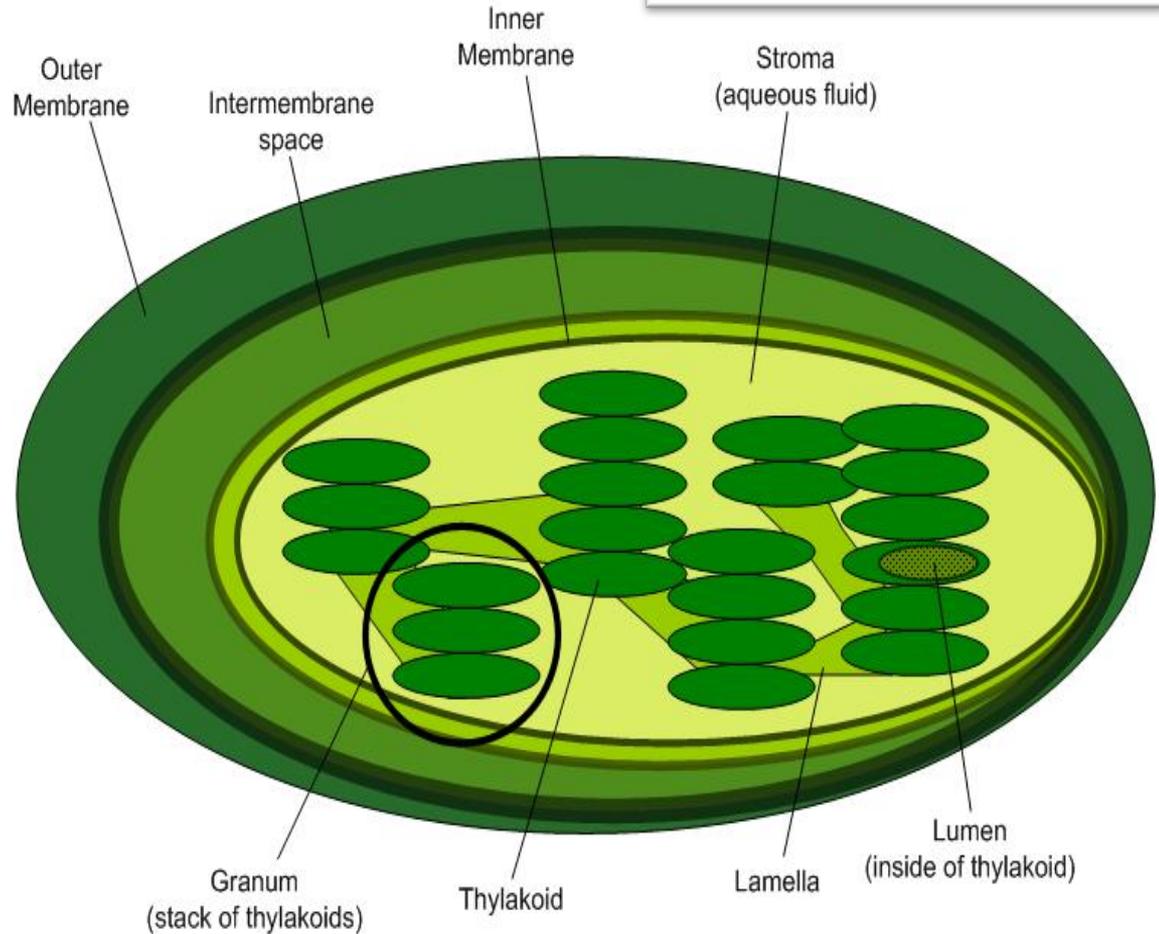
ENERGY-RELATED ORGANELLES: Chloroplasts



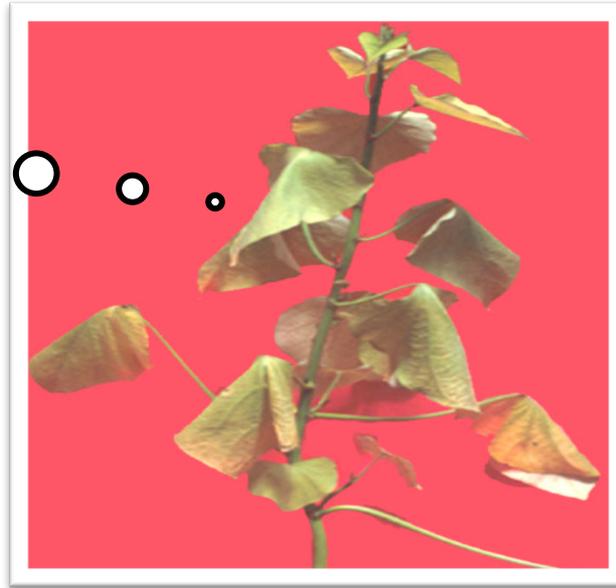
Nickname:
Solar Panels

Captures sunlight energy to make [ATP](#).

chlorophyll (a green pigment) absorbs solar energy and [carbohydrates](#) are made in the stroma.

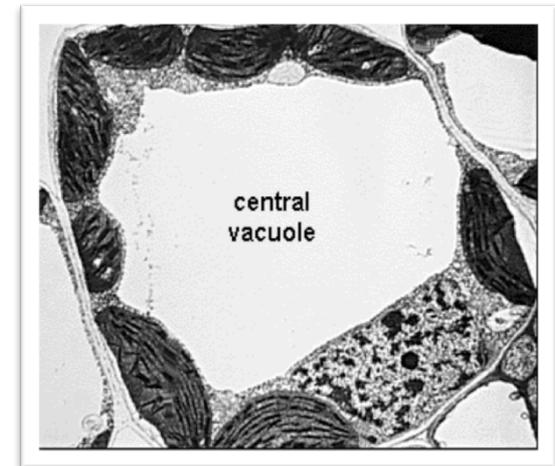
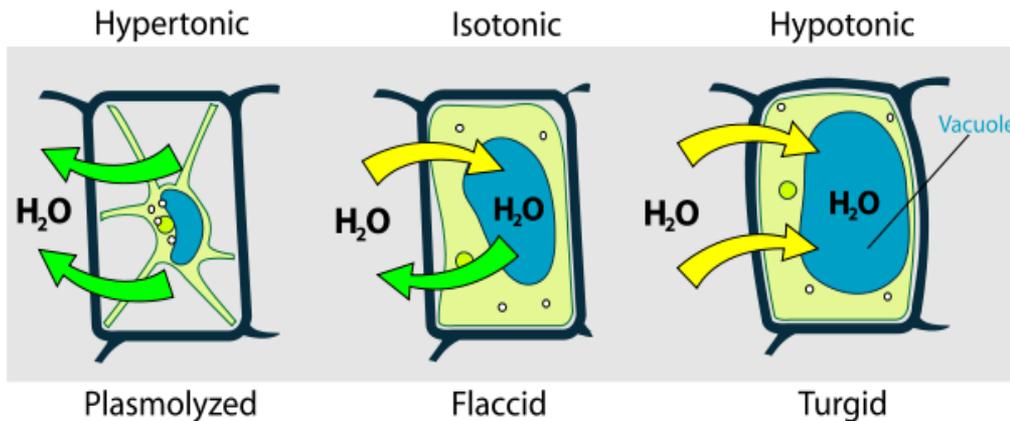


PLANT CELL: Vacuole

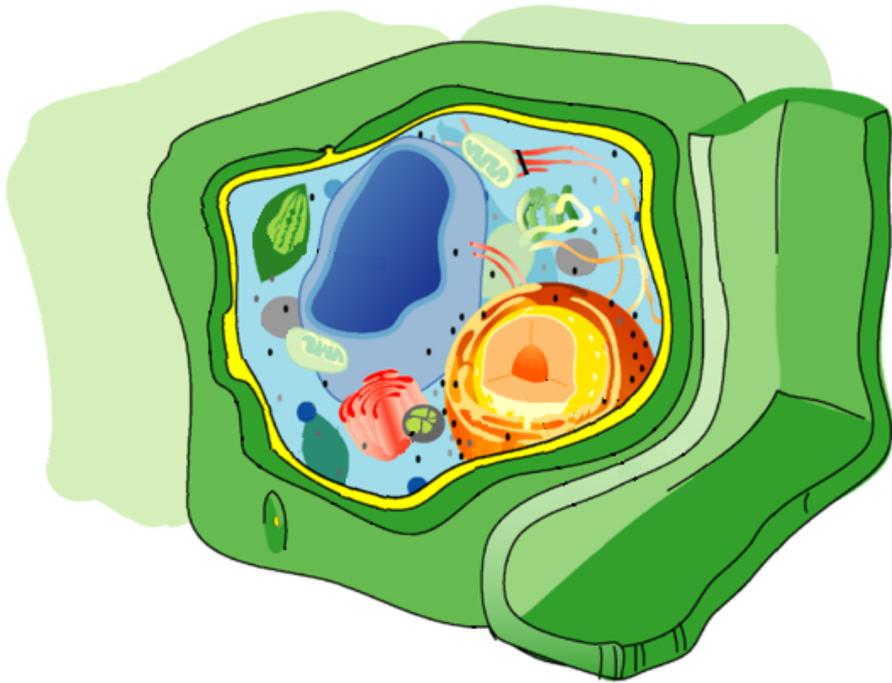


Nickname: Reservoir

- Stores water.
- This is what makes lettuce crisp.
- When there is low water, the plant wilts.



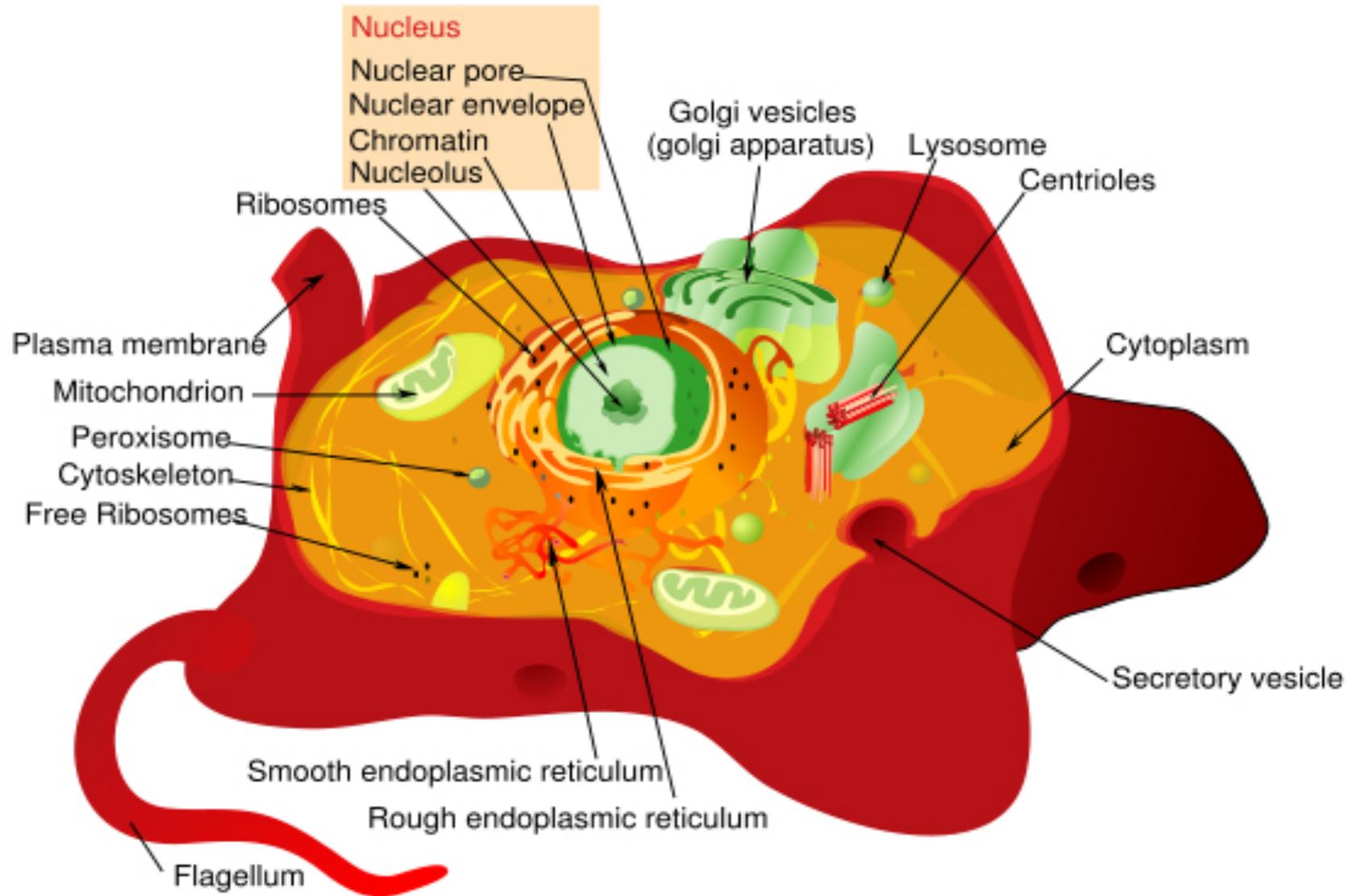
PLANT CELLS: Cell Wall



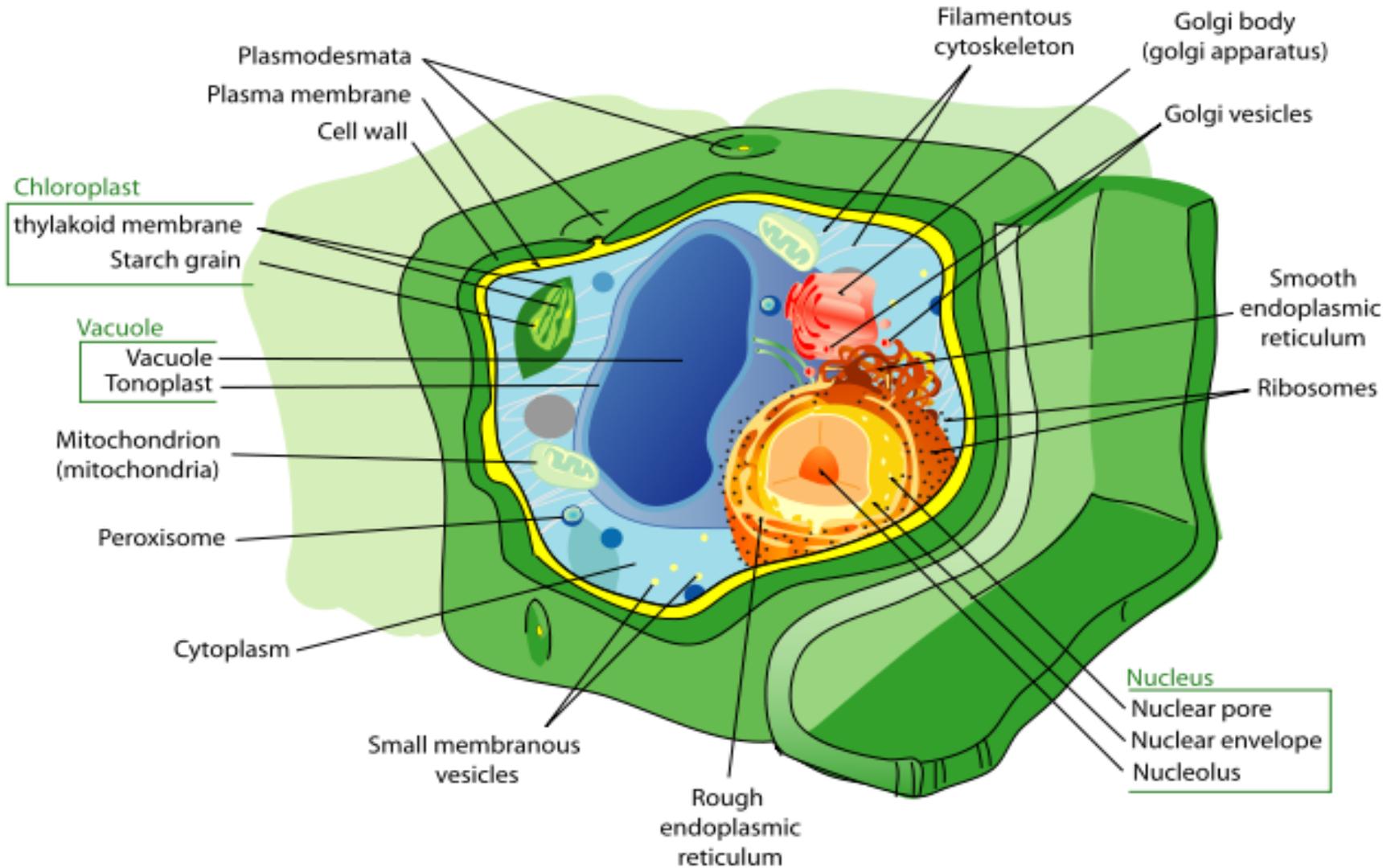
Function: Provides support and protection to the cell membrane

Found outside the cell membrane in plant cells.

Animal Cell (Eukaryote)



Plant Cell (Eukaryote)



Confused?

Links to resources that further explain Cell Biology:

- [Prokaryotic Cells Main Page](#) on the Virtual Cell Biology Classroom of [Science Prof Online](#) website.
- [Prokaryotic Cell](#): Structures, Functions & Diagrams, an article from SPO.
- [Prokaryotic Cell](#) interactive diagram from [Cells Alive](#) website.
- [Eukaryotic Cells Main Page](#) on the Virtual Cell Biology Classroom of [Science Prof Online](#).
- [Prokaryotic & Eukaryotic](#): Two Types of Biological Cells, an article from SPO.
- [Eukaryotic Cell](#): Structures, Functions & Diagrams, an article from SPO.
- “[Cells](#)” music video by They Might Be Giants.
- [Cells Alive](#) interactive website.
- [Cell Structure](#) tutorials and quizzes from Interactive Concepts in Biochemistry.
- [Eukaryotic Cell Tour](#) an Animated Science Tutorial.
- [Endomembrane System](#) animation and quiz.
- [Endocytosis / Exocytosis](#) animation and quiz from McGraw Hill.
- Biology4Kids – [Cell Biology Main Page](#) by Raders.

(You must be in PPT slideshow view to click on links.)

