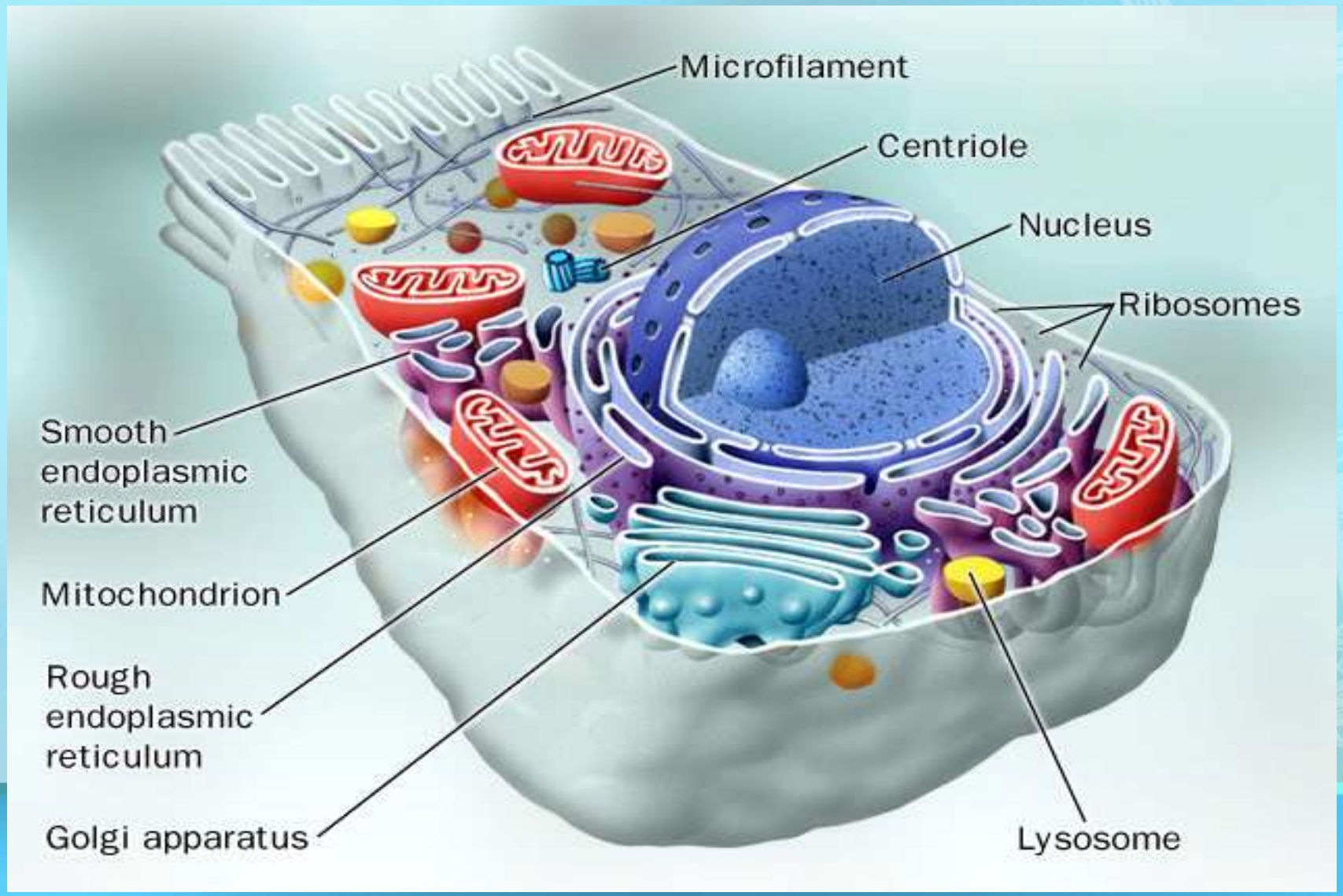
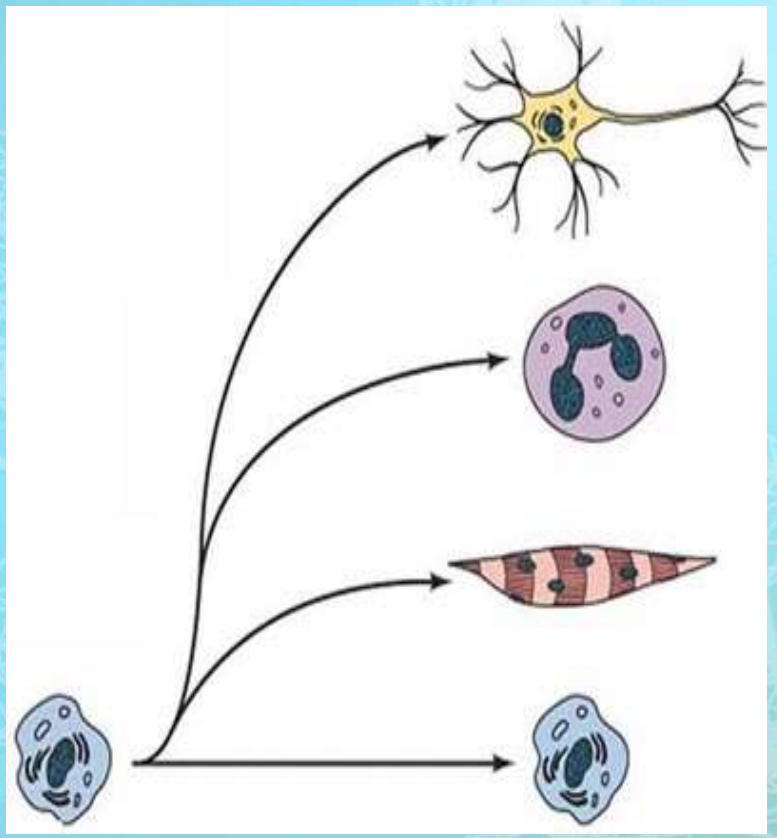
Basic Structure of a Cell



History of Cells & the Cell Theory

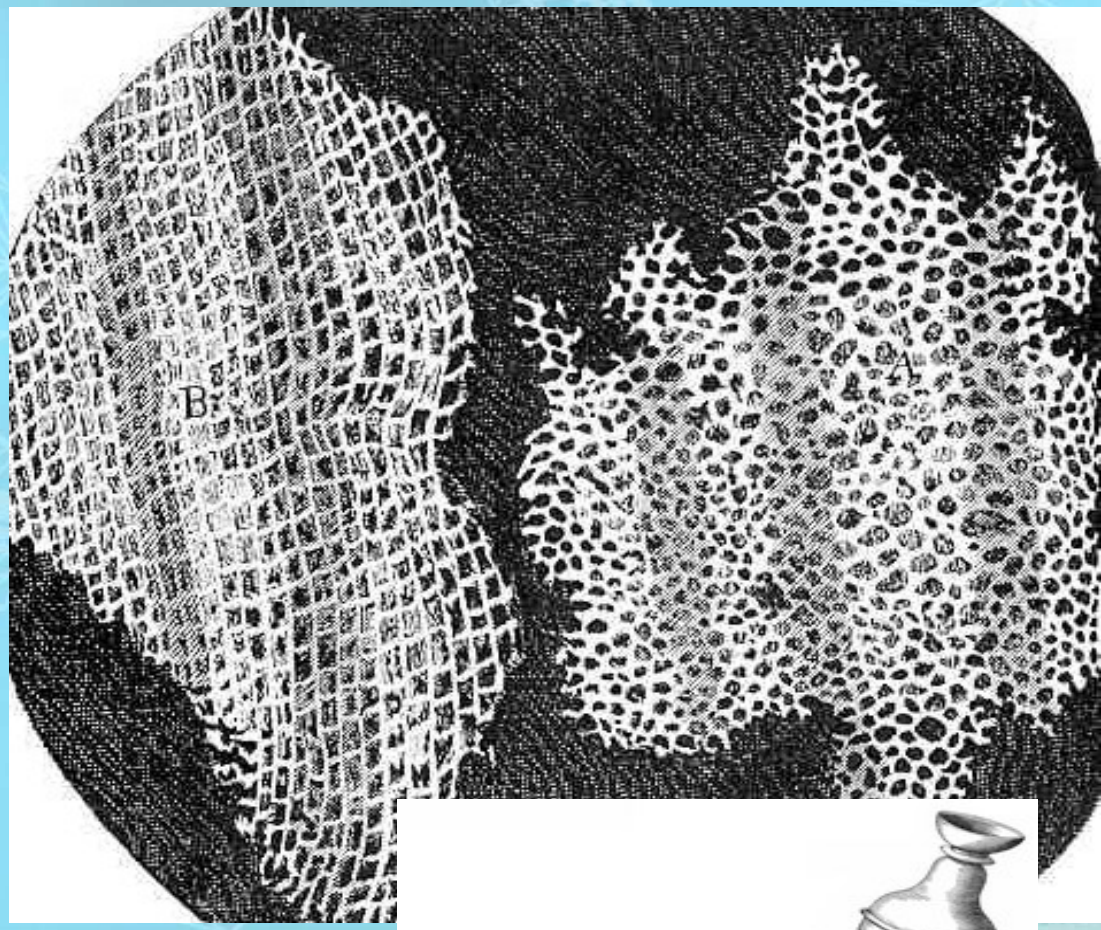
Virchow

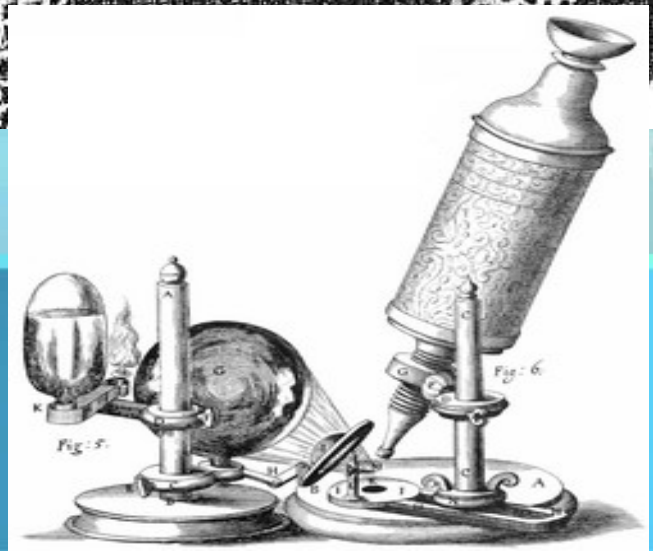


Cell Specialization

First to View Cells

- In 1665, Robert Hooke used a microscope to examine a thin slice of cork (dead plant cells)
- What he saw looked like small boxes



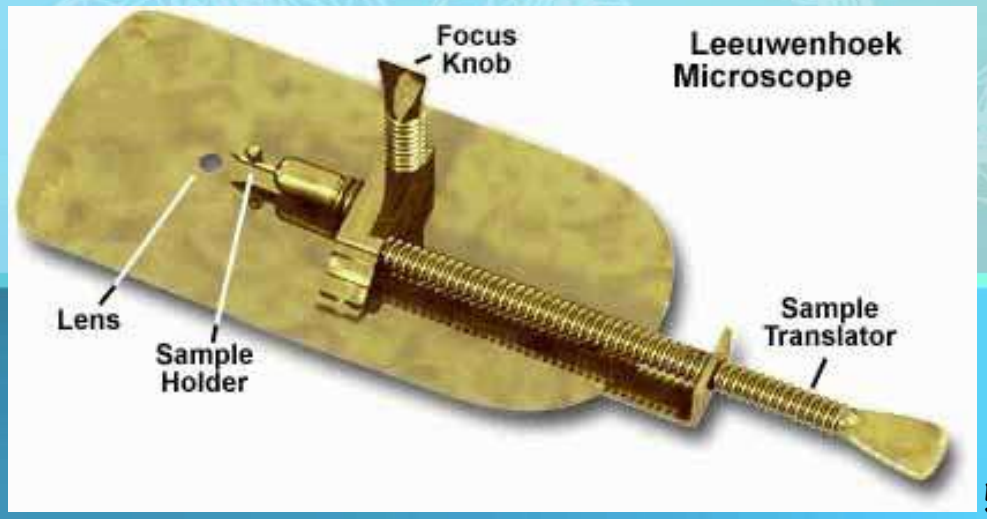


First to View Cells

- Hooke is responsible for naming cells
- Hooke called them "CELLS" because they looked like the small rooms that monks lived in called Cells

Anton van Leeuwenhoek

- In 1673, Leeuwenhoek (a Dutch microscope maker), was first to view organism (living things)
- Leeuwenhoek used a simple, handheld microscope to view pond water & scrapings from his teeth



Beginning of the Cell Theory

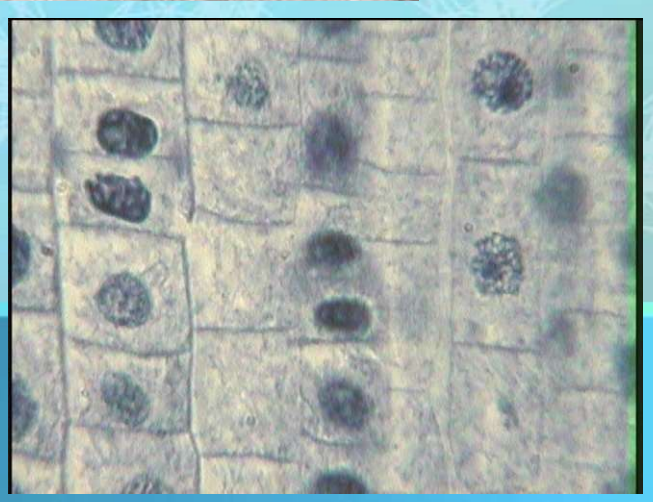
- In 1838, a German botanist named Matthias Schleiden concluded that all plants were made of cells
- Schleiden is a cofounder of the cell theory

Beginning of the Cell Theory

- In 1839, a German zoologist named Theodore Schwann concluded that all animals were made of cells
- Schwann also cofounded the cell theory

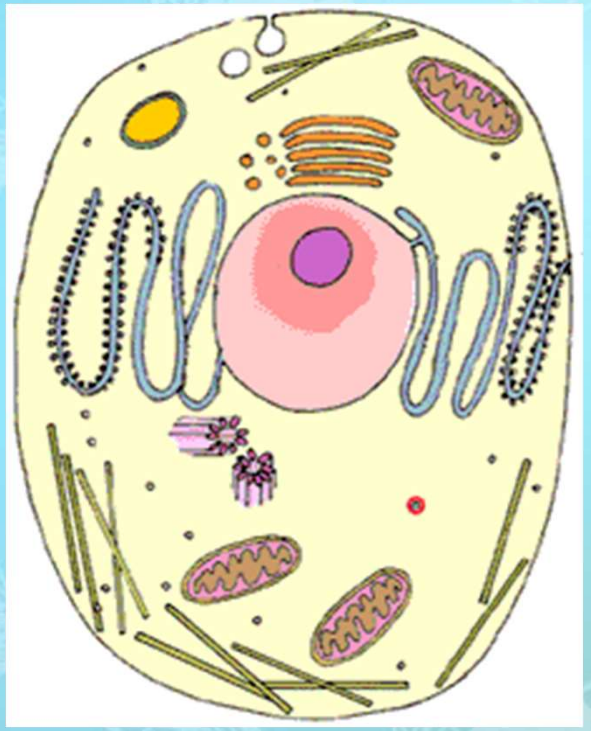
Beginning of the Cell Theory

- In 1855, a German medical doctor named Rudolph Virchow observed, under the microscope, cells dividing
- He reasoned that all cells come from other pre-existing cells by cell division

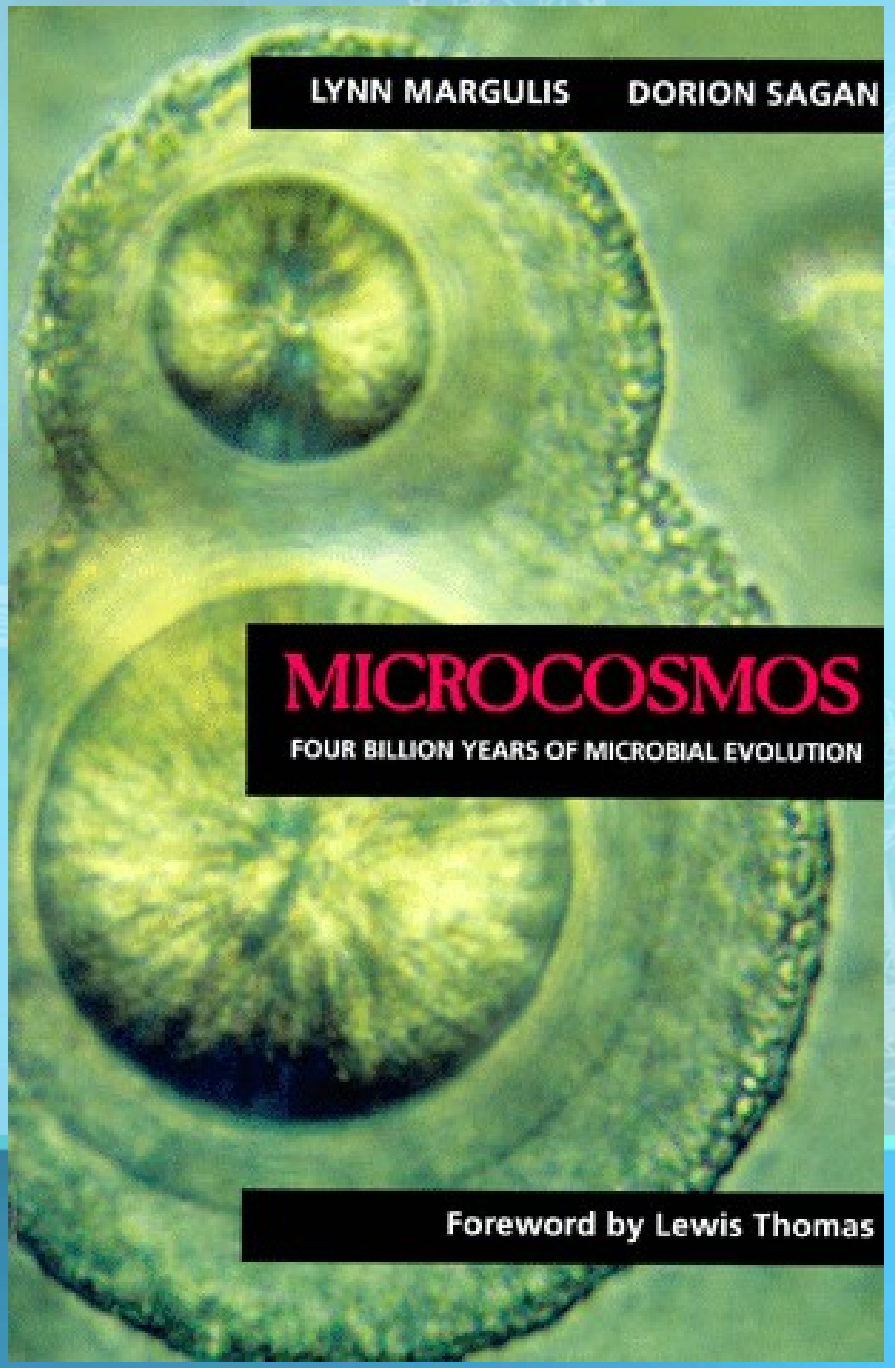


CELL THEORY

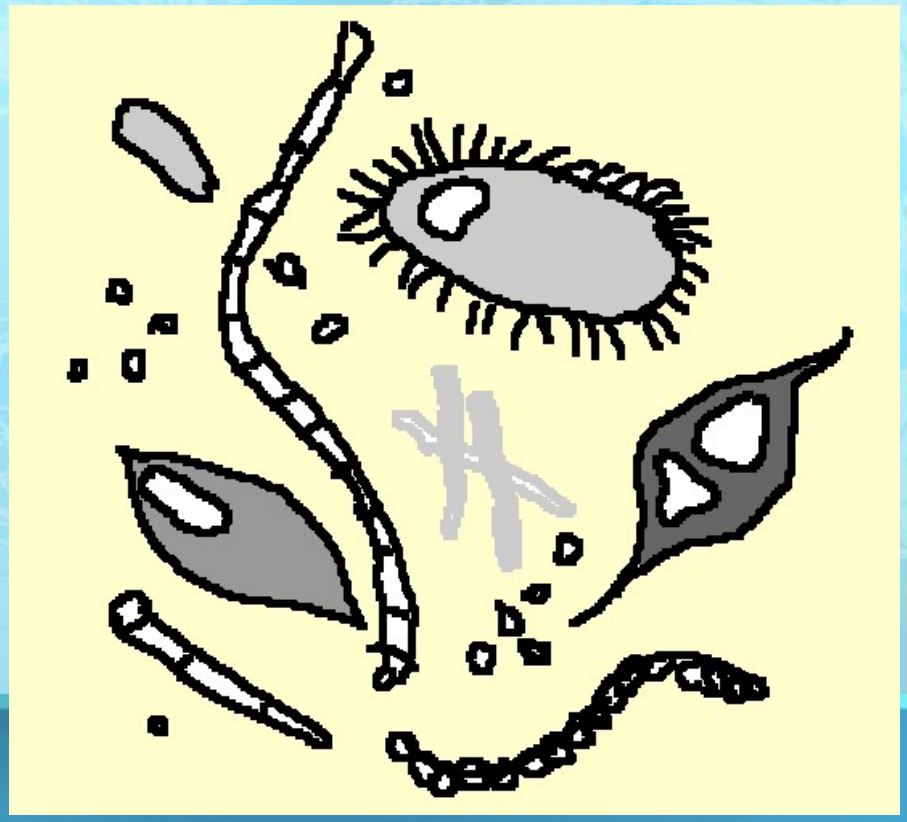
- All living things are made of cells
- Cells are the basic unit of structure and function in an organism (basic unit of life)
- Cells come from the reproduction of existing cells (cell division)



Discoveries Since the Cell Theory

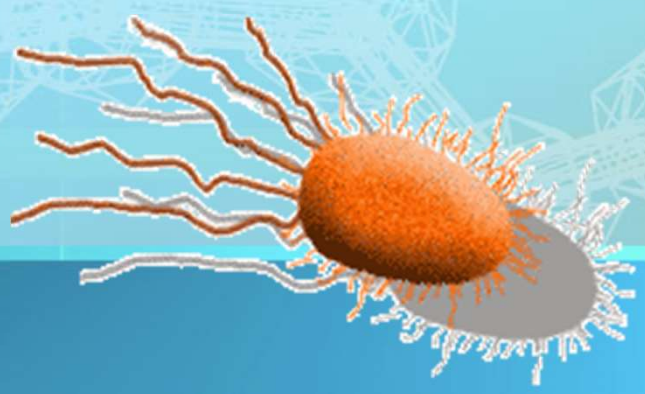


Simple or Complex Cells



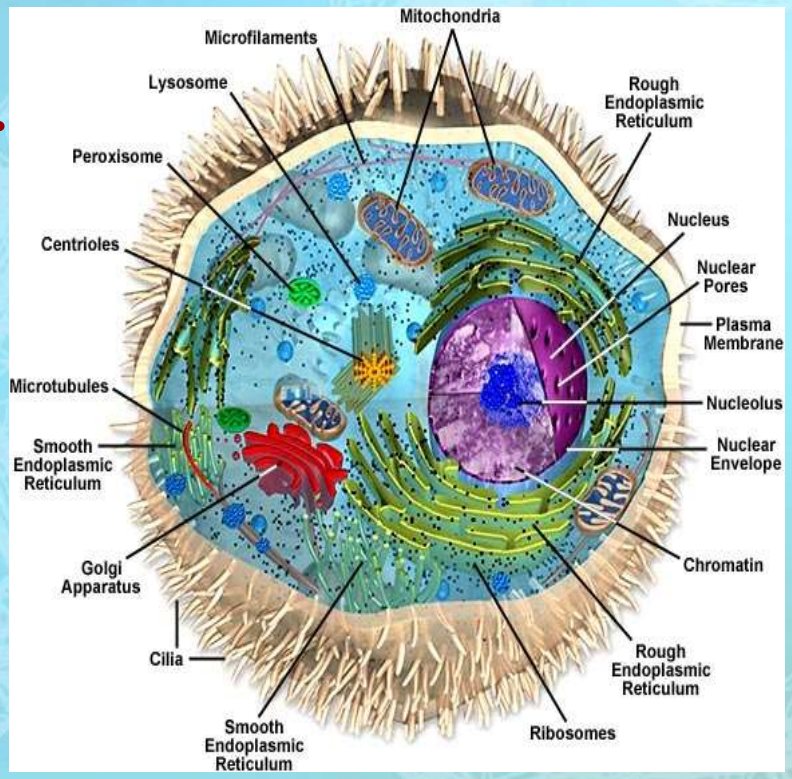
Prokaryotes – The first Cells

- Cells that lack a nucleus or membrane-bound organelles
- Includes bacteria
- Simplest type of cell
- Single, circular chromosome



Eukaryotes

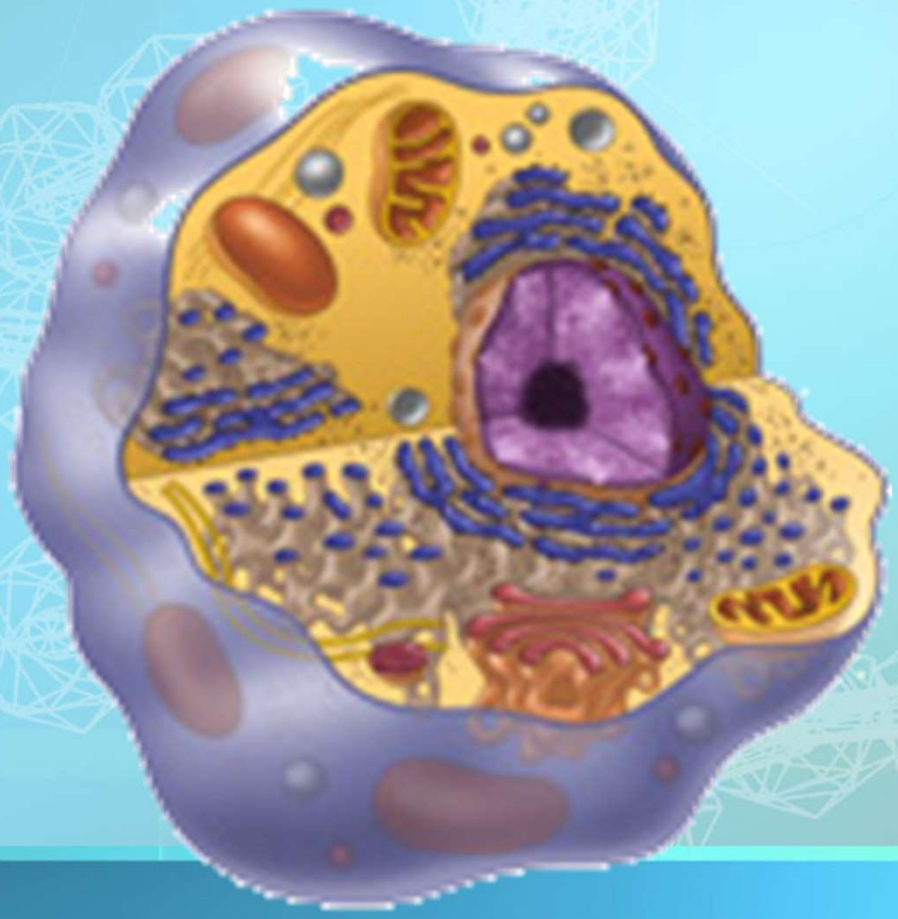
- Cells that HAVE a nucleus and membrane-bound organelles
- Includes protists, fungi, plants, and animals
- More complex type of cells



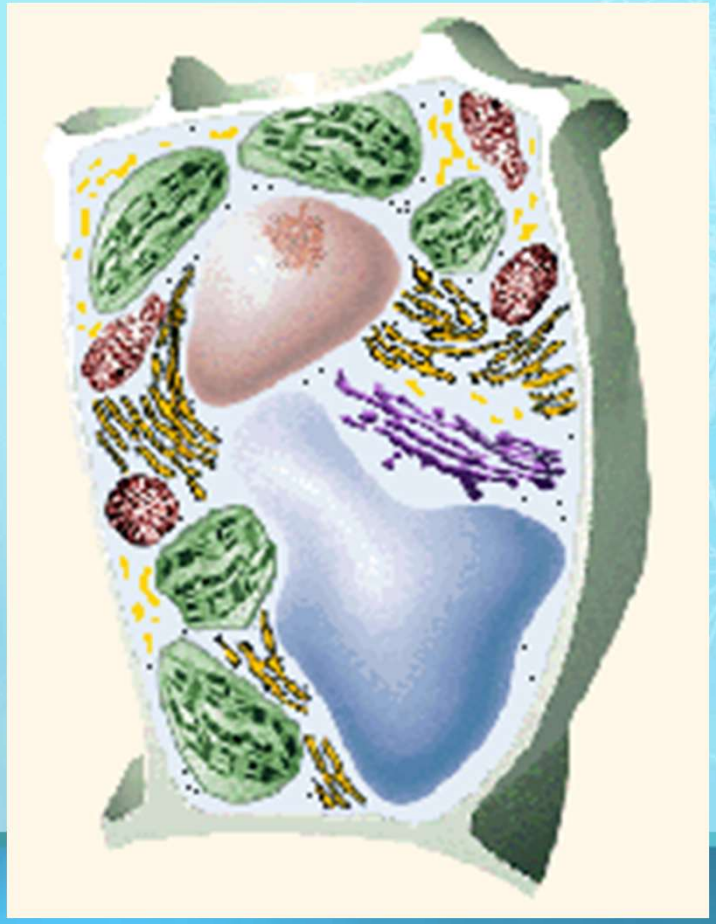
Eukaryotic Cell

Contain 3 basic cell structures:

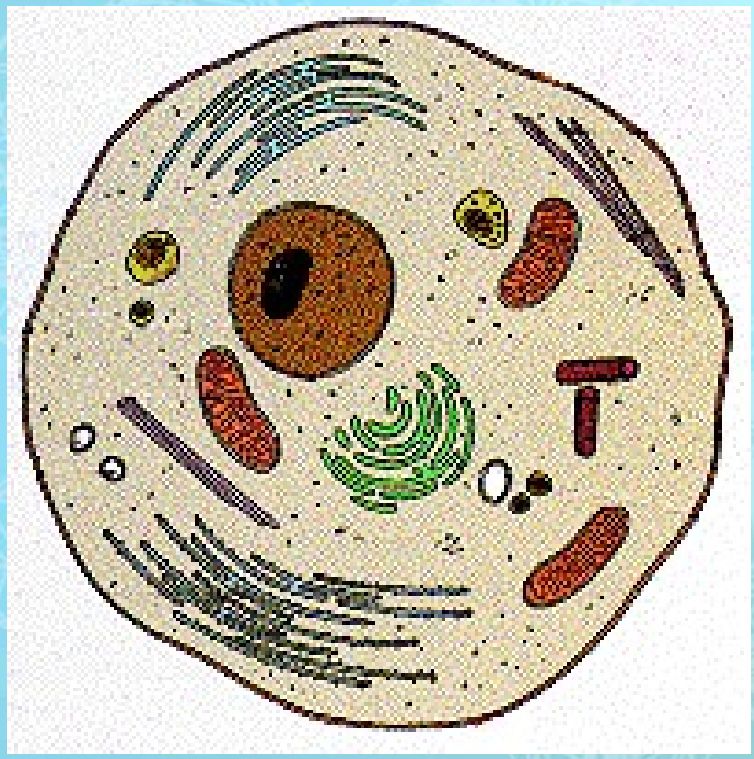
- Nucleus
- Cell Membrane
- Cytoplasm with organelles



Two Main Types of Eukaryotic Cells



Plant Cell



Animal Cell

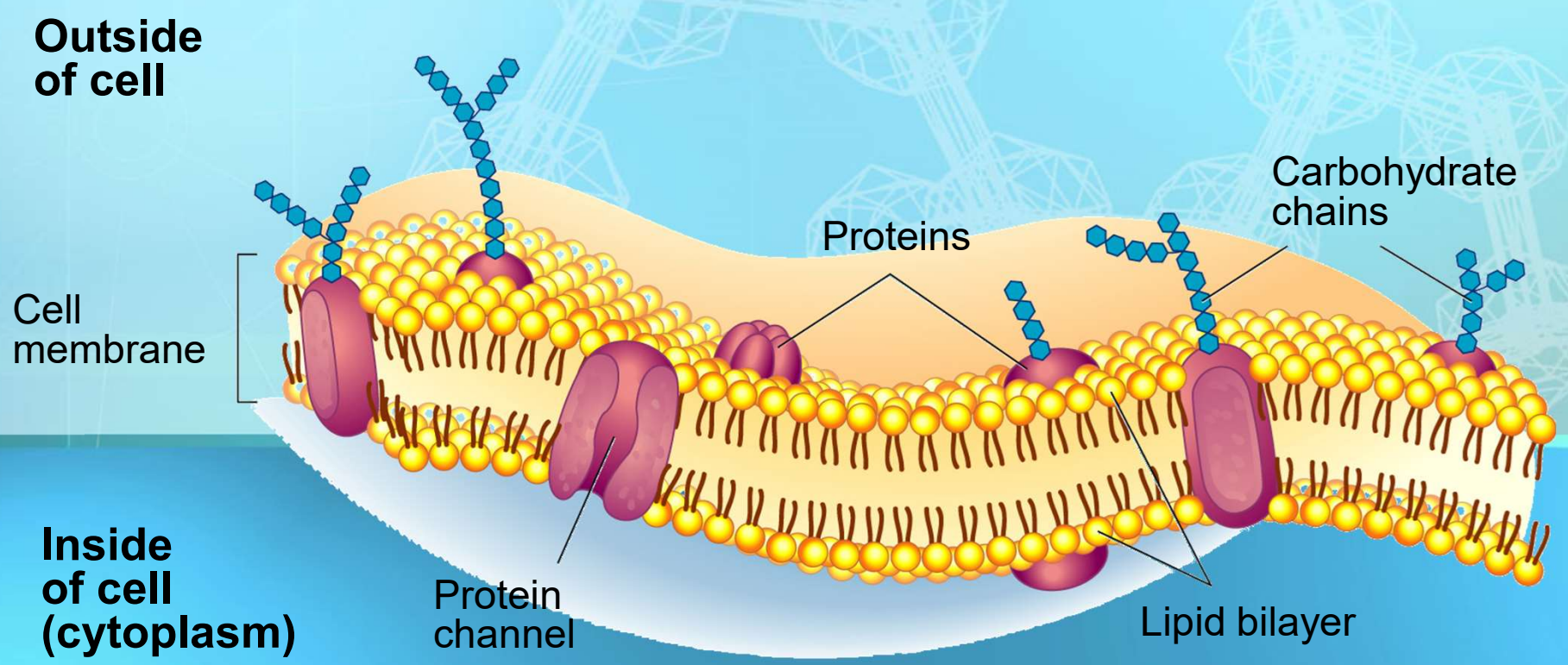
Organelles

Organelles

- Very small (Microscopic)
- Perform various functions for a cell
- Found in the cytoplasm
- May or may not be membrane-bound

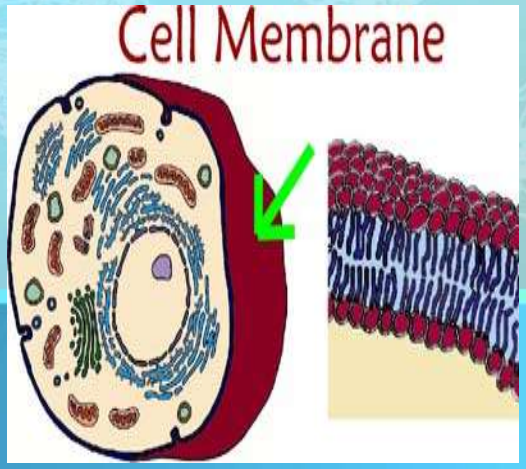
Cell or Plasma Membrane

- Composed of double layer of phospholipids and proteins
- Surrounds outside of ALL cells
- Controls what enters or leaves the cell
- Living layer

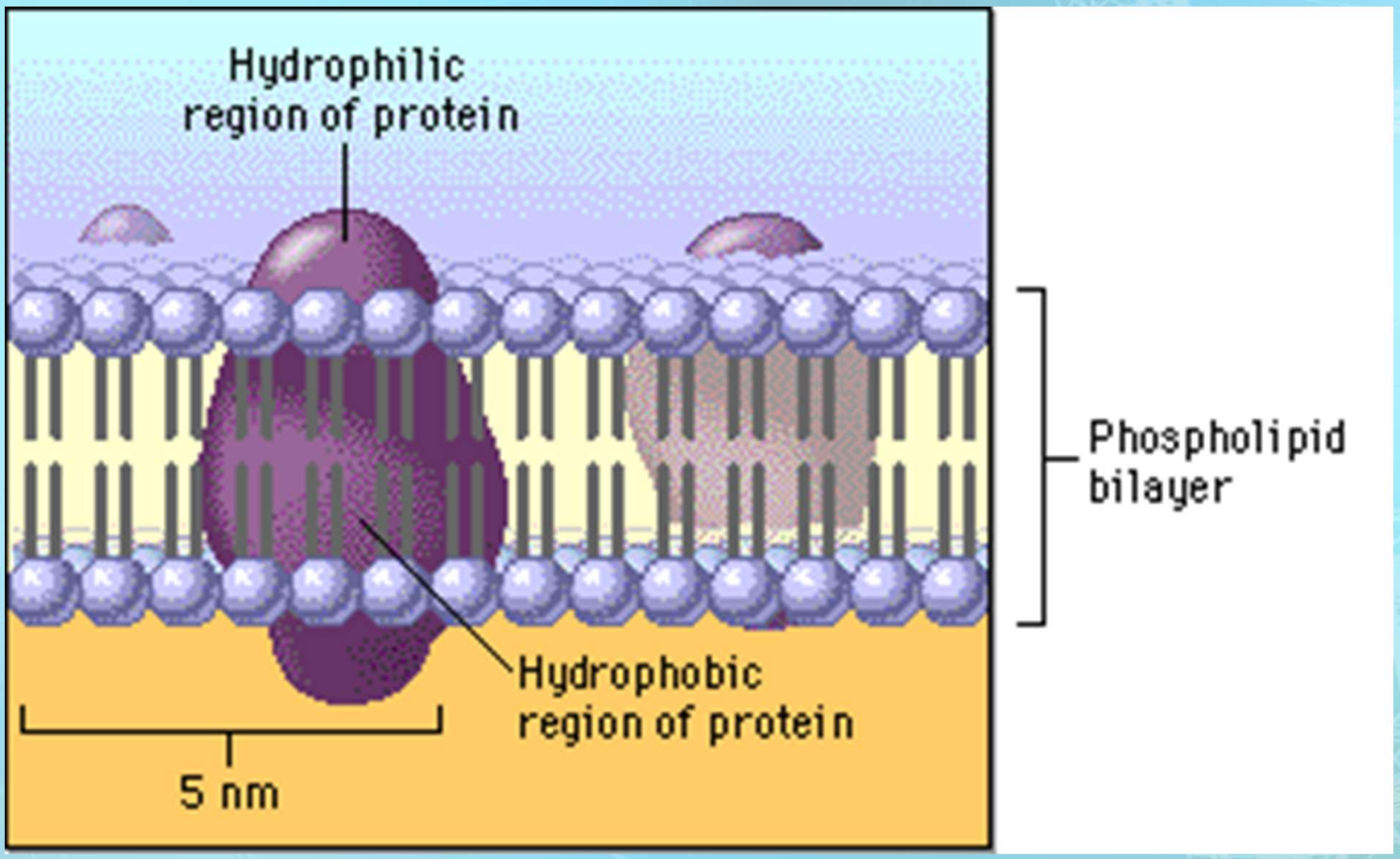


Phospholipids

- **Heads** contain glycerol & phosphate and are **hydrophilic** (attract water)
- **Tails** are made of **fatty acids** and are **hydrophobic** (repel water)
- Make up a **bilayer** where tails point inward toward each other
- Can **move laterally** to **allow small molecules** (O_2, CO_2, & H_2O to enter)



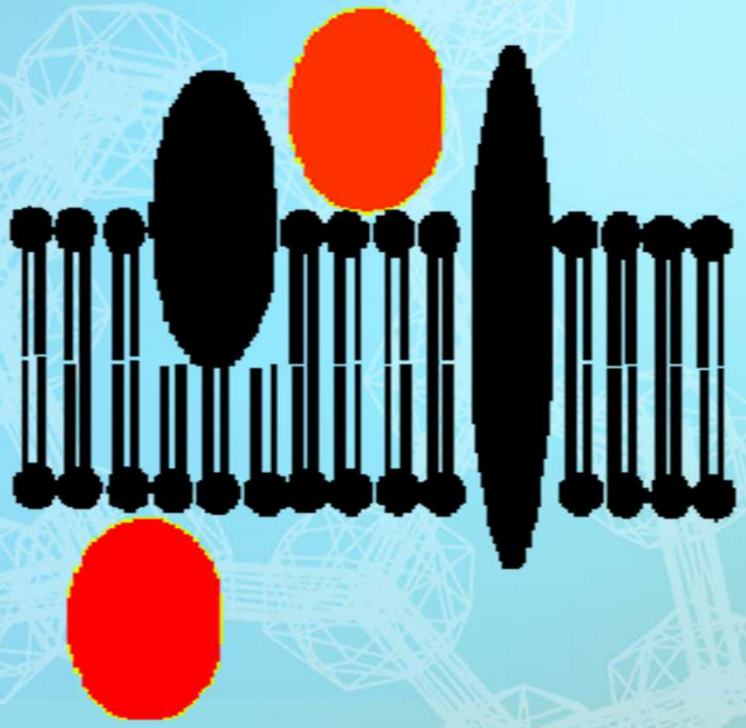
The Cell Membrane is Fluid



Molecules in cell membranes are constantly moving and changing

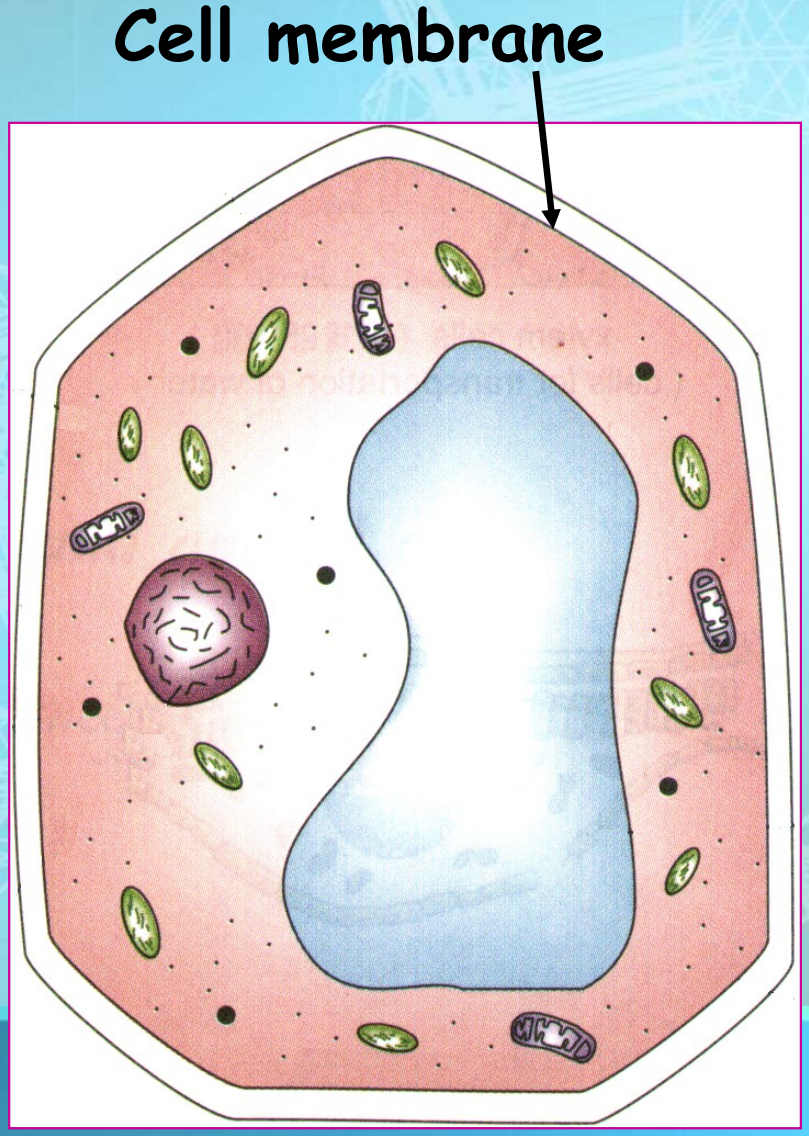
Cell Membrane Proteins

- Proteins help move large molecules or aid in cell recognition
- Peripheral proteins are attached on the surface (inner or outer)
- Integral proteins are embedded completely through the membrane



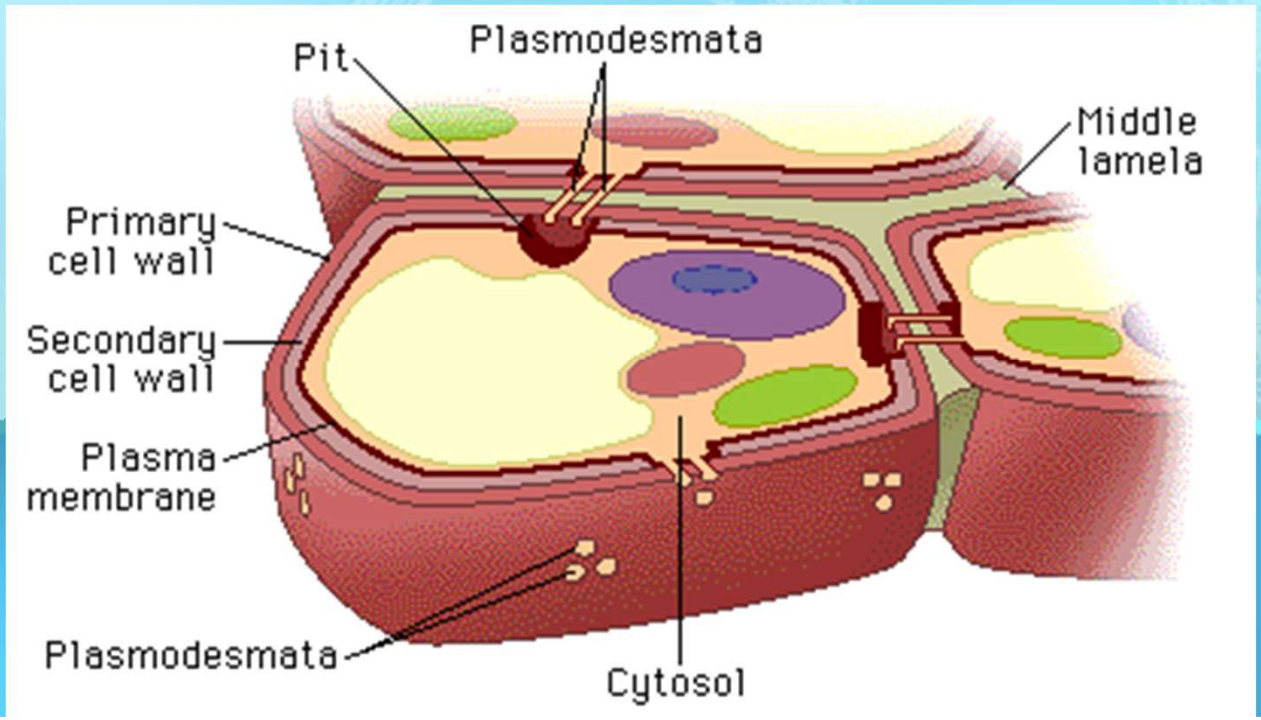
Cell Membrane in Plants

- Lies immediately against the cell wall in plant cells
- Pushes out against the cell wall to maintain cell shape



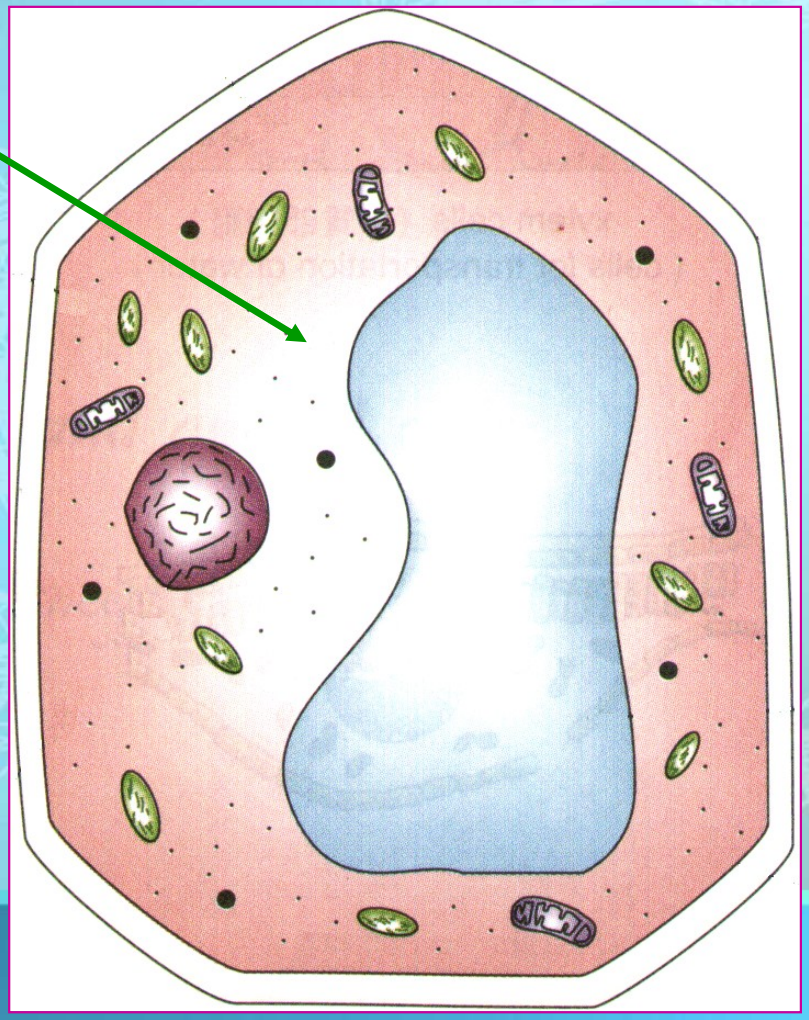
Cell Wall

- Found outside of the cell membrane
- Nonliving layer
- Supports and protects cell
- Found in plants, fungi, & bacteria

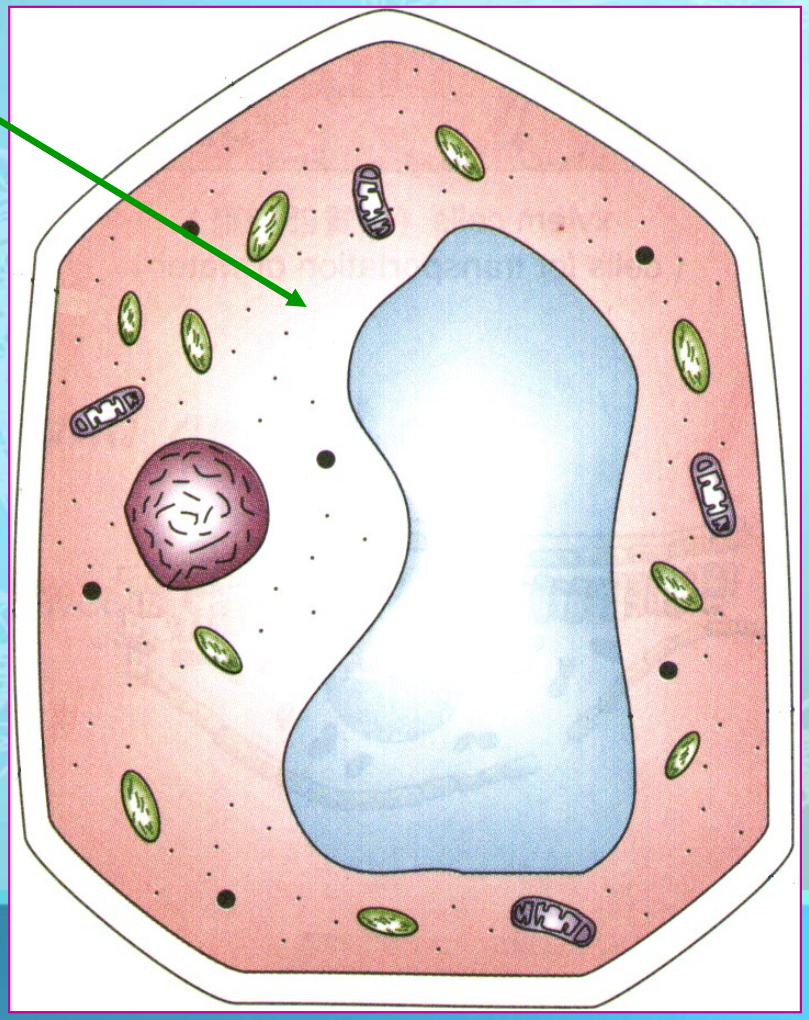


Cytoplasm of a Cell

- Jelly-like substance enclosed by cell membrane
- Provides a medium for chemical reactions to take place

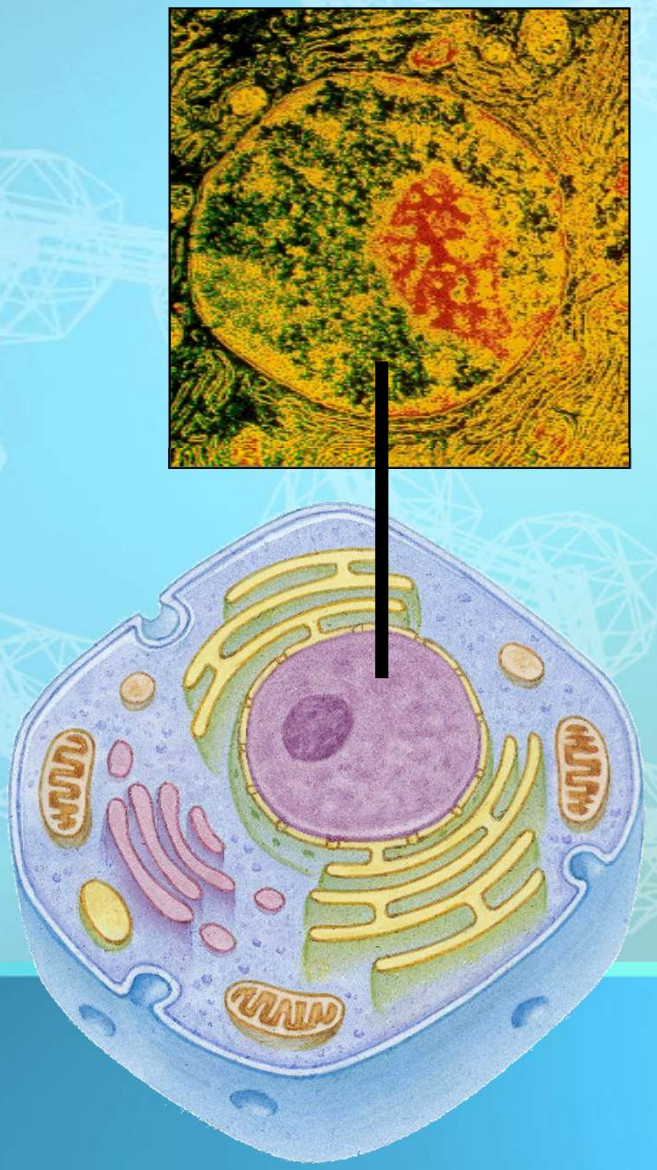


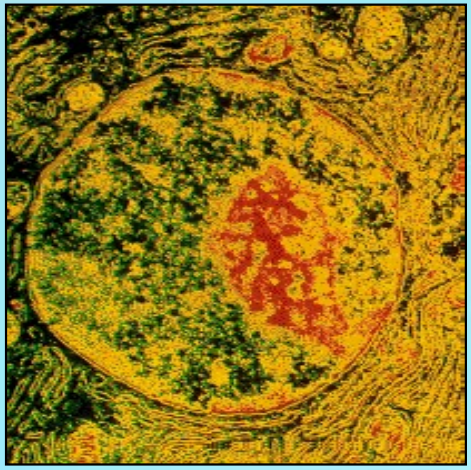
- Contains **organelles** to carry out specific jobs

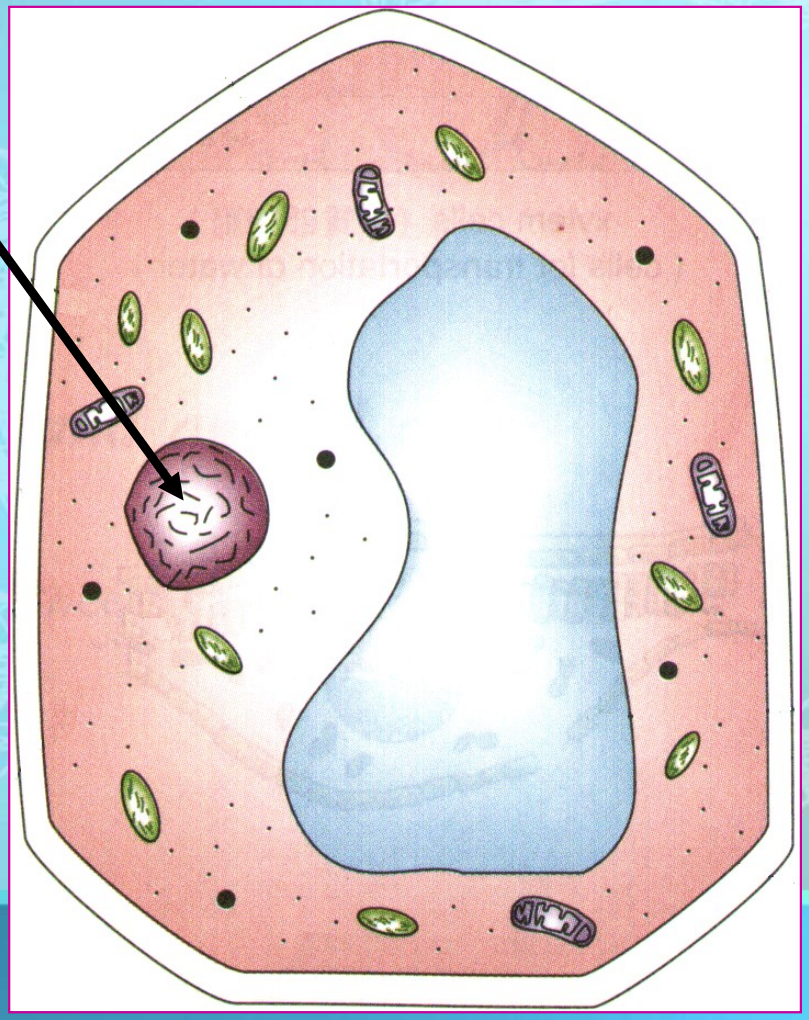


The Control Organelle - Nucleus

- Controls the normal activities of the cell
- Contains the DNA in chromosomes
- Bounded by a nuclear envelope (membrane) with pores
- Usually the largest organelle



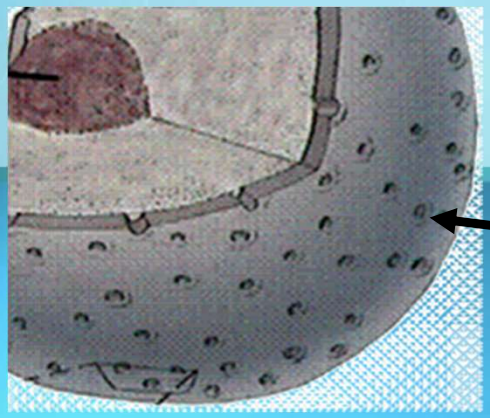




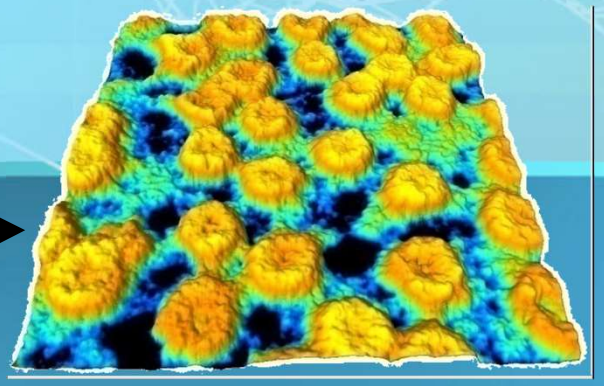
- Each cell has fixed number of chromosomes that carry **genes**
- **Genes control cell characteristics**

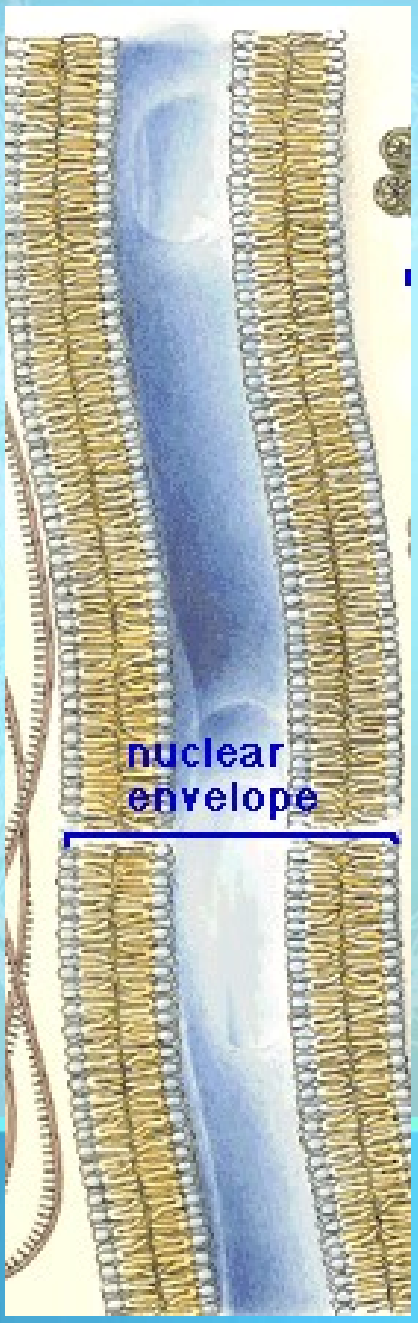
Nuclear Envelope

- Double membrane surrounding nucleus
- Also called nuclear membrane
- Contains nuclear pores for materials to enter & leave nucleus



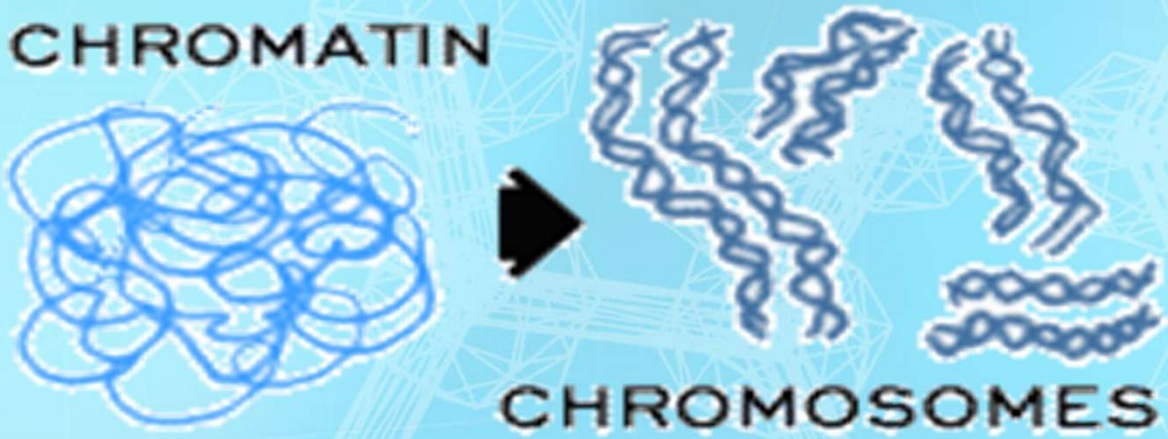
Nuclear pores





Inside the Nucleus -

The genetic material (DNA) is found

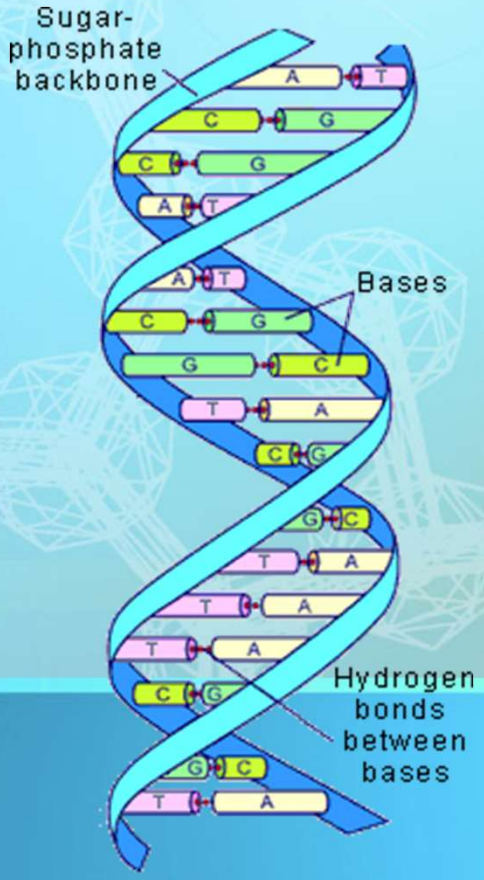


DNA is spread out
And appears as
CHROMATIN
in non-dividing cells

DNA is condensed &
wrapped around proteins
forming
as CHROMOSOMES
in dividing cells

What Does DNA do?

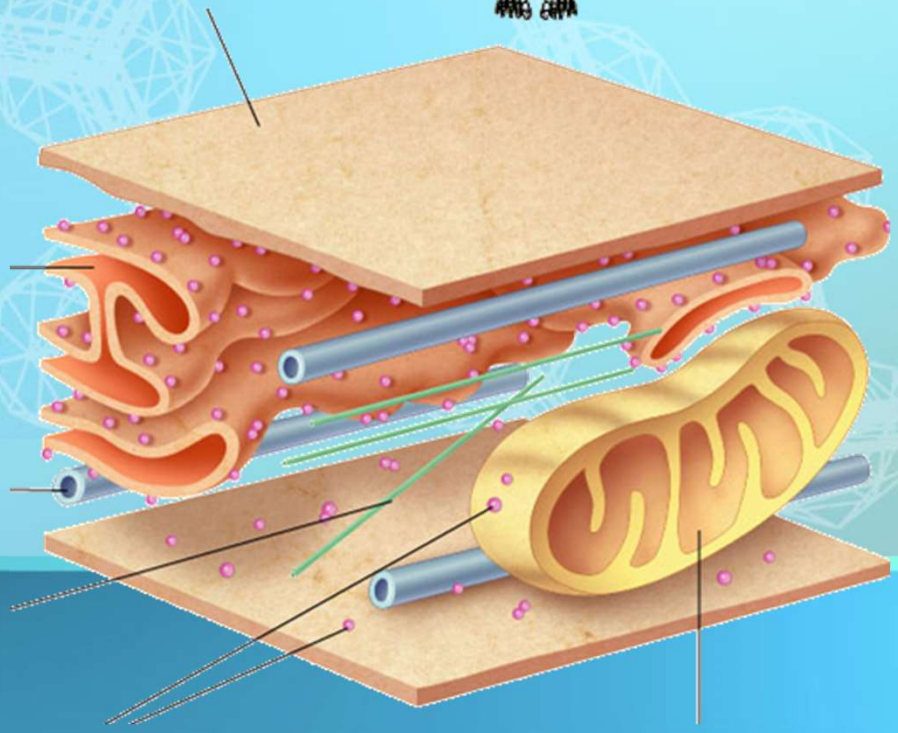
DNA is the **hereditary material** of the cell



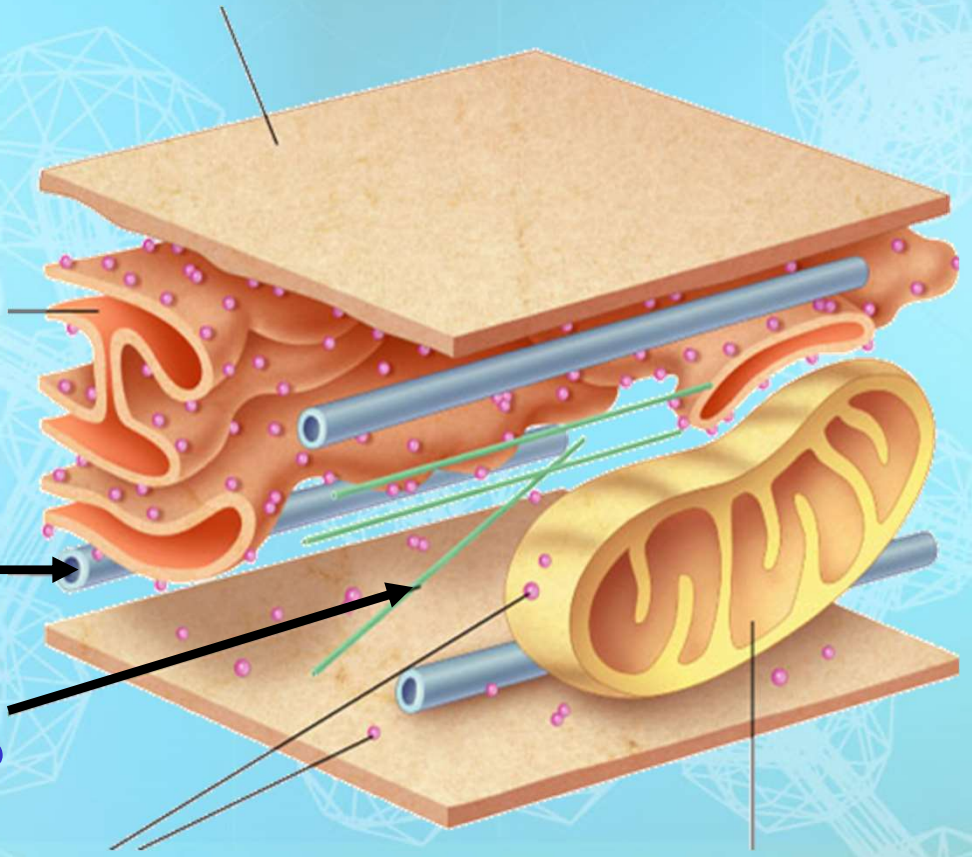
Genes that make up the DNA molecule code for different **proteins**

Cytoskeleton

- Helps cell maintain cell shape
- Also help move organelles around
- Made of proteins
- Microfilaments are threadlike & made of ACTIN
- Microtubules are tubelike & made of TUBULIN



Cytoskeleton



MICROTUBULES

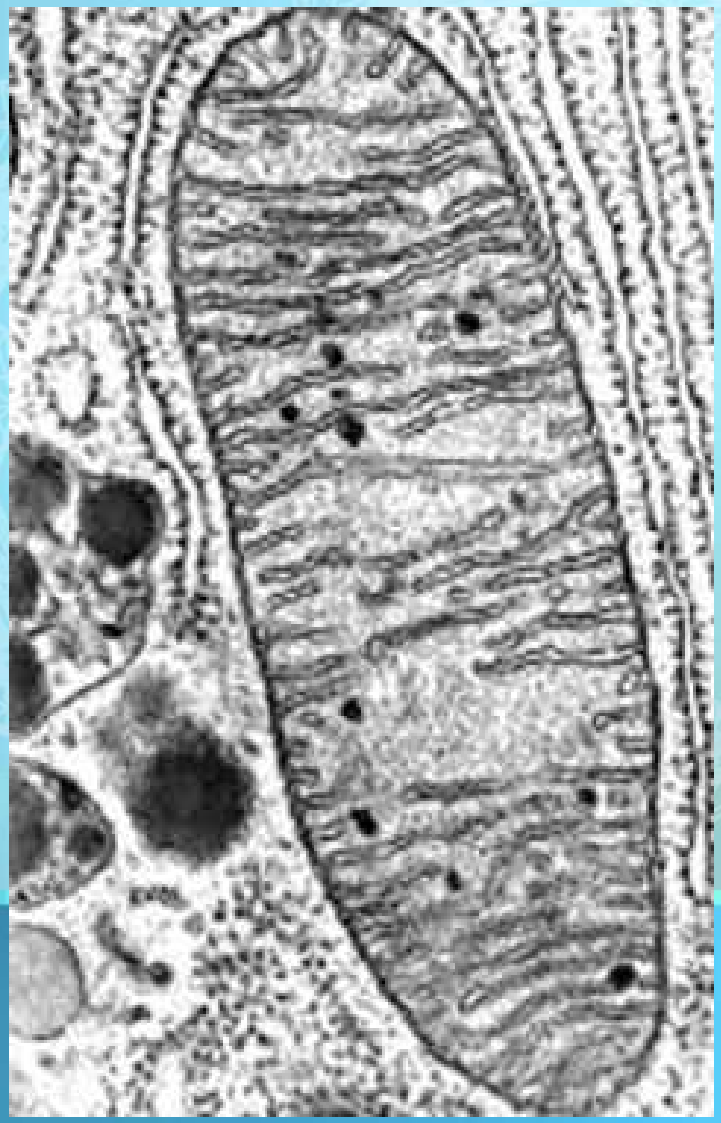
MICROFILAMENTS

Centrioles

- Found only in animal cells
- Paired structures near nucleus
- Made of bundle of microtubules
- Appear during cell division forming mitotic spindle
- Help to pull chromosome pairs apart to opposite ends of the cell

Mitochondrion (plural = mitochondria)

- "Powerhouse" of the cell
- Generate cellular energy (ATP)
- More active cells like muscle cells have MORE mitochondria
- Both plants & animal cells have mitochondria
- Site of CELLULAR RESPIRATION (burning glucose)



MITOCHONDRIA

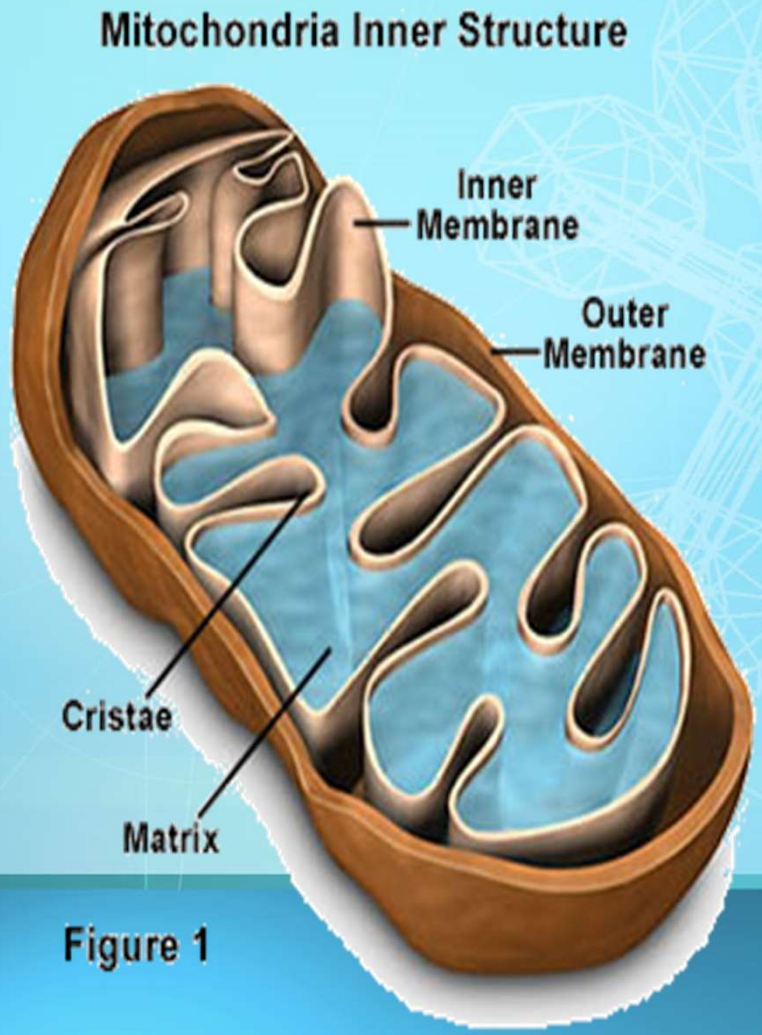


Figure 1

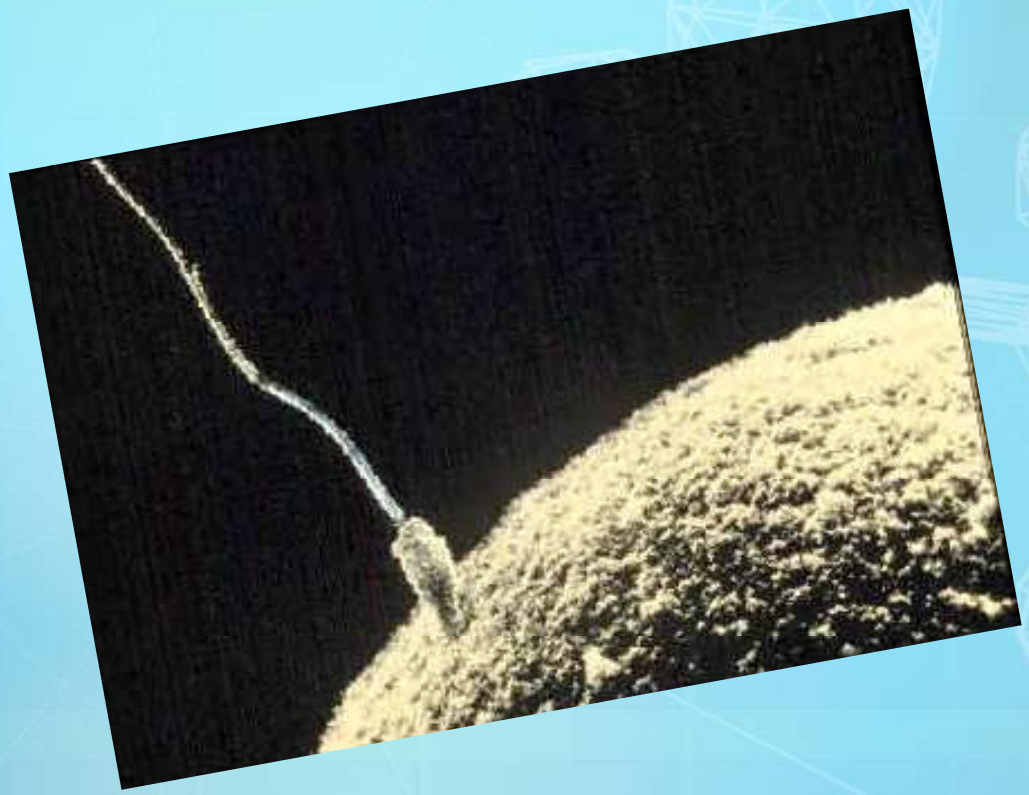
Surrounded by a DOUBLE membrane

Has its own DNA

Folded inner membrane called CRISTAE (increases surface area for more chemical Reactions)

Interior called MATRIX

Interesting Fact ---



- Mitochondria Come from cytoplasm in the EGG cell during fertilization

Therefore …

- You inherit your mitochondria from your mother!

Endoplasmic Reticulum - ER

- Network of hollow membrane tubules
- Connects to nuclear envelope & cell membrane
- Functions in Synthesis of cell products & Transport

Two kinds of ER ---ROUGH & SMOOTH

Rough Endoplasmic Reticulum (Rough ER)

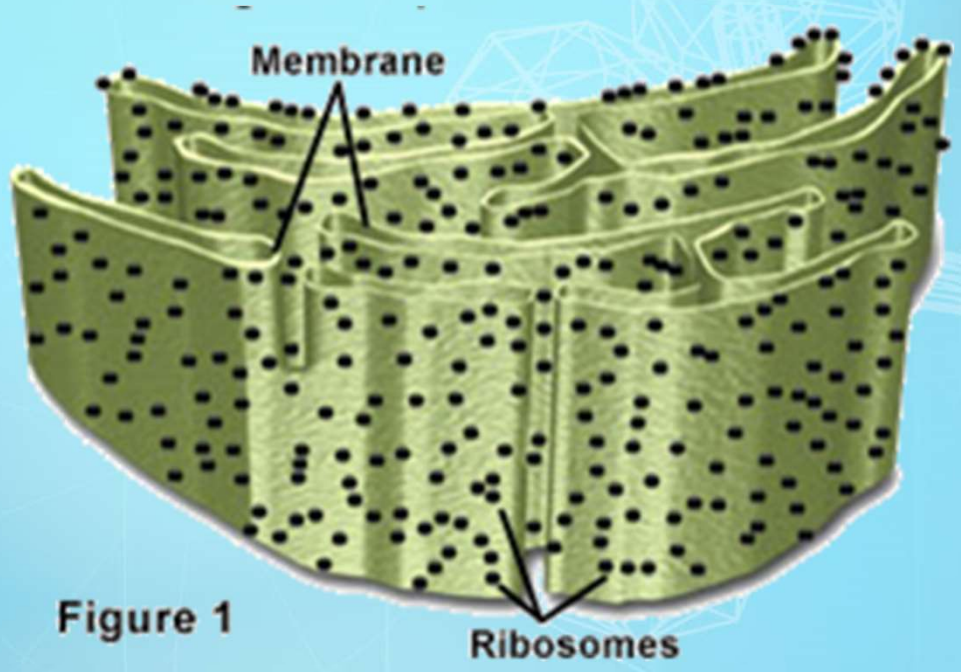
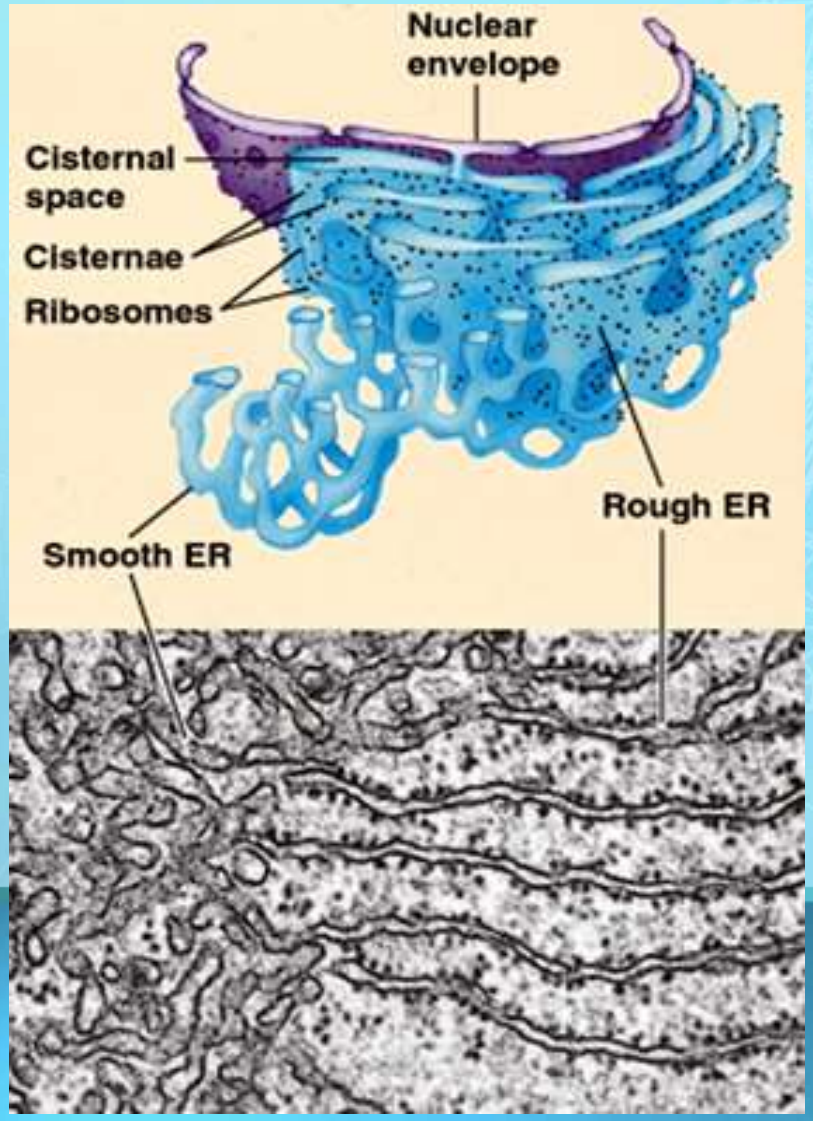


Figure 1

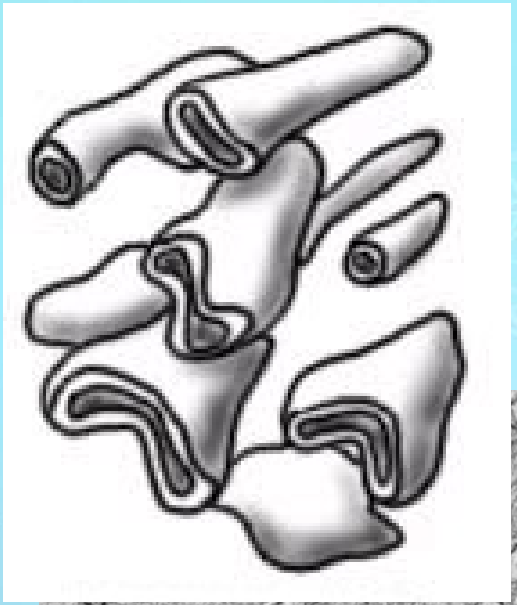
- Has ribosomes on its surface
- Makes membrane proteins and proteins for export out of cell

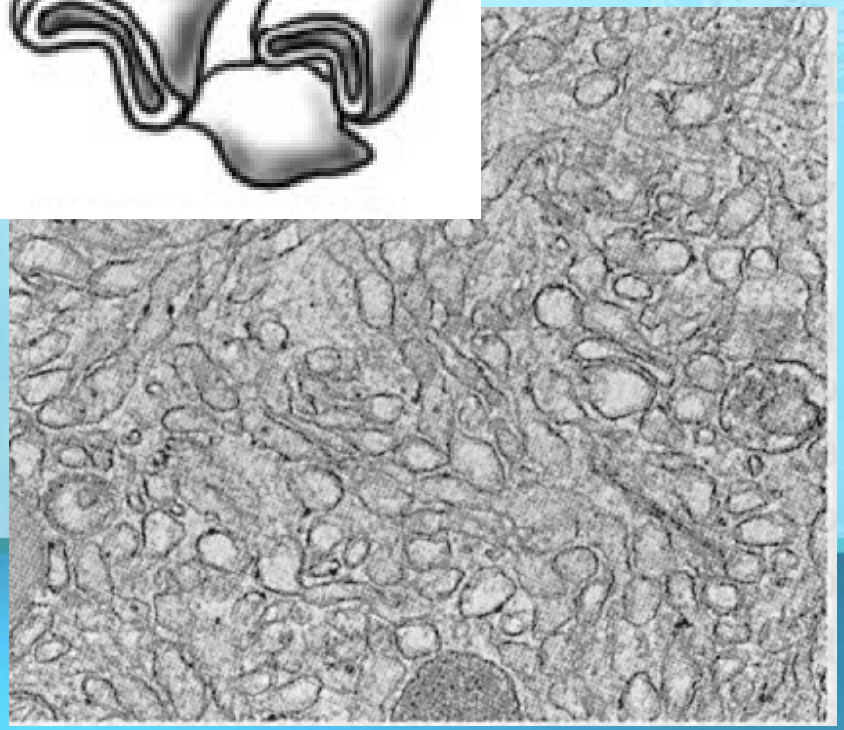
Rough Endoplasmic Reticulum (Rough ER)



- Proteins are made by ribosomes on ER surface
- They are then threaded into the interior of the Rough ER to be modified and transported

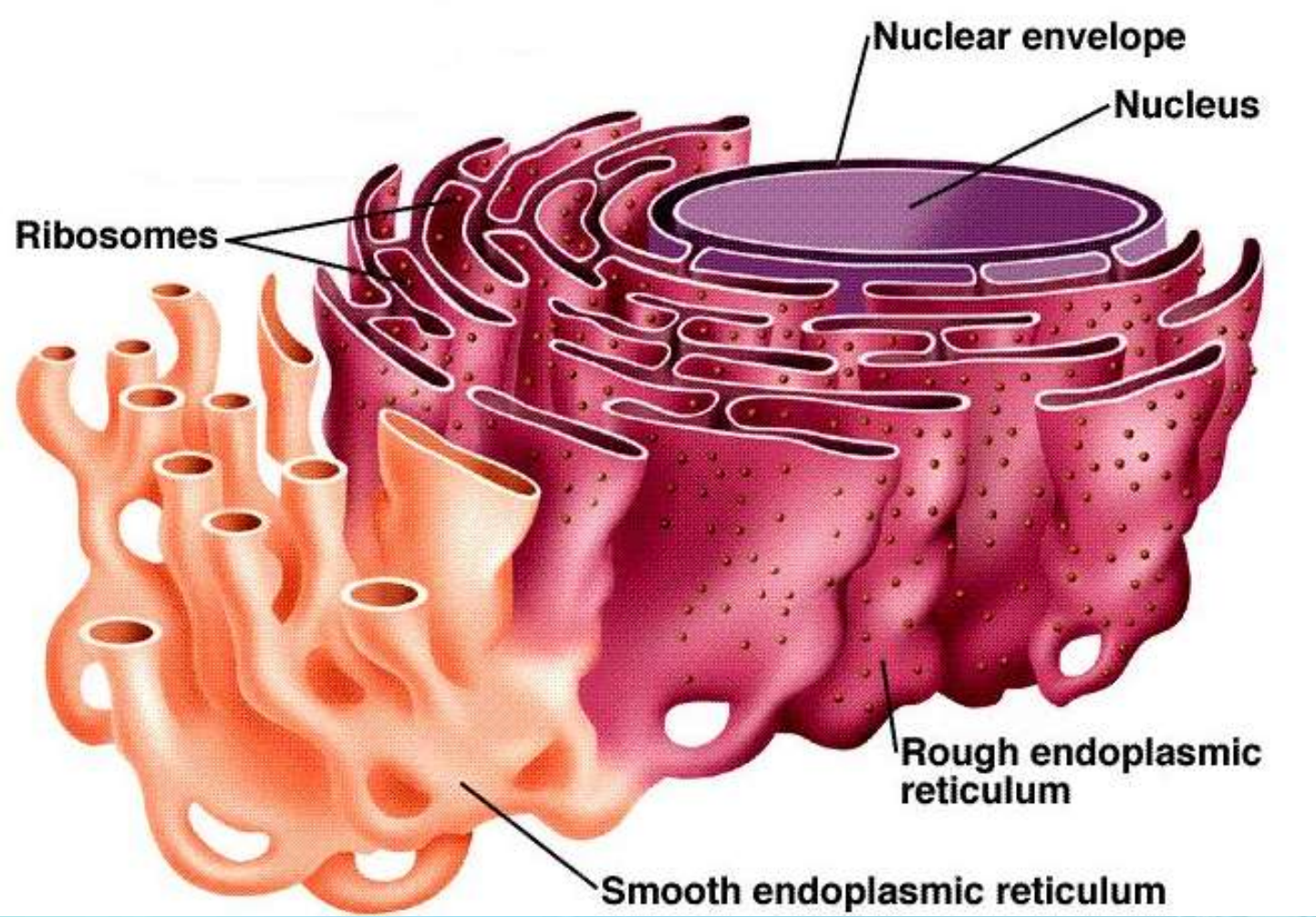
Functions of the Smooth ER





- Makes membrane lipids (steroids)
- Regulates calcium (muscle cells)
- Destroys toxic substances (Liver)

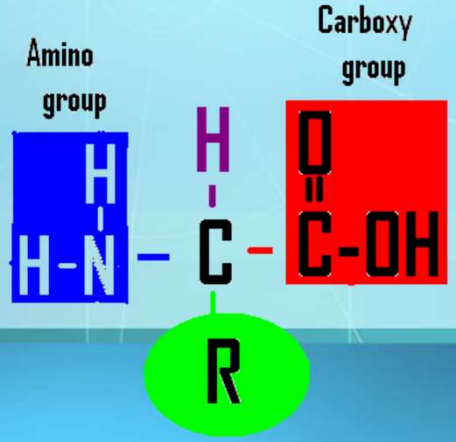
Endomembrane System

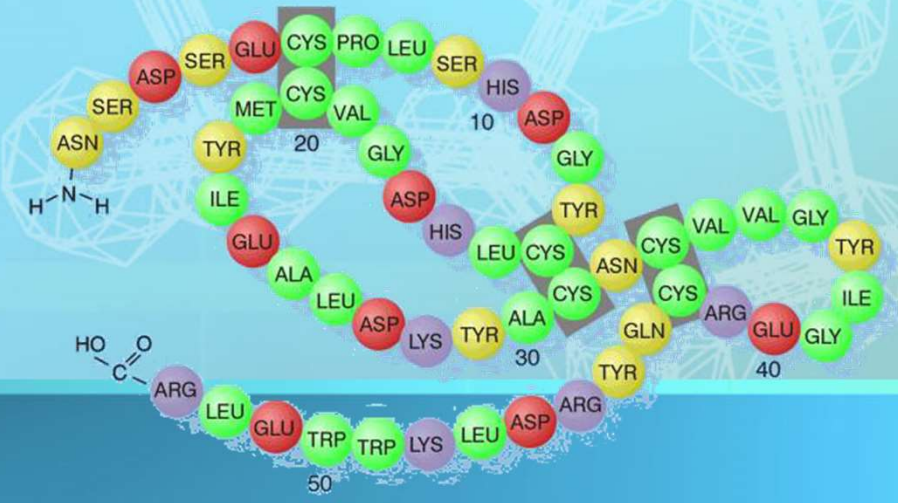


Includes nuclear membrane connected to ER connected to cell membrane (transport)

Ribosomes

- Made of PROTEINS and rRNA
- "Protein factories" for cell
- Join amino acids to make proteins through protein synthesis





Ribosomes

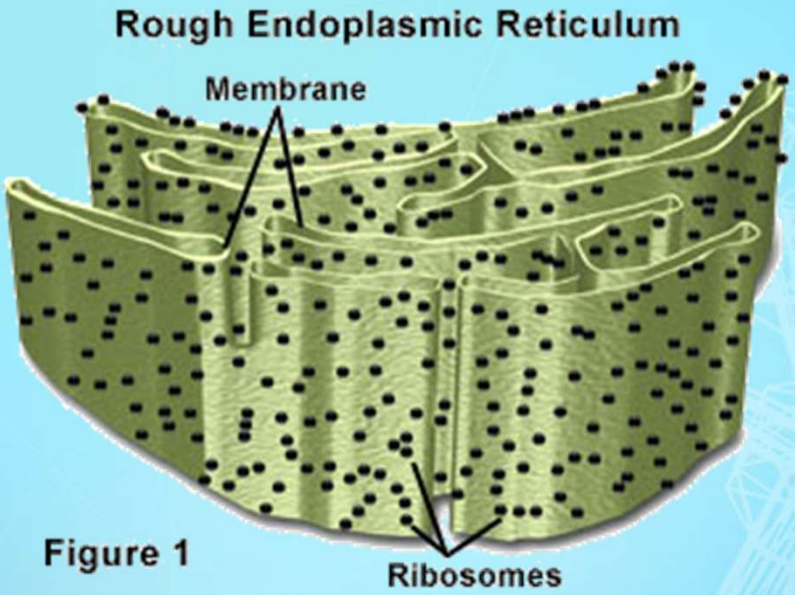
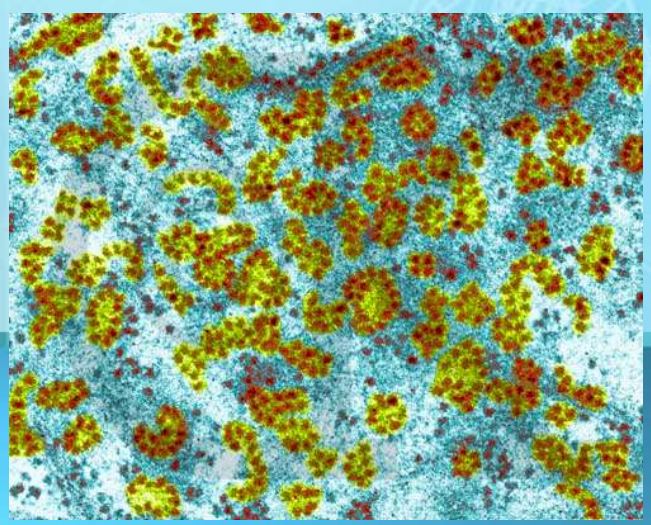


Figure 1



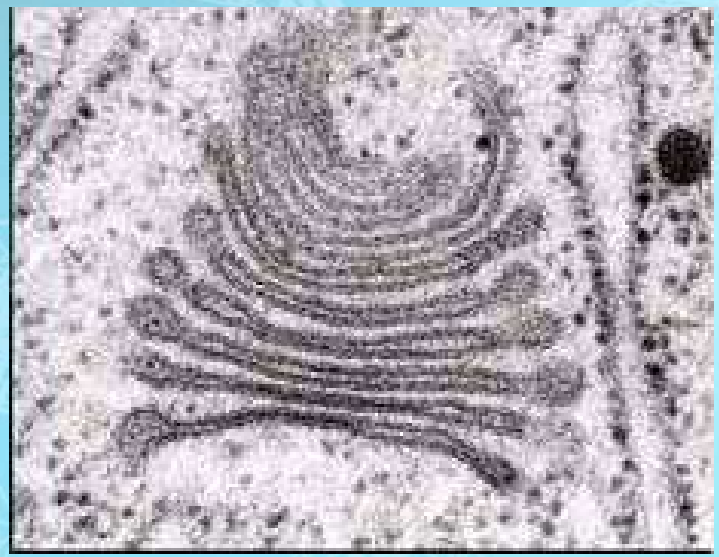
Can be attached to Rough ER

OR

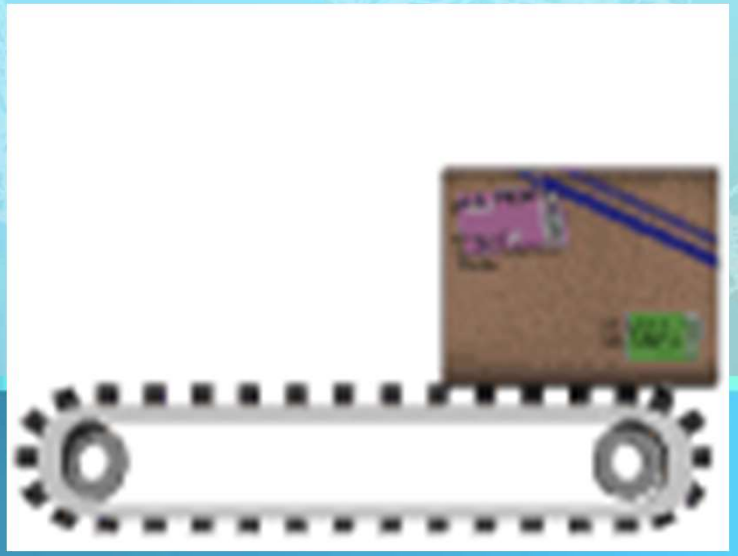
Be free (unattached) in the cytoplasm

Golgi Bodies

Look like a stack of pancakes



Modify, sort, & package molecules from ER for **storage** OR **transport** out of cell

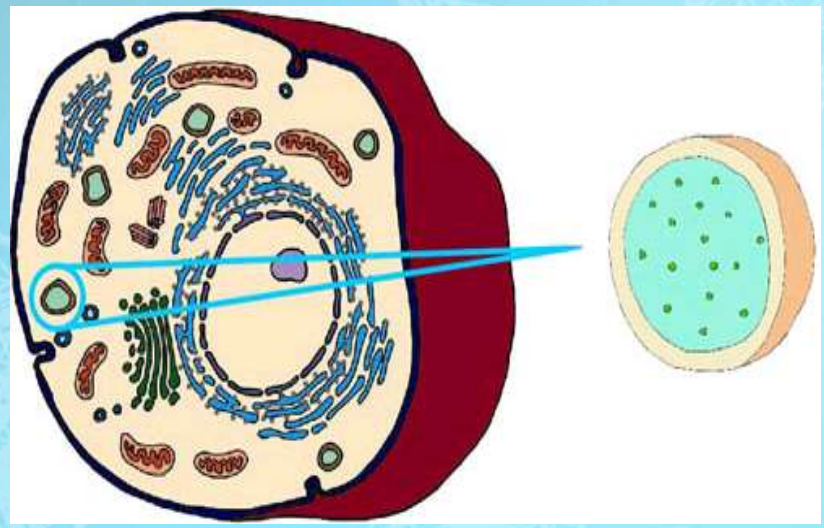


Golgi Animation

Materials are transported from Rough ER to Golgi to the cell membrane by VESICLES

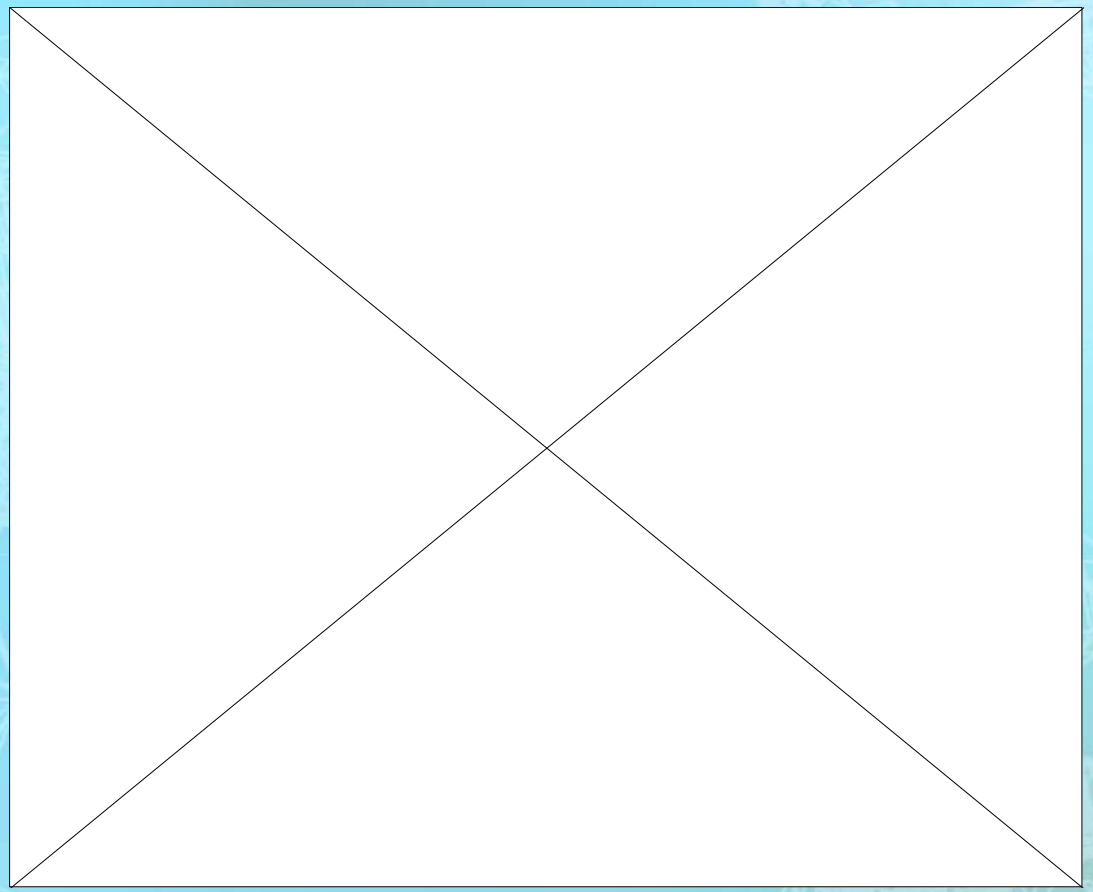
Lysosomes

- Contain digestive enzymes
- Break down food, bacteria, and worn out cell parts for cells
- Programmed for cell death (APOPTOSIS)
- Lyse & release enzymes to break down & recycle cell parts)



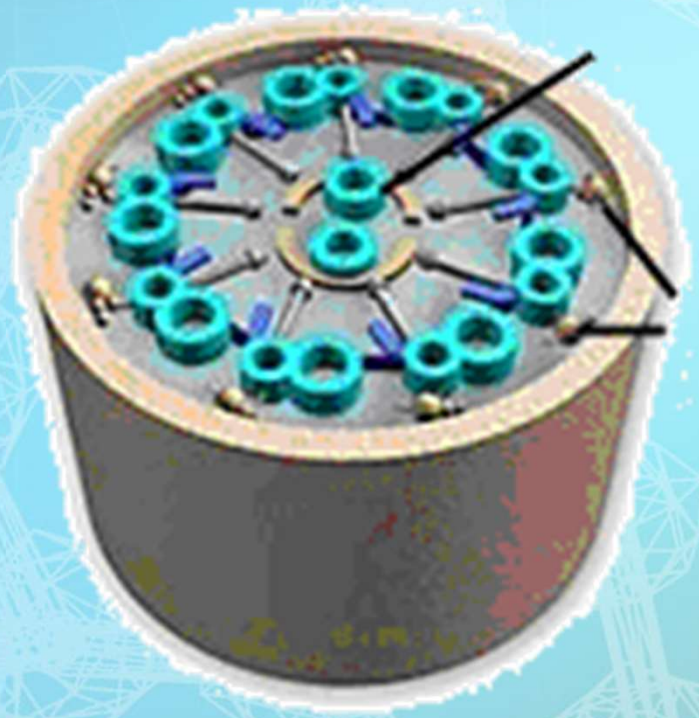
Lysosome Digestion

- Cells take in food by phagocytosis
- Lysosomes digest the food & get rid of wastes



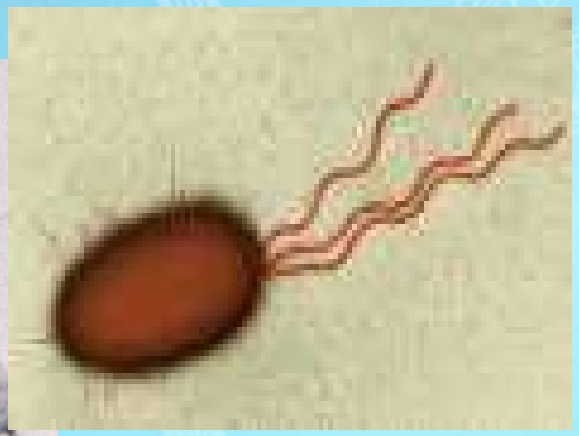
Cilia & Flagella

- Function in moving cells, in moving fluids, or in small particles across the cell surface

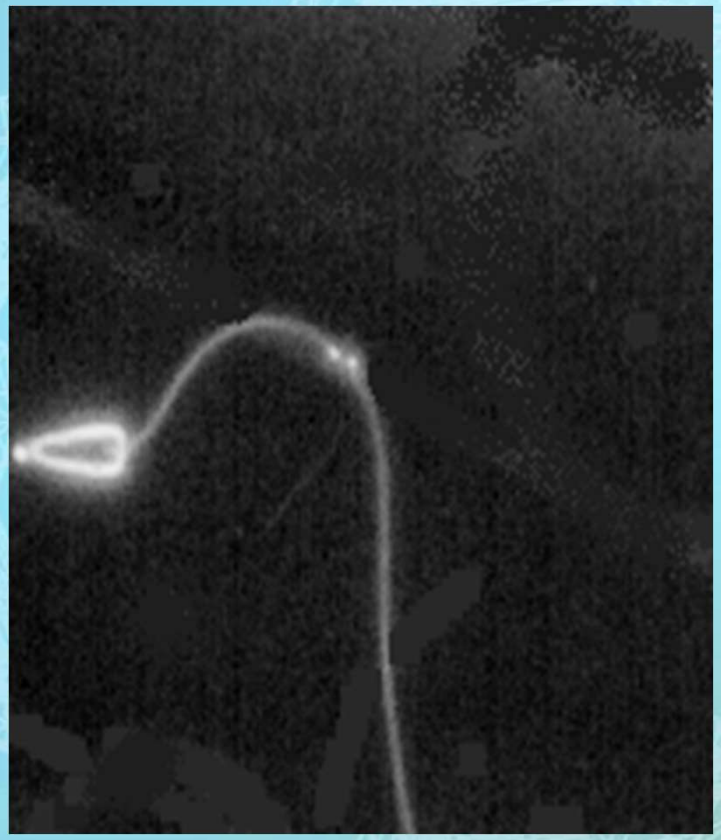


Cilia & Flagella

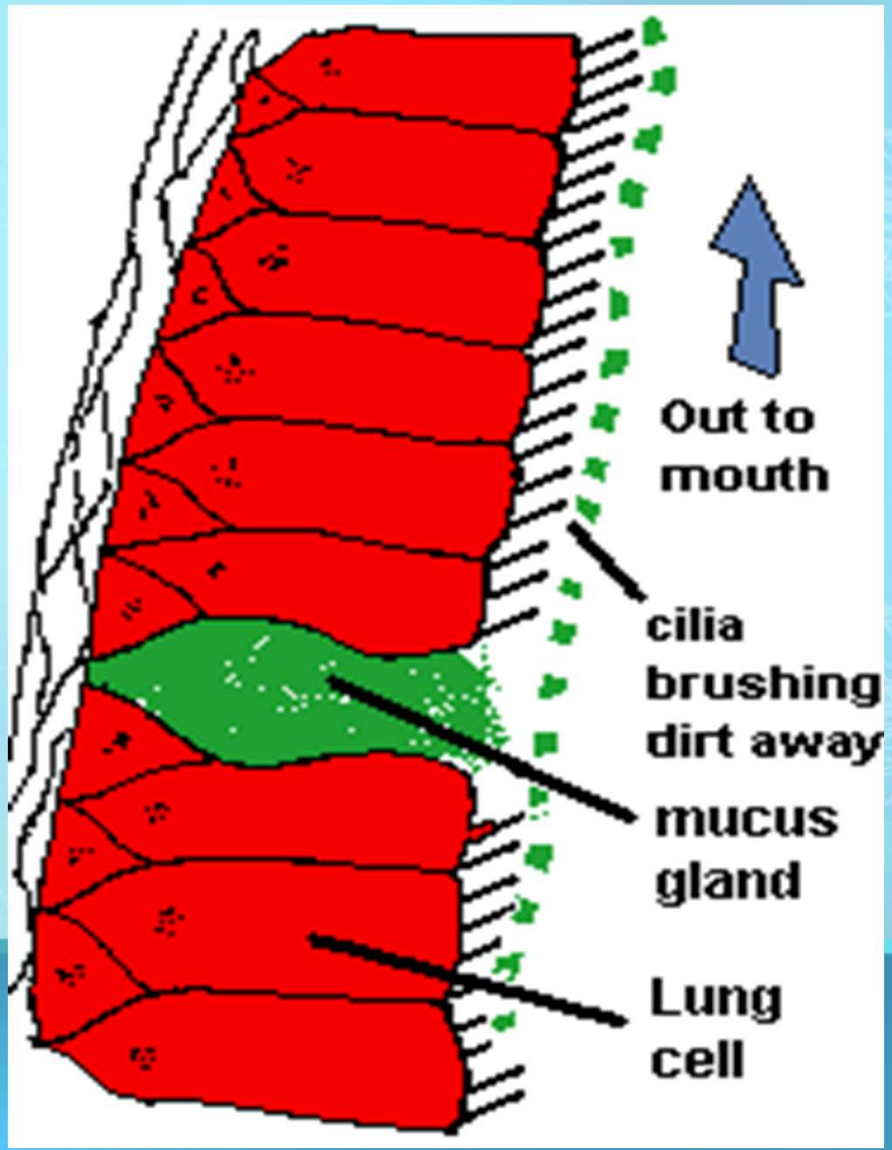
- **Cilia** are shorter and more numerous on cells
- **Flagella** are longer and fewer (usually 1-3) on cells



Cell Movement with Cilia & Flagella

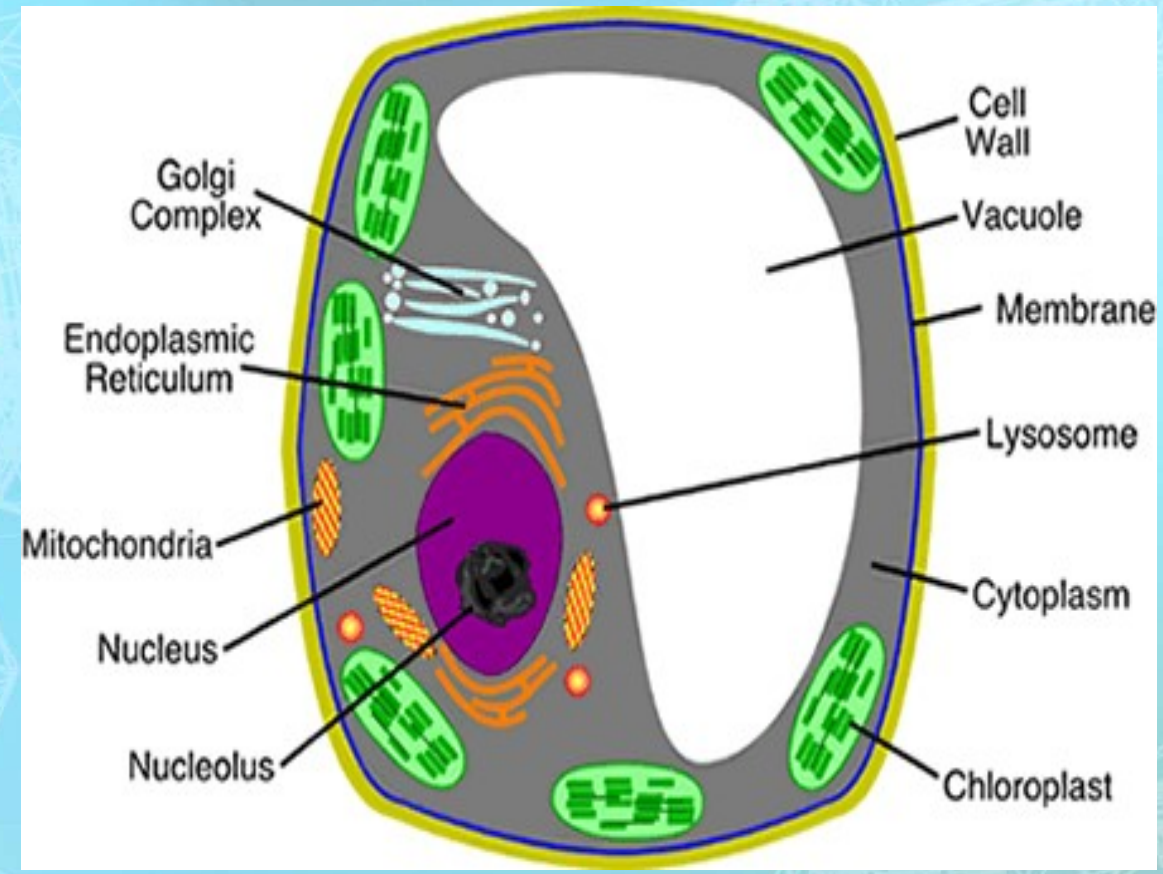


Cilia Moving Away Dust Particles from the Lungs



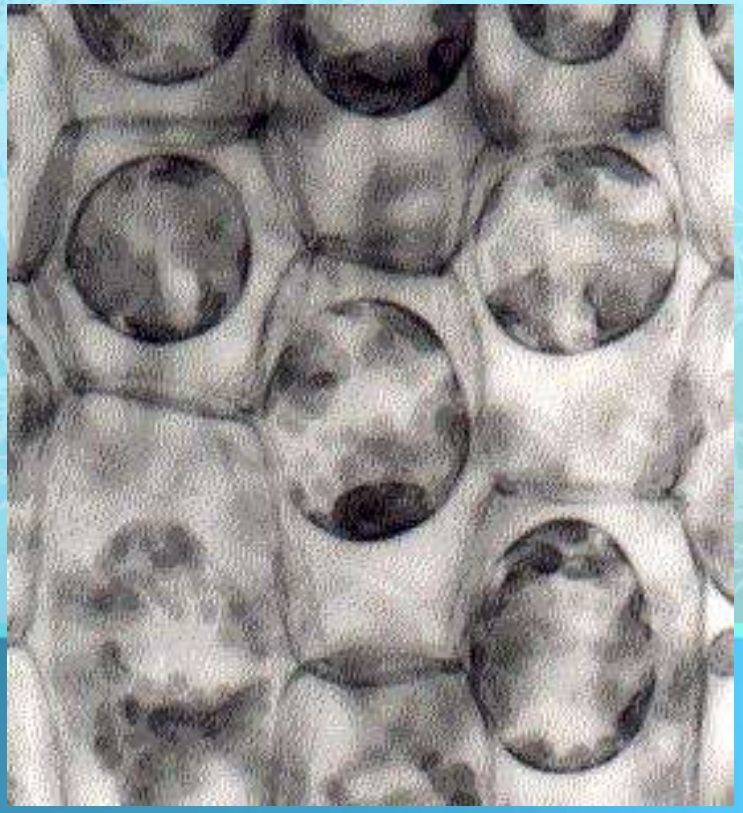
Vacuoles

- **Fluid filled** sacks for storage
- **Small or absent** in *animal* cells
- *Plant* cells have a **large Central Vacuole**



Vacuoles

- In plants, they store **Cell Sap**
- Includes storage of sugars, proteins, minerals, lipids, wastes, salts, water, and enzymes

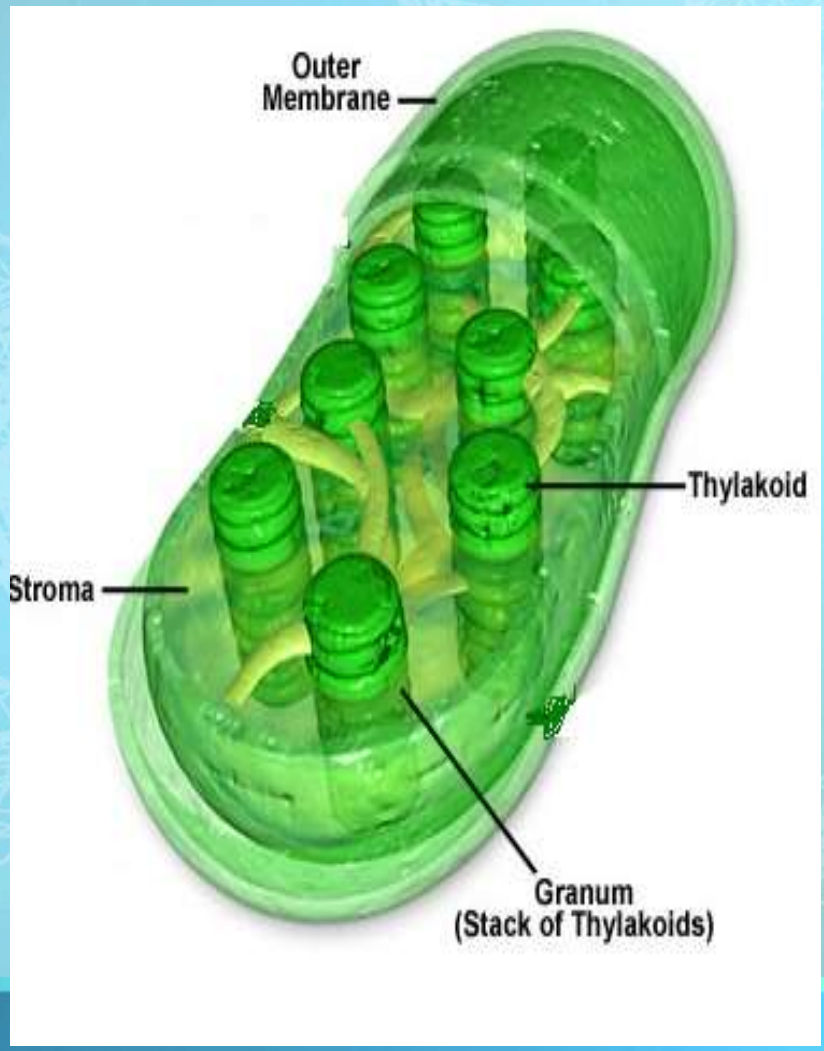


Chloroplasts

- Found only in producers (organisms containing chlorophyll)
- Use energy from sunlight to make own food (glucose)
- Energy from sun stored in the Chemical Bonds of Sugars

Chloroplasts

- Surrounded by DOUBLE membrane
- Outer membrane smooth
- Inner membrane modified into sacs called Thylakoids
- Thylakoids in stacks called Grana & interconnected
- Stroma – gel like material surrounding thylakoids



Characteristic	Prokaryotic cell	Eukaryotic cell
Size of cell	Typically 0.2-2.0µm in diameter	Typically 10-100 µm in diameter
Example	Bacteria and Archaea	Animals and Plants
Nucleus	Absent	Present
Membrane-enclosed organelles	Absent	Present; examples include lysosomes, Golgi complex, endoplasmic reticulum, mitochondria & chloroplasts
Flagella	Consist of two protein building blocks	Complex; consist of multiple microtubules
Cell wall	Usually present; chemically complex	Only in plant cells and fungi (chemically simpler)
Plasma membrane with steroid	Usually no	Yes
Cytoplasm	No cytosketeton or cytoplasmic streaming	Cytoskeleton; cytoplasmic streaming
Ribosomes	Smaller	Larger
Cell division	Binary fission	Mitosis
Number of chromosomes	One, but not true chromosome	More than one
Sexual reproduction	No meiosis; transfer of DNA fragments only (conjugation)	Involves meiosis