

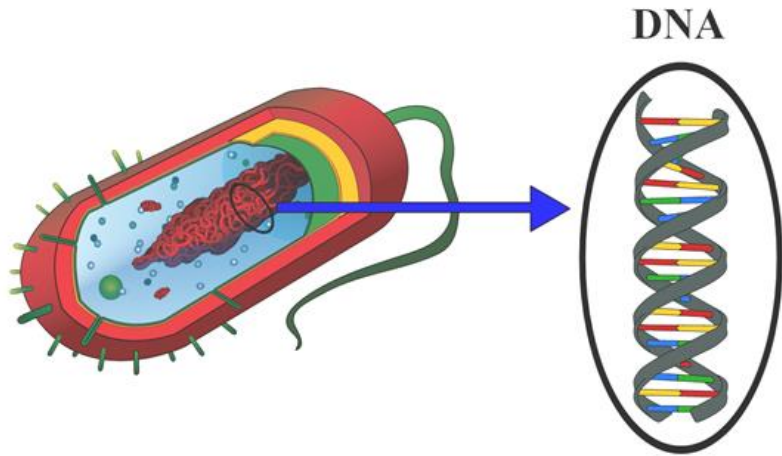
# Artistic Design, Computer Modeling, and 3D Printing of Cell Structures

## Part I: Structure of An Animal Cell

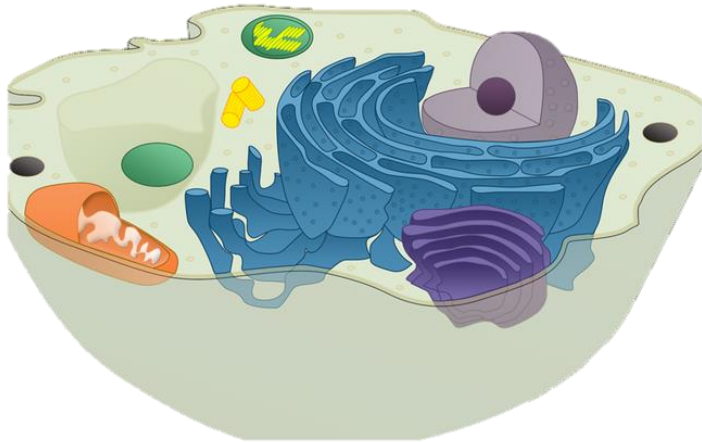
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American Society of Cell Biology  
COMPASS Outreach

# Animal cells are eukaryotic cells



**Prokaryotic cells:** cells that lack a cell nucleus or any membrane-encased organelles.  
Include: Bacteria and the Archaea

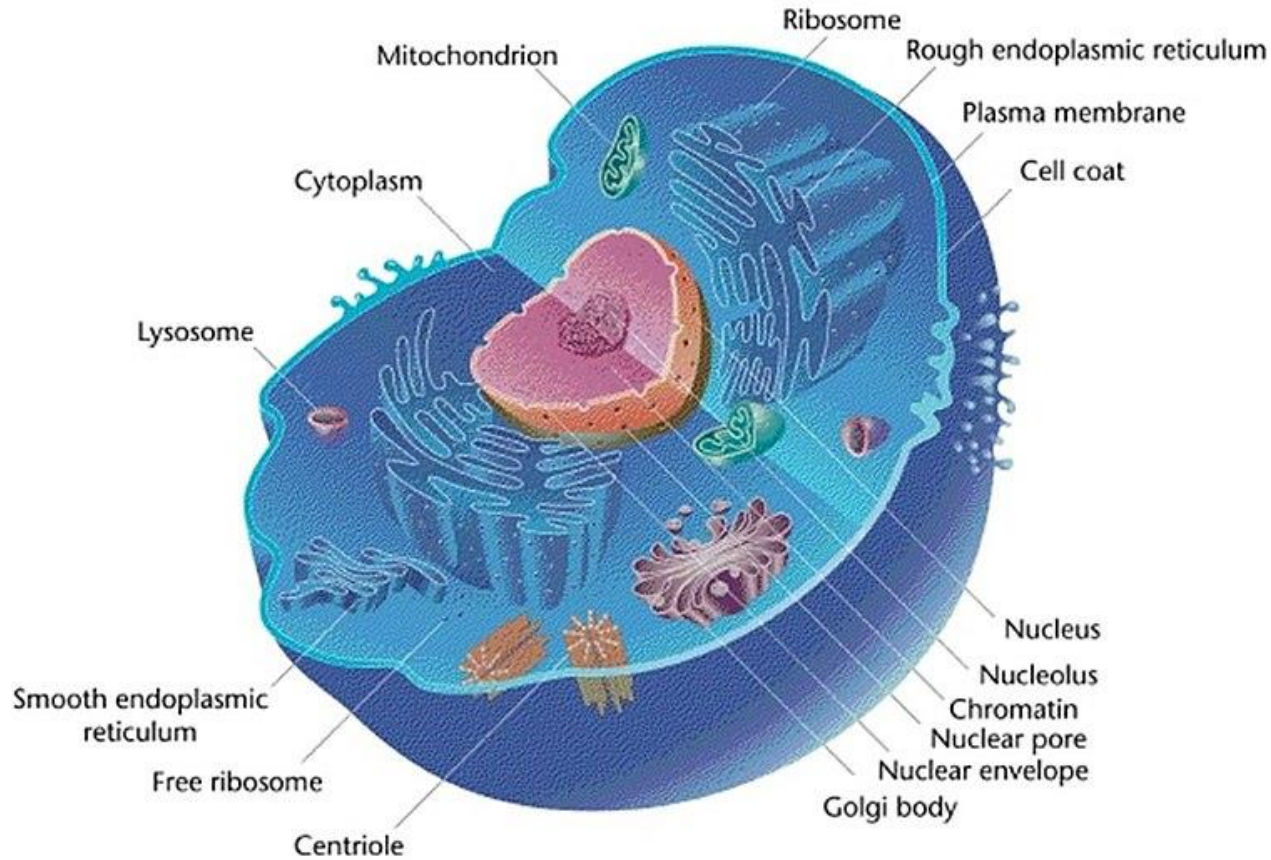


**Eukaryotic cells:** cells that possess a membrane-bound nucleus that holds genetic material as well as membrane-bound organelles.  
Include: plants, fungi, protists, and animal cells.

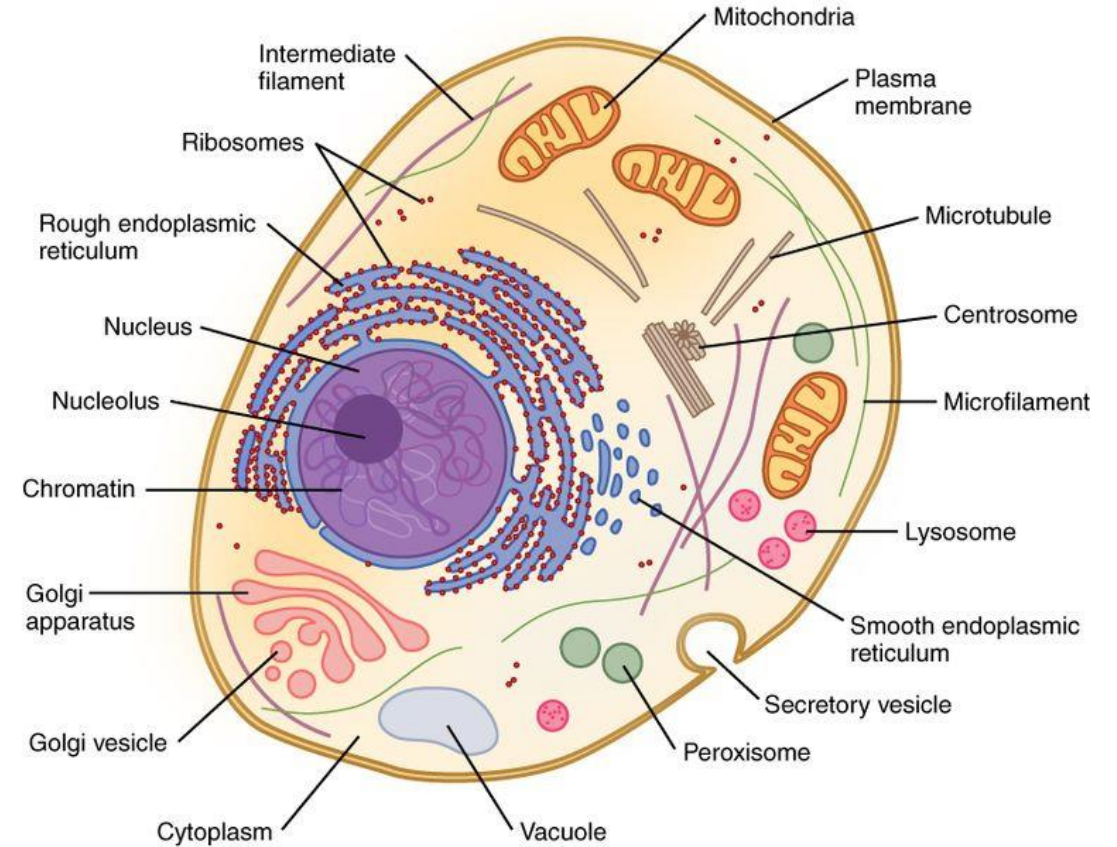


# Structure of an animal cell

Diameter: 10  $\mu\text{m}$  to 30  $\mu\text{m}$  (thickness of a human hair: 20  $\mu\text{m}$  to 180  $\mu\text{m}$ )

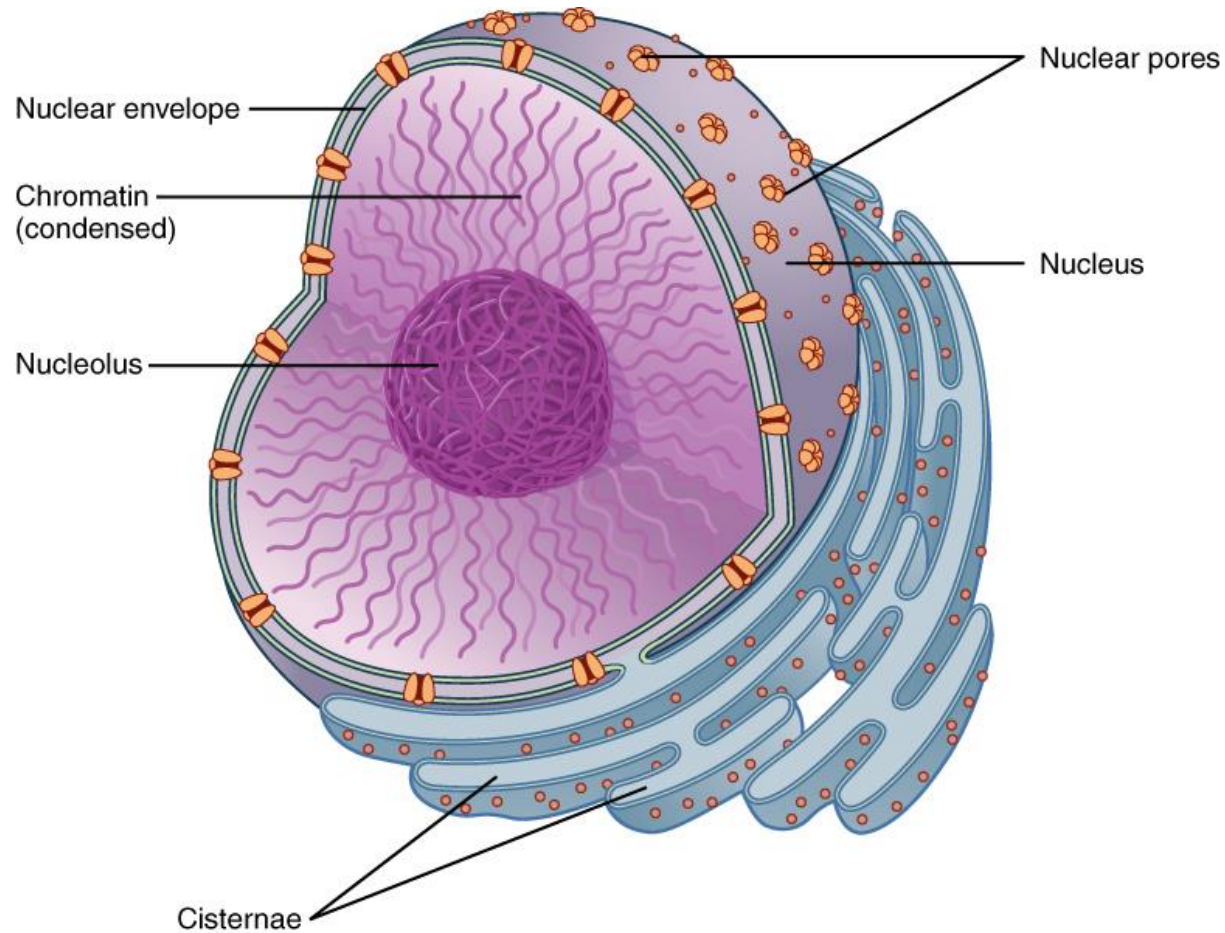


**A 3D View**



**A 2D View**

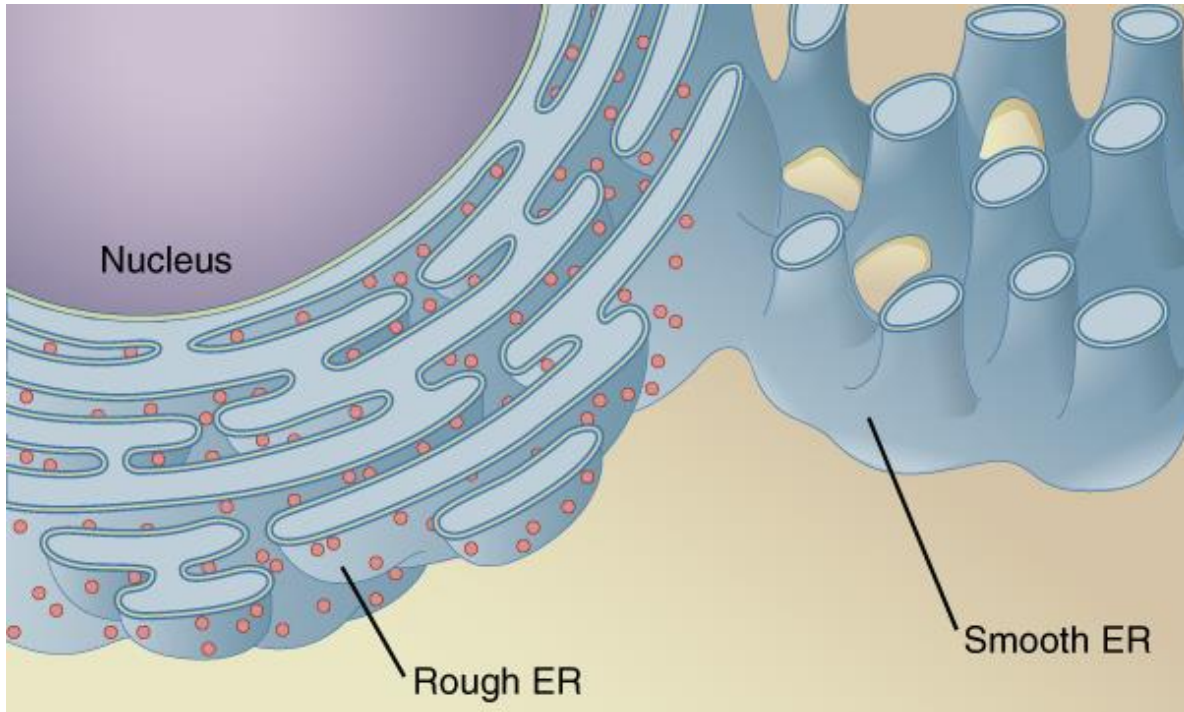
# Nucleus, nuclear envelope, and nuclear pores



- The nucleus stores the cell's DNA and regulates the cell's growth, intermediary metabolism, protein synthesis, and reproduction.
- The nuclear envelope is comprised of inner and outer membranes and contains nuclear pores that allow communication and transport between the nucleus and cytoplasm.

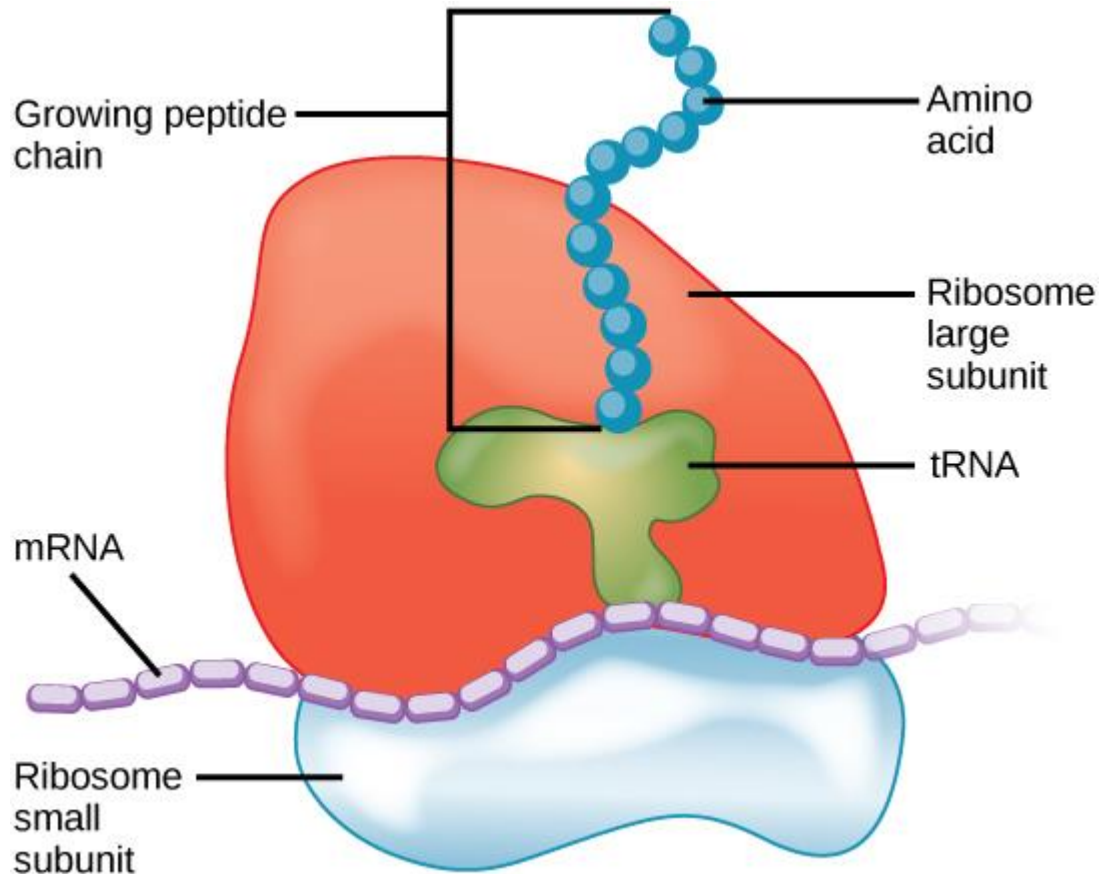


# Endoplasmic Reticulum (ER)



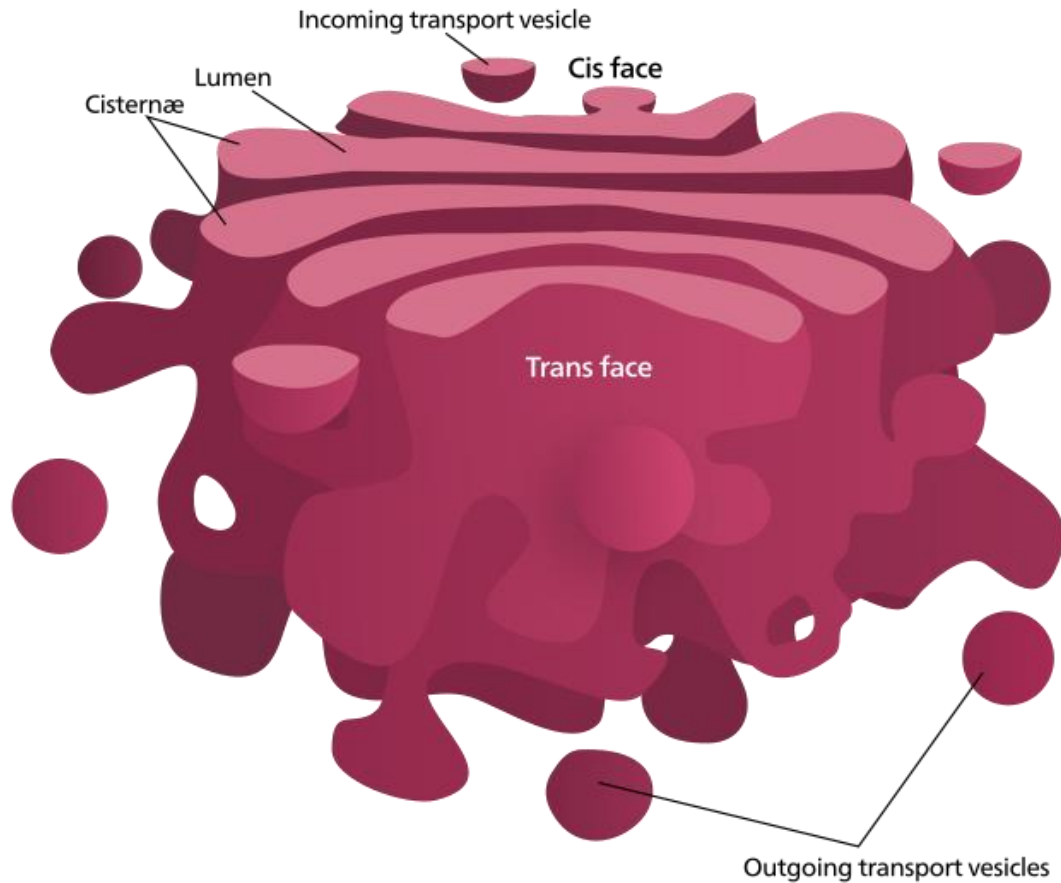
- The ER is connected to the double-layered nuclear envelope.
- A network of sacs that manufactures, processes, and transports chemical compounds for use inside and outside of the cell.
- Rough ER is embedded with protein-manufacturing ribosomes. Smooth ER does not.

# Ribosomes



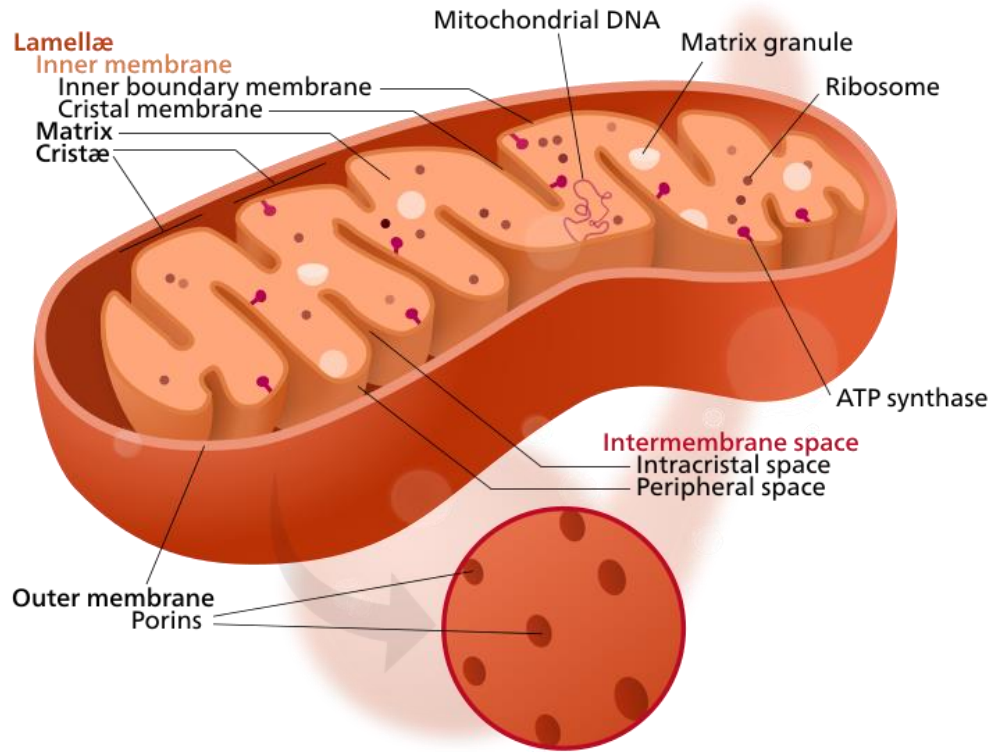
- Ribosomes are macromolecular machines, found within all living cells, that perform biological protein synthesis.
- Ribosomes link amino acids together in the order specified by the codons of messenger RNA molecules to form polypeptide chains.

# Golgi Apparatus



- The Golgi apparatus packages proteins into membrane-bound vesicles inside the cell before the vesicles are sent to their destination.
- It is the distribution and shipping department for the cell's chemical products. It modifies proteins and fats built in the endoplasmic reticulum and prepares them for export to the outside of the cell.

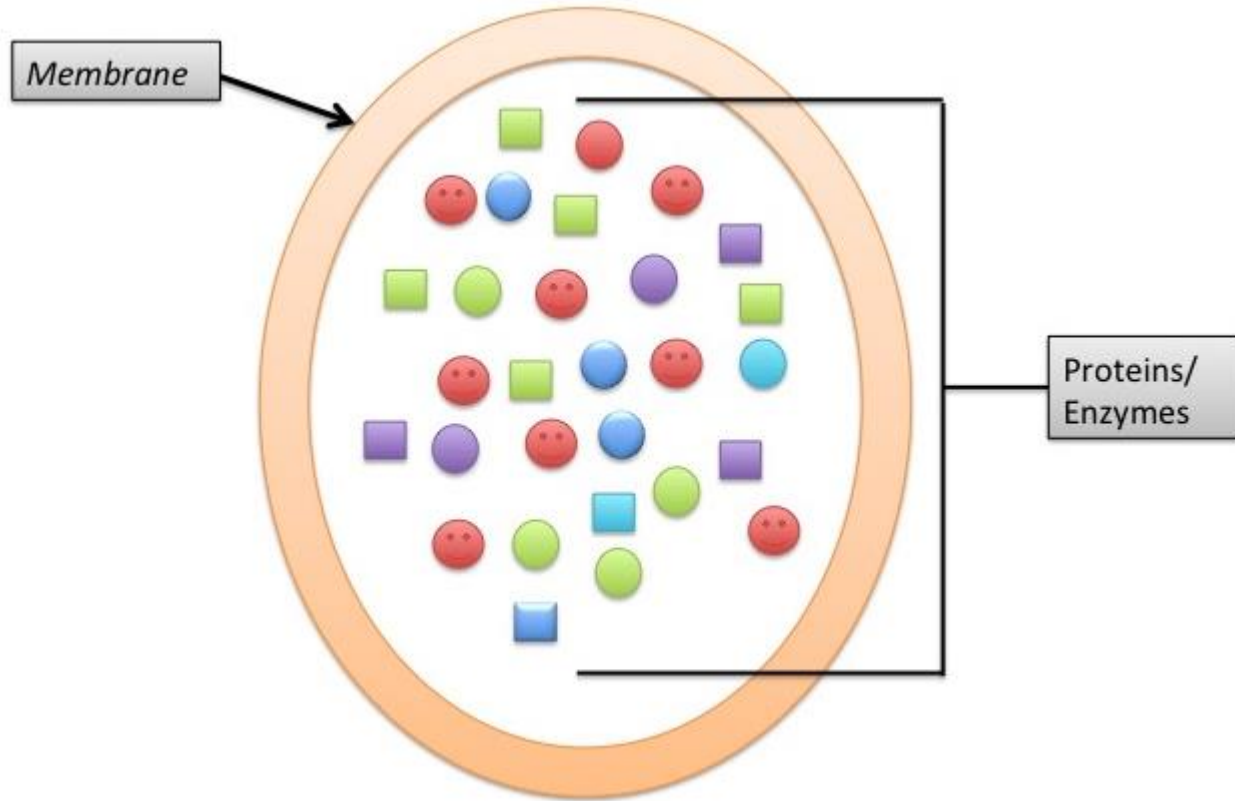
# Mitochondria



- A mitochondrion is a double-membrane-bound organelle found in most eukaryotic organisms.
- Mitochondria are the powerhouse of a cell. They generate most of the cell's supply of energy for biochemical reaction.
- Mitochondria have their own DNA, which come from mother.

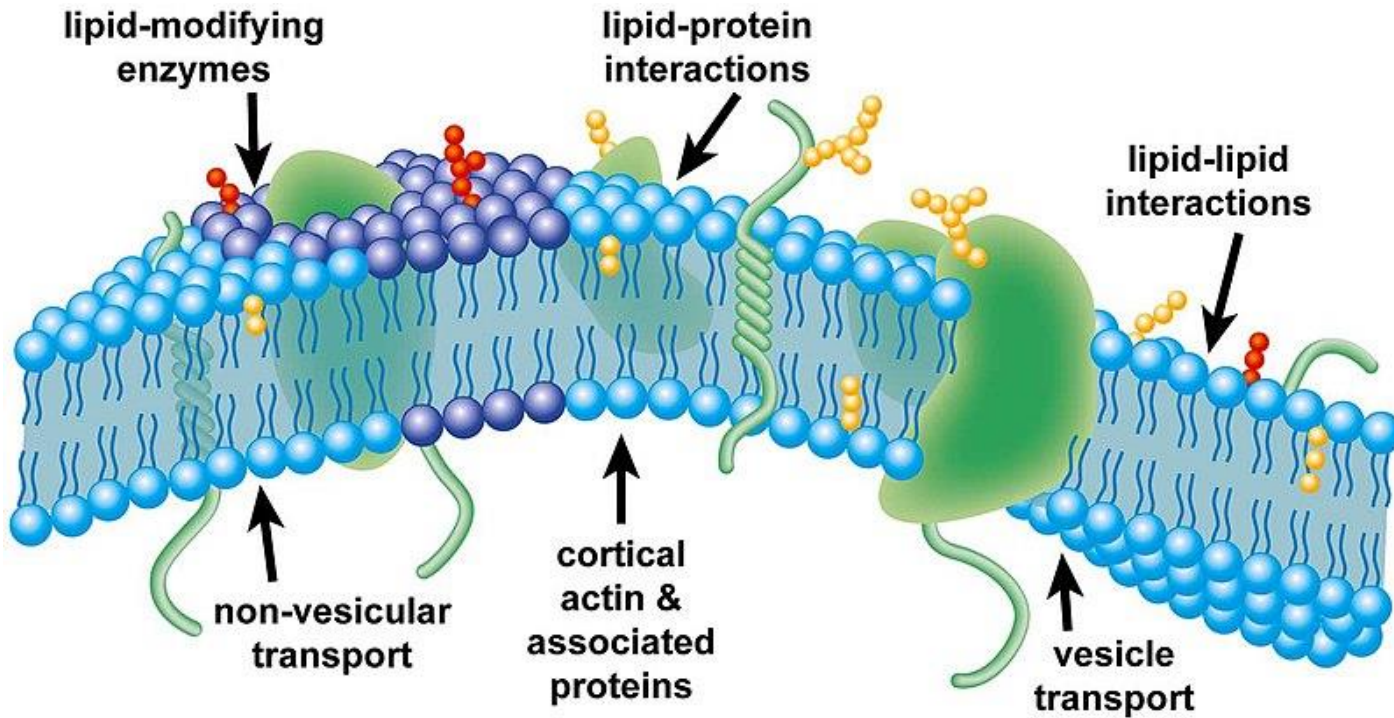


# Lysosomes



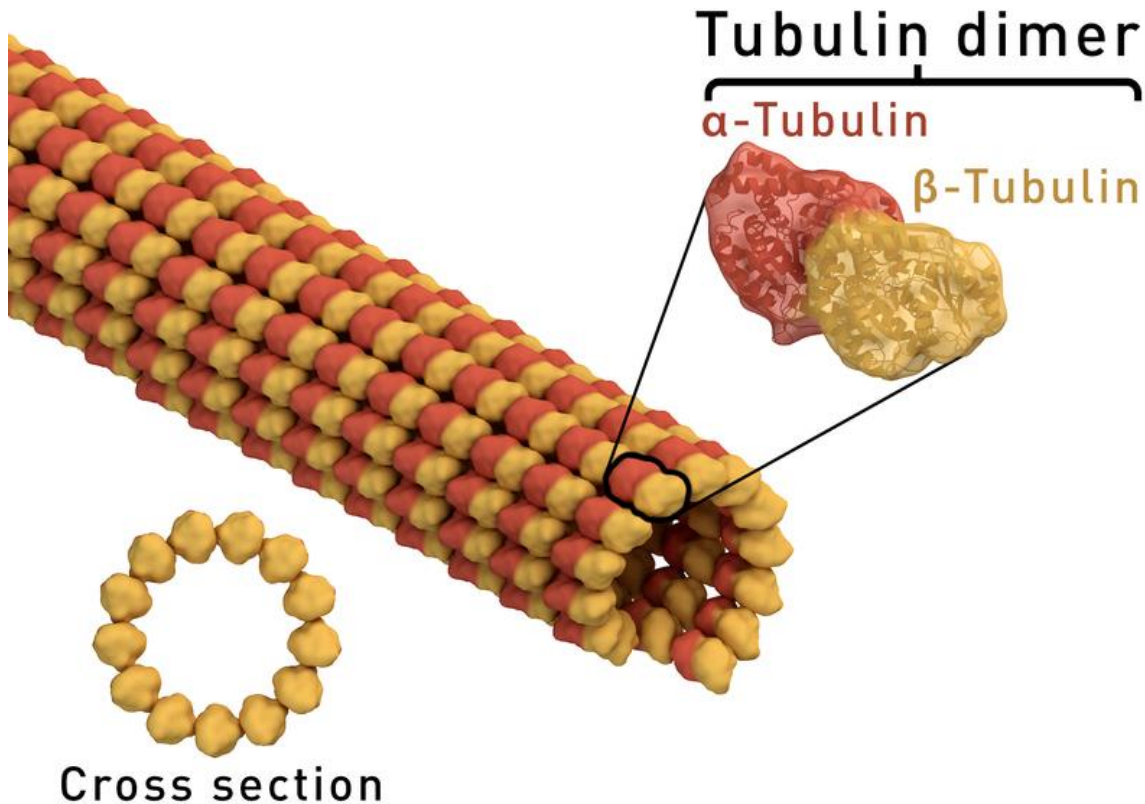
- A lysosome is a membrane-bound cell organelle that contains digestive enzymes.
- Lysosomes break down cellular waste products and debris from outside the cell into simple compounds, which are transferred to the cytoplasm as new cell-building materials.

# Plasma Membrane



- Animal cells do not have a cell wall and only use the plasma membrane to contain and protect their contents.
- Everything enclosed by the plasma membrane, including the water, is called cytoplasm.
- The membrane regulates the passage of molecules in and out of the cells.

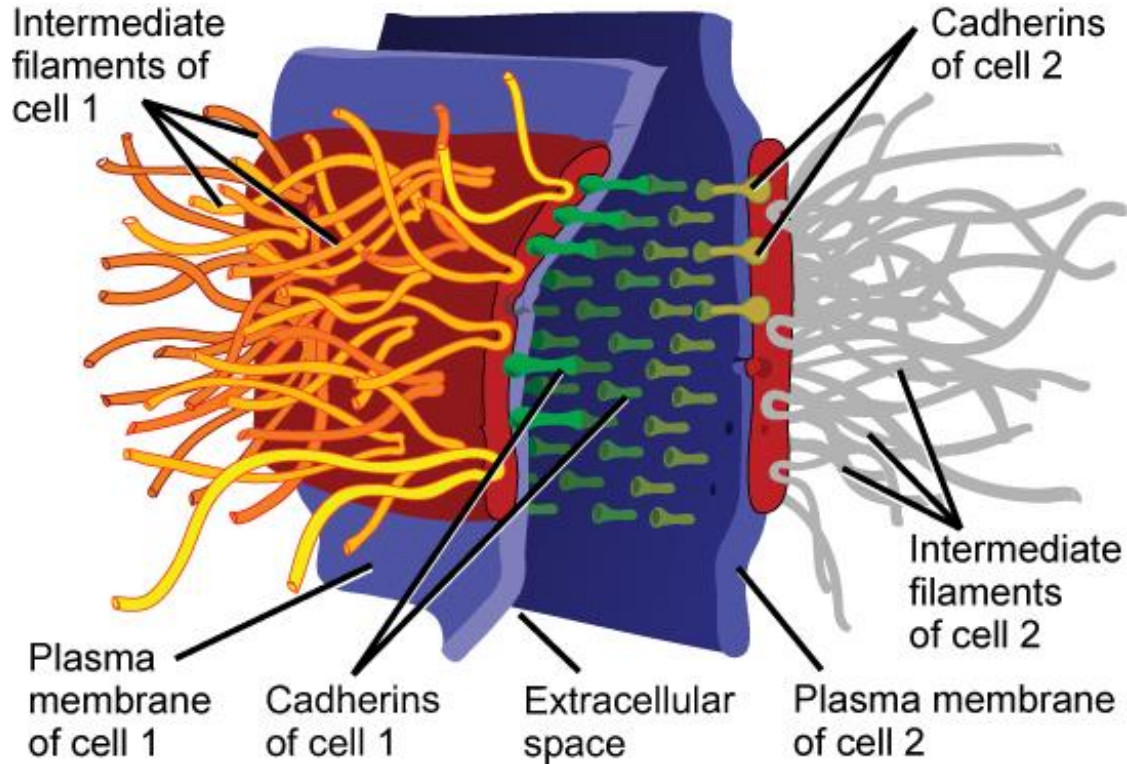
# Cytoskeleton: Microtubules



- Microtubules are found in all eukaryotic cells, and they are involved in mitosis, cell motility, intracellular transport, and maintenance of cell shape.
- Microtubules can grow as long as 50  $\mu\text{m}$  and are highly dynamic.
- Outer diameter: 23 nm to 27 nm  
Inner diameter: 11 nm to 15 nm.

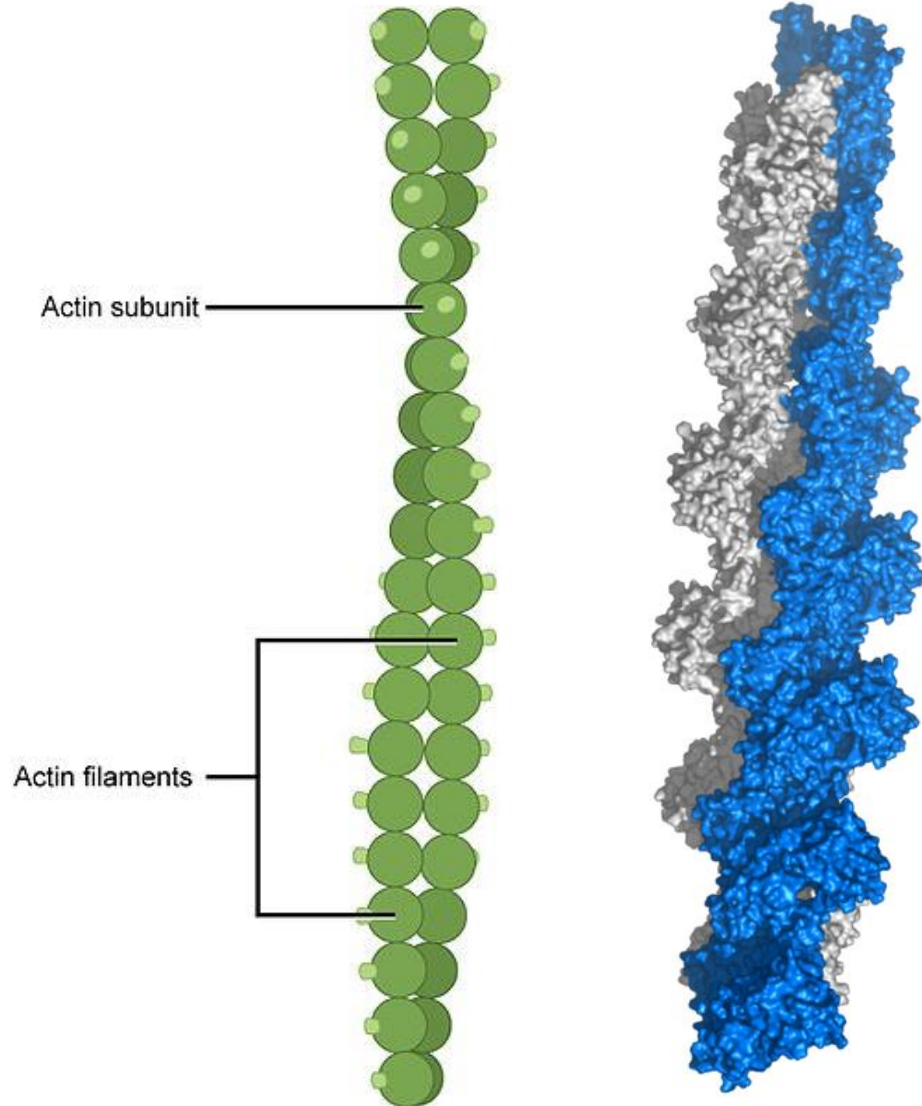


# Cytoskeleton: Intermediate Filaments



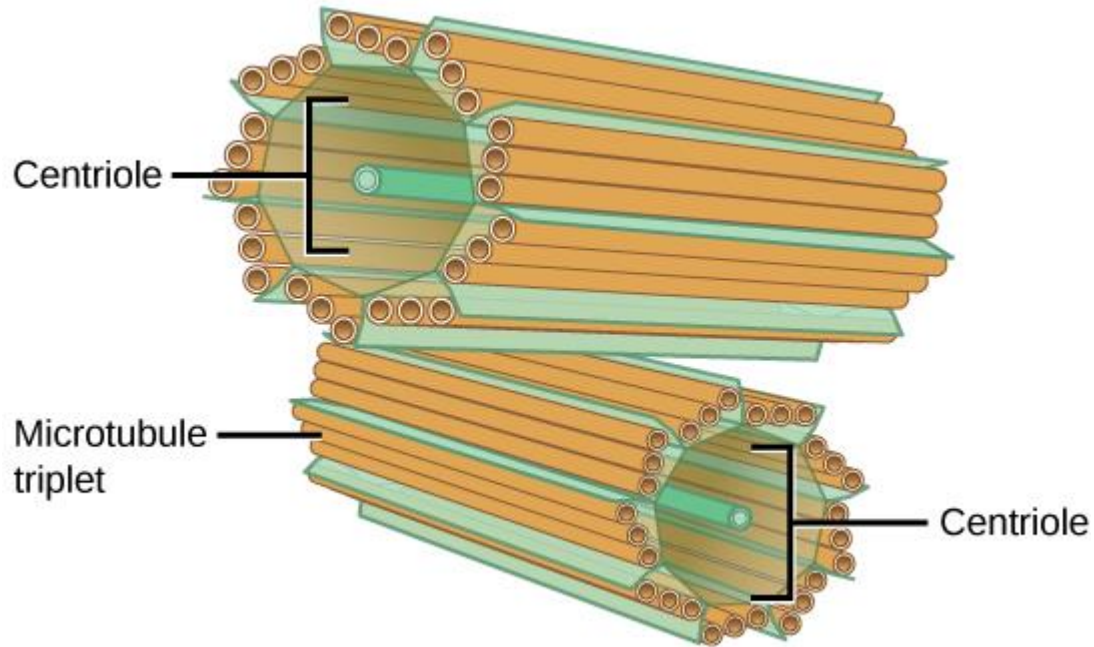
- Intermediate filaments are a very broad class of fibrous proteins that play an important role as both structural and functional elements of the cytoskeleton.
- Ranging in size from 8 nm to 12 nm, intermediate filaments function as tension-bearing elements to help maintain cell shape and rigidity.

# Cytoskeleton: Microfilaments

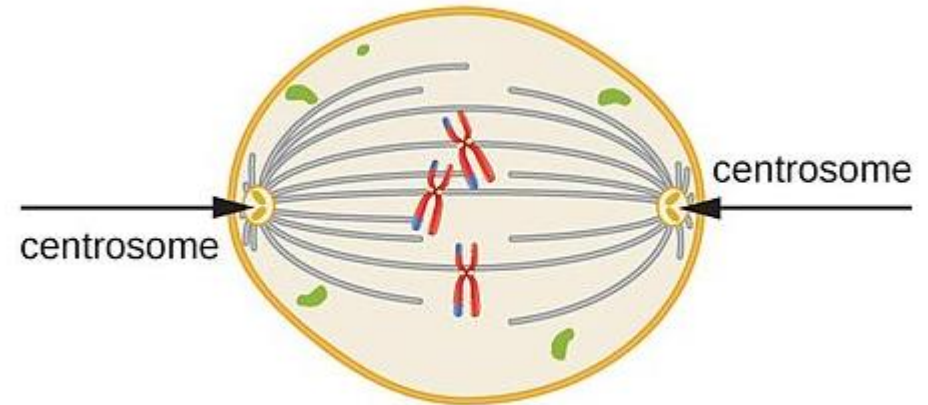


- Microfilaments are solid rods made of globular proteins called actin.
- Microfilament functions include cytokinesis, amoeboid movement, cell motility, changes in cell shape, endocytosis and exocytosis, cell contractility, and mechanical stability.

# Centrioles



- Centrioles are self-replicating organelles made up of nine bundles of microtubules and are found only in animal cells.
- They appear to help in organizing cell division but aren't essential to the process.





# Acknowledgement

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