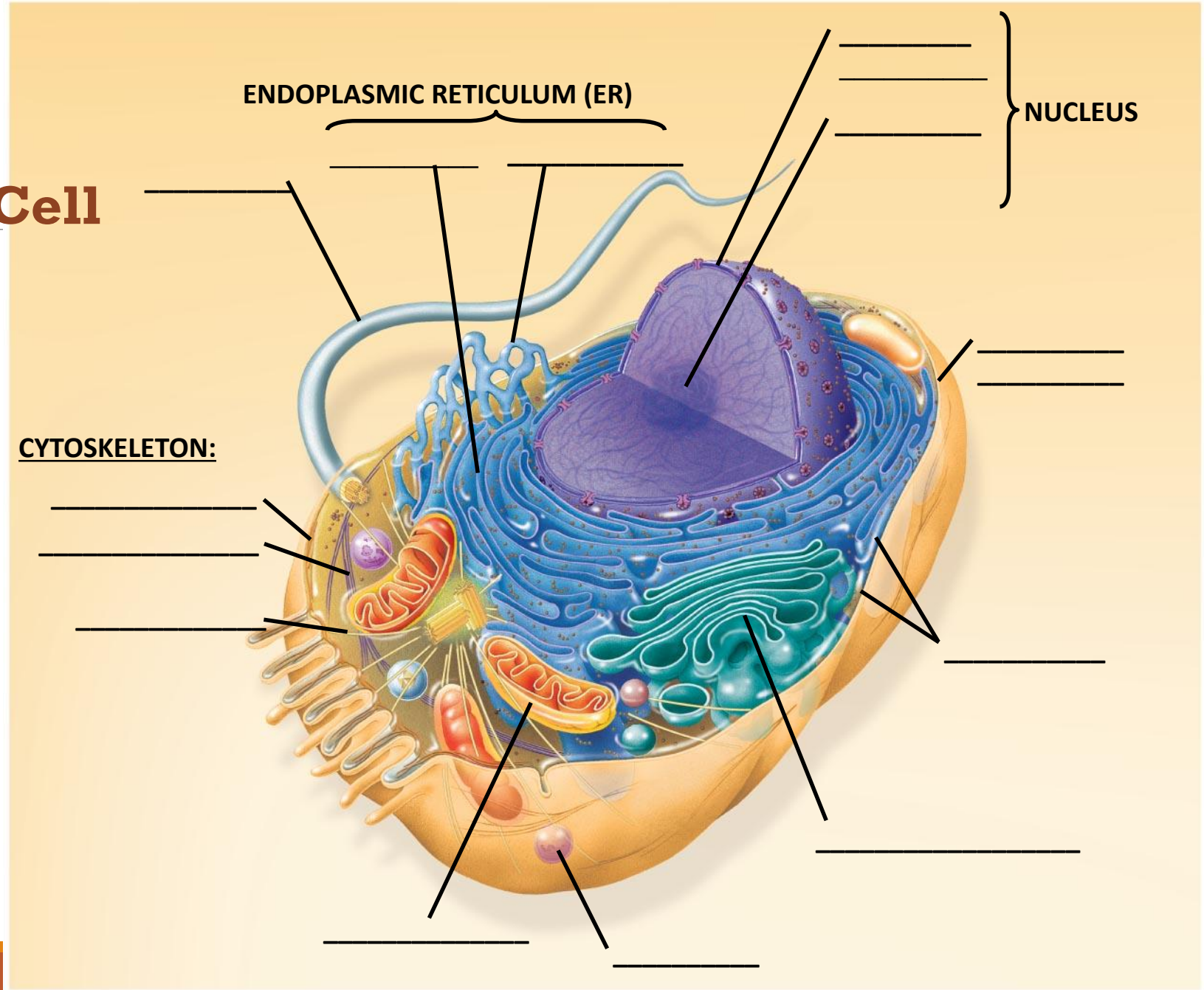
Structure and Functions of a Eukaryotic Cell

SBI4U

MRS. FRANKLIN

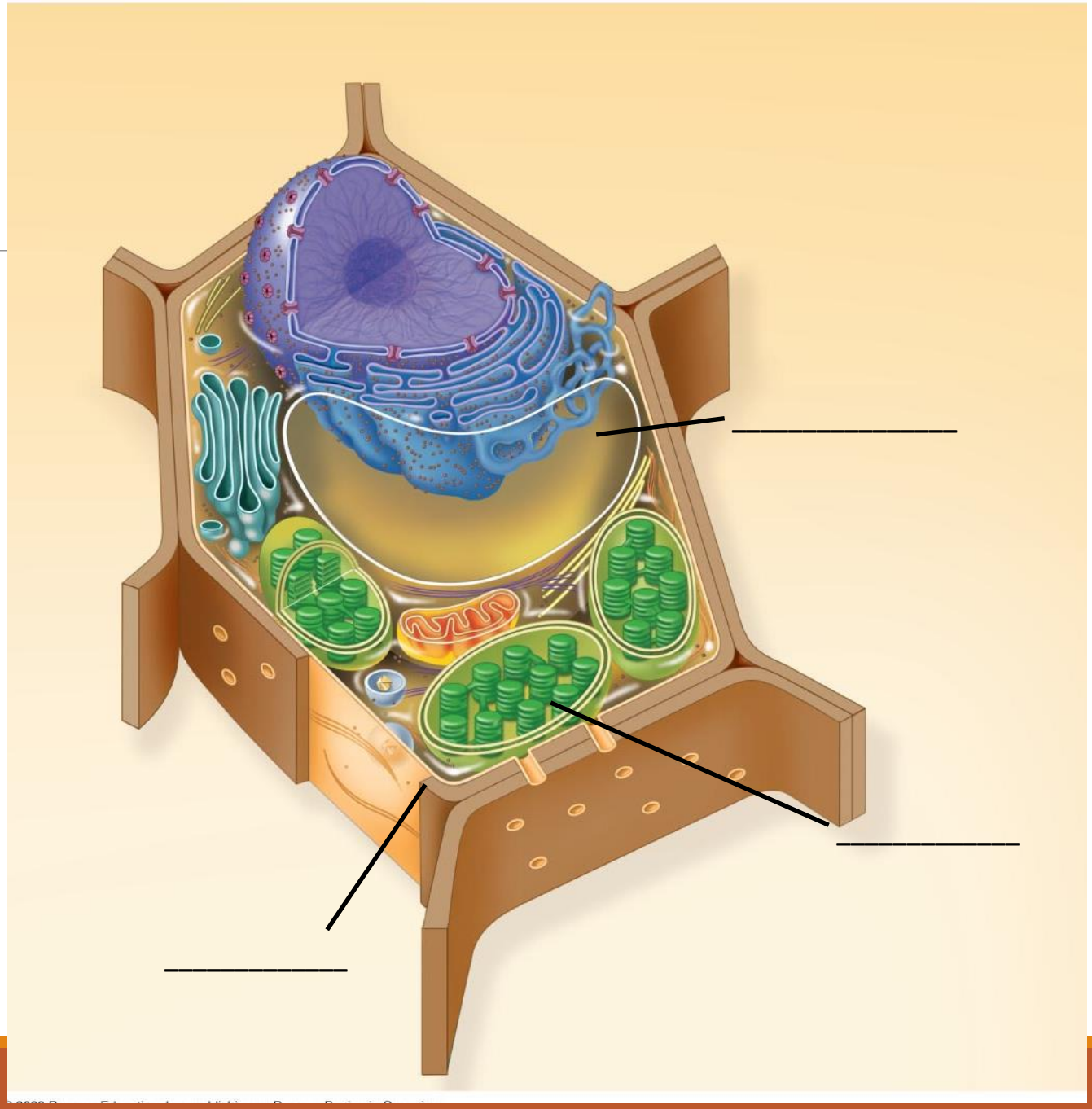
Eukaryotic Animal Cell



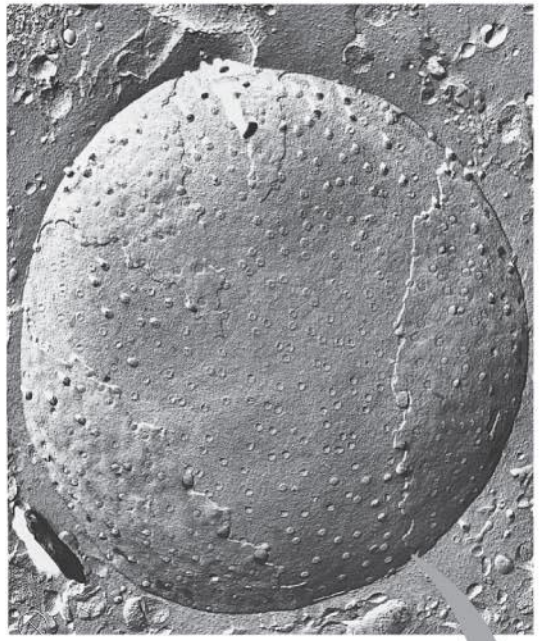
Eukaryotic Plant Cell

There are three main differences between plant and animal cells.

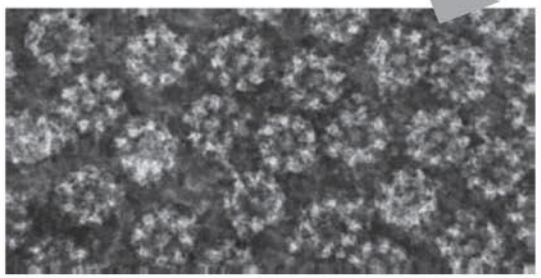
Can you remember?



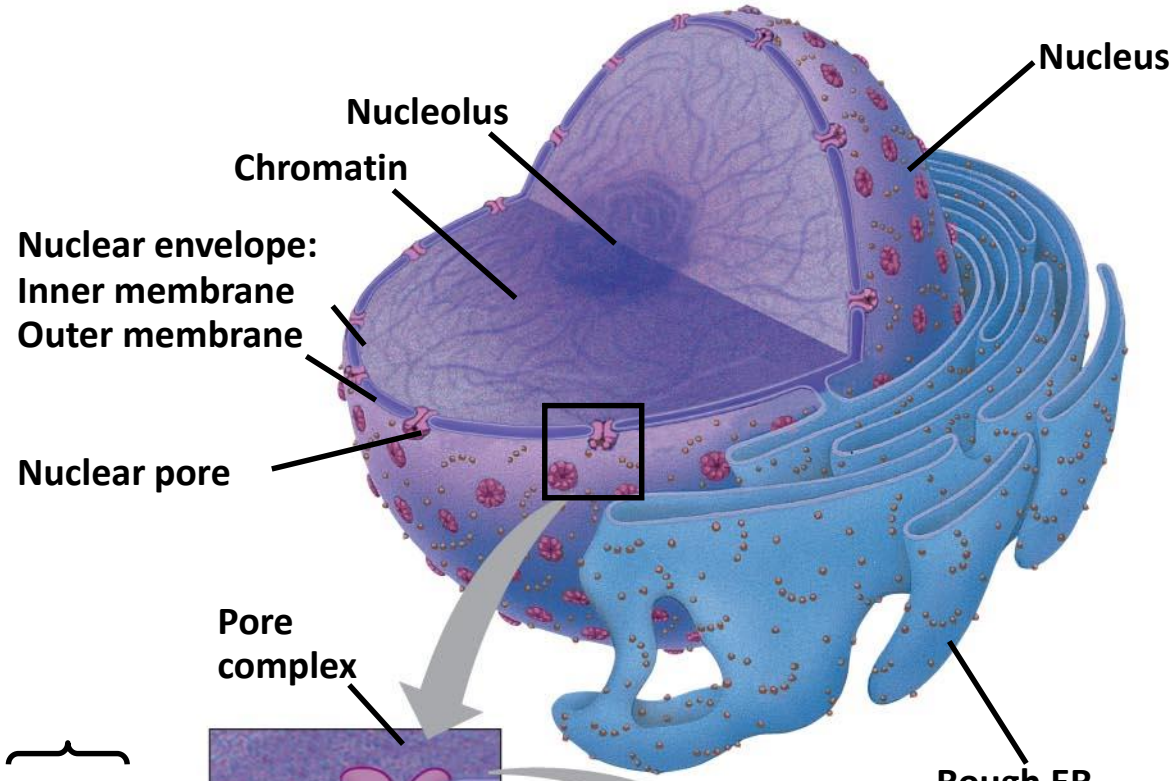
Nucleus



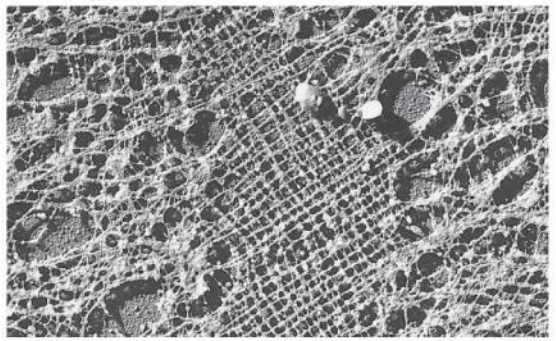
Surface of nuclear envelope



Pore complexes (TEM)



Close-up of nuclear envelope



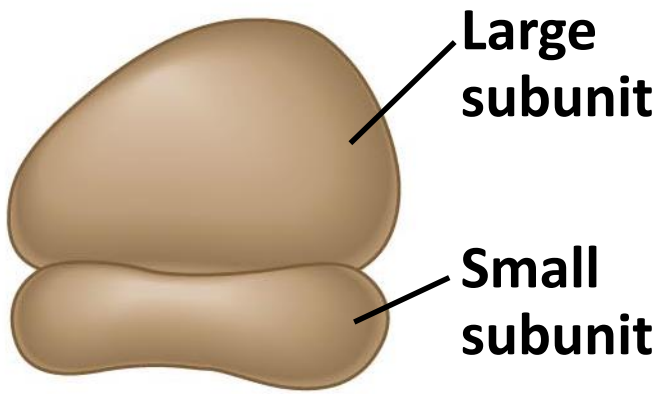
Nuclear lamina (TEM)

Ribosomes

Ribosomes carry out protein synthesis in two locations:

- In the cytosol (free ribosomes)
- On the outside of the endoplasmic reticulum or the nuclear envelope (bound ribosomes)

Ribosomes *are particles made of ribosomal RNA and protein*

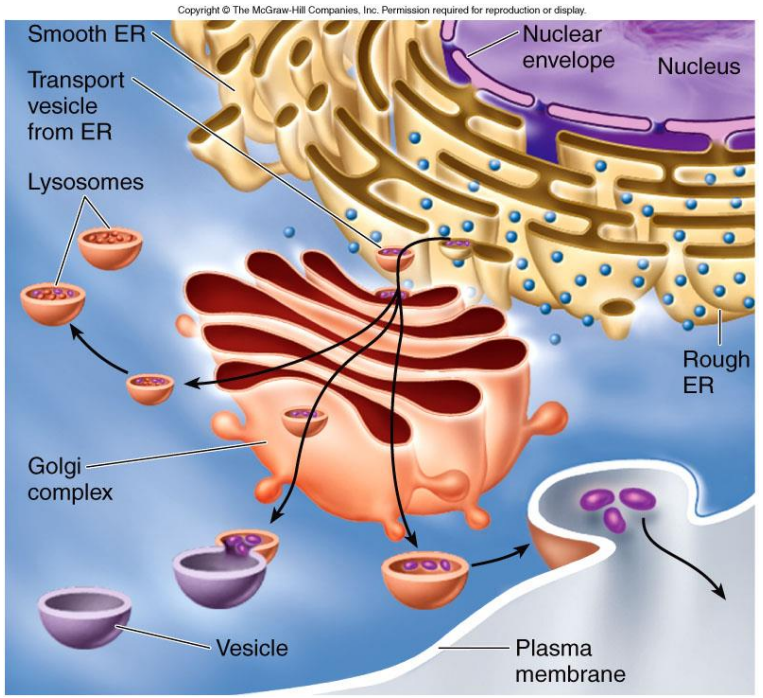


Endomembrane System

The endomembrane system regulates protein traffic and performs metabolic functions in the cell.

Components of the endomembrane system:

- Nuclear envelope
- Endoplasmic reticulum
- Golgi apparatus
- Lysosomes
- Vacuoles
- Plasma membrane

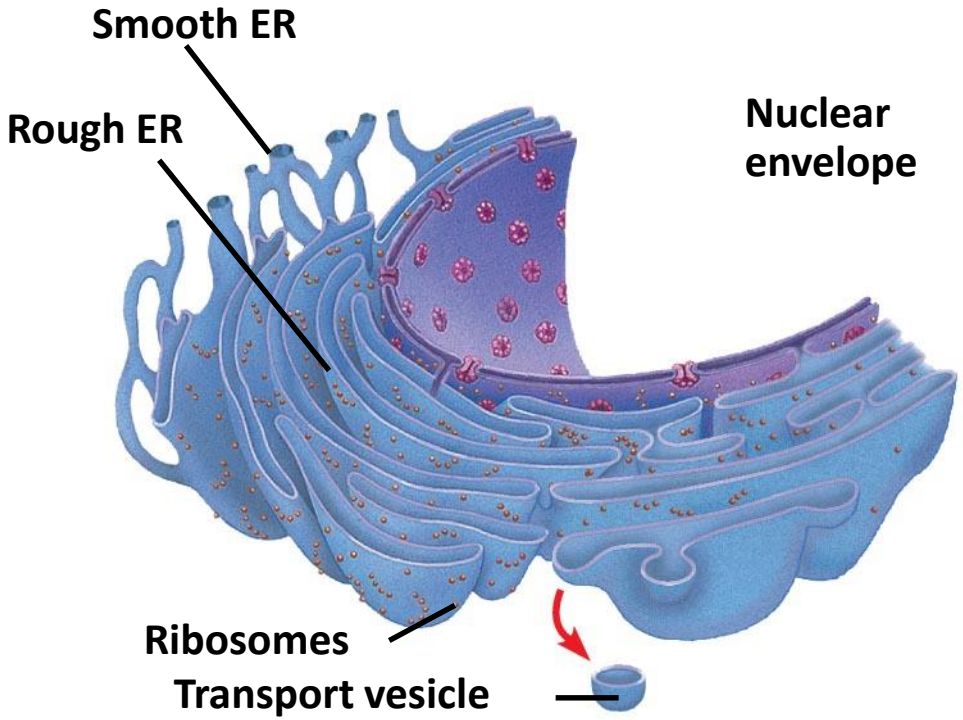


Endoplasmic Reticulum (ER)

The ER membrane is continuous with the nuclear envelope

There are two distinct regions of ER:

- **Smooth ER**, which lacks ribosomes
- **Rough ER**, with ribosomes studding its surface

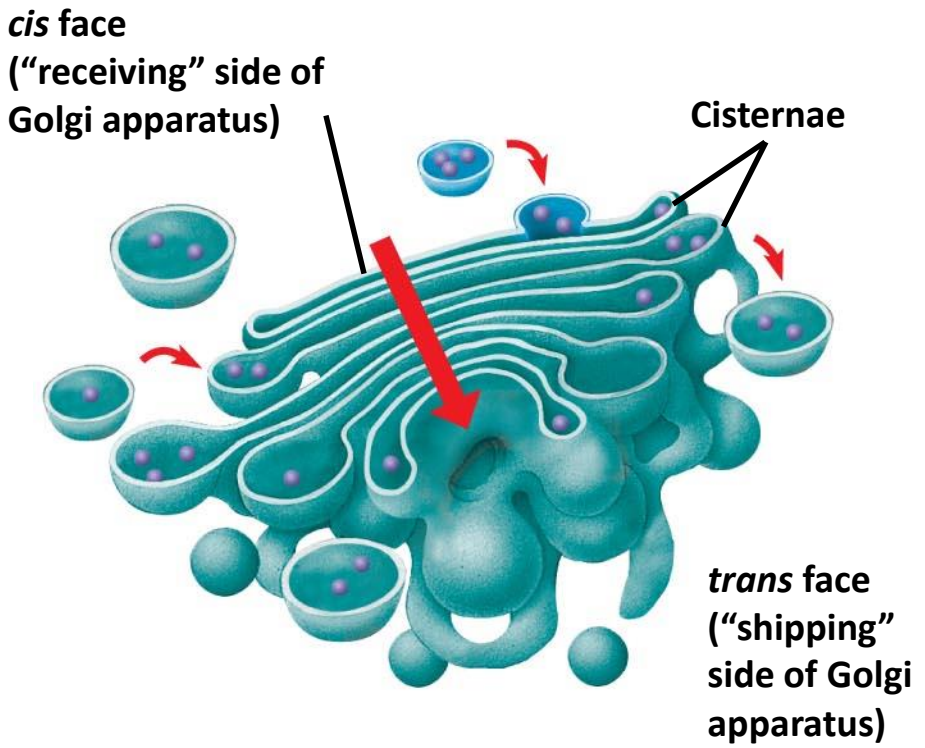


Golgi Apparatus

The **Golgi apparatus** consists of flattened membranous sacs called cisternae

Functions of the Golgi apparatus:

- Modifies products of the ER
- Manufactures certain macromolecules
- Sorts and packages materials into transport vesicles

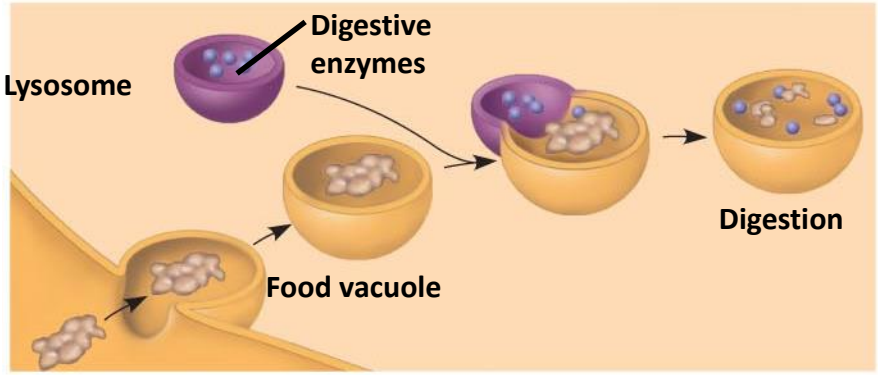


Lysosomes

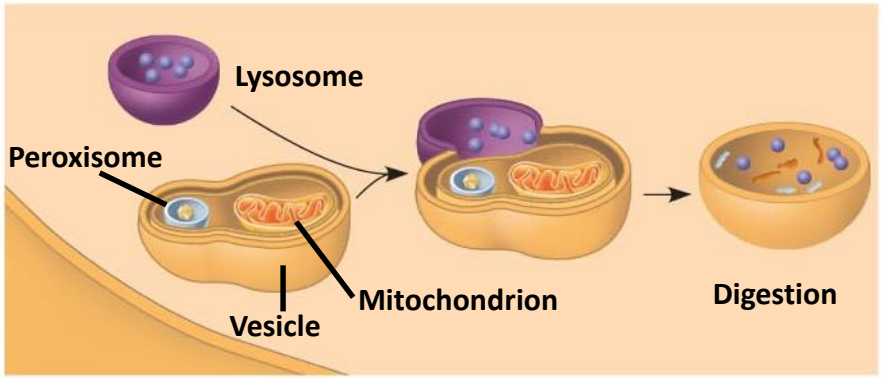
Lysosome: membranous sac of hydrolytic enzymes that can digest macromolecules
(hydrolyze proteins, fats, polysaccharides, and nucleic acids)

A lysosome fuses with the food vacuole and digests the molecules

Lysosomes also use enzymes to recycle the cell's own organelles and macromolecules, a process called autophagy



(a) Phagocytosis



(b) Autophagy

Vacuoles

There are three main forms of vacuoles:

- **Food vacuoles** are formed by phagocytosis
- **Contractile vacuoles**, found in many freshwater protists, pump excess water out of cells
- **Central vacuoles**, found in many mature plant cells, hold organic compounds and water

Fig. 6-16-1

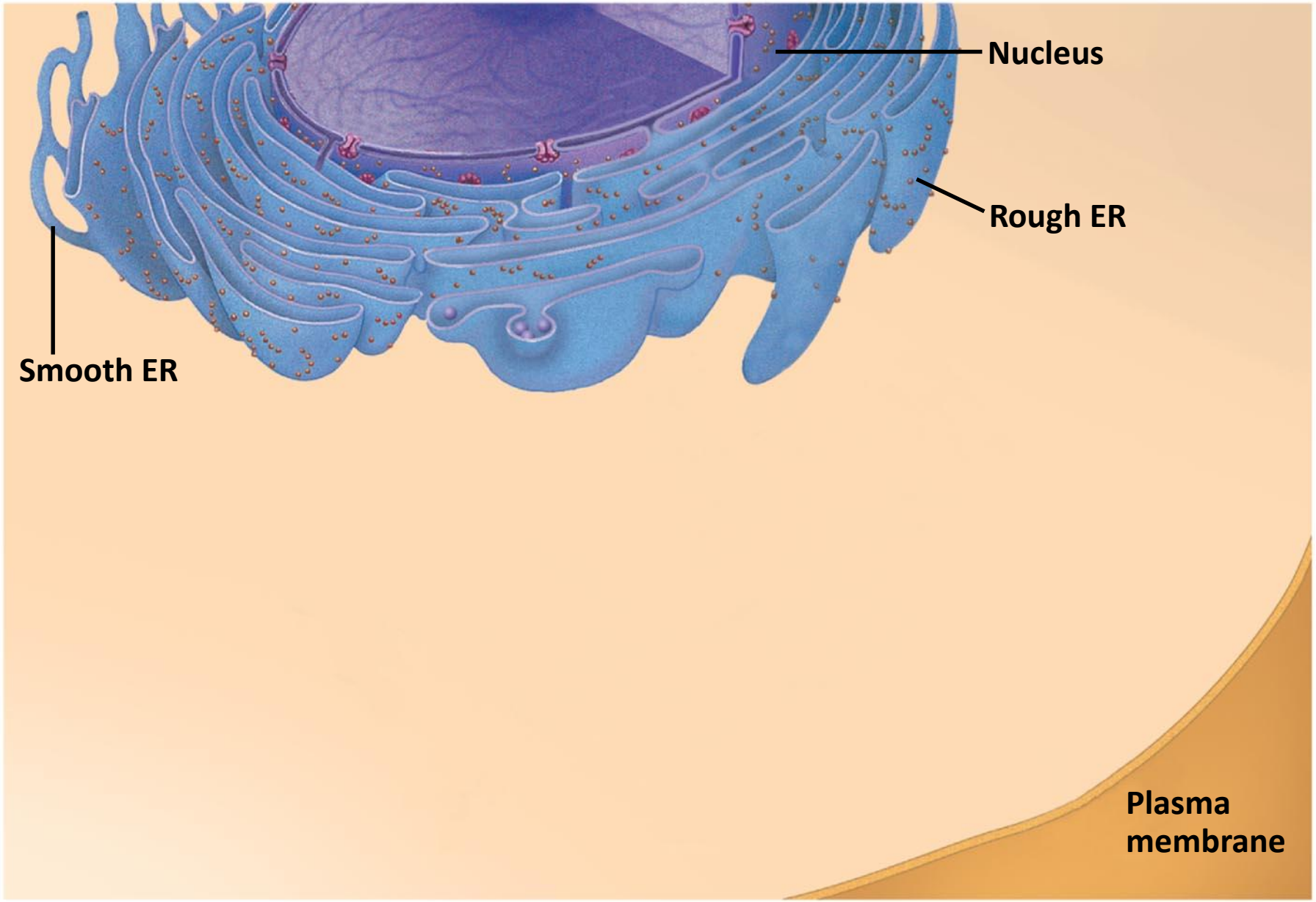


Fig. 6-16-2

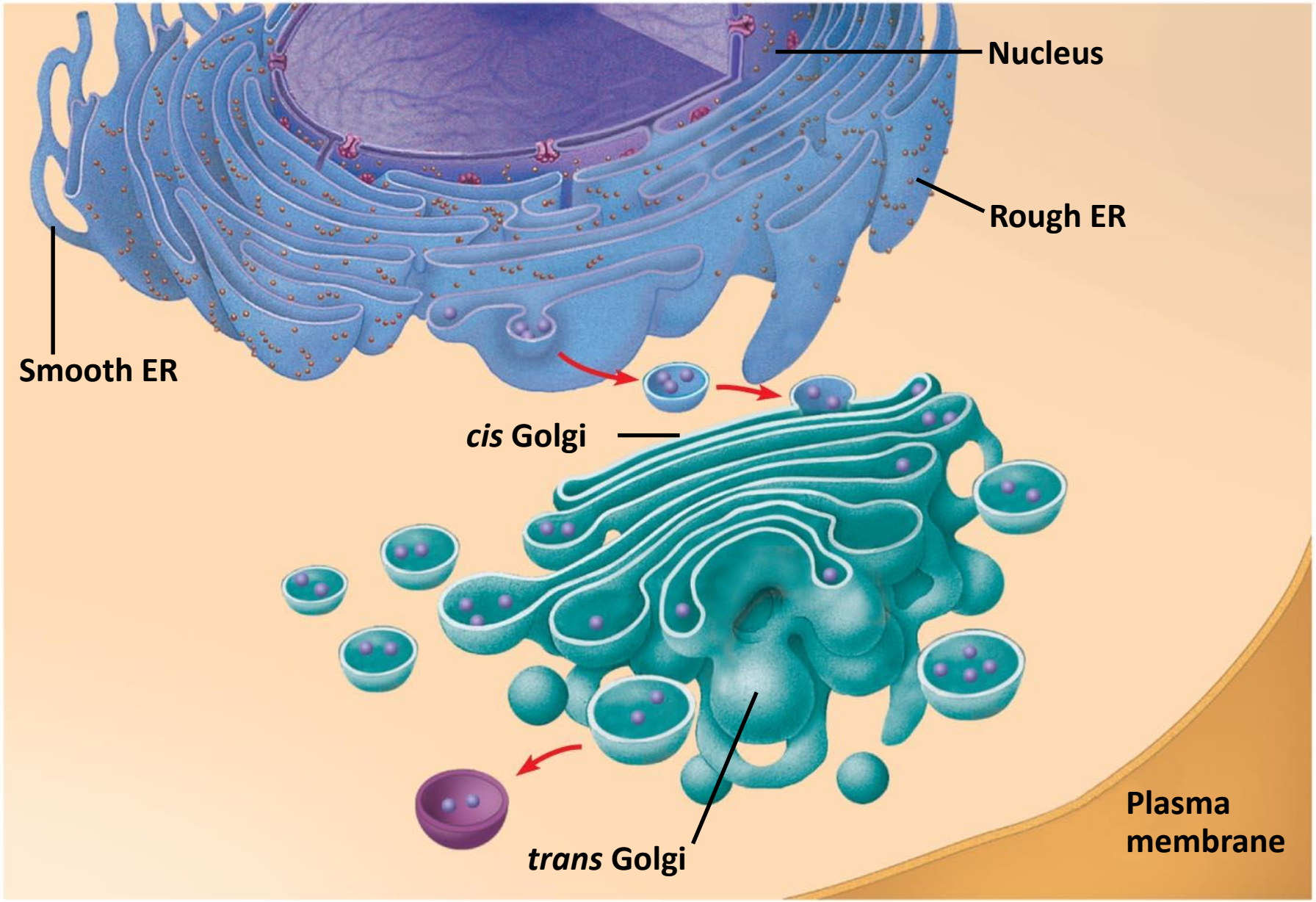
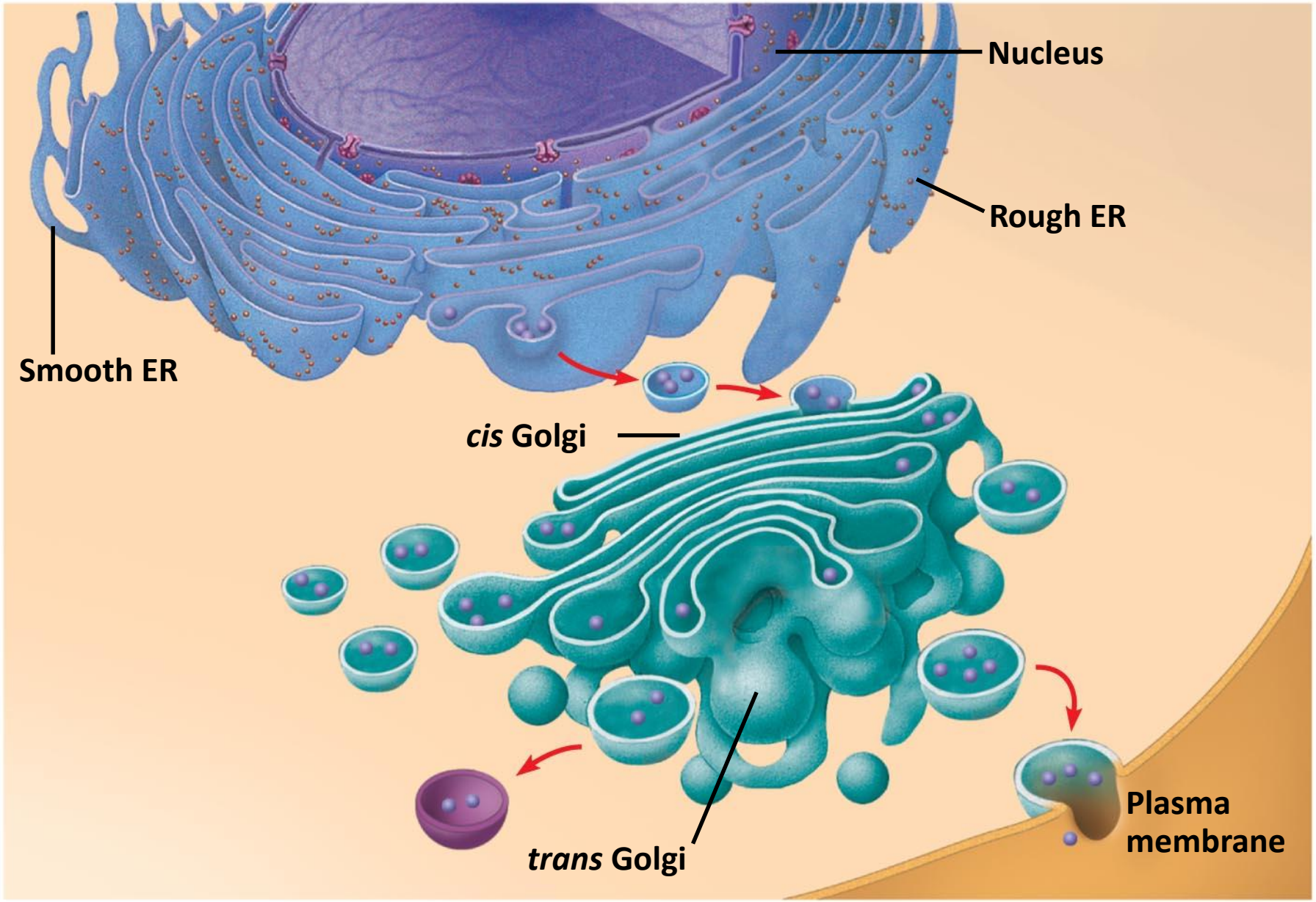

Nucleus
Rough ER
Smooth ER
cis Golgi
trans Golgi
Plasma membrane

Fig. 6-16-3


Nucleus
Rough ER
Smooth ER
cis Golgi
trans Golgi
Plasma membrane

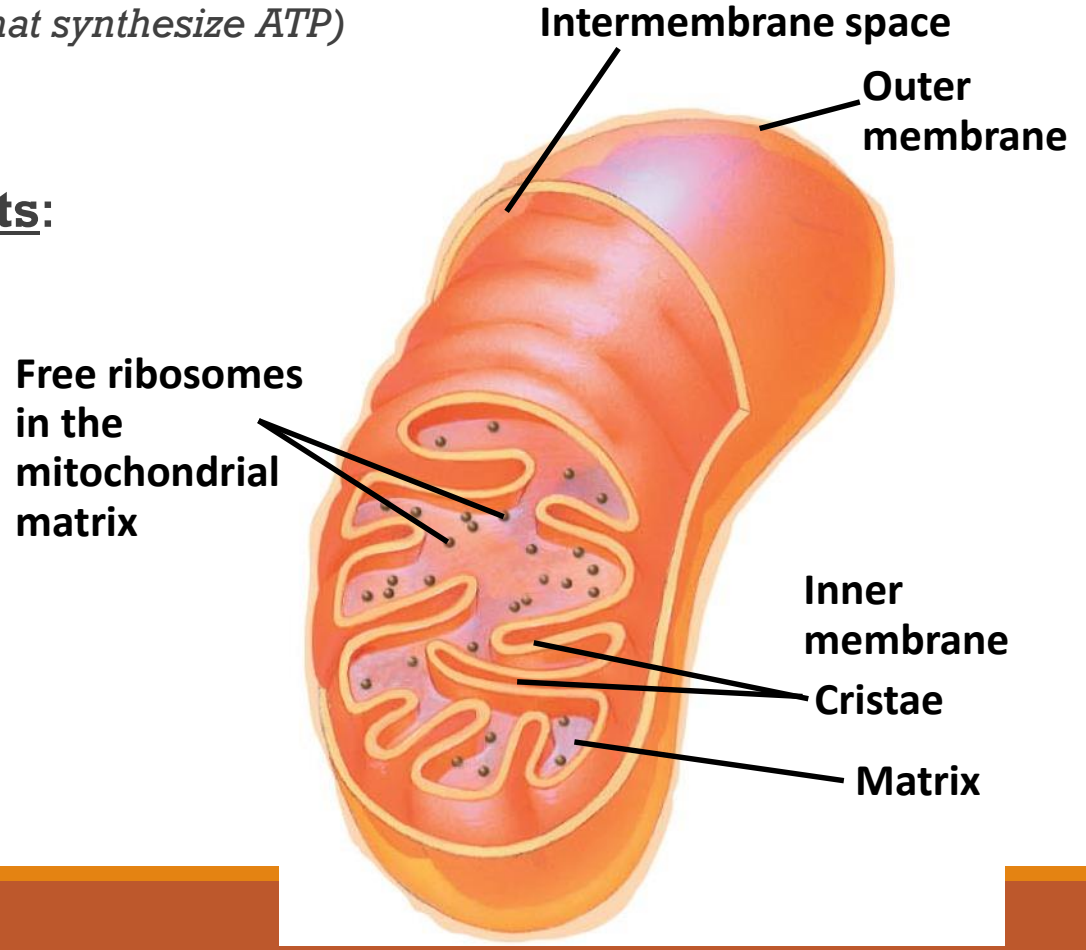
Mitochondria

Mitochondria: have a smooth outer membrane and an inner membrane folded into **cristae** *(Cristae present a large surface area for enzymes that synthesize ATP)*

The inner membrane creates **two compartments**:

1. intermembrane space
2. mitochondrial matrix

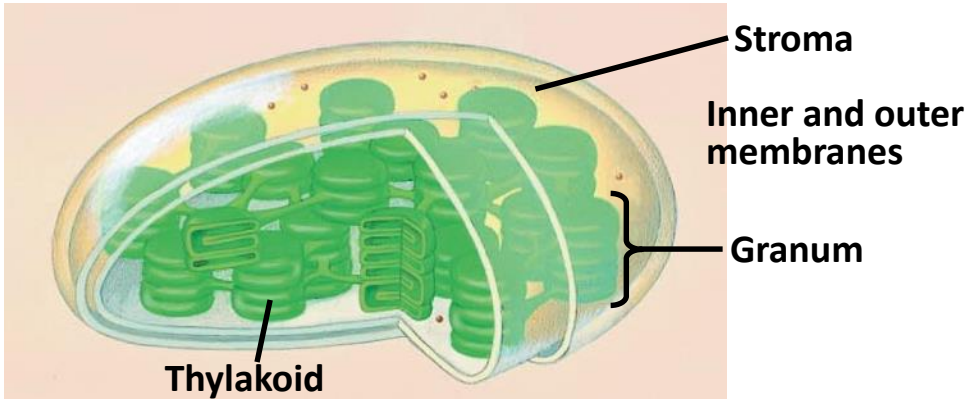
Some metabolic steps of cellular respiration are catalyzed in the mitochondrial matrix



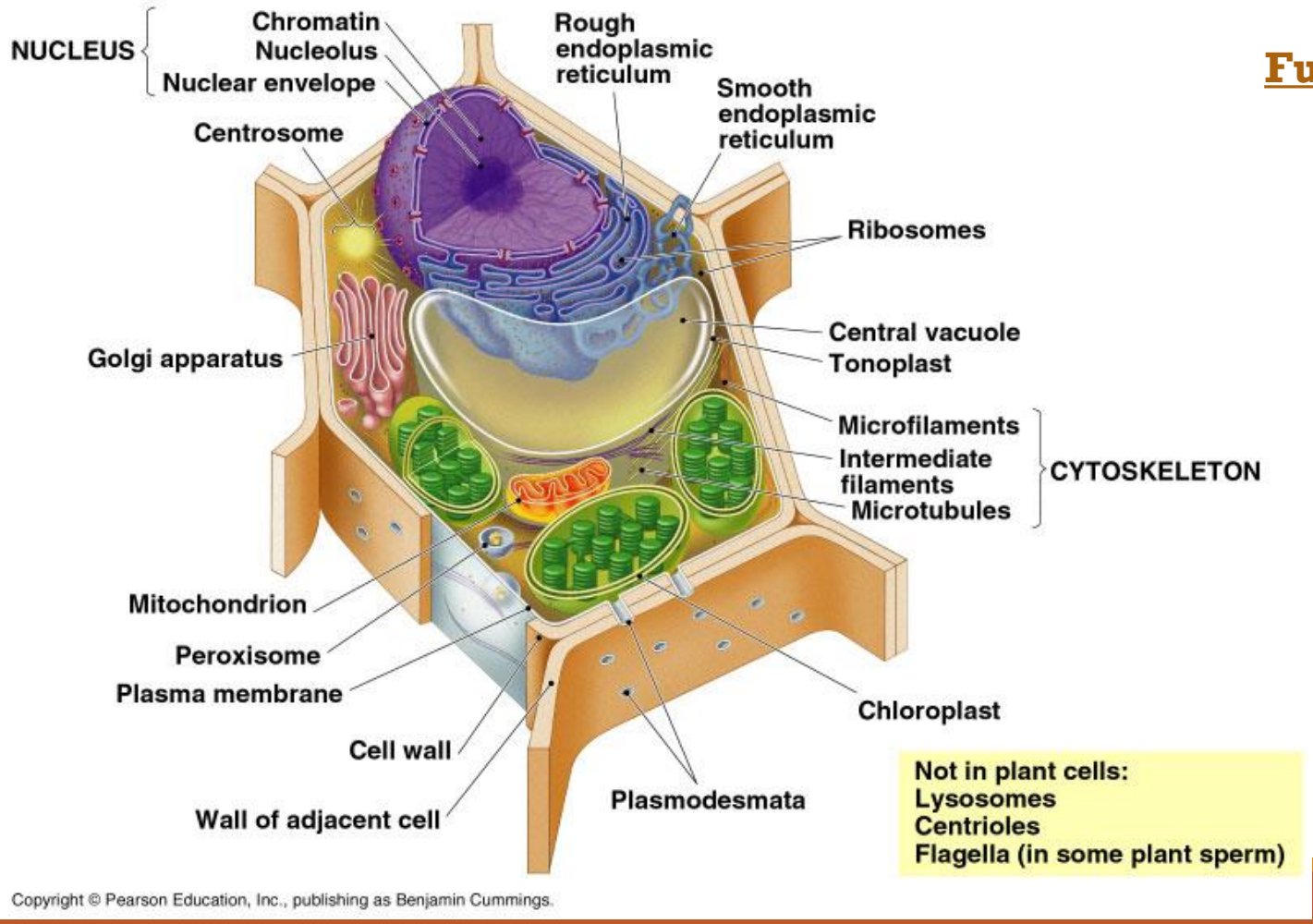
Chloroplasts

- Chloroplasts are found in plant cells and help capture light to produce glucose.

- Chloroplasts contain the green pigment chlorophyll, as well as enzymes and other molecules that function in photosynthesis. Chloroplasts are found in leaves and other green organs of plants and in algae



The Cell Wall and Cytoskeleton



Function:

- Protection
- Support

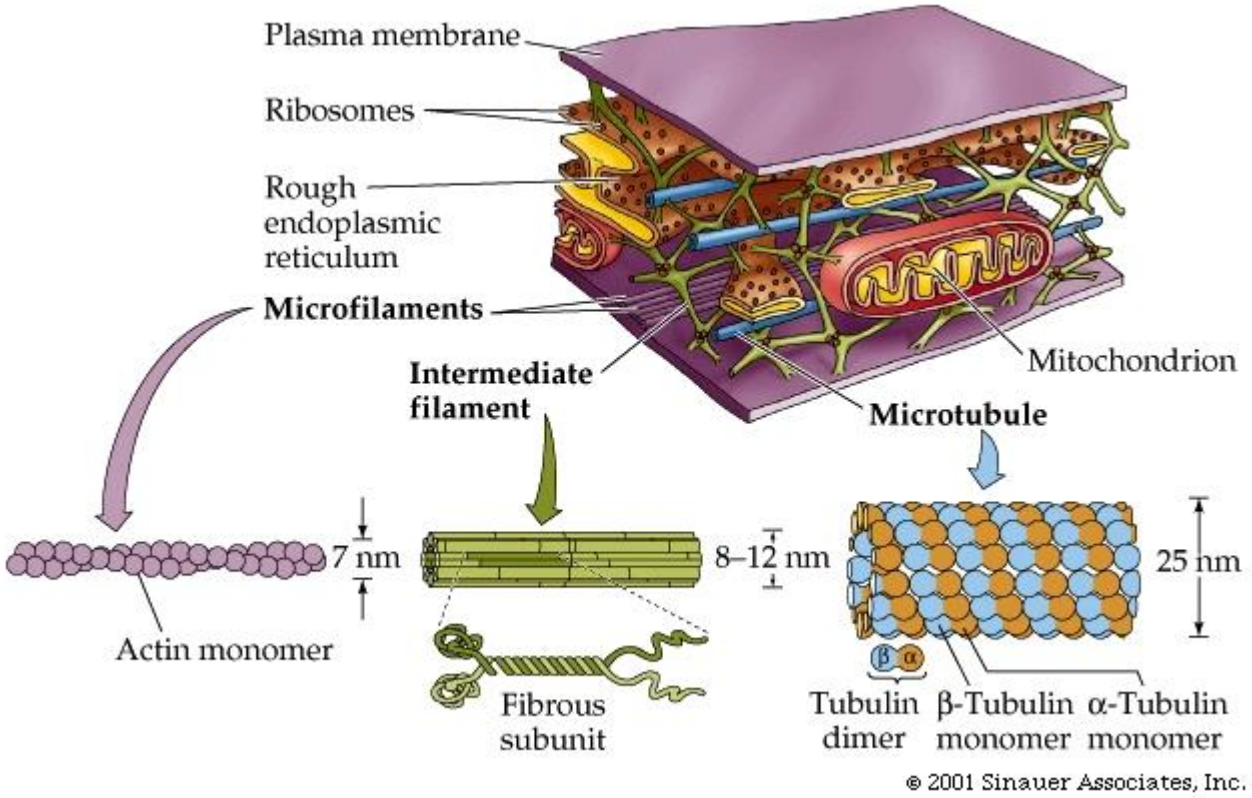
Cell walls are primarily found in plants, fungi and protists.

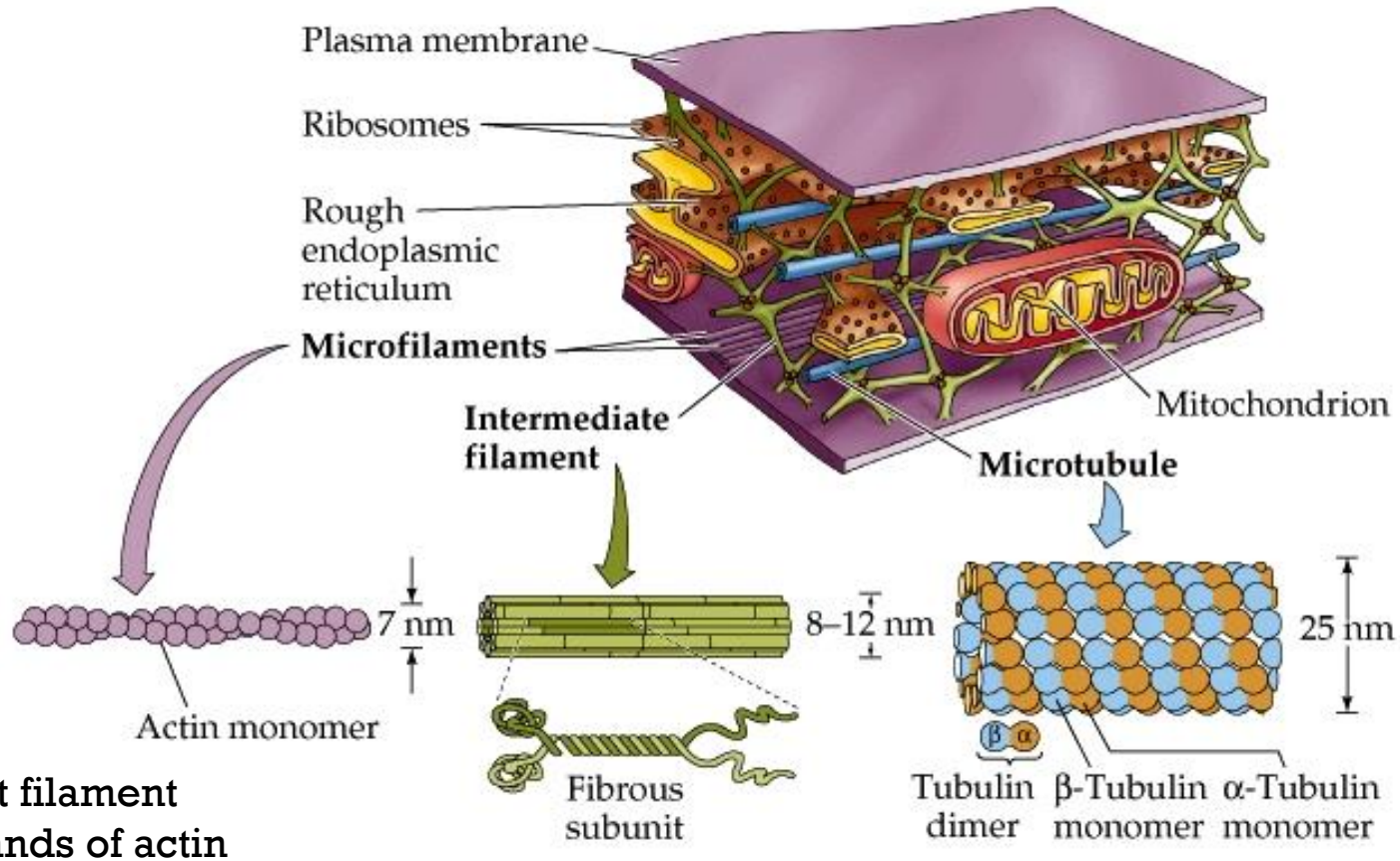
Their cell walls will vary in terms of composition, but it is mostly composed of polysaccharides and/or glycoproteins.

The Cell Wall and Cytoskeleton

Overall Function:

- Provide Structure
- Anchoring the cell membrane and organelles in place
- Transportation of vesicles and other organelles
- Movement of the cell (pseudopodia)





- Thinnest filament
- Two strands of actin
- Allows for cytoplasmic streaming and cell division

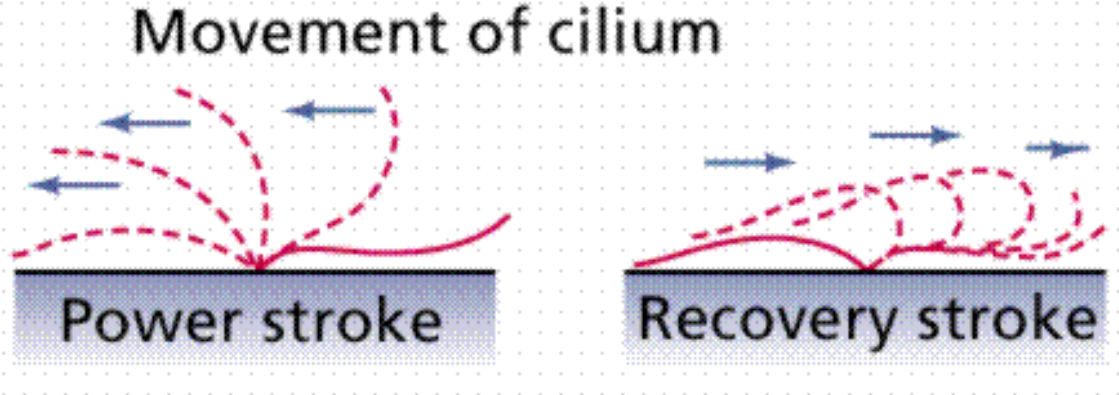
- Intermediate thickness
- Forms a cable-like structure
- Maintains cell shape

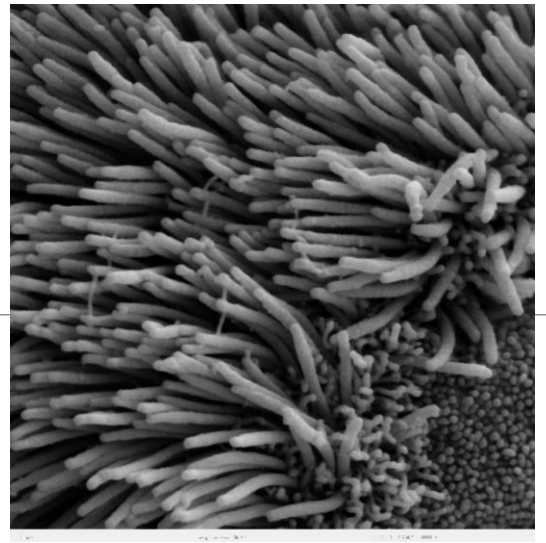
- Thickest filament
- Forms a series of hollow tubes
- Enables organelle movement

Cilia and Flagella

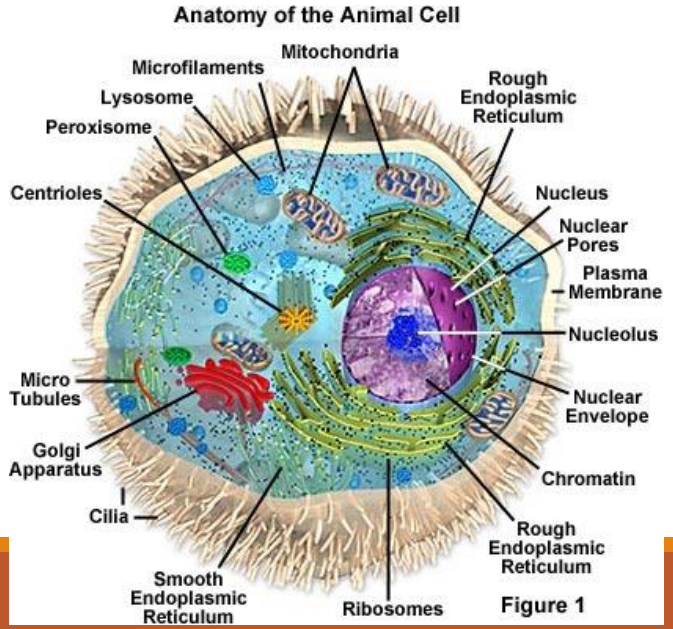
Cilia:

Enables organisms to move within a medium using a back-and-forth motion.



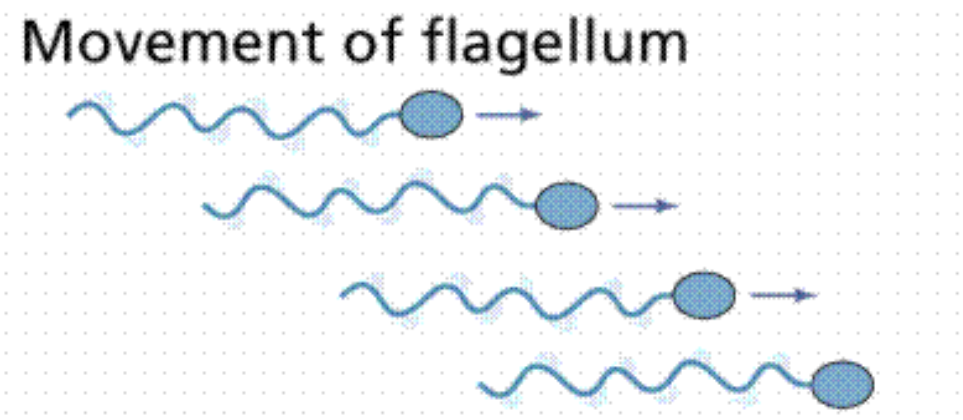


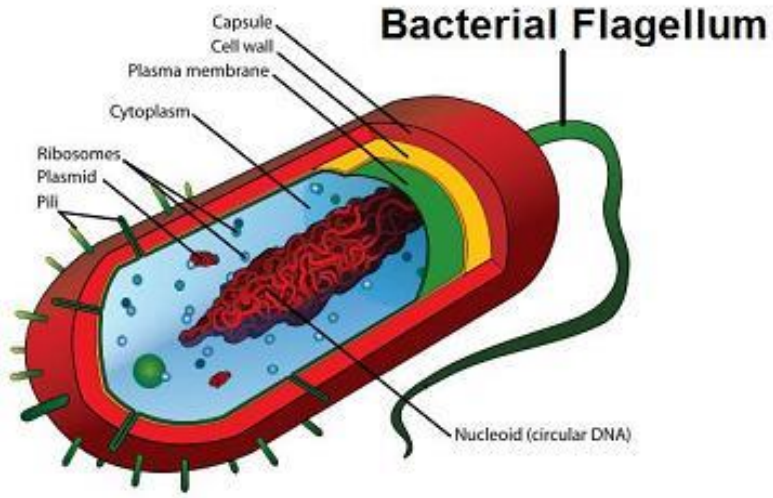
*The cilia present in the **respiratory tract** simply beats back and forth to remove debris.*



Cilia and Flagella

Flagella: tail-like structure that is usually present in one or two appendages.



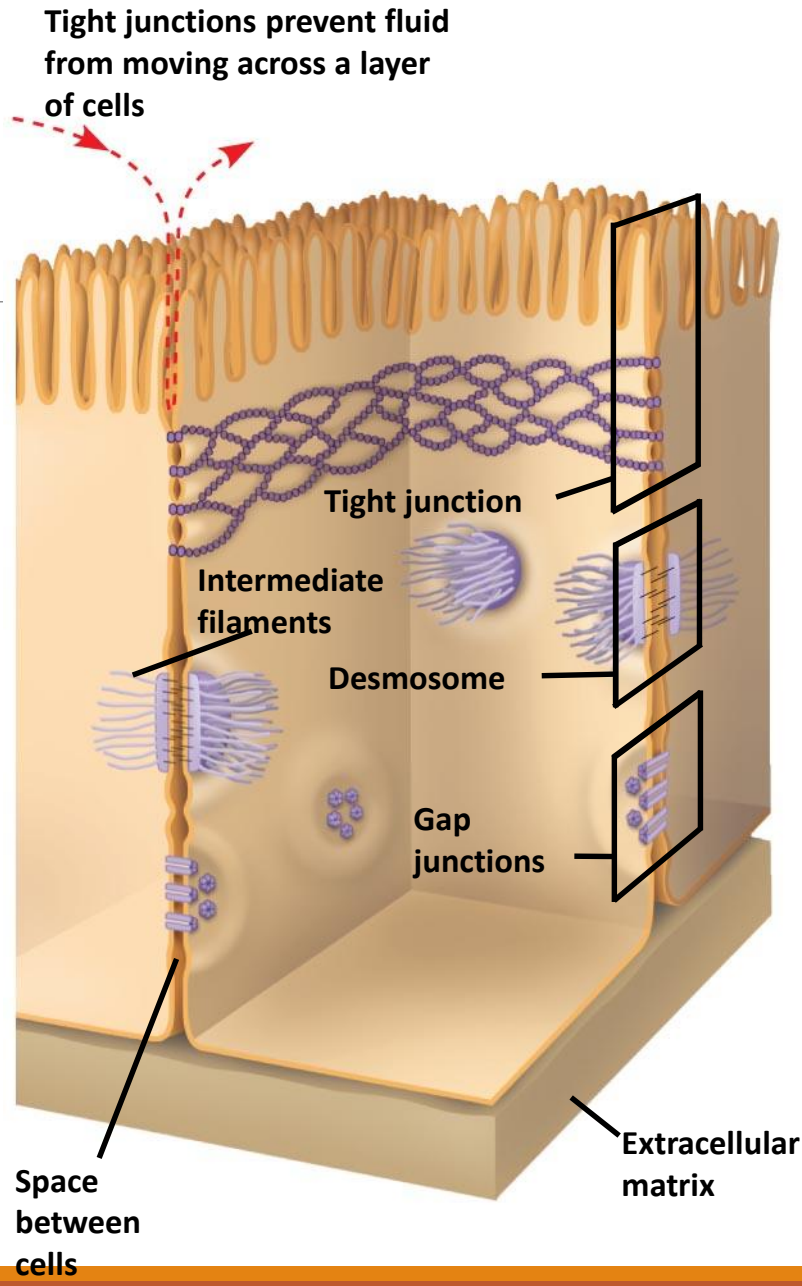


Intercellular Junction

Neighboring cells in tissues, organs, or organ systems often adhere, interact, and communicate through direct physical contact (intercellular junctions)

There are several types of intercellular junctions

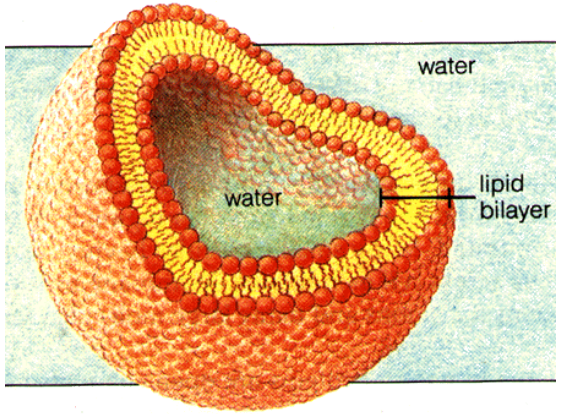
- Tight junctions
- Desmosomes
- Gap junctions

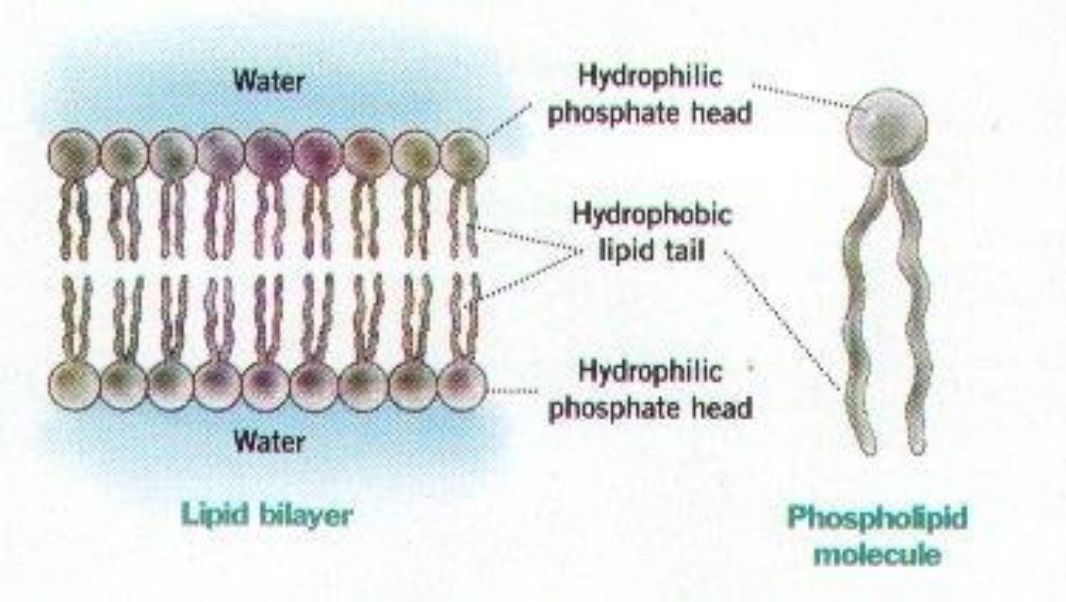


Cell Membrane

Function:

- Semi-permeable (controls what enters and leaves the cell)
- Separates the inside of the cell form the extracellular fluid.





Recap…

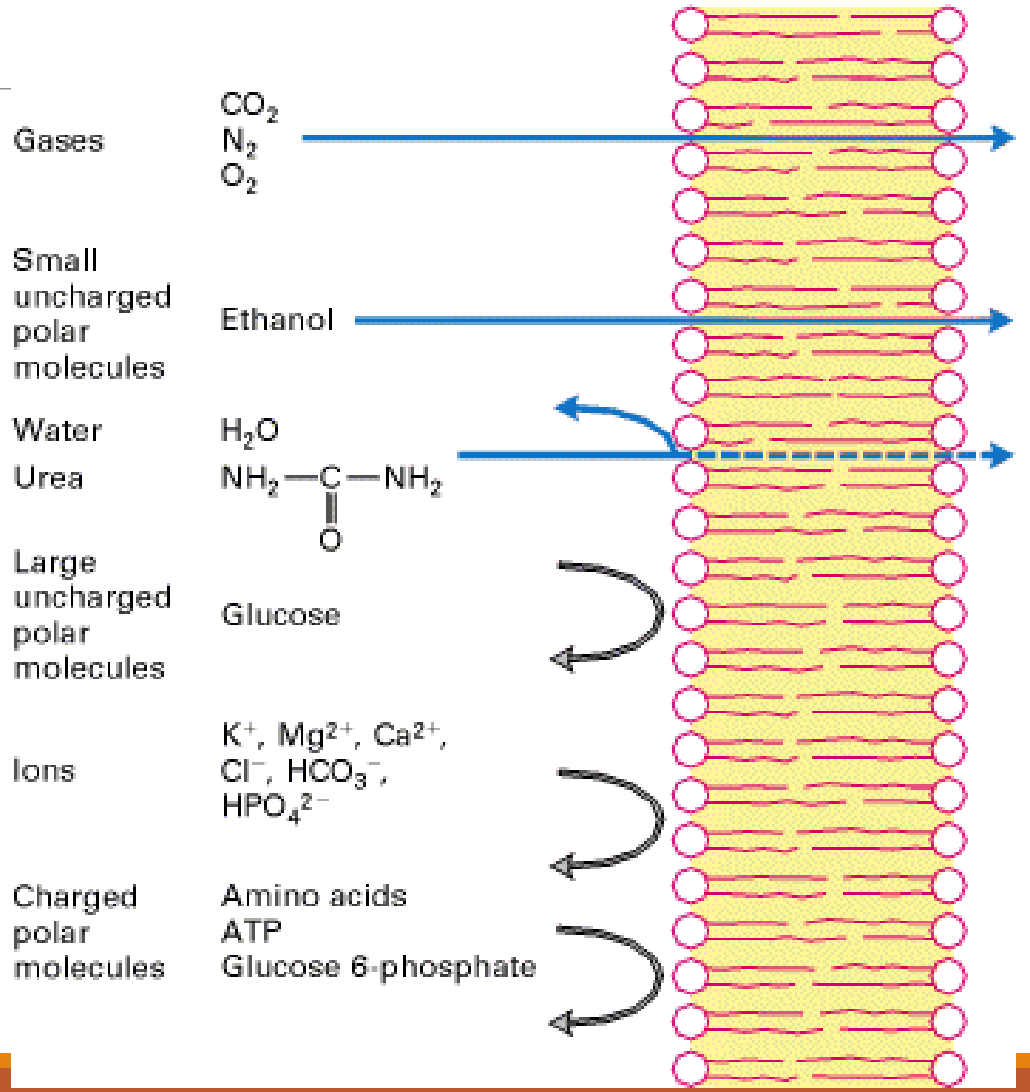
What features of the phospholipid enable it to form a spherical shape?

If lipid-soluble molecules (non-polar) are able to enter the cell rapidly what information does this provide about the cell?

Cell Membrane

- **Non-polar molecules** are able to diffuse readily across the cell membrane.
- **Small and uncharged polar** molecules can also diffuse into the cell.
- Any **large, polar or charged** molecules cannot diffuse through the membrane on its own.

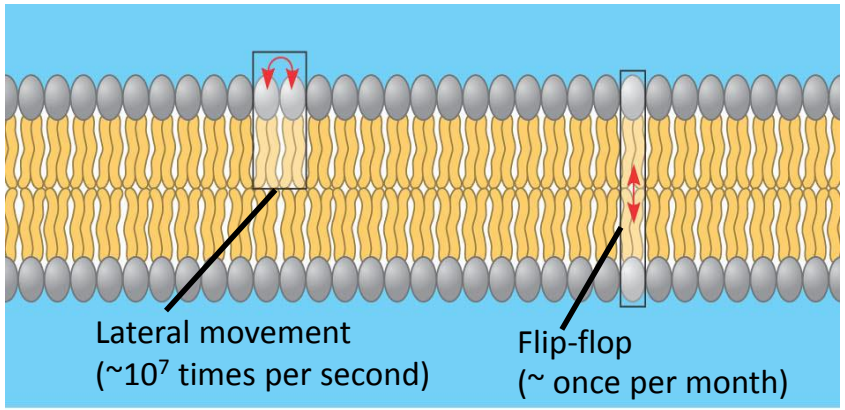
How is the cell able to receive essential ions and molecules that are charged, large and polar?



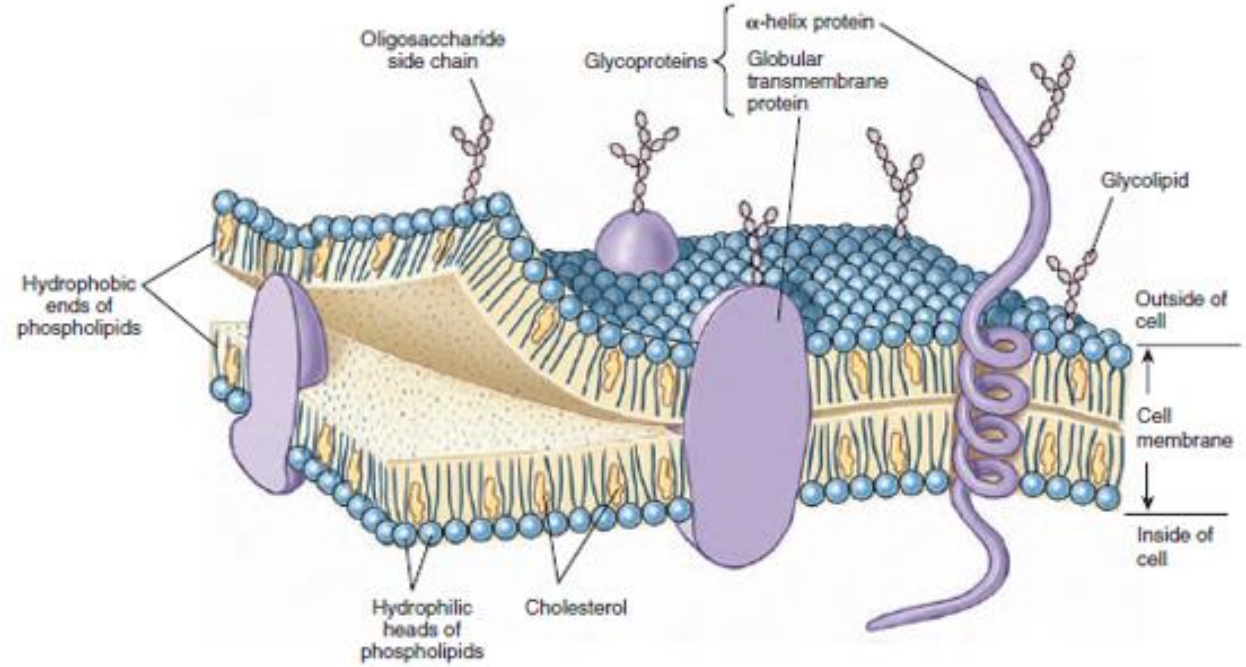
Cell Membrane

Jonathan Singer and Garth Nicolson, proposed the ***'Fluid Mosaic Model'.*** The cell membrane is a bilayer of phospholipids that contains cholesterol, proteins and glycoproteins.

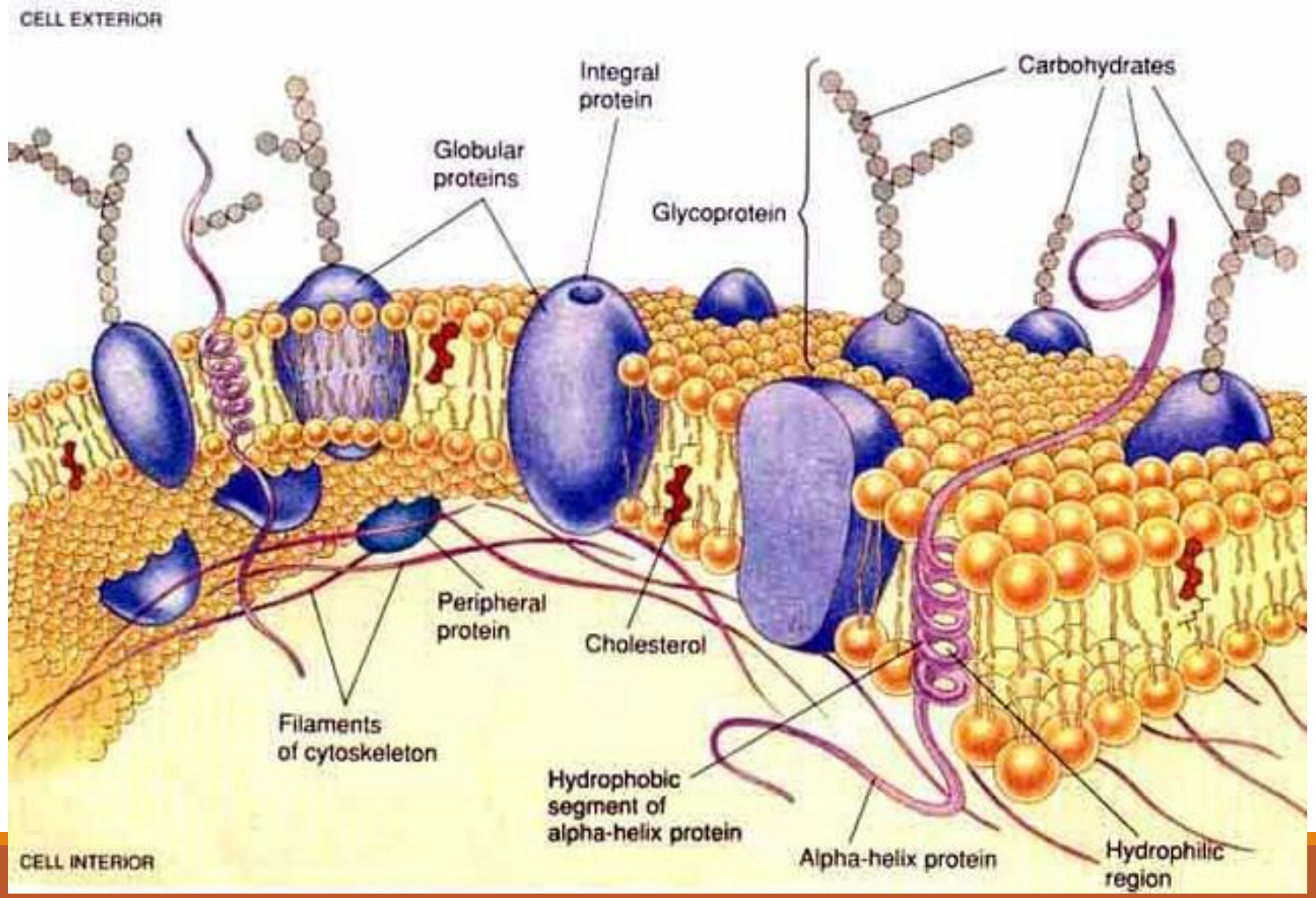
Phospholipids scaffold macromolecules together. It is continuously moving due to the weak intermolecular forces.



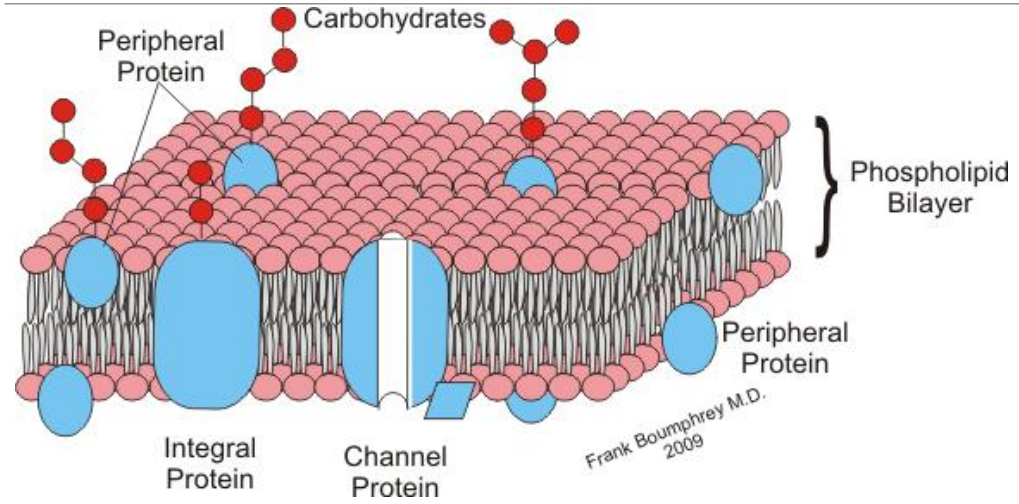
(a) Movement of phospholipids



Cell Membrane



Cell Membrane

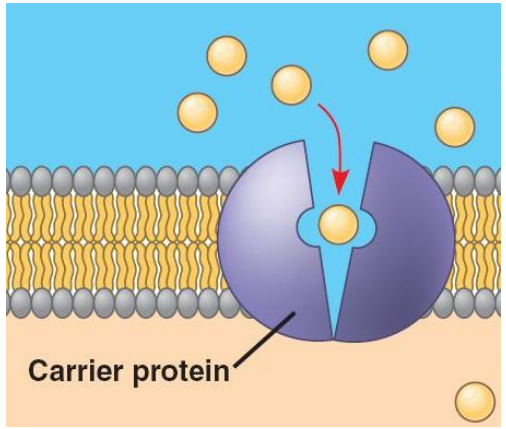


Peripheral protein located within the cell membrane

Integral protein: embedded within the cell membrane and are exposed outside and inside of the cell membrane.

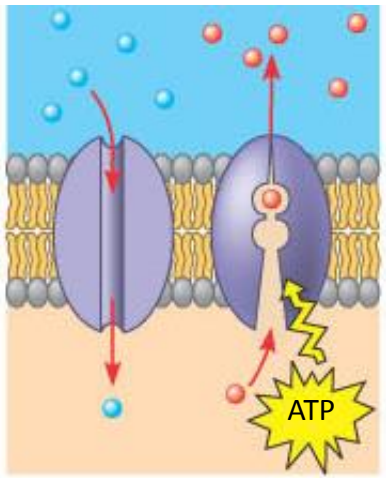
Functions:

- Transportation of substances across the cell
- Enzymes that undergo chemical reactions
- Cell recognition – glycoproteins
- Signal reception/transduction

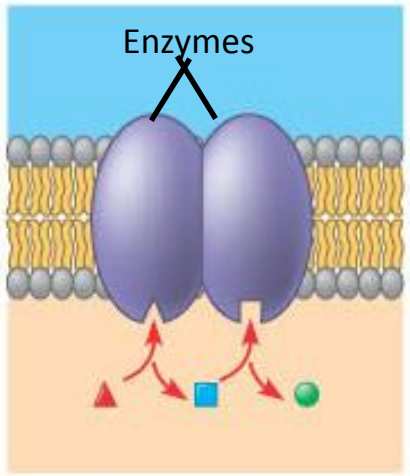


E.g carrier protein: transports Na+ and K+ into and out of the cell.

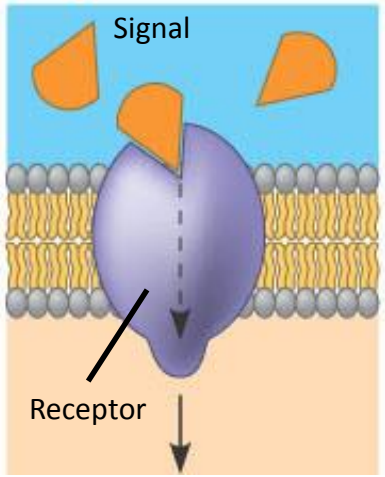
Functions of Integral Proteins



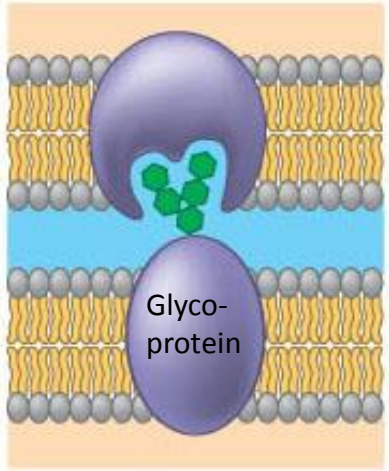
Transport



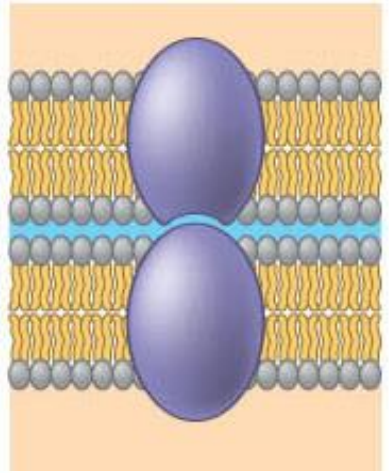
Enzymatic Activity



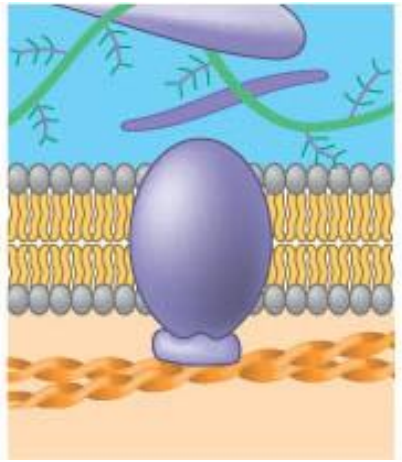
Signal Transduction



Cell-to-cell recognition



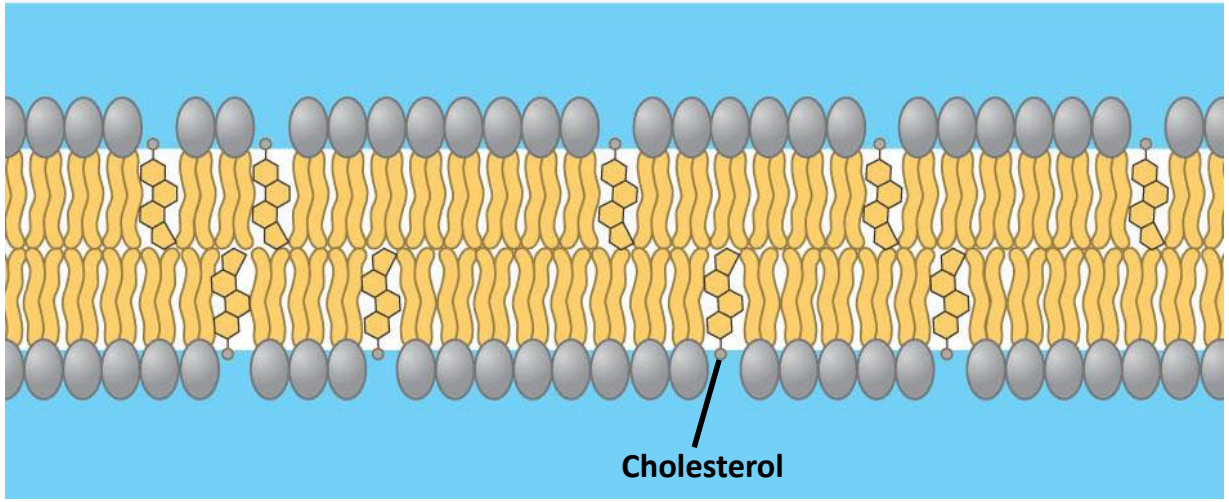
Intercellular joining



Attachment of cytoskeleton

Cell Membrane

Cholesterol:



(c) Cholesterol within the animal cell membrane

Function:

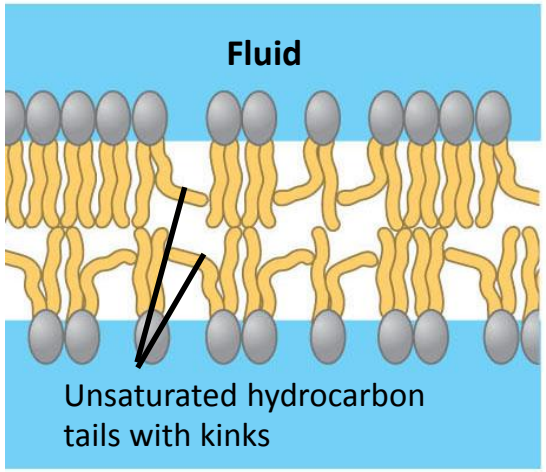
- Maintains the fluidity of the cell membrane
- If temperature increases the cholesterol stabilizes the membrane
- If temperature decreases the cholesterol prevent close packing of phospholipids.

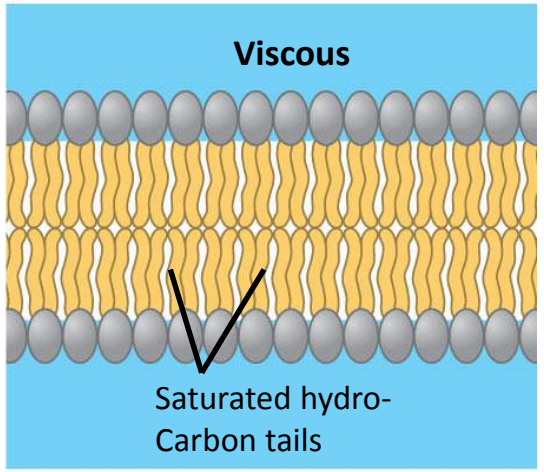
Cell Membrane

Factors that affect membrane fluidity:

a) **Temperature:** At high temperatures, the bilayer becomes increasingly more fluid and is no long semi-permeable. At low temperatures, the cell membrane solidifies.

b) **Fatty acid tails:**





c) **Fatty Acid Tail length:** The longer the fatty acid tail of the phospholipid, then more intermolecular interactions with surrounding molecules, this the more stable the membrane.

Homework

- Complete the online assignment
- Complete worksheets given in class.