UNIT 1

Chapter 1:

- Cell morphology
- Cell organelles – structure and function

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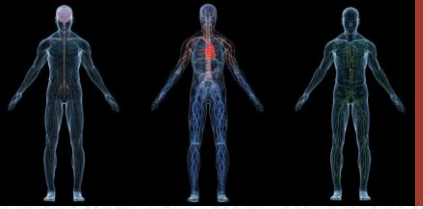
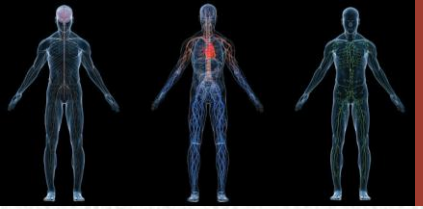


Physiology

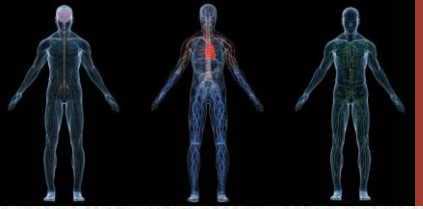
The science that is concerned with the function of the living organism and its parts, and of the physical and chemical processes involved.

- Human Physiology



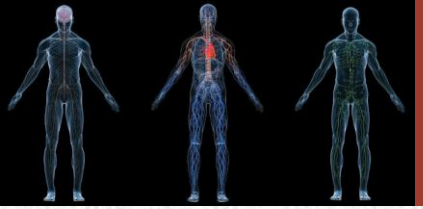
Pathophysiology

- The study of disordered body function (i.e., disease)
- The basis for clinical medicine



The Human Body - A Complex Society of Differentiated Cells

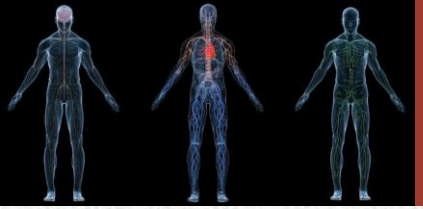
- Cells: the basic structural and functional unit (~ 100 trillion)
- Tissues: (e.g. muscles, epithelial, nervous)
- Organs: (e.g. kidney, heart, liver, pancreas)
- Organ systems: (e.g. cardiovascular, urinary)



Regulation and Integration

- Exists at all levels of organization

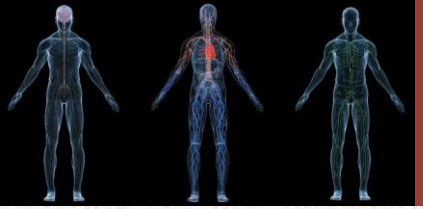
- Cells: e.g. genes, operons, repressor proteins, transcription factors, membrane transport
- Tissues: e.g. autacoids, paracrines
- Organ systems: e.g. nervous and endocrine systems



Homeostasis

The maintenance of a stable "milieu interieur"

Claude Bernard (1813 - 1878)



General Organization of the Circulatory System

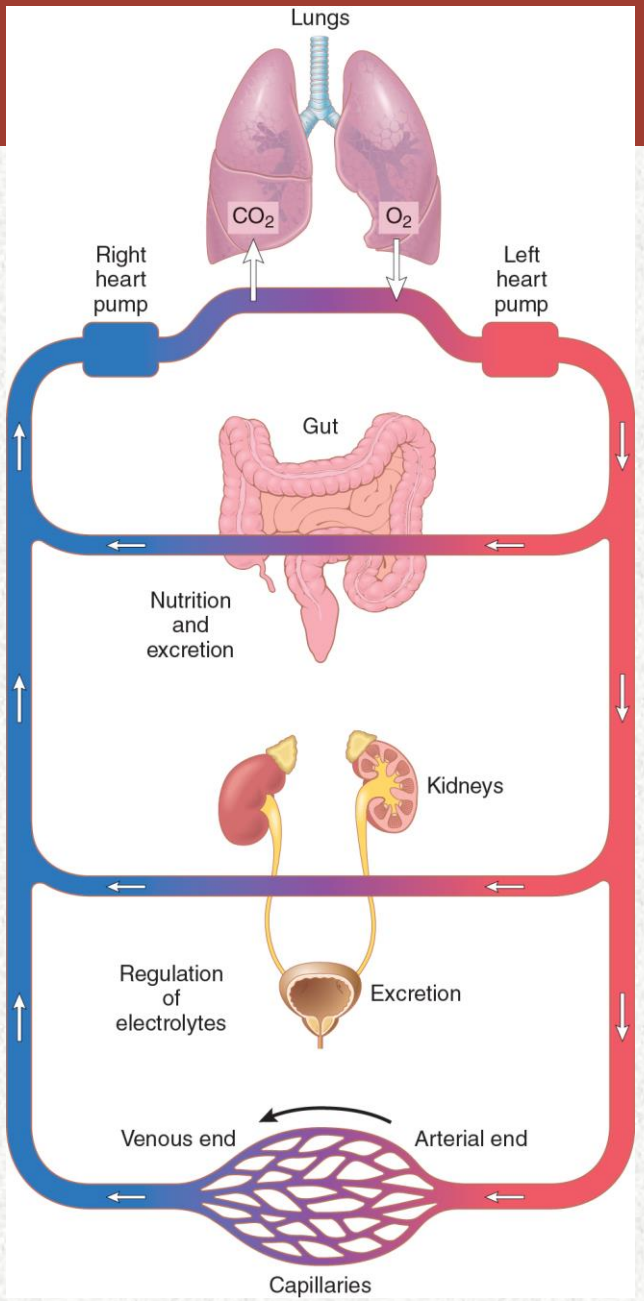


Figure 1-1

Organization of the Cell

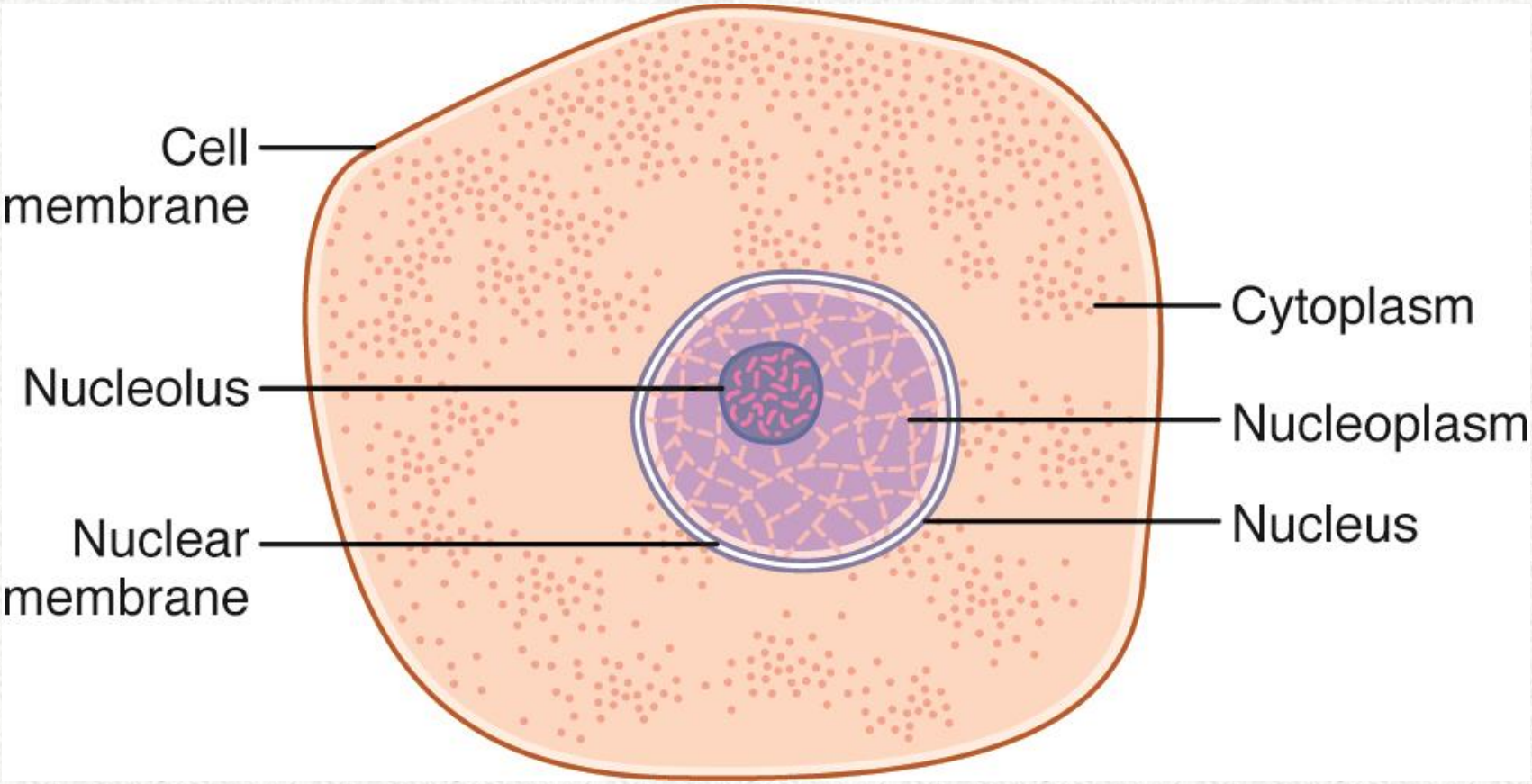
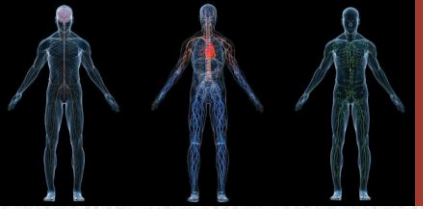
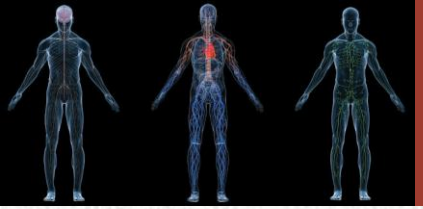


Figure 2-1



Cell Composition

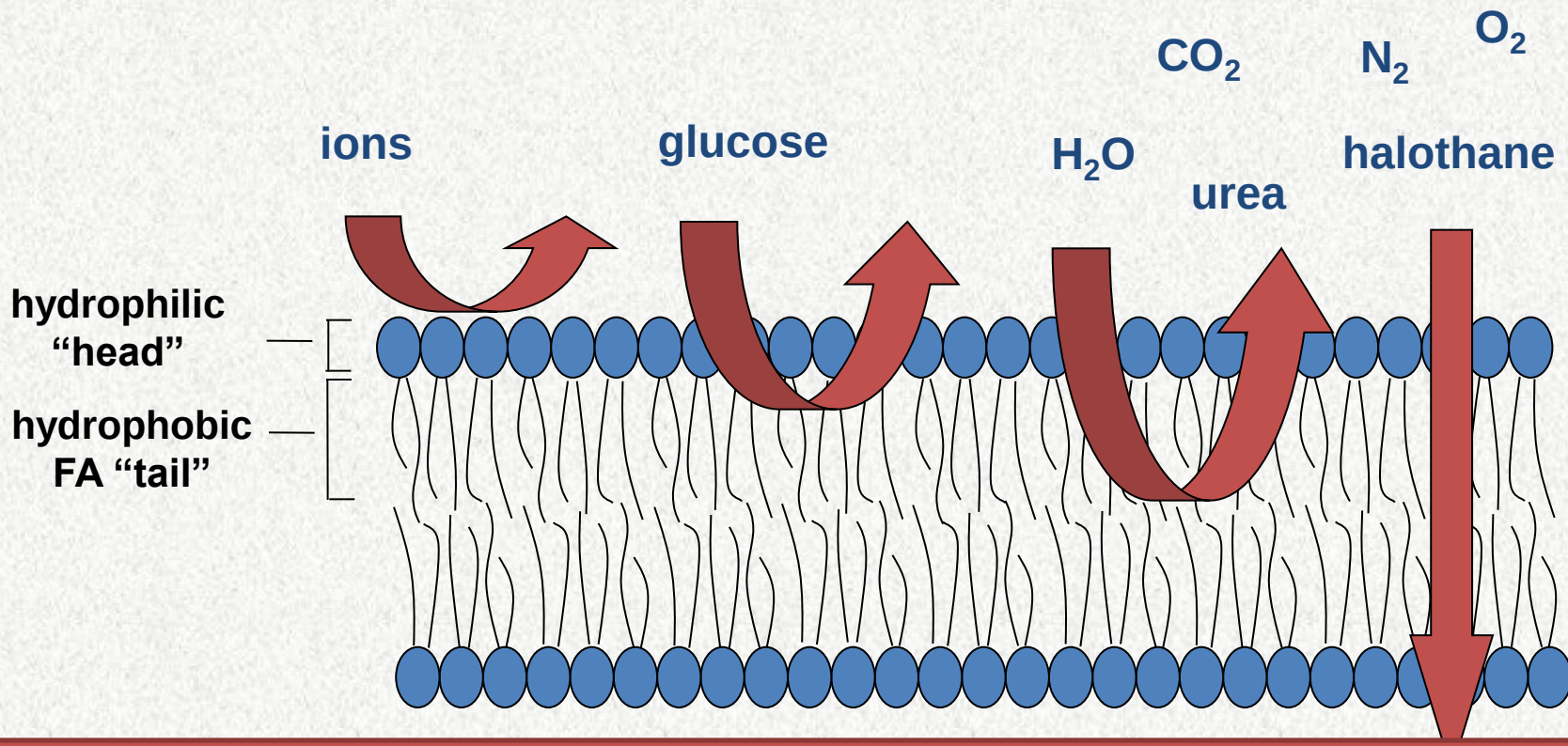
Water	...70-85% of cell mass
Ions	
Proteins	...10-20%
Lipids	...2-95%
Carbohydrates	...1-6%

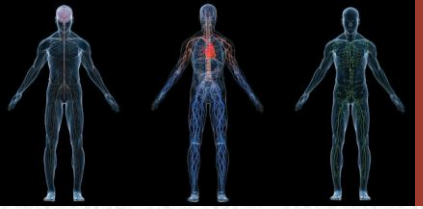


Membrane Components:

LIPIDS:

- **Barrier to water and water-soluble substances**
- **Organized in a bilayer of phospholipid molecules**





Cell Membrane: Bilayer of Phospholipids with Proteins

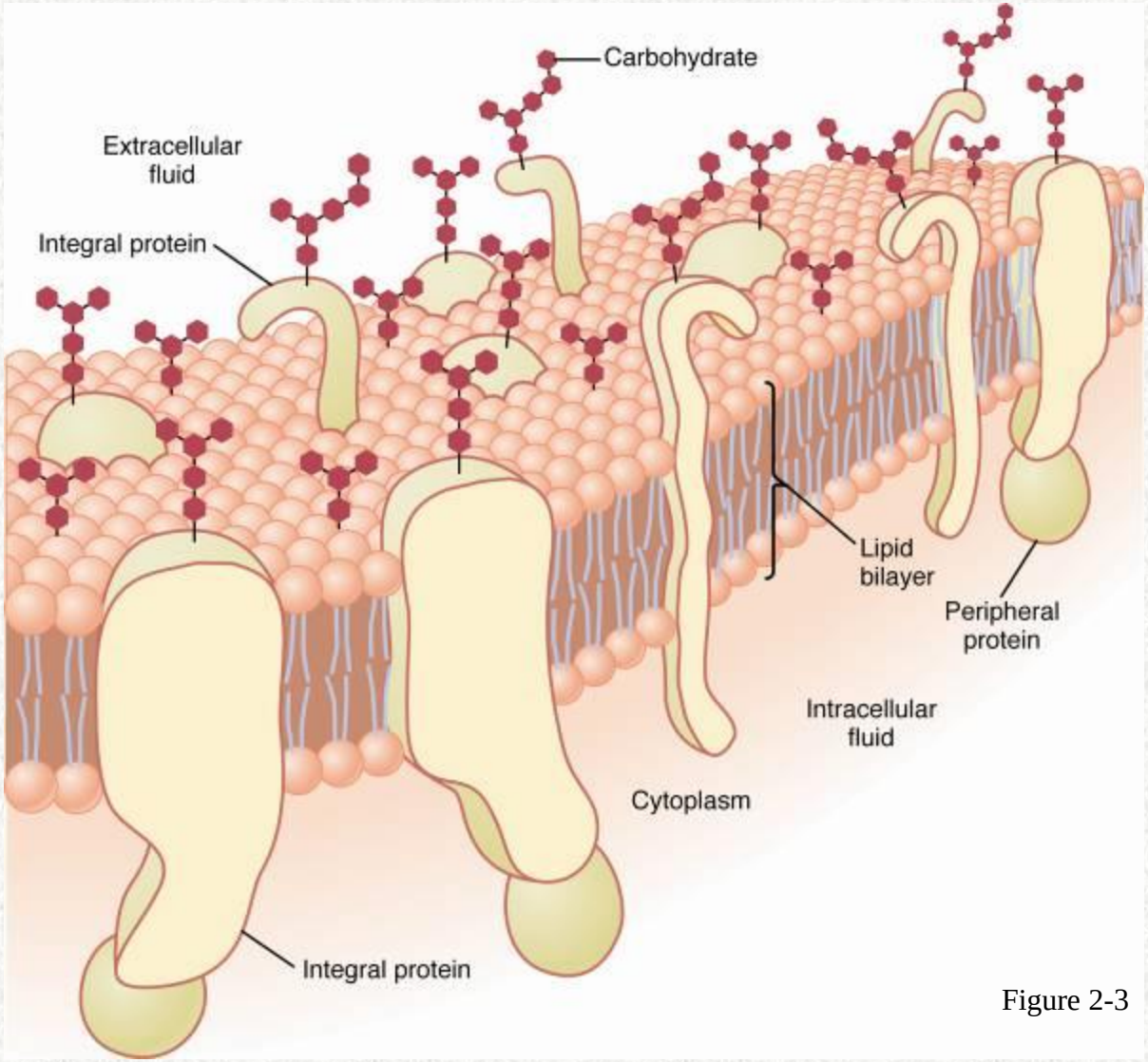
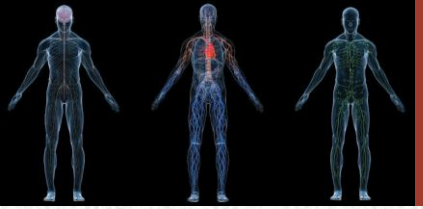


Figure 2-3



Proteins:

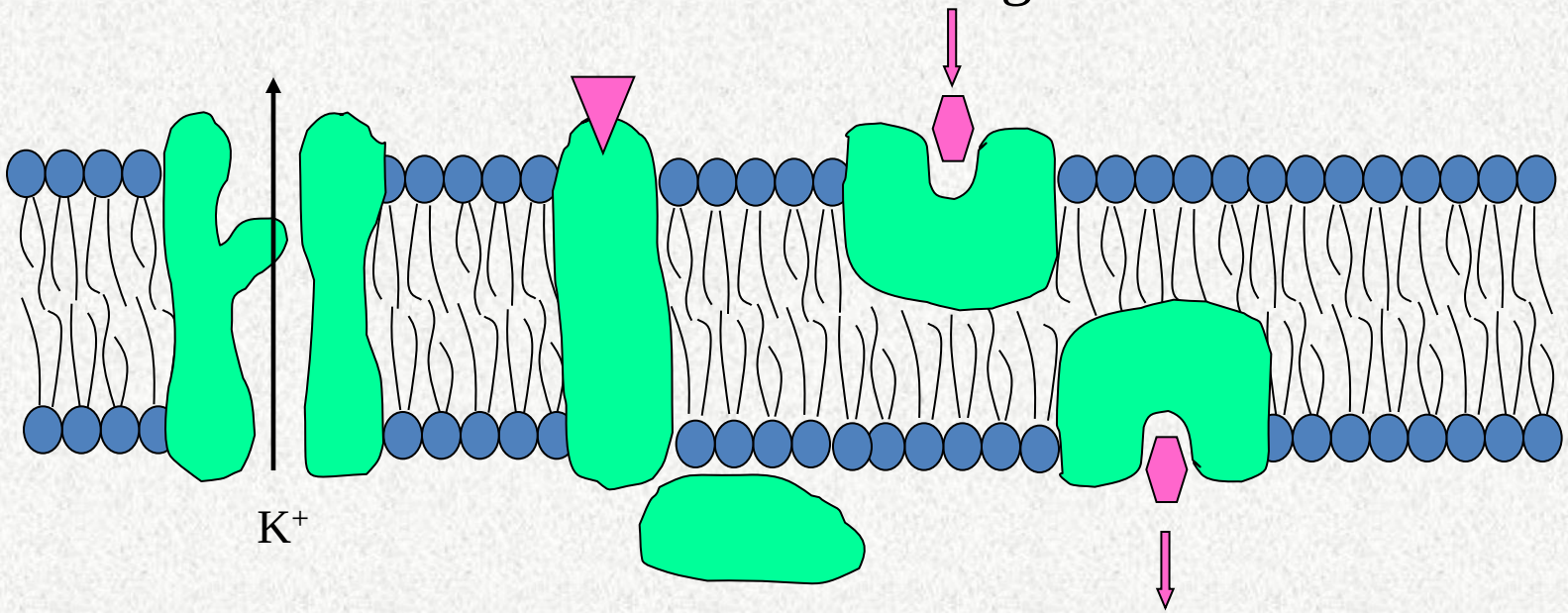
- Provide “specificity” to a membrane
- Defined by mode of association with the lipid bilayer

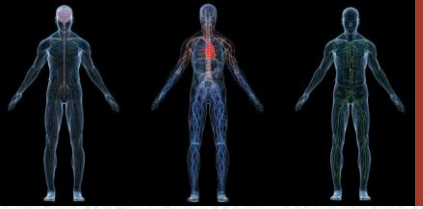
A. Integral: channels, receptor, antigen, pump, pores, carriers, enzymes

B. Peripheral:

a) Intrensic – inside surface of lipid layer - enzymes

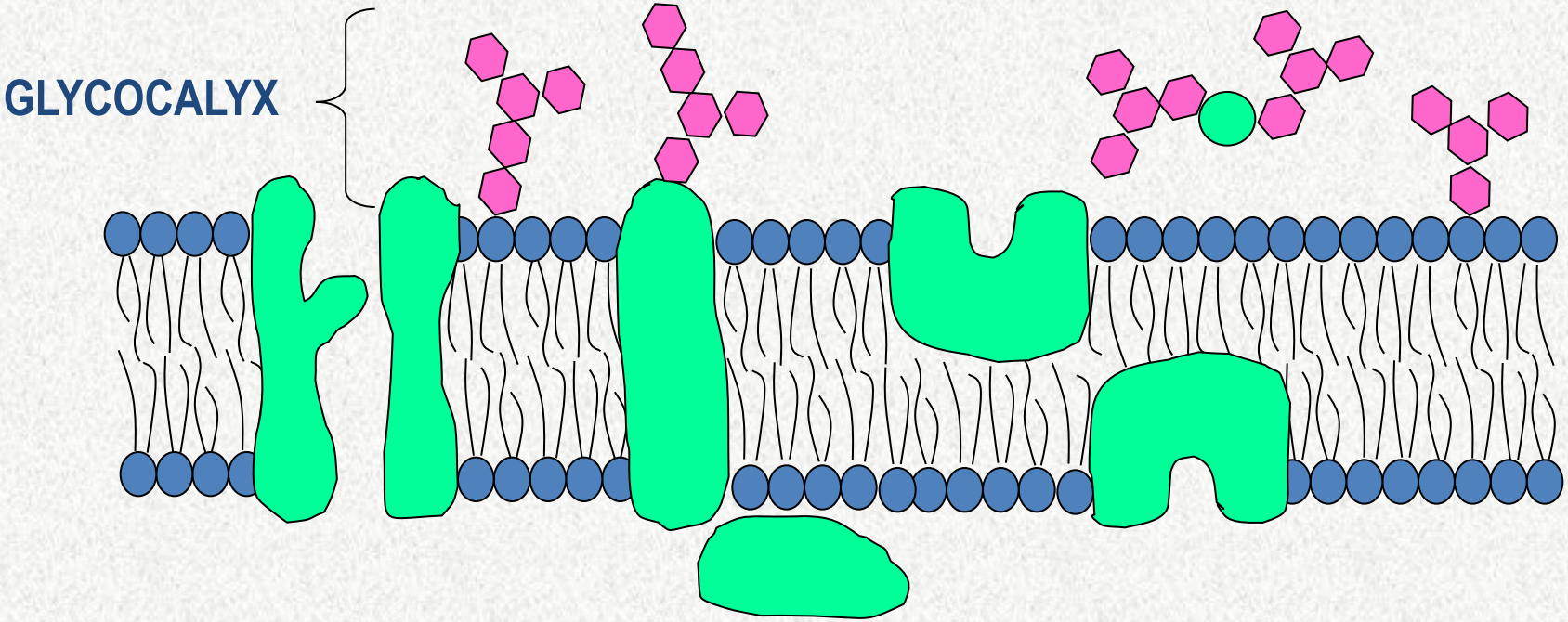
b) Extrinsic – outer surface - intracellular signal mediators

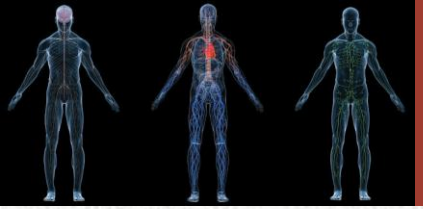




Carbohydrates:

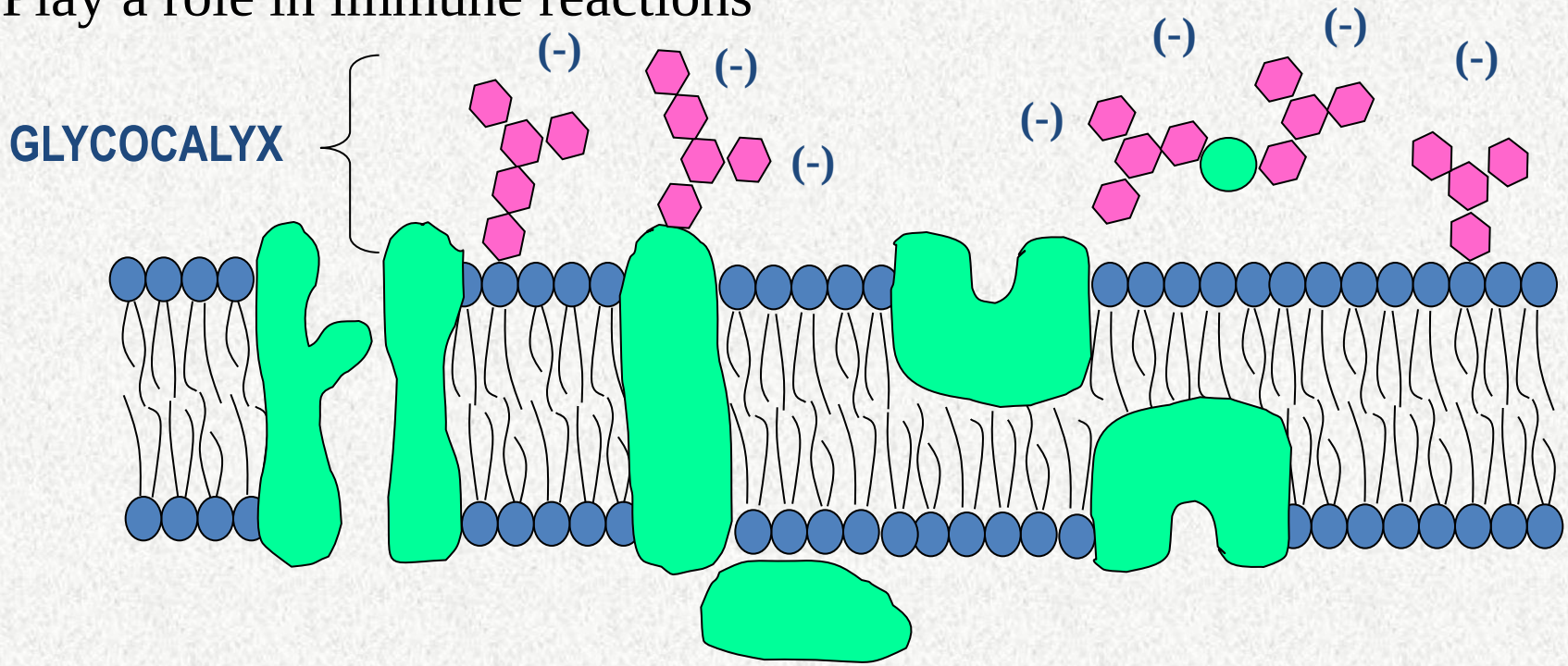
- Glycolipids (approx. 5 - 10%)
- Glycoproteins (majority of integral proteins)
- Proteoglycans

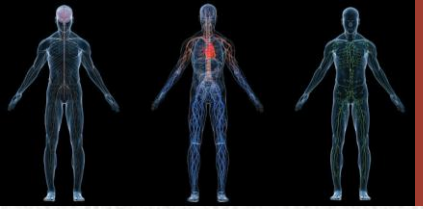




Carbohydrates (Cont.):

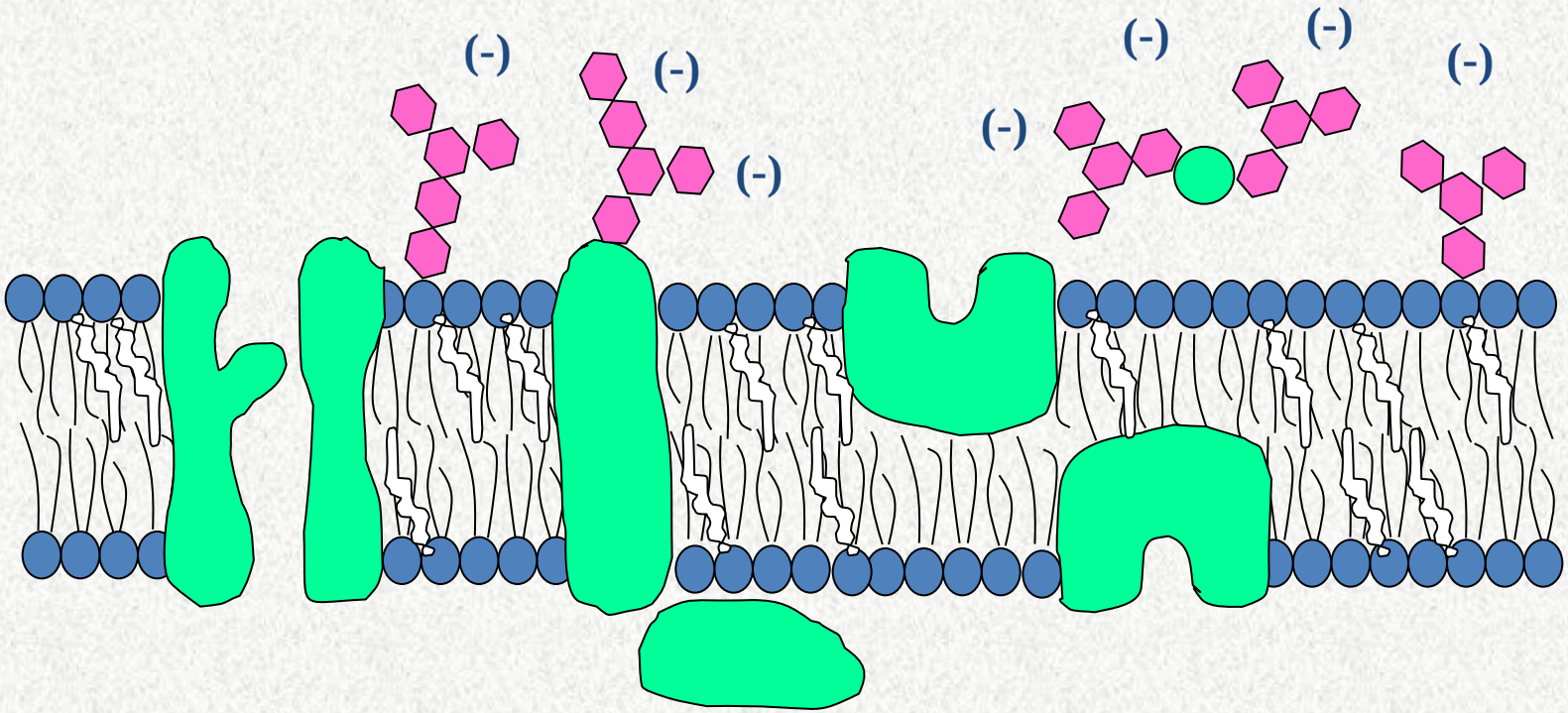
- Negative charge of the carbo chains repels other negative charges
- Involved in cell-cell attachments/interactions
- Tight fixation of cell
- Receptor
- Play a role in immune reactions





Cholesterol

- **Present in membranes in varying amounts**
- **Generally decreases membrane FLUIDITY and PERMEABILITY (except in plasma membrane)**
- **Increases membrane FLEXIBILITY and STABILITY**



Chromatin (condensed DNA) is found in the nucleoplasm

Nucleolus

- one or more per nucleus
- contains RNA and proteins
- not membrane delimited
- functions to form the granular "subunits" of ribosomes

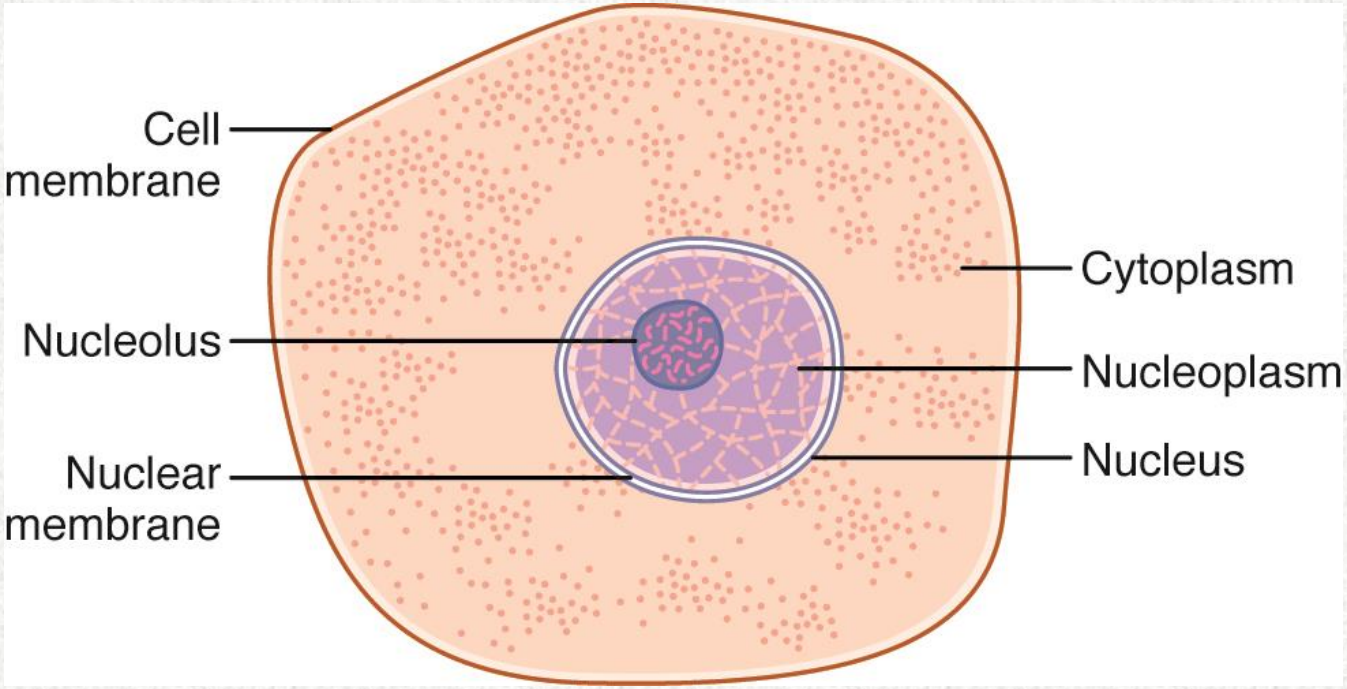
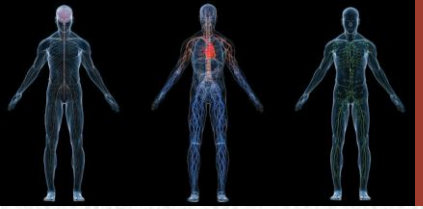


Figure 2-1



Cell Composition

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Ions	
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Lipids	...2-95%
Carbohydrates	...1-6%

The Nucleus: "Control Center" of the Cell

The double **nuclear membrane** and matrix are contiguous with the endoplasmic reticulum

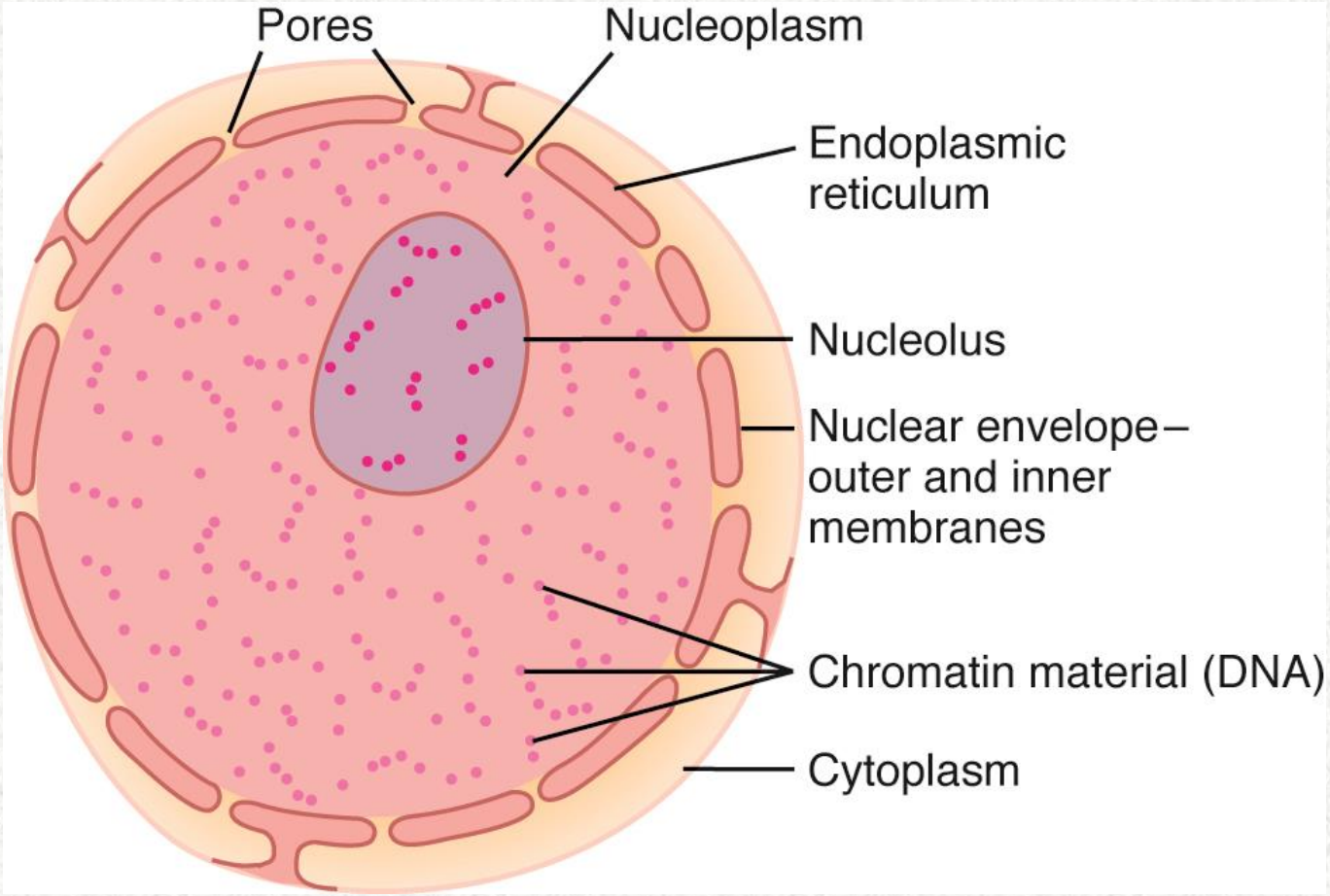
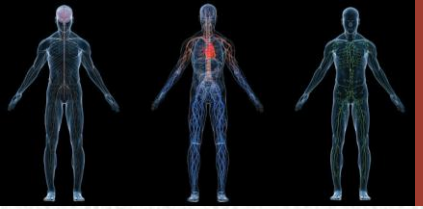
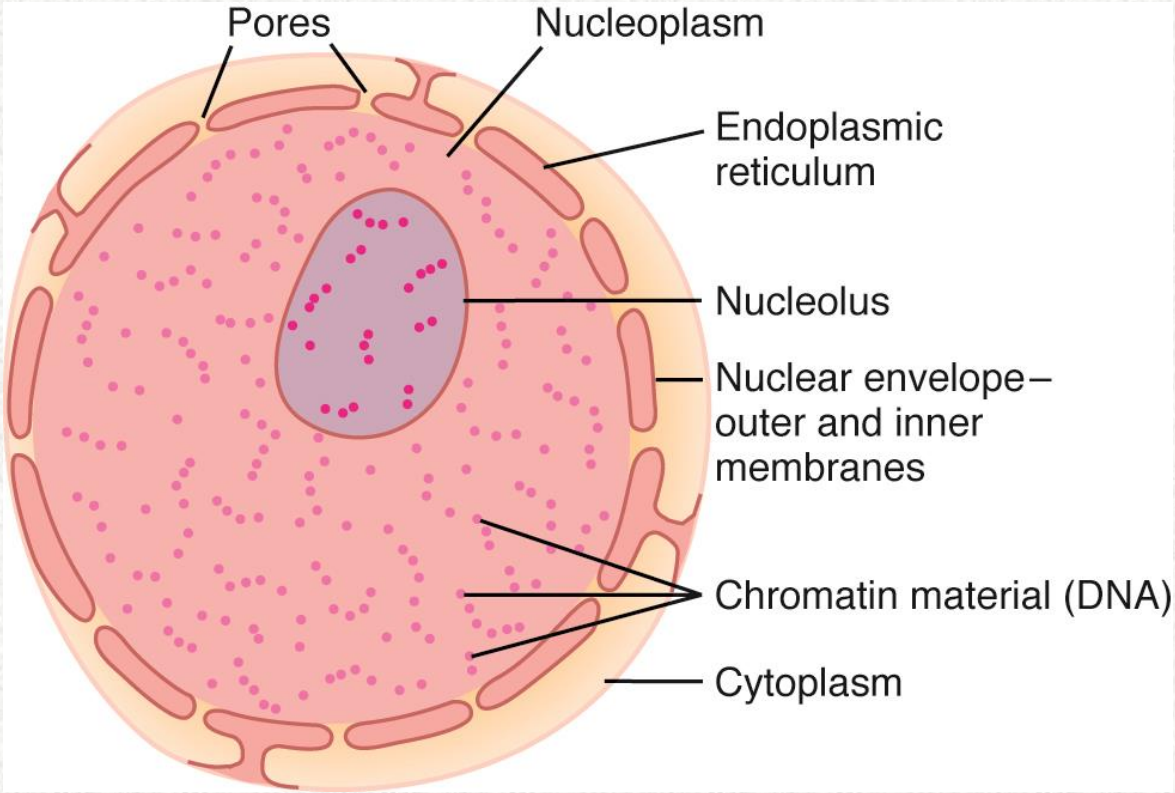


Figure 2-9



The nuclear membrane is permeated by thousands of nuclear pores

- 100 nm in diameter
- functional diameter is ~9 nm
- (selectively) permeable to molecules of up to 44,000 MW



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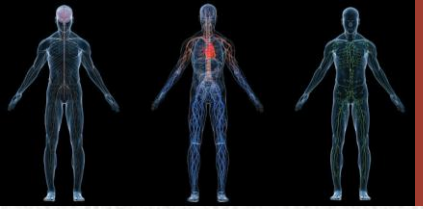


Cell Organelles

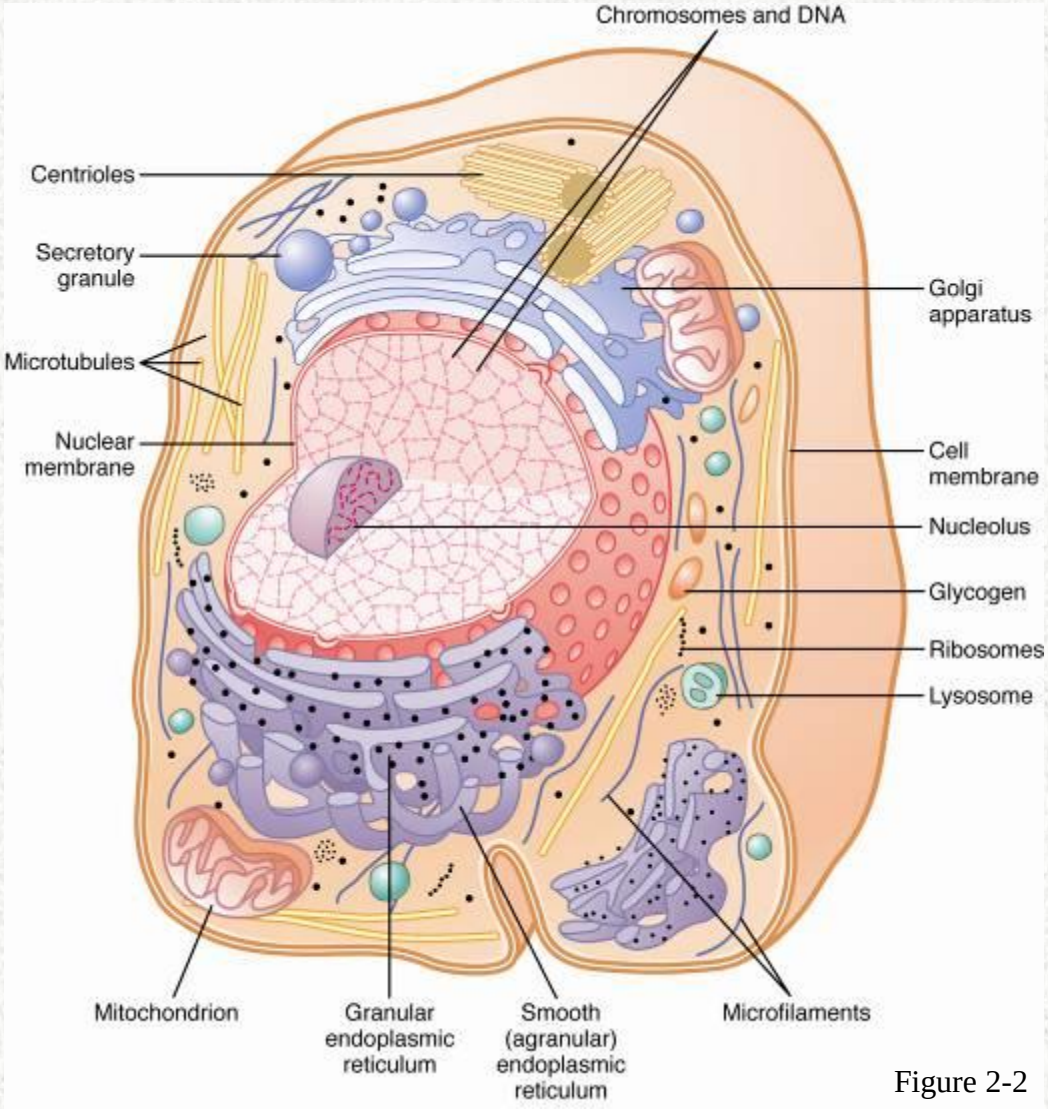


Figure 2-2

Mitochondria:

<u>Primary function</u>:

Extraction of energy from nutrients Aerobic respiration.

KREB CYCLE.

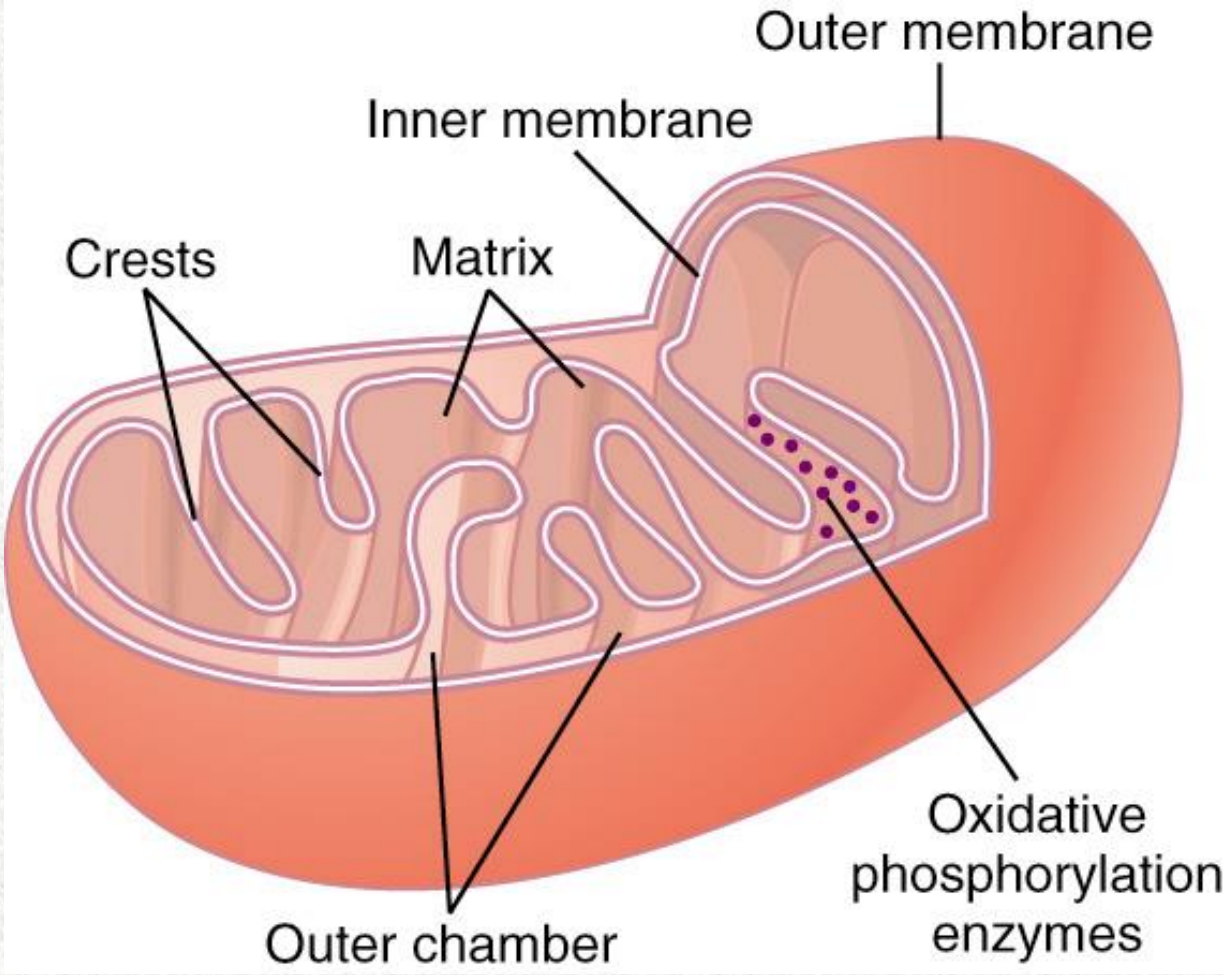
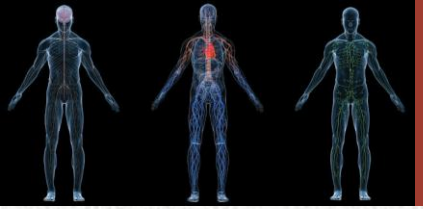


Figure 2-7



The Endoplasmic Reticulum:

- Network of tubular and flat vesicular structures
- Membrane is similar to (and contiguous with) the plasma membrane
- Space inside the tubules is called the endoplasmic matrix

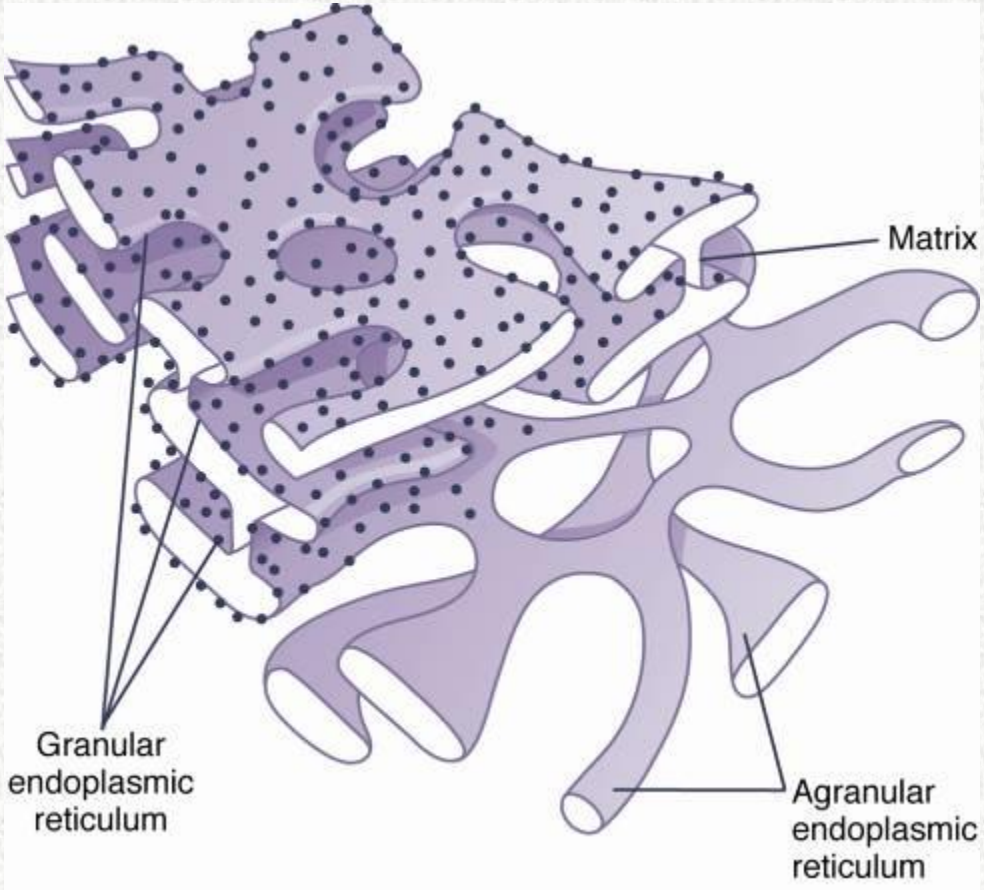


Figure 2-4

Rough or Granular ER

- **Outer membrane surface covered with ribosomes**
- **Newly synthesized proteins are extruded into the ER matrix**
- **Proteins are "processed" inside the matrix**
  - **crosslinked**
  - **folded**
  - **glycosylated (N-linked)**
  - **cleaved**

E.g.
Russells body in plasma
Nissels granules of nerve cell
Acinar cell of pancreases

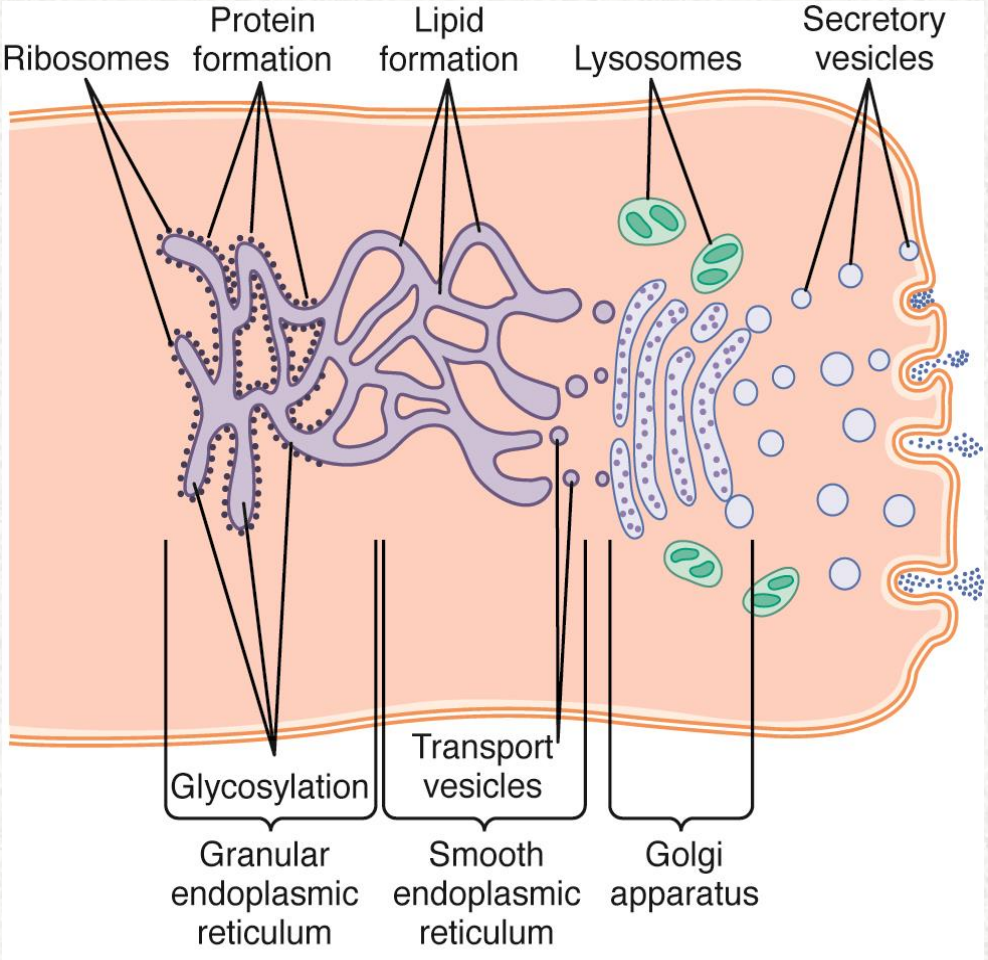
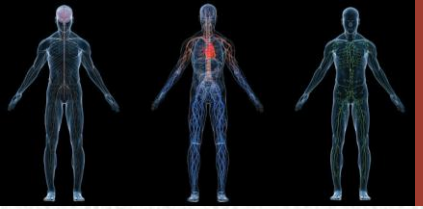


Figure 2-13



Smooth ER

- Site of lipid synthesis
  - phospholipids
  - cholesterol

- Growing ER membrane buds continuously forming transport vesicles, most of which migrate to the Golgi apparatus

- Sarcoplasmic reticulam – NM & CVS

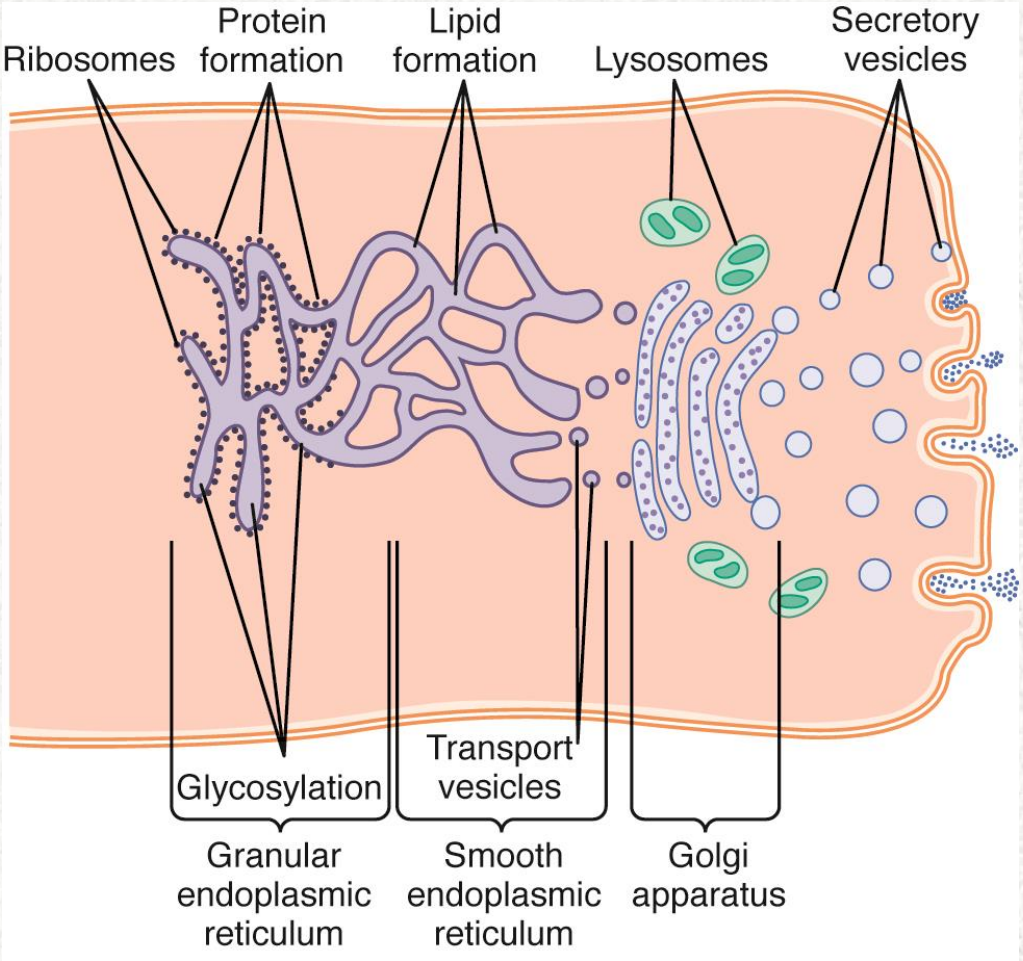


Figure 2-13

The Golgi Apparatus:

- Membrane composition similar to that of the smooth ER and plasma membrane
- Composed of 4 or more stacked layers of flat vesicular structures

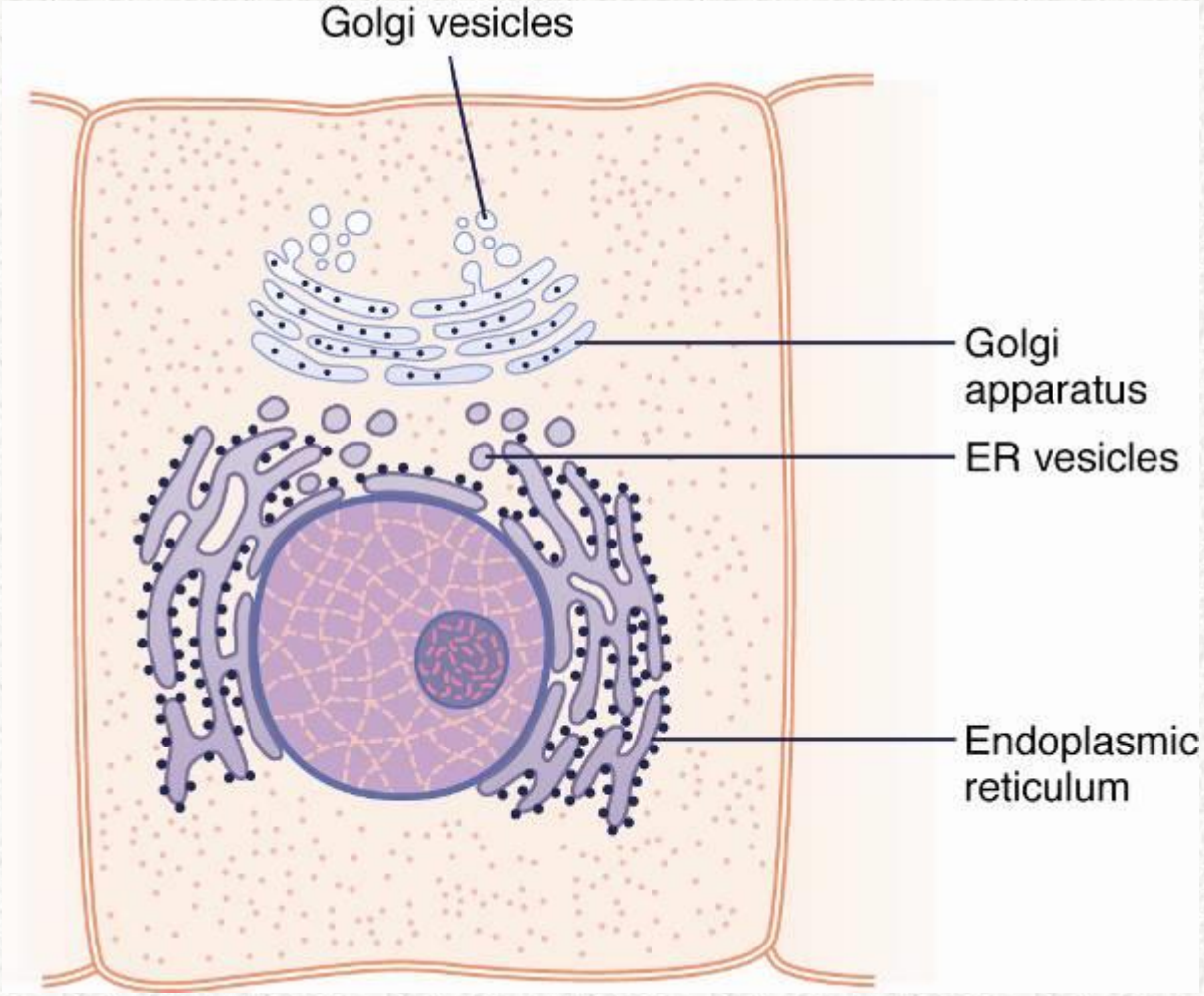
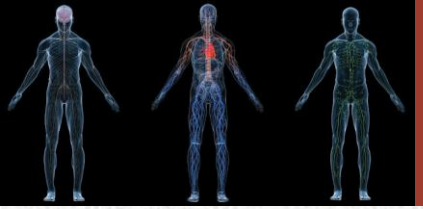


Figure 2-5



The Golgi Apparatus:

- Receives transport vesicles from smooth ER
- Substances formed in the ER are "processed"
  - phosphorylated
  - glycosylated
- Substances are concentrated, sorted and packaged for secretion.
- Synthesis of carbohydrate and protein
- Lysosomal enzyme formation
- Transport to other parts in cell

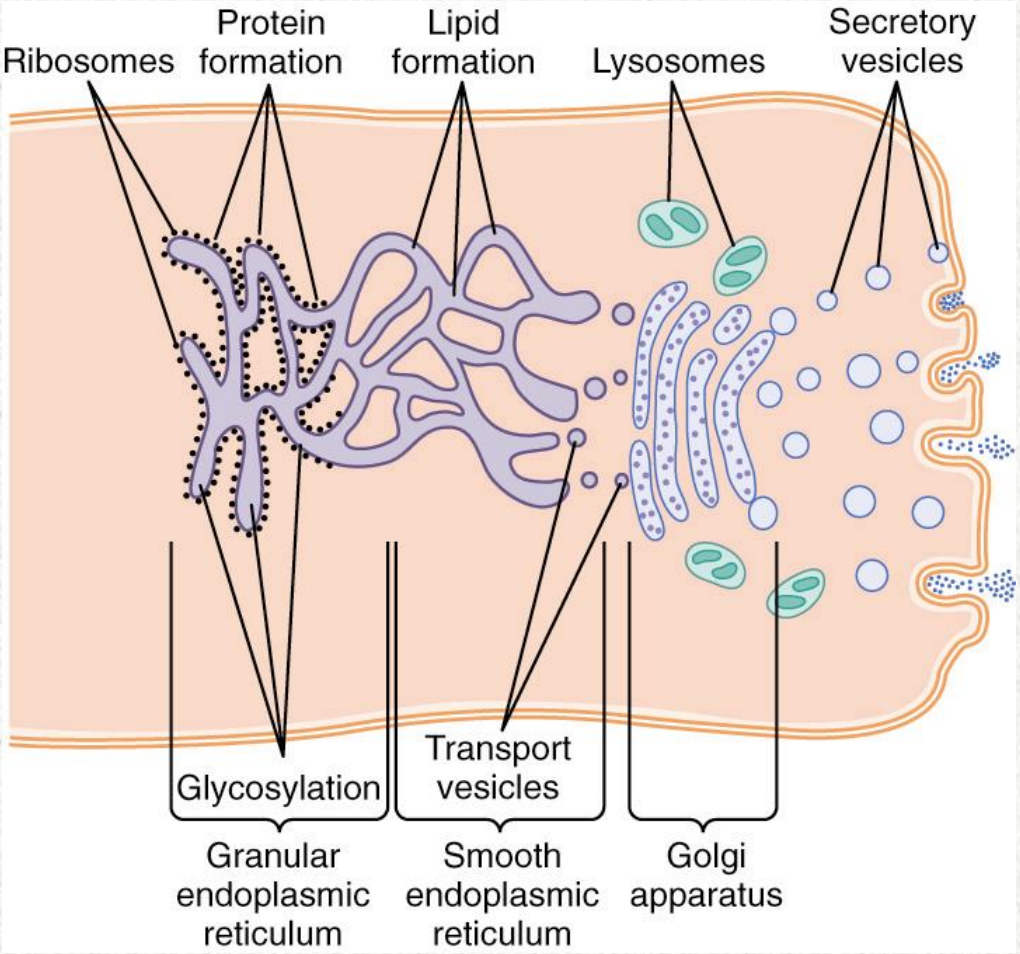


Figure 2-13

Exocytosis:

Secretory vesicles diffuse through the cytosol and fuse to the plasma membrane

Lysosomes fuse with internal endocytotic vesicles

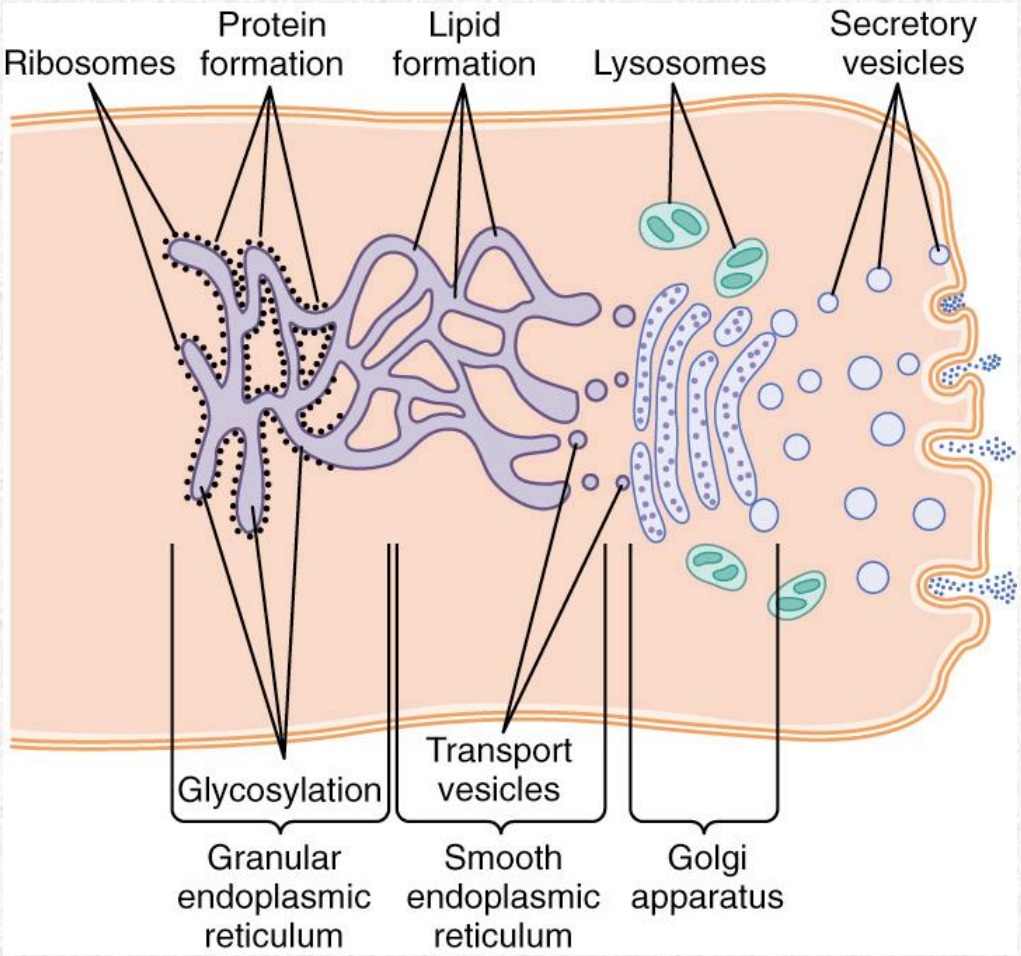
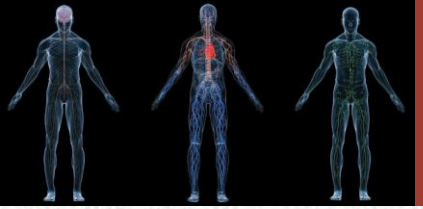


Figure 2-13



Secretion:

- **Secretory vesicles** containing proteins synthesized in the RER bud from the Golgi apparatus

- Fuse with plasma membrane to release contents
  - constitutive secretion – happens randomly
  - stimulated secretion – requires trigger

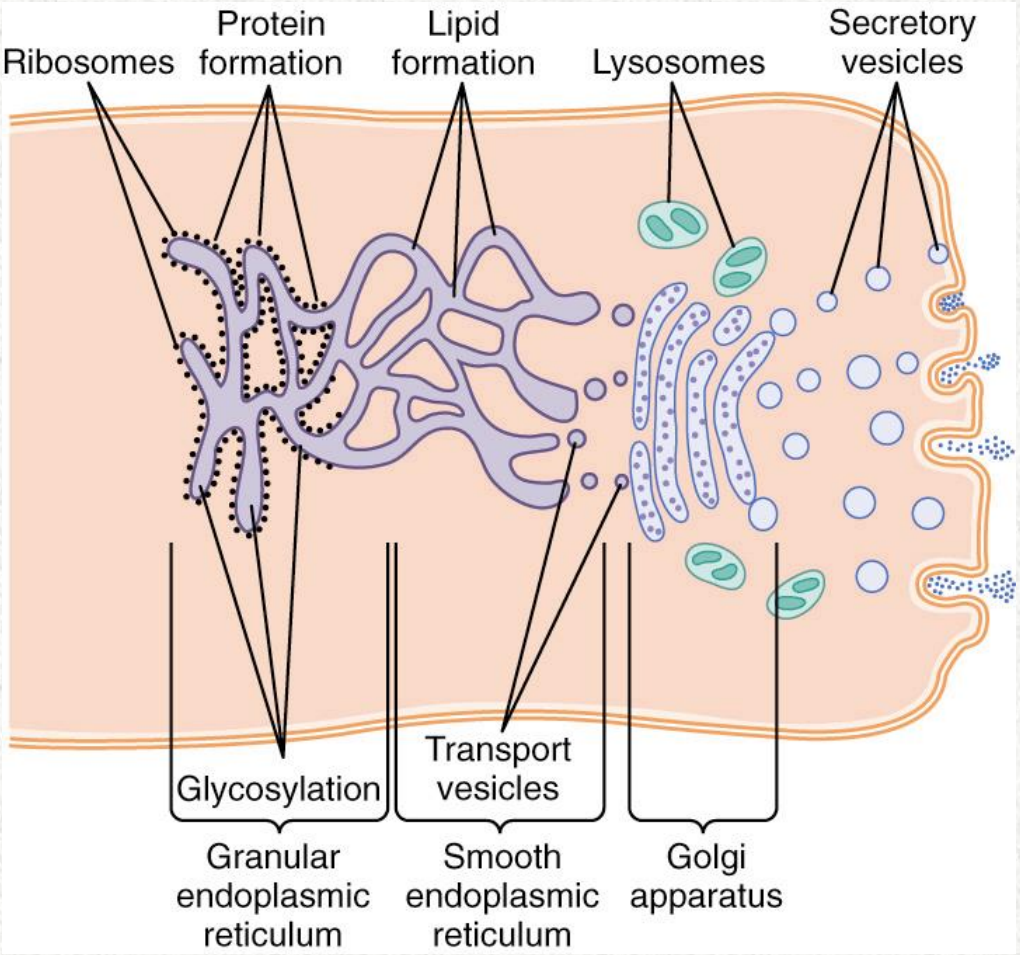
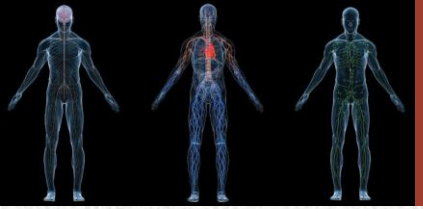
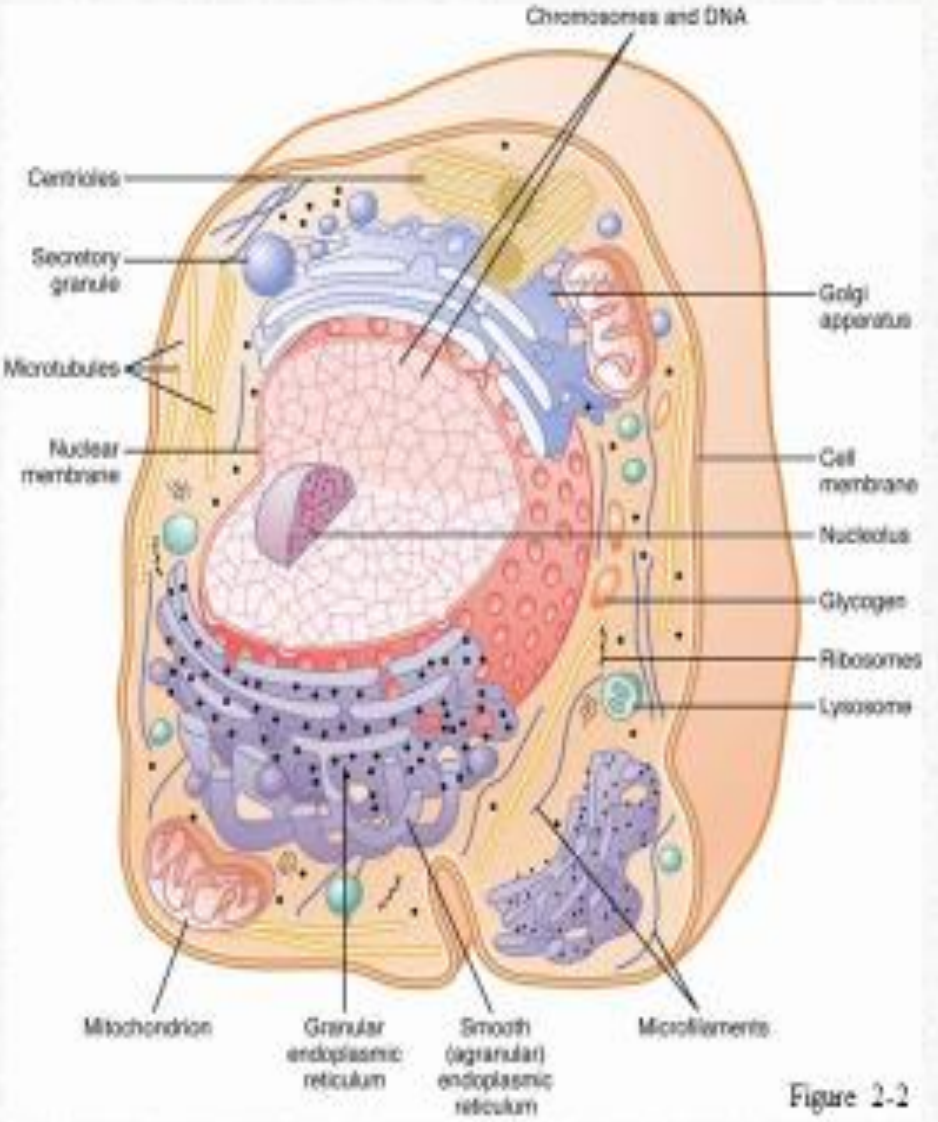


Figure 2-13



RIBOSOME

- Spherical particles
- Present in cytosol in free form or in bound form attached with ER
- Function - Protein synthesis



Lysosomes:

- Vesicular organelle formed from budding Golgi

- Contain hydrolytic enzymes (acid hydrolases)
  - phosphatases
  - nucleases
  - proteases
  - lipid-degrading enzymes
  - lysozymes digest bacteria

- Fuse with pinocytotic or phagocytotic vesicles to form digestive vesicles

•1ry lysosomes – storage vacuoles
•2ry lysosomes – autophagic vacuoles, worn out cell component
•Residual bodies- indigestible material

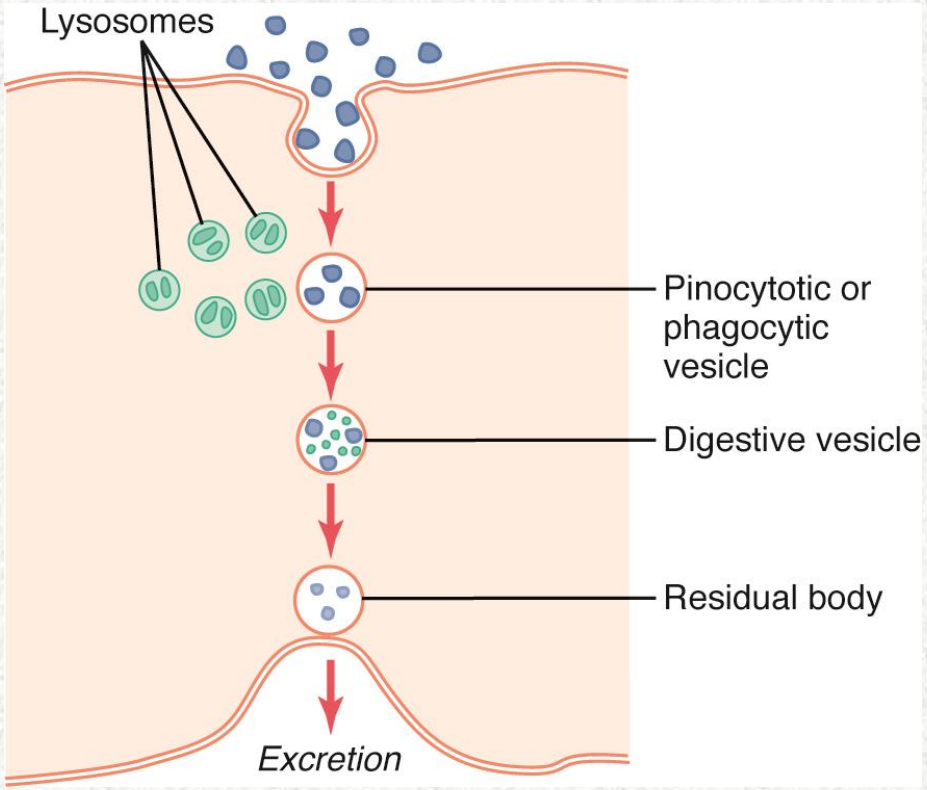
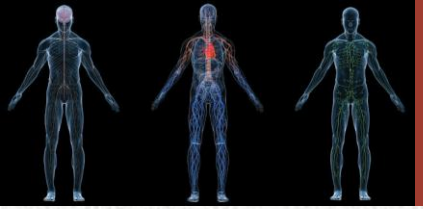


Figure 2-12



Lysosomal Storage Diseases

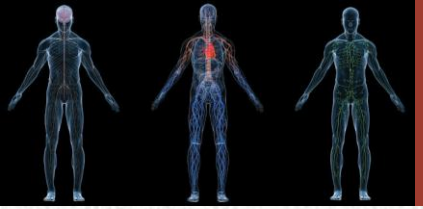
Absence of one or more hydrolases

- not synthesized
- inactive
- not properly sorted and packaged

Result: Lysosomes become engorged with undigested substrate

Examples:

- Acid lipase A deficiency
- I-cell disease (non-specific)
- Tay-Sachs disease (HEX A)

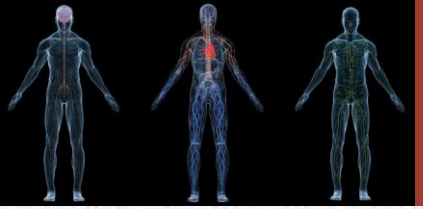


Peroxisomes:

- Similar physically to lysosomes
- Micro bodies
- Single layer of unit membrane

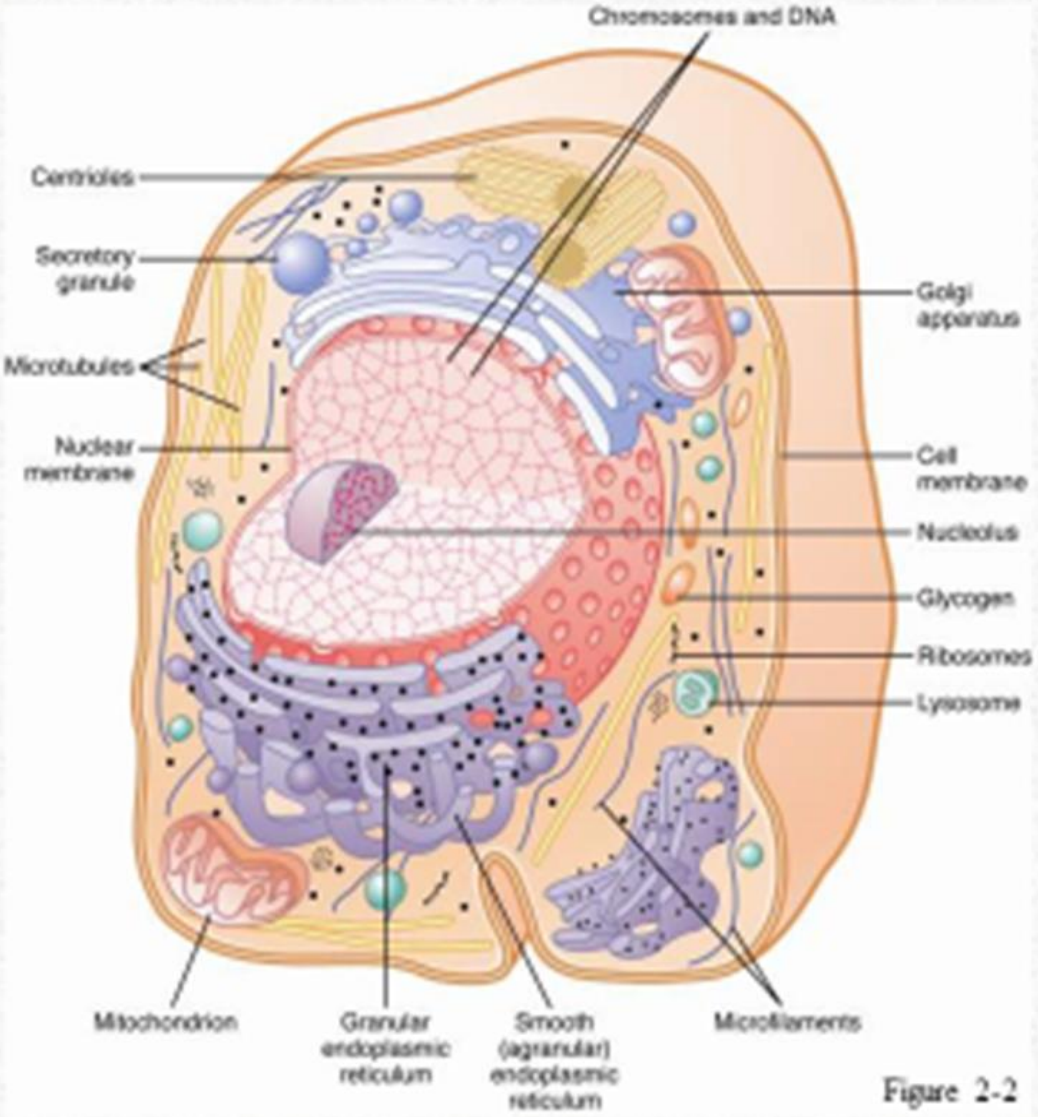
- Two major differences:
  - formed by self-replication
  - they contain oxidases, catalyses

Function: oxidize substances (e.g. alcohol) that may be otherwise poisonous



Centrosomes:

- 2 short cylindrical structure
- Function: Movement of chromosomes



Secretory Granules

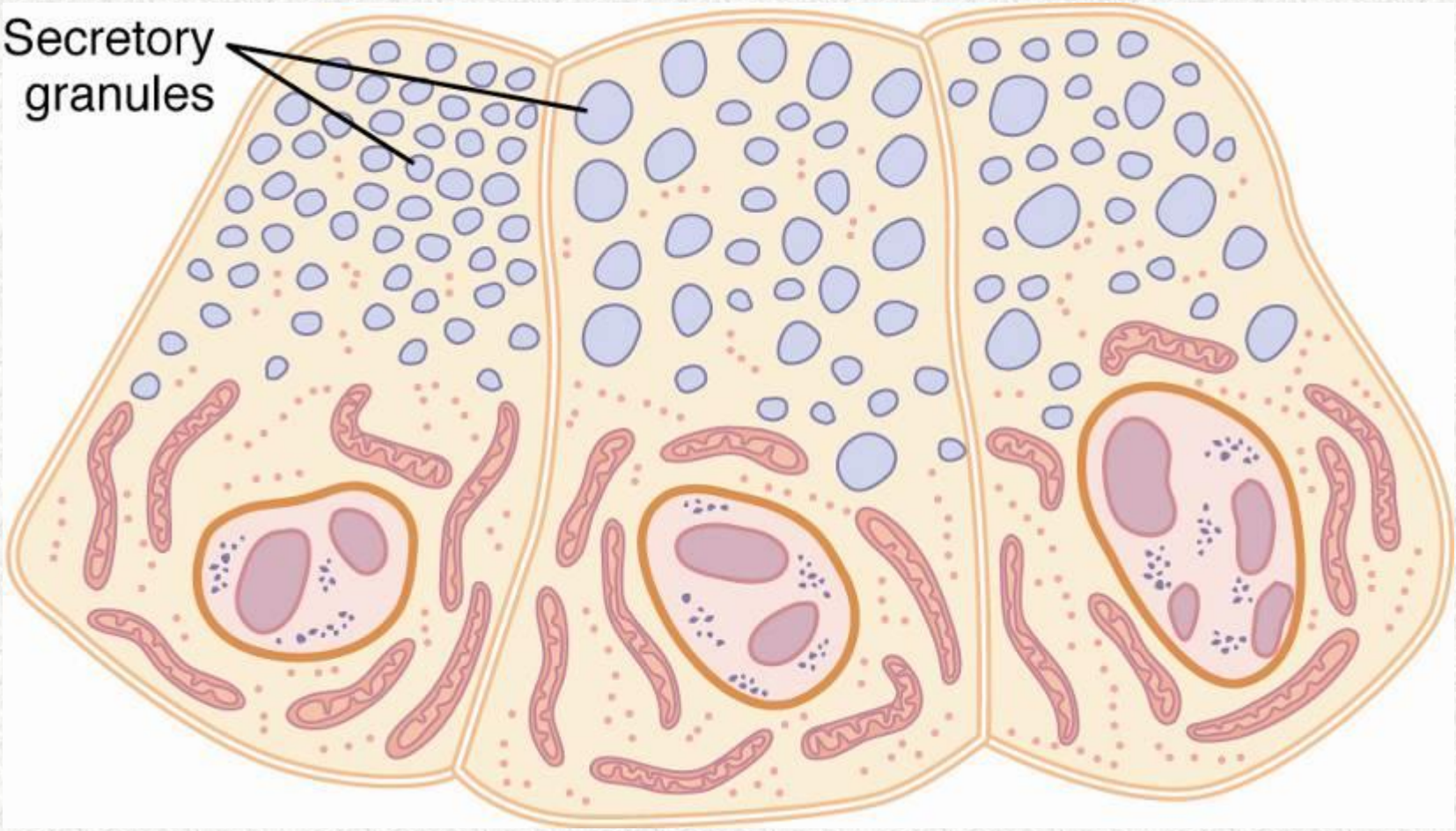


Figure 2-6