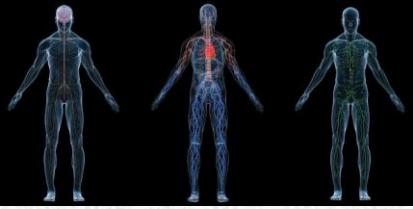


- Cell morphology
- Cell organelles – structure and function

Chapter 1:

Dr. Charushila Rukadikar

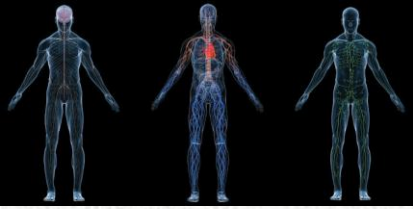
**Assistant Professor
Department Of Physiology
ZMCH, Dahod**



Physiology

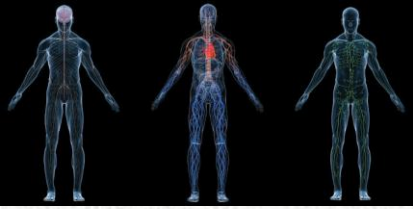
The science that is concerned with the function of the living organism and its parts, and of the physical and chemical processes involved.

- Human Physiology



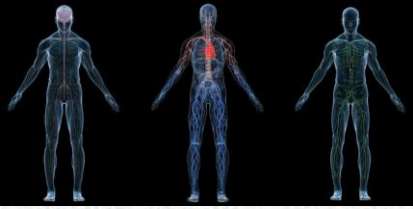
Pathophysiology

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



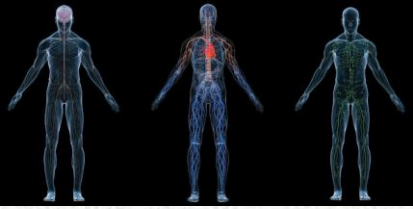
The Human Body - A Complex Society of Differentiated Cells

- **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

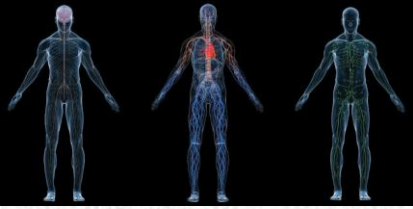
- Exists at all levels of organization
- **Cells:** e.g. genes, operons, repressor proteins, transcription factors, membrane transport
- **Tissues:** e.g. autacoids, paracrines
- **Organ systems:** e.g. nervous and endocrine systems



Homeostasis

**The maintenance of a stable
“milieu interieur”**

Claude Bernard (1813 - 1878)



General Organization of the Circulatory System

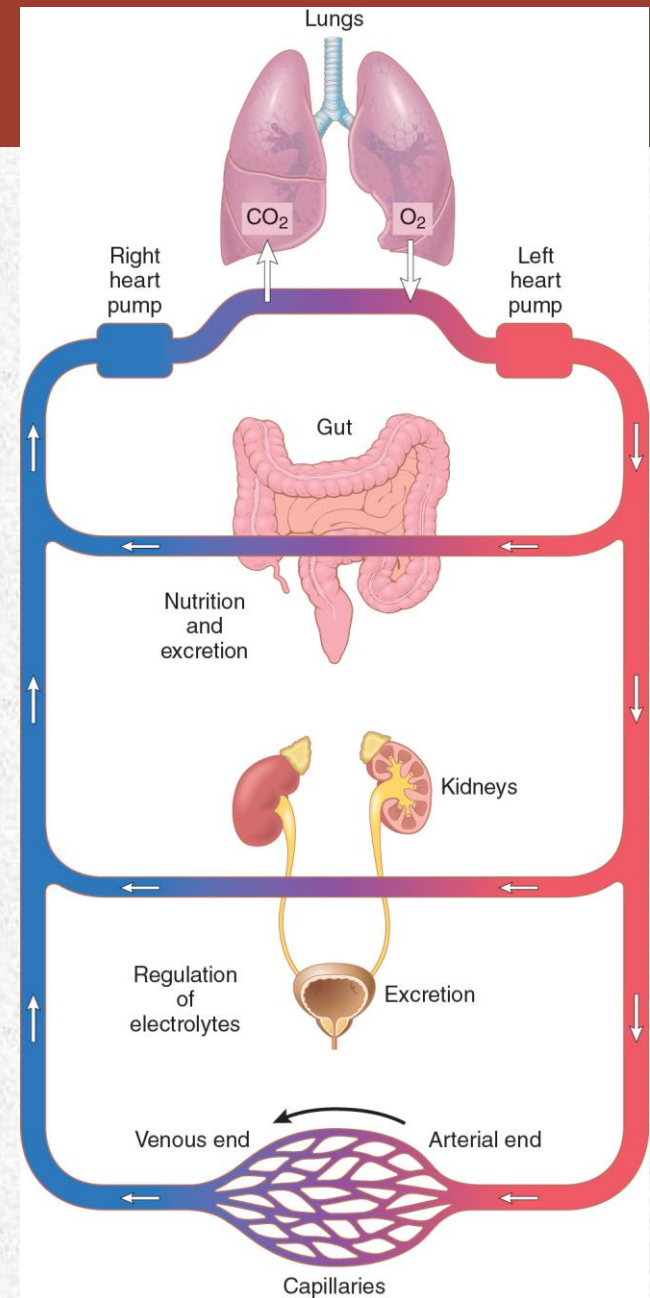
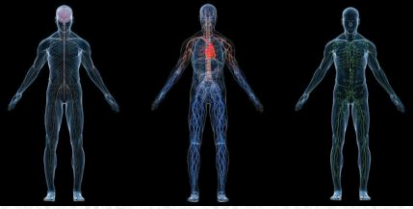


Figure 1-1



Organization of the Cell

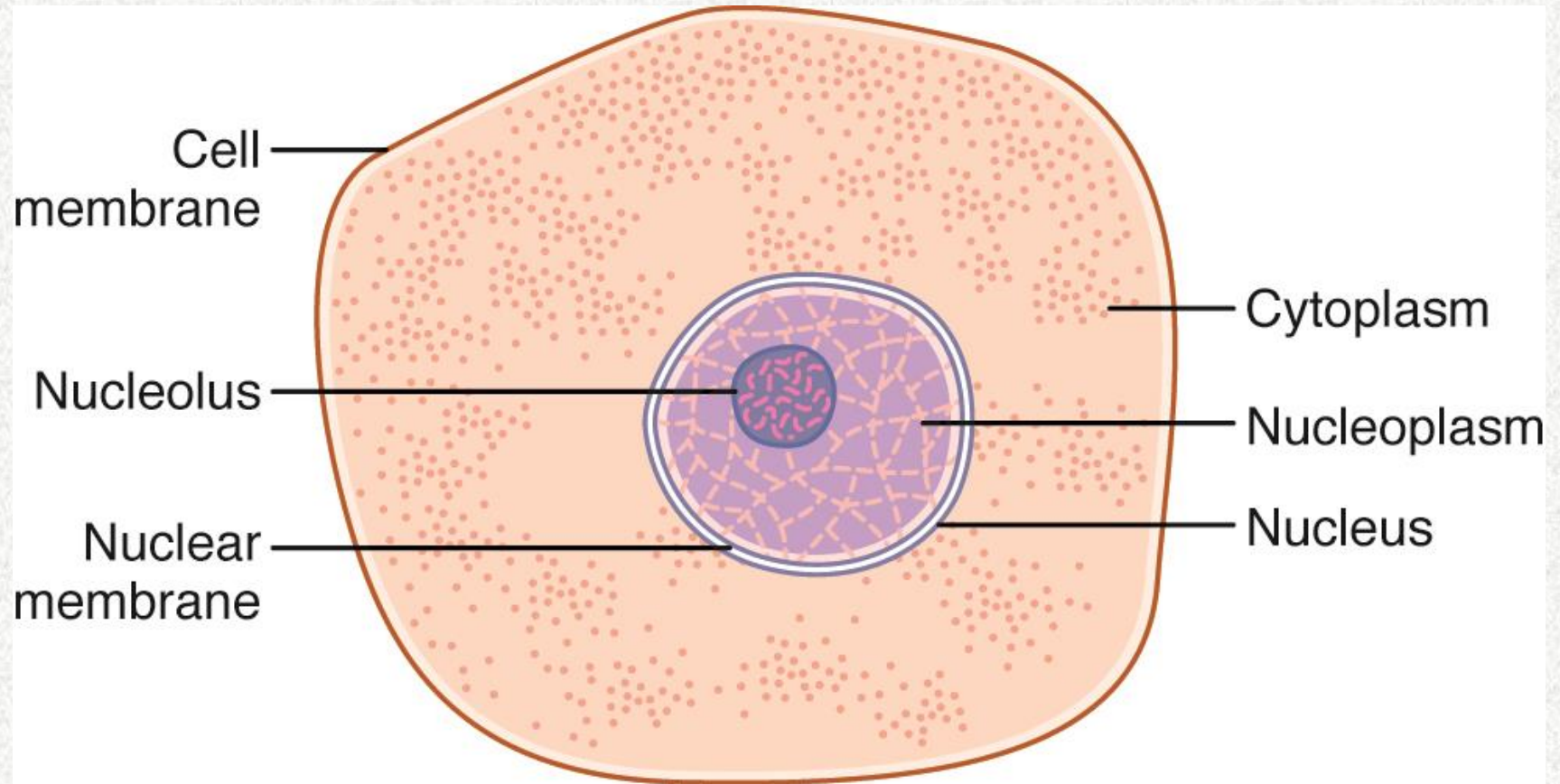
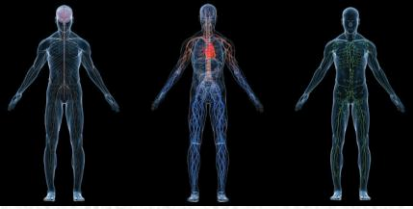
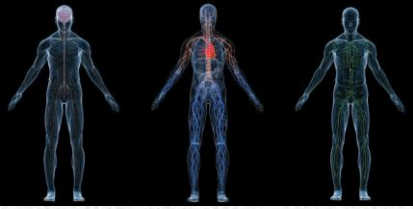


Figure 2-1



Cell Composition

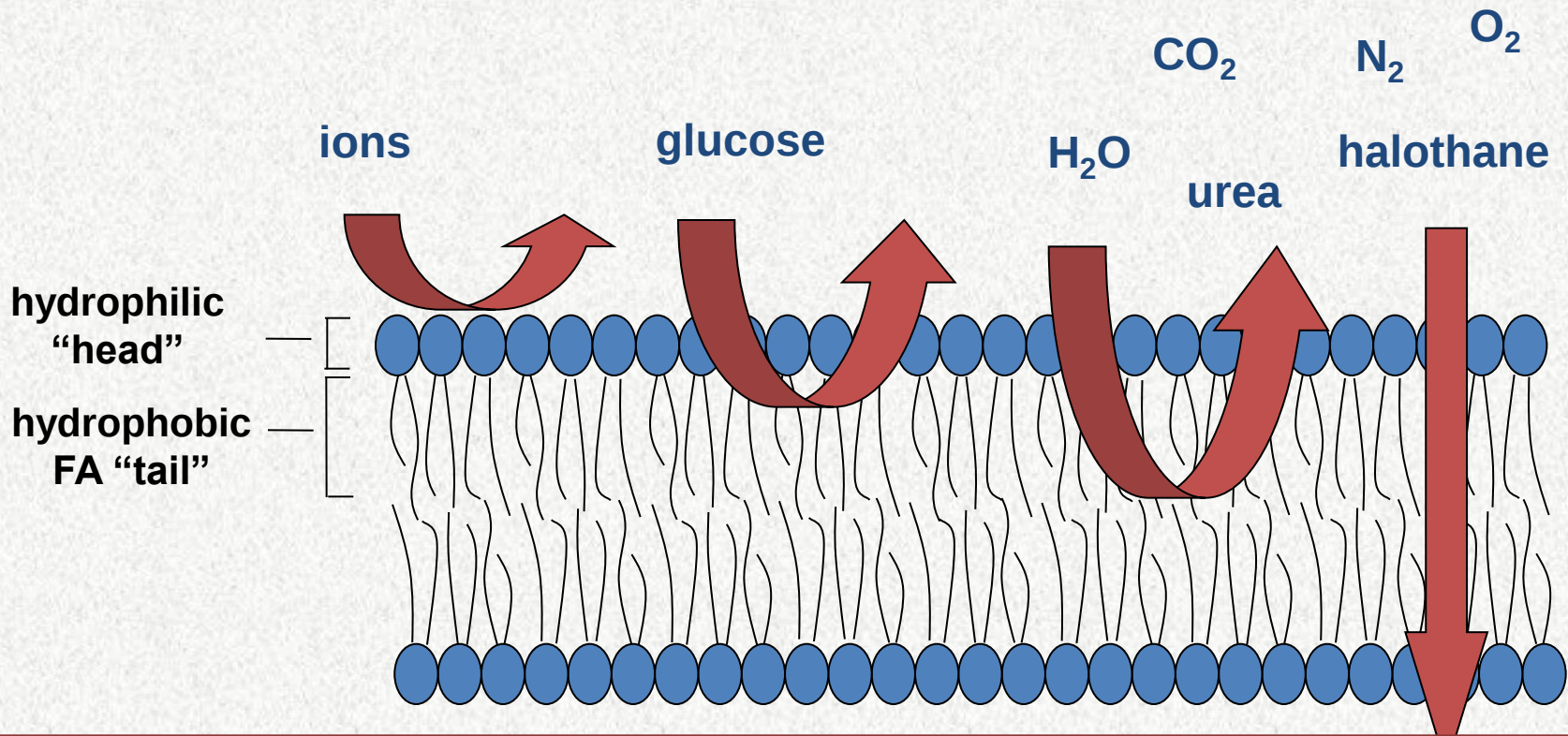
Water	...70-85% of cell mass
Ions	
Proteins	...10-20%
Lipids	...2-95%
Carbohydrates	...1-6%

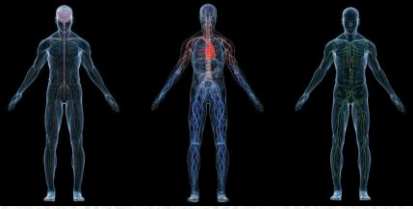


Membrane Components:

LIPIDS:

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





Cell Membrane: Bilayer of Phospholipids with Proteins

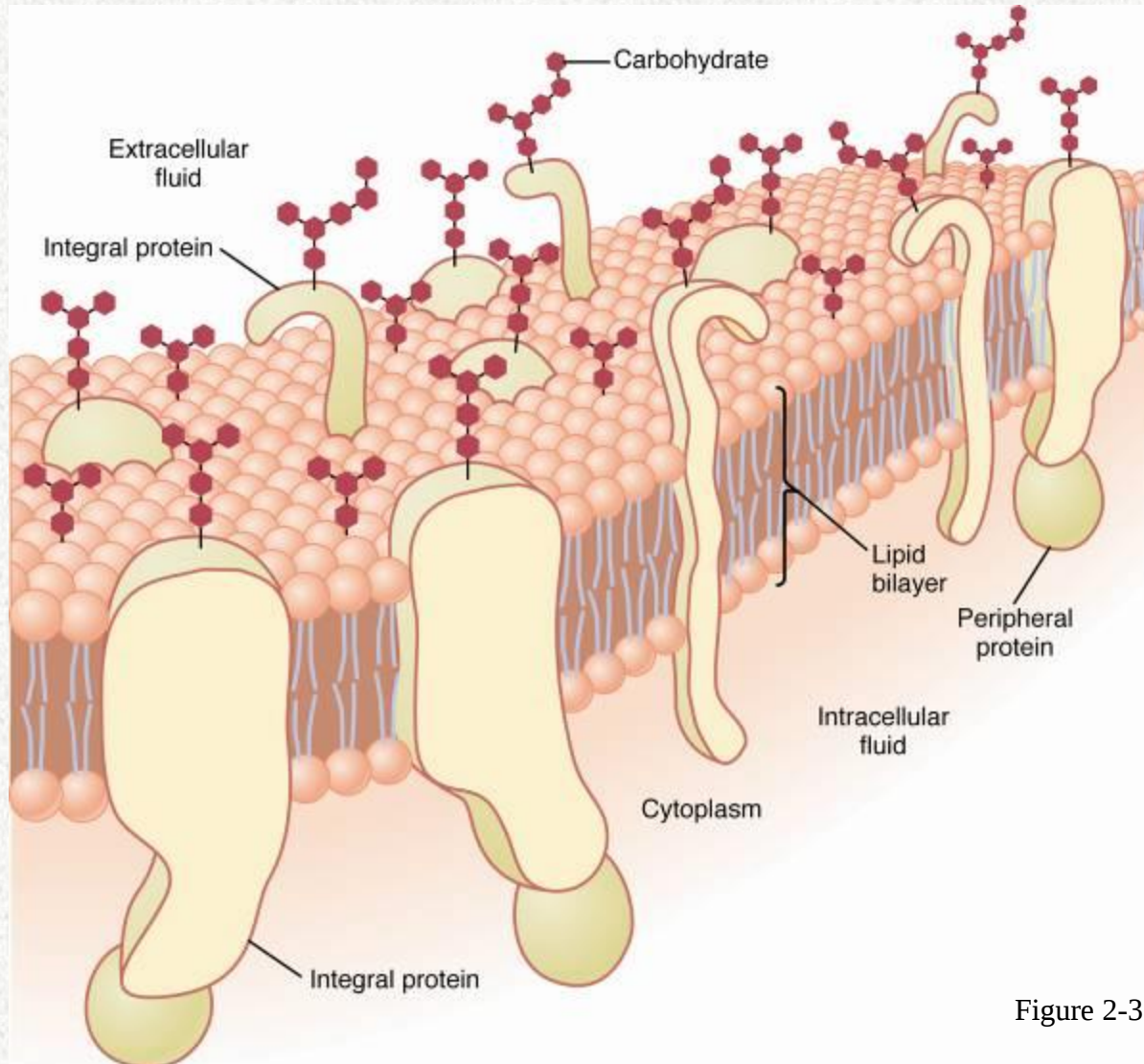
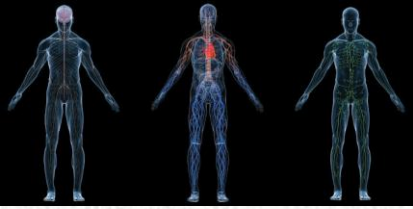
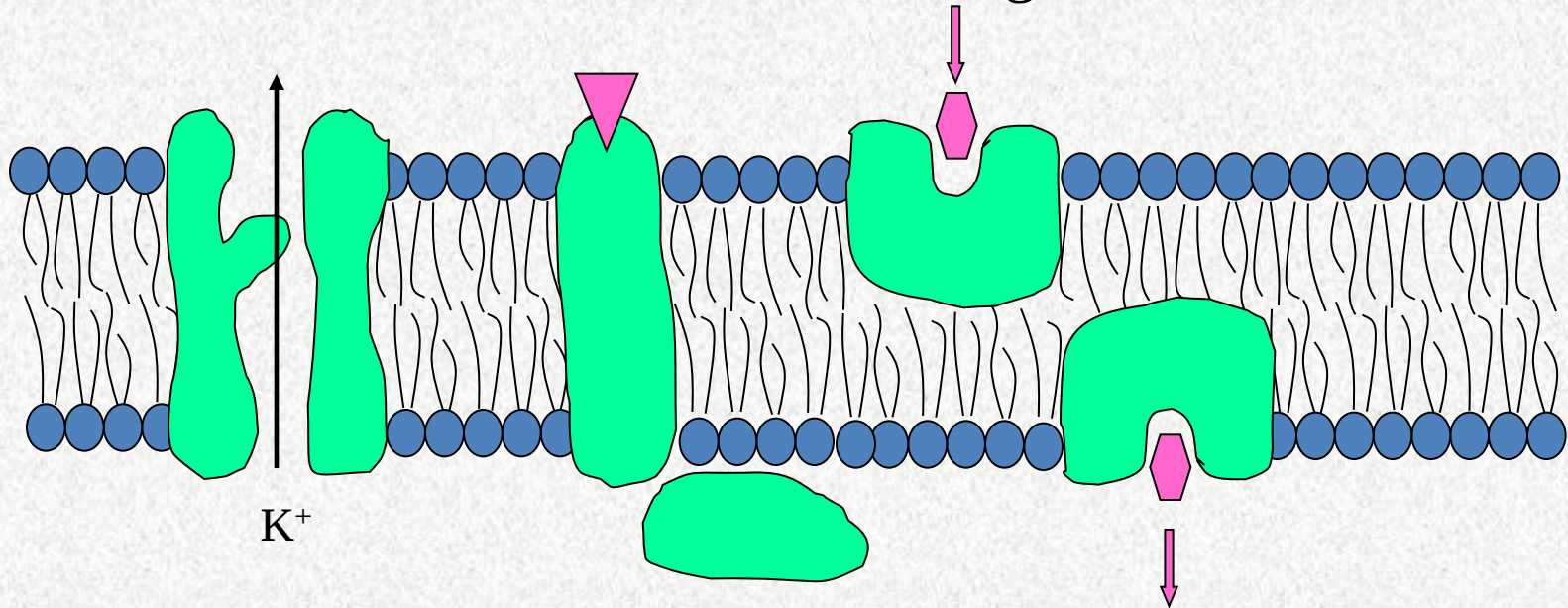


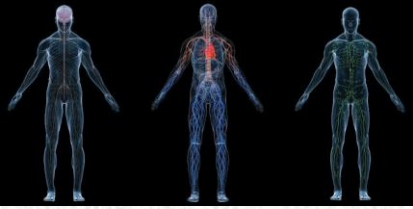
Figure 2-3



Proteins:

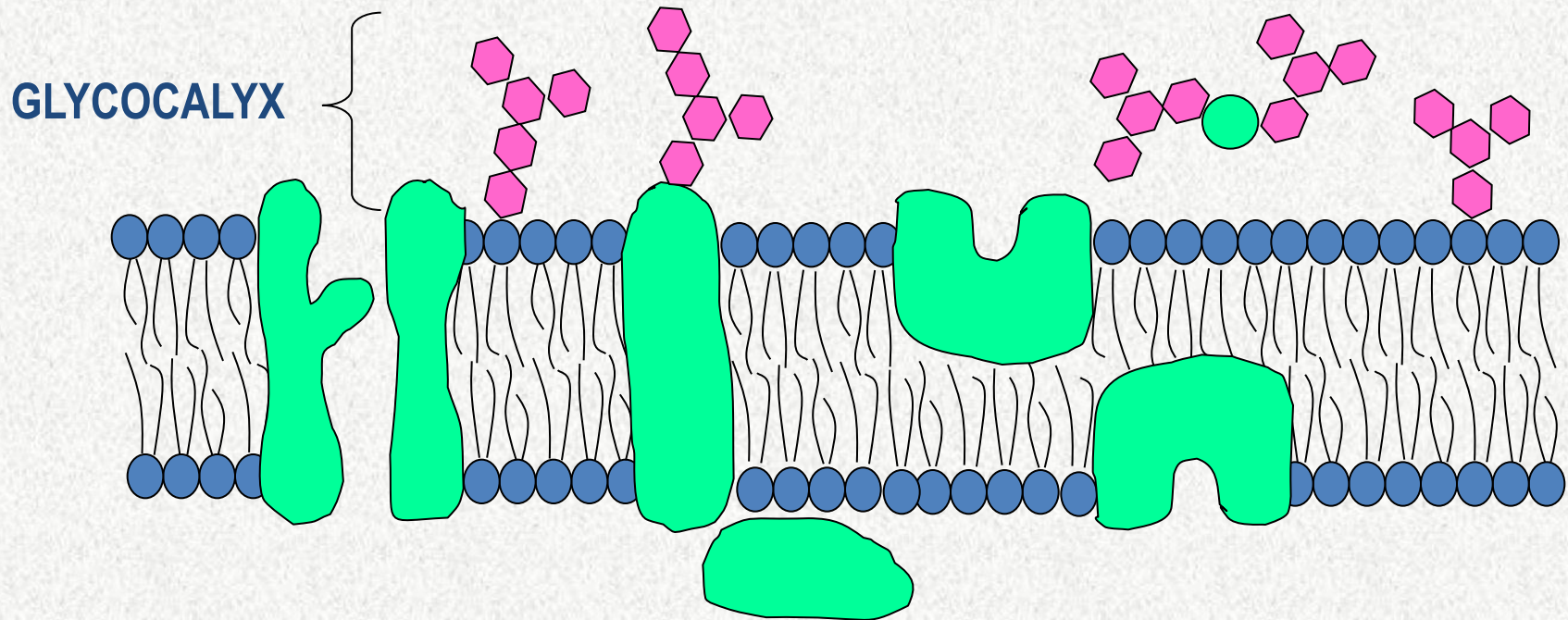
- Provide “specificity” to a membrane
- Defined by mode of association with the lipid bilayer
 - A. Integral: channels, receptor, antigen, pump, pores, carriers, enzymes
 - B. Peripheral:
 - a) Intinsic – inside surface of lipid layer - enzymes
 - b) Extrinsic – outer surface - intracellular signal mediators

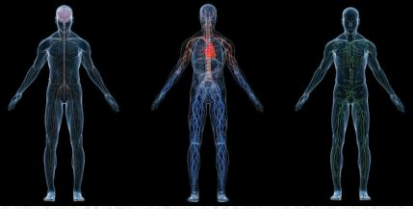




Carbohydrates:

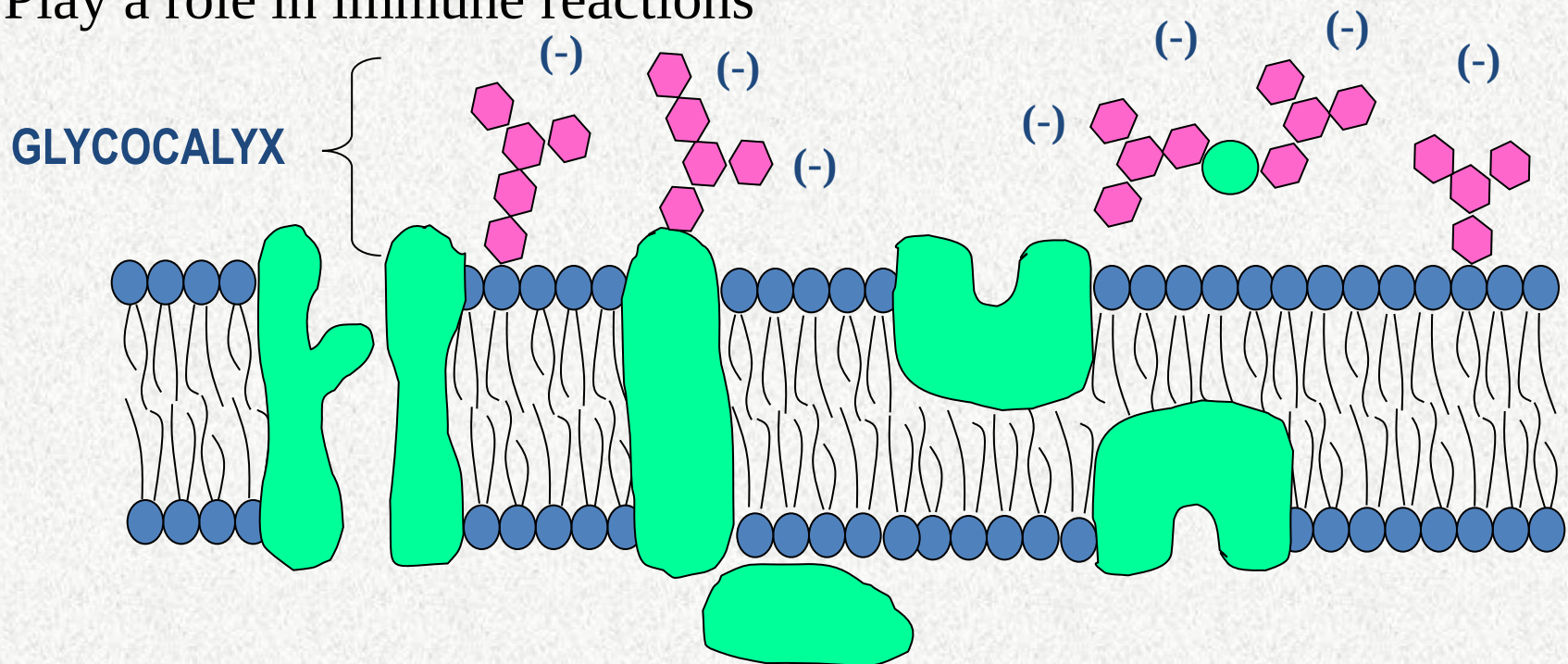
- **Glycolipids (approx. 5 - 10%)**
- **Glycoproteins (majority of integral proteins)**
- **Proteoglycans**

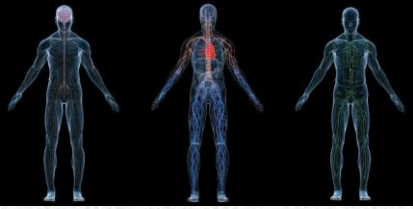




Carbohydrates (Cont.):

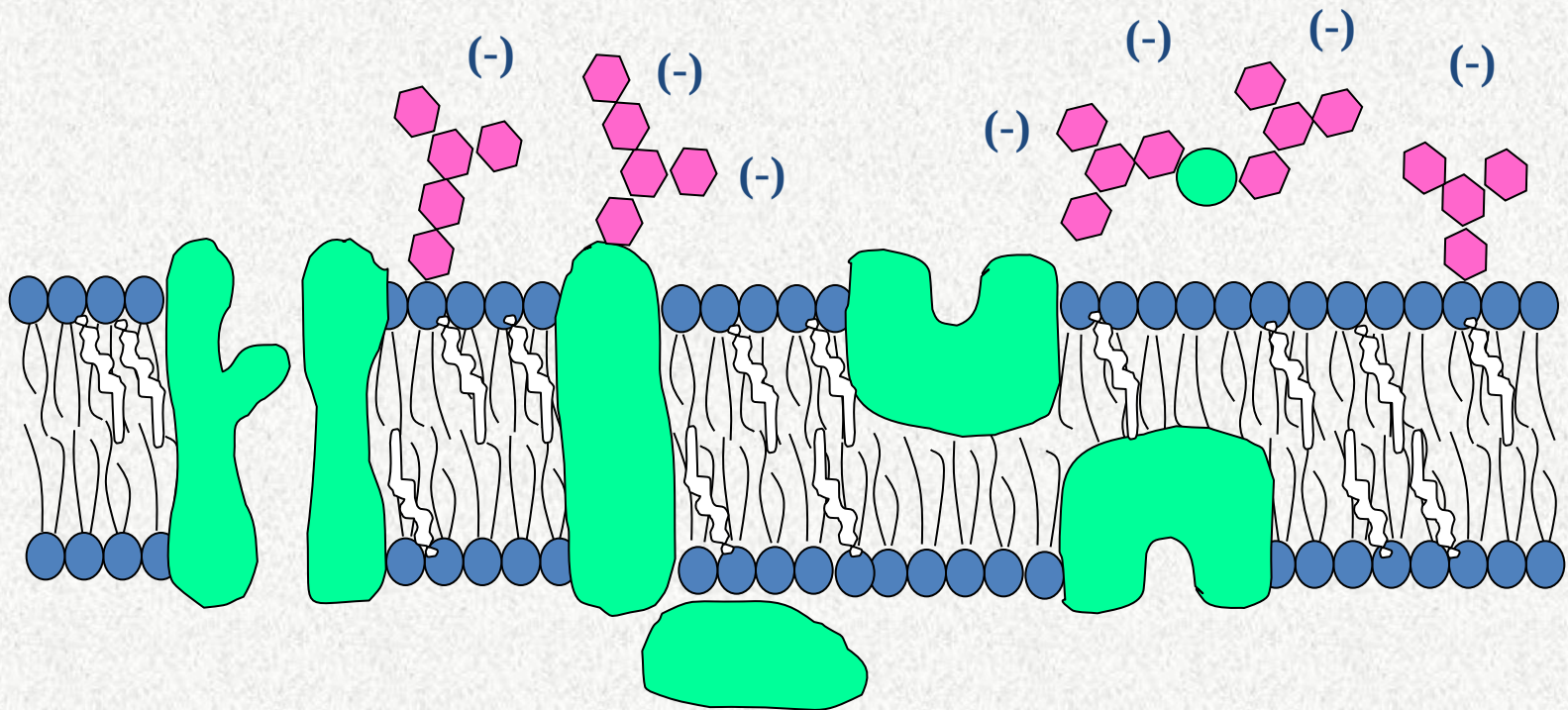
- Negative charge of the carbo chains repels other negative charges
- Involved in cell-cell attachments/interactions
- Tight fixation of cell
- Receptor
- Play a role in immune reactions

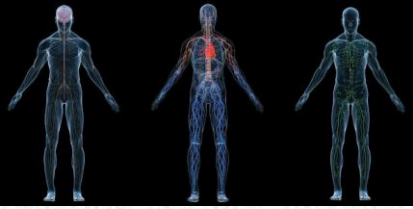




Cholesterol

- 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

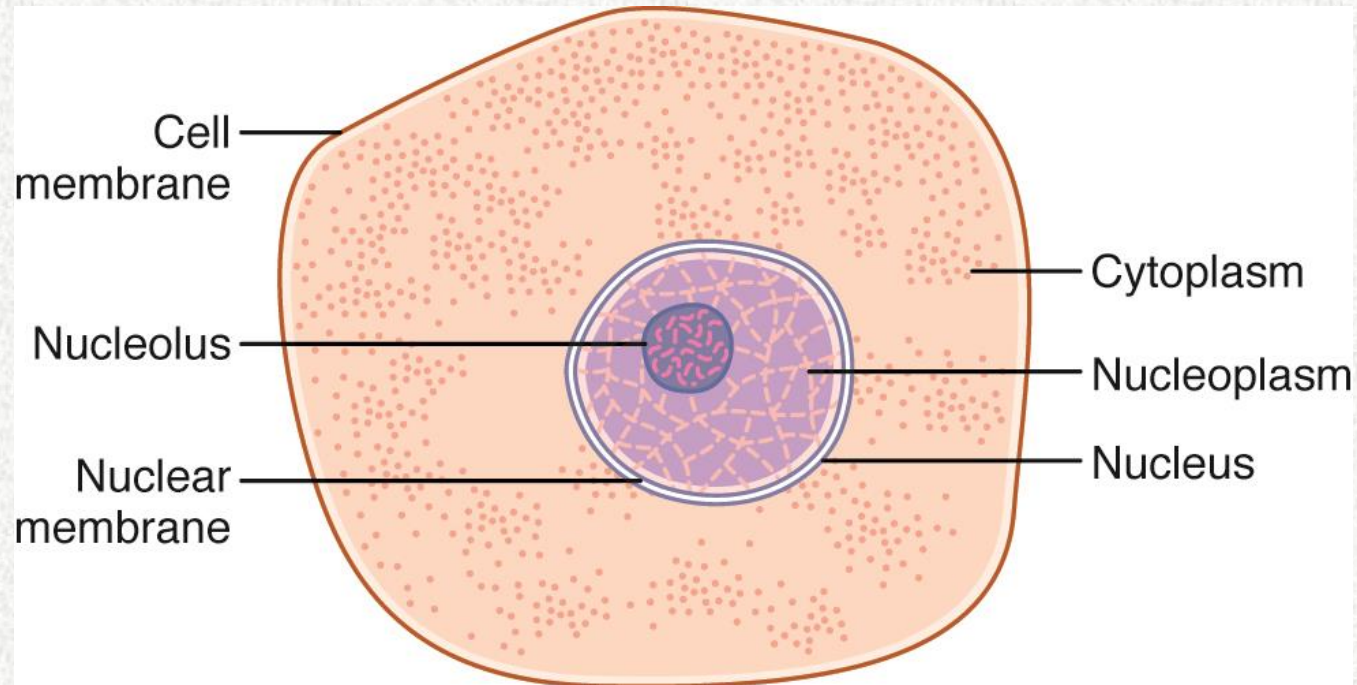
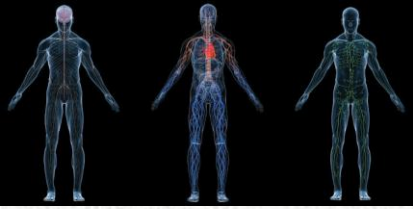
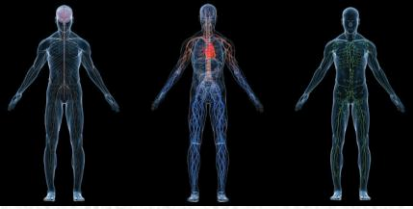


Figure 2-1



Cell Composition

Water	...70-85% of cell mass
Ions	
Proteins	...10-20%
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

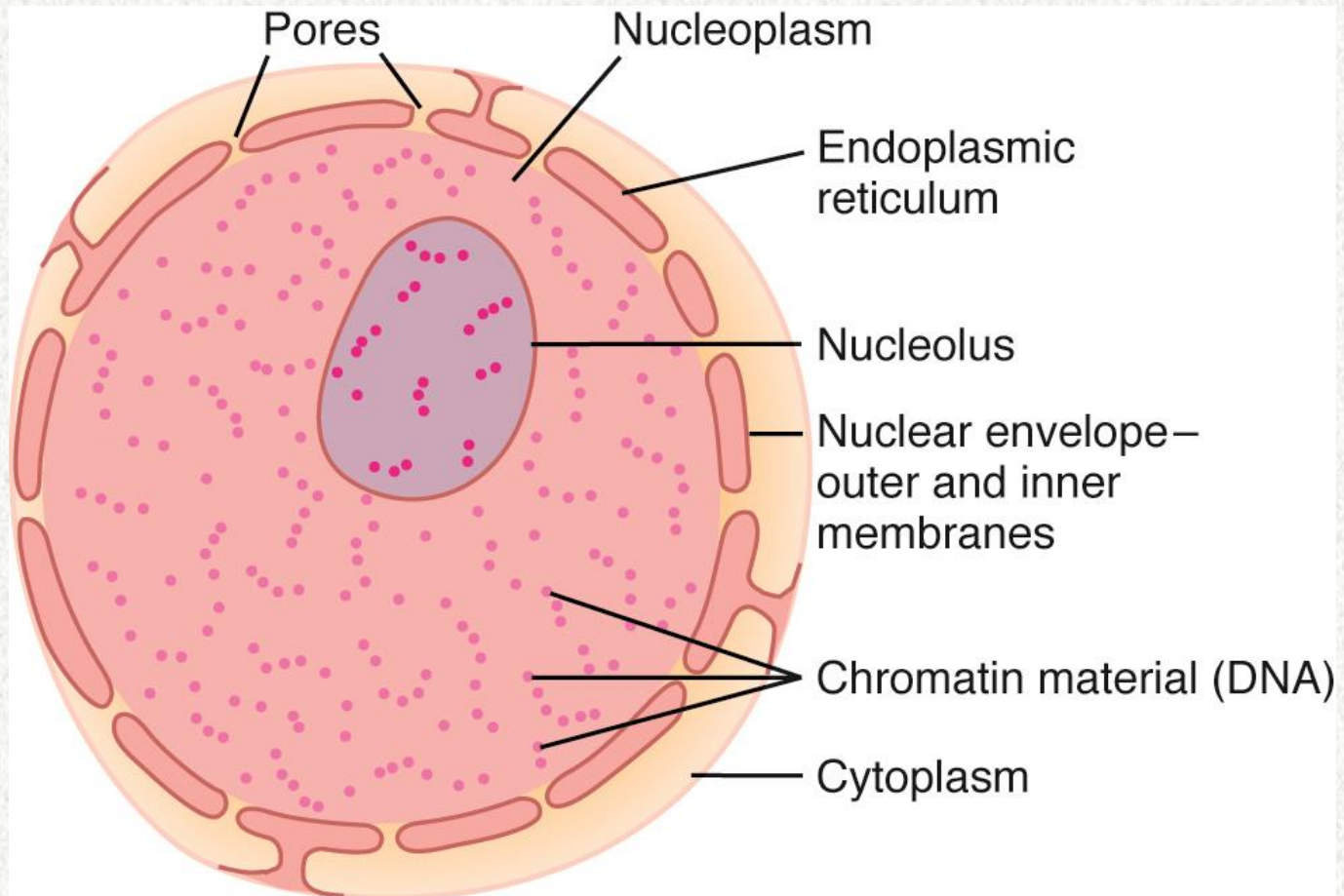
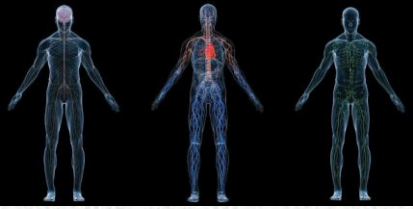


Figure 2-9



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

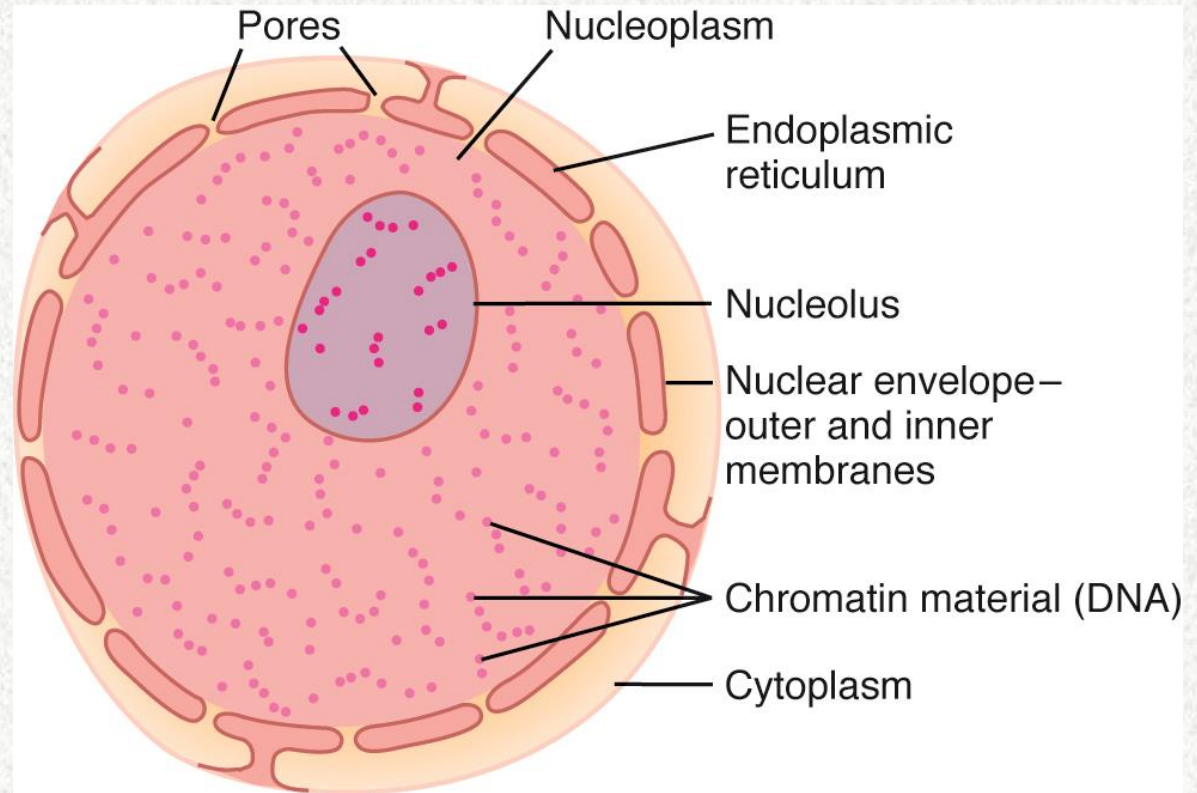
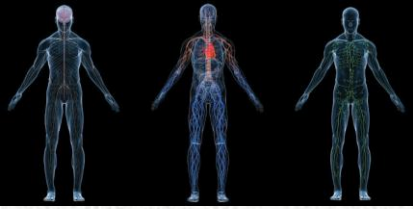


Figure 2-9



Cell Organelles

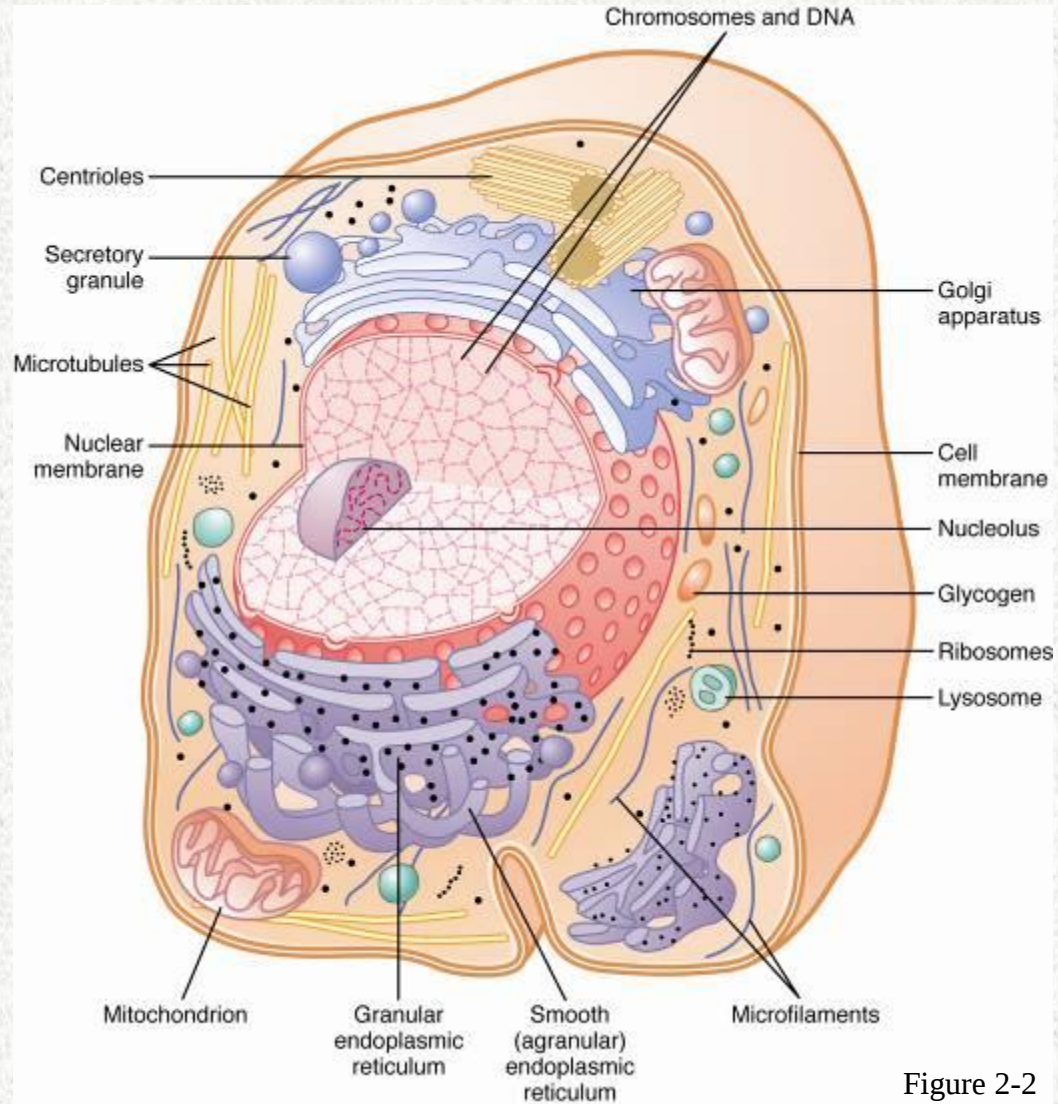
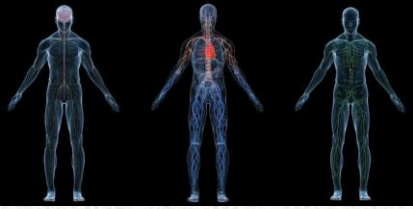


Figure 2-2



Mitochondria:

Primary function:

Extraction of **energy**
from nutrients
Aerobic respiration.

KREB CYCLE.

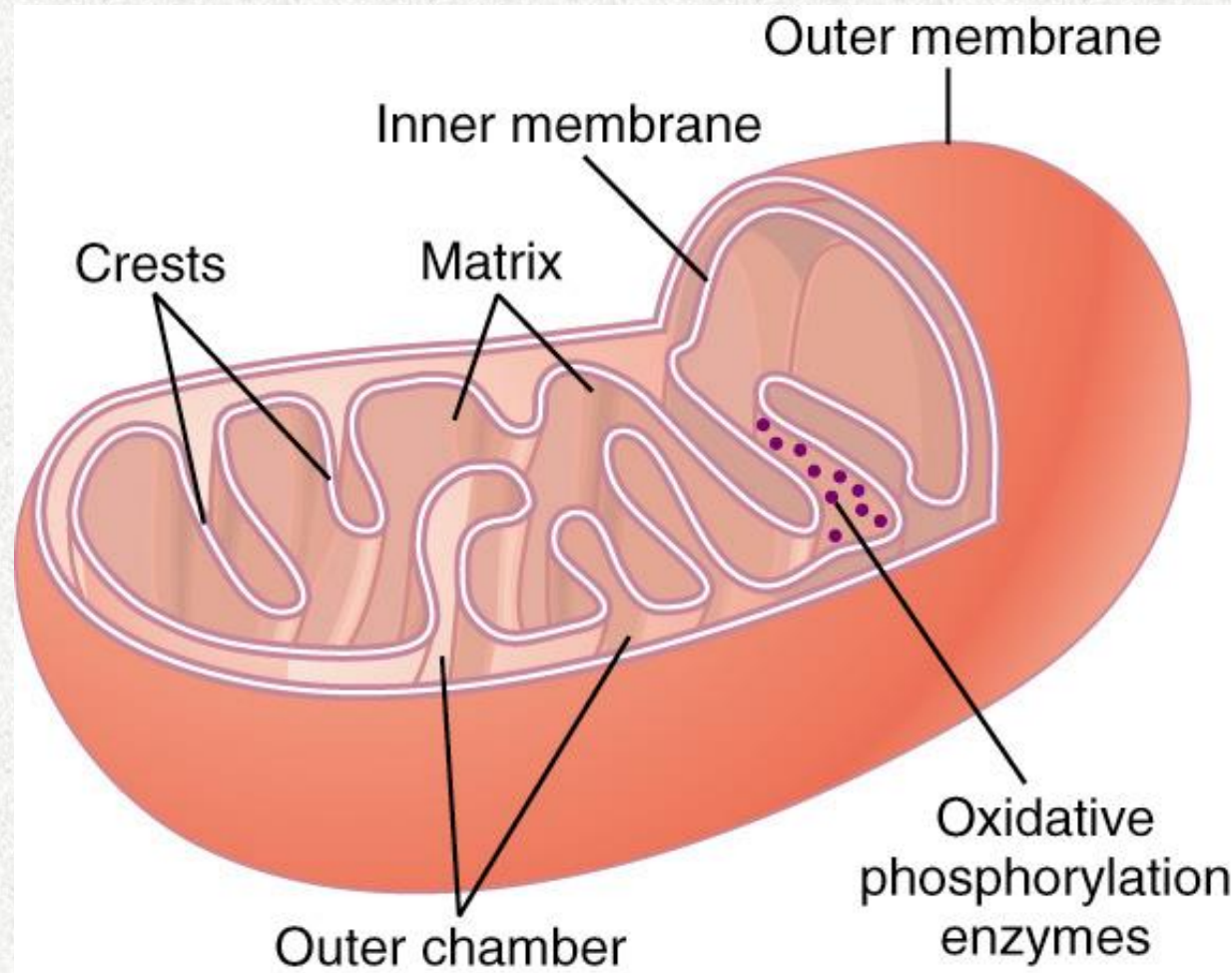
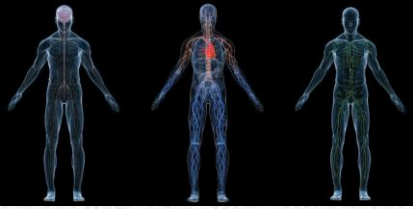


Figure 2-7



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**

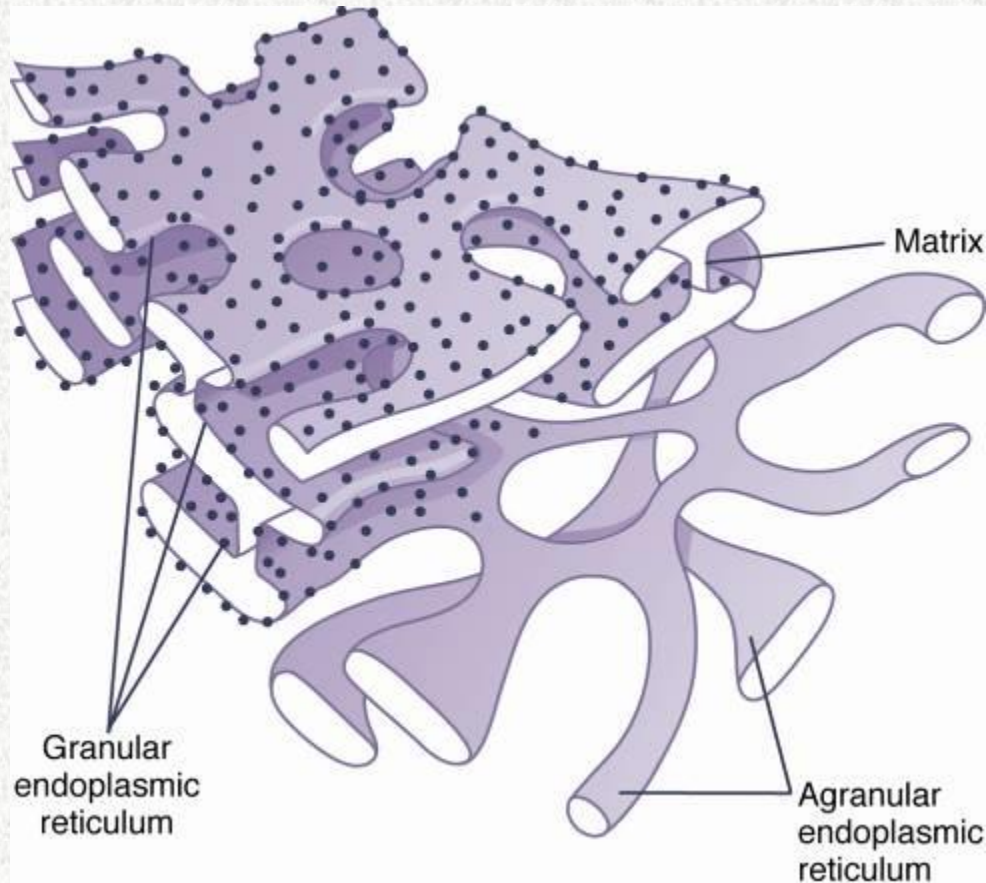
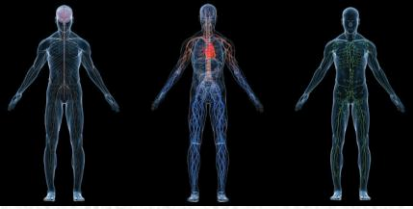


Figure 2-4



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

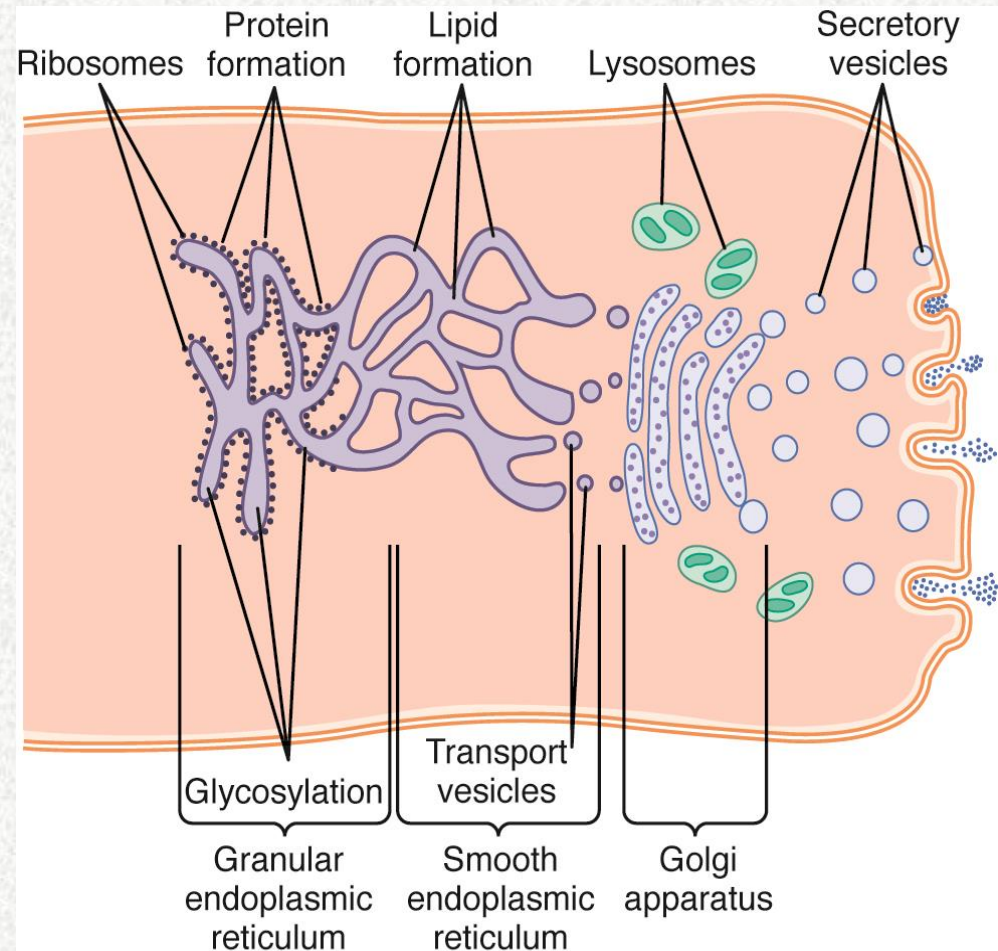
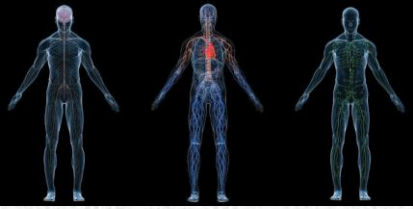


Figure 2-13



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 reticulum – NM & CVS

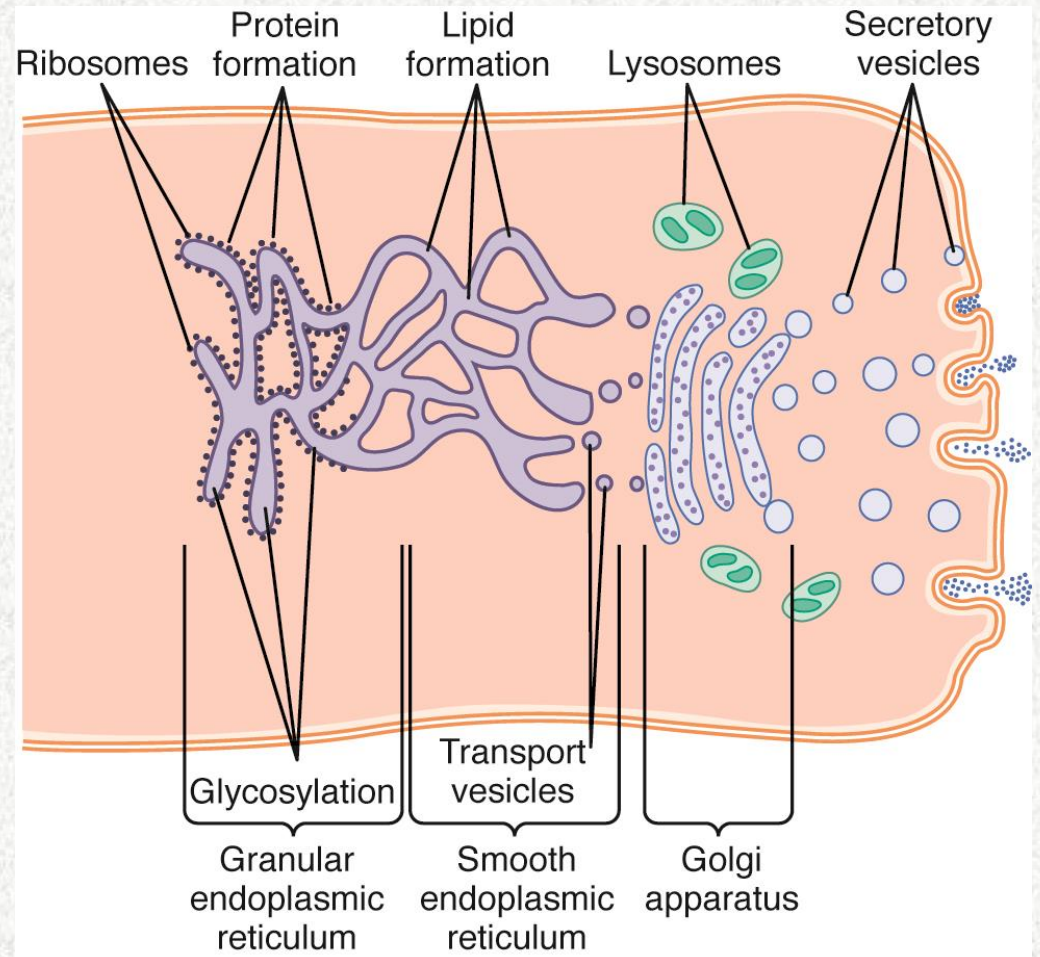
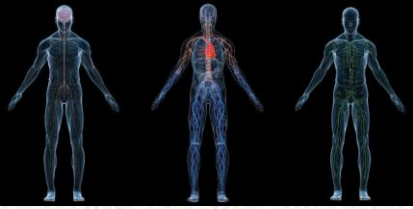


Figure 2-13



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

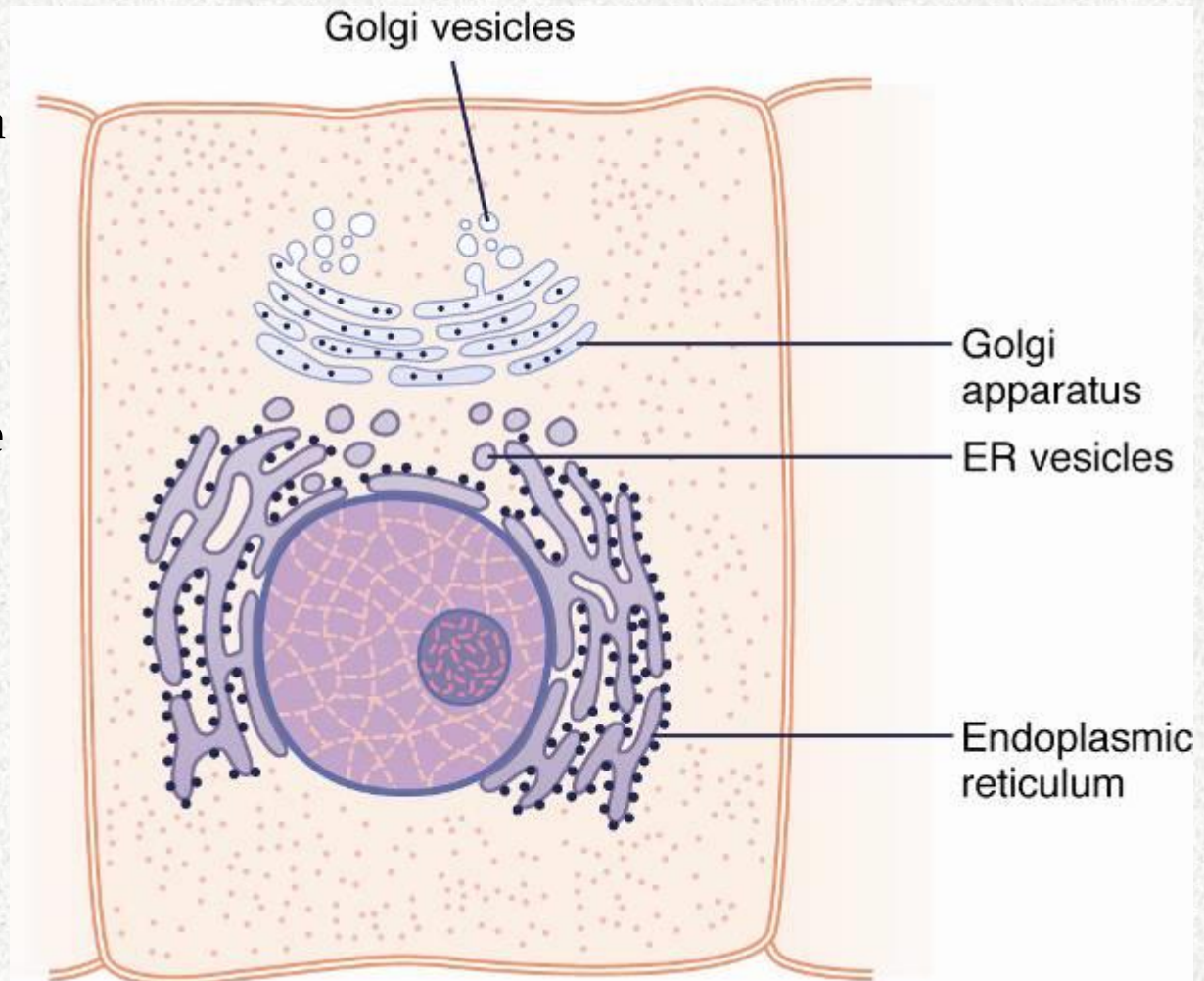
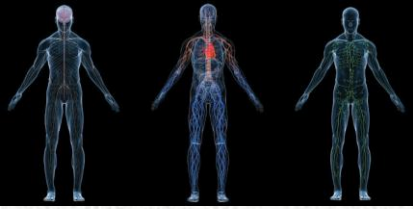


Figure 2-5



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

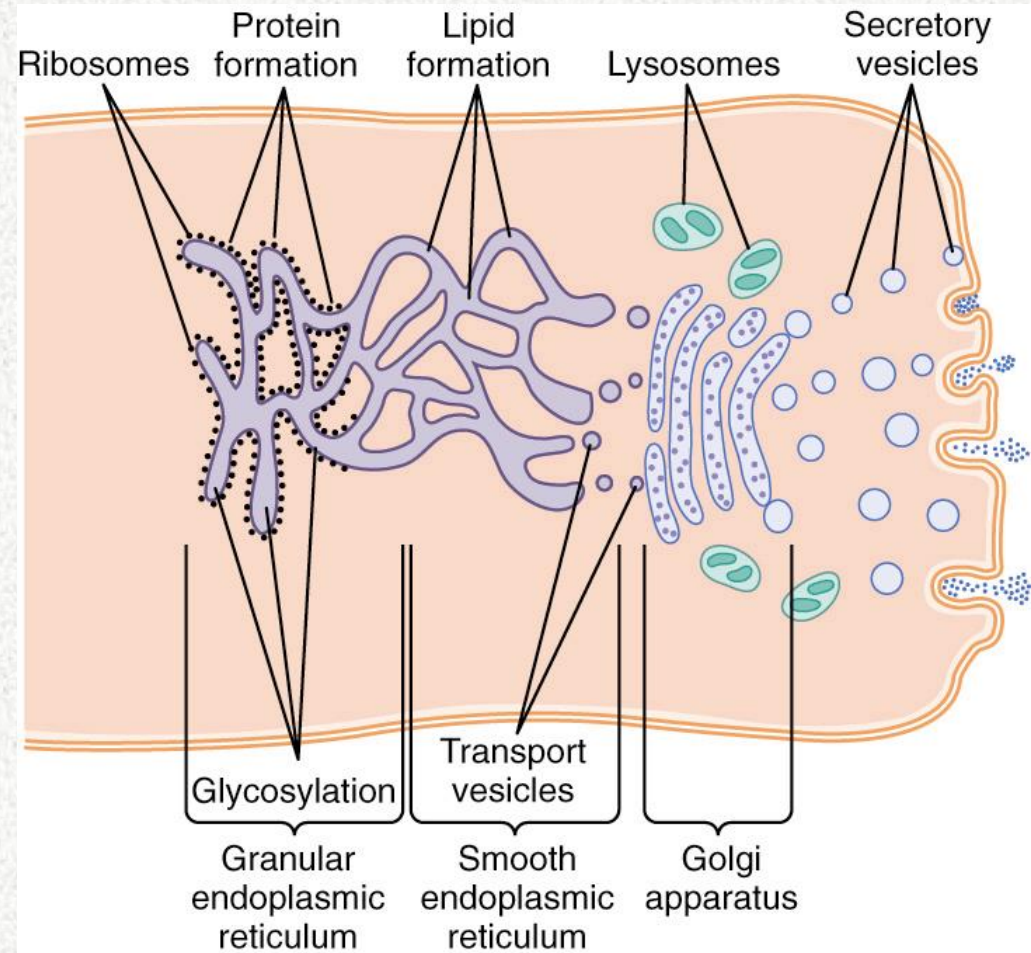
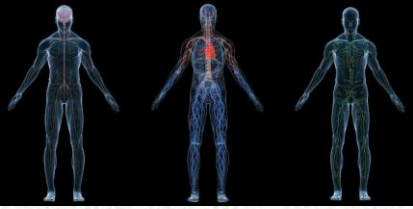


Figure 2-13



Exocytosis:

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

Lysosomes fuse with internal endocytotic vesicles

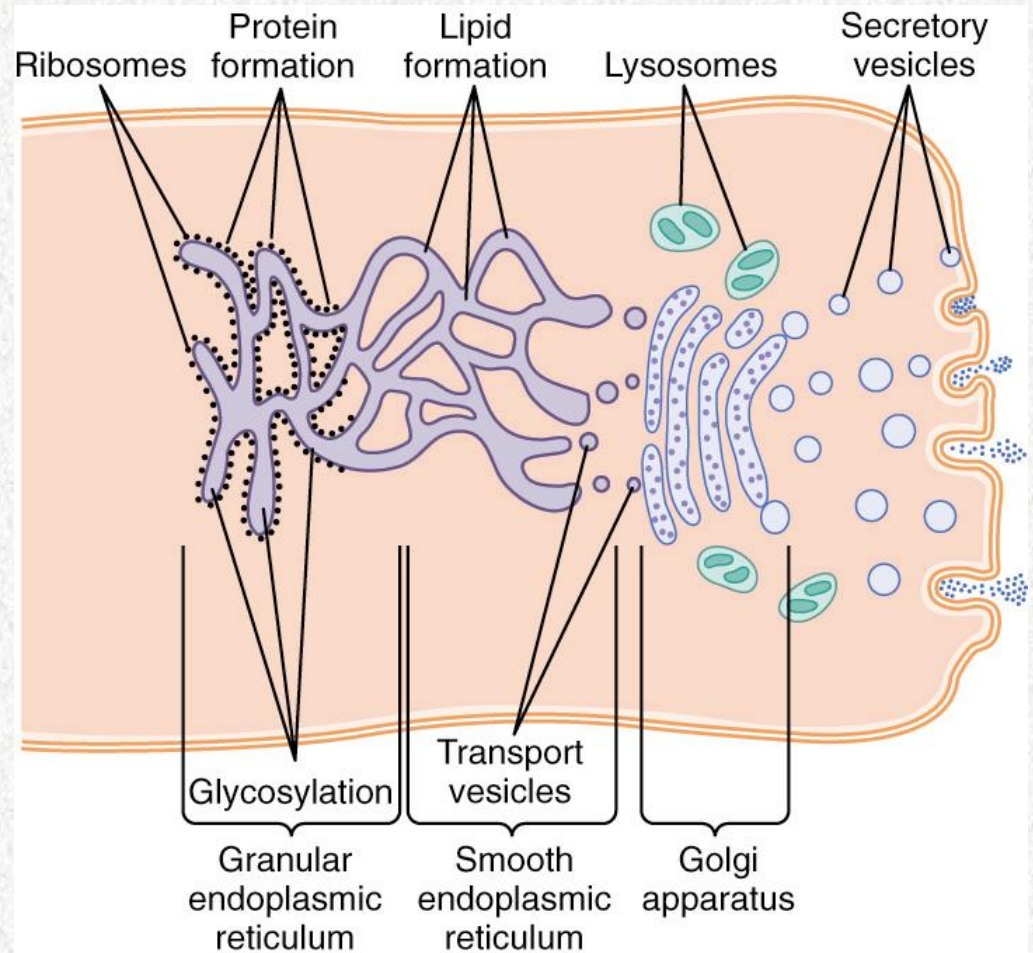
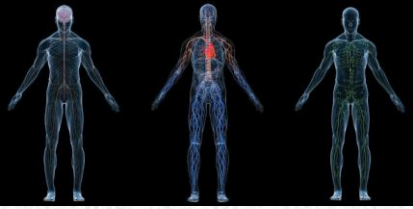


Figure 2-13



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

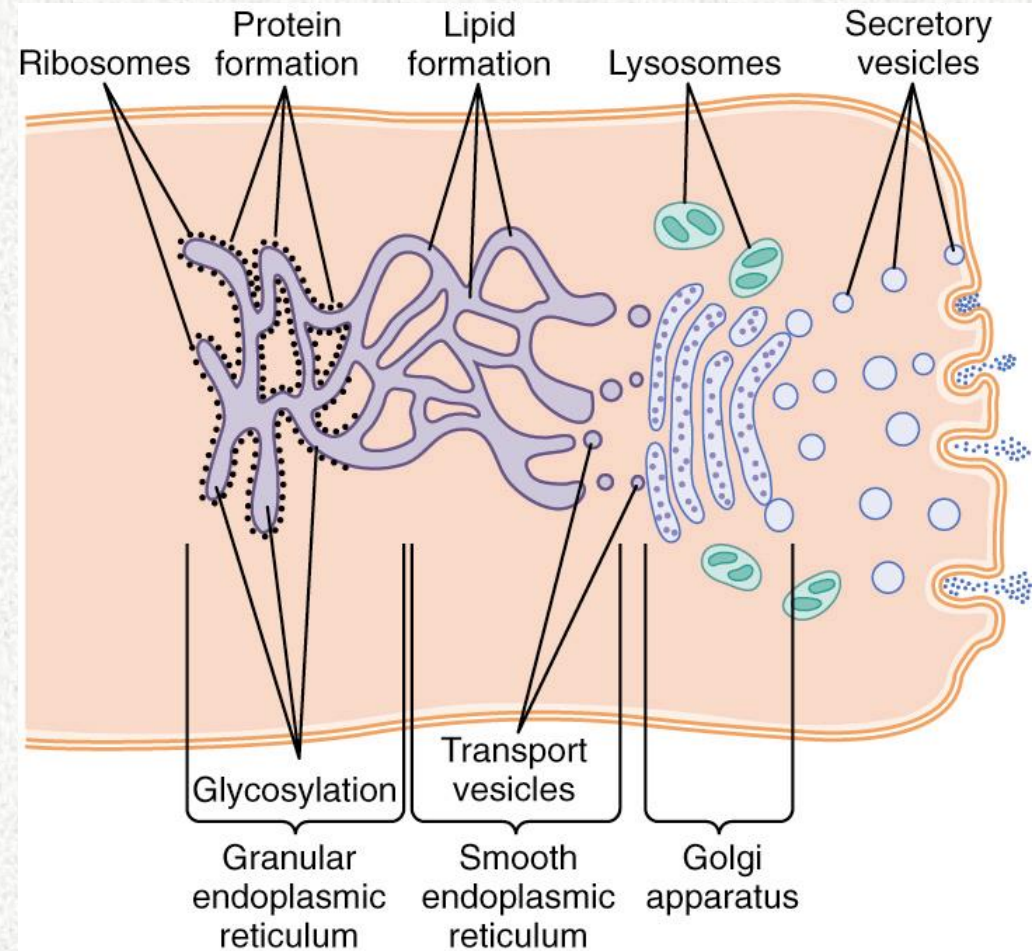
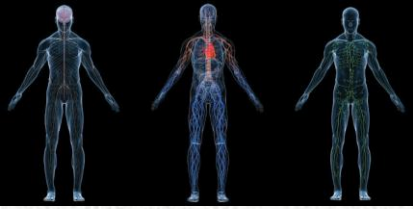


Figure 2-13



RIBOSOME

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

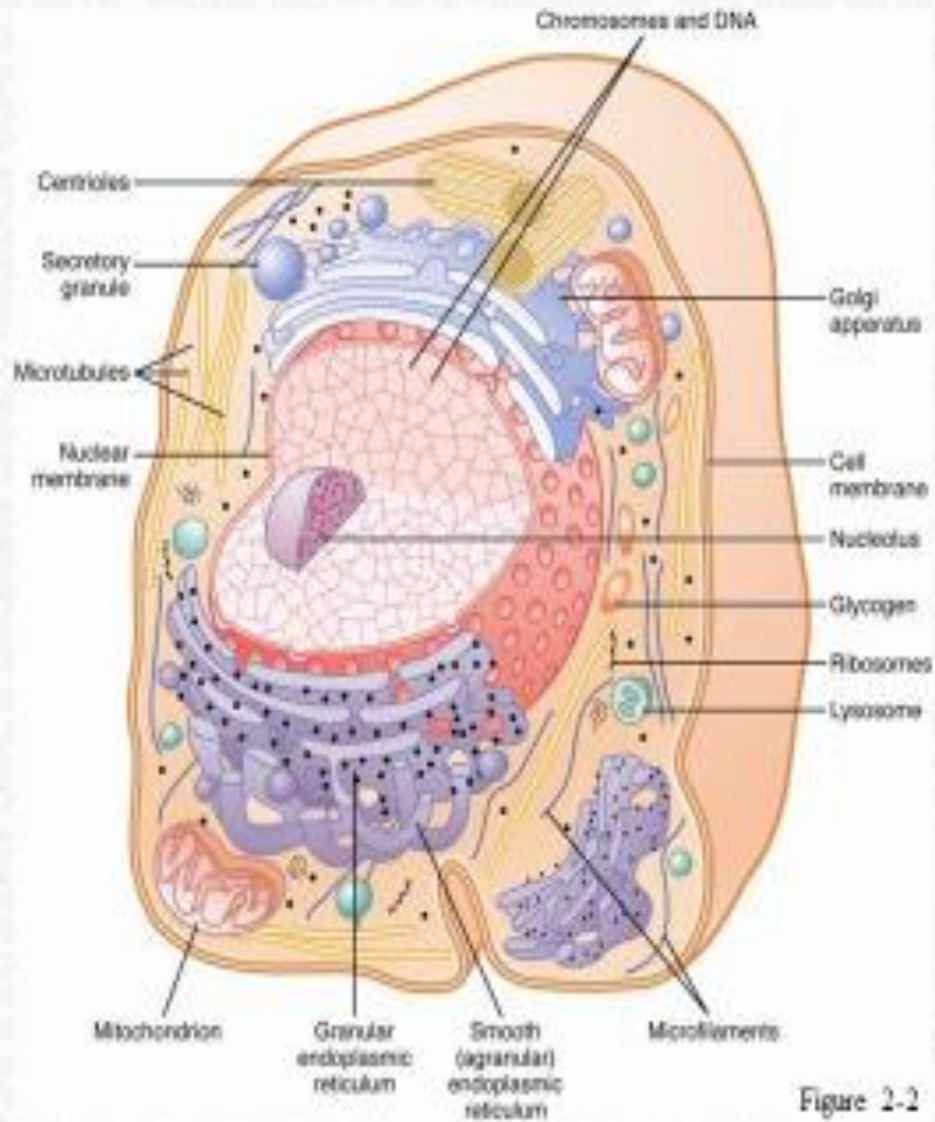
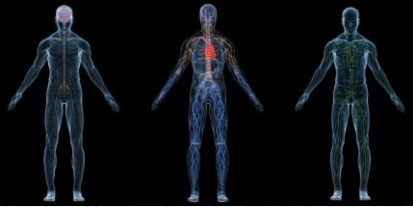


Figure 2-2



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

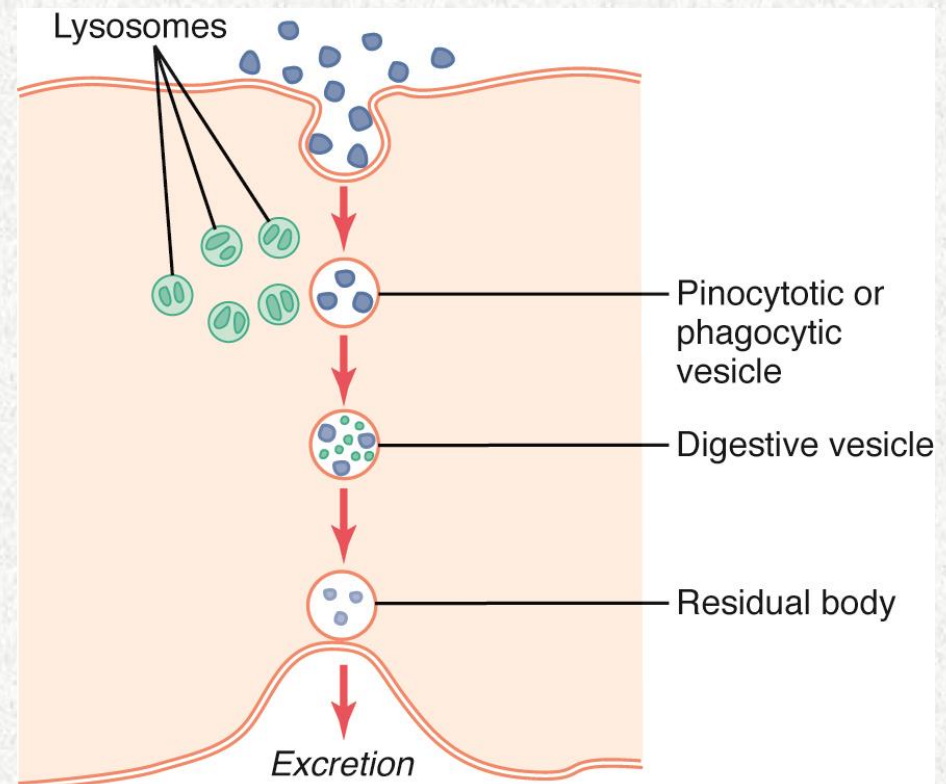
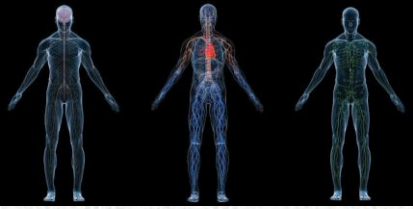


Figure 2-12



Lysosomal Storage Diseases

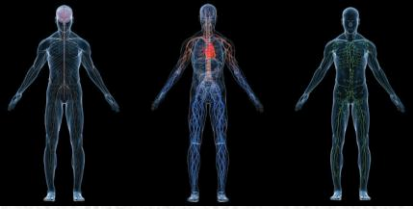
Absence of one or more hydrolases

- not synthesized
- inactive
- not properly sorted and packaged

Result: Lysosomes become engorged with undigested substrate

Examples:

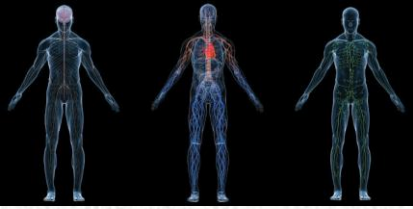
- Acid lipase A deficiency
- I-cell disease (non-specific)
- Tay-Sachs disease (HEX A)



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

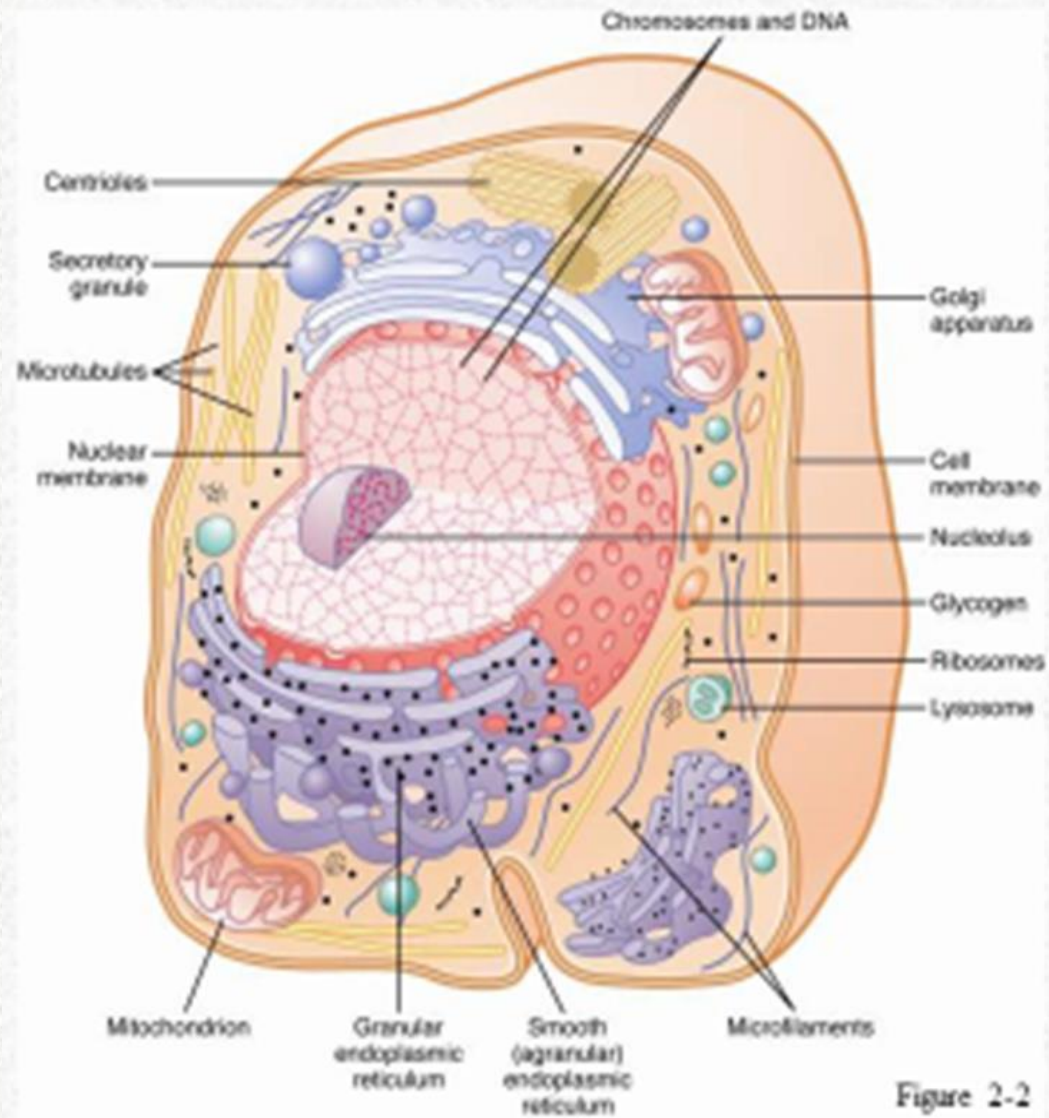
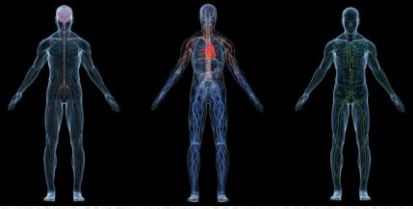


Figure 2-2



Secretory Granules

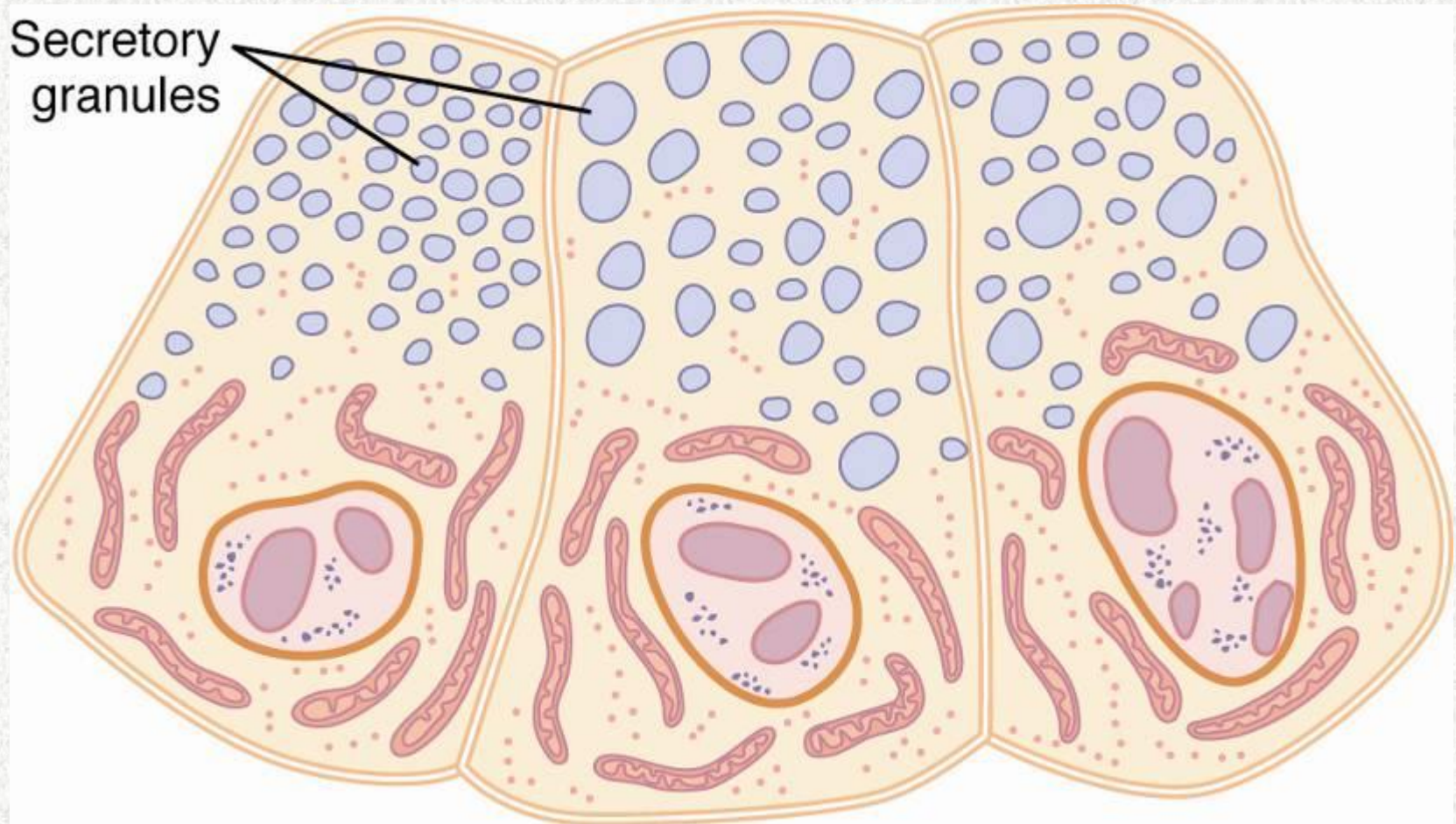


Figure 2-6