

General Physiological Principles
Cell Physiology
Functions of Cellular Membrane and
Intracellular Structures
Basic Principles of Physiological Regulations

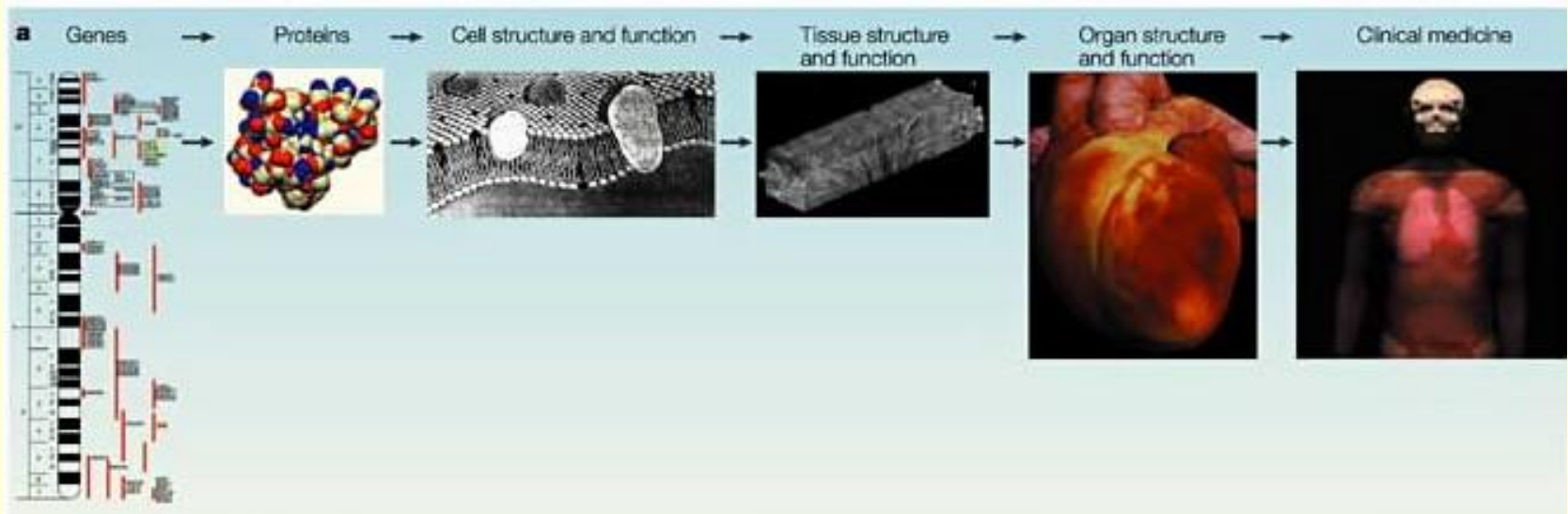
lecture from Physiology and Pathophysiology I

13. 9. 2022

M. Chalupová

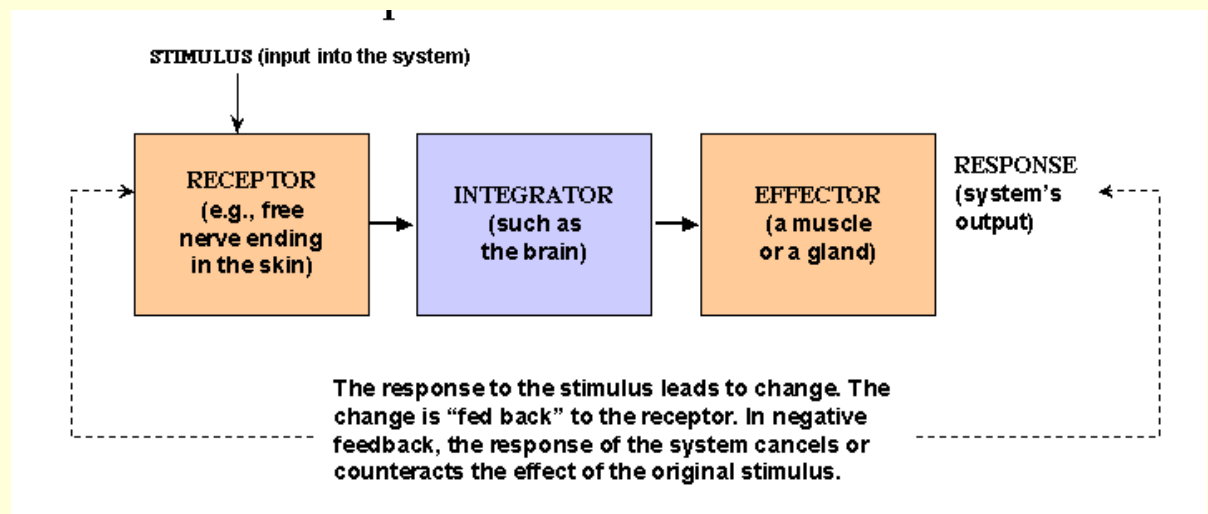
Physiology

- science that describes how organisms **FUNCTION** and survive in continually changing environment
- function can be described at various levels



Basic Physiological Principles

- living organism = open system with steady internal environment
- **HOMEOSTASIS**
 - stable operating conditions in the internal environment
 - dynamic

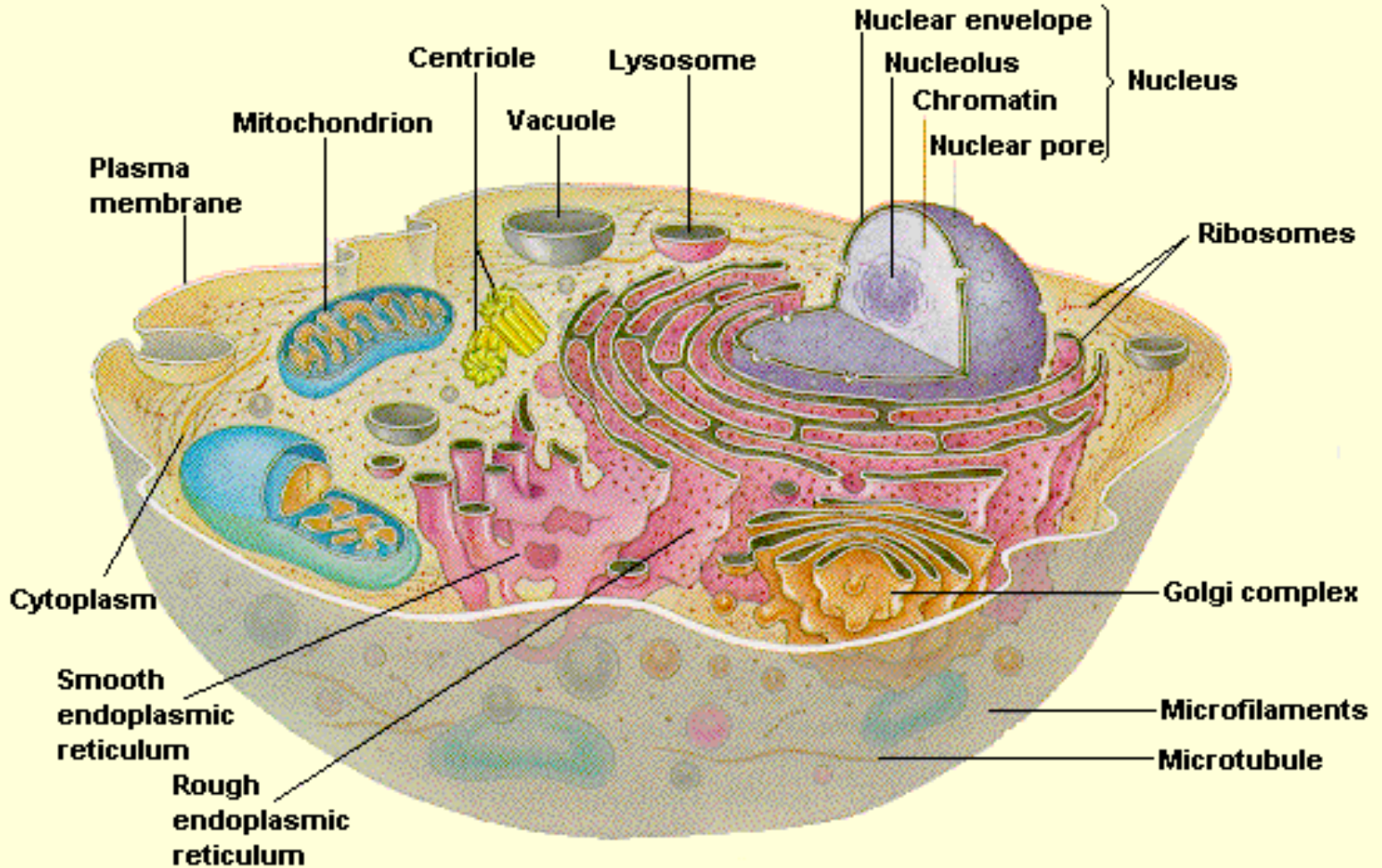


Cell Physiology

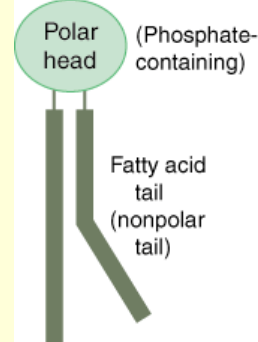
CELL

- the basic structural and functional unit of living organisms
- the smallest unit of life that is classified as a living thing
- consists of functional structures called
CELL ORGANELLES

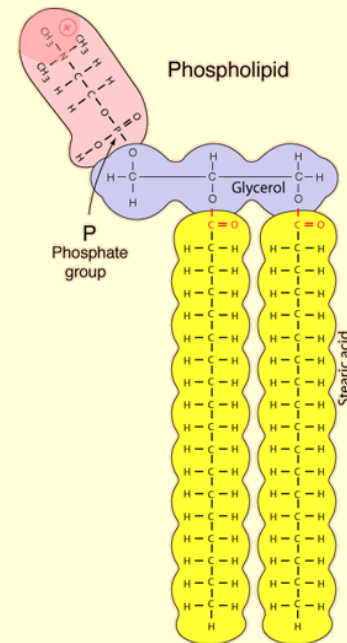
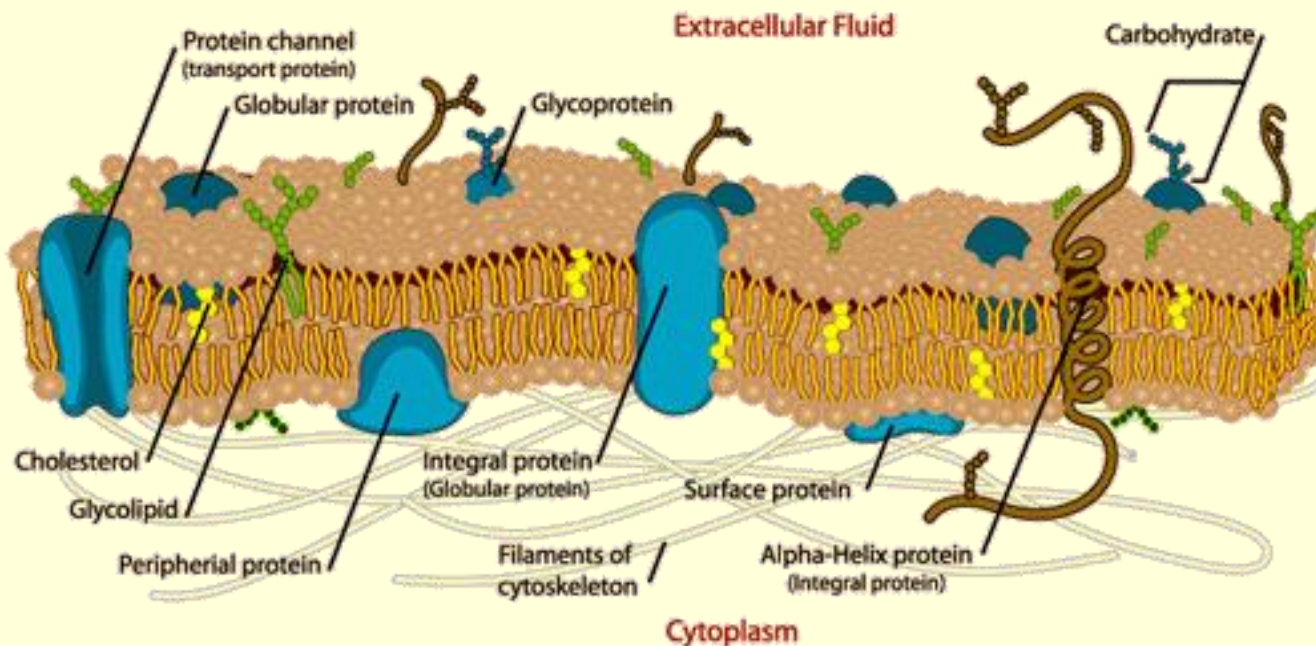
Cell Structure



Cell/Plasma Membrane



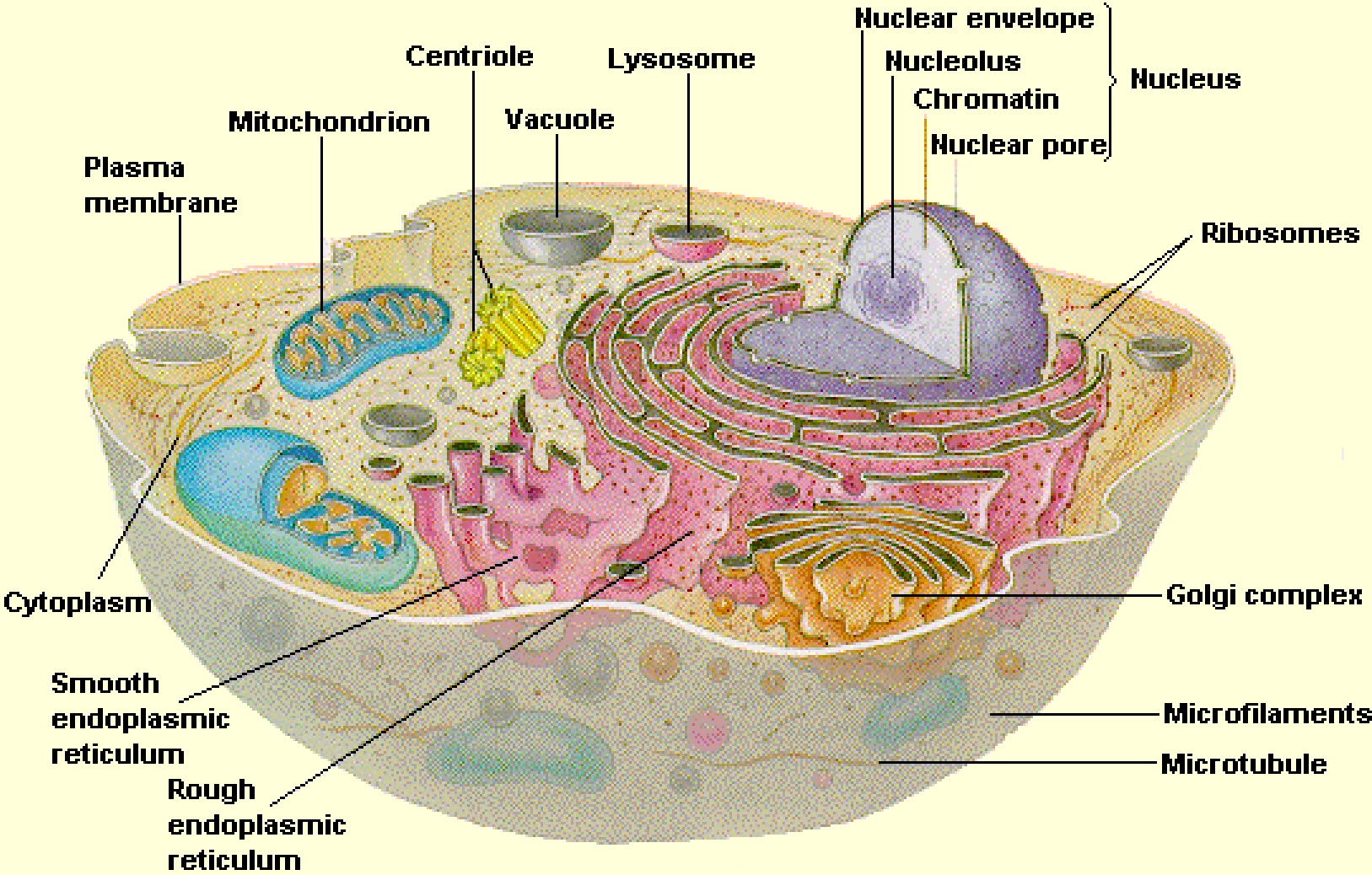
- 2 primary building blocks include protein (about 60% of the membrane) and phospholipid (about 40%)
- molecules of phospholipid form a **phospholipid bilayer** because the two ends of phospholipid molecules have very different characteristics
 - non-polar (hydrophobic)
 - polar (hydrophilic)



Functions of Cell Membrane

- supporting and retaining the cytoplasm
- selective barrier
- transport
- communication (via receptors)
- recognition

Cell Organelles



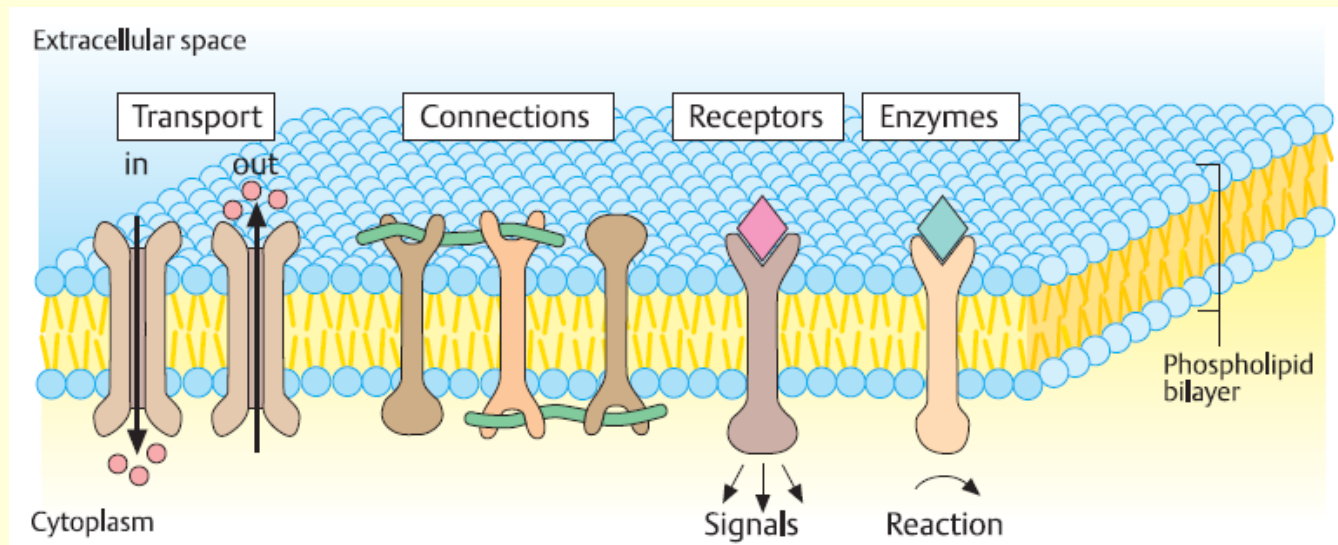
Membrane proteins

Transport proteins

- ion channels
- carriers
- ATP-ases

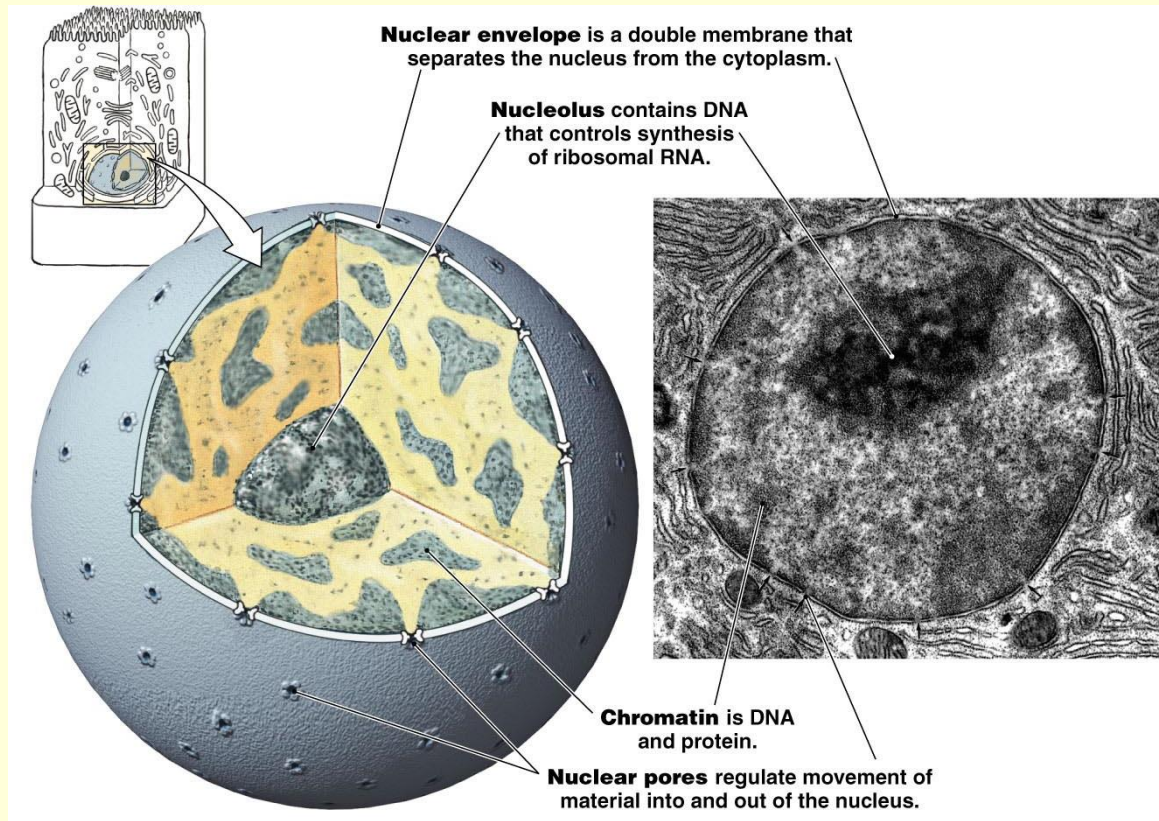
Receptors

- cell surface
- (intracellular)



Nucleus

- replication and transfer of genetic information
- RNA synthesis
- regulation of cell differentiation and maturation

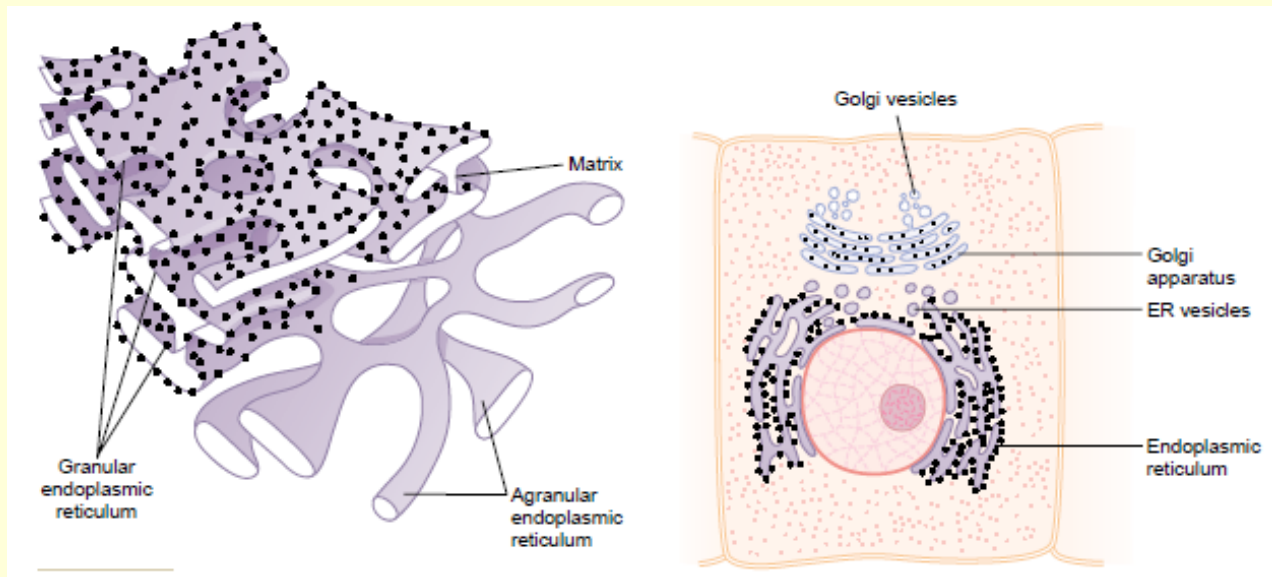


Endoplasmic Reticulum

SMOOTH

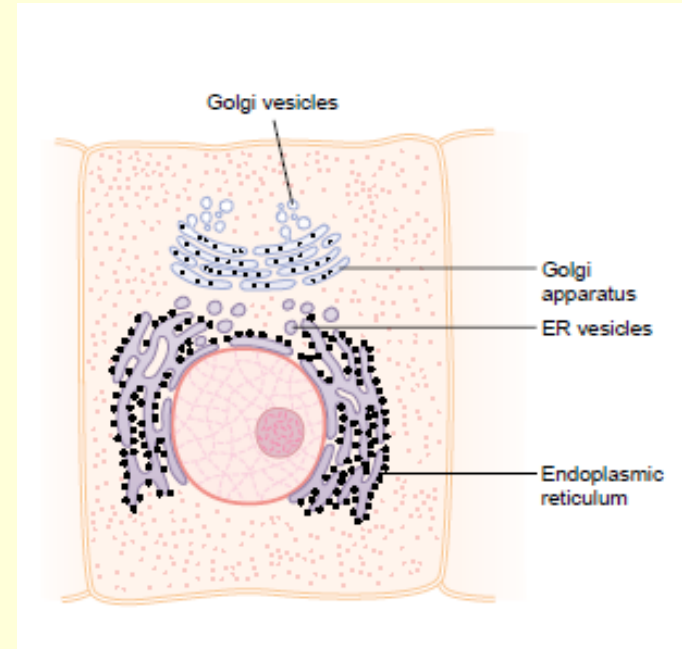
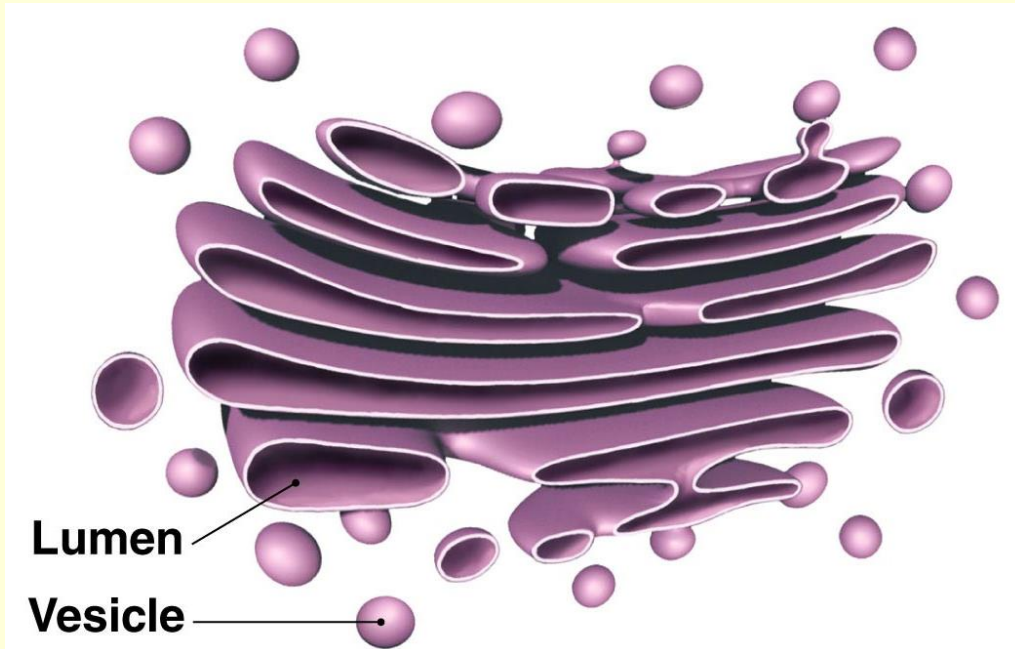
ROUGH

- surface is coated with **ribosomes**
- mechanical support
- synthesis (especially proteins by rough ER)
- transport

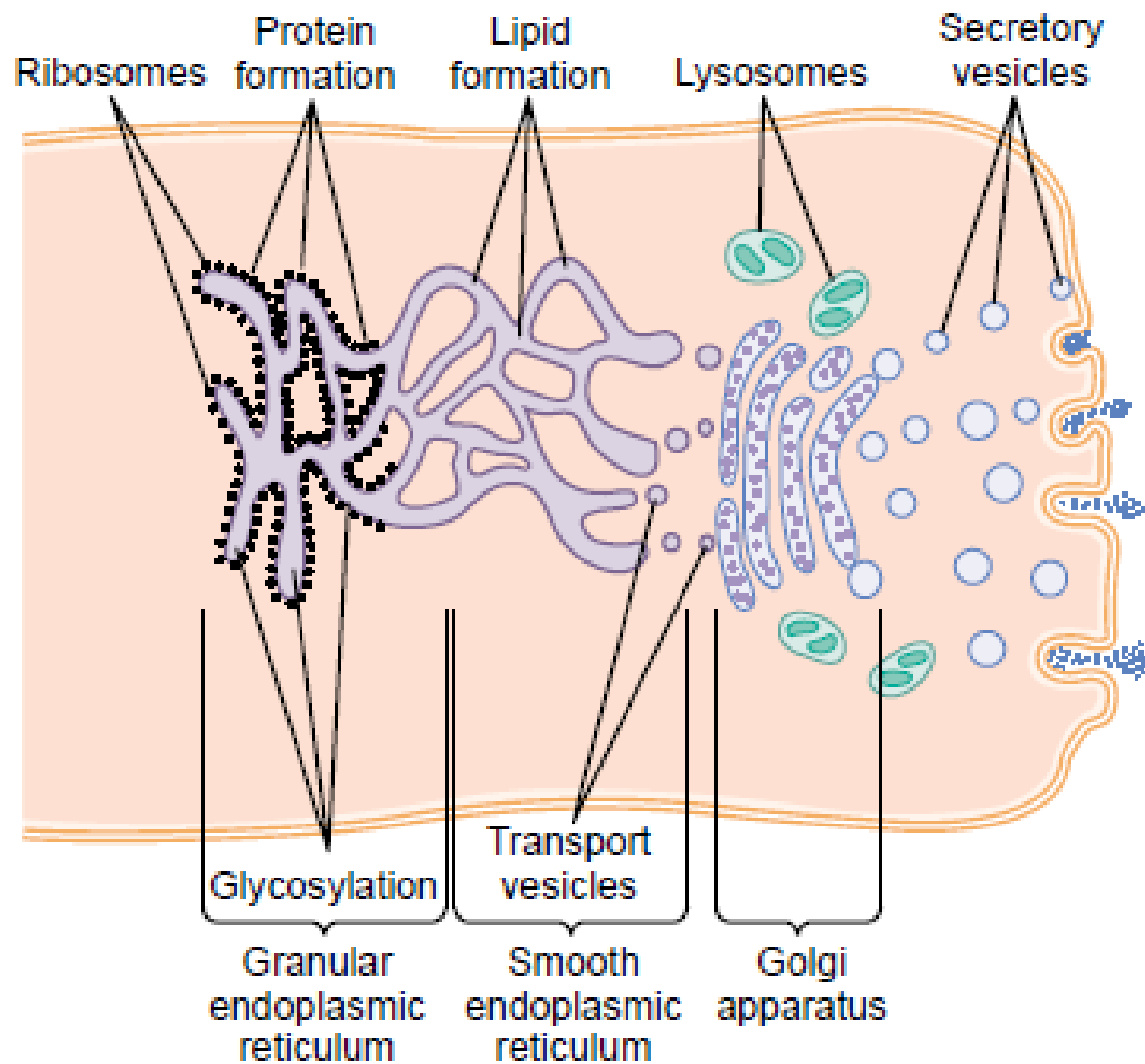


Golgi apparatus

- modifying, sorting, and packaging of substances synthesized in the cell



Function of ER and GA



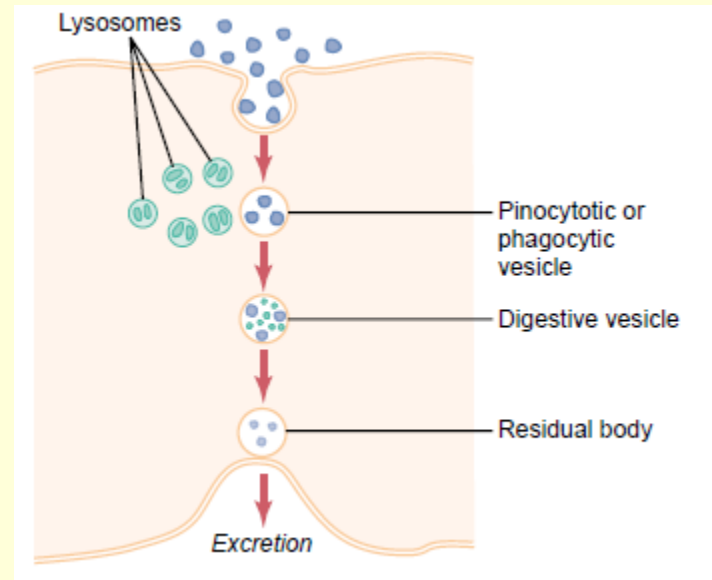
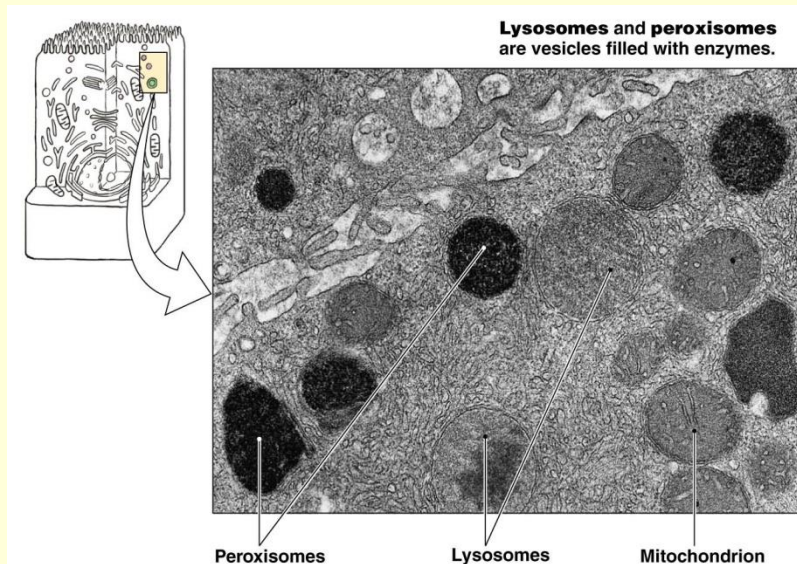
Lysosomes and Peroxisomes

Lysosomes

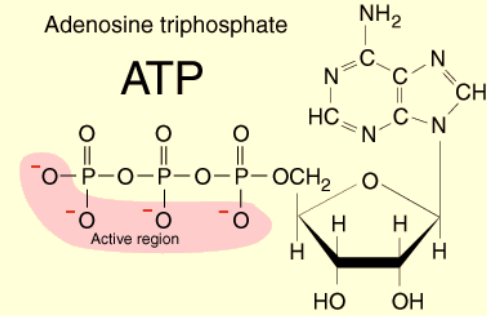
- contain acid hydrolase enzymes that break down waste materials and cellular debris

Peroxisomes

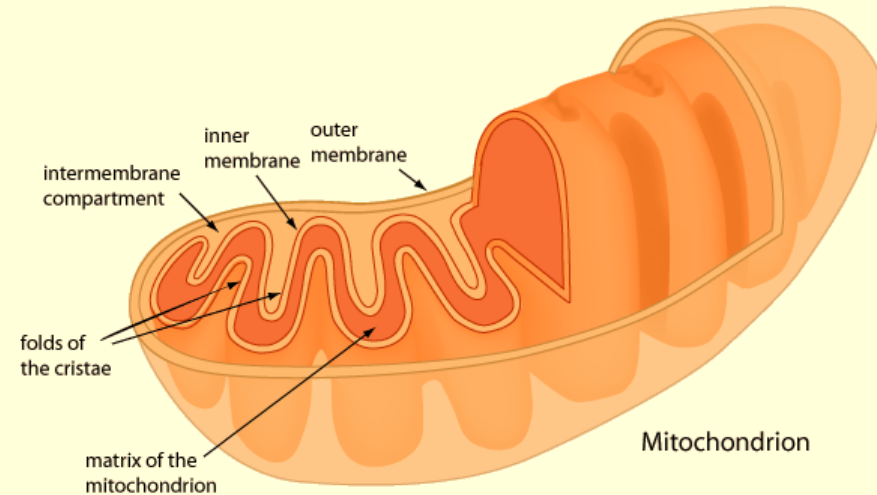
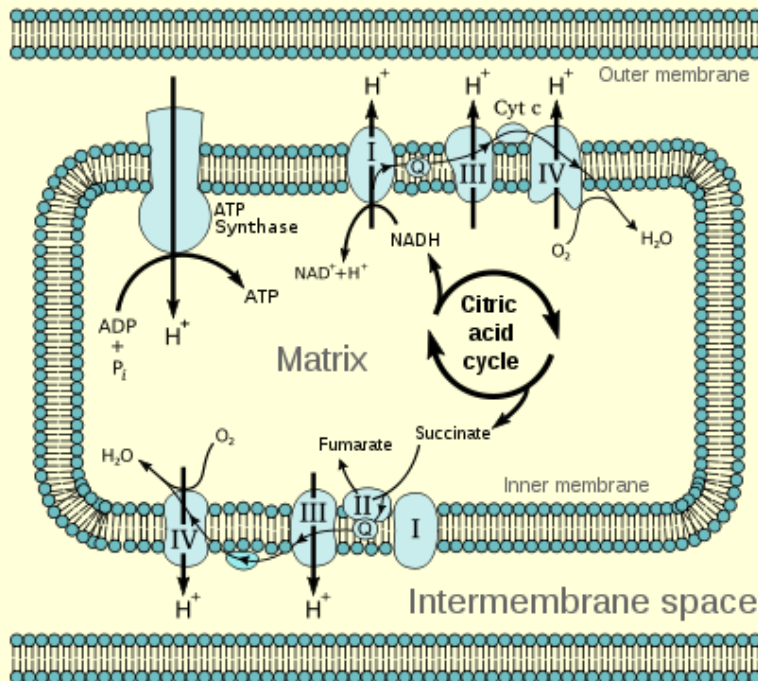
- the breakdown of very long chain fatty acids through beta-oxidation



Mitochondria



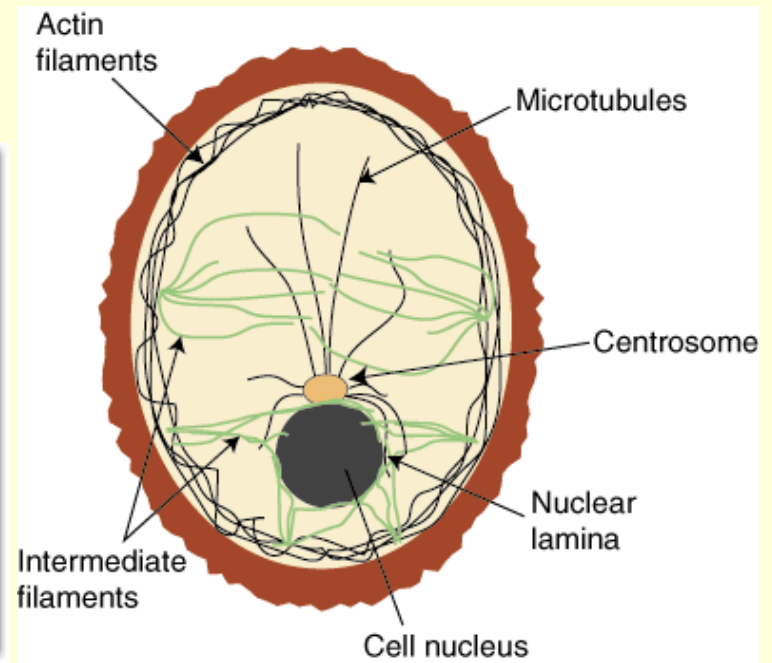
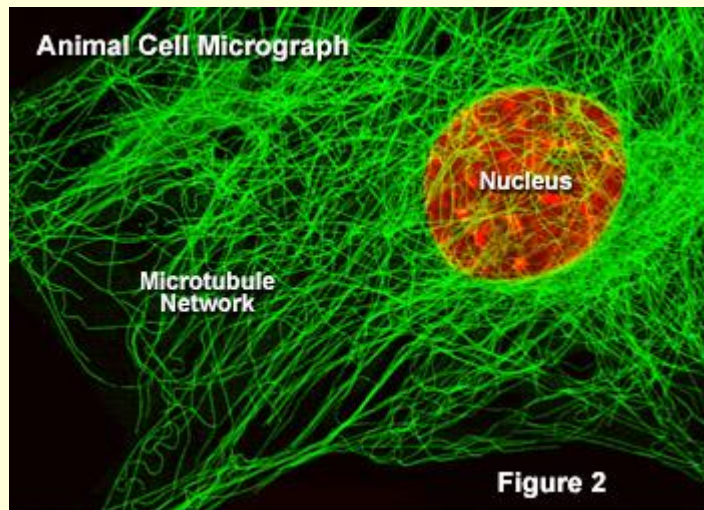
- generate most of the cell's supply of adenosine triphosphate (ATP), used as a source of chemical energy
- contain own DNA



Most of the ATP is produced by enzyme-catalyzed reactions in the matrix, driven by electron transport processes associated with the inner membrane.

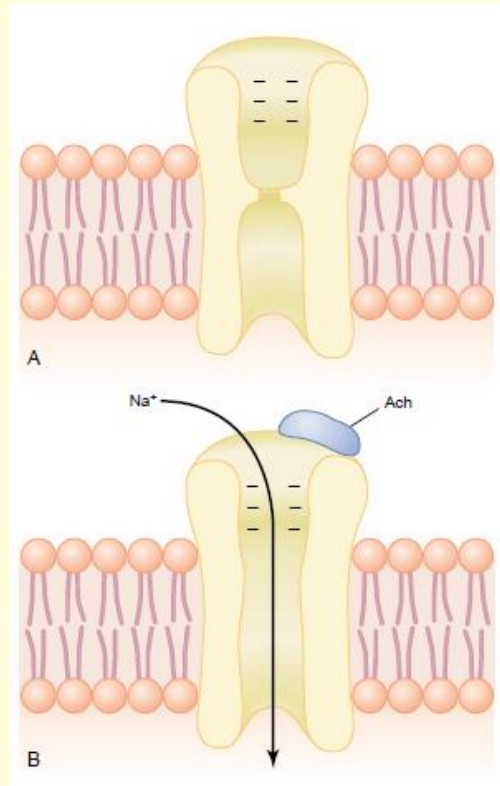
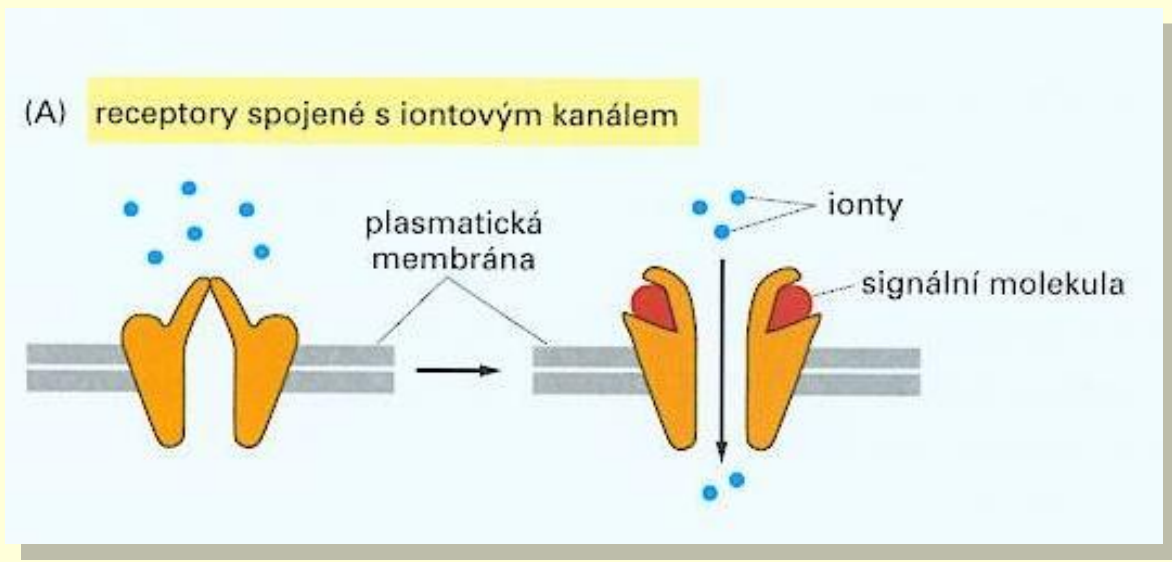
Cytoskeleton

- dynamic system of **microfilaments, intermediate filaments, and microtubules** determining the shape and internal architecture of cell and performing cell movement



Receptors

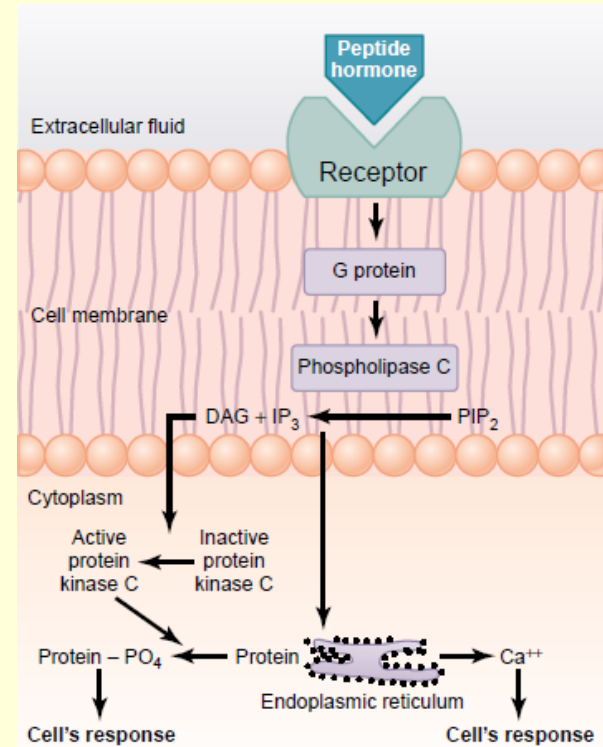
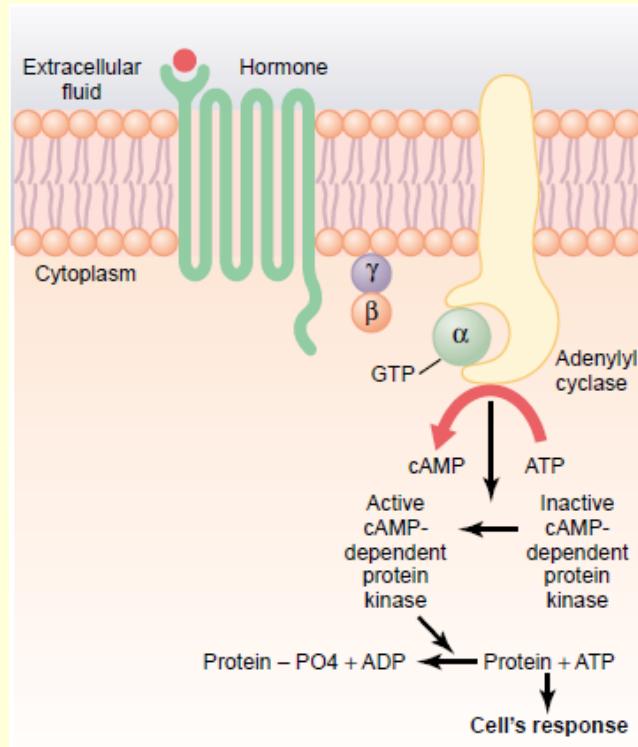
Ion channel linked receptors



Receptors

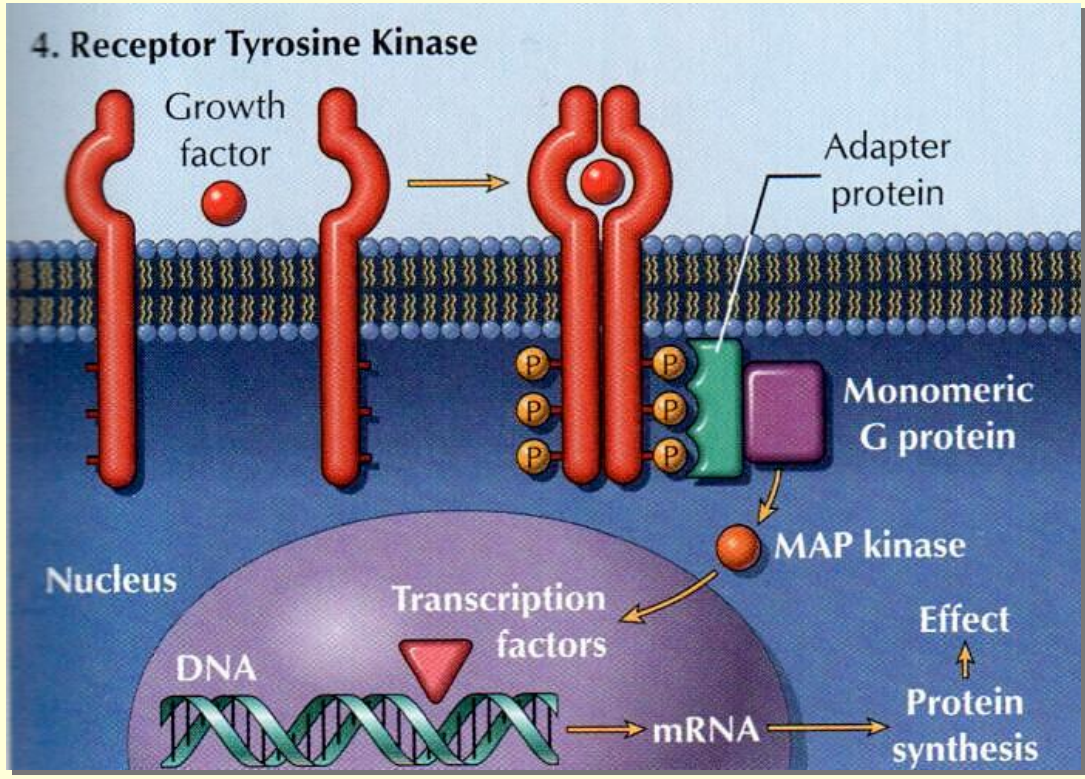
G protein-coupled receptors

- Gs protein
- Gi protein
- Gp protein



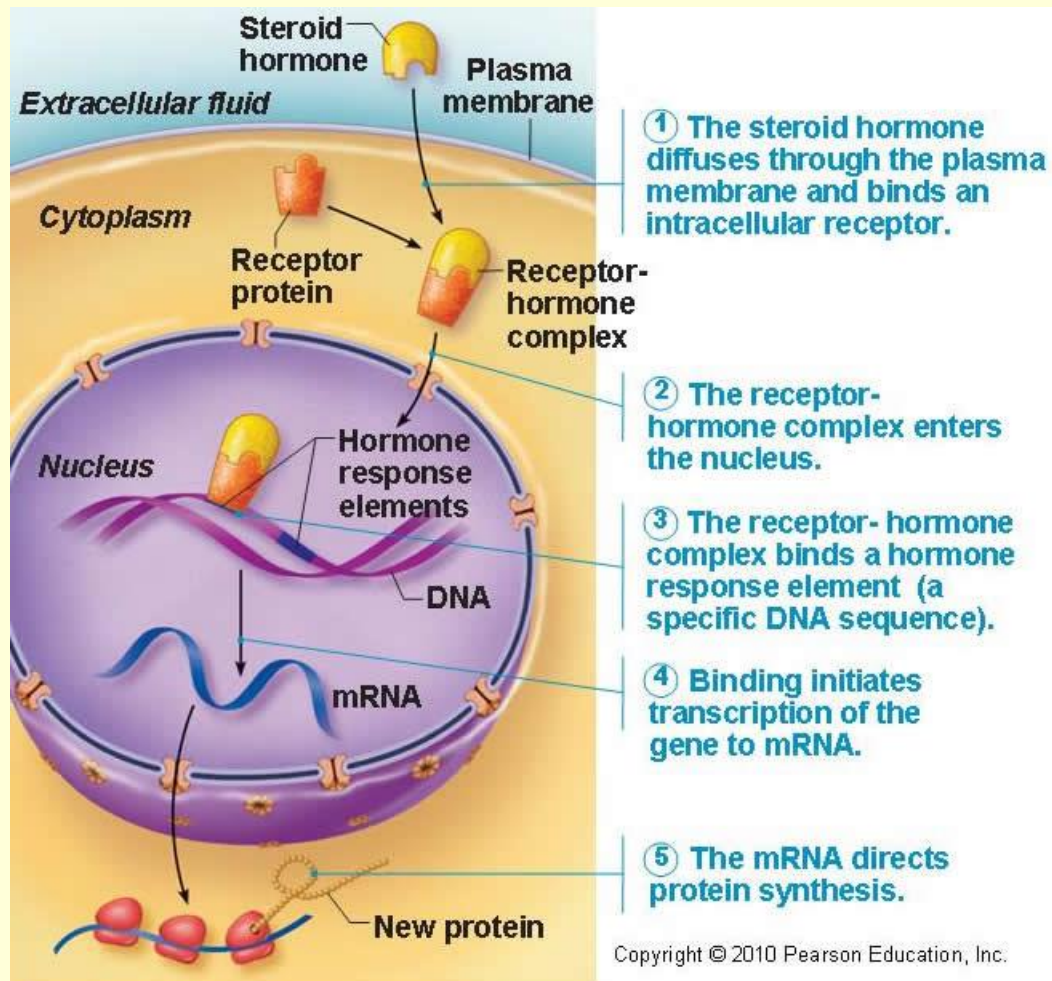
Receptors

Receptors tyrosine kinases



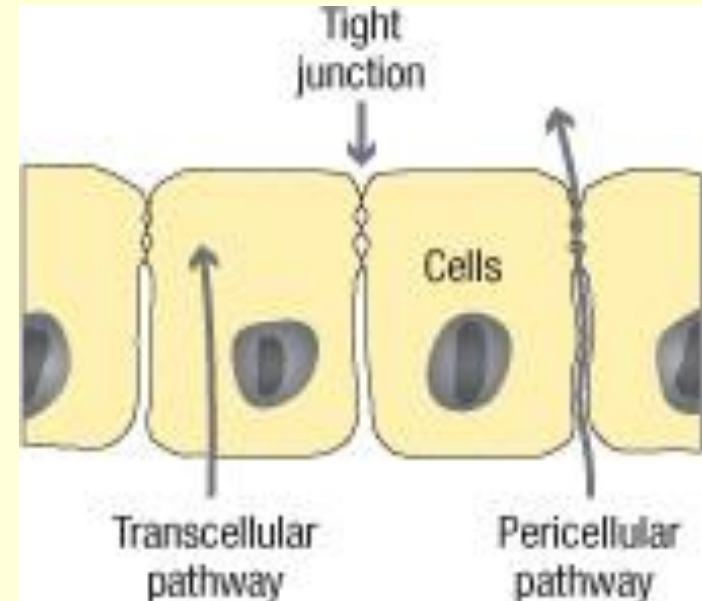
Receptors

Intracellular receptors



Cell Transport

- provides necessary communication between the cell and its environment
- receptors
- carriers
- channels
- pumps
- exo- and endocytosis
- transcellular transport
- paracellular transport



Passive Transport

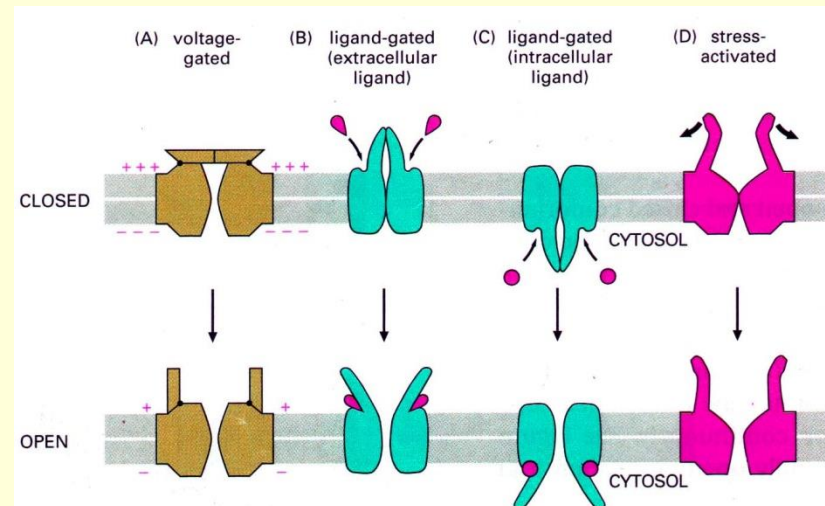
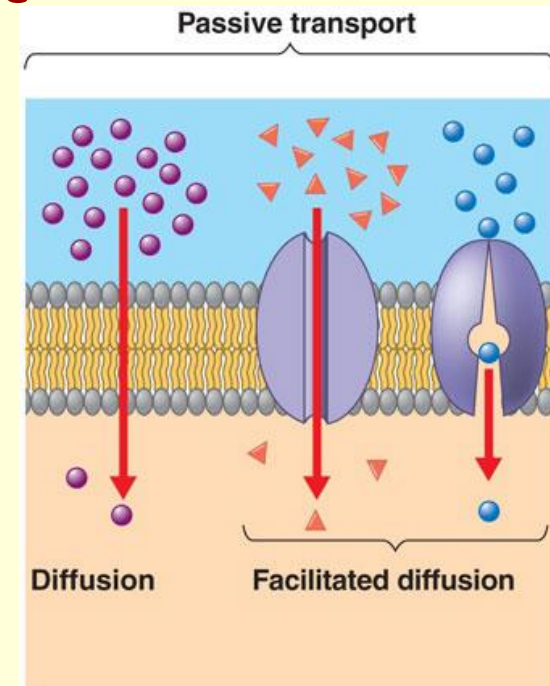
Diffusion

Facilitated diffusion

- membrane carrier

Ion channels

- voltage-gated
- ligand-gated
- stress-activated



Active Transport

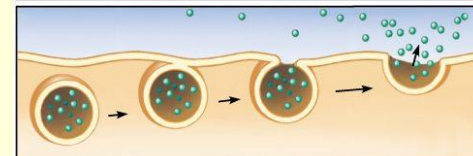
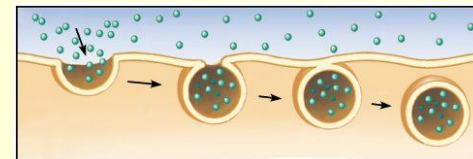
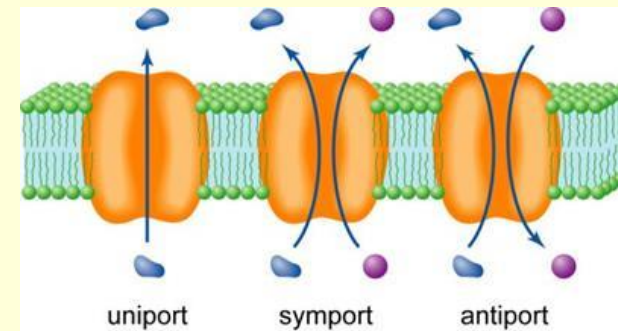
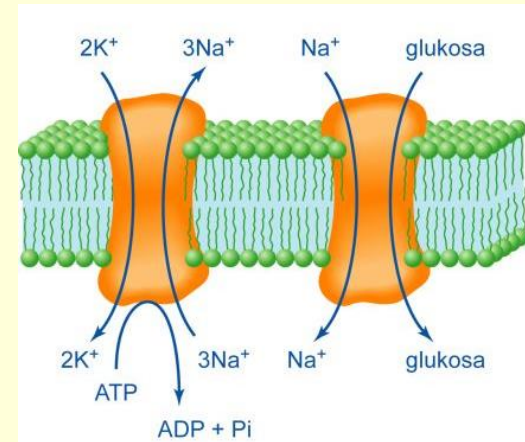
- the movement of a substance against its concentration gradient

Active membrane transporters – pumps

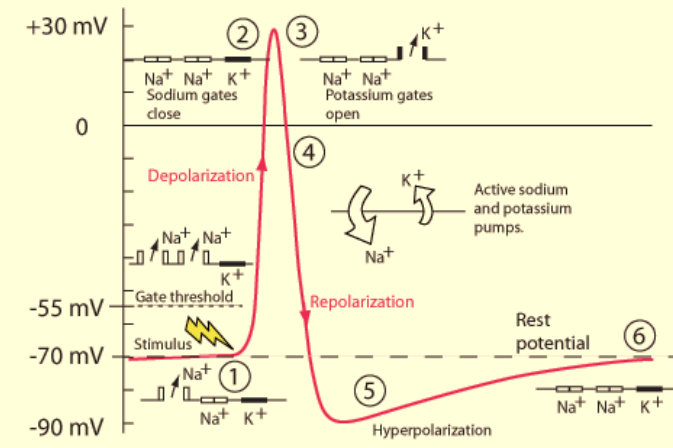
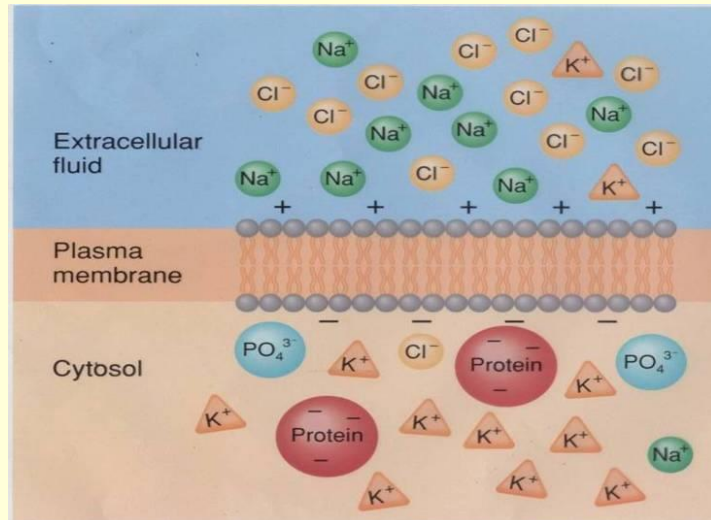
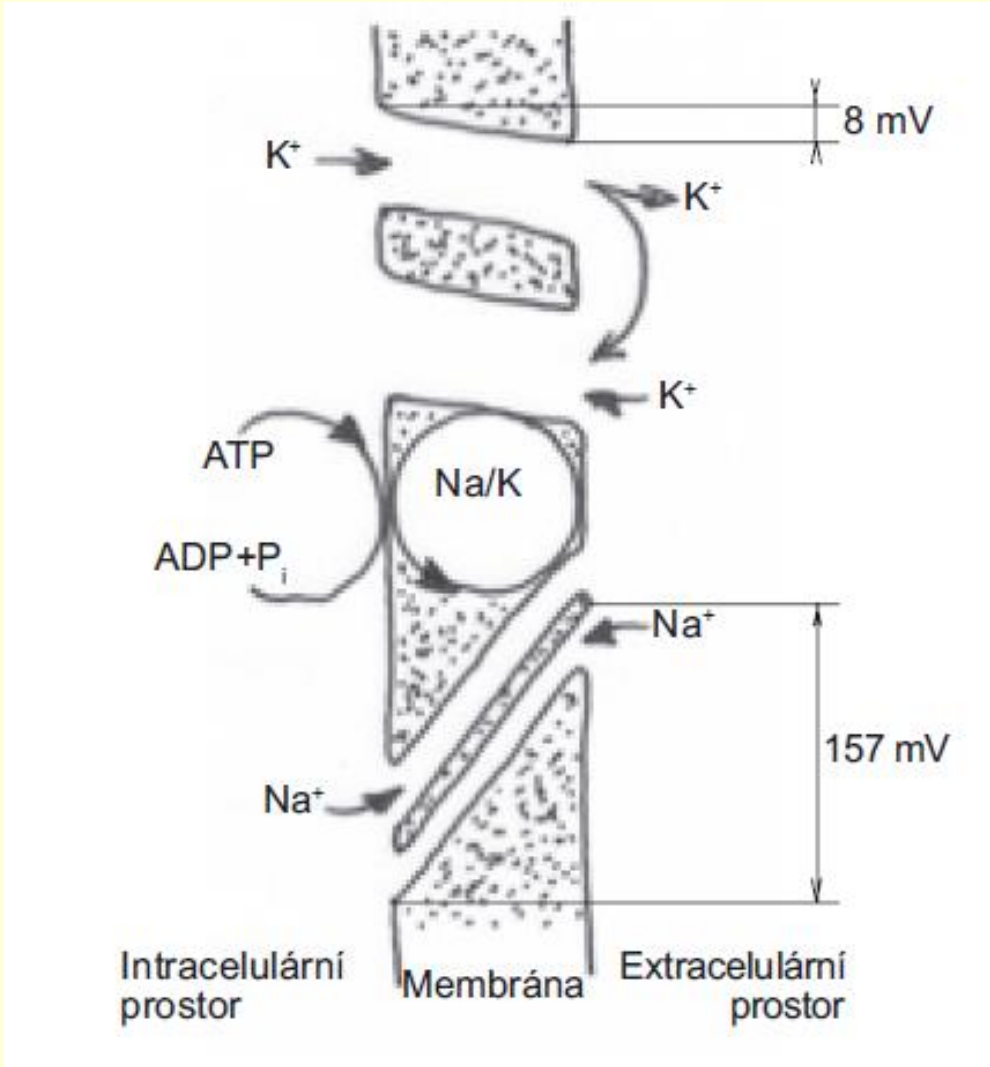
- primary active transport (ATP-ases)
- secondary active transport
 - symport
 - antiport

Cytosis

- endocytosis
- exocytosis



Membrane and Action Potential



Intercellular Communication

Gap junctions

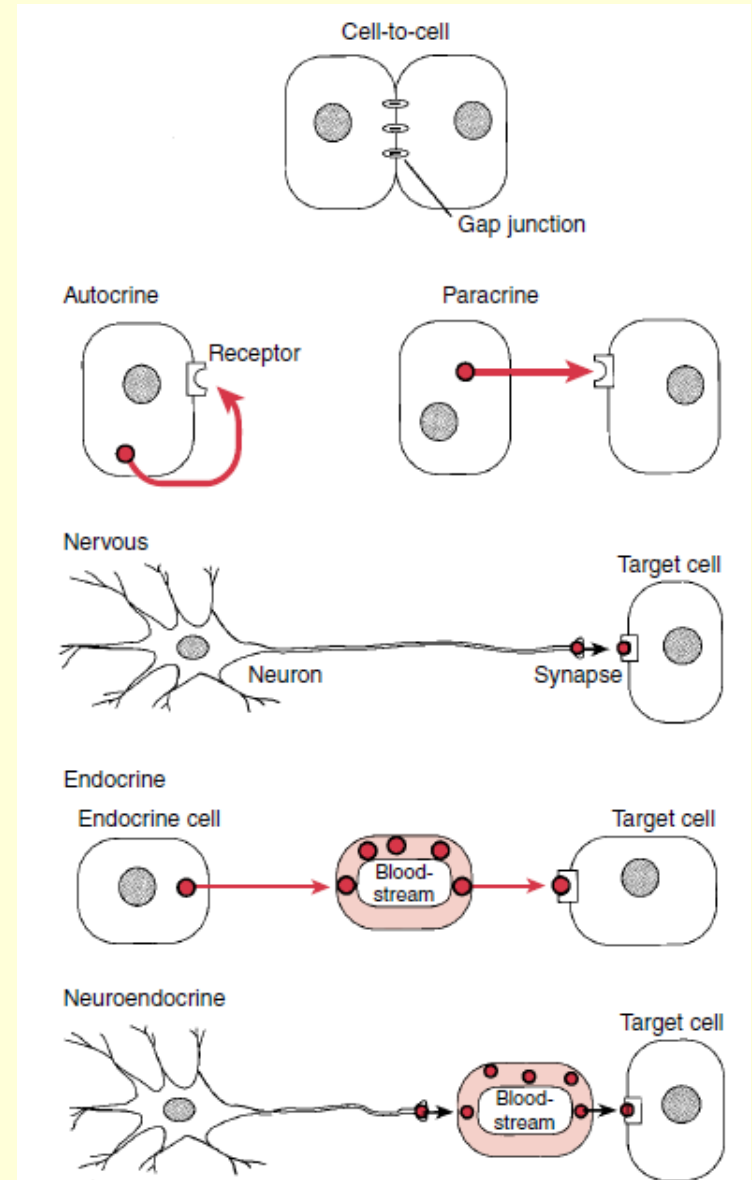
Paracrine

Autocrine

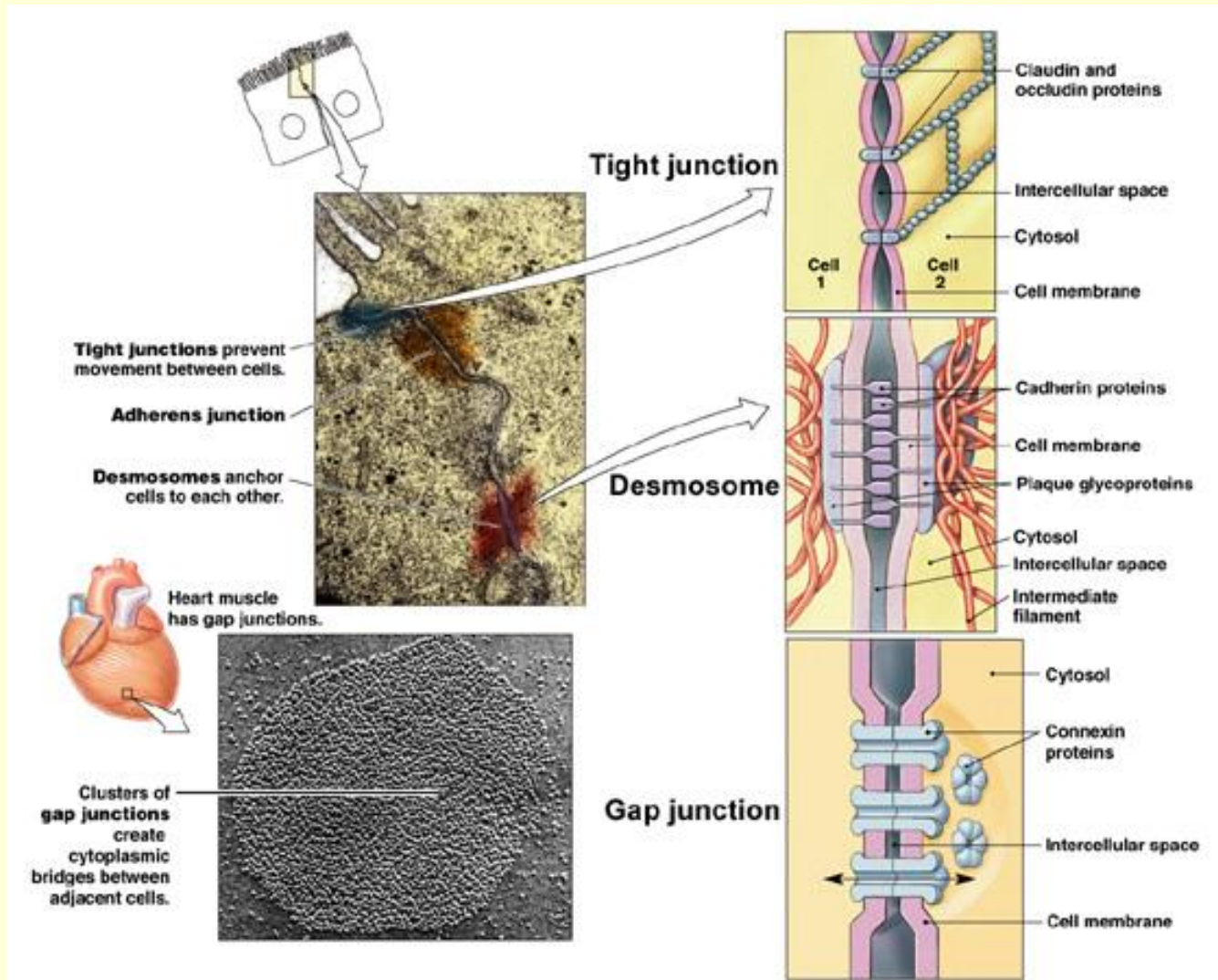
Nervous

Endocrine

Neuroendocrine



Cell Junctions



Homeostasis and Adaptation

- mechanisms consist of reducing the output or activity of any organ or system back to its normal range of functioning

ADAPTATION

- adjustment to the changed life conditions
- selection pressure of the environment changes the frequency of genes performing basic life functions

Feedback

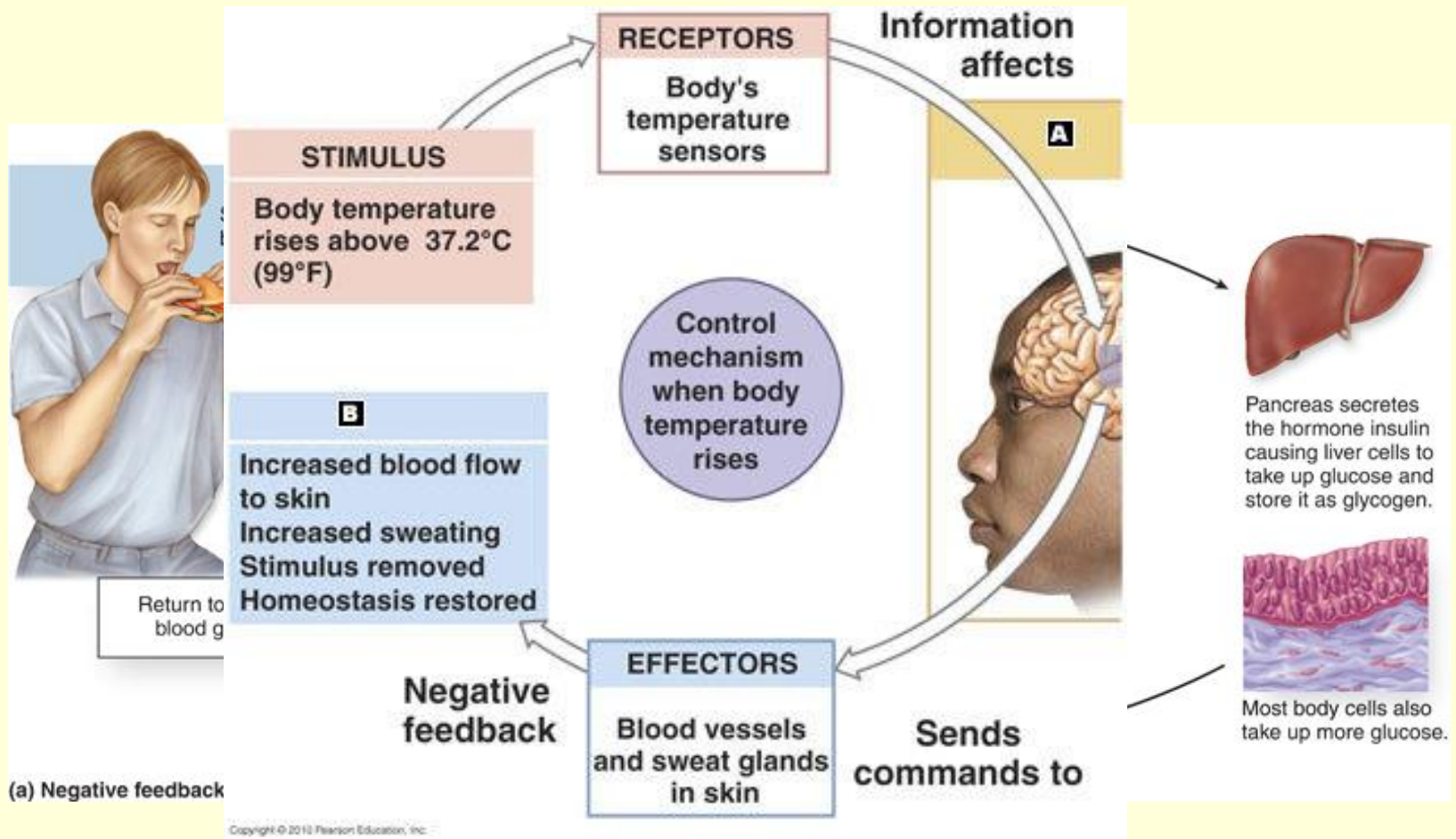
Negative feedback

- mechanisms consist of reducing the output or activity of any organ or system back to its normal range of functioning

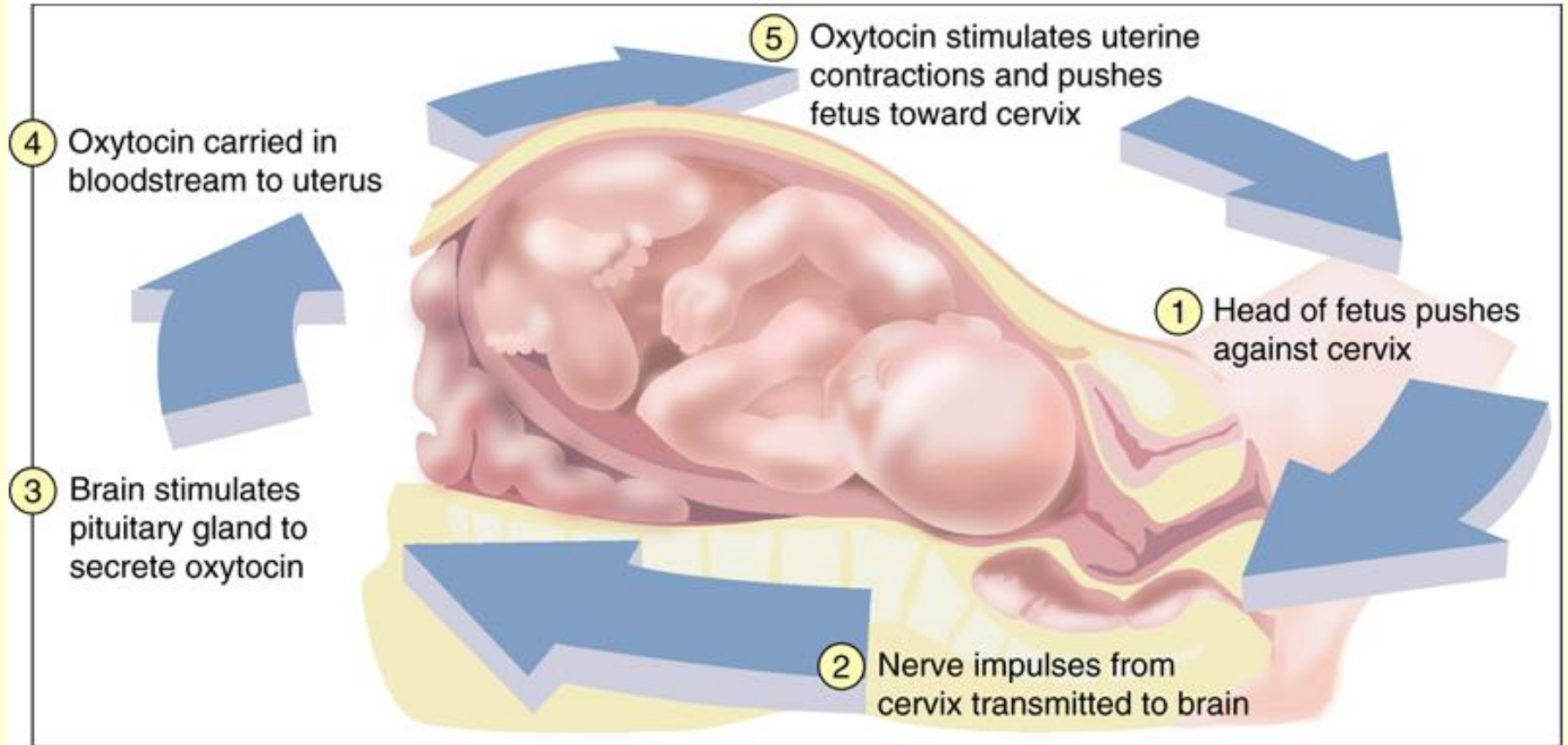
Positive feedback

- mechanisms are designed to accelerate or enhance the output created by a stimulus that has already been activated

Negative Feedback



Positive Feedback



Feedback

