Basic Cell Structure & Organelles

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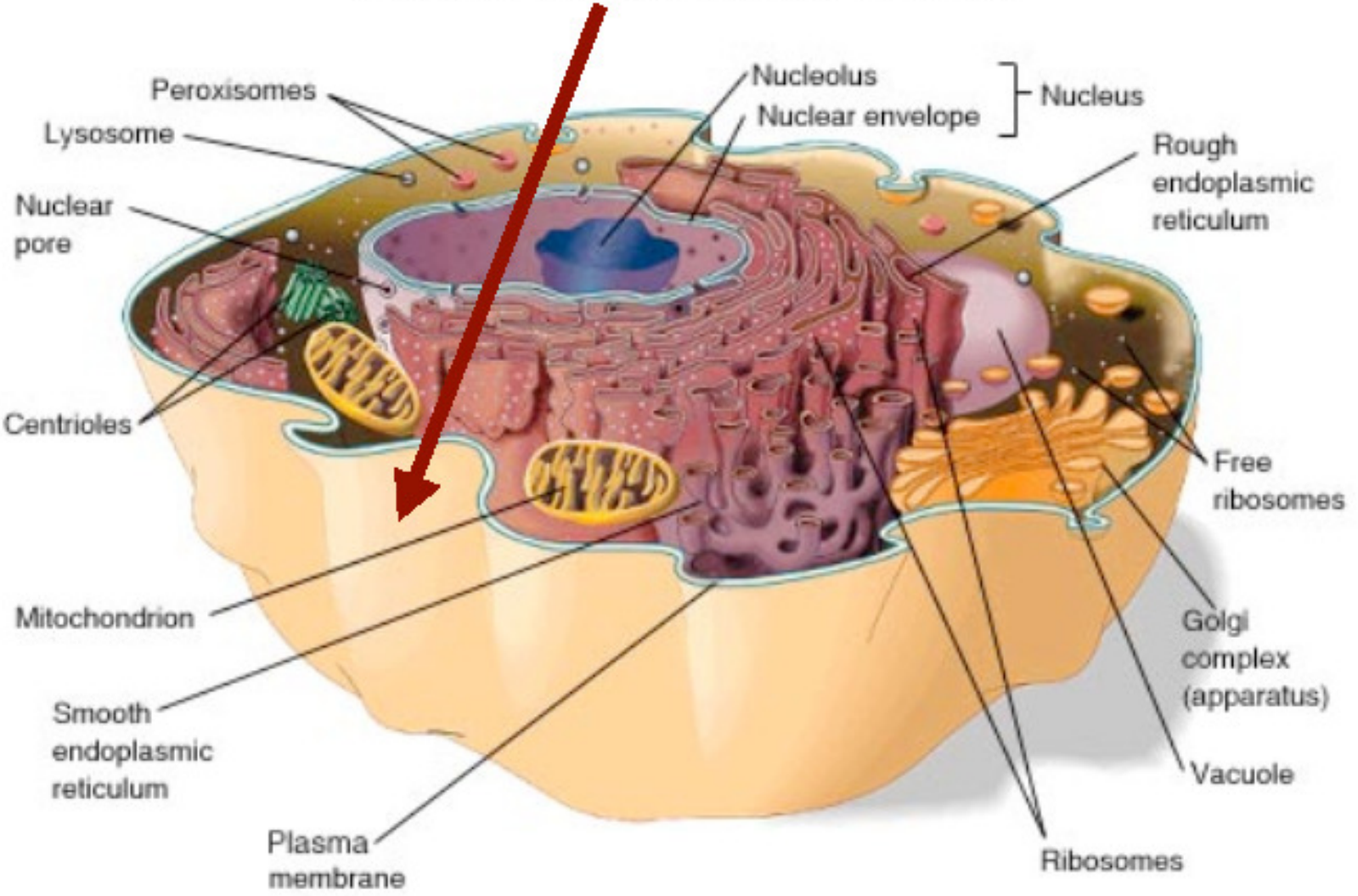
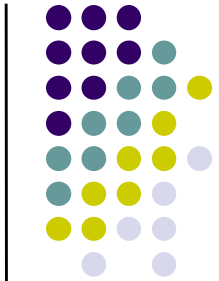
Surat

Cell Membrane



Plasma Membrane

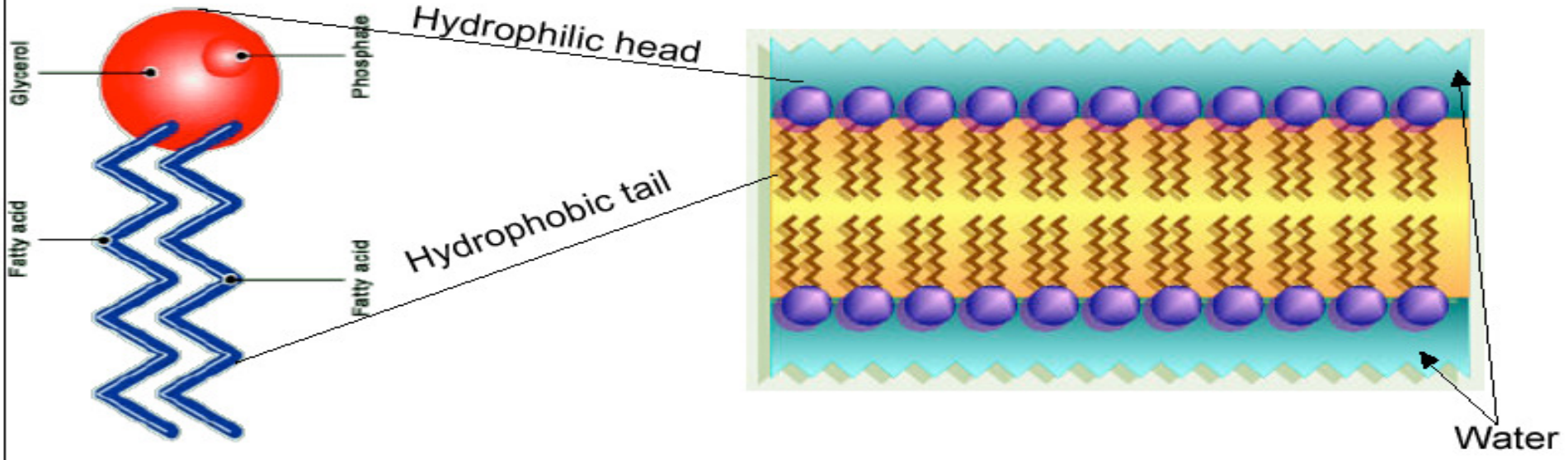


- Made up of lipids, proteins & small amount carbohydrate.
- Carbohydrate present as glycolipids & glycoproteins.
- Phospholipids are most common component & have amphipathic in nature.
- 5’ Nucleotidase & Alkaline Phosphatase are seen on outer part of cell membrane, called Ecto-enzymes.

Fluid Mosaic Model

- The cell membrane is a **PHOSPHOLIPID BILAYER**

- PHOSPHOLIPID BILAYER



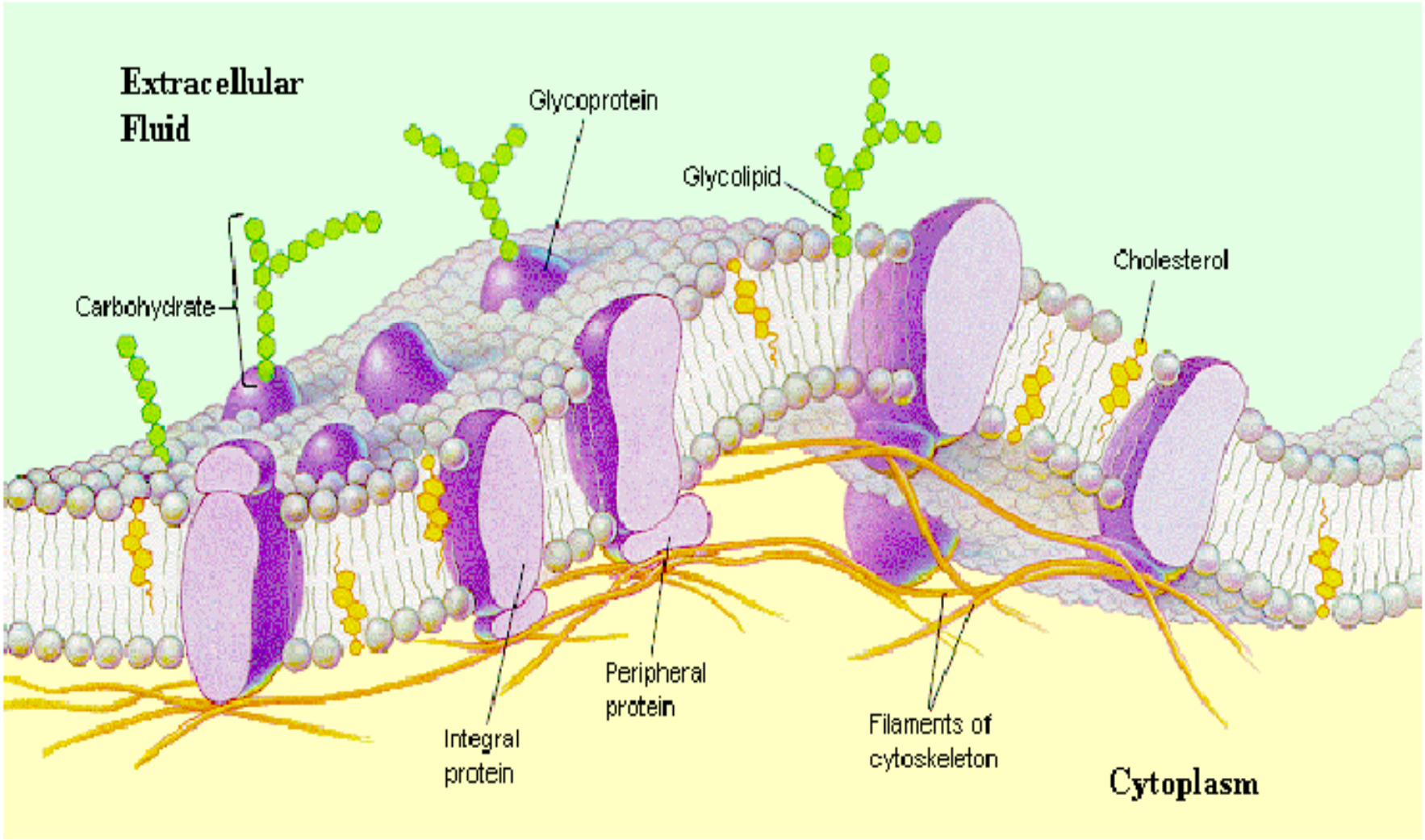
Fluid Mosaic Model

- Choline containing Phospholipids are mainly in the external layer of membrane
- Ethanolamine & Serine containing phospholipids are in internal layer
- Lipid bilayer shows free lateral movement of its components – ***Fluid In Nature***.
- The components do not move freely from inner to outer or outer to inner layer (***Flip-Flop movement restricted***).
- Fluidity enables the membrane to perform endocytosis & exocytosis.

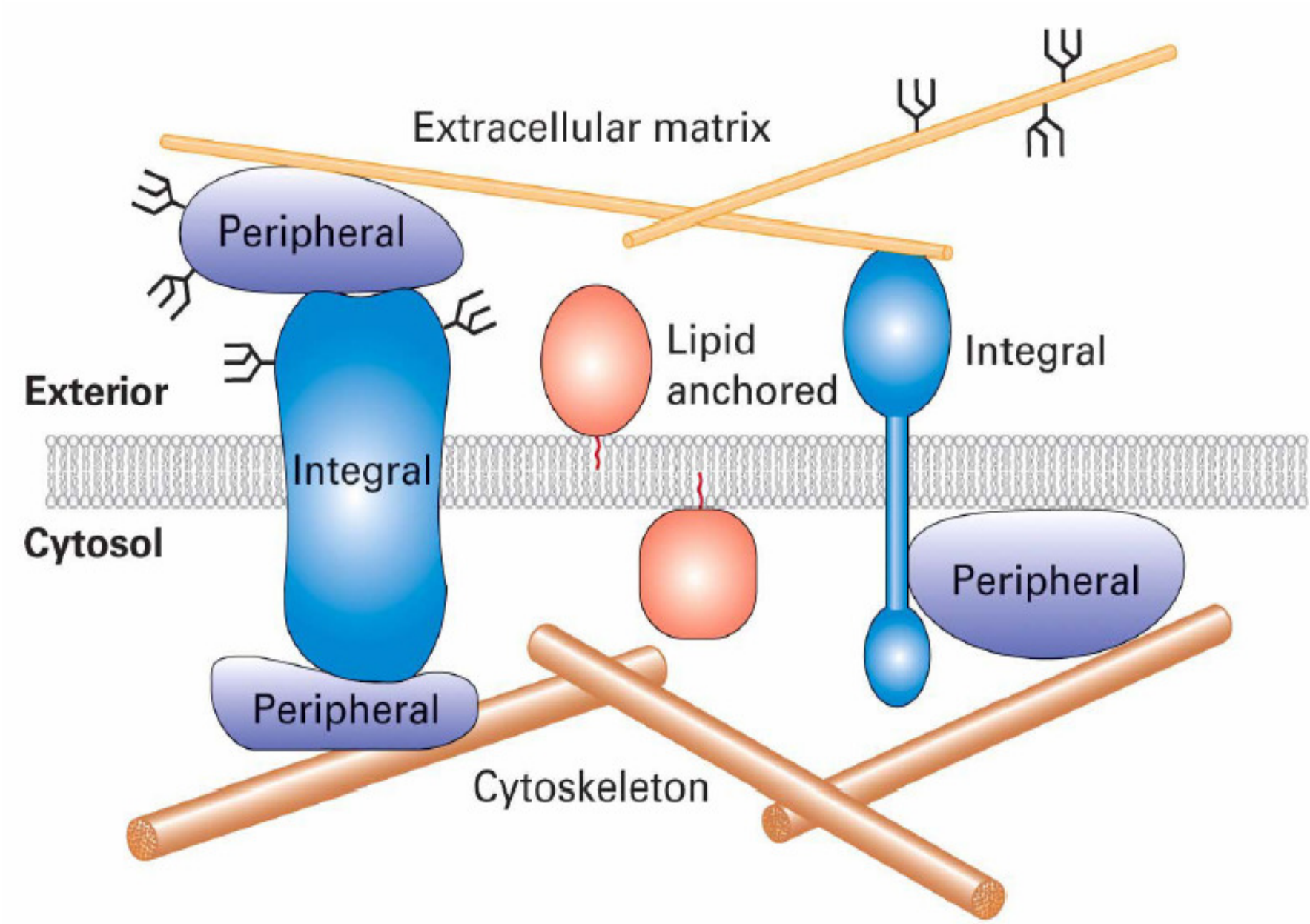
Fluid Mosaic Model

- Increase cholesterol concentration, membrane became less fluid on the outer surface, but more fluid on inner surface.
- Increase Unsaturated cis fatty acids increase the fluidity.
- In alcoholic cirrhosis, cholesterol content in RBC membrane is increase. This decrease fluidity of the membrane. Such cell are spiculated (Spur cell).That are destroyed constantly by spleen resulting in anemia.

The fluid mosaic model of cell membrane



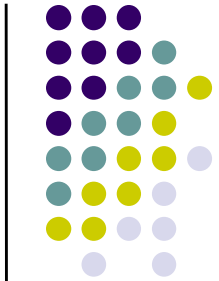
Proteins associated with the lipid bilayer



Eukaryotic Cell Organelles and Function

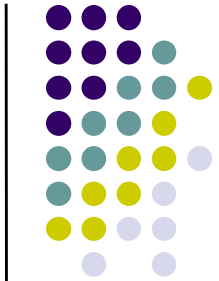
1. **Nucleus**
   - Nickname: "The Control Center"
   - All cell contain except RBC
   - Function: holds the DNA
     DNA Replication.
     RNA Synthesis.
   - Parts:
     1. Nucleolus: dark spot in the middle of the nucleus that helps make ribosomes
     2. Inner one is called Perinuclear membrane
     3. Outer one is continuous with Endoplasmic Reticulum.

Eukaryotic Cell Organelles and Function



1. **Ribosomes**
   - Function: makes proteins
   - Found in all cells, prokaryotic and eukaryotic

Eukaryotic Cell Organelles and Function



1. **Endoplasmic Reticulum (ER)**
   - Nickname: “Roads”
   - Smooth & Rough ER.
   - Membrane is continue with outer layer of nucleus.
   - Railway track appearance
   - Function:

     1.The internal delivery system of the cell.

     2. Actively synthesis protein
        e.g.immunoglobulin,glycoprotein,lipoprotein.

     3.Detoxification of various drugs e.g.
        aniline,morphine,phenobarbitone.

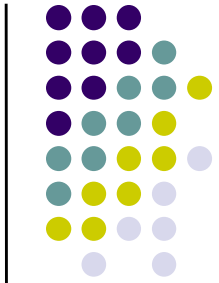
Endoplasmic Reticulum (ER)

- When cell are fractionated ,the complex of ER network is not isolated as a whole, but is disrupted in many places.
- These membrane are automatically re-assembled to form **Microsomes.**

Endoplasmic Reticulum

- 2 Types:
  1. Rough ER:
     - Rough appearance because it has ribosomes
     - Function: helps make proteins, that's why it has ribosomes
  2. Smooth ER:
     - NO ribosomes
     - Function: makes fats or lipids

Eukaryotic Cell Organelles and Function



1. **Golgi Complex**
   - Nickname: The shippers
   - Function: packages, modifies, and transports materials to different location inside/outside of the cell
   - It is reach in Glycoprotein

Lysosomes

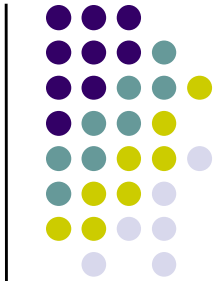
circular, but bigger than ribosomes)

- **Nickname: "Clean-up Crews" - " Bags of Enzymes".**
- **pH inside lysosomes is lower than cytosol.**
- **Function: to break down food into particles the rest of the cell can use and to destroy old cells.**
- **Contain : Polysaccharide hydrolysing enzyme (glucosidase,galactosidase etc.), Protein hydrolysing enzyme (cathepsins,elastase,collegenase),Nucleic acid hydrolysing enzyme (ribonuclease,deoxyribonuclease),lipid hydrolysing enzyme (fatty acyl esterase),phosphatase**
- **Endocytic vesicle & phagosomes are fused with primary lysosome to form the Secondary lysosome.**

Clinical significant of Lysosomes

- In gout
- In meat
- Postmortem autolysis
- Tumour cell – release cathepsin
- Accumulation lipids or Polysaccharide due absence of Lysosomal enzyme
- Silicosis – fibrosis
- Inclusion cell disease

Eukaryotic Cell Organelles and Function



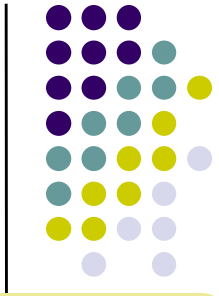
1. **Mitochondria**
   - Nickname: "The Powerhouse"
   - Function: Energy formation

     Breaks down food to make ATP
     - ATP: is the major fuel for all cell activities that require energy

Marker Enzyme

Mitochondria	–	ATP synthase
Lysosome	–	Cathepsin
Golgi complex	–	Galactosyl transferase
Microsomes	–	Glucose 6 phosphatase
Cytoplasm	–	LDH
Peroxime	–	Catalase
Plasma membrane	–	5'Nucleiotidase

Transport Mechanism



Transport Mechanism

1. **Active Transport**

-Require Energy

-Unidirection

-Require specific integrale protein called Transporter

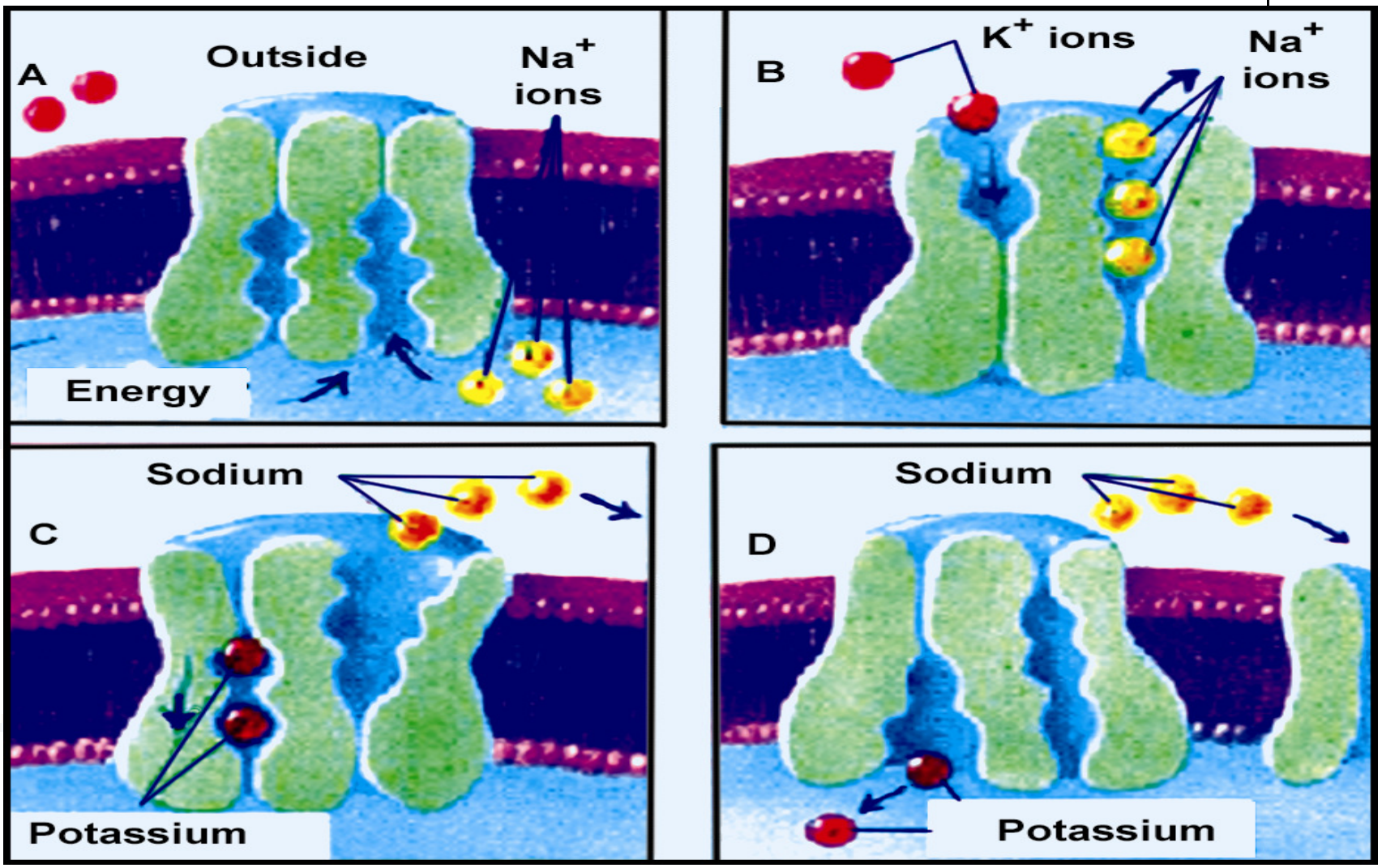
-Susceptible to inhibition

E.g. Sodium pump

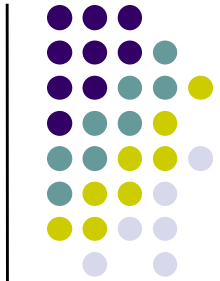
-Can saturated at higher concentration of solutes.

Na^+ - K^+ ATPase pump

- **Four subunit - 2 alpha + 2 beta**
- **Act by Phospharylation mechanism**



Passive Transport



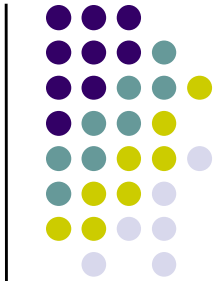
1 ***simple diffusion***

- Very slow process
- Driven by the concentration gradient
- Occurs from higher conc. to lower conc.
- Not require energy

2 ***Facilitated diffusion***

- Carrier Mediated
- Not require energy
- Fast than simple diffusion
- Depend on concentration gradiant
- Structurally similar solute can competitively inhibit
- Bi-direction
- By Ping & Pong mechanism
- e.g. Glucose transporter

Aquaporins



- Water channels
- Tetramer
- More than 10 aquaporins found in human
- AQP 1 – Choroid plexus of lateral ventricle & Play role in formation of CSF
- AQP 4 – Predominant water channel in brain
- In several disease, it's function impaired.

  Congenital cataract.

  Nephrogenic diabetes insipidus.

ION CHANNELS (Cation conductive channels)

- **Quick transporter**
- **For electrolyte like Ca^{+}, K^{+} ,Na^{+} ,Cl^{-}**
- **Important for Nerve impulse conduction, Synaptic transmission, Secreation biologically active substance**

1. Voltage gated channels

- which open by membrane depolarization

- Involve in nerve impulse conduction

- e.g. Na^{+} channels, K^{+} channels

- Local anesthateic like procaine block this channels.

- Point mutation in Na^{+} channels lead to Myotonia (Increase muscle excitability)

- Mutation in K^{+} channels lead to "Long QT syndrome" (Inherited cardiac arrythamia)

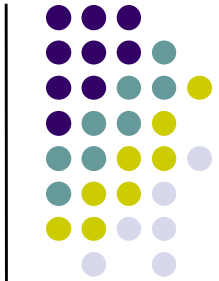
ION CHANNELS (Cation conductive channels)

2.Ligand gated channels

- **Open by binding of effector**
- **Acetyl choline which open Na^+ channel & generate action potential in post synaptic membrane.**
- **Inositol triphosphate opens Ca^+ channel in sarcoplasmic reticulum**

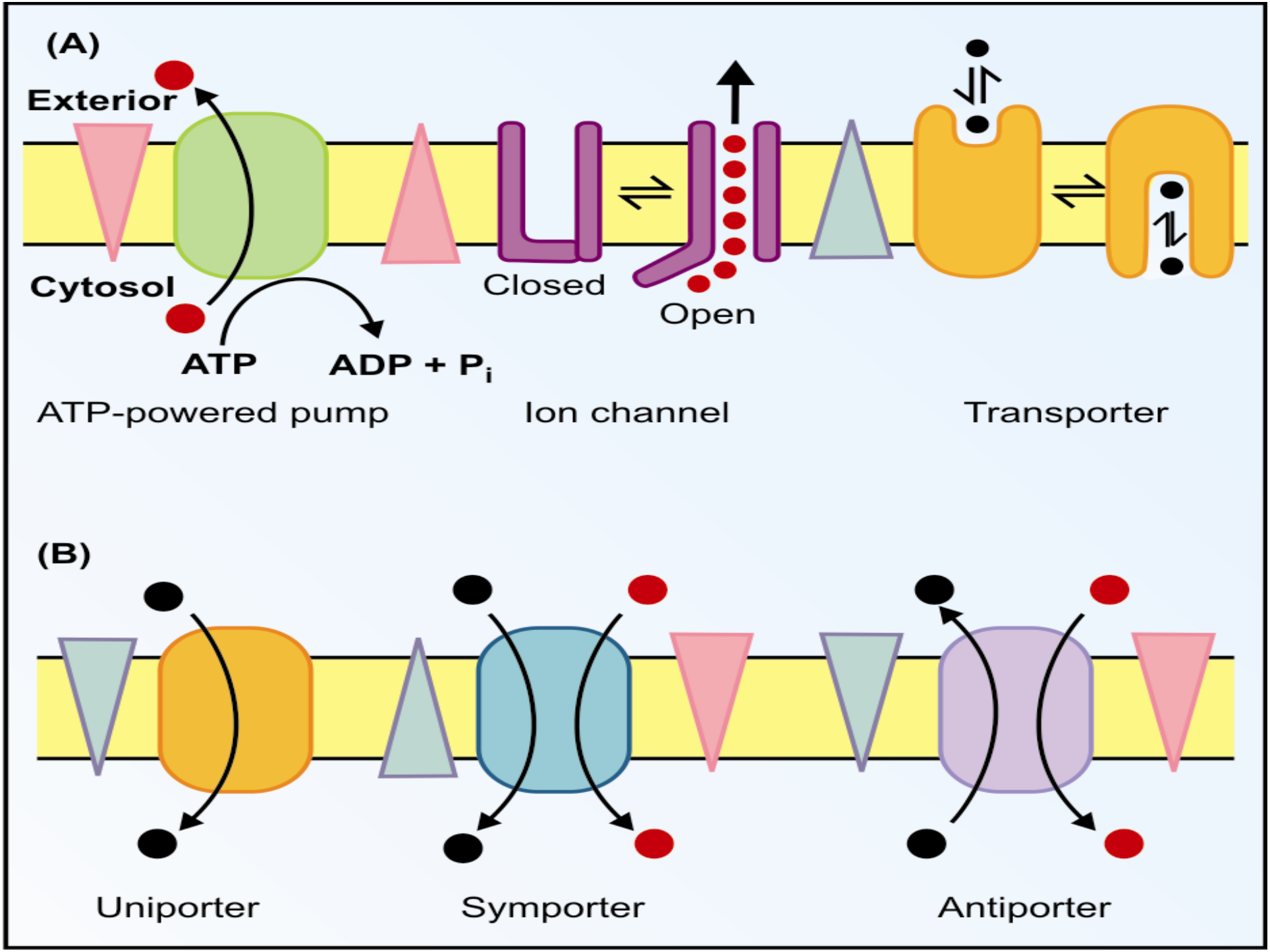
Ionophores

- It is a Transport antibiotic
- Mobile ion carriers – Valinomycin
- Channel formers - Gramicidin



- Uniport
- Glucose transporter
- Co – Transport

1. Symport
   - e.g. Sodium dependent glucose transport
   - Amino acid transport
2. Antiport
   - Na^+ - K^+ ATPase pump
   - Chloride – Bicarbonate exchange in RBC


(A)
Exterior
Cytosol
ATP
ADP + P_i
Closed
Open
ATP-powered pump
Ion channel
Transporter
(B)
Uniporter
Symporter
Antiporter

Secretory Vesicle & Exocytosis

- Under appropriate stimuli, the secreatory vesicle or vecuoles move towards & fuse with plasma membrane.
- Thus content of vesicles are externalised.This process is called Exocytosis or Reverse pinocytosis
- E.g.

- release of trypsinogen from pancreatic acinar cell
- release of insulin by beta cell of langerhans

Endocytosis

- Endocytosis is mechanism by which cells internalise extracellular macromolecules.
- Two type – Pinocytosis & Phagocytosis

Pinocytosis

- **"Drinking by cell" = take up fluid**
- **Receptor mediated**
- **E.g. LDL, several hormone take up by cell**

Phagocytosis

- **"Eating by cell"**
- **Engulfment of large particles such as bacteria by macrophages & granulocytes.**