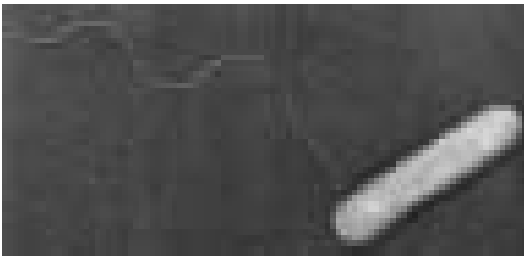


Plasma Membrane

- Prokaryotes & Eukaryotes
- isolates cell contents from surrounding environment
- allowed the development of complex biochemical reactions



Nuclear Membrane

- Eukaryotes
- isolates nuclear contents from cytoplasmic environment

- **Membranes- Functions**

- compartments
- localization of function
- regulation of transport
- detection of signals
- cell-cell communication

Membranes- History

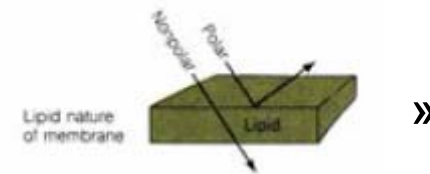
1890 Charles Overton

- selective permeation of membranes
 - » non-polar pass through (lipid soluble)
 - polar refractory
- lipids present as a coat

1905 Irving Langmuir

1925 Gorter & Grendel

- monolayer of lipid isolated from rbc's
- 2x surface area of cell (bilayer)



1935 Davson & Danielli



»

- differential permeability of sugars
- » more permeable to ions than artificial membranes
- protein present as a coat over lipids

1960 Robertson

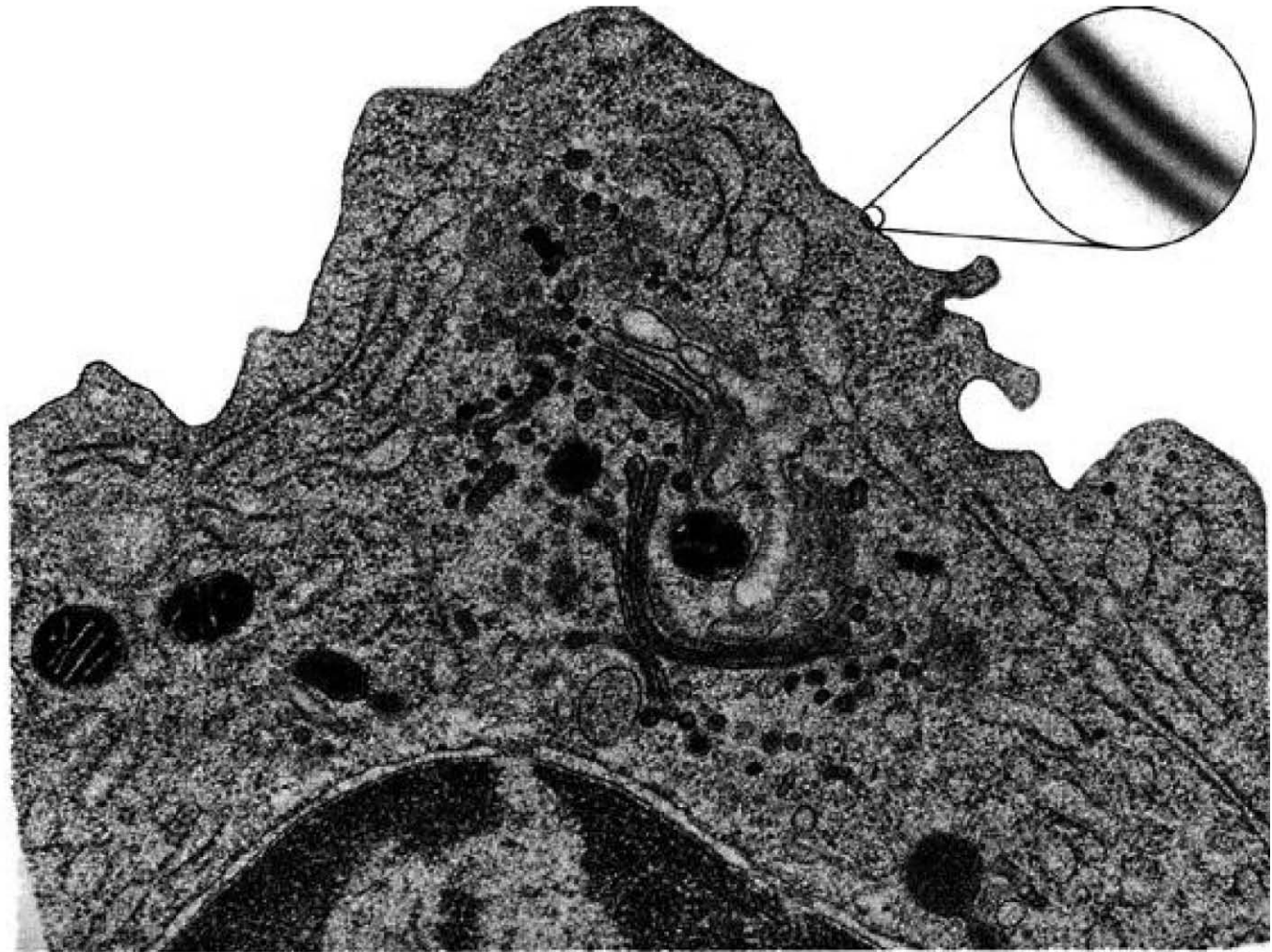
- EM study shows “railroad track”
trilaminar dark-light-dark, 7.5 nm
- unit membrane
- protein on outside of lipid bilayer

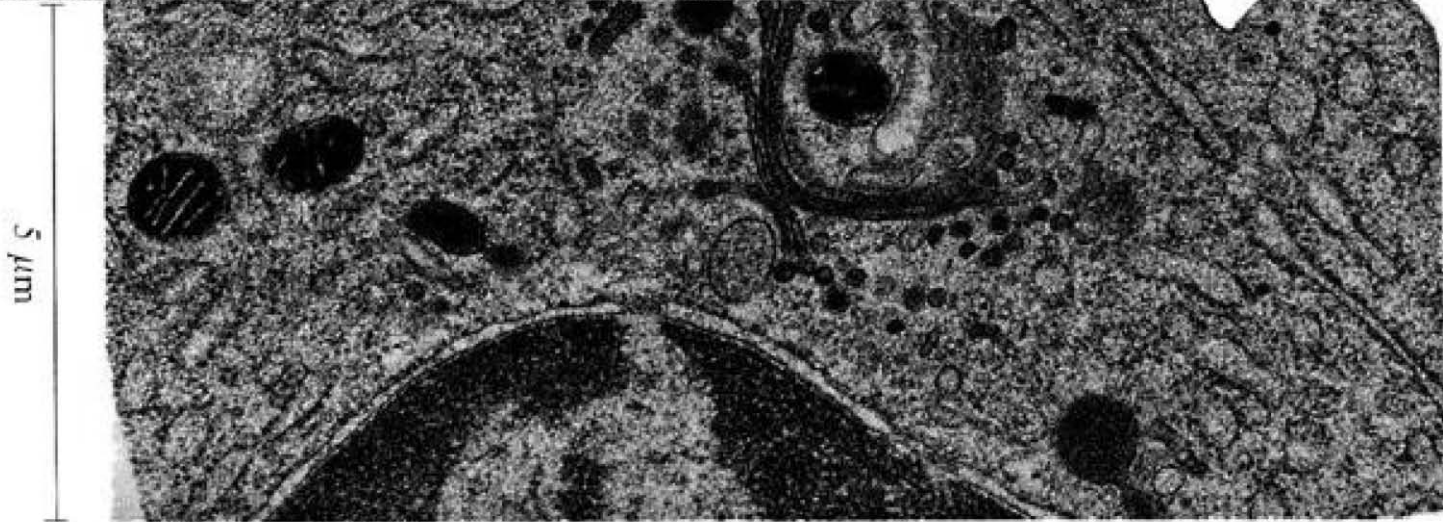
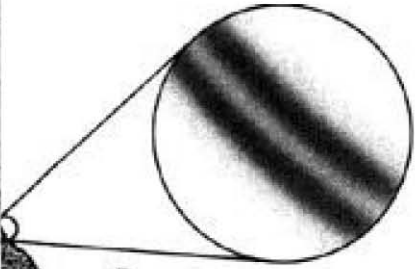
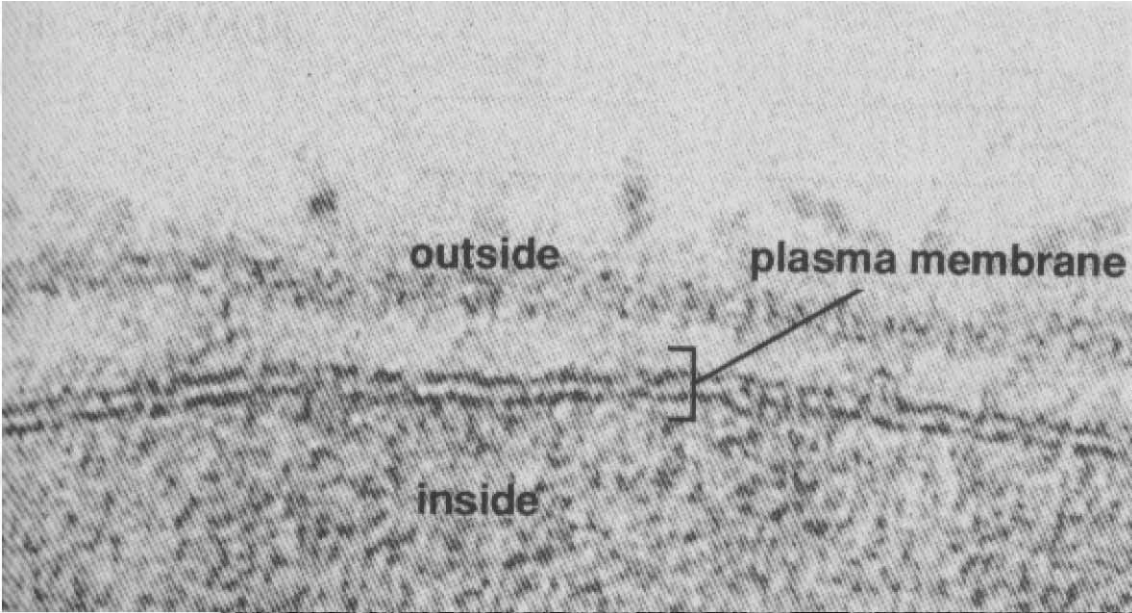


»



5 μm





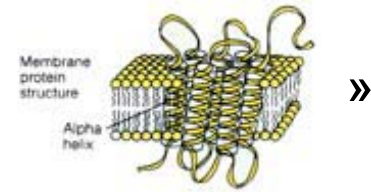
1972 Singer & Nicholson

- fluid mosaic model
 - » protein/lipid ratio too variable
 - 3 bacteria, 0.23 myelin
 - mitochondria outer 1.2, inner 3.5
 - » isolated membrane proteins- globular
- membrane proteins were discrete
 - » mosaic of proteins discontinuously embedded in lipid bilayer
- lipid components in constant motion
 - » integral and peripheral membrane proteins
 - » free and anchored proteins



1975 Unwin & Henderson

- integral membrane proteins
 - » both hydrophobic and hydrophilic
- bacteriorhodopsin



- alternating -phobic and -philic represent trans-membrane loops.

• Glycoproteins

- carbohydrate groups on outer surface

1997 “Membrane Rafts”

- “A new aspect of cell membrane structure is presented, based on the dynamic clustering of sphingolipids and cholesterol to form rafts that move within the fluid bilayer. It is proposed that these rafts function as platforms for the attachment of proteins when membranes are moved around inside the cell and during signal transduction.”
 - » Simons K, Ikonen E. Nature 1997 Jun 5;387(6633):569-72

“Membrane Rafts”

- Many types of experiment show that the plasma membranes of cells are patchy and locally differentiated into domains.

- Some of these domains seem to arise through the confinement of diffusible membrane proteins.
- Others might arise through lipid-lipid interactions.
- Both types of domain are transient on a biological timescale but both could create local conditions that enhance molecular interactions, such as those that occur in receptor-mediated signaling.

» TRENDS in Cell Biology Vol.11 No.12 December 2001 492

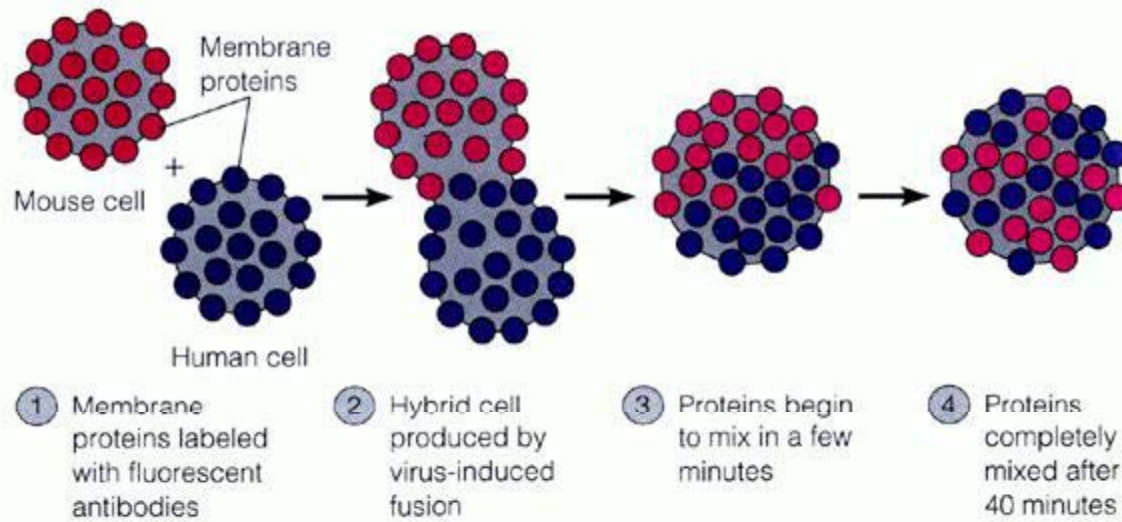
1997 “Membrane Rafts”

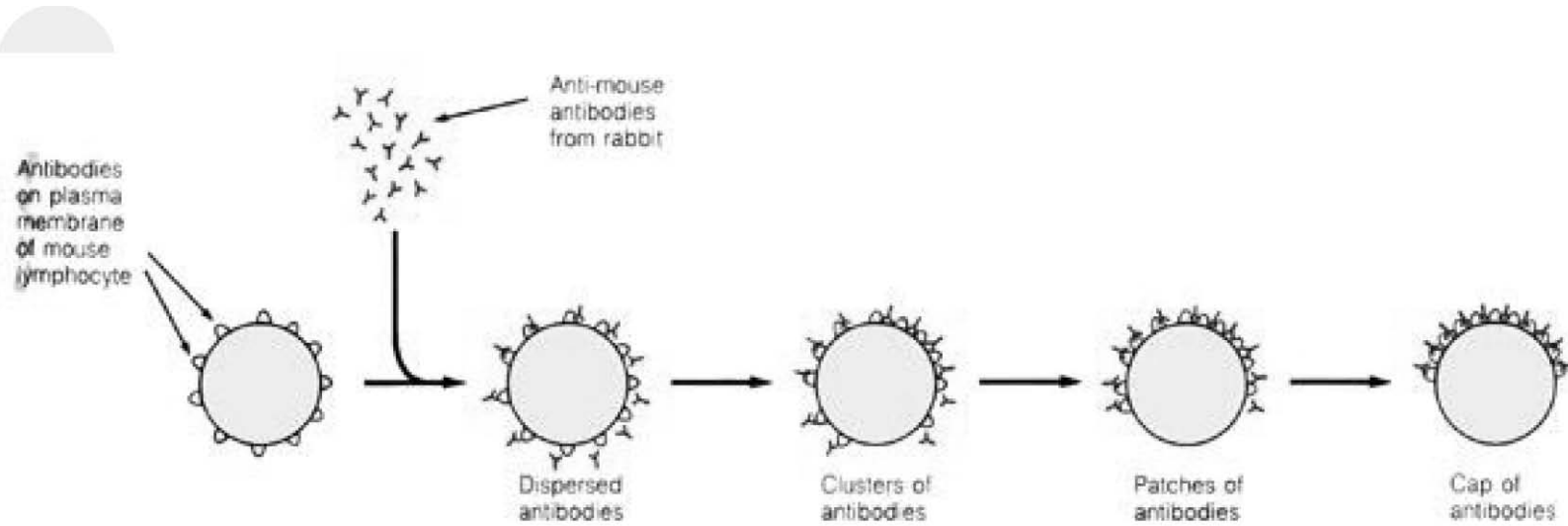
- "membrane-active sterols" appear in biological membranes of eukaryocytes is one of the major steps in membrane evolution.
 - » membrane-active sterols can control membrane permeability by reducing average "fluidity" and free volume
- Cholesterol also has a key role in the lateral organization of

membranes and free volume distribution. » The latter two parameters may control membrane protein activity and "raft" formation.

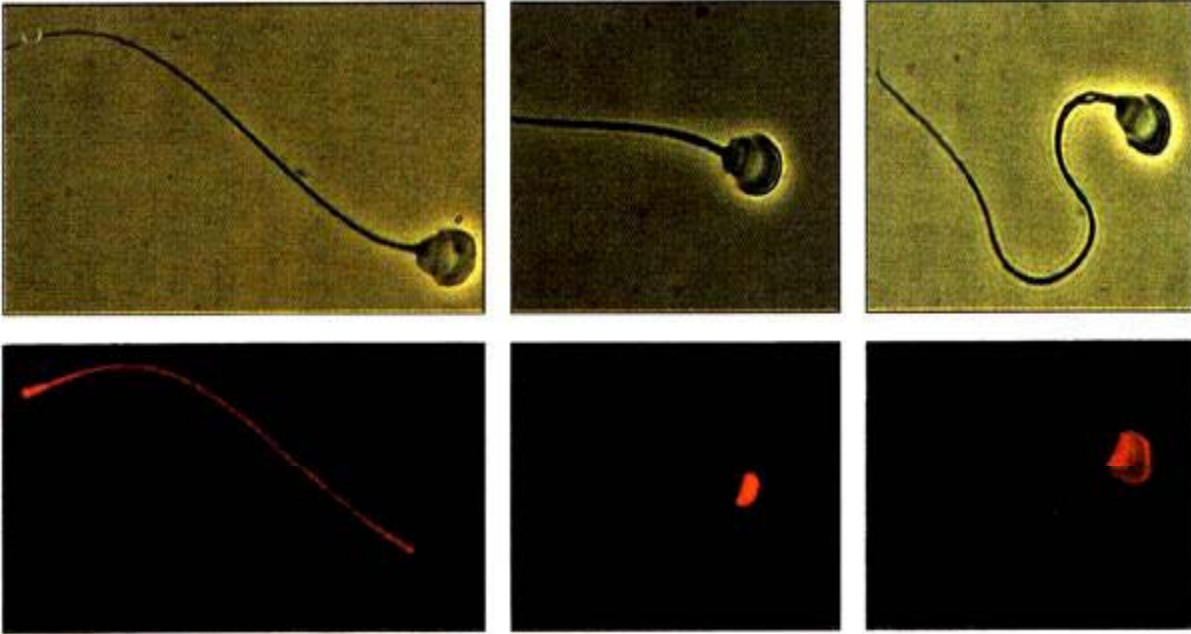
- » fine tuning of membrane lipid composition, organization/dynamics, and function.

Membrane Fluidity





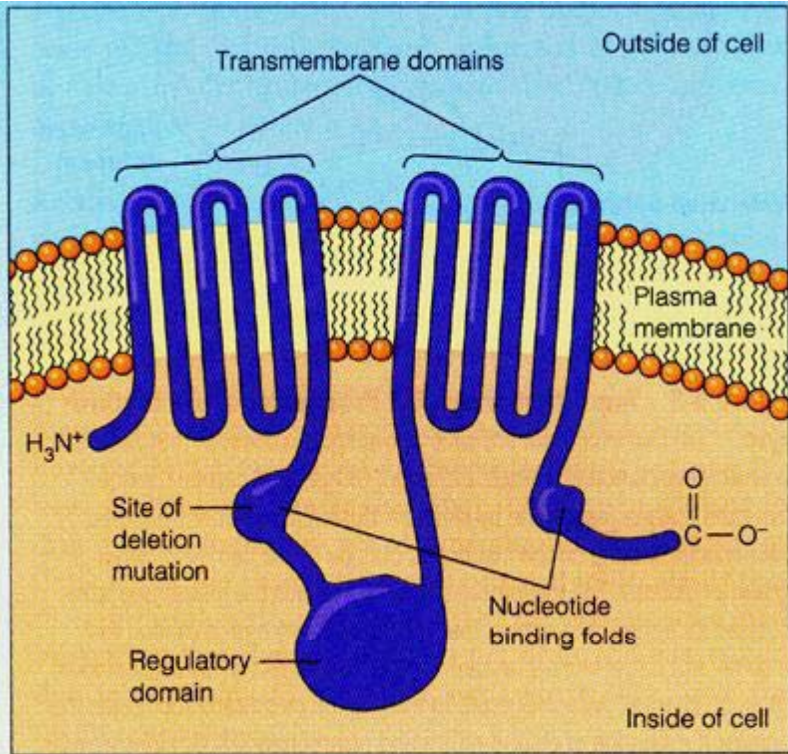
Membrane domains



Membrane Transport

Cystic Fibrosis

- 1989 Collins (US), Tsui & Riordan (Can)
 - . • mutation of Chloride channel protein
 - . • point mutant, folded improperly, trapped and degraded in ER



Membrane Transport

Passive

- Simple diffusion

Facilitated

- transport proteins
- Active
- nutrient uptake, secretion, ion balance

phospholipid impermeable to ions in aqueous solution protein channels permit rapid ion flux

» 1960's structure and function, ionophores (simple ion channels)

- **common structural motif**

- alpha helix

Ion Channels

75 + different ion channels

- Allosteric proteins
- conformation regulated by different stimuli
- opening/closing, “gating” of ions

- 3 rapid gate + 1 slow gate (gap junction)
- Gap junction
- allow ions to flow between adjacent cells • open/close in response to Ca^{2+} and protons

Voltage-gated

- propagation of electrical signals
- along nerve , muscle

Ligand-gated

- opened by non-covalent, reversible binding of ligand
- between nerve cells, nerve-muscle, gland cells

Mechanical-gated

- regulated by mechanical deformation

Action Potentials

(covered in Physiology and Neuroscience)

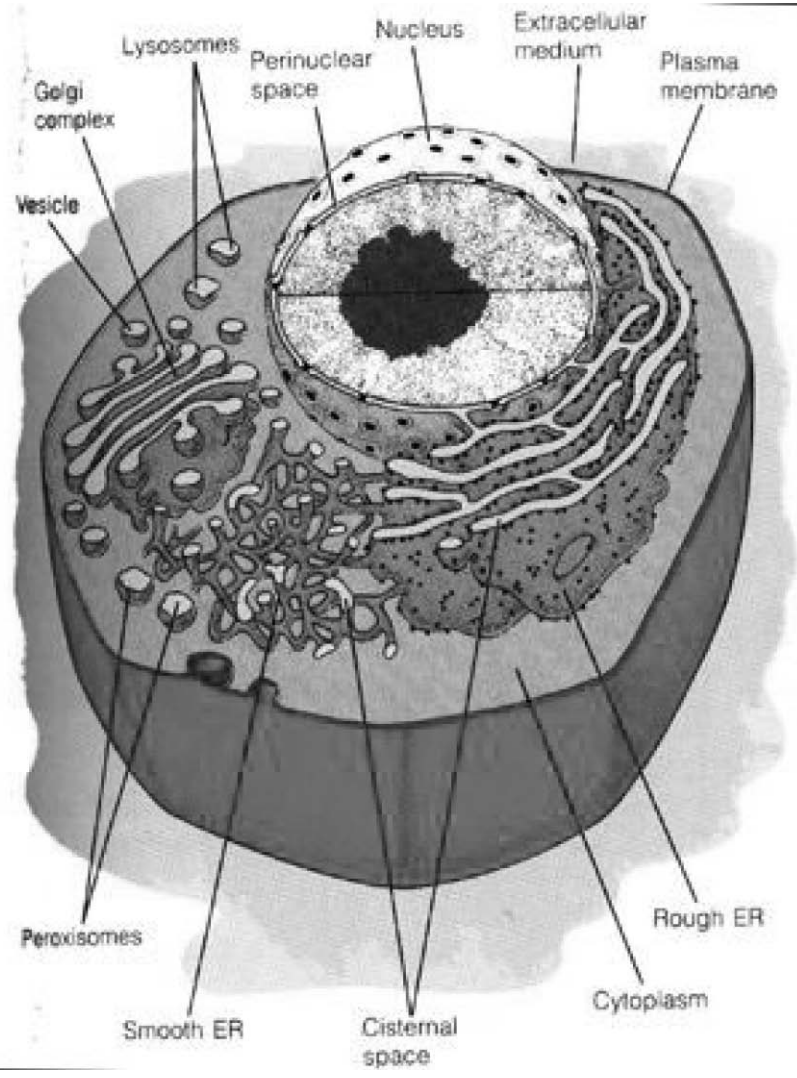
- transfer of information over long distances
- voltage gated sodium and potassium ion channels make cells electrically excitable
- velocity
 - » axon calibre and myelin

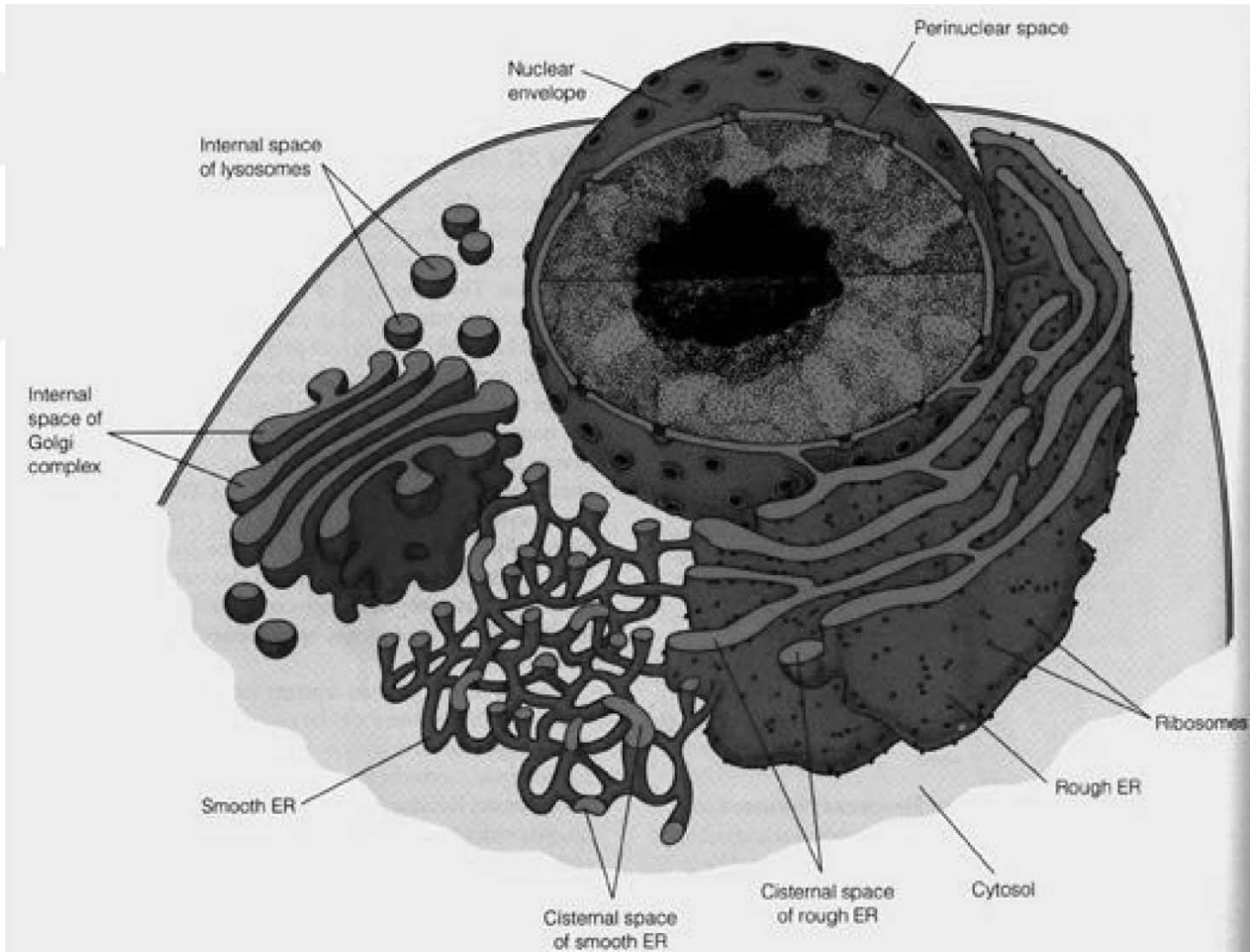
Endoplasmic Reticulum

- Golgi Complex

Lysosomes & Peroxisomes

- protein sorting





Endoplasmic Reticulum

