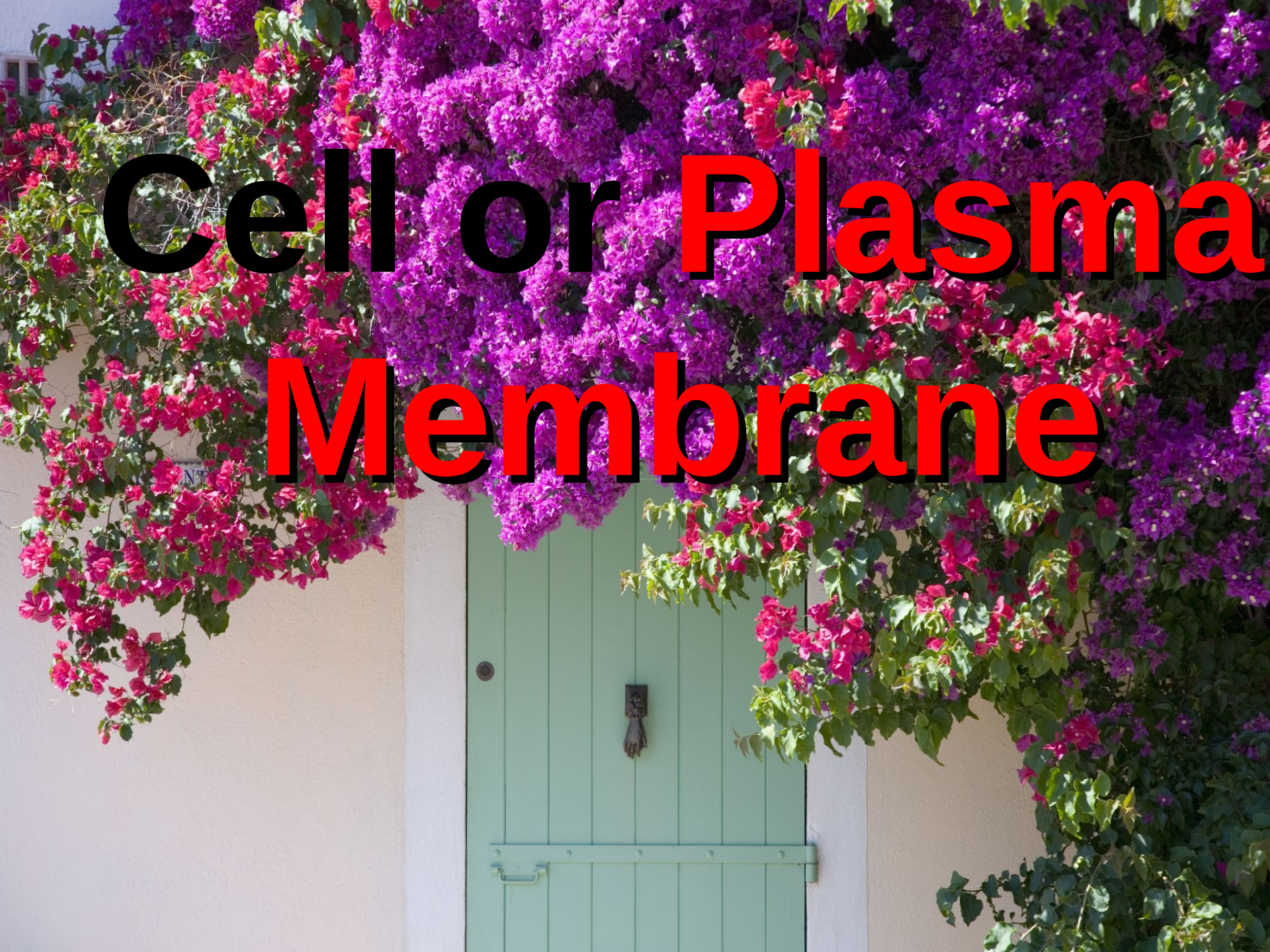
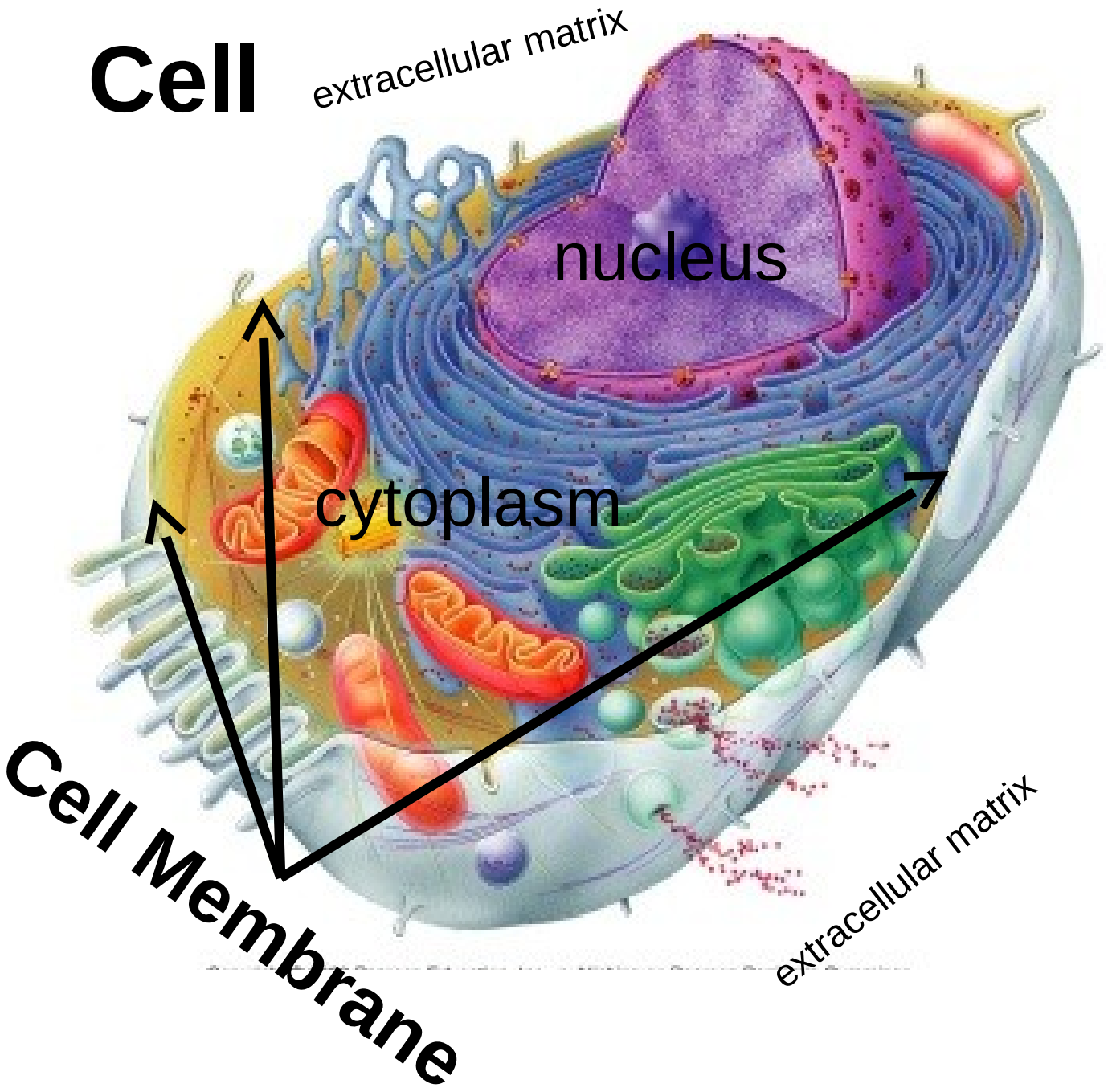
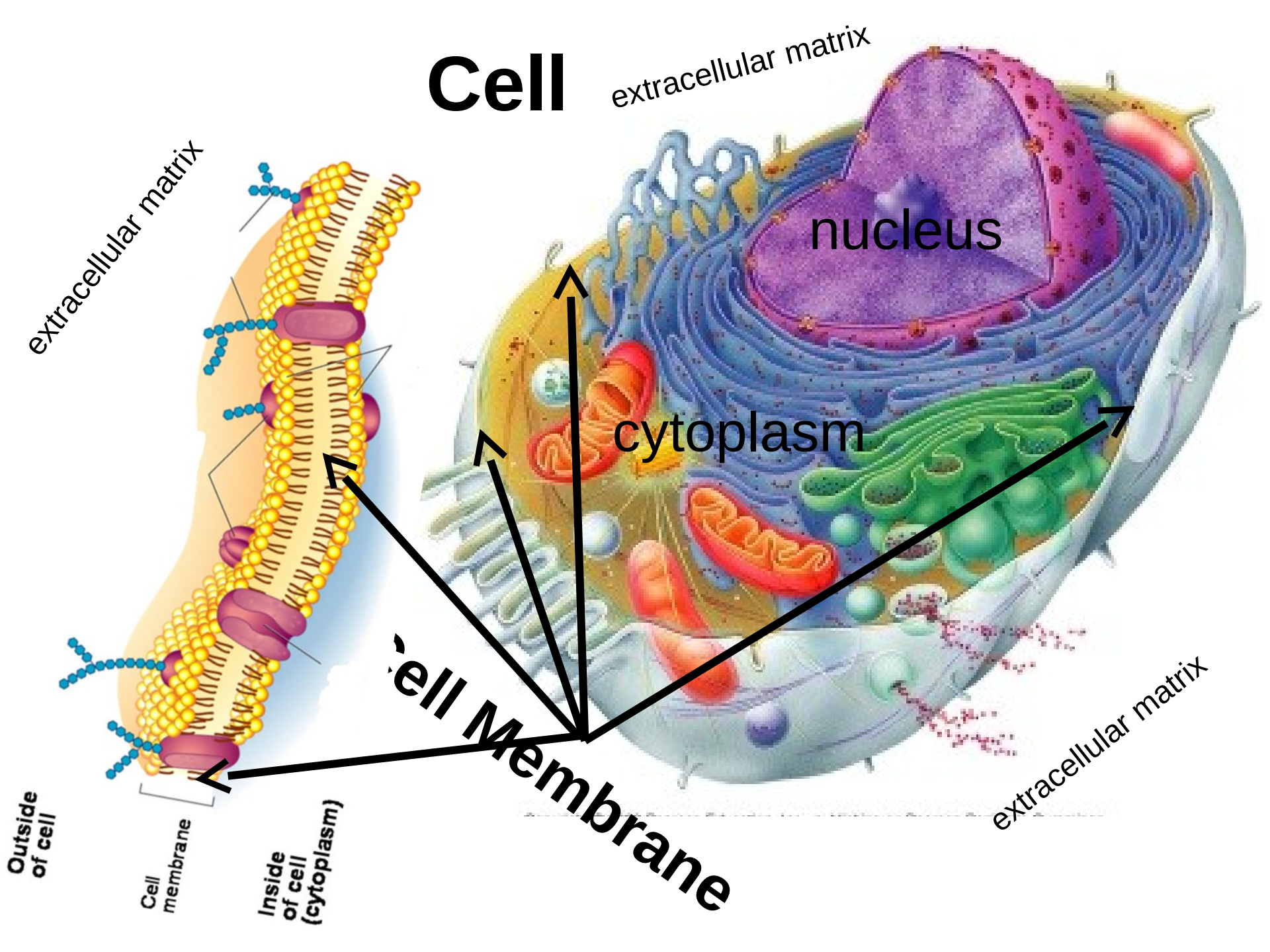
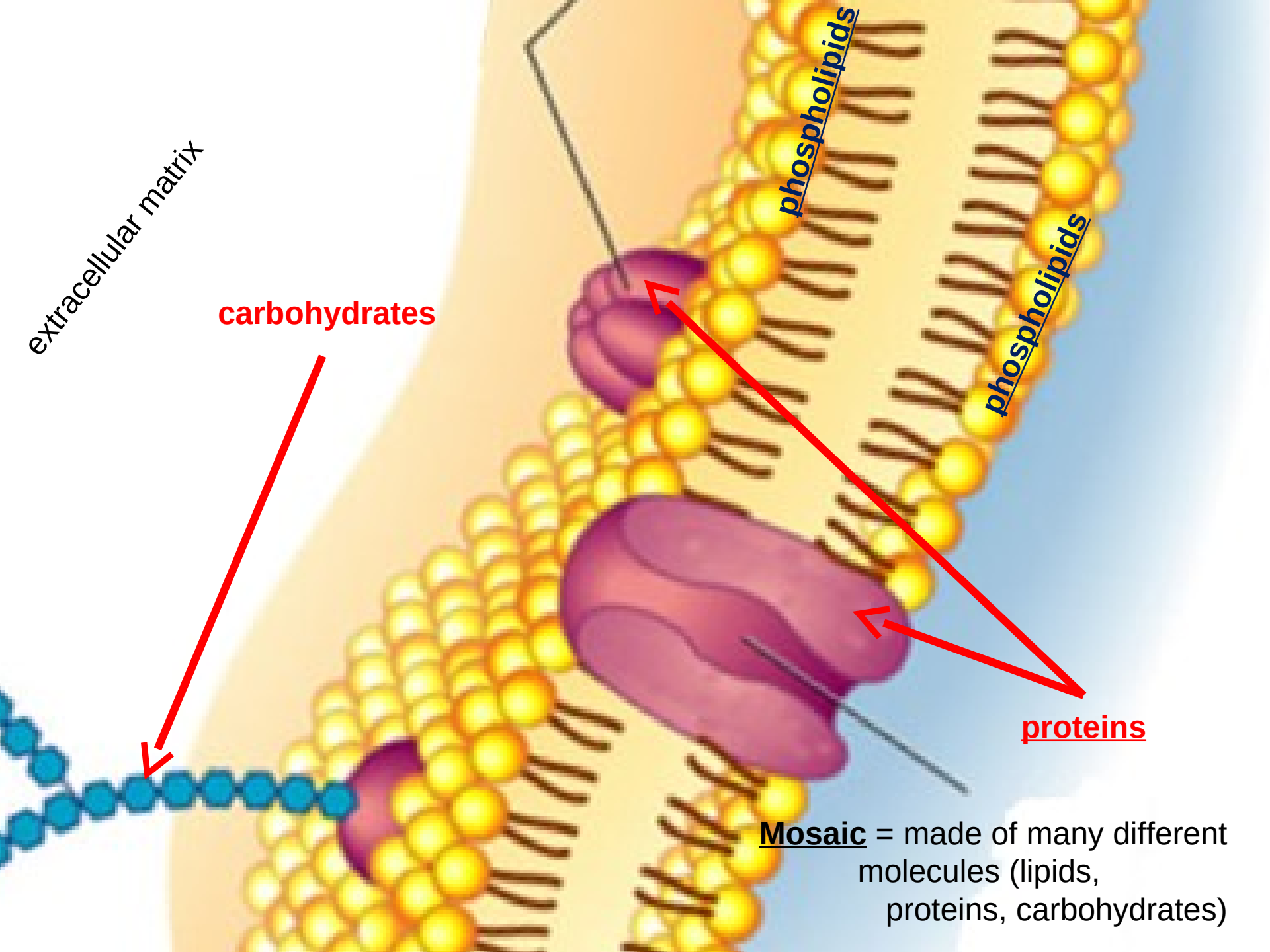

Cell or Plasma
Membrane

Cell


extracellular matrix
nucleus
cytoplasm
Cell Membrane
extracellular matrix


Cell
extracellular matrix
extracellular matrix
nucleus
cytoplasm
Cell Membrane
extracellular matrix
Outside of cell
Cell membrane
Inside of cell (cytoplasm)



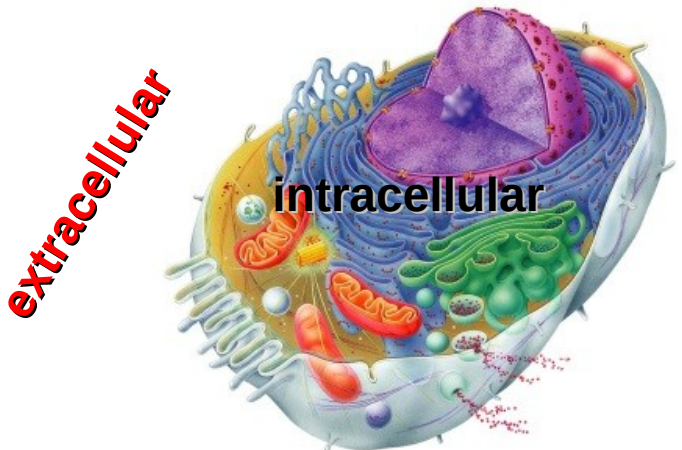
Mosaic = made of many different molecules (lipids, proteins, carbohydrates)

plasma membrane

- The outermost component of cell, separating cytoplasm from its extracellular environment, is **plasma membrane** (**plasmalemma**).

- It is the external limit of the cell, there is a continuum between the interior of cell (**intracellular**) & (**extracellular**) macromolecules.

- It contains proteins called **integrins** that are linked to cytoplasmic cytoskeletal filaments and to extracellular molecules in matrix.



- All eukaryotic cells are enveloped by a limiting membrane composed of:
  - **phospholipids**, **cholesterol**, **proteins**, & chains of **oligosaccharides** covalently linked to phospholipids and protein molecules.
- Membranes range from **7.5 - 10 nm** in thickness and consequently are visible only in the electron microscope.

plasma membrane functions:

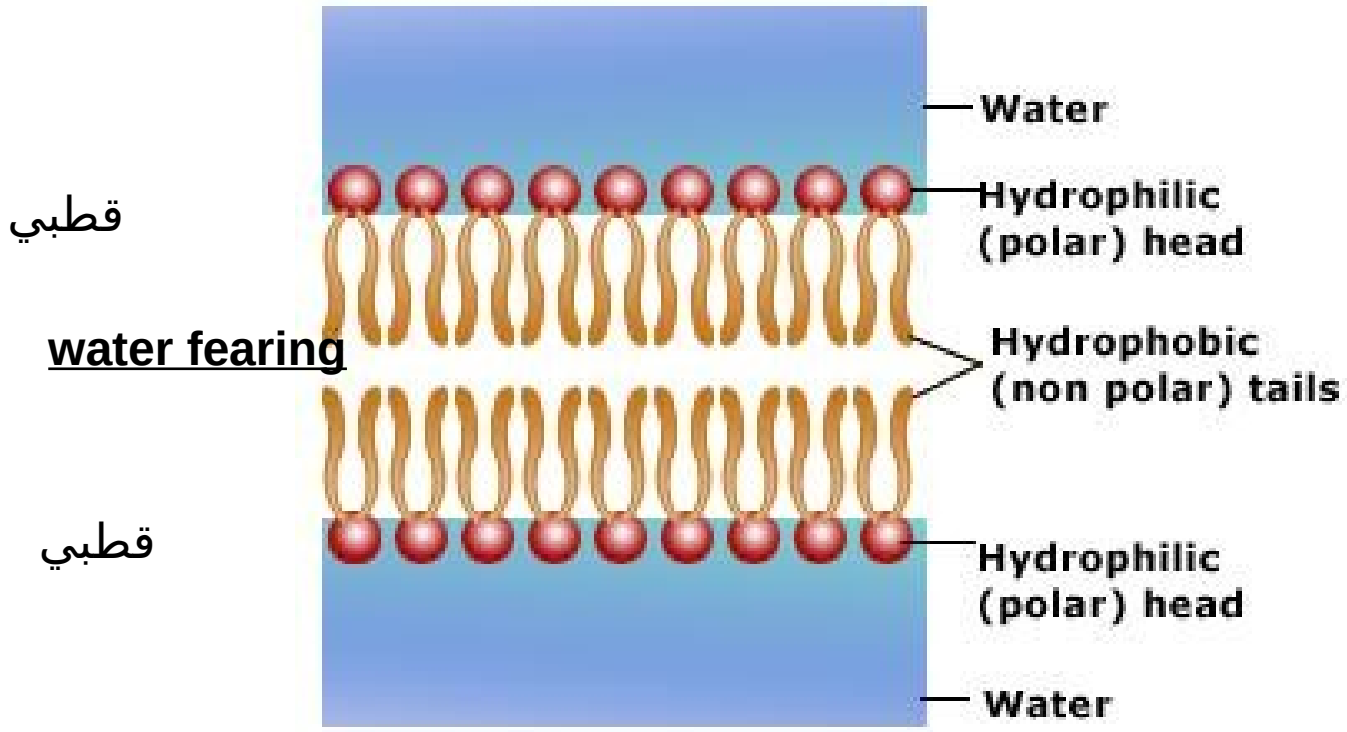
A. **Act** as a selective barrier that regulates the passage of certain materials into and out of the cell and facilitates the transport of specific molecules.

B. keep **constant** the intracellular milieu, which is different from the extracellular fluid.

C. carry out a number of specific recognition and regulatory functions, playing an important role in the interactions of the cell with its environment.

Components
of
plasma membrane

1-Phosopholipid Bi-Layer



-polar heads are hydrophilic "**water loving**"

-tails (fatty acids) are hydrophobic "**water fearing**" and face inward

Phospholipids (PL) are a group of polar lipids that consist of two **fatty acids**, a **glycerol** unit and a **phosphate group** which is esterified to an organic molecule (X) such as choline, ethanolamine, inositol, etc.

Membrane **phospholipids**, such as phosphatidylcholine (lecithin) and phosphatidylethanolamine (cephalin), consist of two long, nonpolar (hydrophobic) hydrocarbon chains linked to a charged (hydrophilic) head group.

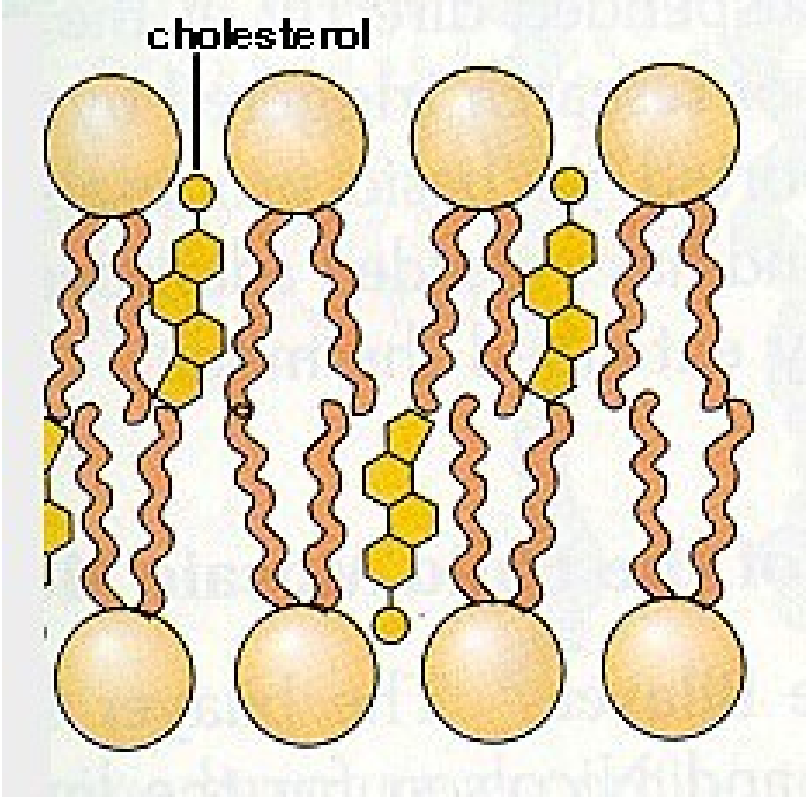
Cholesterol is a constituent of cell membranes. Within the membrane, phospholipids are most stable when organized into a double layer with their hydrophobic (nonpolar) chains directed toward the center of the membrane and their hydrophilic (charged) heads directed outward.

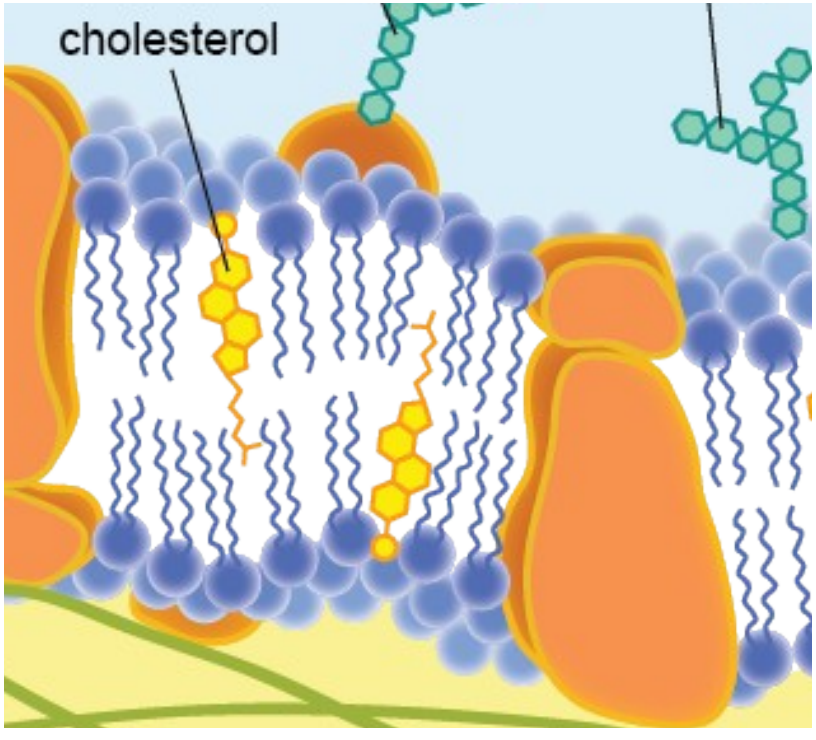
Cholesterol breaks up the close packing of the phospholipid long chains, and this disruption makes the membrane more fluid.

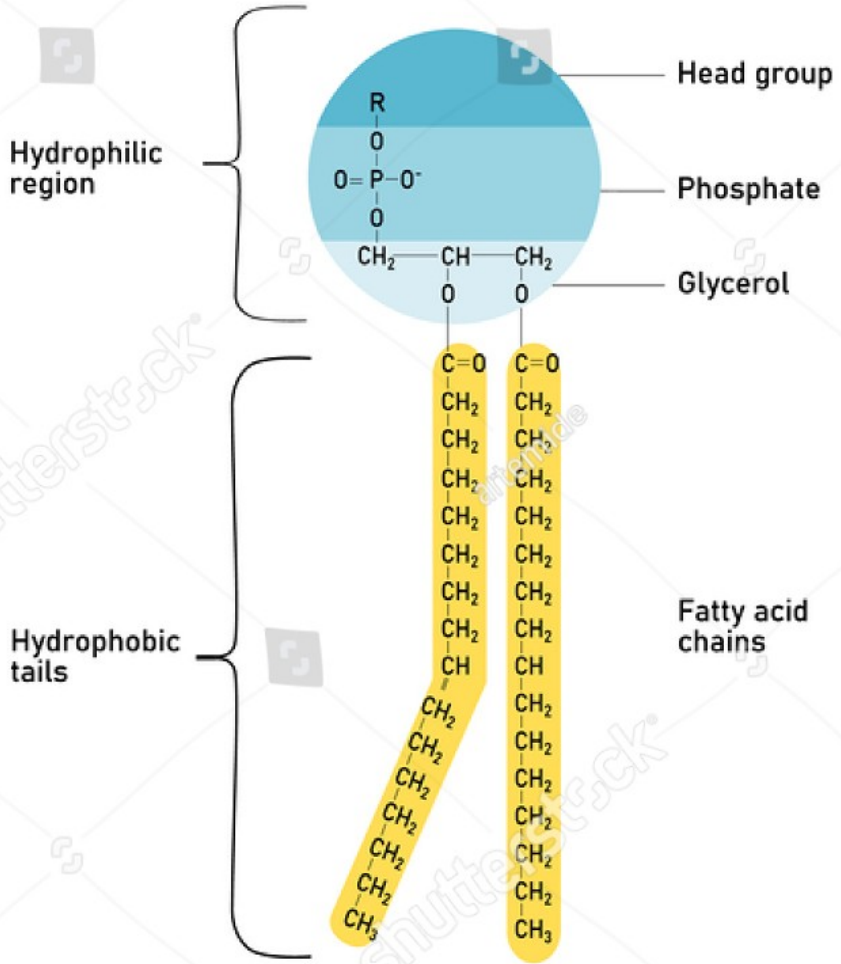
The cell controls the fluidity of the membranes through the amount of cholesterol present.

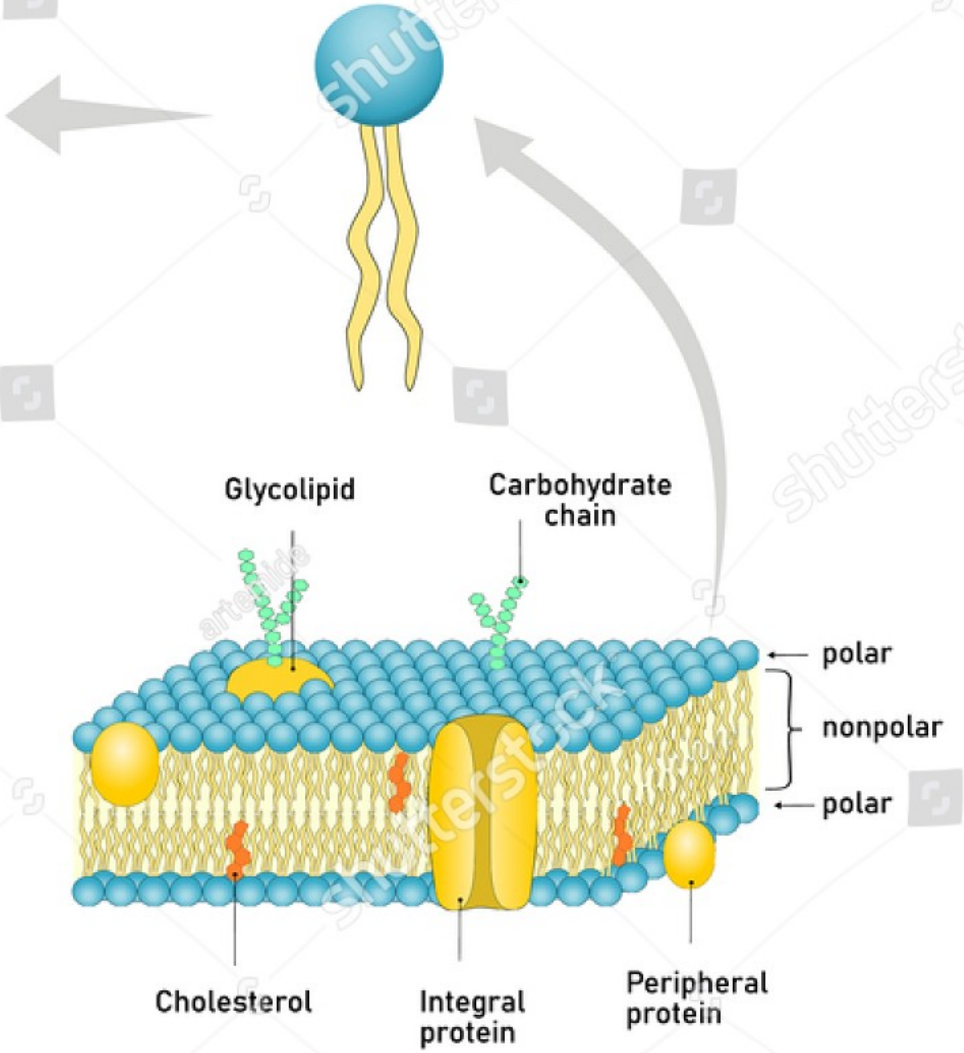
2- Cholesterol within Phosopholipid bilayer

- Type of steroid (lipid) that make cell membrane more **Fluid** = pliable/easily moved
  - Changes fluidity of cell membrane
    - Higher temps – stiffens membrane
    - Lower temps – prevents membrane from freezing

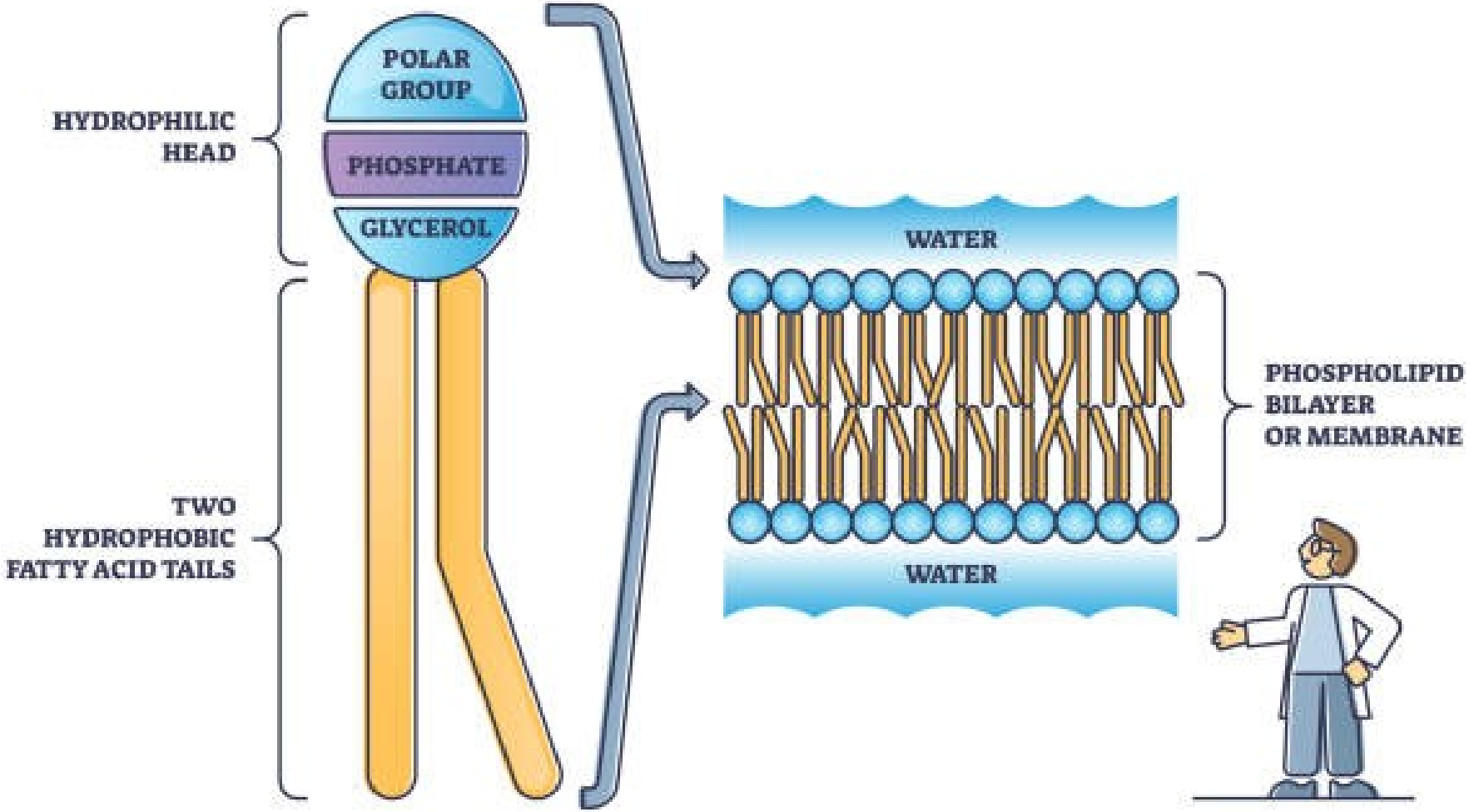


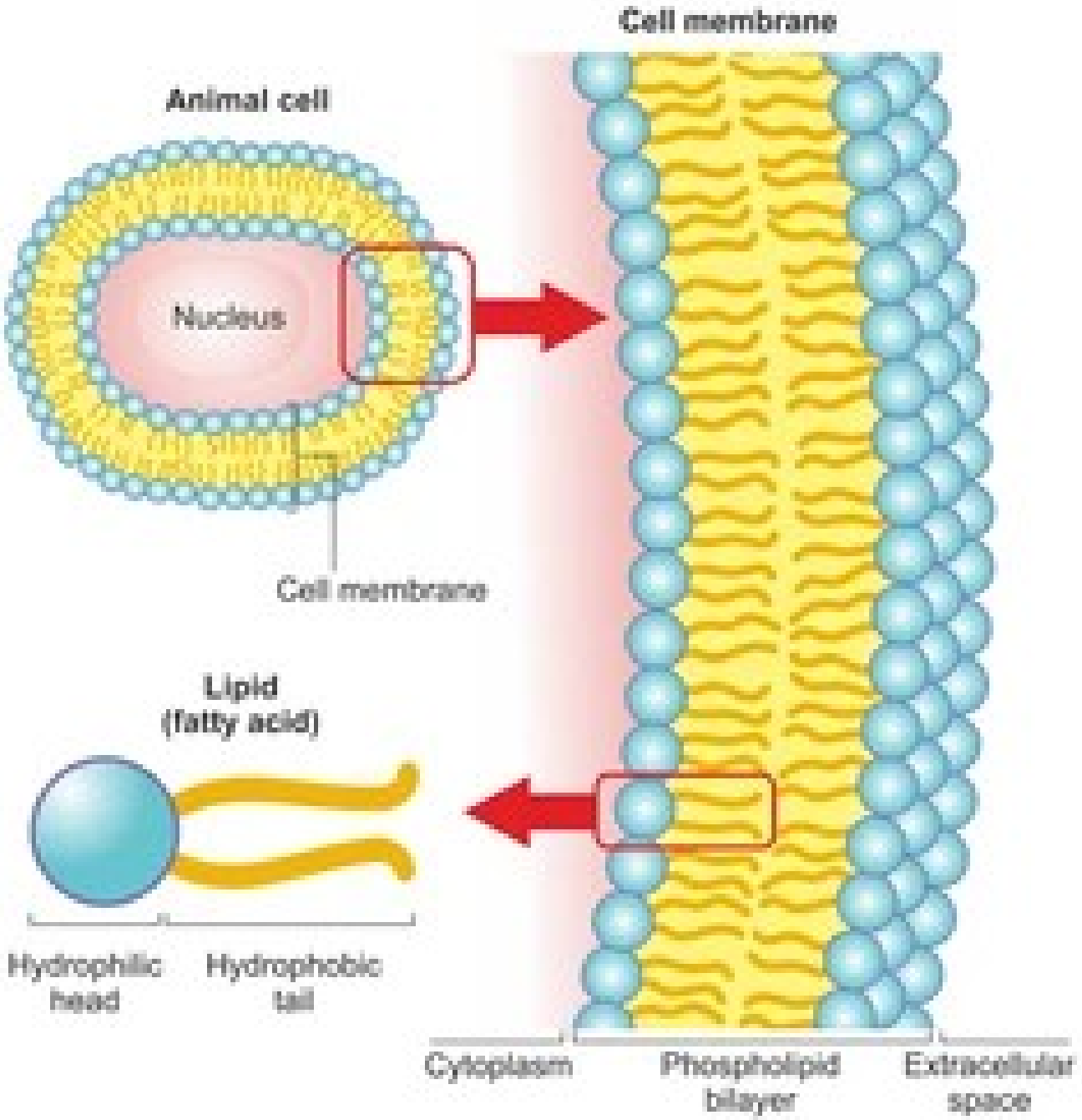



Hydrophilic region
Hydrophobic tails
Head group
Phosphate
Glycerol
Fatty acid chains

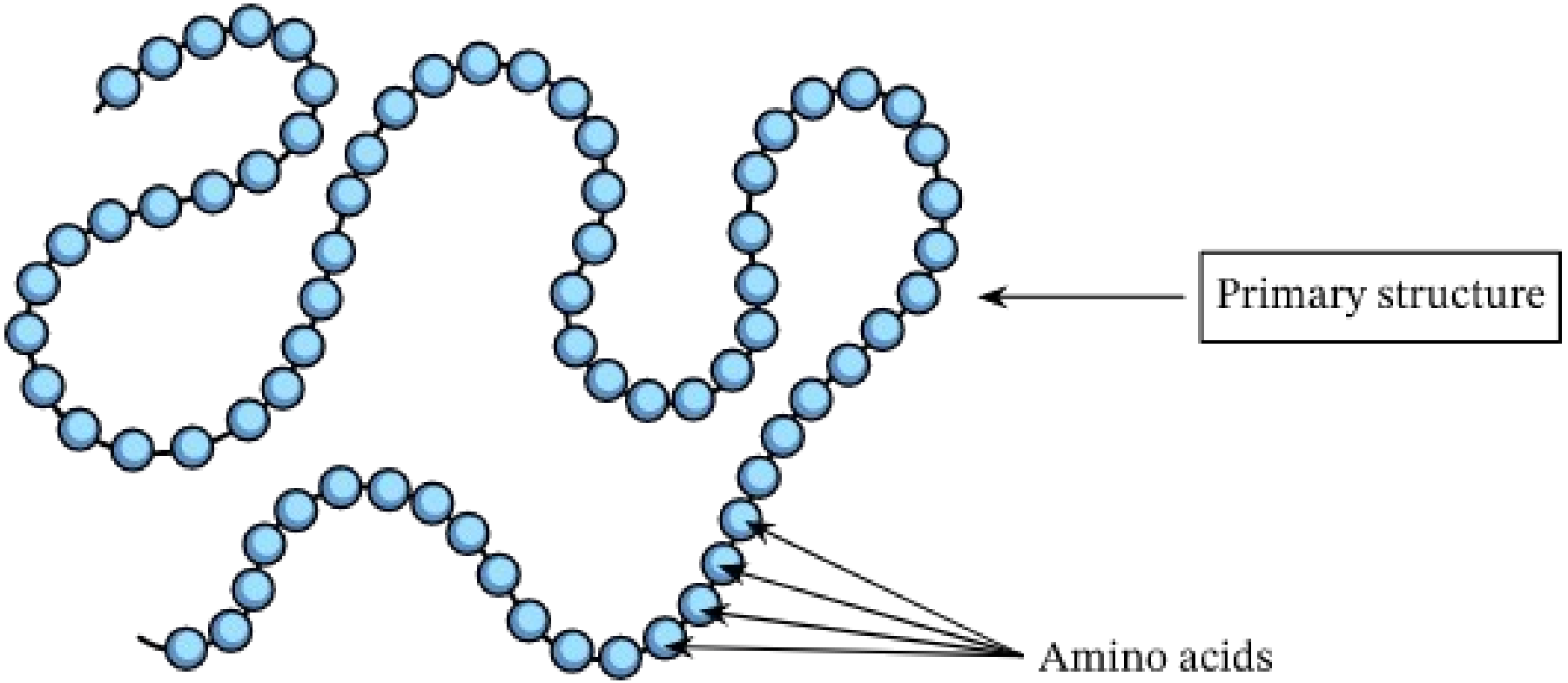

Glycolipid
Carbohydrate chain
polar
nonpolar
polar
Cholesterol
Integral protein
Peripheral protein

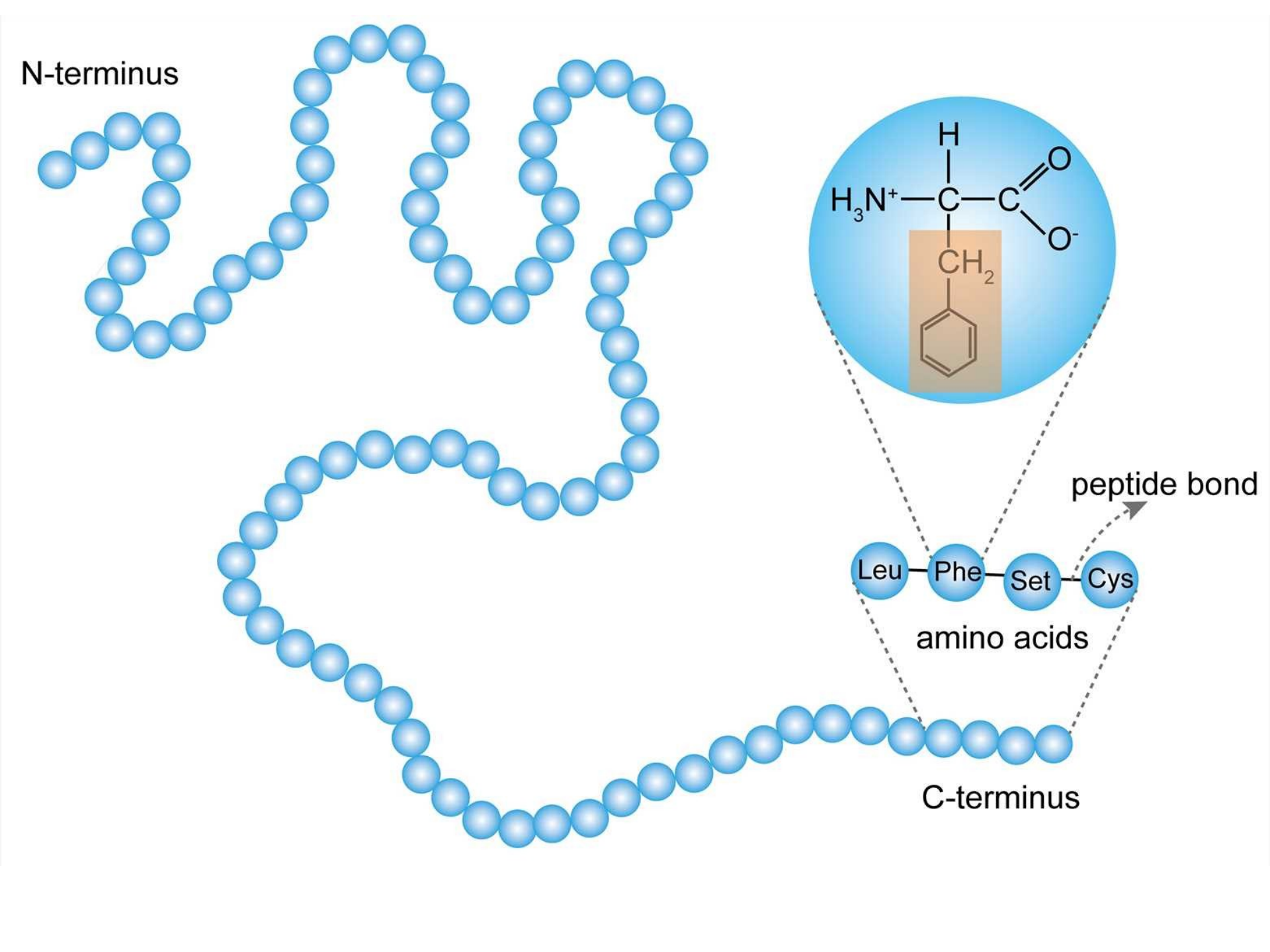
PHOSPHOLIPIDS



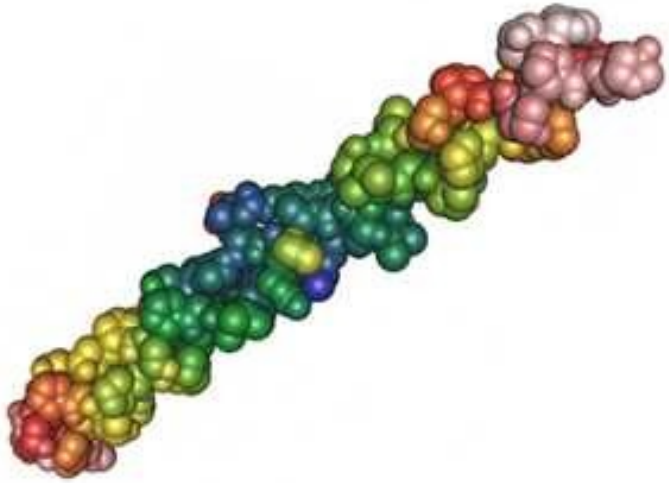

Cell membrane
Animal cell
Nucleus
Cell membrane
Lipid
(fatty acid)
Hydrophilic
head
Hydrophobic
tail
Cytoplasm
Phospholipid
bilayer
Extracellular
space

3-Proteins

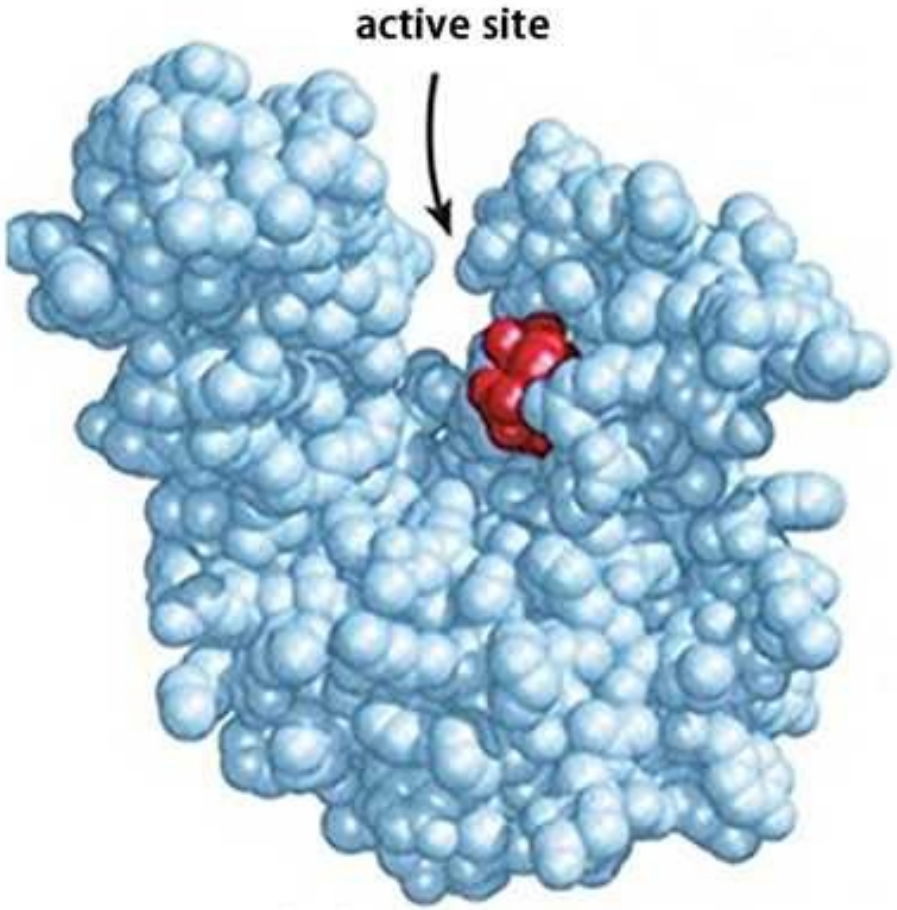



N-terminus
H
H_3N^+
C
C
O
O^-
CH_2
peptide bond
Leu
Phe
Set
Cys
amino acids
C-terminus

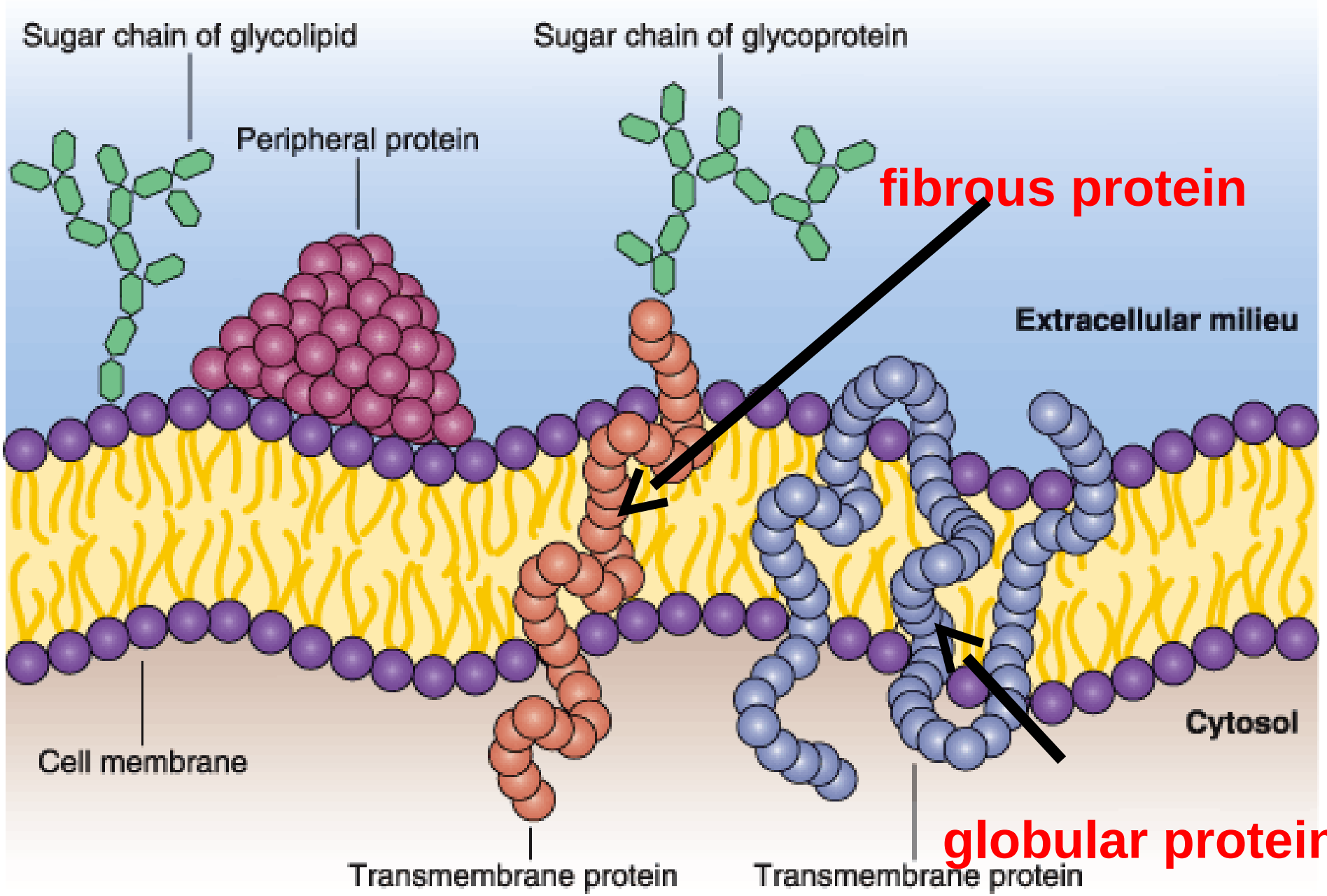
Proteins structure have two configurations: fibrous or globular protein



Fibrous protein

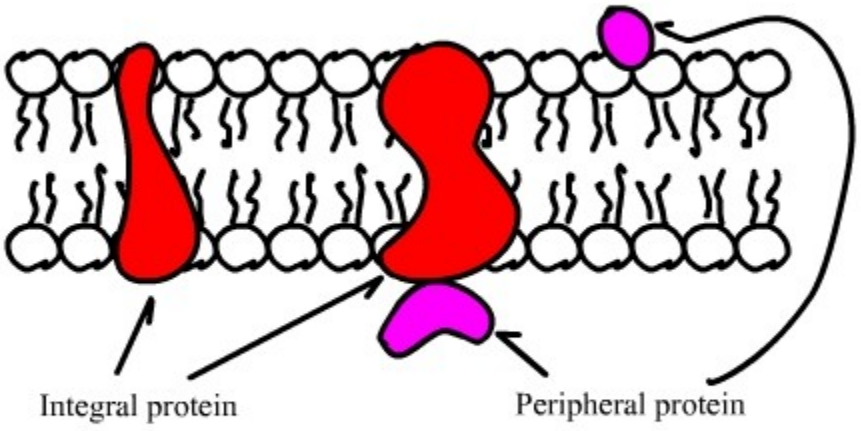


Globular protein


Sugar chain of glycolipid
Sugar chain of glycoprotein
Peripheral protein
fibrous protein
Extracellular milieu
Cytosol
Cell membrane
Transmembrane protein
Transmembrane protein
globular protein

3-Proteins in the cell membrane either:

- **Integral**
  - Proteins that cross both layers of the phospholipid bilayer
- **Peripheral**
  - proteins that are only on the top half or bottom half of the phospholipid bilayer



Function of protein in the cell membrane:

a-Recognition Proteins

- Proteins that have carbohydrate chains attached
- Carbohydrate chains aid in cell identification
  - "Name Tags"

b-Receptor Proteins

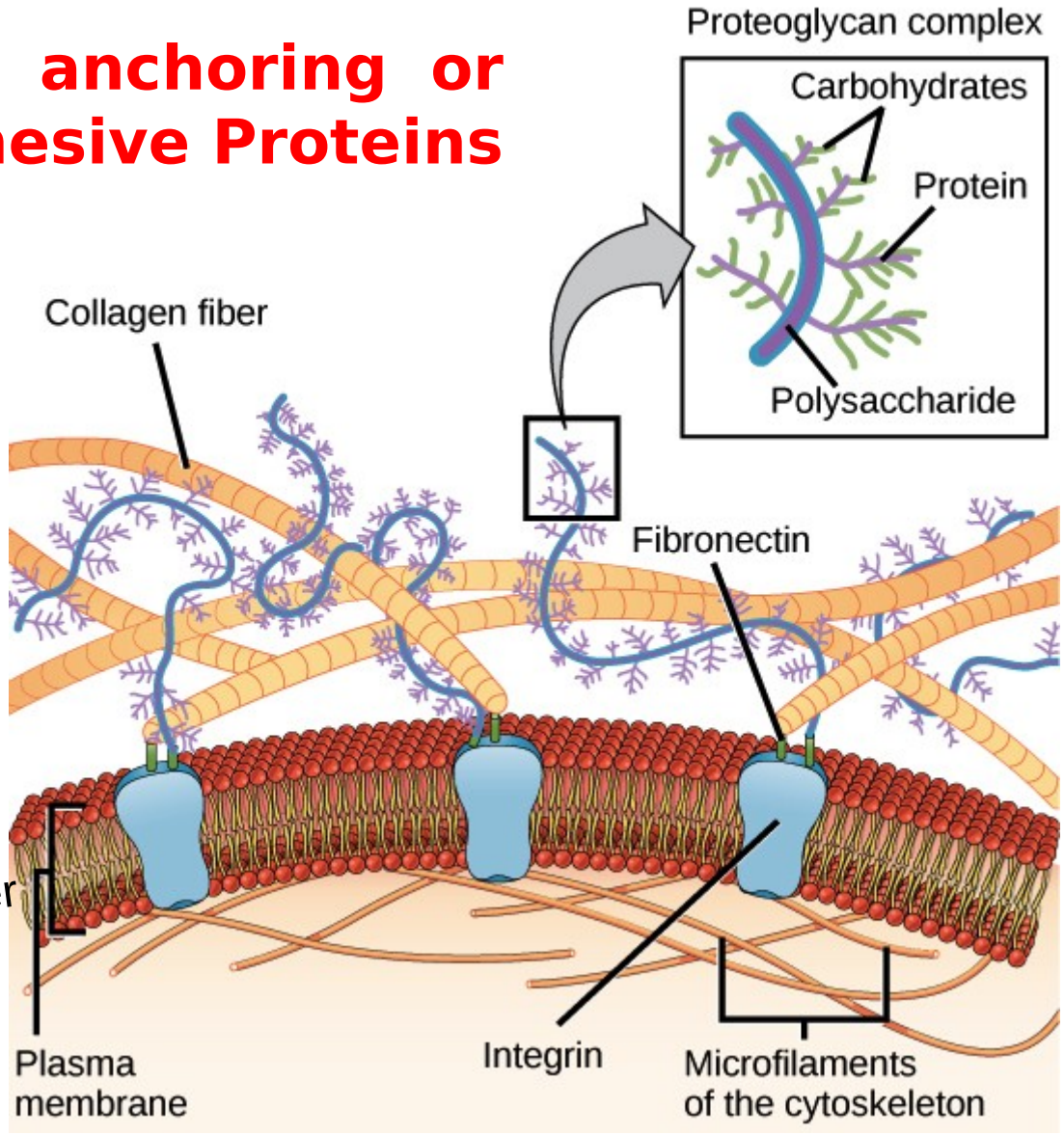
- Proteins that receive chemical signals from other cells
- Such as nervous system cells

Function of protein in the cell membrane:

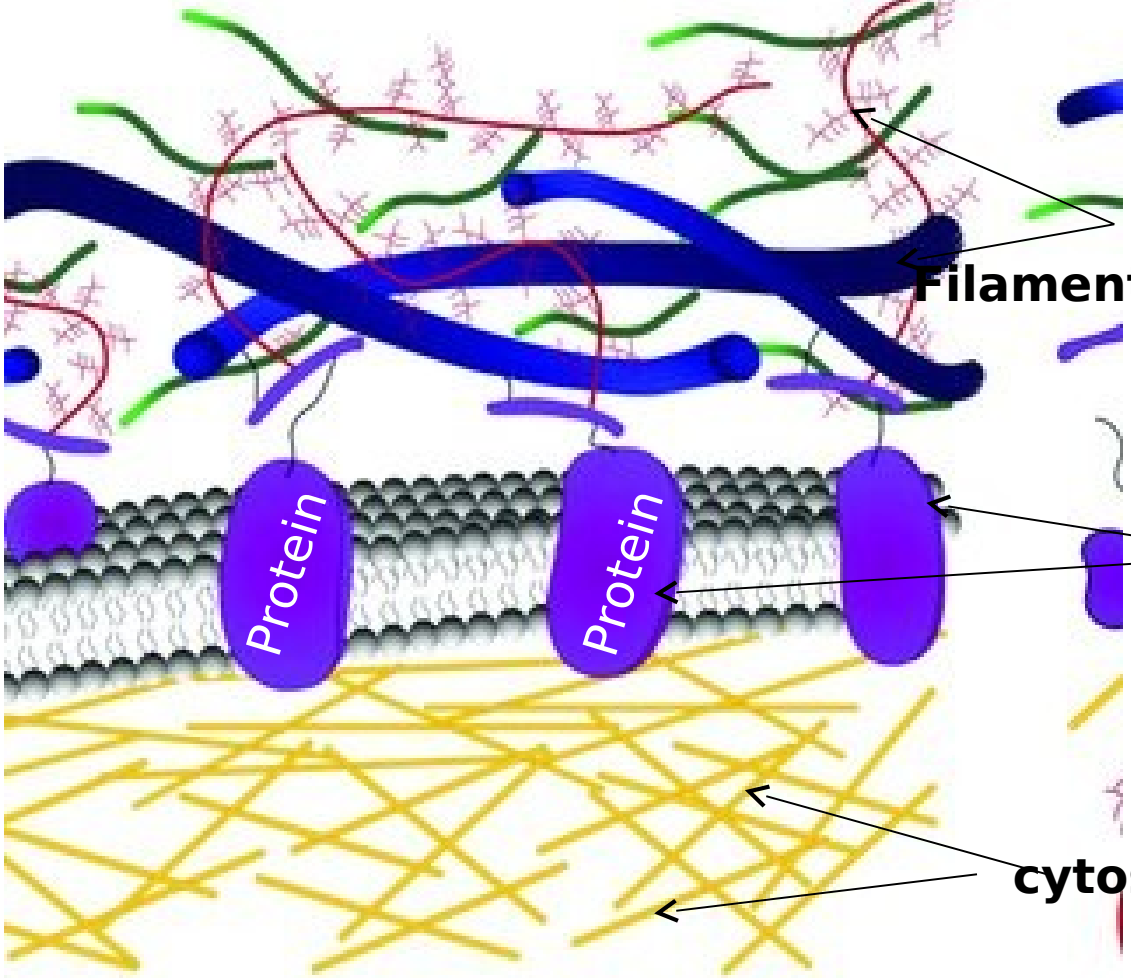
c-anchoring or adhesive Proteins

- **Proteins that bind its cytoskeletal filaments or filaments of matrix**
- laminin, fibronectin, which allow the binding and movement of cells within the extracellular matrix.

anchoring or adhesive Proteins

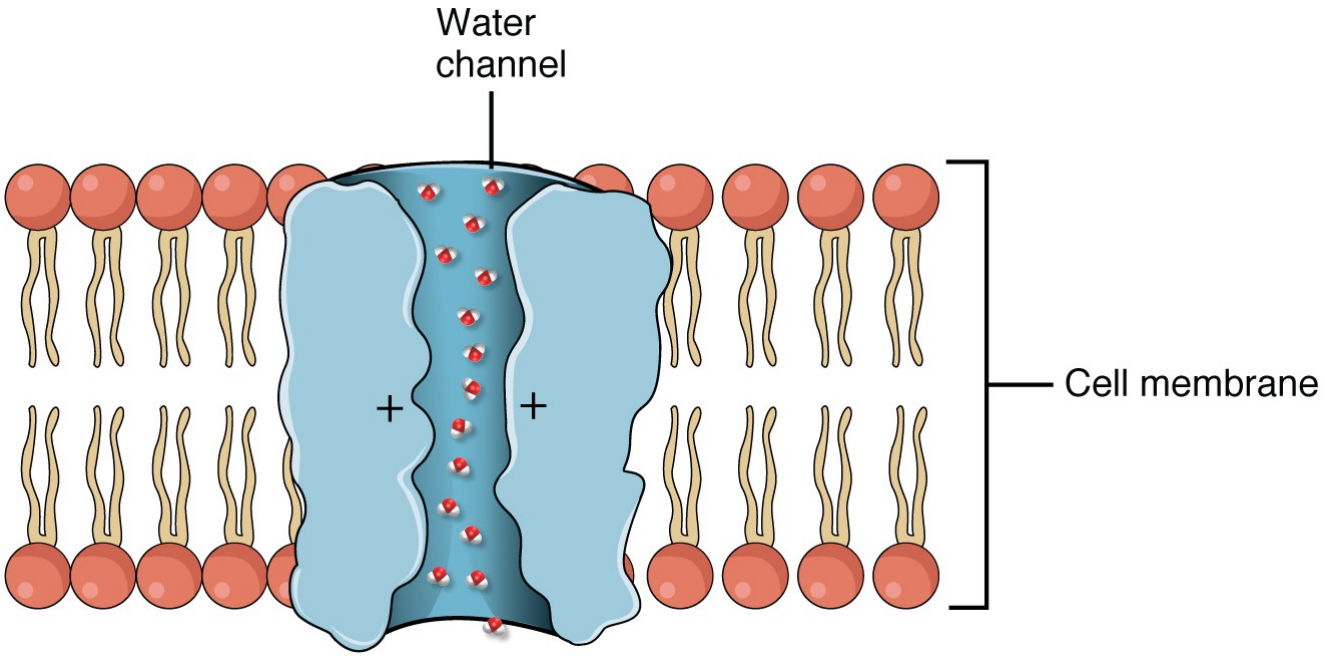


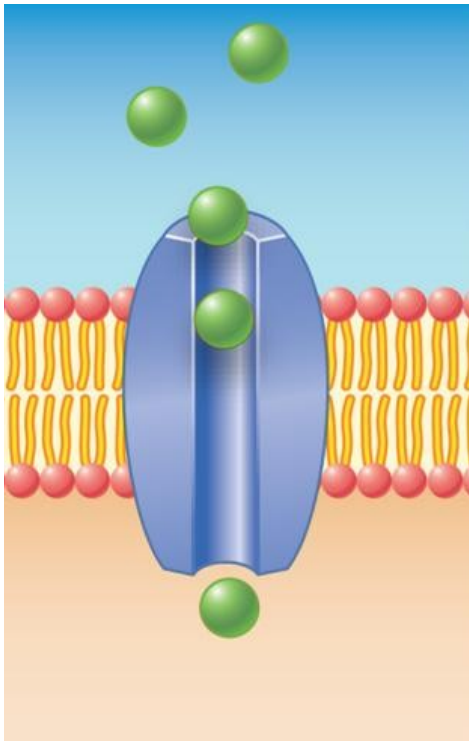
anchoring or adhesive Proteins



d- Channel Proteins

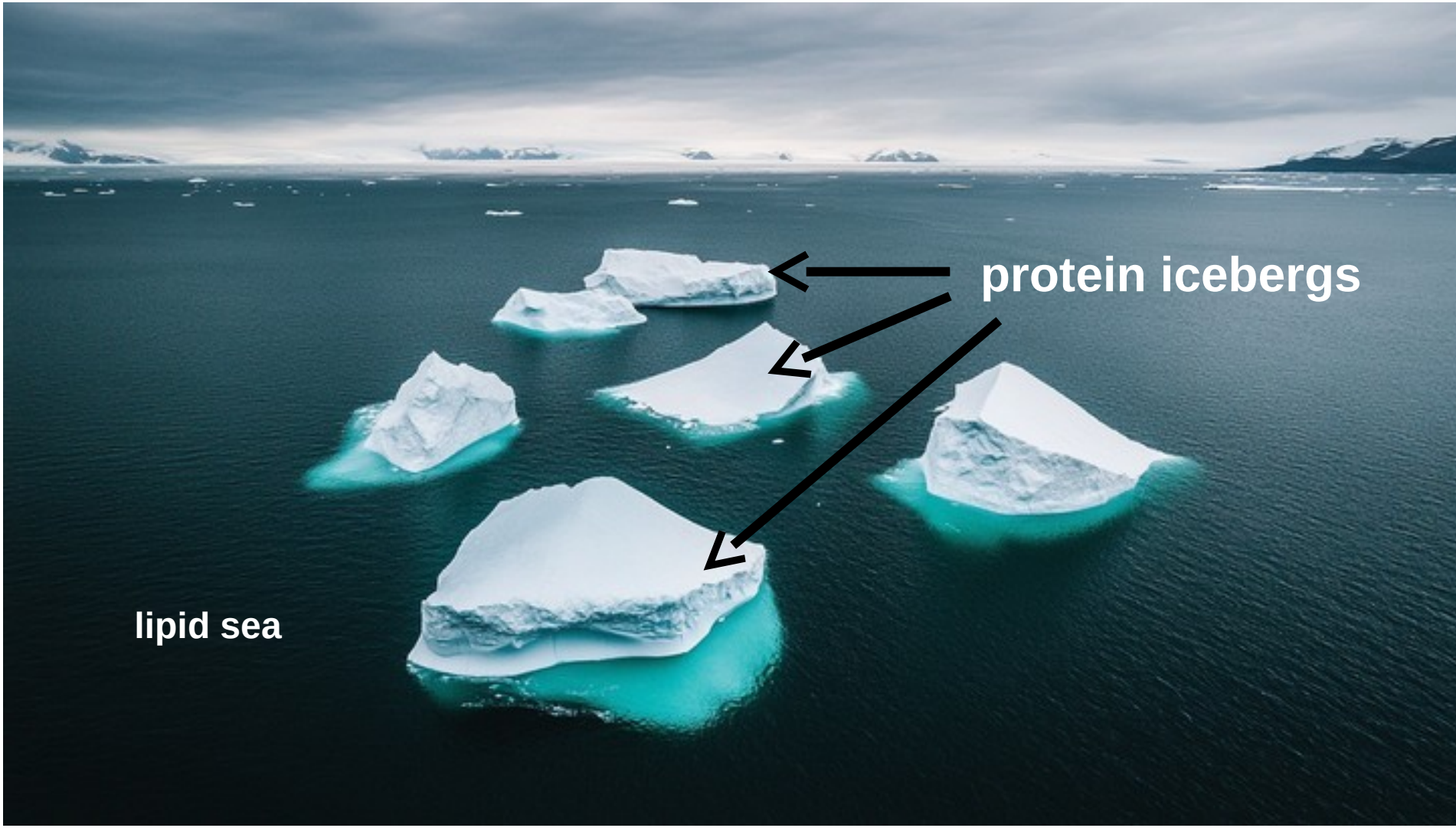
- Proteins that involved in letting certain substances in and out of cells Aquaporins- let <u>water</u> in and out of cells





Membrane organization:

- **Fluid mosaic** : protein icebergs in a lipid sea are associate.
- Integral protein exhibit lateral mobility within the membrane and has association with peripheral proteins& cytoskeletal protein filaments within the cell and extracellular matrix components or membrane components of adjacent cells.
- Integral proteins may be diffuse or may accumulate in one membrane region called (**capping**)

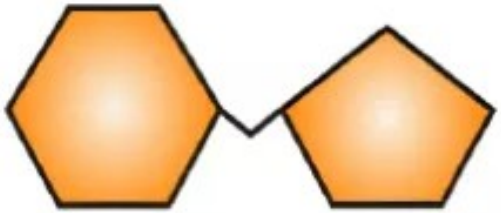


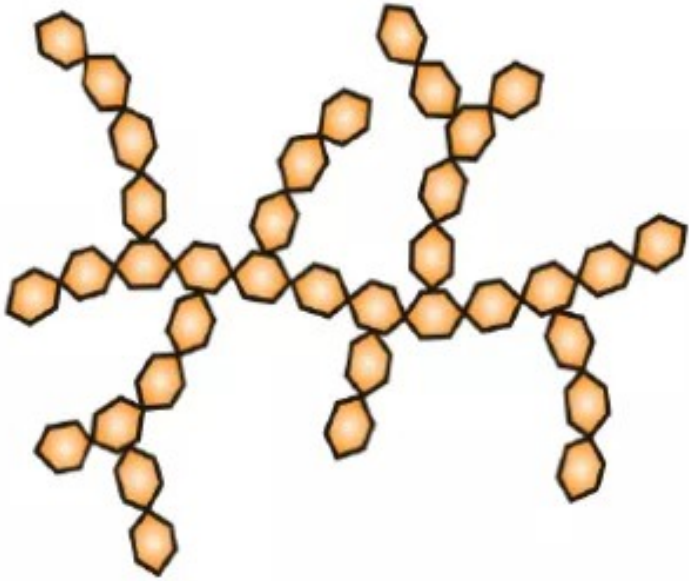
Fluid mosaic

The carbohydrate moieties

CARBOHYDRATES

Monosaccharide Disaccharide Polysaccharide



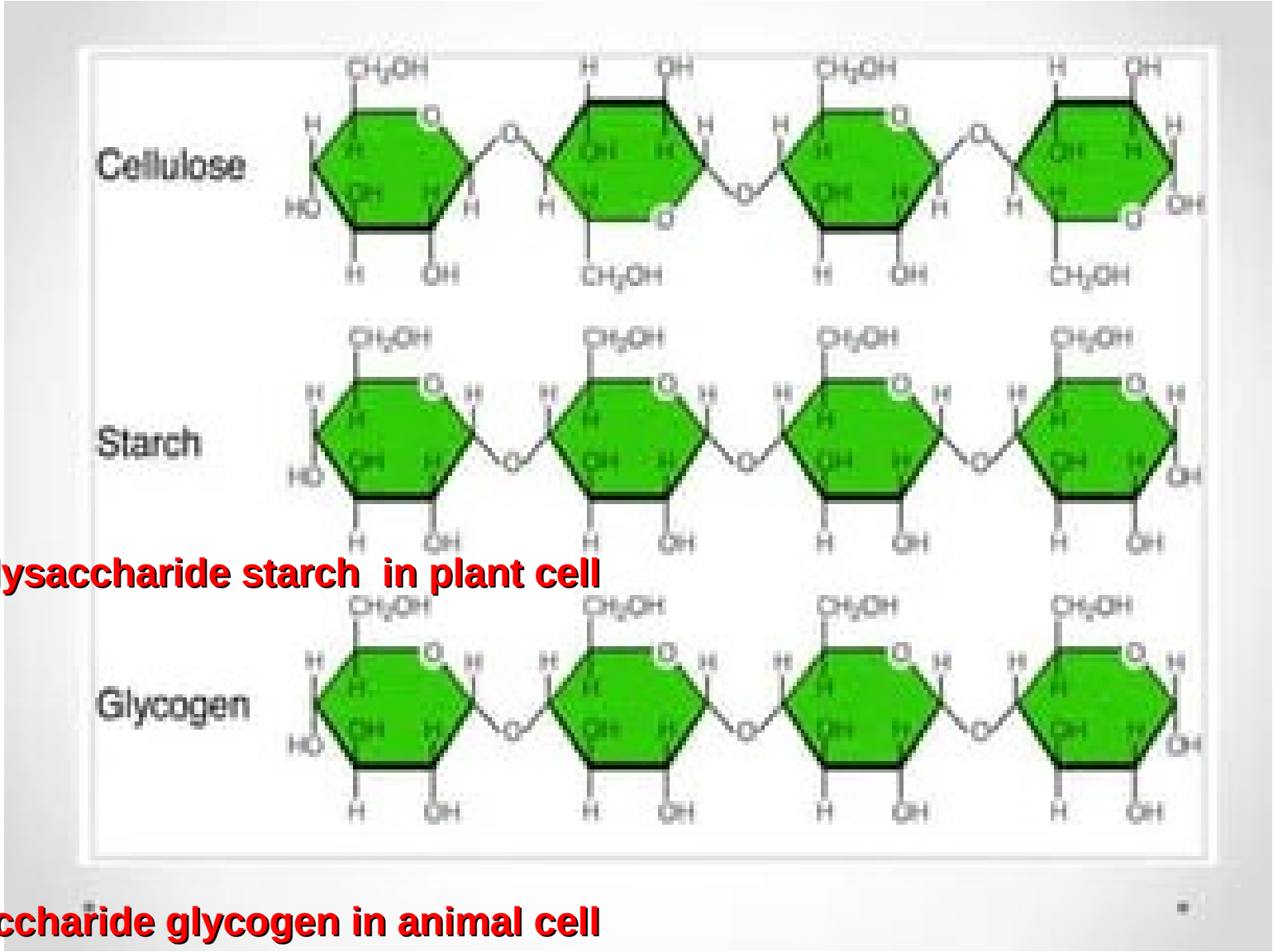


carbohydrate moieties forming 4 forms:

1.Monosaccharide one glucose molecule
2.Disaccharide two glucose molecules
3.Oligosaccharide from 3-10 glucose molecules
4.polysaccharide more than 11 glucose molecules

Oligosaccharides occur only on the membrane outer surface of cell.

polysaccharide



Polysaccharide starch in plant cell

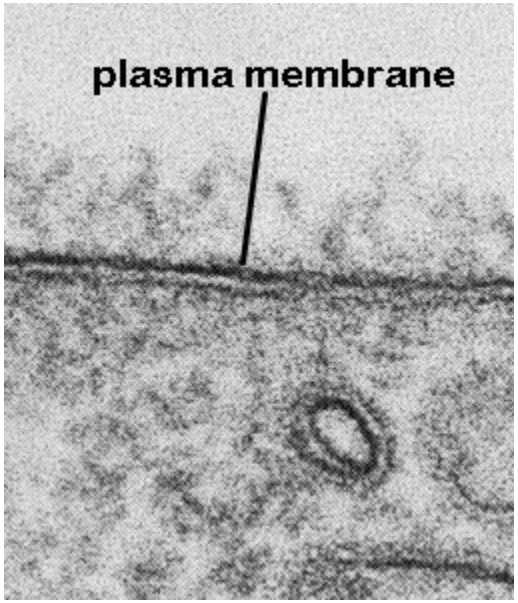
Polysaccharide glycogen in animal cell

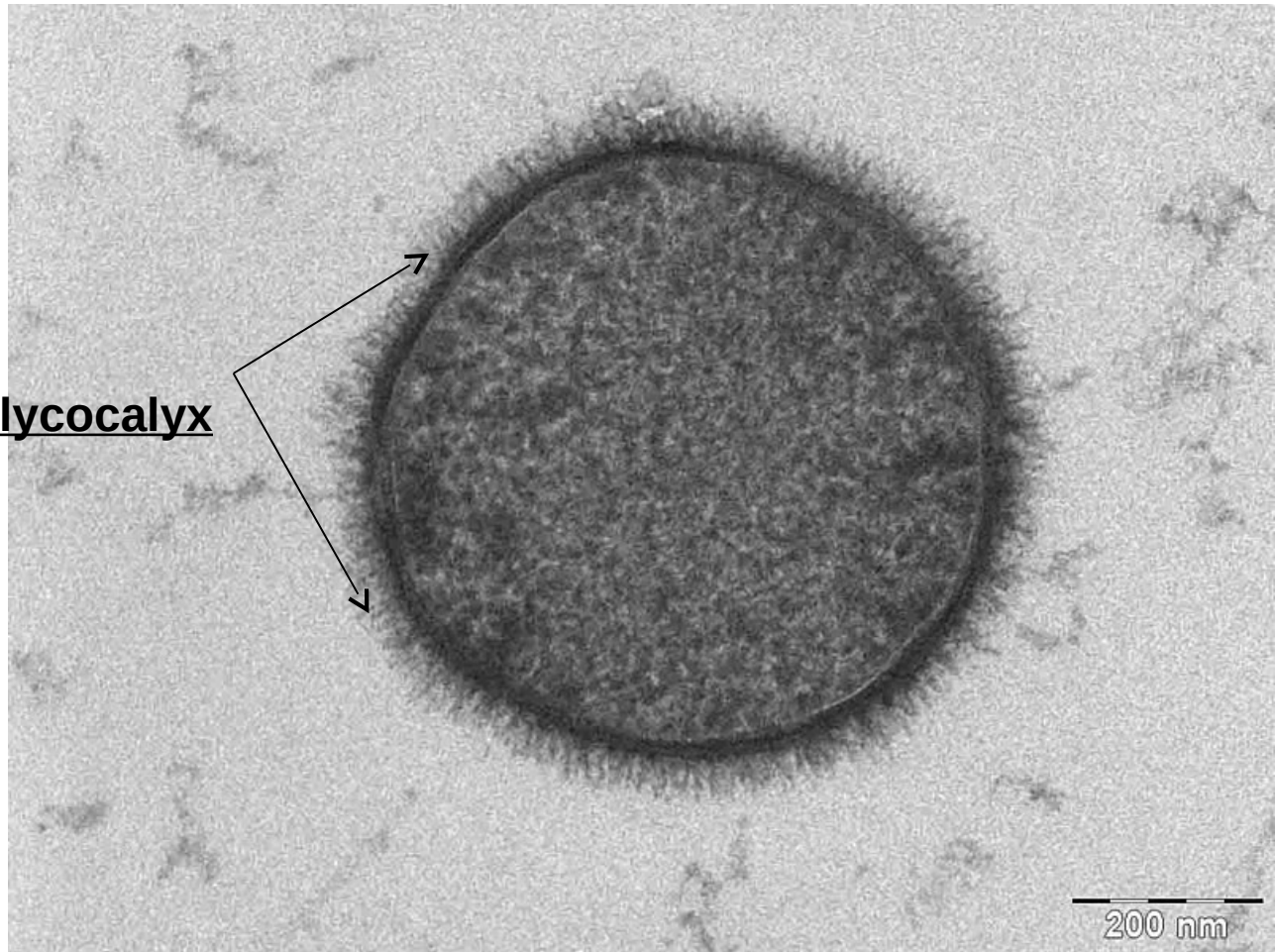
carbohydrate moieties of glycoproteins & glycolipids:

project from the external surface of the plasma membrane; they are important components of specific molecules called **receptors** that participate in important interactions such as cell adhesion, recognition, and response to protein hormones.

In the electron microscope the external surface of the cell shows a fuzzy carbohydrate-rich region called the **glycocalyx**. This layer is composed of carbohydrate chains linked to membrane proteins and lipids and of cell-secreted glycoproteins and proteoglycans.

glycocalyx has a role in cell recognition and attachment to other cells and to extracellular molecules.





on the light microscope between adjacent cells:

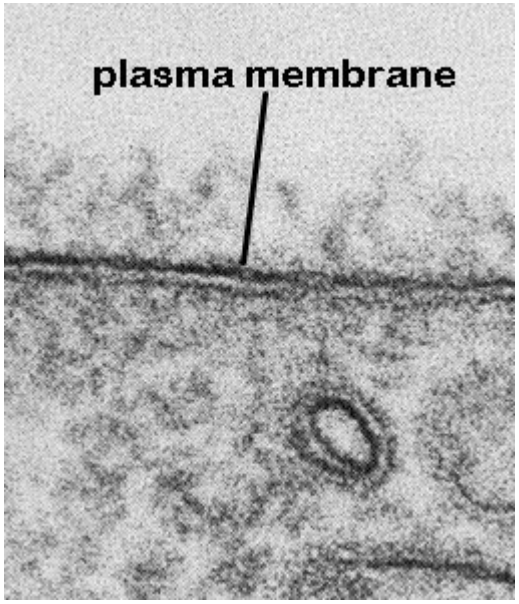
is formed by the membranes of the two cells plus extracellular molecules. These three components together reach a dimension visible on the light microscope.

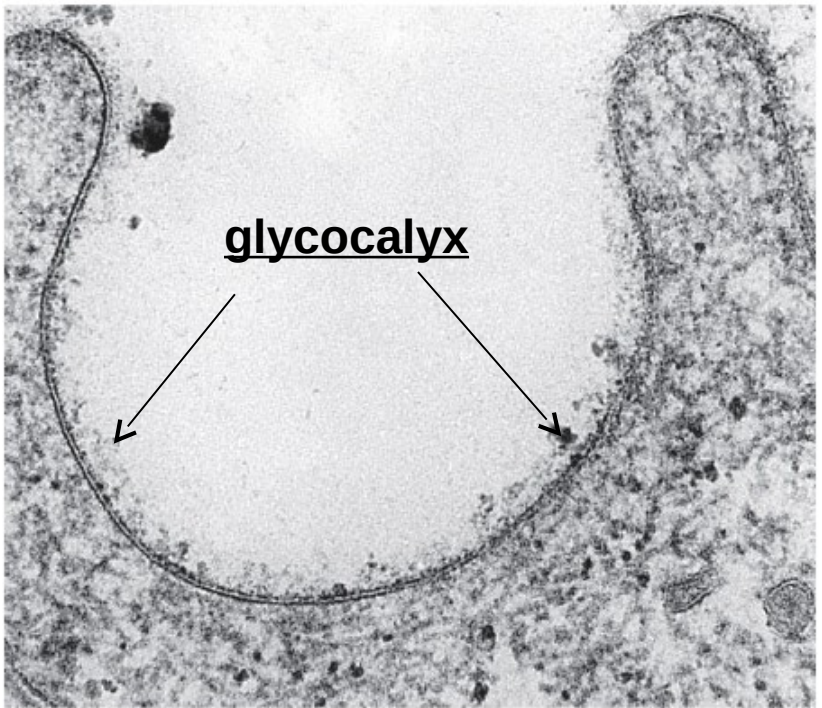
Electron micrographs:

reveal that the plasmalemma—and, for that matter, all other organellar membranes—exhibit a trilaminar structure after fixation in **osmium tetroxide.**

Because all membranes have this appearance, the **three-layered** structure has been designated the **unit membrane**.

The **three layers** seen in the electron microscope by the deposit of reduced osmium on the hydrophilic groups present on each side of the lipid bilayer.





Membrane functions:

1-Selective permeability

A. Passive diffusion
B. Facilitated diffusion
C. Active transport

2-Signal transduction:

i. Ion channel-linked receptors
ii. Enzyme-linked receptors
iii. G protein-linked receptors
iv. Steroid hormone receptor family

3-Endocytosis

4-Exocytosis

5-Storage, transport & secretion:

Membrane functions:

1-Selective permeability

Cell membrane separate internal and external environments of a cell or organelle, preventing intrusion of harmful substances, dispersion of macromolecules & dilution of enzymes and substrates. Selective permeability

Is essential to maintaining the functional steady state (**homeostasis**) required for cell survival. Homeostatic mechanisms attributable to the cell membrane maintain optimal intracellular concentrations of ions, water, enzymes & substrates. The three mechanism allow selective molecules to cross membranes.

Membrane functions:

1-Selective permeability

A.Passive diffusion

Some substances(e.g. water) can cross membrane in either direction, without need for energy, by following a concentration gradient.

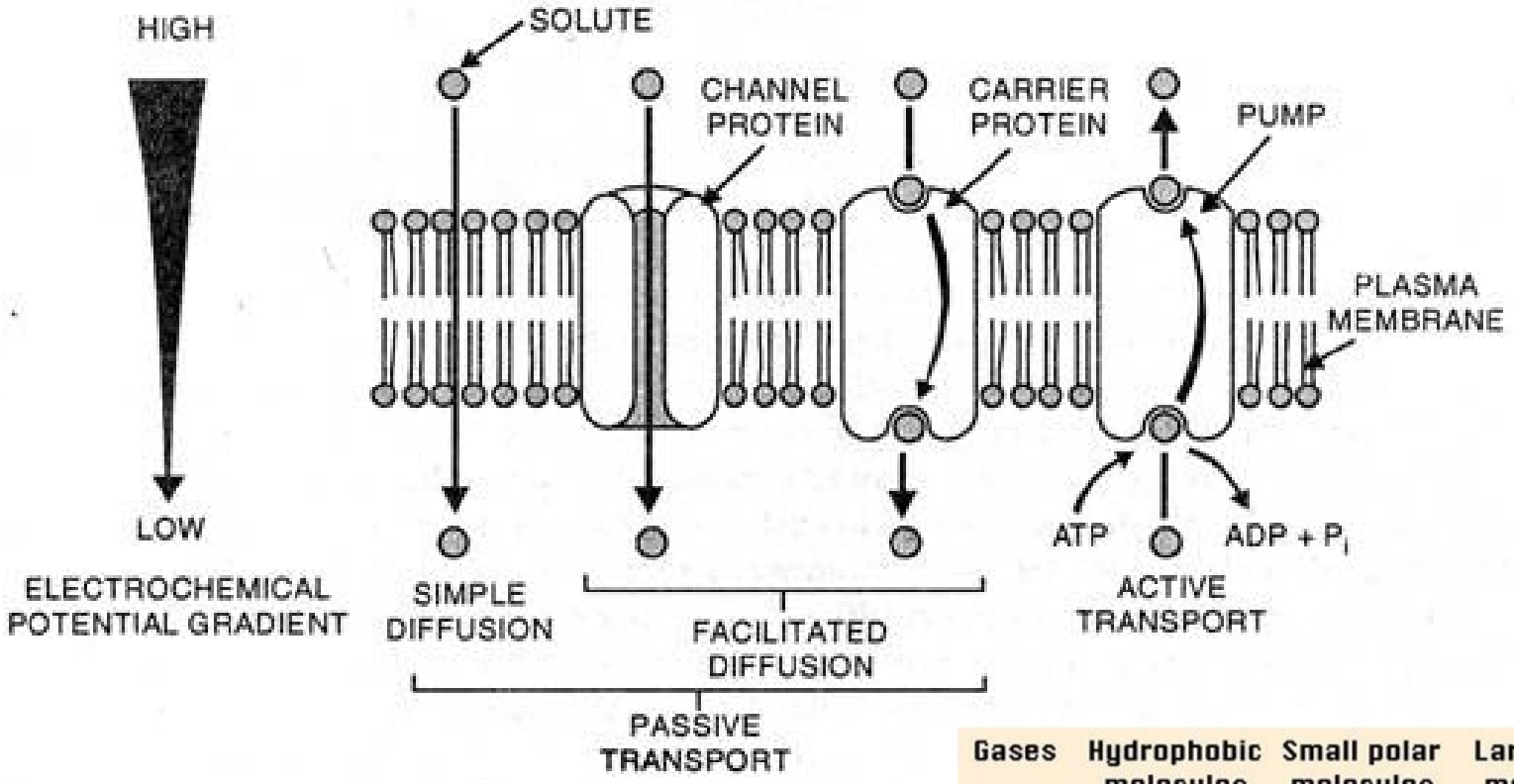
B- Facilitated diffusion

Some molecules (eg. Glucose) are helped across the membrane by a membrane component. Facilitated diffusion is often unidirectional, but it follows a concentration gradient and **no energy** is required

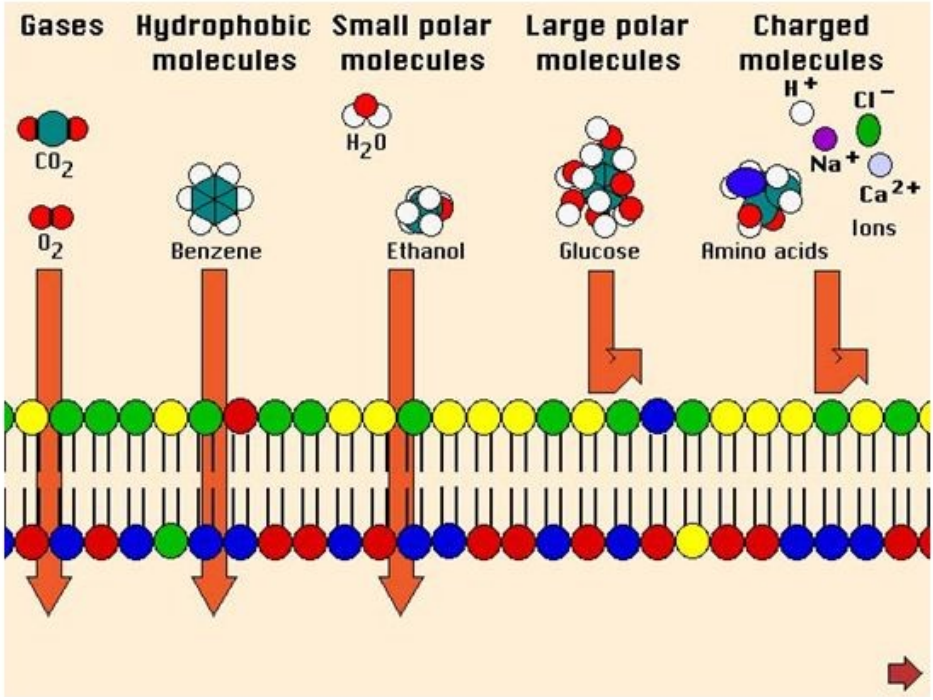
C-Active transport

Some non diffusible molecules can enter or exit a cell against a concentration gradient

This requires **energy** in form of adenosine triphosphate (ATP). One active transport mechanism is the sodium pump Na/ K ATPase). That expel Na ion from a cell even Na concentration is higher outside than inside.



Selectively Permeable



Membrane functions:

2-Signal transduction:

Membrane receptor proteins with strong binding affinities for signal molecules (eg. growth hormone) are found on cell surface . The signal molecules to which a receptor specifically binds is its ligand. the receptor transmits the signal across the membrane. These receptors are important in the intercellular communication. There are 4 types of receptors

A-Ion channel-linked receptors:

Binding of a neurotransmitter as ligand to its receptor at cell surface will induce conformational changes in the receptor that open the transmembrane ion channel.

B-Enzyme-linked receptors

Binding of a enzyme as ligand to its receptor at cell surface will activate an additional protein by phosphrylating them and initiate a cascade of enzyme activations.

C-G protein-linked receptors

On binding its ligand the receptor interacts activates the trimeric G protein

D-Steroid hormone receptor family:

Steroid hormone pass more readily through the membrane and bind to receptor in the nucleus. It enhance or repress gene expression through their association with the DNA flanking the gene coding regions.

Membrane functions:

3-Endocytosis

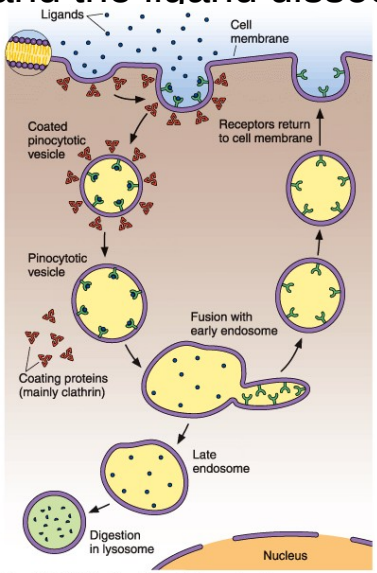
Cell engulf extracellular substances and bring them into cytoplasm in membrane limited vesicles

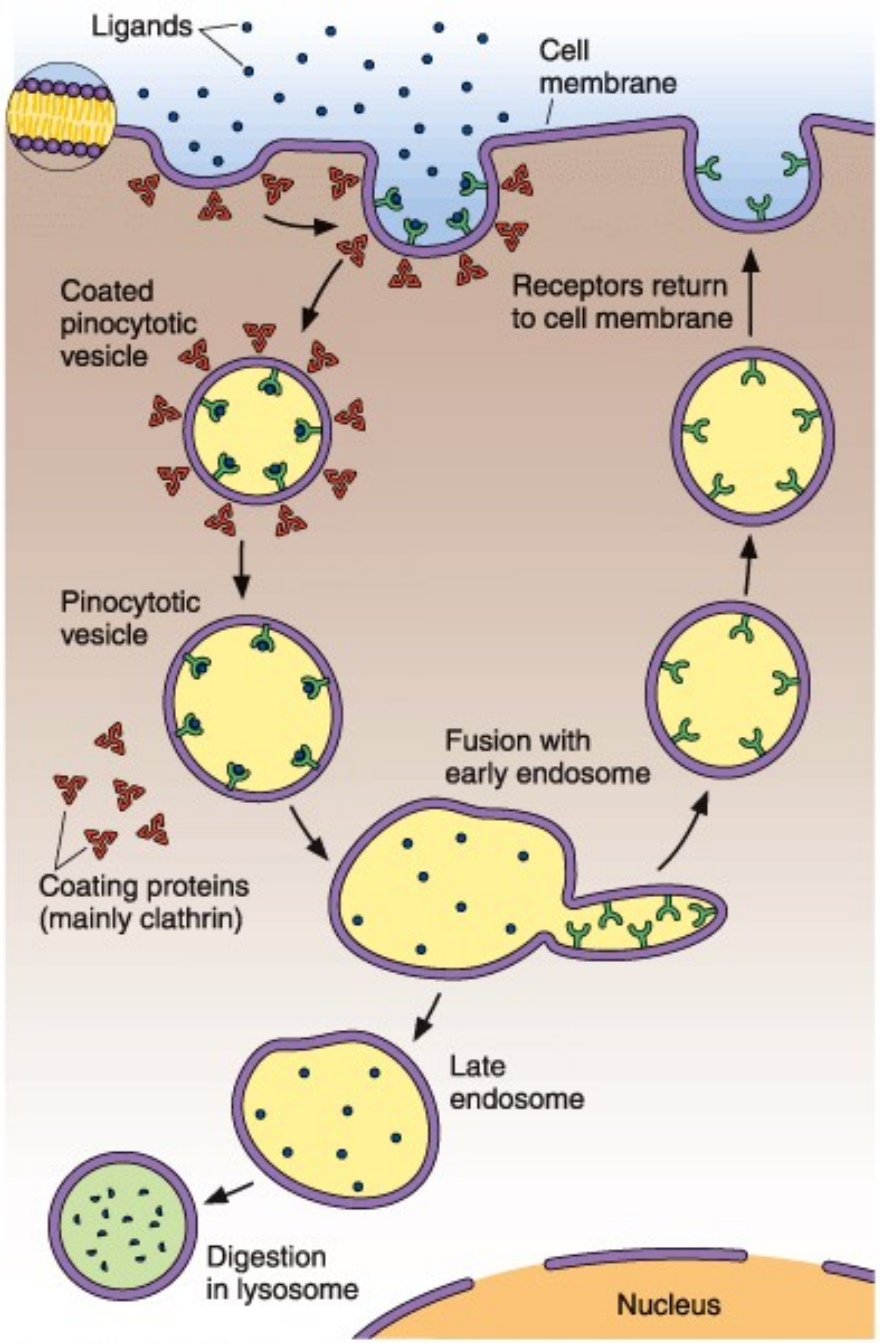
A-phagocytosis: (cell eating) the cell engulf insoluble substances such as large macromolcules or entire bacteria. The vesicles formed are termed phagosomes

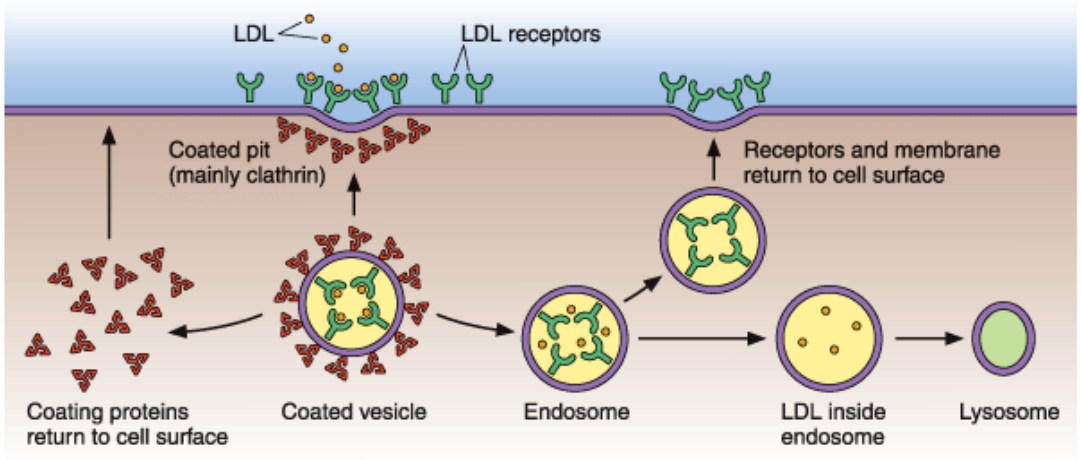
B-pinocytosis (cell drinking) the cell engulf small amounts of fluid (water and solutes. The pinocytotic vesicles are smaller than phagosomes.

C-receptor mediated endocytosis:

cell engulf ligand along with their surface receptor . The binding of ligand to receptor cause ligand-receptor complexes to collect in a coated pit, a shallow membrane depression whose cytoplasmic surface is coated with clathrin protein. Invagination and pinching off of the pit create a coated vesicle, which carries the ligand-receptor complexes into the cell. The Clathrin coat is release from the vesicle know term an endosome, and the ligand dissociated from the receptor.







Internalization of low-density lipoproteins (LDL) is important to keep the concentration of LDL in body fluids low. LDL, which is rich in cholesterol, binds with high affinity to its receptors in the cell membranes. This binding activates the formation of pinocytotic vesicles from coated pits. The vesicles soon lose their coating, which is returned to the inner surface of the plasmalemma: the uncoated vesicles fuse with endosomes. In the next step, the LDL is transferred to lysosomes for digestion and separation of their components to be utilized by the cell.

Membrane functions:

4-Exocytosis

Ejects substances from the cell. The cell use this process for both secretion and excretion of undigested materials. A membrane limited vesicles (secretory granule fuses with plasma membrane and releases its contents in to extracellular space, without disruption of plasma membrane .

5-Storage, transport & secretion:

A membrane limited vesicles isolate certain substances during intracellular processes . Substance in the vesicle may kept for further later use (storage), shuttled from one compartment to another for further process (transport) , or expelled from cell (secretion)

Lecture end