الكلية : كلية الطب

القسم او الفرع : فرع التشريح البشري

المرحلة: الأولى

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اسم المادة باللغة العربية : بايولوجي

اسم المادة باللغة الإنكليزية : Biology

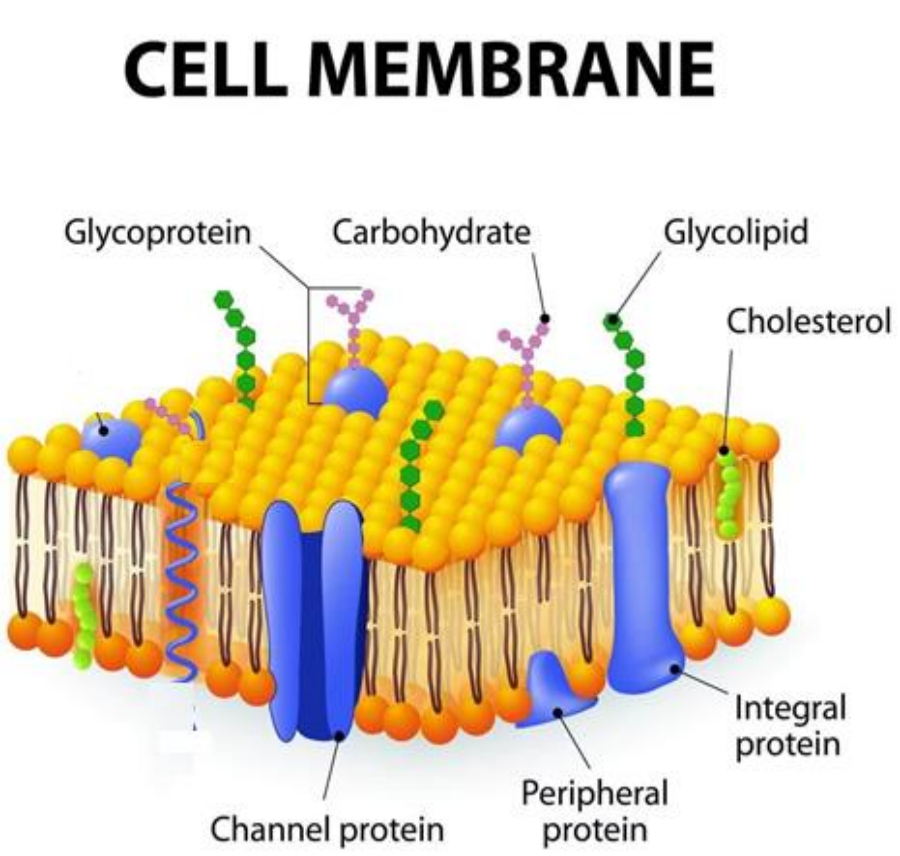
اسم المحاضرة باللغة العربية: الغشاء الخلوي

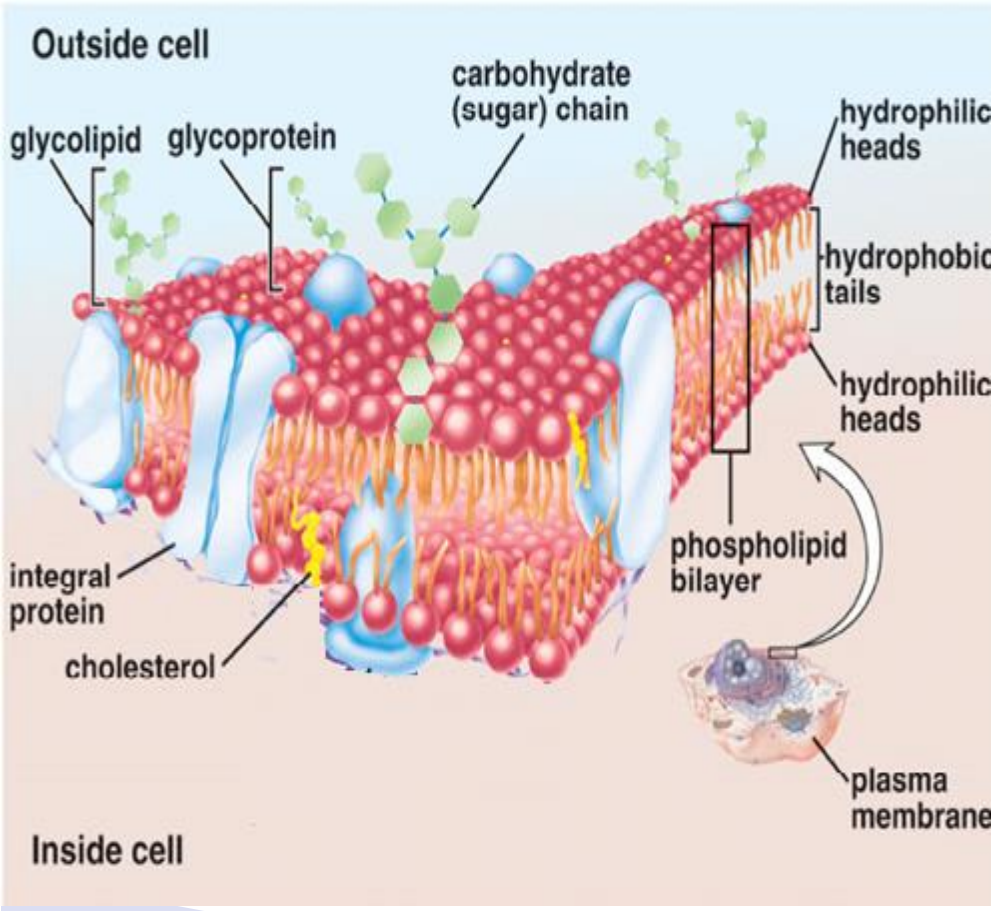
اسم المحاضرة باللغة الإنكليزية : Cell membrane

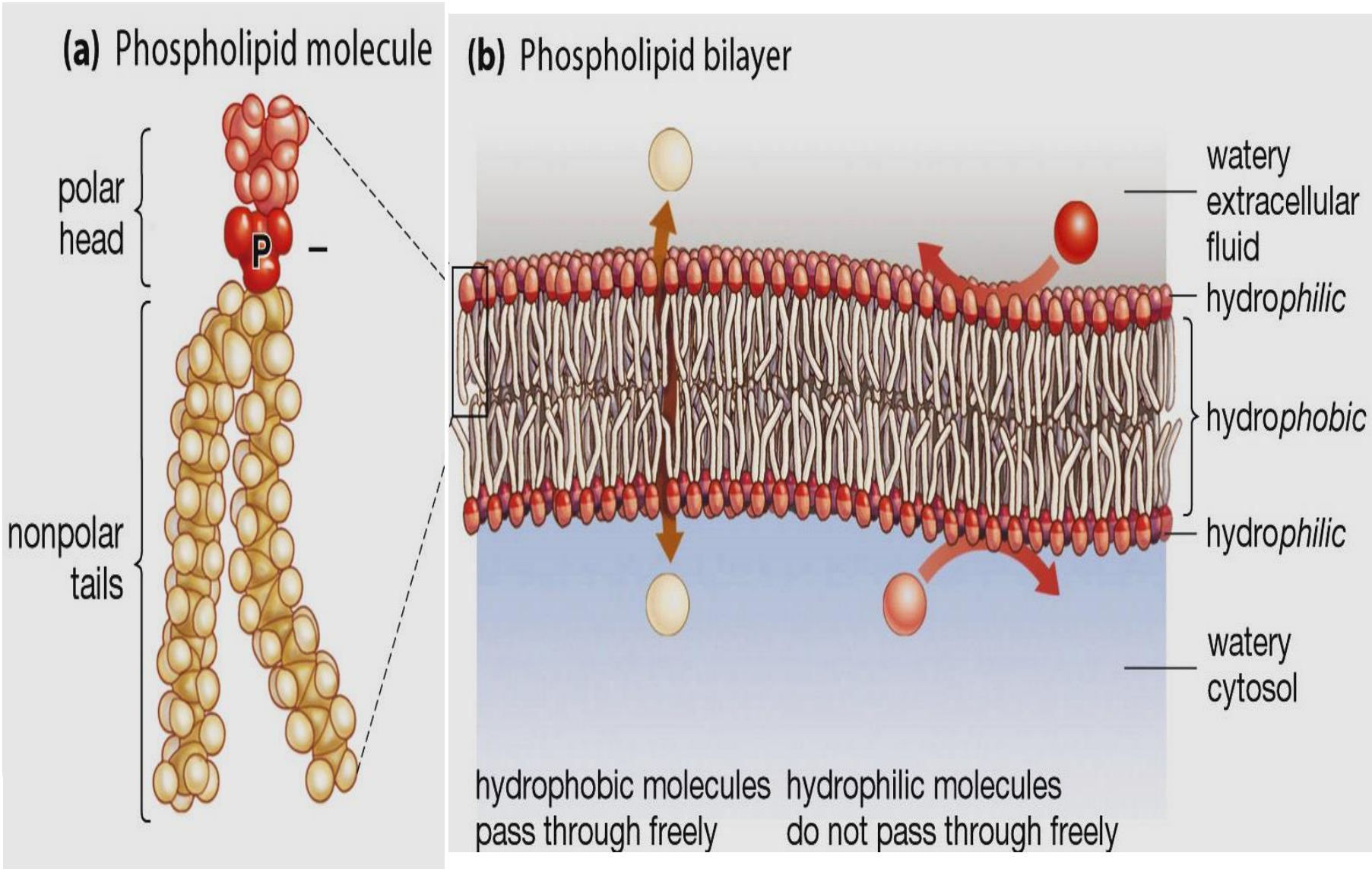
Cell membrane

Cell membrane

The Cell membrane is a membrane that separate the interior of the cell from the outside environment (the extracellular space). The cell membrane consist of a lipid bilayer (phospholipid bilayer). The cell membrane also contain membrane proteins. The cell membrane control the movement of substances in and out of cells. The cell membrane is selectively permeable and able to regulate what enters and exits the cell.

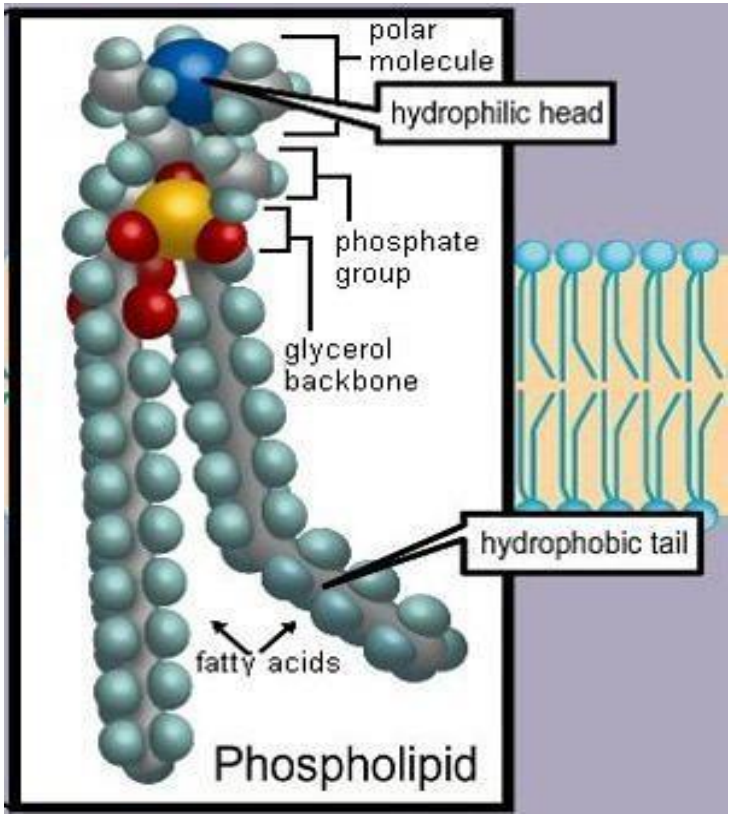





(a) Phospholipid molecule
polar head
P
–
nonpolar tails
(b) Phospholipid bilayer
watery extracellular fluid
hydrophilic
hydrophobic
hydrophilic
watery cytosol
hydrophobic molecules pass through freely
hydrophilic molecules do not pass through freely

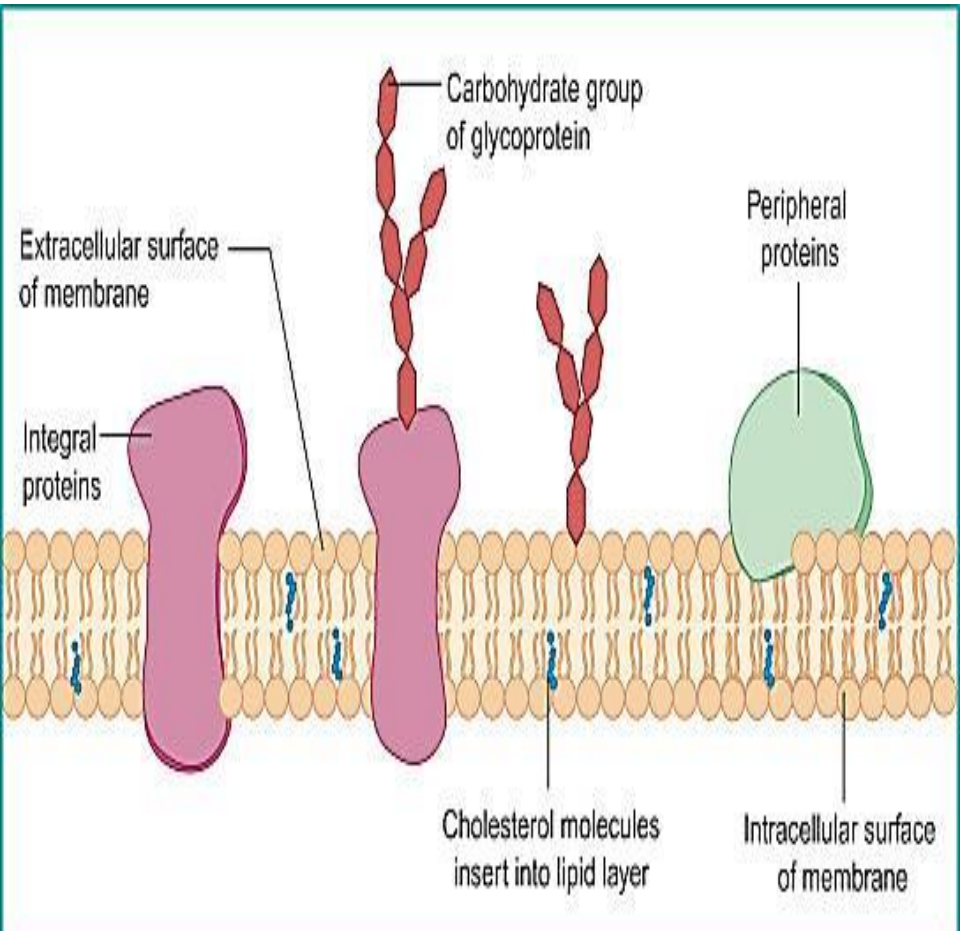
Phospholipid

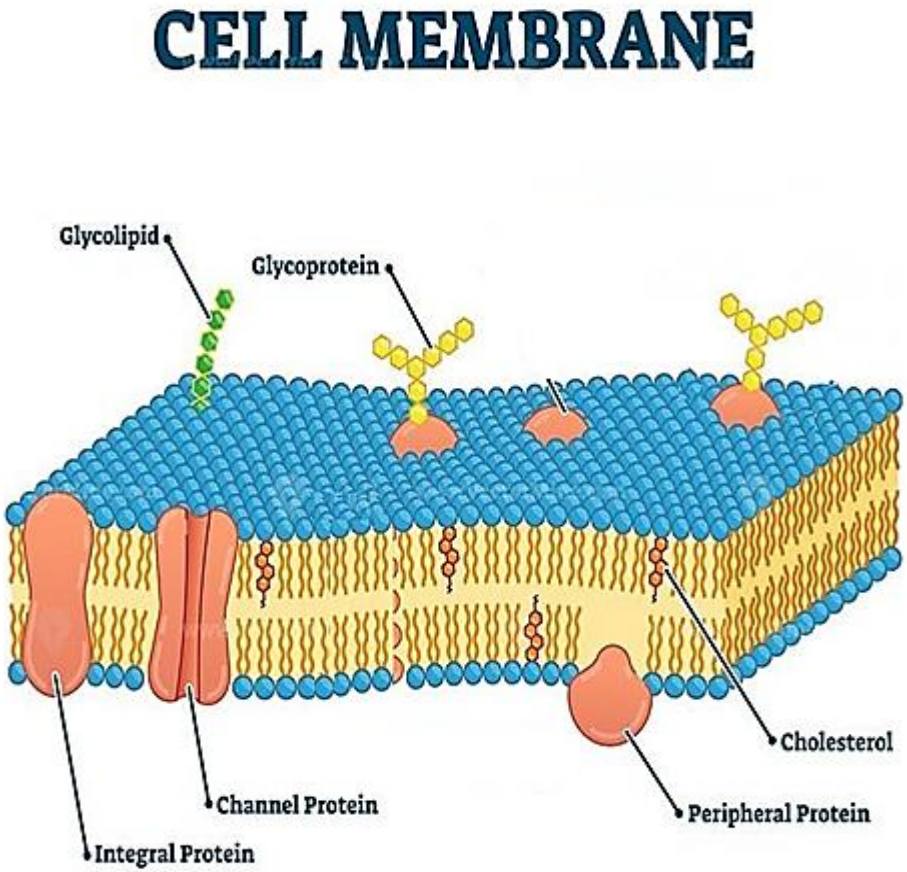
- The hydrophilic portion contain phosphate group
- The hydrophobic portion consist of fatty acids



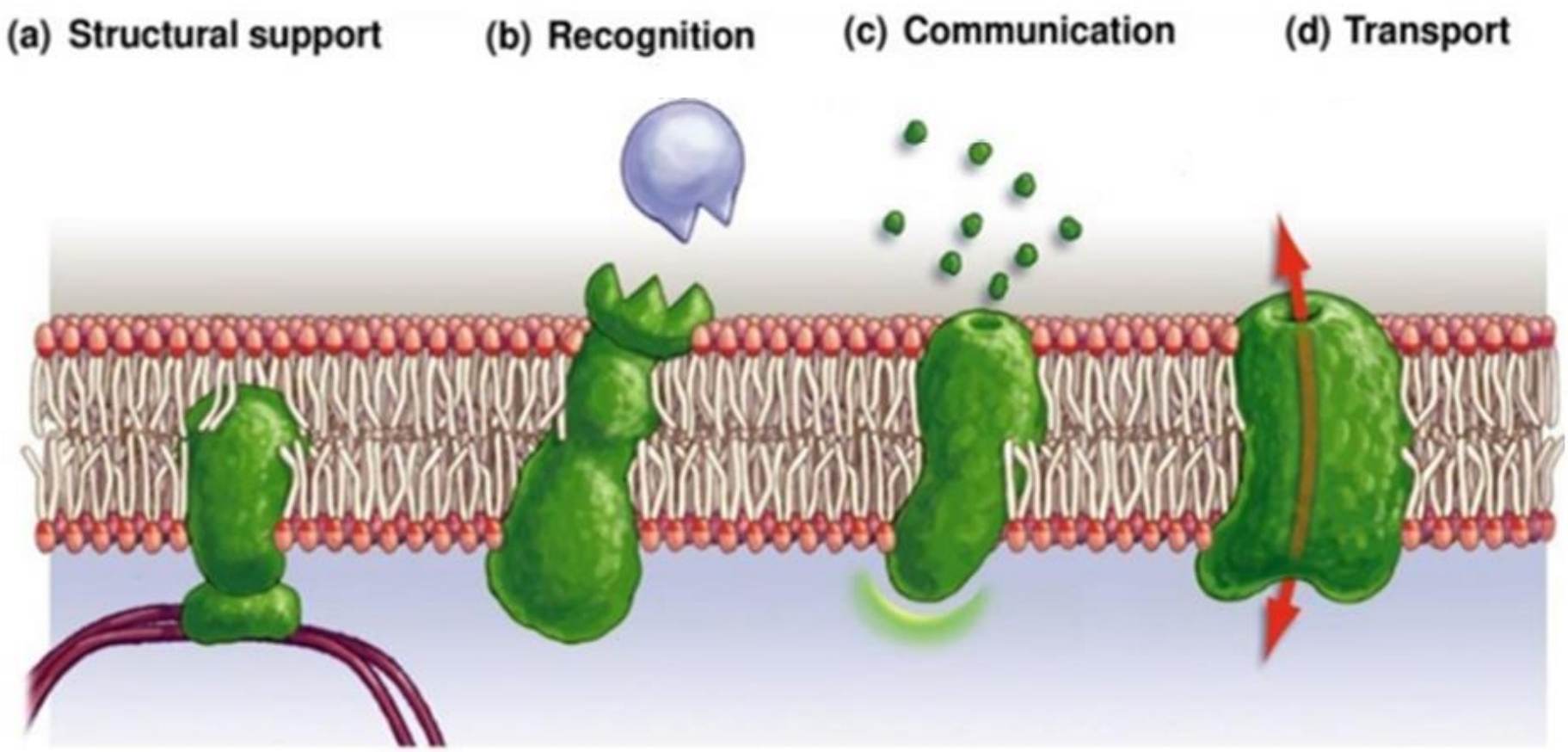
Cell membrane proteins

- **Peripheral proteins** are bound to the surface of the cell membrane
- **Integral proteins** are embedded in the phospholipid bilayer of the cell membrane.





Cell membrane proteins



Membrane proteins can provide structural support.

Binding sites on some proteins can serve to identify the cell to other cells, such as those of the immune system.

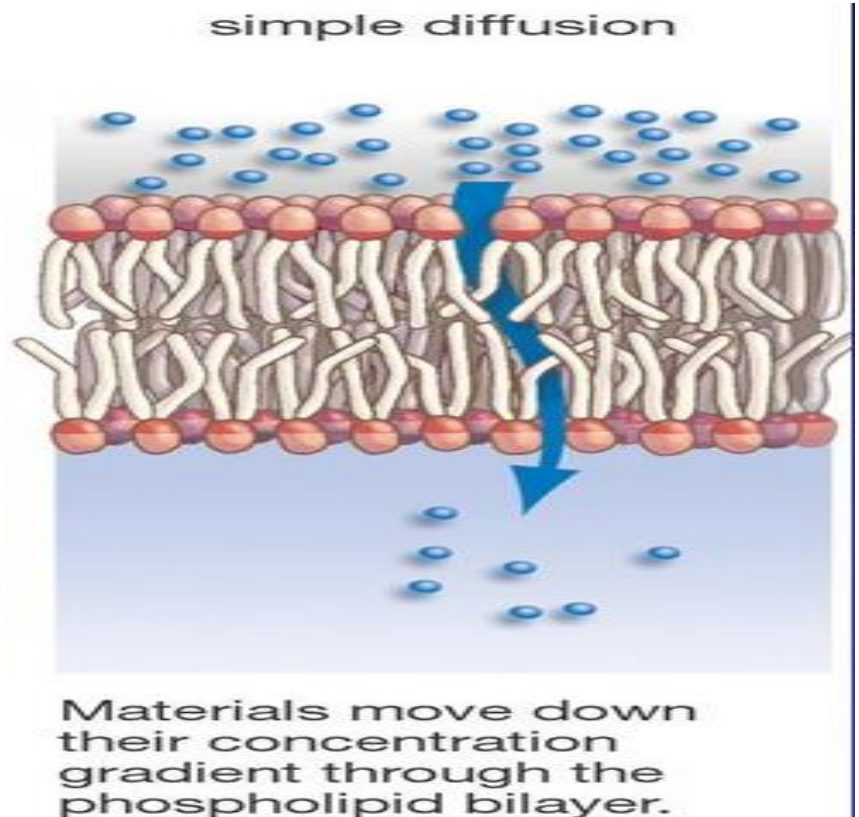
Receptor proteins, protruding out from the plasma membrane, can be the point of contact for signals sent to the cell.

Proteins can serve as channels through which materials can pass in and out of the cell.

Transport across the cell membrane

Transport of substances across the cell membrane may be passive or active , depending on whether energy is required or not required. Passive transport is the movement of substances across the cell membrane without the expenditure of energy. Passive transport includes simple diffusion, facilitated diffusion, and osmosis. In contrast, active transport is the movement of substances across the cell membrane using energy from adenosine triphosphate (ATP).

Diffusion is the net movement of molecules from an area of high concentration to an area of low concentration.



- does not require energy

The rate of diffusion is determined by four factors:

- **The steepness of the concentration gradient.**

The bigger the difference in concentration between the two sides of the membrane, the quicker the rate of diffusion.

- **Temperature.**

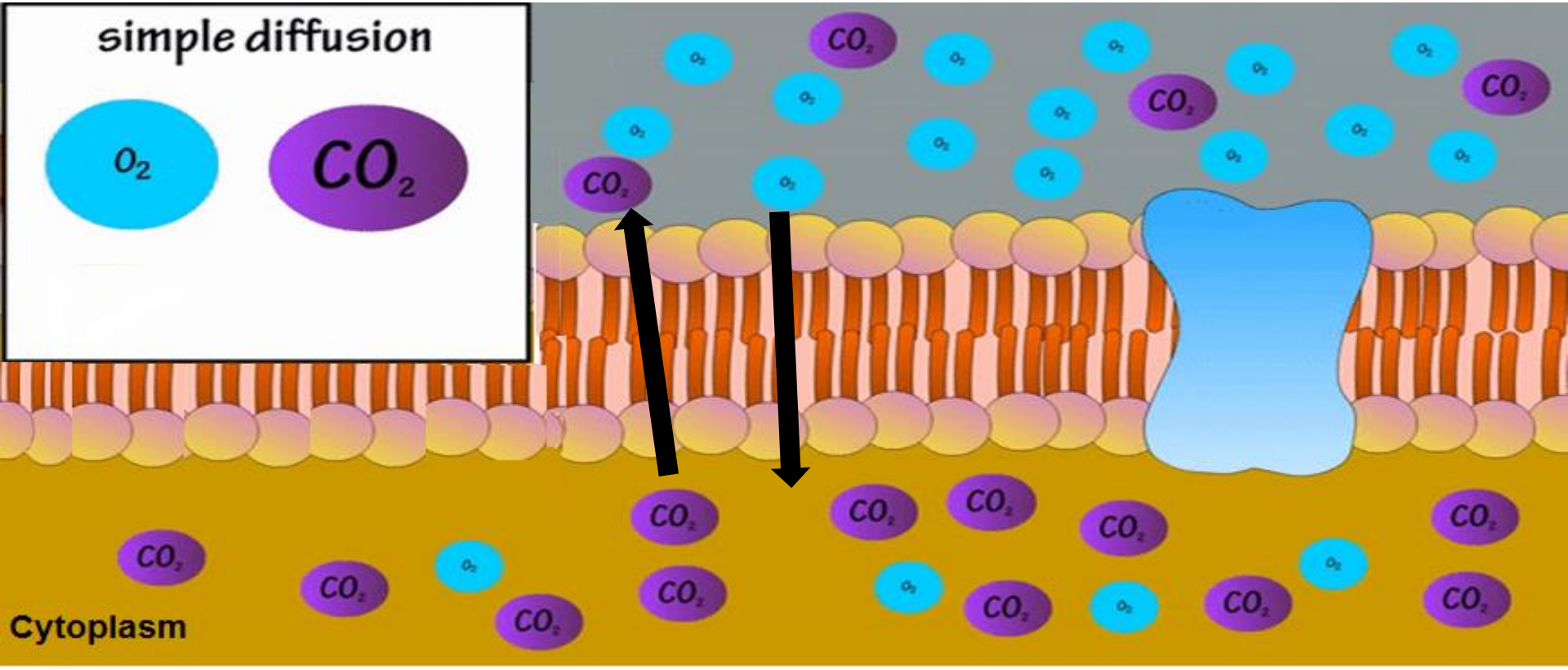
Higher temperatures give molecules or ions more kinetic energy. Molecules move around faster, so diffusion is faster.

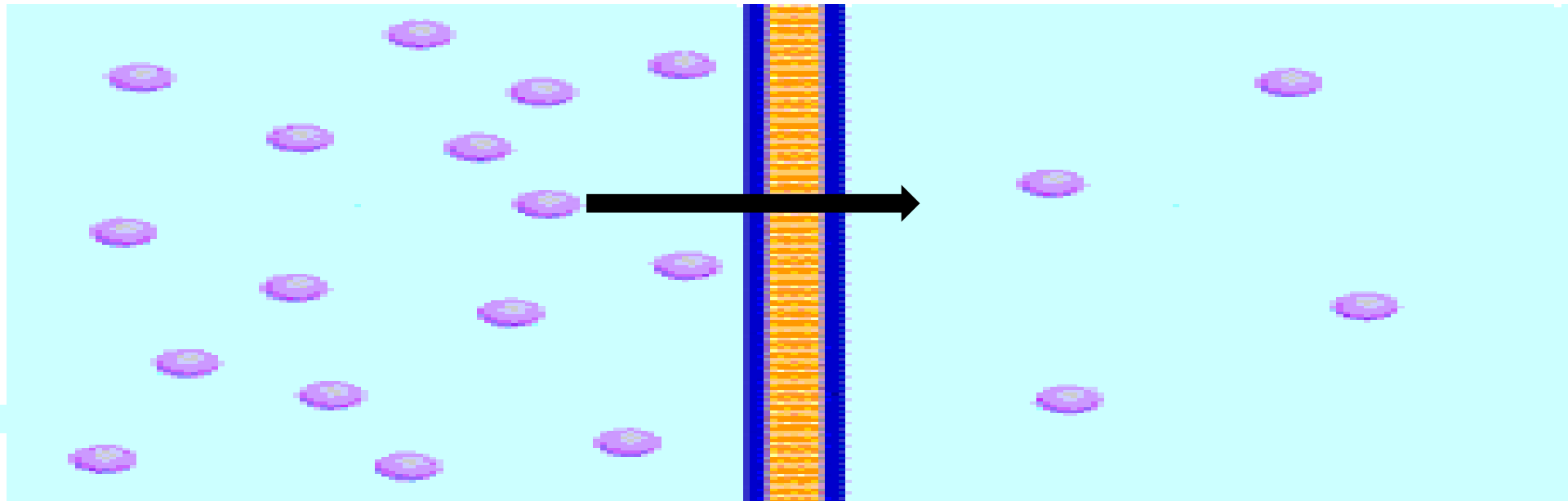
- **The surface area.**

The greater the surface area the faster the diffusion can take place. This is because the more molecules or ions can cross the membrane at any one moment.

- **The type of molecule or ion diffusing.**

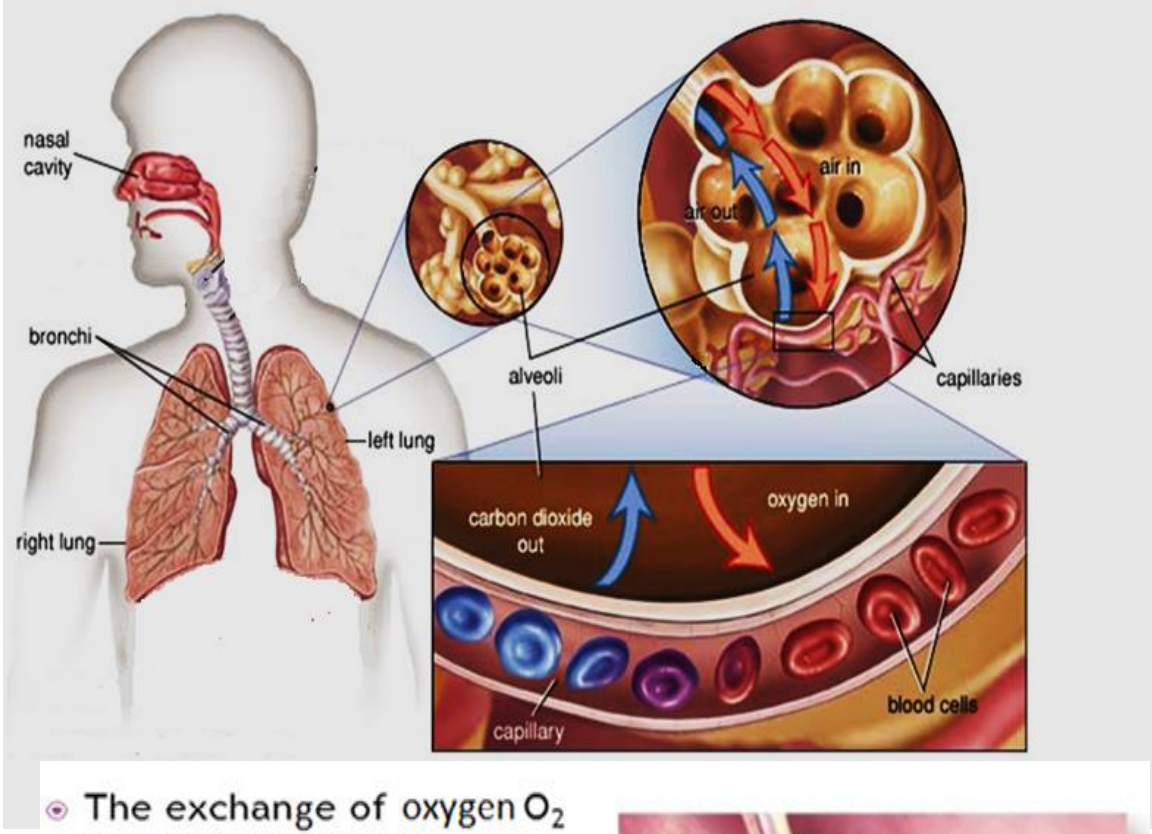
Large molecules diffuse more slowly than small molecules.


simple diffusion
O_2
CO_2
Cytoplasm

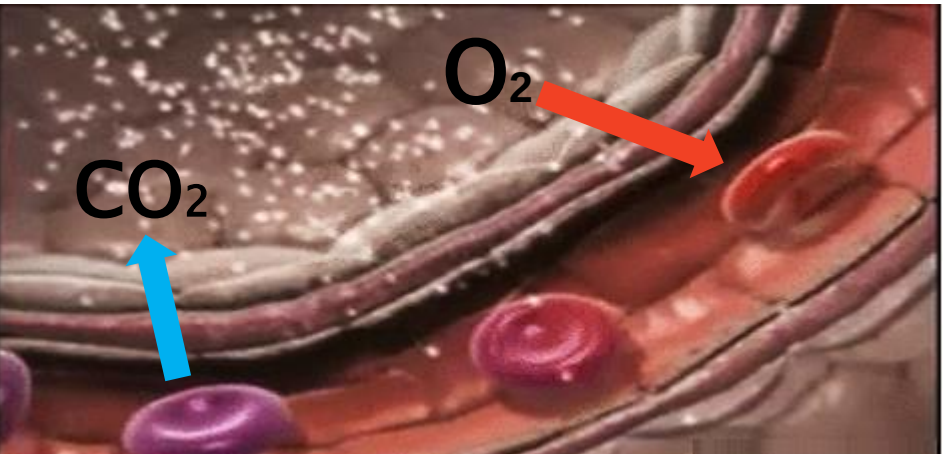


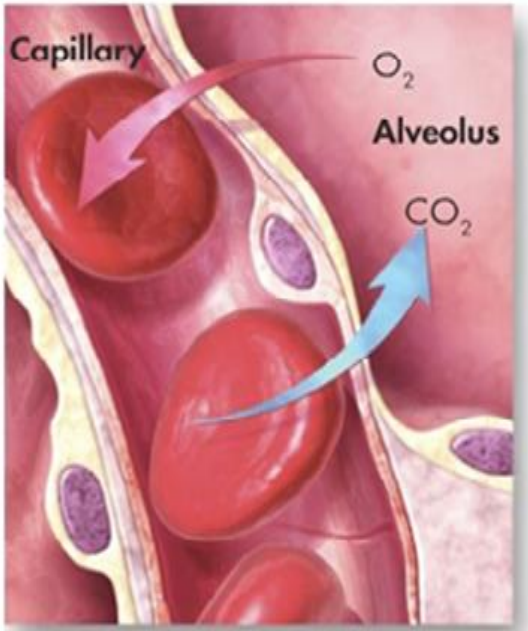
Diffusion

- In the lungs, oxygen diffuses from the alveoli into the surrounding capillaries, where it binds to red blood cells for transport throughout the body.
- Simultaneously, carbon dioxide produced by cellular metabolism diffuses from the blood into the alveoli and is exhaled. The efficiency of this gas exchange relies on the principles of diffusion, where gases move from areas of high concentration to areas of low concentration. This process is essential for maintaining the oxygen supply to the body's cells and removing carbon dioxide.



- The exchange of oxygen O_2 and carbon dioxide CO_2 in the lungs. Occurs by diffusion



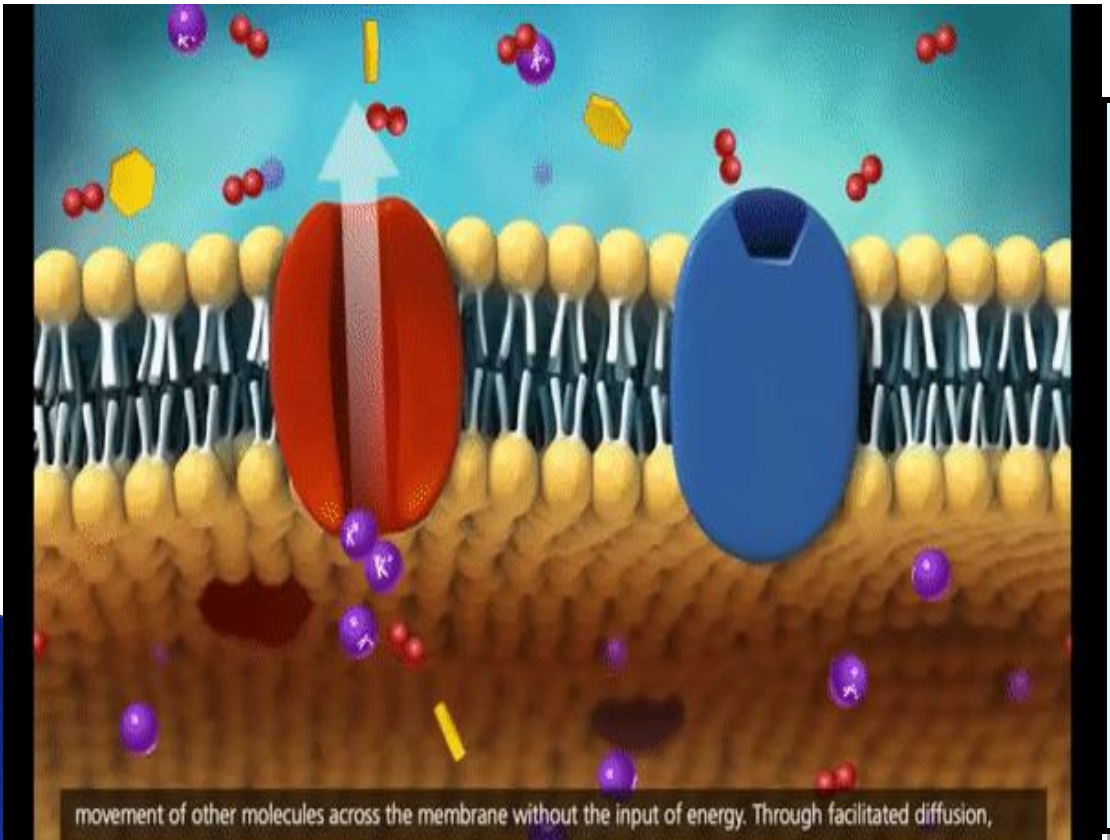


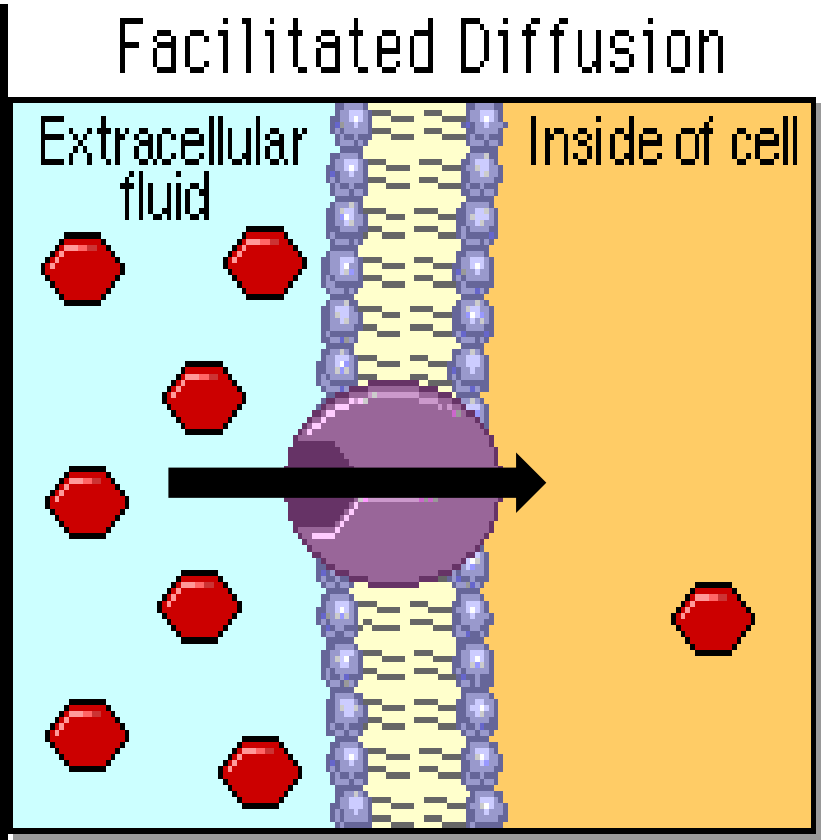
Facilitated diffusion

Facilitated diffusion is a type of passive transport in which ions or molecules move across the cell membrane through specific transport proteins.

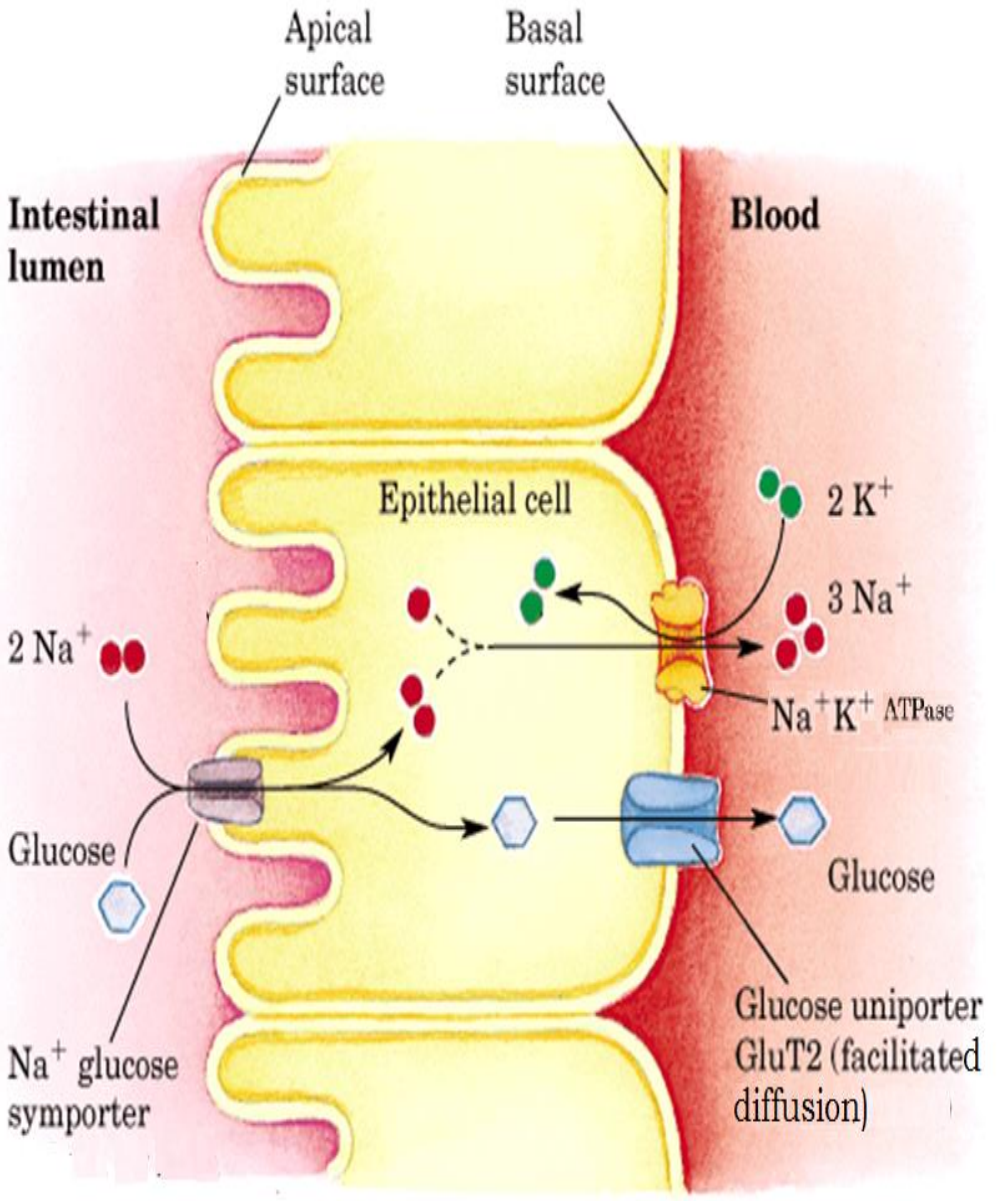
- Large polar molecules such as glucose, cannot diffuse across the phospholipid bilayer. Also ions such as Na^+ or Cl^- cannot pass.
- These molecules pass through protein channels instead. Diffusion through these channels is called facilitated diffusion .

facilitated diffusion through a channel



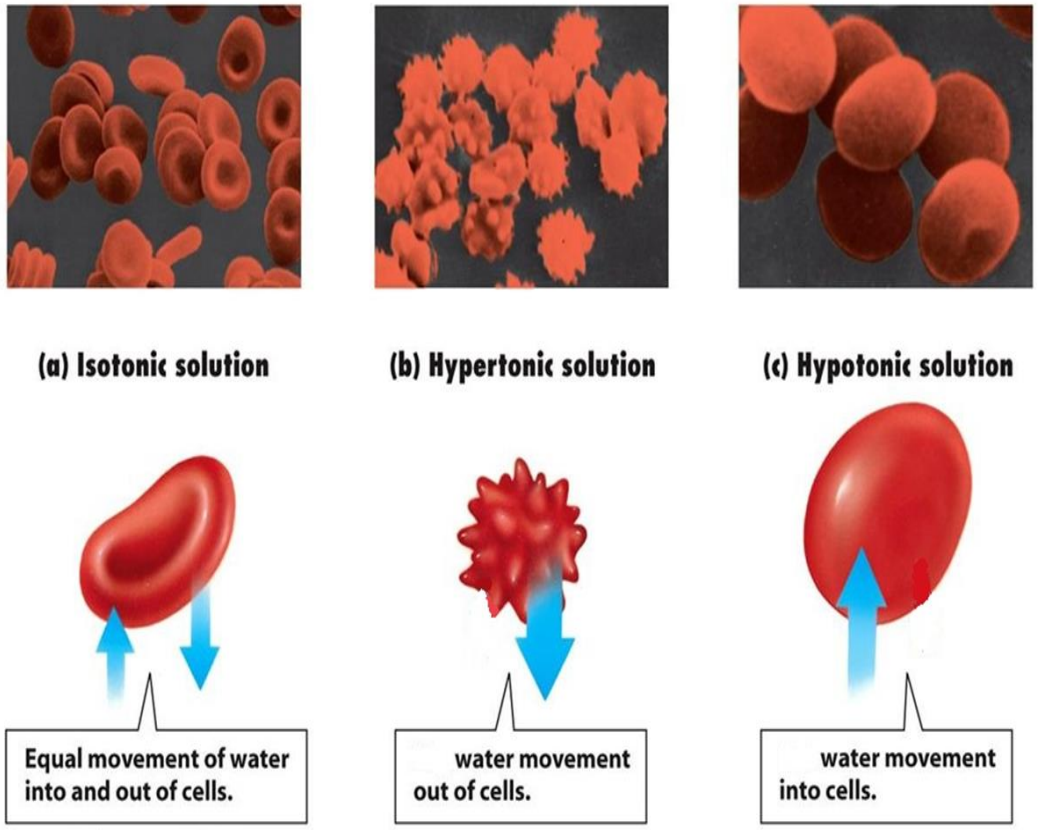


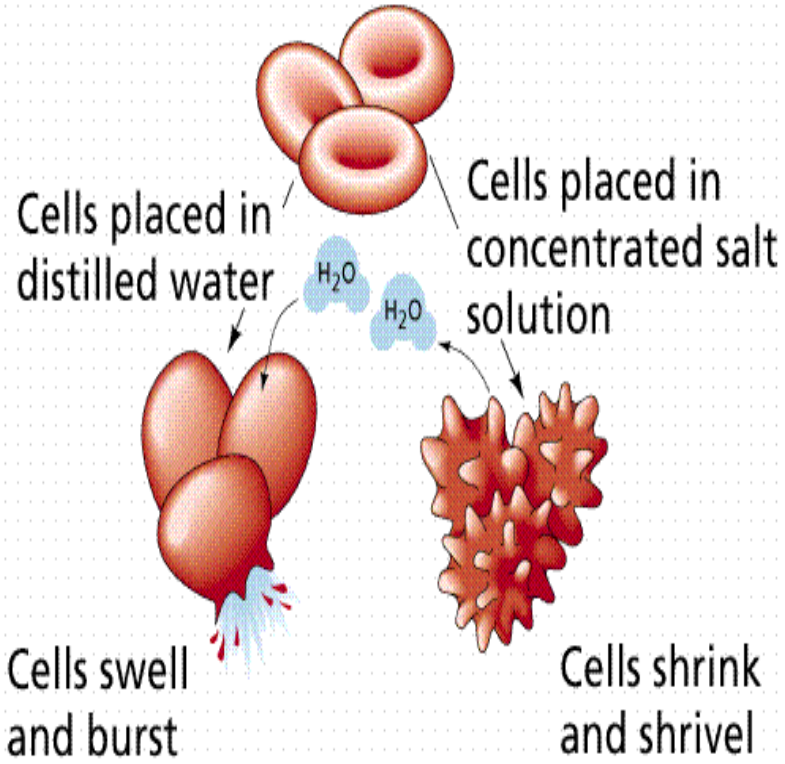
- Glucose is transported from the intestinal lumen into intestinal epithelial cells by sodium-glucose co-transporter. Once inside the intestinal epithelial cells, glucose can be transported across the basolateral membrane to the blood by facilitated diffusion through Glucose transporter (GLUT 2).



Osmosis

Osmosis is the movement of water molecules across a selectively permeable membrane from a region of high water concentration (high water potential) to a region of low water concentration (low water potential).

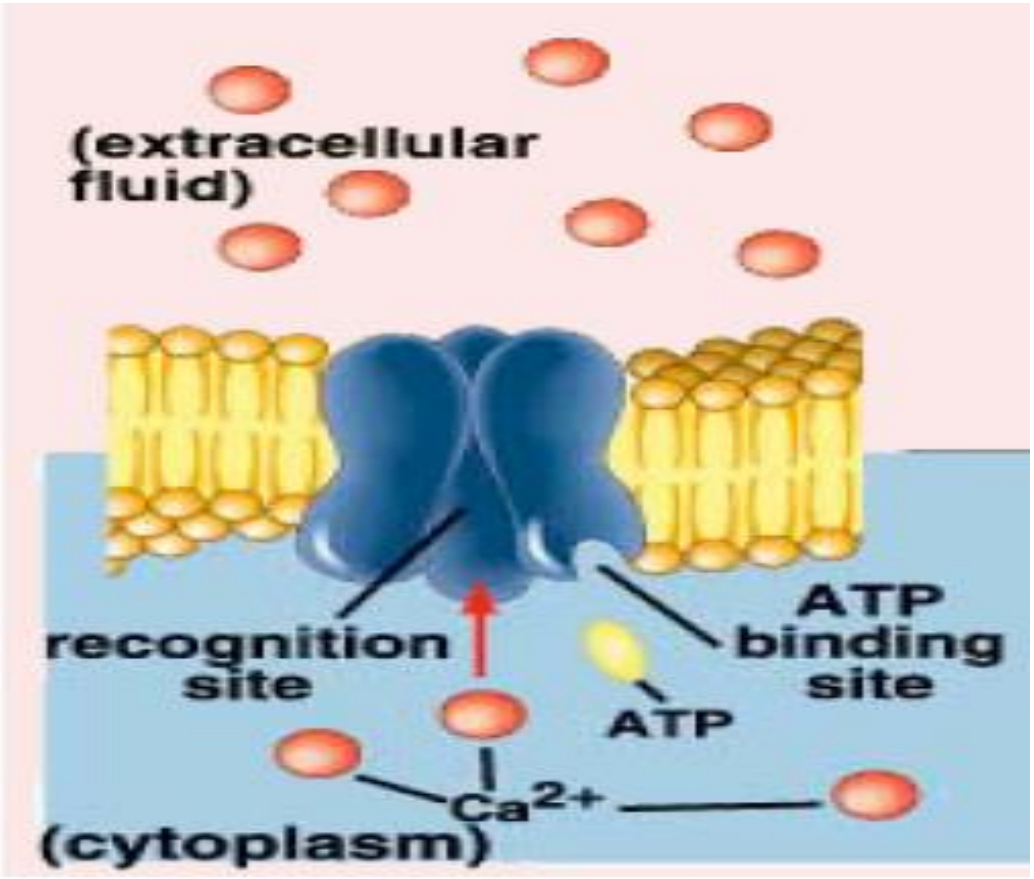




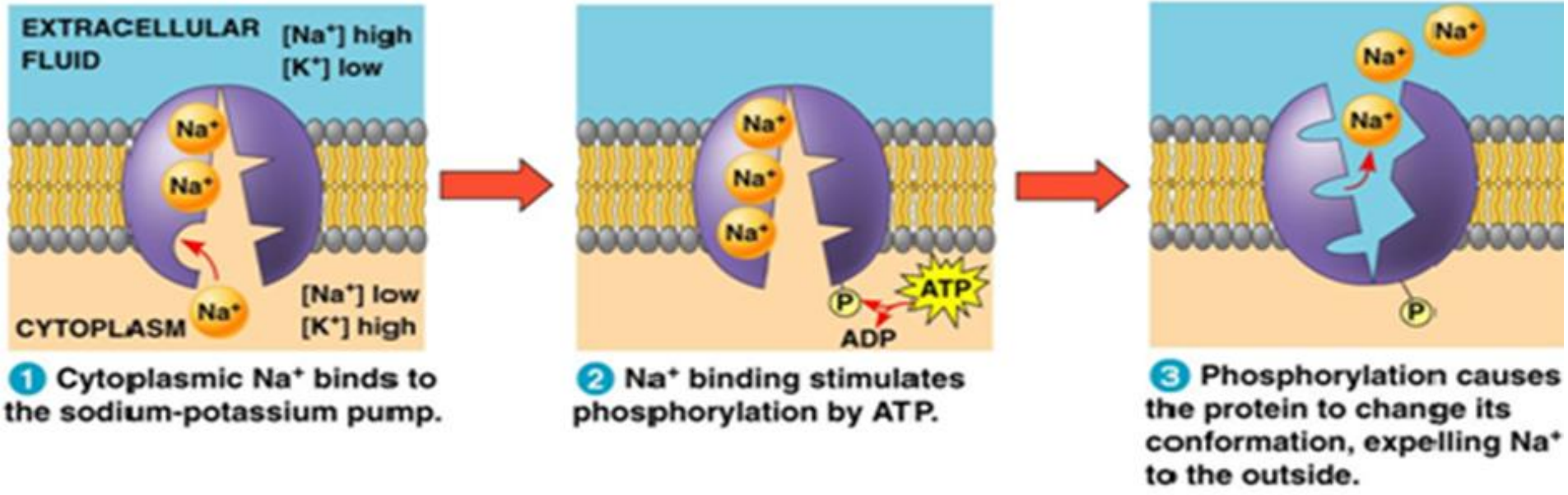
Active transport

Active transport : is the movement of molecules across a cell membrane from a region of lower concentration to a region of higher concentration, against the concentration gradient. Active transport require energy (ATP).

- Active transport proteins use energy to pump molecules into or out of the cell.



Active transport
(Sodium- potassium pump)



1 Cytoplasmic Na^+ binds to the sodium-potassium pump.

2 Na^+ binding stimulates phosphorylation by ATP.

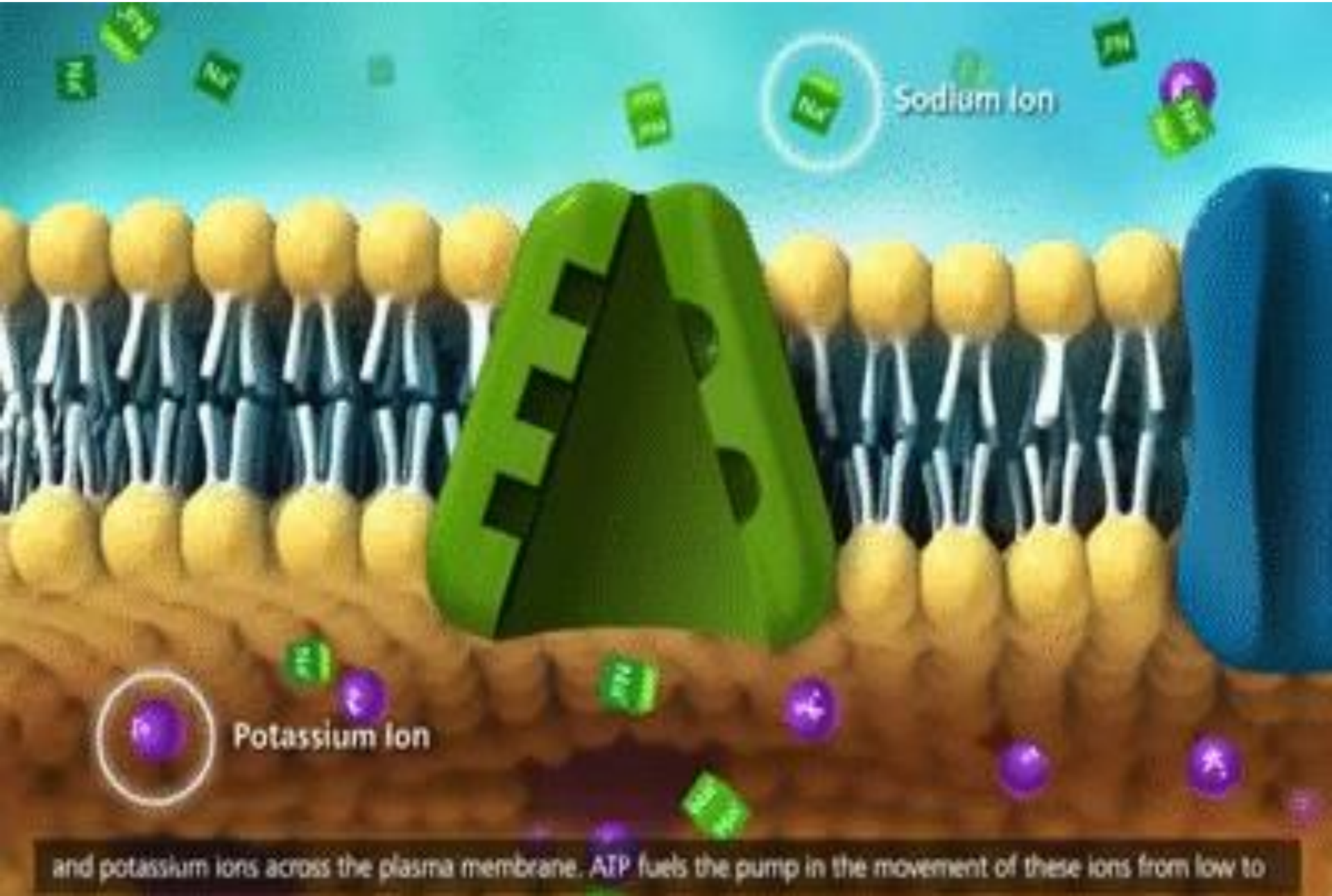
3 Phosphorylation causes the protein to change its conformation, expelling Na^+ to the outside.

4 Extracellular K^+ binds to the protein, triggering release of the phosphate group.

5 Loss of the phosphate restores the protein's original conformation.

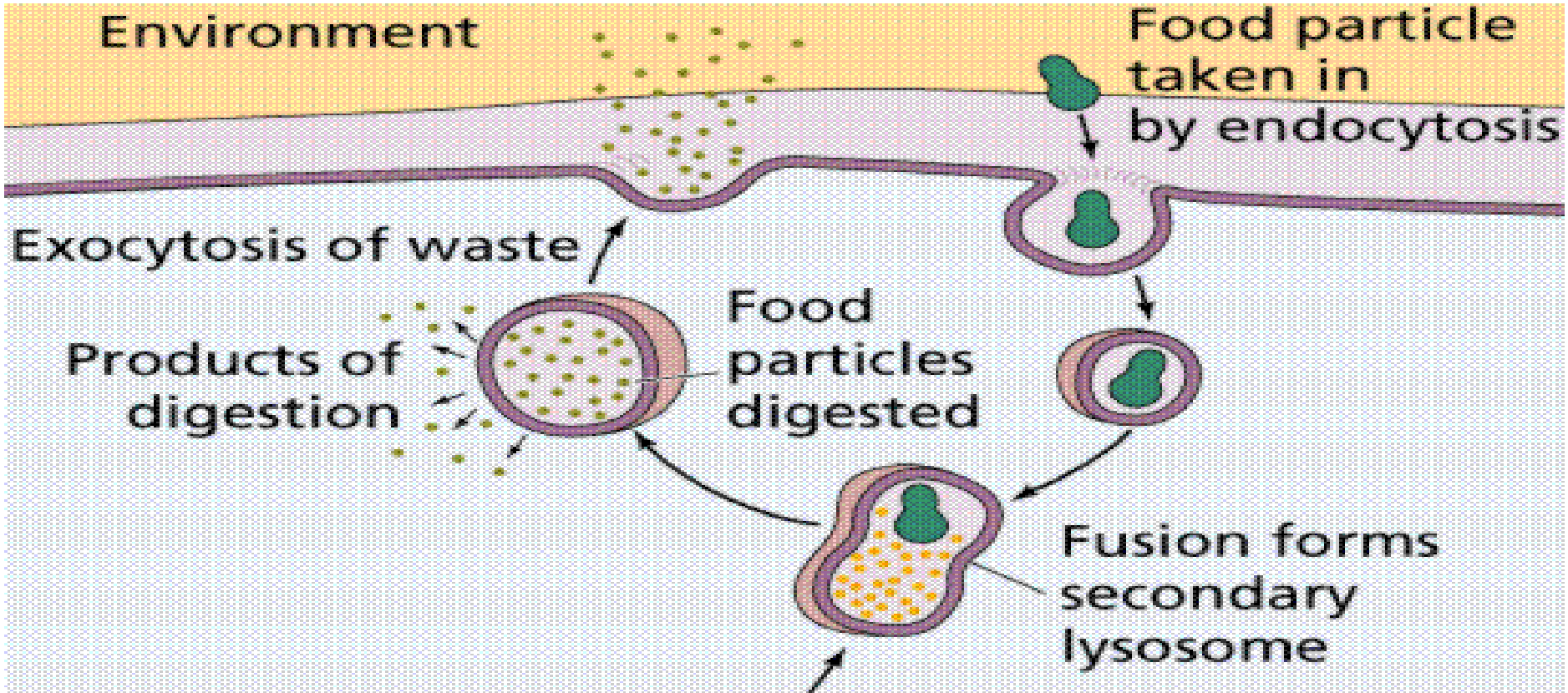
6 K^+ is released and Na^+ sites are receptive again; the cycle repeats.

Sodium- potassium pump

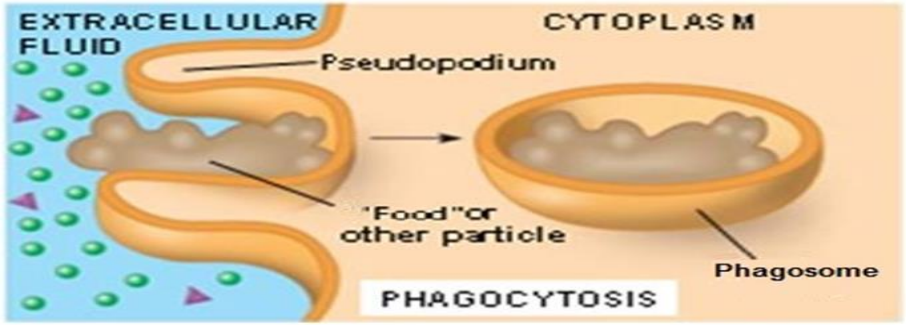


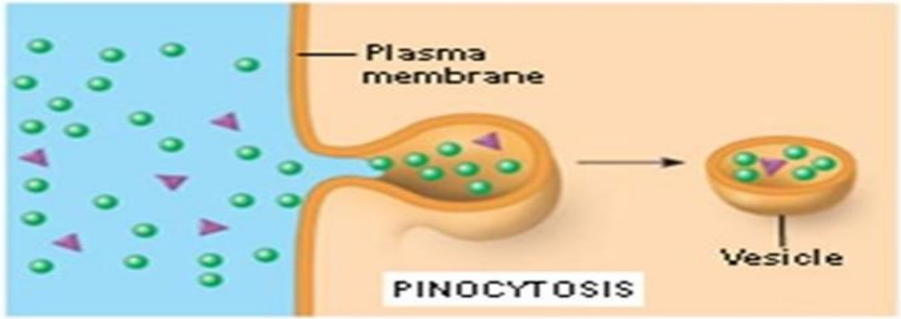
Endocytosis

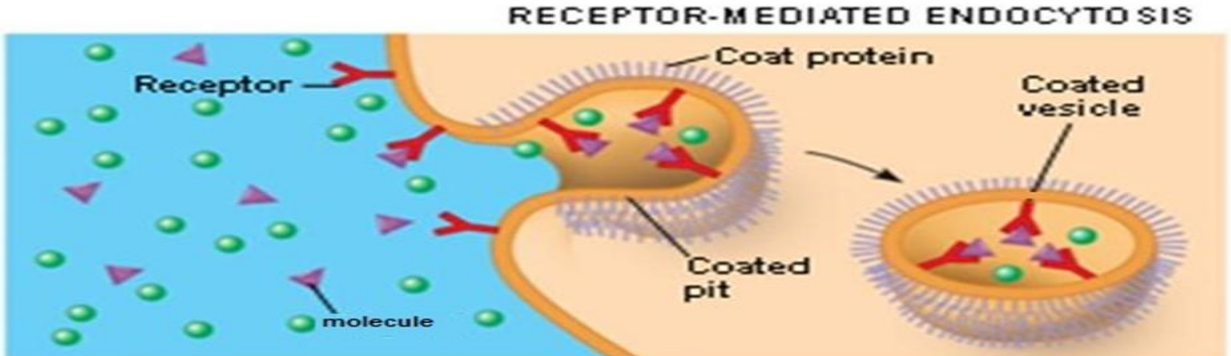
Endocytosis is the case when a molecule causes the cell membrane to bulge inward, forming a vesicle.
Endocytosis includes Phagocytosis , Pinocytosis , Receptor-mediated endocytosis.



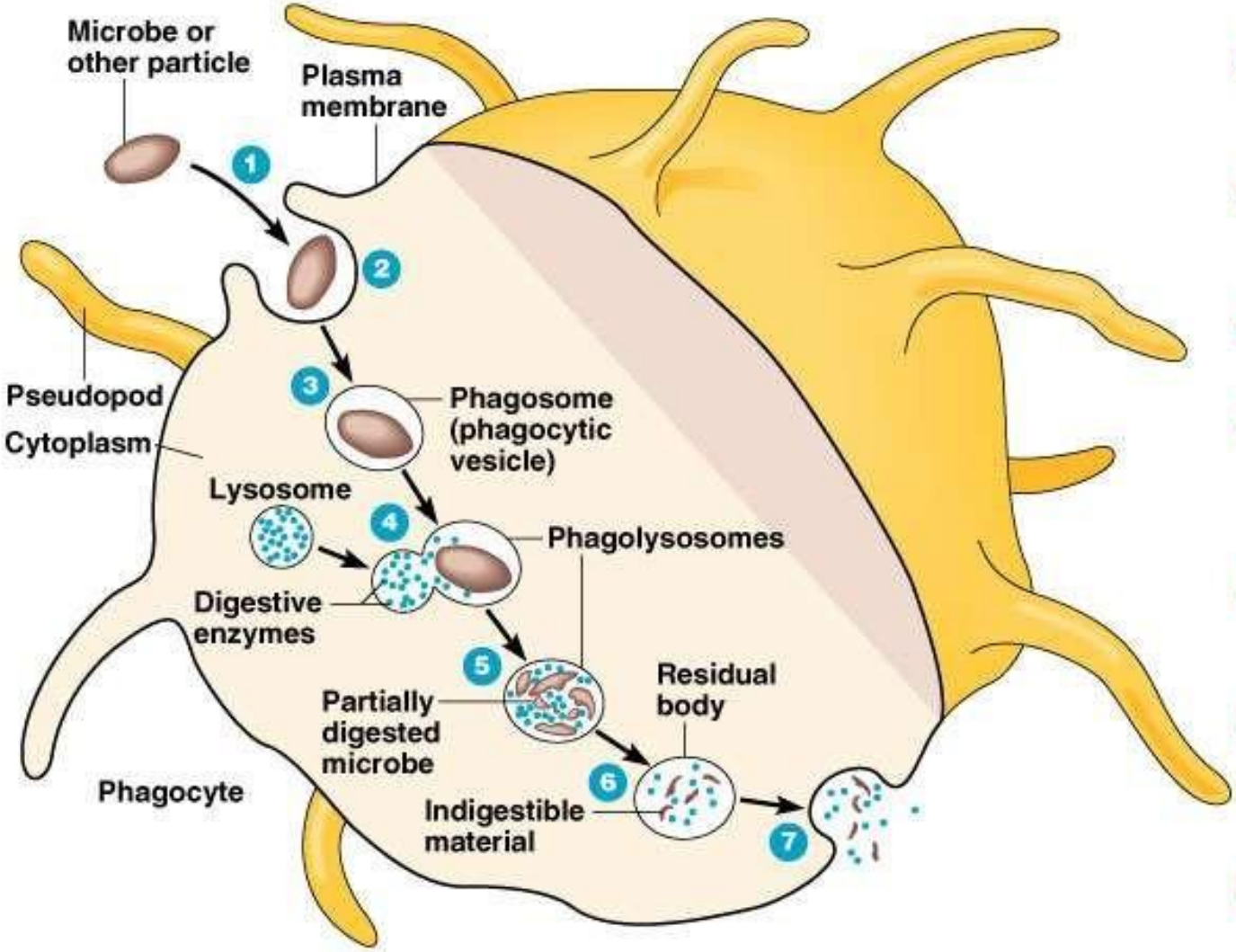
- **Phagocytosis** is a type of endocytosis, also known as " cell eating" , in which a cell engulfs large particles.
- **Pinocytosis** is a type of endocytosis, also known as " cell drinking ". It is a process that occurs when cells engulf extracellular fluid and dissolved substances.
- **Receptor-mediated endocytosis** occurs when the material to be transported binds to a specific receptor protein on the cell membrane.







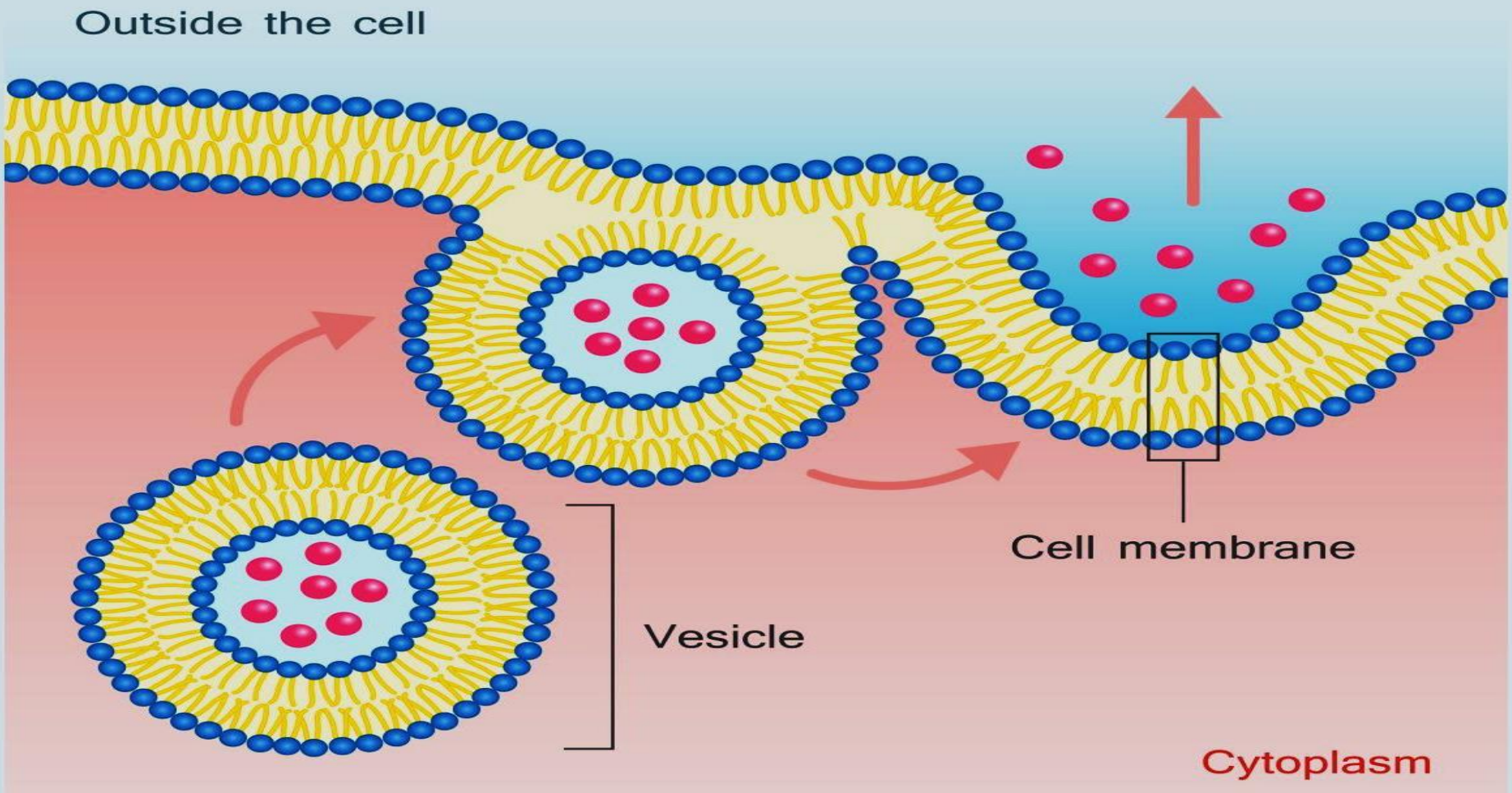
Phagocytosis



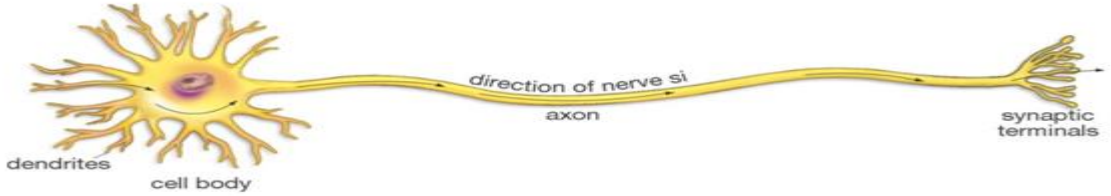
1. Chemotaxis and adherence of microbe to phagocyte.
2. Ingestion of microbe by phagocyte.
3. Formation of a phagosome.
4. Fusion of the phagosome with a lysosome to form a phagolysosome.
5. Digestion of ingested microbe by enzymes.
6. Formation of residual body containing indigestible material.
7. Discharge of waste materials.

Exocytosis

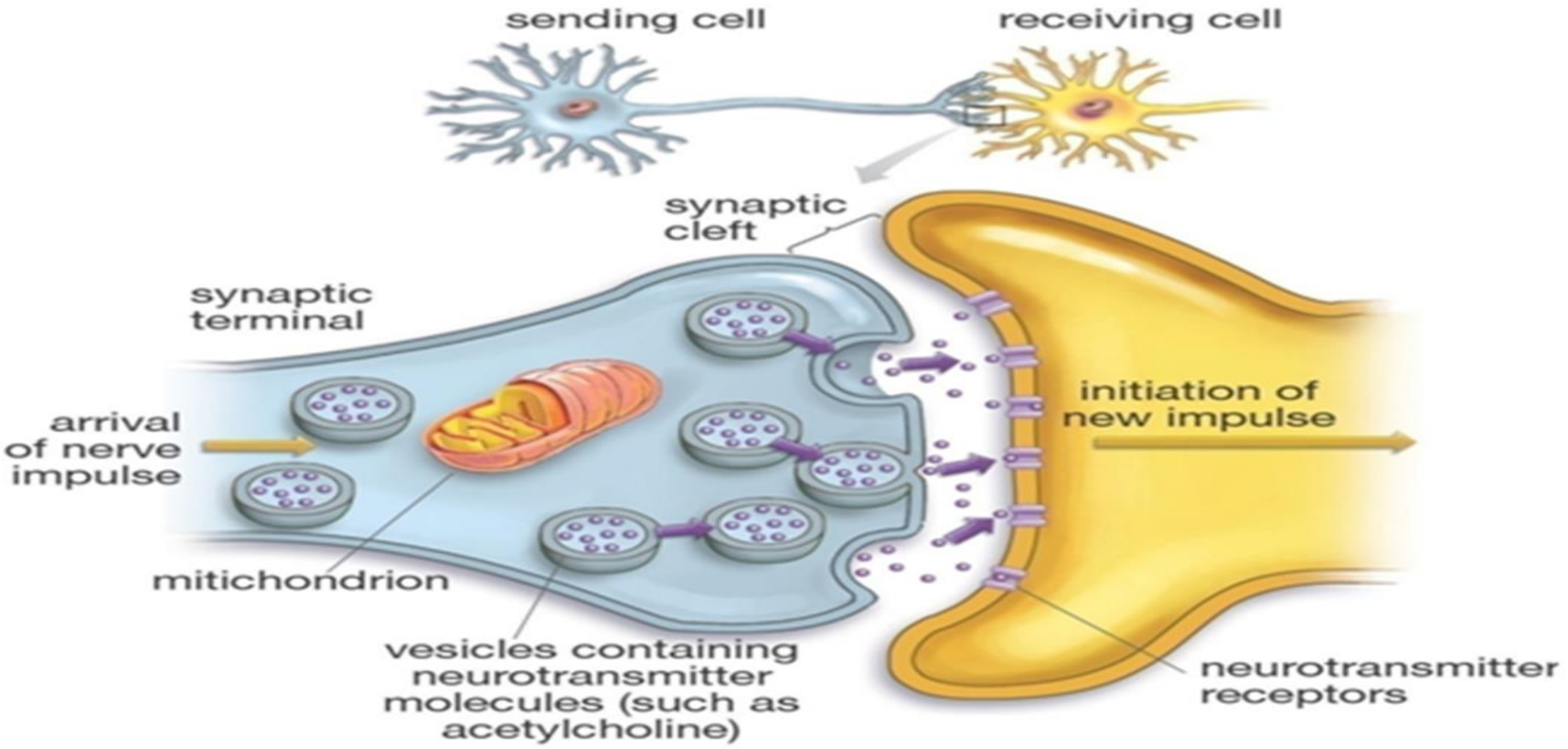
- the cell forms a vesicle around material that needs to be expelled from the cell.
- the vesicle is transported to the cell membrane.
- the vesicle membrane fuses with the cell membrane and releases the contents outside of the cell.

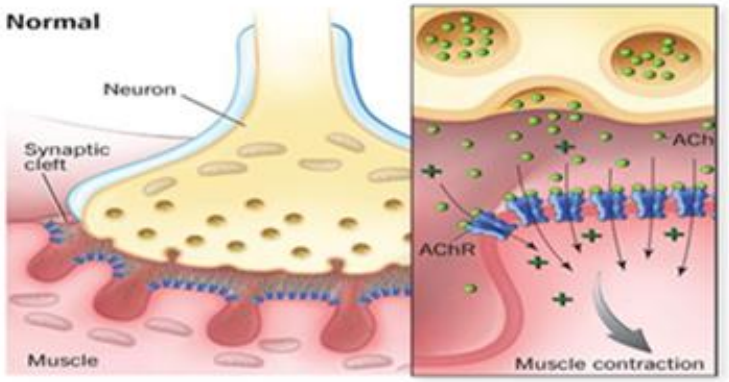


Nerve cell



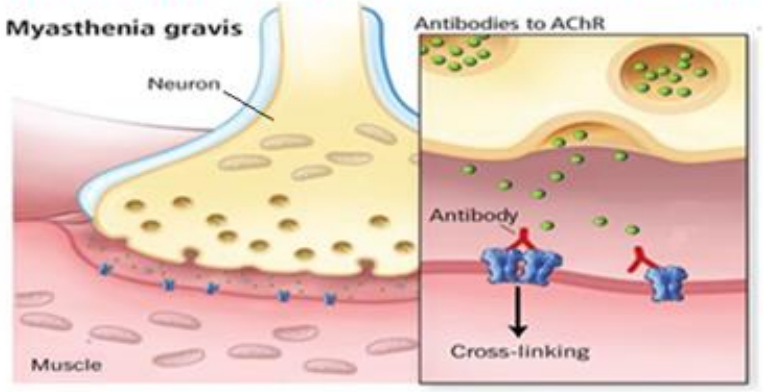
Nerve cells use molecules called neurotransmitters to communicate with each other at junctions known as synapses. Neurotransmitters are stored inside synaptic vesicles. When a vesicle fuses with the cell membrane, neurotransmitters are released into the synaptic cleft of the synapse by **exocytosis**.





At the neuromuscular junction, motor neurons release acetylcholine (ACh), which diffuses across the synaptic cleft and binds to receptors (acetylcholine receptors (AChR)), and the muscle depolarizes and contracts

Myasthenia gravis, an autoimmune disease



Most people with myasthenia gravis have antibodies that block , alter , or destroy acetylcholine receptors (AChR) . The result is less transmission of nerve impulses, leading to muscle weakness.