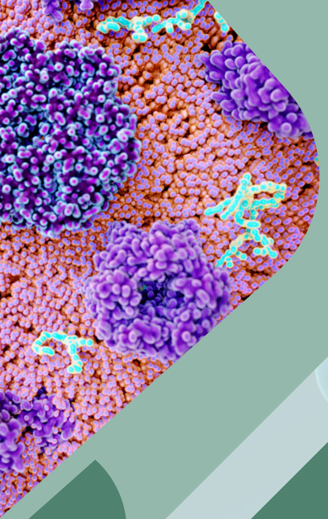

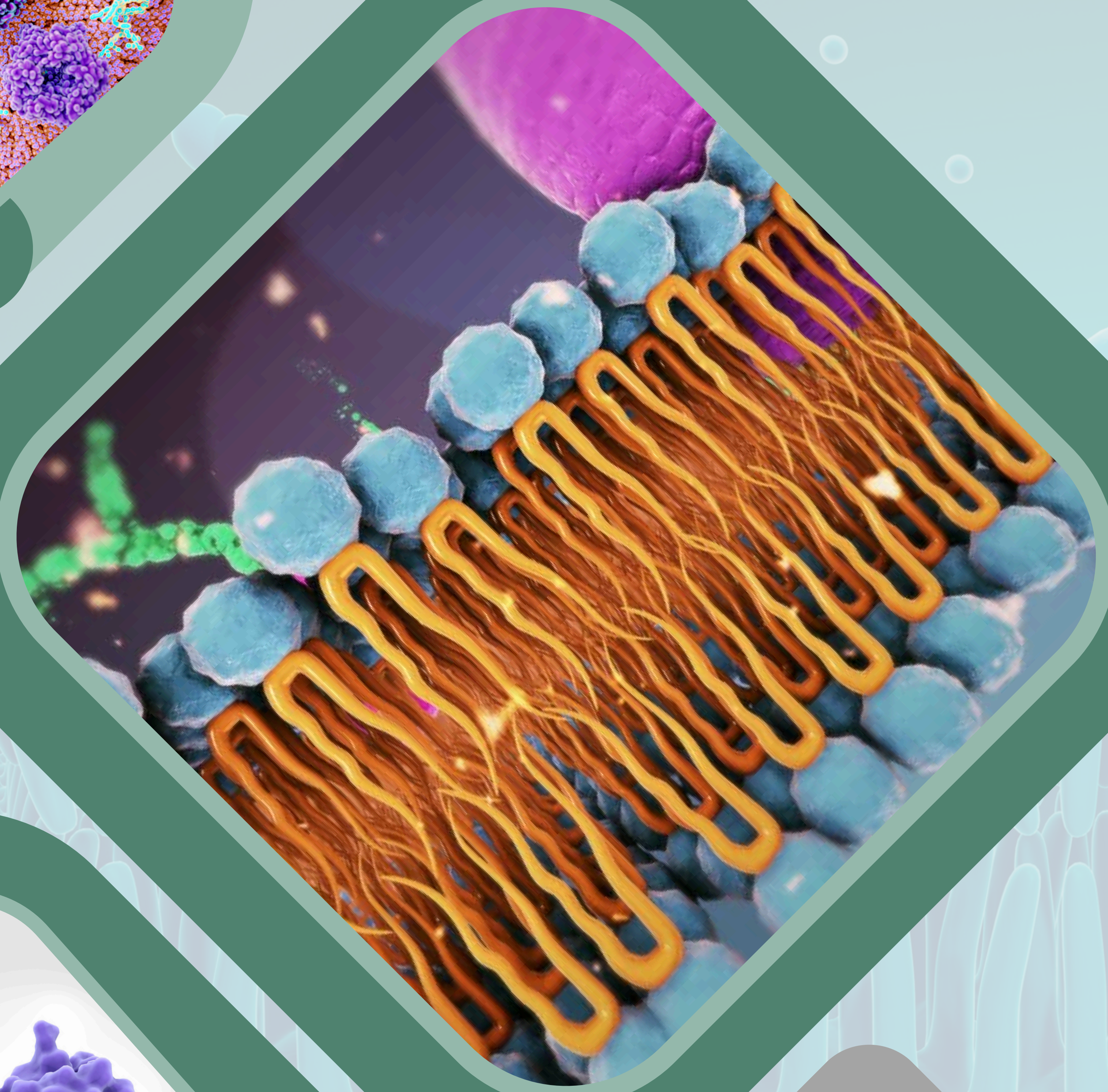

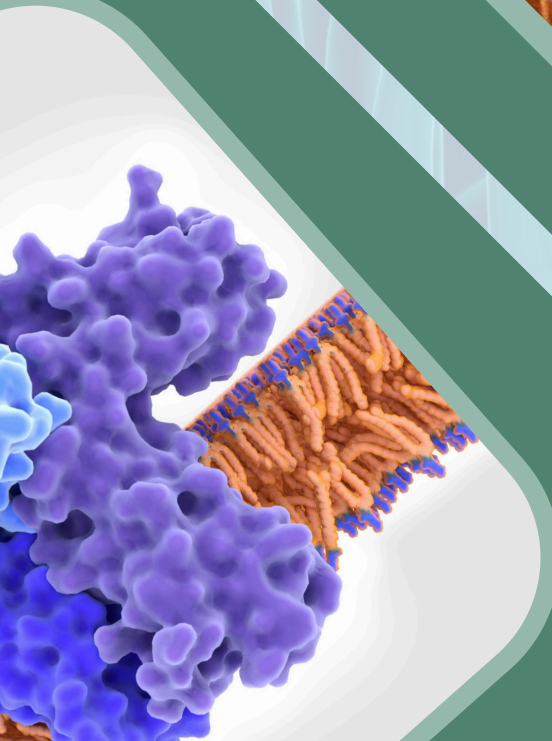

MEMBRANE TRANSPORT and IONIC CONDUCTANCE

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OBJECTIVES

TO UNDERSTAND THE MECHANISMS AND IMPORTANCE OF MEMBRANE TRANSPORT AND IONIC CONDUCTANCE IN MAINTAINING CELLULAR HOMEOSTASIS AND FACILITATING CELLULAR FUNCTIONS.

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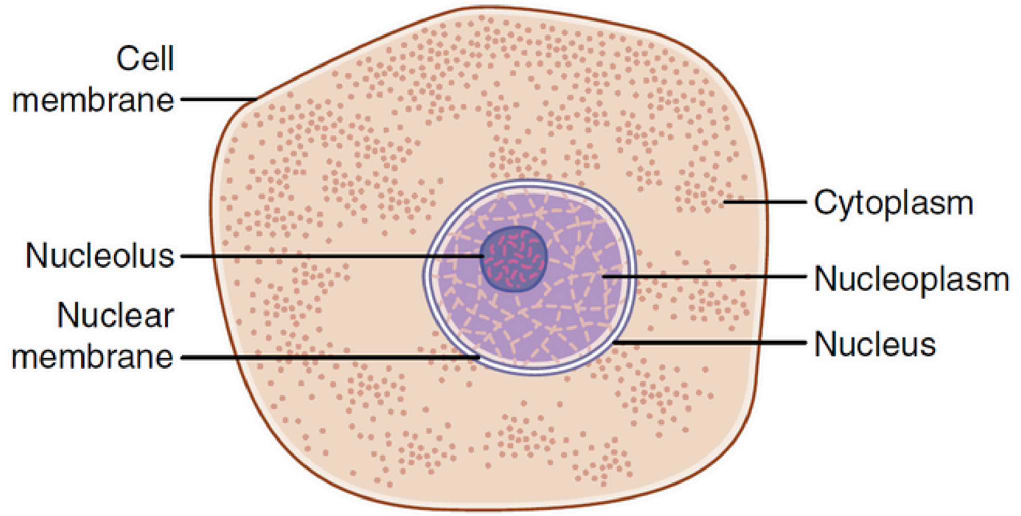
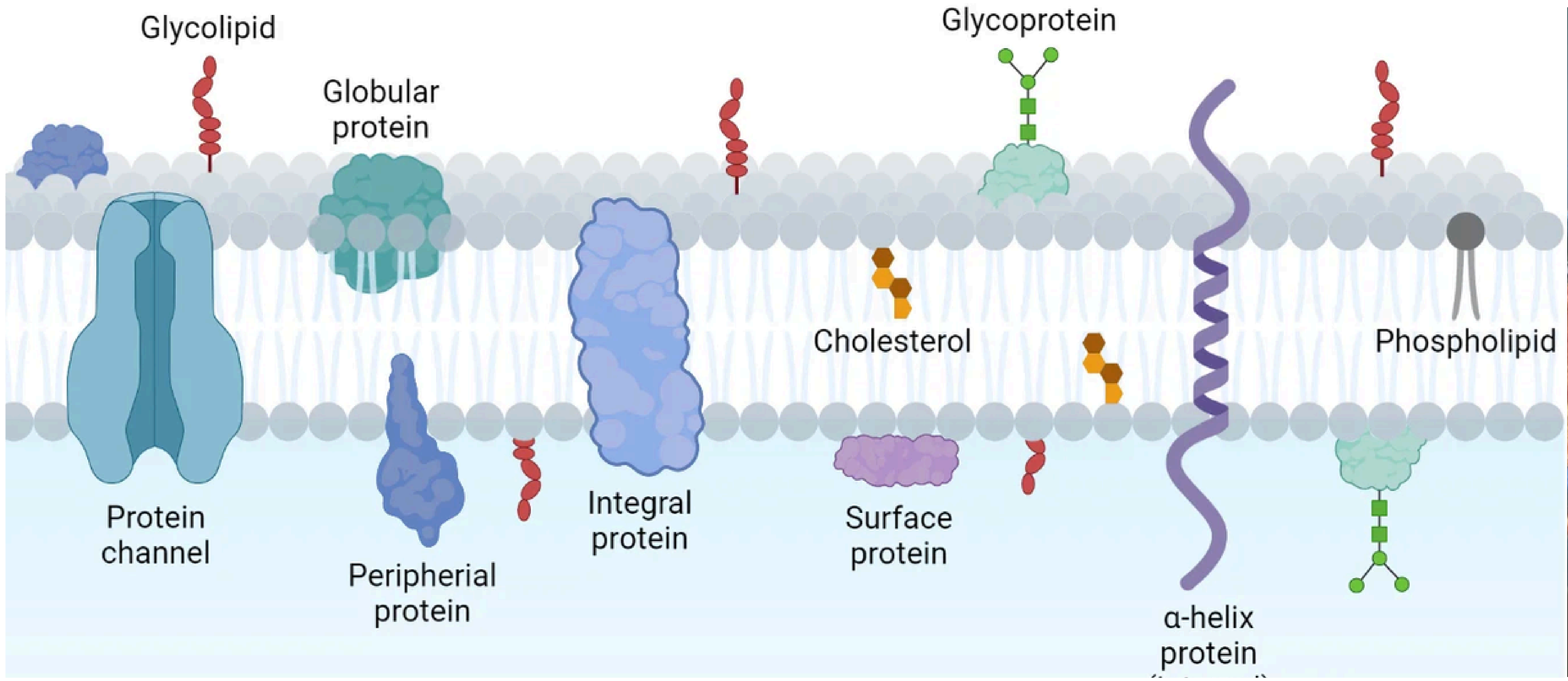
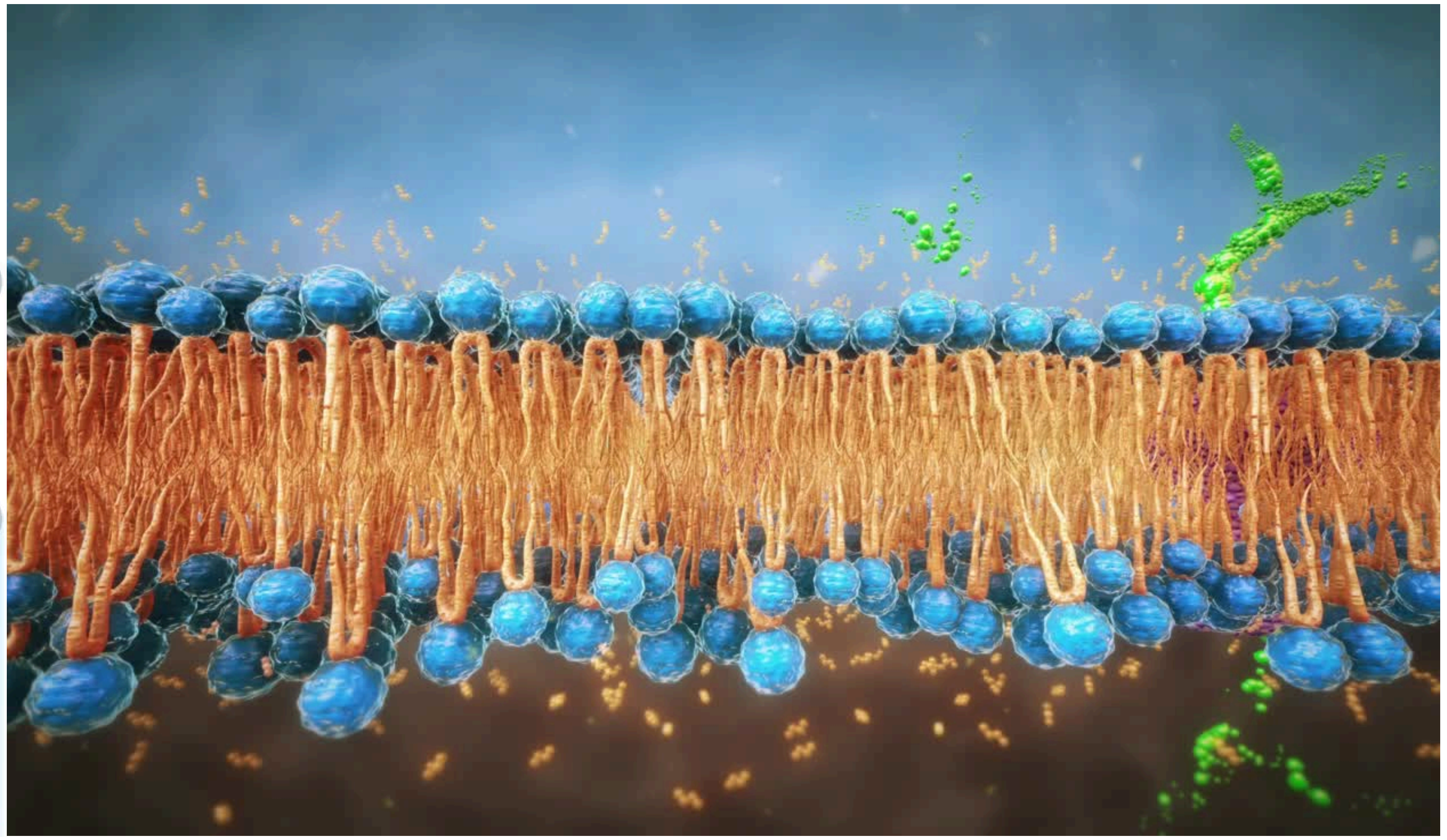
Cell membrane





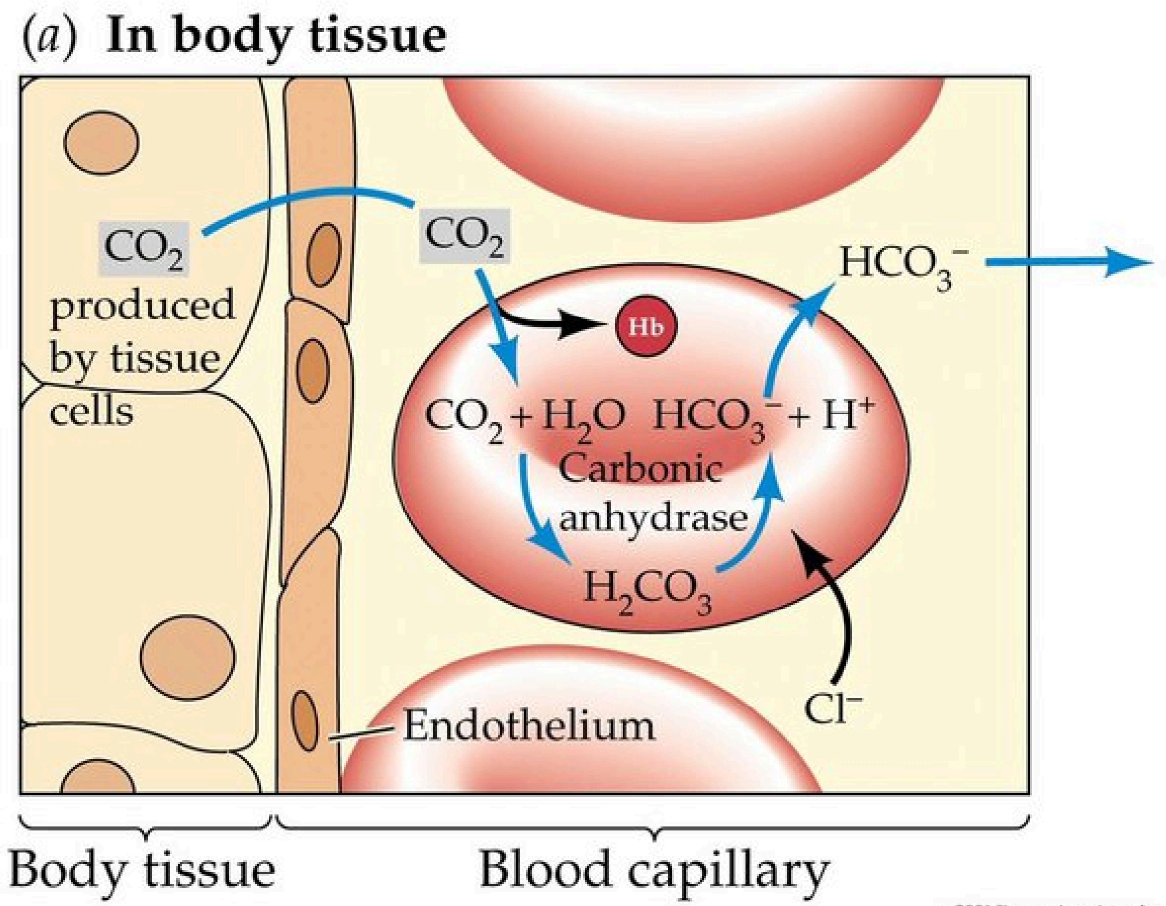


1. ***What is(are) the purpose(s) of membrane transport?***
2. ***How cells control the transport of molecules across the membrane?***

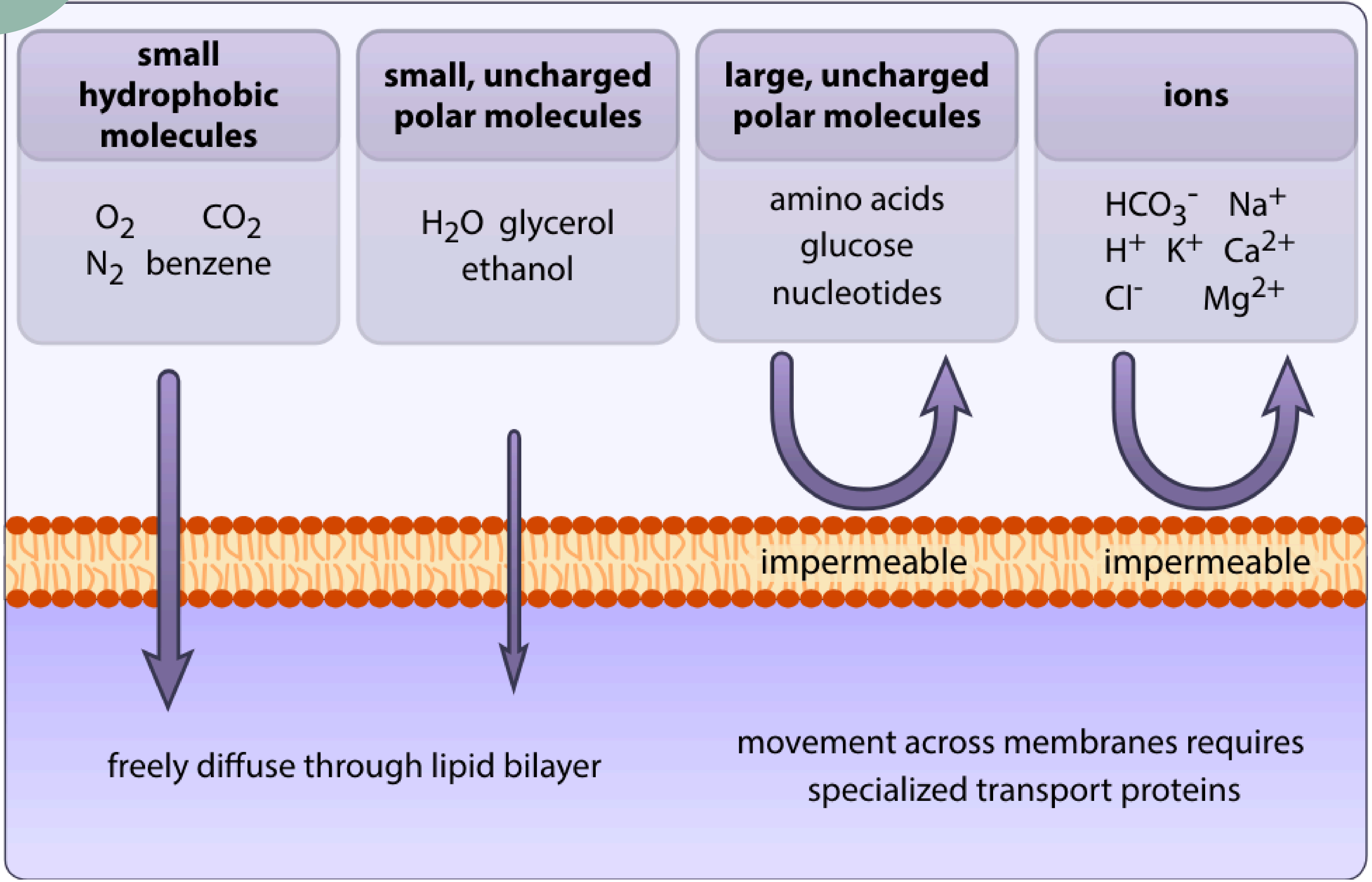
Membrane transport

Maintaining cellular homeostasis

1. **Acquire essential nutrients**: glucose, amino acids, ions
2. **Waste removal**: CO2, nitrogenous waste
3. **Maintaining ionic balance** e.g. pH balance, electrical potentials
4. **Signal transduction**
5. **Cell volume regulation**
6. **Defense and protection**
7. **Energy production**



Membrane permeability

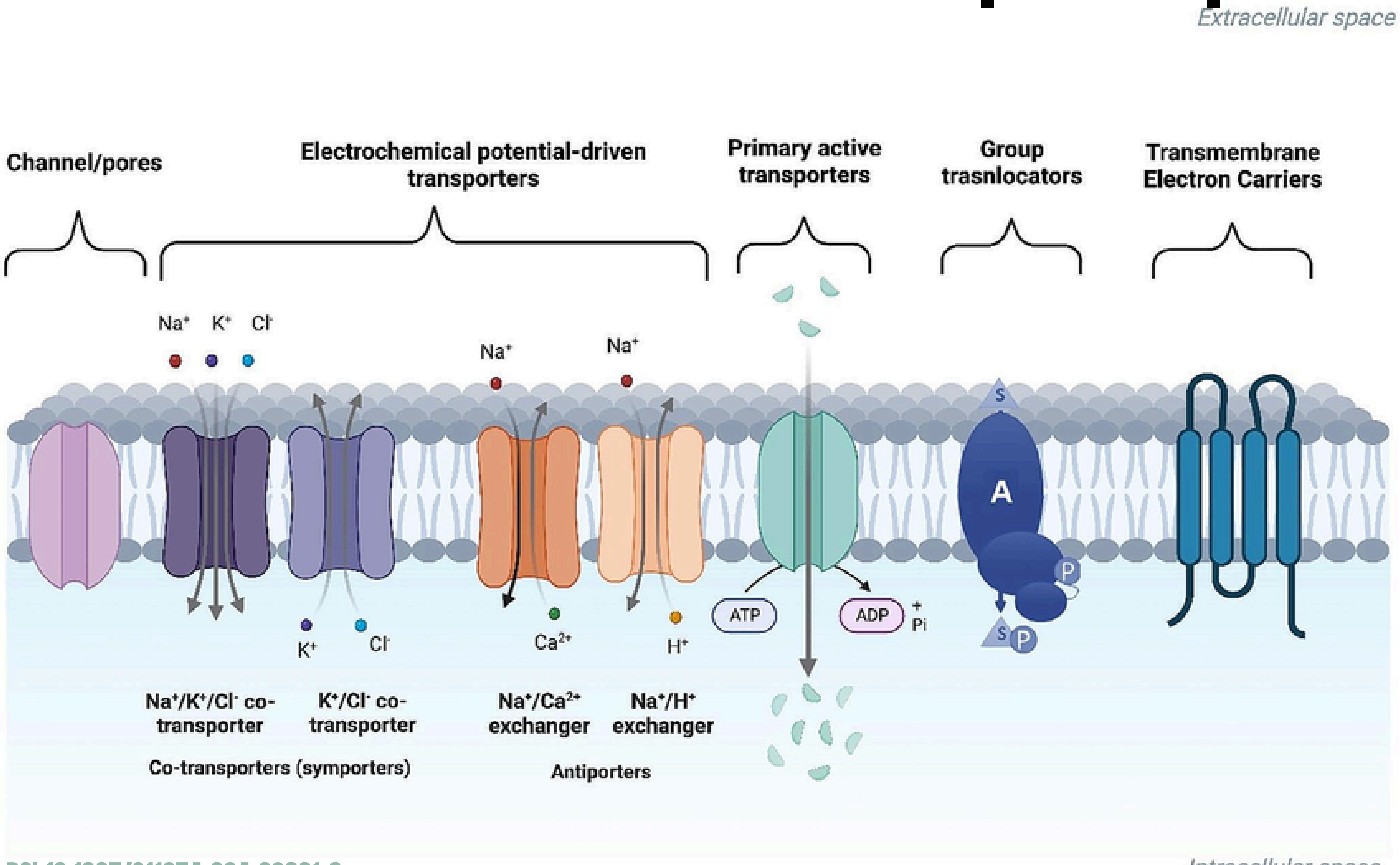


SEMI-PERMEABLE BARRIER

LIPID BILAYER WITH PROTEINS

ATTACHED ON THE SURFACE

Membrane transport proteins



DOI:10.1007/S11274-024-03891-6

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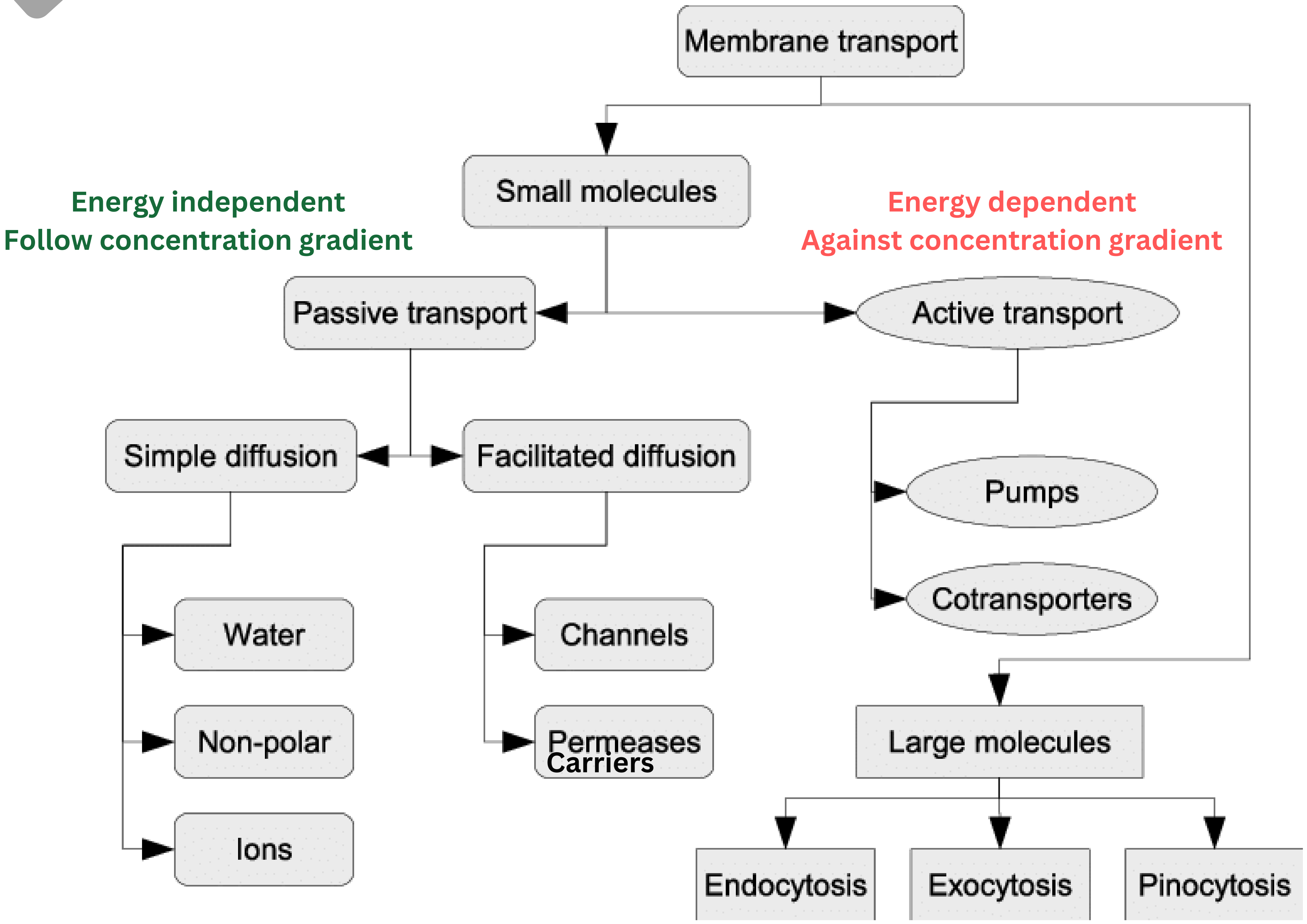
Types of membrane transport



VERLAN, SERGEY. (2010). STUDY OF LANGUAGE-THEORETIC COMPUTATIONAL PARADIGMS INSPIRED BY BIOLOGY.

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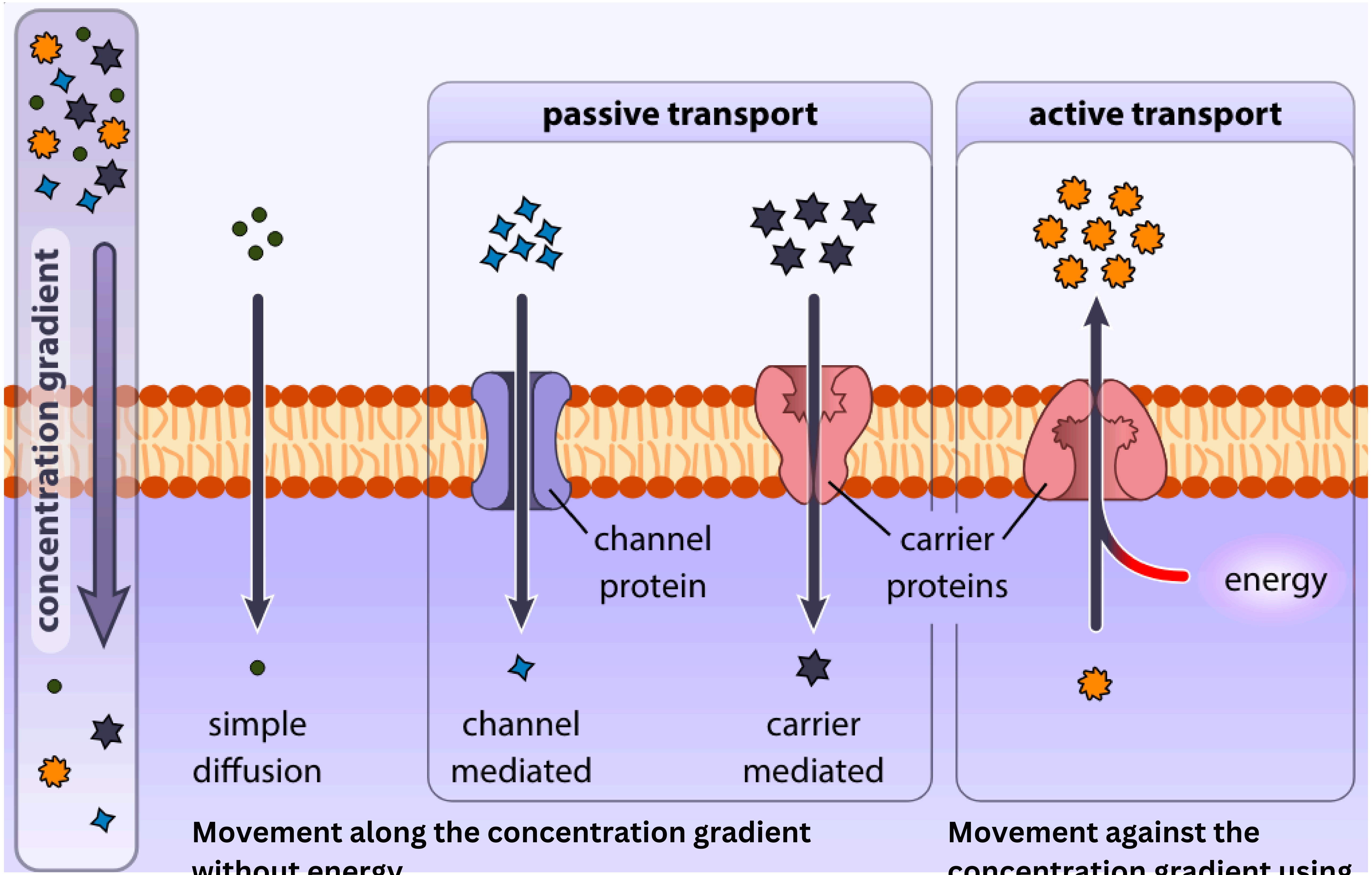
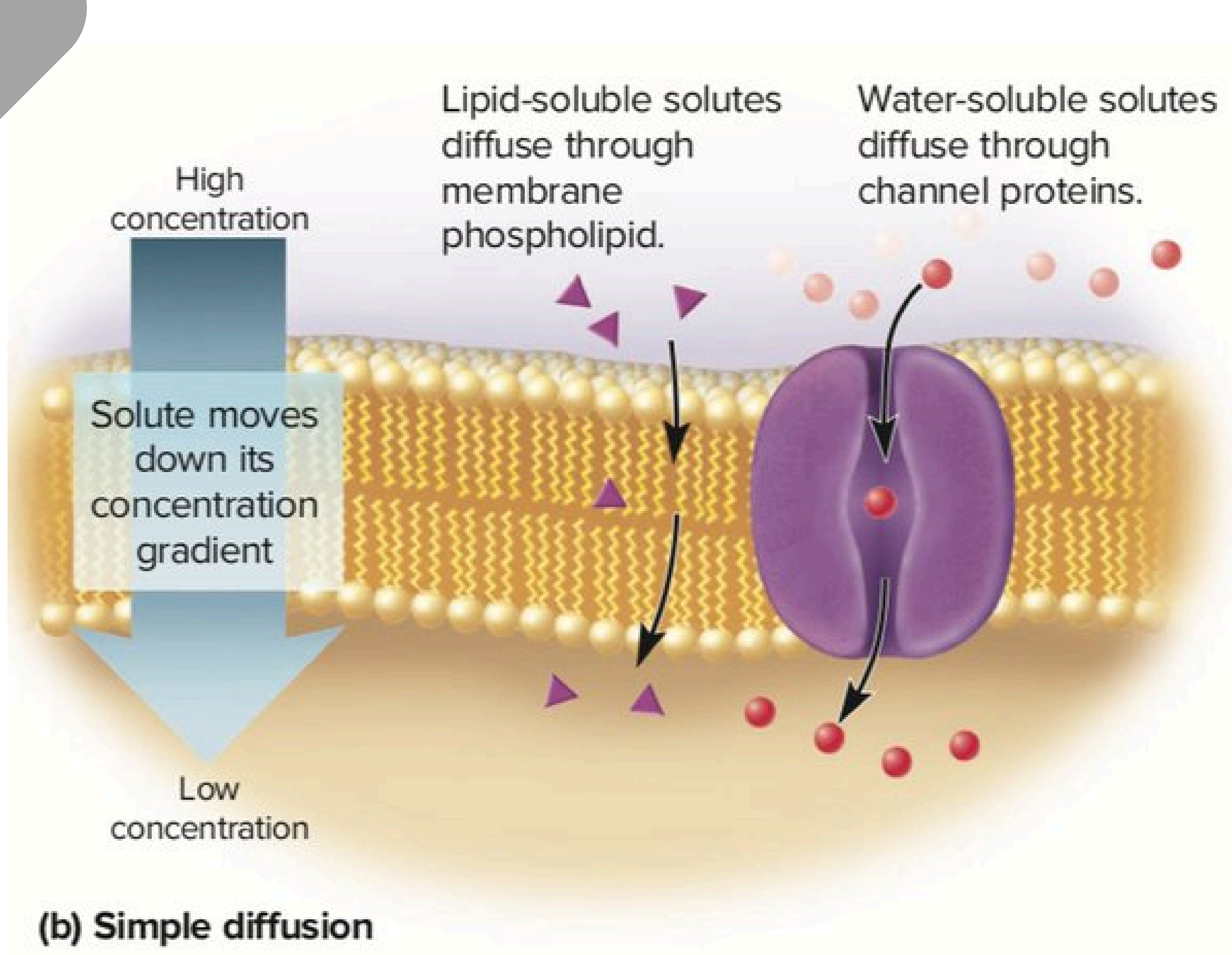
Small molecule transportation



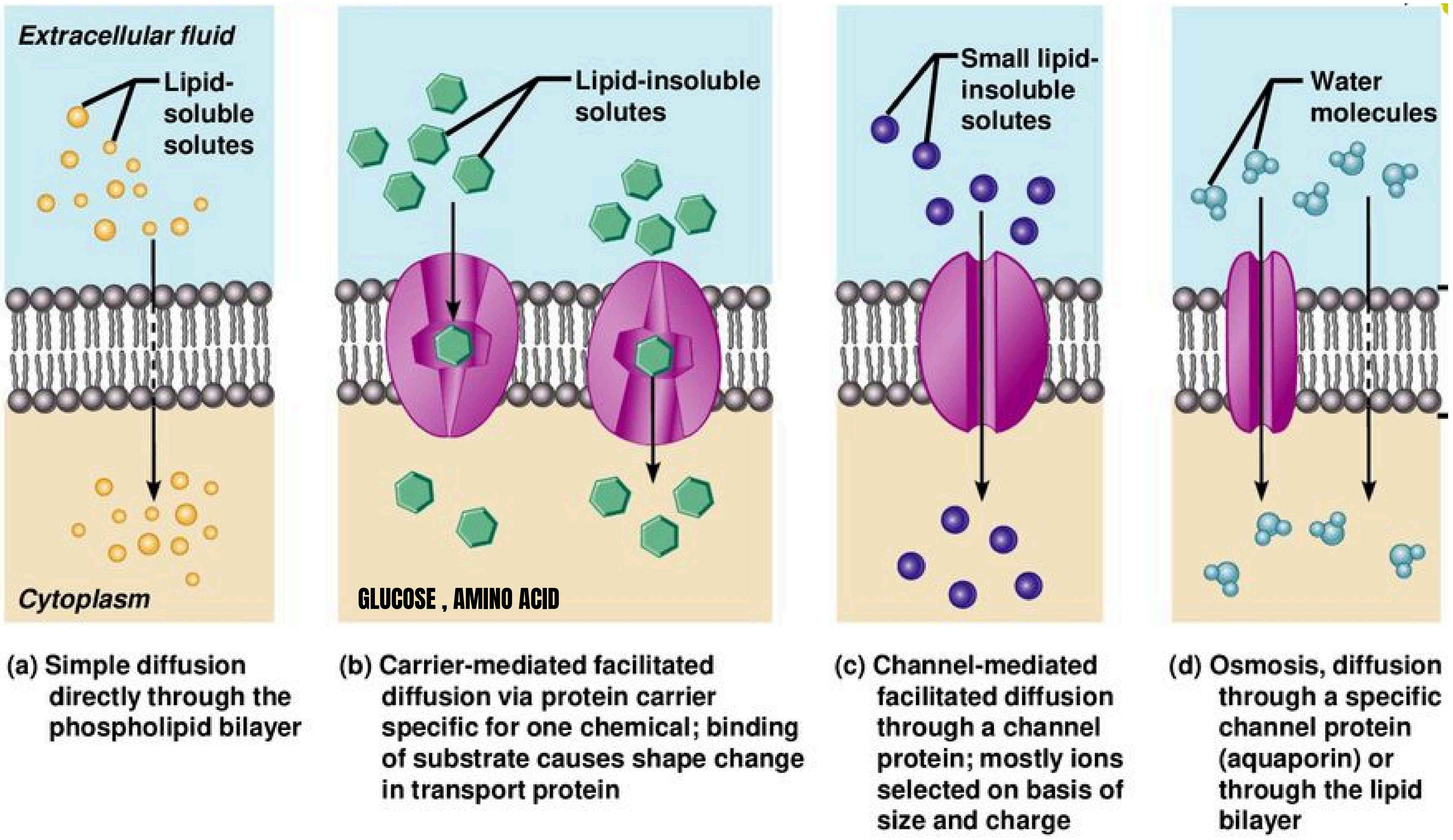
Movement along the concentration gradient without energy

Movement against the concentration gradient using energy (ATP)

Passive transport



(b) Simple diffusion



(a) Simple diffusion directly through the phospholipid bilayer

(b) Carrier-mediated facilitated diffusion via protein carrier specific for one chemical; binding of substrate causes shape change in transport protein

(c) Channel-mediated facilitated diffusion through a channel protein; mostly ions selected on basis of size and charge

(d) Osmosis, diffusion through a specific channel protein (aquaporin) or through the lipid bilayer

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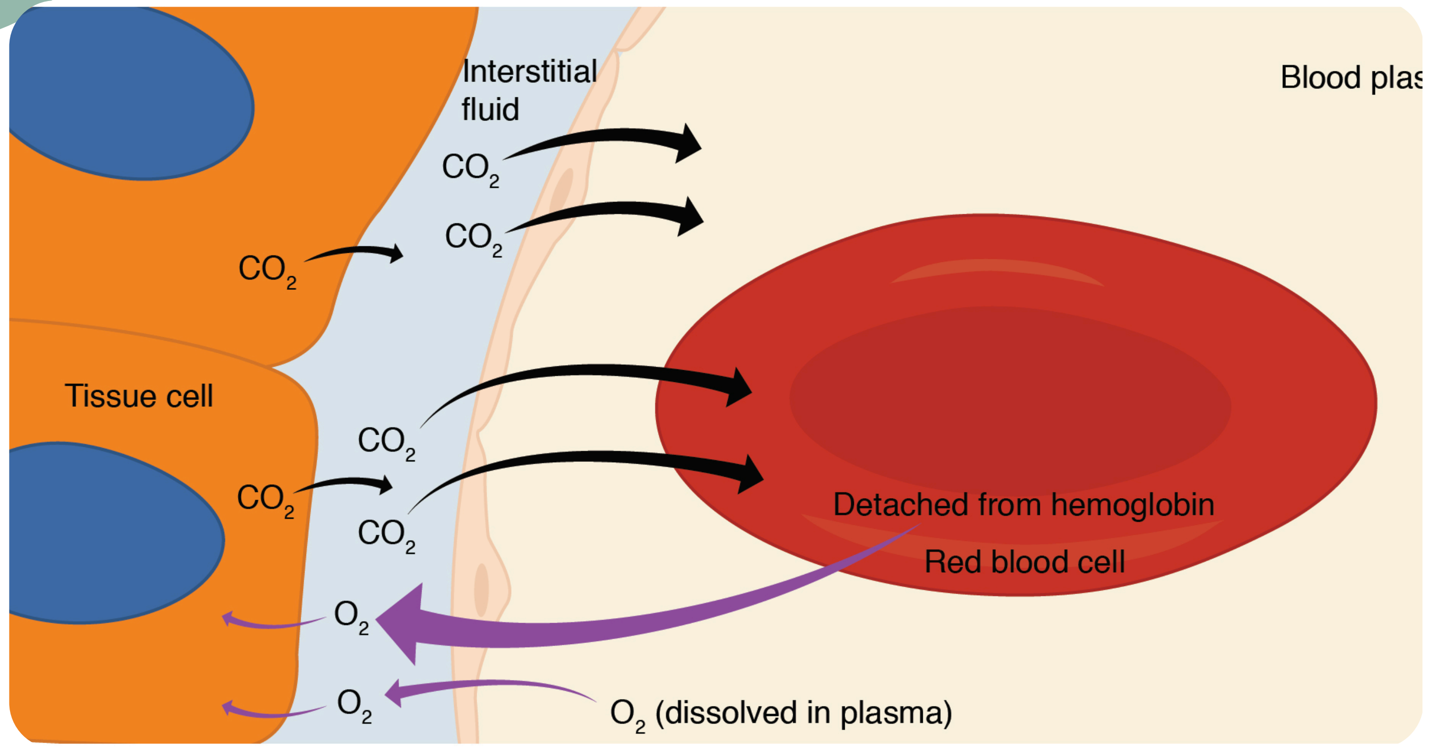
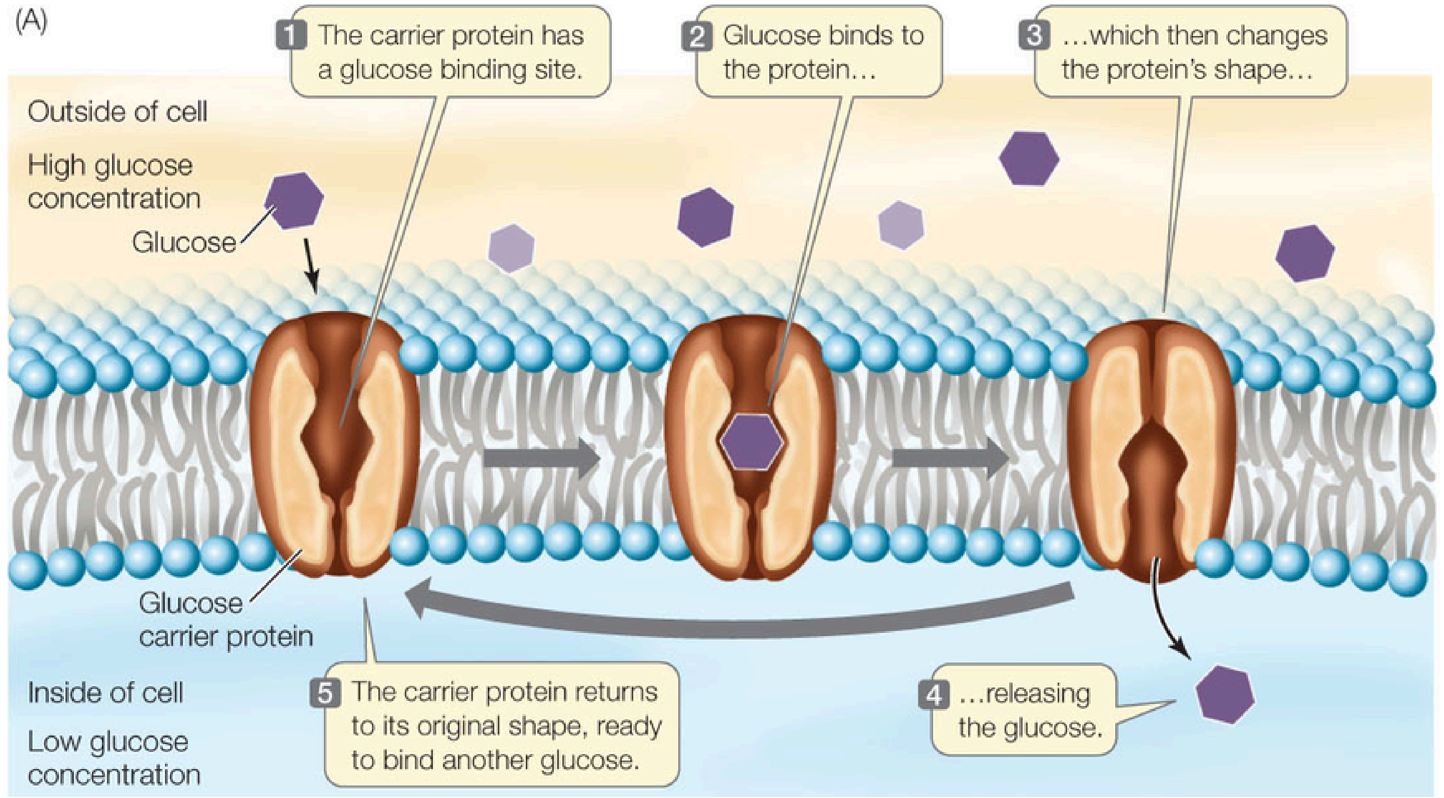
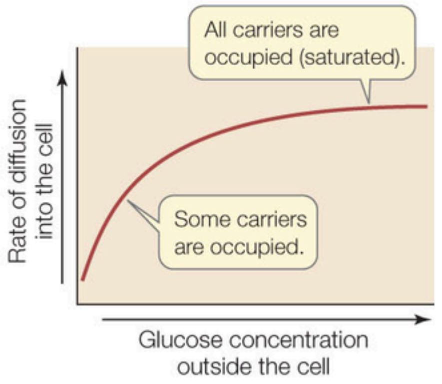
Passive transport

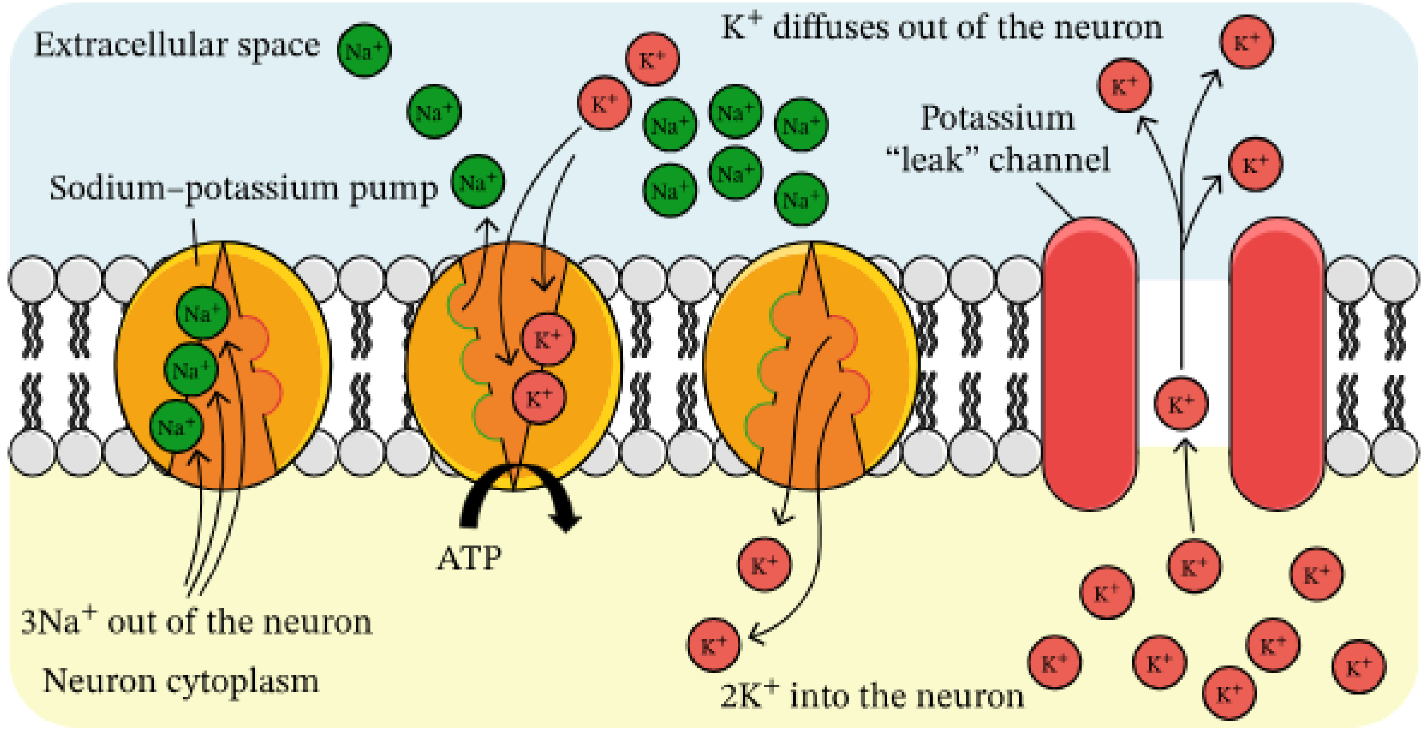


Simple diffusion of CO2 across the cell membrane

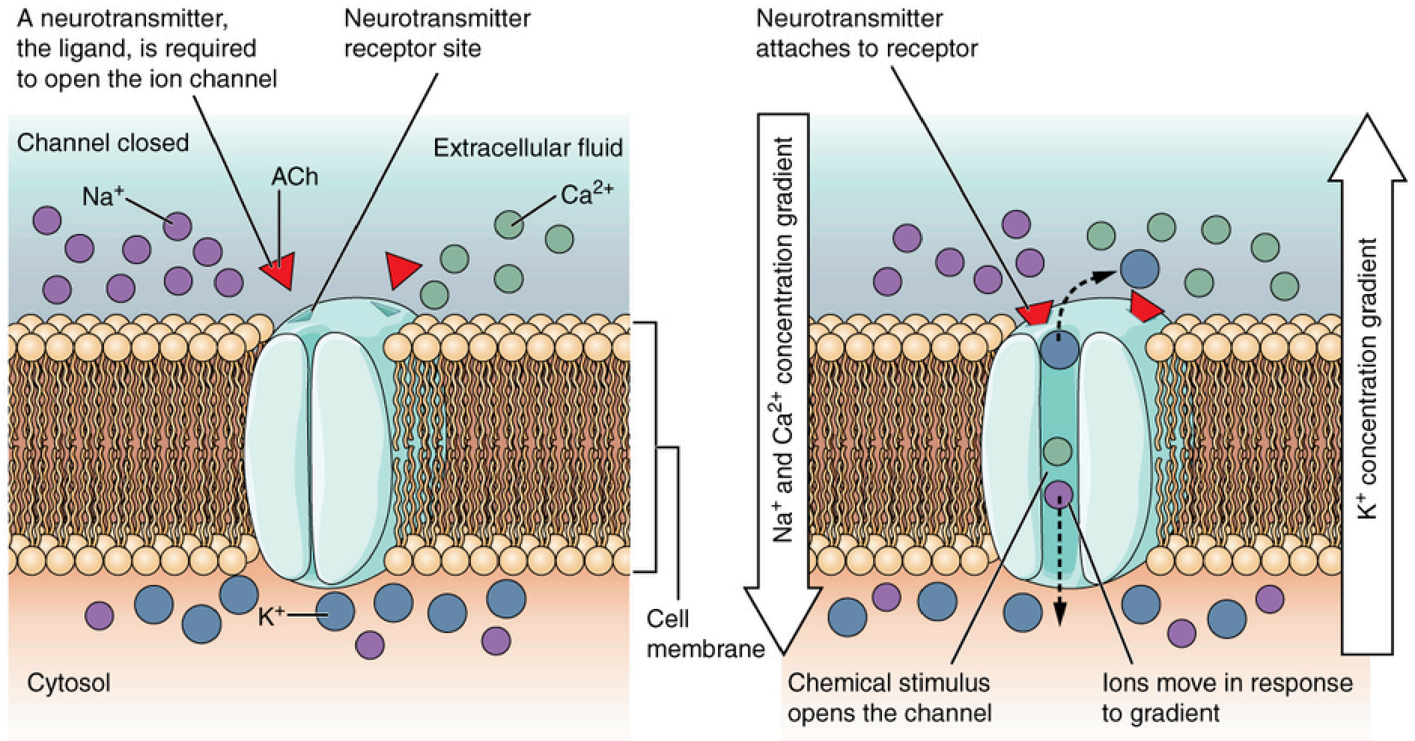




A carrier protein facilitates diffusion of glucose across the cell membrane (most cells).

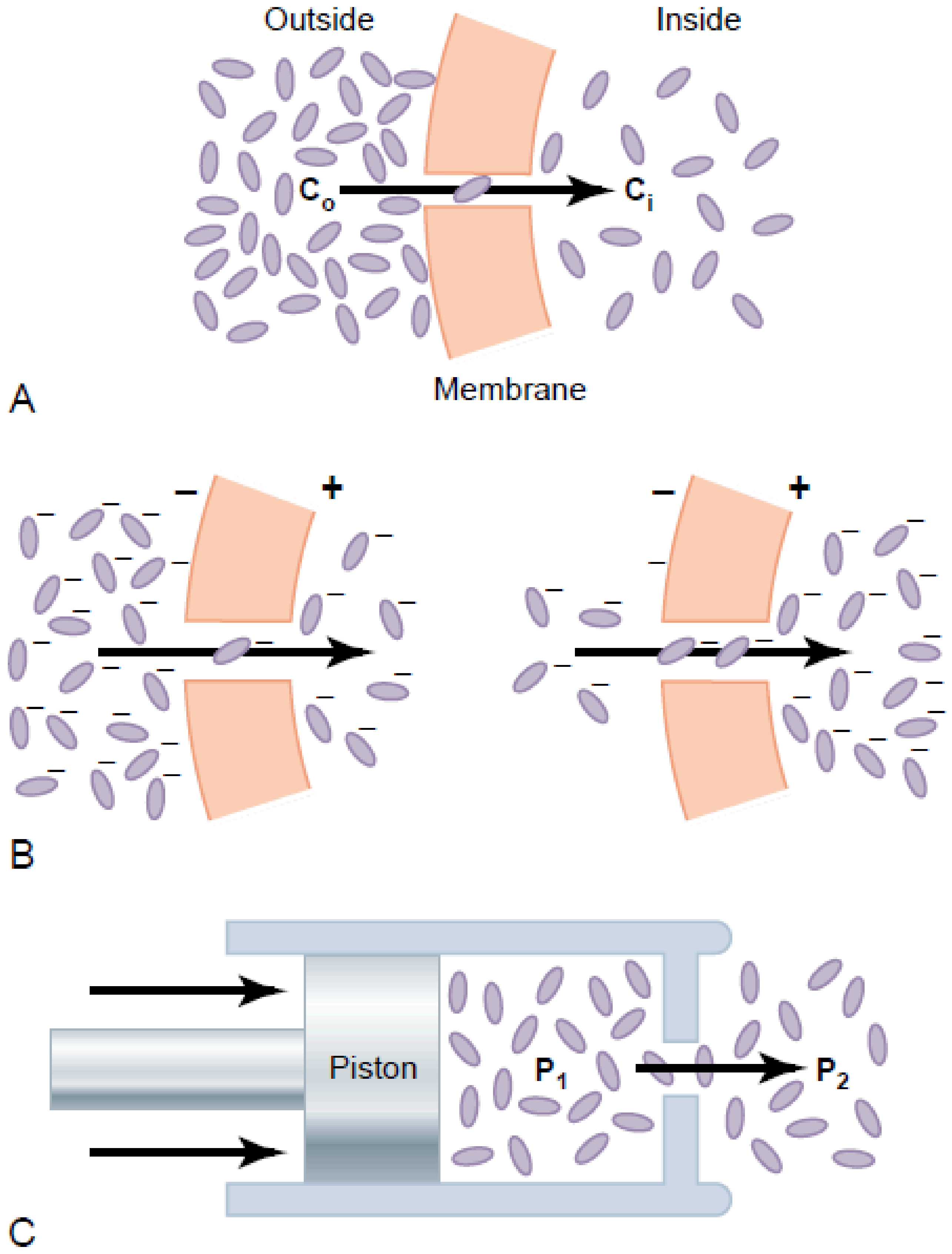


K+ leakage channel allows K+ flow out of the cell along concentration gradient



Activation of ion channels allow movement of ion crossing plasma membrane

Factors affect rate of diffusion

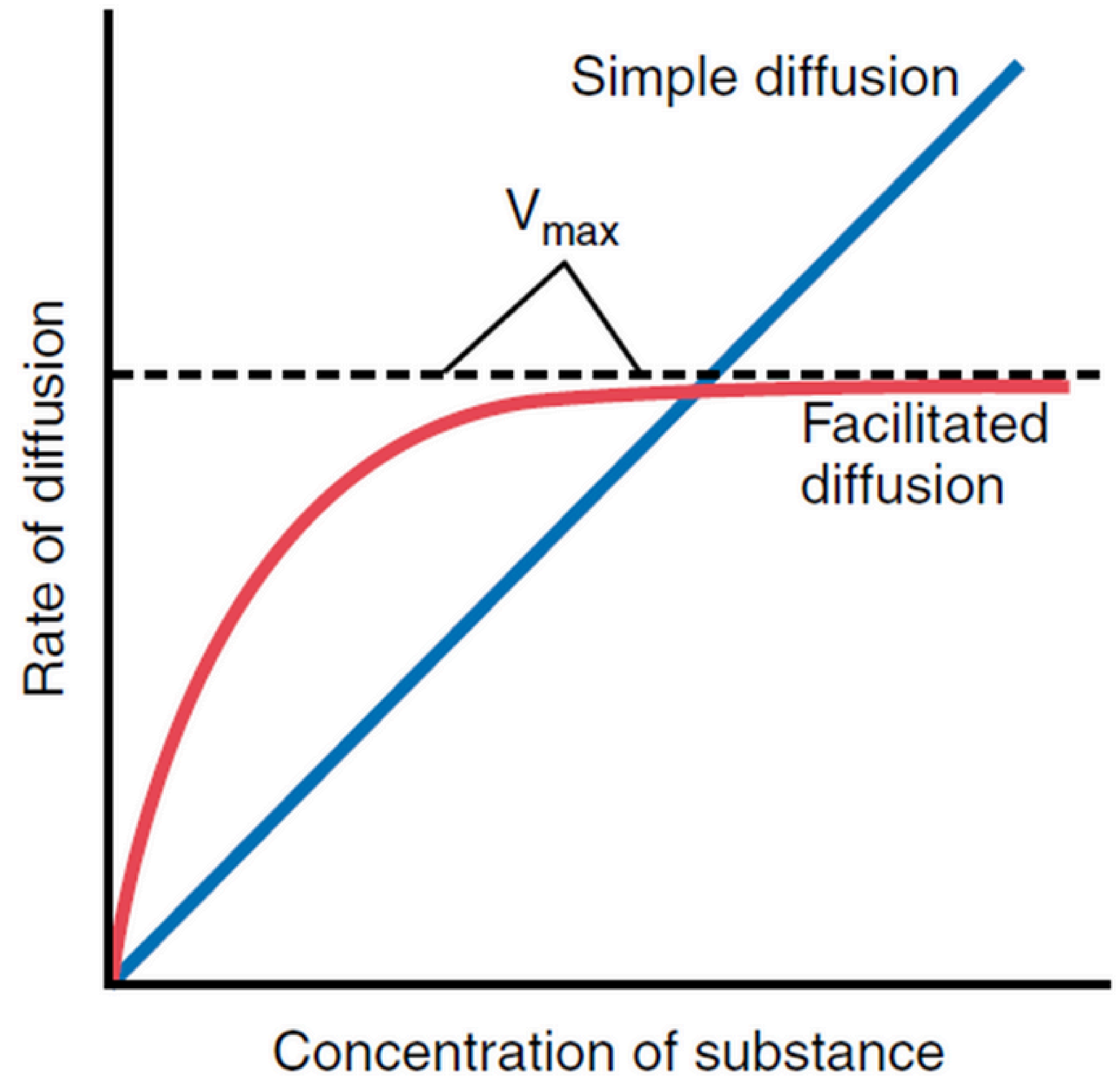


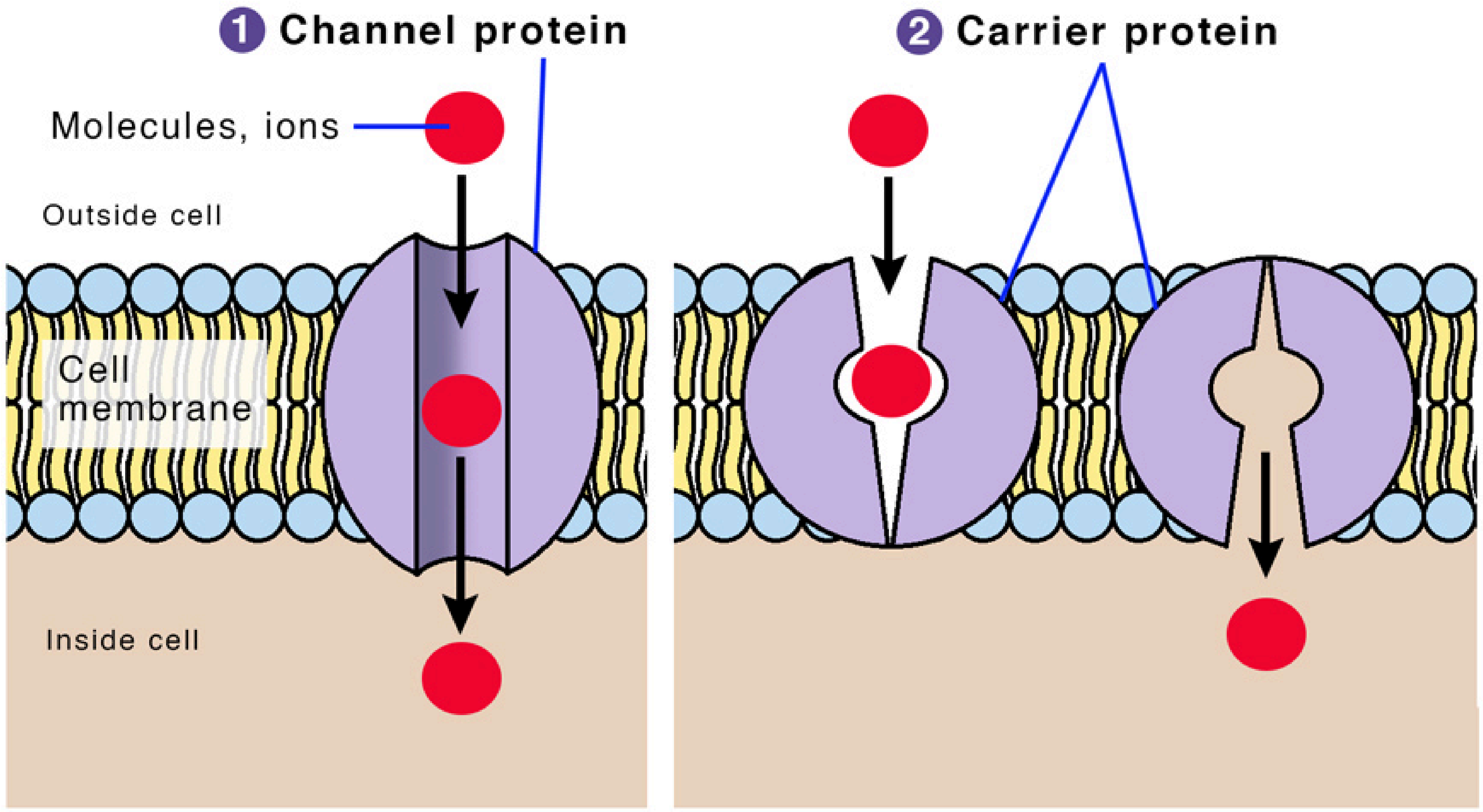
Simple Diffusion

- Size of the particle
- Temperature
- Surface area
- Membrane permeability
- Concentration gradient
- Electrical gradient
- Pressure gradient

Rate of diffusion

"AMOUNT OF SUBSTANCE THAT DIFFUSES PER UNIT OF TIME"

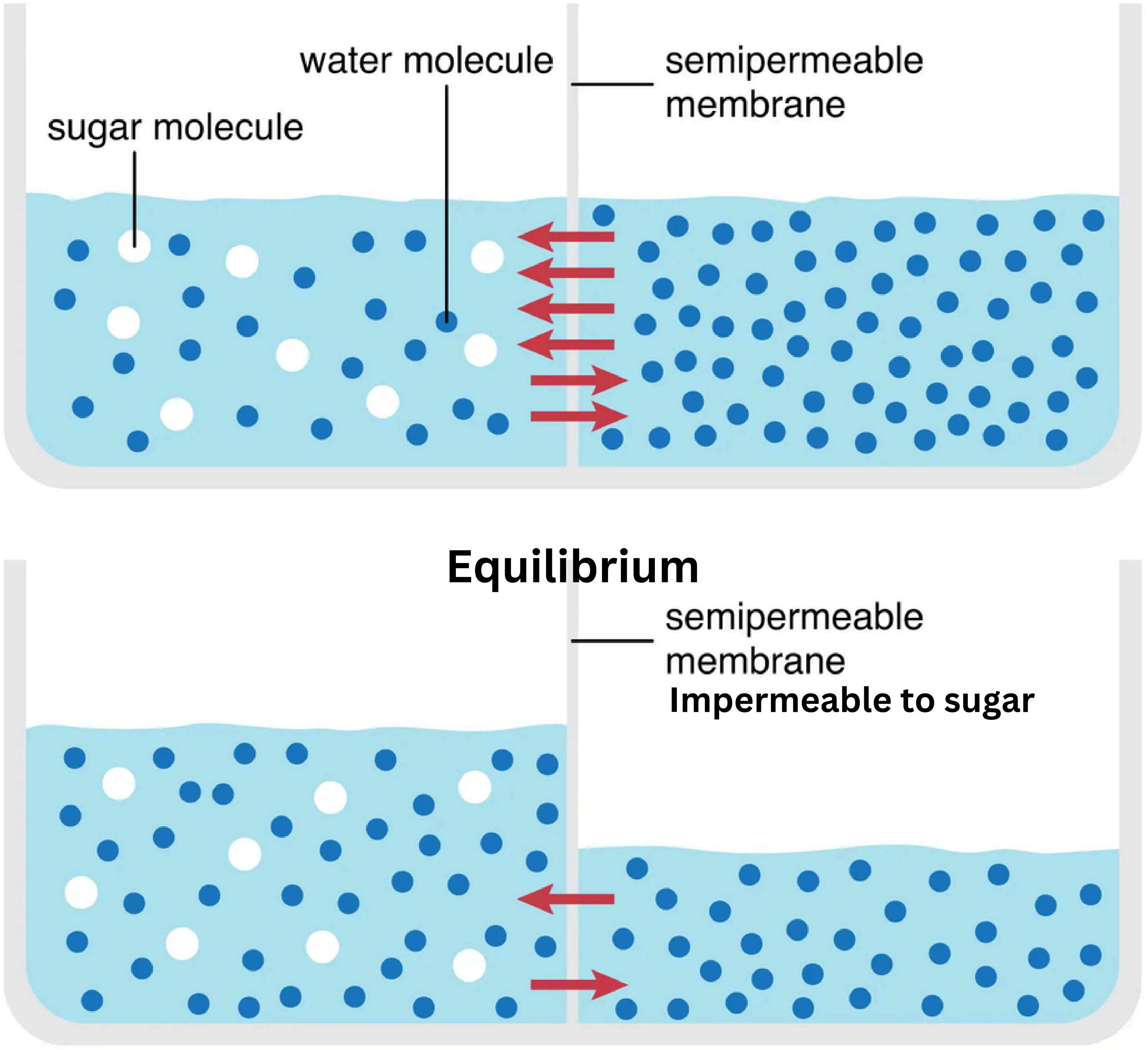




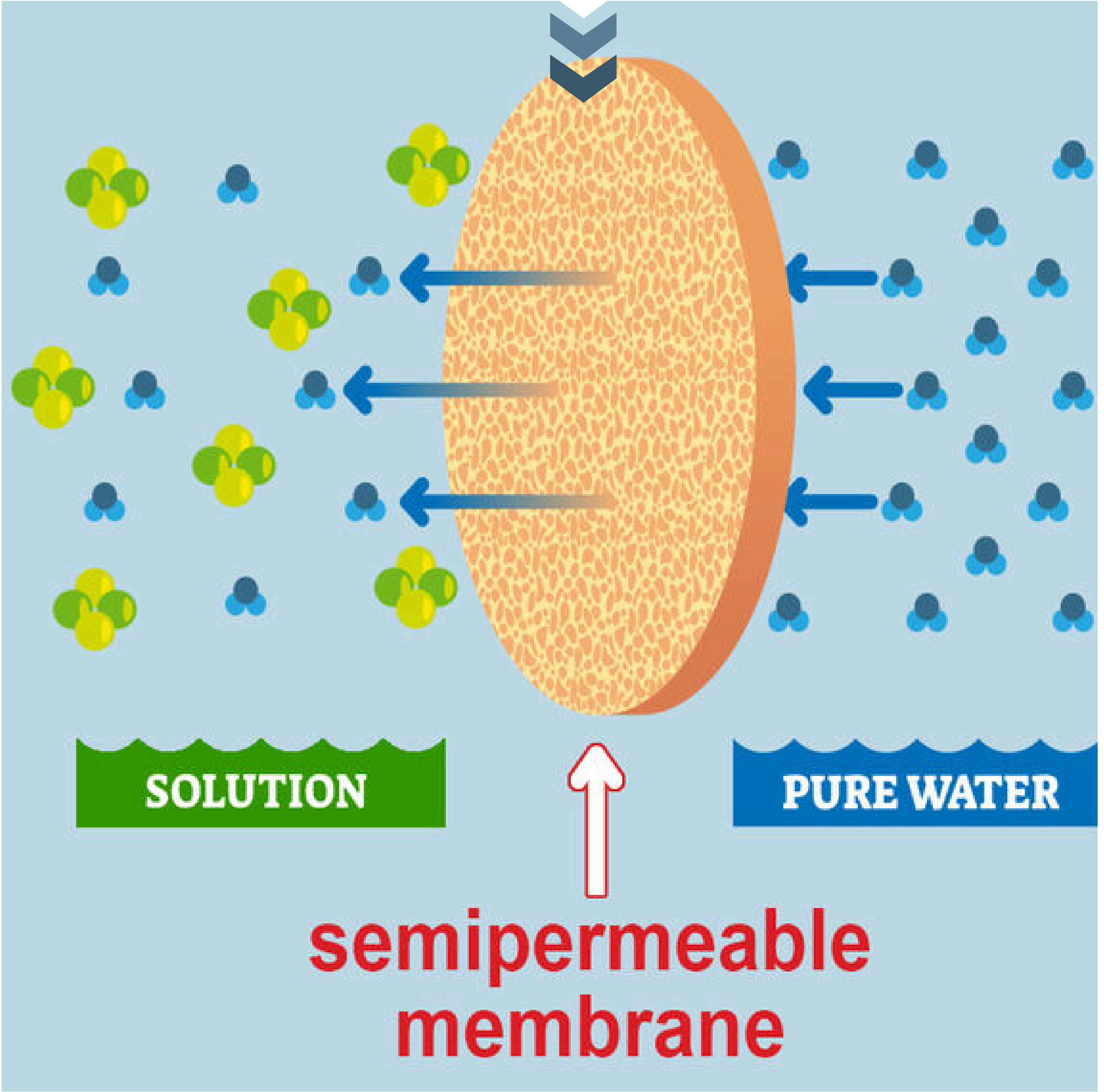
1. ***What is (are) difference (s) b/w carrier and channel protein?***
2. ***Which one transports substances the faster?***

Osmosis

THE PROCESS OF NET MOVEMENT OF WATER CAUSED BY A CONCENTRATION DIFFERENCE OF WATER



Impermeable to sugar



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Tonicity

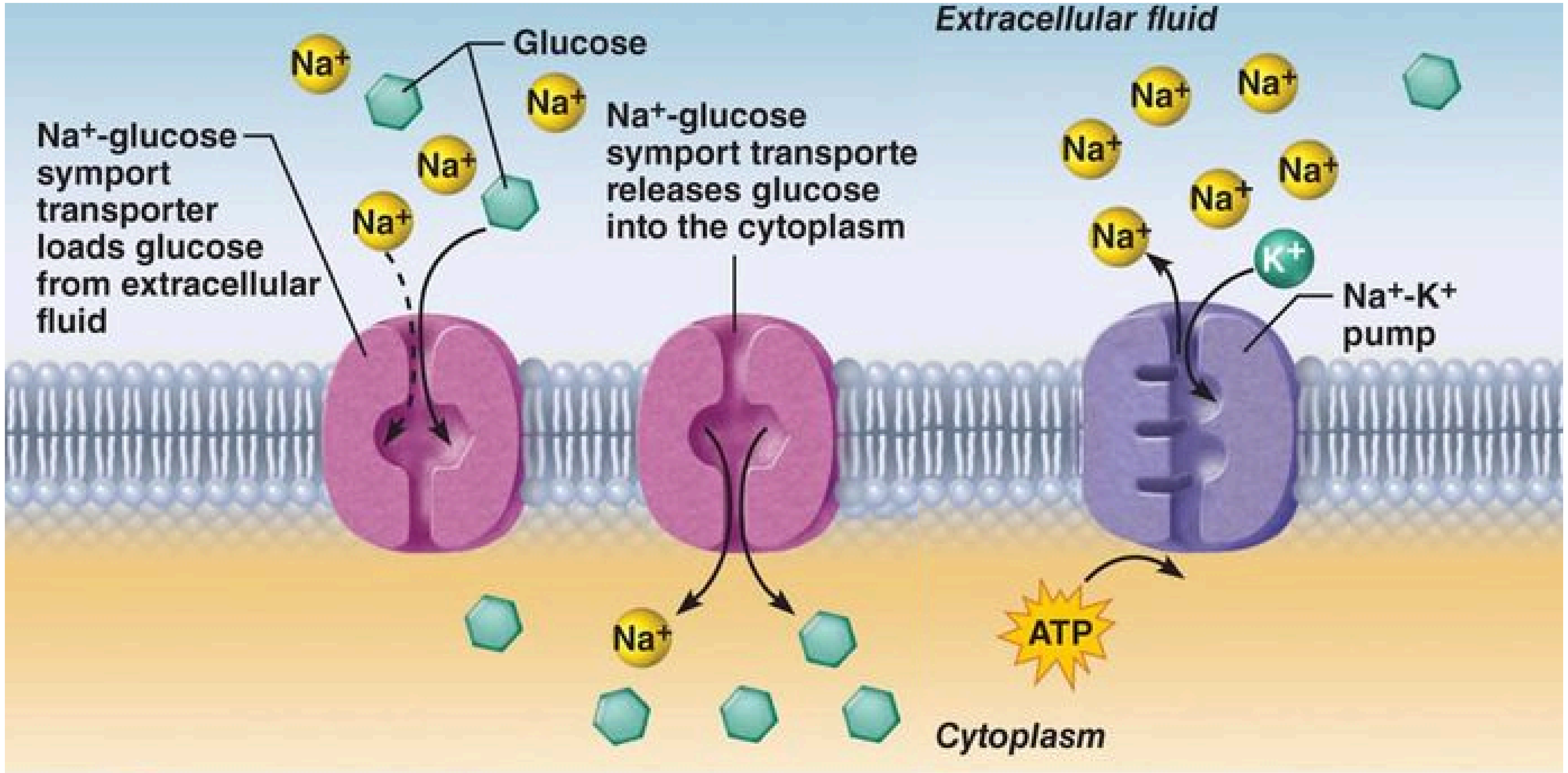
THE ABILITY OF AN EXTRACELLULAR SOLUTION TO MAKE WATER MOVE INTO OR OUT OF A CELL BY OSMOSIS
THE AMOUNT OF SOLUTE DISSOLVED IN A SPECIFIC AMOUNT OF THE SOLUTION (OSMOLARITY)

Hypertonic solution | Hypotonic solution | Isotonic solution

What happens to the red blood cells in each beaker after 10 minutes?

Active transport

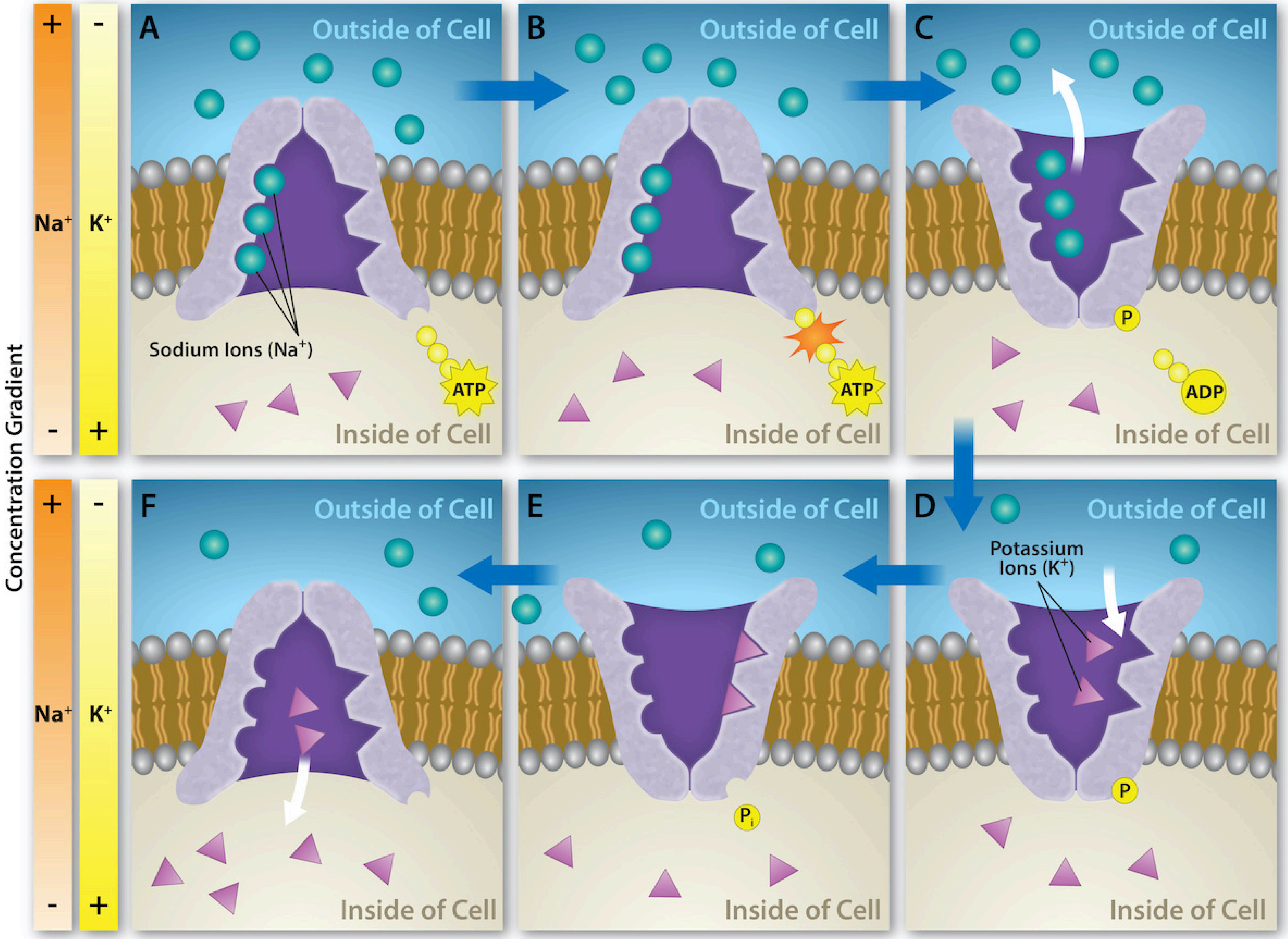
- THE ENERGY-DRIVEN TRANSPORTATION OF IONS, SMALL MOLECULES, AND SOLUTES ACROSS THE MEMBRANE
- AGAINST AN ELECTROCHEMICAL GRADIENT



Could you identify whether A or B is primary or secondary active transport?

Primary active transport

UTILIZES ATP DIRECTLY



THE SODIUM-POTASSIUM PUMP

1. ***How is ATP important for primary active transport?***
2. ***Why is the Na^+-K^+ pump vital for living cells?***

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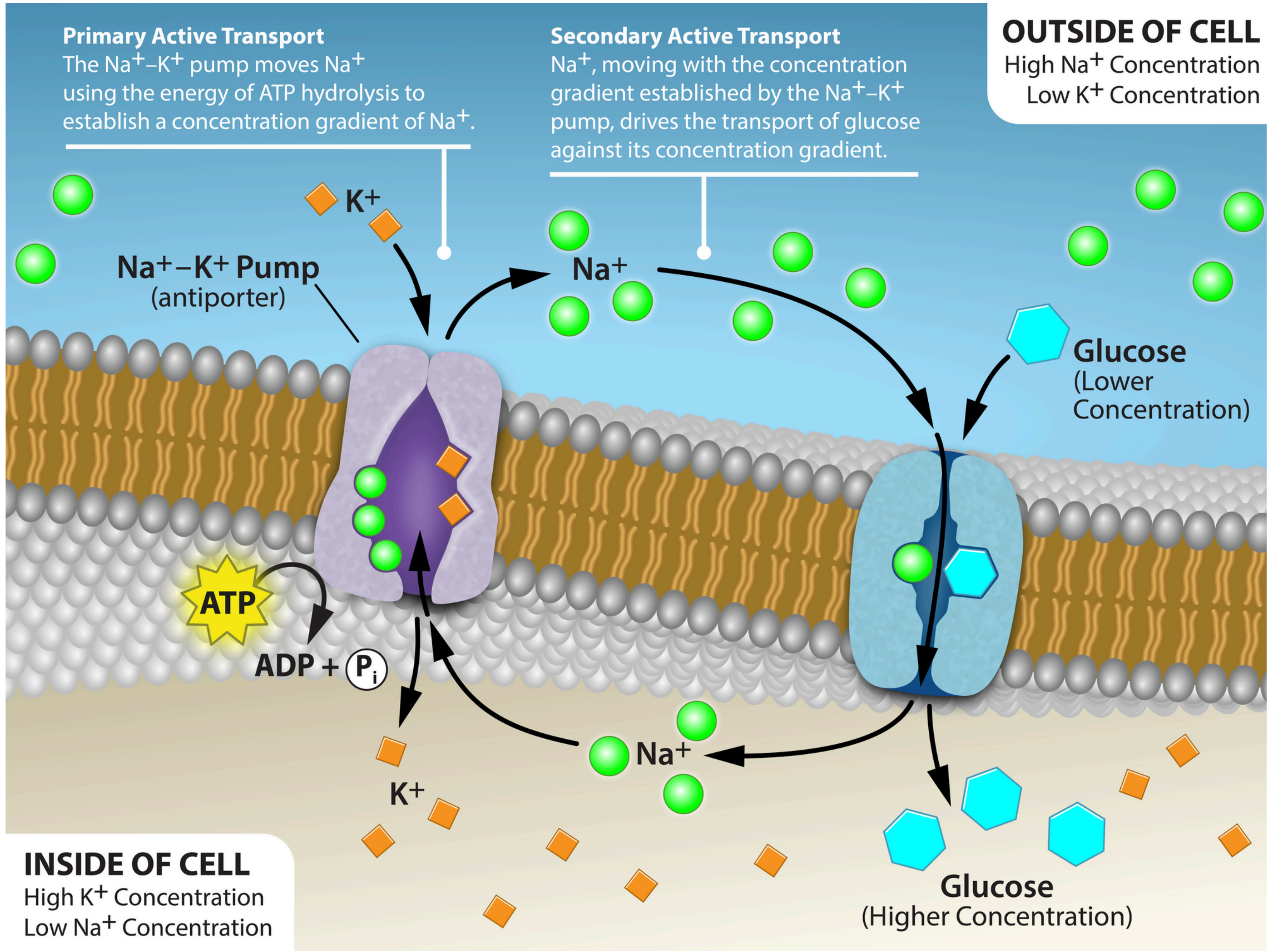
RAO, A., RYAN, K. AND FLETCHER, S. DEPARTMENT OF BIOLOGY, TEXAS A&M UNIVERSITY.

Secondary active transport

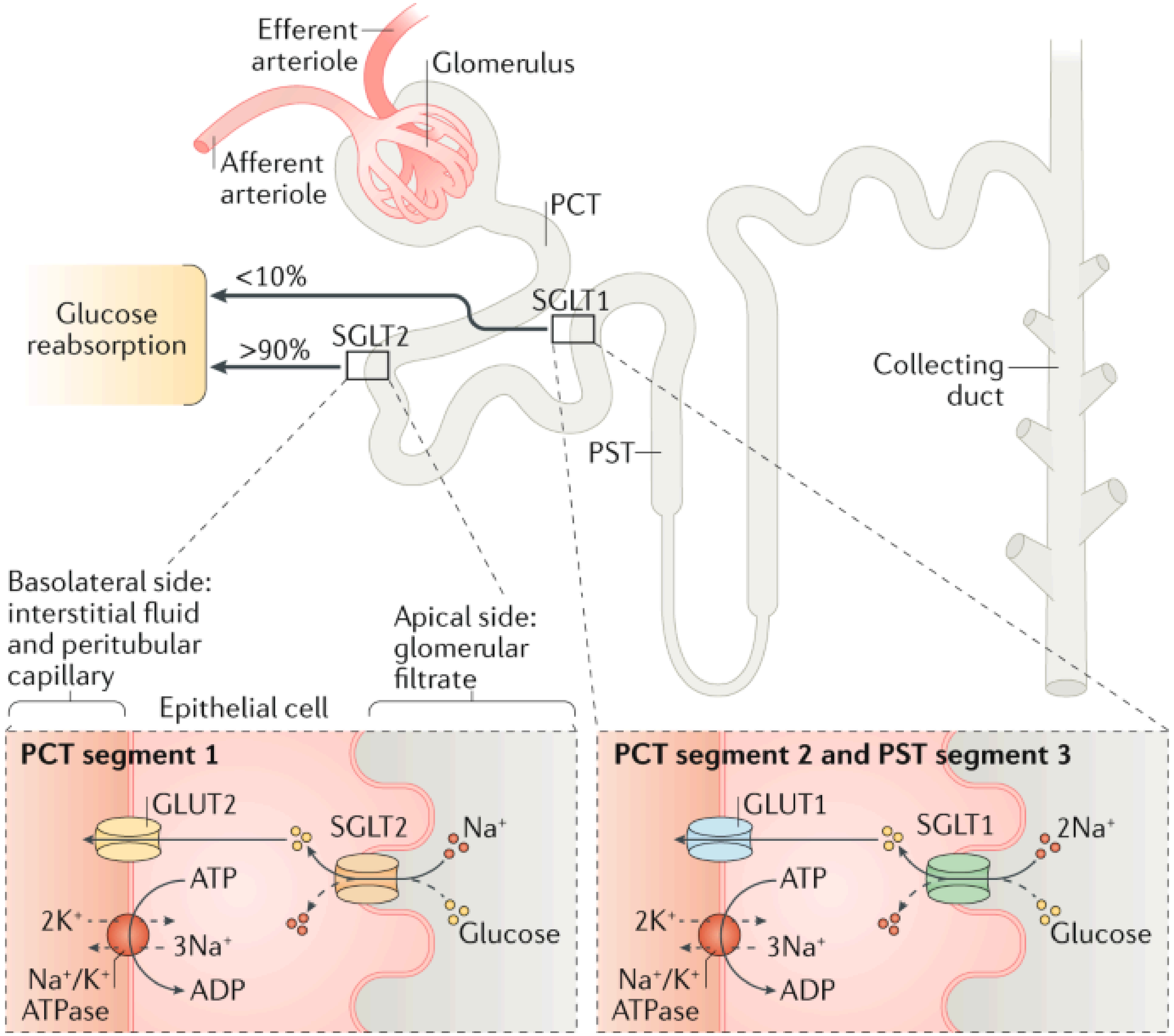
- DOES NOT UTILIZE ATP DIRECTLY
- USES ONE ION GOING DOWN ITS CONCENTRATION GRADIENT TO DRIVE THE MOVEMENT OF ANOTHER ION GOING AGAINST ITS CONCENTRATION GRADIENT



RAO, A., RYAN, K. AND FLETCHER, S. DEPARTMENT OF BIOLOGY, TEXAS A&M UNIVERSITY.

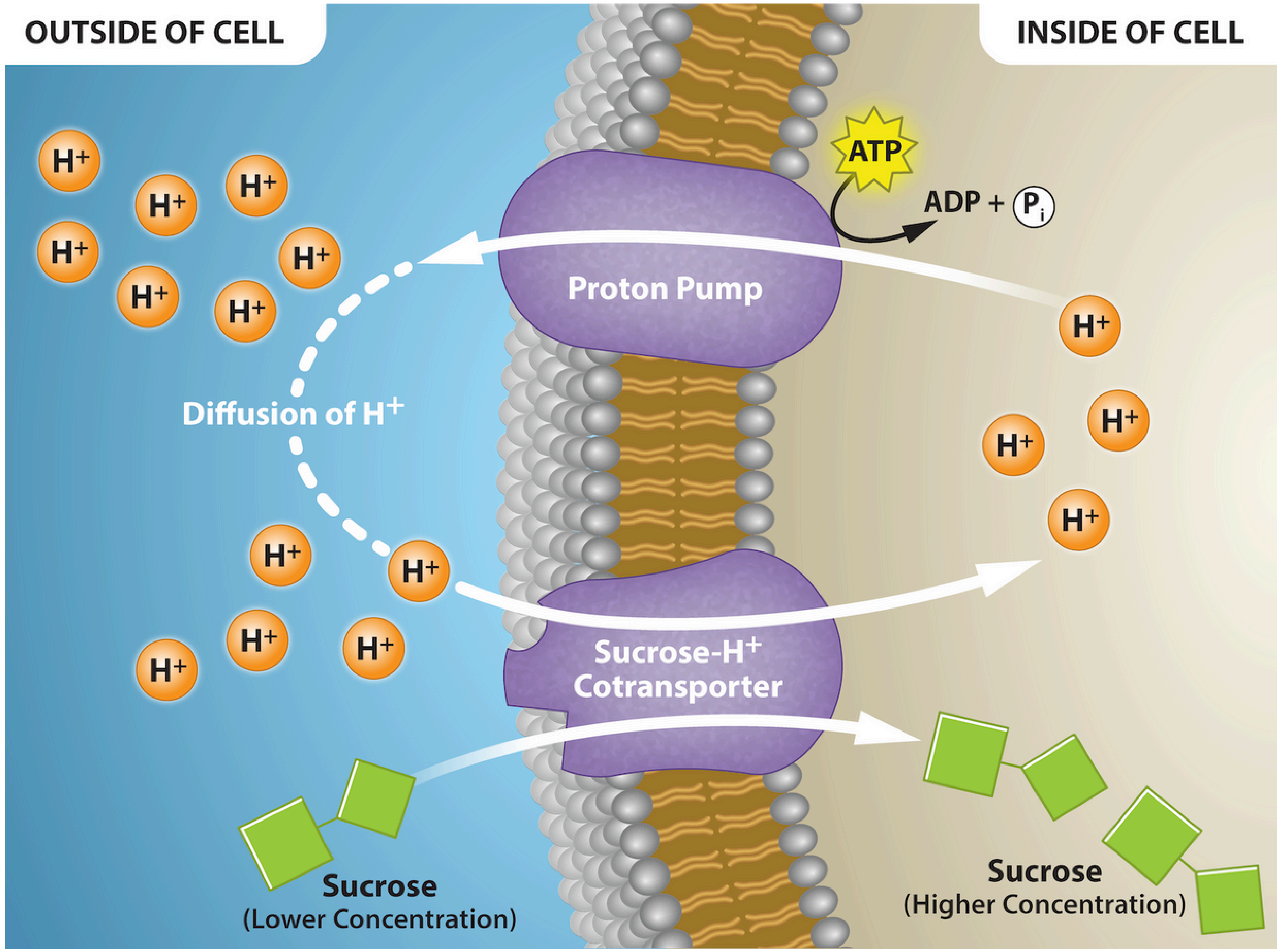
Secondary active transport

Sodium-glucose cotransporter : From basic knowledges to clinical application



What are the beneficial effects of SGLT inhibitors on blood glucose levels in diabetes?

Amino acid /H+ cotransporter



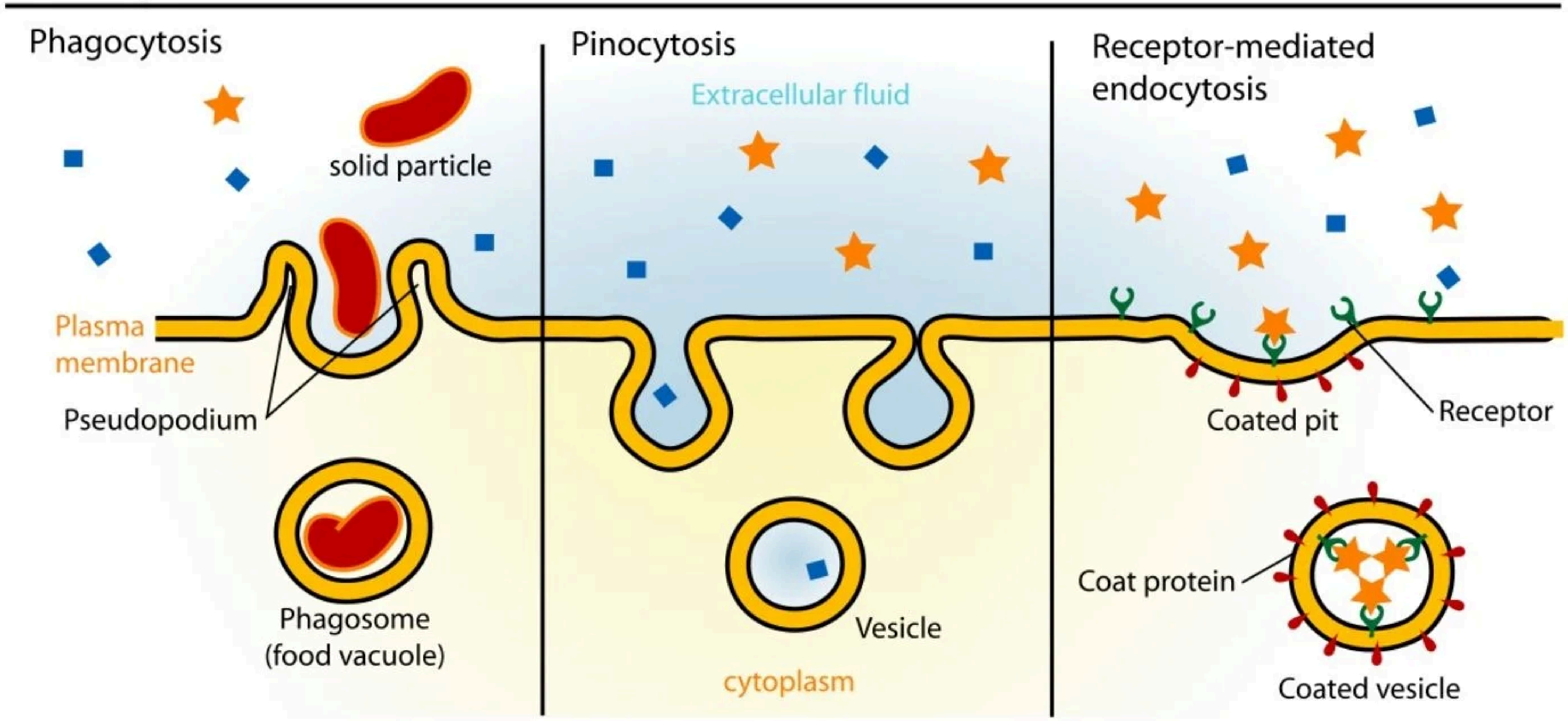
AMINO ACIDS AND GLUCOSE

If the pH outside the cell decreases, would you expect the amount of amino acids transported into the cell to increase or decrease?

Bulk transport

ACTIVE TRANSPORT : LARGE PARTICLES (OR LARGE QUANTITIES OF SMALLER PARTICLES) ARE MOVED ACROSS THE CELL MEMBRANE

Endocytosis SUBSTANCES ARE BROUGHT INTO THE CELL

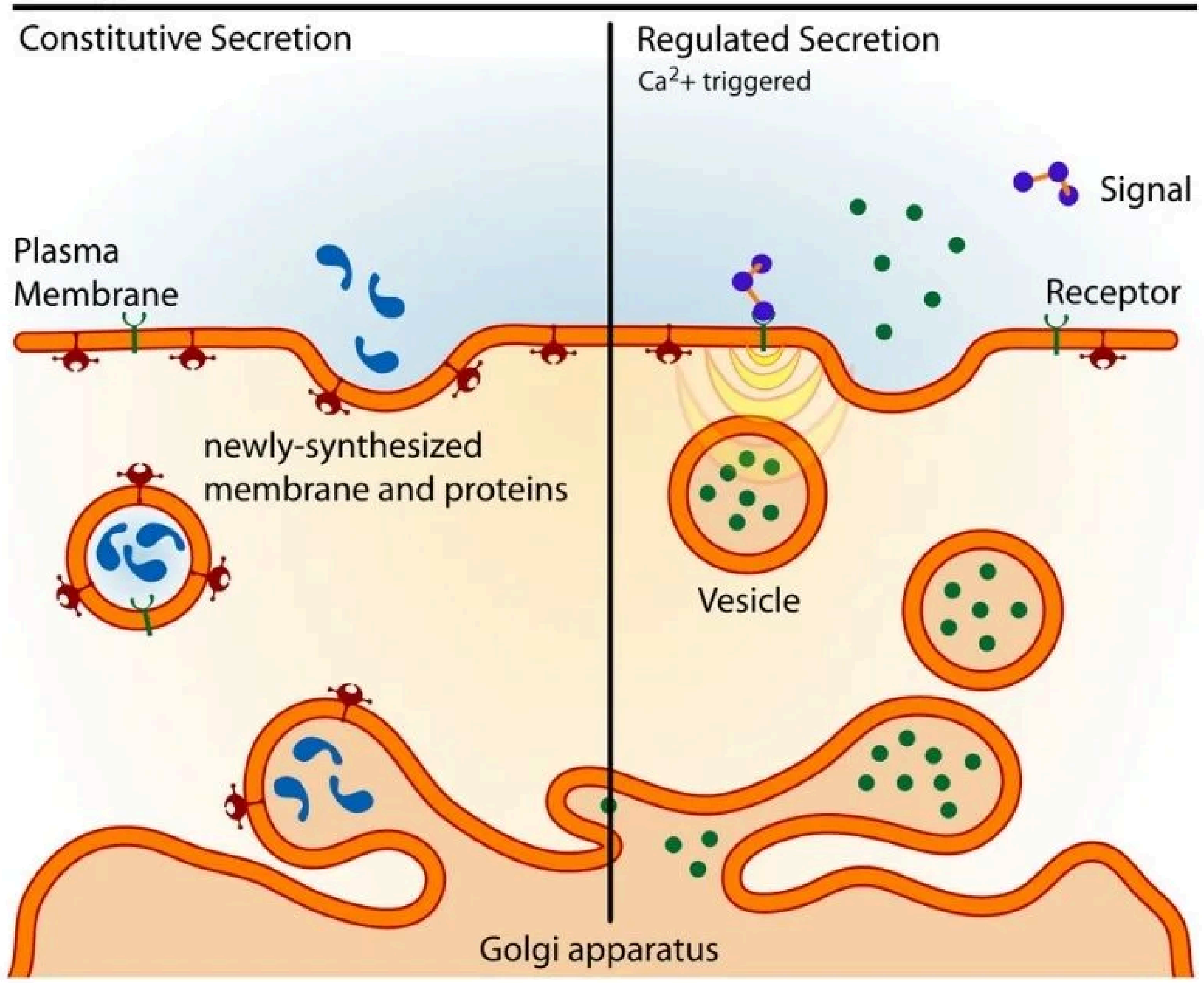


FORMATION OF PSEUDOPODIA .
CREATING A VACUOLE OR PHAGOSOME
THE CELL FOR IMMUNE

INVAGINATION AND FORMATION OF POCKETS
PINOSOME
TAKING NUTRIENTS E.G. ION, HORMONES

CLATHRIN CAUSES THE COATED PIT TO INVAGINATE
COATED VESICLE
DESIRED LIGAND (HIJACKED BY CHOLERA)

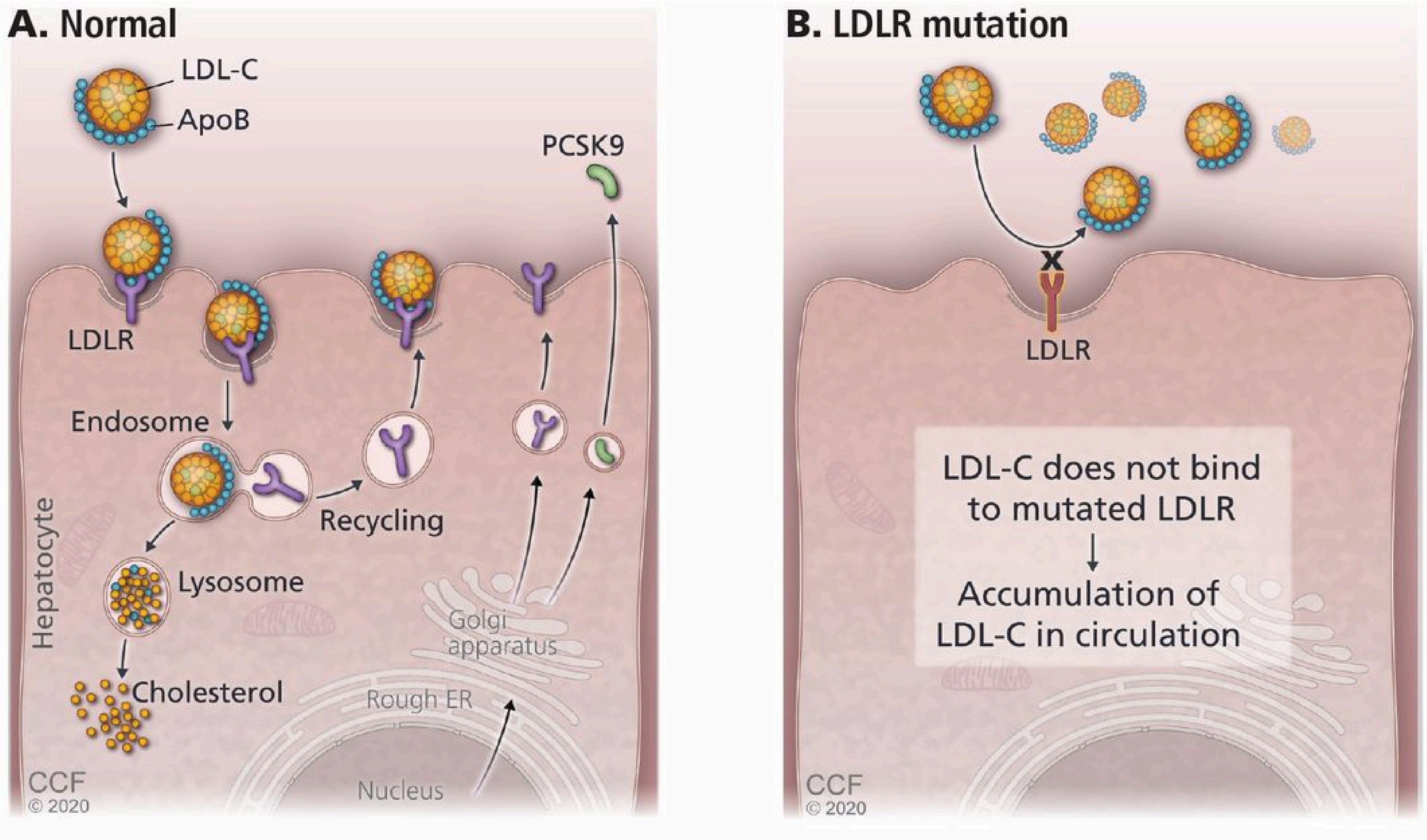
Exocytosis TRANSPORTS MOLECULES OUT OF THE CELL



NEUTROTRANSMITTER RELEASE
HORMONES

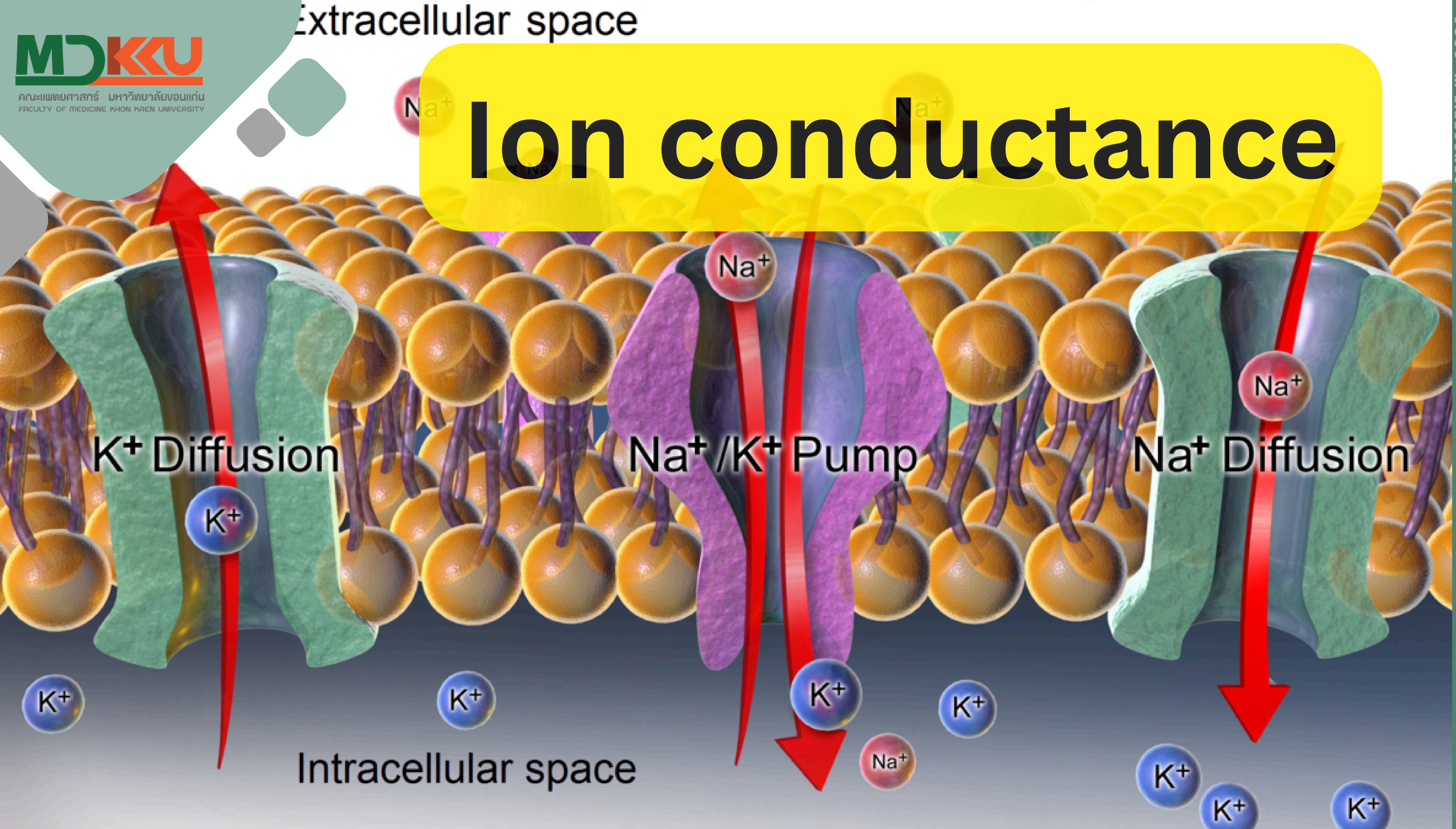
MODIFICATION OF WORK BY MARIANA RUIZ VILLARREAL

Deficiency of LDL receptors



What is the negative result of a deficiency of LDL receptors?

Ion conductance



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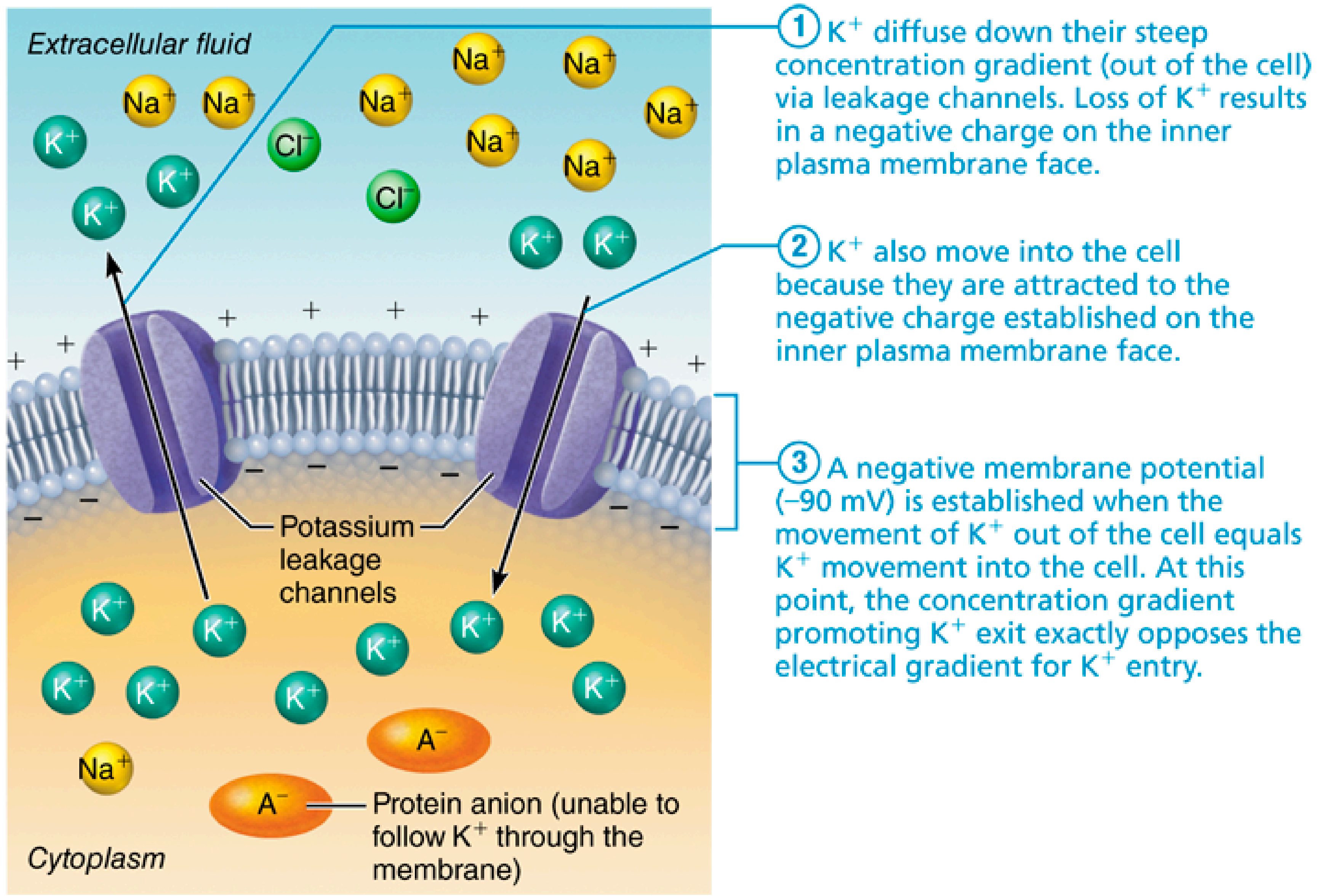
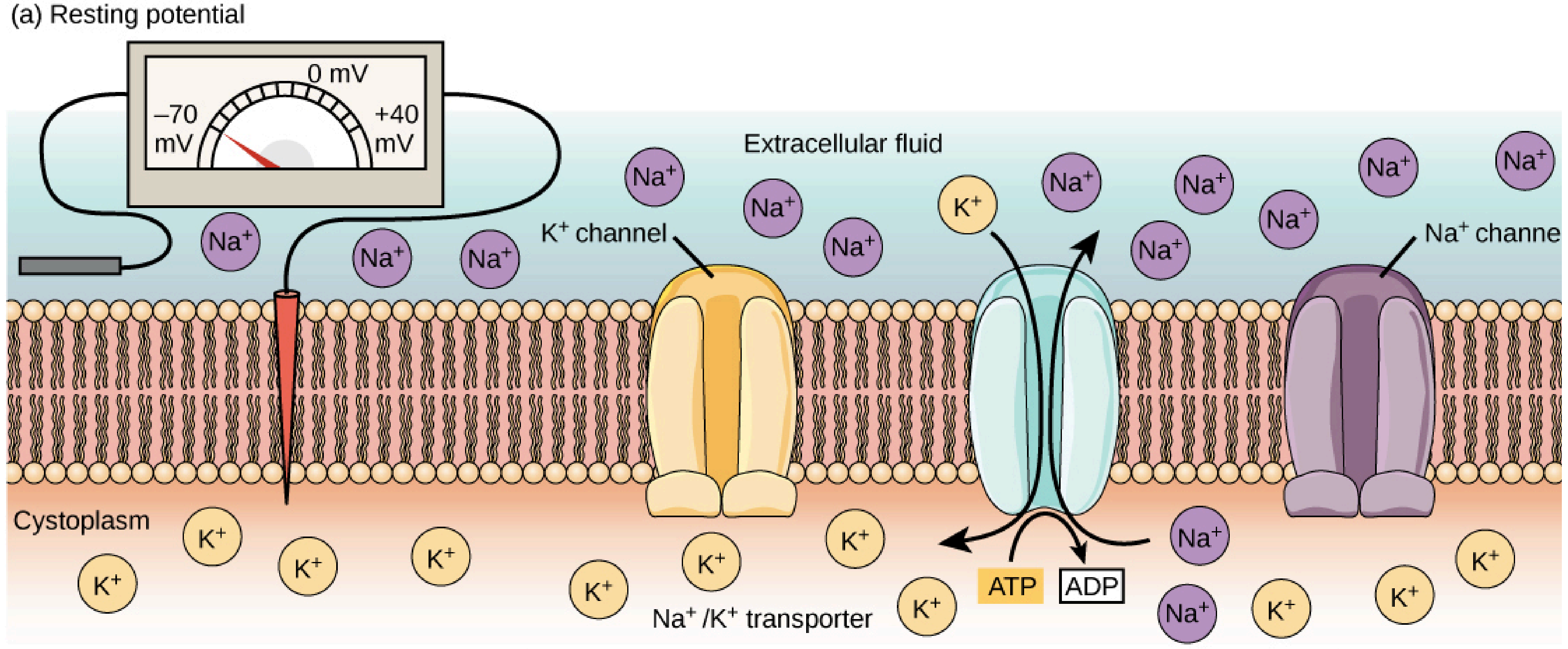
Resting membrane potential

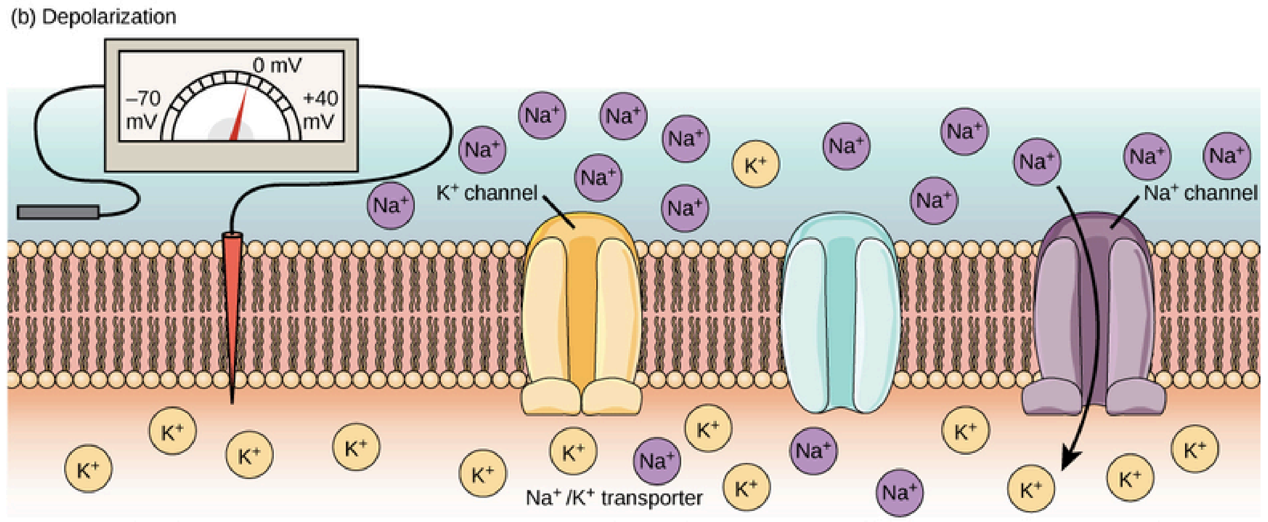




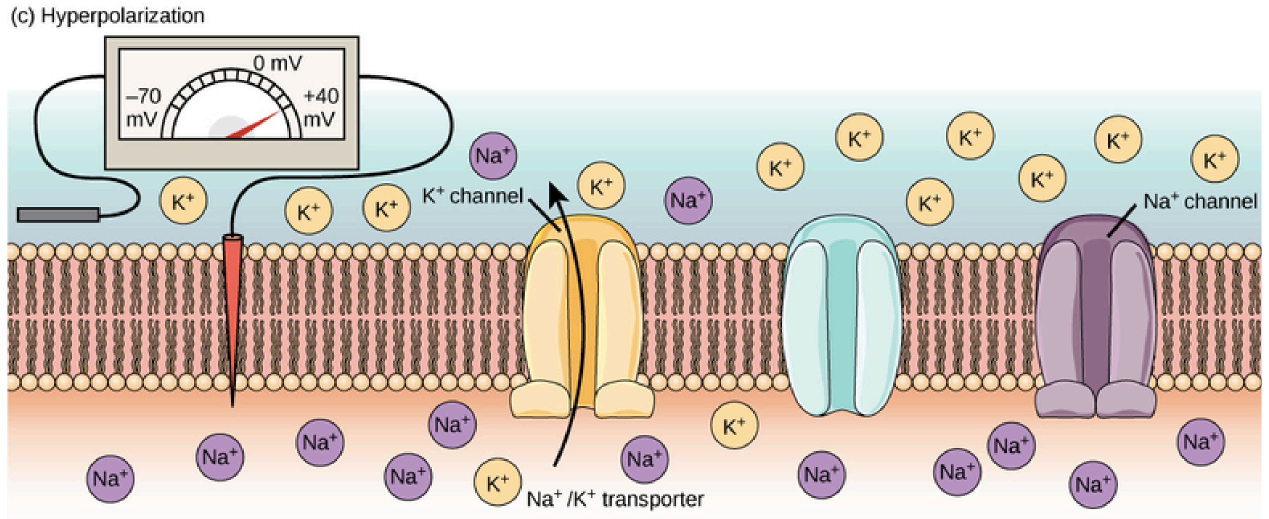
At the resting potential, all voltage-gated Na^+ channels and most voltage-gated K^+ channels are closed. The Na^+/K^+ transporter pumps K^+ ions into the cell and Na^+ ions out.

1. ***How is the Resting Membrane Potential Formed?***
2. ***How is the Resting Membrane Potential Maintained?***

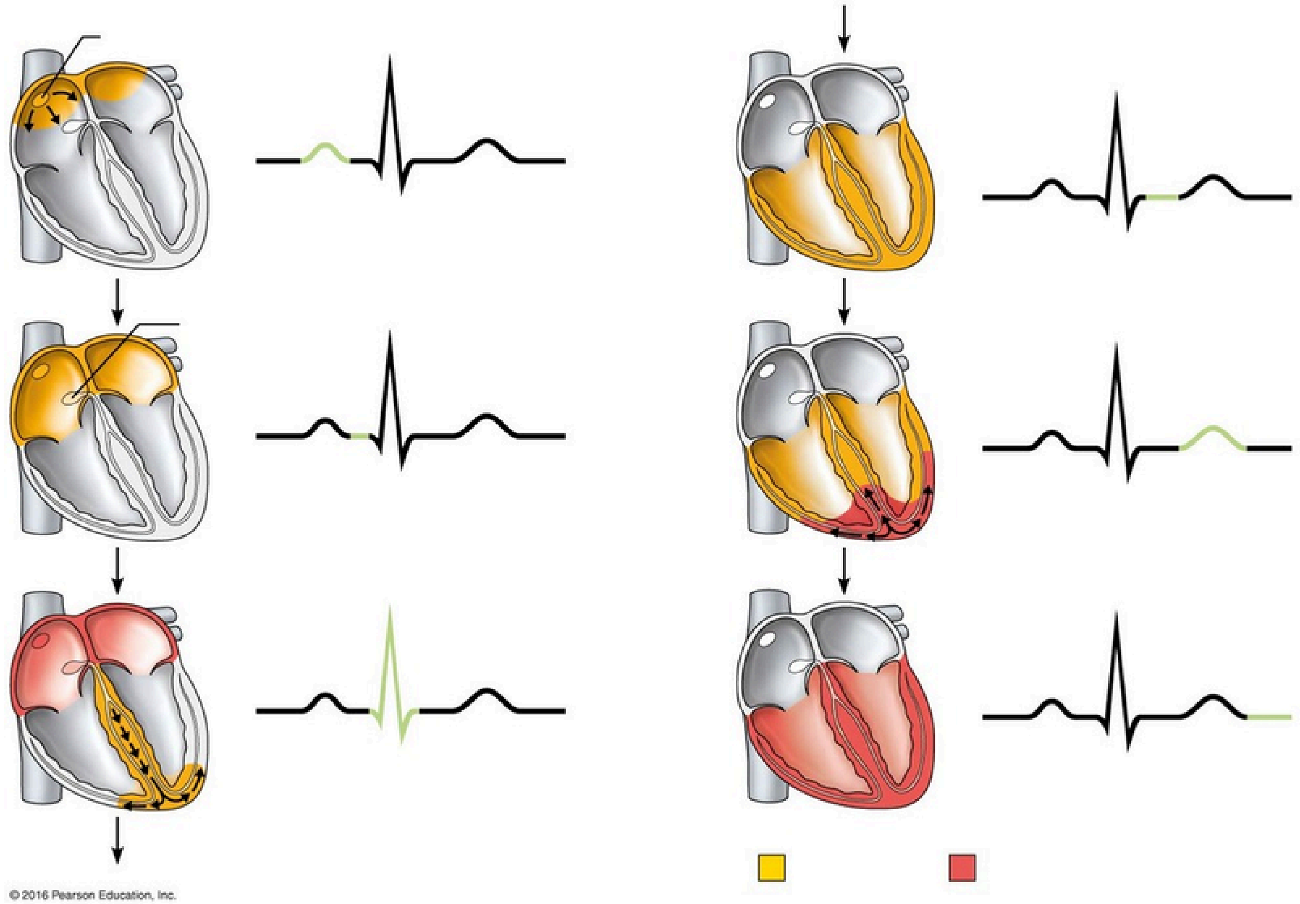
Action potential



In response to a depolarization, some Na^+ channels open, allowing Na^+ ions to enter the cell. The membrane starts to depolarize (the charge across the membrane lessens). If the threshold of excitation is reached, all the Na^+ channels open.

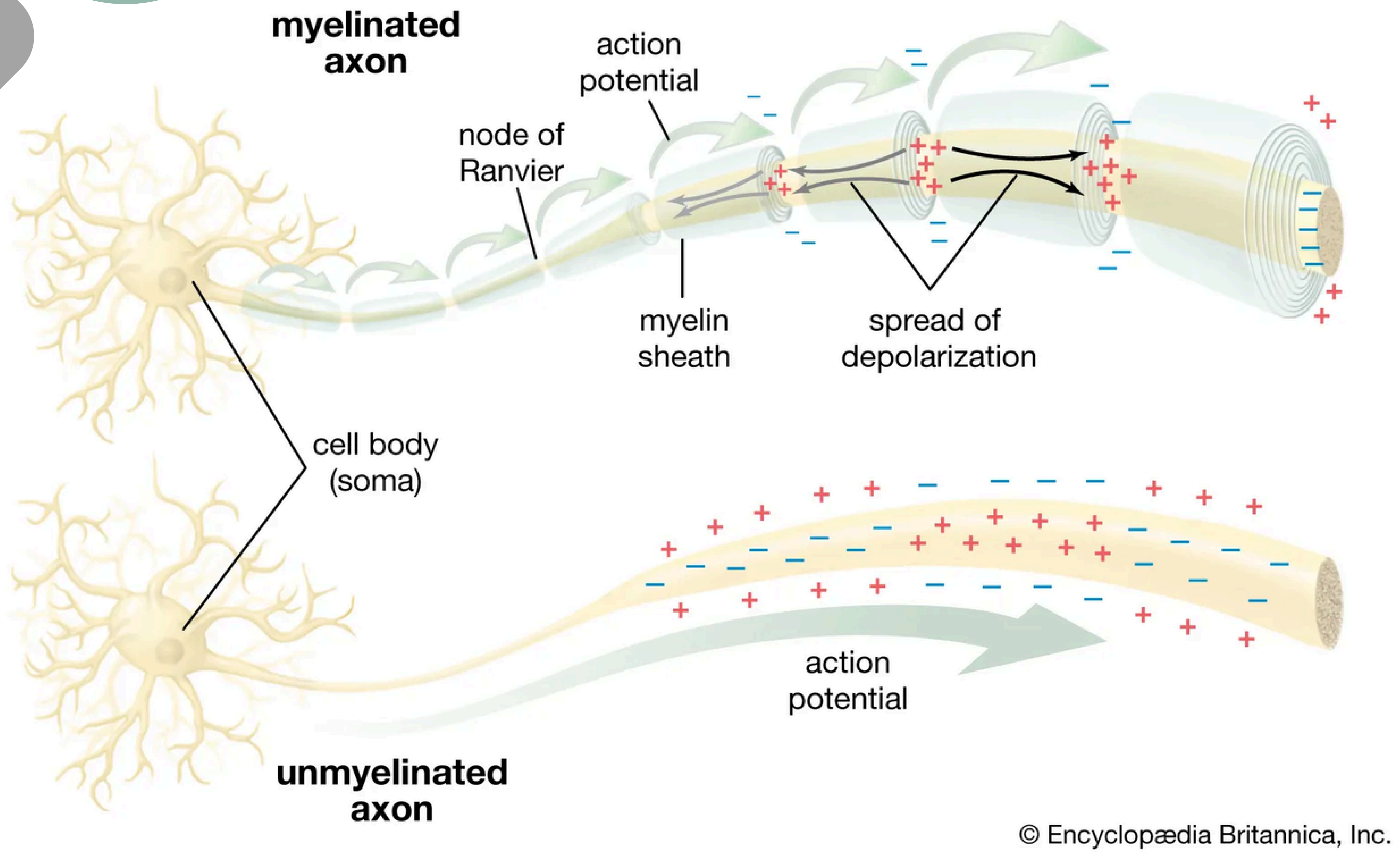


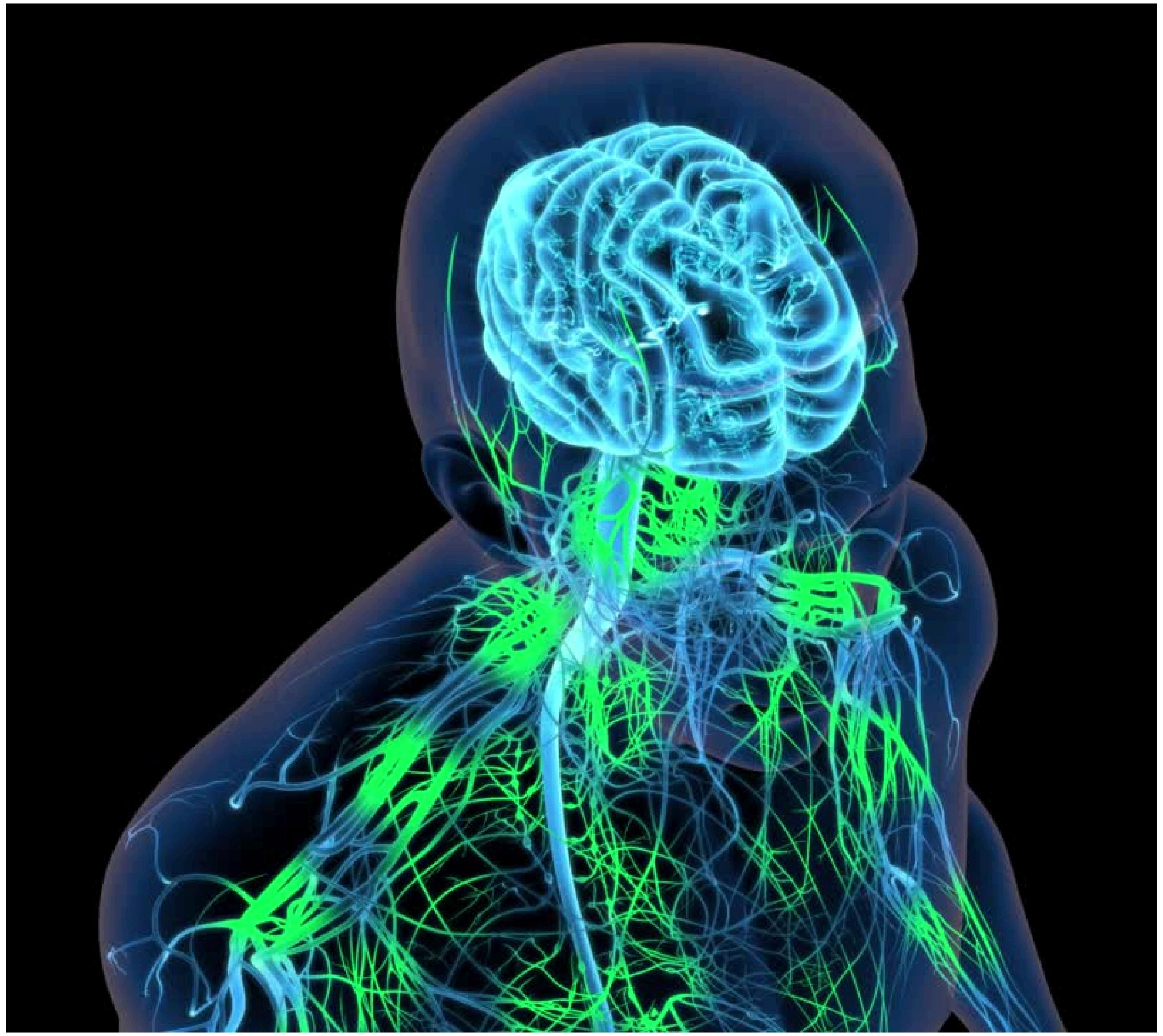
At the peak action potential, Na^+ channels close while K^+ channels open. K^+ leaves the cell, and the membrane eventually becomes hyperpolarized.



How is the action potential required for cellular activity?

Transmission of nerve impulse





How is the action potential required for cellular activity?


CONCLUSION