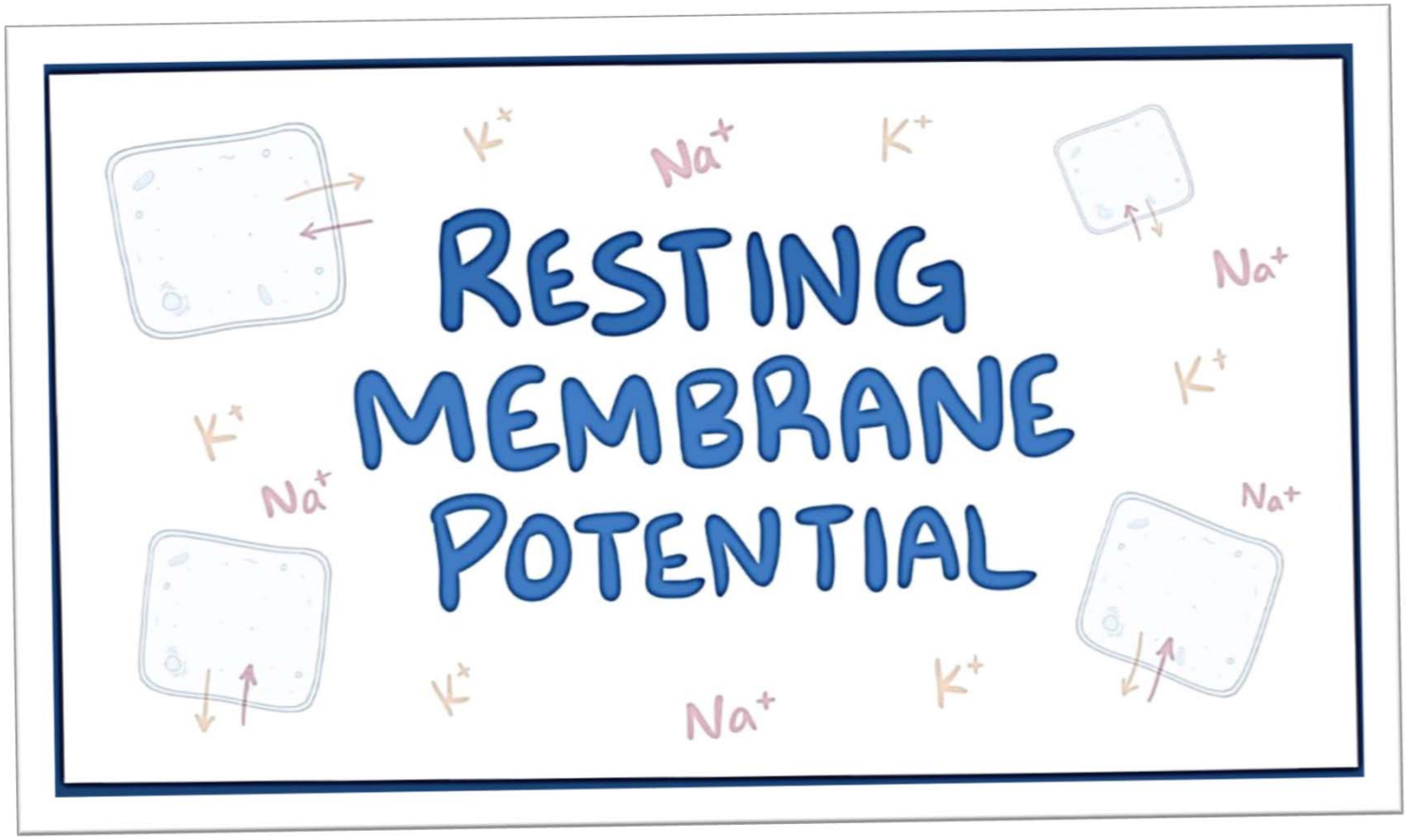

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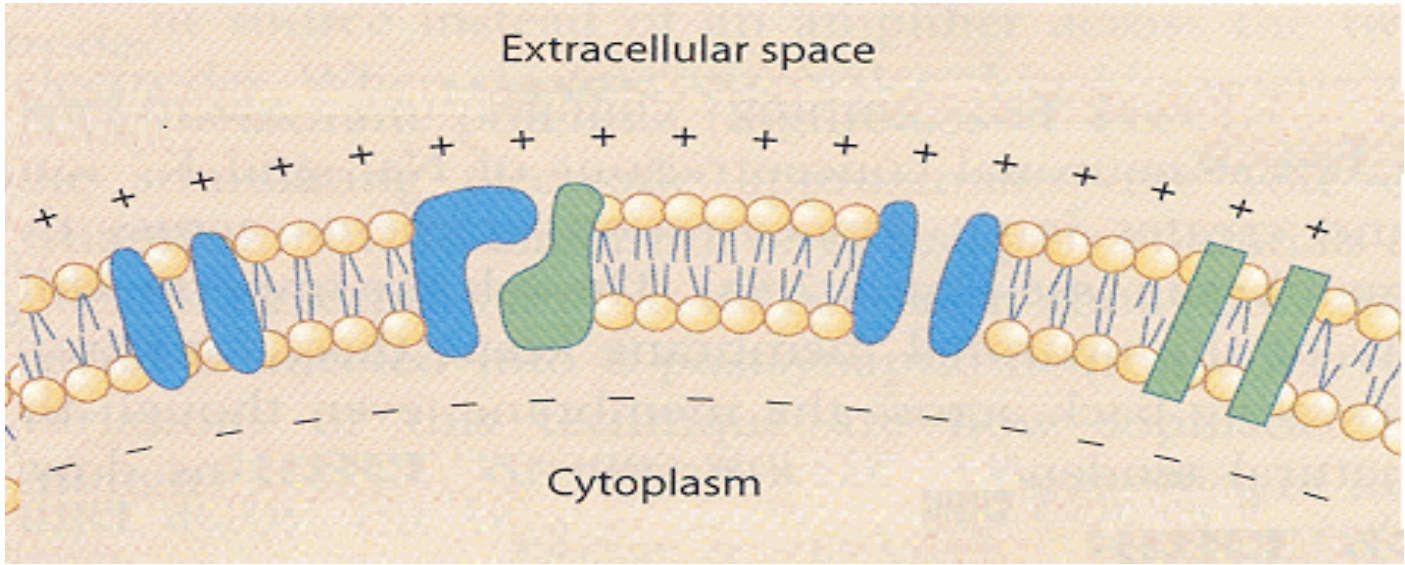
MUTAH SCHOOL OF MEDICINE

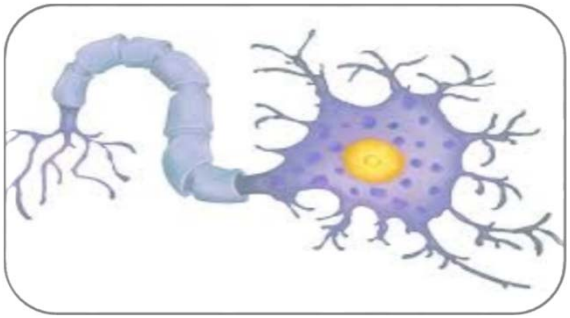
Definition of RMP:

It is the potential difference between inside and outside the cell membrane with inside relatively negative to outside.



http://fourier.eng.hmc.edu/e180/lectures/signal1/node3.html0

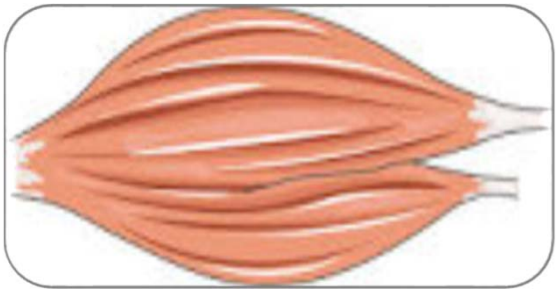
Value:

- 

  In the nerve:

  0-70 in medium sized nerve

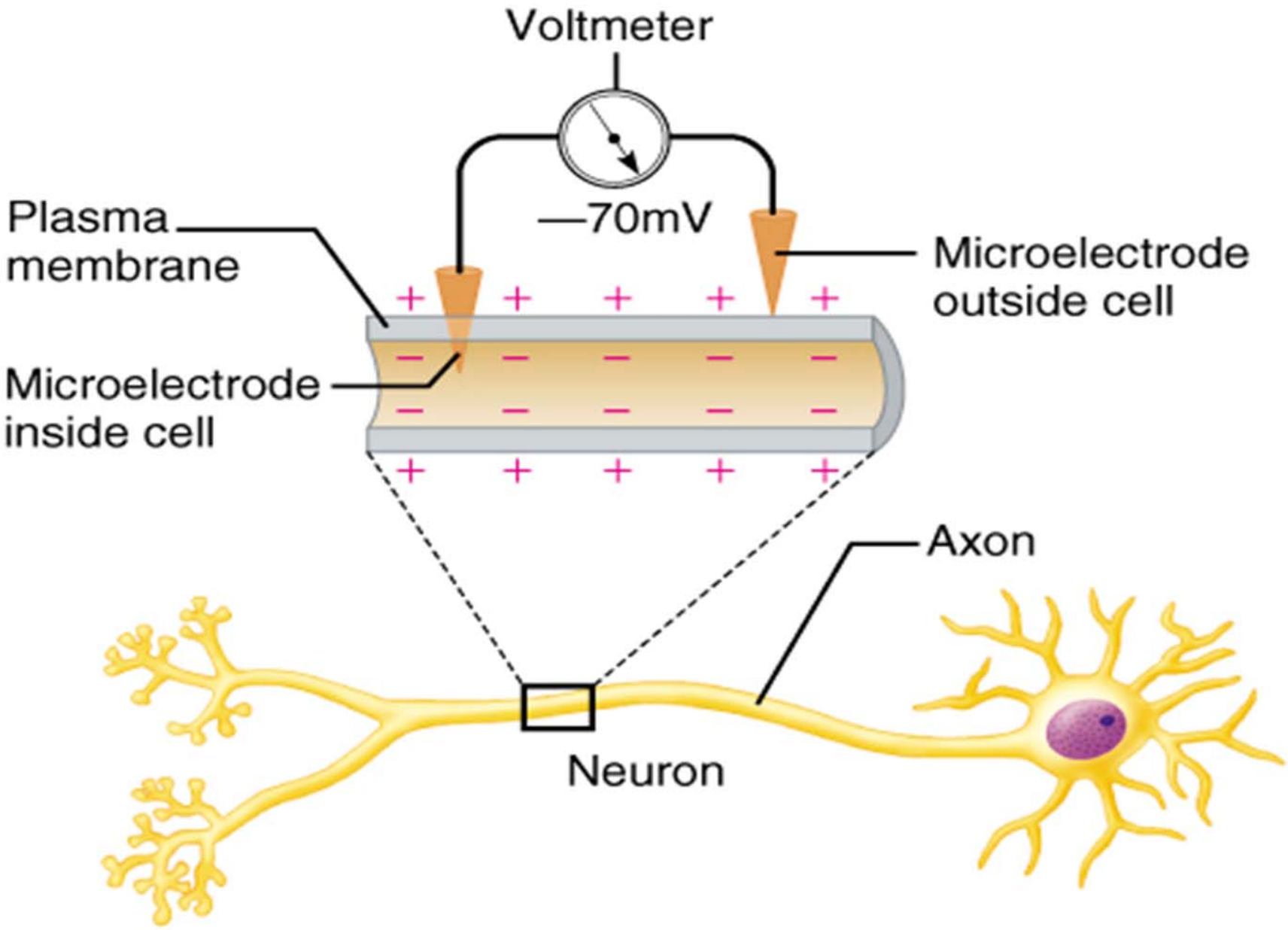
  0-90 in large nerve

- 

  In the muscle -90 m.volt

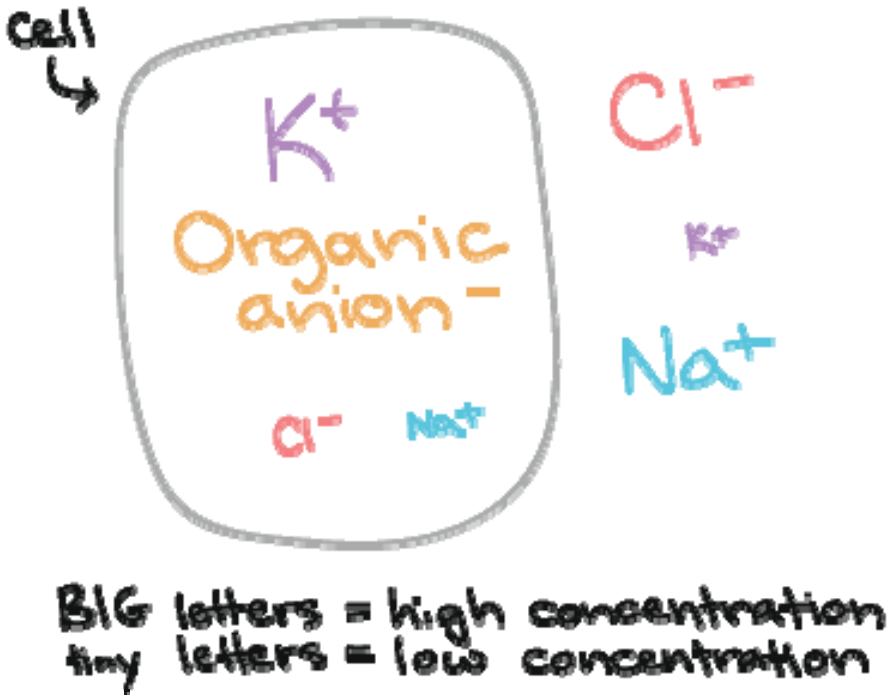
Evidence

- If 2 electrodes are put on the outer surface of the cell membrane or on the inner surface of cell membrane, there is no deflection on the galvanometer (there is no potential difference).
- But if one electrode is put on outside and the other inside the cell membrane there is deflection in the galvanometer.


Voltmeter
−70mV
Plasma membrane
Microelectrode outside cell
Microelectrode inside cell
Axon
Neuron

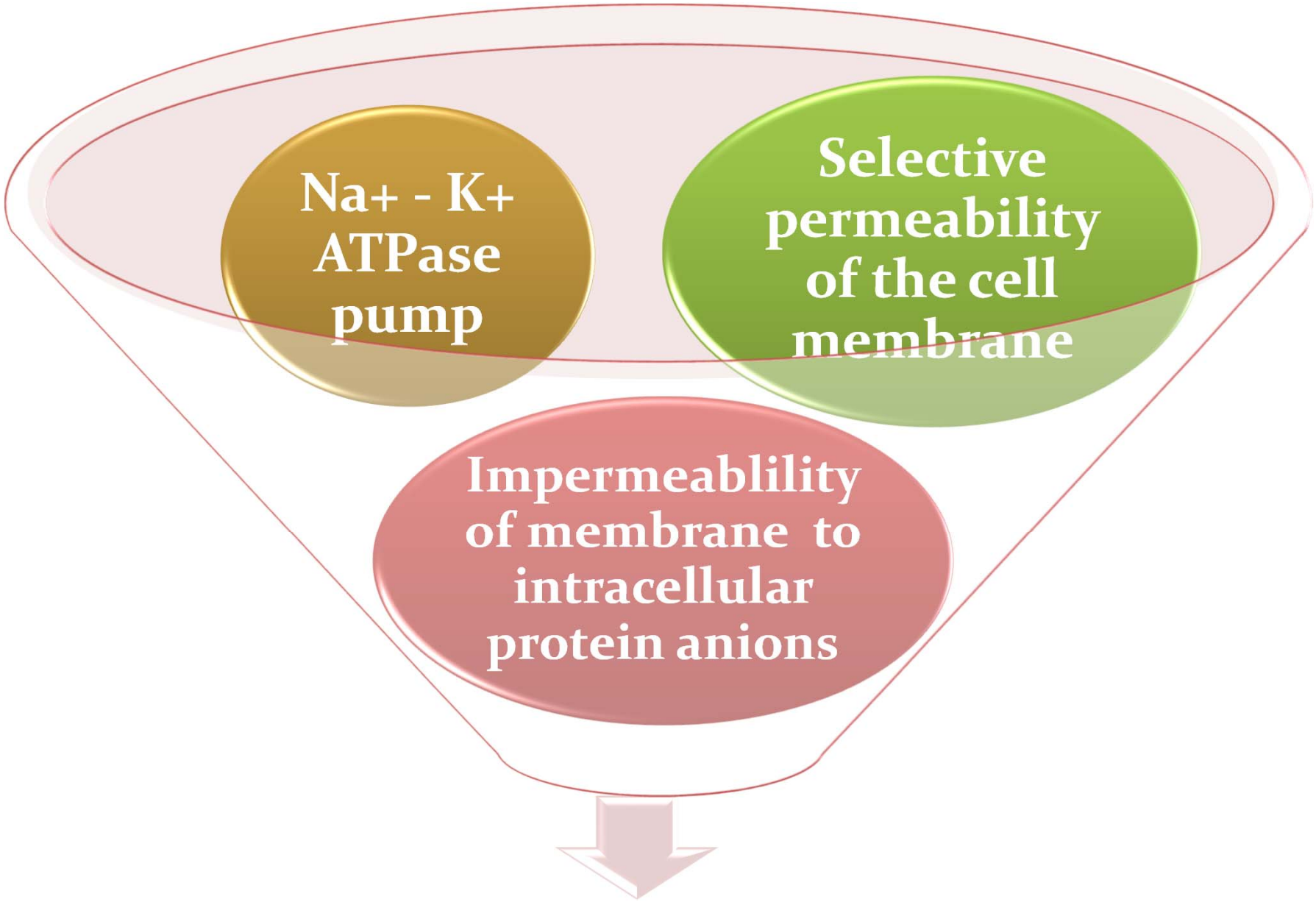
Causes of RMP:

It is due to **unequal distribution of ions** across the cell membrane with more cations outside & more anions inside.



https://www.khanacademy.org/science/biology/human-biology/neuron-nervous-system/a/the-membrane-potential

- It is due to unequal distribution of ions across the cell membrane [**outside**: Na+(142mEq./L), Cl-(103mEq./L), HCO3-(28mEq./L) and **inside**: K+(140mEq./L)& protein-(40mEq./L)) with more cations outside and more anions inside.
- This unequal distribution is caused by **three factors**


Na+ - K+ ATPase pump
Selective permeability of the cell membrane
Impermeablility of membrane to intracellular protein anions
RMP

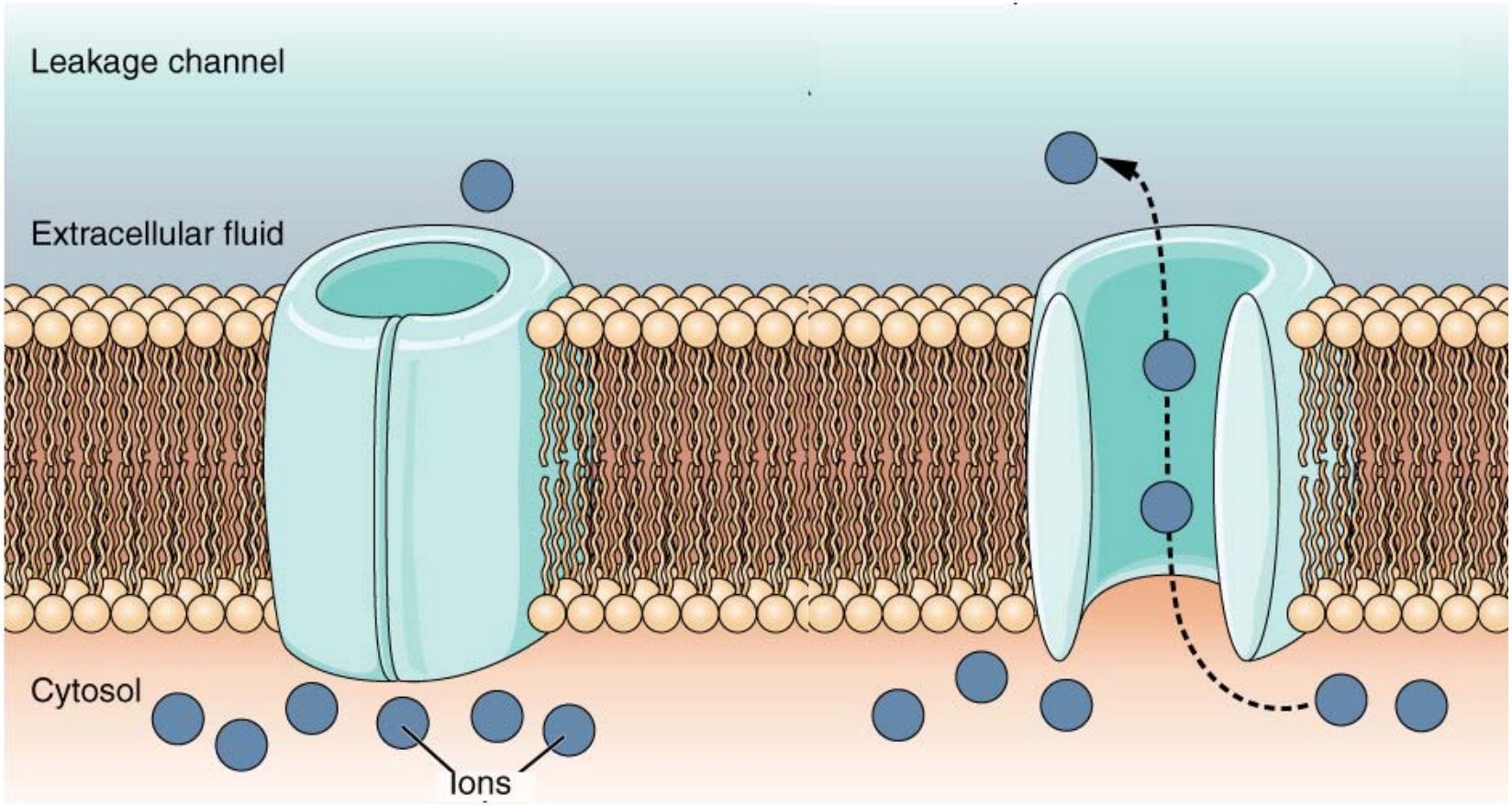
1) Selective permeability of the cell membrane

The cell membrane is semi-permeable with pores or channels

❑ Leakage channels:

❑ Gated channels:

❑ Leakage channels (passive)



https://opentextbc.ca/anatomyandphysiology/chapter/12-4-the-action-potential/

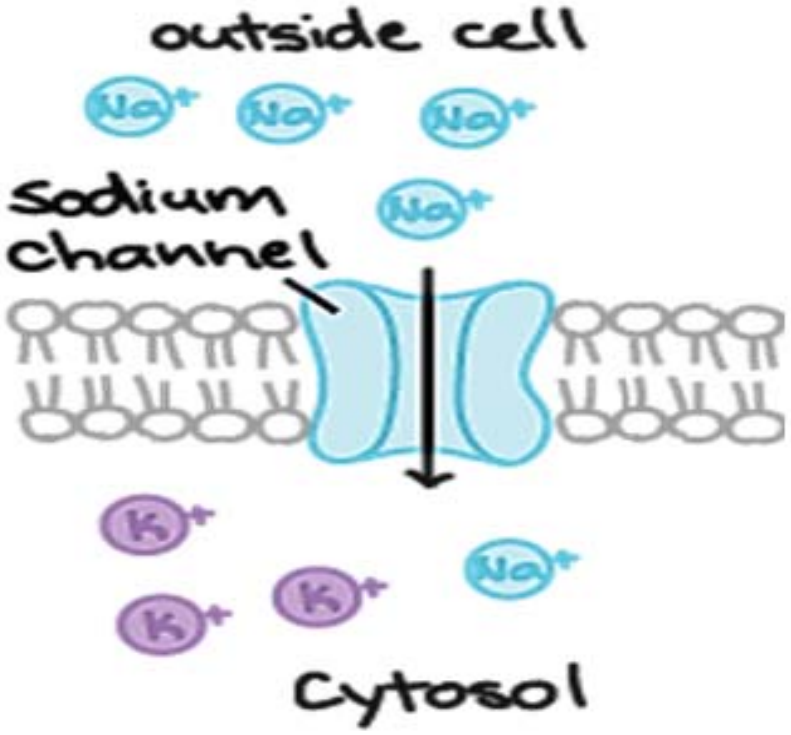
- **a-Leakage channels (passive)** that are characterized by:

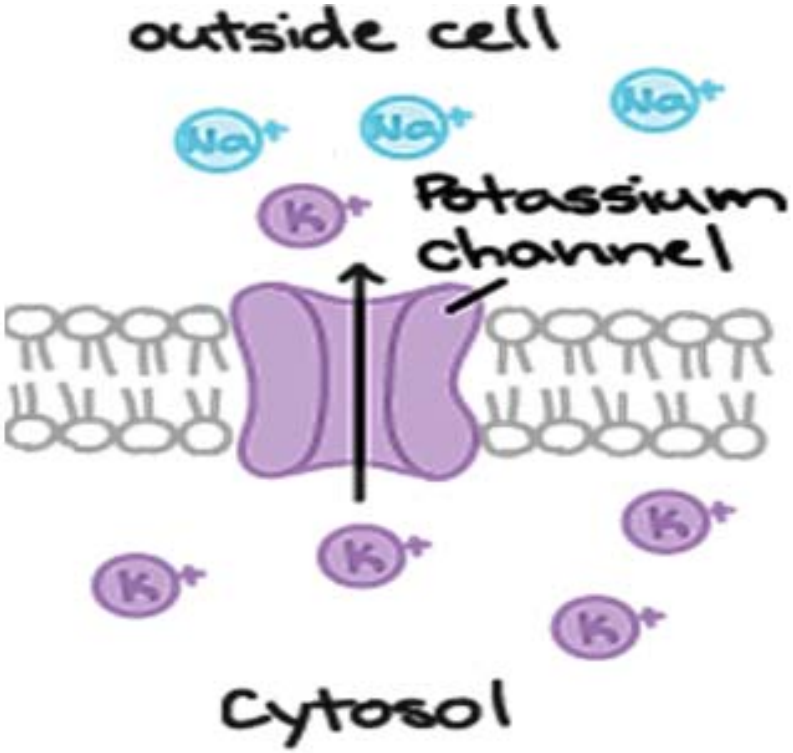
❖ They are opened all time, not gated, tube shaped with diameter of **7Angestrom**.

❖Watery pathway through protein molecule.

❖They are highly selective and this selectivity depends on diameter of channel, shape of channel and charges inside the channel.

❖**e.g.** Na^+ channel has negative charges which pull Na^+ to inside the cell. However, K^+ channels are not charged.





https://www.khanacademy.org/science/biology/human-biology/neuron-nervous-system/a/the-membrane-potential

❑ Gated channels (Active)

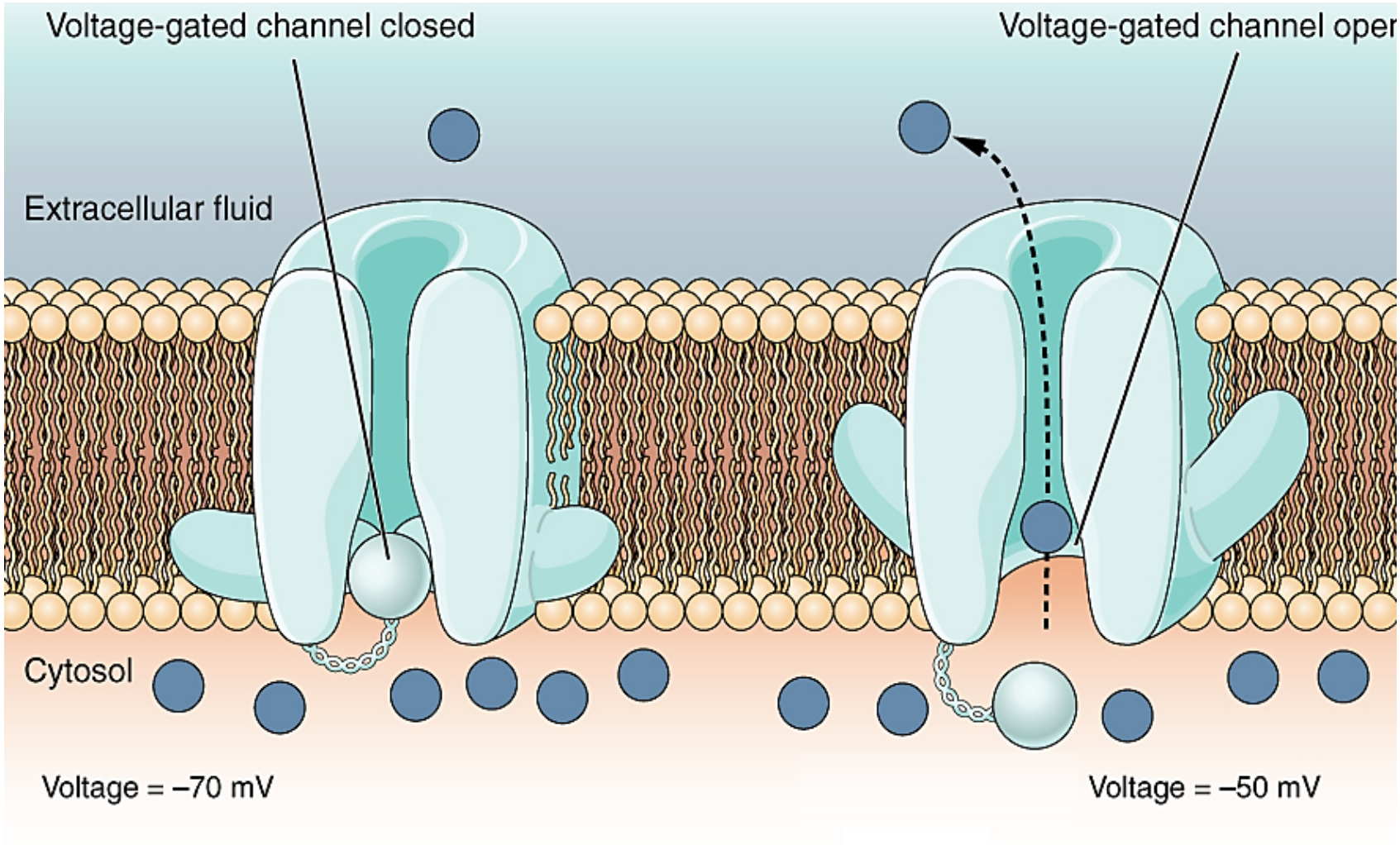
They have **gates**, which open or close by 2 mechanisms

1)Voltage gated channels
2) Ligand gated channels

b-Gated channels (active)

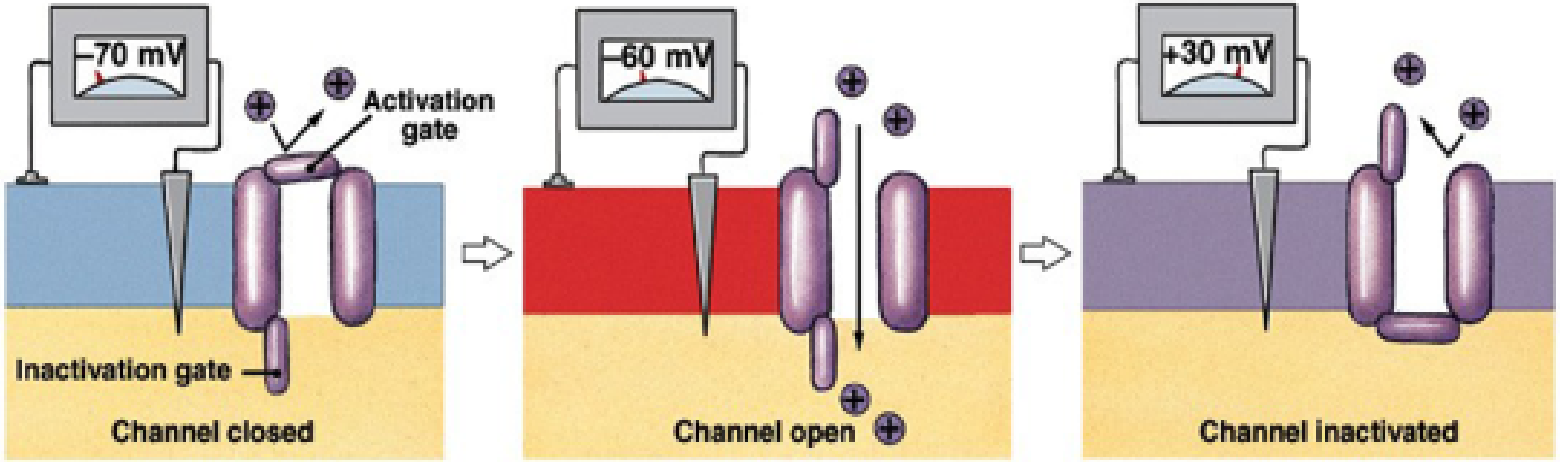
- they have gates :
- **Na+ channels have outer activation and inner inactivation gates .
- ** K+ channels have one inner gate.
- These gates may be opened or closed by:
- 1- change in ionic composition (Voltage gated channels)
- 2- binding with certain chemical substances (ligand gated channels).

1) Voltage gated channels:



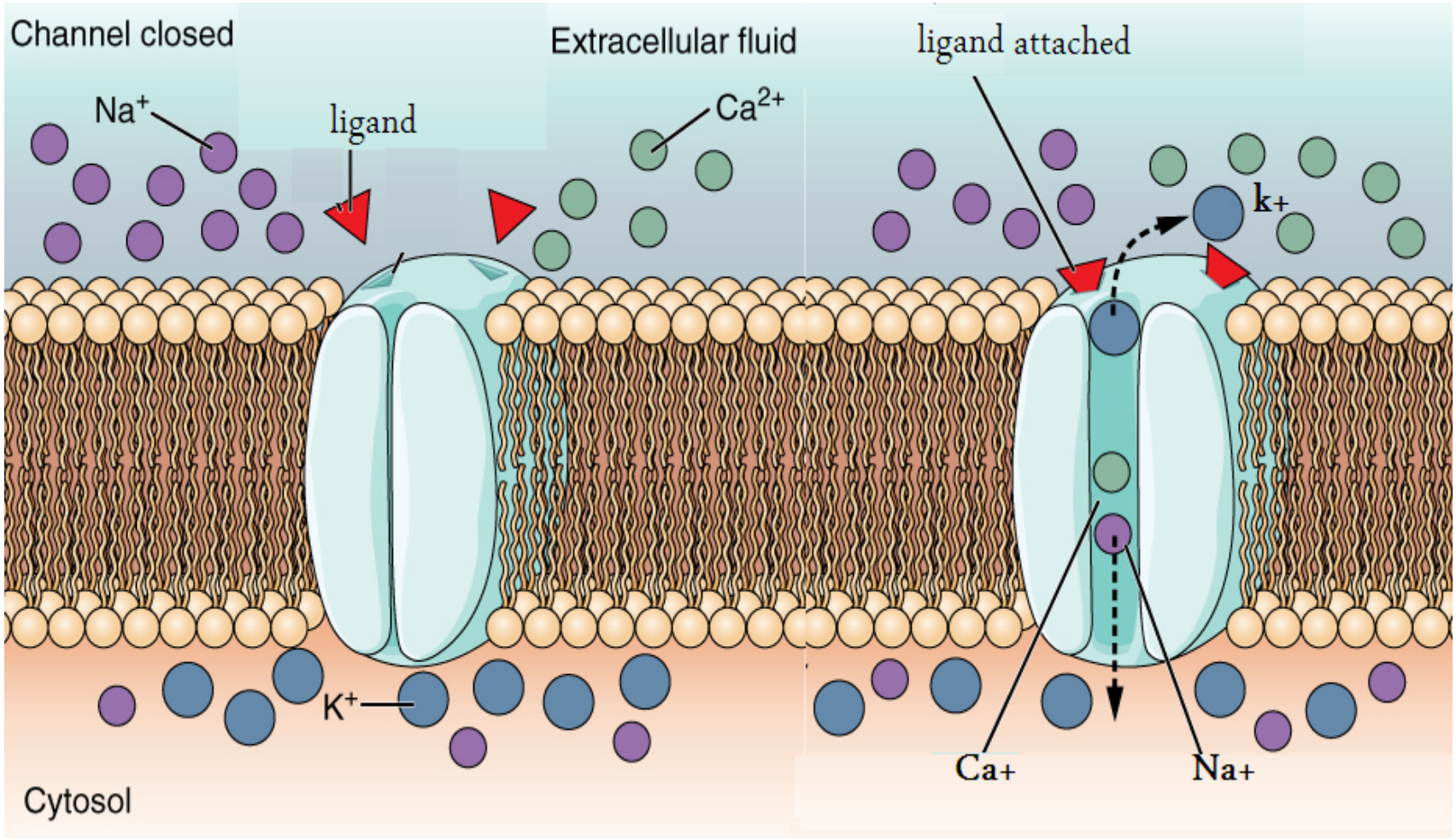
https://opentextbc.ca/anatomyandphysiology/chapter/12-4-the-action-potential/

GATED CHANNELS: VOLTAGE GATED



(b) Voltage-regulated channel

2) Ligand gated channels:



https://opentextbc.ca/anatomyandphysiology/chapter/12-4-the-action-potential/

- N.B. During rest the movement of ions is through the leakage channels but during stimulation and action potential it occurs via the gated ones.

- The membrane is more permeable to K+ than to Na+ ions because the hydrated K+ is smaller in size than the hydrated Na+. So, K+ permeability 50-100 times greater than Na+ permeability

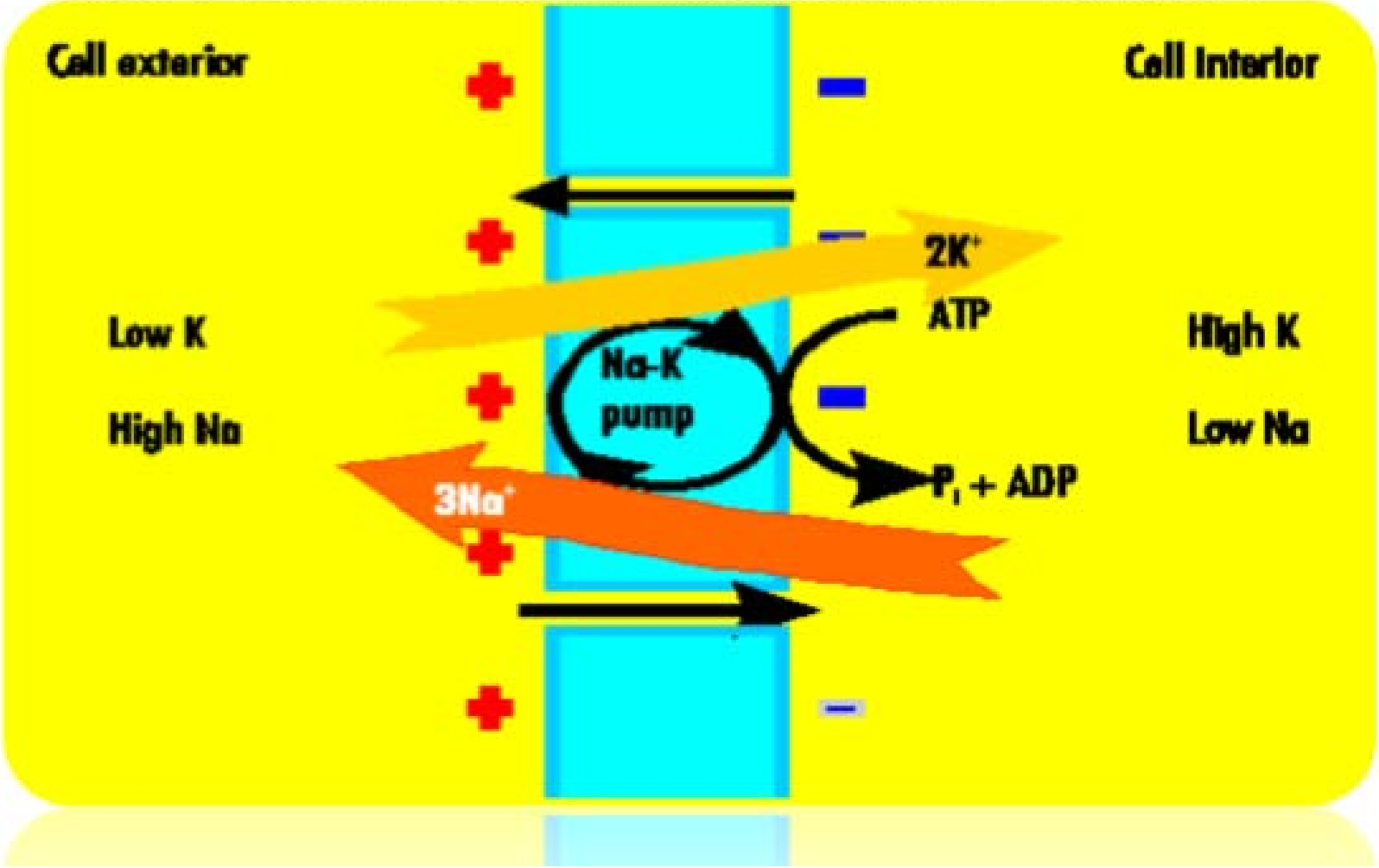
Membrane permeability

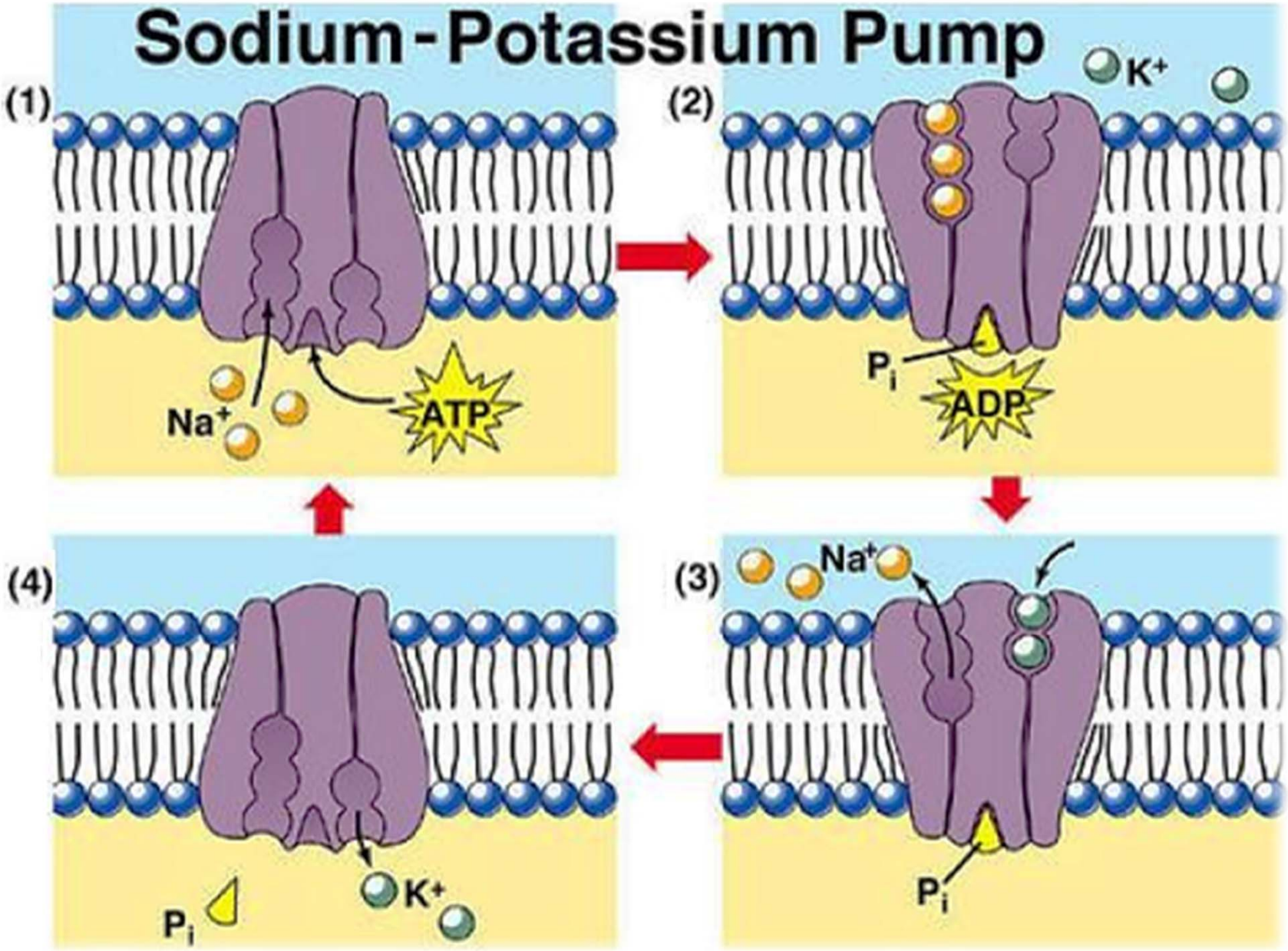
- **As regard to Na+:** Na+ tend to diffuse into the cell according to its concentration and electrical gradient but this is limited due to low permeability of membrane to Na+ helped by Na+/K+ pump so, accumulation of positive charges outside the cell.
- **As regard to K^+:** The cell membrane is highly permeable to K^+
- K^+ ions diffuse from inside to outside according its concentration gradient adding more positive charges to outside

Na^+ - K^+ pump

-**At rest,** some Na^+ can enter inside the nerve fiber also during **action potential** large number of Na^+ ions enter the cell and K^+ efflux occur so, the Na^+ pump is required to return Na^+ outside (against conc. and electrical gradient) and K^+ pump is required for return K^+ inside the cell against the concentration gradient only.

SODIUM-POTASSIUM PUMP.





https://www.quora.com/Whats-the-difference-between-carrier-proteins-and-pumps

- **Na+-K+ pump needs**:

❖energy source (ATP).

❖ATPase enzyme for liberation of energy.

❖large carrier protein present in the cell wall. Its internal surface has 3 receptors for Na^+ and ATPase, the external surface has two receptors for K^+.

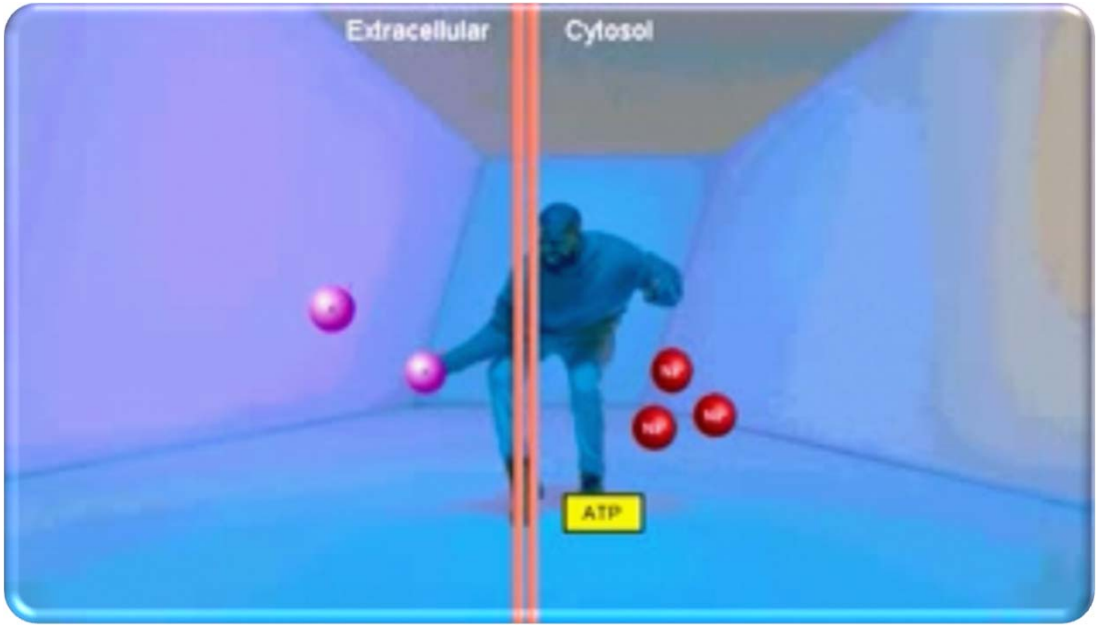
When activated by energy from splitting of ATP by ATPase enzyme the pump rotates to push 3 Na^+ to outside and $2K^+$ to inside the cell membrane.

Importance of the Na+ / K+ pump

1) Maintain of Na+ (extra cellular) and K+ (intracellular).

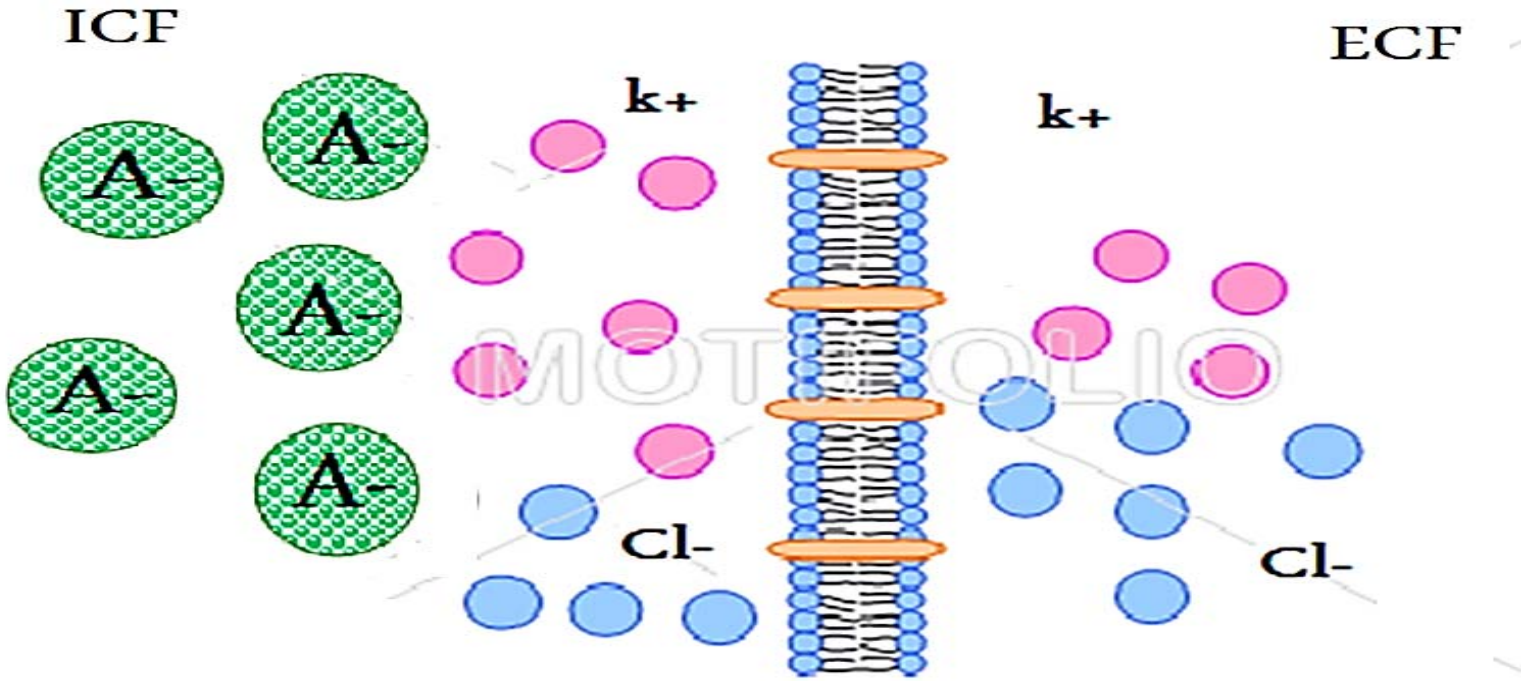
2) Control of cell volume as if Na+ remains inside the cell, water enters by osmosis and the cell swells.

3) It is an electrogenic pump as it causes RMP is more negative inside (2K+ influx and 3 Na+ outflux).

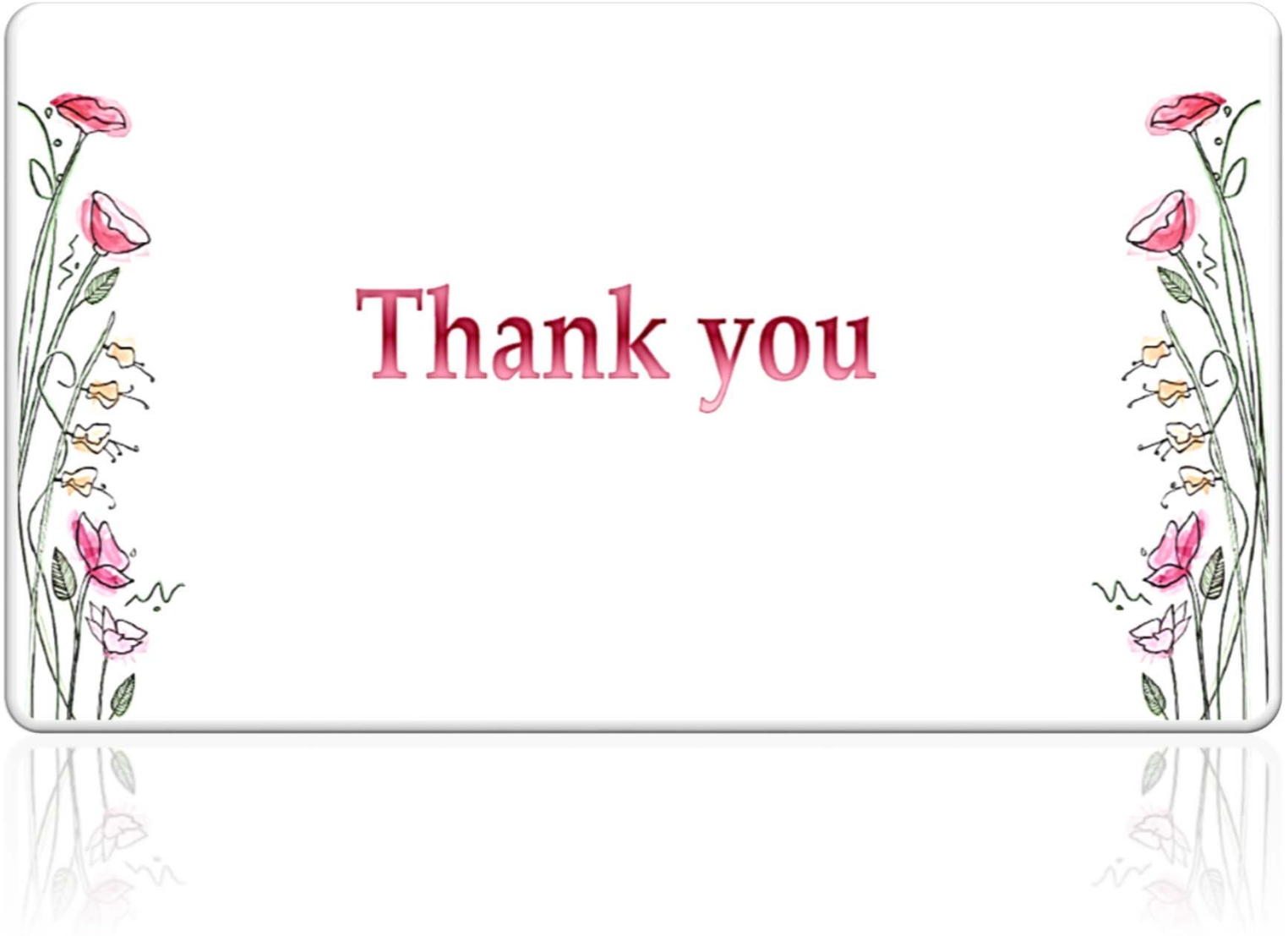


3. Impermeablility of membrane to intracellular protein anions

The membrane is impermeable to large intracellular protein anions ⟶ more negative charges inside the cell.



http://www.motifolio.com/5111213.html


Thank you