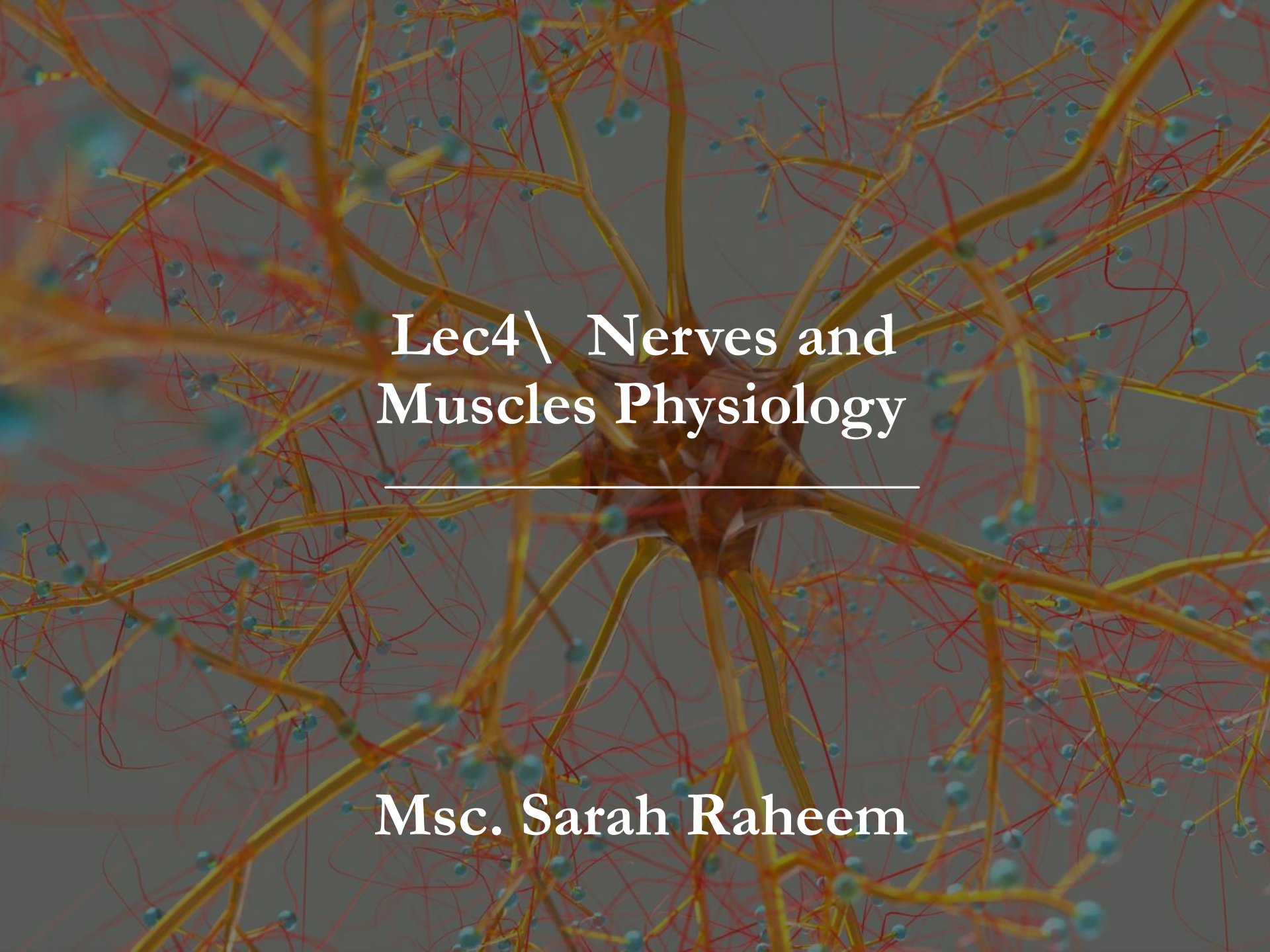


Lec4\ Nerves and Muscles Physiology

Msc. Sarah Raheem

Electrical potentials exist across the membranes of virtually all cells of the body.

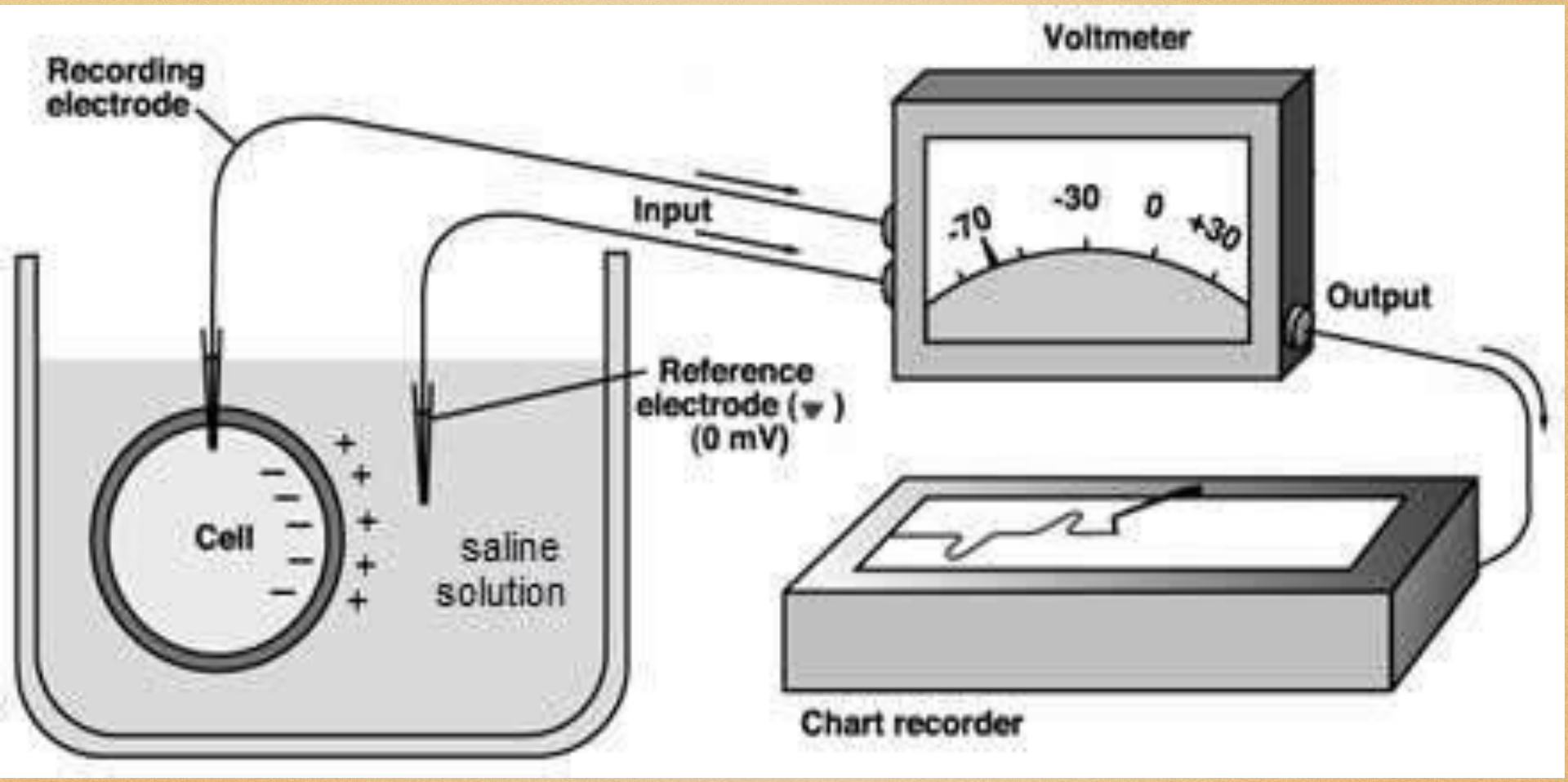
Some cells, such as nerve and muscle cells, are capable of generating rapidly changing Electrochemical impulses at their membranes, and these impulses are used to transmit signals along the nerve or muscle membranes.

Resting membrane potential (RMP):

Is the potential difference between the inner and outer surface of a biological membrane during rest or inactivity at which the forces of concentration gradient and electrical gradient balance ??

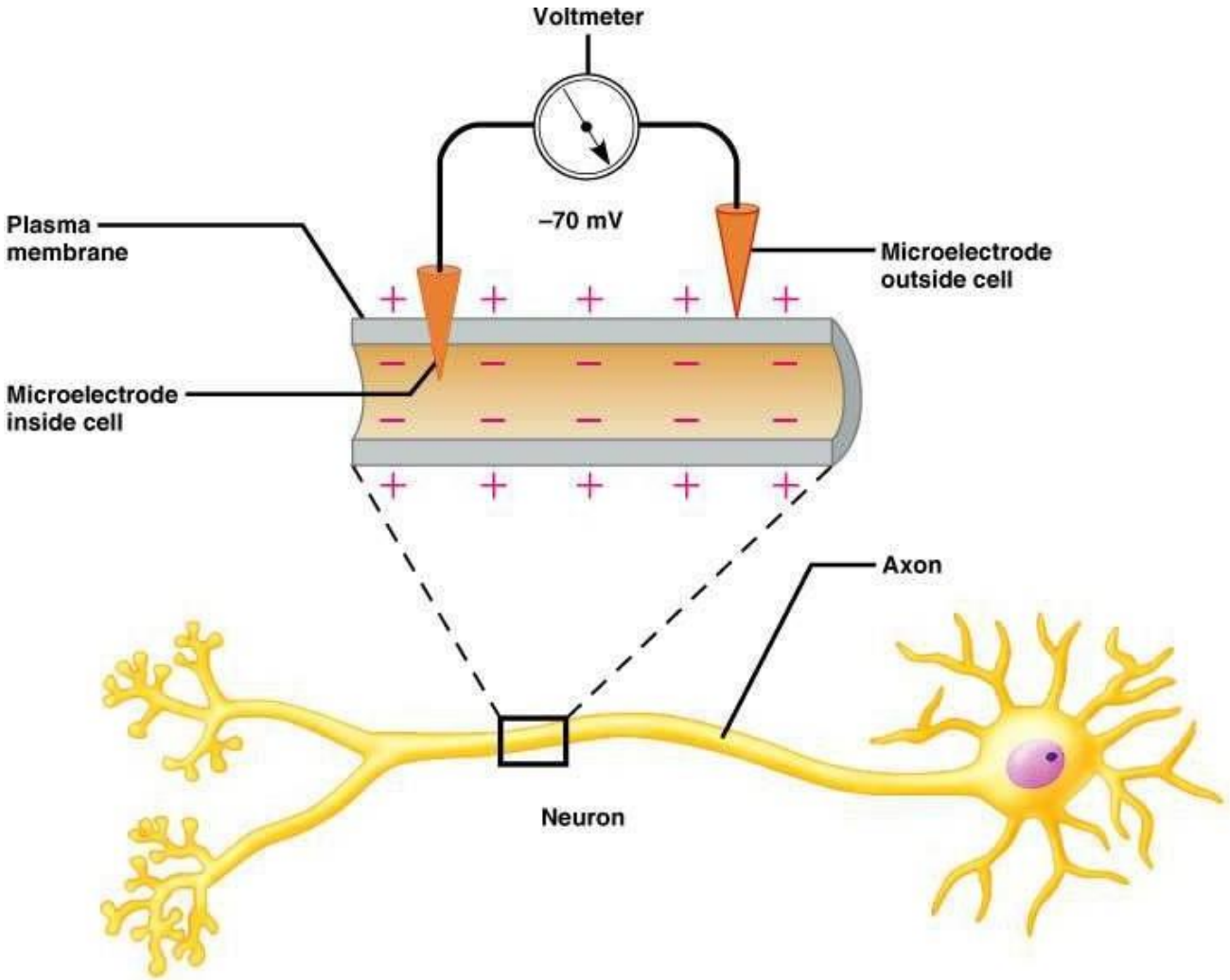
RMP varies **between –100 mV to -10 mV** (on the **inside** relative to the **outside** of the membrane) **depending on the type and the size of tissues**

This mean an excess of **negative** ions (anions) accumulates immediately **inside** the cell membrane along its inner surface and excess of **positive** ions (cations) accumulates immediately **outside** the membrane .



Diagrammatic representation for the membrane potential measurement.

Measuring the resting membrane potential



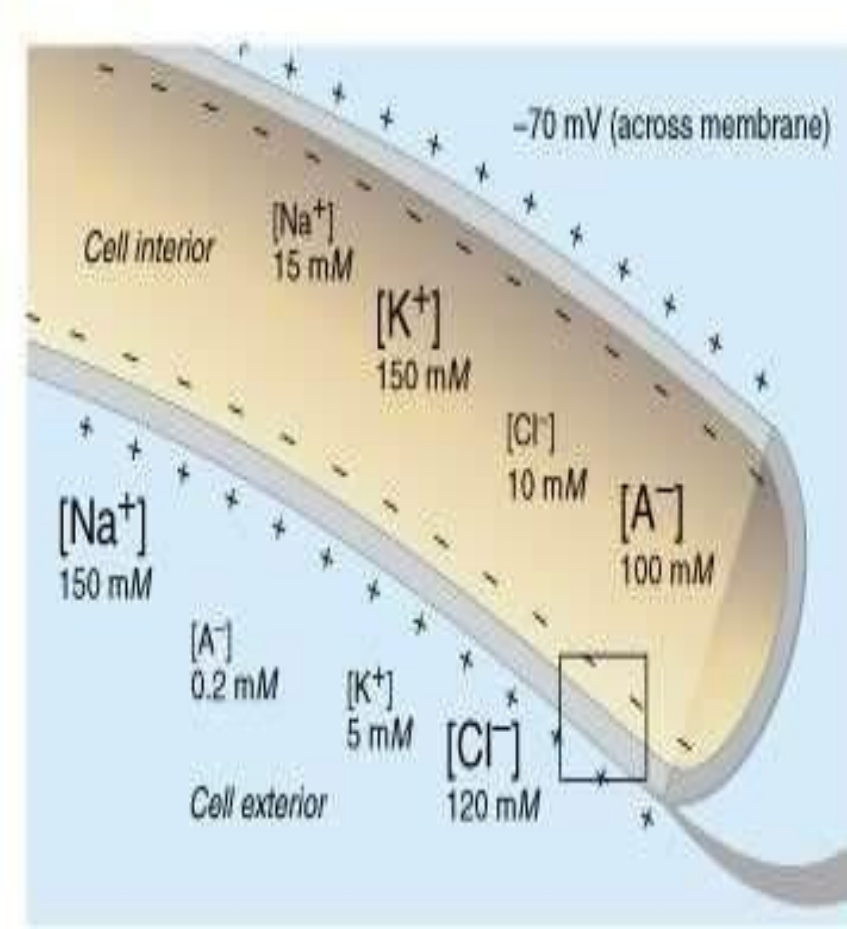
resting membrane potential

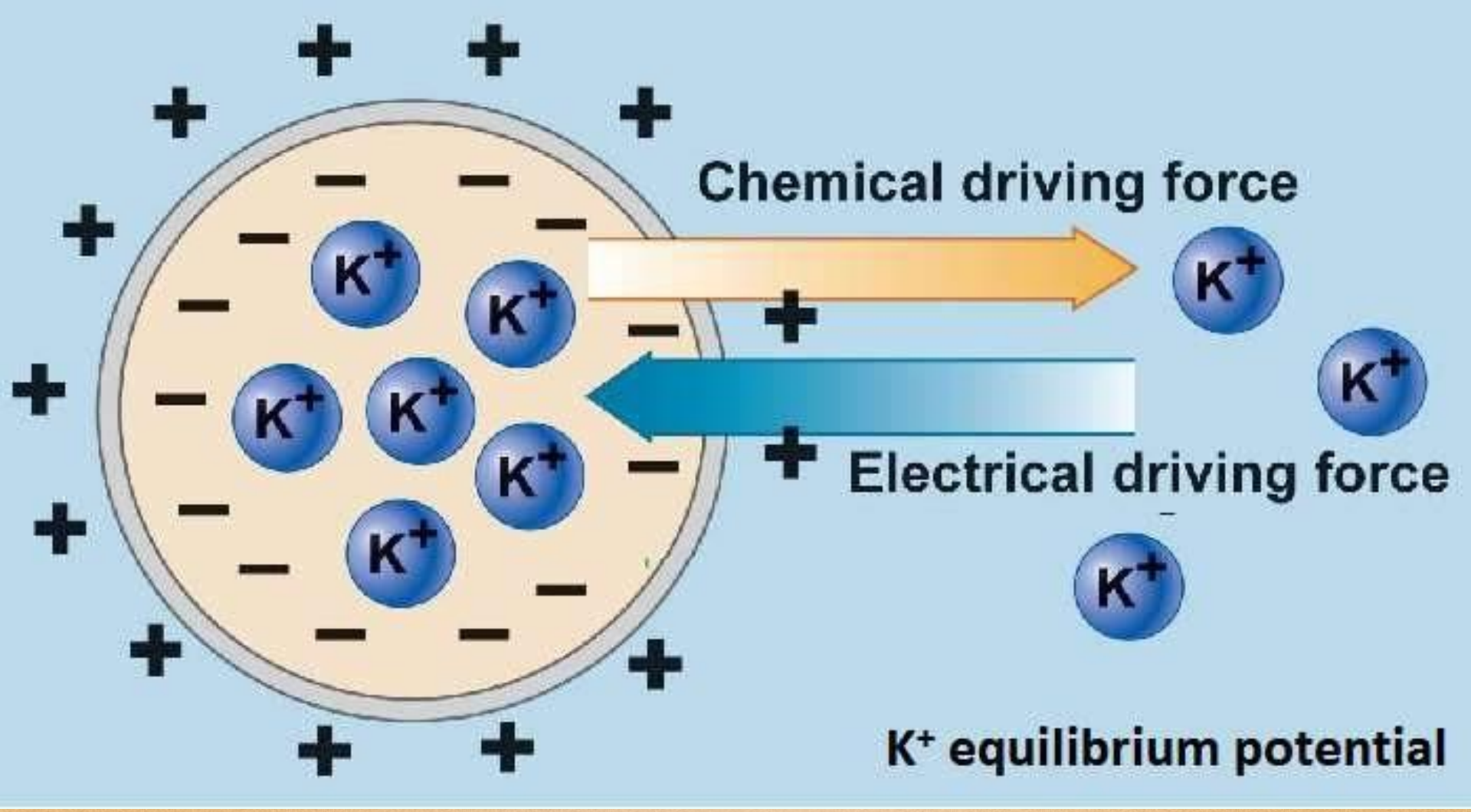
- **Intracellular Fluid ICF**

1. K^+
2. P groups
3. - proteins

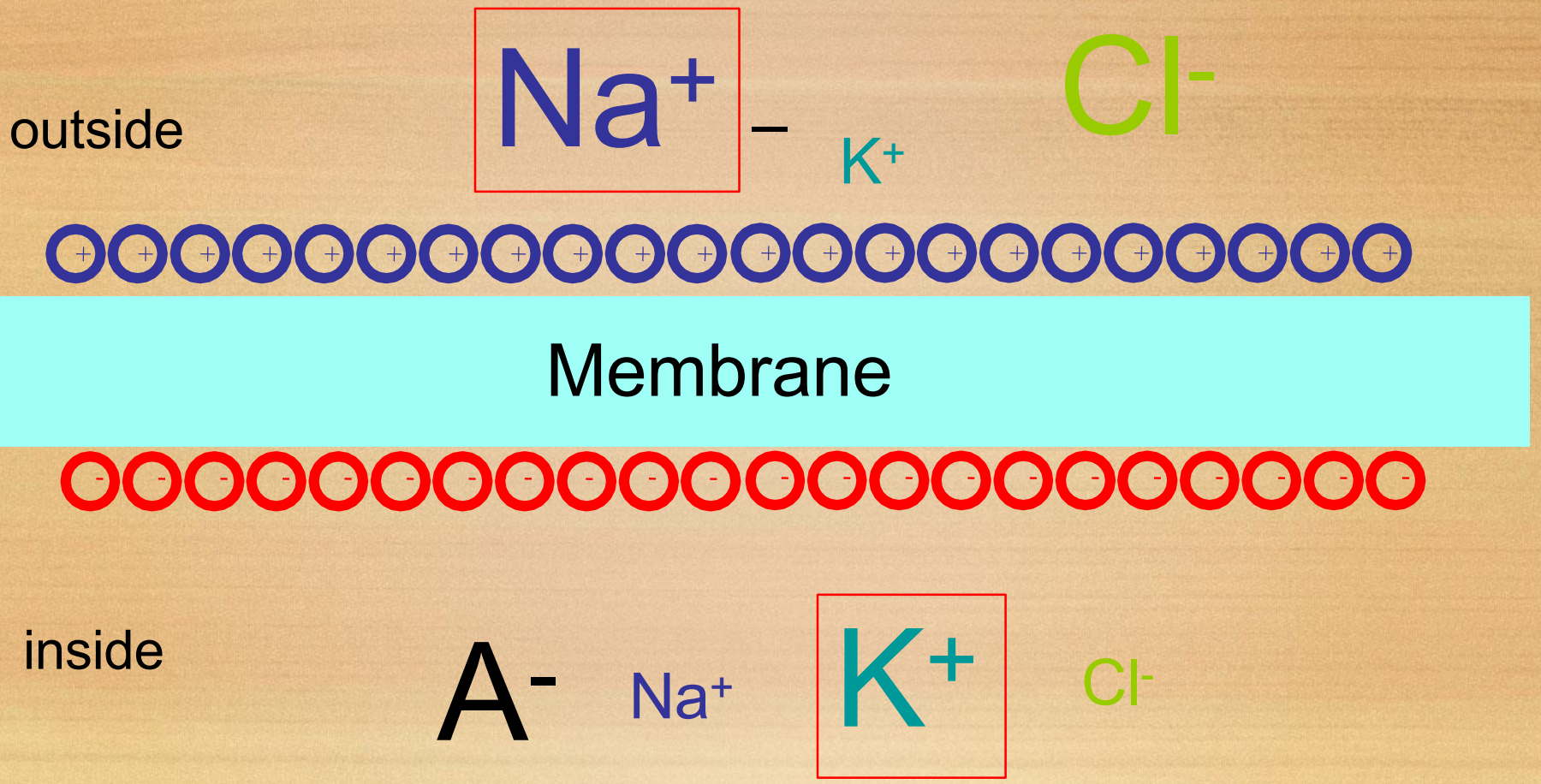
- **Extracellular Fluid ECF**

1. Na^+
2. Cl^- -
3. HCO_3
4. Ca^{2+}




Chemical driving force
Electrical driving force
K+ equilibrium potential

Resting Membrane Potential



resting membrane potential

causes:

1. The plasma membrane is more permeable to K^+ ions than other ions and molecules.

2. K + ions diffuse from the cell due to its concentration gradient.

3. Na^+ ions diffuse from the ECF into the cell due to its concentration gradient.

The genesis and the magnitude of resting membrane potential (RMP)

نشأة وقوة جهد غشاء الراحة:

In humans the genesis and the magnitude of the normal resting membrane potential is mainly due to:

(1)Passive outward diffusion of K^+ ions (diffusion potential) .

(2) Electrogenic pump (Na+-K+ pump).

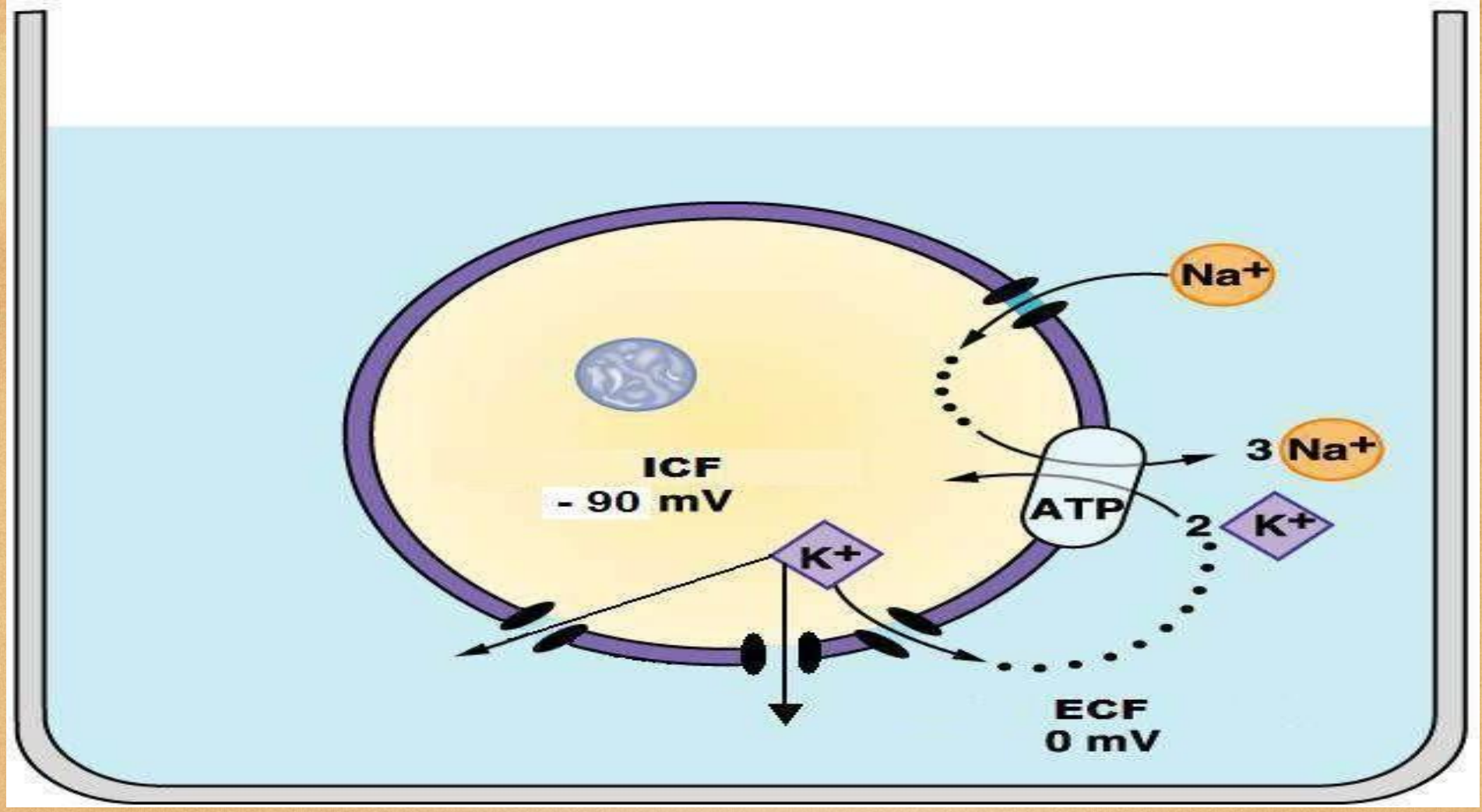
Passive outward diffusion of K^+ ions (diffusion potential) which alone is responsible for about of RMP 95% OF than will the inward diffusion of Na^+ ions.

This is because the permeability of the membrane100 times to K+ ions is more than Na+ channels.

This outward diffusion of K+ will create a state of **electro-positivity outside** the membrane and **electronegativity on the inside** (because of negative anions that remain behind).

سيؤدي هذا الانتشار الخارجي لـ K+ إلى خلق حالة من الشحنة الكهربائية الإيجابية خارج الغشاء والشحنة الكهربائية السلبية في الداخل (بسبب الأنيونات السالبة التي تبقى في الخلف)

This counterbalance forces is called K+ equilibrium potential at which the chemical driving force and the **electrical driving force** on K+ ions are equal and opposite, and the net diffusion **of K+ ions is stopped.**



The genesis for the establishment of RMP.

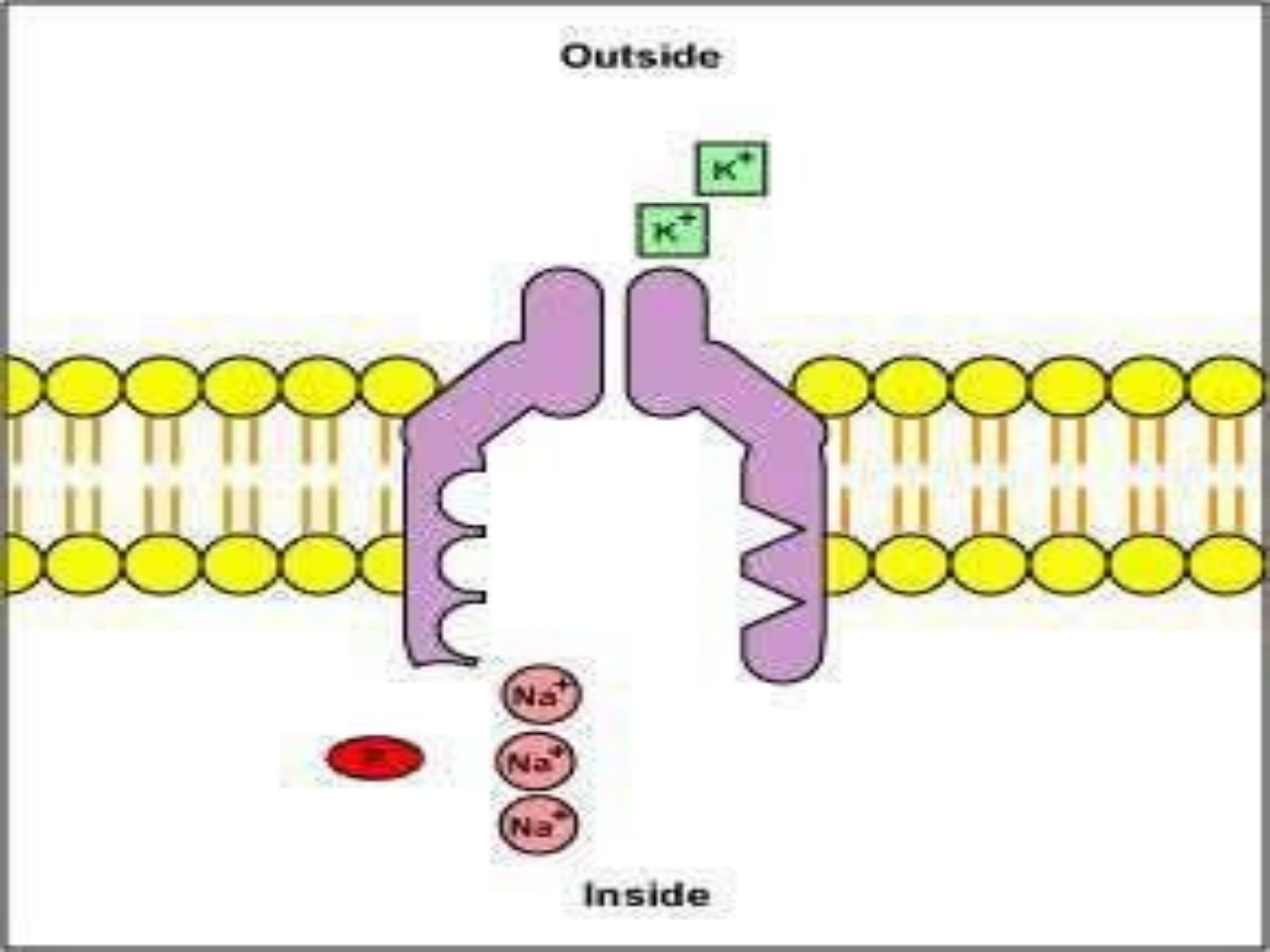
(2) Electrogenic pump (Na^+-K^+ pump)

Pumps three Na^+ ions out of for every two K^+ ions in.

This pump utilizes **energy** for its action, which is derived from ATP.

Thus, for every cycle of the pump the inside of the excitable cell **losses one positive** charge a process that leads to an excess of positive charges outside.

Electrogenic pump is responsible for about of 5% the total resting membrane potential.


Outside
K+
K+
Na+
Na+
Na+
Inside

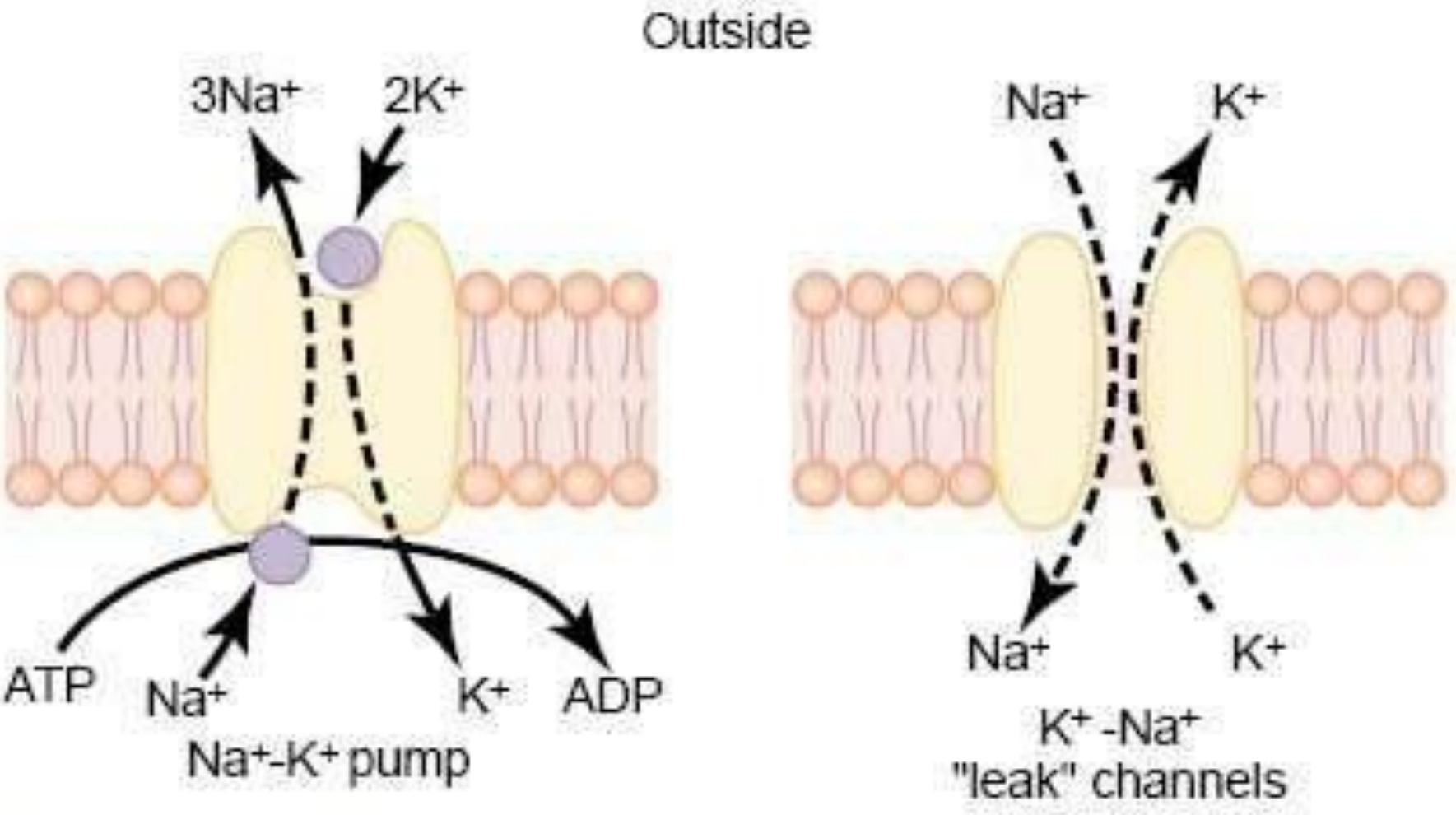


Figure 5–4

Functional characteristics of the Na^+-K^+ pump and of the K^+-Na^+ "leak" channels. ADP, adenosine diphosphate; ATP, adenosine triphosphate.

Na/K PUMP

Maintains Na^+ and K^+ ion concentration gradients by: يحافظ على تدرجات تركيز أيونات الصوديوم والبوتاسيوم عن طريق

- Active transport.
- Pumps 3 Na^+ ions out of the cell
- pumps 2 K^+ ions back into the cell.

In summary, the diffusion potentials **alone** caused by **potassium and sodium diffusion** would give a membrane potential of **about –86 millivolts**, almost all of this being **determined by potassium** diffusion. Then, an additional –4 millivolts

is contributed to the membrane potential by the continuously acting electrogenic Na+-K+ pump, giving a net membrane potential of –90 millivolts