SEM II **CC 3 TH** **2020**

THE RESTING MEMBRANE POTENTIAL

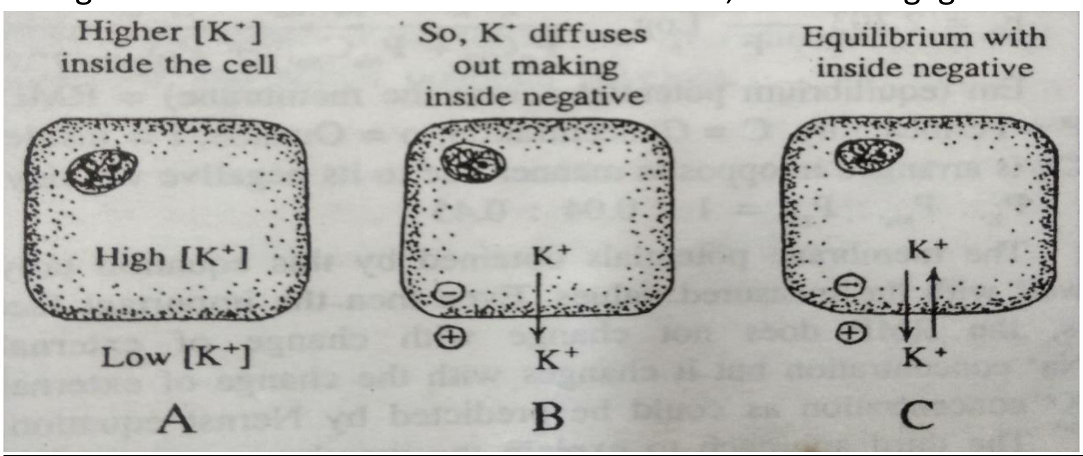
- The resting membrane potential (**RMP**) is the potential difference between the inside and outside the membrane of a cell, in resting condition.
- It is expressed as the measured potential difference across the cell membrane in millivolts (mV). **In neurons** it is usually **-70mV**.
- It can easily be **measured by** putting two microelectrodes, one inside another outside the cell membrane and then connecting them through a suitable amplifier to **cathode ray oscilloscope (CRO**) → showing the inside negative relative to the outside of the cell at rest.
- The **distributions of ions** and their **movements (diffusion) across the cell membrane** and the **nature of this membrane** - provide the explanation for the membrane potential.

MAINTENANCE of RESTING MEMBRANE POTENTIAL

- Normally interior of the cell remains negative (excess anions) and exterior of the cell remains positive (excess cations). This condition is maintained by i) movement (diffusion) of different ions (like Na^+, K^+, CL^-) across the cell membrane at rest and ii) Na^+-K^+ ATPase pump.
  1. **Role of K^+**: The concentration gradient for K^+ (inside more than outside) facilitates its movement out of the cell via K^+ channel (leak channel, K^+ is 100 times more permeable than Na^+), but its electrical gradient is in the opposite (inward) directions (as outside cell membrane always remains positive).
     Consequently, an equilibrium is reached in which tendency of K+ to move out of the cell is balanced by its tendency to move into the cell and at that equilibrium there is slight excess cations on the outside and anions on the inside.
  2. **Role of anions including Cl^-**: There is no matched efflux of intracellular anions, they are mostly very large particles like proteins,

phosphates etc. Hence, they cannot pass on. Cl^- is permeable but can't go out against its concentration gradient, so cannot influence the negativity.

3. **Role of Na^+:** The tendency of Na^+ is to enter the cell. This is firstly, interior of the cell is negative and Na^+ is positive ion, and secondly the $[Na^+]$ in ECF is many times higher than the $[Na^+]$ in ICF. Both the concentration and electrical gradients therefore are directed inwards. But Na^+ cannot pass through the leak channels because of its higher effective diameter along with the water molecules attached to it. The voltage gated Na^+ channels are also closed at rest. Thus Na^+ influx does not compensate for the K^+ efflux because K^+ channels make the membrane more permeable to K^+ than to Na^+, though some Na^+ do enter inside the cell at rest, but it is negligible.



	Na^+ (meq/L)	K^+ (meq/L)	Cl^- (meq/L)	$Protein^-$ etc (meq/L)
Intracellular	15	140	7	60.1
Extracellular	142	4	105	0.1

4. **Role Na^+ - K^+ ATPase Pump:** The condition, inside negativity and outside positivity, is also maintained by Na^+-K^+ ATP-ase (ATP depended active pump), which removes the Na^+ from inside. This way the pump also creates negativity inside the cell, removing 3 Na^+ in exchange of 2 K^+ requiring energy (from ATP) and also maintains a high $[K^+]$ inside which makes persistent K^+ influx possible.

If Na^+-K^+ pump is paralysed, the RMP is lost. So, for maintenance of RMP, this pump is very important. Otherwise action potential cannot be developed.

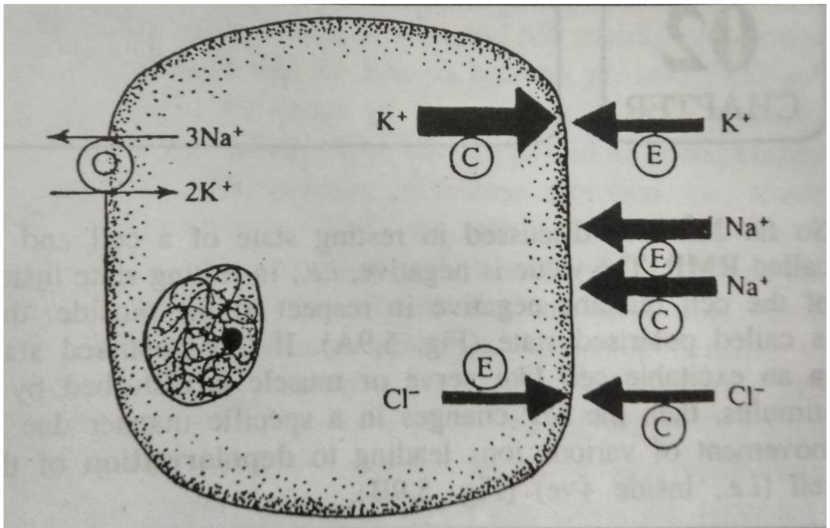


Fig. 5.8. *Showing tendencies of different ions to move. Arrows indicate the forces acting on the ions.* Ⓔ *= electrical gradient,* Ⓒ *= concentration gradient.*