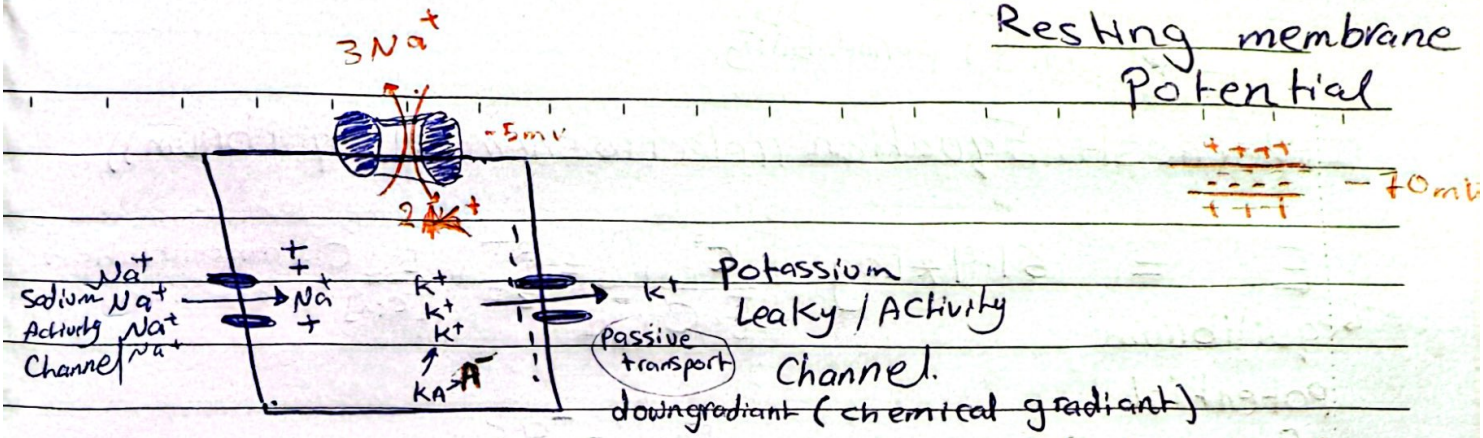
Resting membrane Potential



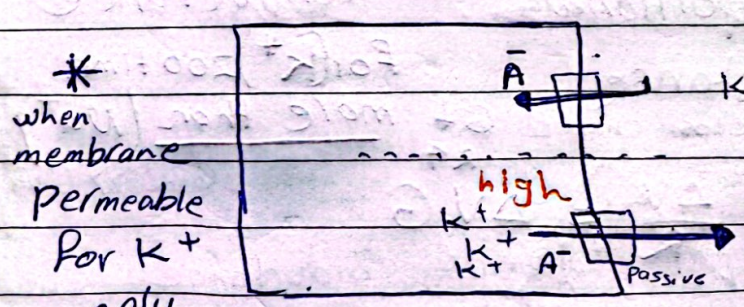
How the rest membrane potential become (-70mv)

① Sodium-potassium pump 0 → (5mv)

② Potassium Activity channel (-5 mv → -90 mv)

③ sodium Activity channel (-90mv → -70mv)

The effect of potassium more than Sodium's
Because the permeability for potassium more
Number of potassium channel more.
Leave Negative ions



* when membrane permeable For K+ only

(electrostatic gradiant
electrical gradiant

$\Delta G_{con} = -\Delta G_{volt}$ = electro chemica equilibrium (ne

concentration gradien (chemical gradient)

At some point when we have accumulation For K^+ in the extracelluler and alot of negative ions intracelluler.
Negative ion will (atract) the K^+ into the inside (chemical will stop) → electrical gradiant

* Electrical = Chemical

ما بيهتم
بال
لمعامل الإيونات permeability

Nernest Equation ((electro chemical eqilibrium))

$$E = 61.4 * \text{Log} \frac{[K^+_{out}]}{[C_{inside}]} = \frac{RT}{ZF} \ln \frac{[C_o]}{[C_{in}]}$$

C: concentration for ion.

↳ equilibrium potential for single ion. (univalent)

$E_{K^+} = -95$ mv

$E_{Na^+} = +60$ mv

$E_{Cl^-} = -80$ mv

$E_{Ca^{+2}} = +130$ mv

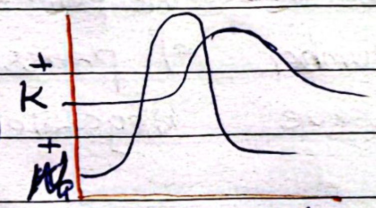
Gold men equation → for all ions

يهتم بال permeability لكل ايون

$$E_m = \frac{RT}{F} \ln \left(\frac{P_{Na^+}[Na^+]_o + P_{K^+}[K^+]_o + P_{Cl^-}[Cl^-]_i}{P_{Na^+}[Na]_i + P_{K^+}[K^+]_i + P_{Cl^-}[Cl]_o} \right)$$

~~cord~~ conductance (G)

how membrane let a specific ion move through it



$G \propto \frac{1}{R}$ inversely proportional with resistance

conductance

conductance for (K^+) 200 time more than (Na^+)

$G_{K^+} >> G_{Na^+}$

open channel $G\uparrow$ $R\downarrow$

close channel $G\downarrow$ $R\uparrow$

Ohm's low ⇒ $I = \frac{\Delta V}{R} = \Delta V . G$

I: Current; ΔV: driving force to move ions; G: conductance.

Cord conductance equation (contribution of permeat ions to resting membrane potential)

↳ to measure the whole membrane voltage.

$$V_m = \frac{G_{K^+}}{G_{Tot}} E_K + \frac{G_{Na^+}}{G_{Tot}} E_{Na^+} + \frac{G_{Cl^-}}{G_{Tot}} E_{Cl^-}$$

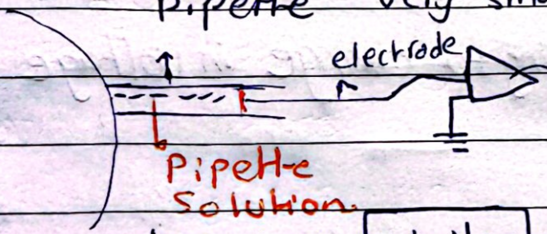
patch clamp → study the voltage gated ion channels at differ membrane potential

→ measure the activity of differ channel at differ voltages (by) measure currents of ion that move.

→ determine: conductance, Action potential, transport characteristics

→ we have it in the excitable cells ((cells which can happen Action potential on it))

pipette very small.

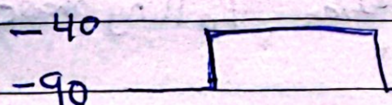


→ amplifier (recording of current
↳ response voltage change

have ions similar compound of Extracelluler fluid (ECF)

لما أغير بـ voltage تبع
الخلية عن طريق Patchclamp
بقدر أعرف شو تأثير المقدار المعين
من الـ voltage على channel معين
من ناحية هل صار open/close
حركة الايونات intercelluler →
Extracelluler

→ Type:
cell-attached → living cell
Inside-out

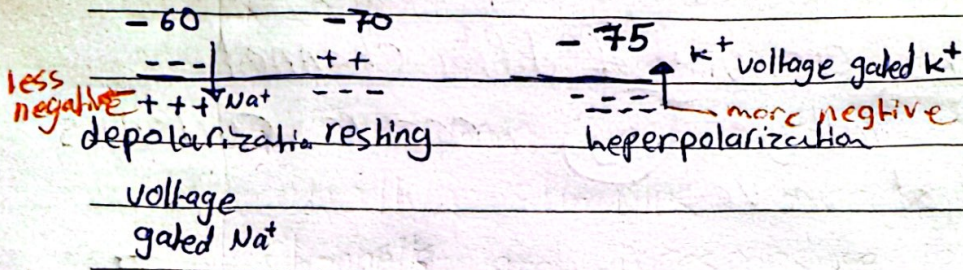


-90 → -40 depolarization

→ open (form Extra → intra)

Changing in Resting membrane potential

It means that potential become ← more negative / less negative



* Rate of activation Na^+ channels higher than K^+ (conductunce increas for Na^+ during first stages.
* Resting potential close to Equilibrium potential for K^+

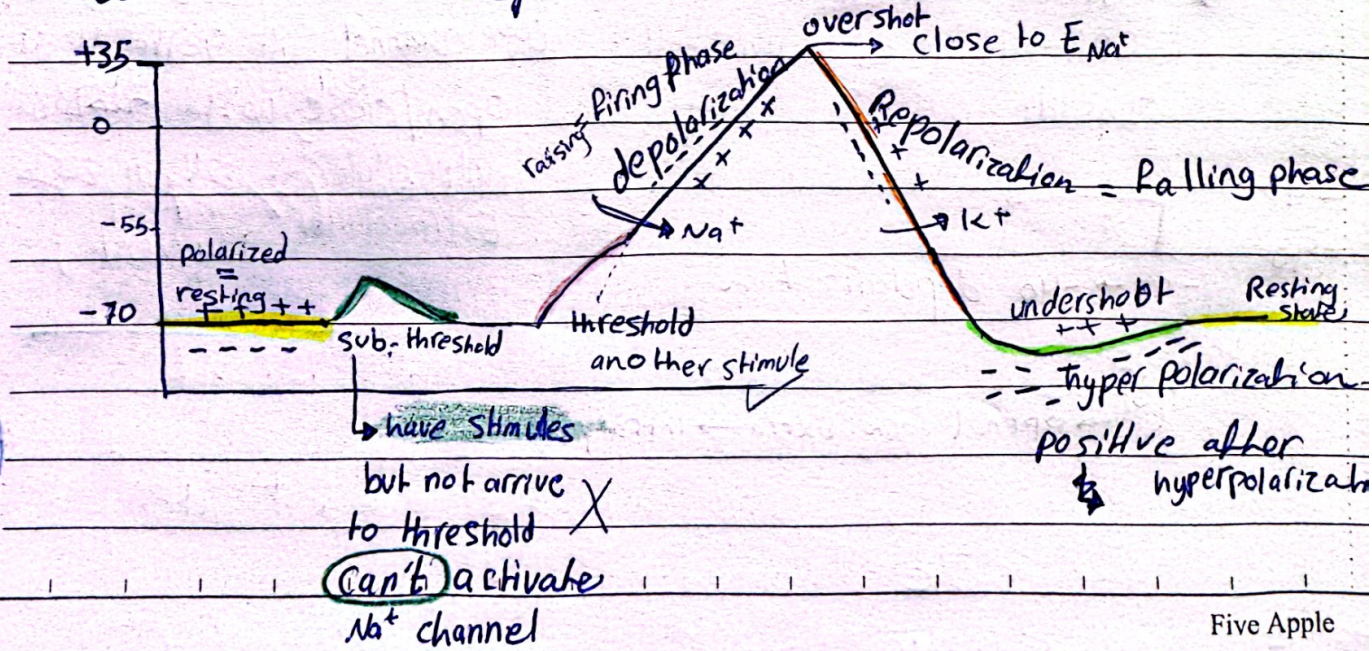
Type of channels.

- voltage gated channel

Change it behavior according to change in voltage across plasma membrane

- Ligand gated channel

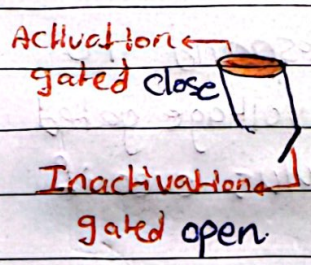
change it behavior according if Ligand is bound into receptor on it



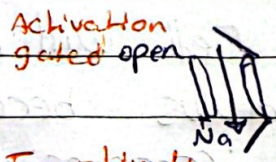
Changing in channels activity result in Action potential.

① Na^+ channels

Resting state.



depolarization
Rising Phase



Repolarization.
Falling phase.

Closed, capable to open
ex. -70mv
↳ can return on it when membrane return to near resting state (hyper)

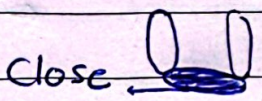
Activated
-55mv → +35mv

Closed, not capable to open

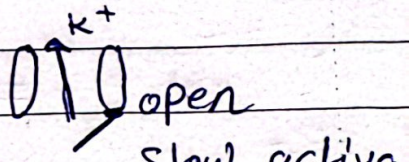
[Non or all principle] It means that when you stimulate a channel you can't stimulate it again at same time until it achelve the end ((back into resting state again))

② K^+ channels

Resting state



Repolarization



+35 → -70 mv

* $Na^+ K^+$ pump → Important in restoring ionic composition of the intra + extracelluler fluied during actionpotential.

Refrachory period

- happen during Action potential
- It mean Cell will not be respond to another stimulus because of voltage gated Channells are irresponsive to stimulus even if it present
- prevent overlapping of (AP) and flow in Unidirection (AP)
  - Absolute
    - depend on Na^+ channels
    - depolarization two gated open
    - Repolarization Inactivate gated Close
  - relative
    - strong stimulus
      - resting state activation cls
      - end of repolarization when return to resting state.