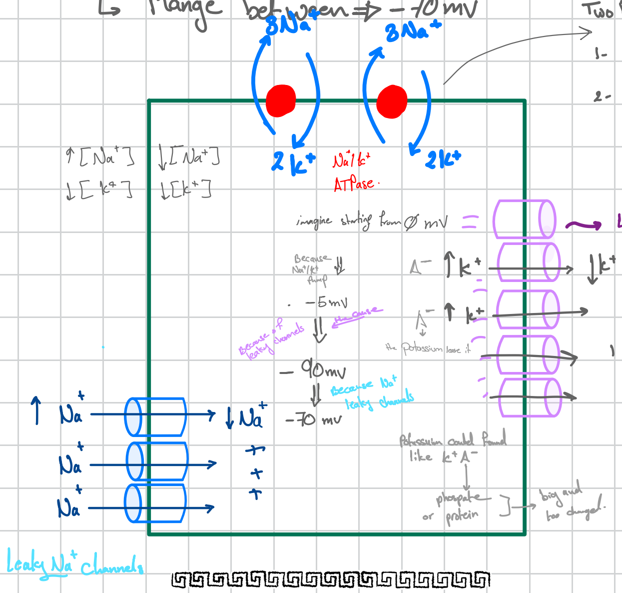
Ninja Nerd lecture

Resting membrane Potential

↳ the voltage diffrence across cell at rest.

↳ Exist in all cells.

↳ Range between ⇒ −70 mV



Two Functions of this pumps:-

1- generating a small negative charge outside the cell.

2- generating concentration gradient for this ions to move

→ Leaky K⁺ channels

↳ this channels are always open and allow to K⁺ transport in and out of the cell freely and passively.

the permeability for K⁺ is significantly higher than Na⁺ Permeability

NERT Potential.

↳ when do you use it

lets talk about K⁺ movement → it moves down its concen. from inside to outside but as it moves with time → the inside of the cell become more negative → That negativity want to pul potassuim back to the cell → that called "Electrostatic gradient".

When ever the rate of K⁺ movement toward outside "down it's concentration" is equal to the rate of macment inside " down it's electrostatic gredient" ⇒ No net movement

→ we reach Nernest potential

reach Nernst potential

What is the equation ?

$$E_{K^+} = \frac{61.5}{z} \times \log_{10} \frac{[K_{out}]}{[K_{in}]} \rightarrow \frac{(5)}{(150)} = -90\ mV$$

z → charge

$$E_{Na^+} = 61.5 \times \log_{10} \frac{[Na^+_{out}]}{[Na^+_{in}]} \left(\frac{140}{11}\right) \Rightarrow +70\ mV$$

⇓

The cell is more permeable to K⁺ than Na⁺ So the Rest equilibrium is closer to K⁺ equilibrium.

Graded Potential

↳ The purpose :- take the Resting MP to the threshold MP

↳ so getting the voltage from −70 mV to → −55 mV

↓

Depolarisation

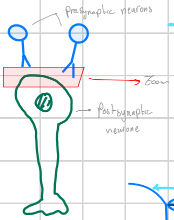
↳ The voltage that we need to open up voltage gated Na⁺ channels in the axons (−55 mV) ⇒ E.P.S.P (excitatory post synaptic potential)

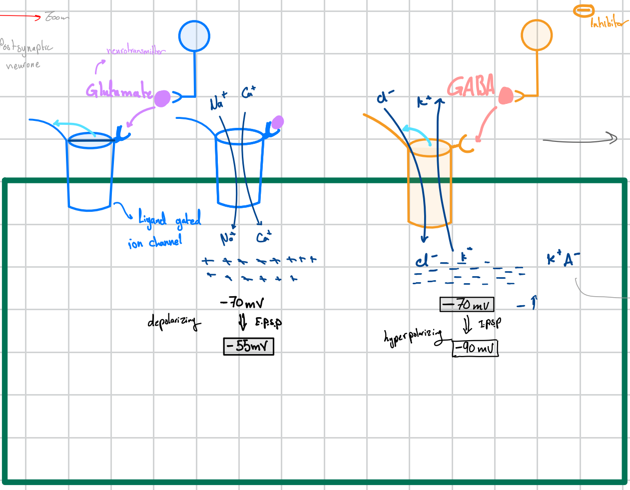
2- some times we need to take the voltage away from the threshold MP. ⇒ I.P.S.P (Inhibitory postsynaptic potential)

−70 mV ——→ −90 mV

hyper polarization.

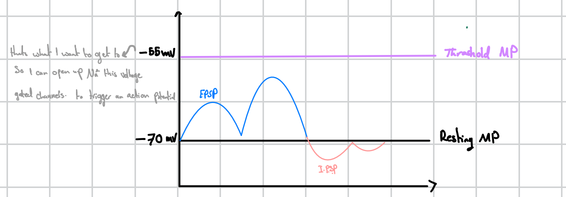
↳ to inhibit this neuron.



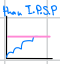


Inhibitory transmission like GABA bind to the receptor of the channel and open the gate to allow the negative ions to move in or allowing the positive cations to move out

This channels are gated and closed at normal but when the transmitter bind to the receptor, the gate will open and allowing the cations to move throw the channel and changing the voltage from −70 mV to −55 mV



I need more E.P.S.P's than I.P.S.P so I have enough EPSP to stagger on top of one another.



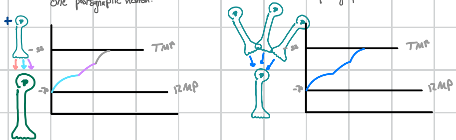
There are two types of summation to get TMP.

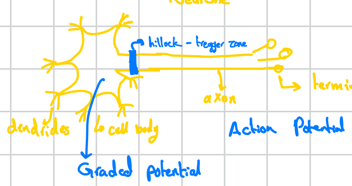
Temporal summation

1 presynaptic neuron that is repidly stimulating one postsynaptic neuron.

Spatial summation

Multiple presynaptic Neurons stimulating one postsynaptic neuron





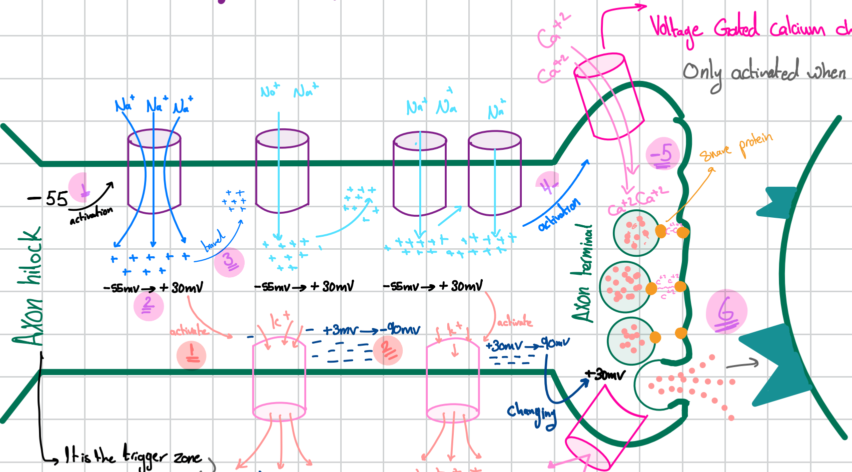
Neuroglia → Nervous cells for supporting (Not excitable)

Resting membrane potential ⟹ Threshold potential ⟹ Action potential
-70mv -55mv

Action Potential

Excitable cells
→ Muscles
→ Nerves
→ glands

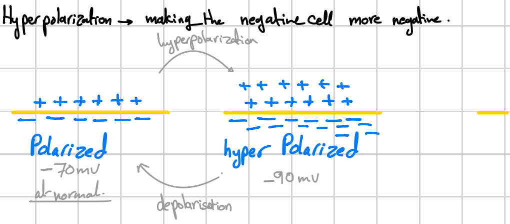
but we will focus on nervous tissue



└→ It is the trigger zone

means ones you hit a particular voltage inside cell ; you can trigger an action potential by opening up these voltage gated Na^+ channels

Depolarization → making the cell postive (less negative)
Repolarization → going back to resting MP which is negative
Hyperpolarization → making the negative cell more negative.



The process:-

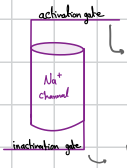
"Depolarization"

1- the -55mV voltage "that occur from graded potential" will activate the Na^+ channel and open the outer gate "inner is already open" to allow the Sodium to inter

2- the entering of Na^+ into the exon will raise the concentration of positive charge inside so the voltage increases from -55mv to +30mv

why specificly +30 mv ?

because the channel has inner gate that is sensitive to the +30mv, and it close on this voltage



└→ outer gate open on -55mv voltage

inner gate closed on +30 mv voltage

3- the positive charges come over to the next channel and activate it to transport more and more Na^+ toward inside and making the voltage -55mV to +30mv and this process magnify the positivity through the hole exon.

"Depolarising or positive way moving down the exon toward the terminal bulb ⟹ this is The Action potential"

4- the voltage gated Calcium Channel is activated when the positive wave arrived to it and the Calcium will start to inter the exon.

5- Calcium has a particular spesific Function that → linking the snare proteins that present on this vesicles and the cell membrane

↓

6- As a result of that, the synaptic vesicles fuses with the membrane and the neurotransmitters are released out into this synaptic space and binds to particular receptors on the surface of another cell.

"Repolarization"

1- the -30 mv that is Created by Na^+ channels stimulate the potassium voltage channels ,so k^+ cations will move outside the cell through the channels

the movement of k^+ cations create a possitave charge outside and negative charge inside the cell

↓

2- change the voltage from +30 mv to -90 mv

we have to stop calcium from releasing neurotransmitters
So we need to stop Ca^{+2} voltage channels, but HOW ?

Ca^{+2} channels are working on +30mV voltage, so the k^+ channels work on "Repolarization" and changing the voltage from +30mv to -90 mv around the Ca^{+2} channel so this channel is inhibited.

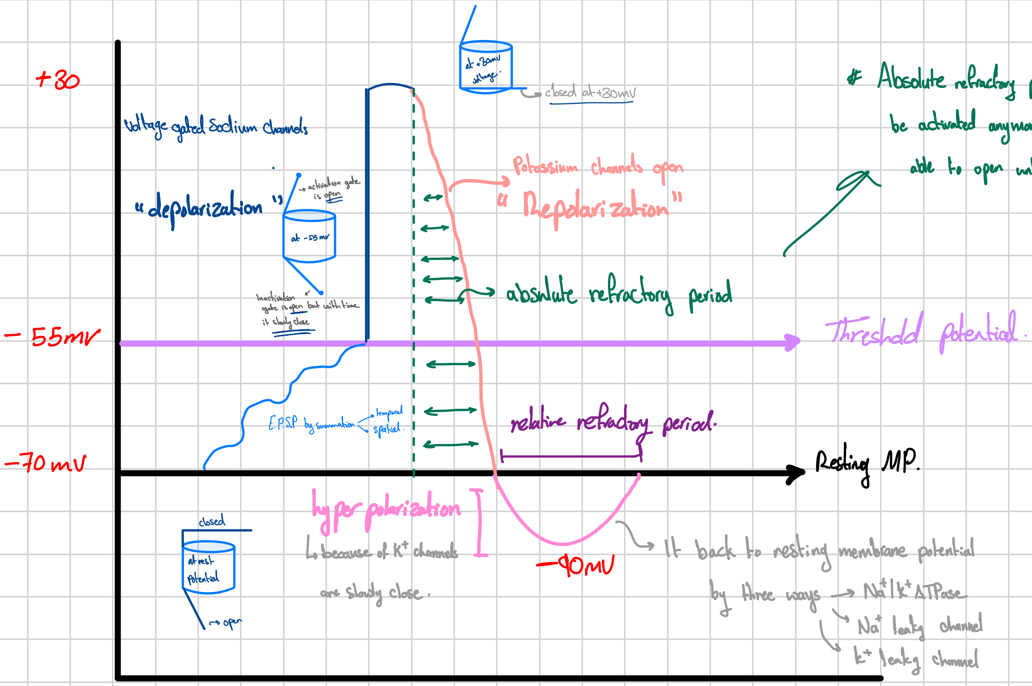
So the neurotransmitters are stoped from releasing.

Note that the voltage become -90mv but the resting voltage is -70mv, so what ?

└→ potassium when it leaves, these voltage-gated k^+ channels are little slow to close → so alittle bit more k^+ than usual are able to leak out and make the cell alittle more negative and hyperpolarize.

but -90mv will tern to -70mv by three things

① Na^+-k^+ ATPase
leaky k^+ channels
Na^+ leaky channels



Absolute refractory period → is the period while the Na^+ gated channels can't be activated anymore because the inactivation gate is close and it won't be able to open unless in the it back to resting PM.

the relatively refracted period :-

the period of time from you hyperpolirize the cell until it goes back to resting potential

↓

where you can't give a stimulus

دعوة حلوة من الناس الحلوة
☘️☘️

Done by Tala Alali