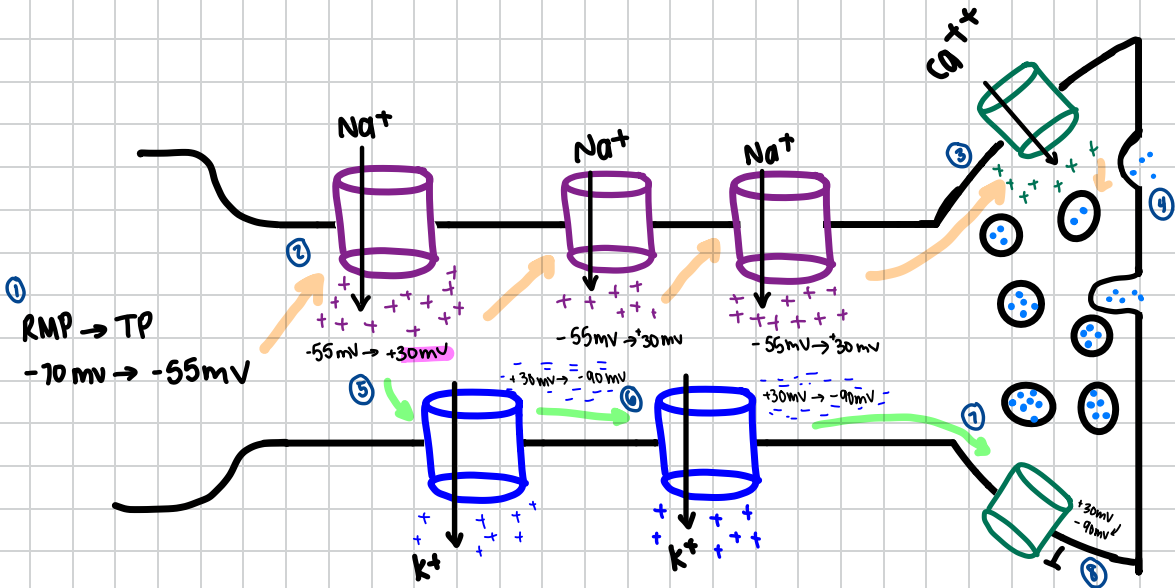
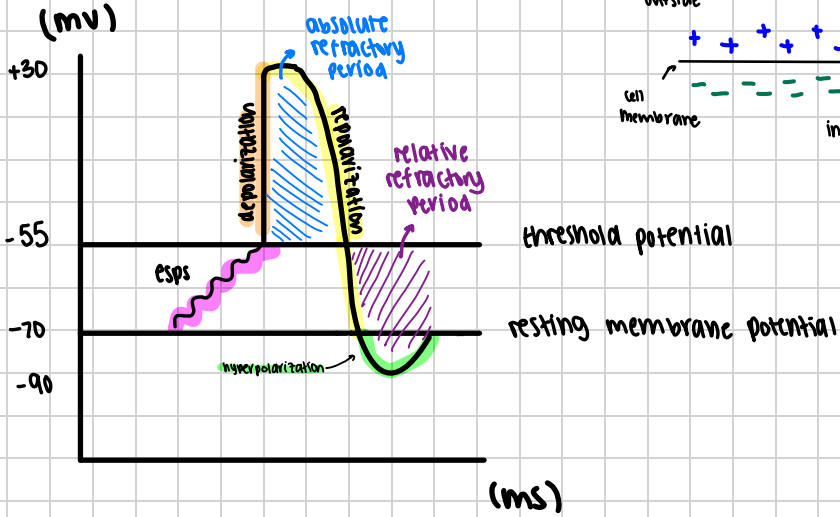


L4 (2/2) - Action Potential

• **action potential**: when membrane potential of a specific cell rises & falls rapidly



• steps:

1) depolarization

make less polar OR less negative

- ① The threshold potential is reached (due to stimulus), which triggers the opening of the sodium channel (-55mv)
- ② The opening of the sodium channel allows for sodium ions to rush into the cell, carrying w/ them positive ions, which causes the voltage to change: $-55 \rightarrow +30\text{mv}$
less -ive, depolarization
 - At +30mv, the channel closes $\frac{1}{2}$ no more Na^+ can pass through.
 - Na^+ causes threshold to be reached at the next Na^+ channel all the way down the axon
- ③ voltage-gated calcium channel is activated because +30mv was reached
 - Ca^{++} rushes in the cell
 - Ca^{++} binds synaptic vesicles $\frac{1}{2}$ proteins
- ④ synaptic vesicles fuse w/ cell membrane $\frac{1}{2}$ releases neurotransmitters

2) repolarization:

make polar OR more negative

- ⑤ +30mv of step 2 activates a potassium channel, which allows for K^+ to move outside the cell $+30\text{mv} \rightarrow -90\text{mv}$
- ⑥ next sodium channel at 30mv stimulates next potassium channel

⑦ voltage-gated calcium channel was at +30mV, but since potassium leak changed the voltage to -90mV

↓
• the calcium channel is inhibited

↓
• Ca^{++} can't move in the cell → no synaptic fuse → no neurotransmitter release

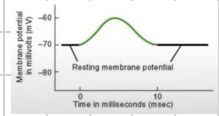
• hyper polarization

increase negative charge OR make more polar

• NOTES:

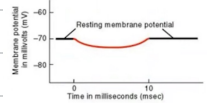
• > resting membrane potential = depolarization ↗

• < resting membrane potential = hyper polarization ↘



• voltage-gated channels: channels that open due to change in voltage

• nerve cells follow a "all-or-none" principle: there is no strong/weak signal. Only "there is/it a signal" which depends on if the threshold potential is reached



• refractory periods-

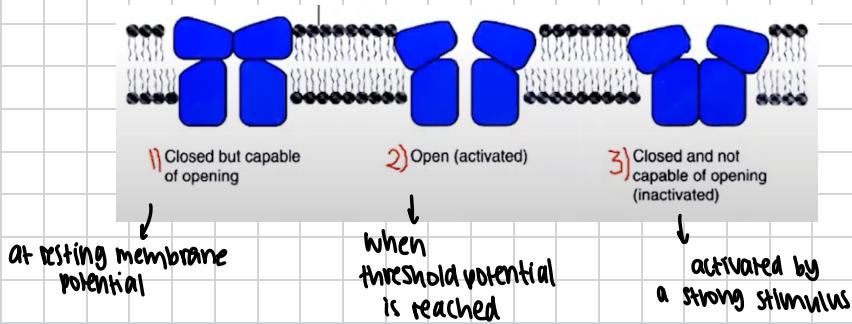
Absolute refractory period

- A period of time at which a membrane cannot generate a new action potential even when there is a large or a small stimulus.
- This period starts after the threshold to the end of first third of falling (repolarization) phase.
- no new action potential can be generated because the sodium channels are already in the opened state in this period, so a stimulus would NOT change anything.

Relative refractory period

- A period of time at which a membrane cannot generate a new action potential when there is a small stimulus BUT if there is a large stimulus (suprathreshold), a new action potential would be generated.
- This period starts after the Absolute refractory period and ends when the resting membrane potential is achieved.
- The sodium channels are in the closed and incapable of opening stage but a strong stimulus (suprathreshold) may activate these channels.

• types of channels :



كلمات خفيفتان على اللسان، ثقيلتان في الميزان، حبيبتان إلى الرحمن: سبحان
الله وبحمده، سبحان الله العظيم