MSS physiology

Cell Membrane ⇒ Phospholipid bilayer

Prevents entry of substances unless Lipophilic

Substances are found in ECF & ICF, but in diff distribution

Extracellular	Na^+	Cl^-
Intracellular	K^+	PO_4^{3-} Proteins (-ve charged)

note: Extracellular charge = Intracellular charge

At peripheral of CM: ECM +ve charged, ICF -ve charged } net charge of CM ≠ 0

Ions travel in & out of CM by special ion channels NOT through CM

Factors affecting movement of ions :

Concentration Gradient (unequal distribution of ions across CM)

Charge

Permeability of Membrane

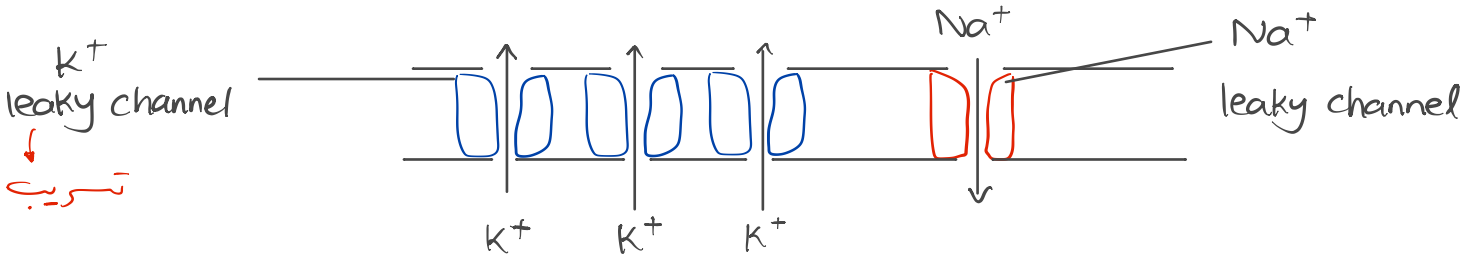
	Extracellular conc.	Intracellular conc.	Relative Permeability
Na^+	150	15	1
K^+	5	150	25-30 ↗ main factor in determining RMP
A^-	0	65	0

A^- -vely charged protein

RMP ⇒ difference between EC and IC potential at membrane

w/either:

* no Stimulus
* Weak Stimulus ⇒ causes graded potential



How is RMP maintained ?

① # of K^+ leaky channels much higher than # of Na^+ leaky channels ⇒ K^+ leaves cell by diffusion
Na^+ tries to compensate, but Na^+ does not enter cell enough (due to lower # of leaky Na^+ channels) ⇒ Overall -ve charge

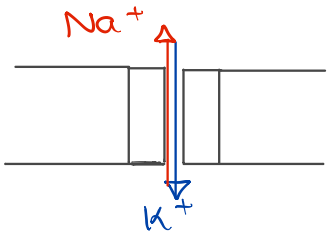
② A^- permeability = 0 : -vely charged proteins cannot leave Stay inside

③ Sodium - Potassium ATP pump : 3 Na^+ out, 2 K^+ in
ATP pump (against concentration gradient)

Nernst - Equation : Reason why RMP is always -ve

Goldmann Equation : Considering K^+ (no other ions)

ATPase Pump :



3 Na^+ out

2 K^+ in

net export of -ve charge

Excitable Cells : Neurons + Muscle fibres

Neuron ⟶ Neuron

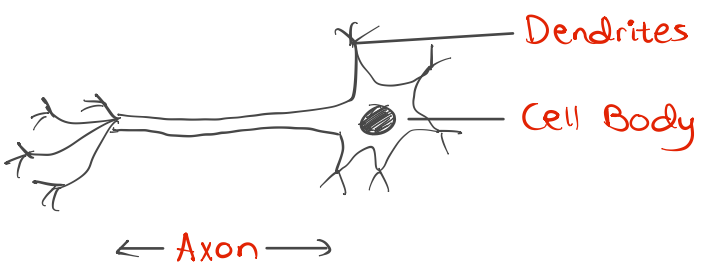
Neuron ⟶ Muscle fibre

Muscle fibre ⟶ Muscle organ

Ligand - gated Channel : Ligand binds to receptor

Mechanical channels : force, pressure etc.

Voltage - gated Channels : Difference in Polarity of membrane



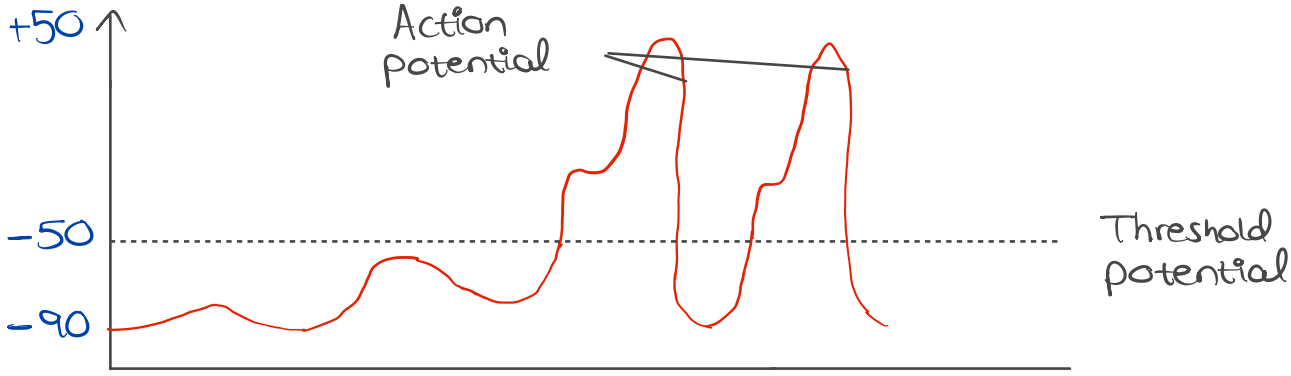
graded potential

(−90 → −80/−70)

lack of voltage gated channel

Many Voltage gated Na^+ channels

∴ Influx of Na^+



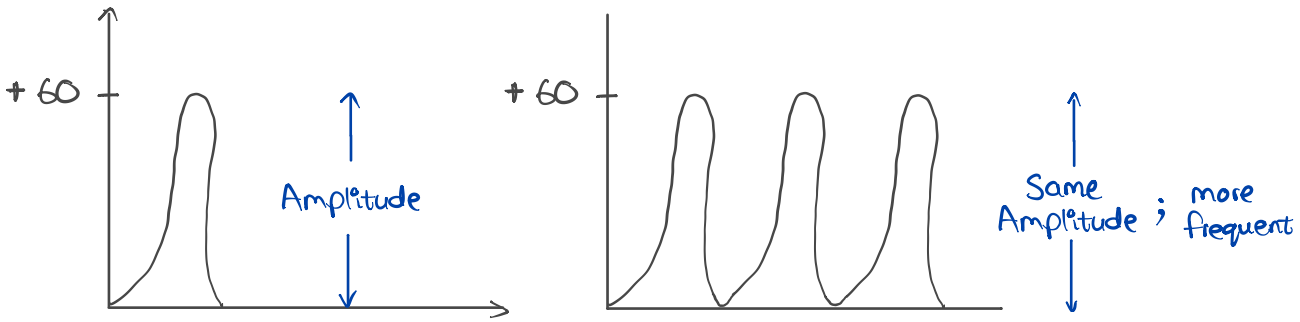
Graded potential ⇒ Slight changes in −80/−90 (RMP)

not enough to reach Action Potential

when? when we cross threshold potential

If threshold potential not reached ⇒ no Action Potential

If Stimulus becomes Stronger ⇒ Amplitude of Action Potential does not change, but frequency ↑↑↑



Graded Potentials experience Summation

A + B ⟶ C

weak potential + weak potential

Stronger potential than A + B combined

If Summation is enough to cross Threshold

⇒ Action Potential ✓

" not enough to cross threshold

⇒ Action Potential ✗

Action Potential : Voltage-gated Na^+ channel

& Voltage gated K^+ channel

Voltage-gated Na^+ channel ⇒ Has Activation & deactivation gate

Depolarization

Voltage-gated Na^+ channels open by opening Activation gate ⇒ Na^+ channel opens, Na^+ enters

Repolarization

Voltage-gated Na^+ channels close by closing inactivation gate ⇒ Na^+ channel closes ⇒ Na^+ does not enter

K^+ channels open, K^+ leaves cell

Hyperpolarization

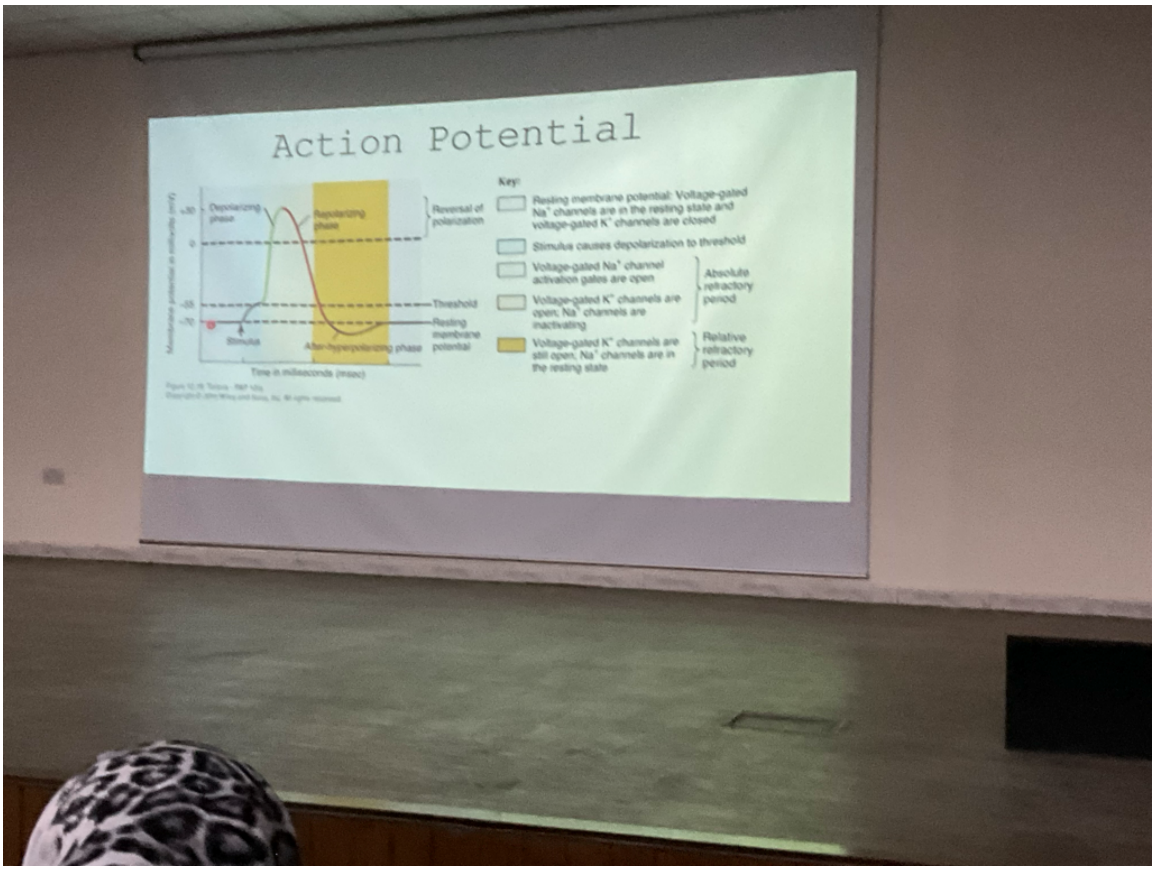
K^+ channels are slow-closing; K^+ leaves cell more than normal; more -ve

All-Or-Nothing : Action Potential either occurs or does not

Graded Potentials do not experience

Graded potential vs Action potential

CHARACTERISTIC	GRADED POTENTIALS	ACTION POTENTIALS
Origin	Arise mainly in dendrites and cell body.	Arise at trigger zones and propagate along axon.
Types of channels	Ligand-gated or mechanically-gated ion channels.	Voltage-gated channels for Na^+ and K^+.
Conduction	Decremental (not propagated); permit communication over short distances.	Propagate and thus permit communication over longer distances.
Amplitude (size)	Depending on strength of stimulus, varies from less than 1 mV to more than 50 mV.	All or none; typically about 100 mV.
Duration	Typically longer, ranging from several milliseconds to several minutes.	Shorter, ranging from 0.5 to 2 msec.
Polarity	May be hyperpolarizing (inhibitory to generation of action potential) or depolarizing (excitatory to generation of action potential).	Always consist of depolarizing phase followed by repolarizing phase and return to resting membrane potential.
Refractory period	Not present; summation can occur.	Present; summation cannot occur.



Relative Refractory period: Period in which a response may be achieved if a strong enough stimulus (stronger than initial) is used

Absolute Refractory period: Period in which no response is shown (no Na^+ channels open if a stimulus is used) no matter how strong stimulus is