« Study material notes »

→ important laws

* Ficks' law of diffusion :

• $J = P \cdot \Delta C$ → rate of diffusion

P: Permeability , ΔC : concentration gradient

Factors affect the (J)
P , A , ΔC , ΔX

• $P = \frac{D \cdot A}{\Delta X}$

A: surface area
ΔX : membrane thickness
D: diffusion coefficient

When you feel my heat look into my eyes

* other influencers :

→ membrane electrical potential → mainly affects charged particles (ions)

→ effect of pressure → in one compartement : higher pressure causes higher kinetic energy causes higher J .

high pressure side to→ low pressure side

carriers → facilitated diffusion

channels → simple diffusion

*** Van't Hoffs law :

$$\pi = RTC$$

R: gas constant

T: absolute temprature

C: concentration

π: osmotic pressure

molar concentration

$$C = \frac{m}{Mm * L}$$

m → mass / Mm: molar mass

L → volume

$\frac{m}{Mm}$ → moles (n) → this is called **osmole**

for example :

if we have a material that it's molecular weight = it's mass then we have **1 osmole**

وفي حال كان مركّب بحامل كل ايون او عنصر لحال ، مثلاً :

NaCl in water , if we have (58.8 g) which is = to it's (MW)

then we have 1 gram molecular weight of Na & 1 gram molecular weight of Cl then we have 2 osmoles

important notes

1- high osmolarity → hypertonic solution

2- low osmolarity → hypotonic solution

3- same osmolarity as our blood's → isotonic solution (normal)

(280 milli osmole/kg) & (300 milli osmole/L)

osmolarity = concentration (Molar) * (number of ions) or moles

Molarity (M) = $\frac{\text{Osmolarity (Osm/L)}}{\text{\# of particles per formula unit}}$

* important (from the doc's handout) *

H+ pump: Some cells are specialized in expelling H+, such as parietal cells of gastric mucosa, intercalated cells of the distal tubules and cortical collecting ducts in the kidney. The presence of H+ pumps at the lumenal side of plasma membrane in the gastric mucosa is responsible for decreasing the pH of gastric juice. While H+ of the lower parts of the nephron are responsible for controlling H+ concentration in the body.

*** important:

how many particles does the solution have.

Solution	its "osmolarity"
Isotonic	same as plasma same as blood
hypertonic	higher than plasma higher than blood
hypotonic	lower than Plasma lower than blood

lec 4

* **Nernest equation:**

can be applied for membranes that are permeable for only one ion (to calculate potential)

$$E = \frac{RT}{ZF} * \ln \frac{[C]_{out}}{[C]_{in}}$$

out: outside cell
in: inside cell

$$V = 2.3 \frac{RT}{ZF} \log \frac{[C]_{out}}{[C]_{in}}$$

R: gas constant
Z: Valence electrons
T: temprature
F: Faraday's constant
(E): equilibrium

$$\frac{RT}{F} = 61.54$$

so: $V = \frac{61.54}{z} \log \frac{[C]_{out}}{[C]_{in}}$

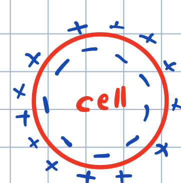
Nernest equation: $E\,(mV) = -61 \cdot \log\,(C_i / C_o)$

C_i: concetration inside the cell
C_o: concentration outside the cell

* memorize:

Ion	Extracellular (mM)	Intracellular (mM)	Nernst potential (mV) + → positive inside in comparison to the outside. - → negative inside in comparison to the outside.
Na^+	145	15	60
Cl^-	100	5	-80
K^+	4.5	160	-95
Ca^{+2}	1.8	10^{-4}	130

high permeability for K^+ & low permeability for Na^+



For our cells we use:

Goldman Hodgkin Katz Equation

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

P: Permeability of the membrane to that ion.

*** another law

Cord Conductance eqn of plasma membrane

Ohm's law

- I = ΔV/R
- G (conductance)= 1/R
- I = G. ΔV

When we talked about the permeability of particles, we used Fick's law but here we're talking about ions, so we'll use electrical terms.

I: Current.

V: The voltage difference across the plasma membrane (**the driving force that moves ions**).

R: Resistance across the plasma membrane.

G: Conductance; how that membrane conducts or lets a specific ion move through it.

* * *

- Also, we can measure the whole membrane voltage according to its conductivity for different ions.

It can be calculated by this equation:

The cord Conductance equation describes the contributions of permeant ions to the resting membrane potential

G: Conductance for the ion

G_{tot}: Total conductances

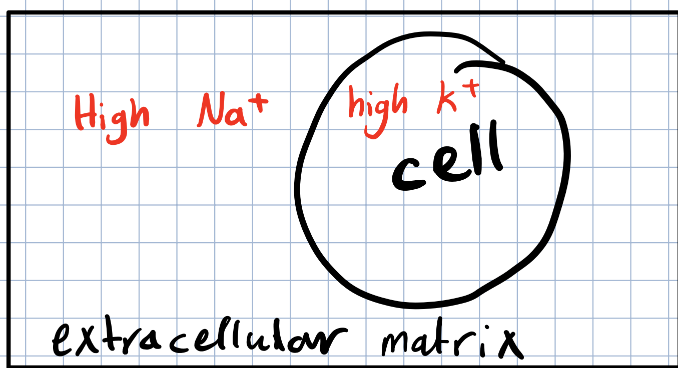
E: Equilibrium potential.

$$V_m = \frac{g_K}{g_{tot}} E_K + \frac{g_{Na}}{g_{tot}} E_{Na} + \frac{g_{Cl}}{g_{tot}} E_{Cl}$$

Patch clamp technique : the technique by which we can measure the currency of different ions.

polarized state = resting state

#no-channels-are-open



more negative potential : Hyper polarization (repolarizing)
by activating (k^+) channells

less negative potential : Depolarization
by activating (Na^+) channels

* the potential equilibrium for sodium is +61 at this potential the Na^+ channels will close & k^+ channels will open.