no. 5

Physiology

Doctor 2019 | Medicine | JU

◉ Sheet ○ Slides

Done By

Heba Al-hyasat

Contributed in the Scientific Correction

Elaf Al-sqoor

Contributed in the Grammatical Correction

Elaf Al-sqoor

Doctor

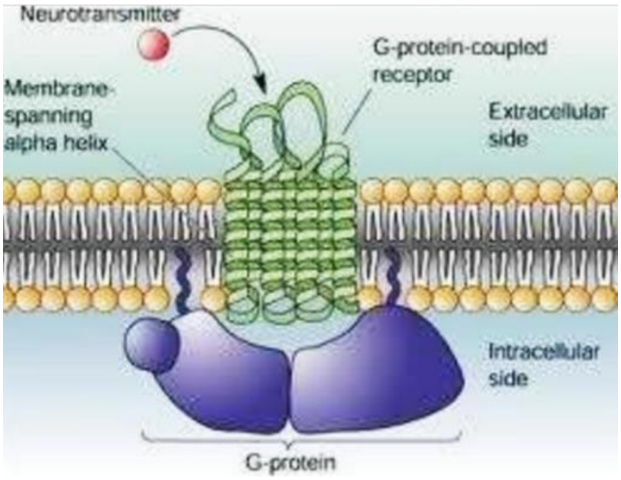
Mohammad Khatatbeh

The process of transport substances across the plasma membrane is highly regulated by many aspects , we will discuss some of them ….

1-G-protein and signal transduction :-

A-It is named G-Protein because it is assuming GTP rather than ATP .

B- It is made up of 3 subunits (α, β andϒ).

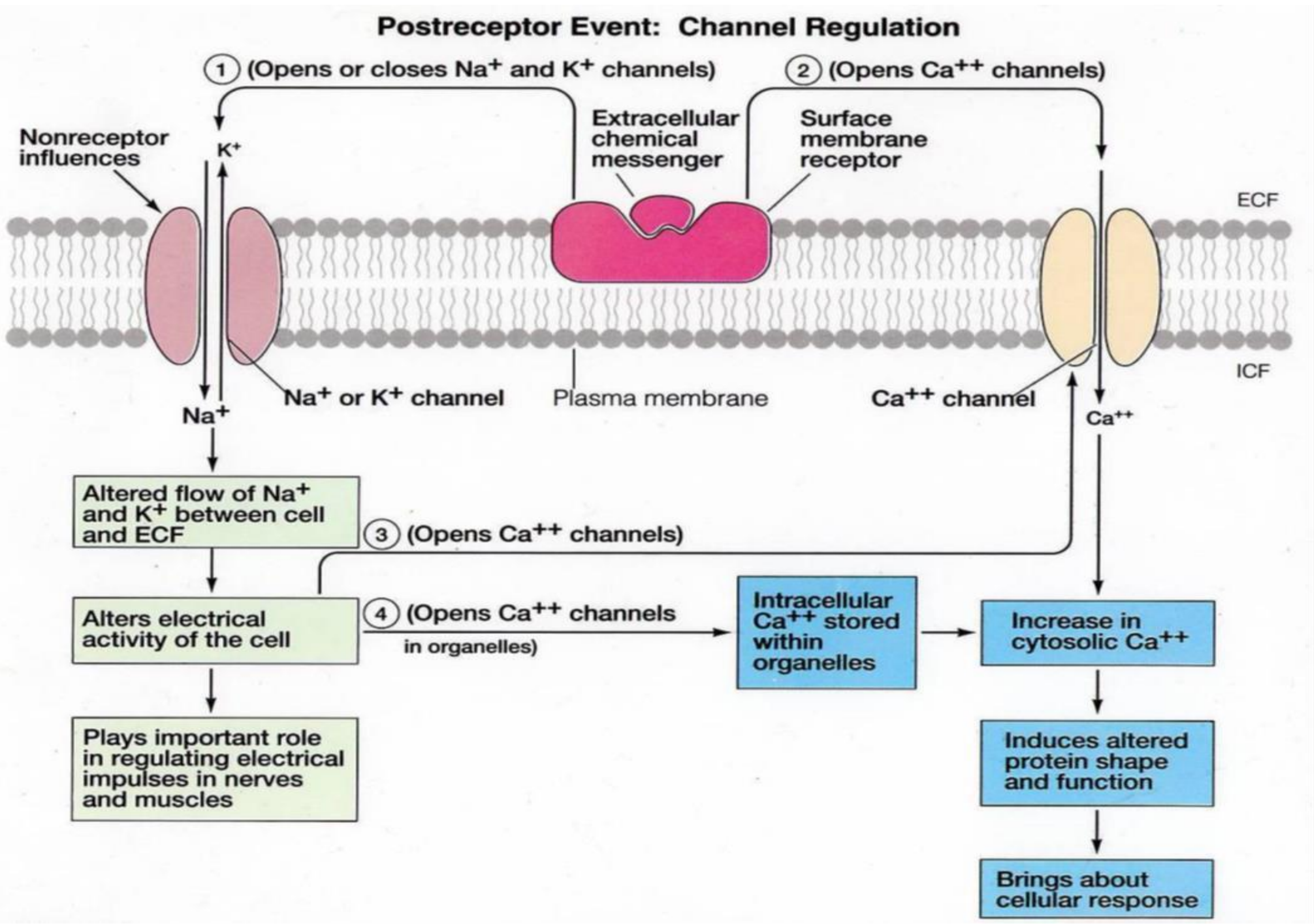


Mechanisms (not important …we will talk about it in details later)

When a ligand binds to a G-protein receptor , then G- protein separates into pieces ,after that the α subunit interacts with other proteins (channels or enzymes)to activate it

Note : activating a channel means opening it

The main purpose is to understand that we can change permeability across membrane for specific ions , by receptors that bind to a channel (e.g: Na+ or k+ channels).



G-proteins can regulated :

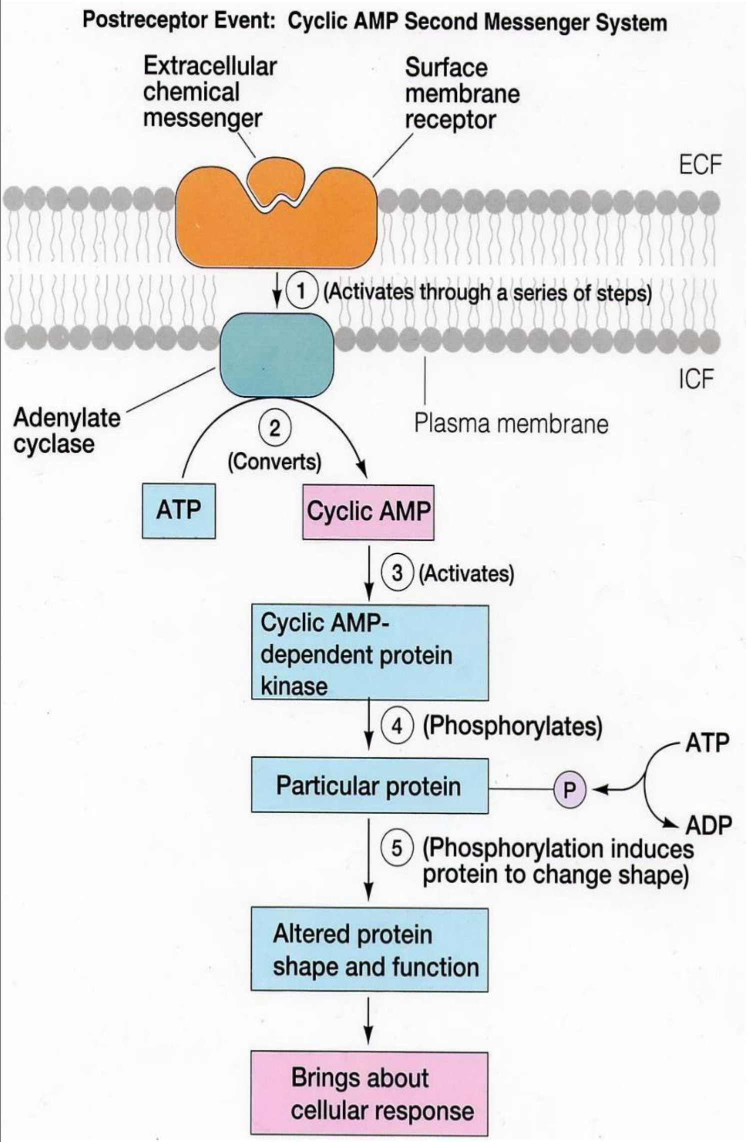
Adenylyl cyclase

Converts ATP to cyclic AMP

Cyclic AMP activation Protein Kinase

Kinase means Phosphorylation

for many proteins.



PL-C

Phospholipase -C

splitting membrane phospholipids into:-

DAG	IP3
Diacylglycerol	Inositol triphosphate

How IP3 play its role in transporting ions?

1-IP3 binds to a receptor at ER .

2-That receptor linked to Ca+2 channel.

3-Ca+2 channel become activation , so more calcium ions can diffuse through open channels from inside to the cytosol.

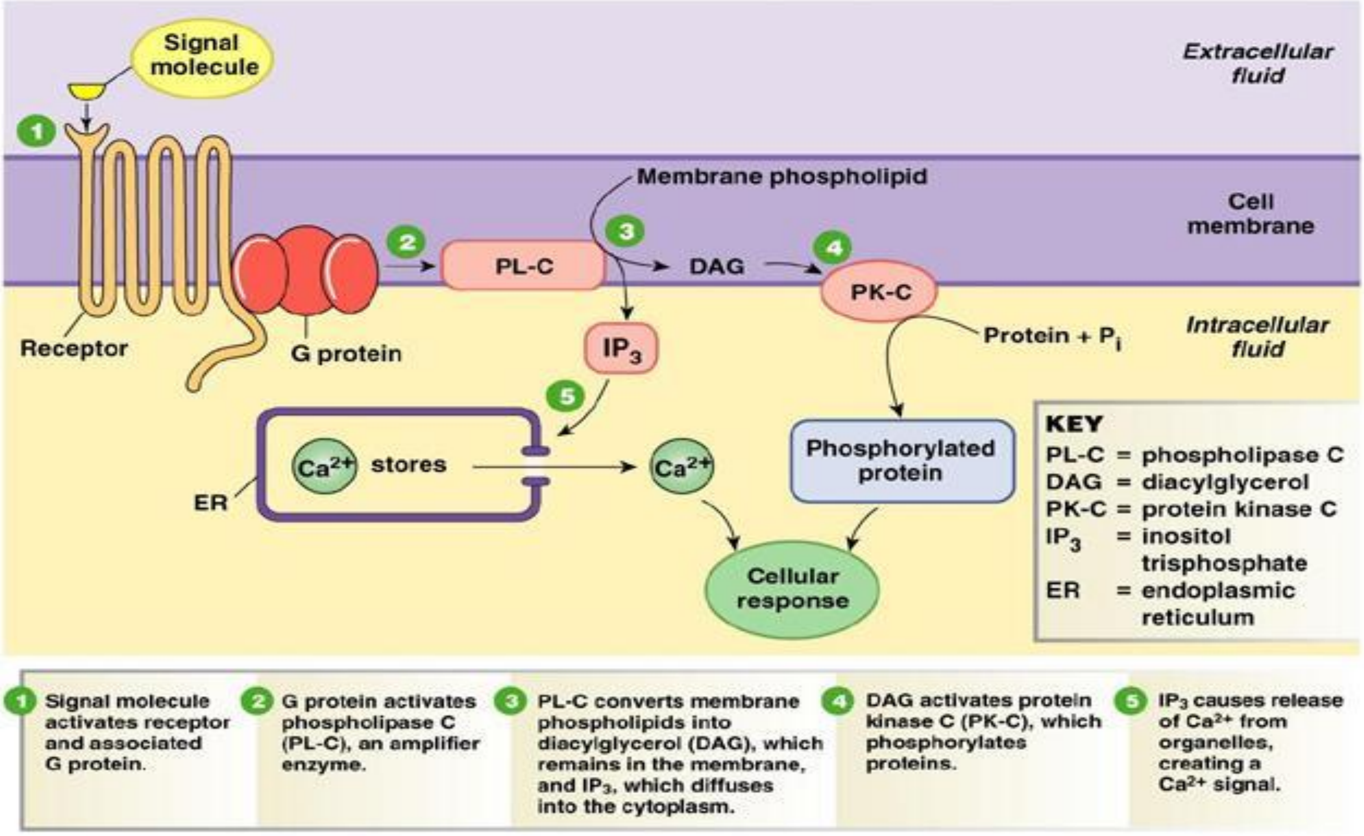
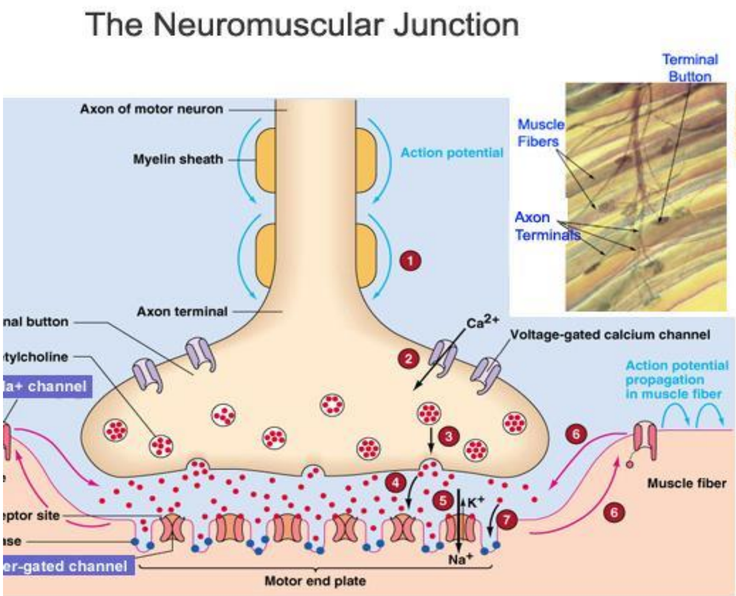


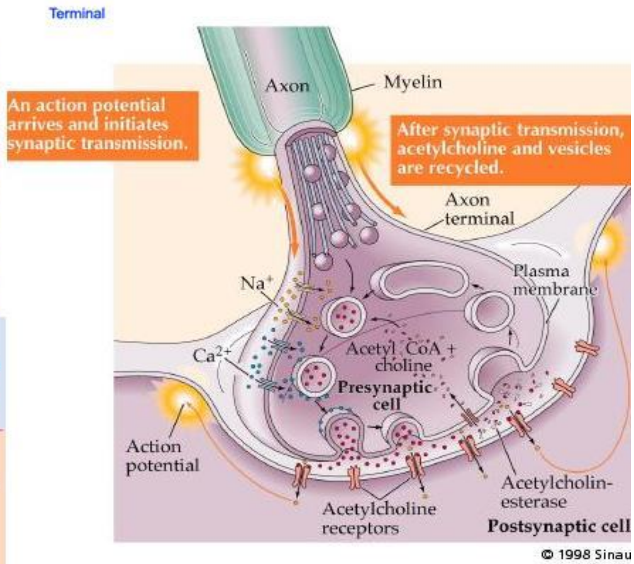
Fig. 6-12

<u>Vesicular transport (specifically exocytosis):</u>

Assuming that the vesicles and the axon membrane are both negative; repulsion will occur, but as the Ca+2 concentration increases inside , then the repulsion will decrease and more exocytosis, because vesicles will dock and diffusion on the plasma membrane.

NOTE : this is a summary of that techniques , but it is actually highly regulated process we will talk about its details later on .





What do we mean by excitable tissue ?

the ability to generate membrane potentials (voltages). e.g: neurons, muscle cells.

""To Understand Only""…

Assuming that we have only K+1 inside and only Na+1 outside , and imagine that the membrane is permeable only for K+1 , What will happen ?

K+1 will move from inside to outside until getting equilibrium (same concentration) and that will create a membrane potential across membrane which will be negative charge inside and positive charge outside .

This potential is preventing K+1 to move from inside to outside ,now we reaching that we will called **electrochemical equilibrium**.

**imagine the same condition , but assuming that membrane is permeable only for Na+1 …. The sodium ions will move from outside to inside and create a membrane potential across membrane which will be positive charge inside and preventing Na+1 to move ,also we now reaching electrochemical equilibrium .

So, we need 2 forces to reach equilibrium :-

1-concentartion gradient (chemical force)

2-electical force

electrochemical equilibrium

$$\Delta G_{conc} + \Delta G_{volt} = 0$$

$$zFV - RT \ln \frac{C_o}{C_i} = 0$$

$$V = \frac{RT}{zF} \ln \frac{C_o}{C_i} = 2.3 \frac{RT}{zF} \log_{10} \frac{C_o}{C_i}$$

We can measure the membrane potential by place two electrodes in the outer and inner surfaces of the plasma membrane .Also, we can calculate the equilibrium potential for only one ion using Nernst equation.

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

R (Gas Constant) = 8.314472 (J/K·mol)
T (Absolute Temperature) = t °C + 273.15 (°K)
Z (Valence)
F (Faraday's Constant) = 9.6485309×10^{4} (C/mol)
[C]out (Outside Concentration, mM)
[C]in (Inside Concentration, mM)

For example :

E (for Na+1) =+61 mV (means that it is positive inside with regard to outside)

E(for K+1) = - 84 mV (means that is negative inside with regard to outside)

Does our membrane of cell permeable only for one ion?

NO, so we have Goldman Hodgkin Katz equation for many ions on the cell membrane .

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

i = Conc. inside
O = Conc. outside
P = permeability of the membrane to that ion.

<u>The End</u>

Done by : Heba Al-hyasat & Elaf Al-sqoor