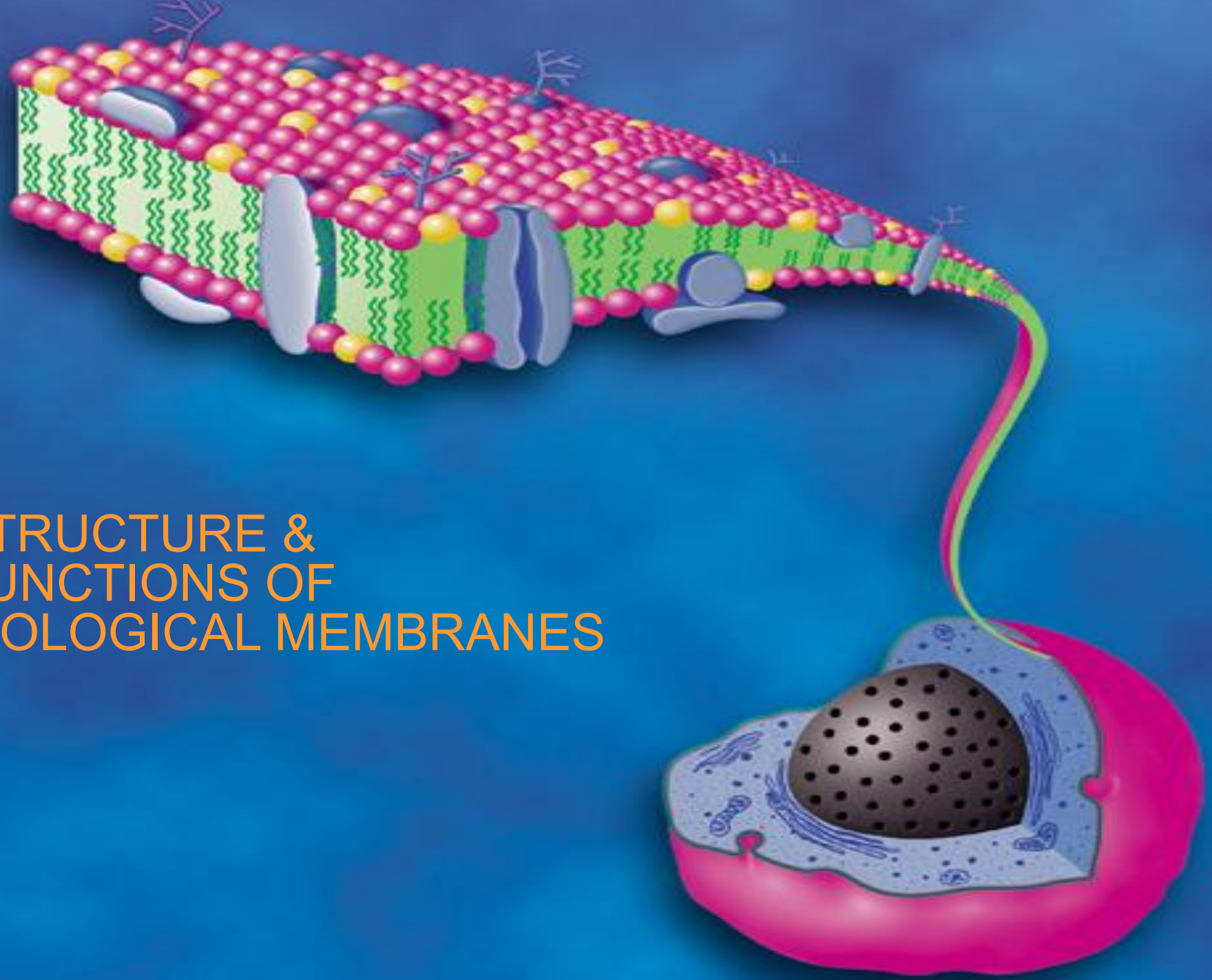
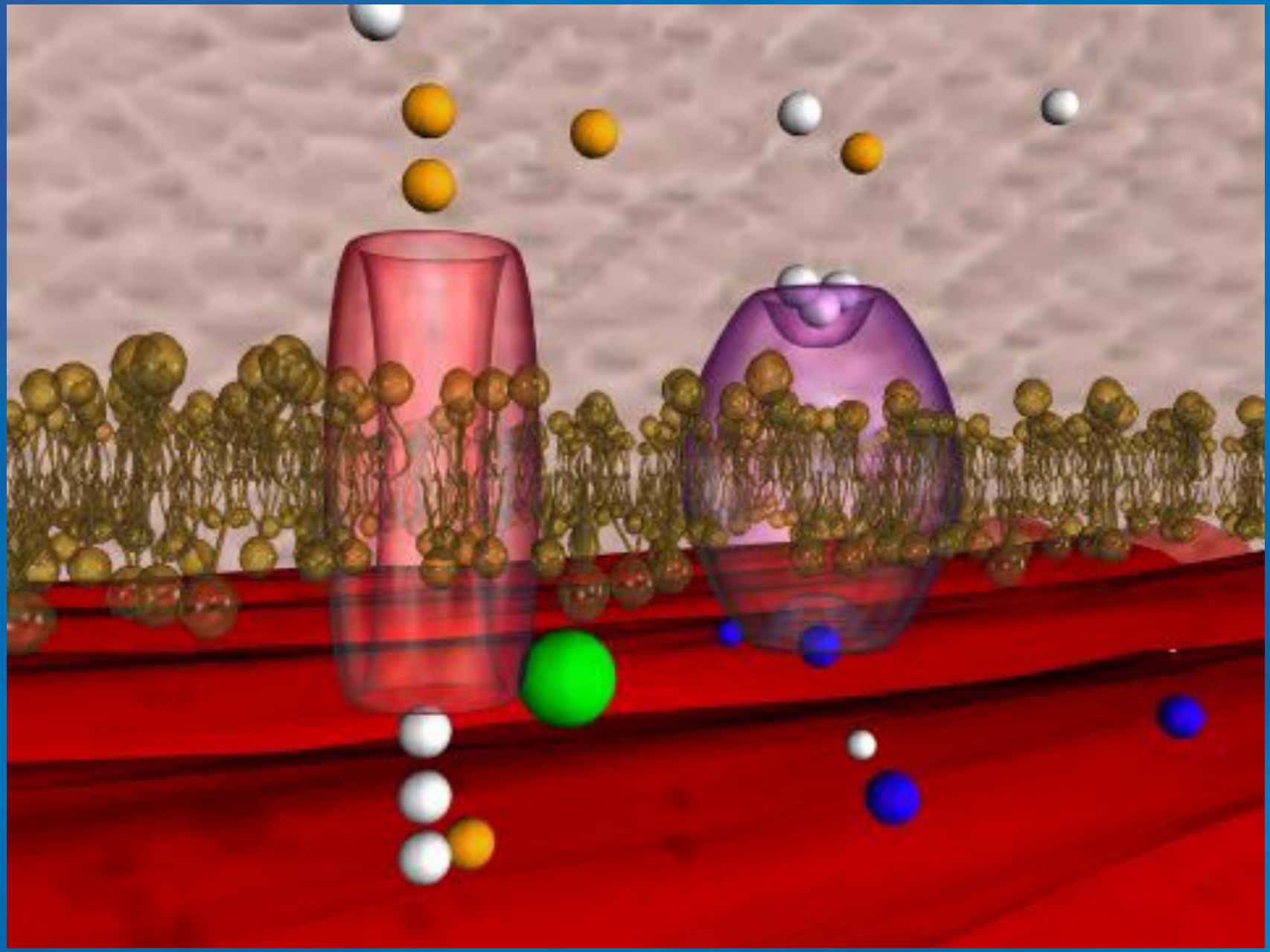
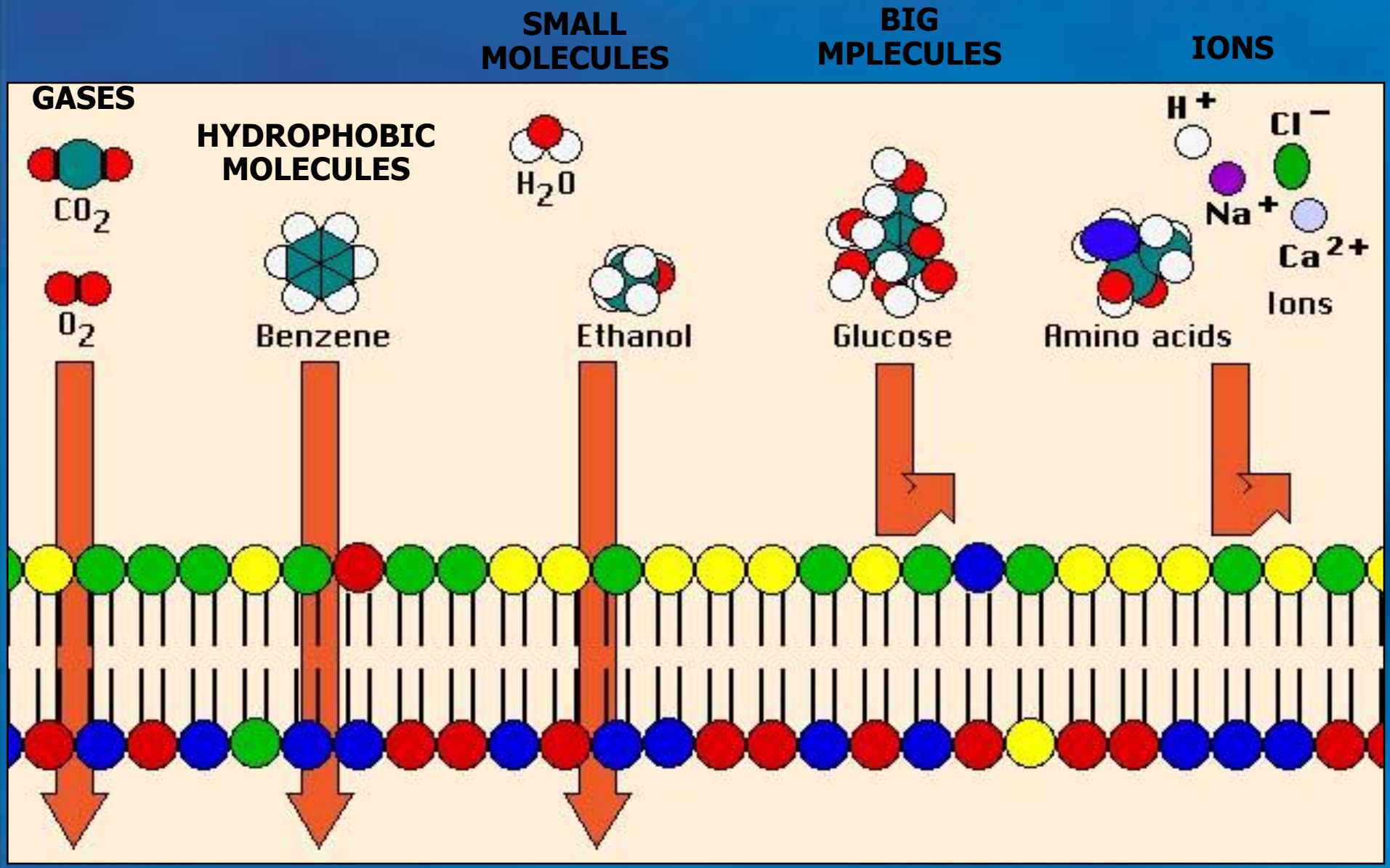
STRUCTURE & FUNCTIONS OF BIOLOGICAL MEMBRANES



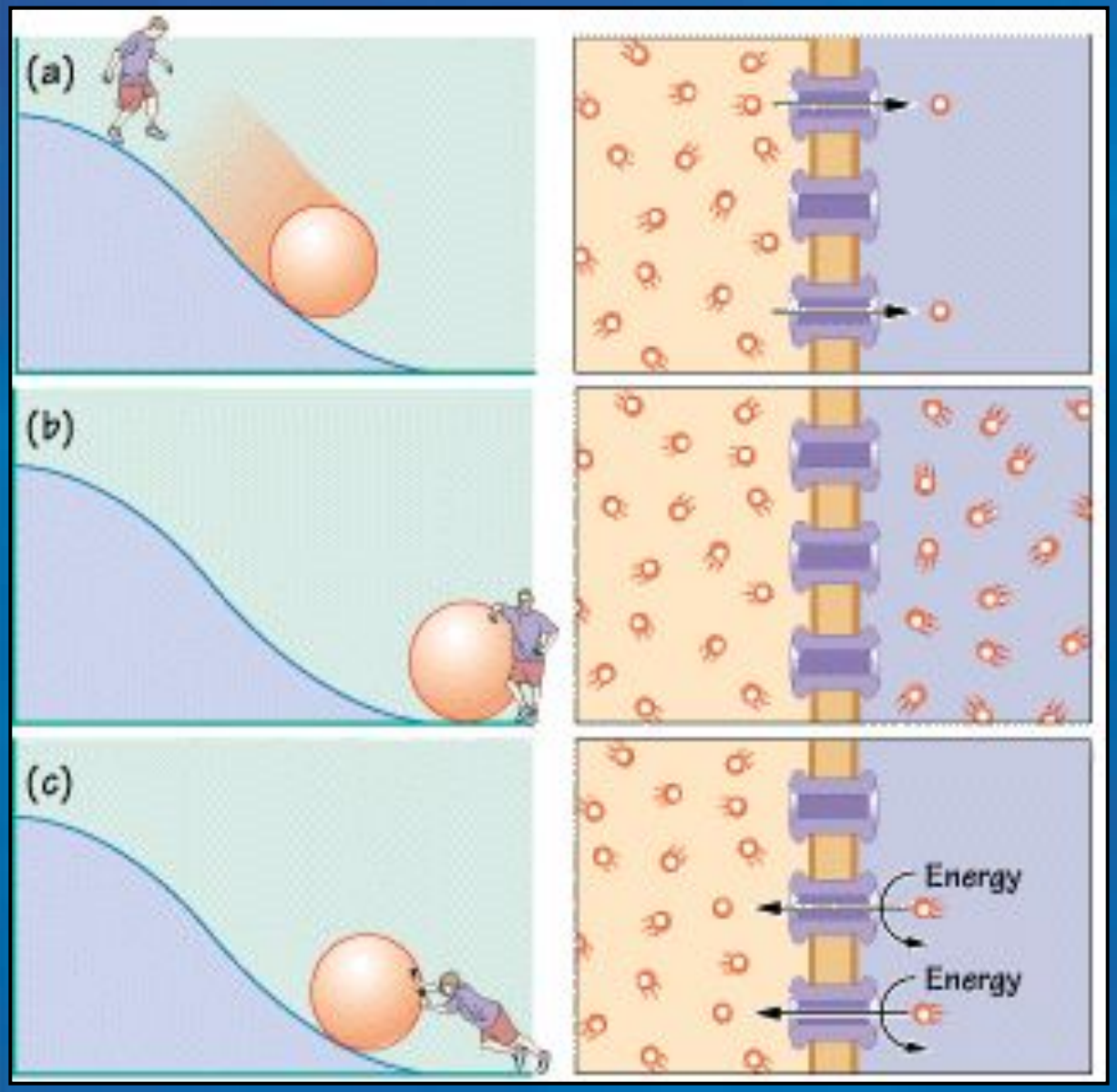
TRANSPORT FUNCTION



BILIPID LAYER PENETRABILITY



MEMBRANE TRANSPORT FUNCTION



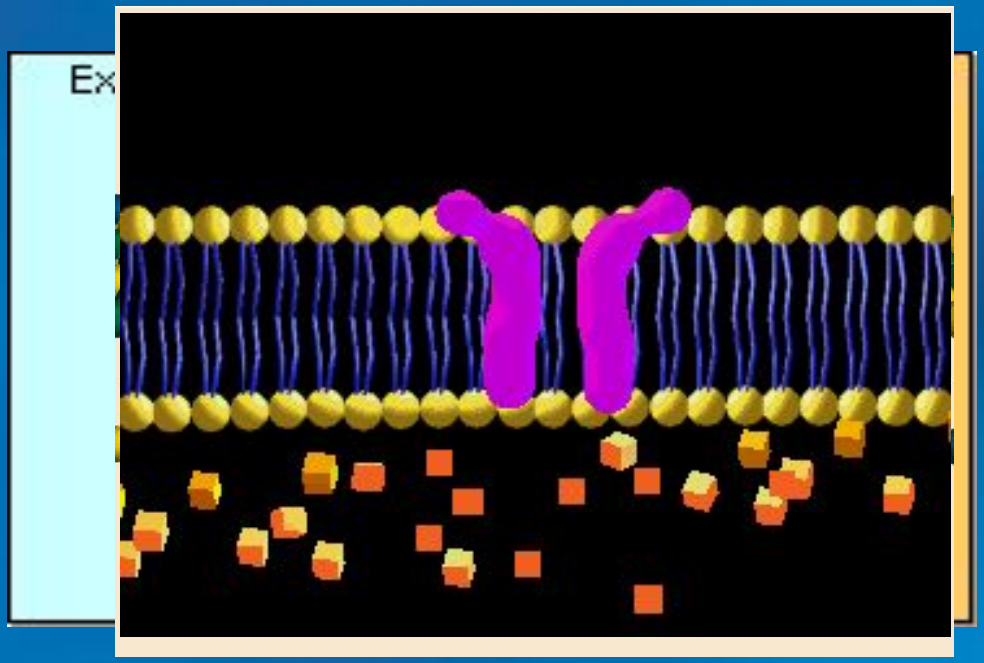
PASSIVE TRANSPORT

ACTIVE TRANSPORT

PASSIVE TRANSPORT

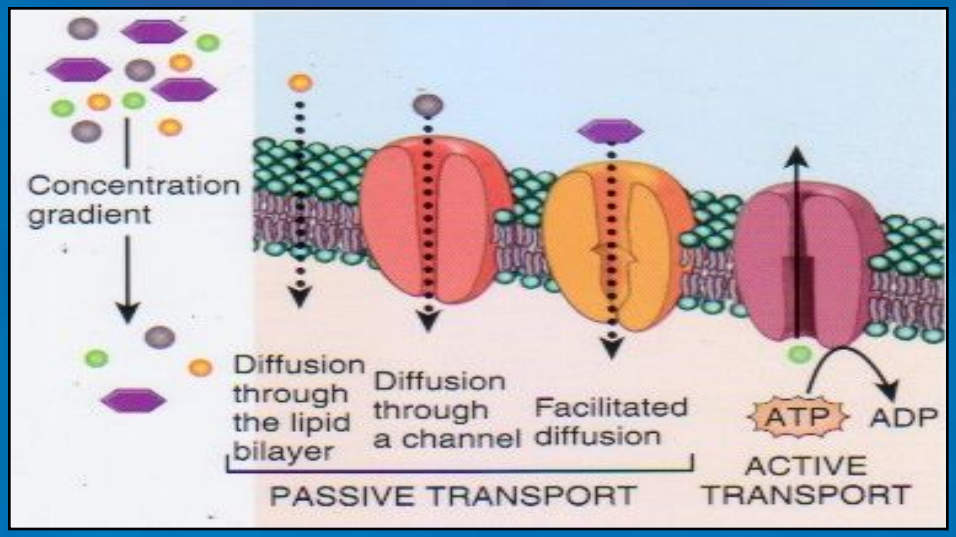
- Osmosis
- Simple diffusion
  - Through lipid bilayer
  - Through lipid bilayer pores
  - Through protein pores
- Facilitated diffusion
  - Nonfixed carrier
  - Fixed carrier
- Filtration

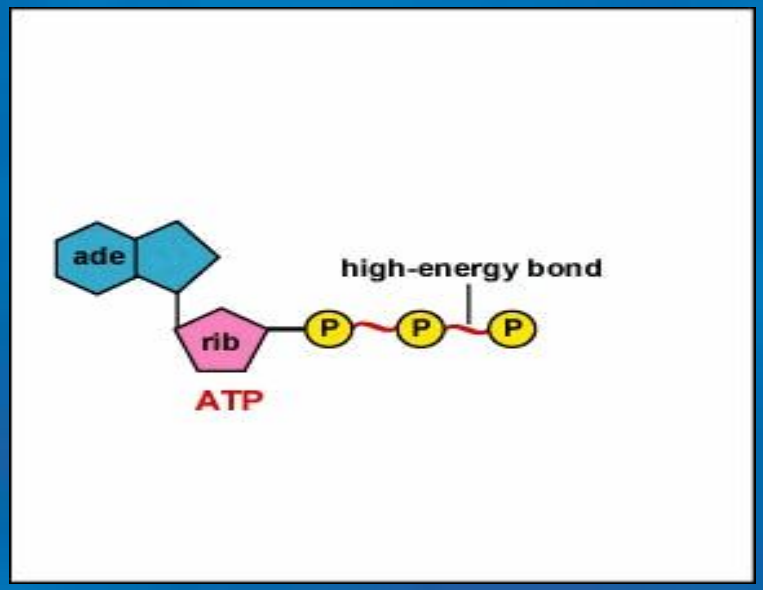
$$\frac{dm}{dt} = -D\frac{dc}{dx}S$$



ACTIVE TRANSPORT

- ION PUMPS
- SECONDARY ION TRANSPORT
- ENDOCYTOSIS
- EXOCYTOSIS



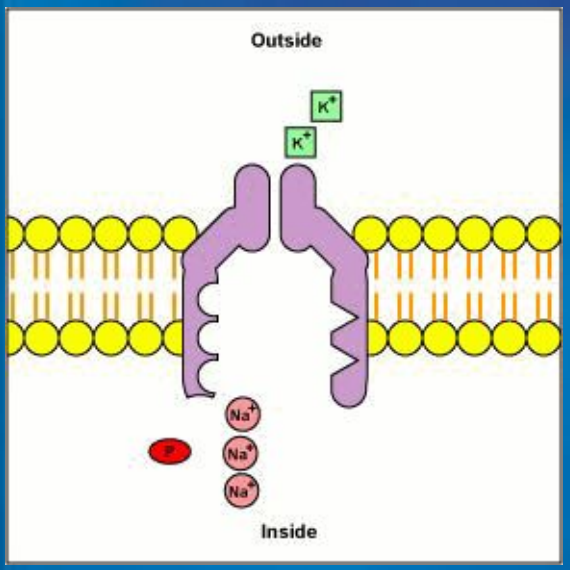


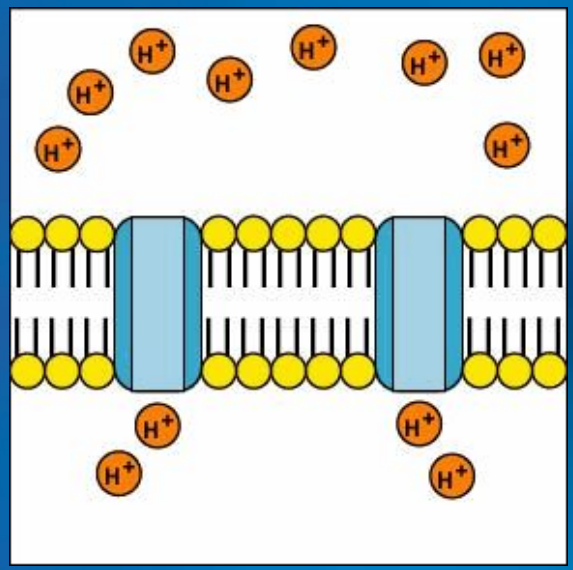
ION PUMPS

K^+-Na^+ pump

Ca^{2+} pump

H^+ or proton pump

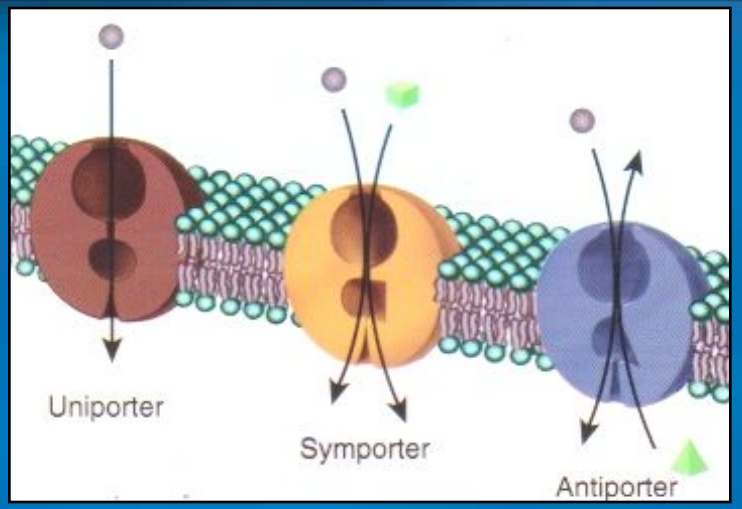


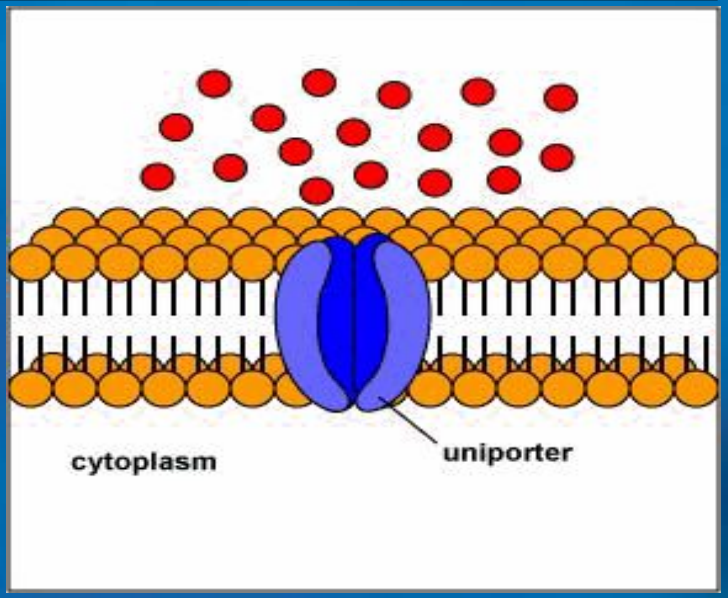


SODIUM-POTASSIUM PUMP

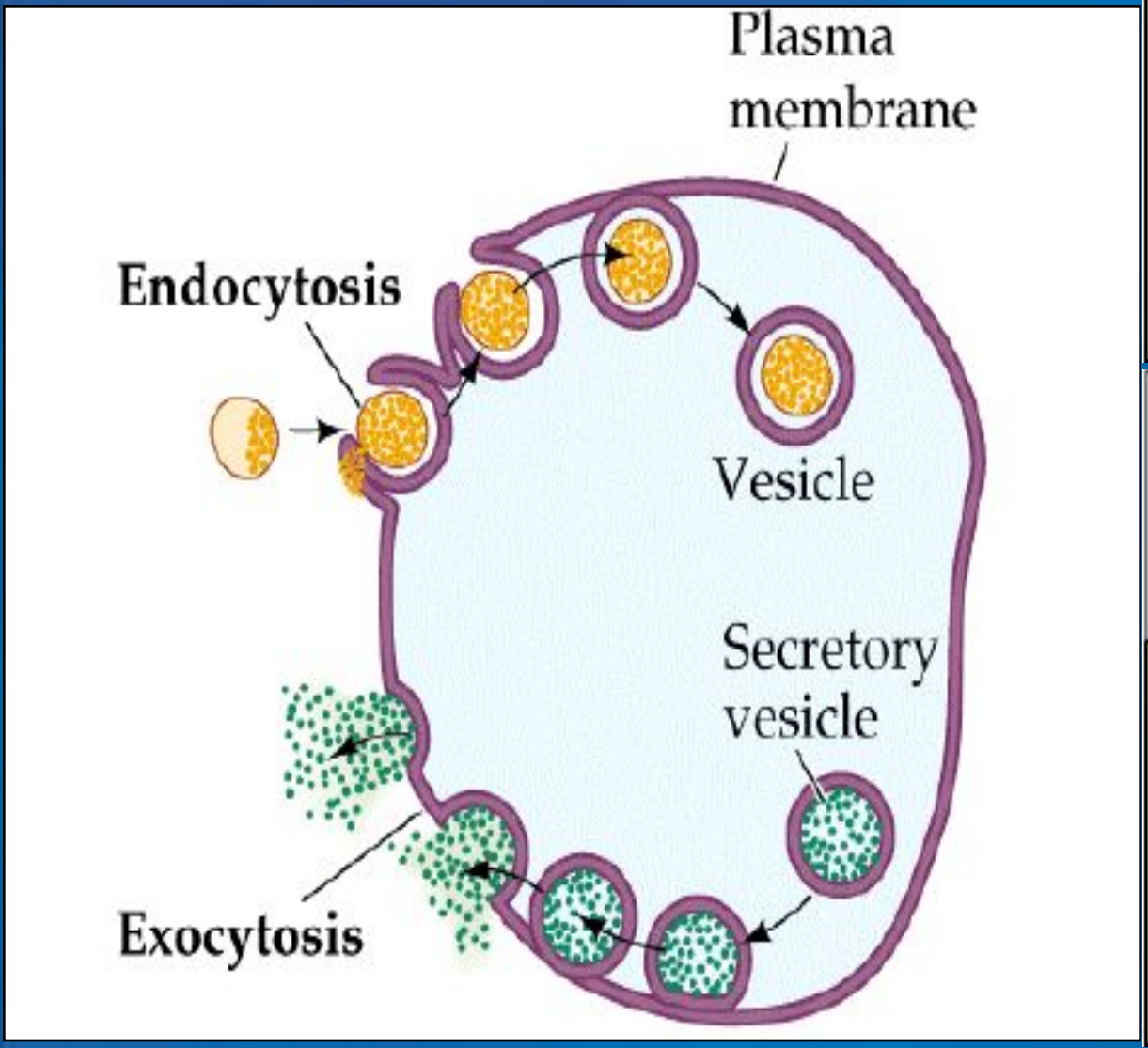
Secondary active transport

uniport simport antiport

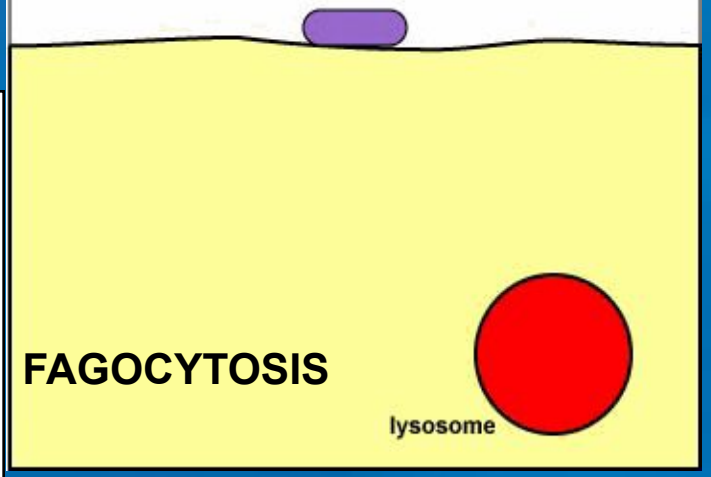


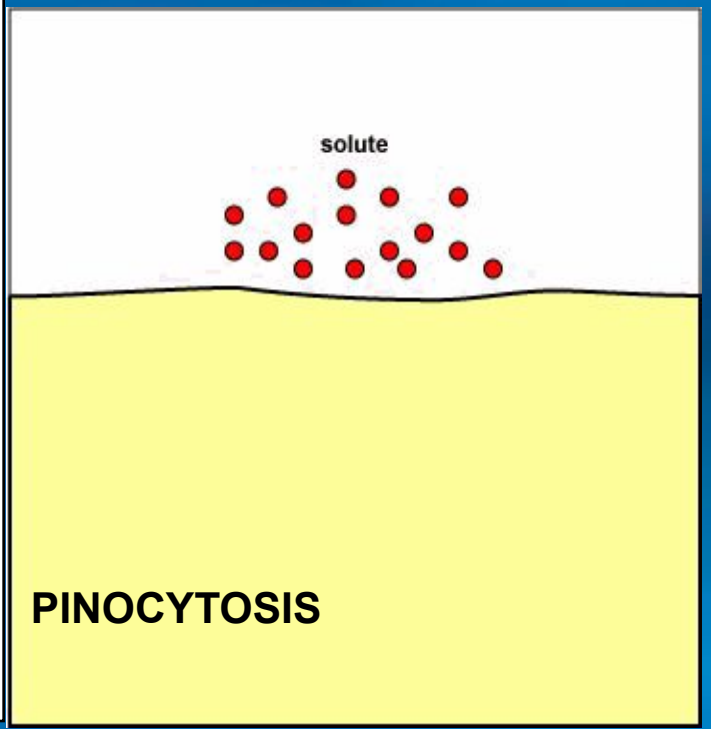


ENDO- & EXOCYTOSIS

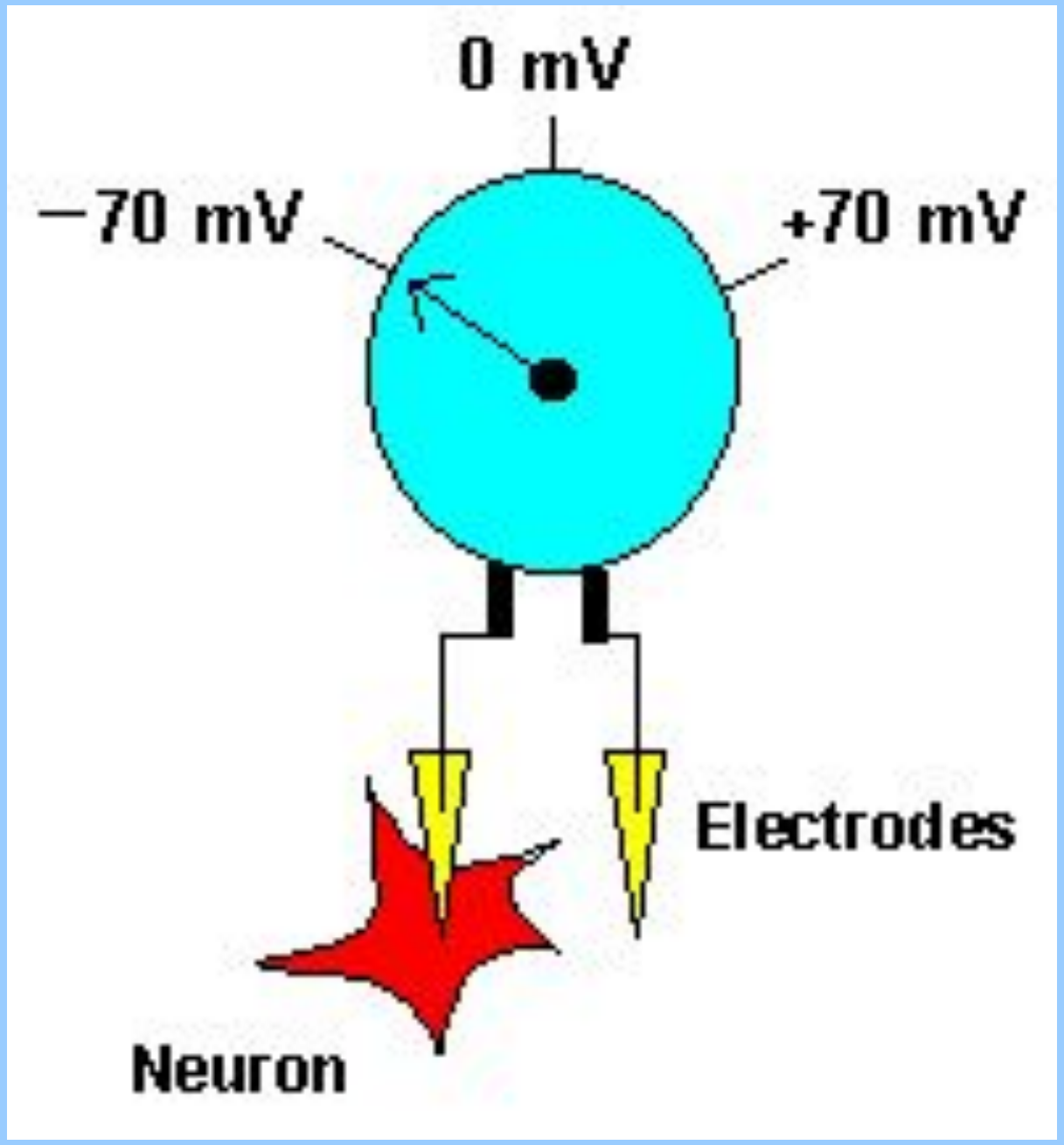


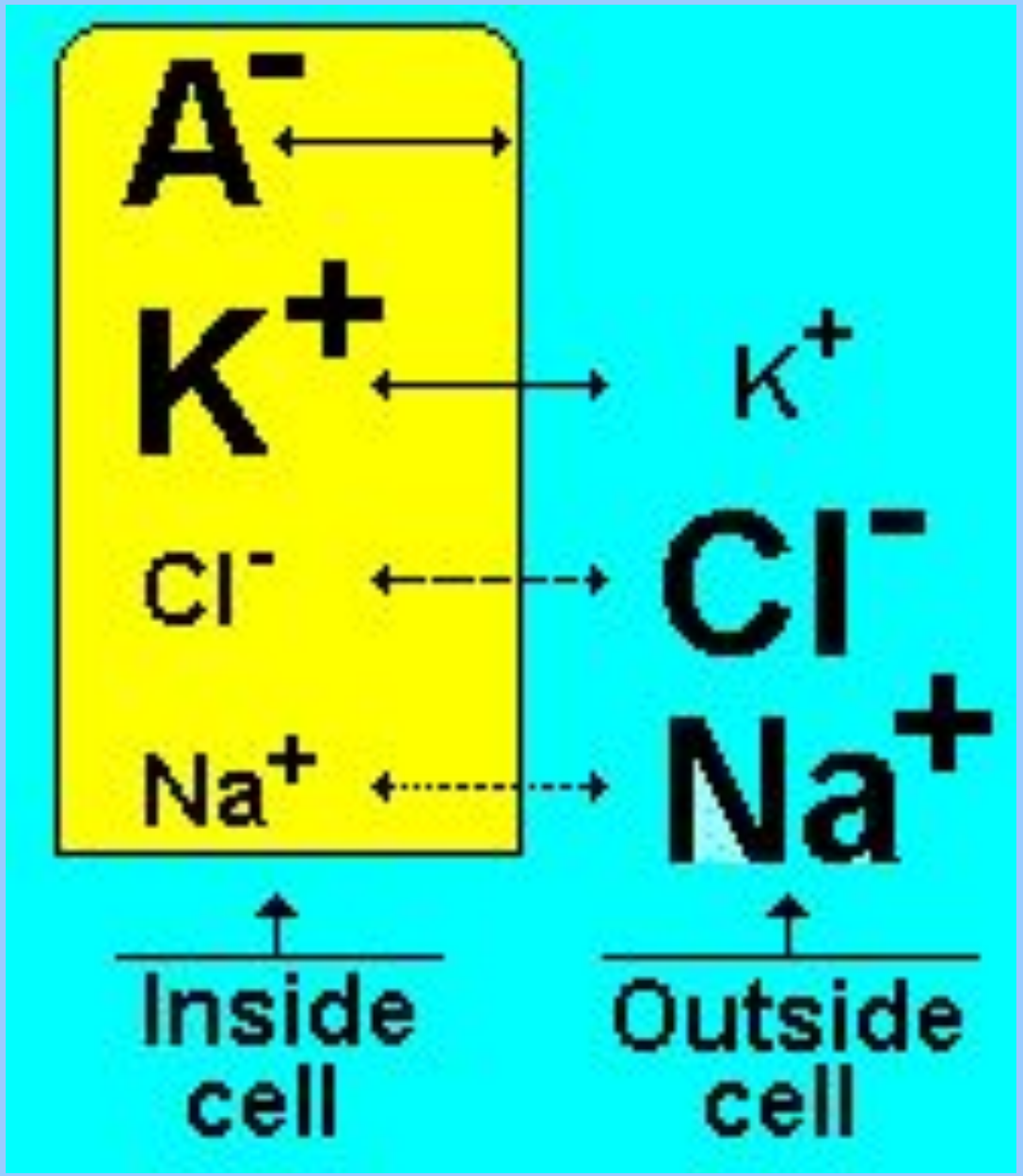
ENDOCYTOSIS KINDS



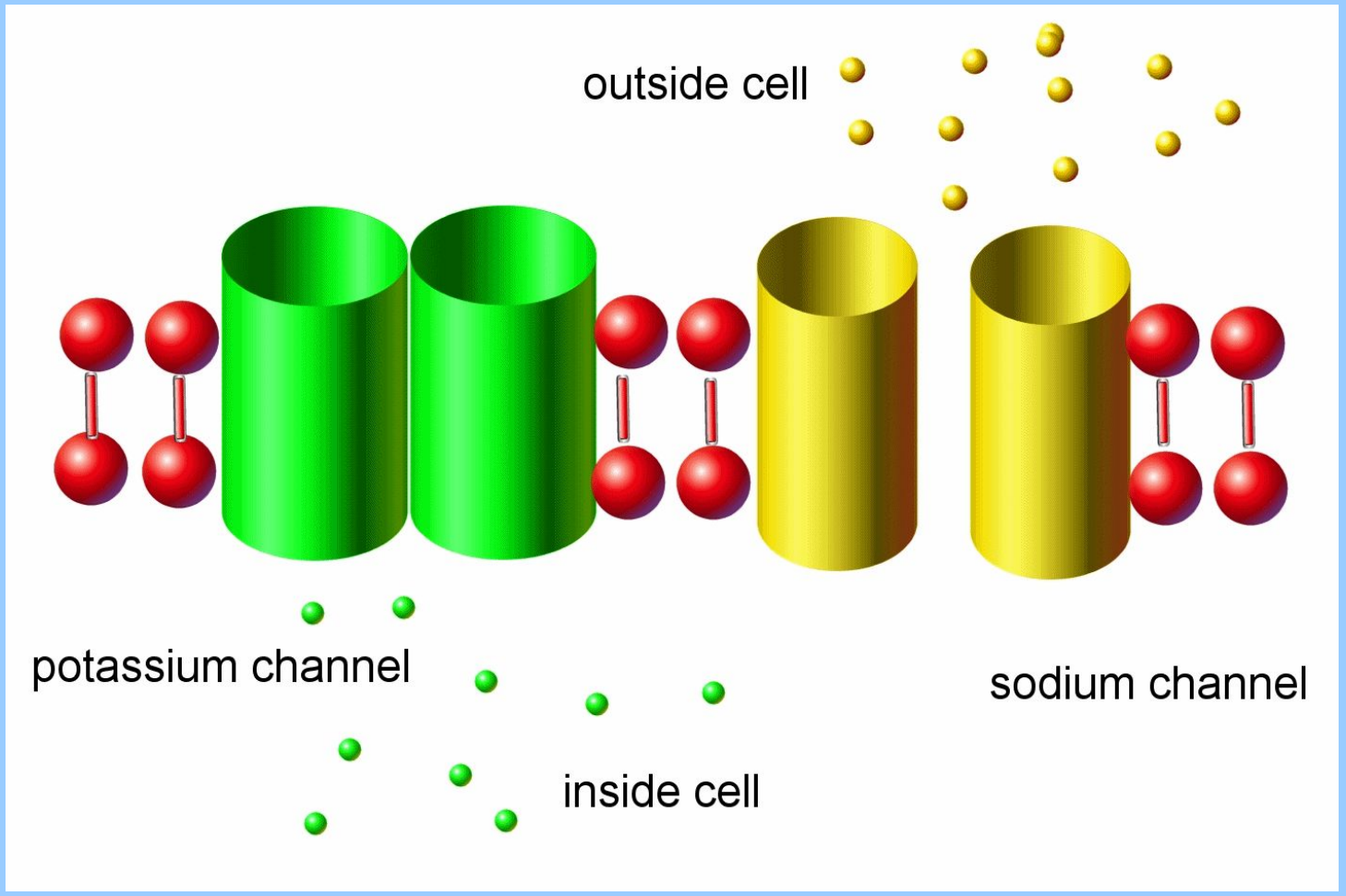


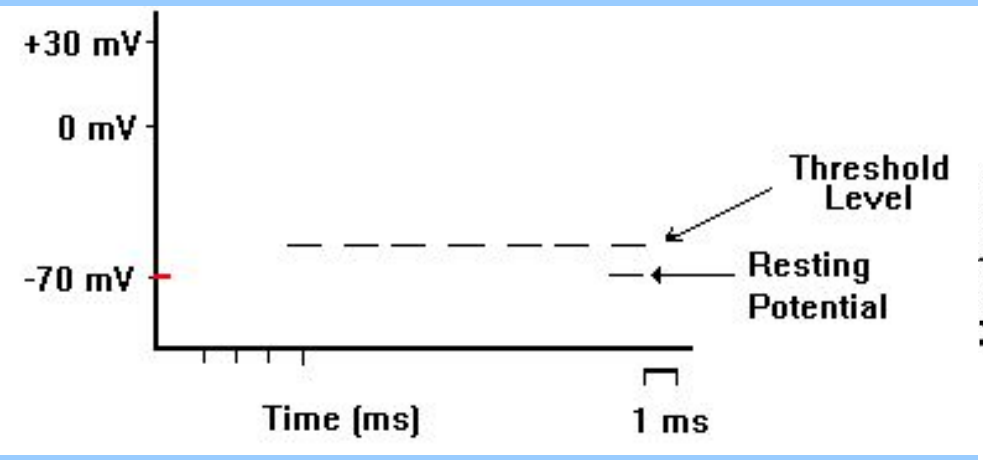
REST AND ACTION POTENTIALS OF THE CELL

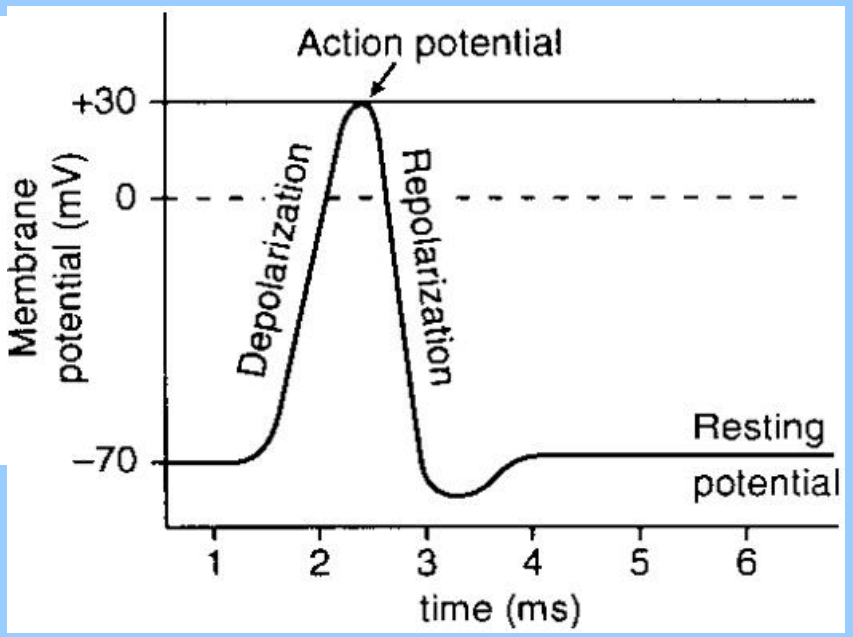

0 mV
−70 mV
+70 mV
Electrodes
Neuron

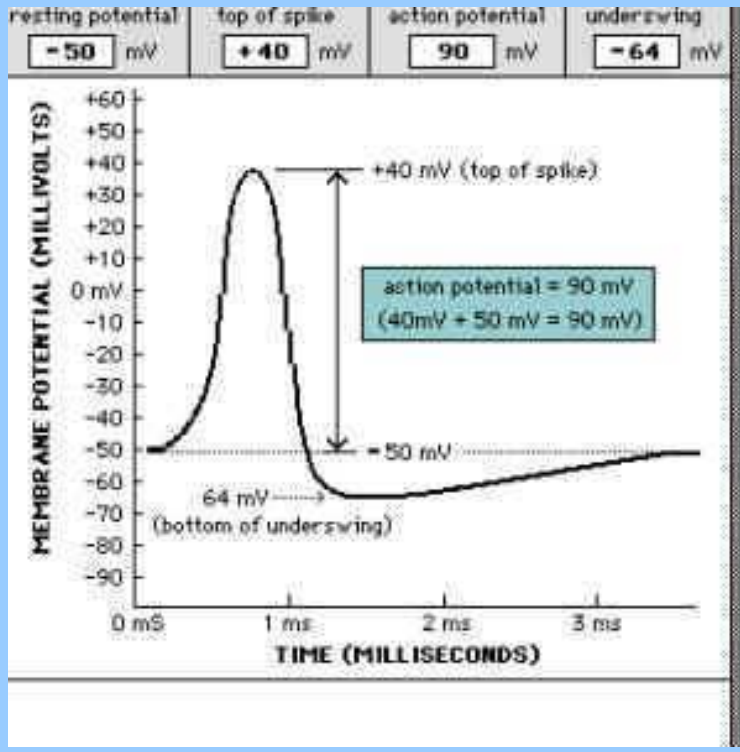

A-
K+
Cl-
Na+
K+
Cl-
Na+
Inside cell
Outside cell

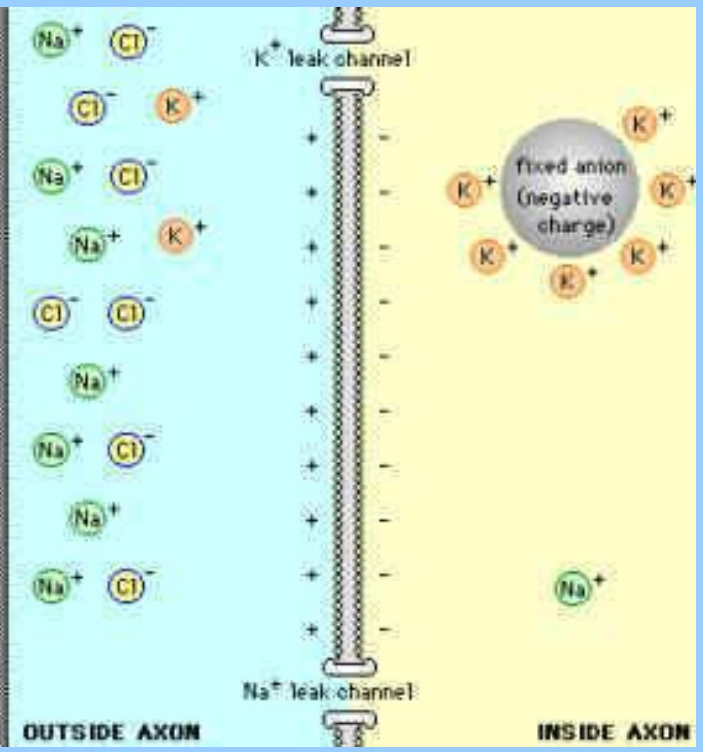
$$E_m = \frac{RT}{zF} \ln \left(\frac{P_{\mathrm{K}}[\mathrm{K}^+]_{\mathrm{out}} + P_{\mathrm{Na}}[\mathrm{Na}^+]_{\mathrm{out}} + P_{\mathrm{Cl}}[\mathrm{Cl}^-]_{\mathrm{in}}}{P_{\mathrm{K}}[\mathrm{K}^+]_{\mathrm{in}} + P_{\mathrm{Na}}[\mathrm{Na}^+]_{\mathrm{in}} + P_{\mathrm{Cl}}[\mathrm{Cl}^-]_{\mathrm{out}}}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

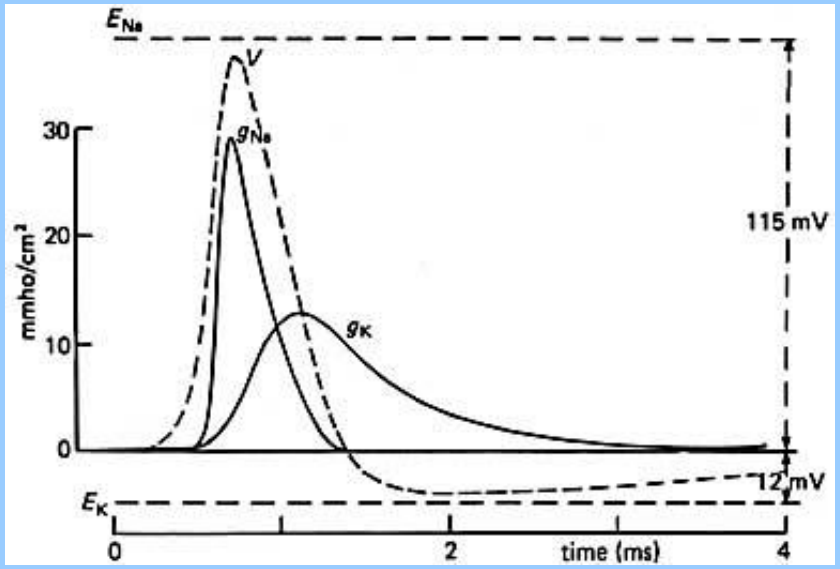


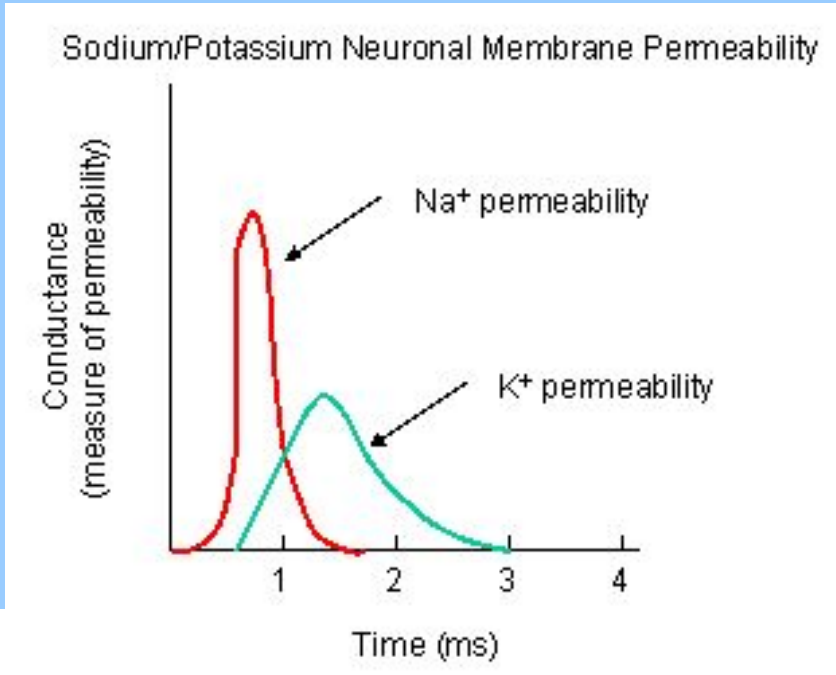

+30 mV
0 mV
-70 mV
Threshold Level
Resting Potential
Time (ms)
1 ms

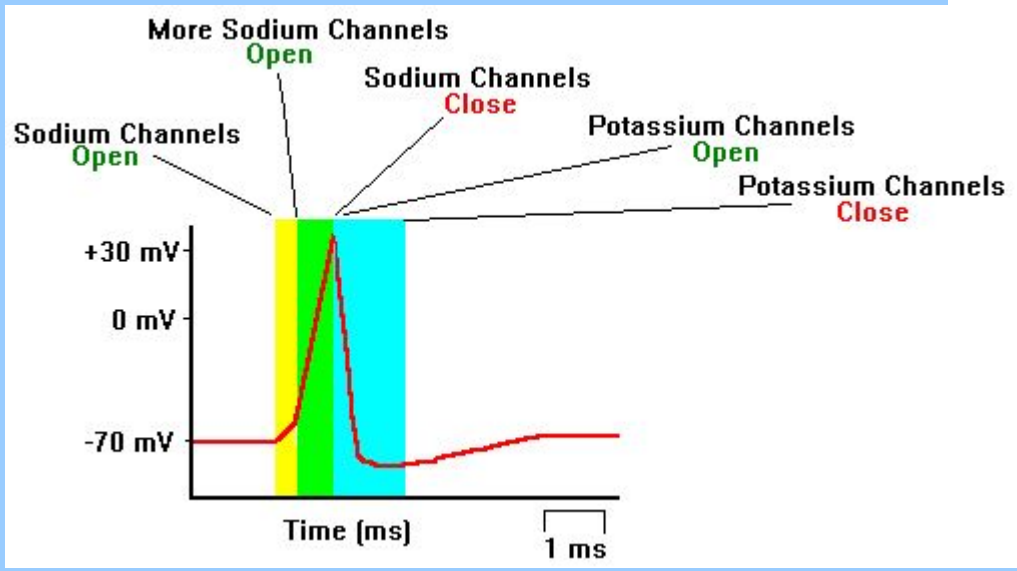

Action potential
+30
0
−70
Membrane potential (mV)
Depolarization
Repolarization
Resting potential
1
2
3
4
5
6
time (ms)

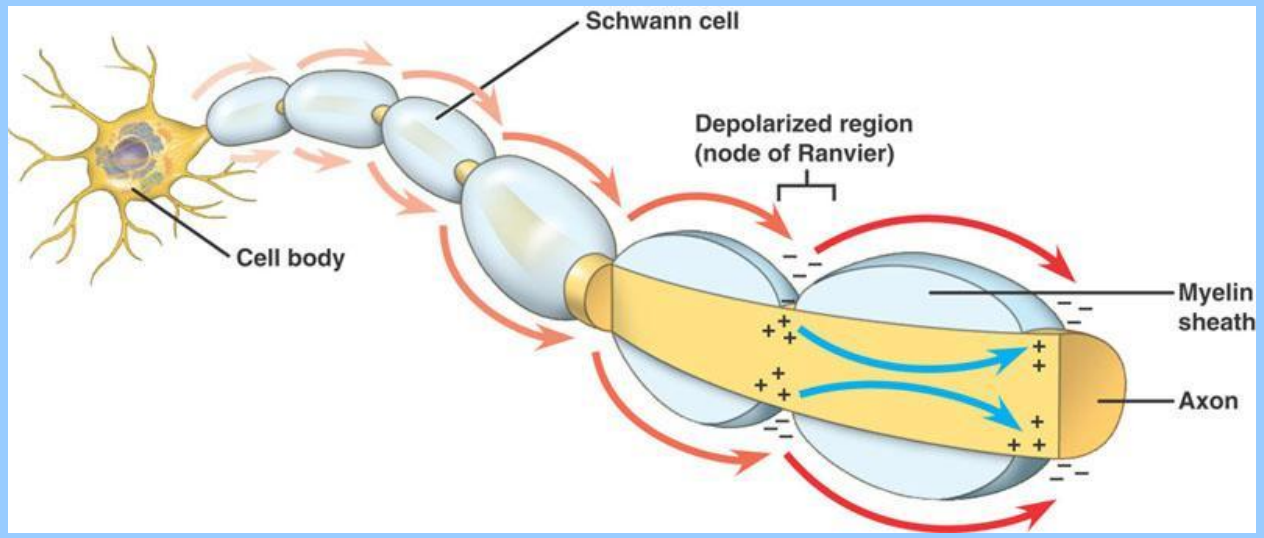

resting potential
-50 mV
top of spike
+40 mV
action potential
90 mV
underswing
-64 mV
MEMBRANE POTENTIAL (MILLIVOLTS)
+40 mV (top of spike)
action potential = 90 mV
(40mV + 50 mV = 90 mV)
-50 mV
64 mV
(bottom of underswing)
0 mS
1 ms
2 ms
3 ms
TIME (MILLISECONDS)

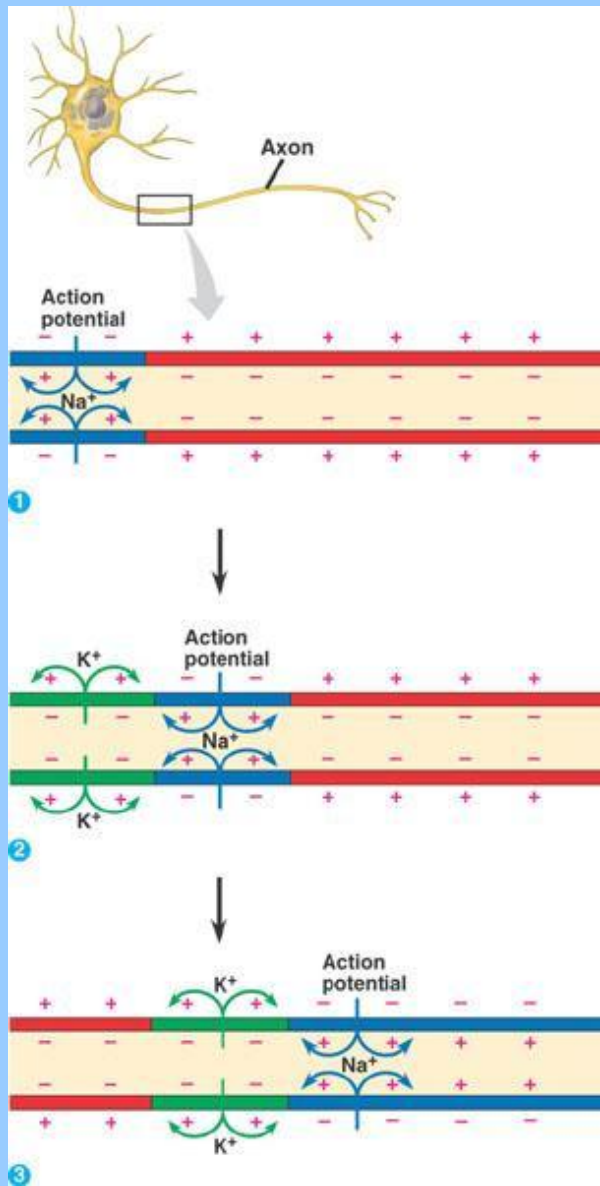

K+ leak channel
fixed anion (negative charge)
Na+ leak channel
OUTSIDE AXON
INSIDE AXON


E_{Na}
V
g_{Na}
30
20
10
0
mmho/cm²
115 mV
g_K
12 mV
E_K
0
2
time (ms)
4


Sodium/Potassium Neuronal Membrane Permeability
Conductance
(measure of permeability)
Na+ permeability
K+ permeability
1
2
3
4
Time (ms)


More Sodium Channels
Open
Sodium Channels
Close
Sodium Channels
Open
Potassium Channels
Open
Potassium Channels
Close
+30 mV
0 mV
-70 mV
Time (ms)
1 ms


Schwann cell
Depolarized region
(node of Ranvier)
Cell body
Myelin
sheath
Axon


Axon
Action
potential
Na+
1
K+
Action
potential
Na+
K+
2
K+
Action
potential
Na+
K+
3