Basic Electrophysiological Methods

Assoc. Prof. Erkan Tuncay

Department of Biophysics

GROUP1 Brugada syndrome	GROUP2 Long QT syndrome	GROUP3 Timothy syndrome	GROUP4 Dravet syndrome
1.	1.	1.	1.
2.	2.	2.	2.
3.	3.	3.	3.
4.	4.	4.	4.
5.	5.	5.	5.

1. Group leader
   Responsibility: time arrangement for the group discussion
   Everyone will have an idea about the syndremes
   Each person will choose an article related to the syndrome which includes electrophysiological methods
   In the group discussion
      Talk about the syndrome
      Discuss about the methods and results

Homework:

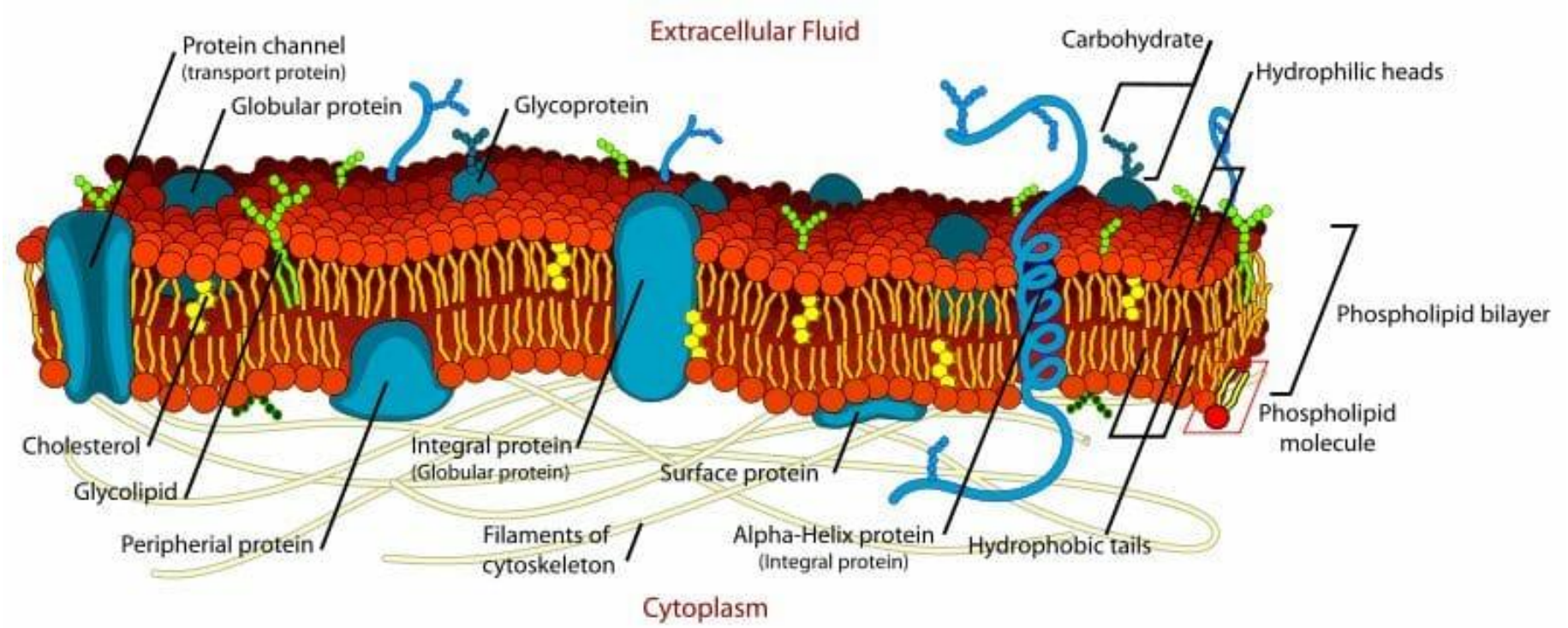
- Give information about the syndrome:
  - What is the ……syndrome?
  - What are the symptoms of ……. syndrome?
  - How common is ……. Syndrome in Turkey and in the world ?
  - Are there any similar syndromes?
  - …….
- Find articles about ……syndrome
  - Each student will find an article related to the syndrome (includes electrophysiological methods)
    - In the article;
      - Methods
      - Results
      - Discussion

Lecture Outline:

- **Structure of the plasma membrane**
- **Diffusion**
- **Nernst Equation**
- **Goldman-Hodgkin-Katz Equation**
- **Membrane potential**

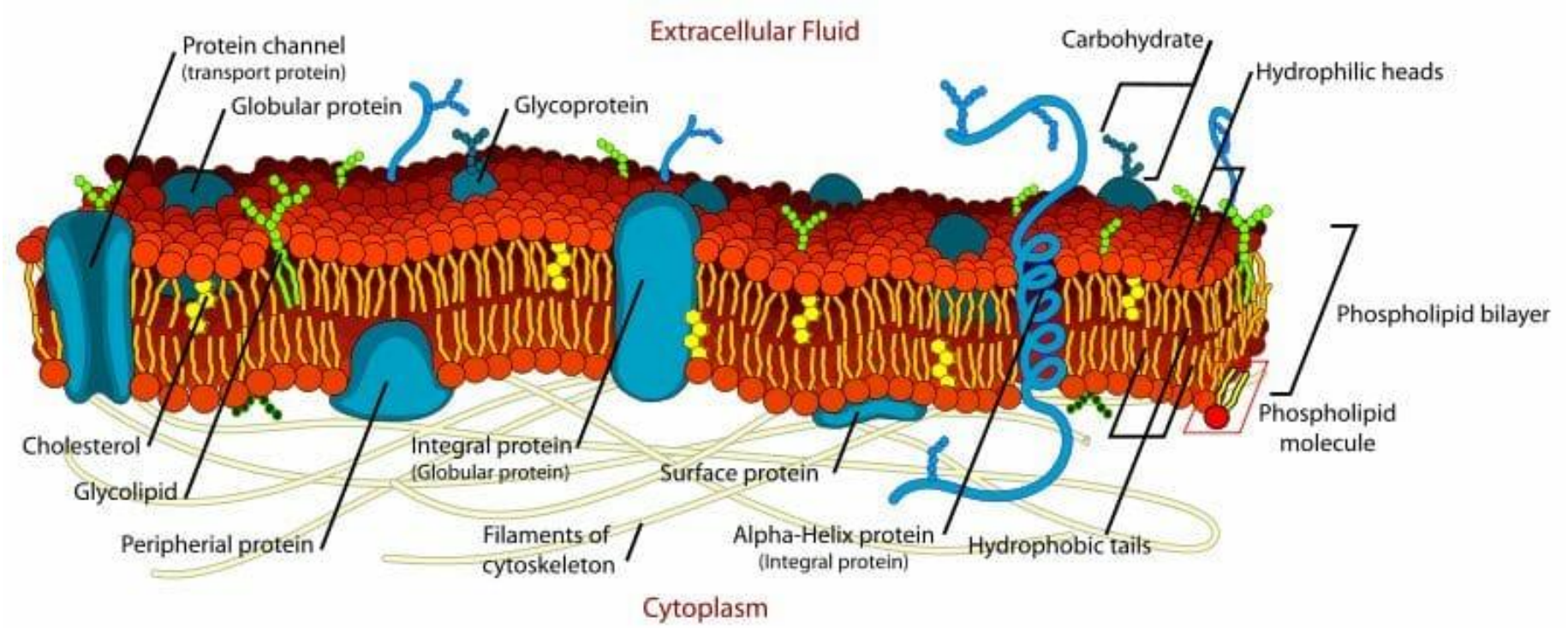
Structure of the plasma membrane

The plasma membrane, also called the cell membrane, is the membrane found in all cells that separates the interior of the cell from the outside environment. The plasma membrane consists of a lipid bilayer that is semipermeable. The plasma membrane regulates the transport of materials entering and exiting the cell.



Structure of the plasma membrane

According to the fluid mosaic model, was first proposed in 1972, the plasma membrane is a mosaic of components—primarily, phospholipids, cholesterol, and proteins—that move freely and fluidly in the plane of the membrane.



The components of the plasma membrane

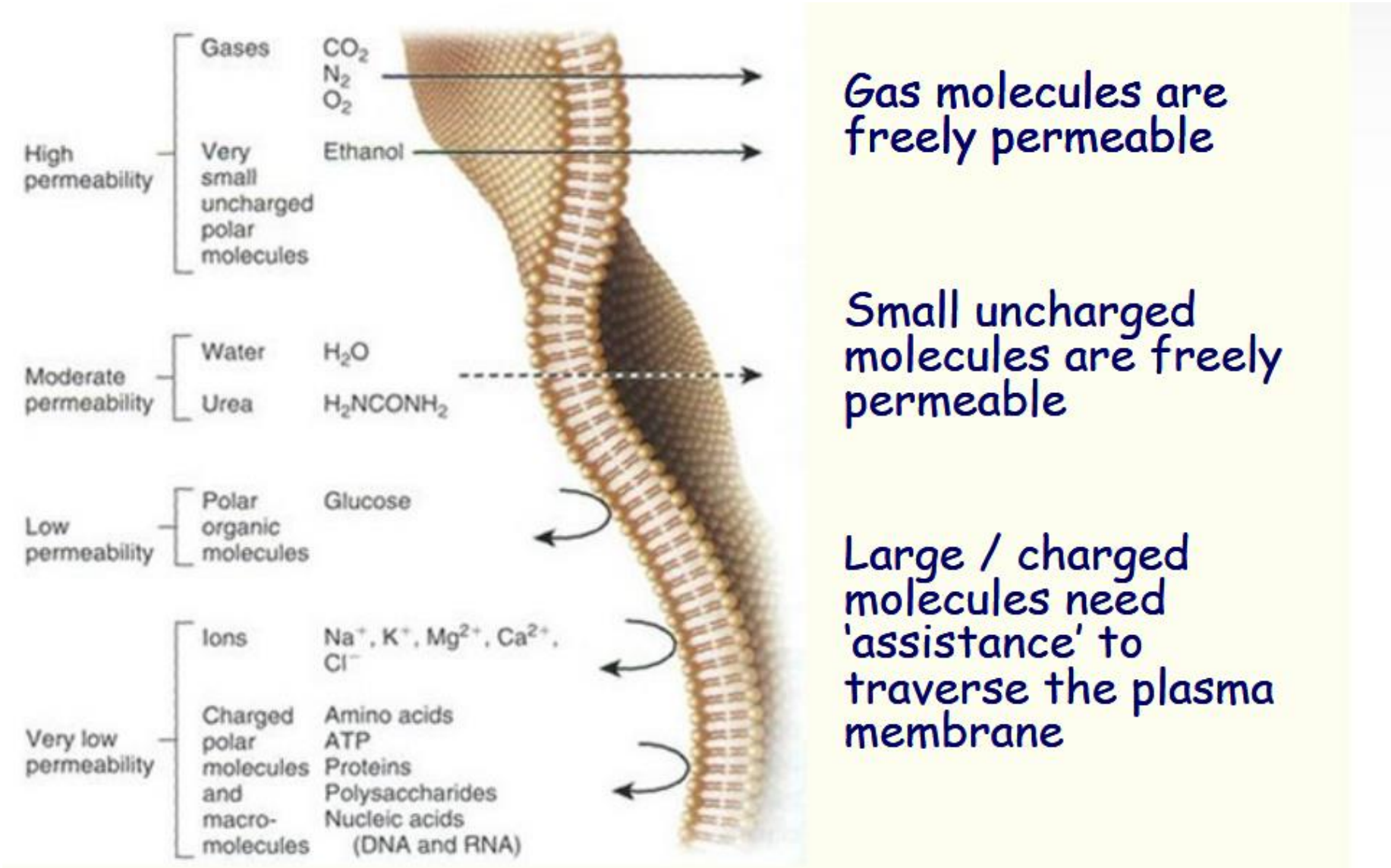
Component	Location
Phospholipids	Main fabric of the membrane
Cholesterol	Tucked between the hydrophobic tails of the membrane phospholipids
Integral proteins	Embedded in the phospholipid bilayer; may or may not extend through both layers
Peripheral proteins	On the inner or outer surface of the phospholipid bilayer, but not embedded in its hydrophobic core
Carbohydrates	Attached to proteins or lipids on the extracellular side of the membrane (forming glycoproteins and glycolipids)

The Extracellular Matrix

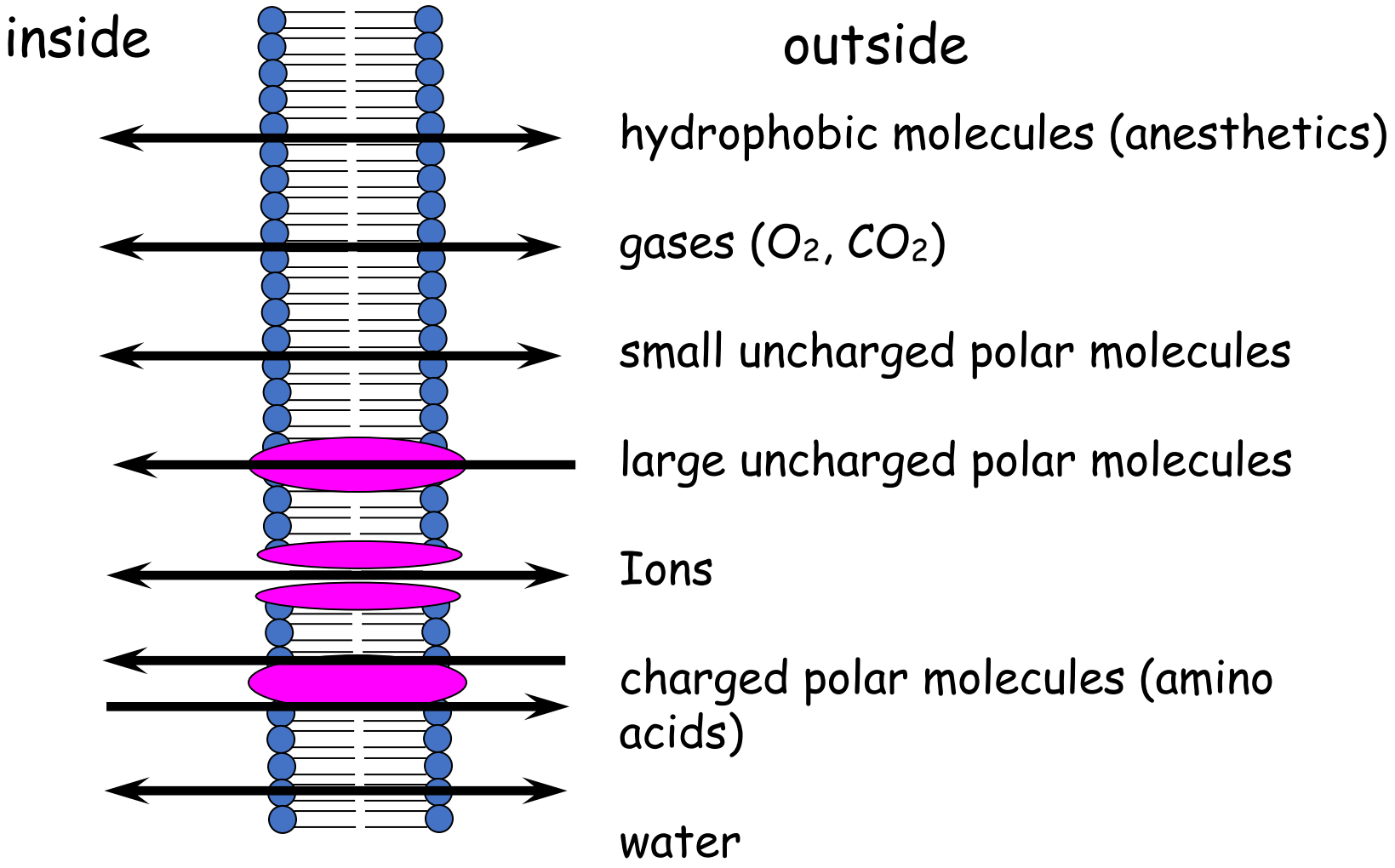
- The ECM is an organized meshwork of polysaccharides and proteins secreted by fibroblasts. Commonly referred to as connective tissue.
- COMPOSITION:
- Proteins: Collagen (major protein comprising the ECM), fibronectin, laminin, elastin
- Two functions: structural or adhesive
- Polysaccharides: Glycosaminoglycans, which are mostly found covalently bound to protein backbone (proteoglycans).
- Cells attach to the ECM by means of transmembrane glycoproteins called integrins
- Extracellular portion of integrins binds to collagen, laminin and fibronectin.
- Intracellular portion binds to actin filaments of the cytoskeleton

Question: What is amphipathic?

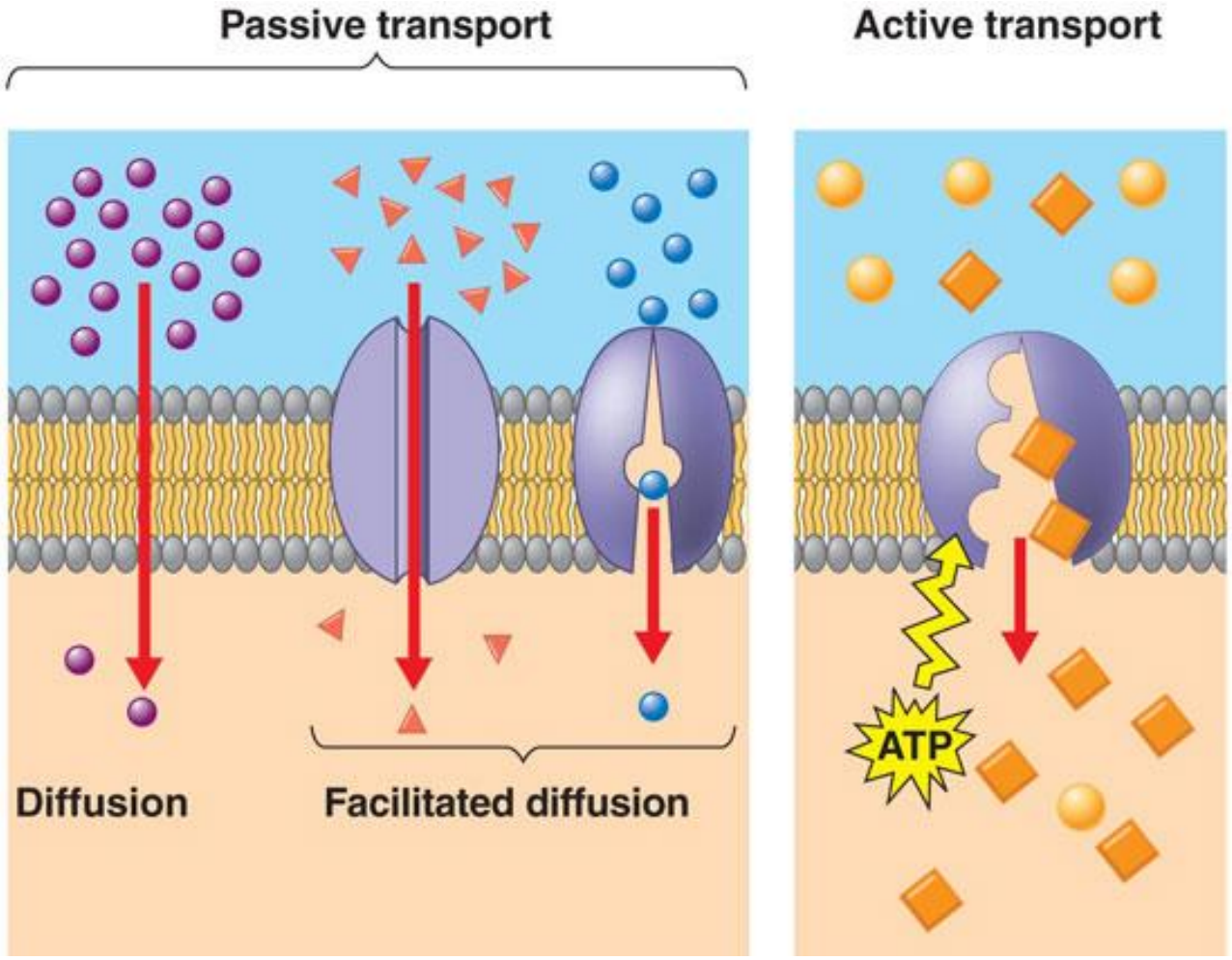
Membranes are selectively permeable

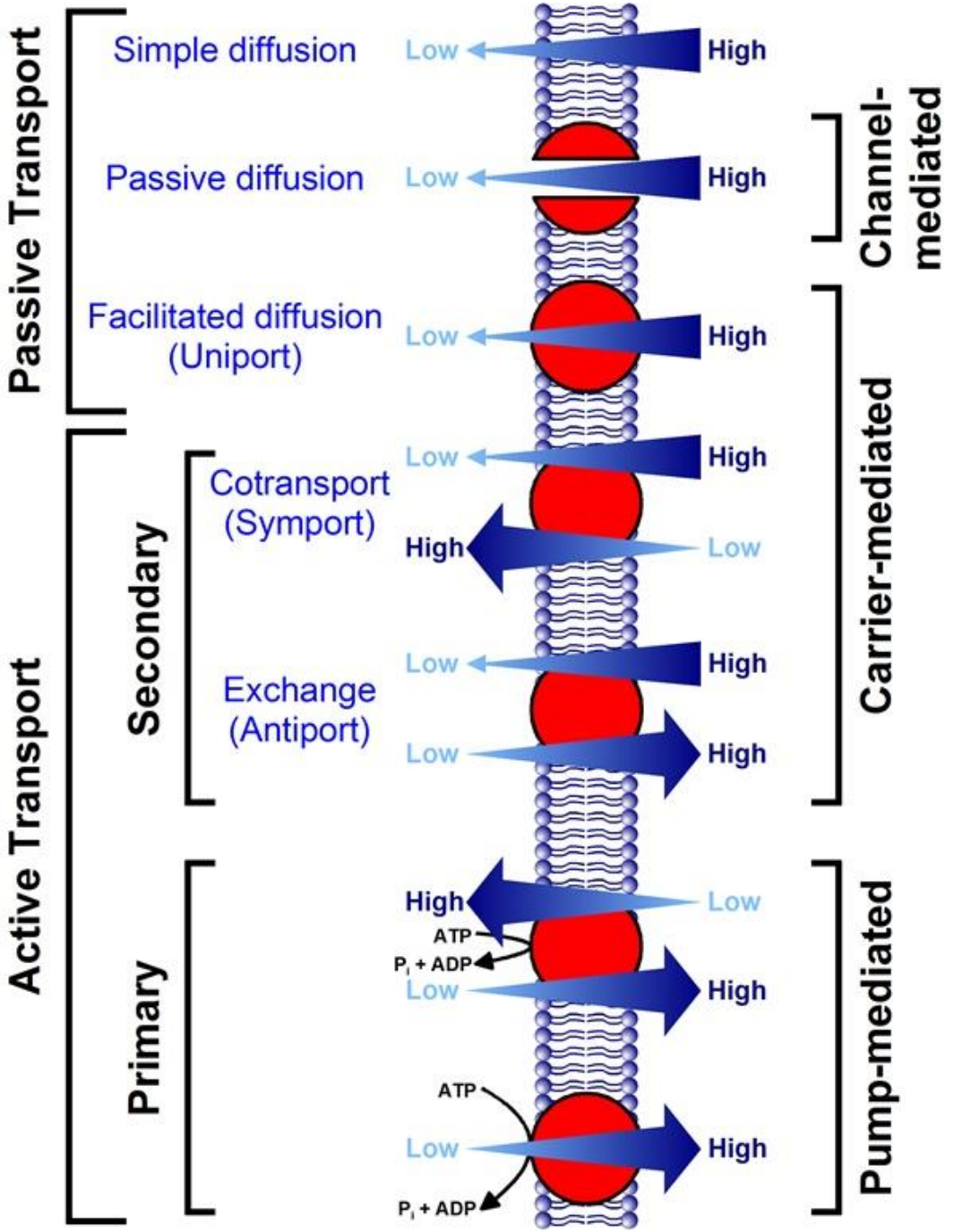


The Lipid Bilayer is a Selective Barrier



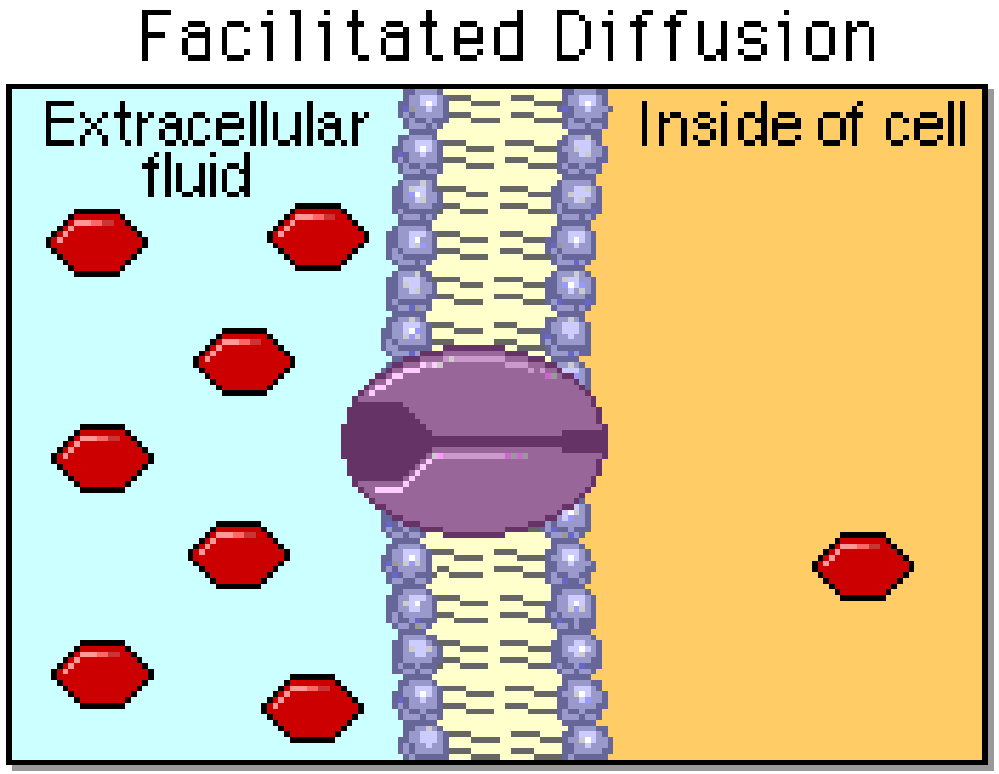
Membrane Transport



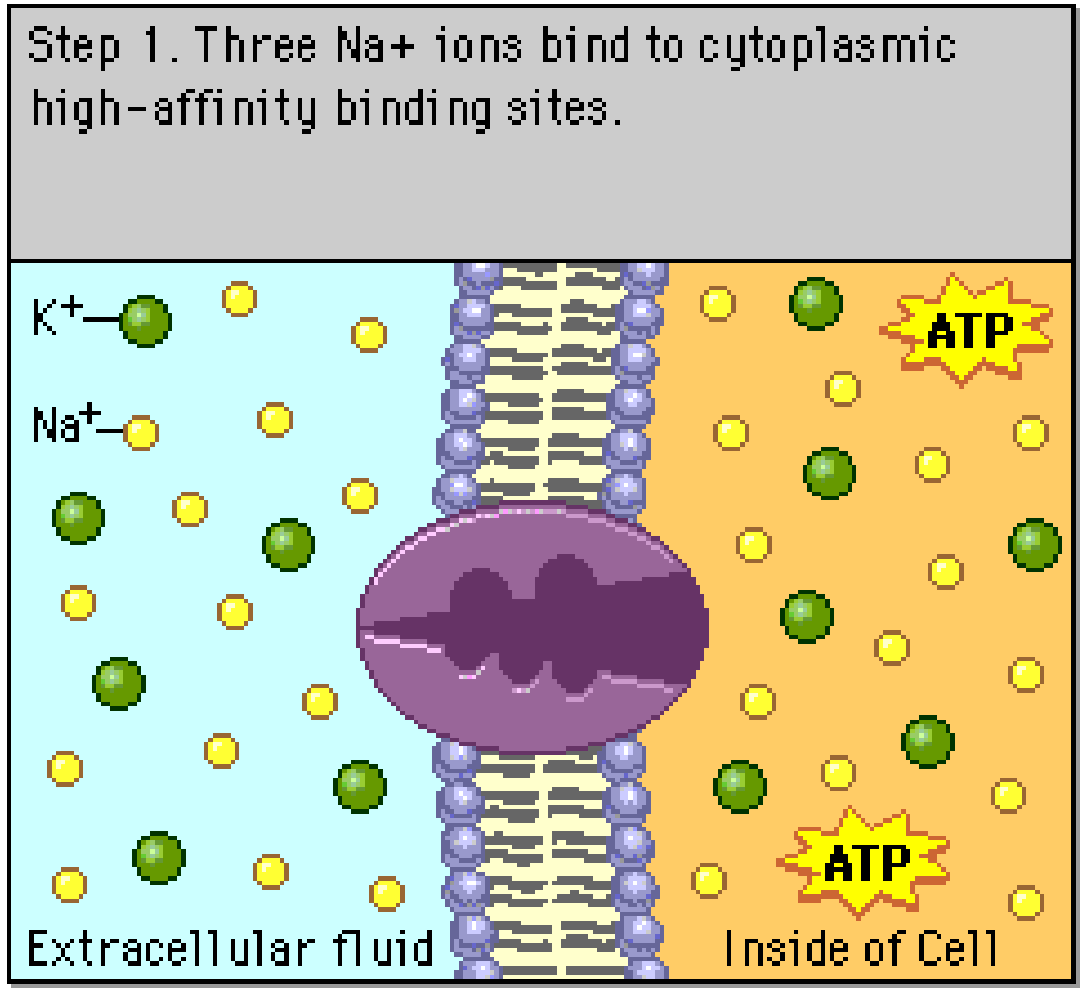


Facilitated diffusion

Facilitated diffusion is a form of facilitated transport involving the passive movement of molecules along their concentration gradient, guided by the presence of another molecule – usually an integral membrane protein forming a pore or channel.



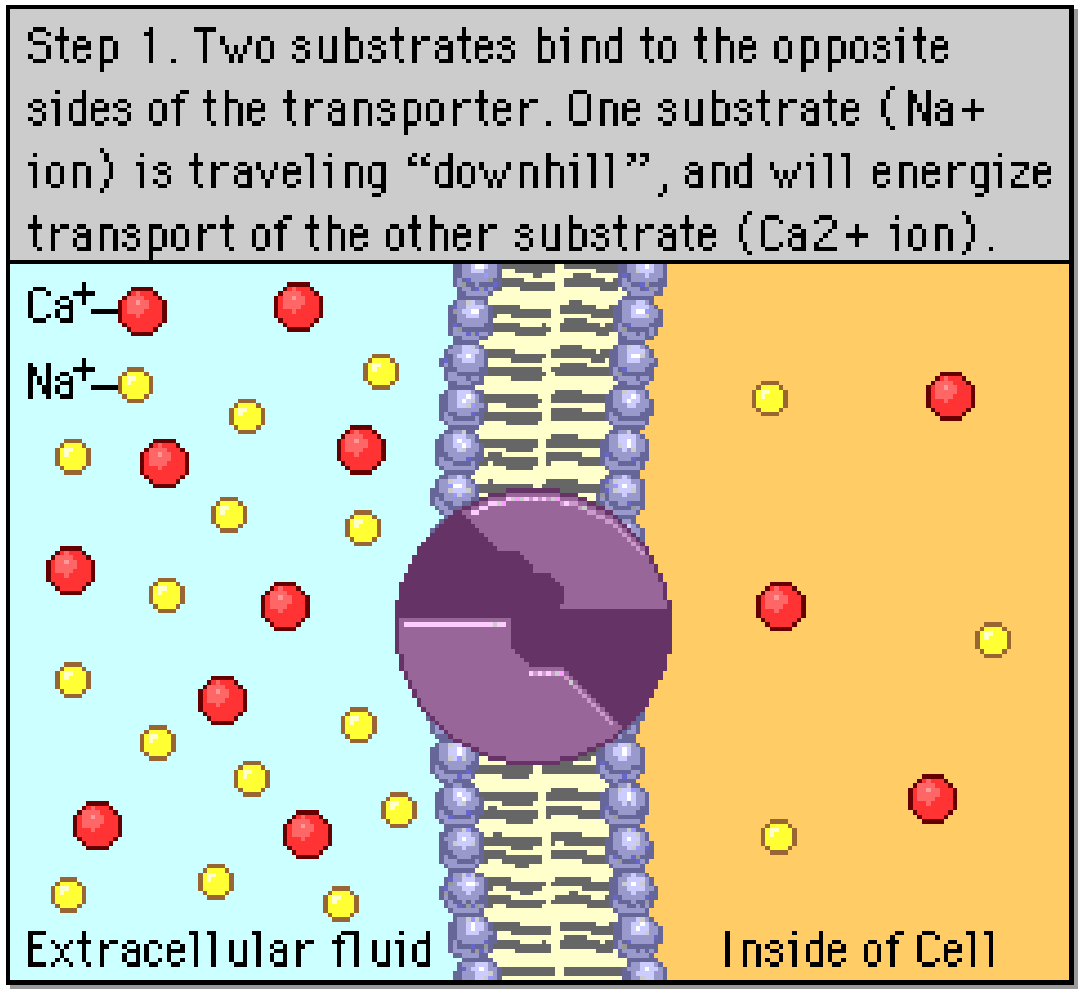
Primary Active Transport



Active transport use energy in the form of **ATP** in the process of pumping molecules against the concentration gradient.

Secondary Active transport

To transport some ions or substances (glucose or amino acid) against a concentration gradient, cells use energy already stored in ion gradients, such as calcium (Ca^{2+}) or sodium (Na^{+}) gradients, to power membrane proteins called transporters.

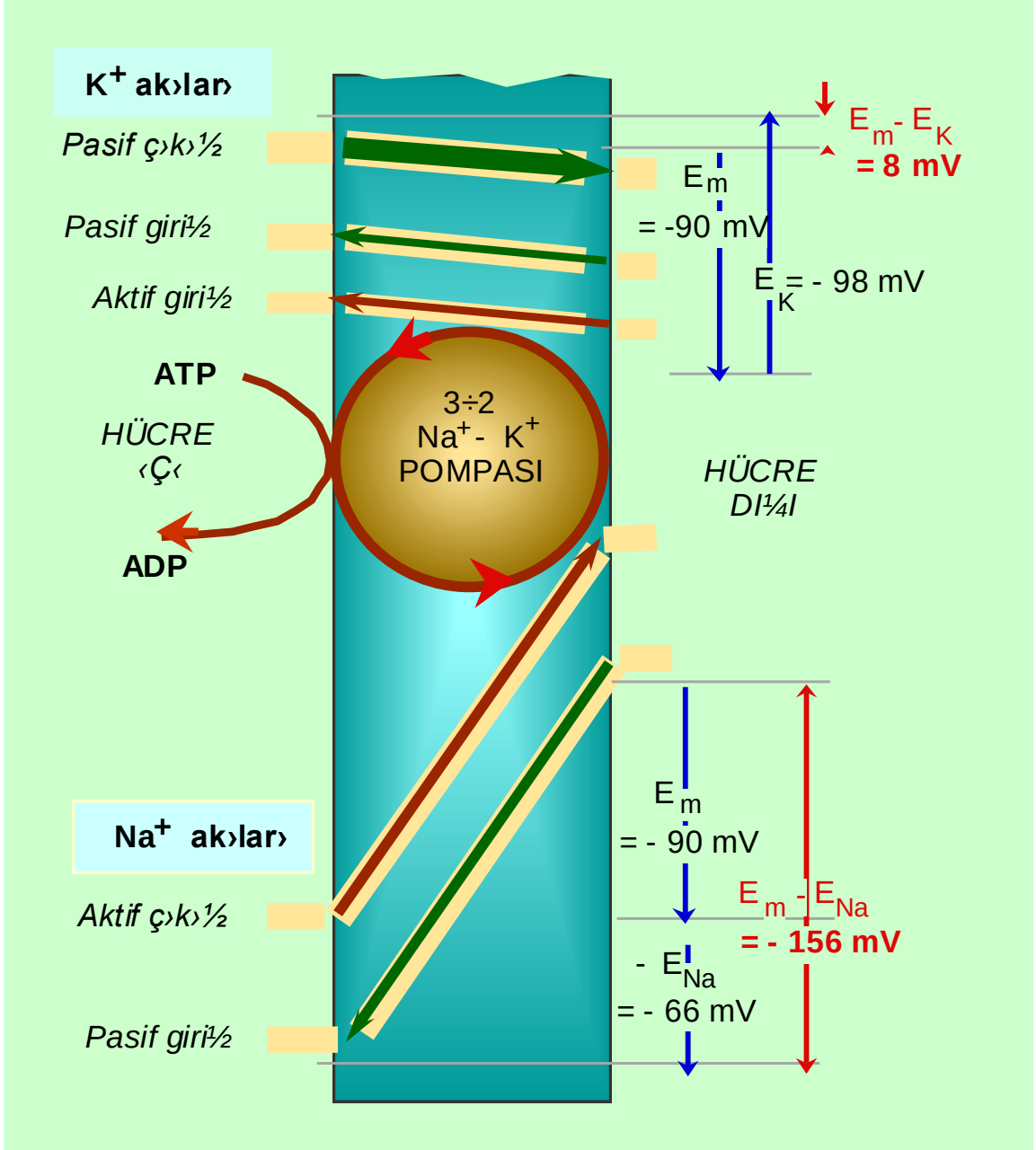


Gradient

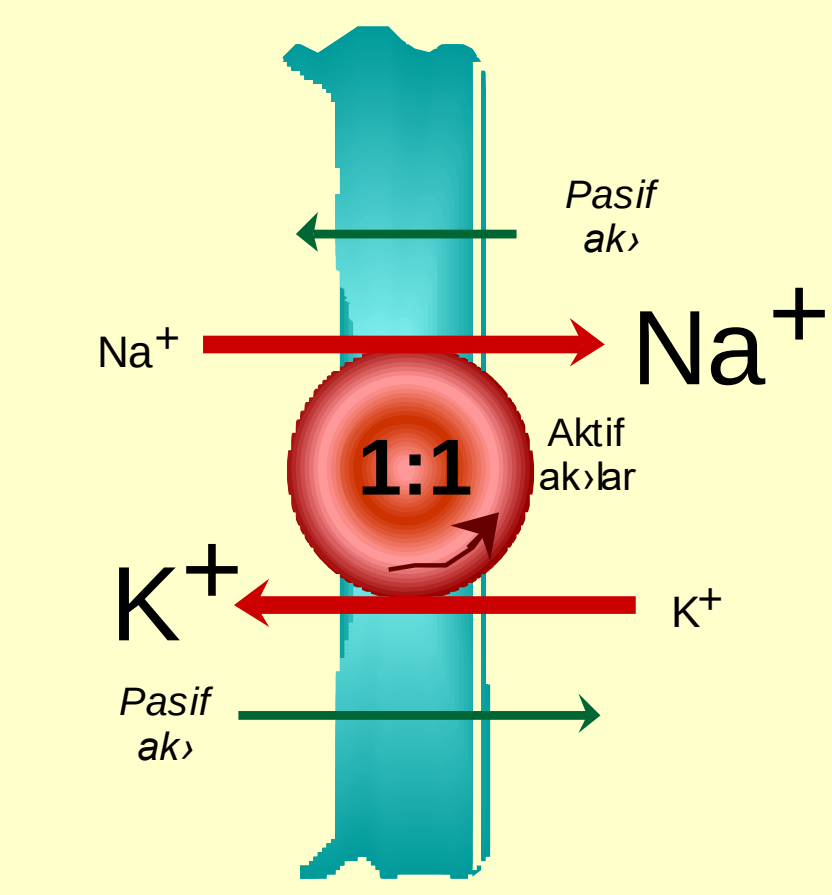
The gradient is a vector operation which operates on a scalar function to produce a vector whose magnitude is the maximum rate of change of the function at the point of the gradient and which is pointed in the direction of that maximum rate of change.

Gradient in 3D space:

$$\nabla \varphi = \frac{\partial \varphi}{\partial x}\vec{i} + \frac{\partial \varphi}{\partial y}\vec{j} + \frac{\partial \varphi}{\partial z}\vec{k}$$


K+ ak›lar›
Pasif ç›k›¼
Pasif giri¼
Aktif giri¼
ATP
HÜCRE
‹Ç‹
ADP
3÷2
Na+ - K+
POMPASI
HÜCRE
DI¼I
Em - EK
= 8 mV
Em
= -90 mV
EK = - 98 mV
Na+ ak›lar›
Aktif ç›k›¼
Pasif giri¼
Em
= - 90 mV
Em - ENa
= - 156 mV
- ENa
= - 66 mV

Gradient in cell membrane produced by pumps



Even if pump work as 1:1 ratio, it may still produce gradient