Biology Background
Different # of Ions in a Cell than outside

Table 4.1-1: Intra- and extracellular ion concentrations

Ion species	**Concentration inside cell**	**Concentration outside cell**
Na^+	15 mM	150 mM
K^+	150 mM	6 mM
Cl^-	9 mM	125 mM
Ca^{++}	100 **n**M	1.2 mM

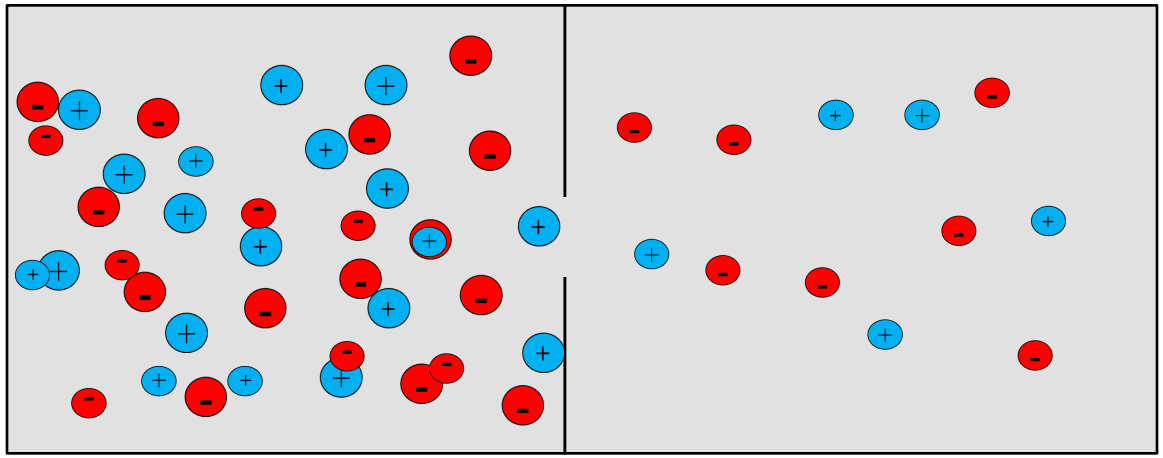
http://watcut.uwaterloo.ca/webnotes/Pharmacology/page-4.1.html

Does this concentration difference lead to an electrostatic potential?

1. *Yes*
2. *No*
3. *depends*

Two boxes one starting with 18 red and blue molecules, the other with 6 of each kind. Membrane has a channel THAT IS ONLY PERMEABLE to red molecules. At the start (shown)

1. Red molecule are equally likely to enter the channel from each side
2. Red molecules are 3 times more likely to enter the channel from the right
3. Red molecules are 3 times more likely to enter the channel from the left
4. Not enough information given

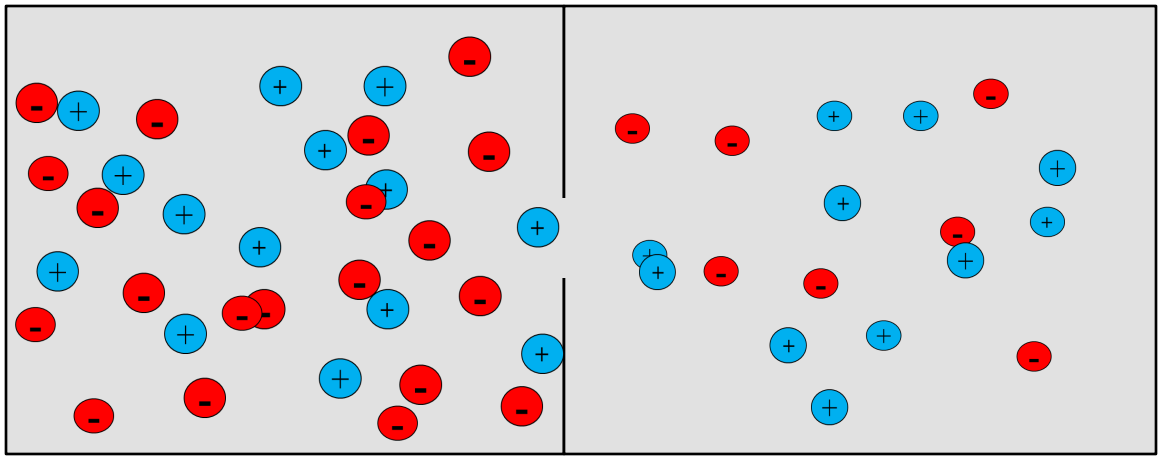


Sketch equilibrium state

- How many positive ions on each side?
  1. More than 6
  2. 6
  3. Less than six?
- Electric fields?
  1. None
  2. Near membrane
  3. everywhere

Below you see a membrane that has a channel that is permeable for one of the ions only.

1. The membrane is permeable to positive ions
2. The membrane is permeable to negative ions
3. Depends on the initial distribution of ions
4. other



Quantifying the electrostatic energy penalty:
how much more (or less) likely is it for an ion
to have an electrostatic energy of E_1 compared to E_0
(i.e., $P(E_1)/P(E_0)$)

1. $P \sim e^{\frac{E_1 - E_0}{k_B T}}$

2. $P \sim e^{-\frac{E_1 - E_0}{k_B T}}$

3. $P \sim e^{\frac{E_1}{E_0}}$

4. $P \sim e^{-\frac{E_1}{E_0}}$

5. *Need more information*