• This can be predicted by the **Nernst equation**
  
  $\text{Ex} = \left( \frac{RT}{zF} \right) \ln \left( \frac{[X]_2}{[X]_1} \right)$

  - Ex is the equilibrium potential for any ion, X
  - R = gas constant
  - T = absolute temperature
  - Z = valence of the permeant ion
  - F = faraday constant (amount of charge in one mol)

  - Simplified = $\text{Ex} = \frac{58}{z} \log \left( \frac{[X]_2}{[X]_1} \right)$
  - slope will be $\frac{58}{z}$

If the right side was replaced with 10mM of Na+ and the left with 1mM of Na+ (ions were now sodium) the equilibrium potential would be +58mV because the valence is +1

  - Ca$^{2+}$ ions it would be +29mV
  - Cl$^{-}$ ion it would be +58mV again

Balance of chemical and electrical forces at equilibrium means that the **electrical potential** can determine ion fluxes across the membrane while ionic gradient can determine the **membrane potential** (voltage of the left side – voltage of the right side)

  - -58mV is the voltage needed to counter the difference in K+ concentrations on two sides of the membrane
  - If the left side is initially made more negative that -58k that K will flow right to left
  - Battery off = net flux of K+ from left to right
  - Battery on @ -58mV = No net flux of K+
  - Battery on @ -116mV = net flux of K+ from right to left

**Electrochemical Equilibrium in an Environment with more than one Permeant Ion**

Scenario:
10mM of K+ and 1mM of Na+ on left
10mM of Na+ and 1mM of K+ on right

  - If the membrane was only permeable to K+, membrane potential = -58mV