• Ability to create: *Discrete electrical signals*

  * **Action Potentials**
    - Rapid: Changes in charge distribution of across the membrane
    - Rapid: Reversal of Membrane Potential
      > Negative – Positive – Negative
Charge distribution: measured in **VOLTAGE**

• 2 Key Charged Ions:
  Create “moving” or **Action Potentials**
  1. Sodium: Na⁺
  2. Potassium: K⁺
“Resting” Membrane Potential:

- Present in all cells
- UNEQUAL distribution of charged particles across a membrane

Inside Cell: Average voltage -65 to -70 mV
- Overall: Negatively charged
  - Due to fixed “anions”: Negatively charged proteins
  - Higher concentration of K^+

Outside Cell:
- Overall: Positively charged
  - Higher concentration of Na^+

Voltage difference: ~65 mV

Distribution of Na^+, K^+, and Cl^- Determines Voltage
Movement / distribution of Charged Ions

- Dependent on:
  1. **Permeability:**
     a. Presence of *Channels*

2. **BALANCE** between 2 main Driving Forces:
   a. **Electrical Force:**
      - Attraction / Repulsion of +/-
   b. **Concentration (Chemical) Gradient Force**

- **Electro-chemical Force**
  - Fixed anions: Create an initial negative interior
    - Electrical gradient
Mechanism: Changing permeability

**Opening of Voltage Gated Ion Channels**

a. Sodium: $\text{Na}^+$
b. Potassium: $\text{K}^+$

→ Resting Potential:

Protein conformation = CLOSED

At the resting potential, voltage-gated Na$^+$ channels are closed.

→ Change in charge distribution:

Membrane Voltage

Protein conformation changes = OPEN

Voltage Gated Ion Channels
1. **Depolarization**: “Loss of polarity”

- Membrane potential voltage becomes: less negative and more positive
  
  - Ending voltage: +30mV
  - Become less negative: loose voltage difference move toward ZERO mV
  - Starting voltage: -70mV

**Mechanism of Depolarization**:

- Influx (entering) of positive Na⁺

2. **Repolarization**: “Regain of polarity”

- Membrane potential voltage becomes: more negative and less positive
  
  - Starting voltage: +30mV
  - Become more negative: gain voltage difference move toward -70 mV
  - Ending voltage: -70mV
**Mechanism of Repolarization:**

- Efflux (leaving) of positive K⁺

**Mechanism of Hyperpolarization:**

- Further efflux of positive change
- K⁺ channels open longer than Na⁺