Cells have negative resting membrane potentials
- Water is a polar solvent
- Ions are charged molecules or atoms

\[ \text{cation} = \text{positive ion} \]
\[ \text{anion} = \text{negative ion} \]
Cells are surrounded by a membrane composed of a phospholipid bilayer. This bilayer serves as a semi-permeable barrier, allowing selective permeability of substances based on their size and charge. Proteins embedded in the phospholipid bilayer further contribute to the selective permeability of the membrane, controlling the passage of molecules and ions into and out of the cell. The extracellular fluid and cytosol (intracellular fluid) are separated by this membrane, maintaining the internal environment of the cell.
Ionic movement through channels influenced by:

- diffusion
- electricity
Diffusion

- Ions are driven by the chemical gradient
  high concentration $\Rightarrow$ low concentration

- Ions flow until there is no net movement across the membrane (equilibrium)
Electricity

Current
movement of electrical charge

Electrical potential (voltage)
force exerted on a charged particle

Electrical conductance
ease at which charges can migrate

like charges repel!!
Permeable membrane permits current flow !!

No current flow

Current flow
Establishing an equilibrium between the electrical and chemical gradients

No net movement of ions
Ionic equilibrium potential (equilibrium potential if selectively permeable to that ion)

<table>
<thead>
<tr>
<th>Outside</th>
<th>Inside</th>
<th>Ratio Outside:Inside</th>
<th>$E_{ion}$ (at 37°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[K$^+$]_o = 5 mM</td>
<td>[K$^+$]_i = 100 mM</td>
<td>1:20</td>
<td>-80 mV</td>
</tr>
<tr>
<td>[Na$^+$]_o = 150 mM</td>
<td>[Na$^+$]_i = 15 mM</td>
<td>10:1</td>
<td>62 mV</td>
</tr>
<tr>
<td>[Ca$^{2+}$]_o = 2 mM</td>
<td>[Ca$^{2+}$]_i = 0.0002 mM</td>
<td>10,000:1</td>
<td>246 mV</td>
</tr>
<tr>
<td>[Cl$^-$]_o = 150 mM</td>
<td>[Cl$^-$]_i = 13 mM</td>
<td>11.5:1</td>
<td>-65 mV</td>
</tr>
</tbody>
</table>
Cells have negative resting membrane potentials due to an uneven distribution of electric charge across the membrane.
Dendrites

Cell body

Axon

Direction of message

Axon terminals synapse with dendrites on target cell
The Action Potential:

- A signal that travels rapidly over distances in the brain.
- A rapid reversal of the polarity of the neuronal membrane.
- Currency for information exchange in the nervous system.
Anatomy of the Action Potential

- Threshold
- Rising phase
- Overshoot
- Falling Phase
- Undershoot
- Refractory Period

(duration approximately 1 msec)
Action potential firing frequency depends on the level of depolarization.