**SNS COLLEGE OF ALLIED HEALTH SCIENCES**
SNS Kalvi Nagar, Coimbatore - 35
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**DEPARTMENT :** PHYSICIAN ASSISTANT

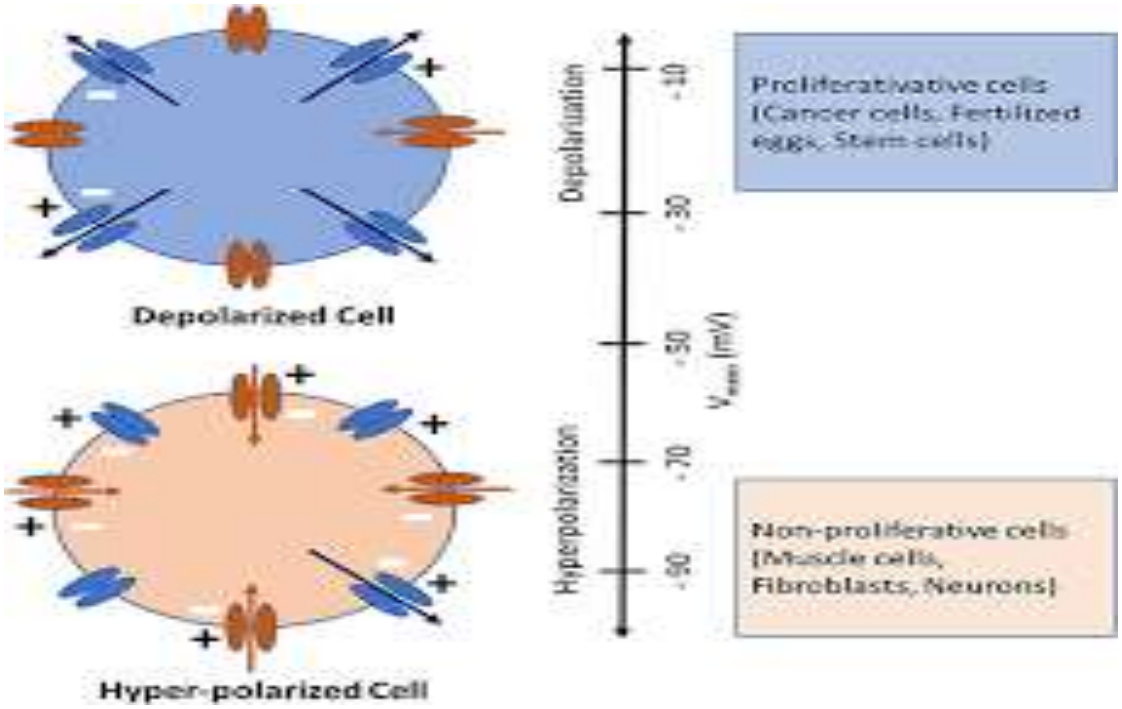
**COURSE NAME :** NEUROLOGY

**UNIT :** NERVOUS SYSTEM

**TOPIC :** CELL MEMBRANE - BIOELECTRICITY AND GENESIS OF RESTING POTENTIAL (RMP)

# BIOELECTRICITY

- Bioelectricity refers to the electrical phenomena that occur within living organisms. Bioelectricity primarily involves the generation, propagation, and modulation of electrical signals across cell membranes.
- These electrical signals play critical roles in various physiological processes, including cellular communication, signal transduction, muscle contraction, and nerve impulse transmission.


Depolarized Cell
Hyper-polarized Cell
Depolarization
Hyperpolarization
-10
-30
-50
-70
-90
$V_{mem}$ (mV)
Proliferativative cells (Cancer cells, Fertilized eggs, Stem cells)
Non-proliferative cells (Muscle cells, Fibroblasts, Neurons)

## Resting Membrane Potential (RMP):

- The resting membrane potential is the voltage difference across the cell membrane when the cell is at rest.
- It is typically negative inside the cell relative to the extracellular fluid, with values around -70 millivolts (mV) in most cells.
- The RMP is primarily maintained by the differential distribution of ions across the cell membrane and the selective permeability of ion channels.

## Action Potential (AP):

- Action potentials are transient changes in membrane potential that propagate along the membrane of excitable cells, such as neurons and muscle cells.

- The generation of an action potential involves a rapid depolarization phase followed by repolarization and, in some cases, hyperpolarization.

## Ion Channels:

- Ion channels are integral membrane proteins that form pores spanning the lipid bilayer of the cell membrane.
- They selectively allow specific ions, such as sodium (Na+), potassium (K+), calcium (Ca2+), and chloride (Cl-), to pass through the membrane in response to various stimuli.
- Ion channels are essential for the generation and modulation of membrane potentials and action potentials.

## Ion Pumps:

- Ion pumps are membrane proteins that actively transport ions across the cell membrane against their concentration gradients.
- Examples include the sodium-potassium pump (Na+/K+-ATPase), which pumps three sodium ions out of the cell and two potassium ions into the cell for every ATP molecule hydrolyzed.

## Electrogenic Processes:

- Electrogenic processes involve the movement of charged particles (ions) across the cell membrane, resulting in changes in membrane potential.

- Electrogenic processes underlie the bioelectricity observed in excitable cells and contribute to cellular excitability and signaling.

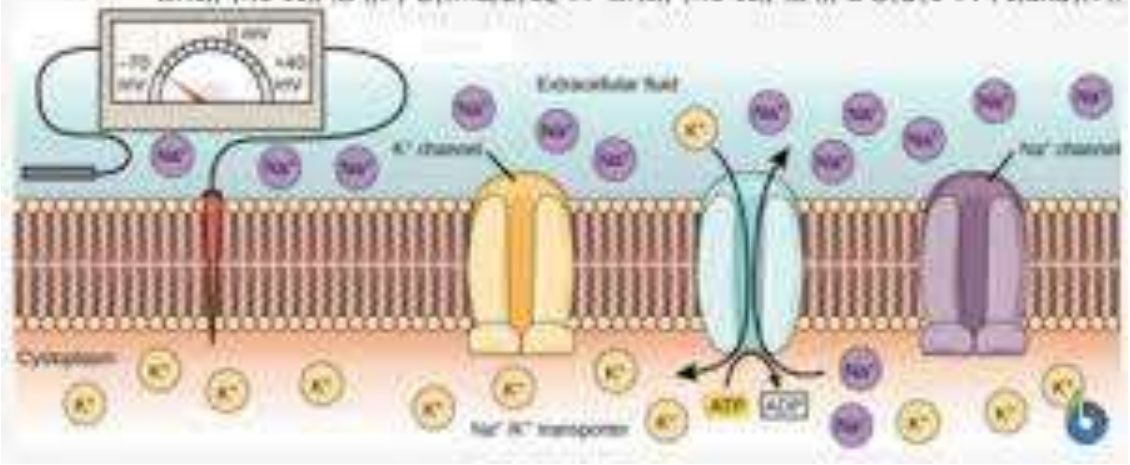
# GENESIS OF RESTING MEMBRANE POTENTIAL (RMP)

- The resting membrane potential is the electrical potential difference across the cell membrane when the cell is at rest, typically around -70 millivolts (mV) in neurons.

- The RMP arises from the differential distribution of ions across the membrane and the selective permeability of ion channels.

# Resting potential

Resting potential is the difference in electrical potential across the plasma membrane when the cell is not stimulated or when the cell is in a state of relaxation



## Ionic Gradients:

- The cell maintains concentration gradients of ions across the membrane, with higher concentrations of sodium ions (Na+) outside the cell and higher concentrations of potassium ions (K+) inside the cell.

- These gradients are established and maintained by ion pumps, particularly the sodium-potassium pump (Na+/K+-ATPase), which actively transports Na+ ions out of the cell and K+ ions into the cell against their concentration gradients, utilizing ATP hydrolysis.

## Selective Permeability:

- The cell membrane is selectively permeable to different ions due to the presence of ion channels, including leak channels and gated channels.
- Leak channels, particularly potassium leak channels, allow a small, continuous leakage of K+ ions out of the cell, contributing to the negative RMP.

- The selective permeability of the membrane to K+ ions is higher than that of Na+ ions, primarily due to the abundance of K+ leak channels.

## Electrogenic Properties:

- The movement of ions across the membrane generates electrical charges, contributing to the establishment of membrane potential.
- The unequal distribution of ions and the selective permeability of the membrane result in an electrical potential across the membrane, with the inside of the cell being negatively charged relative to the outside.

## Equilibrium Potential:

- The equilibrium potential for an ion is the membrane potential at which the electrical driving force is balanced by the concentration gradient, resulting in no net movement of ions.
- The Nernst equation calculates the equilibrium potential for a specific ion based on its intra- and extracellular concentrations.

## Resting Potential Maintenance:

- The balance between ion movement through leak channels and active transport processes, particularly the Na+/K+-ATPase pump, maintains the RMP.
- The cell continuously expends energy to maintain the ionic gradients and the RMP, which is essential for cellular function and excitability.

# ASSESSMENT

- What is Bioelectricity ?
- What is RMP ?