



# SNS COLLEGE OF TECHNOLOGY

Coimbatore-35  
An Autonomous Institution



Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A+' Grade  
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

## DEPARTMENT OF BIOMEDICAL ENGINEERING

### 19BMB302 - BIOMEDICAL SIGNAL PROCESSING

III YEAR/ V SEMESTER

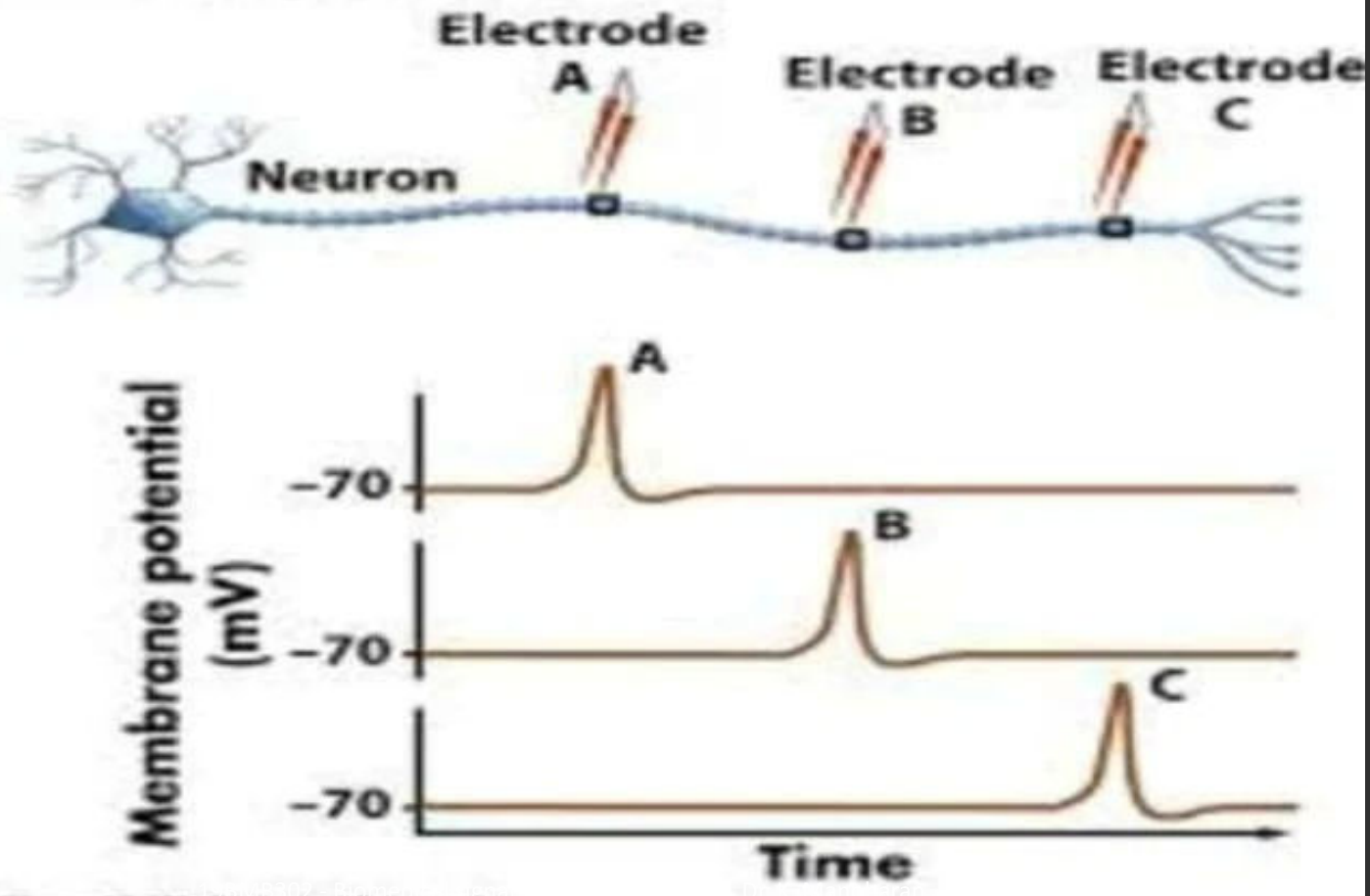
# Unit IV : BIOSIGNALS AND THEIR CHARACTERISTICS



- Source of Bioelectric potential
- Resting and action potential
- Propagation of action potentials in nerves
- Characteristics of biomedical signals
- The ECG-Cardiac electrophysiology
- Relation of ECG components to cardiac events
- Clinical applications



## Action potential spreads as a wave of depolarization.



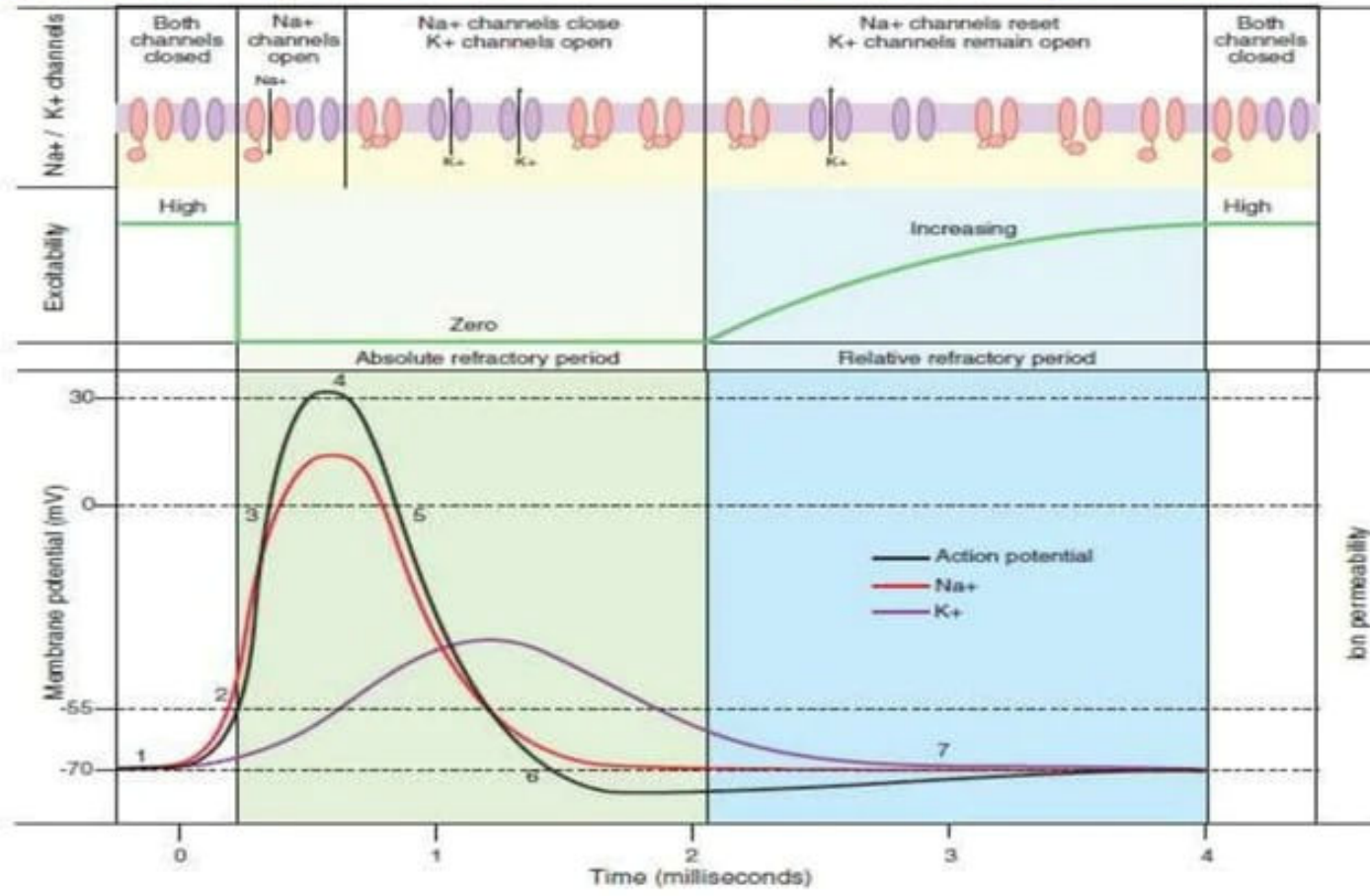


## IONIC FLUXES DURING THE ACTION POTENTIAL

- The conductance of an ion is the reciprocal of its electrical resistance in the membrane and is a measure of the membrane permeability to that ion.
- In response to a depolarizing stimulus, some of the voltage-gated  $\text{Na}^+$  channels open and  $\text{Na}^+$  enters the cell and the membrane is brought to its **threshold potential and the voltage-gated  $\text{Na}^+$  channels overwhelm the  $\text{K}^+$  and other channels.**



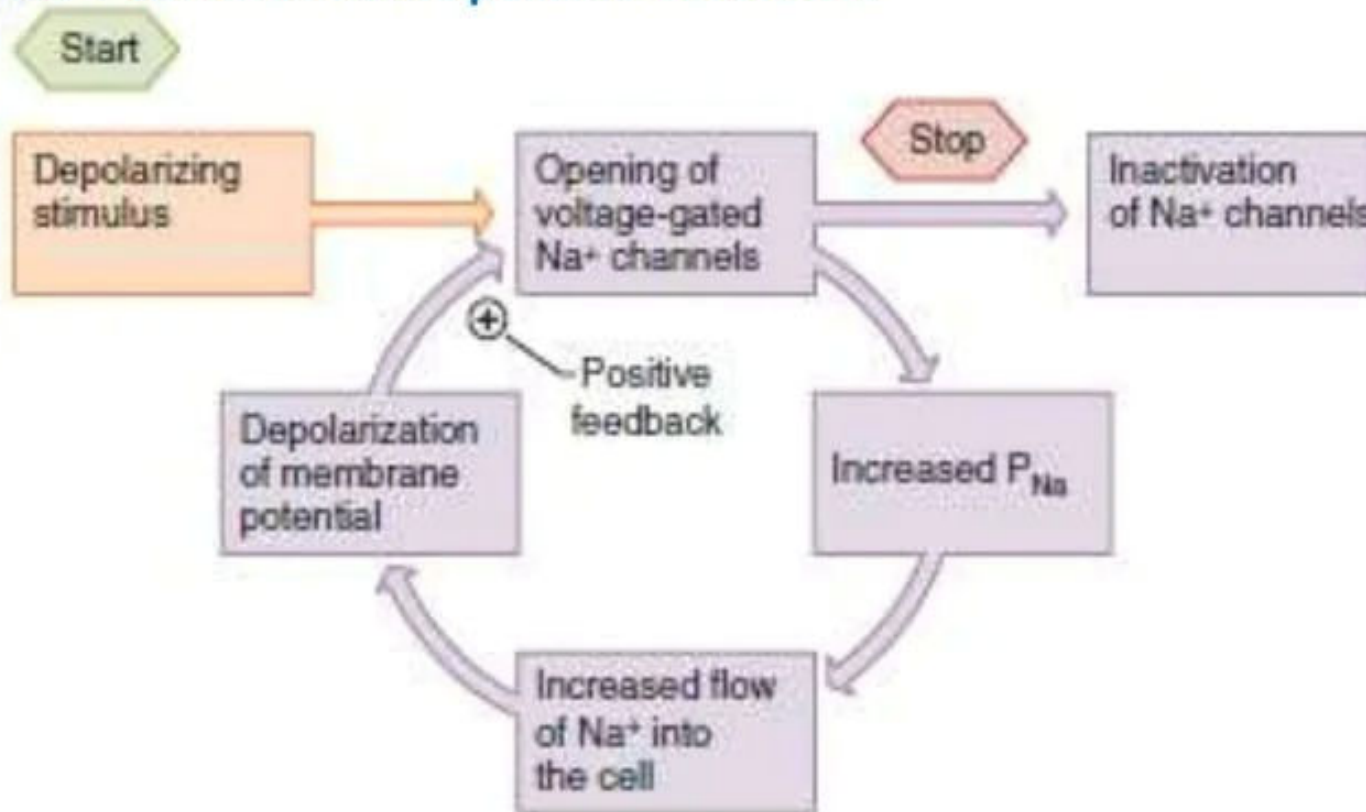
## Changes in membrane potential and relative membrane permeability to Na<sup>+</sup> and K<sup>+</sup> during an action potential.





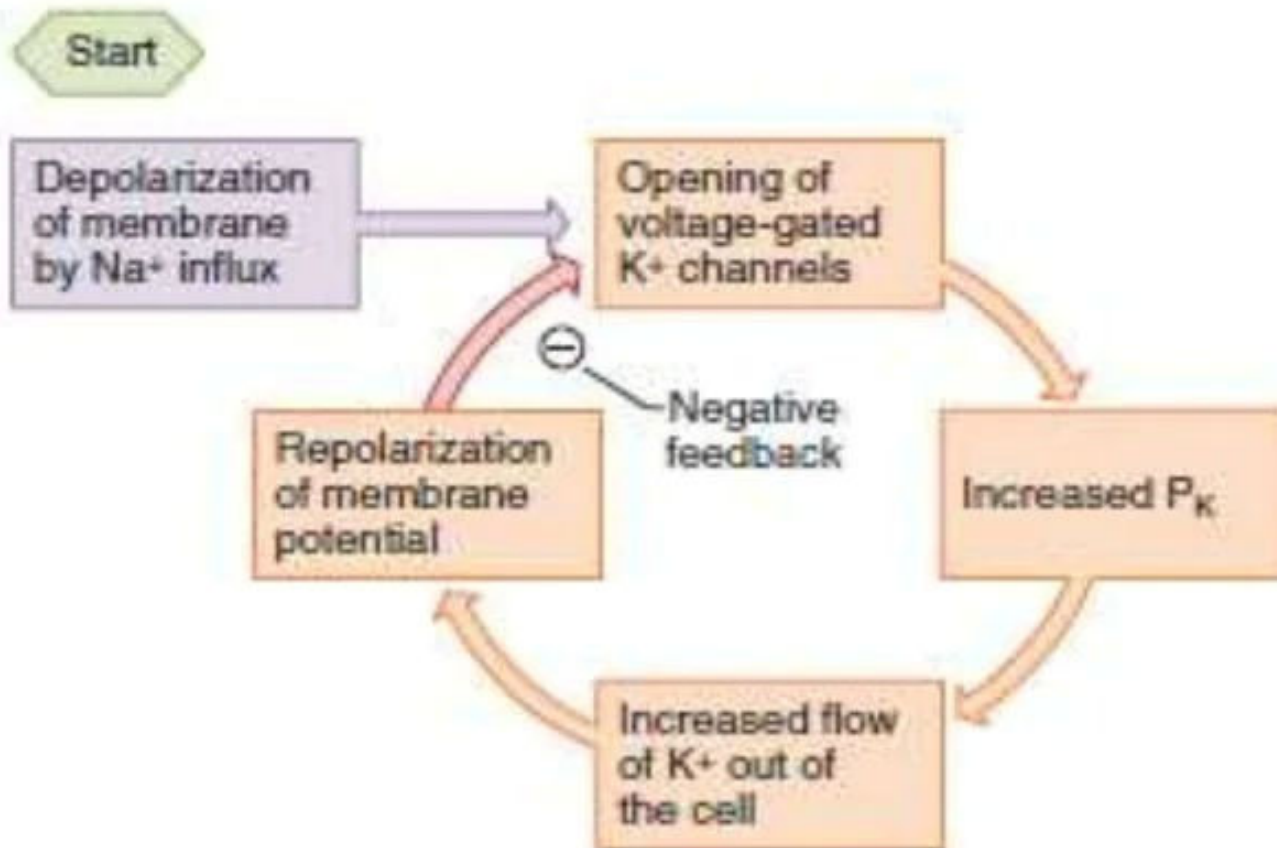
## Feedback control in voltage-gated ion channels in the membrane.

Na<sup>+</sup> channels exert positive feedback.





## K<sup>+</sup> channels exert negative feedback

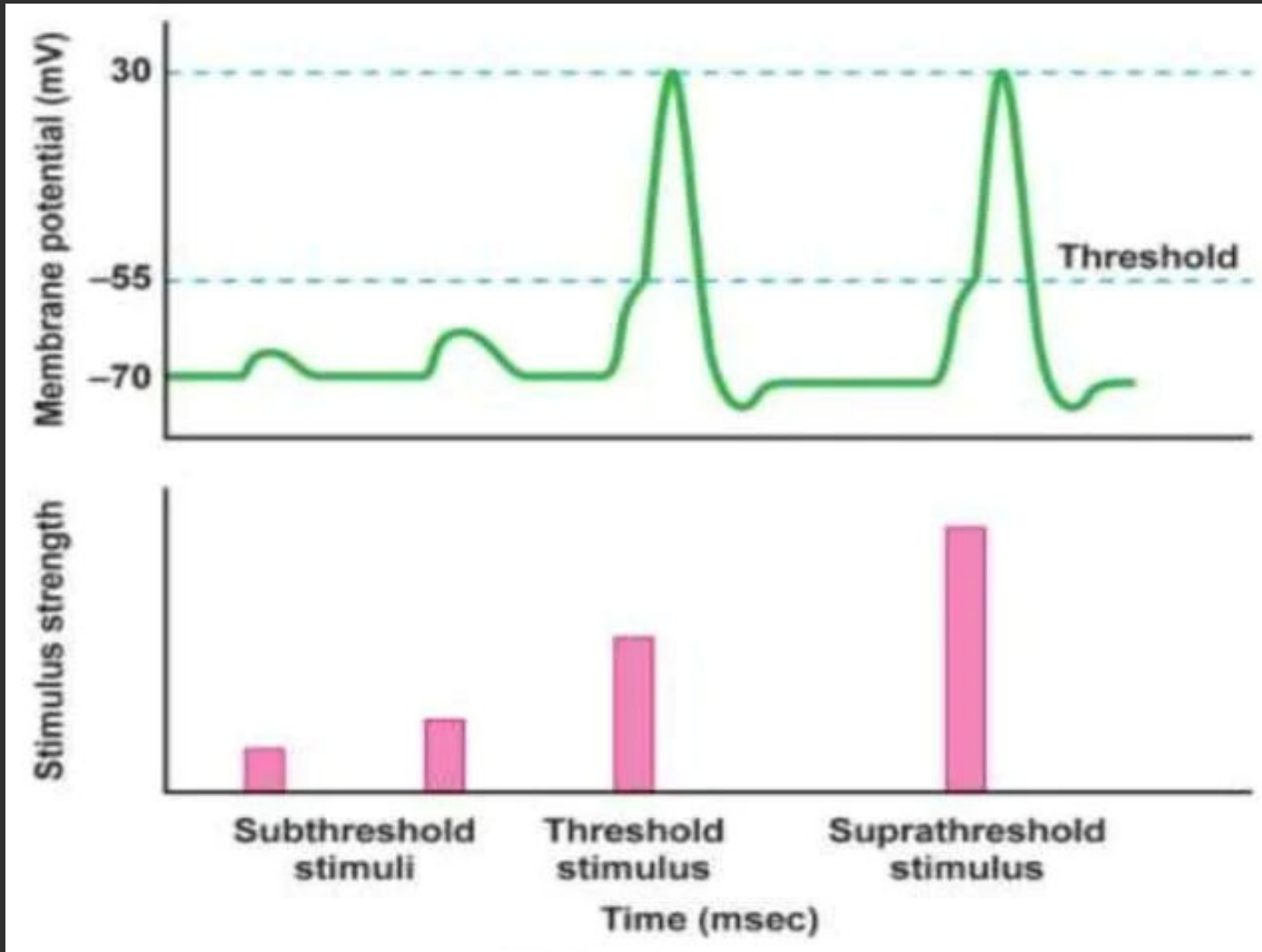




## ALL-OR-NONE ACTION POTENTIALS

- The **all-or-none law** is the principle that the strength by which a nerve or muscle fiber responds to a stimulus is independent of the strength of the stimulus.
- If that stimulus exceeds the threshold **potential**, the nerve or muscle fiber will give a complete response; otherwise, there is no response.

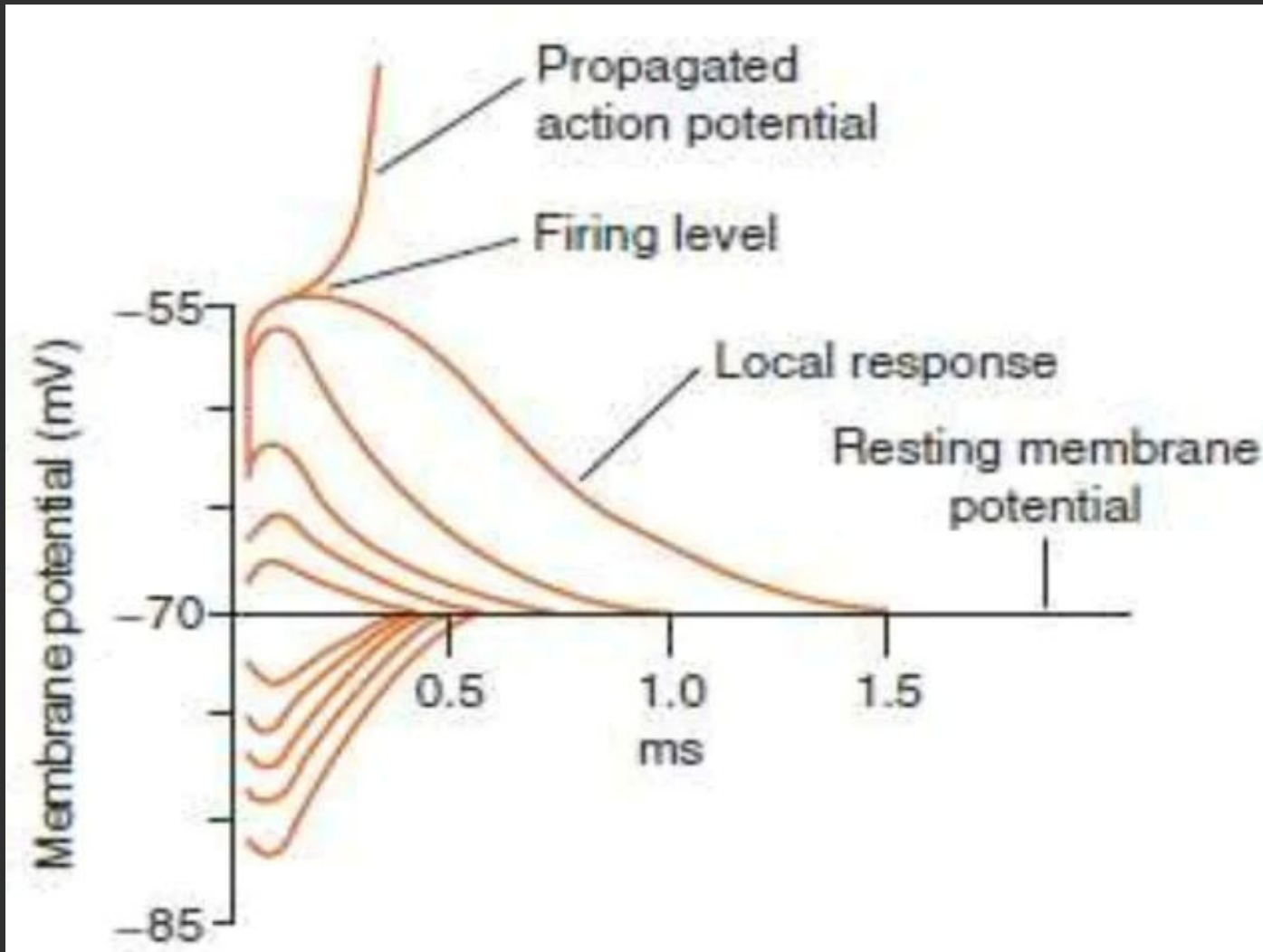






## ELECTROTONIC POTENTIALS, LOCAL RESPONSE, & FIRING LEVEL

- A non-propagated local **potential**, resulting from a local change in ionic conductance.
- Although subthreshold stimuli do not produce an action potential, they do have an effect on the membrane potential.
- This can be demonstrated by placing recording electrodes within a few millimeters of a stimulating electrode and applying subthreshold stimuli of fixed duration.
- Application of such currents leads to a localized depolarizing potential change that rises sharply and decays exponentially with time.





## **CHANGES IN EXCITABILITY DURING ELECTROTONIC POTENTIALS & THE ACTION POTENTIAL**

- During the action potential, as well as during electrotonic potentials and the local response, the threshold of the neuron to stimulation changes.
- Hyperpolarizing responses elevate the threshold, and depolarizing potentials lower it as they move the membrane potential closer to the firing level.



## CONDUCTION OF THE ACTION POTENTIAL

- The nerve cell membrane is polarized at rest, with positive charges lined up along the outside of the membrane and negative charges along the inside. During the action potential, this polarity is abolished and for a brief period is actually reversed.
- **Positive charges from the membrane ahead of and behind the action potential flow into the area of negativity represented by the action potential (“current sink”).**