

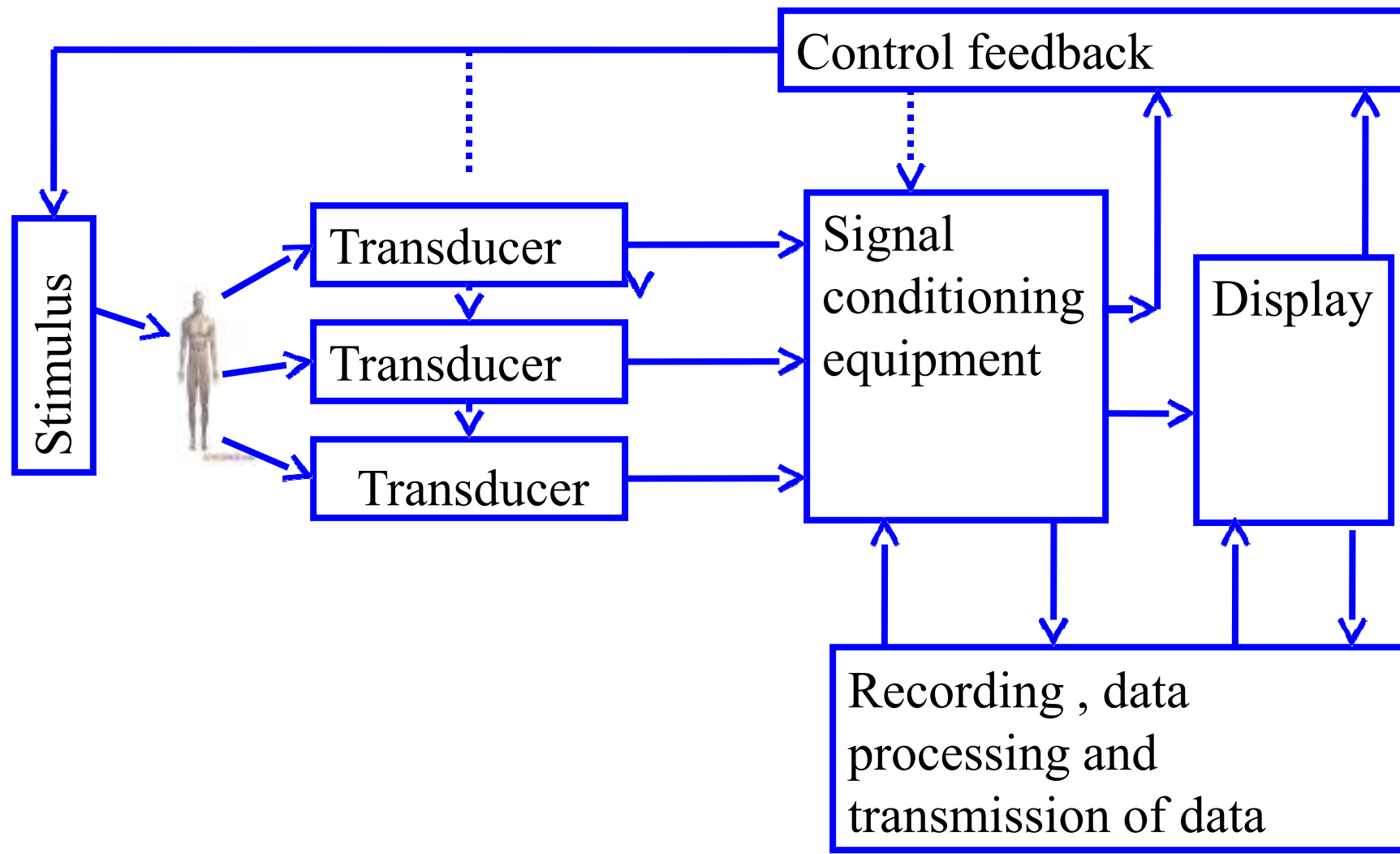
MEDICAL ELECTRONICS

Medical Instruments

Classification of Biomedical Equipments

- 1. Diagnostic equipment**
- 2. Therapeutic equipment**
- 3. Clinical equipment**
- 4. Laboratory equipment**

Components in Man – Instrument system



Man – Instrument system

□ **Measurement in biomedical instrumentation can be divided in to two**

1.VO

- **Measurement is made on or within the human body**
 - **Eg . Device inserted in to the blood stream to measure PH of blood**

2.VITRO

- **Measurement is performed outside of the body.**
- **Eg . Measurement of blood PH from blood samples.**

Sources of Bioelectric potentials

- The systems in the human body generate their own monitoring signals when they carry out their functions.**
- These signals provide useful information about their function.**
- Bioelectric potentials are actually ionic voltages produced as a result of electrochemical activity of certain cells.**
- Transducers are used to convert these ionic potentials into electrical signals**

Resting and Action potentials

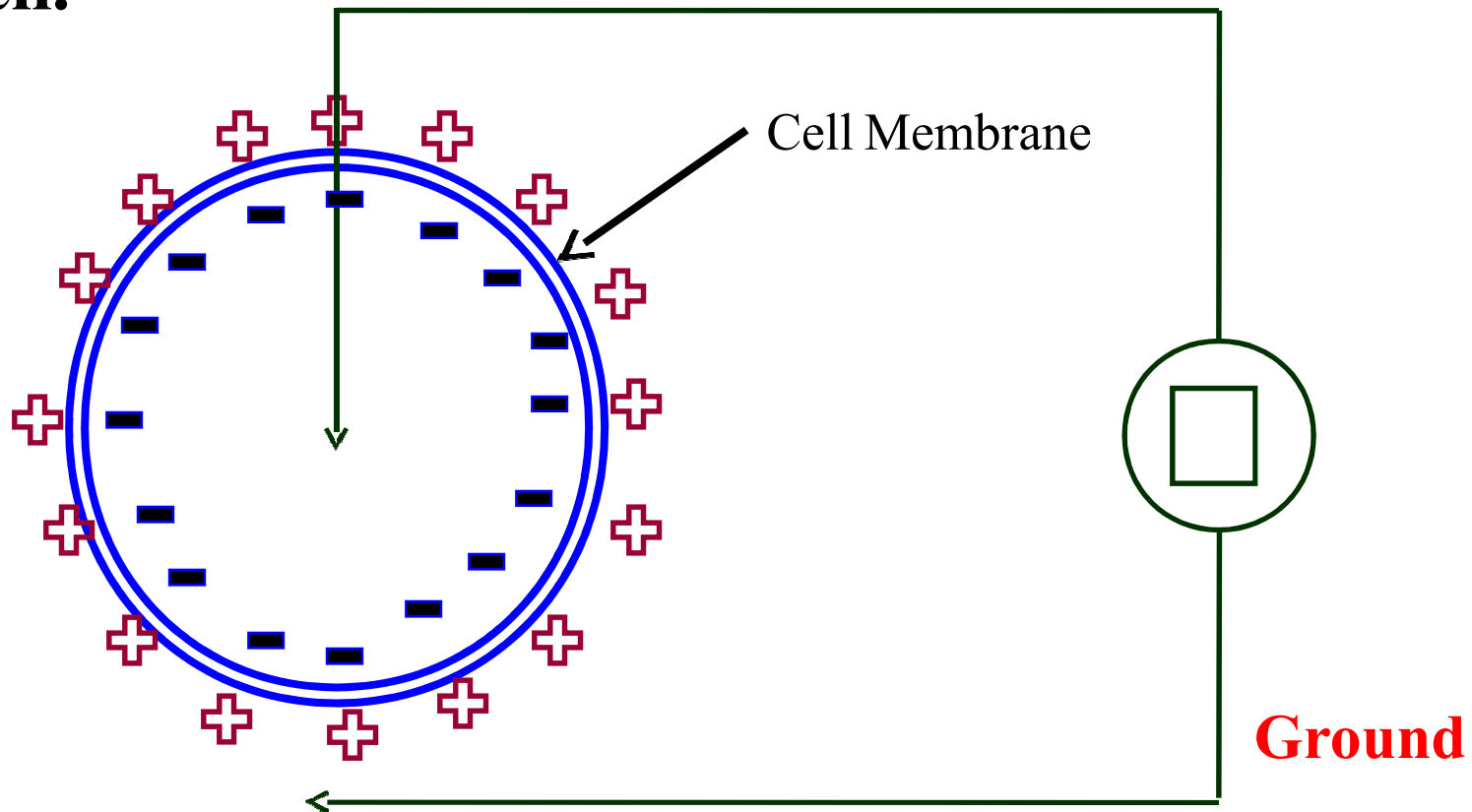
- □ Certain types of cells within the body , such as nerve and muscle cells are encased in a semi permeable membrane.**
- This membrane permits some substances to pass through while others are kept out.**
- Surrounding the cells of the body are the body fluids**
- These fluids are conductive solutions containing charged atoms known as ions**

Resting potentials

- **The principle ions are sodium(Na^+) Potassium(K^+) and chloride(C^-)**
- **The membrane of excitable cells permit entry of Potassium(K^+) and chloride(C^-) ions but blocks the entry of sodium(Na^+) ions.**
- **So inside the cell is more negative than outside cell**
- **This membrane potentials is called Resting potentials**
- **This potential is measured from inside the cell with respect to body fluids.**
- **So resting potential of a cell is negative.**

Resting potentials/Polarization

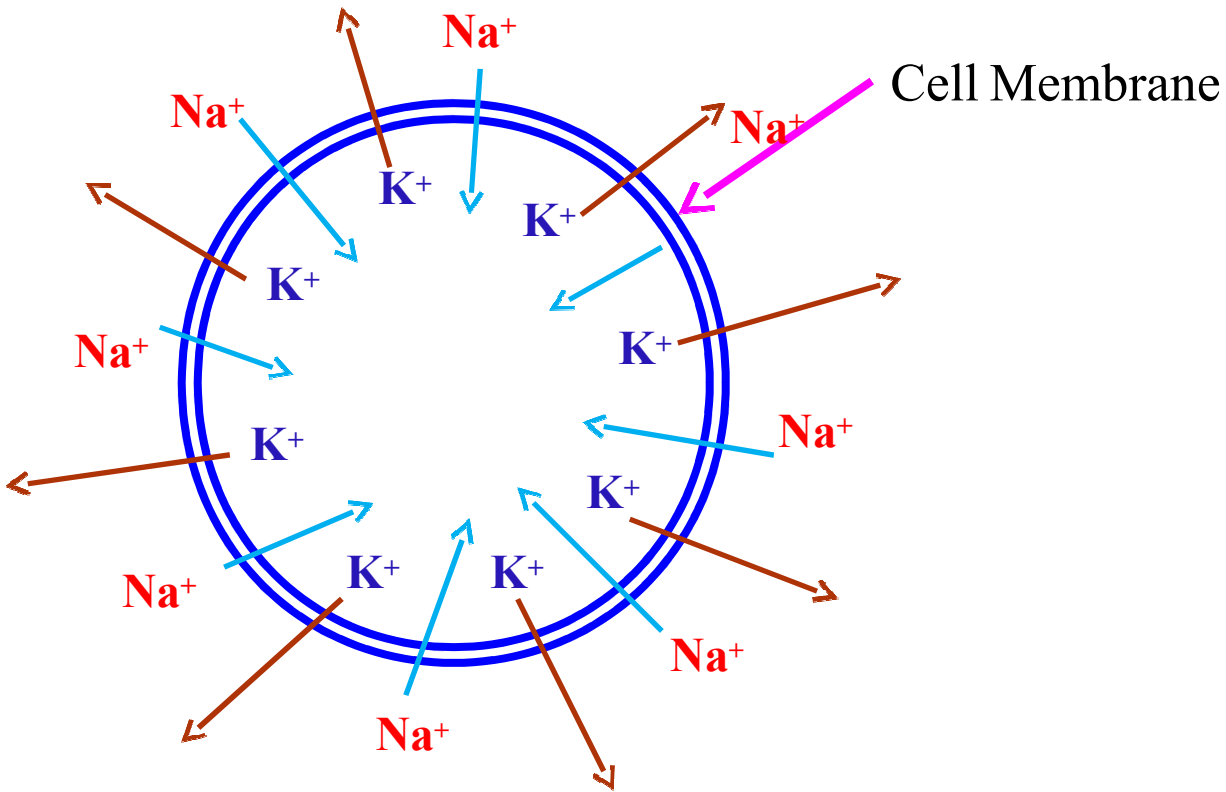
- This resting potential ranging from -60mv to -100 mv .
- Cell in the resting state is called polarized cell.



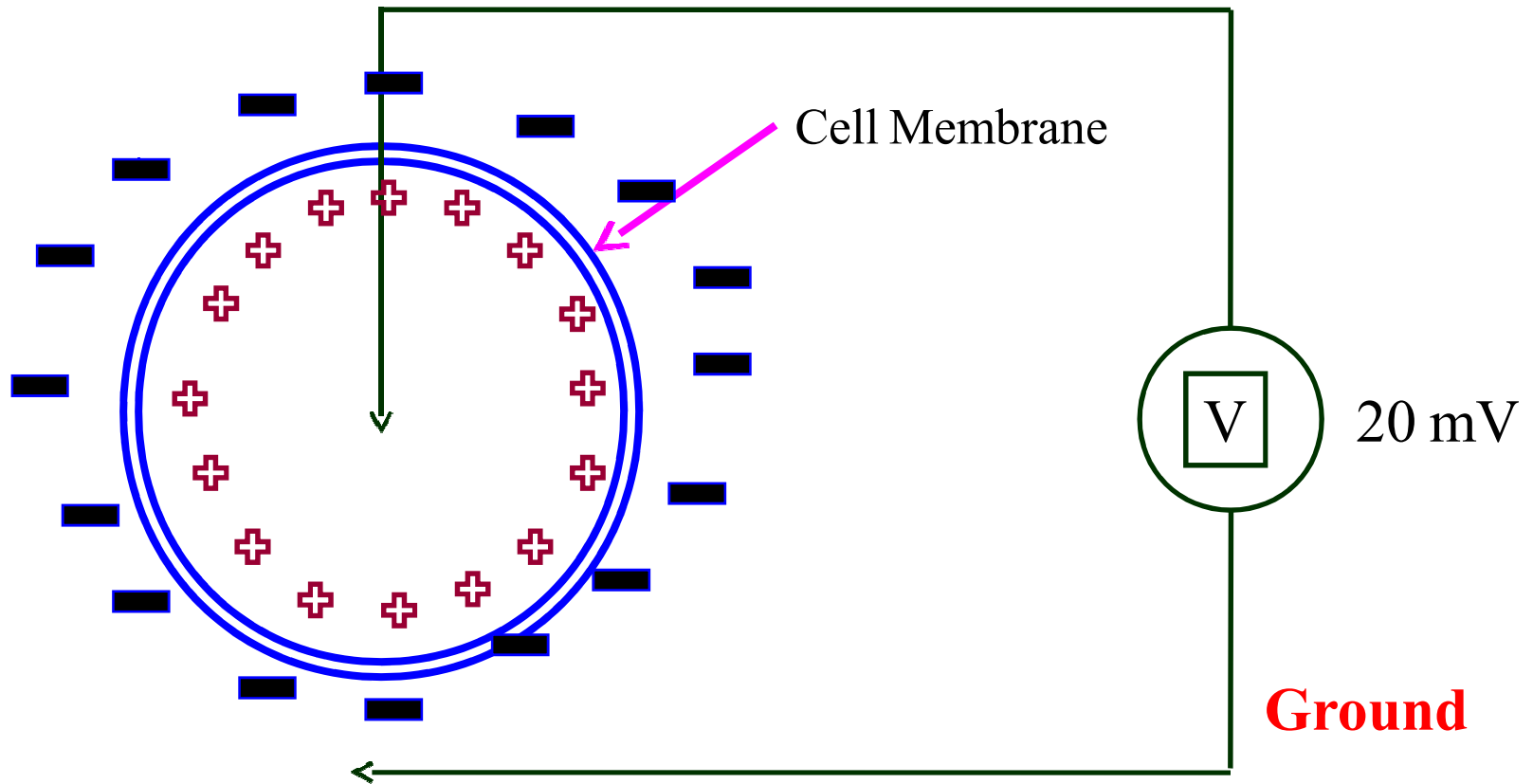
Depolarization of cell

- When a cell is excited, the membrane changes its characteristic
- **The sodium ions are rushed in to the cell.**
- **At the same time potassium ions try to move from inside.**
- **After an equilibrium state is reached, the sodium is moved back to outside**

Depolarization of cell

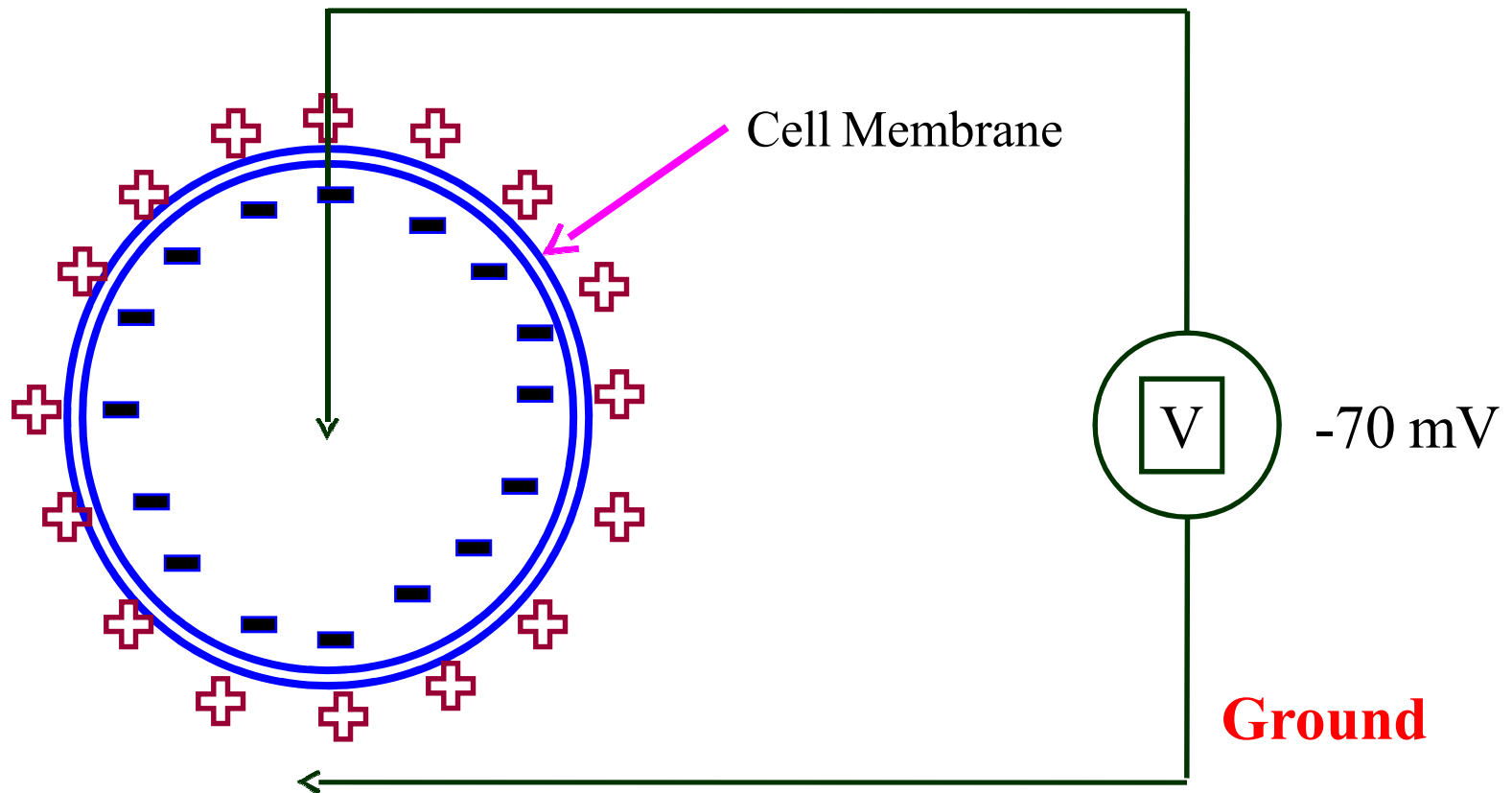


Action potentials

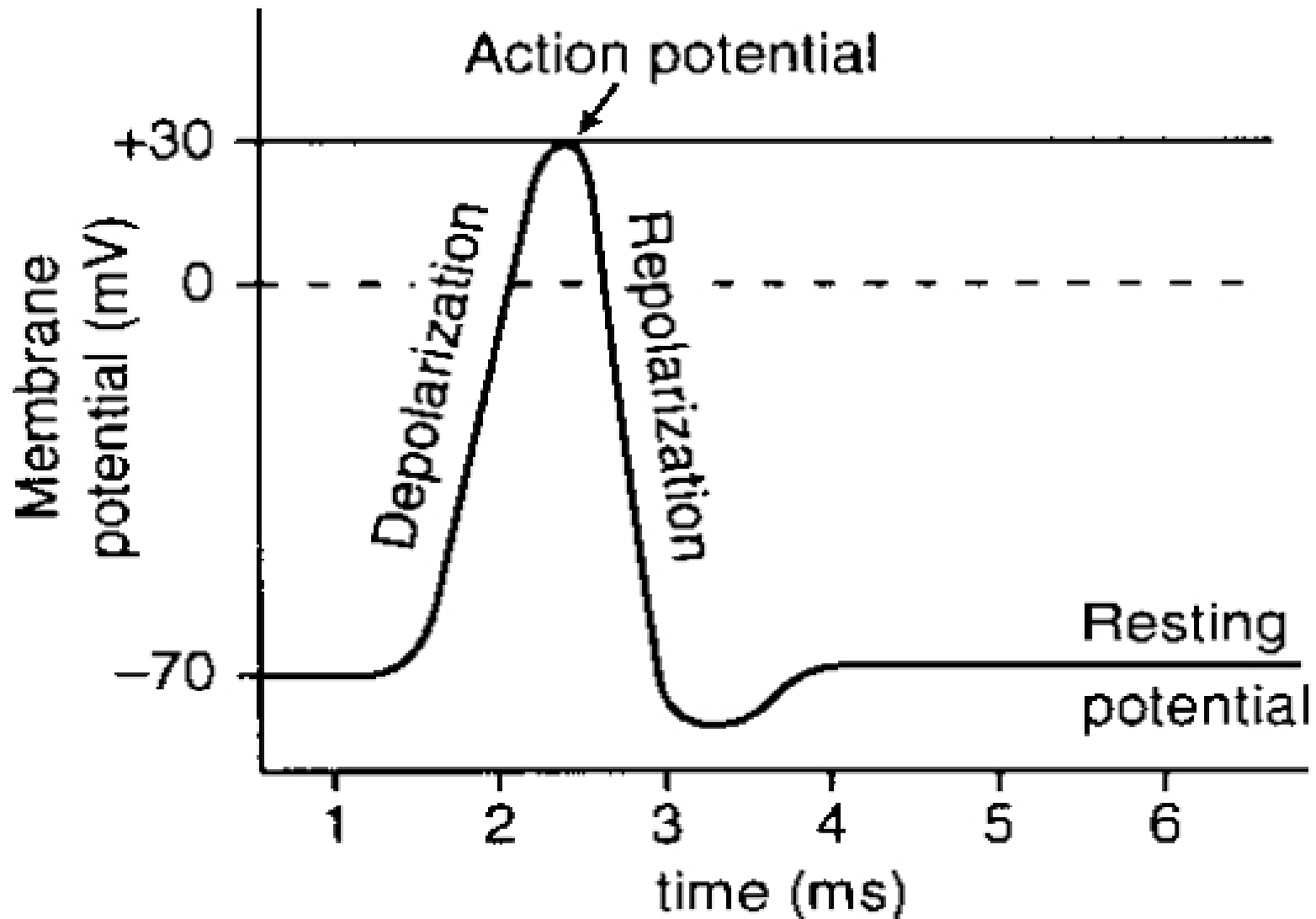


Re Polarization

□ Cell comes from de polarized state in to polarized state is called Re polarization.

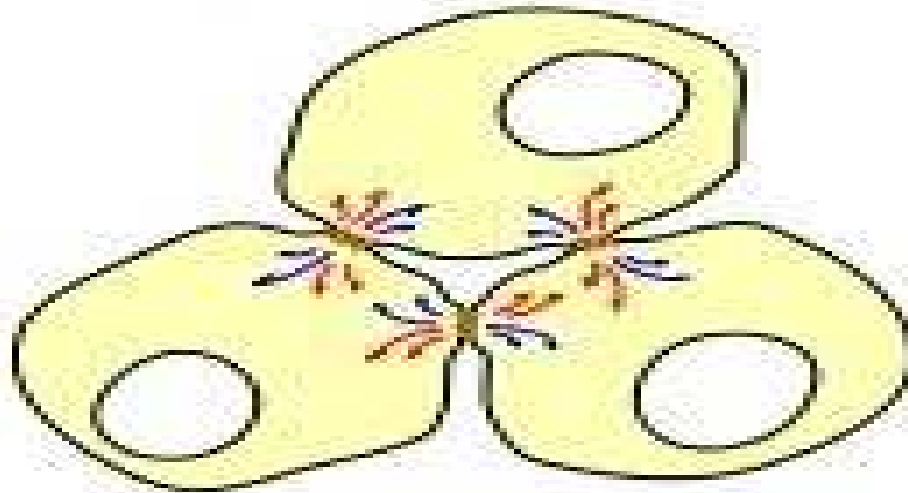


Resting and Action potentials



Propagation of Action potentials

- **When a cell is excited and generates an action potential ionic currents to flow.**
- **This process excite neighboring cells or adjacent area of the same cell**



Transducers

- **A transducer is necessary to convert one variable in to another form**
- **Used to measure physiological variables**
- **Variable is a quantity that vary with time.**
- **The term active and passive has different meaning when they are applied to Transducers**

Transducer can be classified in to two

□ **Active Transducer**

Known principles is used to convert variables in to electrical signal

□ **Passive Transducer**

It involves control of an excitation voltage or modulation of a carrier signal

Principles used in Active Transducers

□ It can convert electrical signal in to physical variables and also in reverse direction.

1. Magnetic Induction

2. Piezoelectric effect

3. Thermoelectric effect

4. Photoelectric effect

Passive Transducers

- **Utilize the principles of controlling a DC excitation or an AC carrier signal.**
- **It consists of a passive circuit element which changes its value as a function of physical variables to be measured.**
- **It cannot convert electrical signal into physical variables**

Principles used in Passive Transducers

- **Using Resistive element**

1. **Ordinary Potentiometer**

- a. **Linear**

- b. **Rotary**

2. **Strain gage**

- a. **Un bonded**

- b. **Bonded**

- c. **Semiconductor strain gage**

- **Using Inductive element**

1. **Variable reluctance Transducer**

LVDT

Using Capacitive element

Transducers for Biomedical field

- 1. Force transducer**
- 2. Photoelectric displacement transducer**
- 3. Pressure Transducers**
- 4. Flow transducers**
- 5. Transducers with digital O/P**

Transducers for Biomedical field

- 1. Resistive transducers - Muscle force and Stress (Strain gage), Spirometry (Potentiont) , humidity, (Gamstrers), Respiration (Thermistor)**
- 2. Inductive Transducers - Flow measurements, muscle movement (LVDT)**
- 3. Capacitive Transducers - Heart sound measurement, Pulse pick up**
- 4. Photoelectric Transducers - Pulse transducers, Blood pressure, oxygen Analyses**
- 5. Piezoelectric Transducers - Pulse pickup, ultrasonic blood flowmeter**
- 6. Chemcial Transducer - Ag-Agfallas (Electrodes, PH electrode**