

Biosignals and Systems

Lecture 3

Resting and action potentials

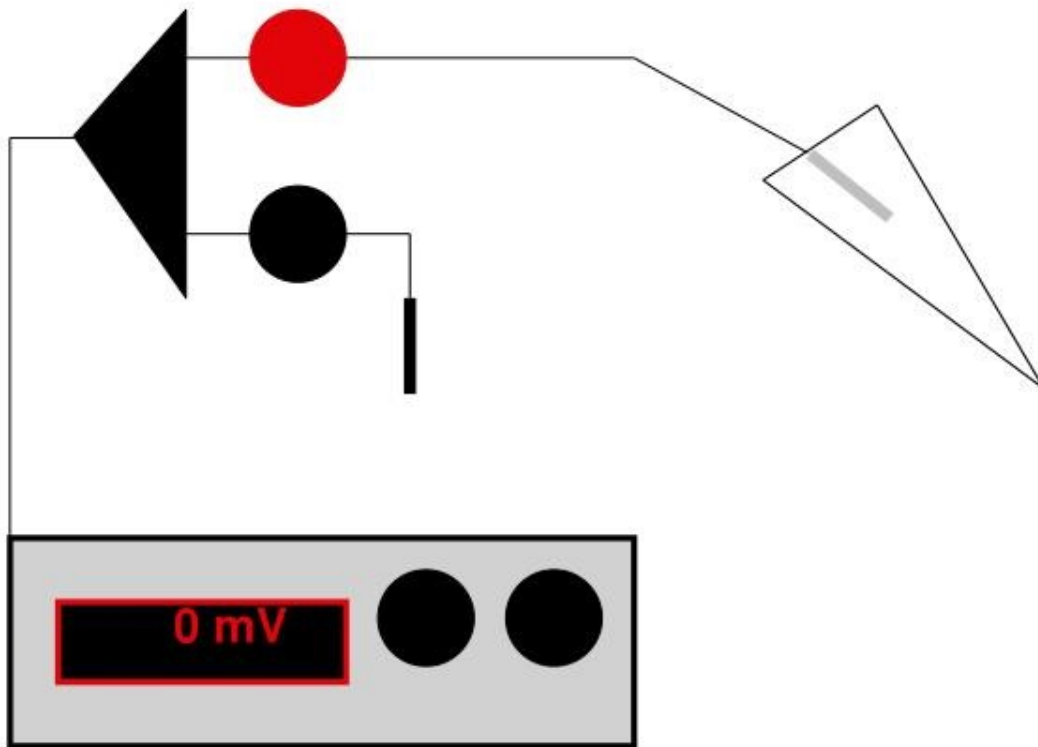
Resting and action potentials

- The resting potential is the result of an unequal distribution of ions across the membrane.
- The resting potential is sensitive to ions in proportion to their ability to permeate the membrane.

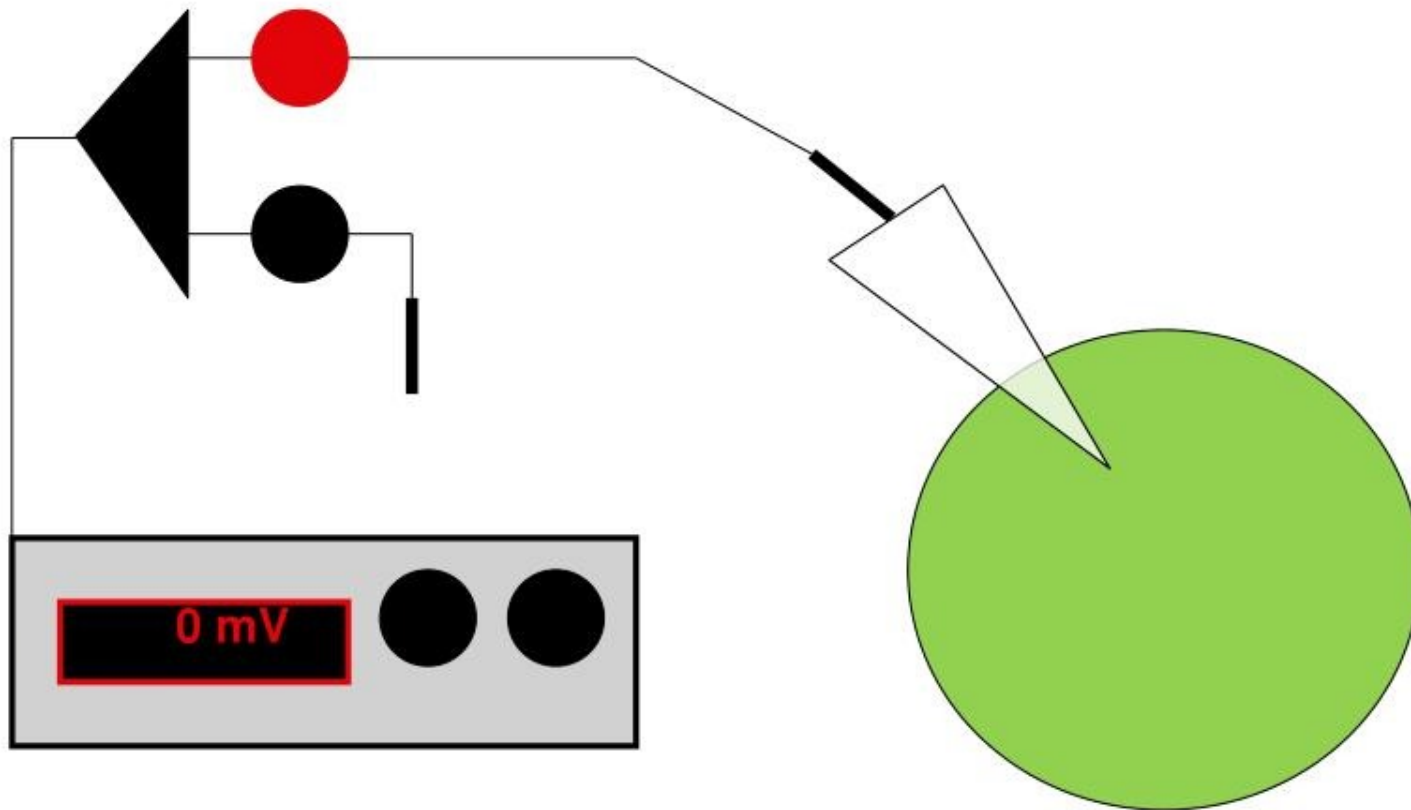
Resting potentials

- Forget the membrane and consider what factors determine the movement of ions in solution.
 - **Aqueous diffusion**
and
 - **Electrophoretic movement**

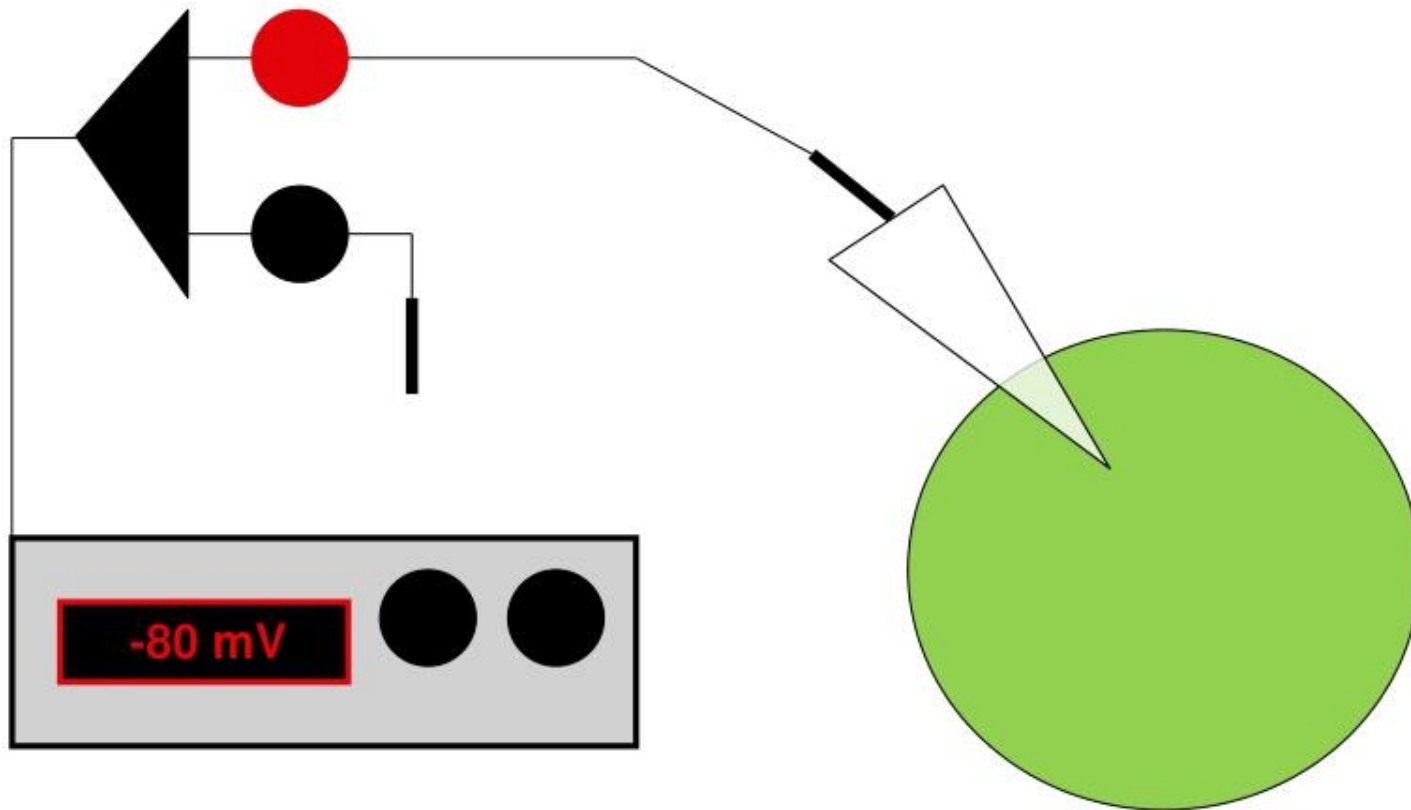
Resting potentials



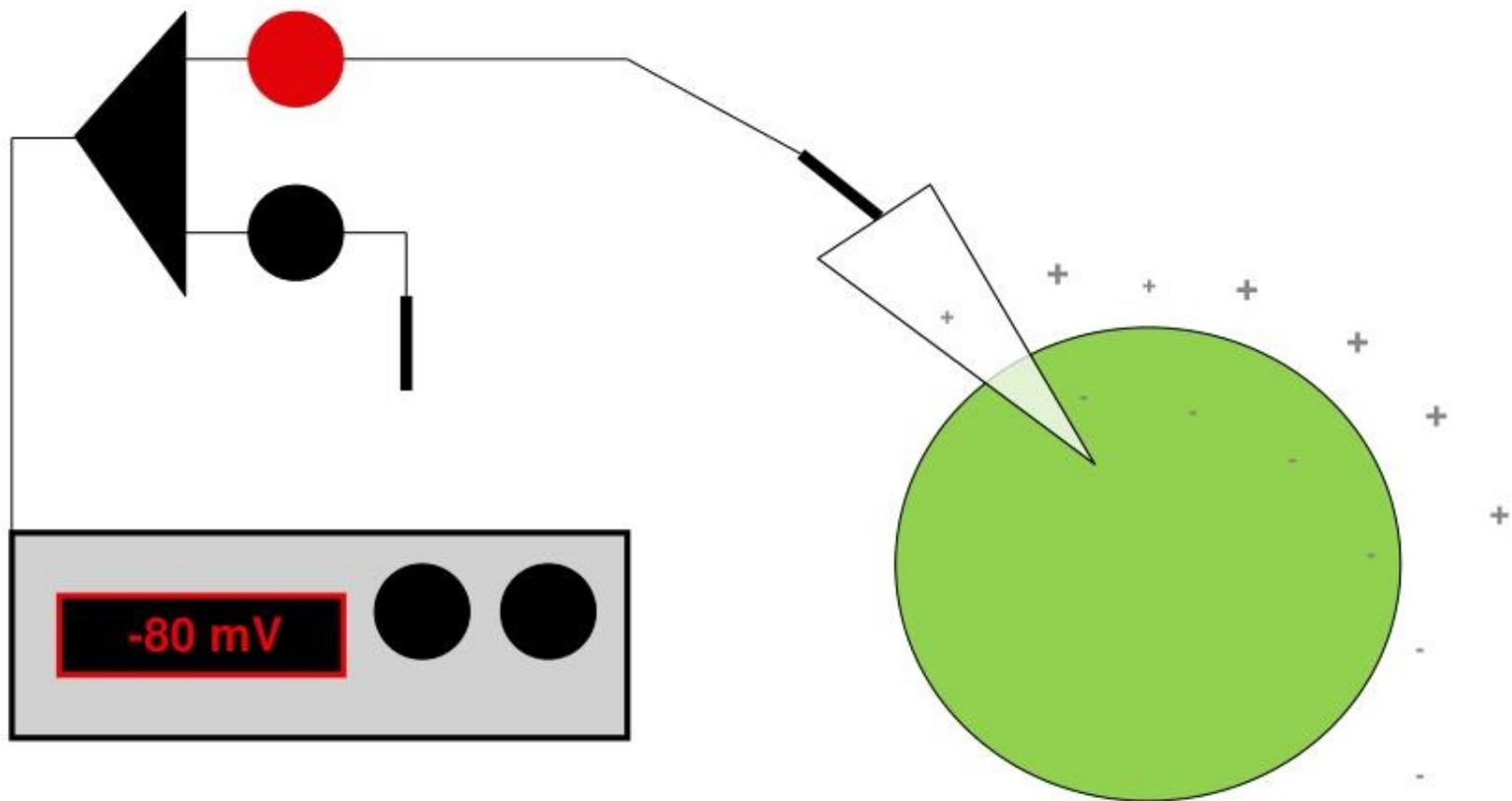
Resting potentials



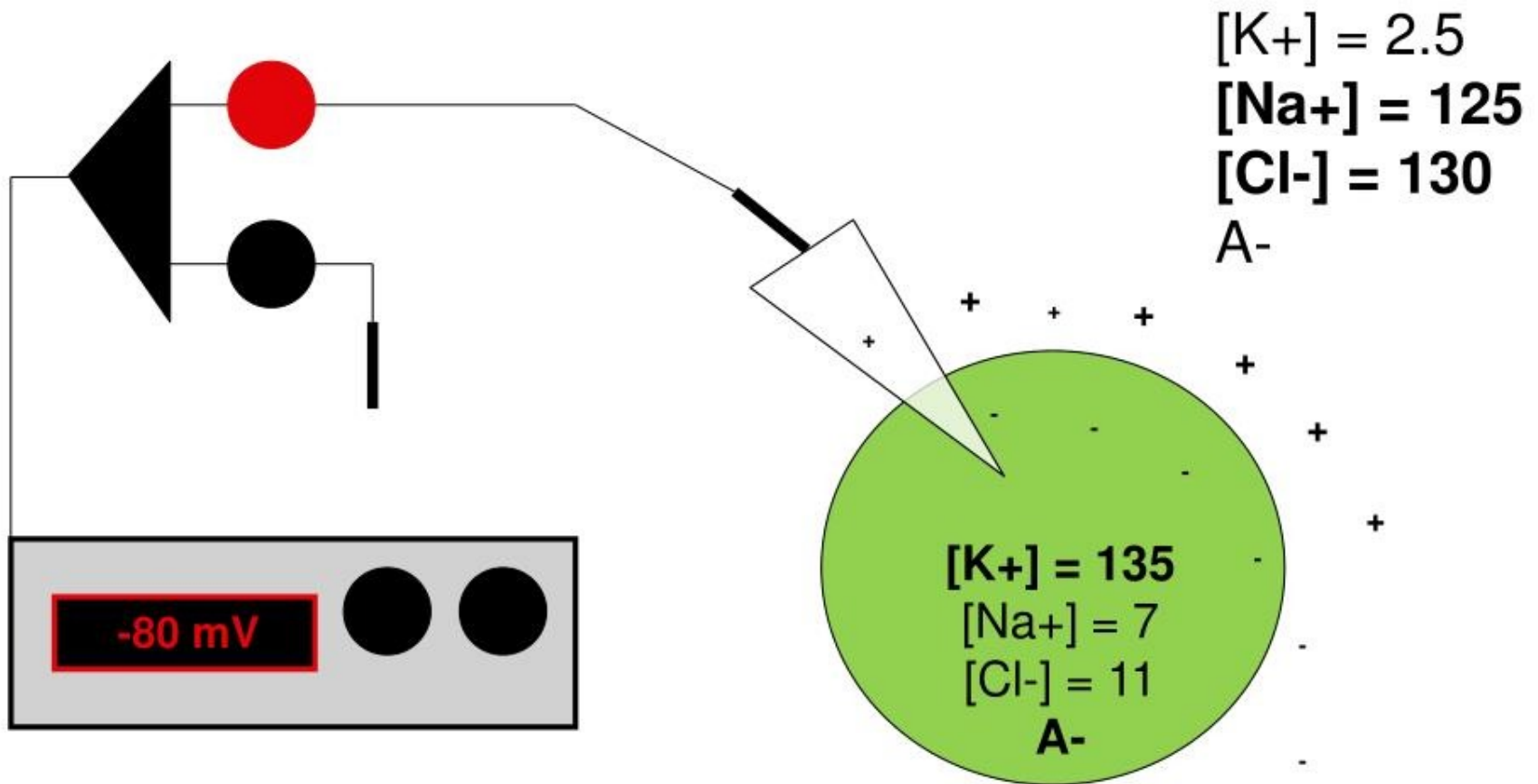
Resting potentials



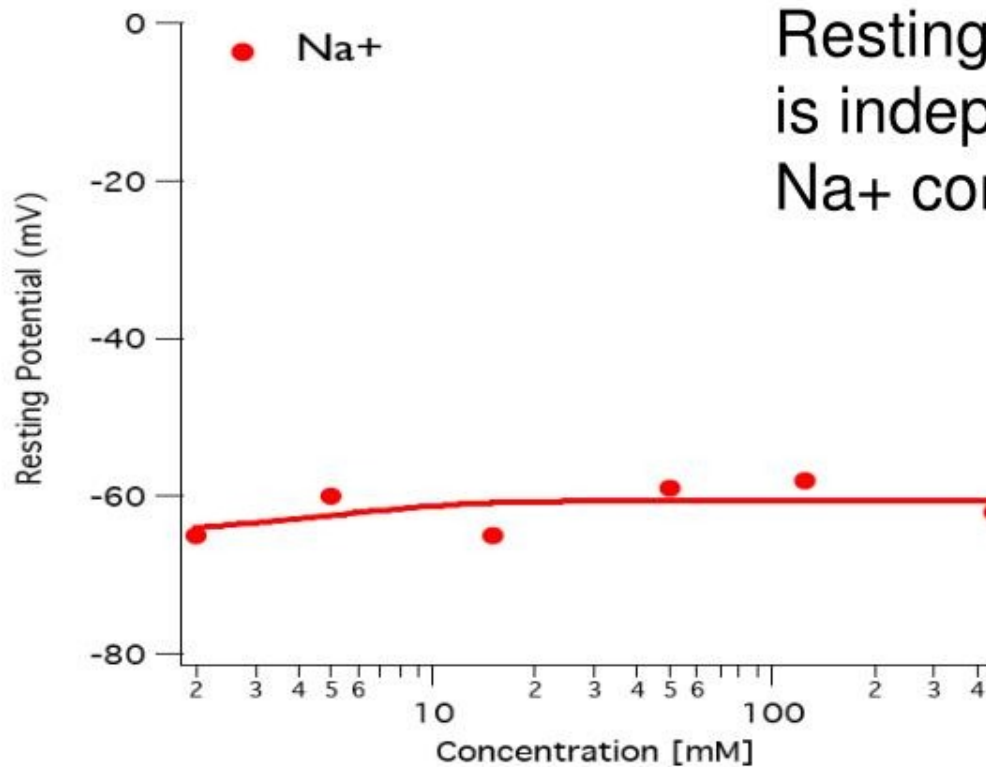
Resting potentials



Resting potentials

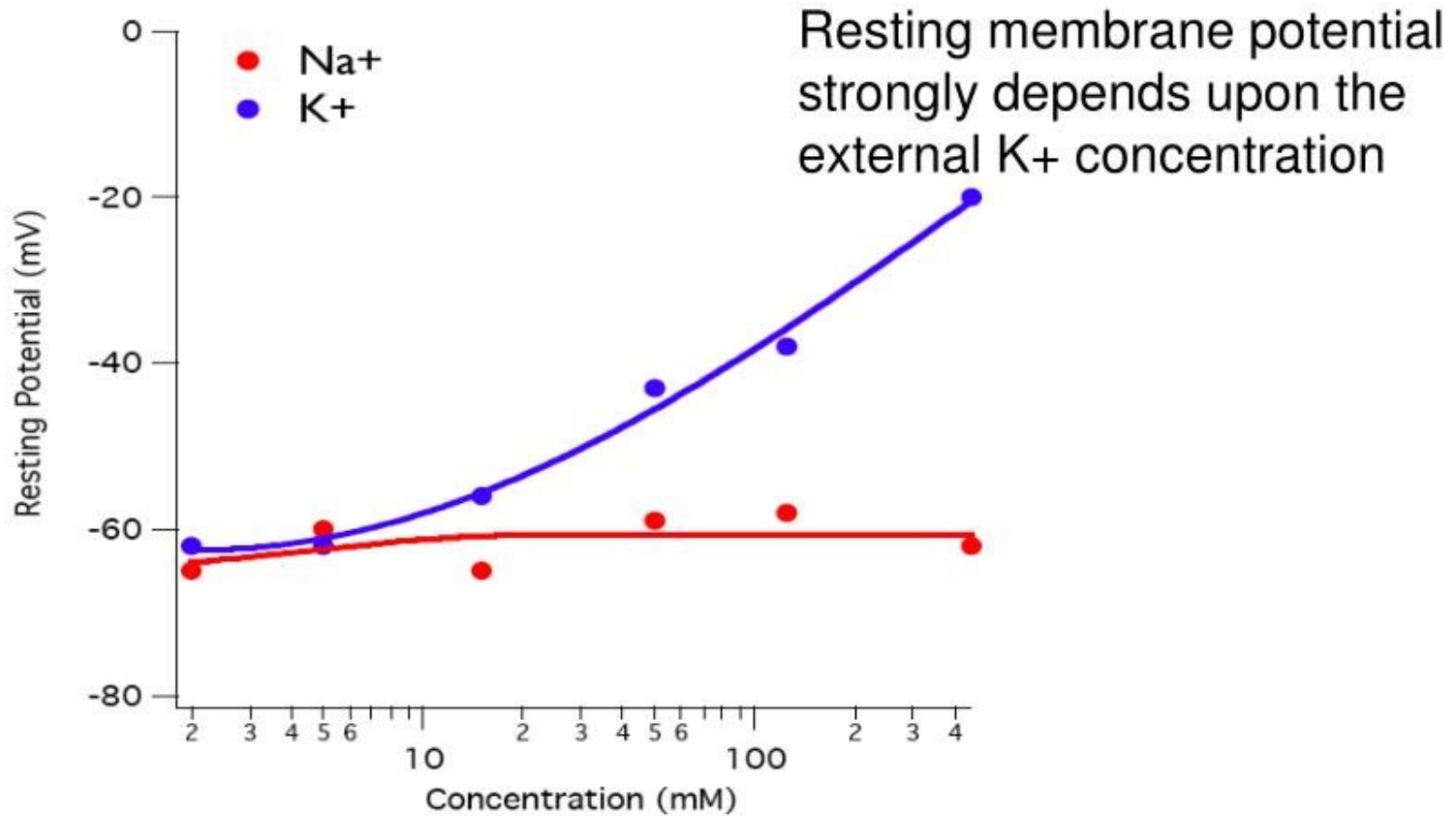


Resting potentials



Resting membrane potential is independent of external Na⁺ concentration

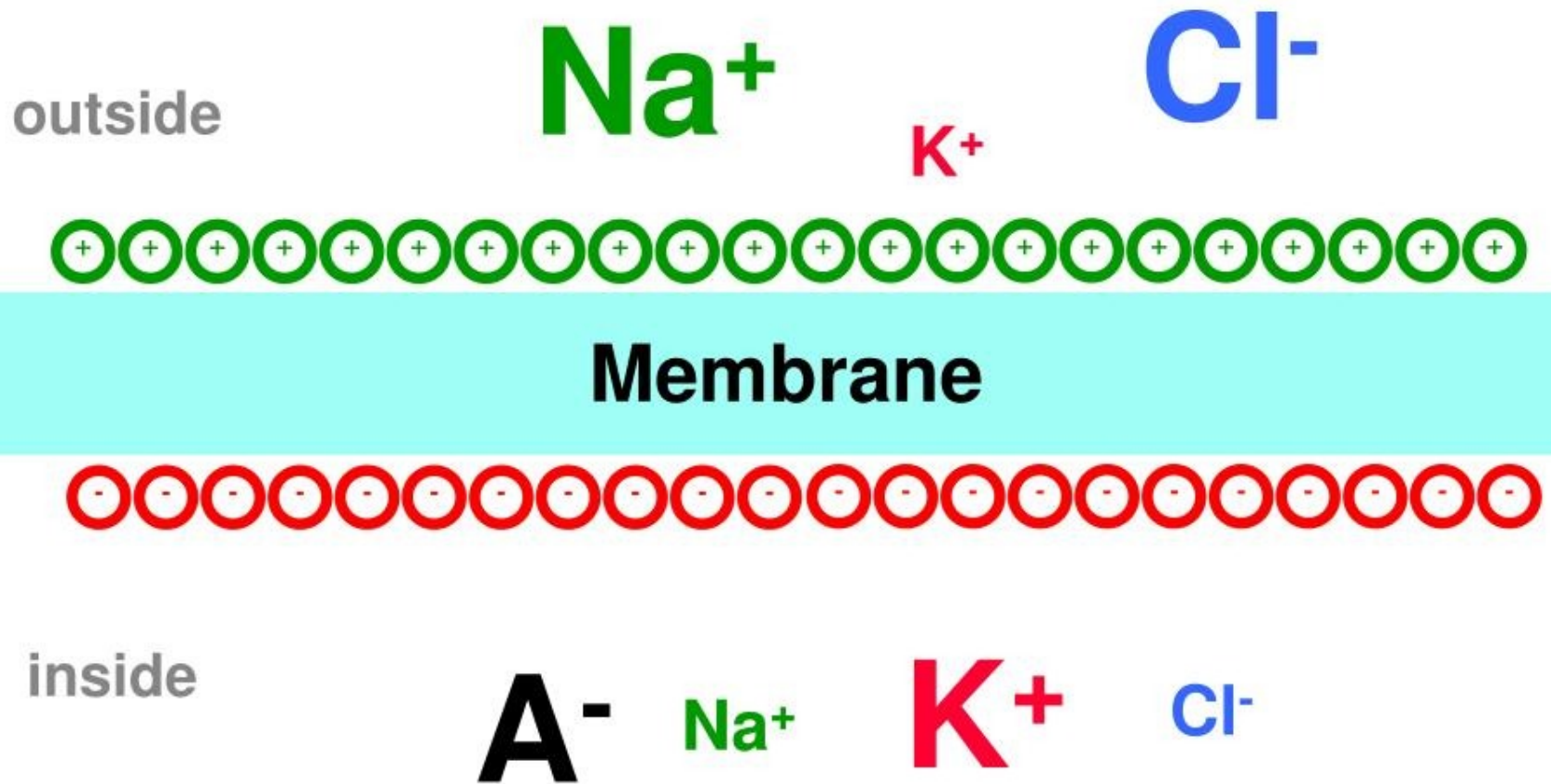
Resting potentials



Summary

- The membrane conducts ions very poorly and allows the separation of ionic species.
 - This results in a potential difference between the outside and the inside of the membrane.
- The magnitude of the resting potential is determined by the selective permeability of the membrane to ionic species.
- We can quantify the magnitude of the resting potential by considering both the **diffusive** and **electrophoretic** properties.
- In order to understand the time dependence and individual contributions of ionic species to the membrane potential it is convenient to use an electrical equivalent circuit.

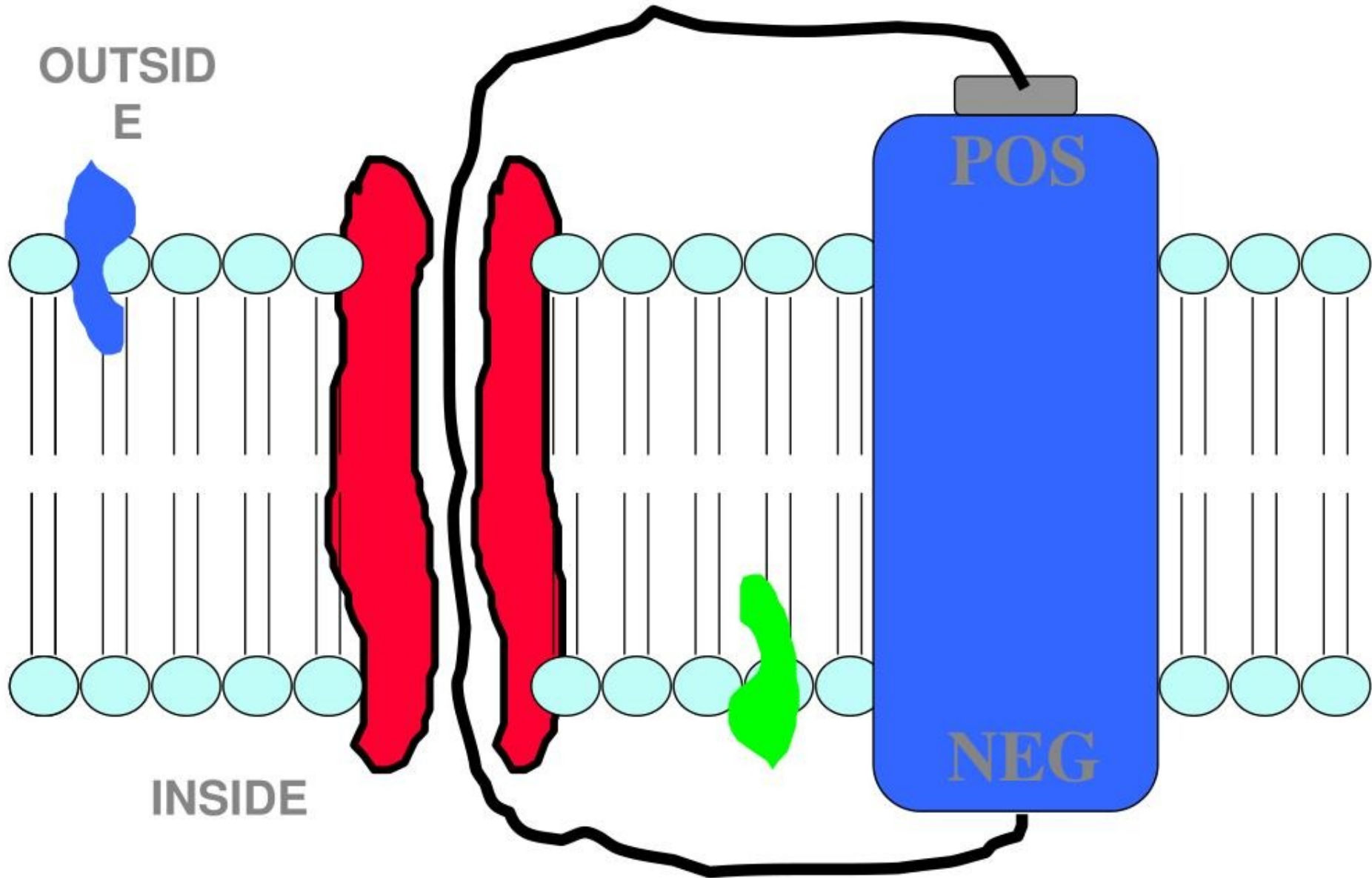
Resting Membrane Potential



Membrane is polarized

- more negative particles in than out
- Bioelectric Potential
 - like a battery
 - Potential for ion movement
 - current ~

Bioelectric Potential



Questions

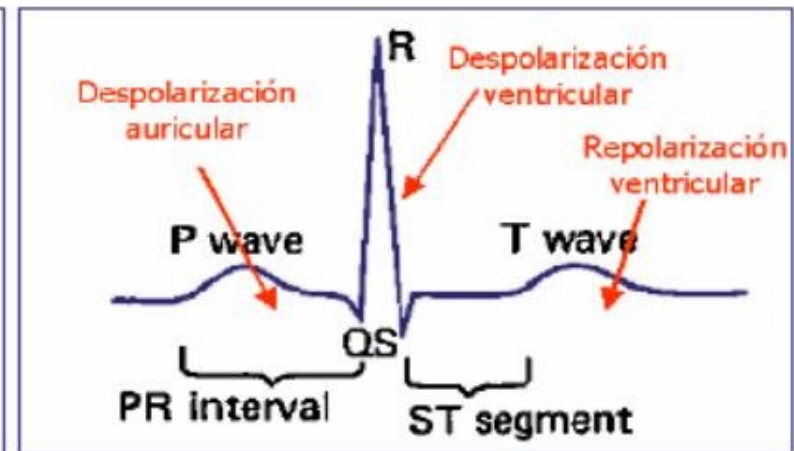
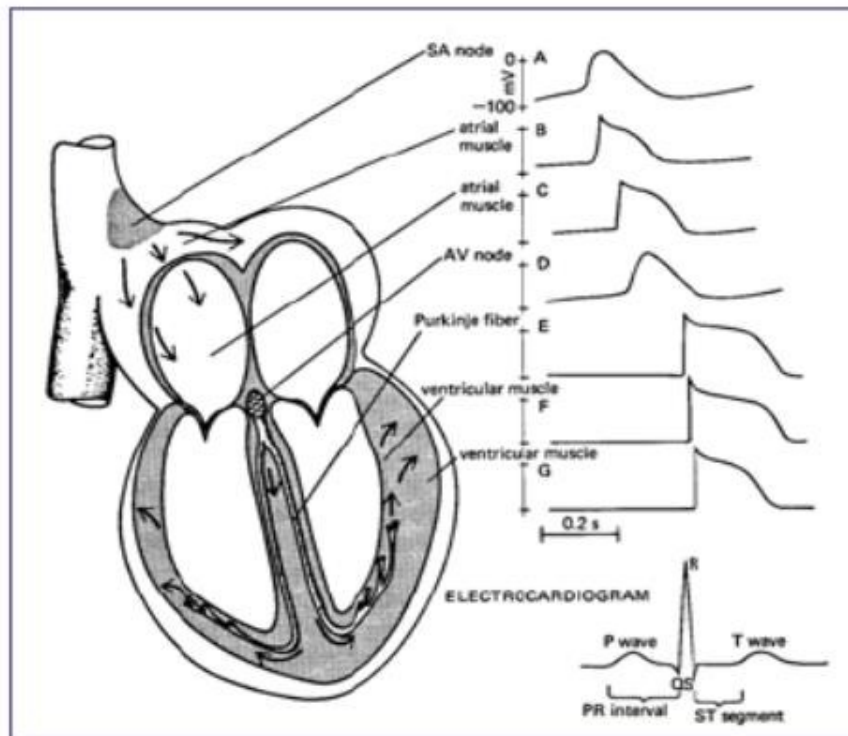
- What is the Bioelectric potentials?
- What is Membrane is polarization?
- Draw a graph of Resting membrane potential ?
- What are Resting Membrane Potential?
- Explain PROPOGATION OF POTENTIALS ?

Biopotentials

- ECG
 - electrocardiography
- EEG
 - electroencephalography
- EMG
 - electromyography
- ERG
 - electroretinography
- EOG...
 - electrooculography

Signal	Frequency range (Hz)	Amplitude range(mV)
ECG	0.01 - 100	0.05 - 3
EEG	0.1 - 80	0.001 - 1
EOG	0.01 - 10	0.001 - 0.3
EMG	50 - 3000	0.01 - 100

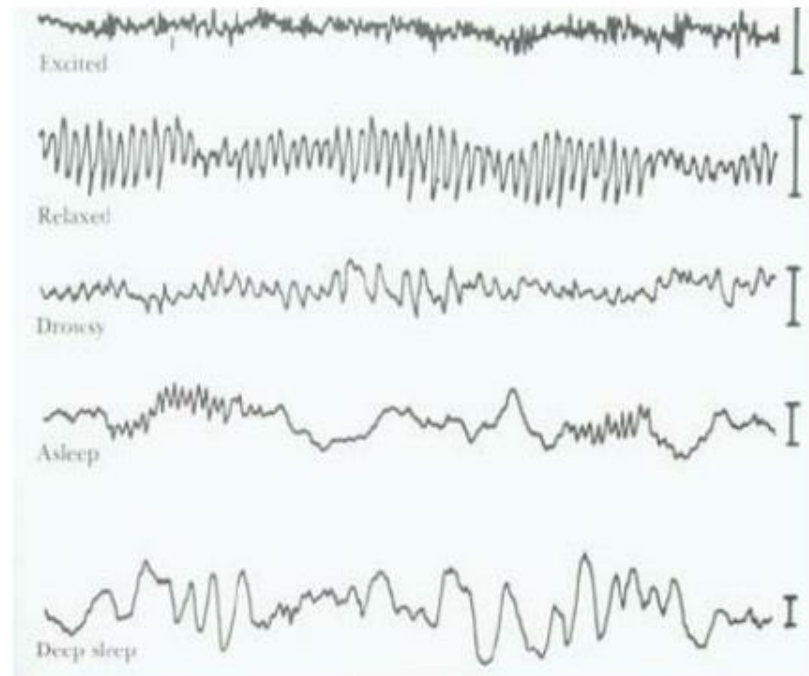
Electrocardiogram (ECG)



P: Contracción auricular
QRS: Contracción ventricular
T: Repolarización ventricular

Recording System EEG

- EEG recording is done using a standard lead system called 10-20 system
- Recall dipole concept to identify source of brain activity



Electromyogram (EMG)

- Measures muscle activity
- Record intramuscularly through needle electrodes
- Record surface EMG using electrodes on biceps, triceps...
- Use in muscular disorders, muscle based prosthesis – prosthetic arm, leg

Electroretinogram Electroretinogram (ERG)

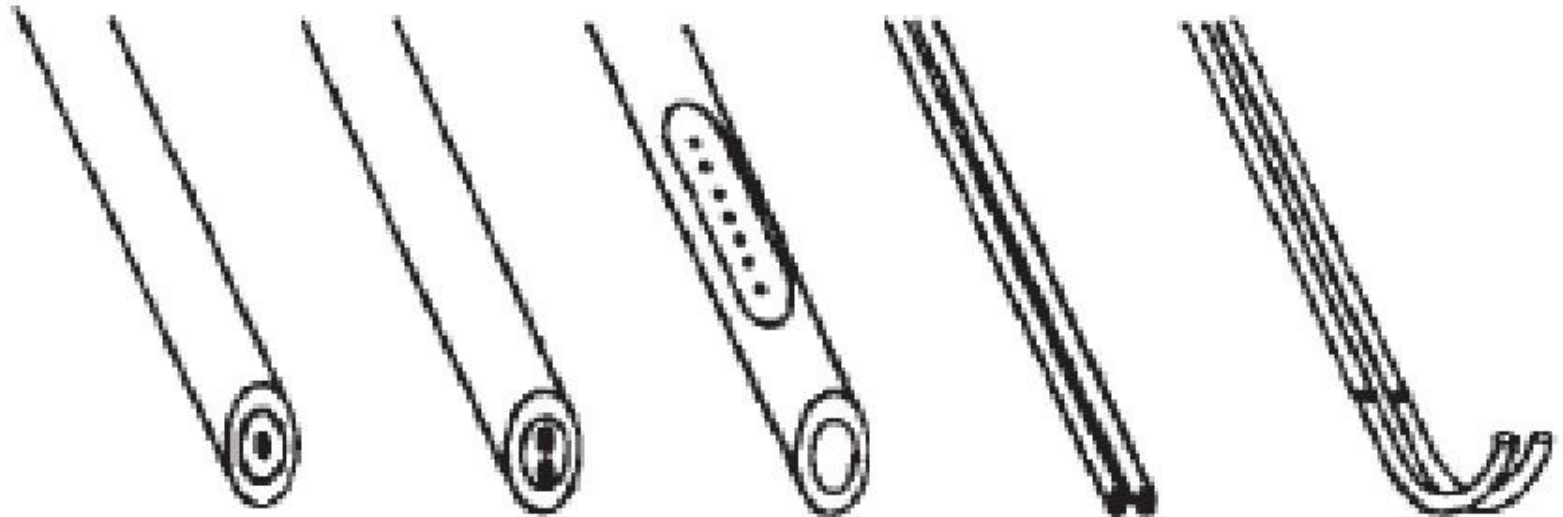
- Biopotential of the eye (retina)
- Indicator of retinal diseases such as retinal degeneration, macular degeneration
- Invasive recording

Questions

- What is Electroretinogram Electroretinogram ?
- What is EEG?
- Draw a graph of Resting membrane potential ?
- What are the Frequencies of Biopotentials?
- Explain EMG

Electrodes

Electromyography

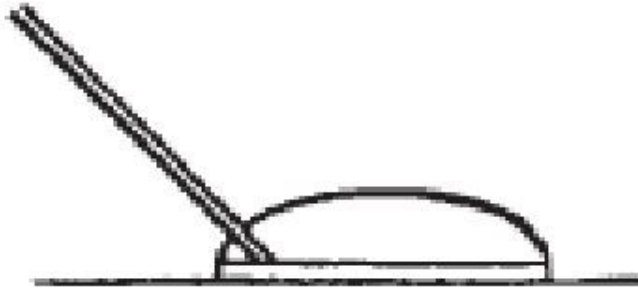


- Detection site

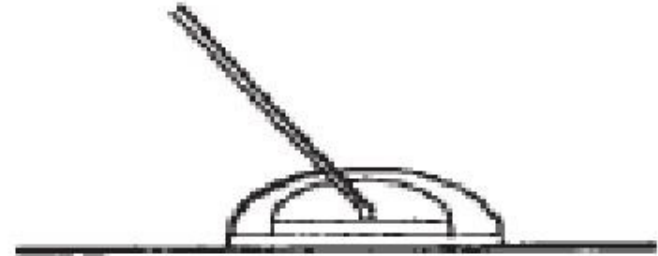
Needle electrodes

Wire electrodes

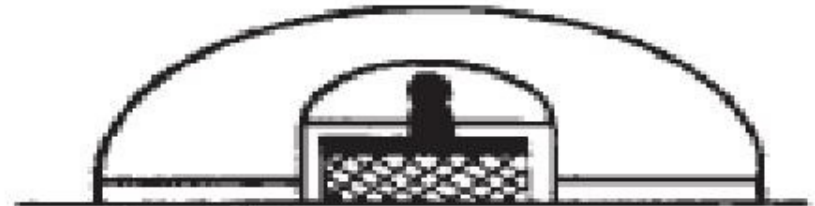
Electrodes



Dry electrode



Wet gel electrode



Surface electrodes

Electrodes

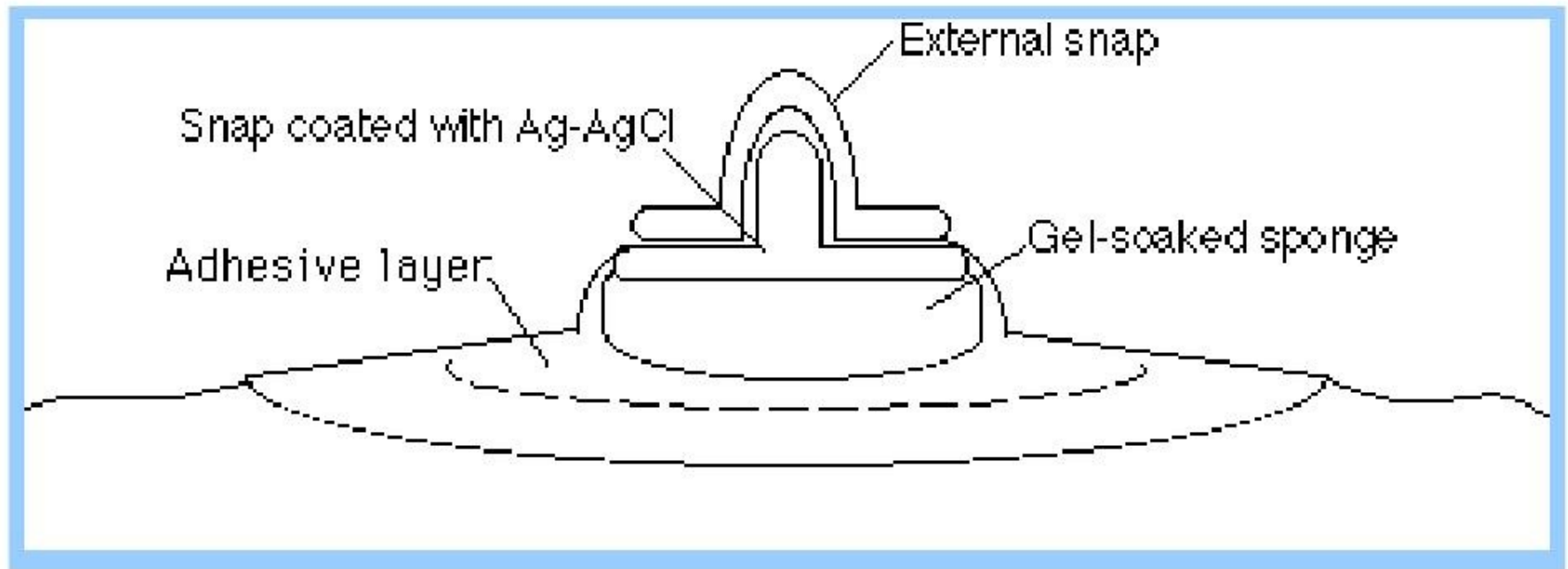
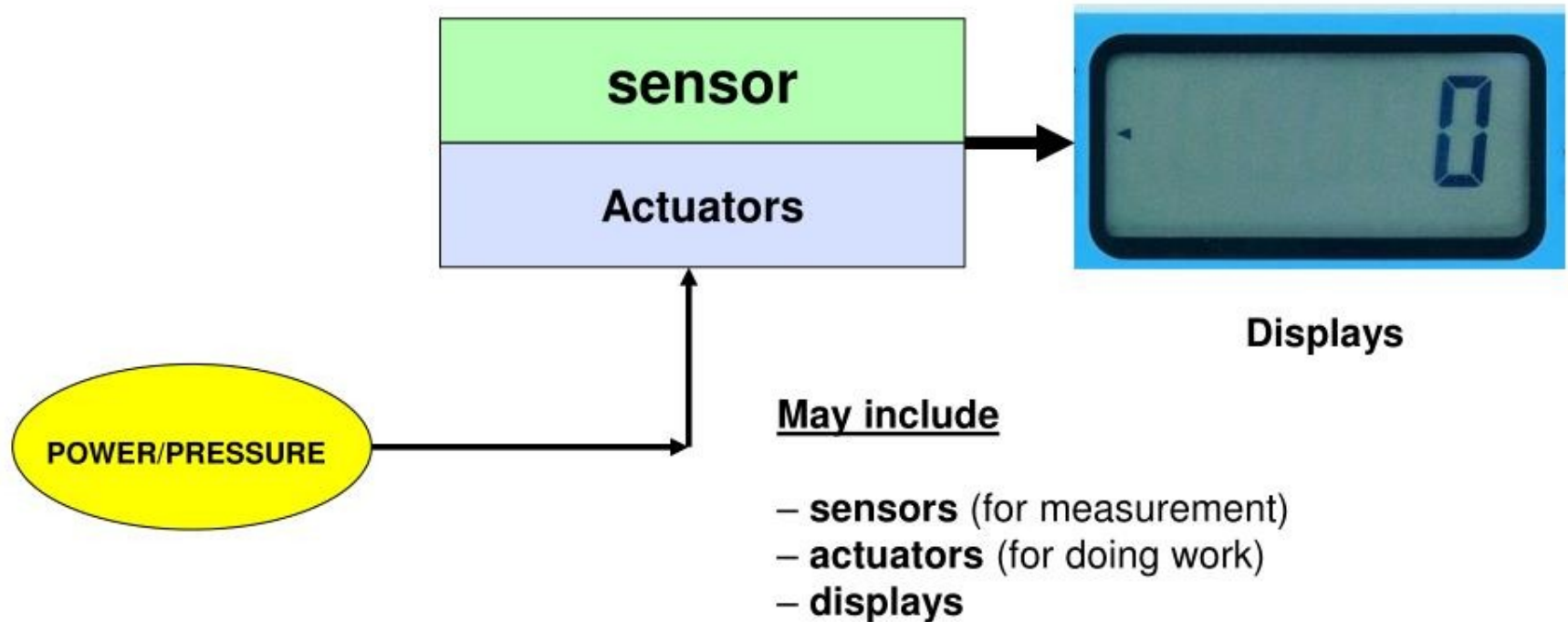
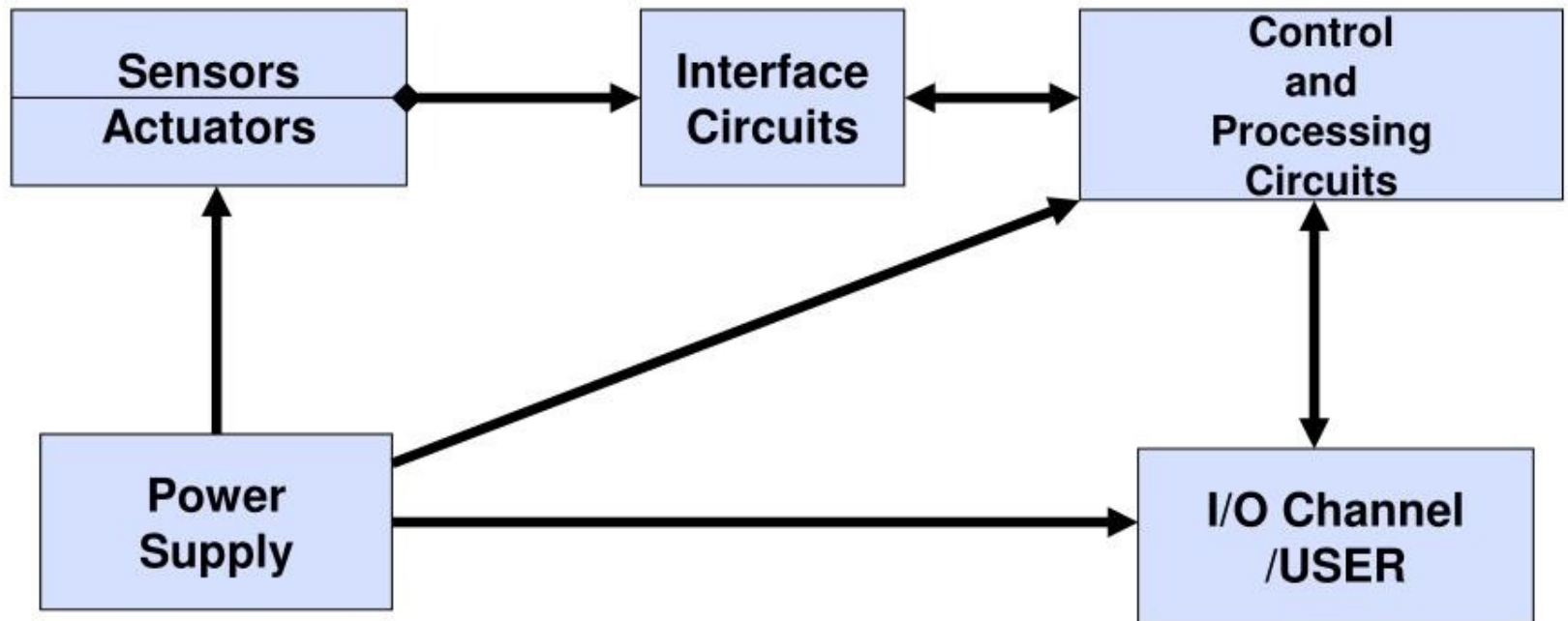


Figure A disposable surface electrode. A typical surface electrode used for ECG recording is made of Ag/AgCl. The electrodes are attached to the patients' skin and can be easily removed.

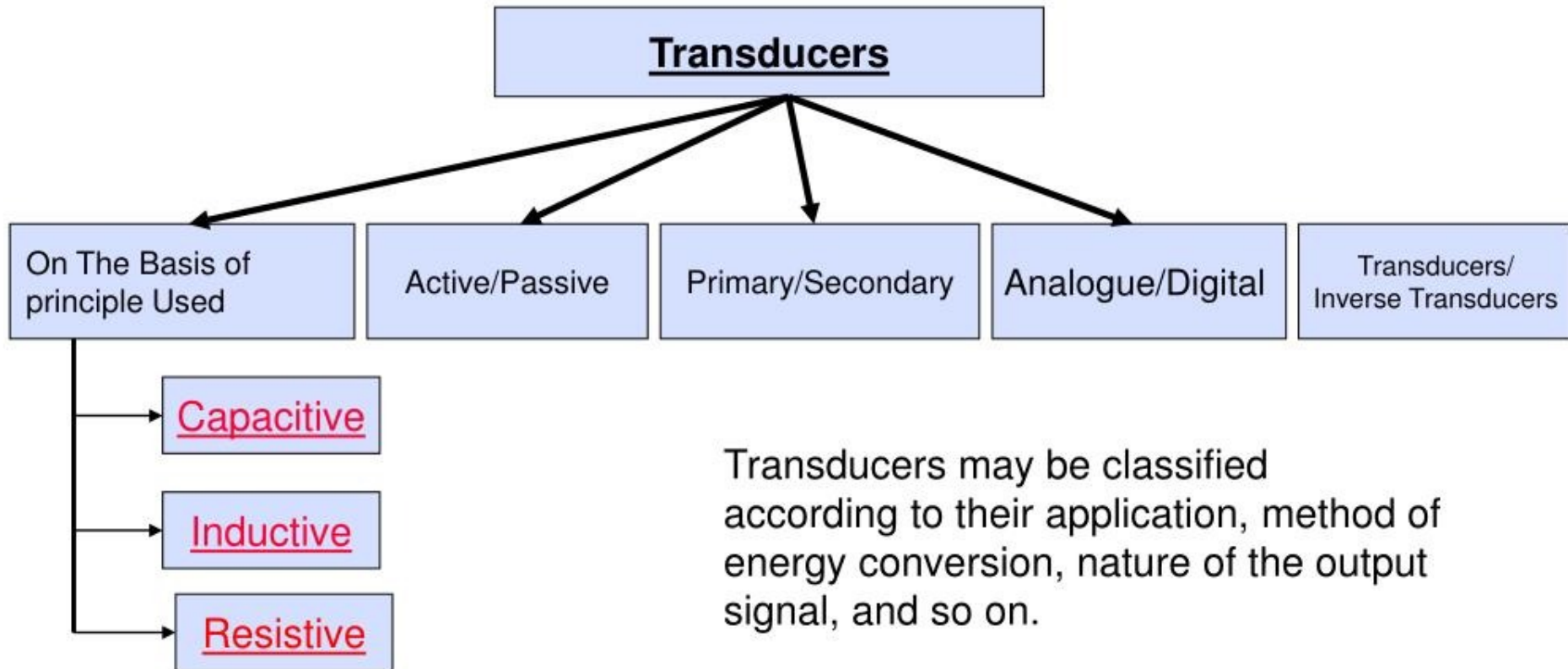
Sensors in Biomedical



Transducer Systems



Classification of Transducers



Questions

- What is bio-potential ELECTRODES?
- What **Transducer Systems**?
- What are the KINDS OF ELECTRODES?
- Explain Classification of Transducers