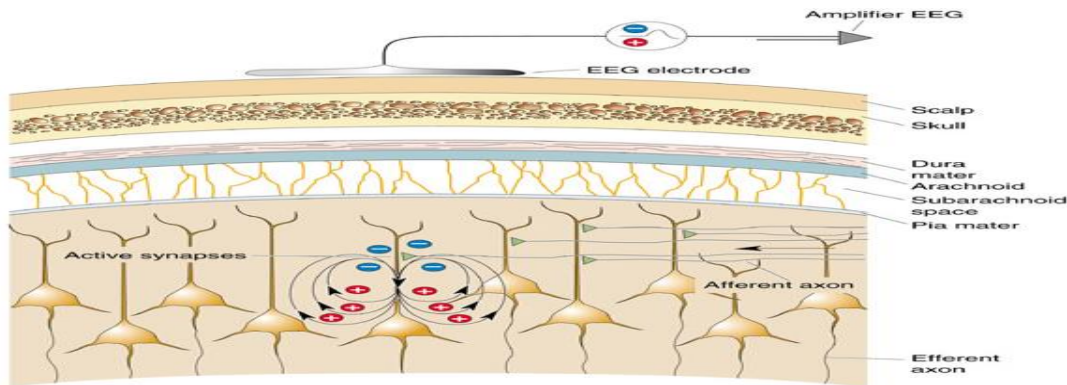


L34 Electroencephalogram (EEG), An electroencephalogram (EEG)

Is a test that detects electrical activity in the brain, using small, flat metal discs (electrodes) of chloride silver attached to your scalp.

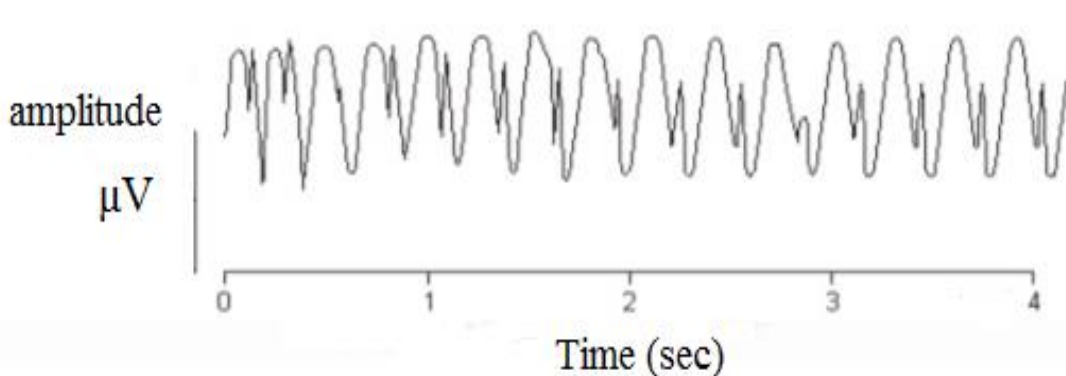
The brain cells communicate via electrical impulses and are active all the time, even at a sleep.

This activity shows up as wavy lines on an EEG recording.



Electrodes measure voltage-differences at the scalp in the microvolt (μV) range.

Voltage- traces are recorded with millisecond resolution – great advantage over brain imaging



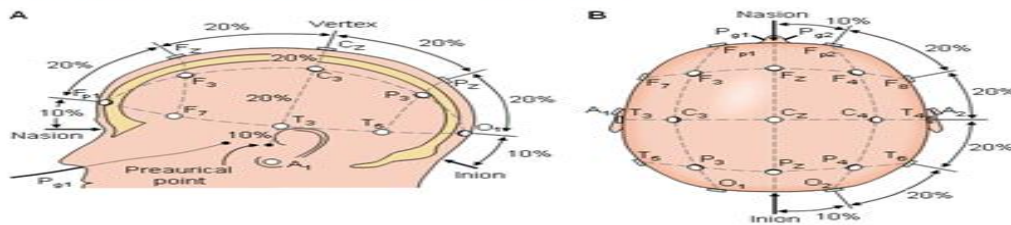
A typical adult human EEG signal is about $10\ \mu\text{V}$ to $100\ \mu\text{V}$ in amplitude when measured from the scalp with a frequency falling in the range $0.5 - 40\text{Hz}$.

The amplitude of the EEG signals is low (about $50\ \mu\text{V}$)

Mechanisms

The brain's electrical charge is maintained by billions of neurons. Neurons are electrically charged (or "polarized") by membrane transport proteins that pump ions across their membranes. Neurons are constantly exchanging ions with the extracellular milieu, for example to maintain resting potential and to propagate action potentials. Ions of similar charge repel each other, and when many ions are pushed out of many neurons at the same time, they can push their neighbours, who push their neighbours, and so on, in a wave. This process is known as volume conduction. When the wave of ions reaches the electrodes on the scalp, they can push or pull electrons on the metal in the electrodes. Since metal conducts the push and pull of electrons easily, the difference in push or pull voltages between any two electrodes can be measured by a voltmeter. Recording these voltages over time gives us the EEG .

International standard 10-20 system of electrode location for EEG .



The electrode are attached to the head at location that depend upon the part of the brain to be studied.

✚ EEG waveform is classified into five different frequency bands (alpha, beta, theta, delta, and gamma bands) .The frequencies of the EEG signals seem to be dependent upon the mental activity of the subject.

- **Delta waves (0.5 - 4Hz)** are the slowest EEG waves, normally detected during the deep and unconscious sleep.
- **Theta waves (4 - 8Hz)** are observed during some states of sleep and quiet focus.
- **Alpha band (8 - 14Hz)** originates during periods of relaxation with eyes closed but still awake.
- **Beta band (14 - 30Hz)** originates during normal consciousness and active concentration.
- **Gamma waves (over 30Hz)** are known to have stronger electrical signals in response to visual stimulation.
 - **For example ,**
 - A relaxed person usually has an EEG signal composed primarily of frequencies from 8 to 13 Hz, or alpha wave.
 - When a person is more alert a higher frequency range, the beta wave range (above 13 Hz) dominates the EEG signal .

The (EEG) measures the activity of large numbers (populations) of neurons.

EEG recordings are noninvasive, painless, do not interfere much with a human subject's ability to move or perceive stimuli, are relatively low-cost.

An electroencephalogram (EEG) : It's an effective method for diagnosing many neurological disorder such :

- EEG is most often used to diagnose epilepsy, which causes abnormalities in EEG readings.
- It is also used to diagnose sleep disorders, coma, encephalopathy, and brain death.
- EEG used to be a first-line method of diagnosis for tumors, stroke and other focal brain disorders,

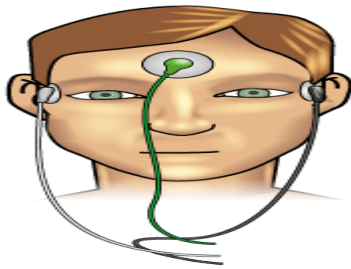
Electrical Signals From The Eye - The Electroretinogram And The Electrooculogram

What is electroretinography (ERG)?

- **Electroretinography (ERG)** is an eye test that detects function of the retina (the light-detecting portion of the eye). The retina is comprised of layers of specialized cells, including photoreceptors (rods and cones), that detect light and ganglion cells that transmit images to the brain. Specifically, the ERG picks up electrical signals from the photoreceptors, as well as other cells (Muller cells and bipolar cells) that act as intermediaries between the photoreceptors and the ganglion cells.
- ERGs are often recorded using a thin fiber electrode that is placed in contact with the cornea or an electrode that is embedded within a corneal contact lens. These electrodes permit the electrical

activity generated by the retina to be recorded at the corneal surface. The ERG can be elicited by diffuse flashes or patterned stimuli.

- Abnormal ERG readings can detect certain abnormalities of these cell layers.
- ERG is usually well tolerated, painless, and medical professionals can perform ERG even in cooperative children and infants.
- ERG is one type of ophthalmic electrophysiology test. Depending on which eye condition is being studied,
- ERG may be performed in conjunction with other tests, such as electrooculography (EOG) or dark adaptometry testing.
- There are a number of retinal conditions in which the ERG may provide useful information, including
 1. cone and rod dystrophies and degenerations,
 2. total retinal detachment, and
 3. retinal abnormalities due to metallic foreign bodies, autoimmune disease, inflammatory diseases, toxic drug damage, retinal vascular occlusion, malnutrition, and metabolic storage diseases.
- **Electrooculography (EOG)** is a technique for measuring the corneo-retinal standing potential that exists between the front and the back of the human eye.
- Primary applications are in ophthalmological diagnosis and in recording eye movements.
- Unlike the electroretinogram, the EOG does not measure response to individual visual stimuli.



Magnetocardiography (MCG) and Magnetoencephalography (MEG)

Magnetocardiography (MCG) is a technique to measure the magnetic fields produced by electrical currents in the heart using extremely sensitive devices such as the superconducting quantum interference device (SQUID).

- If the magnetic field is measured using a multichannel device, a map of the magnetic field is obtained over the chest; from such a map, using mathematical algorithms that take into account the conductivity structure of the torso, it is possible to locate the source of the activity.
- For example, sources of abnormal rhythms or arrhythmia may be located using MCG.

Magnetoencephalography (MEG) is a functional neuroimaging technique for mapping brain activity by recording magnetic fields produced by electrical currents occurring naturally in the brain, using very sensitive magnetometers.

- Applications of MEG include basic research into perceptual and cognitive brain processes, localizing regions affected by pathology before surgical removal, determining the function of various parts of the brain, and neurofeedback.
- This can be applied in a clinical setting to find locations of abnormalities as well as in an experimental setting to simply measure brain activity.

The cardiovascular instrument:

Patient Monitoring : Continuous measurement of patient parameters such as heart rate and rhythm, respiratory rate, blood pressure, blood-oxygen saturation, and many other parameters have become a common feature of the care of critically ill patients.

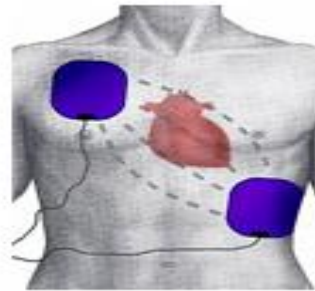
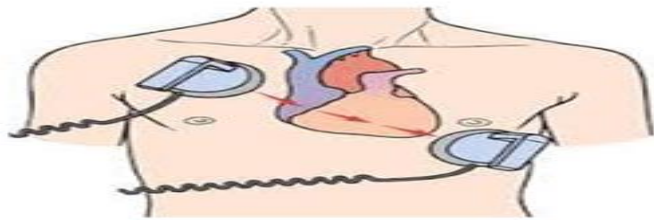
Defibrillation:

A device that gives an electric shock to a person's heart in order to make it beat normally again especially after a heart attack

Defibrillation is a common treatment for life-threatening cardiac dysrhythmias and ventricular fibrillation.

Defibrillation consists of delivering a therapeutic dose of electrical current to the heart with a device called a defibrillator.

This helps reestablish normal contraction rhythms in a heart having dangerous arrhythmia or in cardiac arrest. In recent years small portable defibrillators have become available. These are called automated external defibrillator or AEDs.



Pacemaker:

A system that sends electrical impulses to the heart in order to set the heart rhythm. The pacemaker can be the normal "natural" pacemaker of the heart or it can be an electronic device.

A pacemaker is a small, battery-operated device(uses low-energy electrical pulses) that senses when the heart is beating irregularly or too slowly. It sends a signal to your heart that makes your heart beat at the correct pace.

