

# ELECTROENCEPHALOGRAPHY (EEG)

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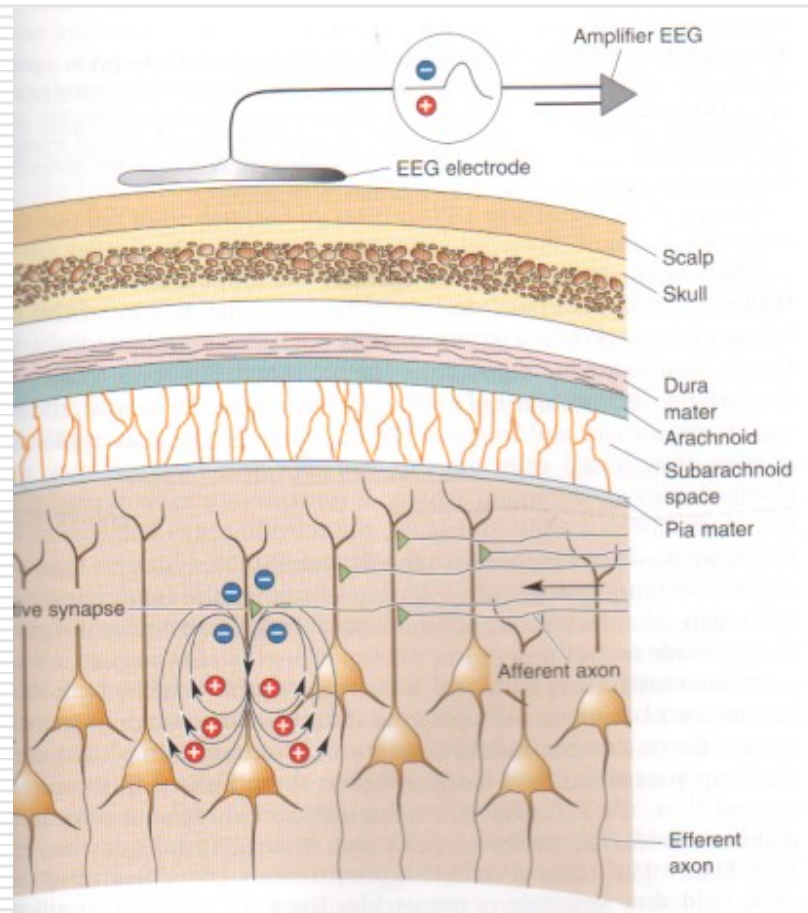
# EEG

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- The electroencephalogram (EEG) is a recording of the electrical activity of the brain from the scalp.
  - The first recordings were made by Hans Berger in 1929
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# Origin of EEG waves

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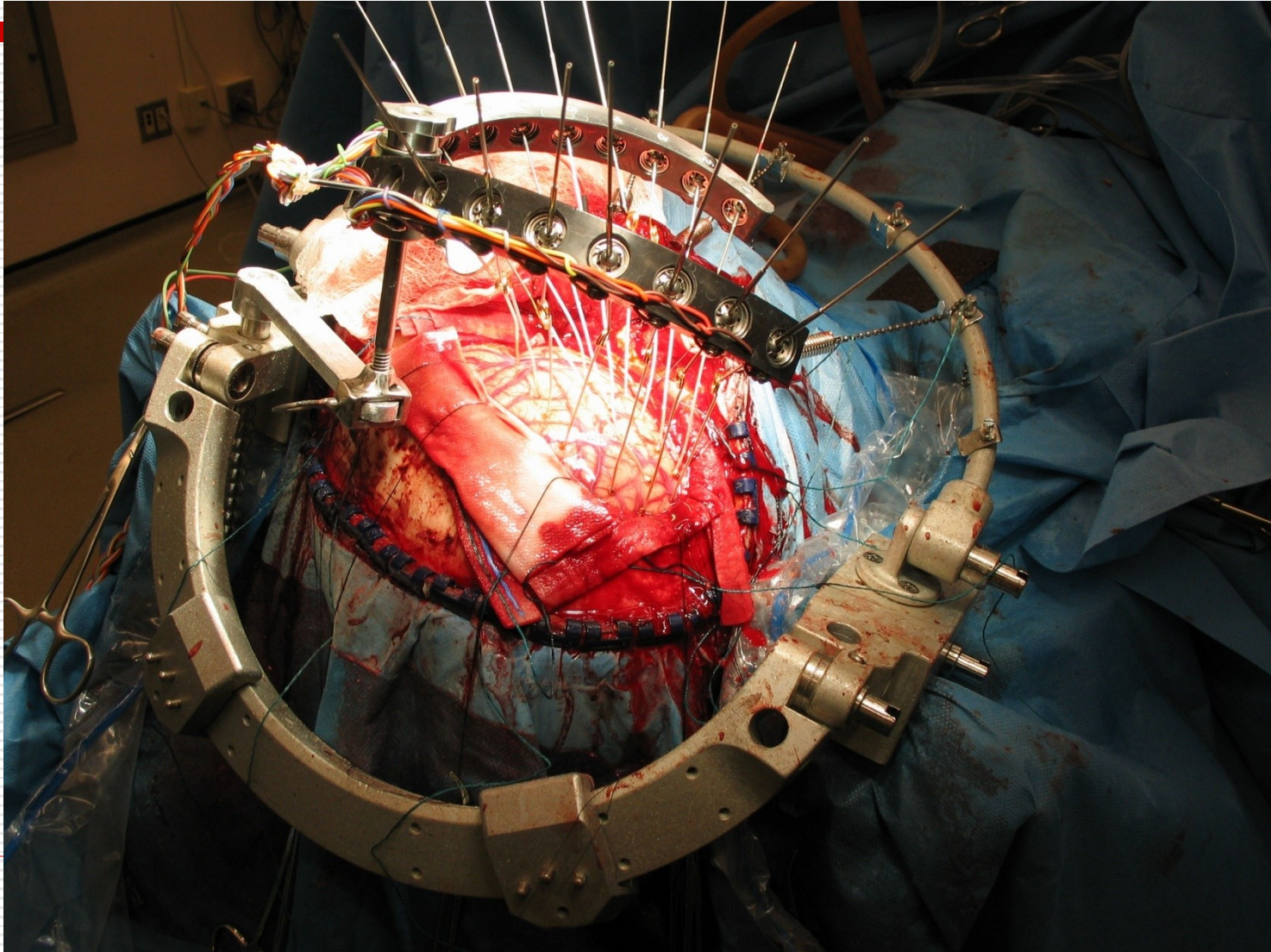
# Electroencephalogram

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- EEG is the record of electrical activity of brain( superficial layer i.e. the dendrites of pyramidal cells) by placing the electrodes on the scalp.

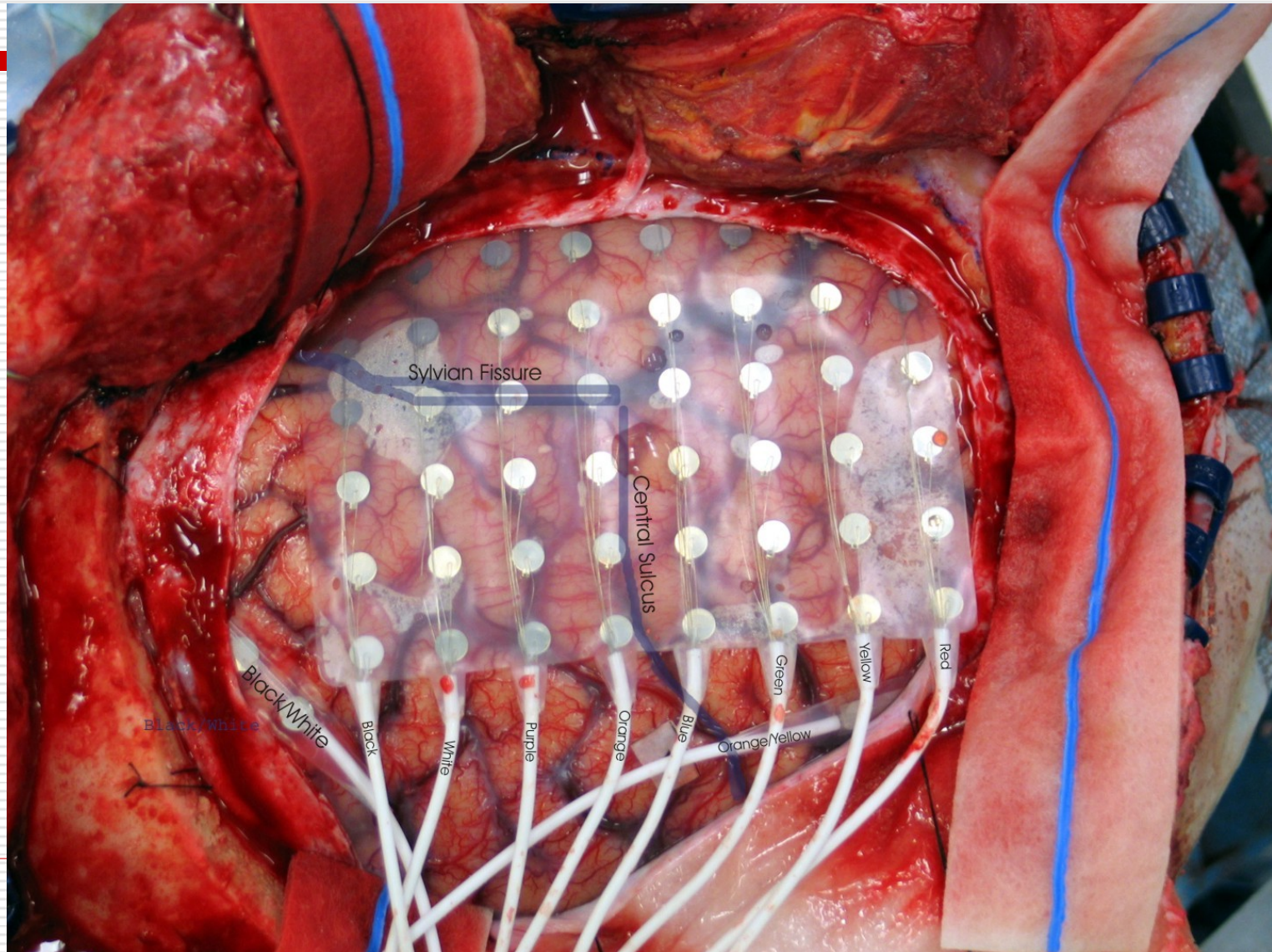


# Intracranial EEG (ECoG)





# Intracranial EEG (ECoG)



# Objectives of EEG practical

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- ❑ Familiarize with the principles of techniques involved
- ❑ Count frequencies and measure the amplitudes of the record obtained.
- ❑ Categories the records into appropriate rhythms –  $\alpha$ ,  $\beta$ ,  $\theta$ , and  $\delta$ .

Cont...

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# Objectives of EEG practical

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- Identify and describe changes produced by provocation tests.

e.g. eye opening & closing, intermittent photic stimulation (IPS) clapping sound, induce thinking & hyperventilation.

- Appreciate clinical uses of EEG
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# EEG Waves

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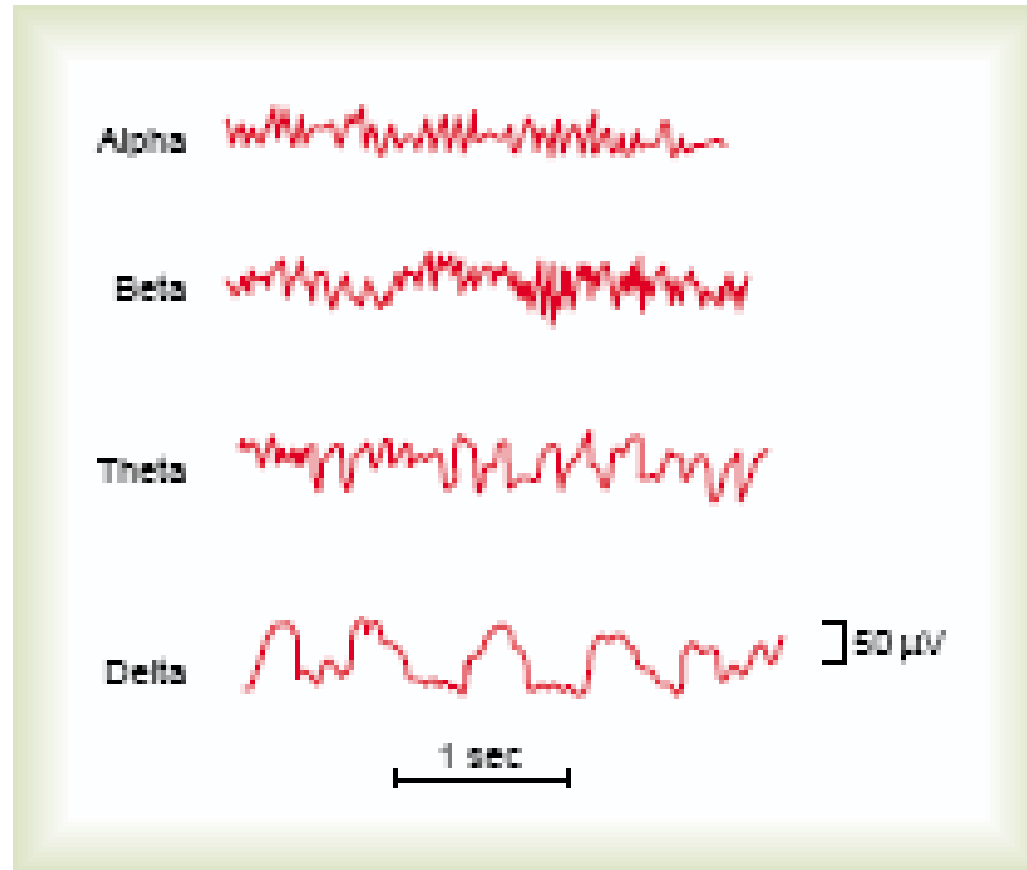
- Alpha wave -- 8 – 13 Hz.
- Beta wave -- >13 Hz. (14 – 30 Hz.)
- Theta wave -- 4 – 7.5 Hz.
- Delta waves – 1 – 3.5 Hz.

■ D T A B

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# Different types of brain waves in normal EEG

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# EEG Recording From Normal Adult Male



# Alpha wave

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- rhythmic, 8-13 Hz
- mostly on occipital lobe
- 20-200  $\mu$  V
- normal,
- relaxed awake rhythm with eyes closed



# Beta wave

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- irregular, 14-30 Hz
- mostly on temporal and frontal lobe
- mental activity
- excitement

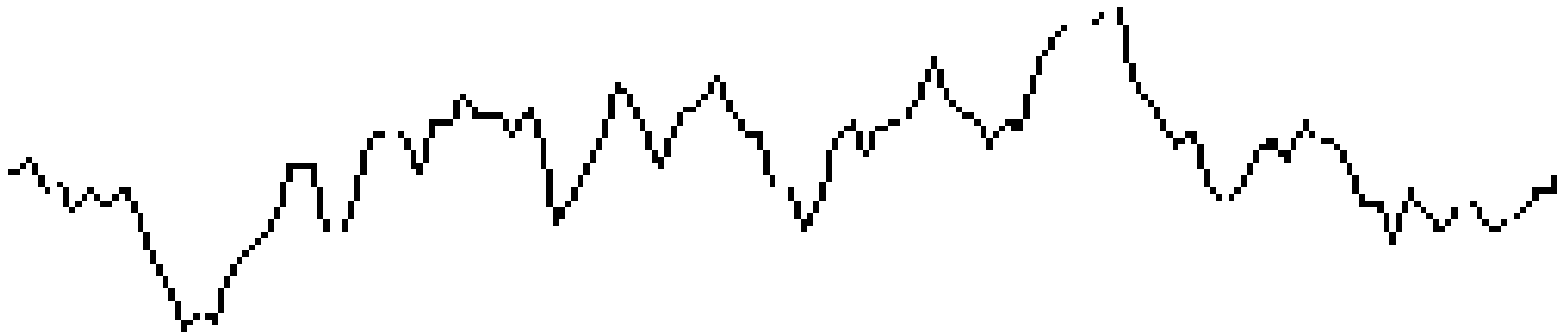




# Theta wave

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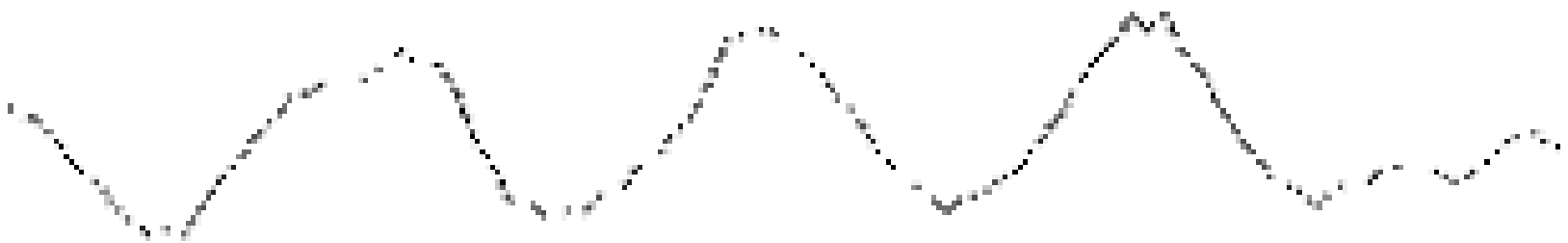
- rhythmic, 4-7 Hz
- Drowsy, sleep

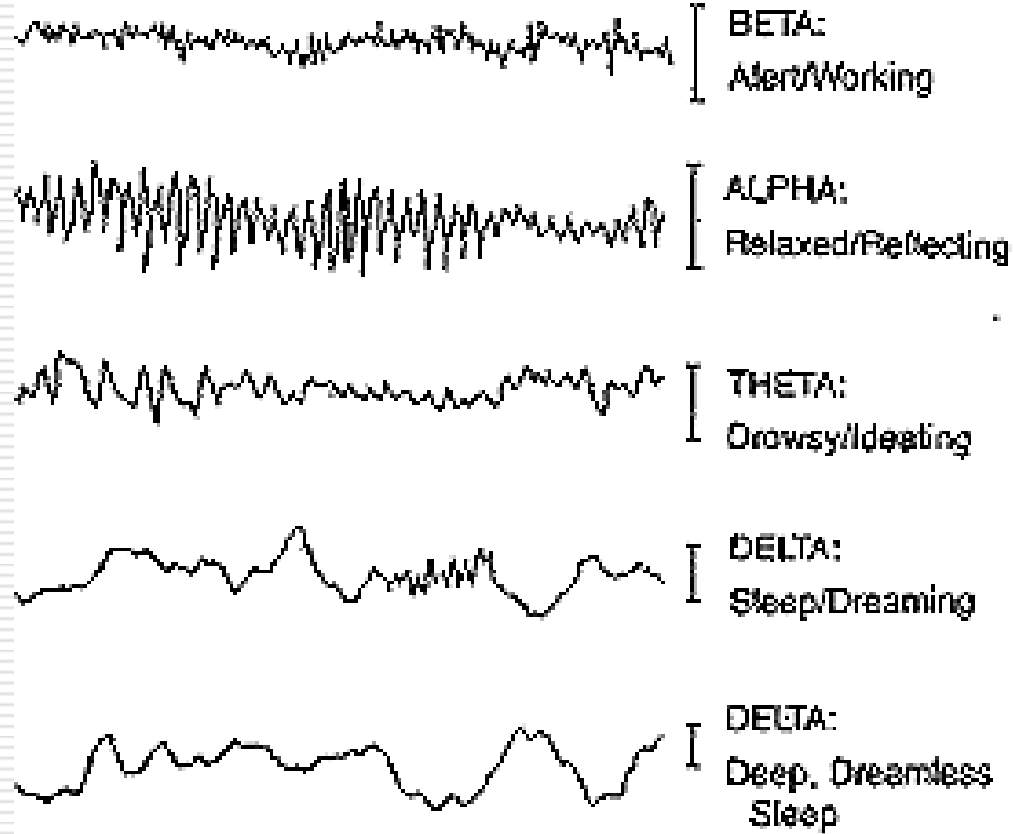


# Delta wave

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- slow,  $< 3.5$  Hz
- in adults
- normal sleep rhythm





# Different types of brain waves in normal EEG

<b>Rhythm</b>	<b>Frequency (Hz)</b>	<b>Amplitude (uV)</b>	<b>Recording &amp; Location</b>
Alpha( $\alpha$ )	8 – 13	50 – 100	Adults, rest, eyes closed. Occipital region
Beta( $\beta$ )	14 - 30	20	Adult, mental activity Frontal region
Theta( $\theta$ )	5 – 7	Above 50	Children, drowsy adult, emotional distress Occipital
Delta( $\delta$ )	2 – 4	Above 50	Children in sleep

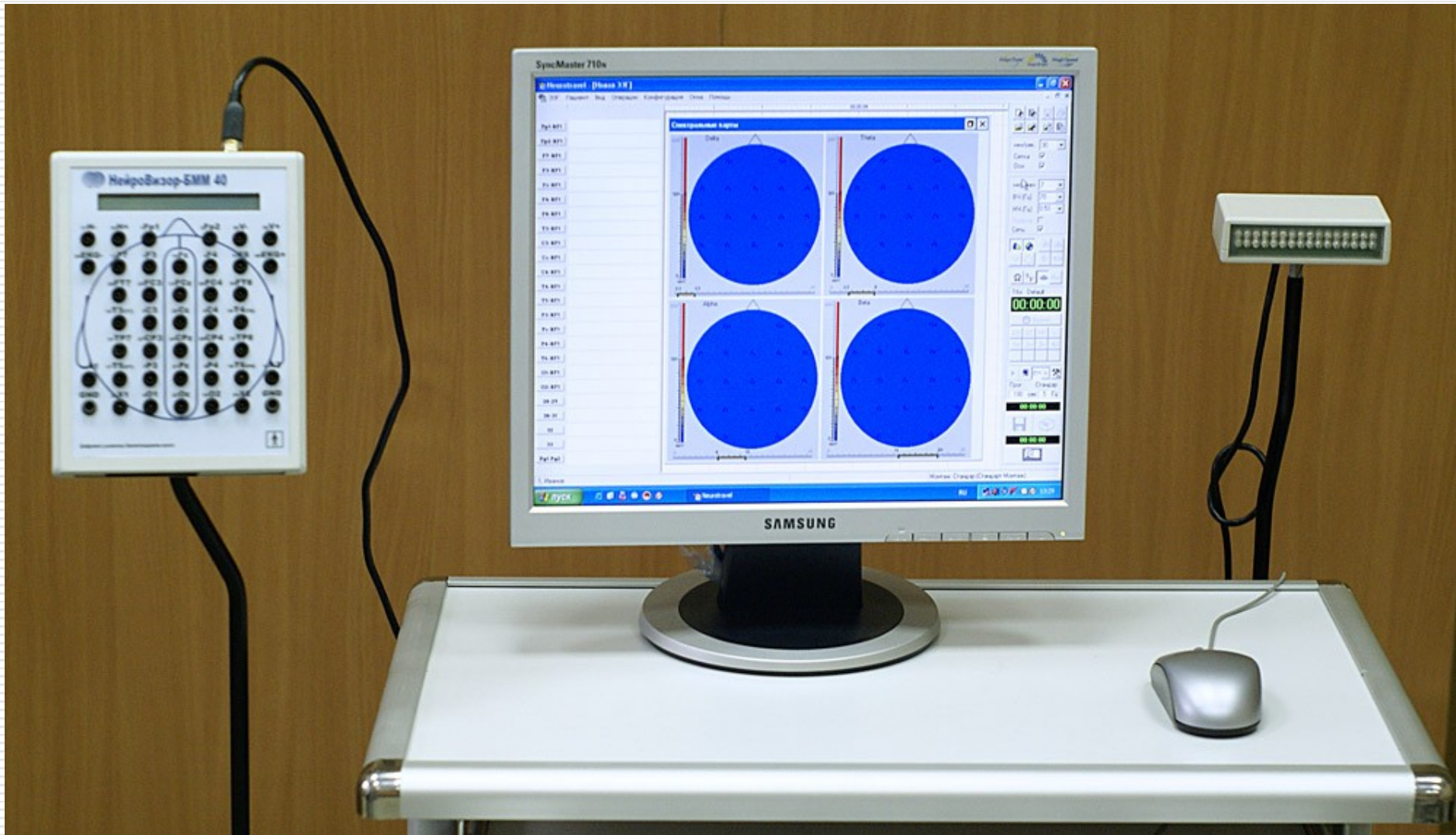
# Requirements

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- ☐ EEG machine (8/16 channels).
  - ☐ Silver cup electrodes/metallic bridge electrodes.
  - ☐ Electrode jelly.
  - ☐ Rubber cap.
  - ☐ Quiet dark comfortable room.
  - ☐ Skin pencil & measuring tape.
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# Computerized EEG Machine



# EEG Electrodes

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**Silver Electrodes**



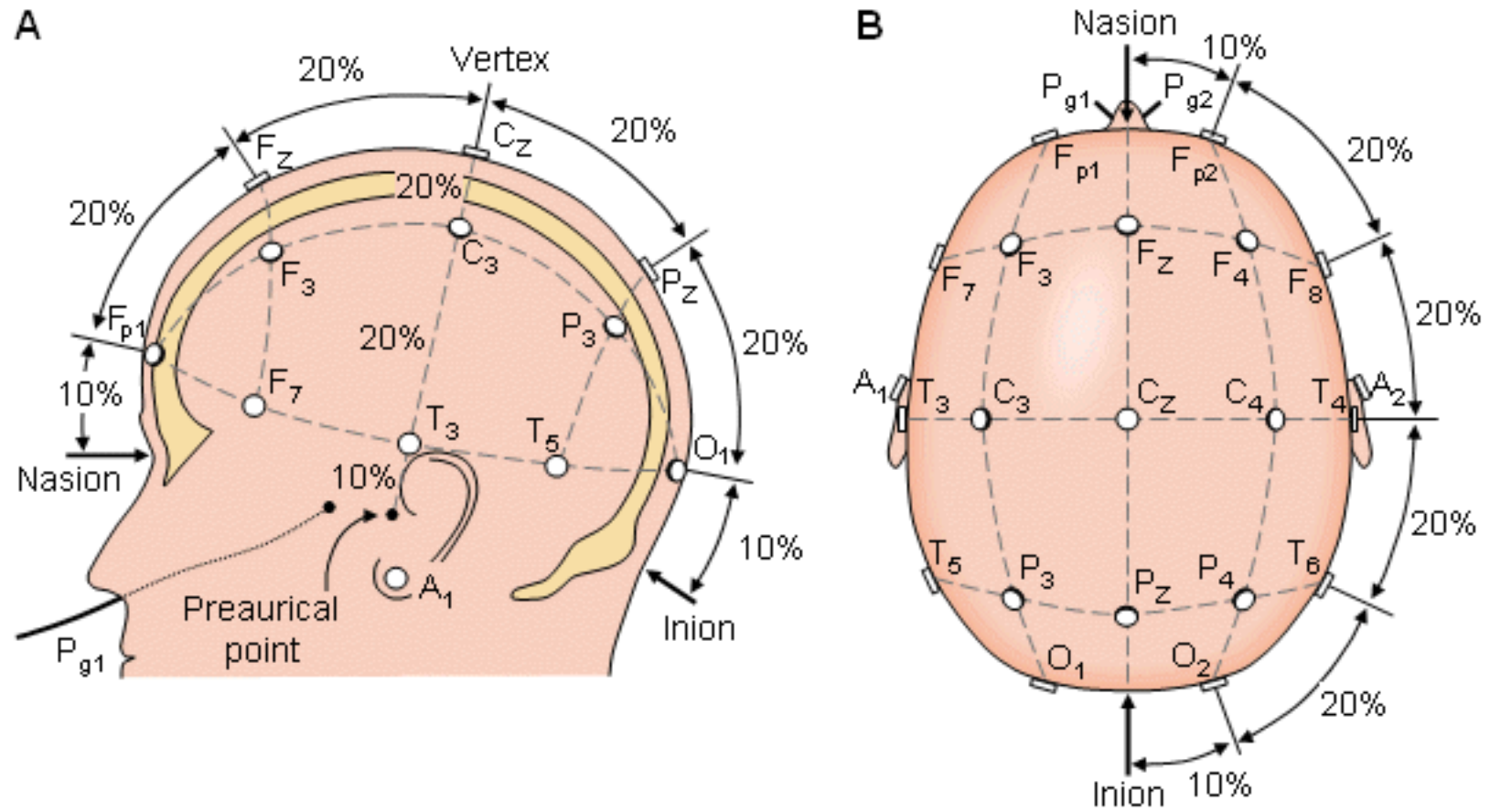
**Electrodes Cap**

# Procedure of EEG recording

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- ❑ A standard EEG makes use of 21 electrodes linked in various ways (Montage).
  - ❑ Apply electrode according to 10/20% system.
  - ❑ Check the impedance of the electrodes.
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# 10 /20 % system of EEG electrode placement



# EEG Electrodes

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- ❑ Each electrode site is labeled with a letter and a number.
  - ❑ The letter refers to the area of brain underlying the electrode  
e.g. F - Frontal lobe and T - Temporal lobe.
  - ❑ Even numbers denote the right side of the head and
  - ❑ Odd numbers the left side of the head.
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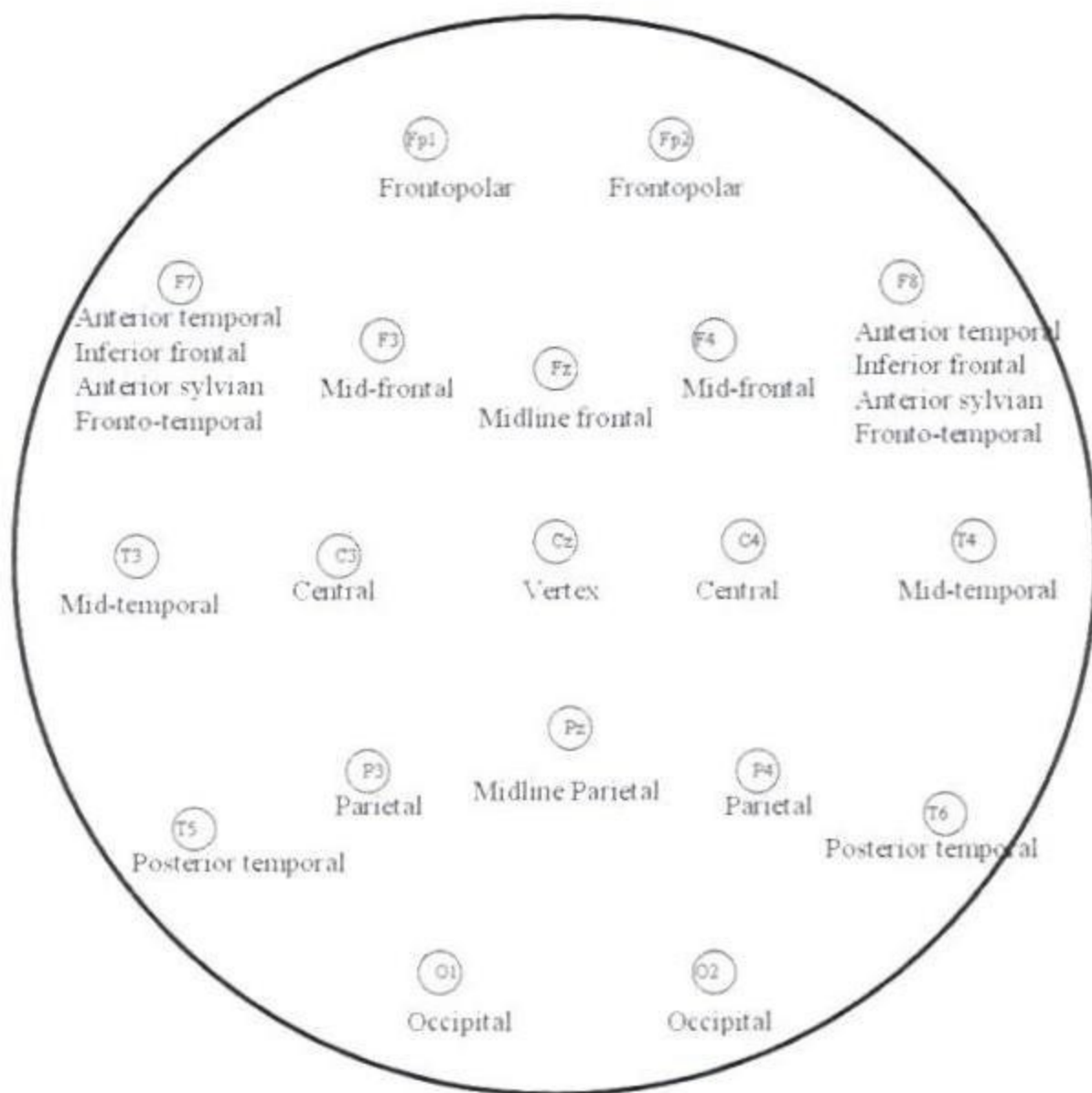


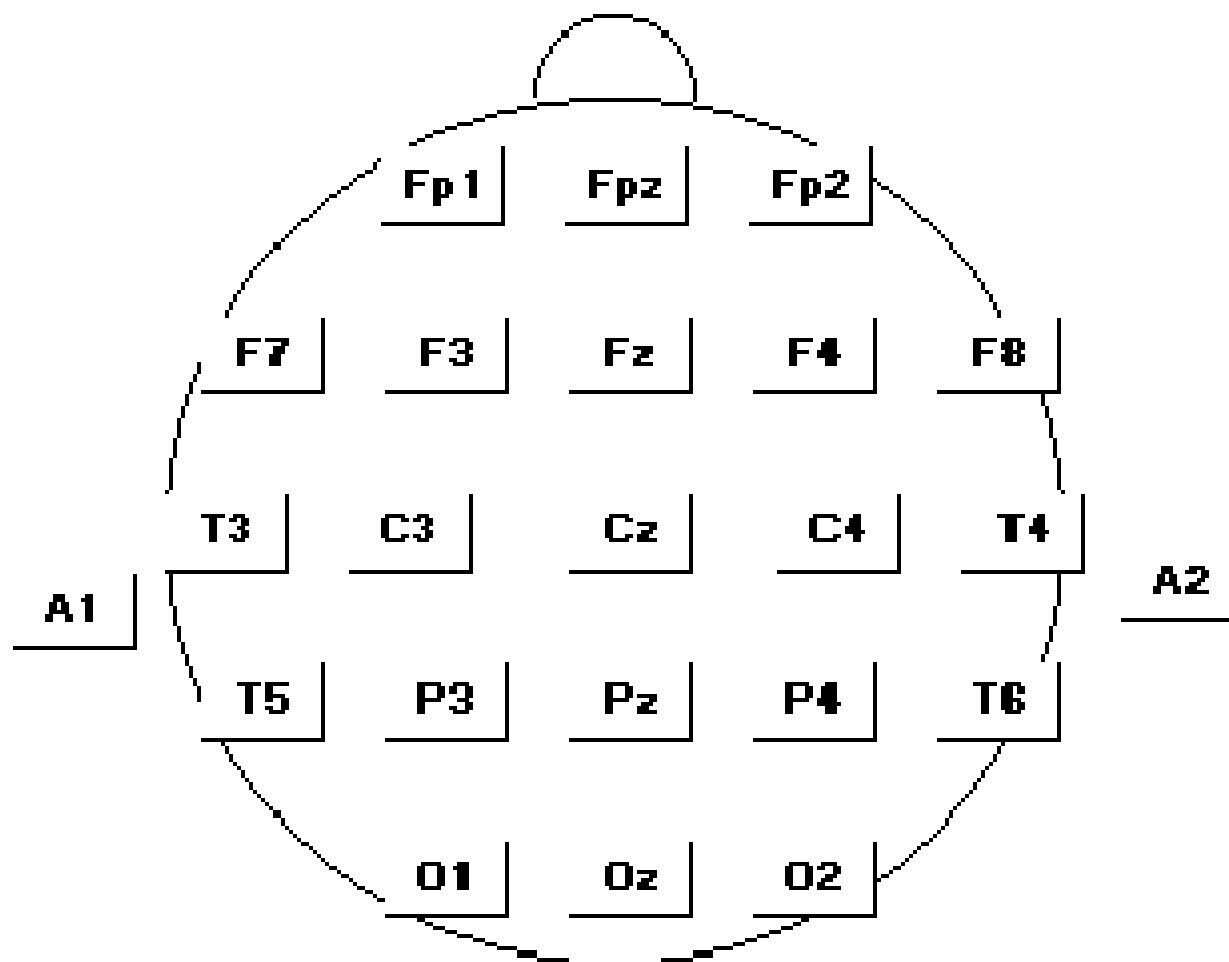
# Two types of recording

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- ❑ Bipolar – both the electrodes are at active site
    - Bipolar montage are parasagittal montage.
  - ❑ Unipolar – one electrode is active and the other is indifferent kept at ear lobe.
    - ❑ Always watch for any abnormal muscle activity.
    - ❑ Ask the subject to open eyes for 10 sec. then ask them to close the eyes.
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## Full names for electrodes





# Montage

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- Different sets of electrode arrangement on the scalp by 10 – 20 system is known as montage.
  - 21 electrodes are attached to give 8 or 16 channels recording.
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# Analysis

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- Electrical activity from the brain consist of primarily of rhythms.
- They are named according to their frequencies (Hz) and amplitude in micro volt ( $\mu\text{v}$ ).
- Different rhythms at different ages and different conditions (level of consciousness)
- Usually one dominant frequency (background rhythm)

# Factor influencing EEG

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## ☐ Age

- Infant – theta, delta wave
- Child – alpha formation.
- Adult – all four waves.

## ☐ Level of consciousness (sleep)

## ☐ Hypocapnia(hyperventilation) slow & high amplitude waves.

## ☐ Hypoglycemia

## ☐ Hypothermia

## ☐ Low glucocorticoids

**Slow waves**

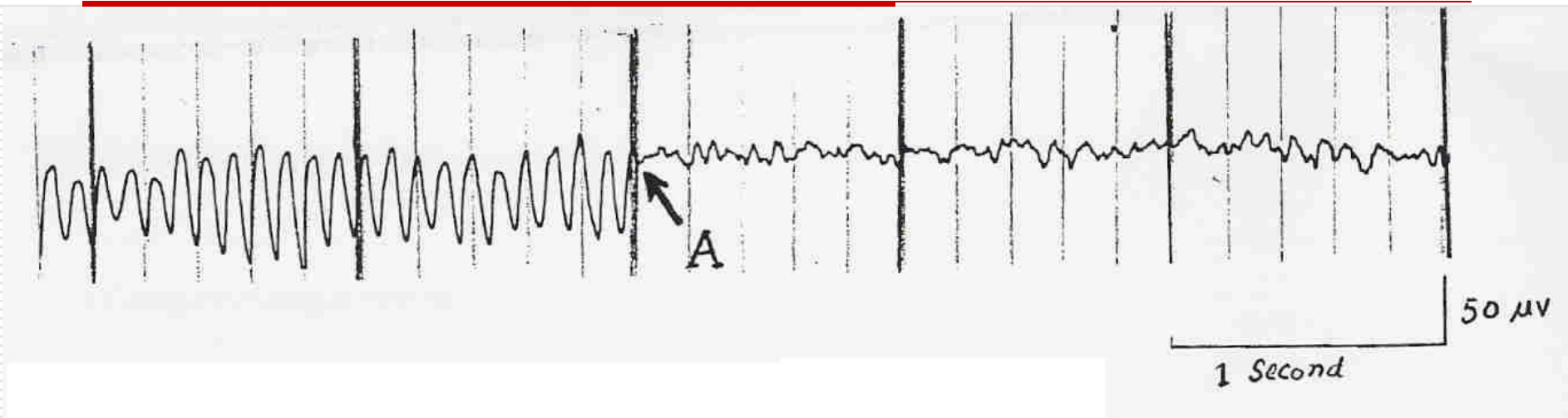
# NORMAL EEG CHANGES

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# Desynchronization or Alpha block

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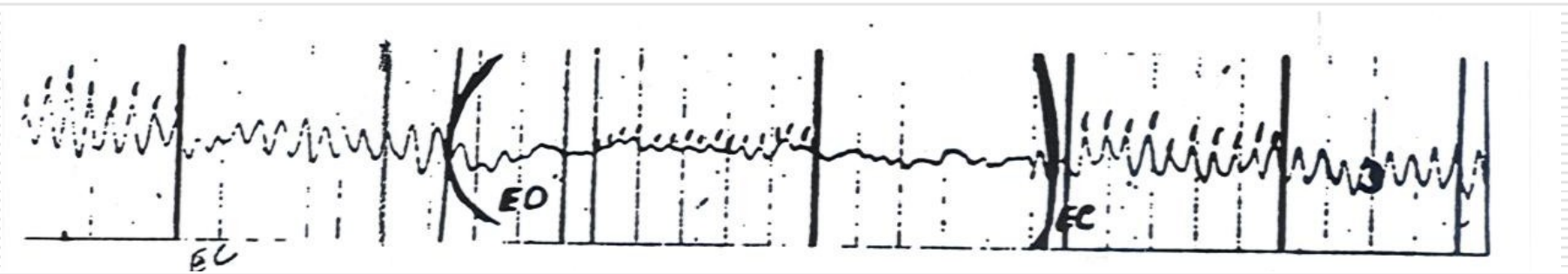
## □ Cause:

- Eyes opening (after closure)
  - Thinking by the subject (mathematical calculation)
  - Sound (clapping)
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# Eye opening

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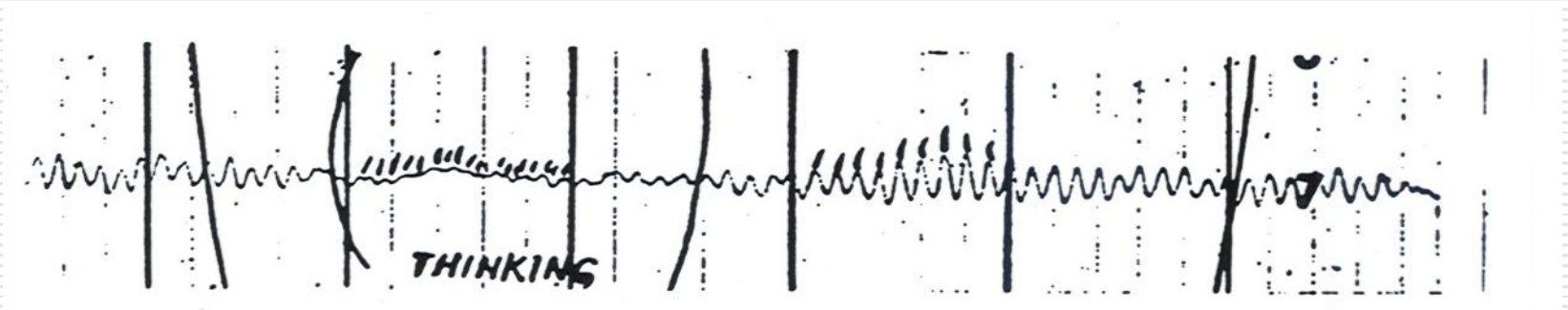
- Alpha rhythm changes to beta on eye opening (desynchronization /  $\alpha$ -block)



# Thinking

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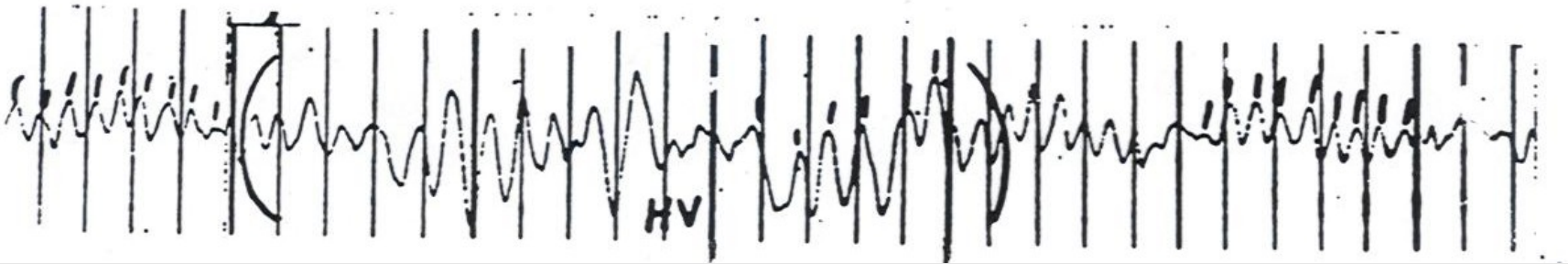
- Beta waves are observed



# Provocation test

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- Intermittent photic stimulation
  - Increase rate & decrease amplitude
  
- Hyperventilation
  - **Decrease rate & increase in amplitude**



# Use of EEG

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## ☐ Epilepsy

- Generalized (grandmal) seizures.
- Absence (petitmal) seizures.

## ☐ Localize brain tumors.

## ☐ Sleep disorders (Polysomnography)

- Narcolepsy
- Sleep apnea syndrome
- Insomnia and parasomnia

## ☐ Helpful in knowing the cortical activity, toxicity, hypoxia and encephalopathy &

## ☐ Determination of brain death.

- Flat EEG(absence of electrical activity) on two records run 24 hrs apart.

# Sleep studies

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- ❑ The EEG is frequently used in the investigation of sleep disorders especially sleep apnoea.
  - ❑ Polysomnography : EEG activity together with
    - heart rate,
    - airflow,
    - respiration,
    - oxygen saturation and
    - limb movement
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# Sleep patterns of EEG

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- ❑ There are two different kinds of sleep:
    - ❑ Rapid eye movement sleep (REM-Sleep)
    - ❑ Non-REM sleep (NREM sleep)/ slow wave sleep
  - ❑ NREM sleep is again divided into 4 stages (I to IV). The EEG pattern in sleep is given in the following table:
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<b>Stages of sleep</b>	<b>EEG pattern</b>	<b>Somatic or Behavioral changes</b>
Alert	Alpha activity on eye closed Desynchronization on eye opening	Respond to verbal commands
I (Drowsiness)	Alpha dropout & appearance of vertex waves & theta.	Reduced HR & RR
II (Light sleep)	Sleep spindles, vertex sharp waves & K-complexes	Reduced HR & RR
III ( Deep Sleep)	Much slow background K-complexes	Reduced HR & RR

IV (very deep sleep)	Synchronous delta waves, some K-complexes	Reduced HR & RR
REM sleep (paradoxical sleep)	Desynchronization with faster frequencies	HR, BP & RR irregular Marked hypotonia Rapid eye movement 50 – 60 /min. Dreaming threshold of arousal