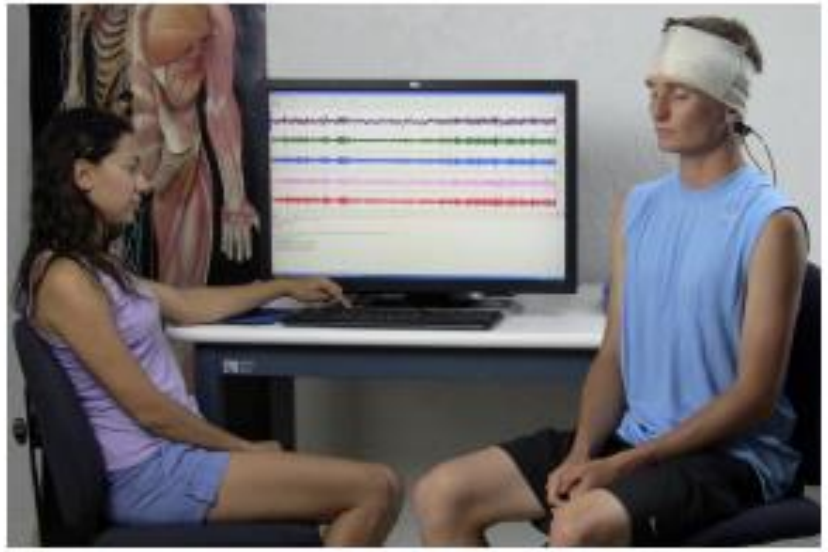
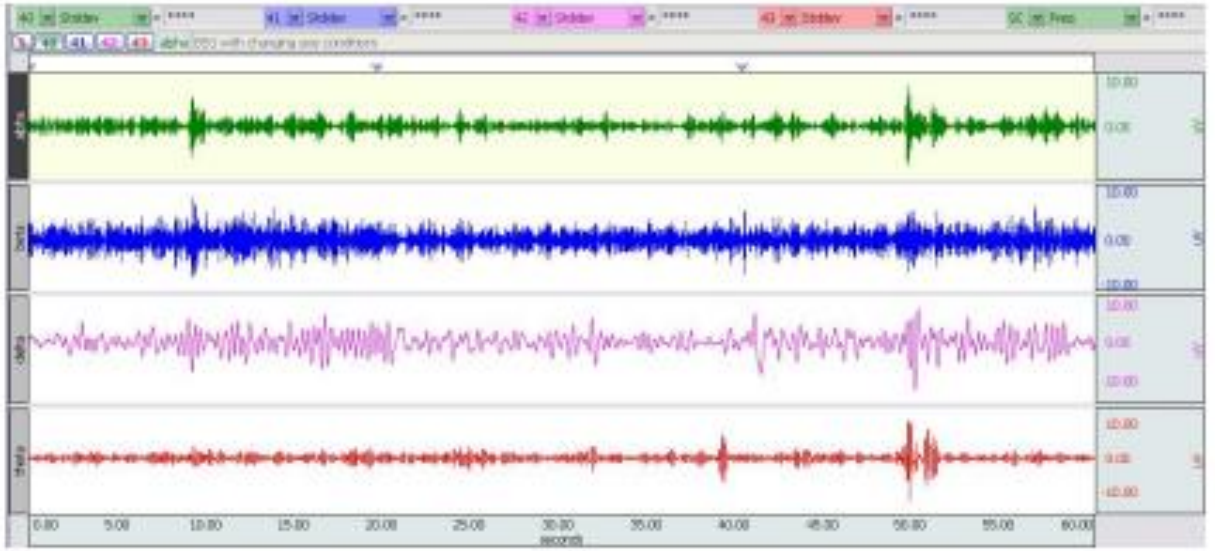
Biopac Student Lab Lesson 3

ELECTROENCEPHALOGRAPHY (EEG) I





- The brain is encased by the cranium, bones of the skull which immediately cover and protect brain surfaces. A thin cover of skin called the scalp, covers most of the cranium.

- The largest part of the brain immediately beneath the bones of the cranium is the cerebral cortex.
- The cerebral cortex is composed of nerve cells (neurons,) many of which are functionally connected to each other, and connected to other parts of the brain.

- Electrical activity in the form of nerve impulses being sent and received to and from cortical neurons is always present, even during sleep. In a biological sense (as well as a medical or legal sense,) absence of electrical activity in the human cerebral cortex signifies death.

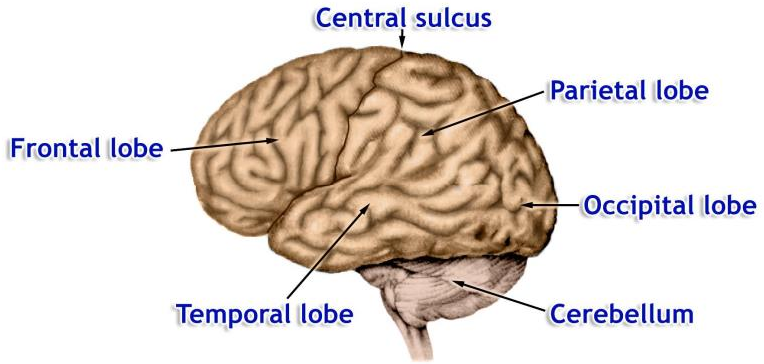


Fig 1: Regions of Brain

- Functions of the cerebral cortex include abstract thought, reasoning, voluntary and involuntary control of skeletal muscle, and the recognition and differentiation of somatic, visceral, and special sensory stimuli.

- Specific regions of the cerebral cortex process or generate various kinds of information. For example, the occipital lobe processes visual information while the parietal lobe processes somatosensory information such as cutaneous pain or temperature (Fig1).

- electrodes placed on the scalp above the various regions of the brain can detect the electrical activity associated with functioning neurons. The recording of the brain's activity obtained by using electrodes is called an electroencephalogram or EEG (electro = electrical, encephelo= brain, gram = record).

- The electrodes receive the activity from thousands of neurons. In fact, one square millimeter of cortex has more than 100,000 neurons. Since each region of the cerebral cortex of an alert person is busy receiving, integrating, and sending many impulses, this activity is detected in the EEG.

- Four simple periodic rhythms recorded in the EEG: are alpha, beta, delta, and theta. These rhythms are identified by frequency (Hz or cycles/sec) (Table 1). The amplitudes recorded by scalp electrodes are in the range of microvolts (mV or of a volt 1\1000000 of a volt).

Rhythm	Typical Frequencies (Hz)
alpha	8-13
beta	13-30
delta	1-5
theta	4-8

Table 1

- Alpha: The alpha rhythm is the prominent EEG wave pattern of an adult who is awake but relaxed with eyes closed.

- Each region of the brain has a characteristic alpha rhythm but alpha waves of the greatest amplitude are recorded from the occipital and parietal regions of the cerebral cortex.

Results from various studies (alpha rhythm) indicate that:

- Females tend to have higher mean frequencies of alpha waves than males.
- Alpha wave amplitudes are likely to be higher in “outgoing” subjects.
- Alpha wave amplitudes vary with a subject’s attention to mental tasks performed with the eyes closed.
- In general, amplitudes of alpha waves diminish when subjects open their eyes and are attentive to external stimuli although some subjects trained in relaxation techniques can maintain high alpha amplitudes even with their eyes open.

- Beta rhythms occur in individuals who are alert and attentive to external stimuli or exert specific mental effort, beta rhythms also occur during deep sleep, REM (Rapid Eye Movement) sleep when the eyes switch back and forth, and it may also be associated with “remembering” or retrieving memories.

- Delta and Theta rhythms are low-frequency EEG patterns that increase during sleep in the normal adult. As people move from lighter to deeper stages of sleep (prior to REM sleep,) the occurrence of alpha waves diminishes and is gradually replaced by the lower frequency theta and then delta rhythms.

- In general, the occurrence and amplitudes of delta and theta rhythms are highly variable within and between individuals.

- Electrode positions have been named according to the brain region below that area of the scalp: frontal, central (sulcus) parietal, temporal, and occipital.

- In the bipolar method, the EEG is measured from a pair of scalp electrodes Fig2. The pair of electrodes measures the difference in electrical potential (voltage) between their two positions above the brain. A third electrode is attached behind the ear as a point of reference, ‘ground’, of the body’s baseline voltage due to other electrical activities within the body.

Fig2: The bipolar method