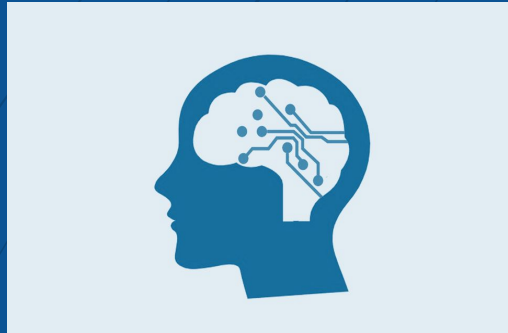




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Introduction to Neuroscience & EEGs

Neurotech@Davis



Recap

Neurotech encompasses all technologies developed to understand the brain, visualise its processes and even control, repair or improve its functions.

Brain Computer Interfaces (BCIs) are a subset of the Neurotechnology field and are based on recording neural activity and outputting it to an external machine output



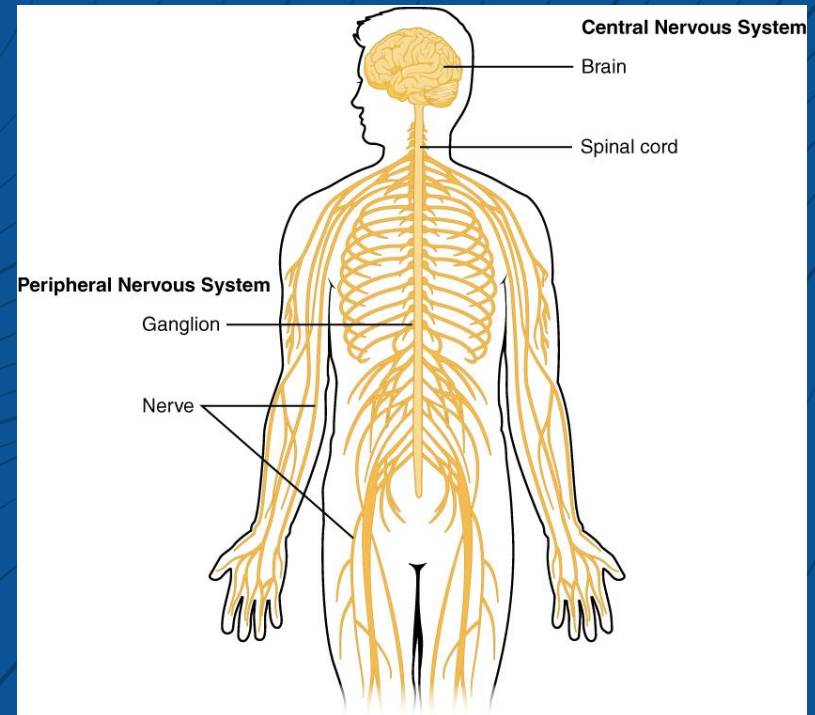
Central and Peripheral Nervous Systems

Central Nervous System

- Composed of the Brain and Spinal Cord
- Takes sensory input and send motor output

Peripheral Nervous System

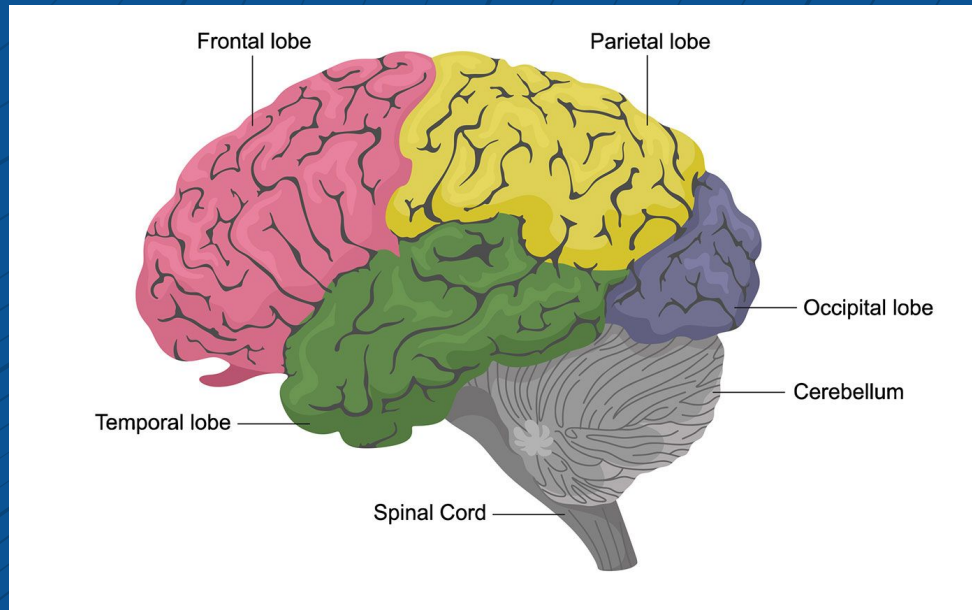
- Composed of Nerves that extend from the brain and spinal cord to other parts of the body
- Responsible for motor output and relaying info between brain and body





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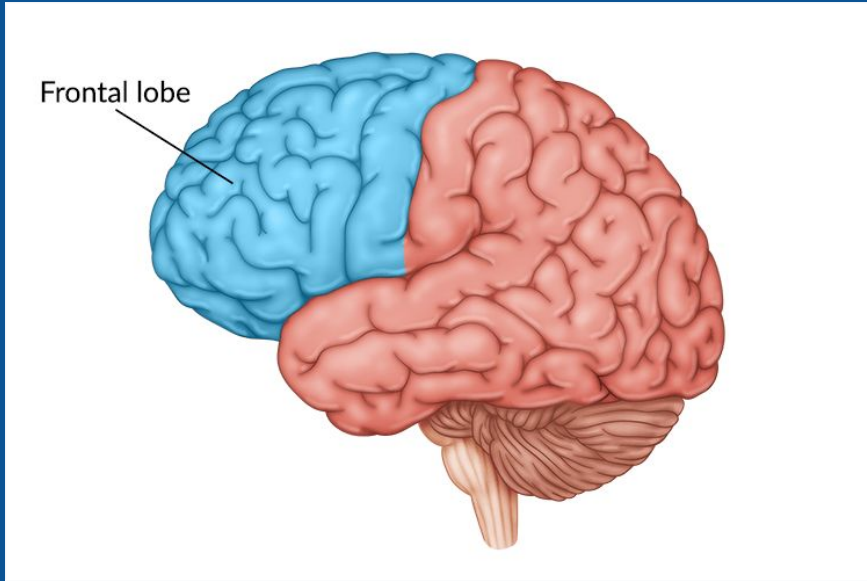
The Brain



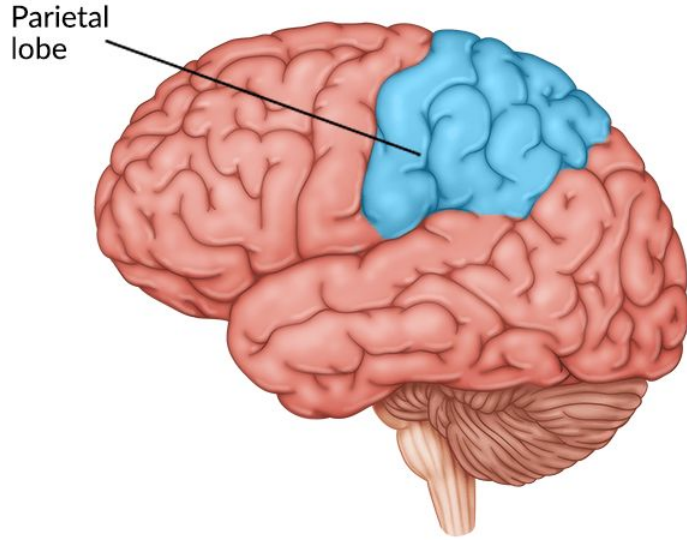
Frontal Lobe

Functions

- High level executive functions
 - Decision Making
 - Planning
 - Goal Oriented responses
 - Emotion Regulation
 - Impulse Control



Parietal Lobe



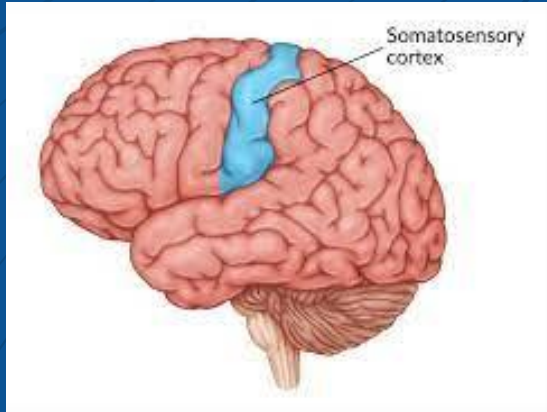
Functions

- Processes somatosensory information
- Integrates multiple sensory modalities together



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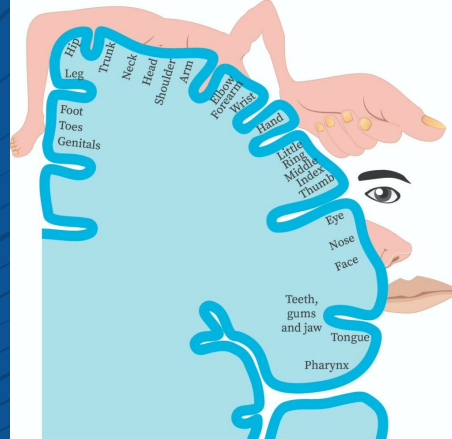
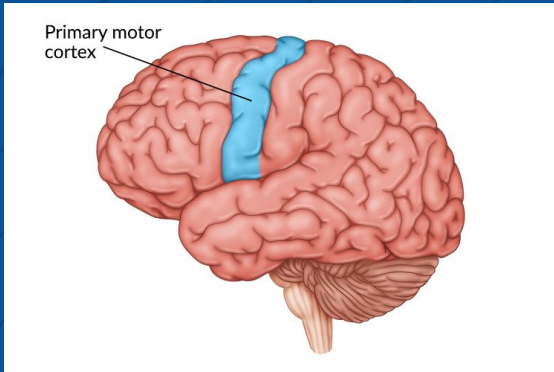
Somatosensory Cortex





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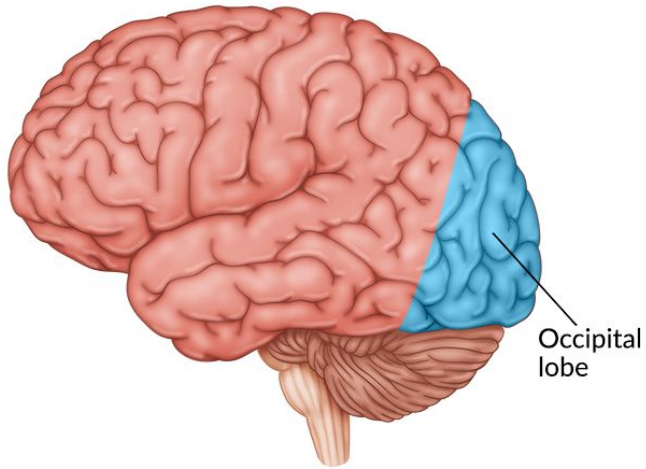
Motor Cortex



Occipital Lobe

Functions

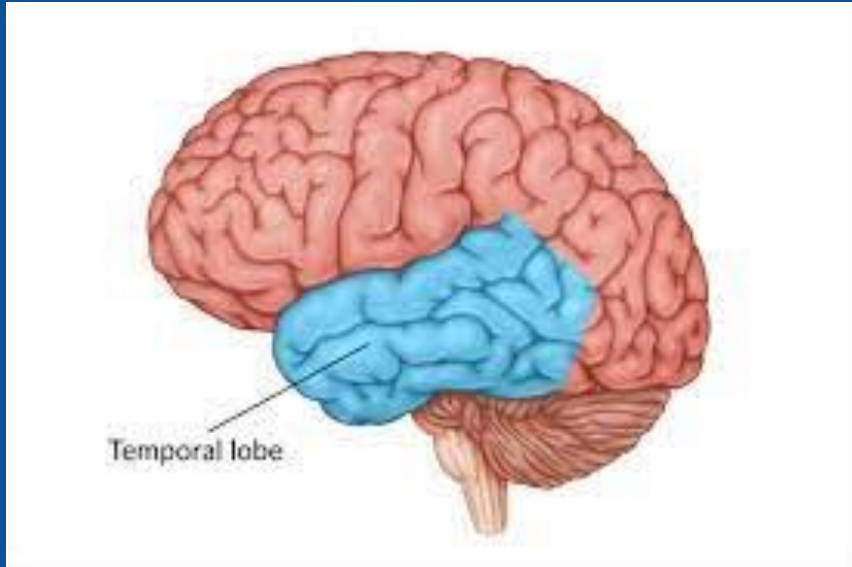
- Visual processing
- Color & Motion
- Object identification and location orientation



Temporal Lobe

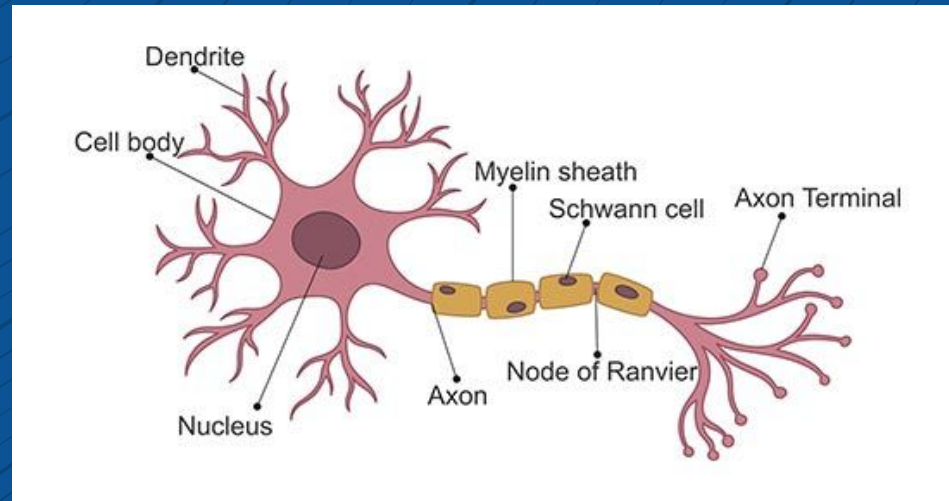
Functions

- Auditory processing
- Language processing





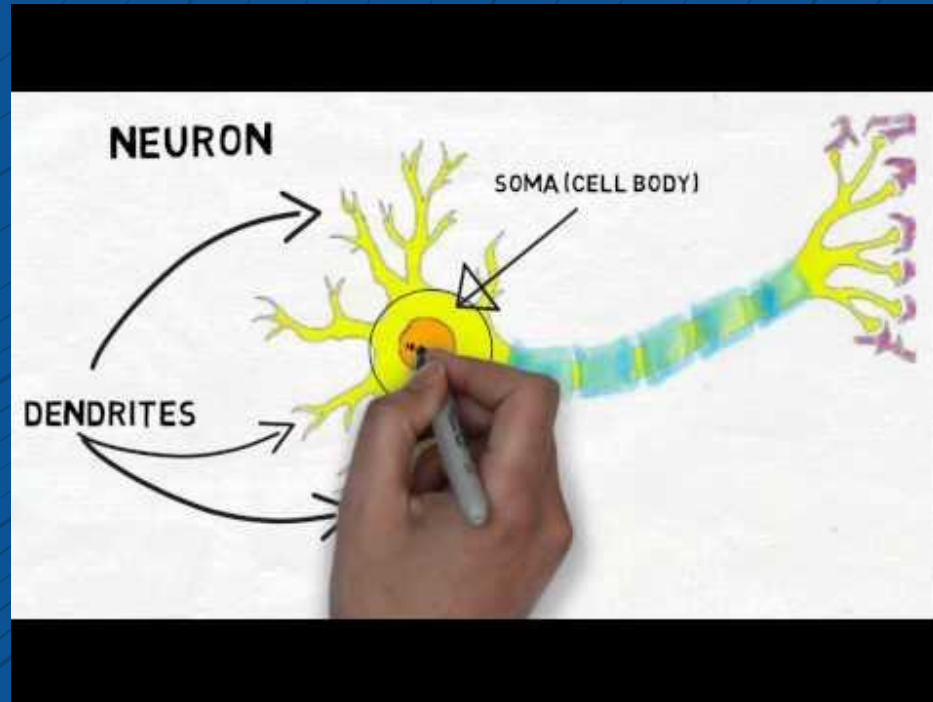
Neurons





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Neuron Video



fMRI

ECoG

fNIRS



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PET

MRI

MEG

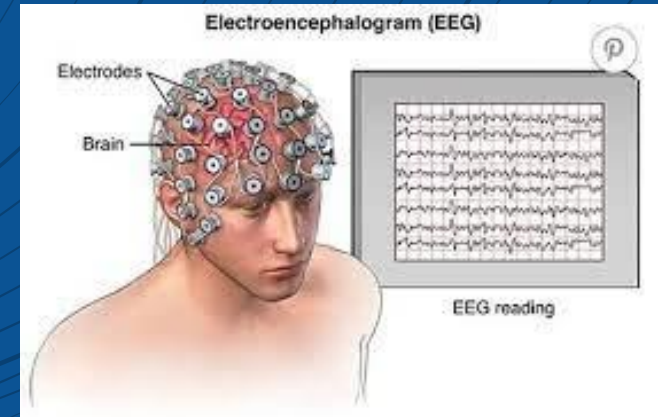
How can we measure neural activity?

EEG



EEG Recap

- Electroencephalogram
- Electrodes pick up changes in neural activity from the clusters of neurons
- Signal travels through skull and scalp



Advantages:

- Non-invasive
- Easily accessible
- Cheap
- Good Temporal Resolution

Disadvantages:

- Noise (SNR)
- Poor Spatial Resolution



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EEG 101

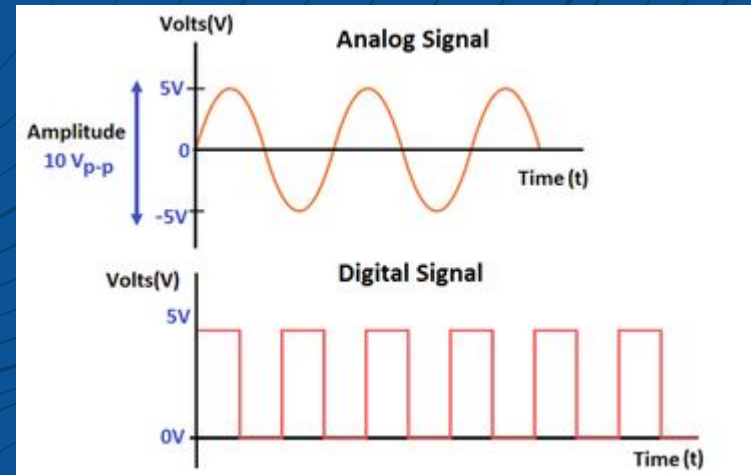


EEG 101

❖ Digital Signal vs Analog Signal

Analog Signal:
continuous electrical
signals

Digital Signal:
non-continuous electrical
signals



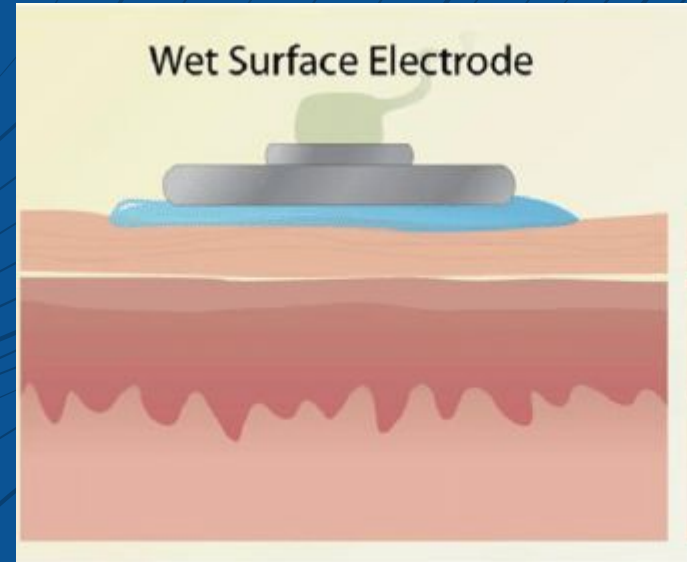


EEG 101

❖ Dry vs Wet Electrodes

Dry Electrodes: single metal that acts as a conductor between skin the and electrode

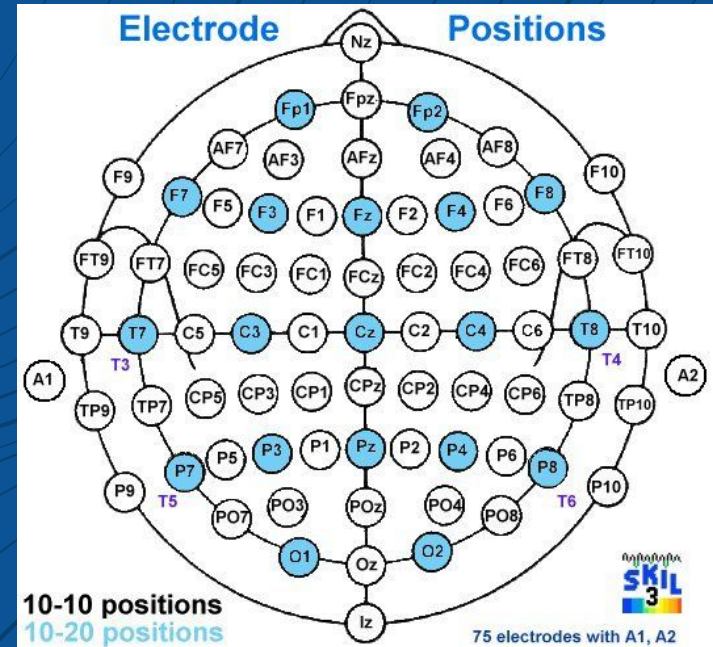
Wet Electrodes: electrolyte gel acts as a conductor between skin the and electrode





EEG 101

- ❖ # of Electrodes
- ❖ Electrode Placement



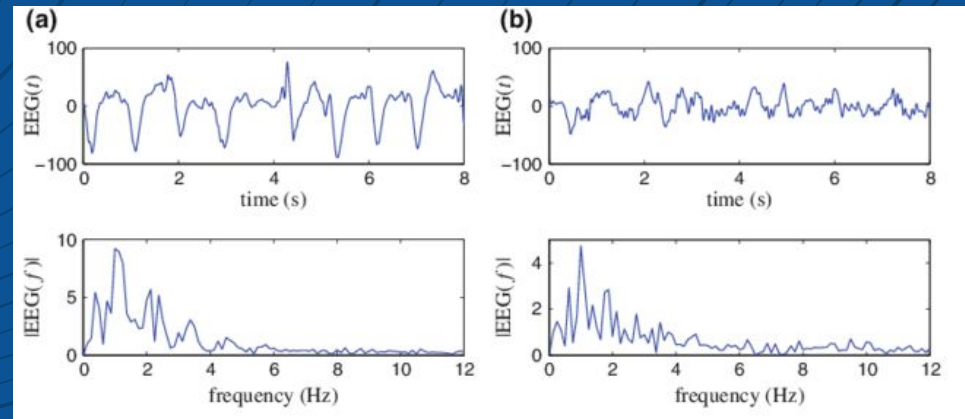


EEG 101

❖ Time Domain & Frequency Domain

Time Domain: shows how a signal changes over time

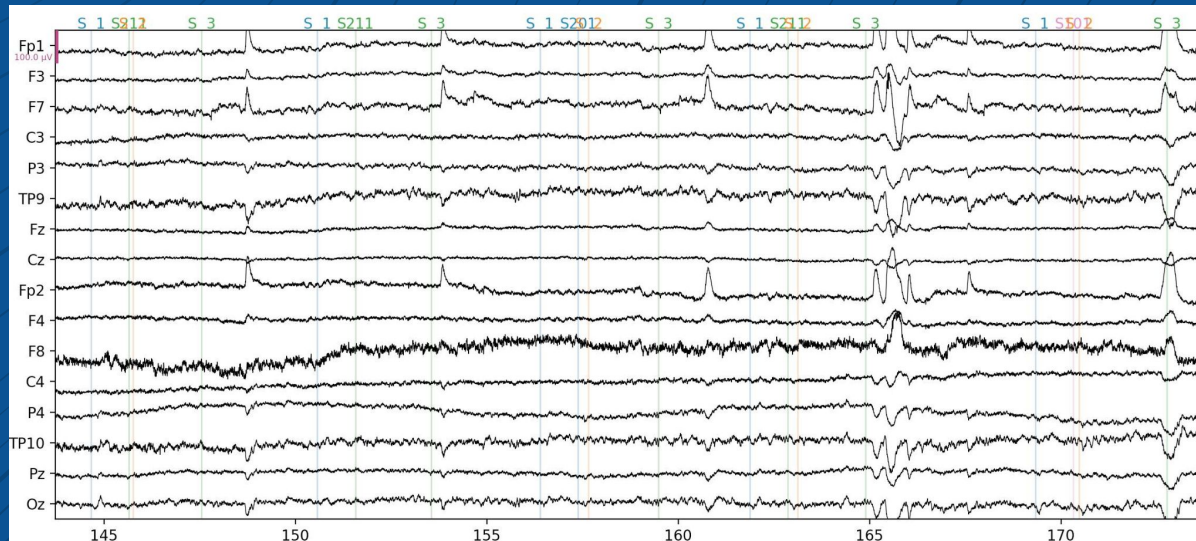
Frequency Domain: shows how the frequency changes





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Visualising EEG Recordings



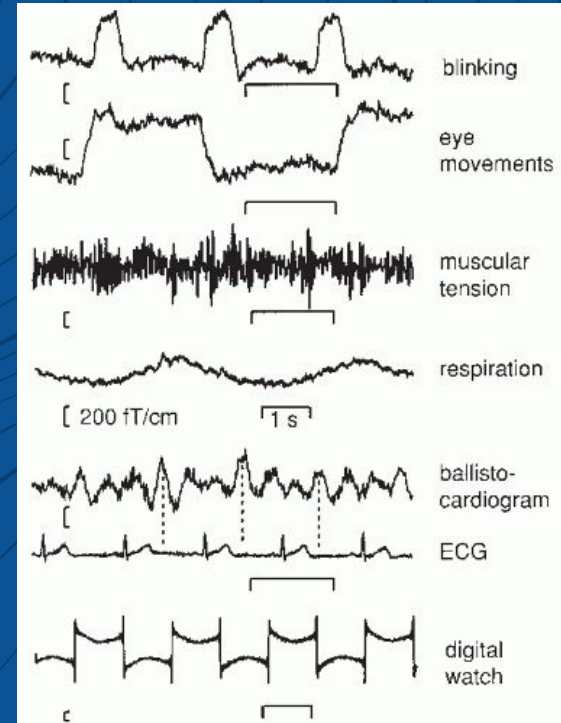


What does EEG pick up?

- Neural Activity
- Motor Movements
- Other Electrical Signals

Key Terms:

- ❖ Noise
- ❖ Signal to Noise Ratio (SNR): measure used in science and engineering that compares the level of a desired signal to the level of background noise
- ❖ Artifacts: any signal that does not arise from the brain itself





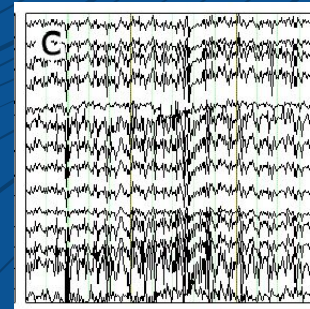
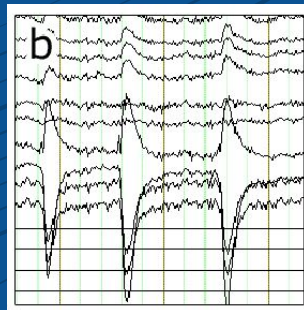
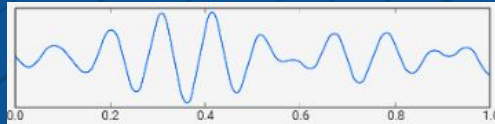
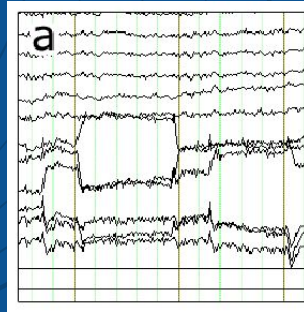
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POP QUIZ!!



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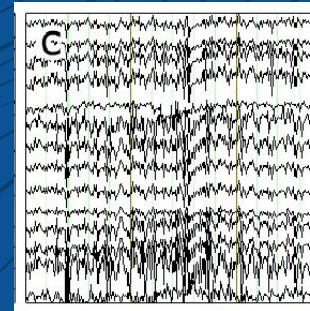
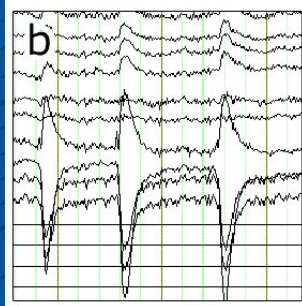
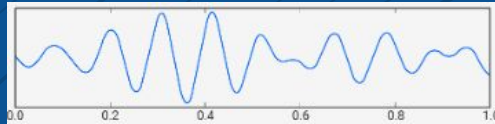
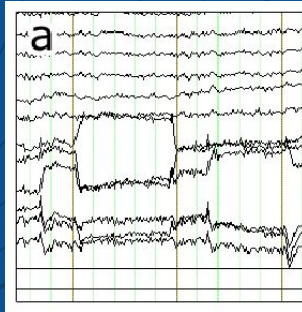
Identify These Artifacts





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Identify These Artifacts





What other signals are detectable through EEG?

Brainwaves AKA Neural Oscillations:

Gamma [>35 Hz]

- Deep focus

Beta [13-35 Hz]

- Awake and active
- Frontal & Central regions

Alpha [8-13 Hz]

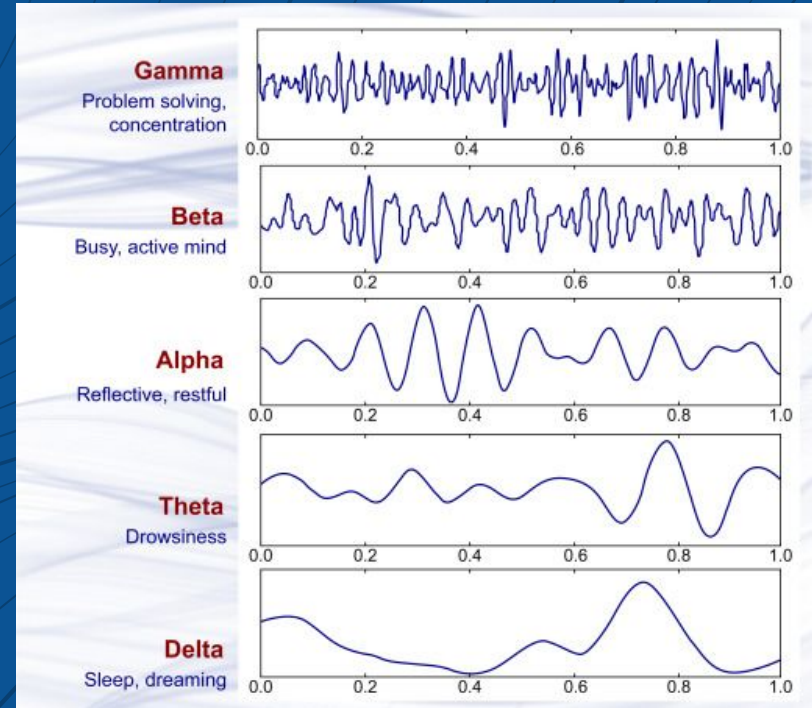
- Awake but relaxed
- Associated with Occipital region

Theta [4-8 Hz]

- Daydreaming, meditation

Delta [0.5-4 Hz]

- Deep sleep, dreaming
- Right Hemisphere





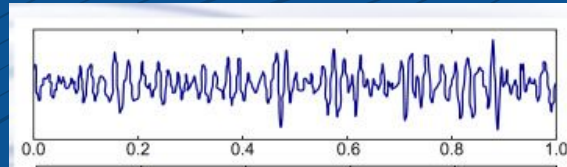
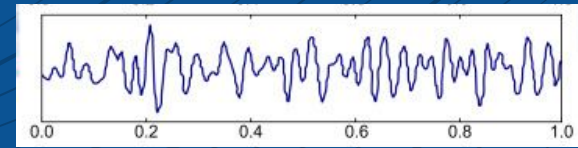
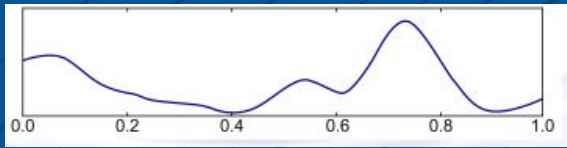
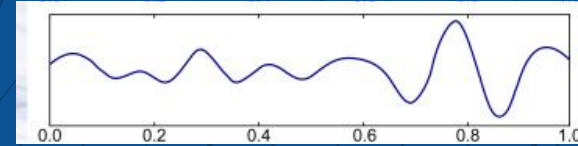
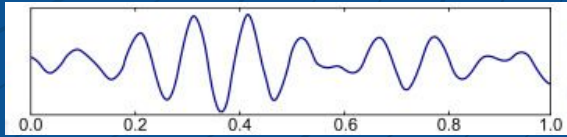
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POP QUIZ!!



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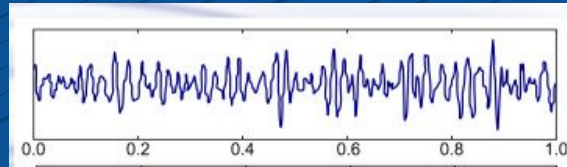
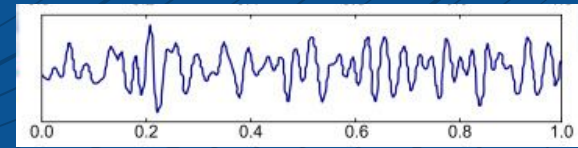
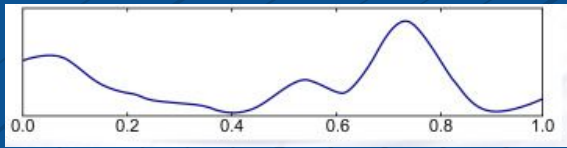
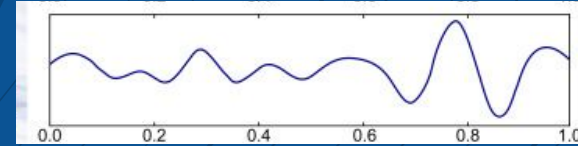
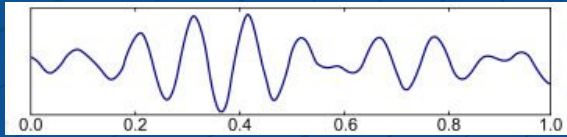
Identify These Brainwaves





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Identify These Brainwaves





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Next Meeting: EEG Hardware & Setup Demo



- Different headsets designed for commercial or research settings



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Any Questions?

Thank you for coming!
Don't forget to sign in before you leave :)



bit.ly/projectsattendance22



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