

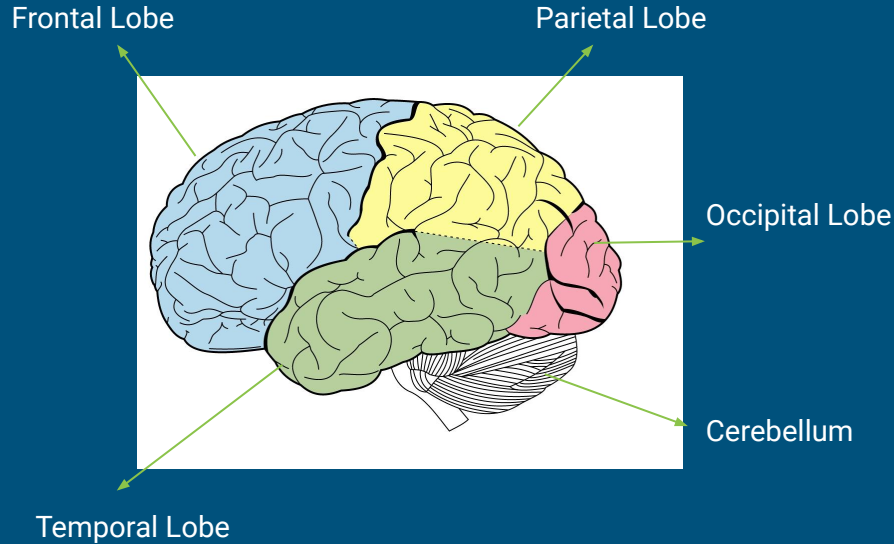
Visualizing and Interpreting Brain Signals

Neurotech@Davis

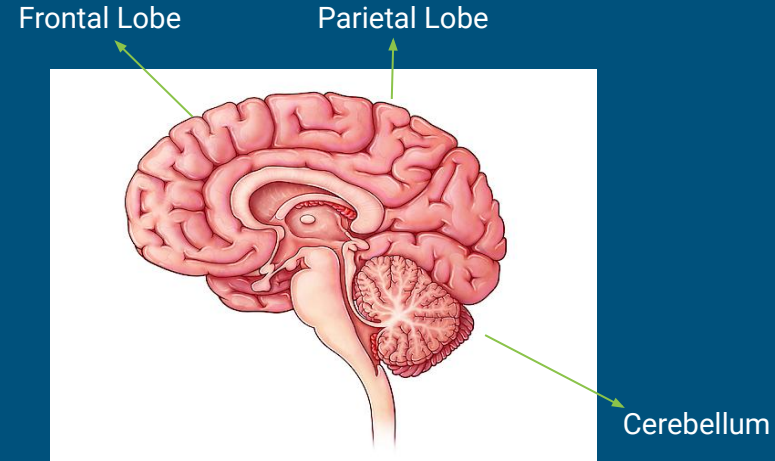
Outline

- Basic Neuroscience and Neuroanatomy
 - Parts of the brain and their functions
- Overview of EEG
 - Electrode placement
 - Wet vs. Dry Systems
- Overview of Time Series Data
 - Understanding EEG data
 - Identifying artifacts

Parts of the Brain



Lateral View



Medial View

Cerebellum

Functions

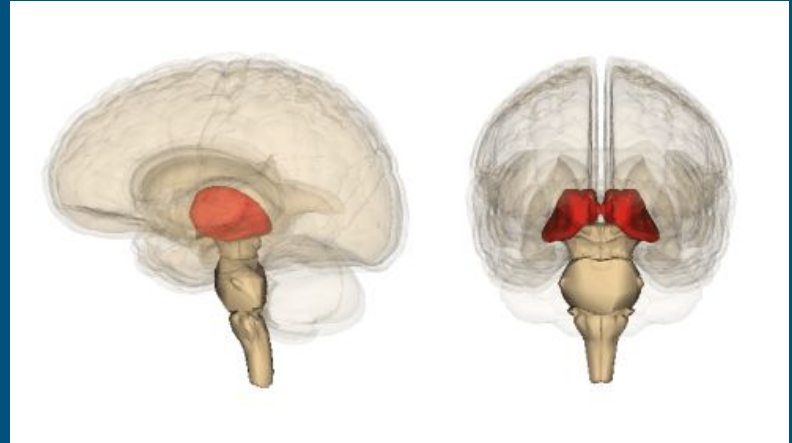
- Balance and coordination
- Voluntary movements
- 50% of neurons in our brain



Thalamus

Functions

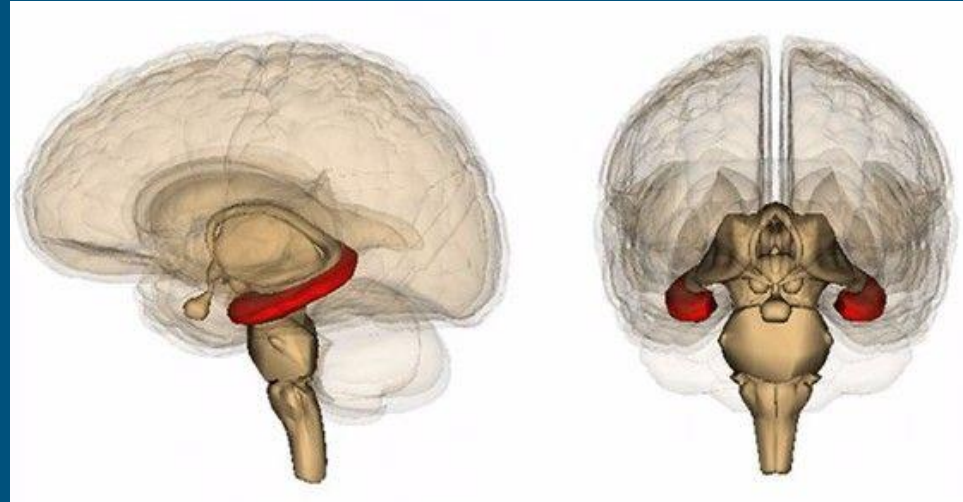
- Brain's official middle man
- Sensory info converges and then routed to the cortex for processing



Hippocampus

Functions

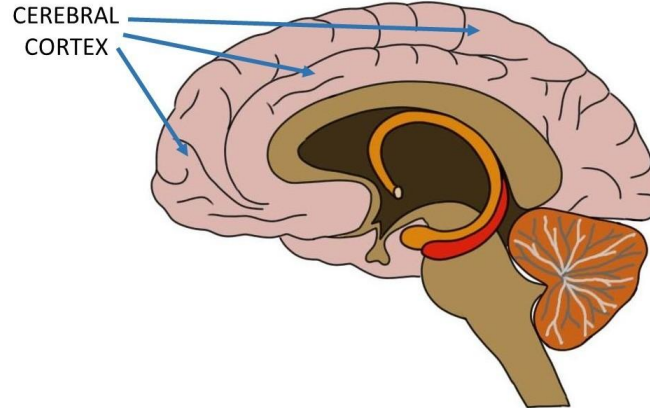
- Encoding and retrieval of long-term memory
- Not a storage space for memory
- Damage leads to amnesia



Cerebral Cortex

Perception,
attention,
planning,
personality

What
makes us
human?

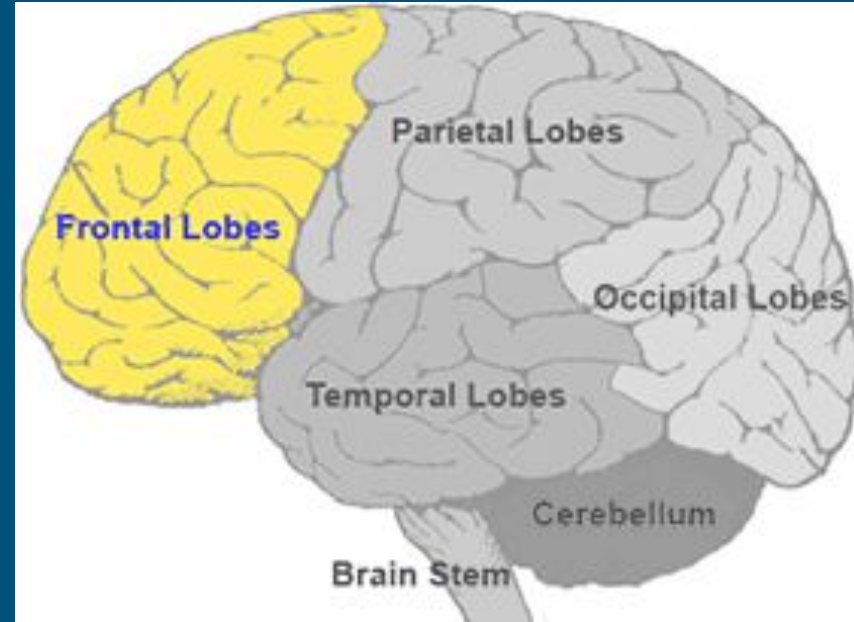


Frontal Lobe

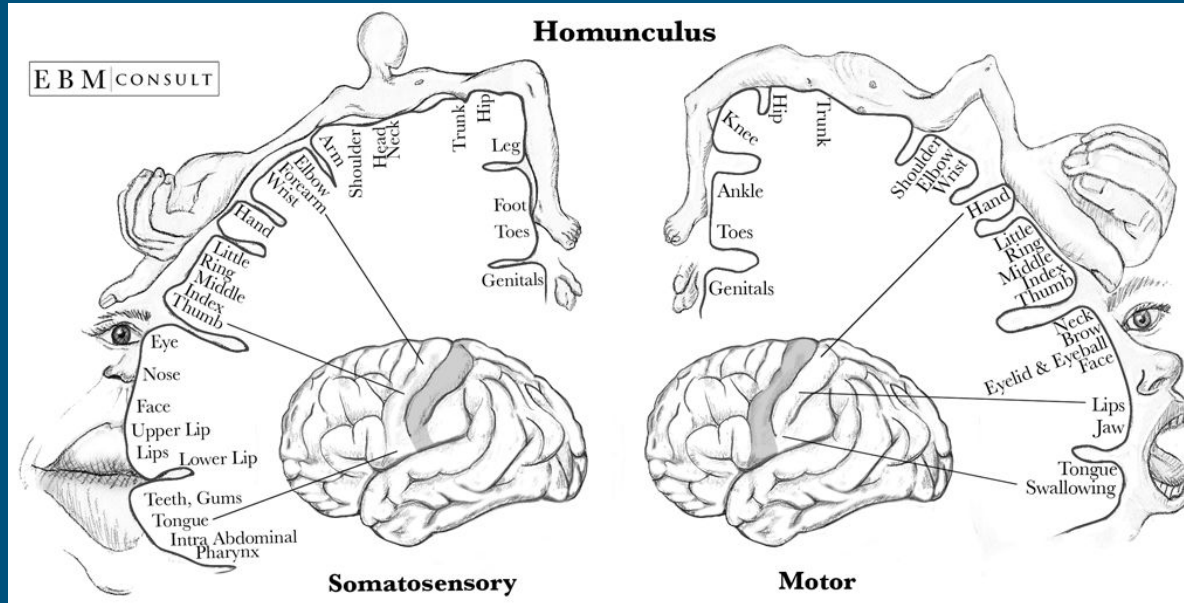
- Thinking
- Planning
- Decision Making

Parietal Lobe

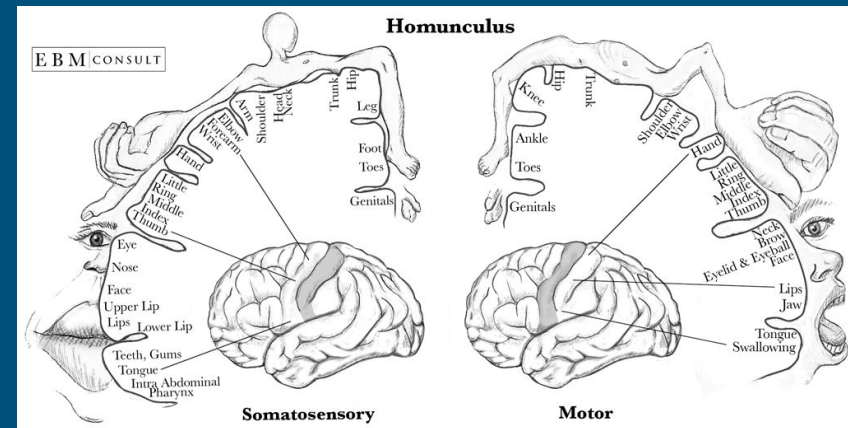
- Sensation + Perception
- Spatial Processing
- Somatosensory Cortex



Somatosensory + Motor Cortex



- Different parts of the cortex map to different parts of the body
- More sensitive regions take up more cortical real estate
 - Face + hands
- Missing limbs cross over into adjacent areas

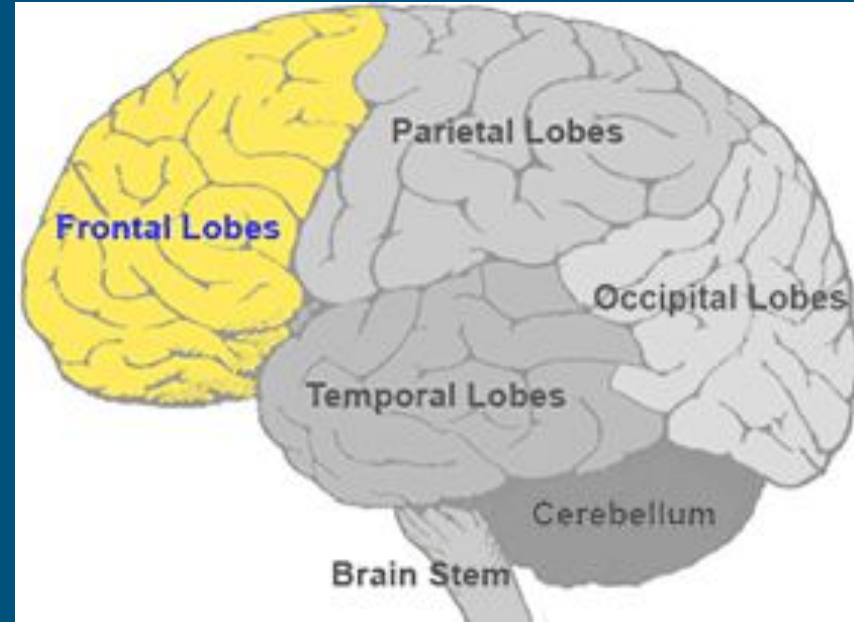


Occipital Lobe

- Visual Processing

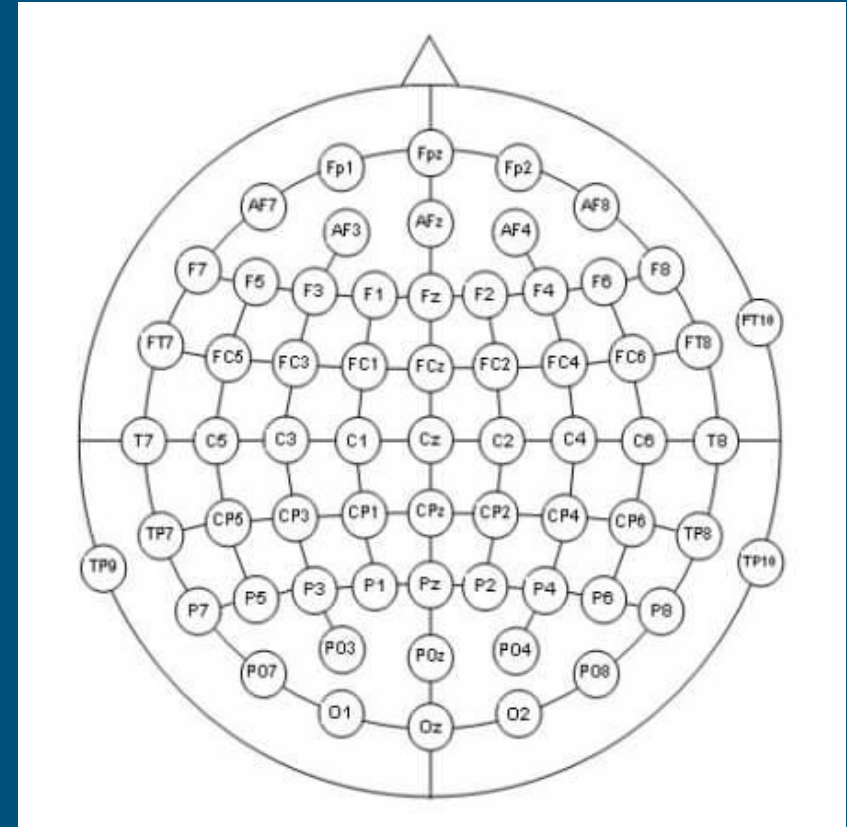
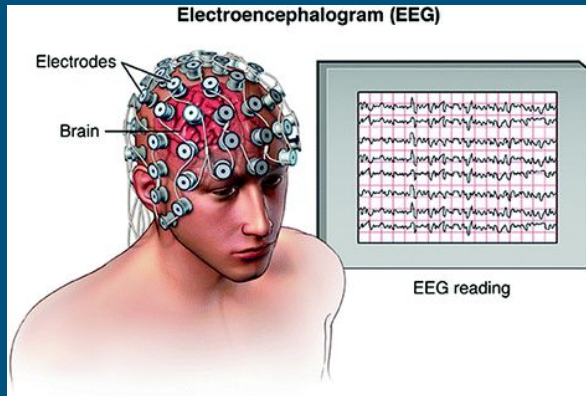
Temporal Lobe

- Auditory processing
- Language comprehension



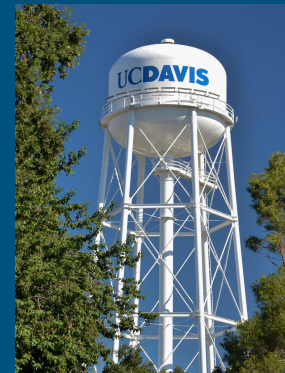
What is EEG?

- Electroencephalogram
- Measure of electrical activity in the brain
- On-scalp electrodes
- Gel like conductive substance



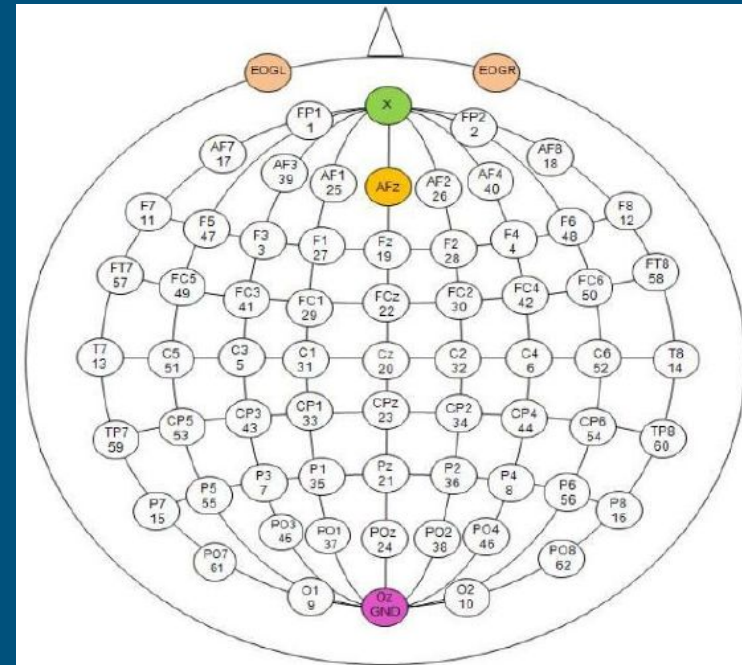
Current and Voltage

- Current
 - Actual flow of electricity through a conductor
 - # of electrons past a given point in a specific amount of time
- Voltage
 - Aka electrical potential
 - Potential for electrical current to flow from one place to another
 - Measuring the *potential*, not the current itself



Active, Reference, Ground

- Every EEG system has active, reference, and ground electrodes
- Every circuit has a ground
 - Dangerous to place ground on human circuits
- Remember that voltage is relative (it's the potential)
- No-Switzerland Principle
- $(A-G) - (R-G) = (A-R)$



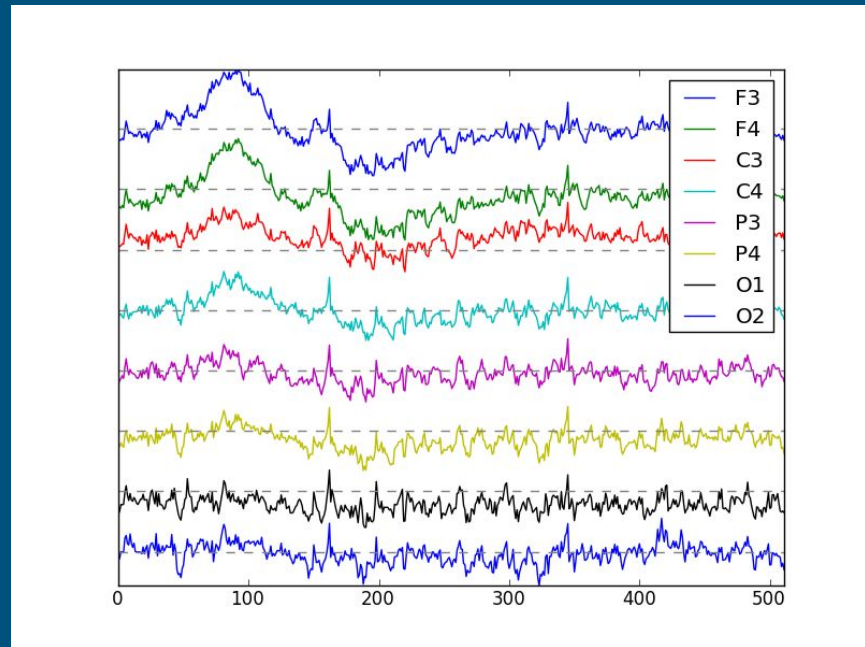


Electrode Placement Matters

- Electrode placement depends on what exactly you are trying to measure

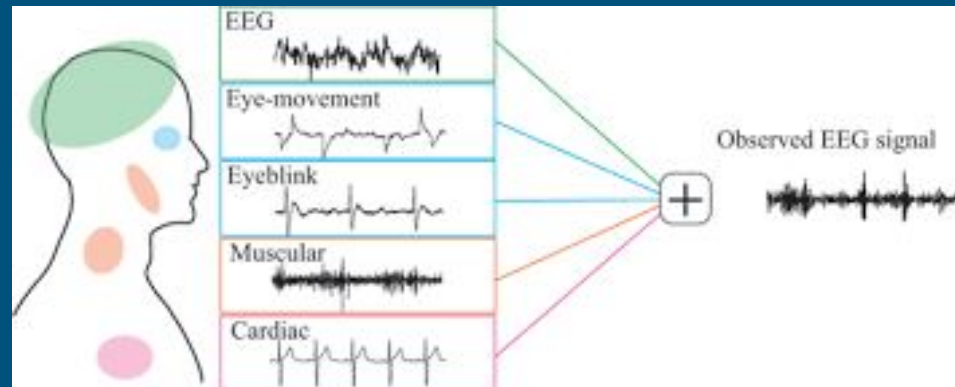
What does EEG data look like?

- Time Series data
 - Microvolts x Milliseconds
- Each electrode represented as its own channel

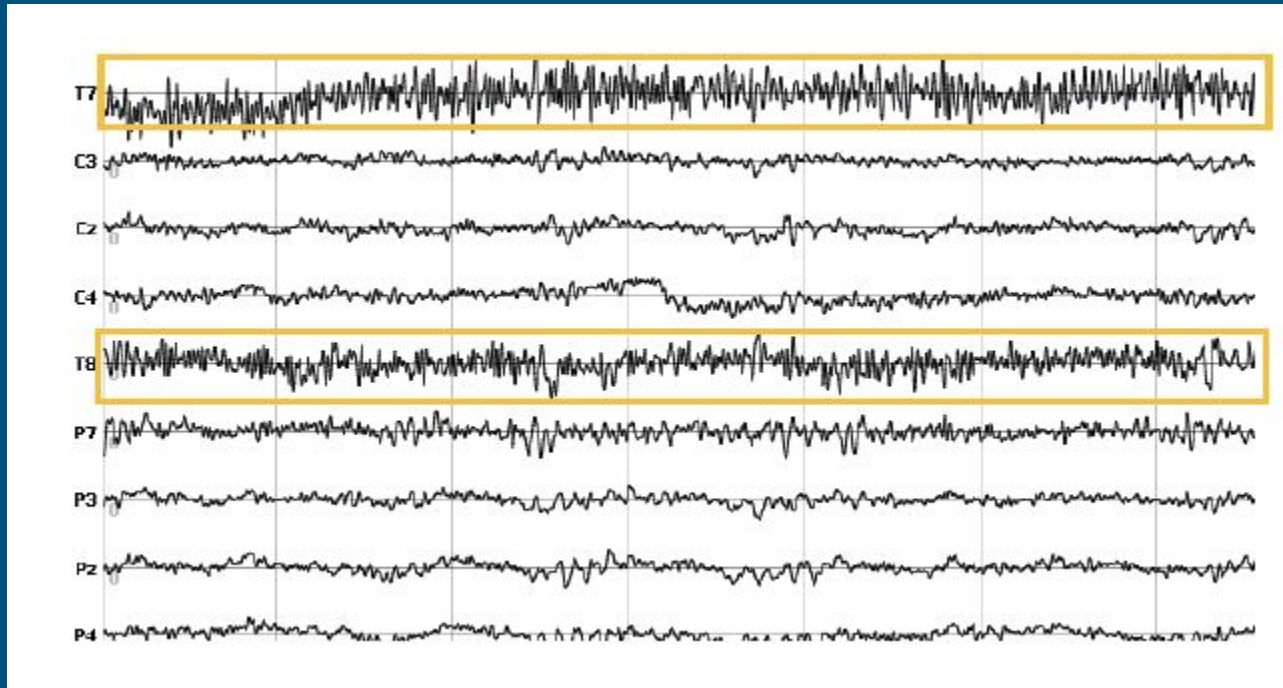


What are Artifacts?

- Signals recorded by the EEG but not generated by the brain
- 3 main problems with artifacts
 - Decrease SNR ratio
 - May be systematic, unable to be removed by the averaging process
 - Cause a potential change of sensory input across experimental conditions
- 2 main strategies
 - Artifact rejection
 - Artifact correction

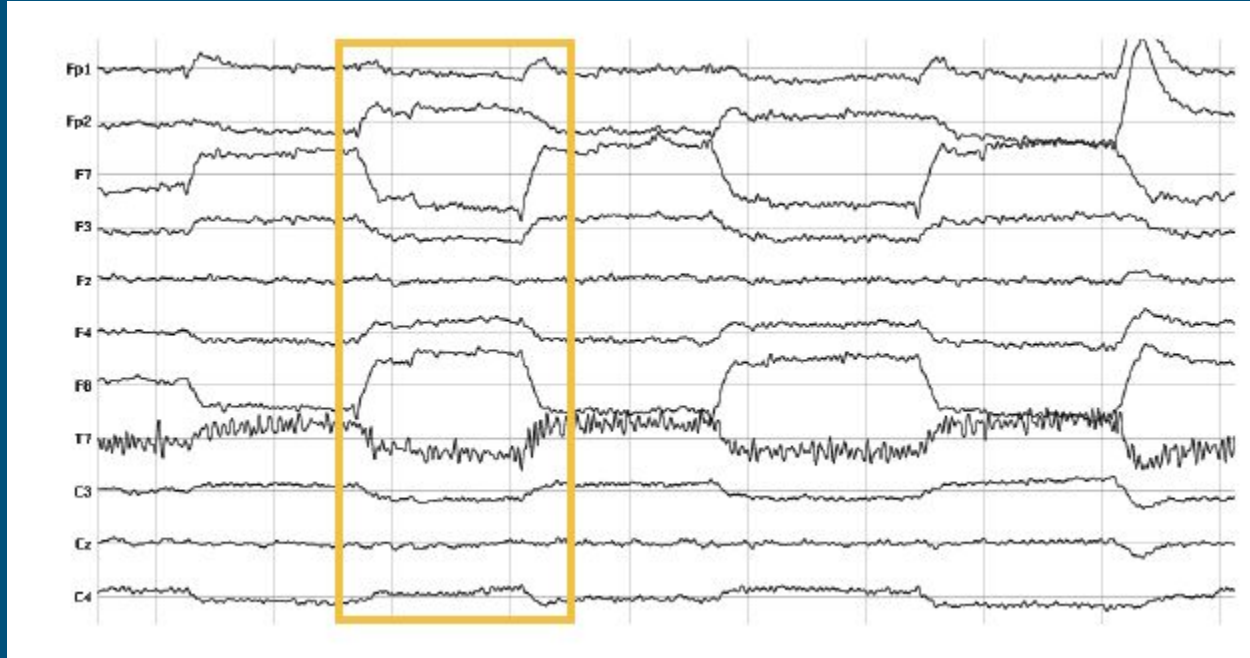


What do Artifacts Look Like?

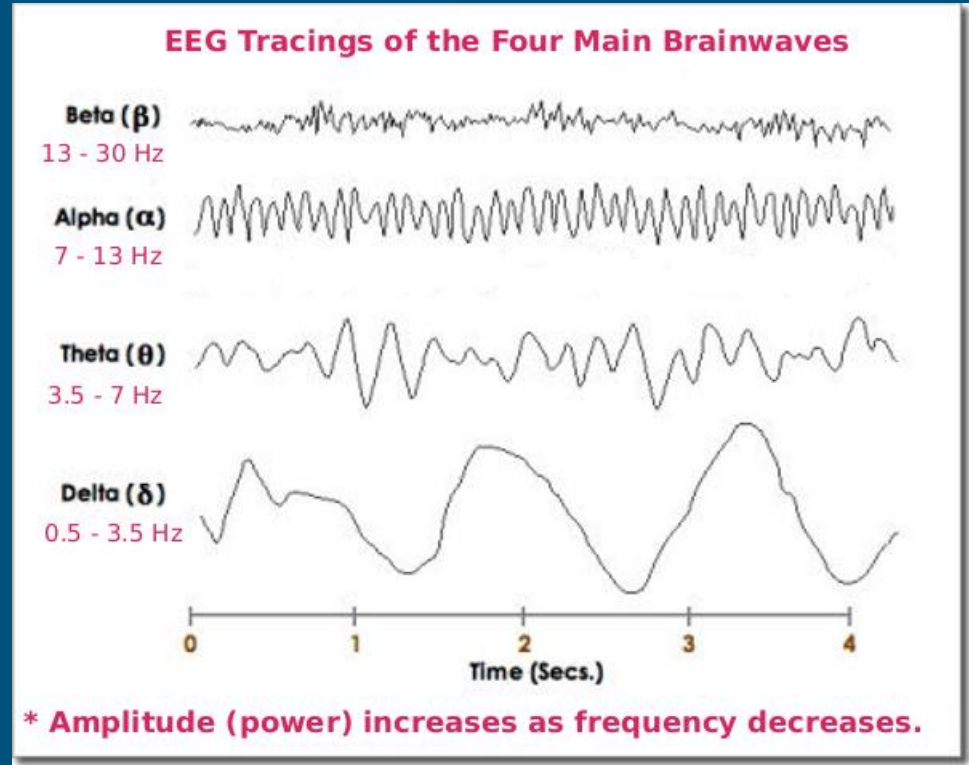




EEG Eye Movements



Next Week: How
do we go from
microvolts x
milliseconds to
frequencies?



Thank You

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davisneurotech@gmail.com

