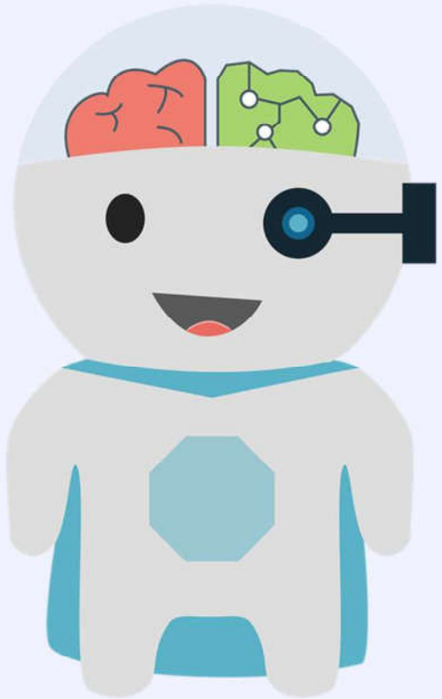
Week 5: Uncovering Oscillatory Processes in EEG

March 4, 2019 6:40 PM

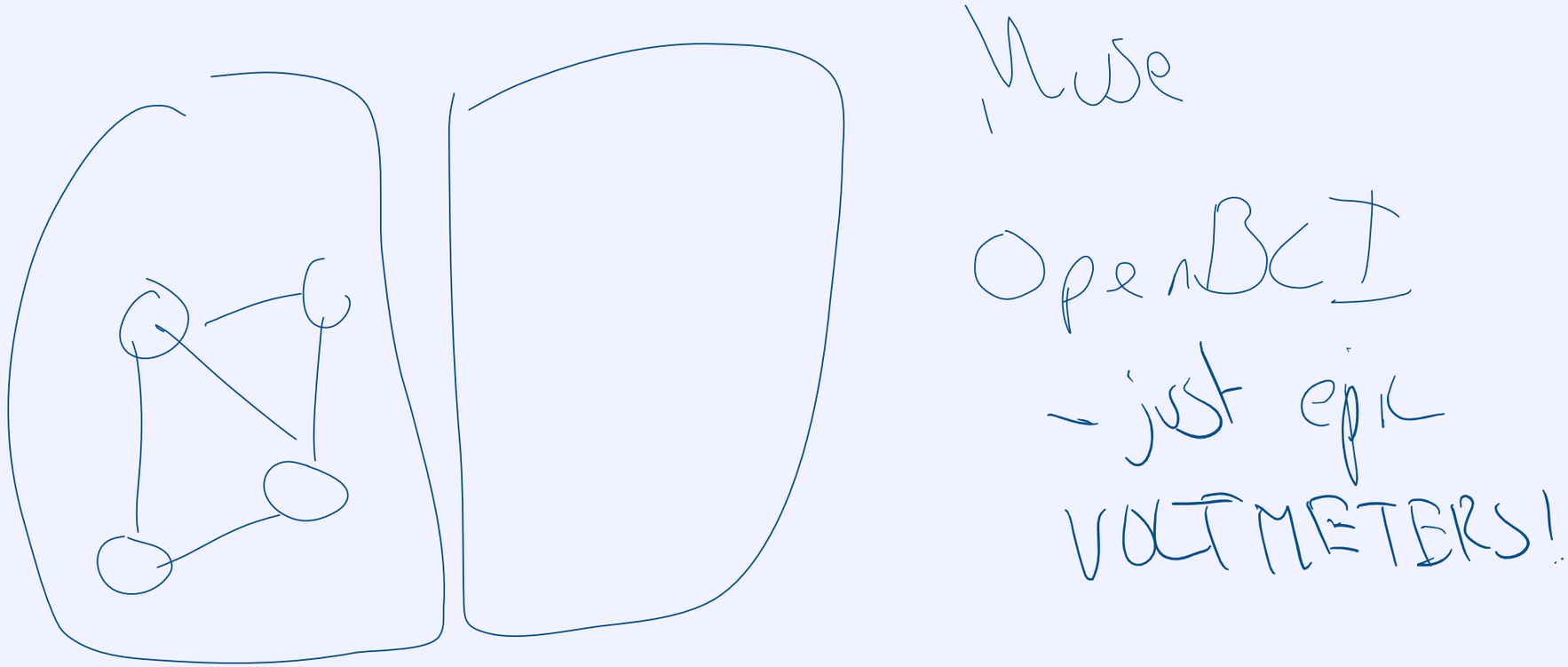


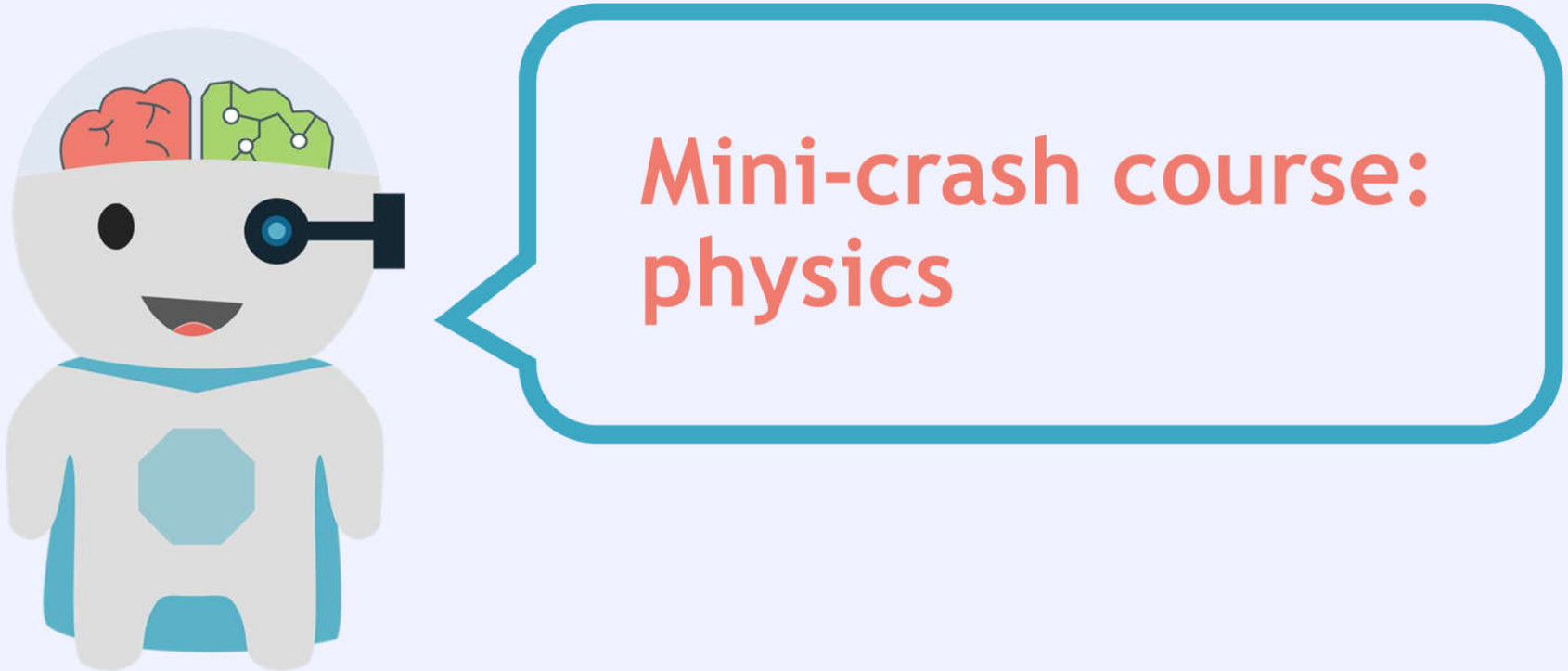
Week 5

UNCOVERING OSCILLATORY PROCESSES IN EEG

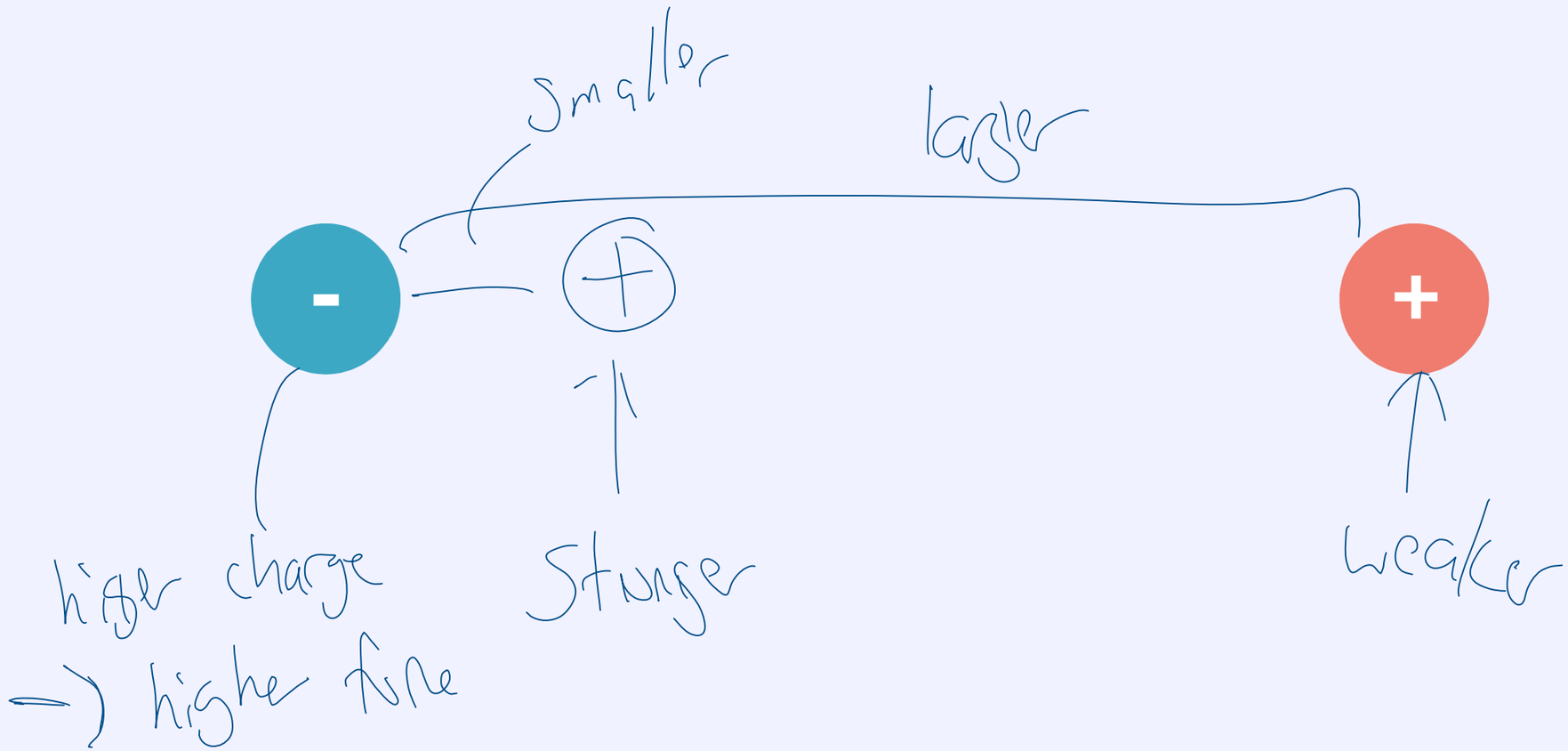
neurotechuoft

EEG, aka *brainwaves*

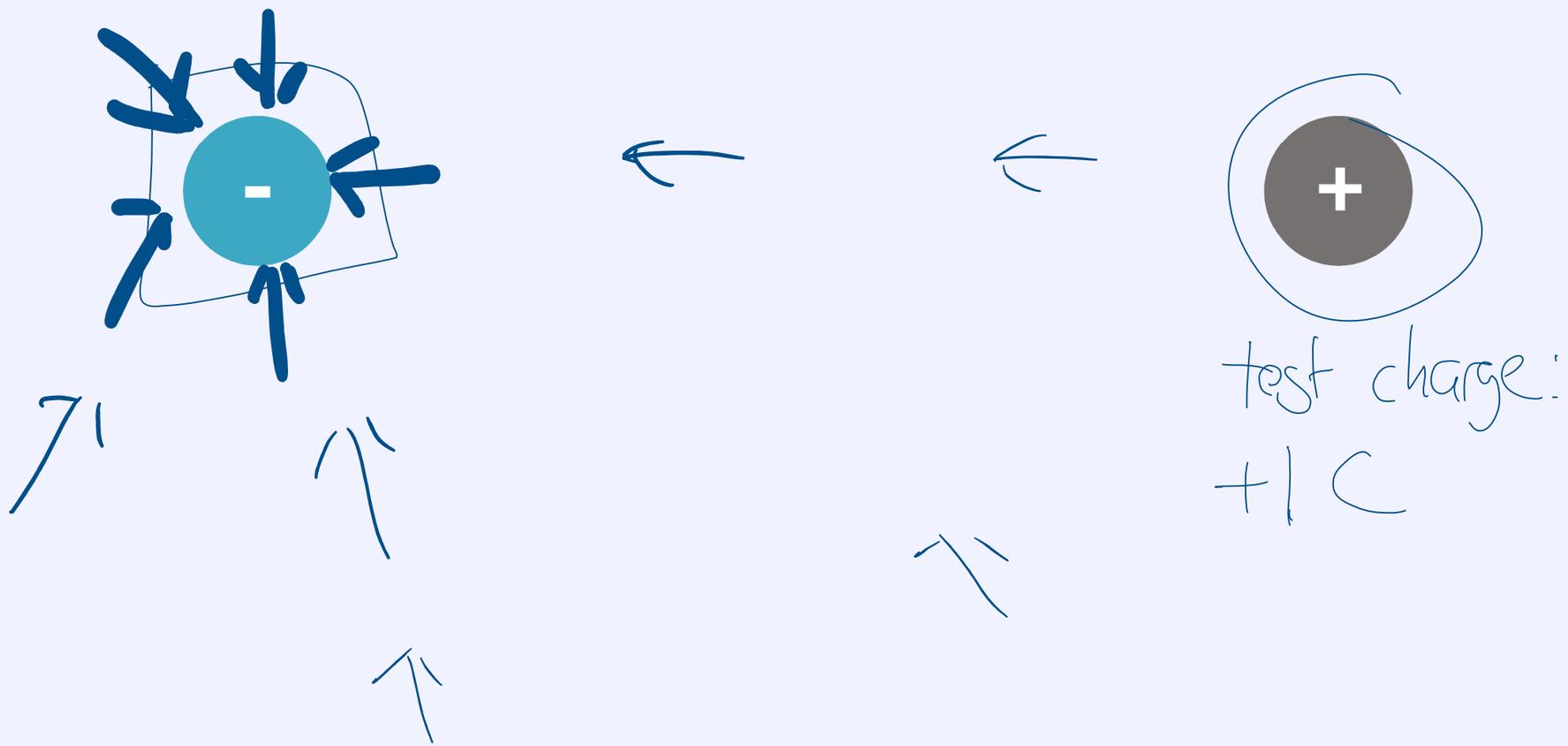



Mini-crash course:
physics

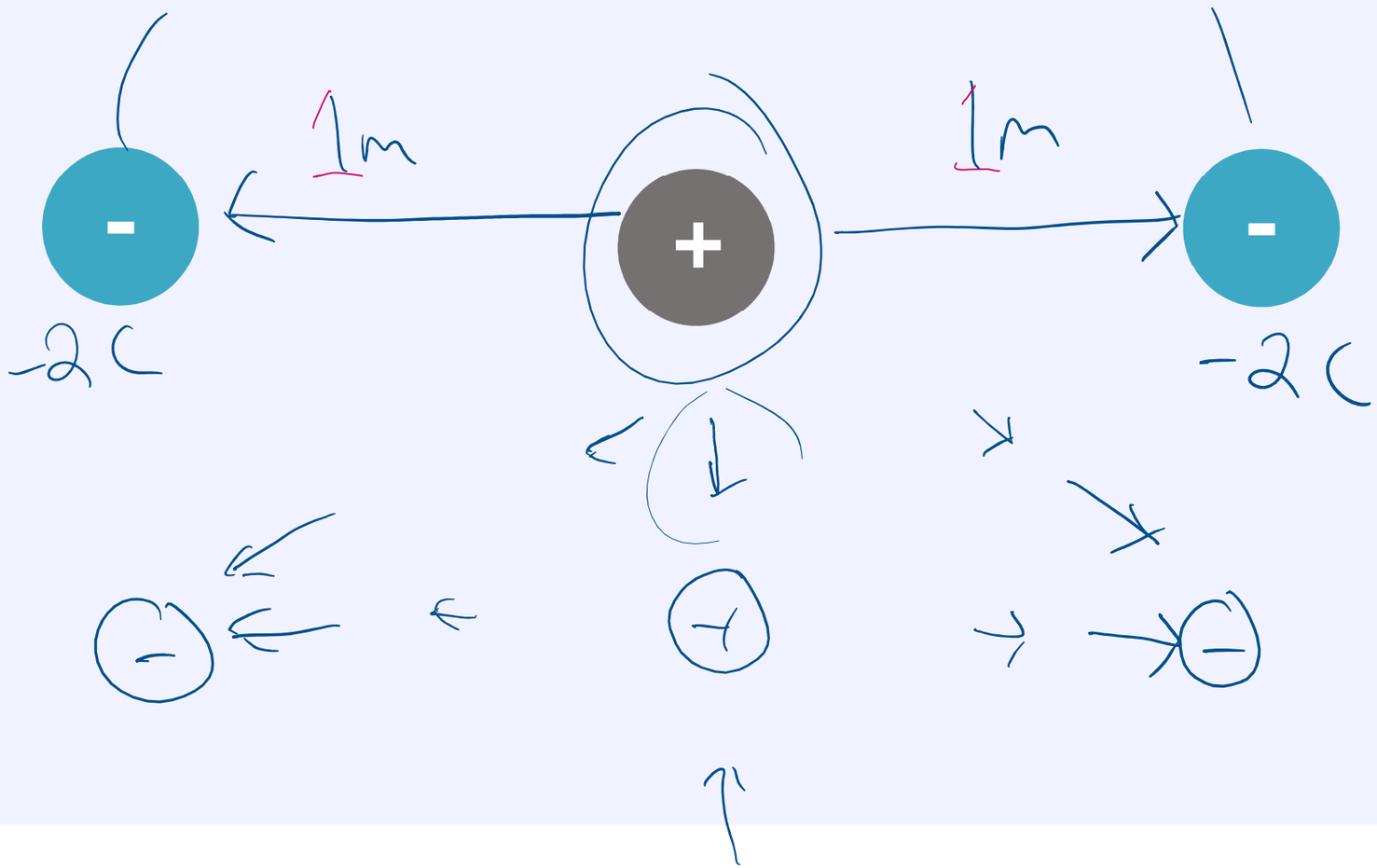
Electric Force



Electric field: *force / unit charge*



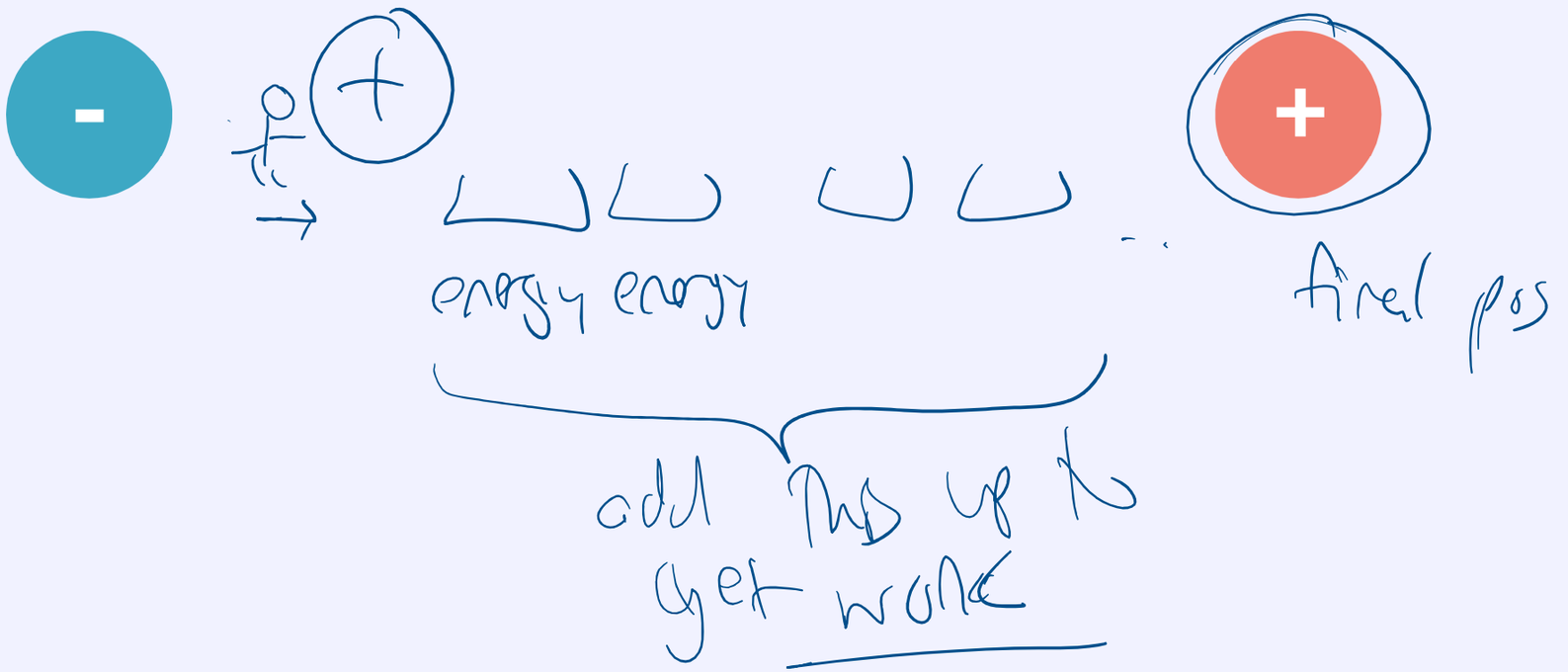
Electric fields add!!



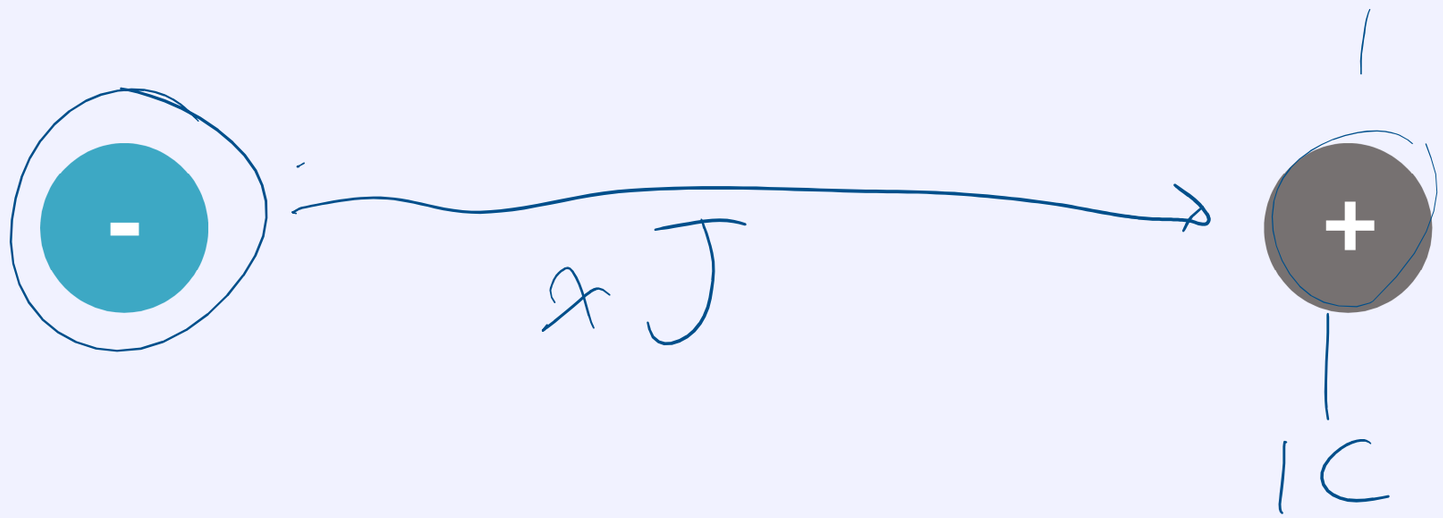
Work

$J = N\,m$

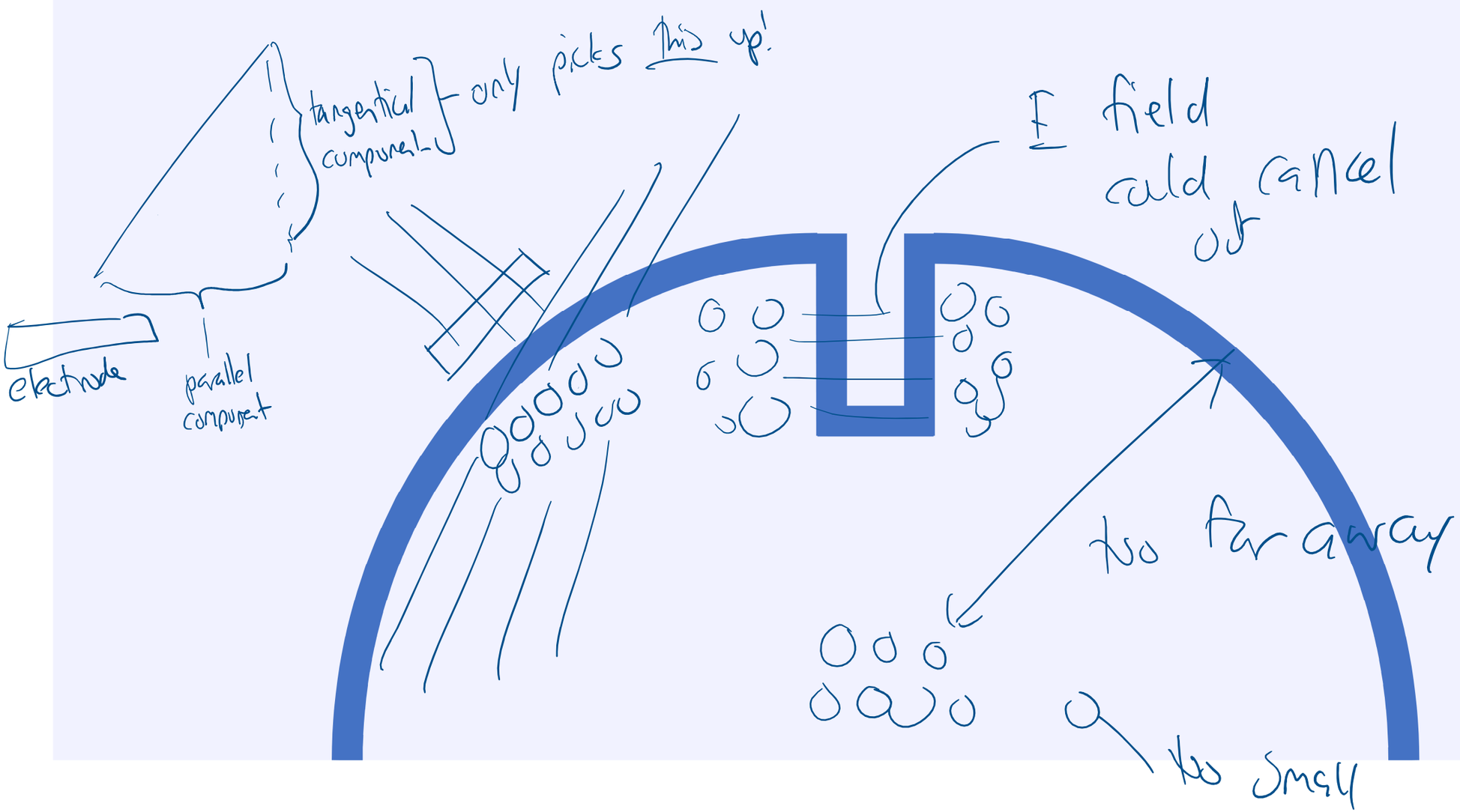
force distance



Voltage: *potential energy / unit charge*



When can you measure EEG?



When can you measure EEG?

neurons don't cancel each other out

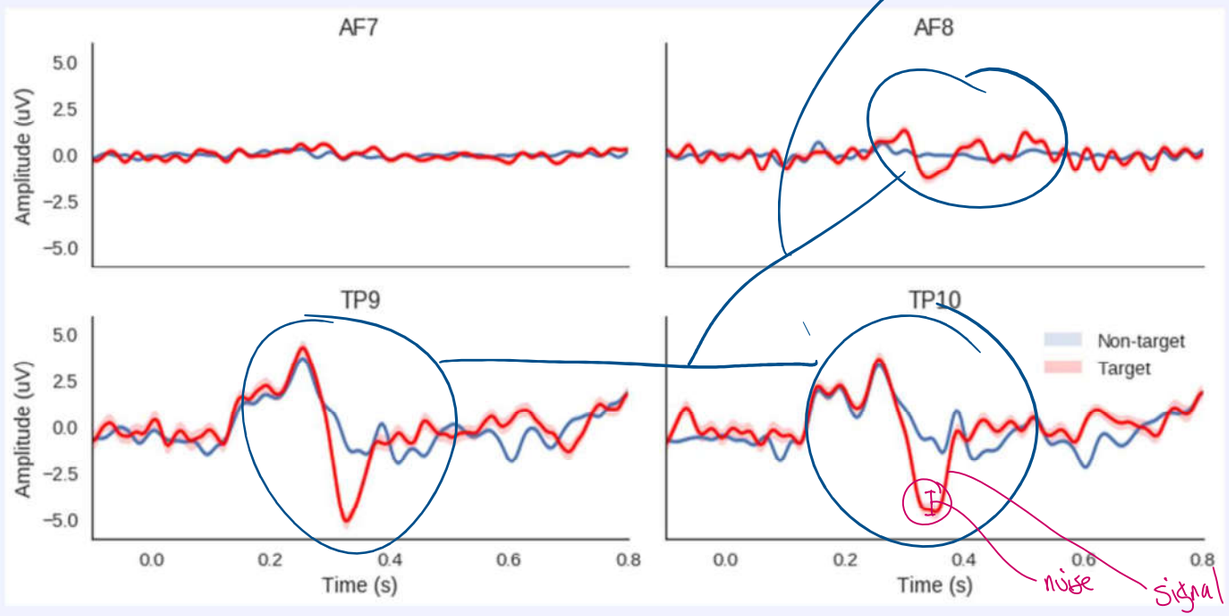
many neurons firing at once

electric field perpendicular to scalp

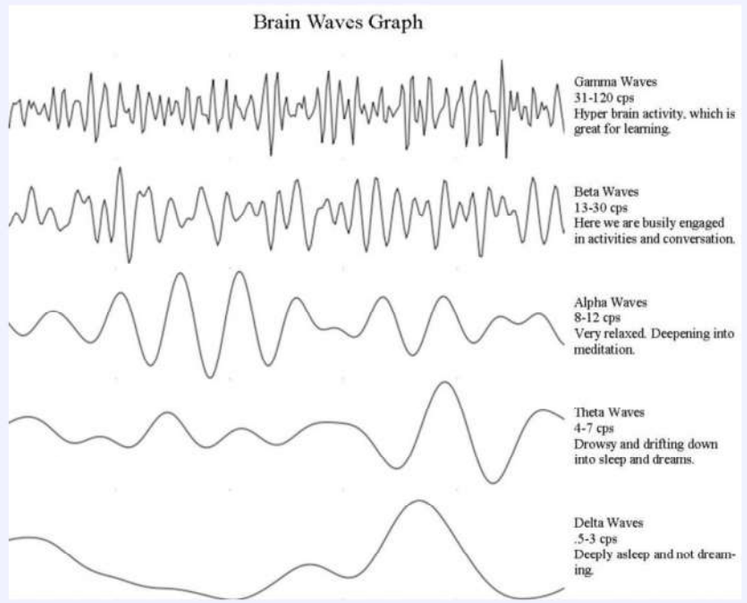
neurons close to skull

When can you measure EEG?

EVENT RELATED POTENTIALS



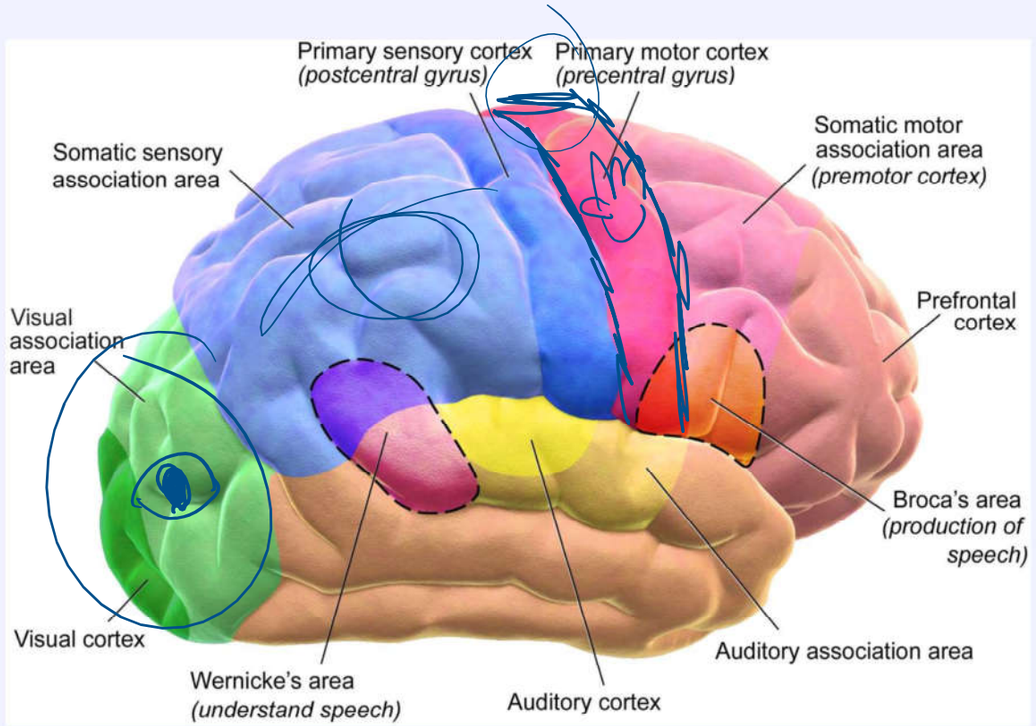
OSCILLATORY PROCESSES

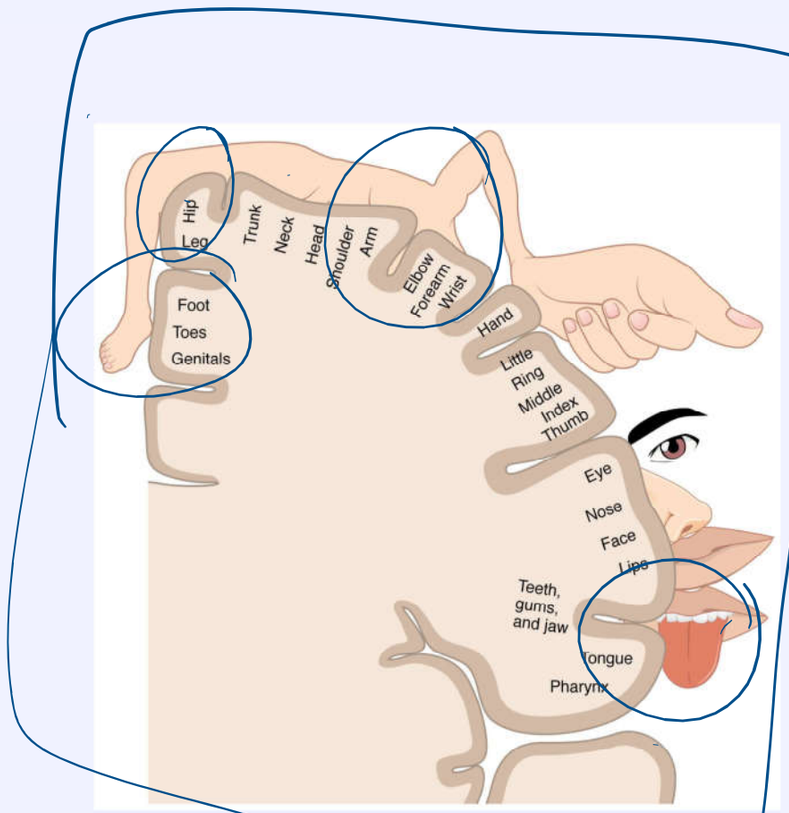


Credit: Alexandre Barachant; Slaven Cvijetic

SPATIAL CHARACTERISTICS

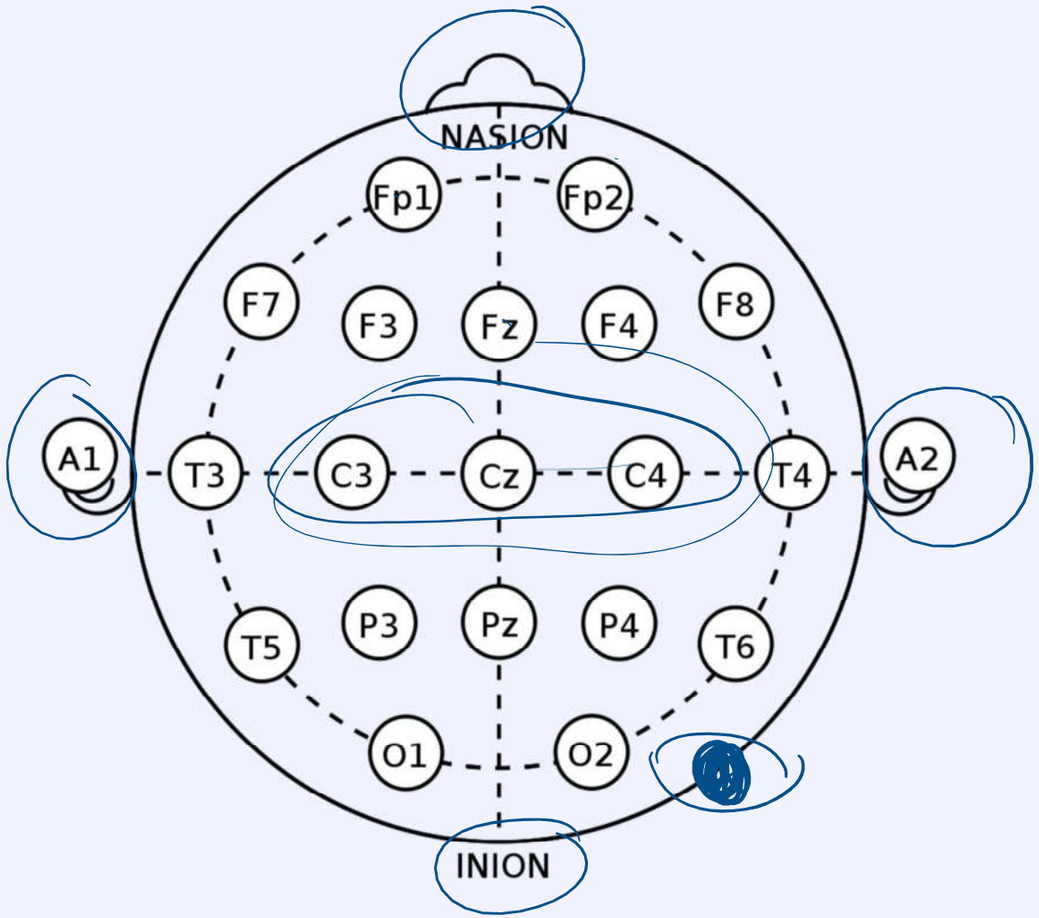
Different regions *kind of* have different functions





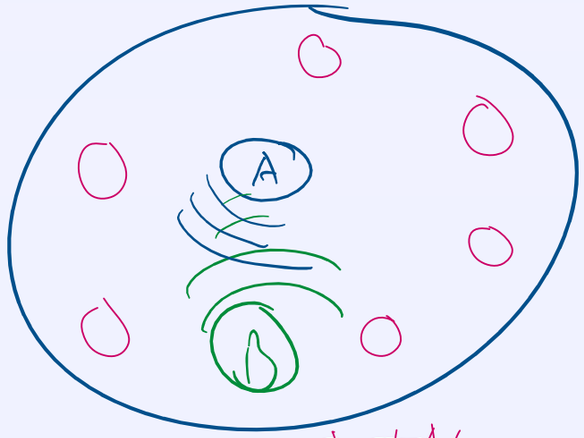
Credit: Wikipedia

10-20 system: *the brain map*



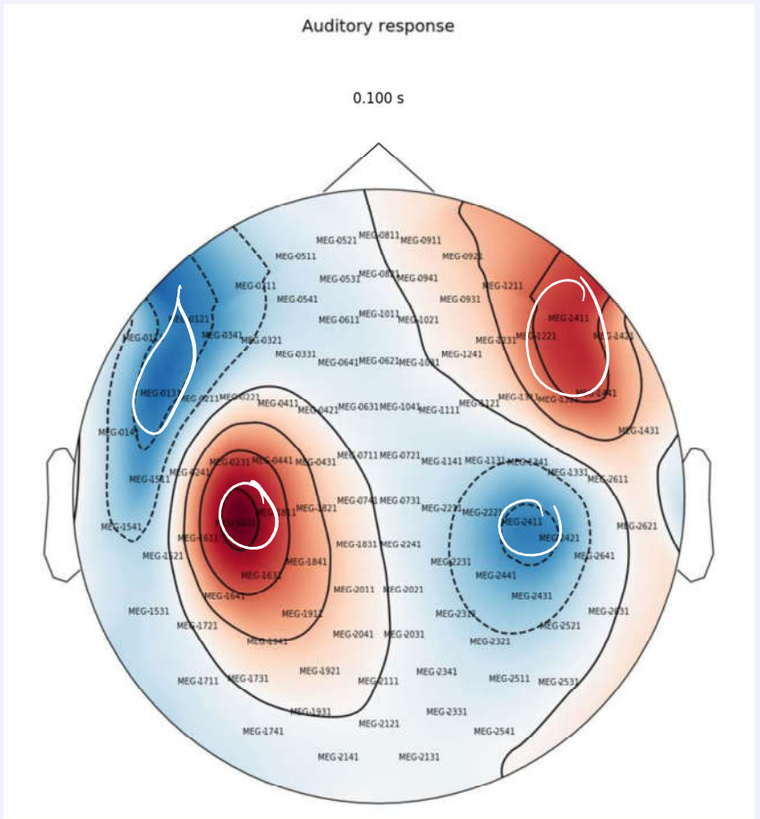
Credit: Wikipedia

Volume conduction / Source Localization



measures TOTAL E field

- can reverse process why source localization because E fields ~ add up linearly



Credit: Wikipedia

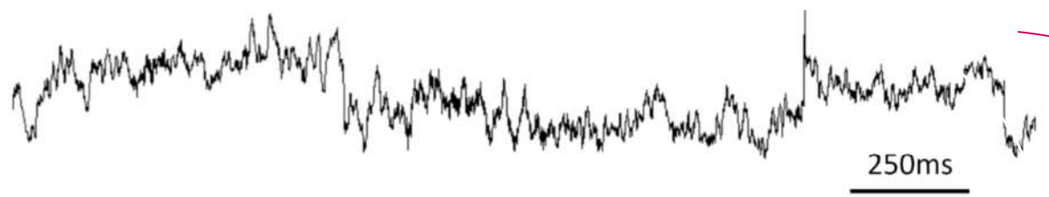
TEMPORAL CHARACTERISTICS

1 Neuron vs Many Neurons

- Typical spiking behavior of a single neuron

Tsodkys, 1997

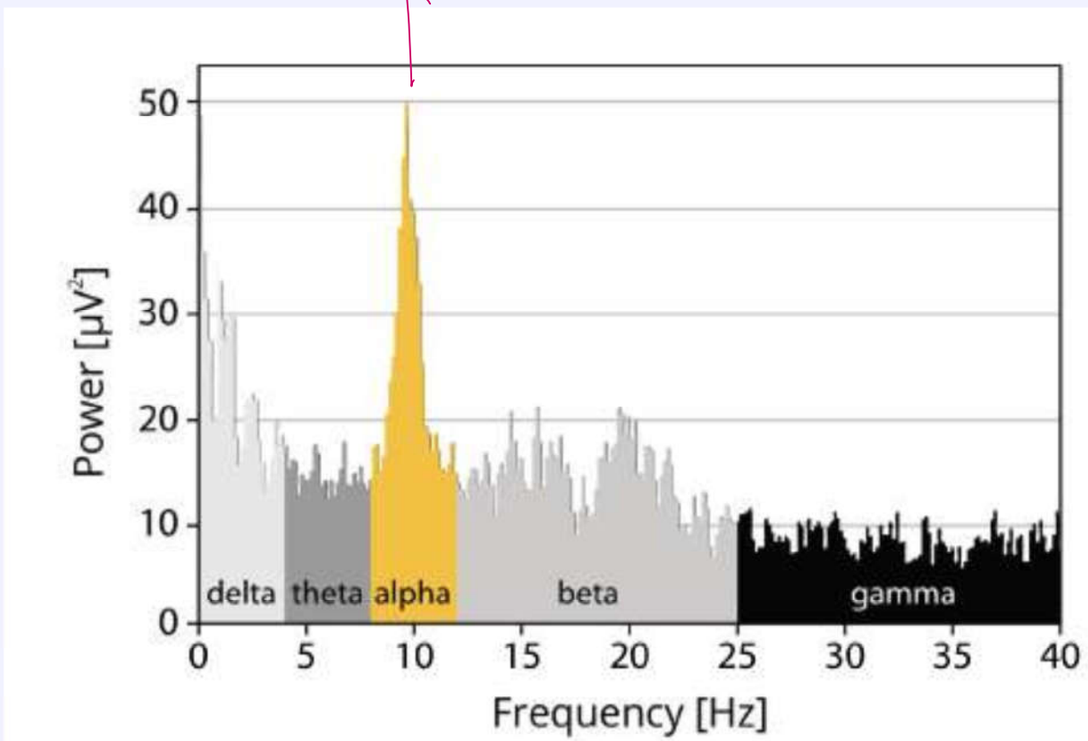
- Typical signal measured at a scalp site



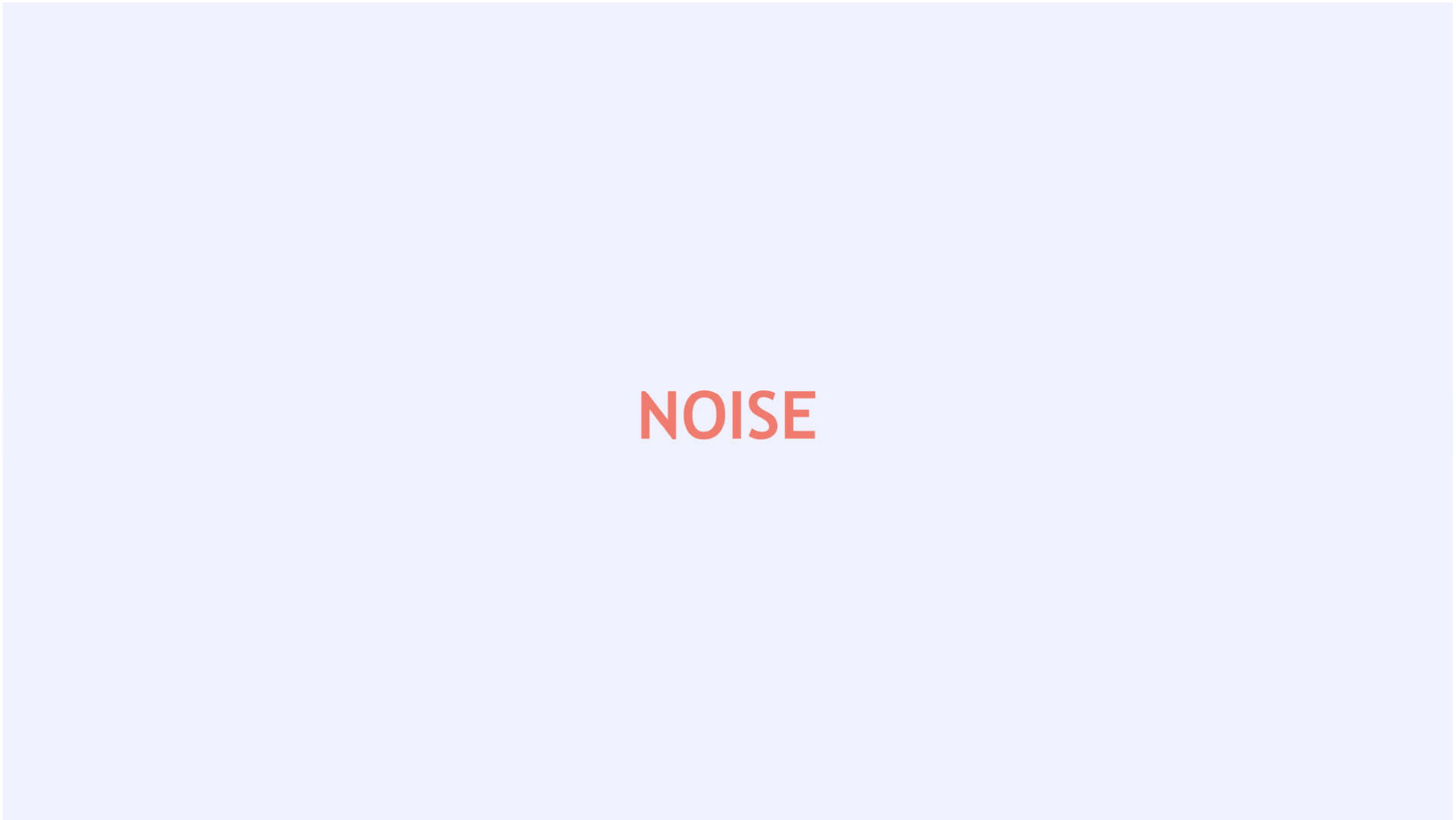
can't tell what's happening!

Credit: Wikipedia

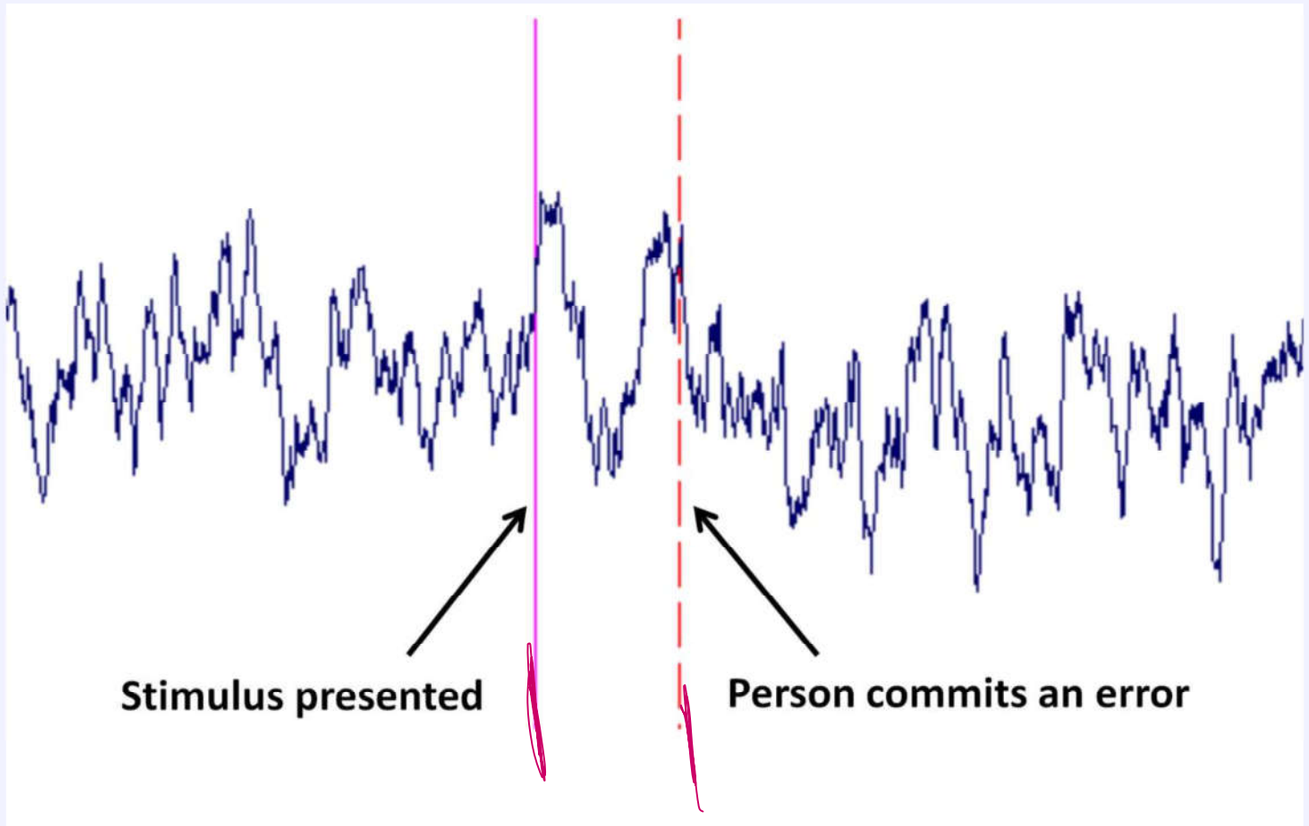
Power spectral analysis



Credit: iMotions

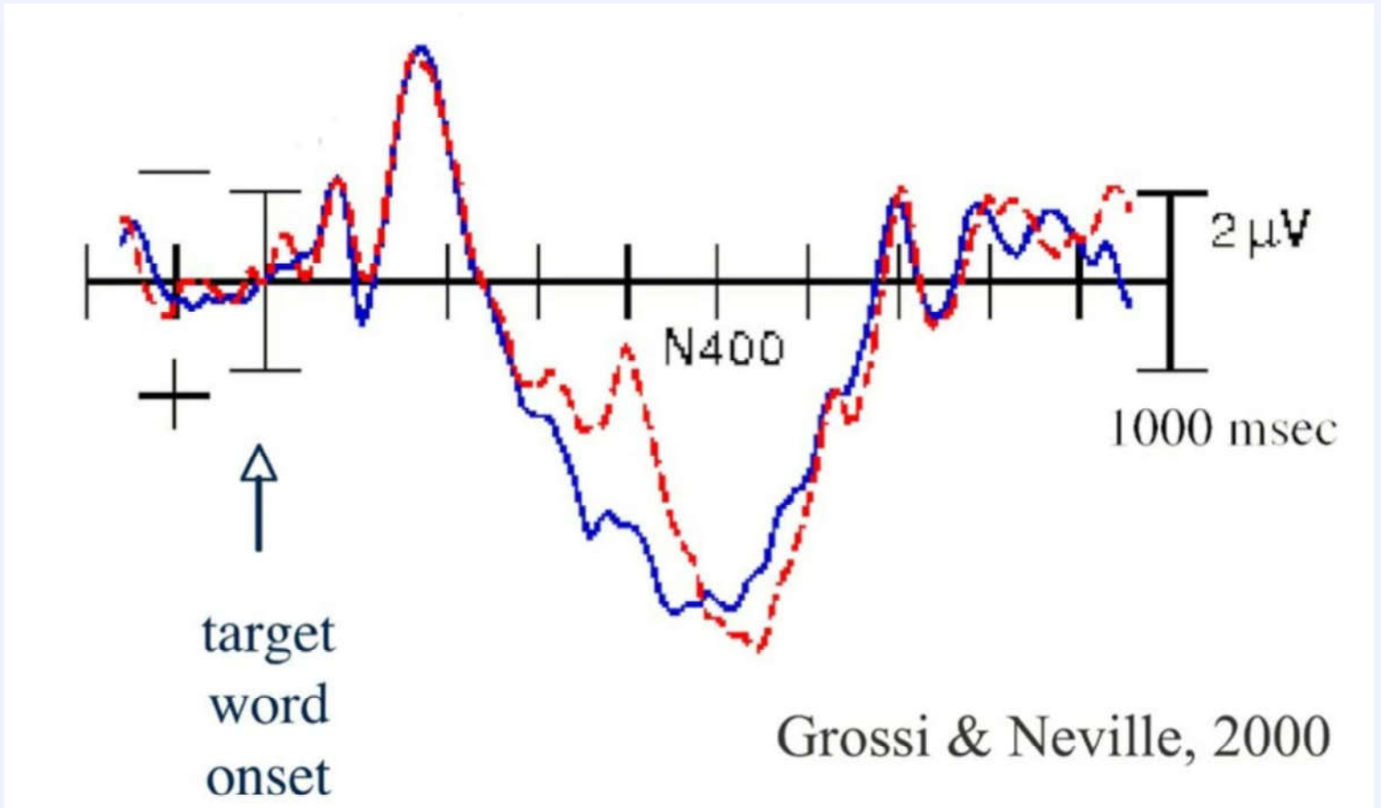

NOISE

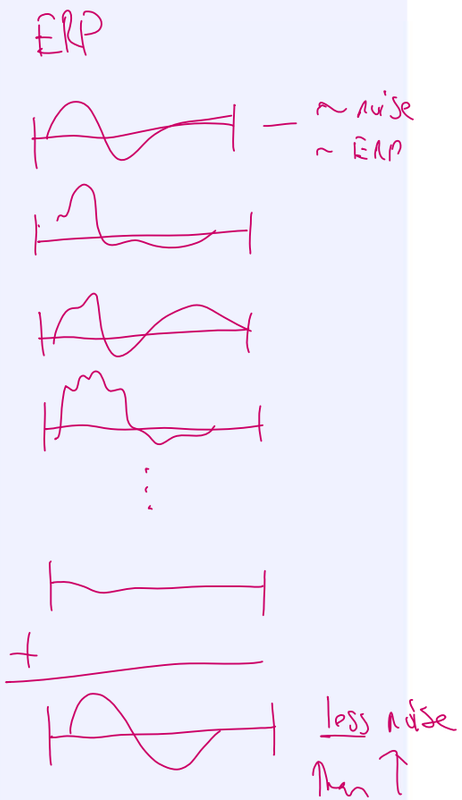
It’s kind of hard to tell what’s happening!



Credit: Wikipedia

How to take out noise?

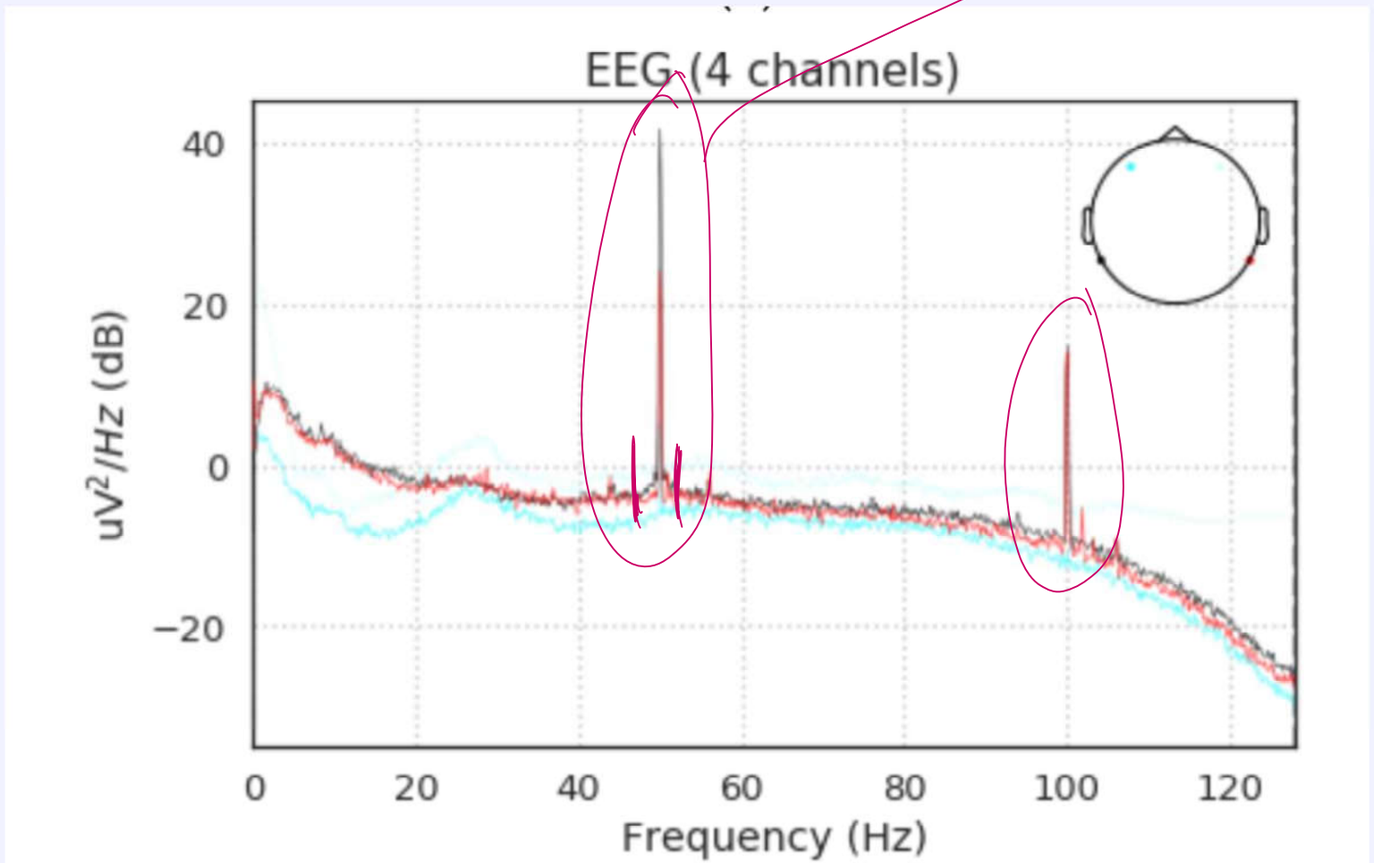




Credit: Grossi, Neville

How to take out noise?

power line noise

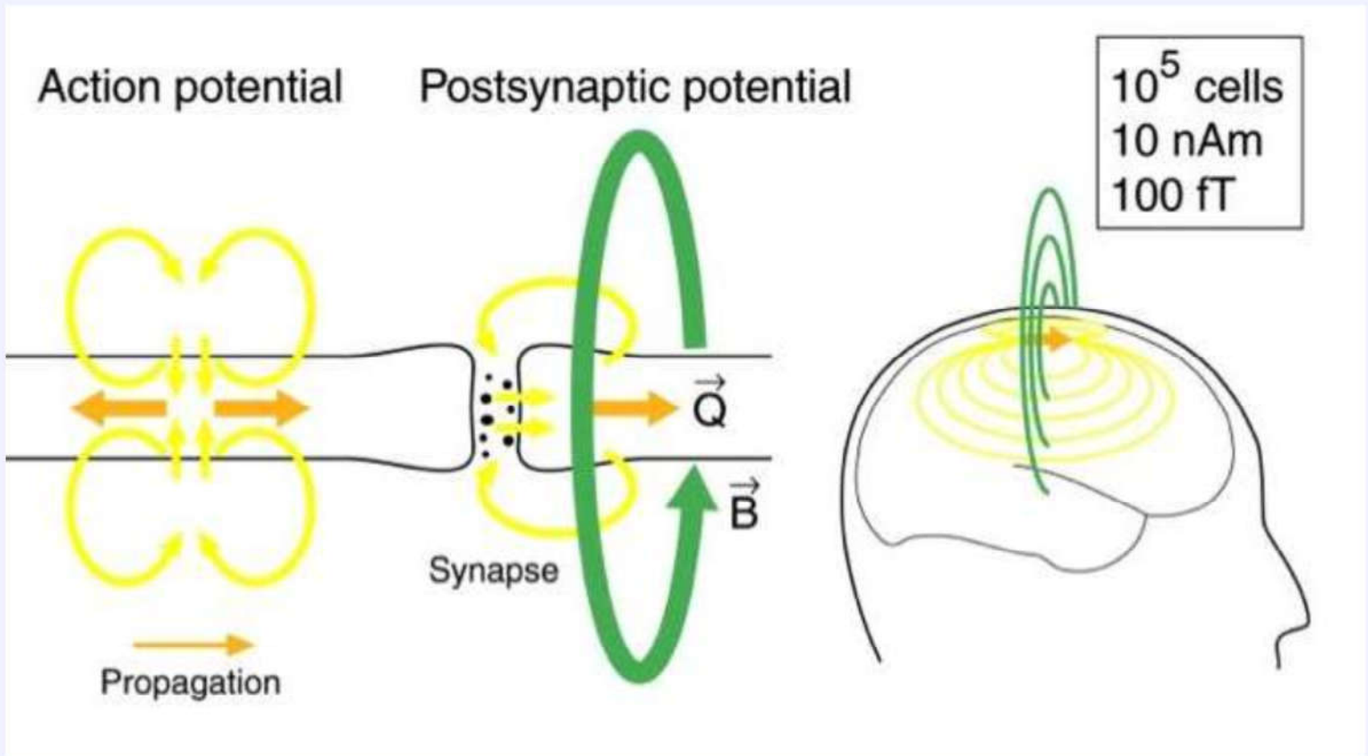


Credit: NeurotechX

The best way to remove noise: get good data!

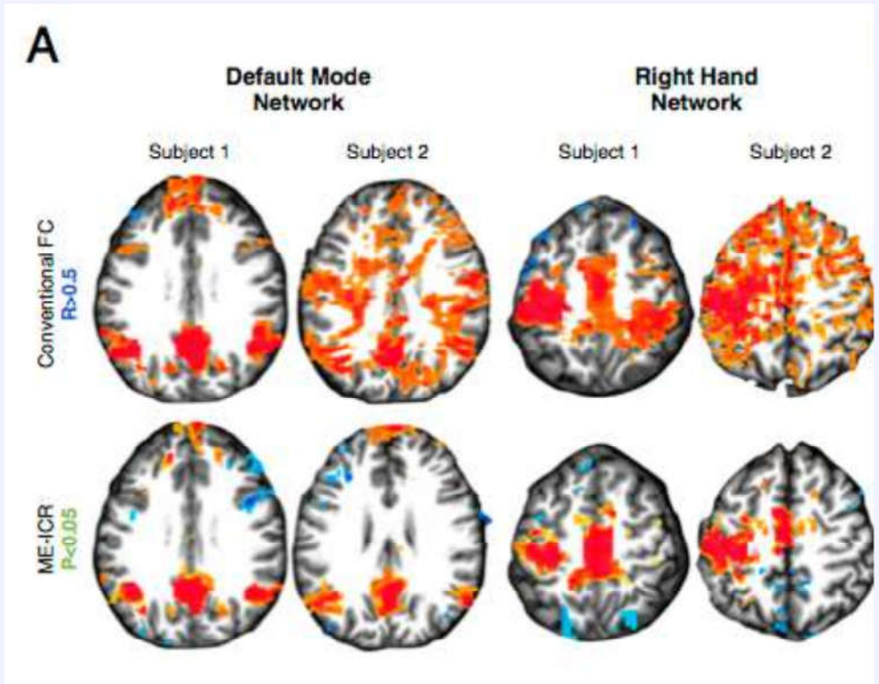
Other ways of *(noninvasively)* collecting brain data

MEG: *magnetoencephelography*



Credit: Institute for Learning and Brain Sciences - University of Washington, Wikipedia

BOLD fMRI: *b*lood *o*xygen-*l*evel *d*ependent *f*unctional *m*agnetic *r*esonance *i*maging



Credit: Institute for Learning and Brain Sciences - University of Washington, Wikipedia

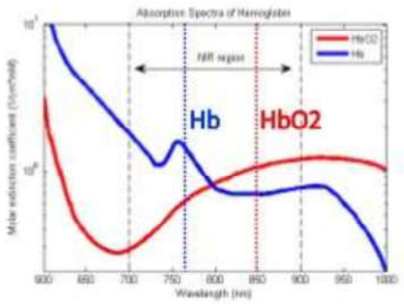
BOLD fNIRS: *bold functional near infrared spectroscopy*

3. Functional near-infrared spectroscopy (fNIRS)

Working principles of fNIRS

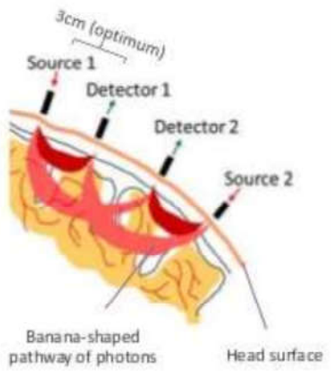
Red light penetrating in biological tissue

Figure obtained from here

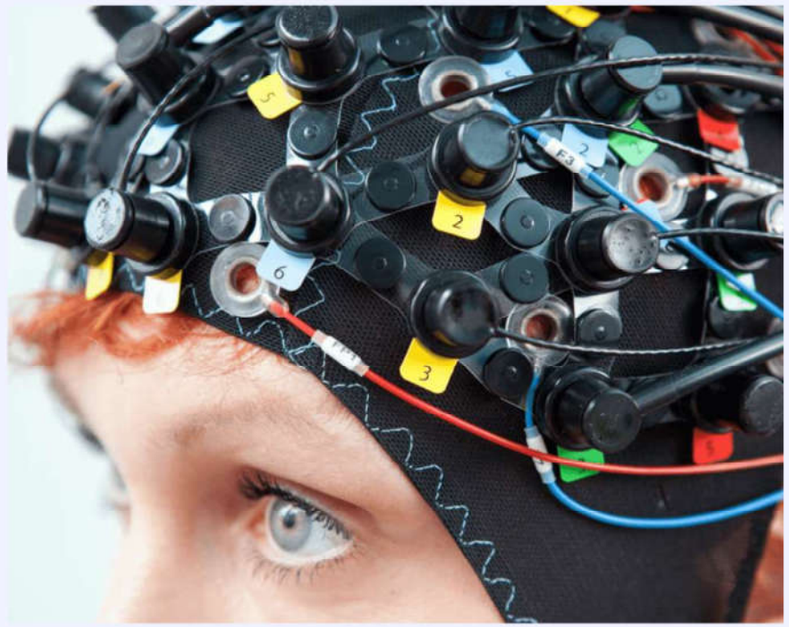


Absorption spectra of Hb

Figure adopted from here



adopted from Naseer (2013)



Credit: Dr. Ujwal Chaudhary, Dr. Bettina Sorger;

EROS fNIRS: *event related optica signal functional near infrared spectroscopy*

https://www.youtube.com/watch?v=yvenz3_VJww

Other biosignals

ECG

SPO2

EMG

GSR

PPG

EOG