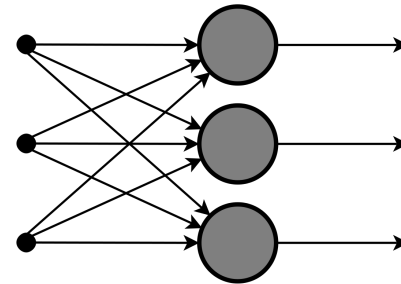
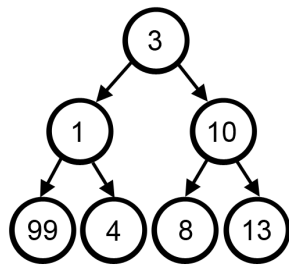


CSE 40171: Artificial Intelligence



Artificial Neural Networks with Functional Fidelity:
Functional Imaging in Neuroscience

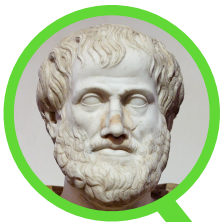
Homework #6 has been released
It is due at 11:59PM on 11/22

Project Updates are Due on 11/25 at
11:59PM

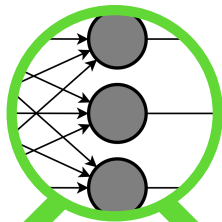
(See Course Website for Instructions)

Course Roadmap

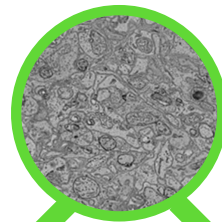
Introduction
(week 1)



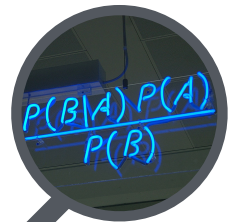
Neural Networks
(week 3)



Brain Structure
(weeks 12 - 13)



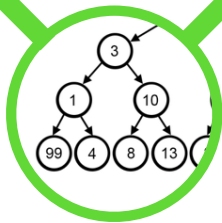
Decisions
(week 16)



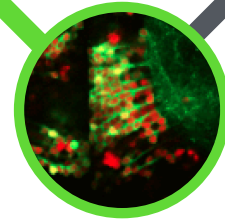
Bio. Intelligence
(week 2)



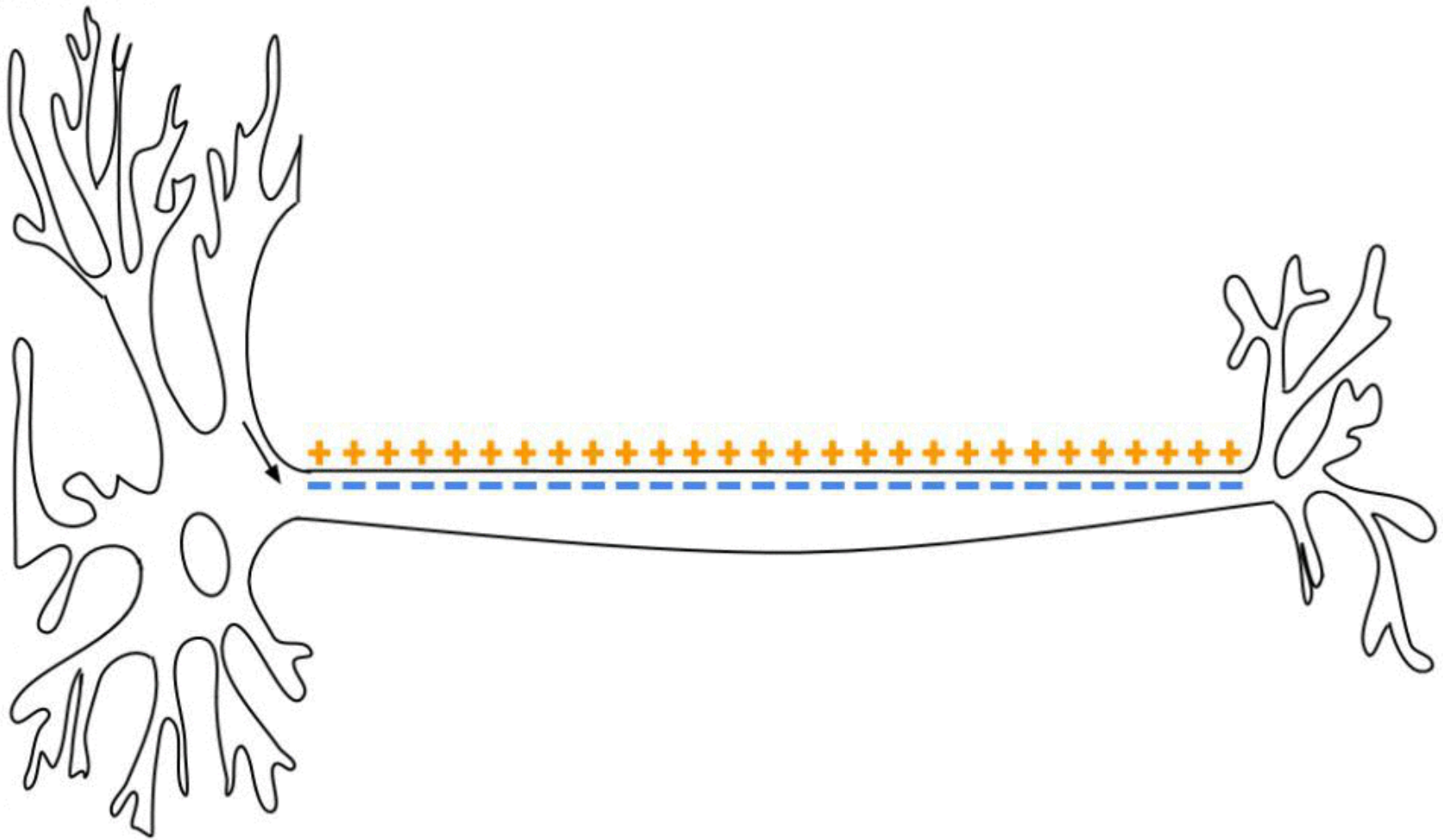
Search Problems
(weeks 4 - 9)

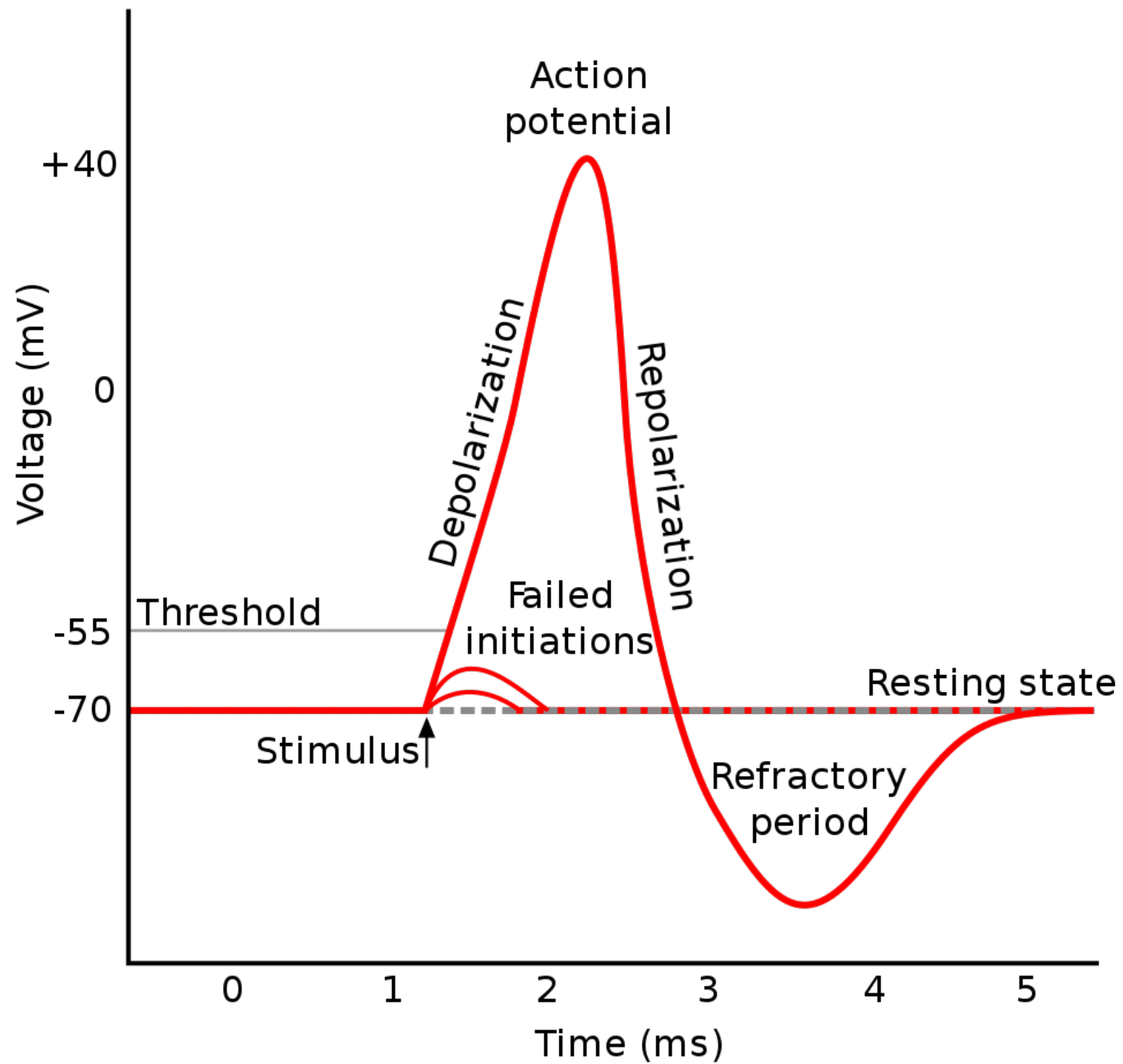


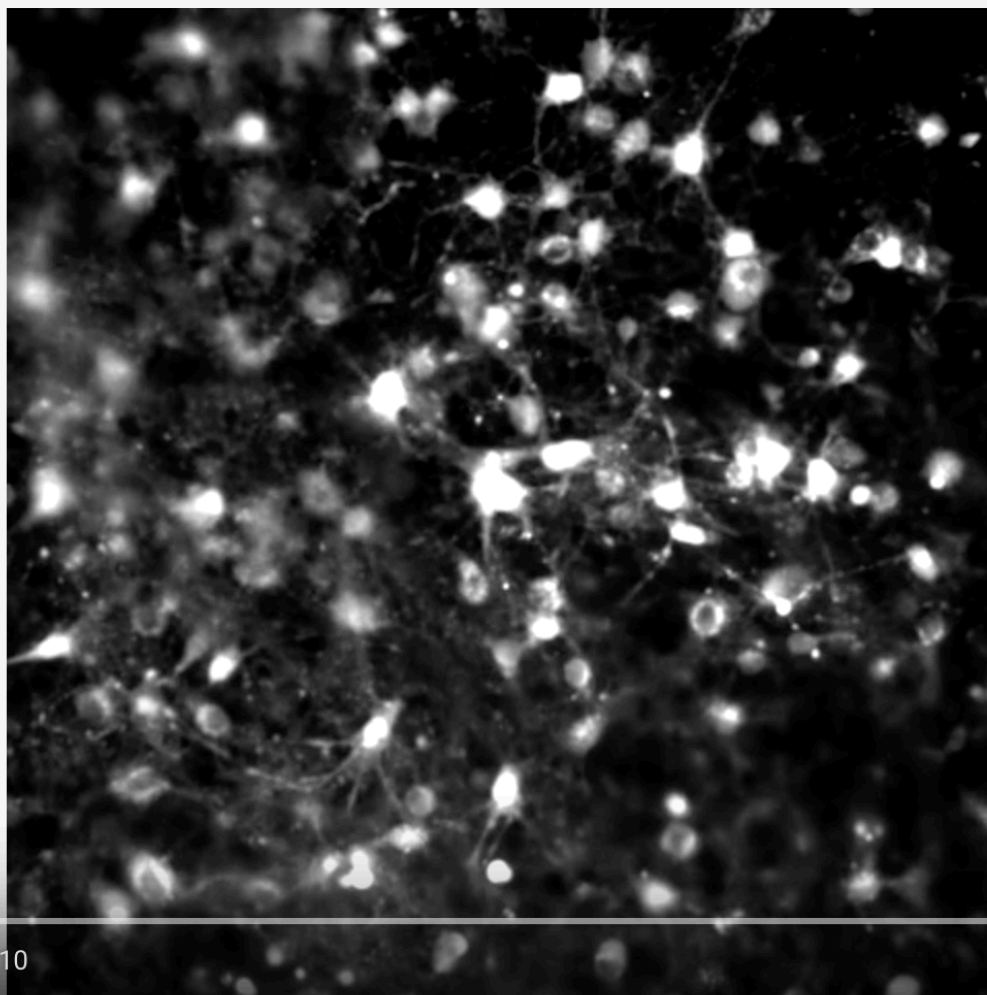
Brain Function
(weeks 14 - 15)



What happens when a neuron “fires”?







0:01 / 0:10



<https://www.youtube.com/watch?v=yy994HpFudc>

What does a physiology experiment look like?

Rodents



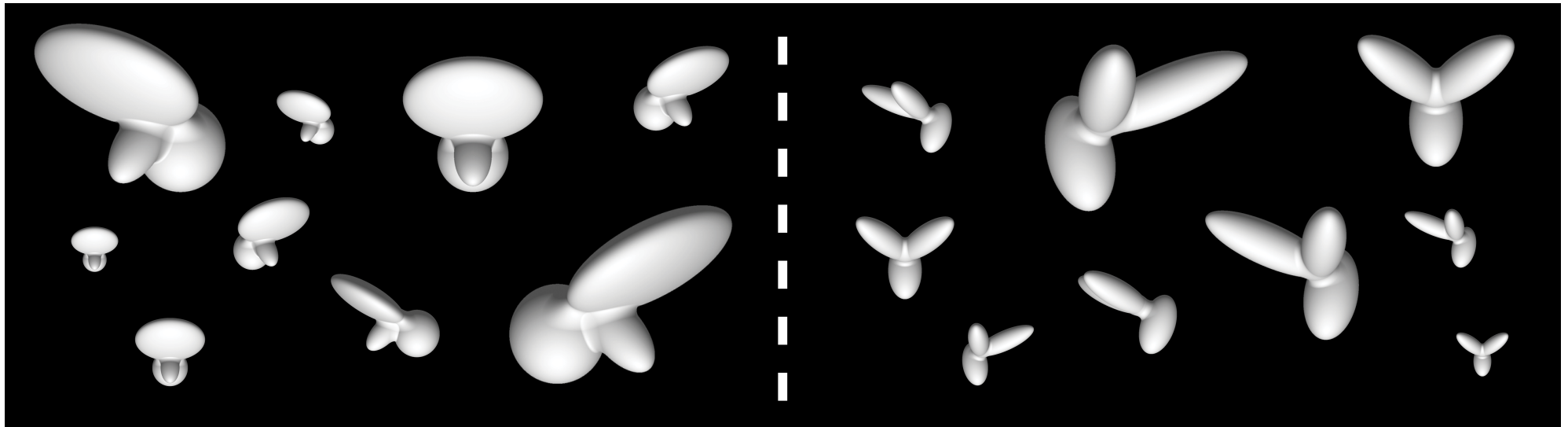
(brain)

THIS

IS FOUND IN
HERE



(*rattus norvegicus*)

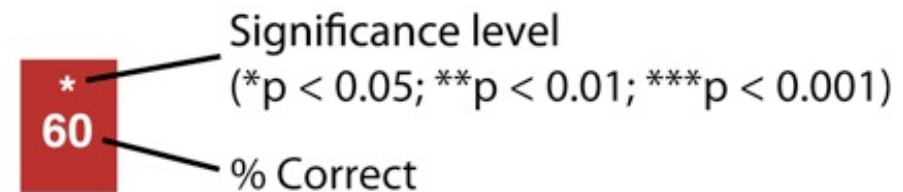
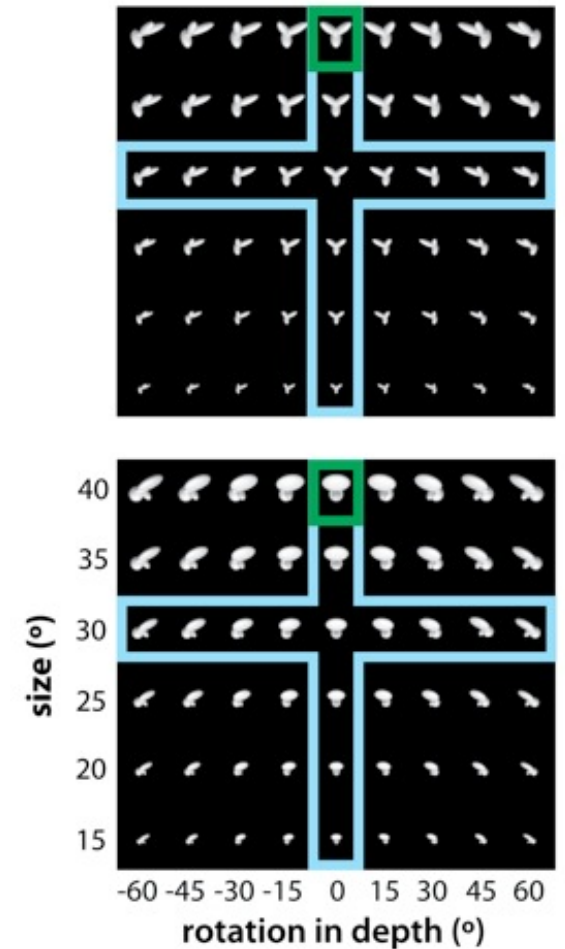
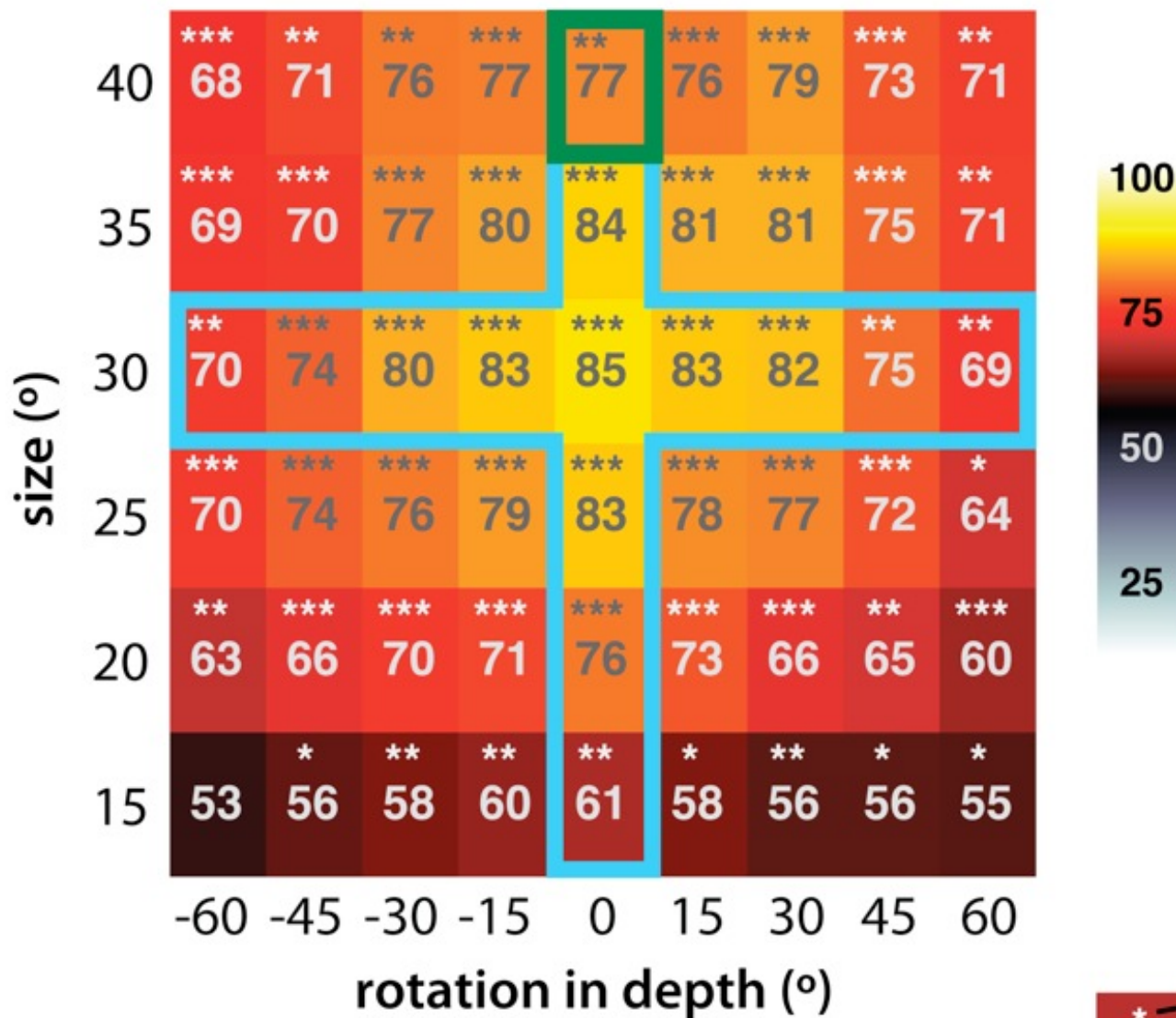


lick left

lick right





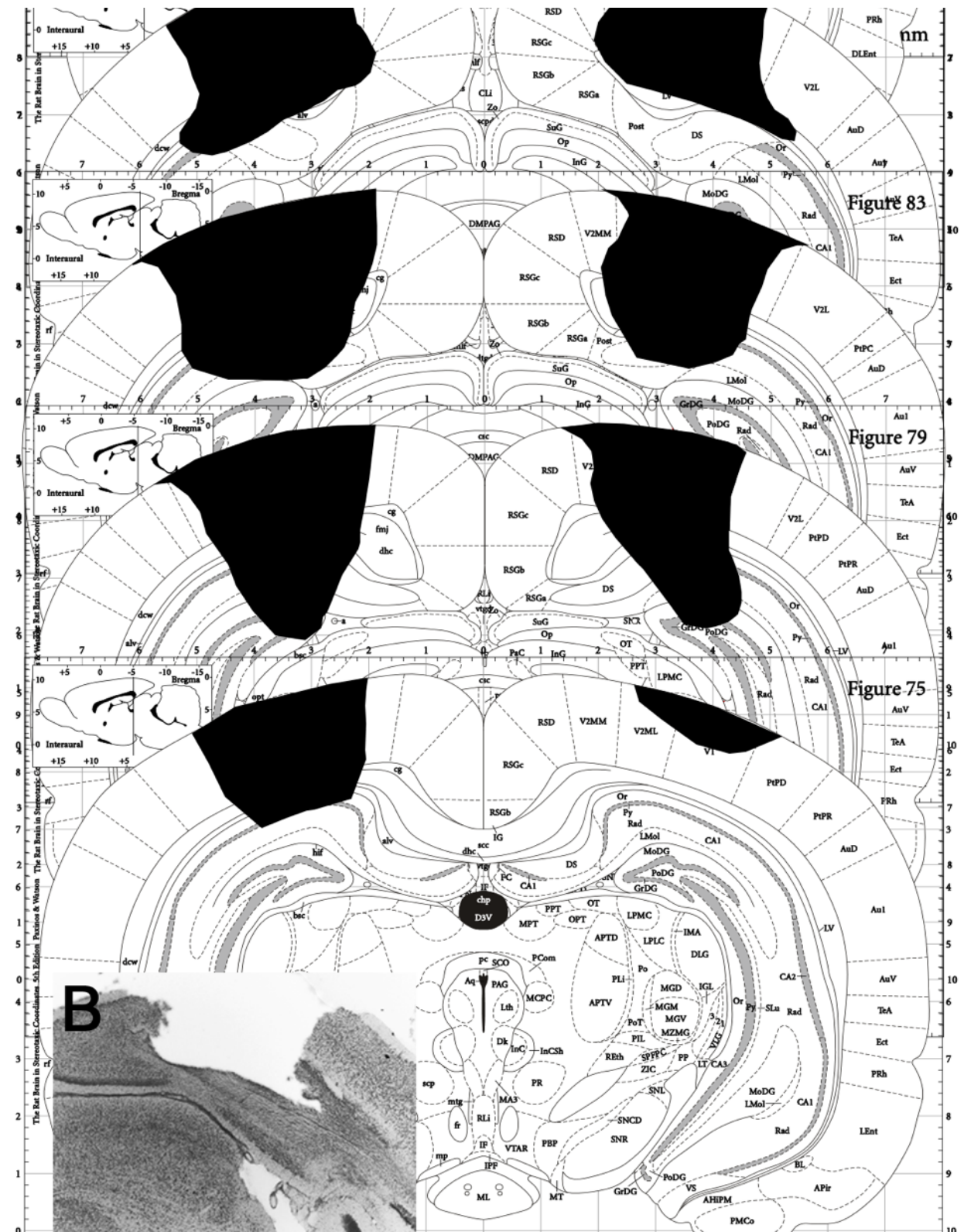


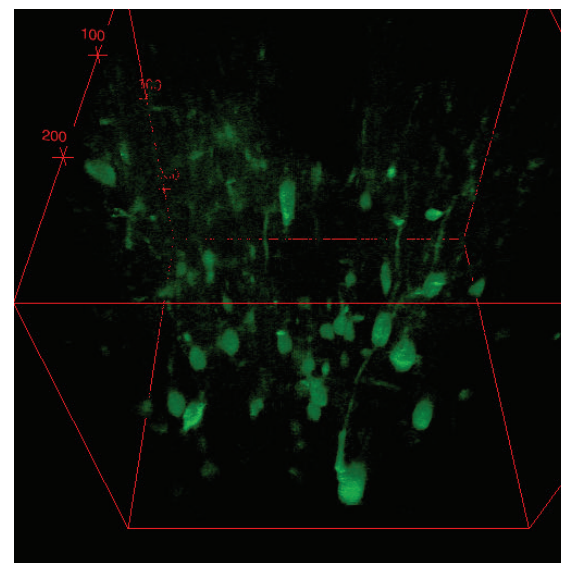
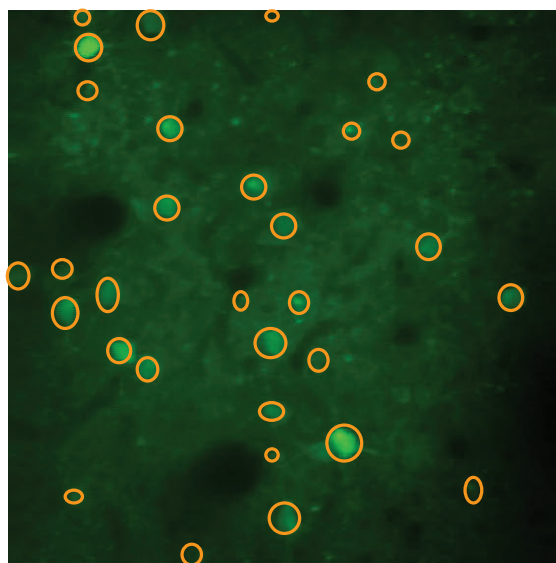
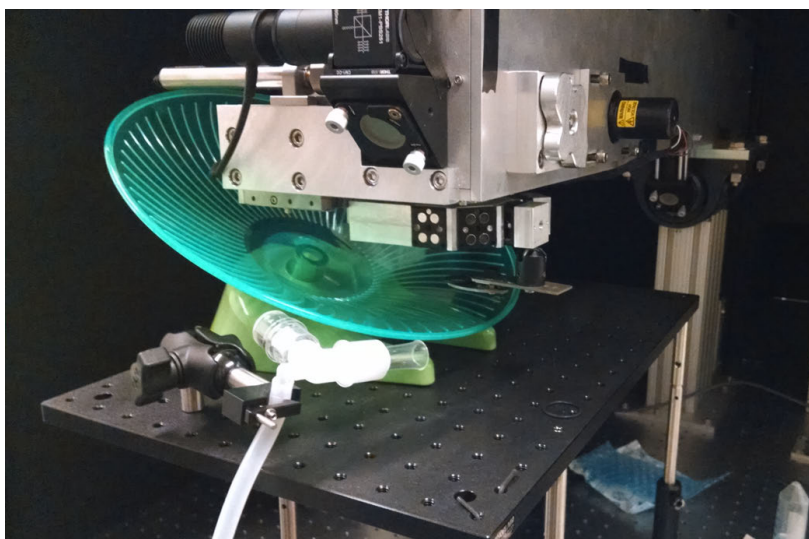
New Experiments

Establishing causal links between cortical areas and function

Understanding decision boundaries between classes

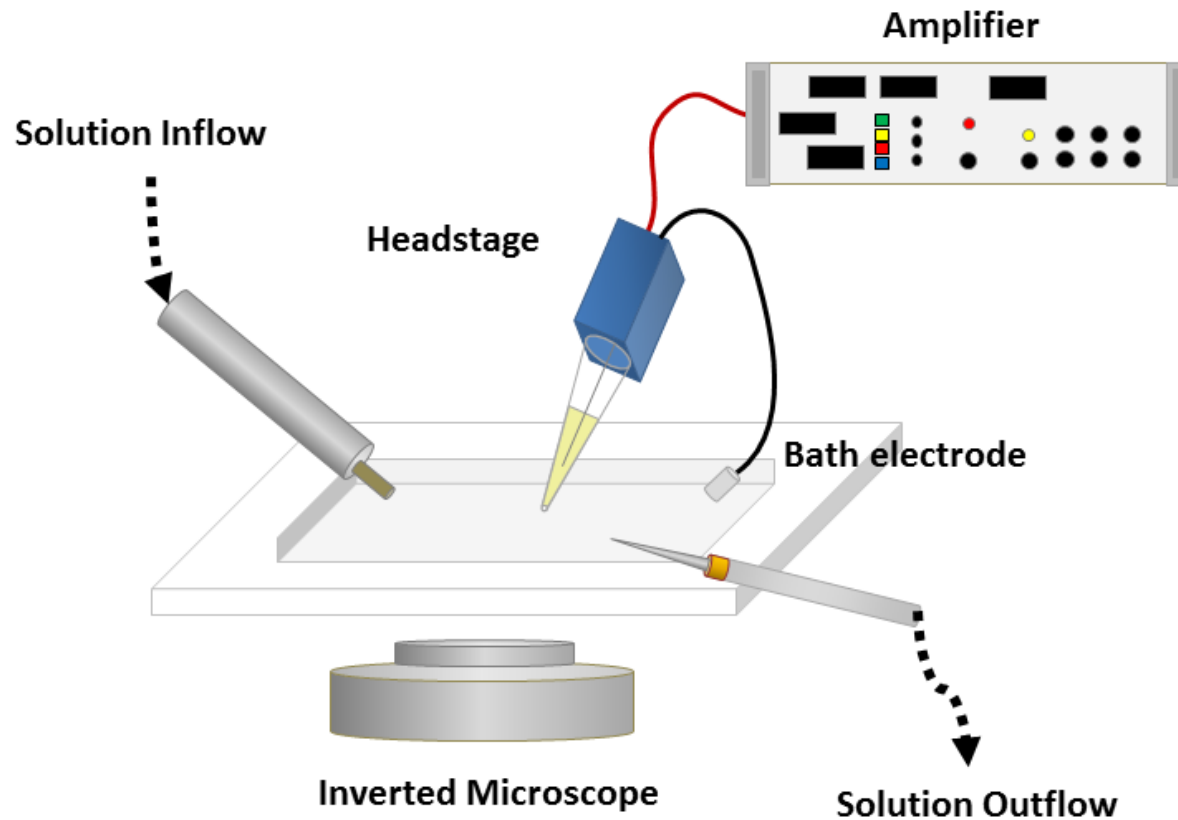
Studying the role of development in learning





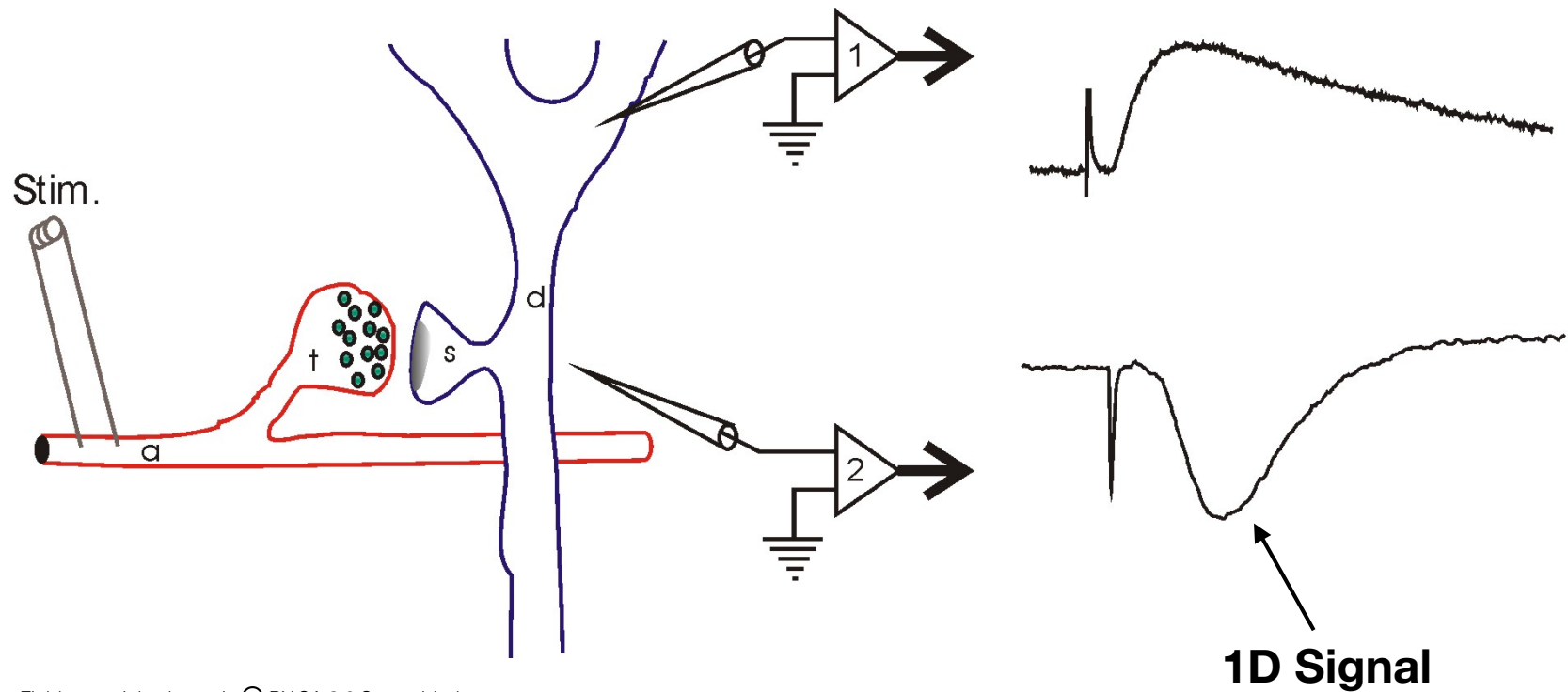
How do we measure activity in the brain?

Electrophysiology

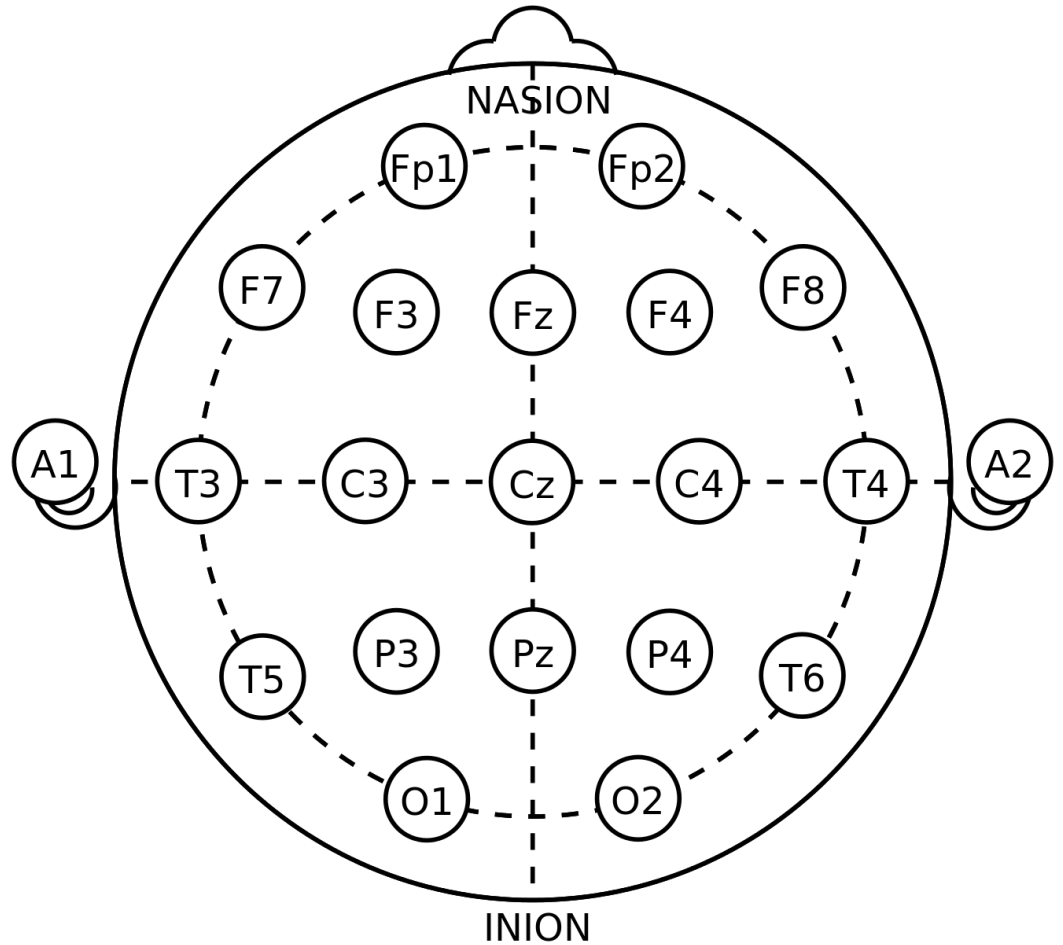


Typical equipment used during classical patch clamp recording © BY-SA 4.0 PeaBrainC

Ephys. Data



Electroencephalography (EEG)

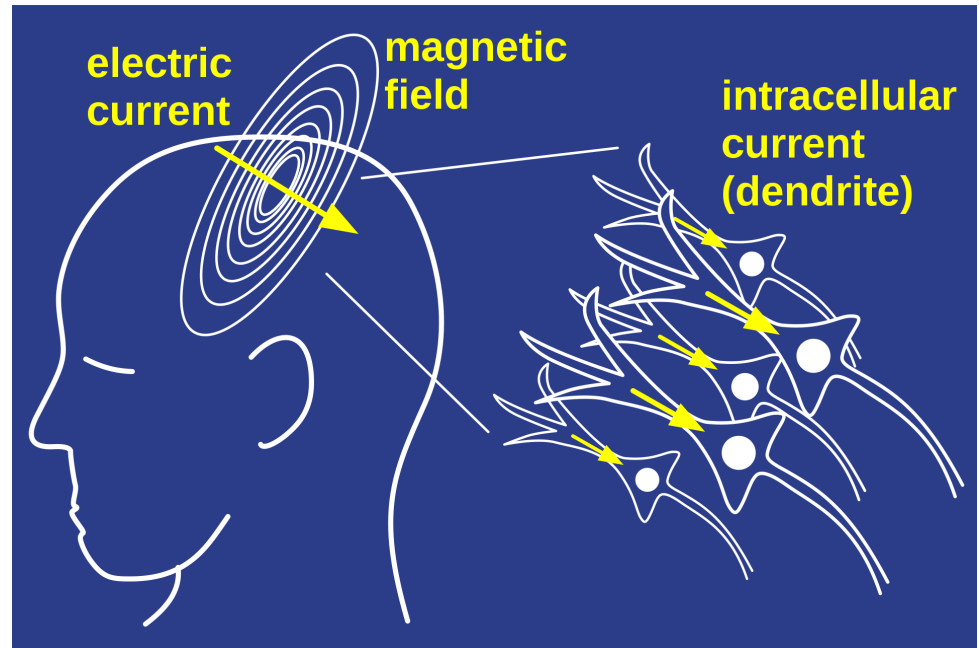


EEG Data

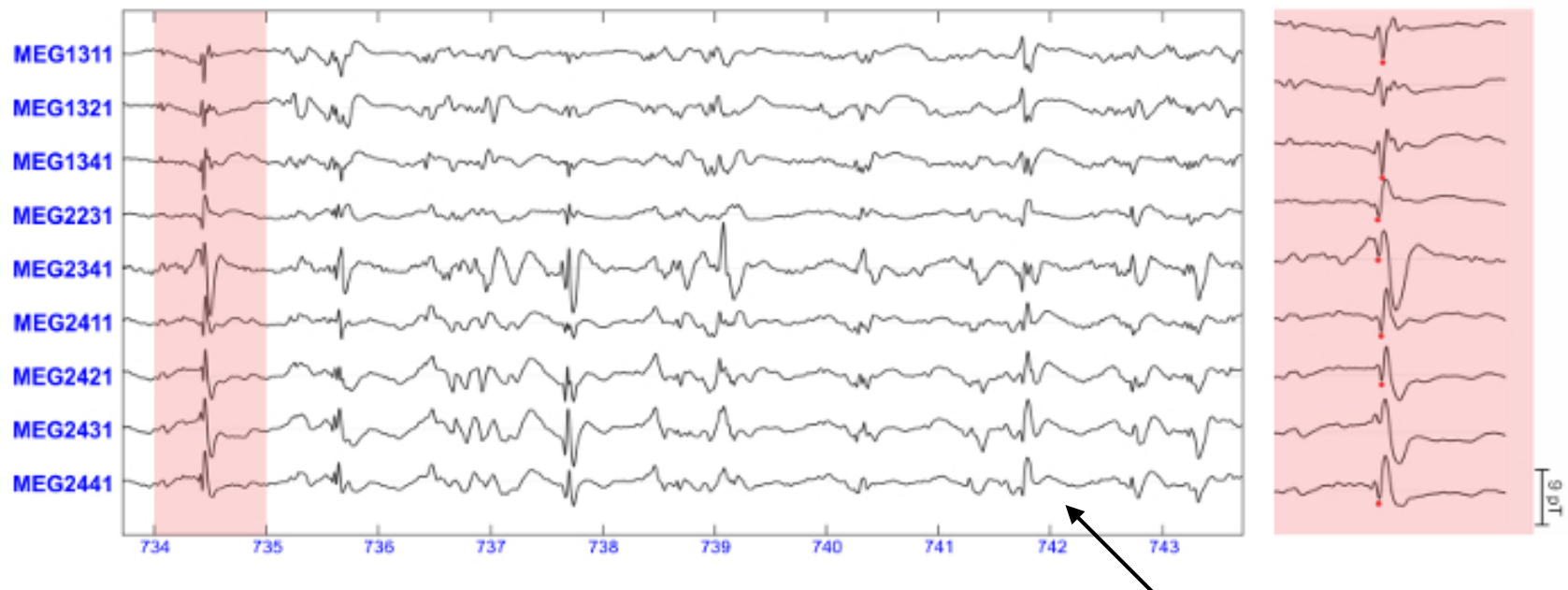


1D Signal

Magnetoencephalography (MEG)



MEG Data



Papadelis et al. J. Vis. Exp. 2016

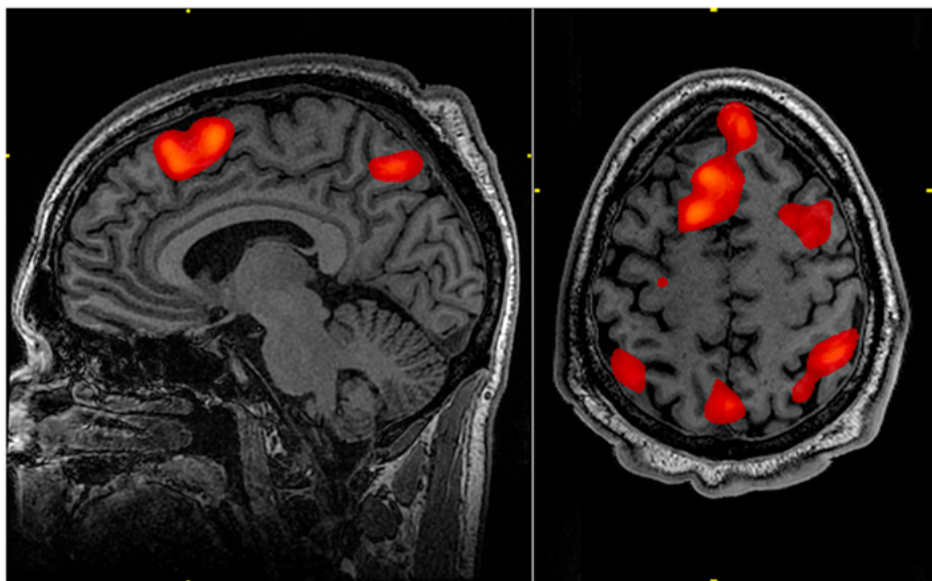
1D Signal

fMRI

A more direct way to measure brain activity

Non-invasive experimentation with humans

Uses blood flow as a proxy for neuronal activations



**Spatial resolution good enough
to identify Brodmann areas**

fMRI Data

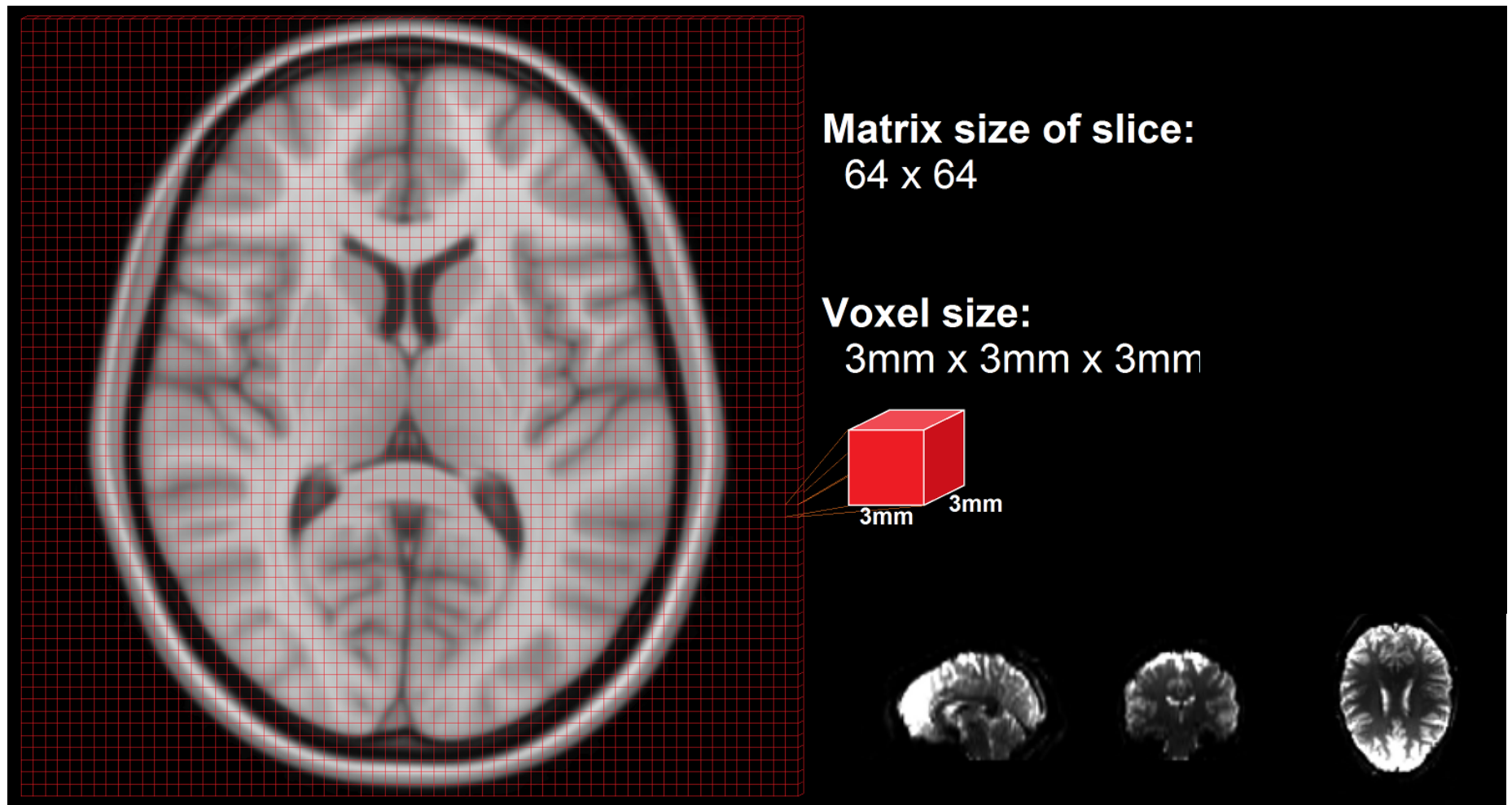
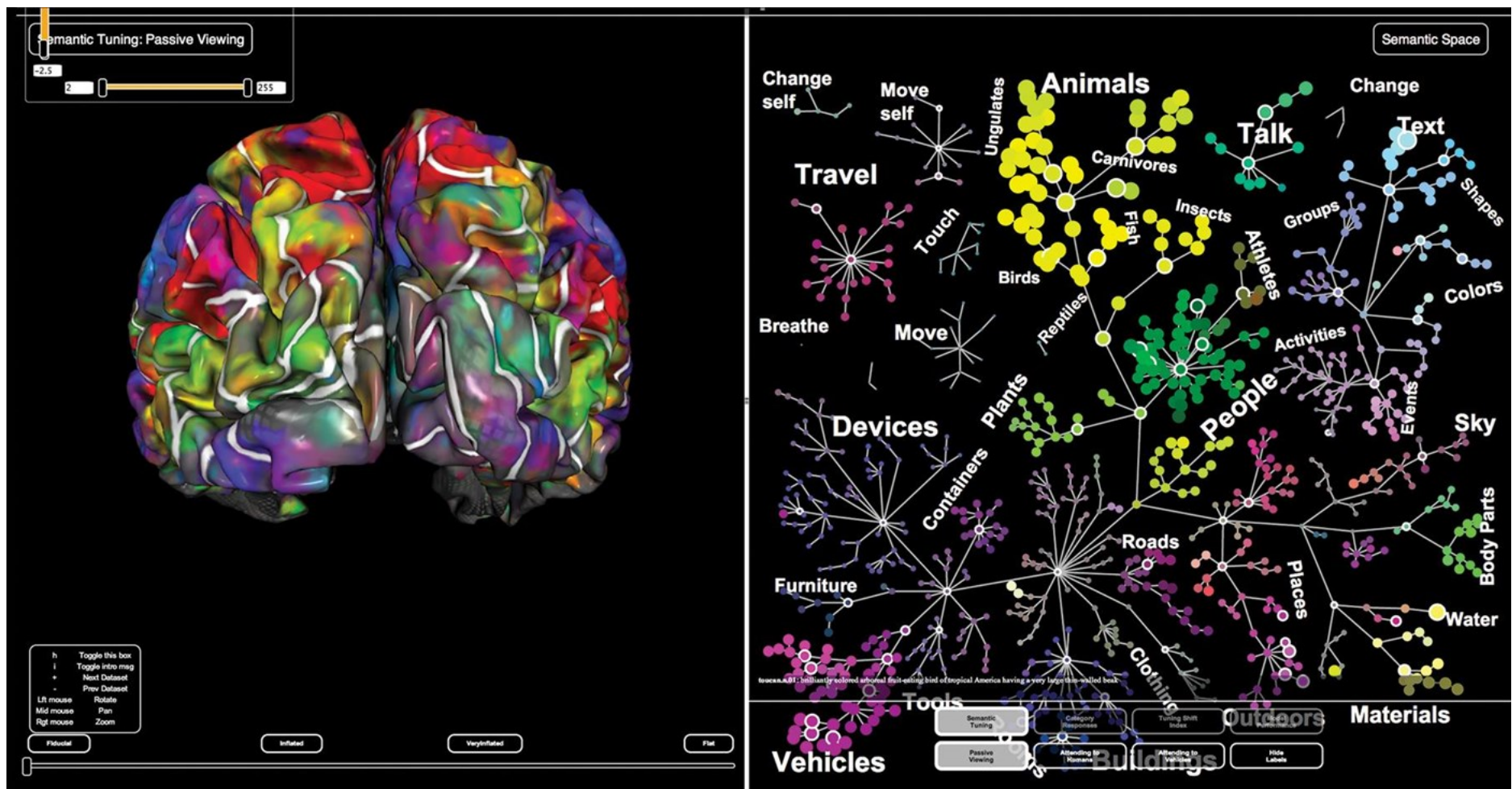
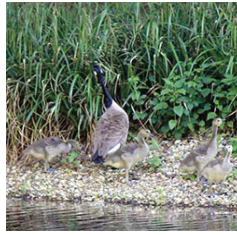


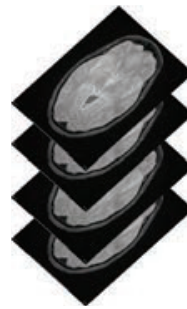
Image adapted from: <https://miykael.github.io/nipype-beginner-s-guide/neuroimaging.html>



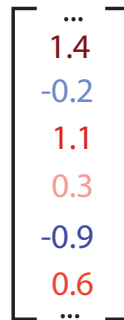
Huth et al. Neuron 2012



Stimulus

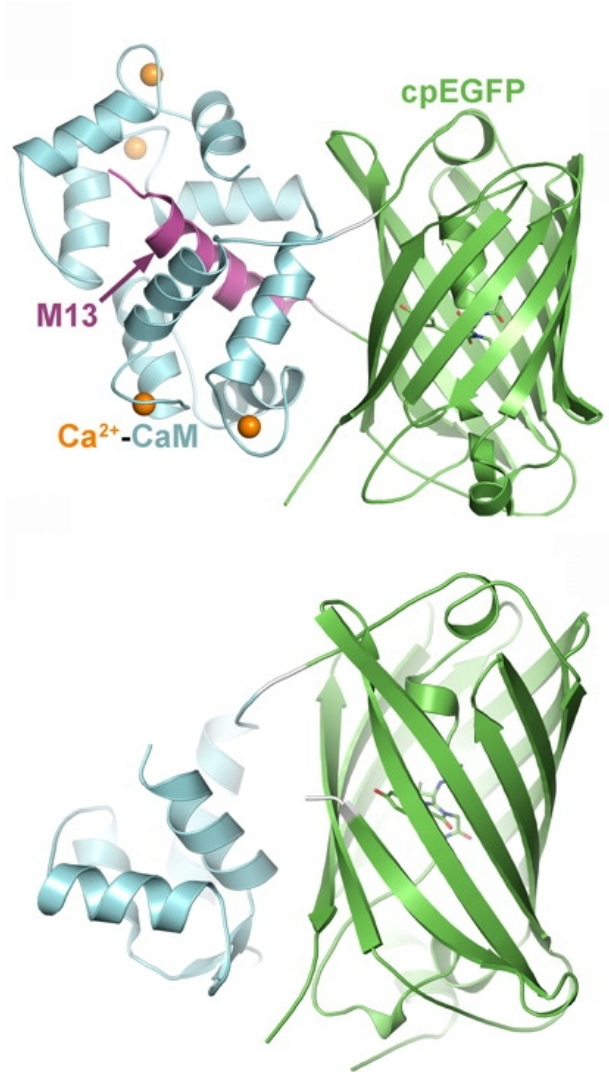


fMRI Images

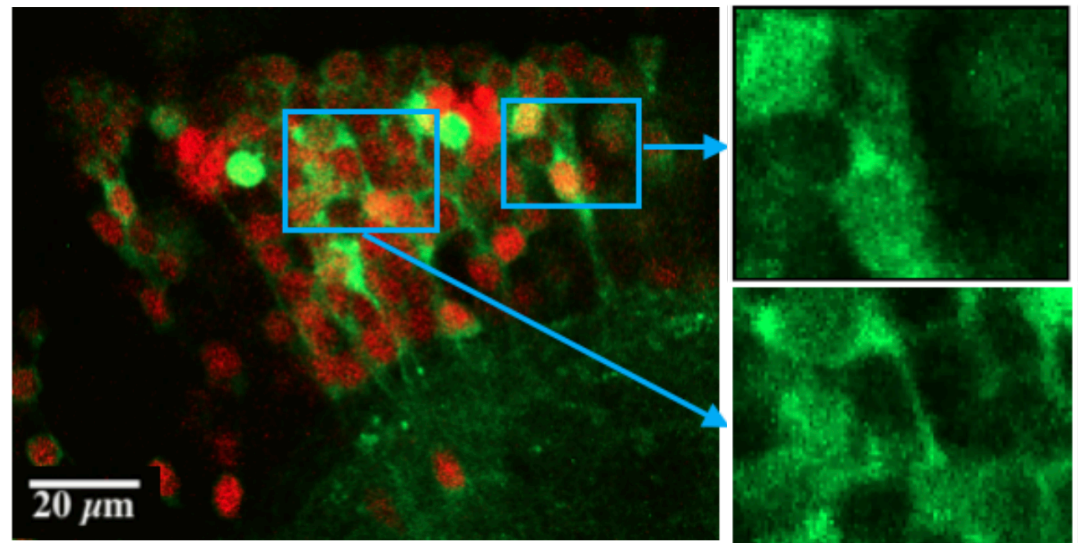


Activity Vector

Confocal Microscopy + GFP



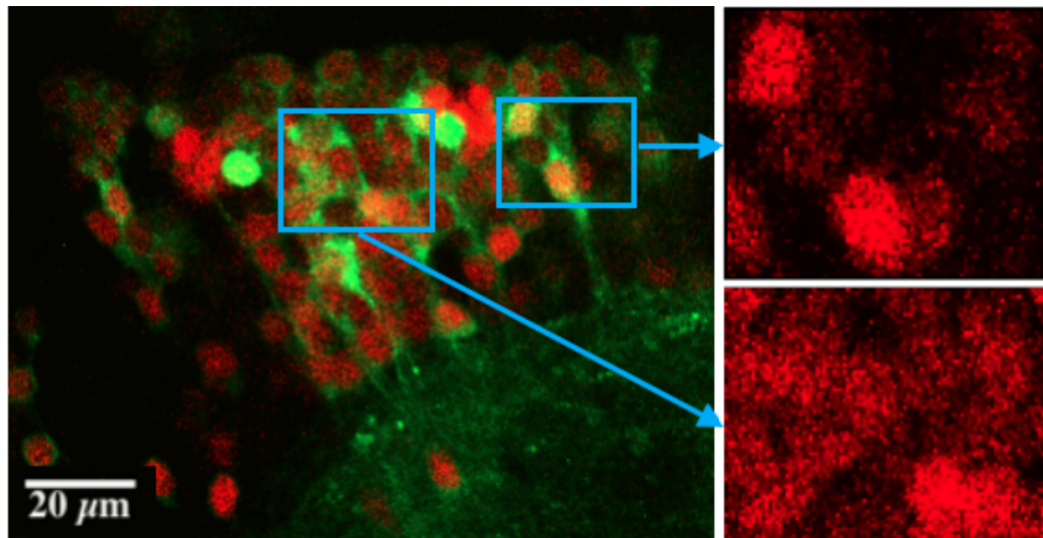
Calcium Indicator expressed in cytosol



Chen et al. MICCAI 2017

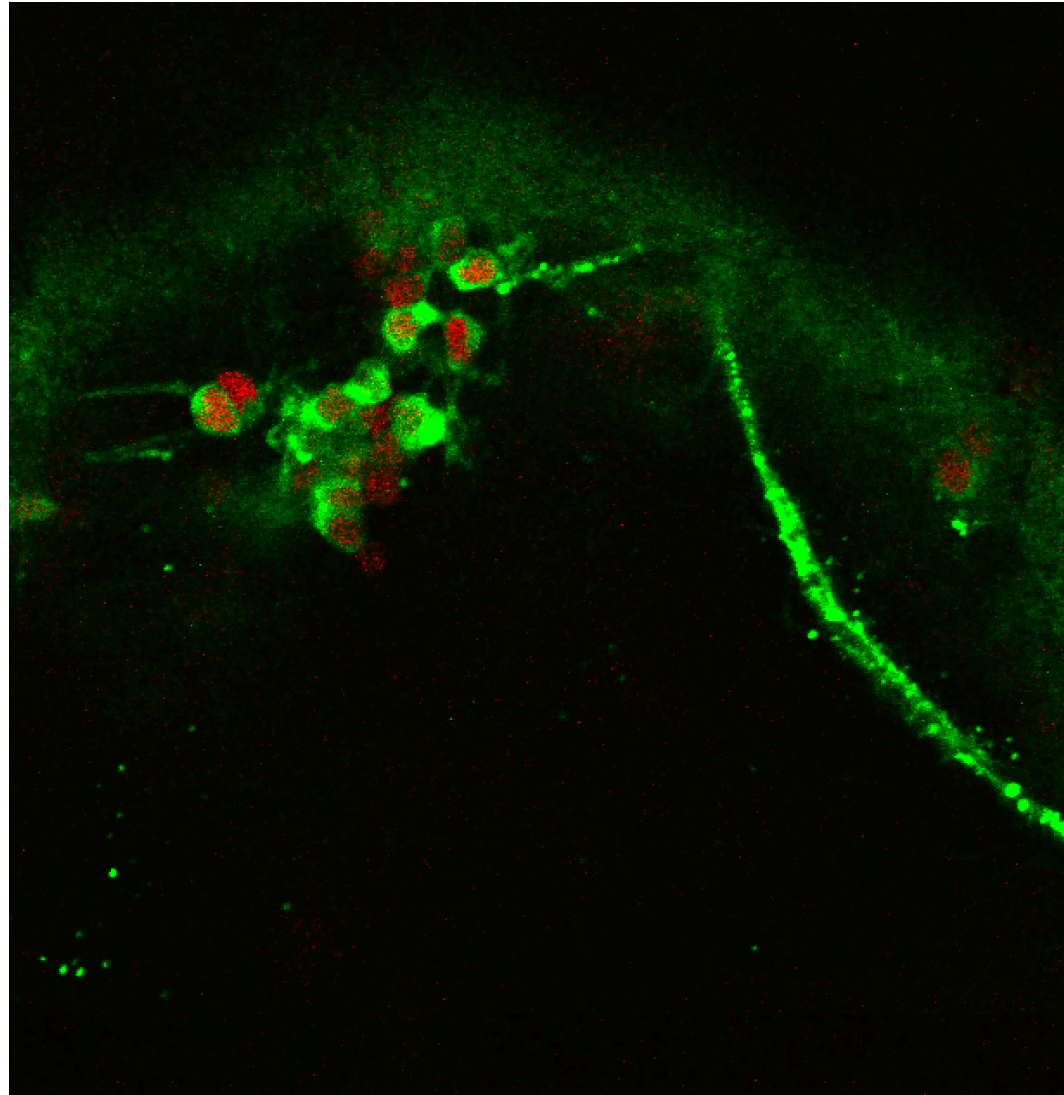
Confocal Microscopy + RFP

H2b-RFP expresses in the nucleus



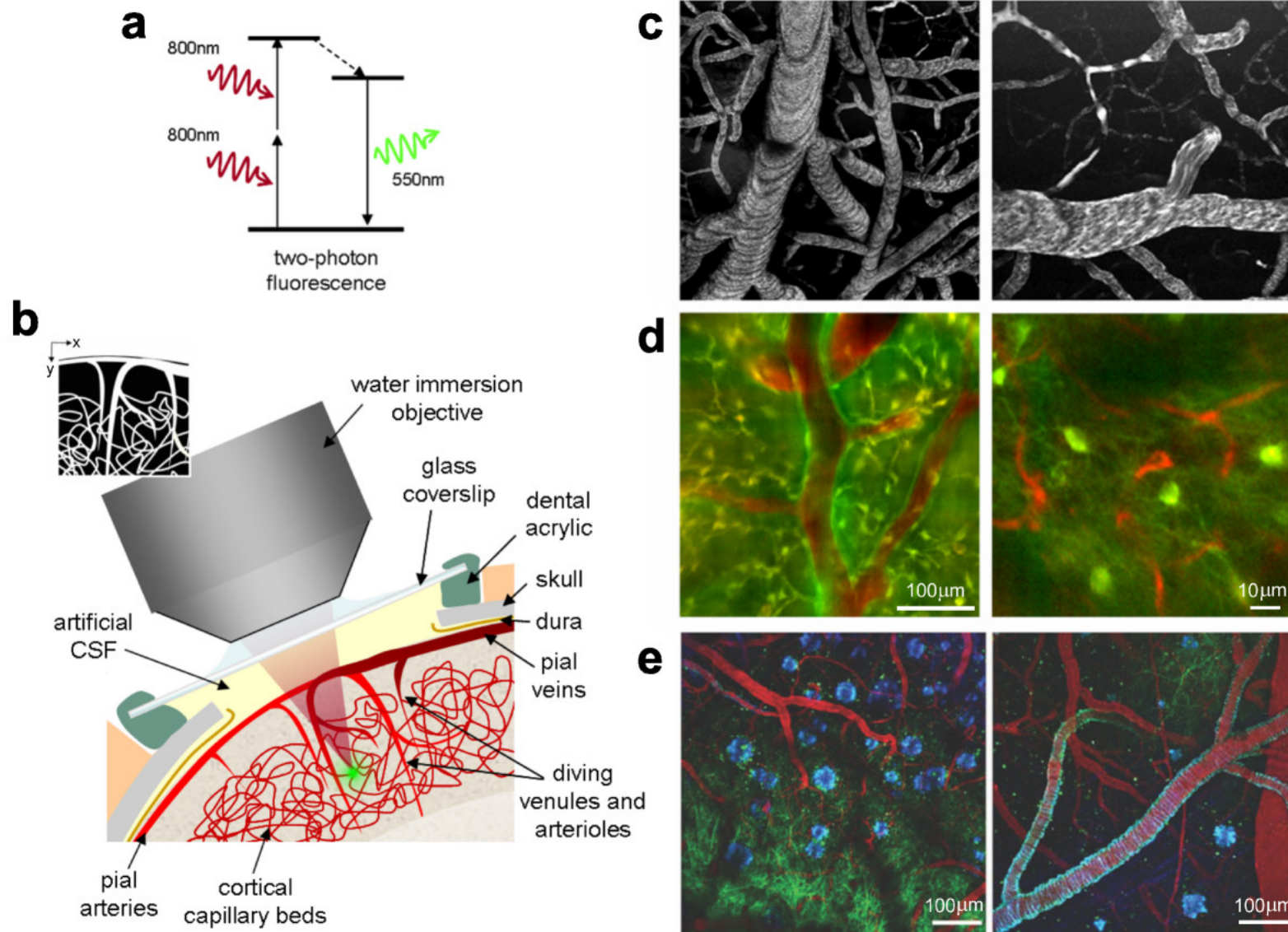
Chen et al. MICCAI 2017

Dual Channel Confocal Image Stack

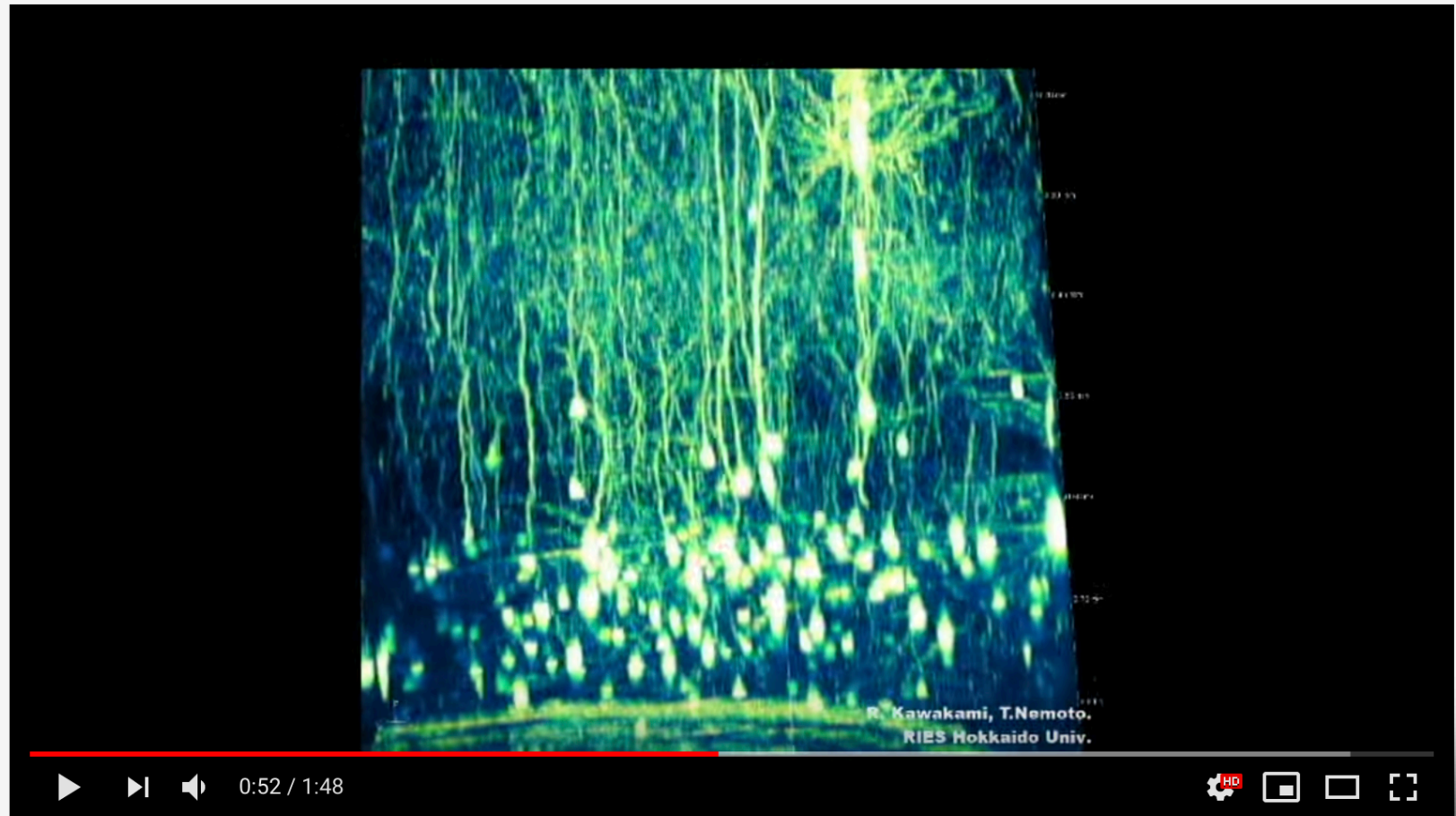


Chen et al. MICCAI 2017 / Engert Lab Harvard University

Two-Photon Excitation Microscopy



2p Imaging in Depth



<https://www.youtube.com/watch?v=ot9tbAsHgOo>