

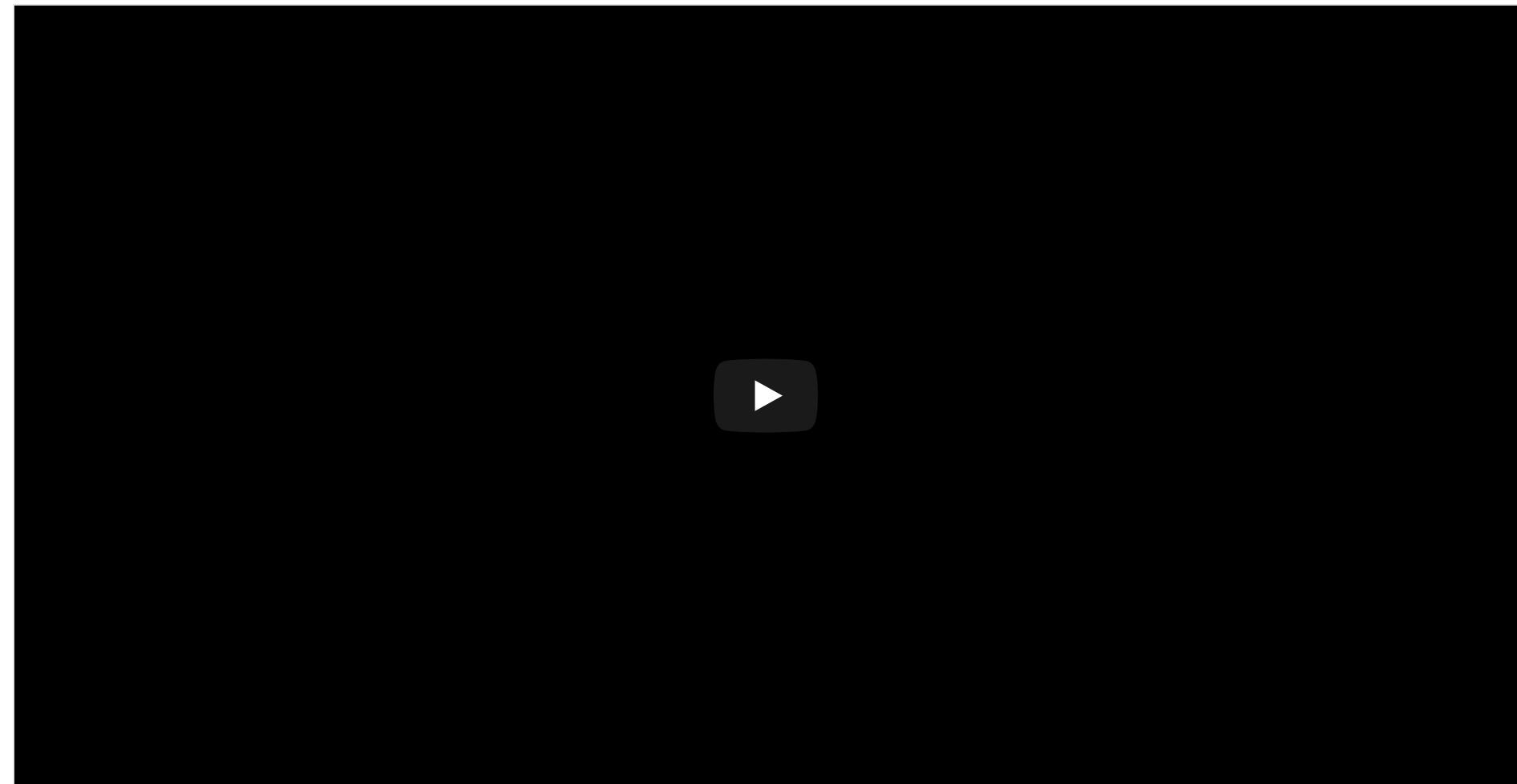
PSYCH 260

Neuroanatomy I

Rick O. Gilmore

2021-09-07 07:19:00

Prelude (2:01)



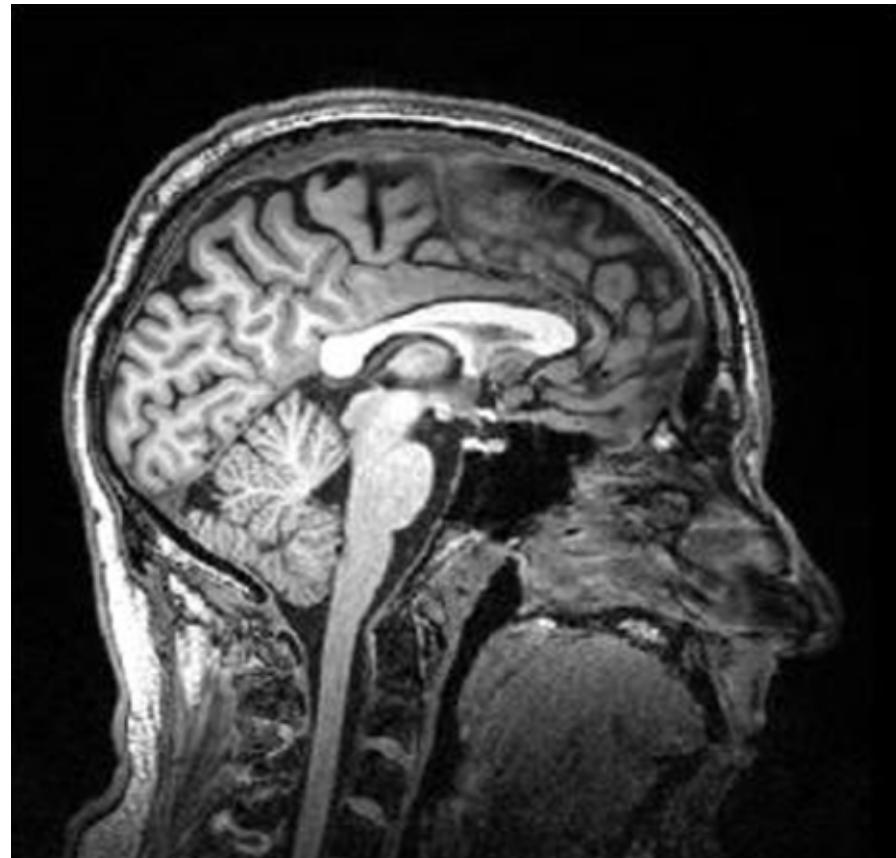
<https://www.youtube.com/embed/Qw8E9WnZTQk>

Today's topics

- Announcement: Quiz 1 next Thursday (online via Canvas)
- Warm-up
- Wrap up on functional methods
- Neuroanatomy
 - Through song and dance

Warm-up

What kind of brain imaging technique does this image represent?



What kind of structural brain imaging technique does this image represent?

- A. Magnetic Resonance Imaging (MRI)
- B. Positron Emission Tomography
- C. Event-related potentials (ERP)

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Which of the following methods has *temporal* resolution on the order of seconds?

- A. functional MRI
- B. EEG
- C. MEG
- D. single-unit recording

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- A. functional MRI
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- C. MEG
- D. ~~single-unit recording~~

Which of the following methods has high/fine *spatial* resolution?

- A. functional MRI
- B. PET
- C. EEG
- D. single-unit recording

Which of the following methods has high/fine *spatial* resolution?

- A. ~~functional~~ MRI
- B. PET
- C. EEG
- D. single-unit recording

Which measure(s) would you use to map connections between brain areas?

- A. retrograde/anterograde cell tracers
- B. diffusion tensor imaging (DTI)
- C. PET neuroimaging
- E. both A & B.

Which measure(s) would you use to measure connections between brain areas?

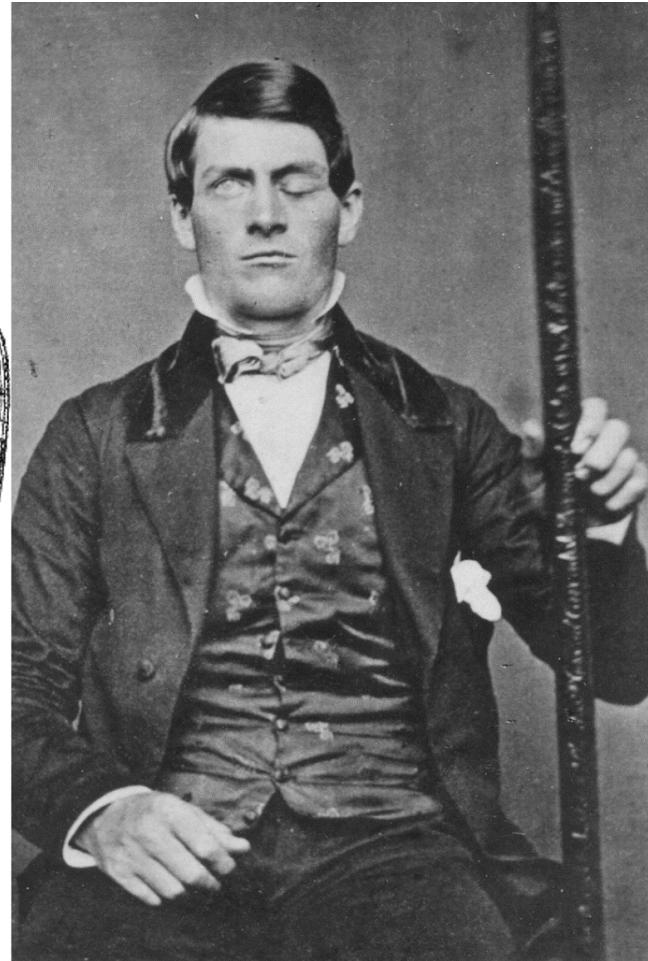
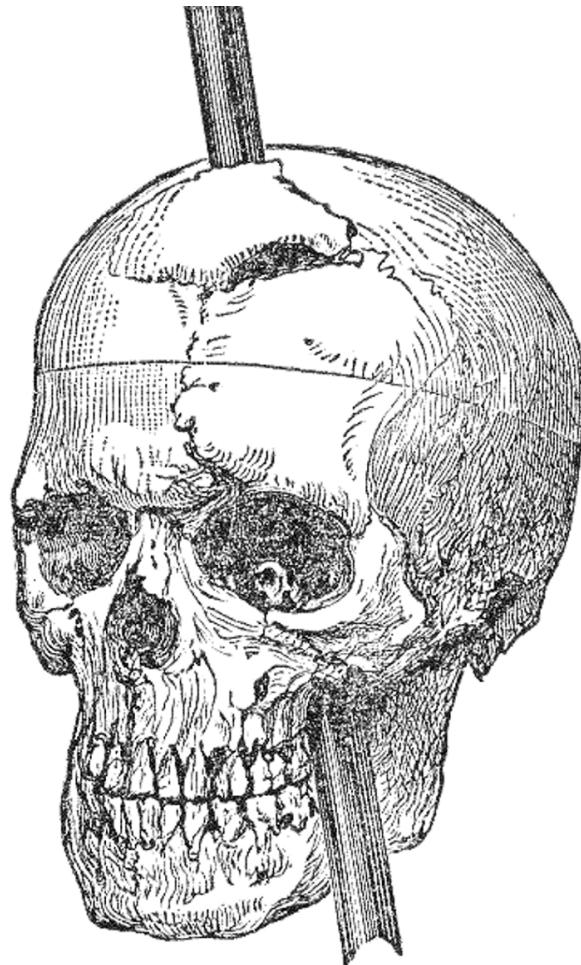
- A. retrograde/anterograde cell tracers
- B. diffusion tensor imaging (DTI)
- C. PET neuroimaging
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Wrap-up on functional methods

Manipulating the brain

- Nature's "experiments"
 - Stroke, head injury, tumor
 - Neuropsychology
- If damage to X impairs performance on Y -> X critical for/controls Y
- Poor spatial/temporal resolution, limited experimental control

Phineas Gage



<http://www.doctorsimpossible.com/the-curious-case-of-phineas-gage/>

Bestselling author of *Awakenings* and *A Leg to Stand On*

OLIVER SACKS
The
MAN
Who
MISTOOK
HIS WIFE
for a
HAT

and Other Clinical Tales

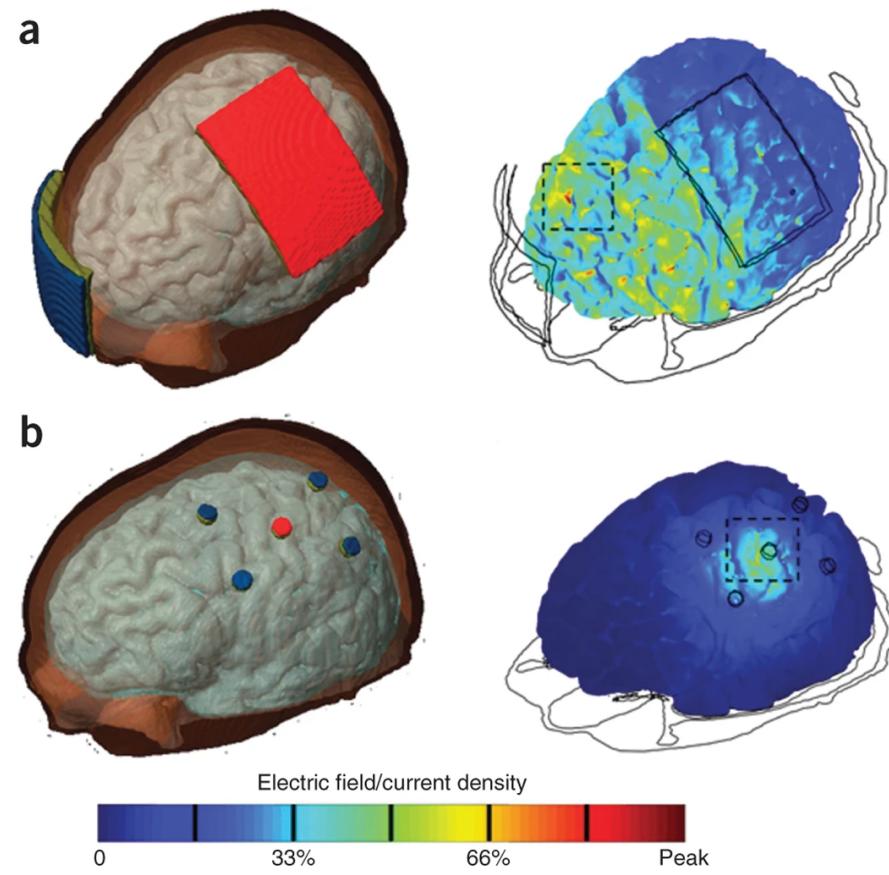
"Beguiling, compassionate, moving....the lucidity and power of a gifted writer."

—John C. Marshall, *The New York Times Book Review*

Stimulating the brain

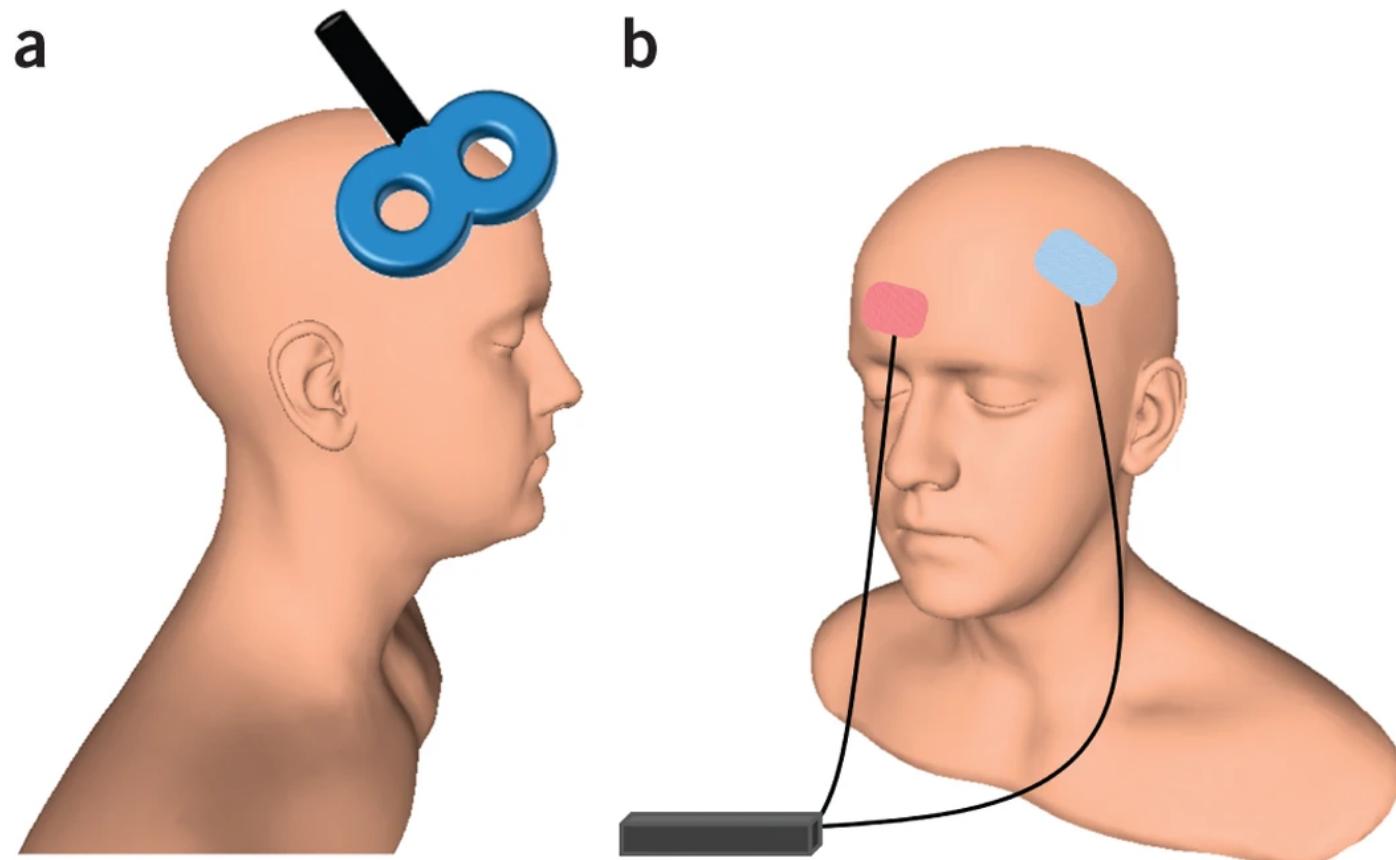
- Pharmacological
- Electrical ([transcranial Direct Current Stimulation - tDCS](#))
 - Inject low levels of electric current
- Magnetic (Transcranial magnetic stimulation - *TMS*)
 - Inject directed pulses of magnetic energy
- Optically (optogenetics)
 - Light activates ion channels in neurons, causes current to flow

tDCS



[\(Dayan, Censor, Buch, Sandrini, & Cohen, 2013\)](#)

TMS



[\(Dayan, Censor, Buch, Sandrini, & Cohen, 2013\)](#)

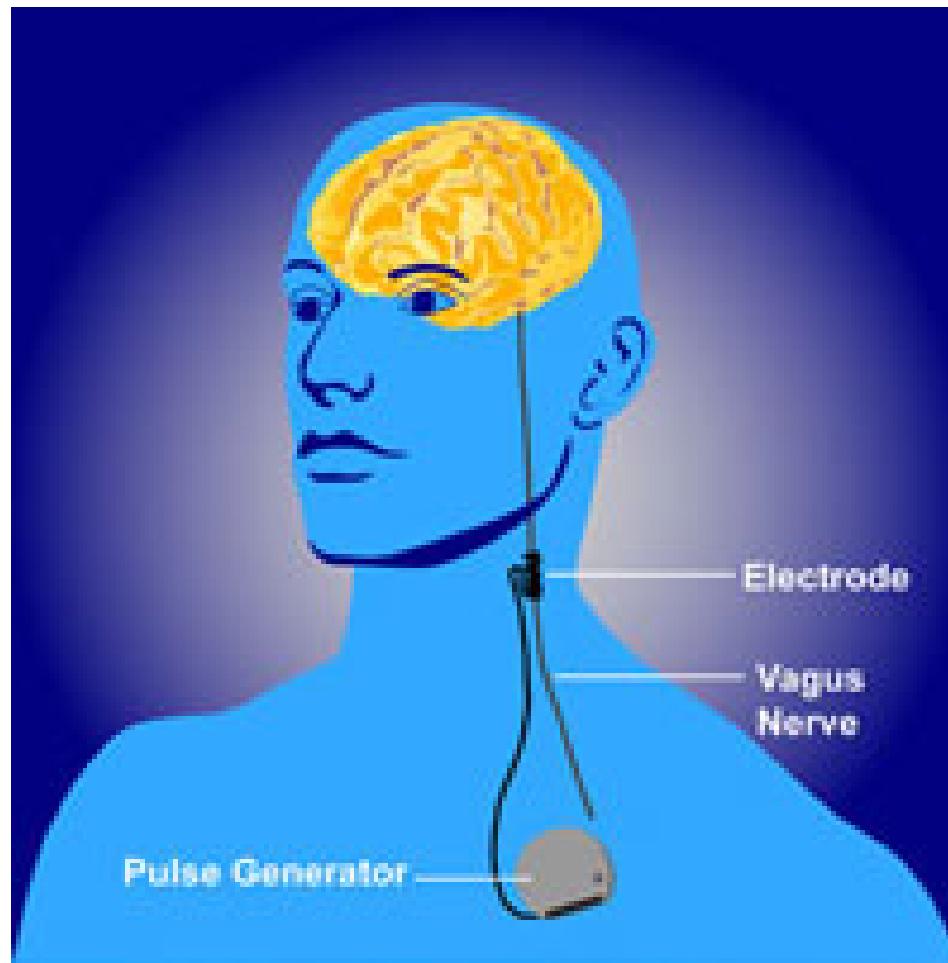
Optogenetic stimulation

- Insert light-sensitive ion channels into neuronal membrane using genetic engineering
- Open/close channels (activate/inhibit neurons) with light

Evaluating stimulation methods

- Spatial/temporal resolution?
 - Assume stimulation mimics natural activity. Does it?
 - Optogenetic stimulation similar to natural stimulation, others less so
- Deep (electrical) brain stimulation as therapy
 - Parkinson's Disease
 - Depression
 - Epilepsy

Deep brain stimulation



<http://www.nimh.nih.gov/health/topics/brain-stimulation-therapies/brain-stimulation-therapies.shtml>



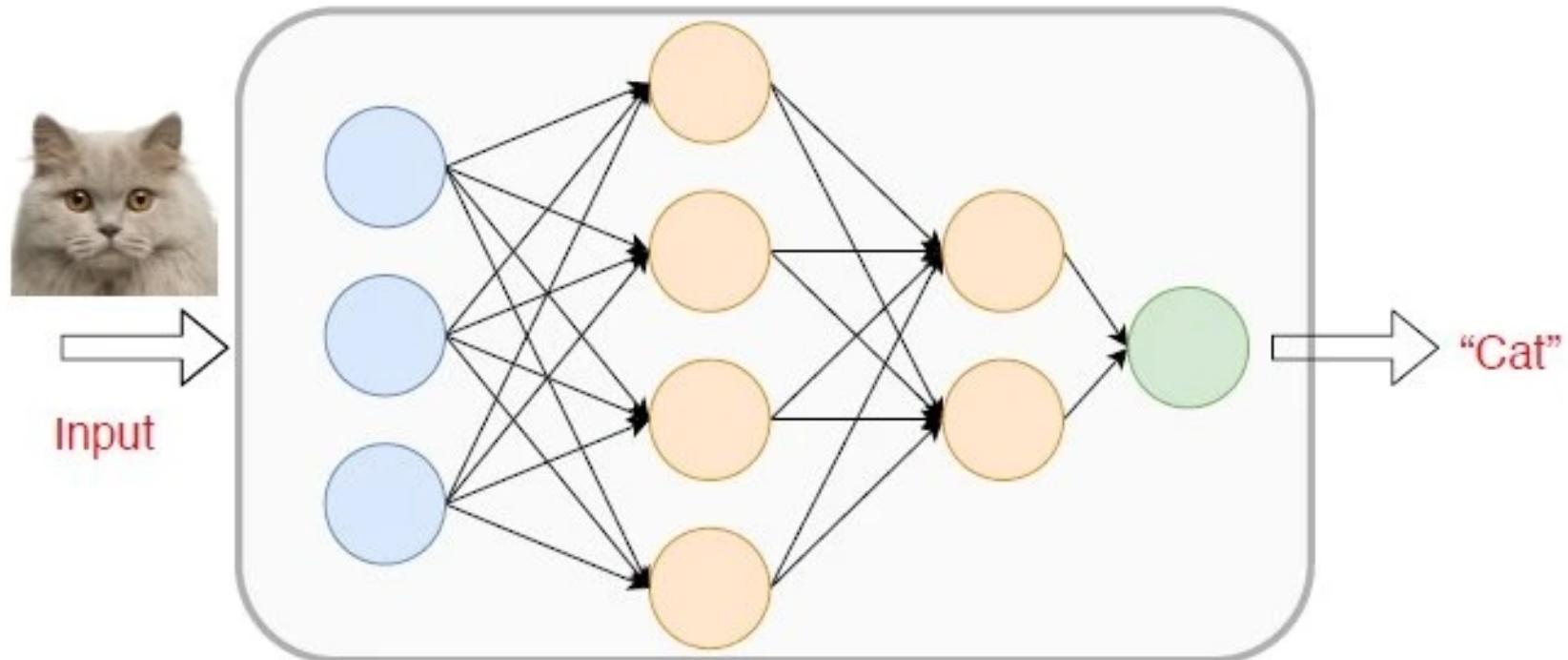
<https://www.youtube.com/embed/KDjWdtDyz5I>

Simulating the brain

- Computer/mathematical models of brain function
- Example: neural networks
- Cheap, noninvasive, can be stimulated or “lesioned”

Application: AI

Multilayer Perceptrons

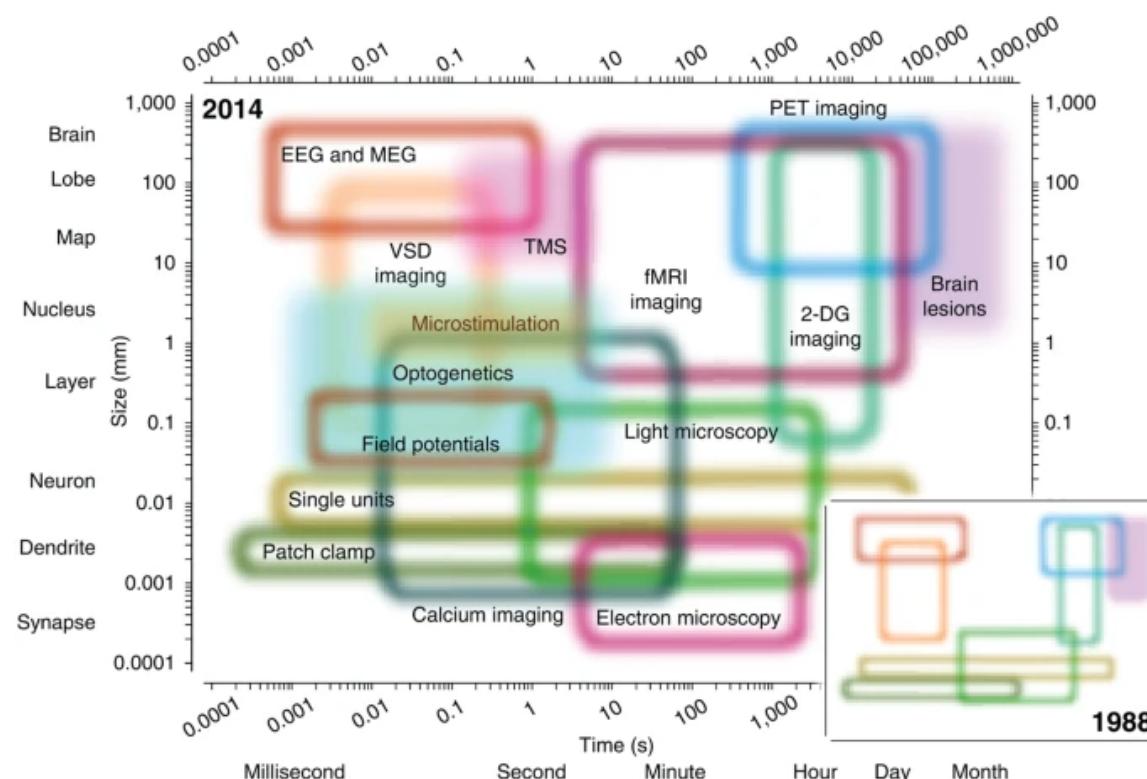


<https://viso.ai/deep-learning/deep-neural-network-three-popular-types/>



<https://www.youtube.com/embed/MPU2HistivI>

Spatial and Temporal Resolution



(Sejnowski, Churchland, & Movshon, 2014)

Bottom line...

- Neuroscientists...
 - need to use many tools
 - seek converging evidence

Neuroanatomy

Brain anatomy through dance



Finding our way around

Anterior/Posterior

Medial/Lateral

Superior/Inferior

Dorsal/Ventral

Rostral/Caudal

Finding our way around

Anterior/Posterior -> front/back

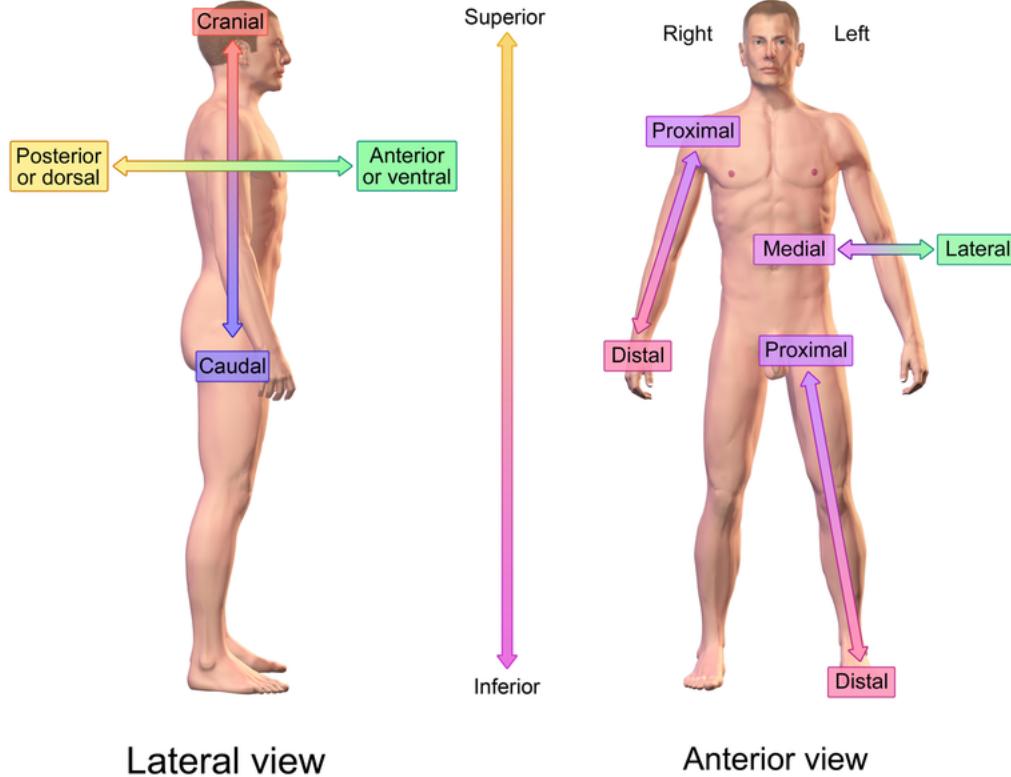
Medial/Lateral -> inside/outside

Superior/Inferior -> upward/downward

Dorsal/Ventral -> back-ward/belly-ward

Rostral/Caudal -> head-ward/tail-ward

Directional image



Lateral view

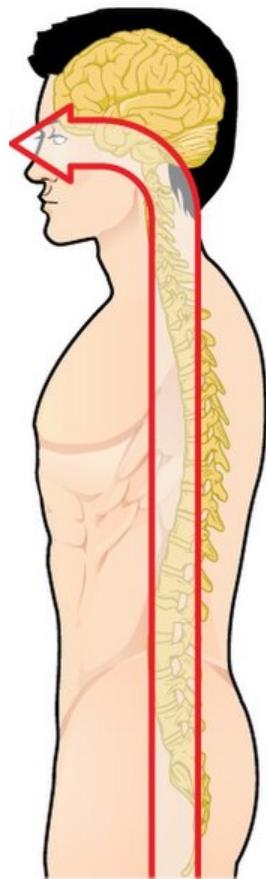
Anterior view

Directional References

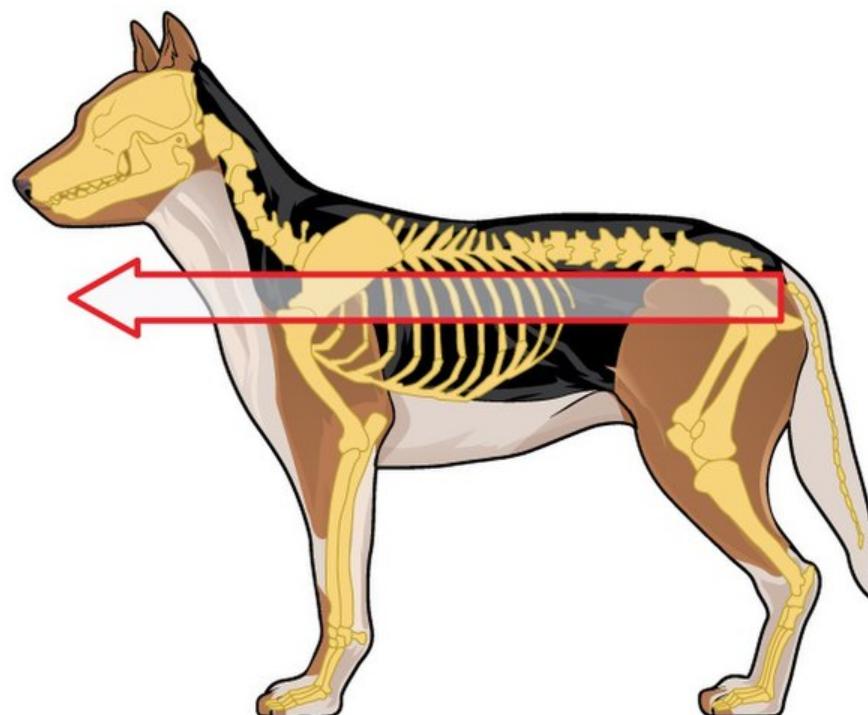
Wikipedia

Bipeds vs. quadripeds

Human (bipedal)



Dog (quadrupedal)



Wikipedia

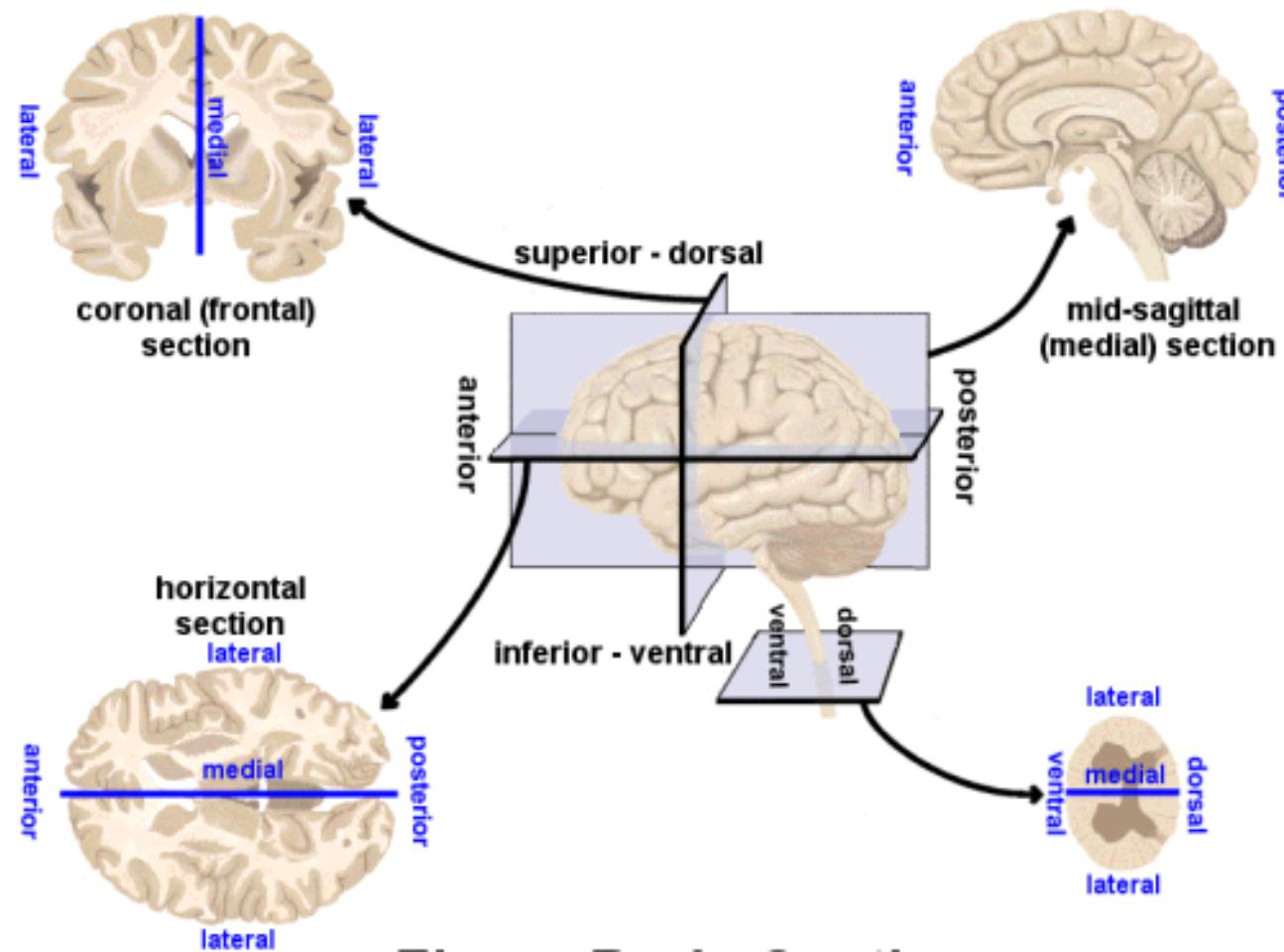
No matter how you slice it

Horizontal/Axial

Coronal/Transverse/Frontal

Sagittal (from the side)

Slice diagram



http://www.scienteteacherprogram.org/biology/chillemistudentguide1-06/brain_directions_planes_sections_directions_-_small.gif

Supporting structures

Meninges

Ventricular system

Blood supply

Meninges

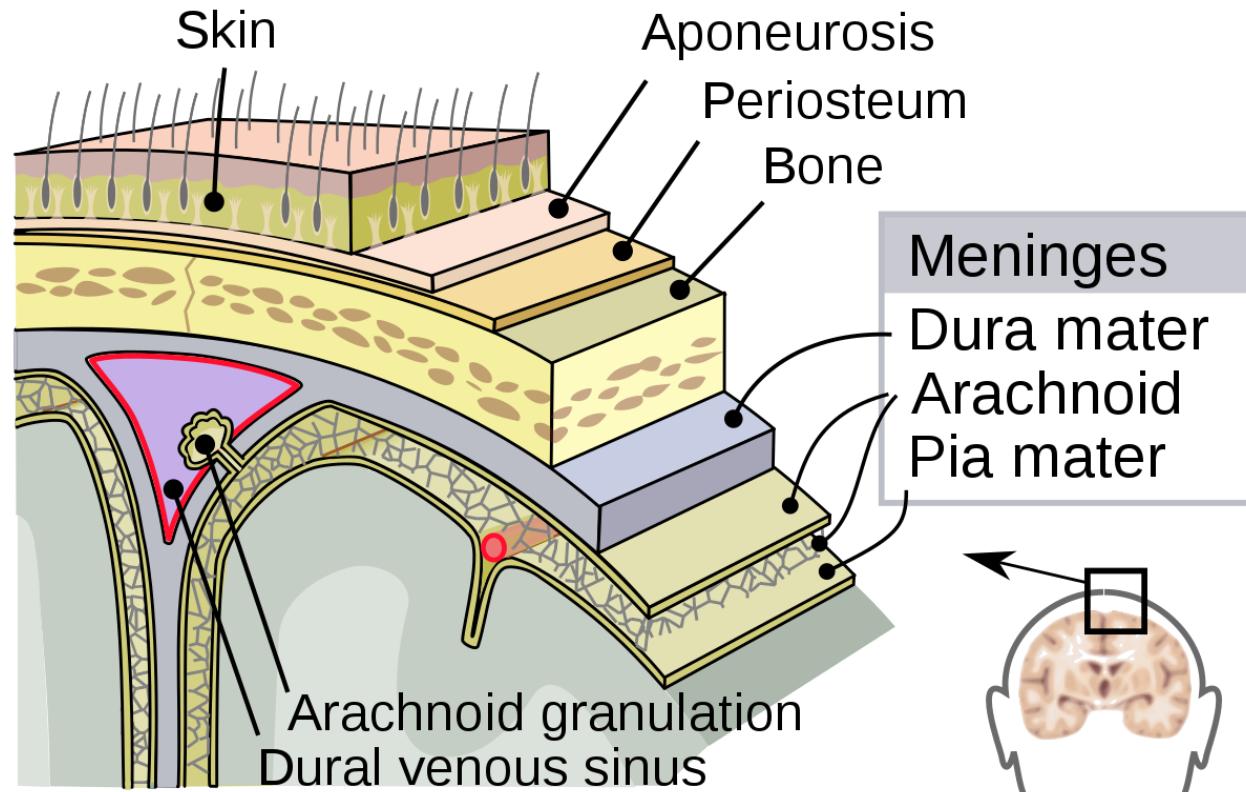
Dura mater

Arachnoid membrane

Subarachnoid space

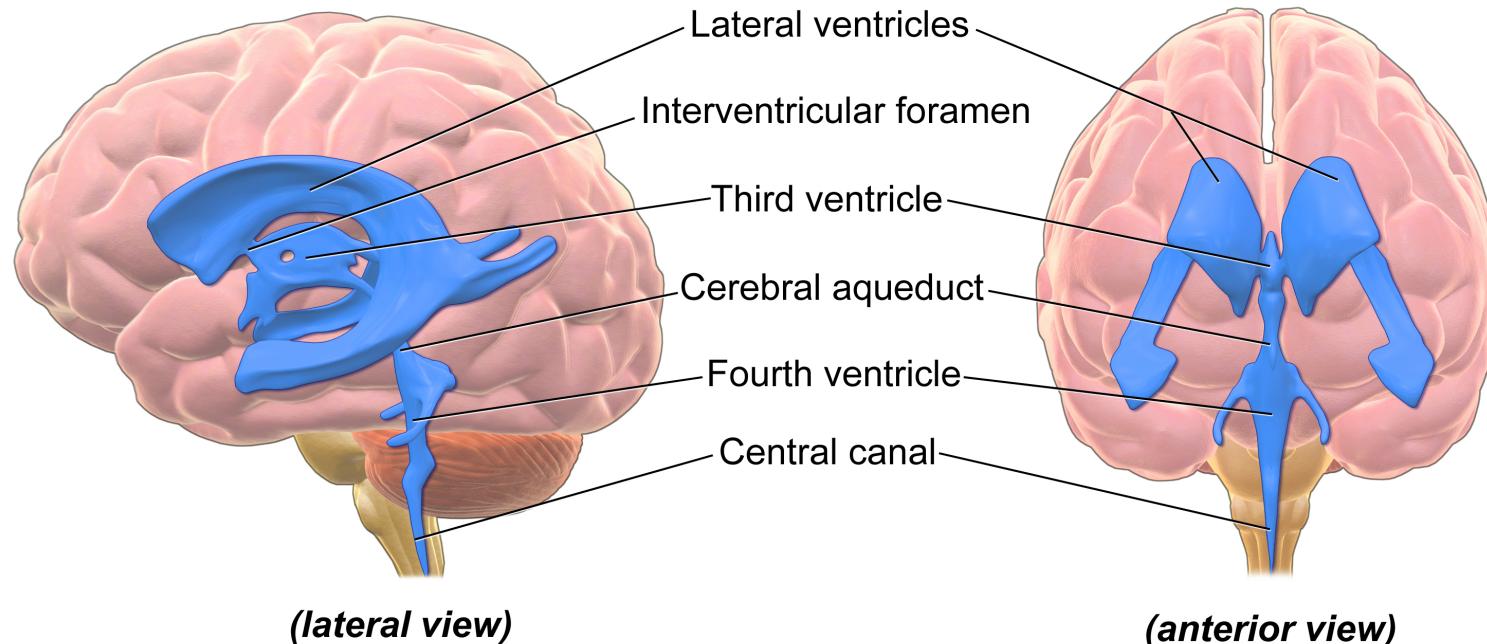
Pia mater

Meninges



<https://upload.wikimedia.org/wikipedia/commons/thumb/8/8e/Meninges-en.svg/1280px-Meninges-en.svg.png>

Ventricular system



https://upload.wikimedia.org/wikipedia/commons/d/d4/Blausen_0896_Ventricles_Brain.png

Ventricles

Lateral (1st & 2nd)

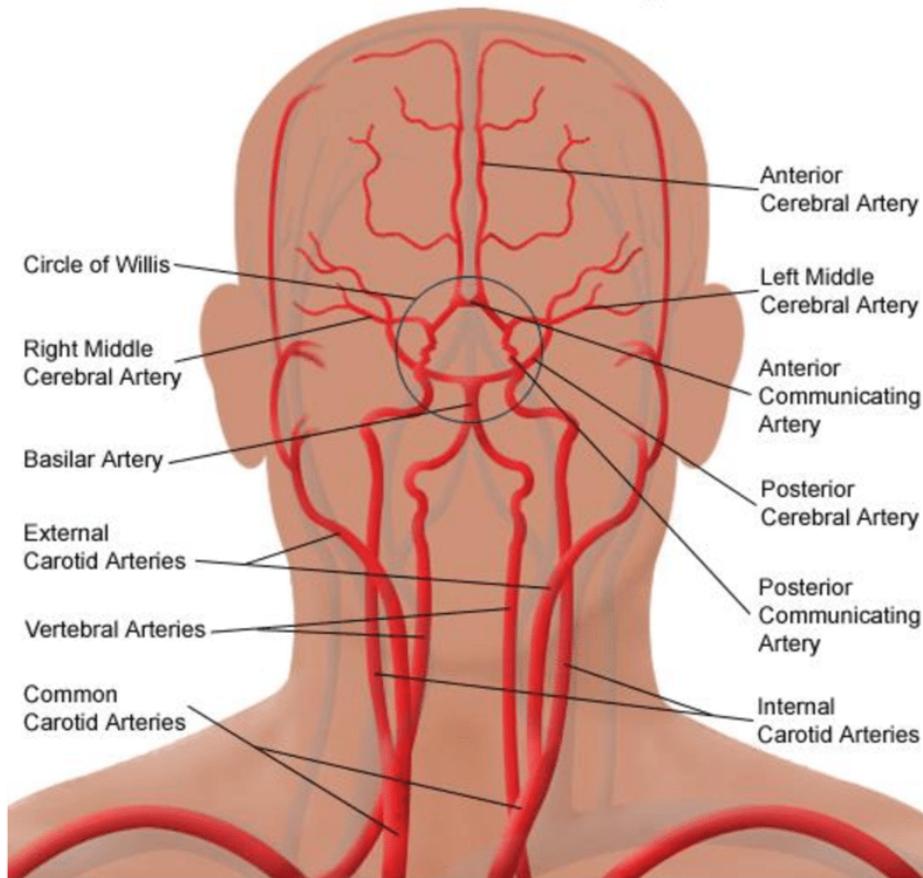
3rd

Cerebral aqueduct

4th

(are filled with) *Cerebrospinal fluid (CSF)*

Blood Supply



https://www.researchgate.net/profile/Yohannes_Mamo/publication/280830140/figure/fig1/AS:649635857174600/Organization-of-the-human-cerebral-circulation-The-brain-receives-its-blood-supply.png

Blood Supply

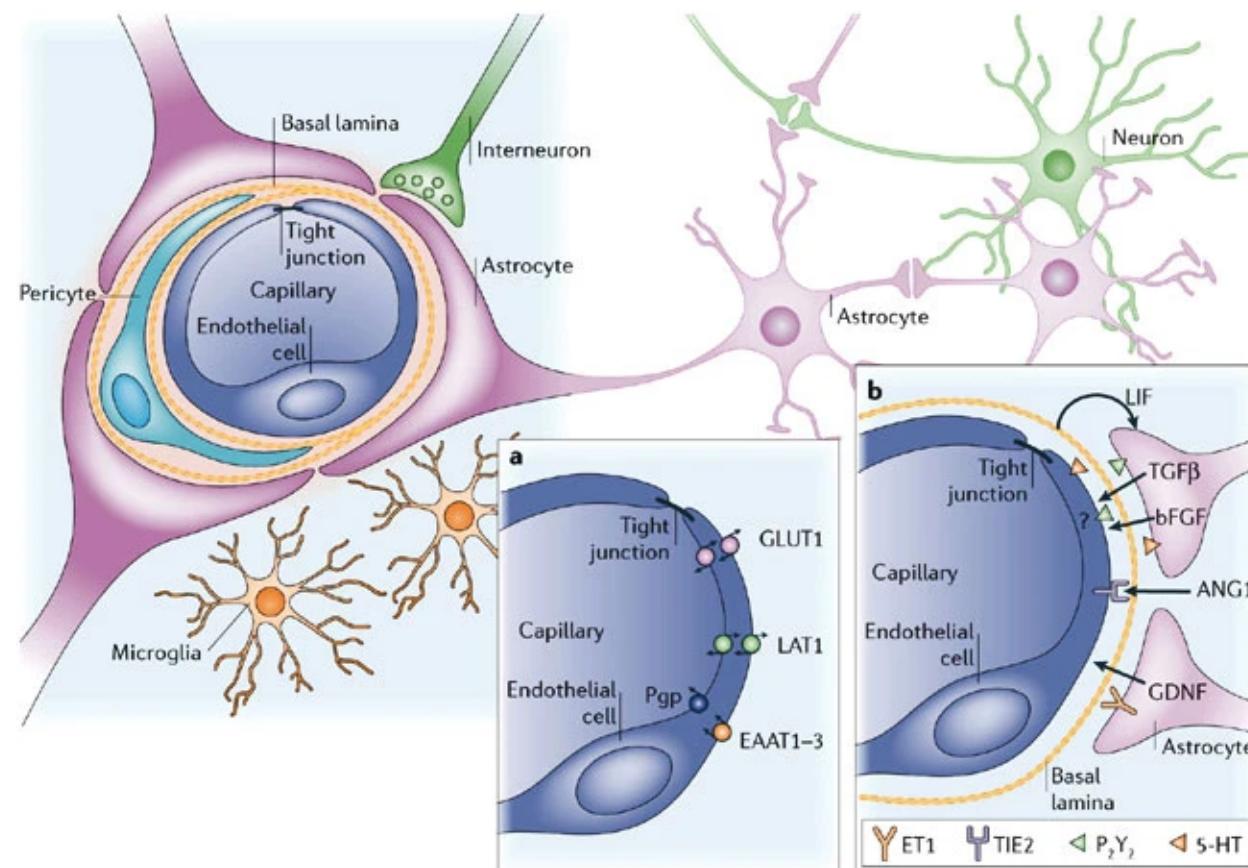
Arteries

- external & internal carotid; vertebral -> basilar
- *Circle of Willis*
- anterior, middle, & posterior cerebral

Blood/brain barrier

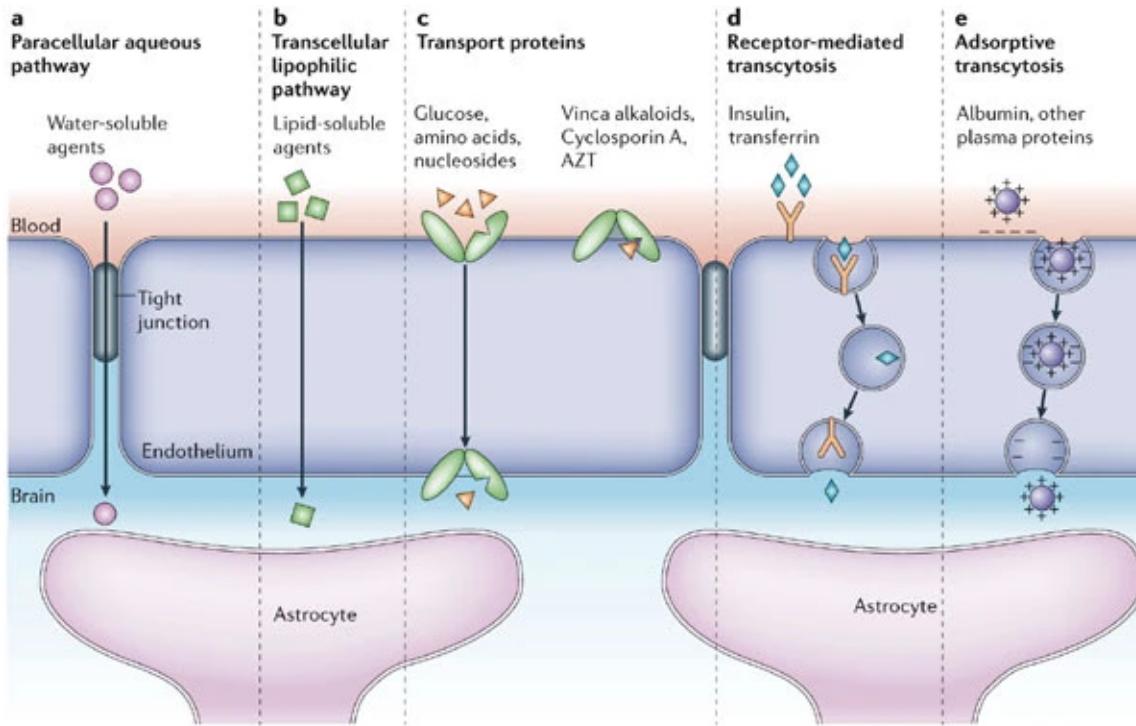
- Isolates CNS from blood stream
- Active transport of molecules typically required
- (endothelial) cells forming blood vessel walls are tightly packed

Blood/brain barrier



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(Abbott, Rönnbäck, & Hansson, 2006)



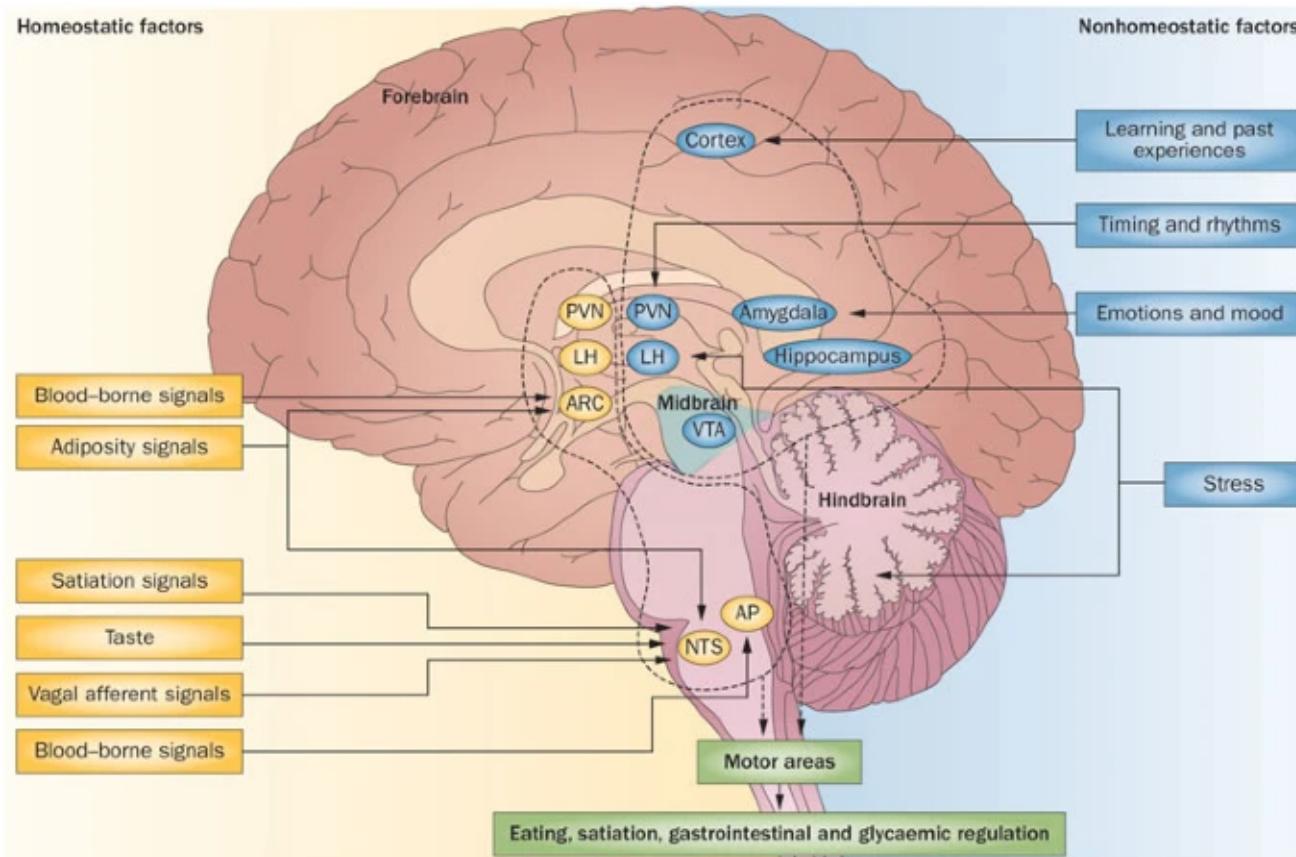
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(Abbott, Rönnbäck, & Hansson, 2006)

exception is *Area Postrema*

- In brainstem
- Blood-brain barrier thin
- Detects toxins, evokes vomiting

Area Postrema



(Begg & Woods, 2013)

Organization of the Nervous System

Central Nervous System (CNS)

- Brain
- Spinal Cord
- Everything encased in bone

Peripheral Nervous System (PNS)

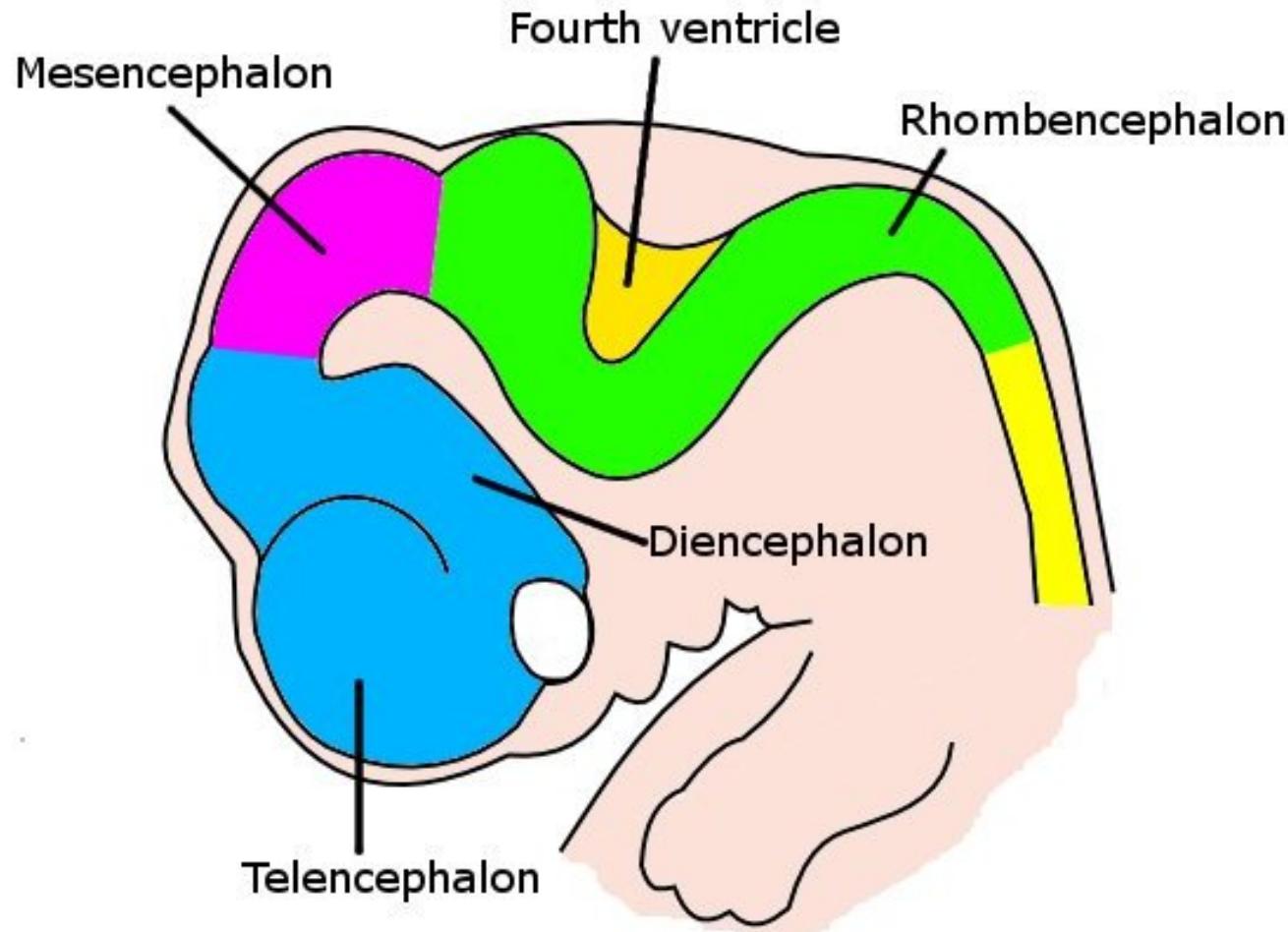
Organization of the brain

Major division	Ventricular Landmark	Embryonic Division	Structure
<i>Forebrain</i>	Lateral	Telencephalon	<i>Cerebral cortex</i>
			<i>Basal ganglia</i>
	Third	Diencephalon	<i>Thalamus</i>
			<i>Hypothalamus</i>
<i>Midbrain</i>	Cerebral Aqueduct	Mesencephalon	<i>Tectum, Tegmentum</i>

Organization of the brain

Major division	Ventricular Landmark	Embryonic Division	Structure
<i>Hindbrain</i>	4th	Rhombencephalon	<i>Cerebellum, pons</i>
	–		<i>Medulla oblongata</i>

Embryonic brain (~6 weeks gestation)



https://upload.wikimedia.org/wikipedia/commons/c/c8/6_week_embryo_brain.jpg

Next time...

- More neuroanatomy...

References

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