

# 3-01-anatomy-I

# Brain anatomy through dance

# Finding our way around

Anterior/Posterior

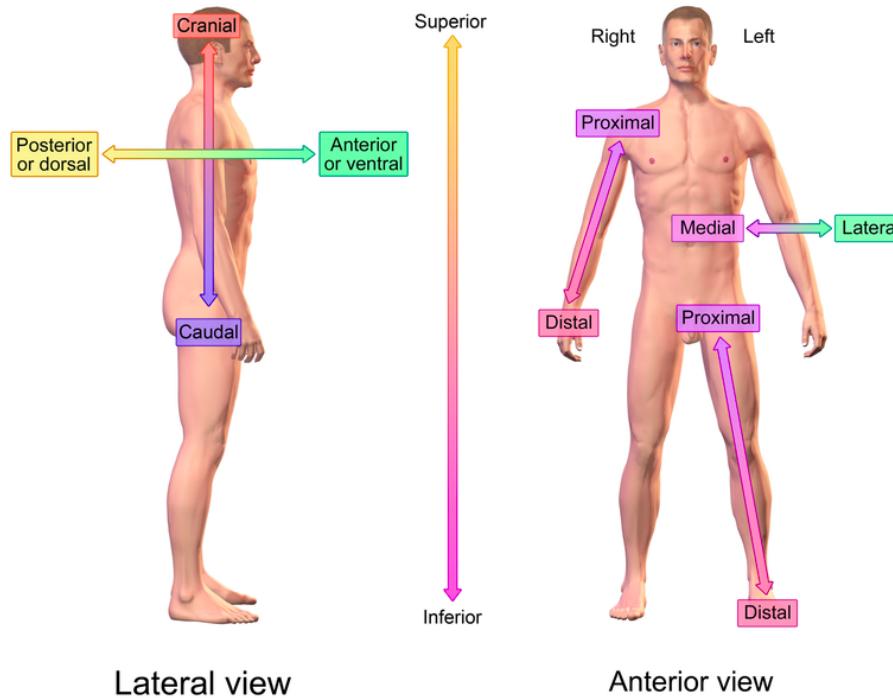
Medial/Lateral

Superior/Inferior

Dorsal/Ventral

Rostral/Caudal

# Directional image



Lateral view

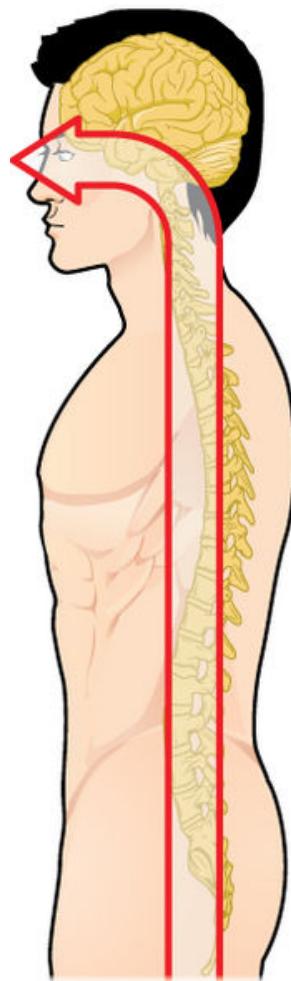
Anterior view

## Directional References

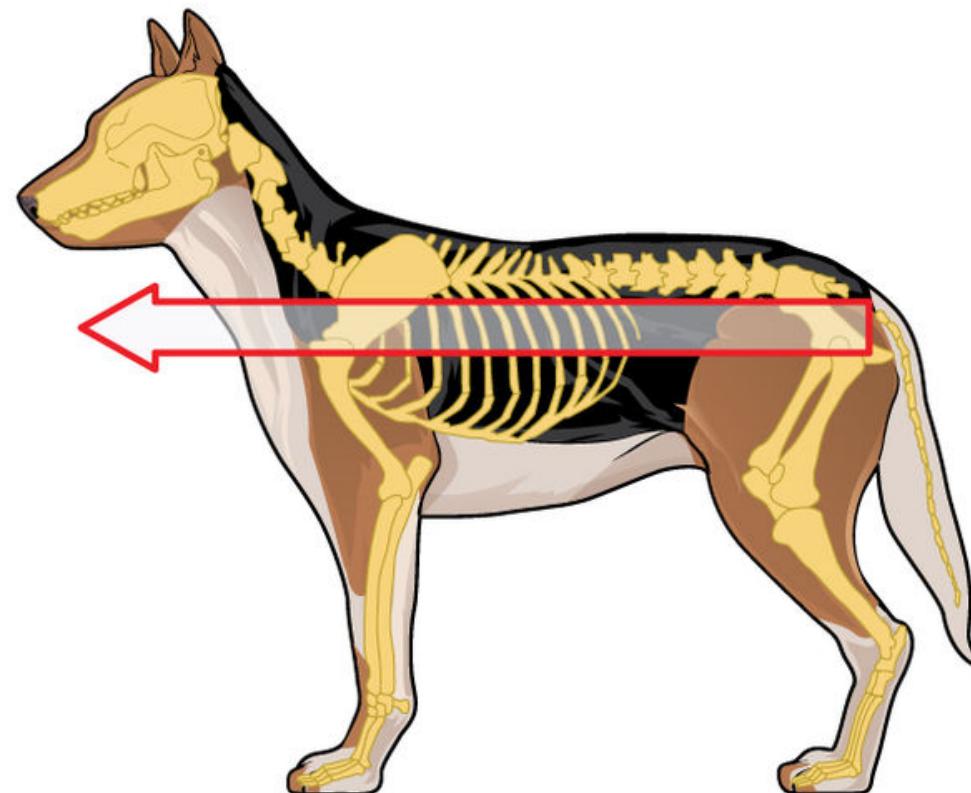
[https://upload.wikimedia.org/wikipedia/commons/thumb/e/e7/Blausen\\_0019\\_AnatomicalDirectionalReferences.png](https://upload.wikimedia.org/wikipedia/commons/thumb/e/e7/Blausen_0019_AnatomicalDirectionalReferences.png)

# Bipeds vs. quadripeds

Human (bipedal)



Dog (quadripedal)



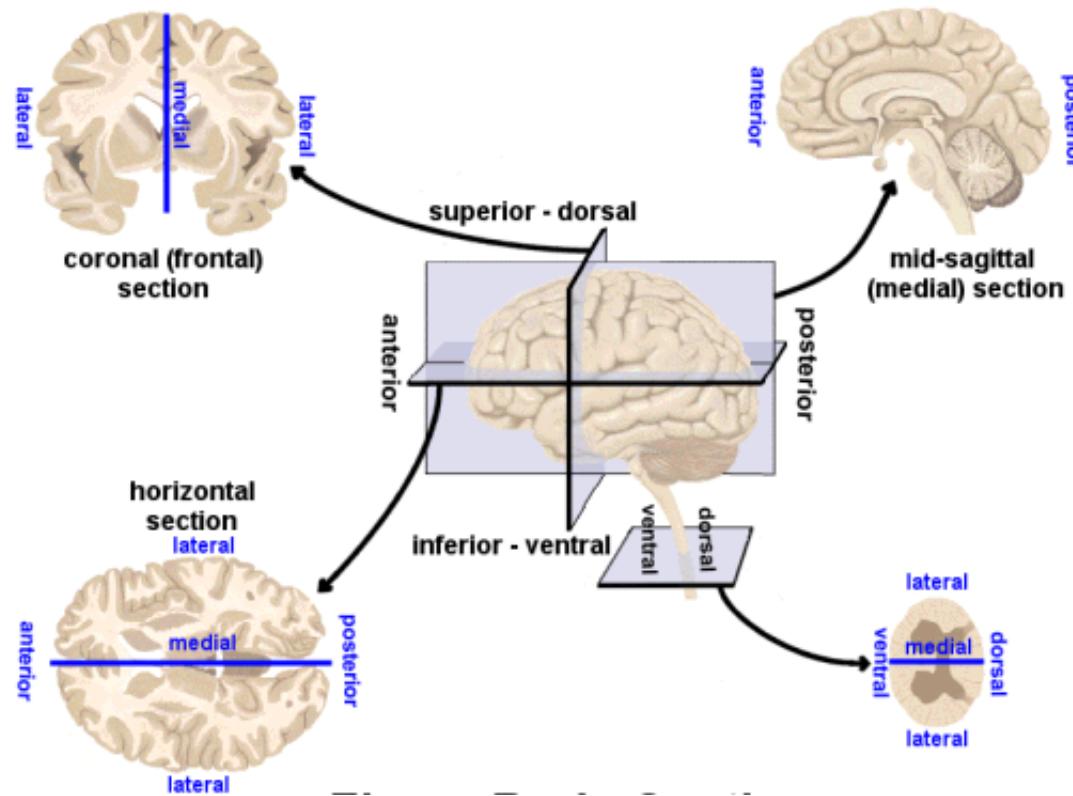
# No matter how you slice it

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

# Supporting structures

Meninges

Ventricular system

Blood supply

# Meninges

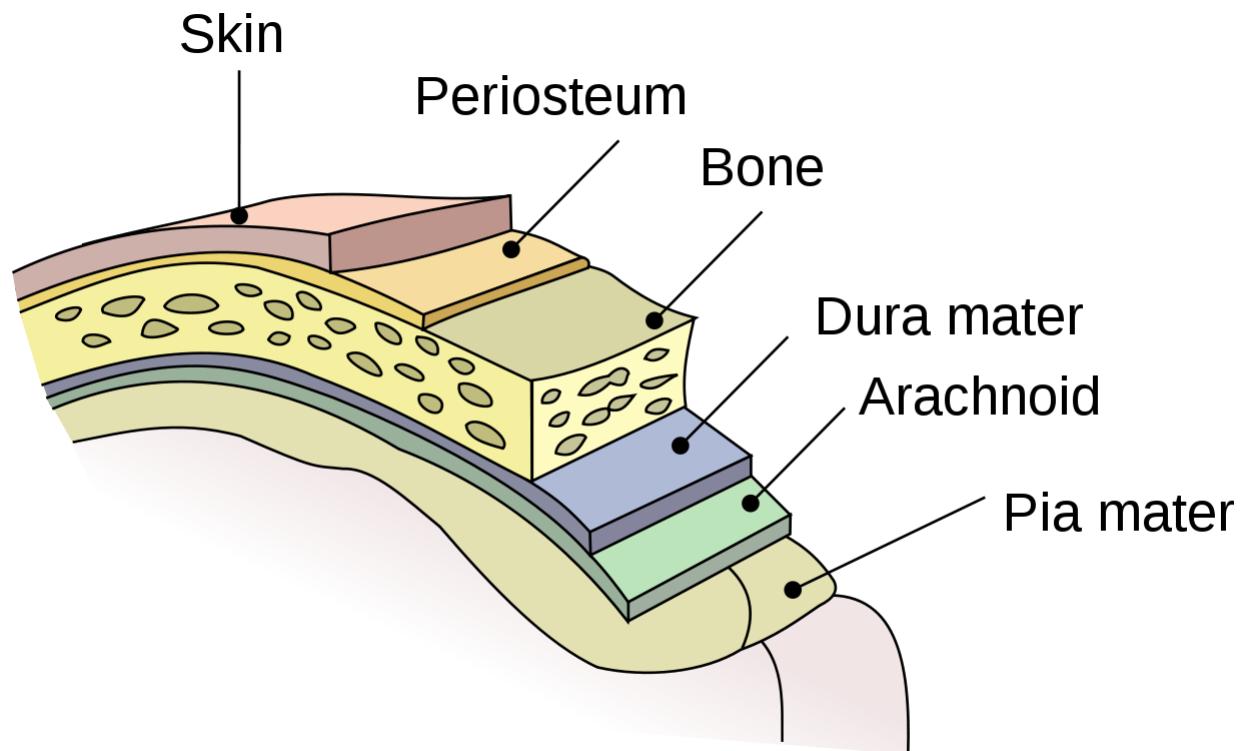
Dura mater

Arachnoid membrane

Subarachnoid space

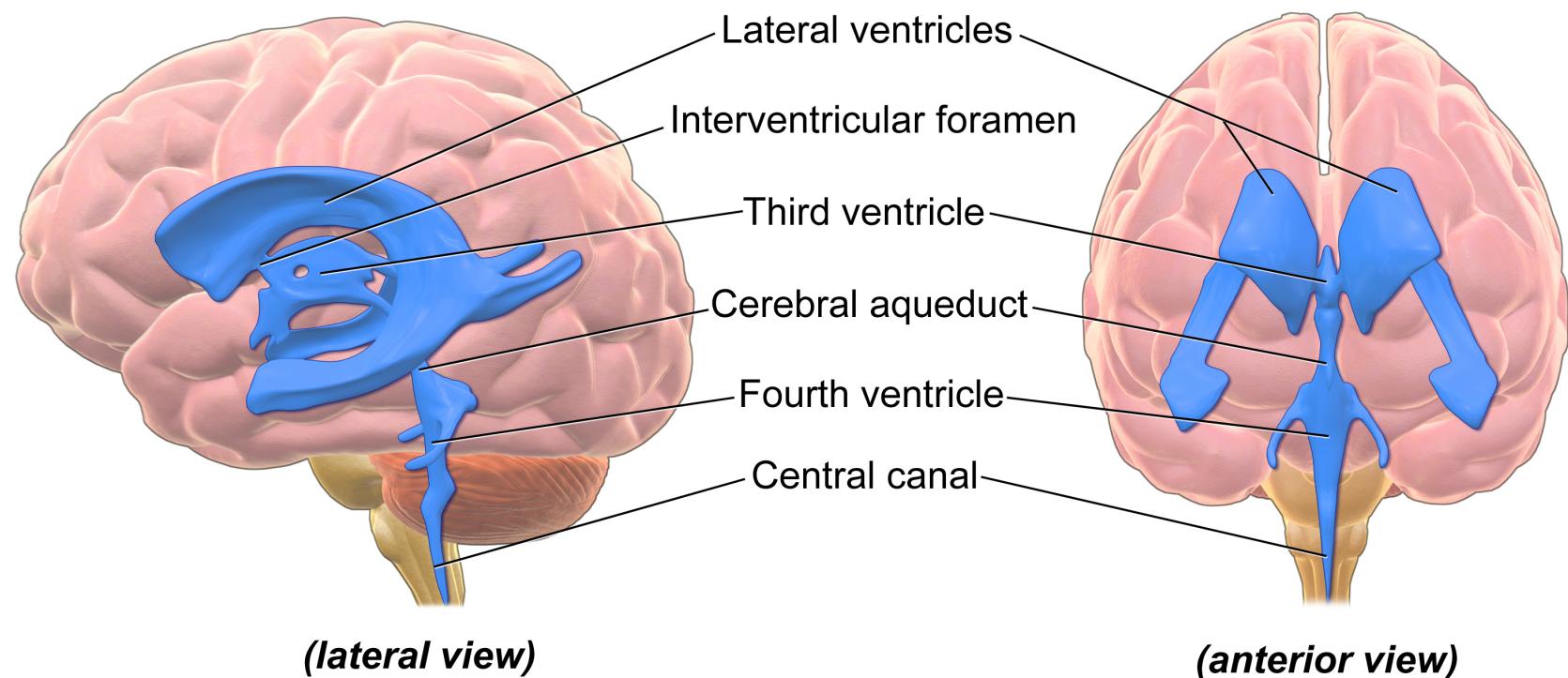
Pia mater

# 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\\_](https://upload.wikimedia.org/wikipedia/commons/d/d4/Blausen_0896_)

# Ventricles

Lateral (1st & 2nd)

3rd

Cerebral aqueduct

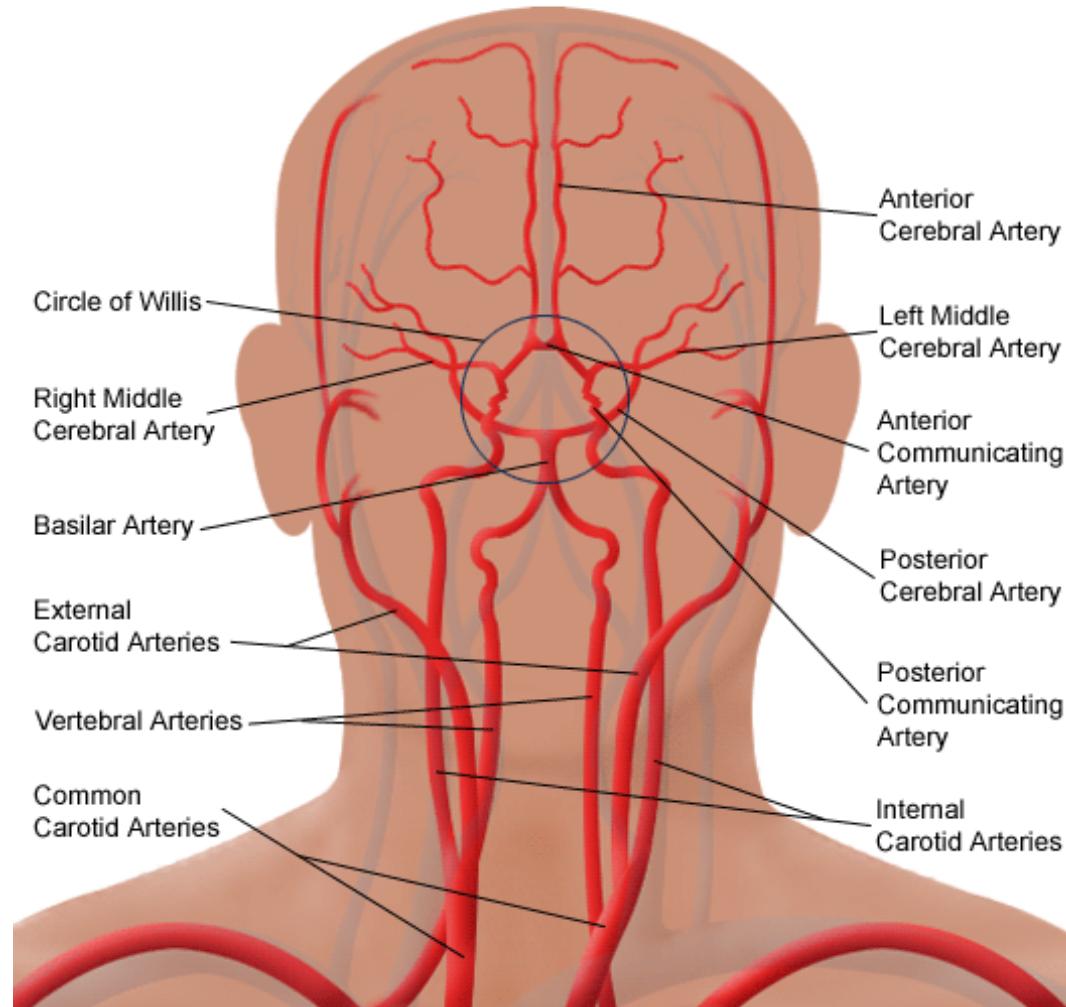
4th

Cerebrospinal fluid (CSF)

- Clears metabolites during sleep (Xie et al. 2013).

# Blood Supply

Arterial Circulation of the Brain, Including Carotid Arteries



# Blood Supply

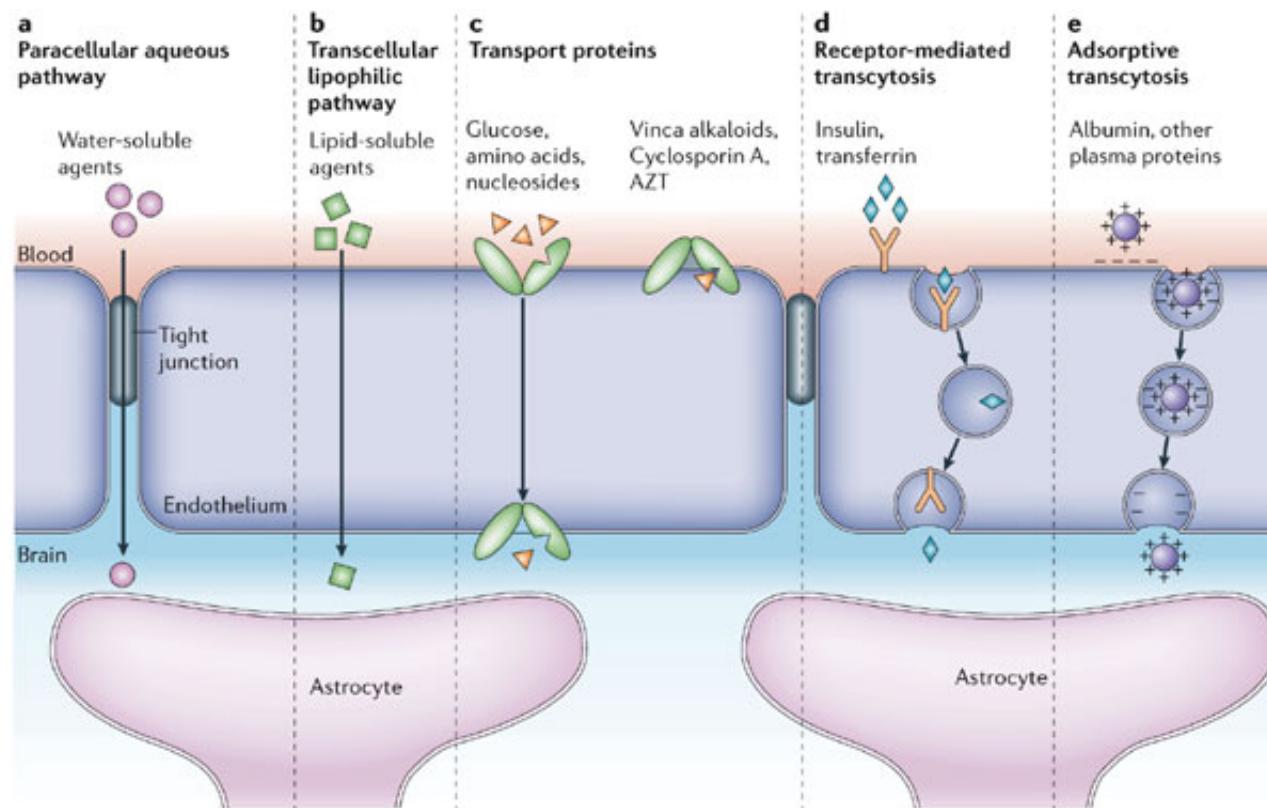
## Arteries

- Circle of Willis

## Blood/brain barrier

- Cells forming blood vessel walls tightly packed
- Active transport of molecules typically required

# Blood/brain barrier

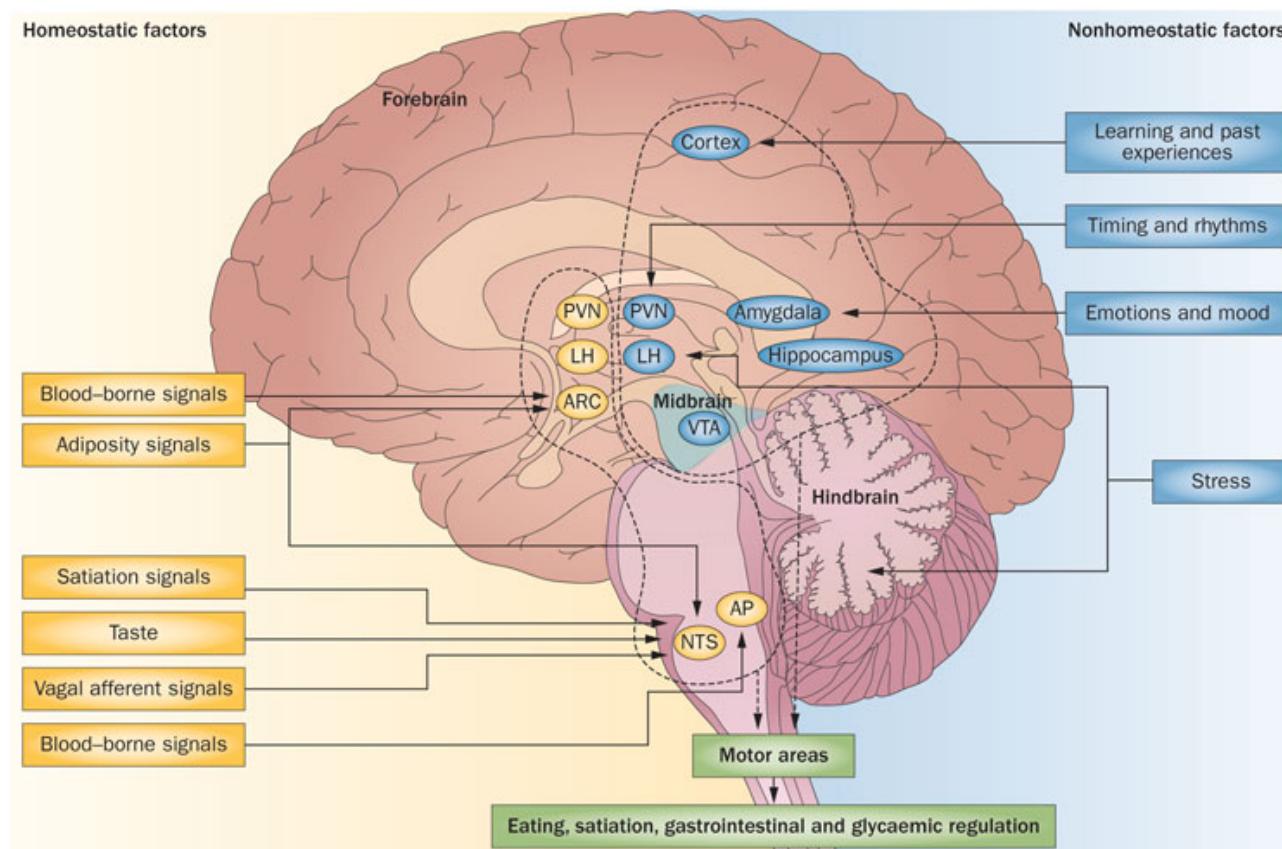


Copyright © 2005 Nature Publishing Group  
Nature Reviews | Neuroscience

<http://www.nature.com/nrn/journal/v7/n1/images/nrn1824-f3.jpg>

# Area Postrema

- Brainstem, blood-brain barrier thin



<http://www.nature.com/nrendo/journal/v9/n10/images/nrendo.2013.13> 17/50

# 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
Forebrain	Lateral	Telencephalon	Cerebral cortex
			Basal ganglia
			Hippocampus, amygdala
Midbrain	Third	Diencephalon	Thalamus
			Hypothalamus
Midbrain	Cerebral Aqueduct	Mesencephalon	Tectum, tegmentum

# Organization of the brain

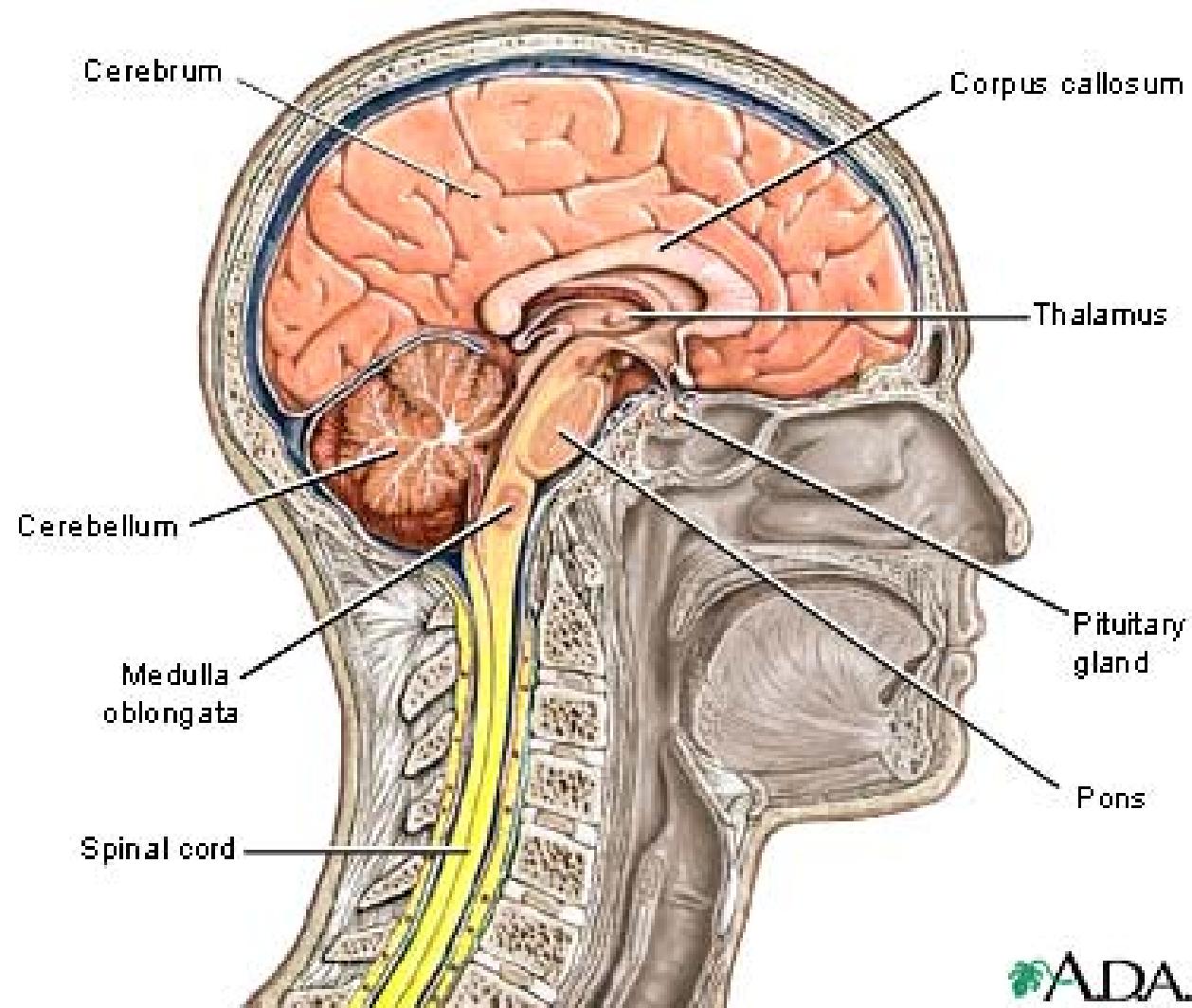
Major division	Ventricular Landmark	Embryonic Division	Structure
Hindbrain	4th	Metencephalon	Cerebellum, pons
	-	Myelencephalon	Medulla oblongata

# Hindbrain

Structures adjacent to 4th ventricle

- Medulla oblongata
- Cerebellum
- Pons

# Medulla oblongata



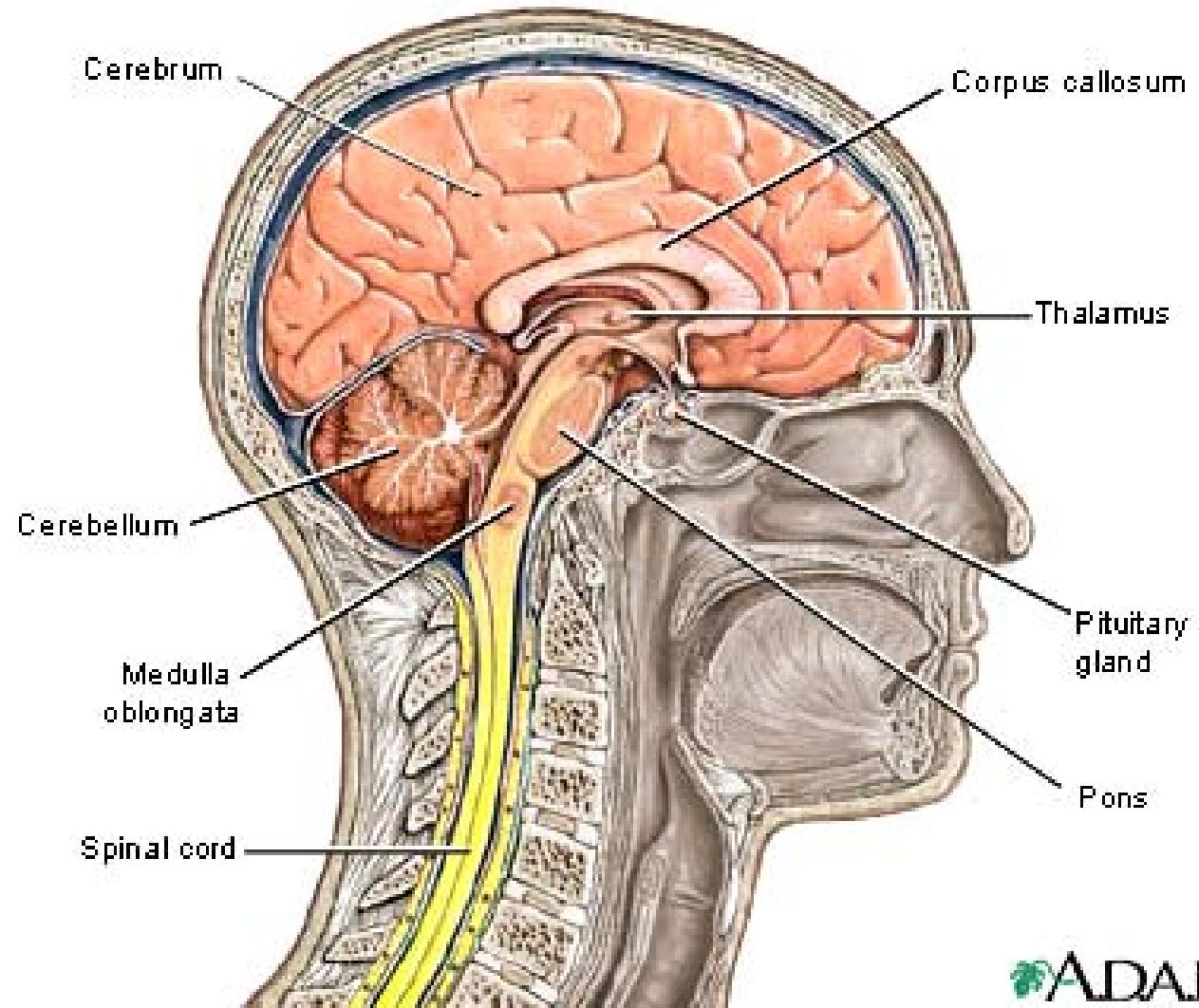
# Medulla

- Cardiovascular regulation
- Muscle tone
- Fibers of passage

# Cerebellum

- “Little brain”
- Dorsal to pons
- Movement coordination, simple learning

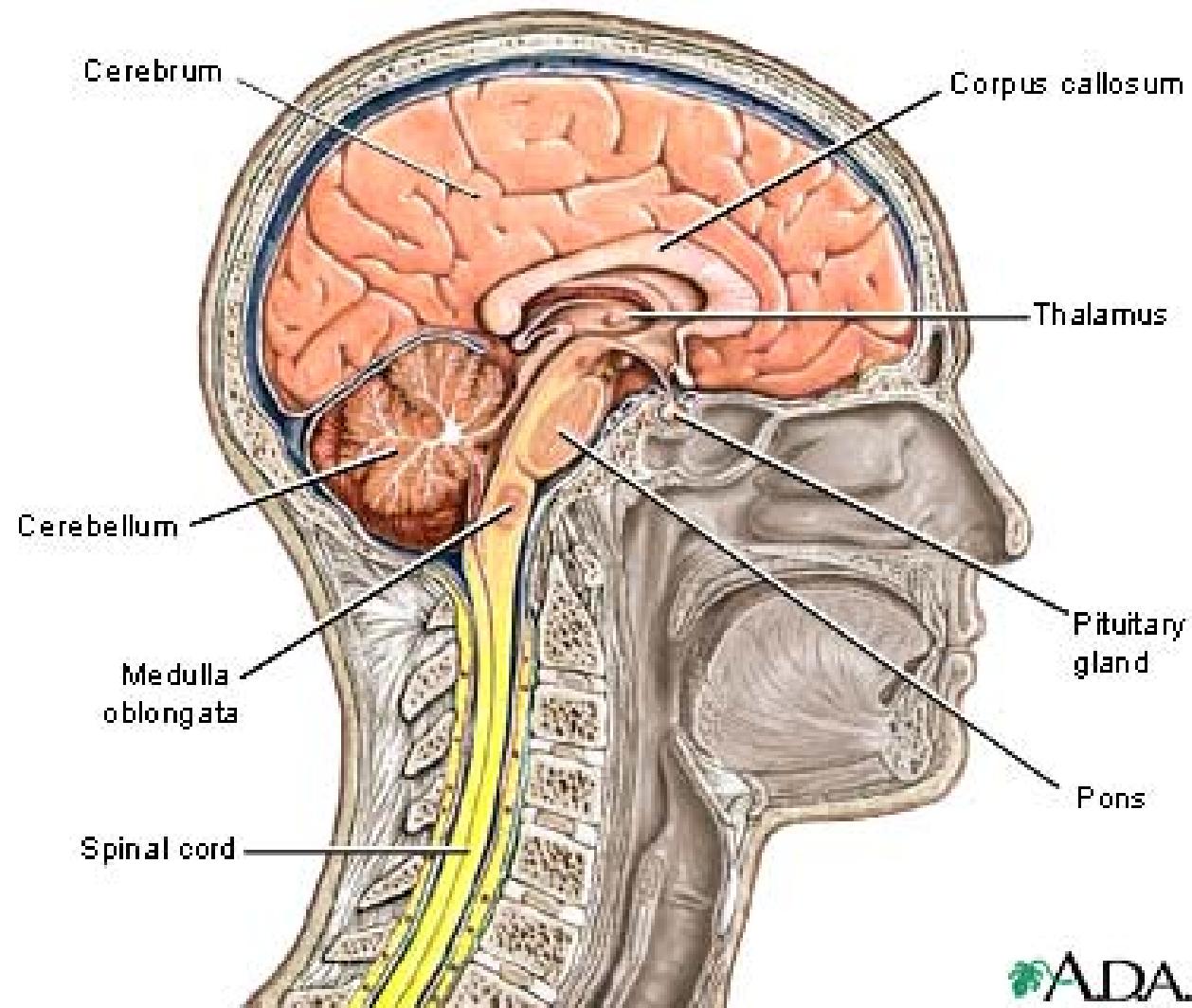
# Hindbrain



# Pons

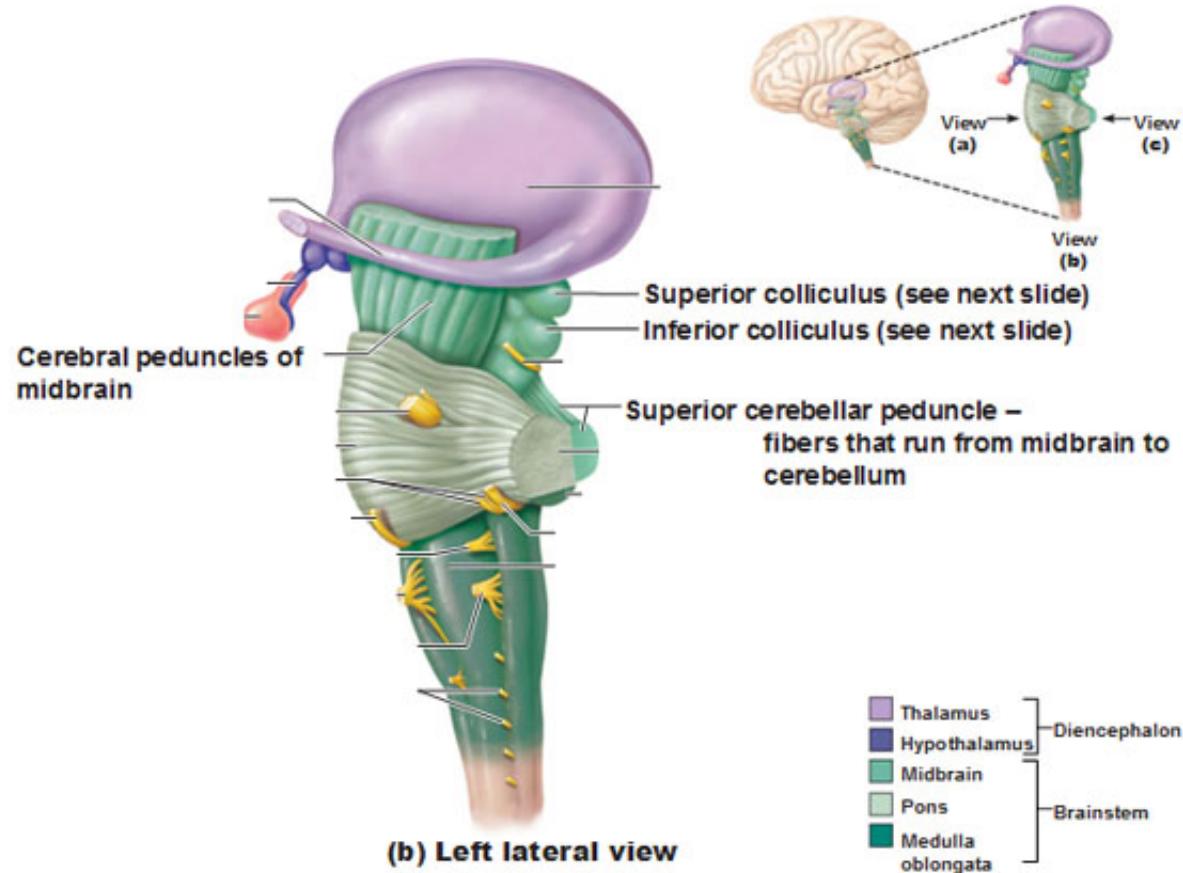
- Bulge on brain stem
- Neuromodulatory nuclei
- Relay to cerebellum

# Hindbrain



# Midbrain

## The Brain Stem– The Midbrain

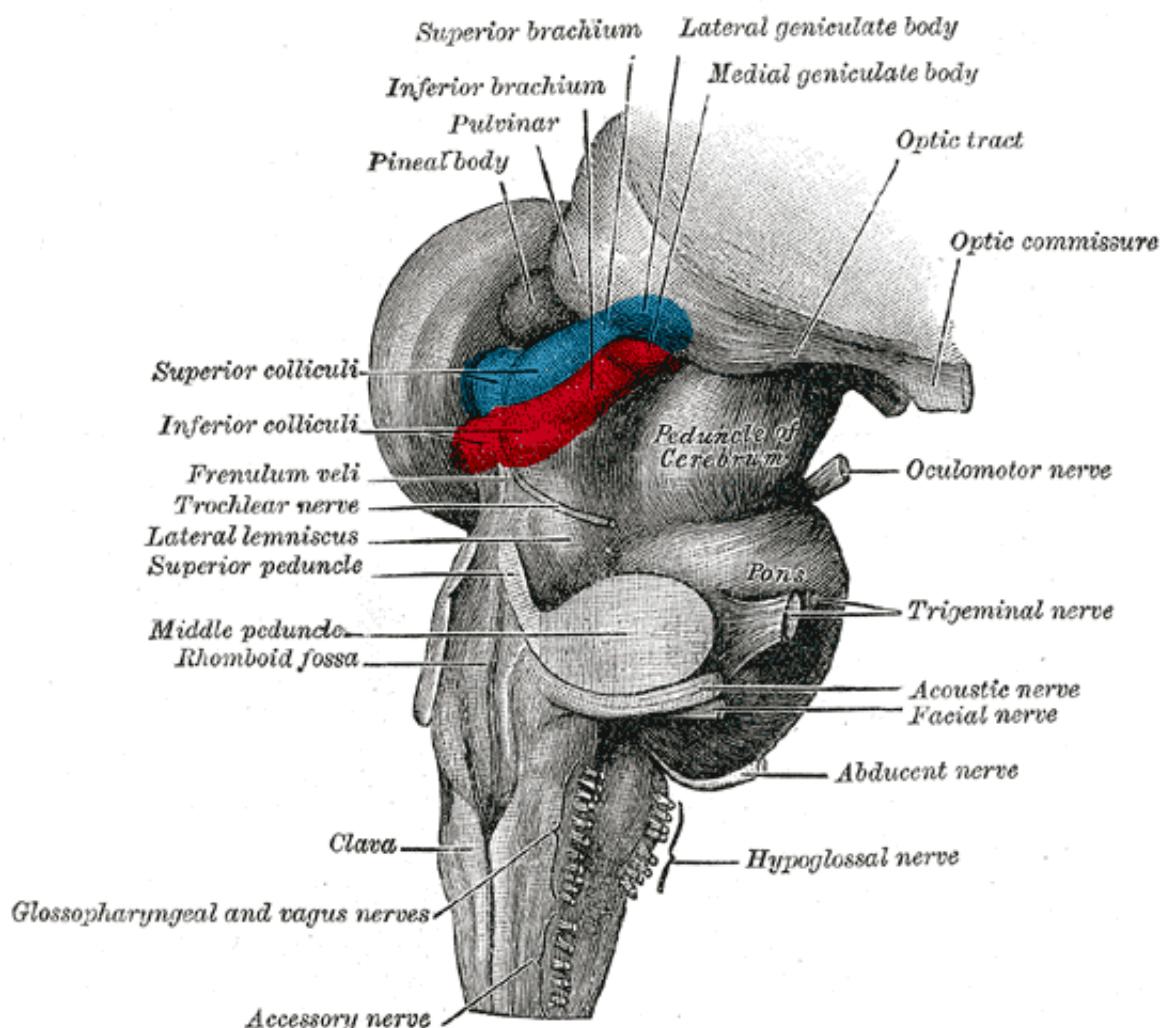


# Midbrain components

Tectum

Tegmentum

# Tectum



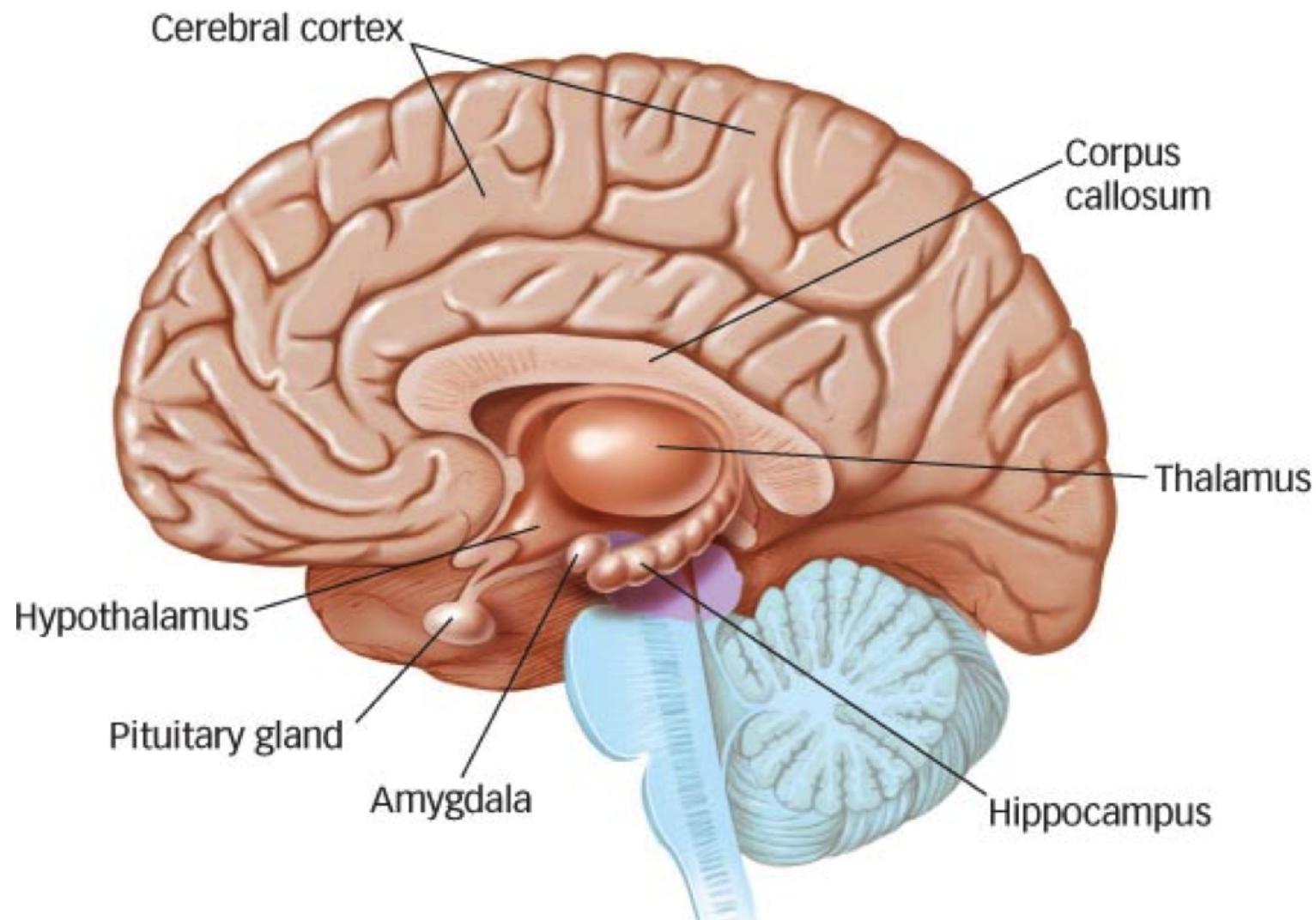
# Tectum

- Superior and inferior colliculus
- Reflexive orienting of eyes, head, ears

# Tegmentum

- Species-typical movement sequences
- Neuromodulatory nuclei
  - Dopamine (DA)
  - Norepinephrine (NE)
  - Serotonin (5-HT)

# Forebrain

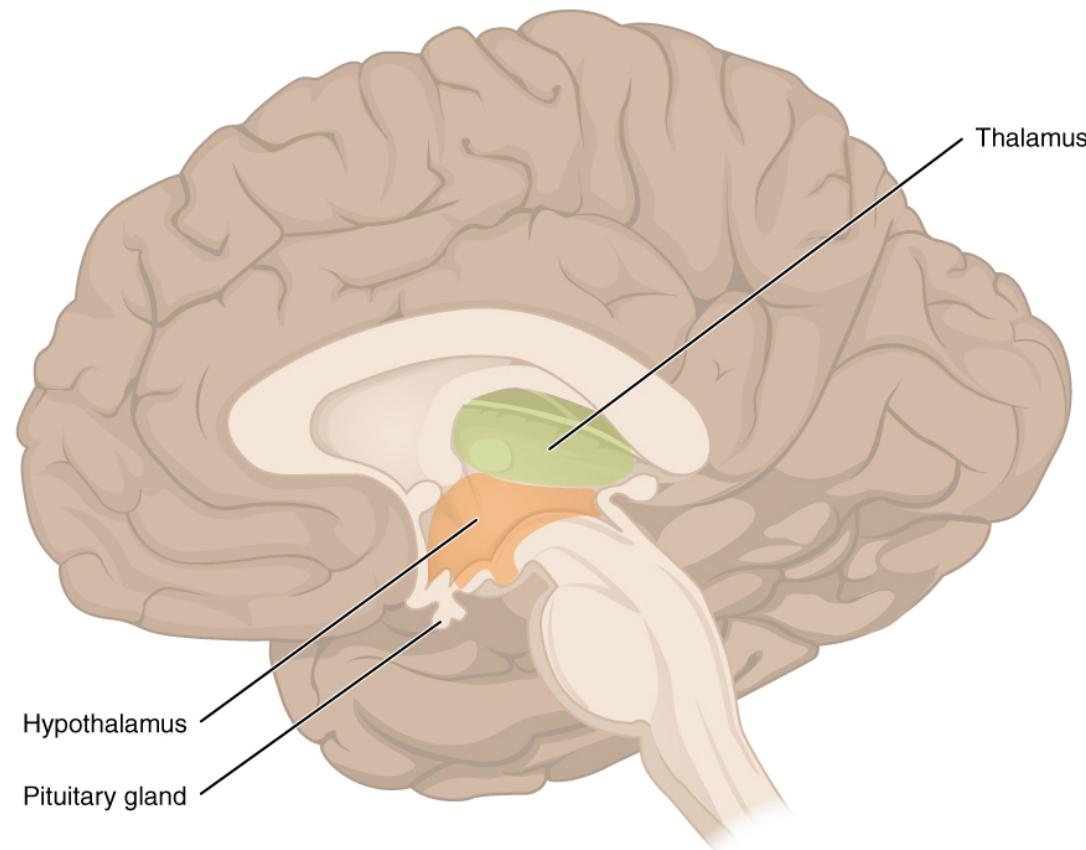


# Forebrain Components

Diencephalon

Telencephalon

# Diencephalon

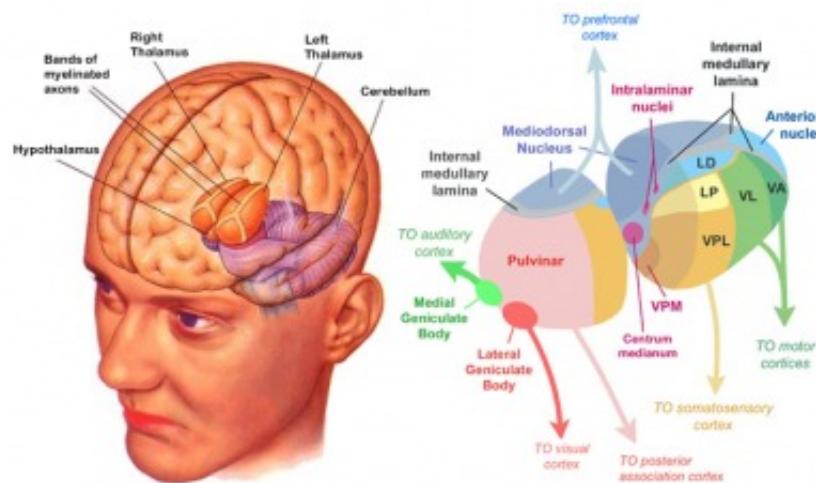


[https://upload.wikimedia.org/wikipedia/commons/a/a0/1310\\_Dienceph](https://upload.wikimedia.org/wikipedia/commons/a/a0/1310_Dienceph)

# Diencephalon Components

- Thalamus
- Hypothalamus

# Thalamus



<http://neurobiologychapter3.weebly.com/uploads/1/4/1/8/1418733/511401x231>

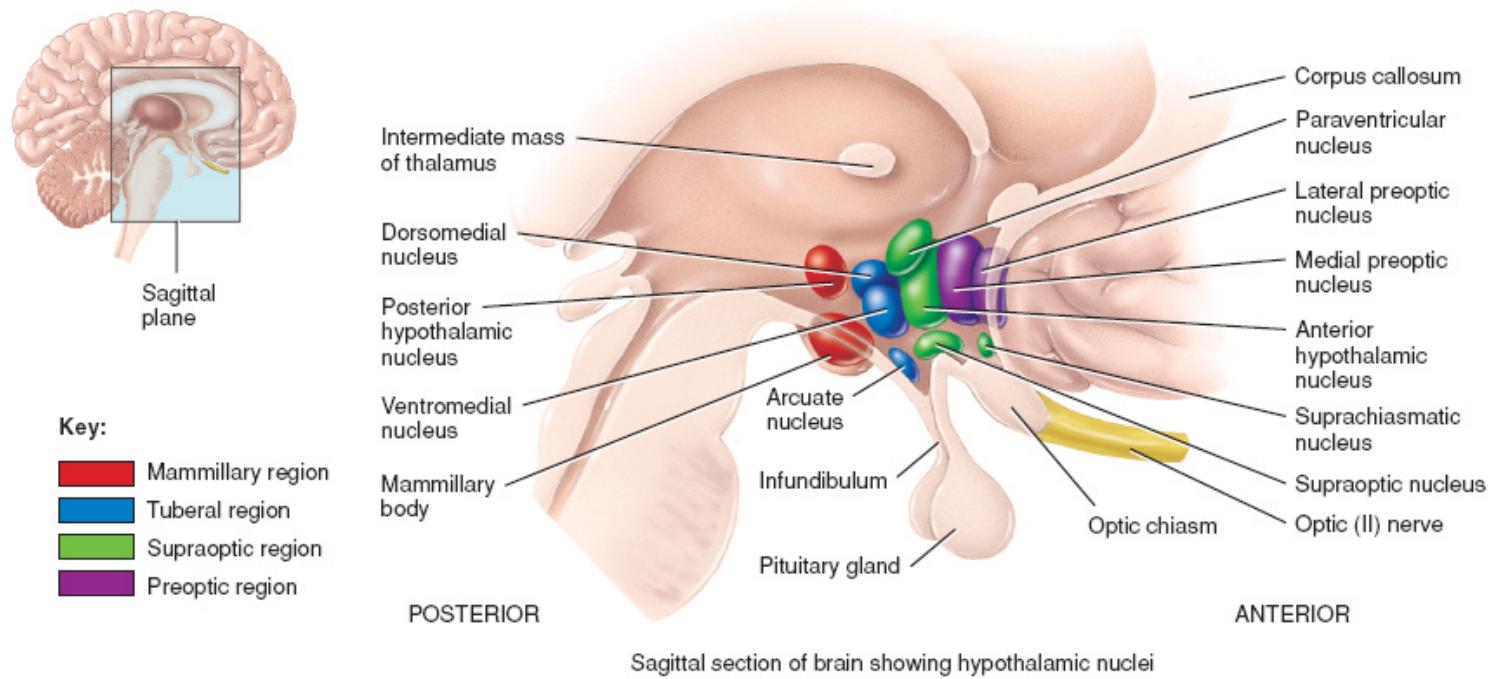
# Thalamus functions

- Input to cortex
- Functionally distinct nuclei (collection of neurons)
- Lateral geniculate nucleus (LGN), vision
- Medial geniculate nucleus (MGN), audition

# Hypothalamus

- Four Fs: fighting, fleeing, feeding, and reproduction
- Controls pituitary gland (“master” gland)
  - Anterior (indirect release of hormones)
  - Posterior (direct release of hormones)
    - Oxytocin
    - Vasopressin

# Hypothalamus



<http://higheredbcs.wiley.com/legacy/college/tortora/0470565101/heart>

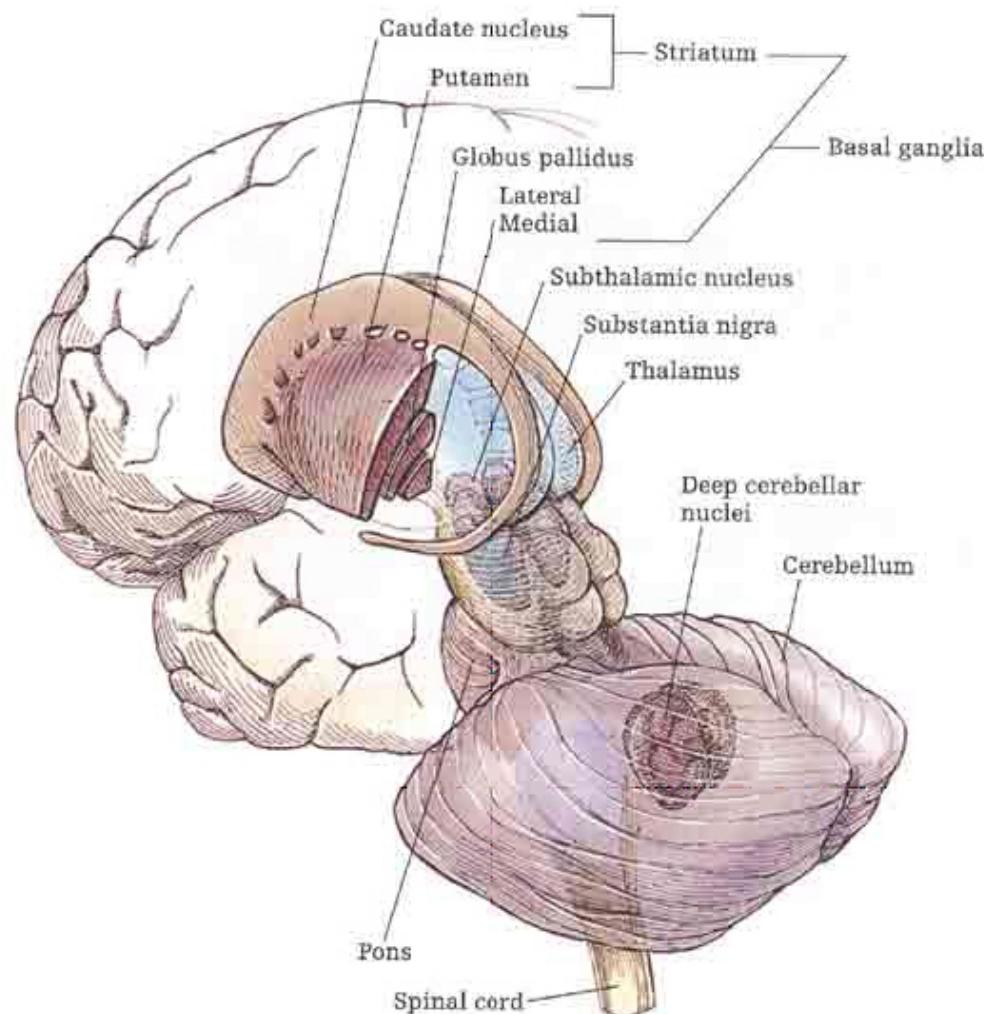
# Telencephalon

- Basal ganglia
- Hippocampus, amygdala
- Cerebral cortex

# Basal ganglia

- Skill and habit learning
- Sequencing of movement
- Example: Parkinson's Disease

# Basal ganglia



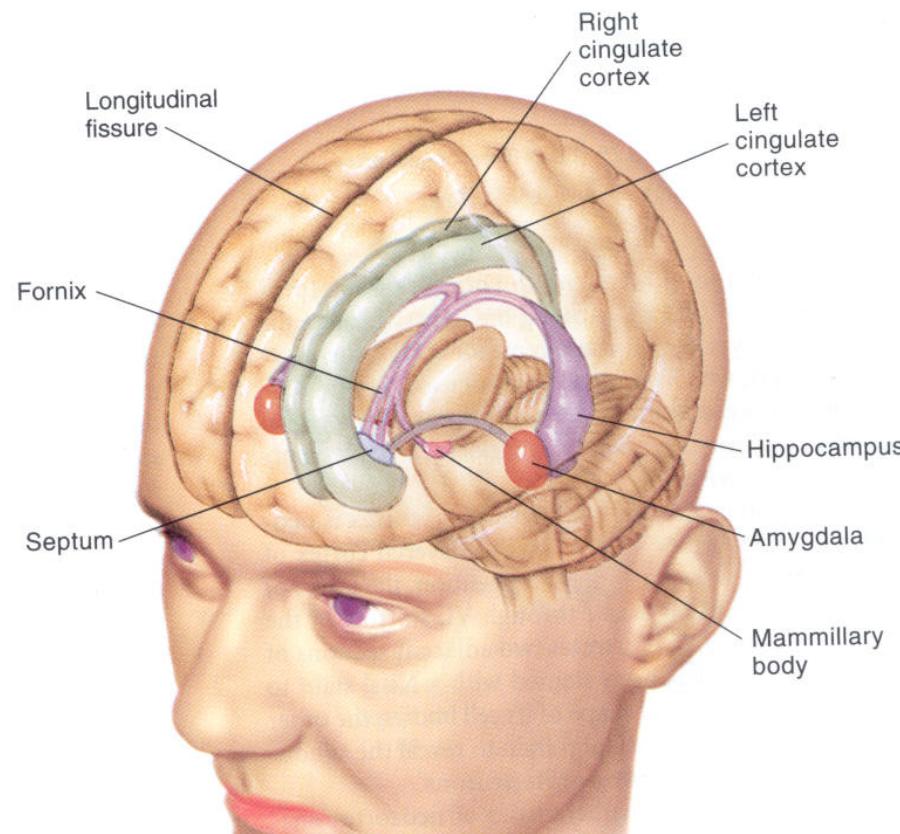
# Basal ganglia

- Striatum
  - Caudate nucleus
  - Putamen
- Globus pallidus
- Subthalamic nucleus
- Substantia nigra (tegmentum)

# Hippocampus

- Immediately lateral to lateral ventricles
- Memories of specific facts or events
- Fornix projects to hypothalamus
- Mammillary bodies

# Hippocampus

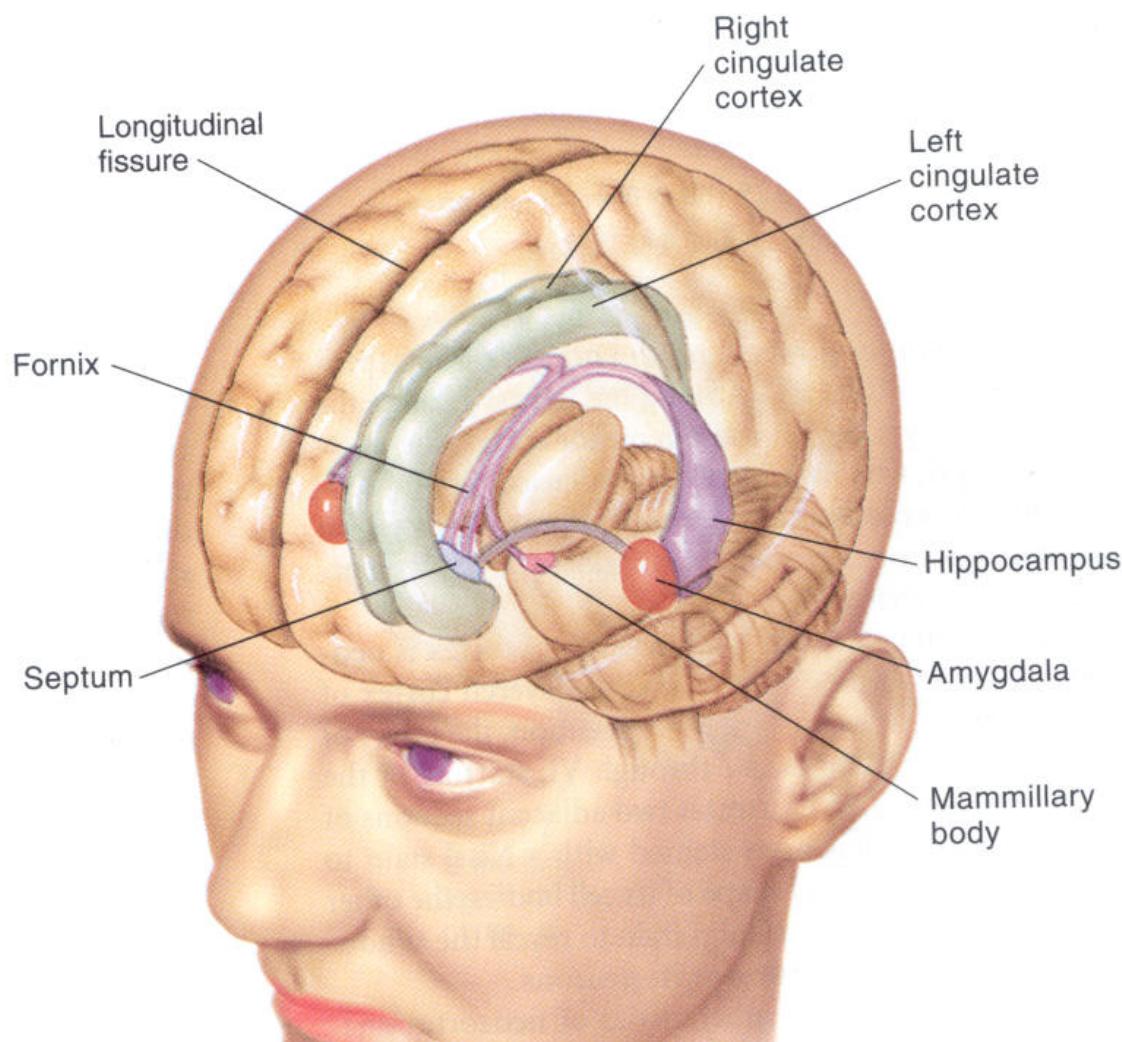


[http://homepage.smc.edu/wissmann\\_paul/physnet/anatomynet/anator](http://homepage.smc.edu/wissmann_paul/physnet/anatomynet/anator)

# Amygdala (“almond”)

- Physiological state, behavioral readiness, affect
- NOT the fear center! (LeDoux 2015).

# Amygdala



# Next Time

Cerebral Cortex

Spinal Cord

The Peripheral Nervous System

# References

LeDoux, Joseph. 2015. "The Amygdala Is NOT the Brain's Fear Center."

<https://www.psychologytoday.com/blog/i-got-mind-tell-you/201508/the-amygda-is-not-the-brains-fear-center>.

Xie, Lulu, Hongyi Kang, Qiwu Xu, Michael J Chen, Yonghong Liao, Meenakshisundaram Thiagarajan, John O'Donnell, et al. 2013. "Sleep Drives Metabolite Clearance from the Adult Brain." 342 (6156). American Association for the Advancement of Science: 373–77. doi:[10.1126/science.1241224](https://doi.org/10.1126/science.1241224).

