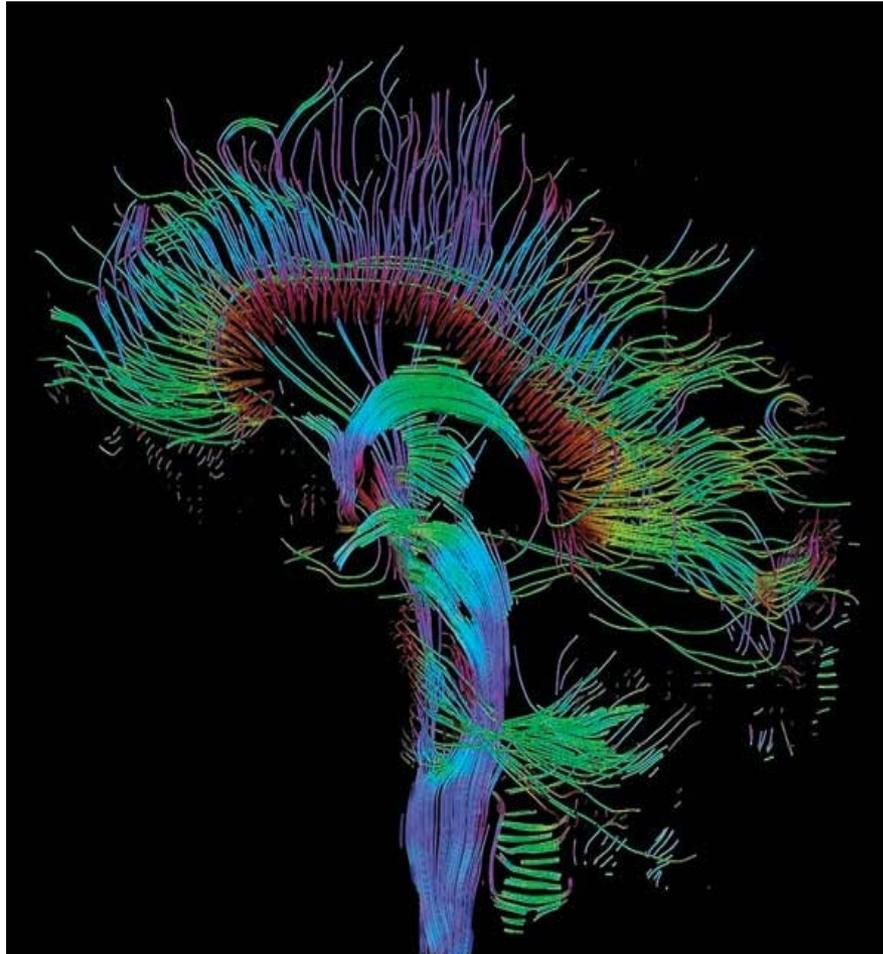


Chapter 14.3

Brain Structure

(Lab Learning Objectives)

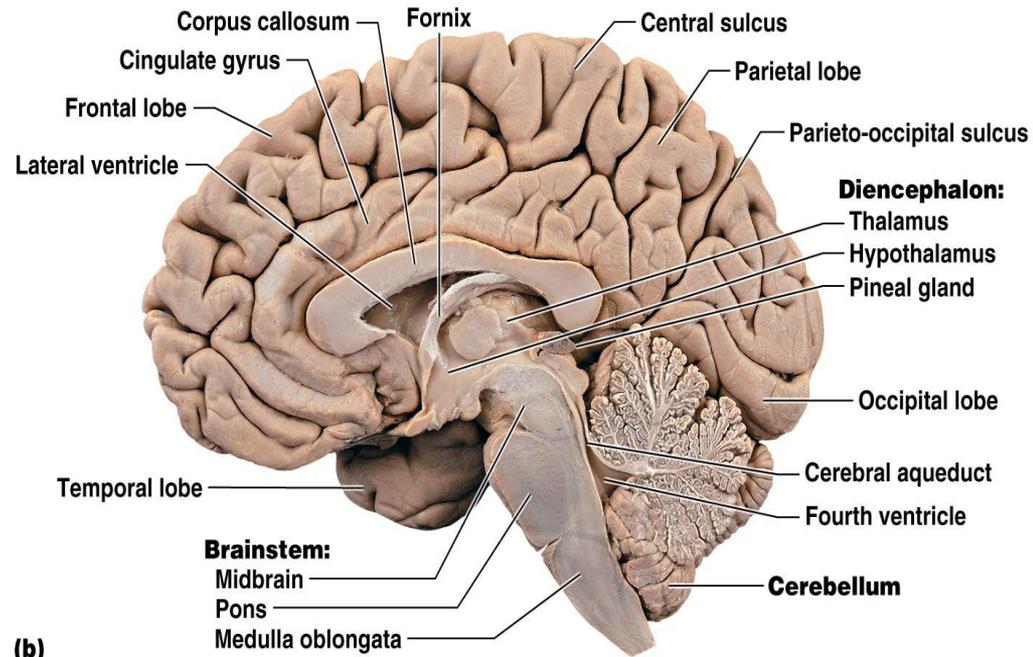


The Three Divisions of the Adult Brain

cerebrum is 83% of brain volume; cerebral hemispheres, gyri and sulci, longitudinal fissure, corpus callosum

cerebellum contains 50% of the neurons; second largest brain region, located in posterior cranial fossa

brainstem the portion of the brain that remains if the cerebrum and cerebellum are removed



Brainstem

After the cerebrum and cerebellum are removed from the brain, you are left with the brainstem and diencephalon.

Major components of the brainstem

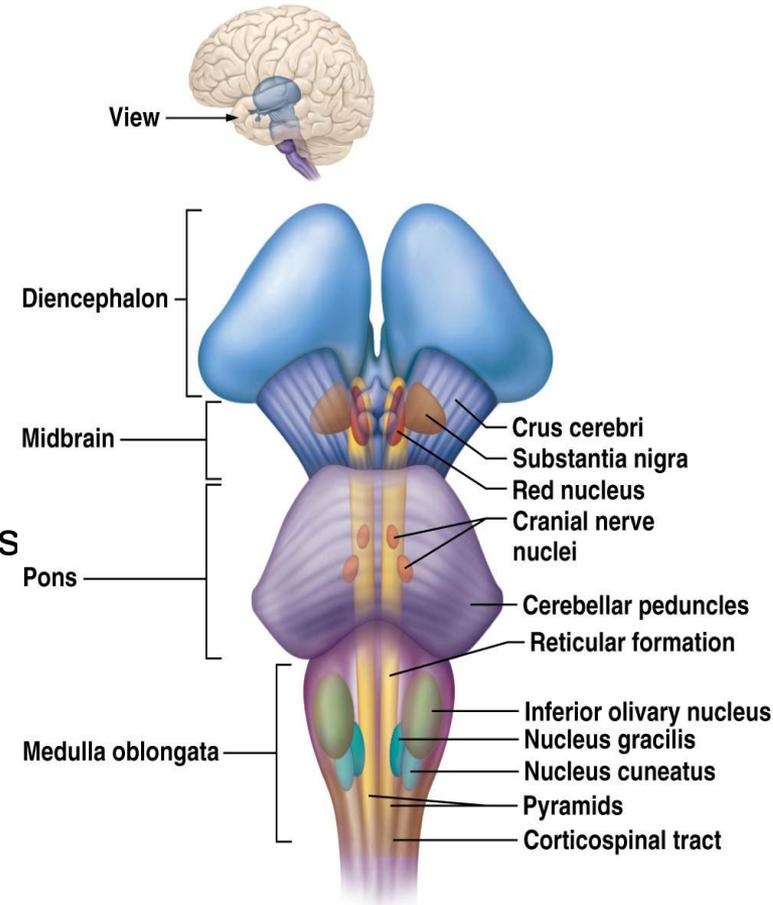
Diencephalon

- Connects brainstem to cerebrum
- Parts = thalamus, epithalamus, hypothalamus

Midbrain

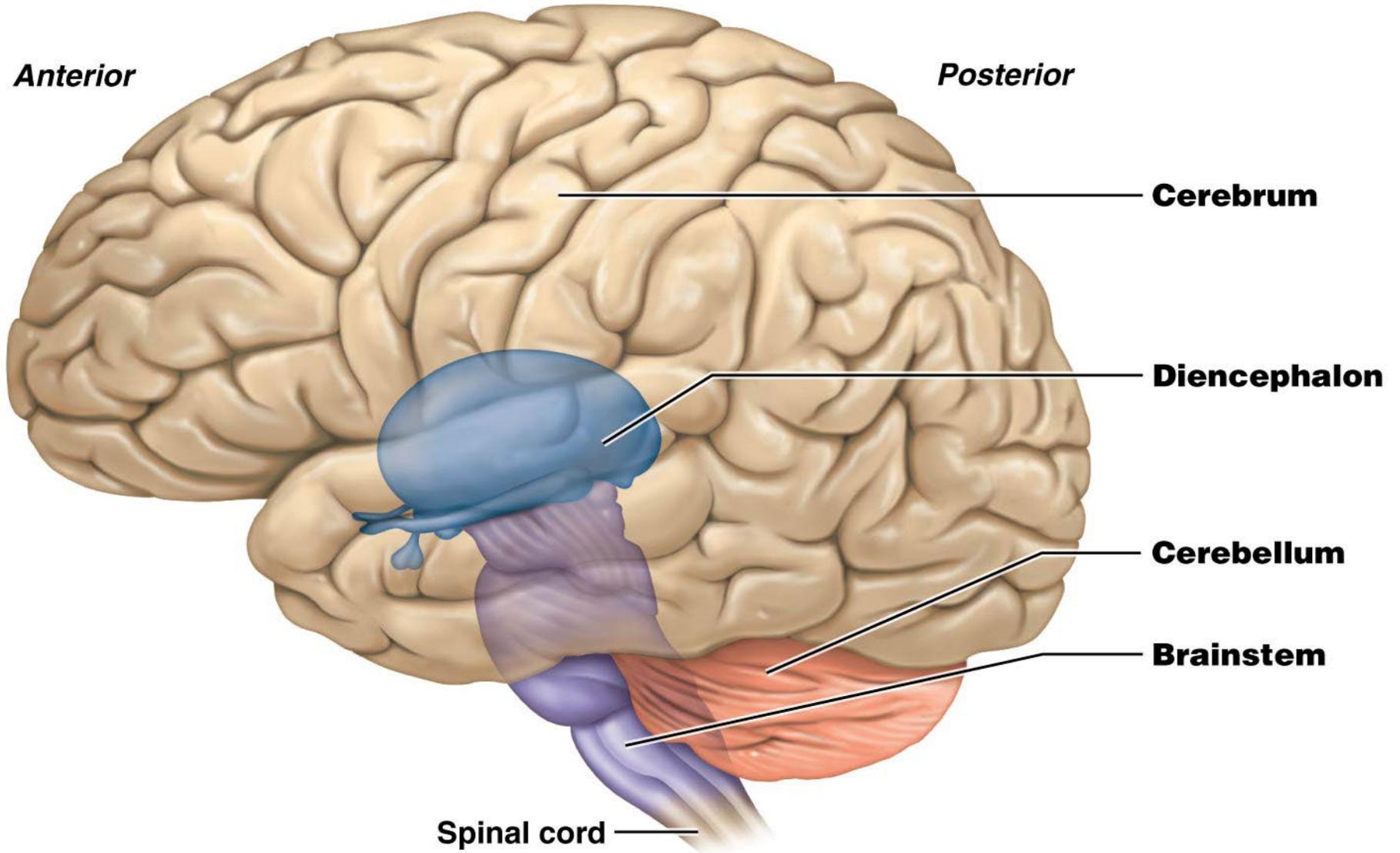
Pons

Medulla oblongata



(a) Brainstem, anterior view

Divisions of the brain (lateral view).





Diencephalon:

- Thalamus
- Lateral geniculate body
- Pineal gland
- Medial geniculate body

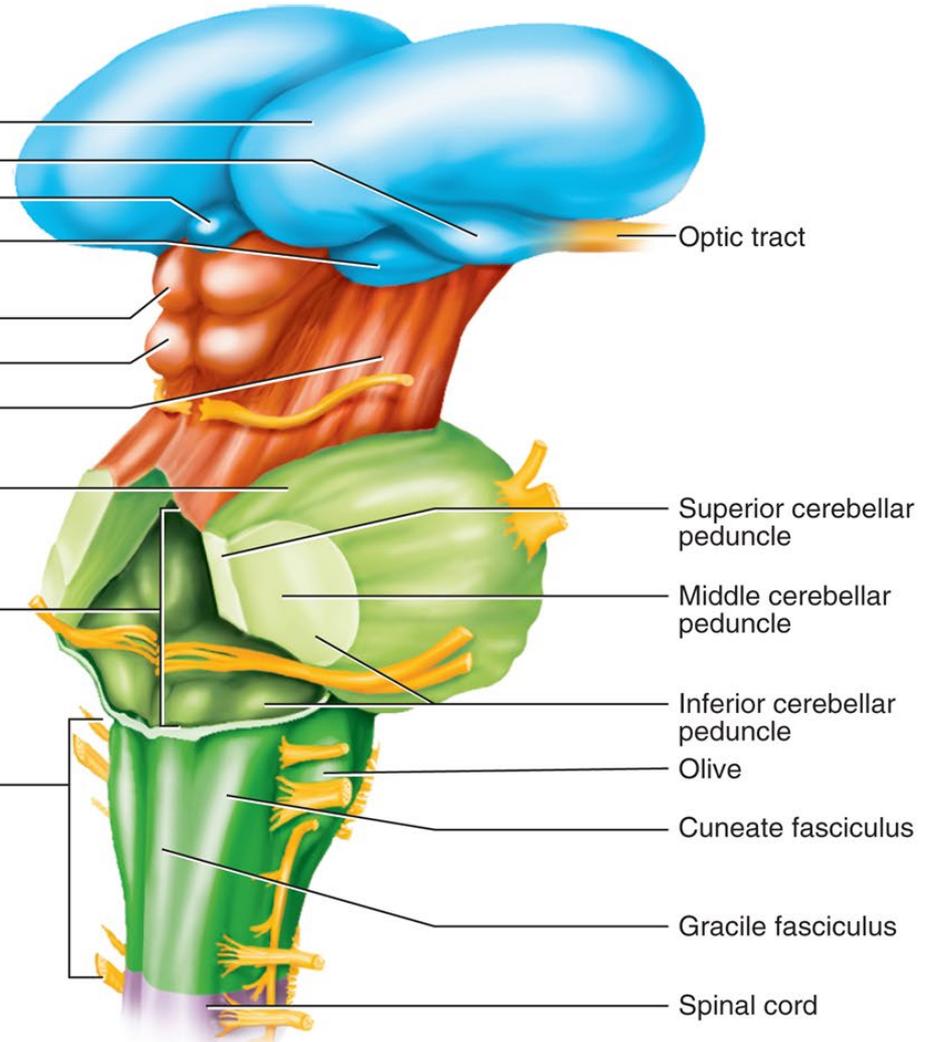
Midbrain:

- Superior colliculus
- Inferior colliculus
- Cerebral peduncle

Pons

- Fourth ventricle

Medulla oblongata



(b) Dorsolateral view

Note: Diencephalon also includes hypothalamus and epithalamus (pineal gland & habenula)

This structural arrangement is commonly used in the study of embryonic growth and brain development.

We will not use this.

Forebrain

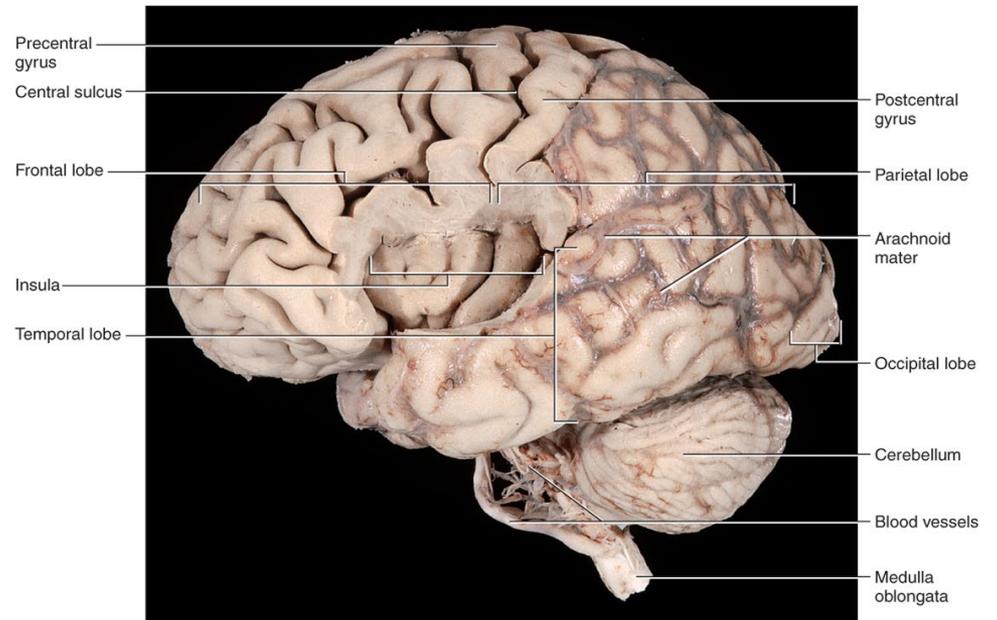
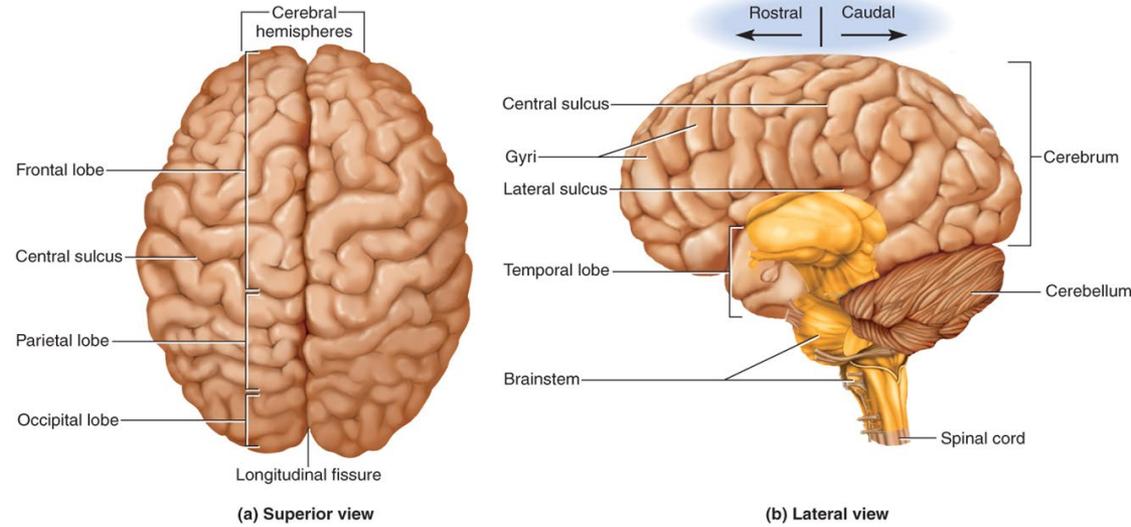
- Diencephalon
- Cerebrum

Midbrain

Hindbrain

- Brain Stem
- Pons
- Midbrain
- Cerebellum

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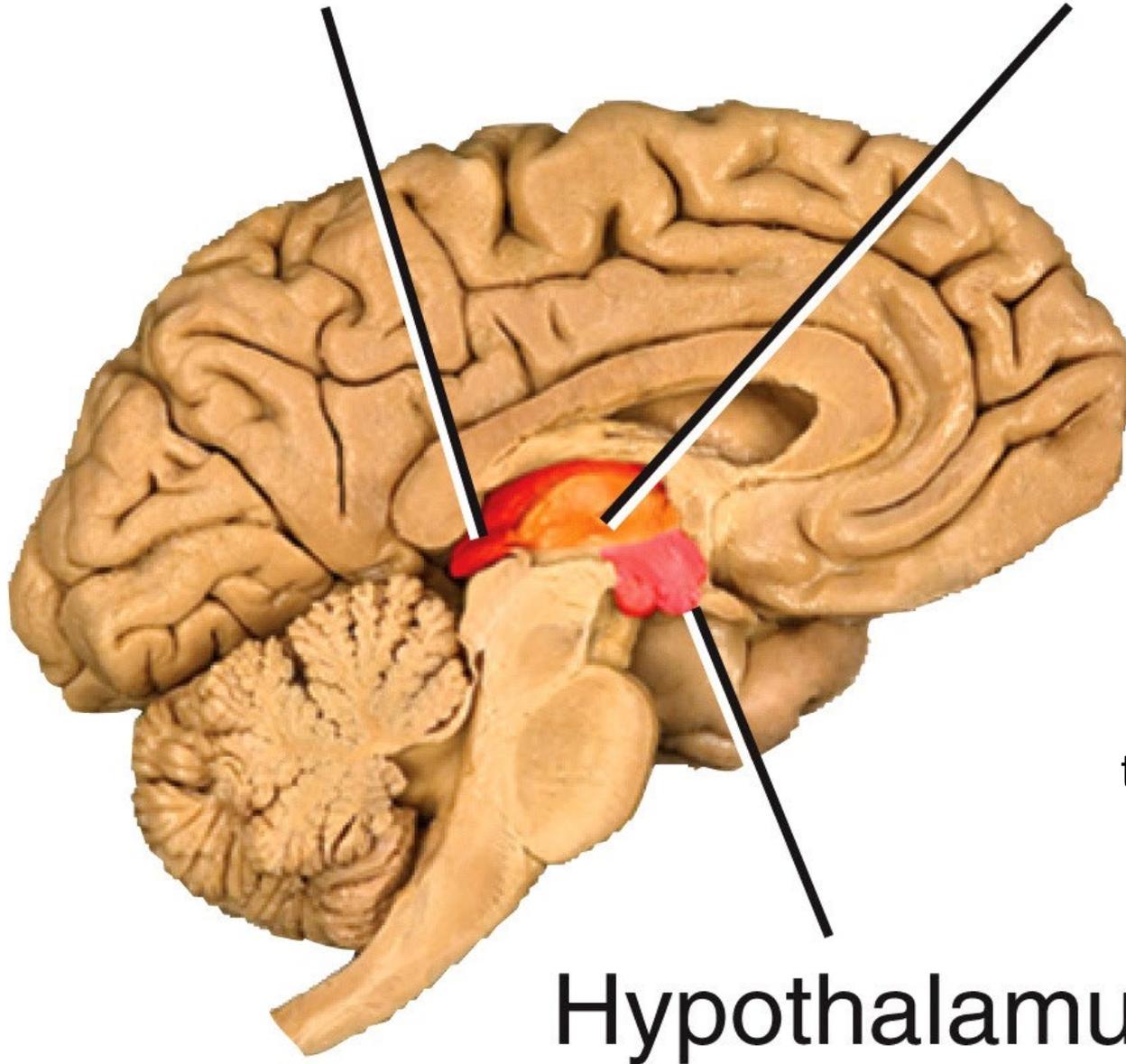


(c) Lateral view

c: © The McGraw-Hill Companies, Inc./Rebecca Gray, photographer/Don Kincaid, dissections

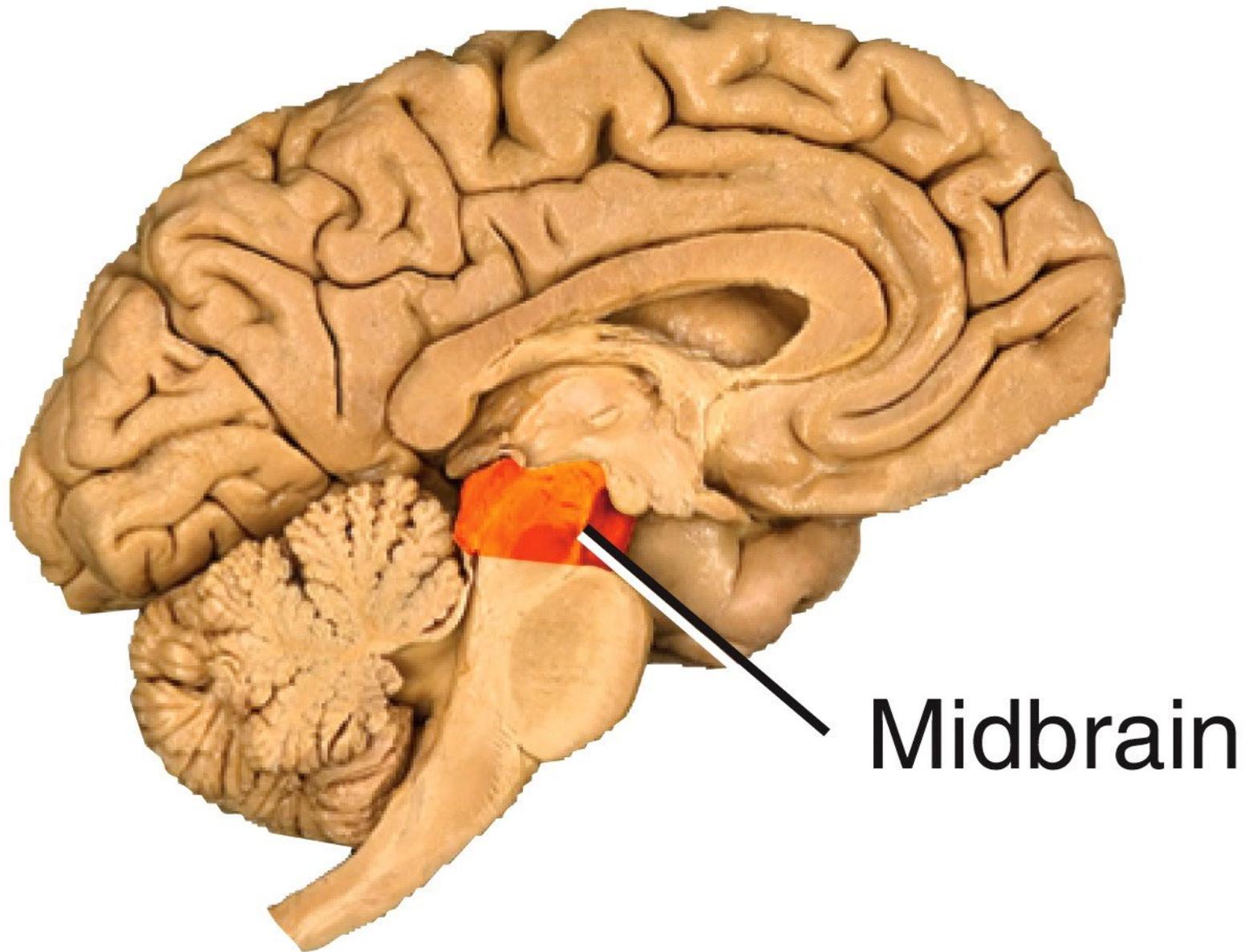
Epithalamus

Thalamus

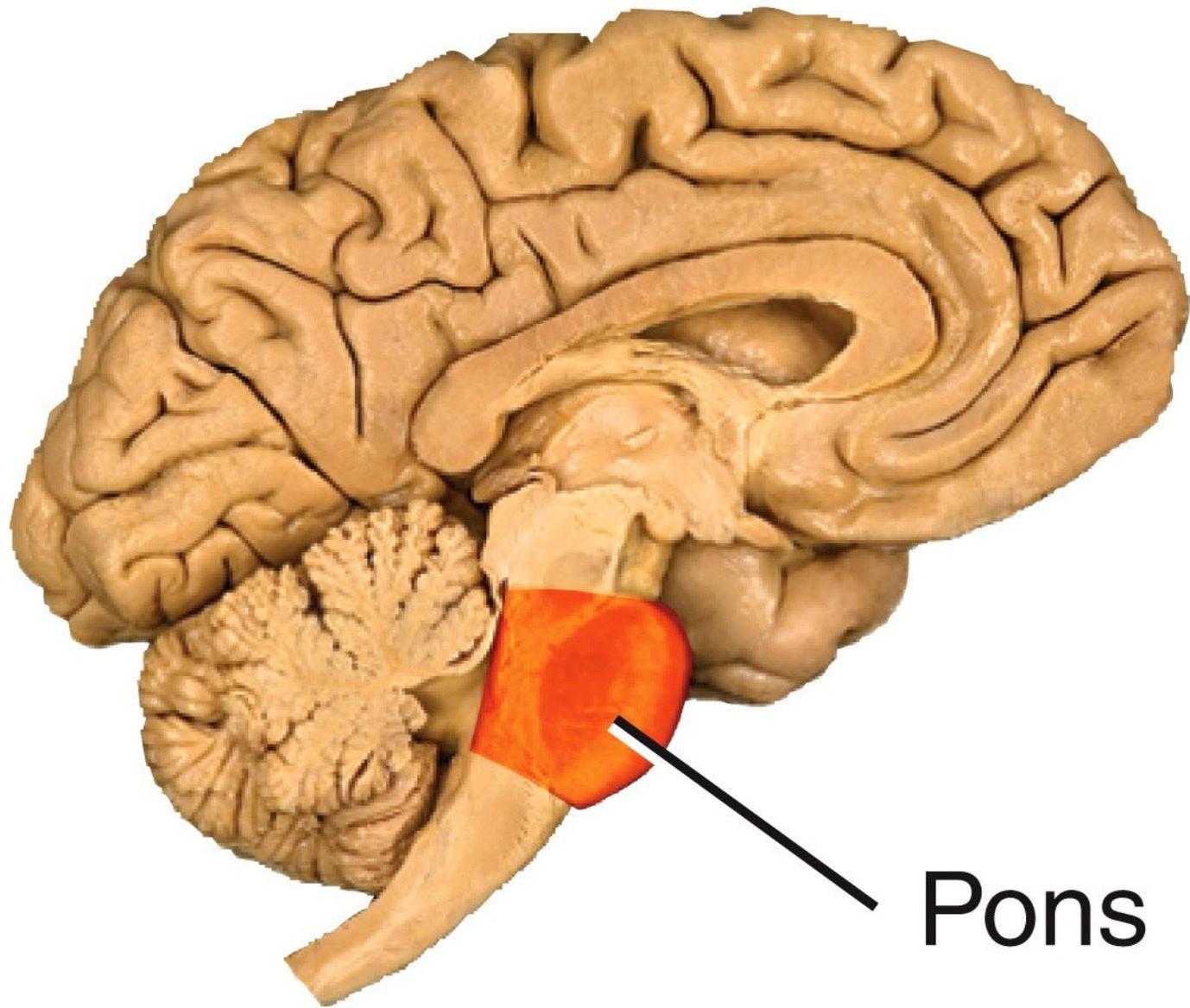


Three major
components of
the diencephalon

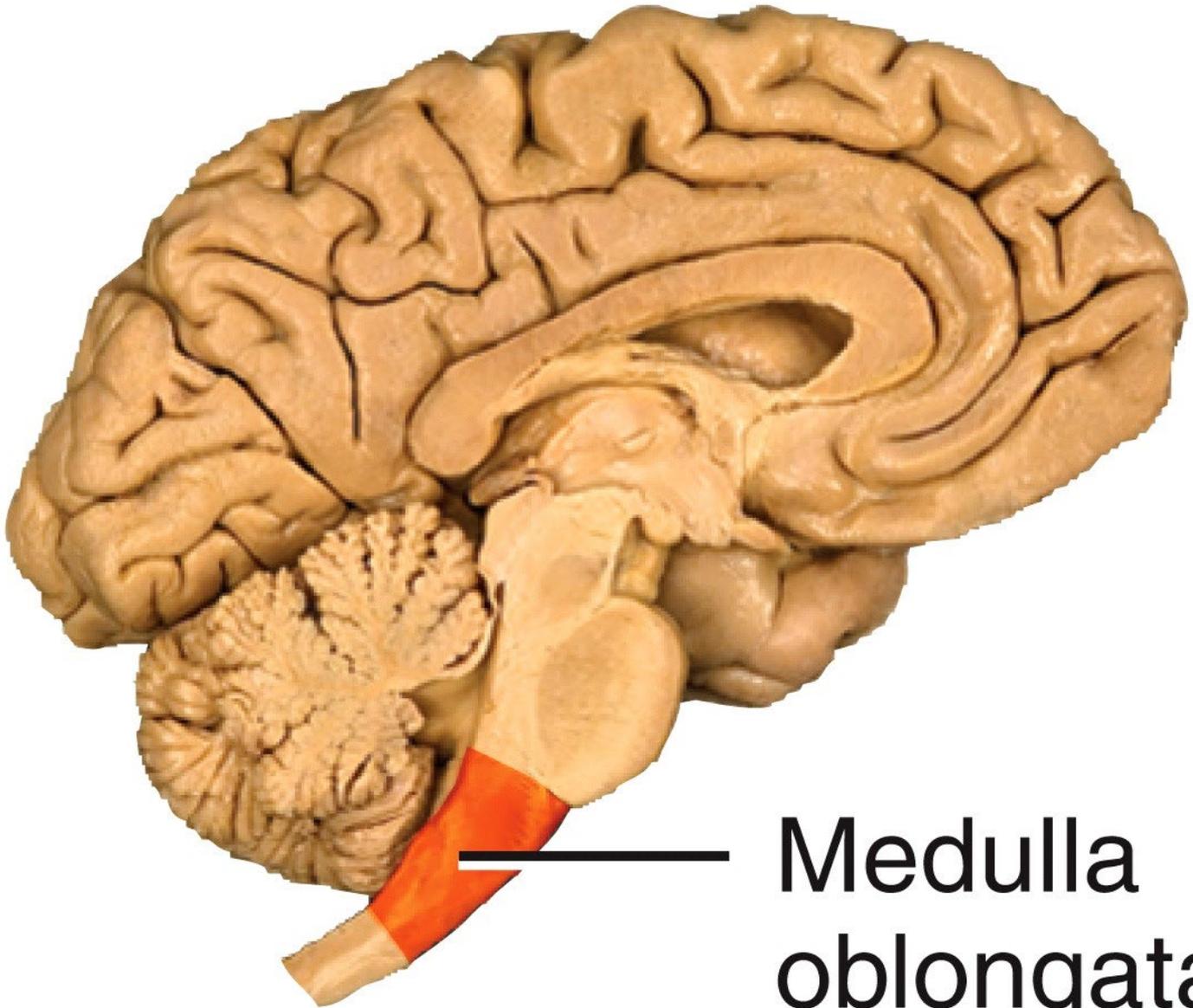
Hypothalamus



Midbrain



Pons



Medulla
oblongata

Dissection Shawn Miller, Photograph Mark Nielsen



Diencephalon:

- Thalamus
- Lateral geniculate body
- Pineal gland
- Medial geniculate body

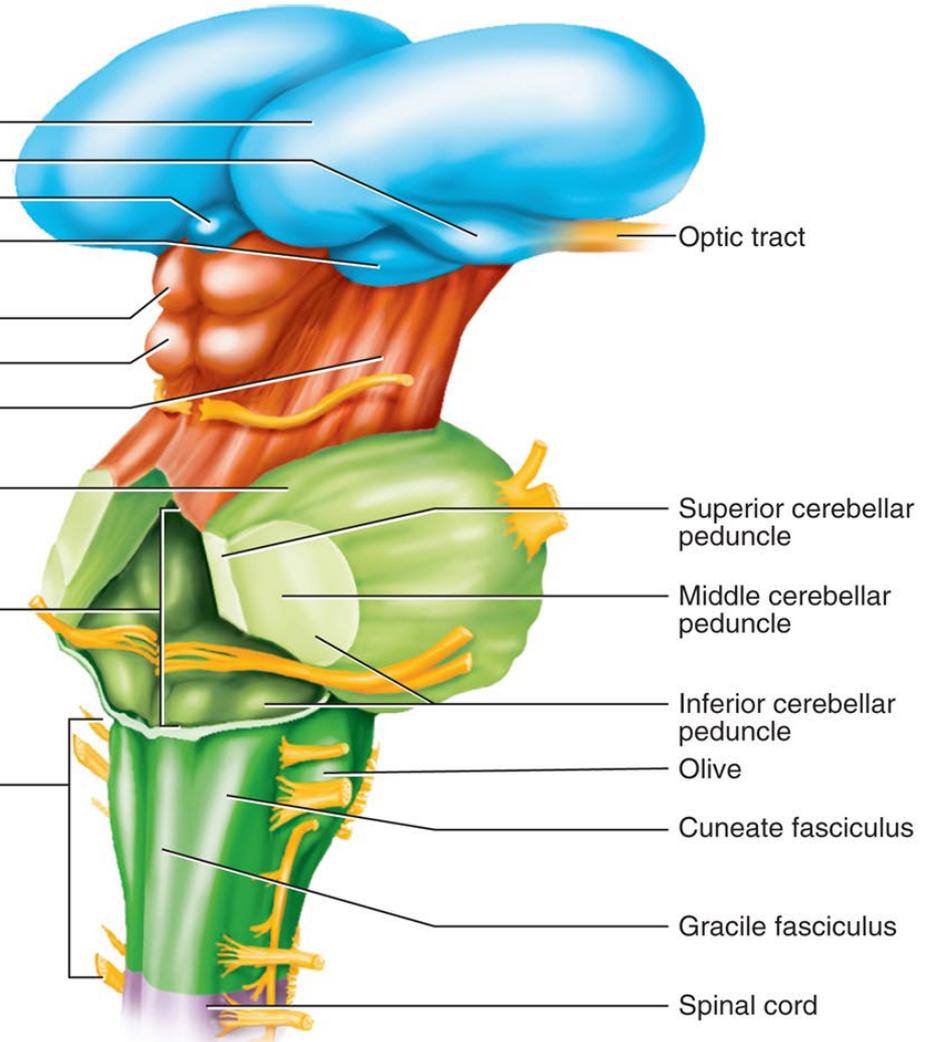
Midbrain:

- Superior colliculus
- Inferior colliculus
- Cerebral peduncle

Pons

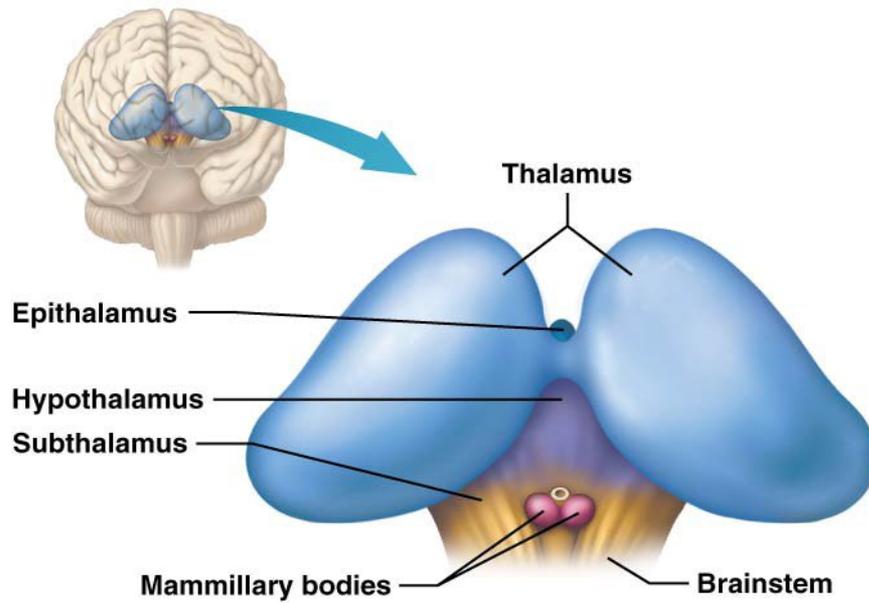
Fourth ventricle

Medulla oblongata

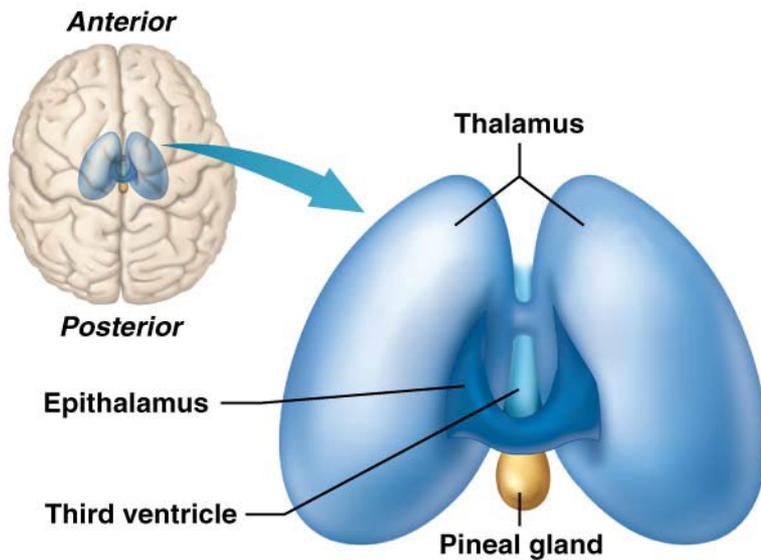


(b) Dorsolateral view

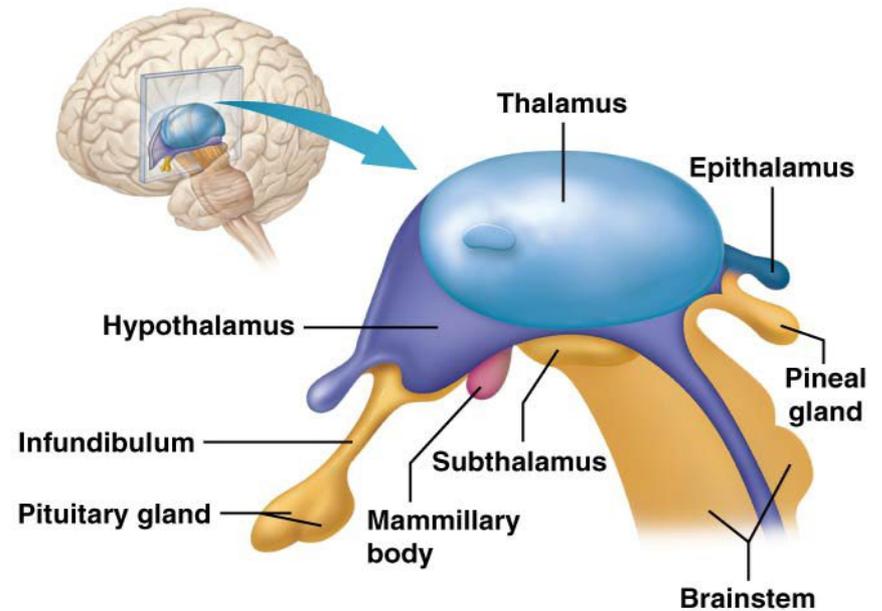
Note: Diencephalon also includes hypothalamus and epithalamus (pineal gland & habenula)



(a) Diencephalon, anterior view

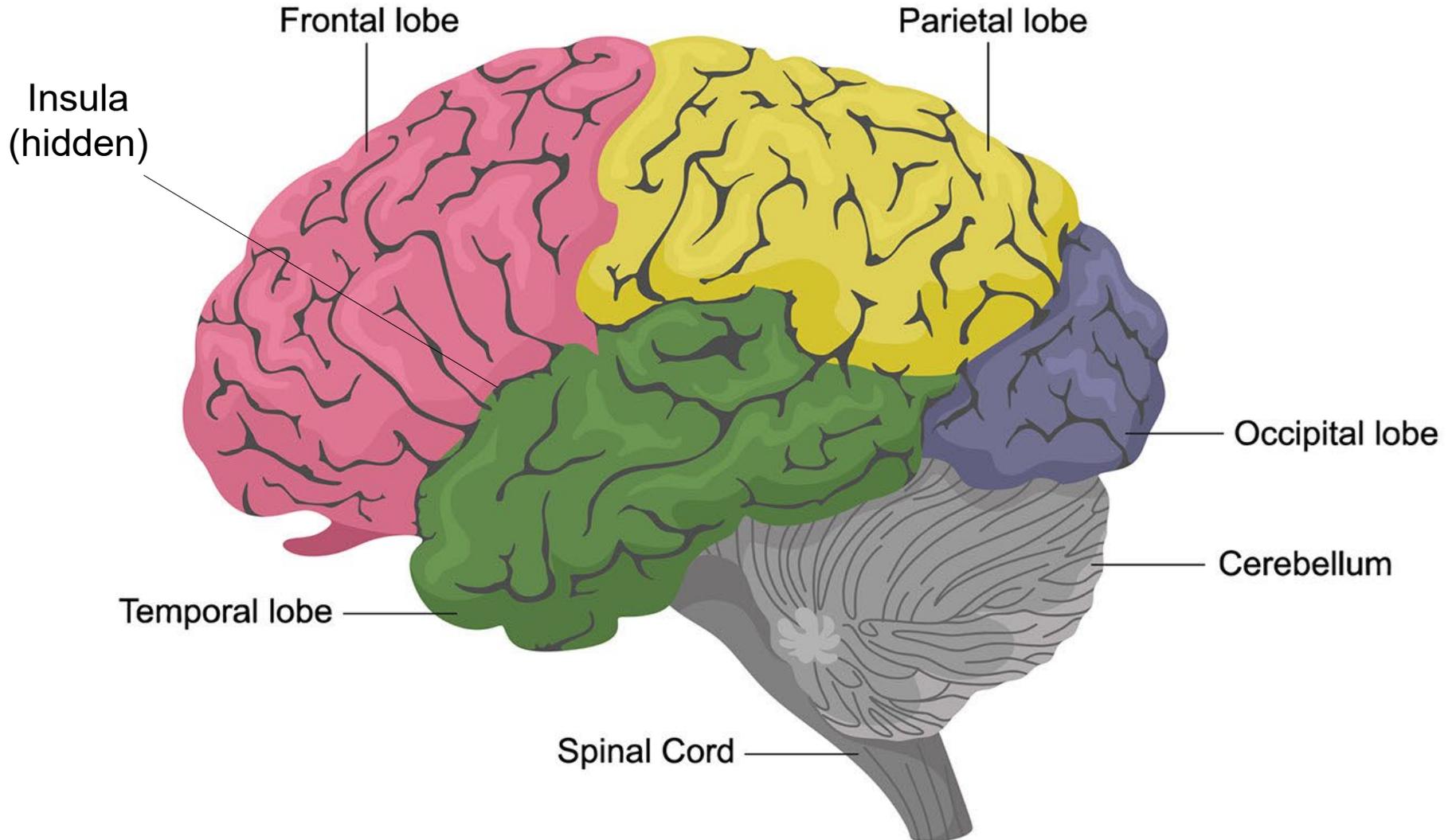


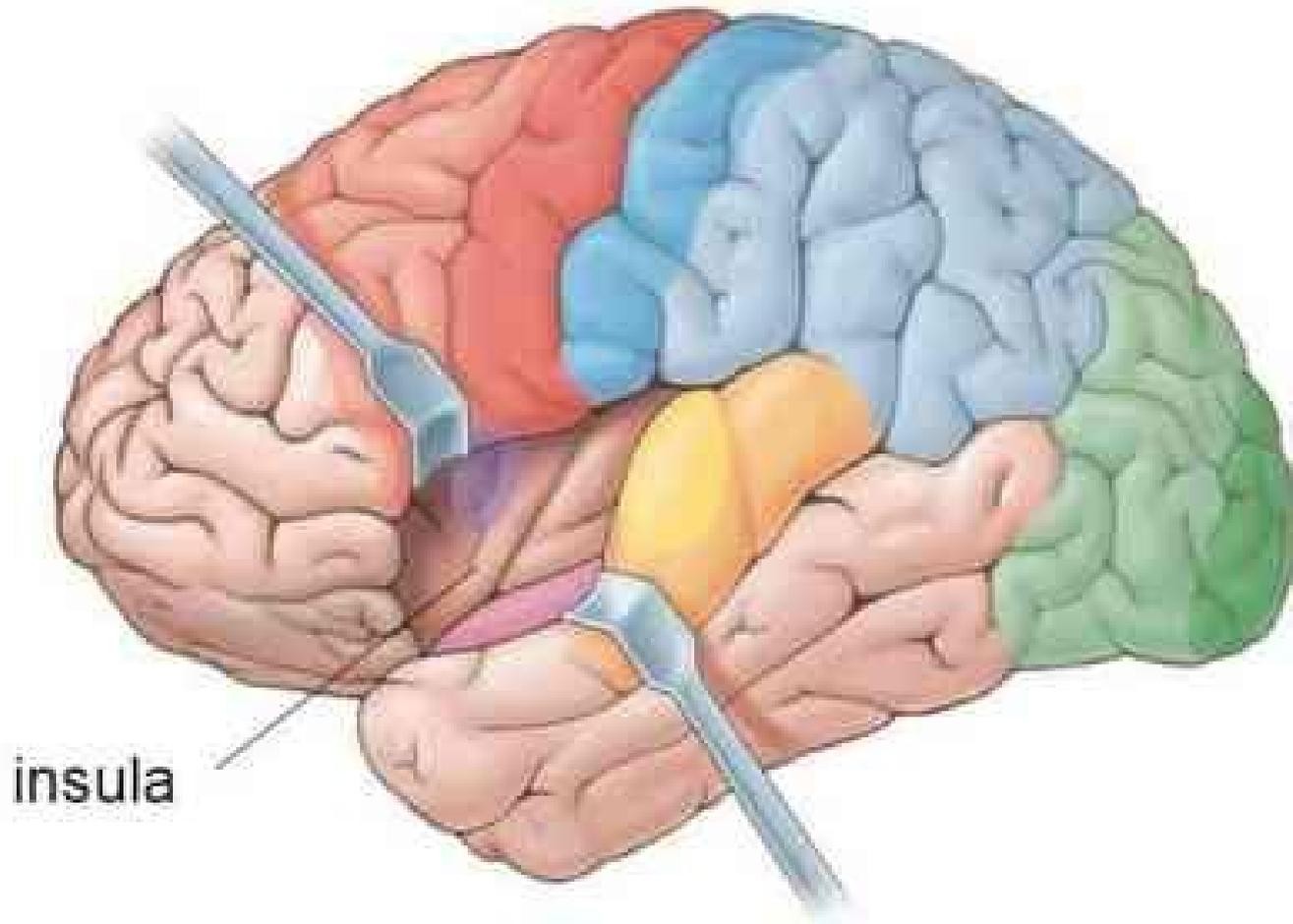
(b) Diencephalon, superior view



(c) Diencephalon, midsagittal section

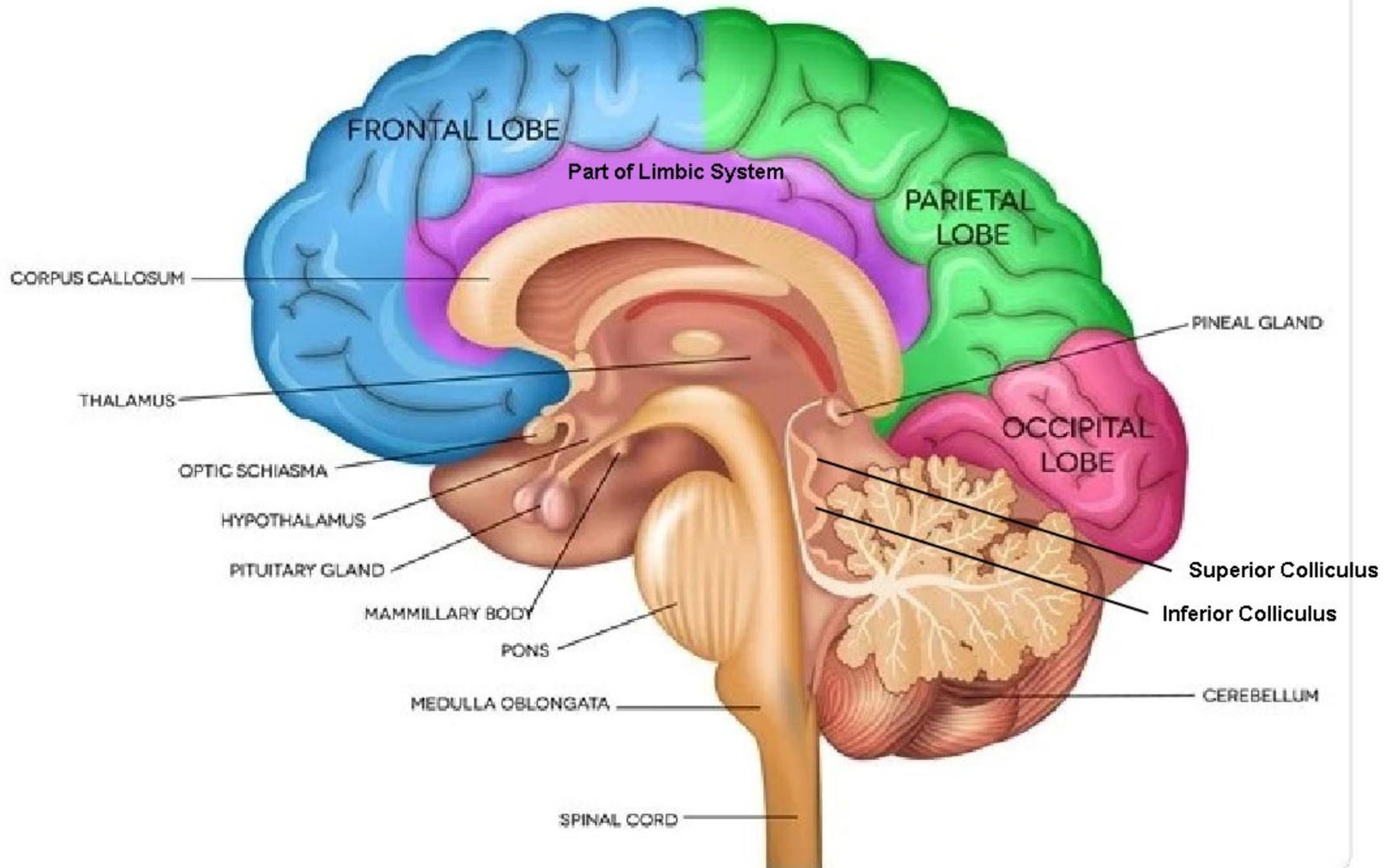
Cerebrum (Five Lobes)



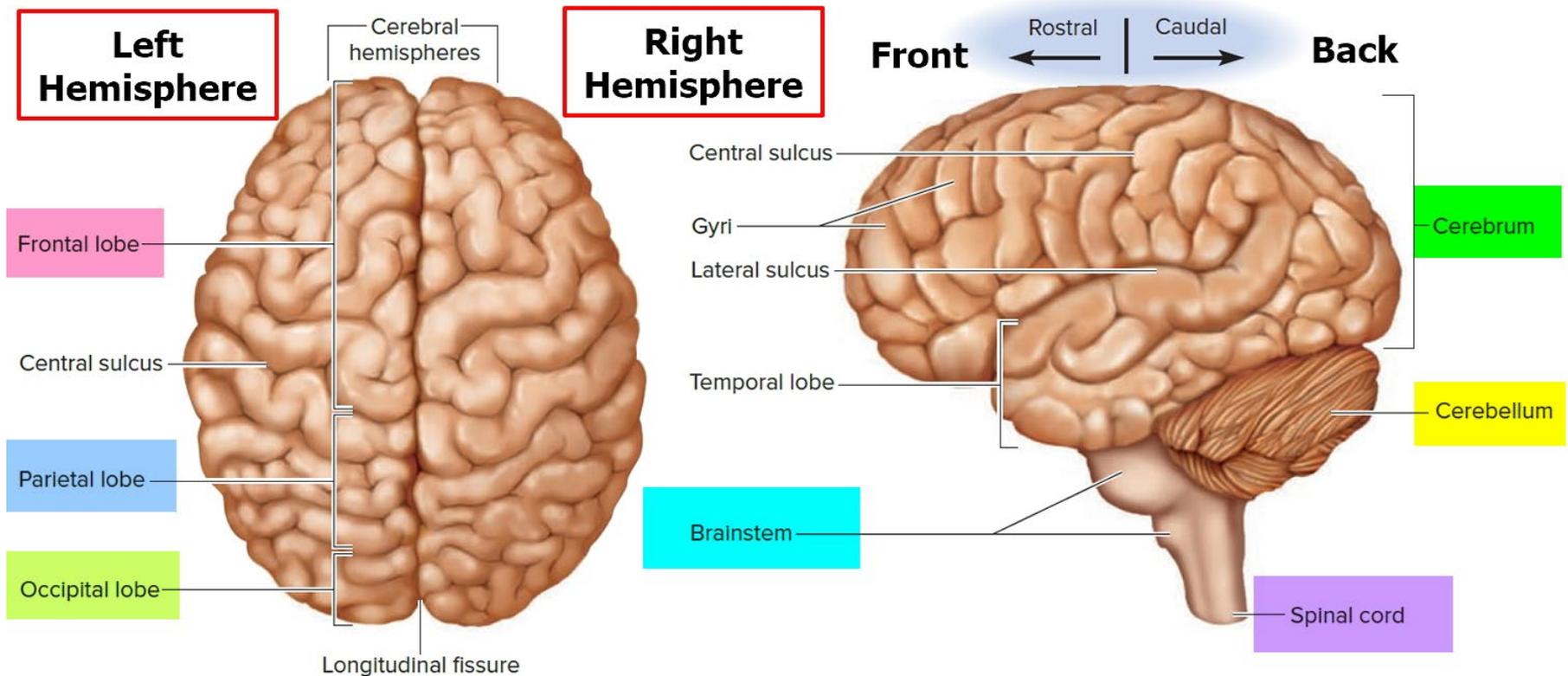


insula

ANATOMY OF THE BRAIN



Cerebrum's Structures



adult human brain weighs // 1600 g (3.5 lb) in men and 1450 g in women

Cerebrum Structures

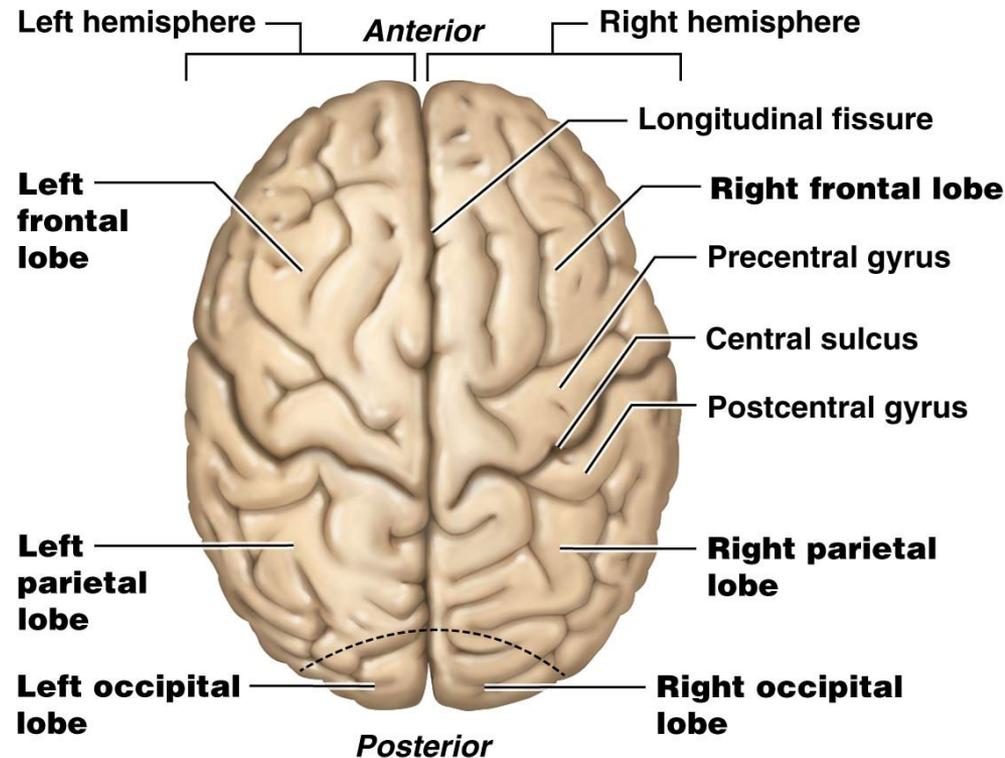


Longitudinal fissure – deep groove that separates cerebral hemispheres

Central sulcus – shallow groove // separates motor and sensory functions

Gyri - thick folds

Sulci - shallow grooves



(b) Superior view

Gyrus singular (plural: gyri)

Sulcus singular (plural: sulci)

The Gross Anatomy of the Cerebrum

Consist of two **cerebral hemispheres** // divided by **longitudinal fissure**

–hemispheres connected by white fibrous tract the **corpus callosum**

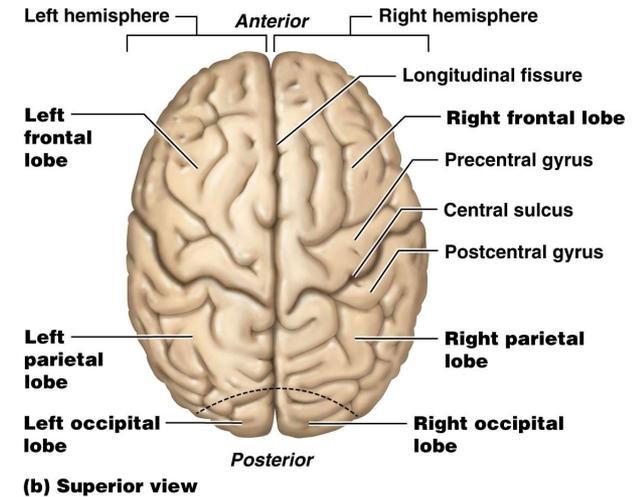
–**gyri and sulci** – increases amount of cortex in the cranial cavity

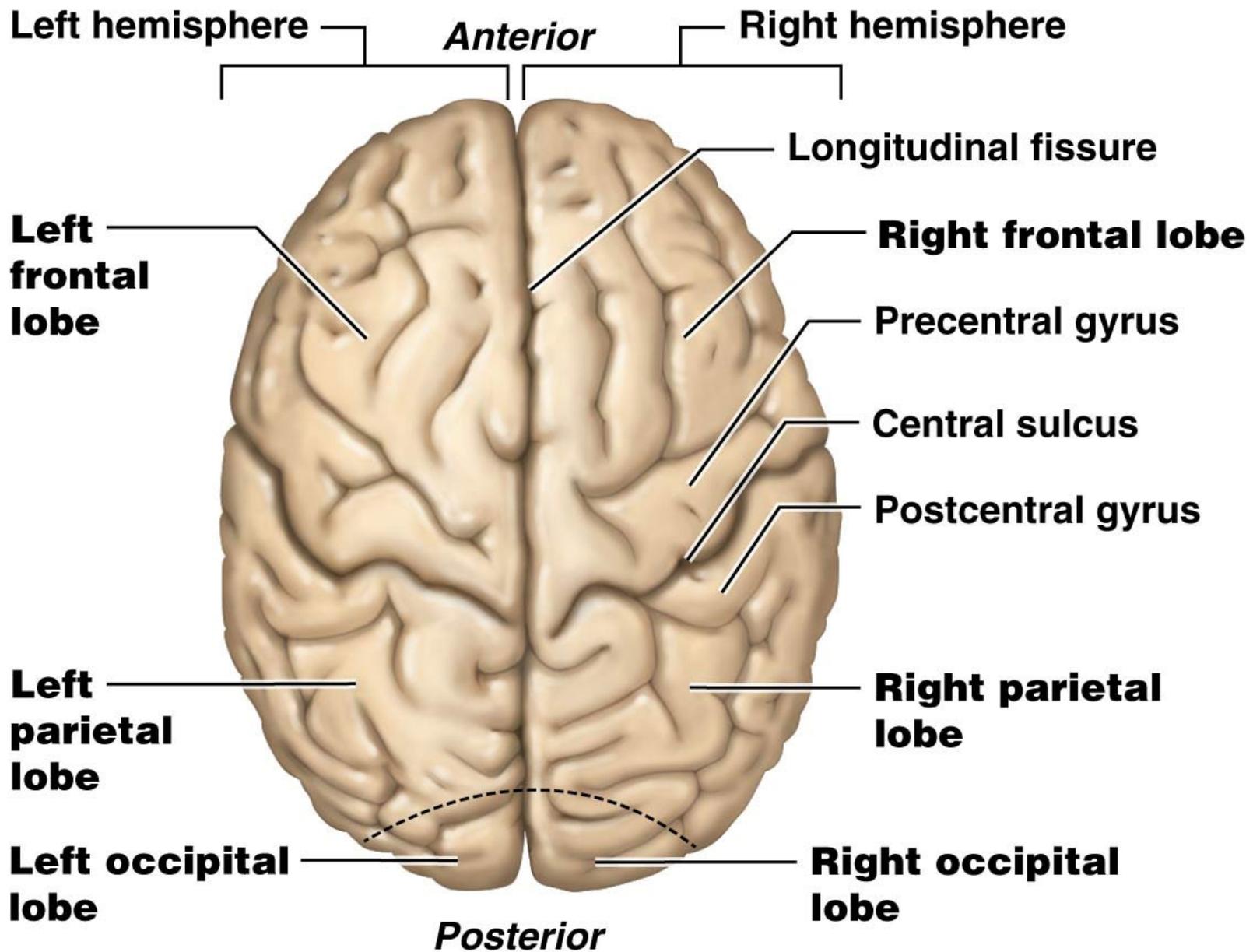
–gyri increases surface area for information processing capability

–sulci divide each hemisphere into five lobes named for the cranial bones that overlie them

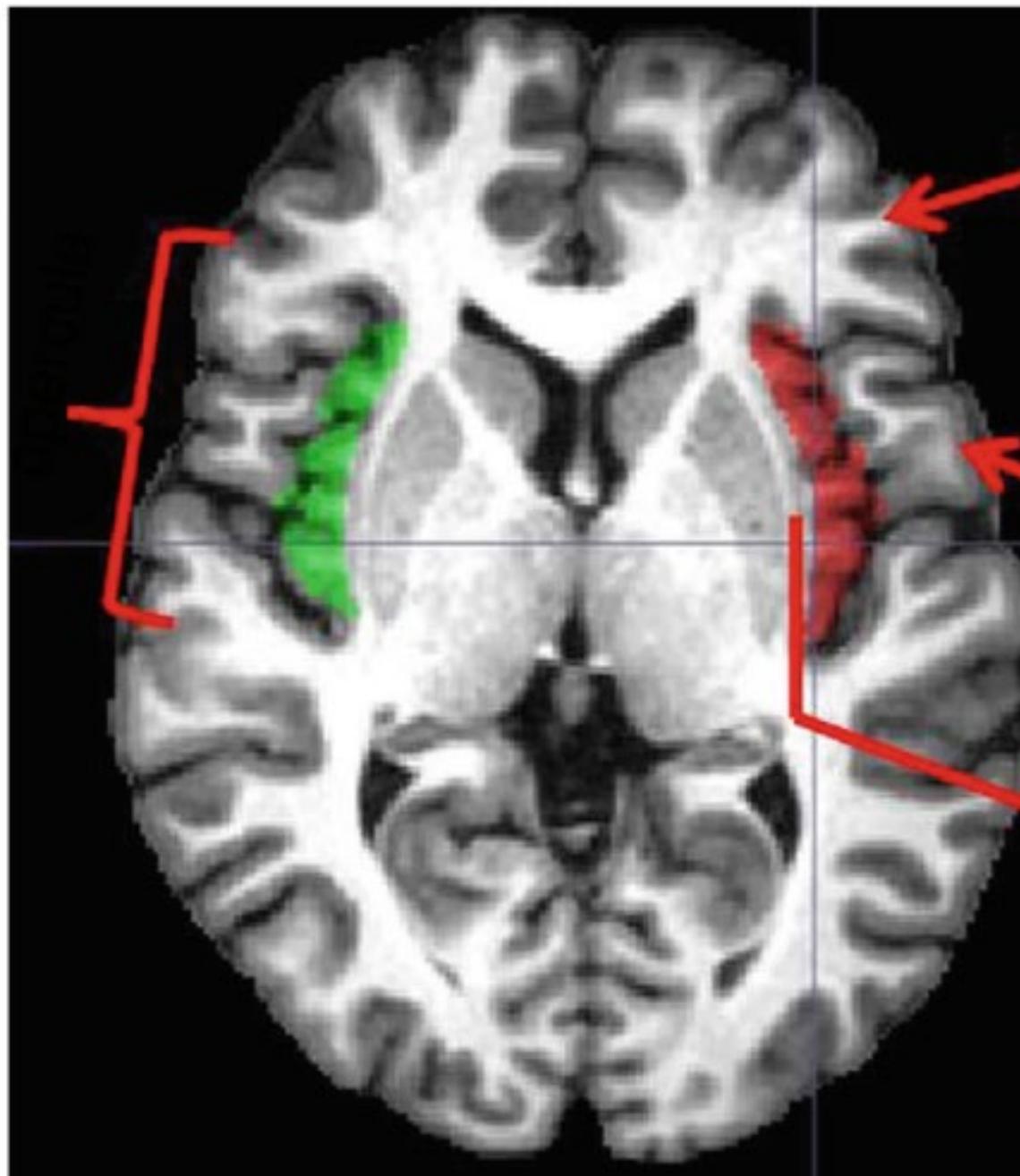
–**cerebral cortex** = tissue directly beneath pia matter / **4 mm**

–each hemisphere if flattened would be the size of a **13” pizza**





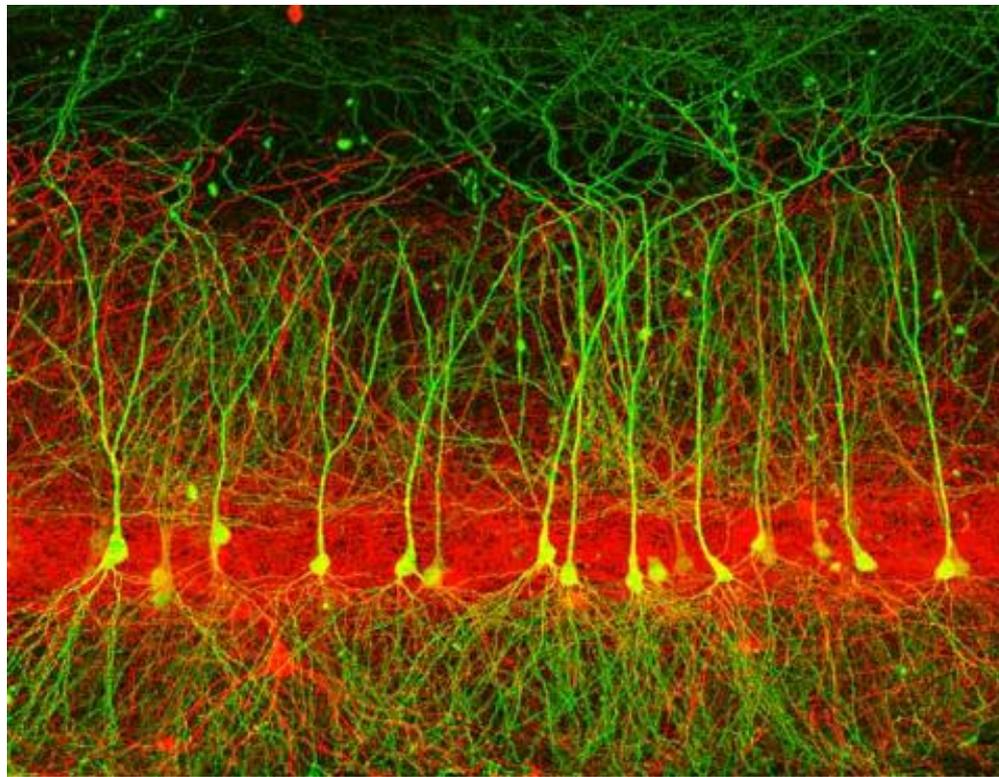
(b) Superior view



Frontal lobe

Temporal lobe

Claustrum



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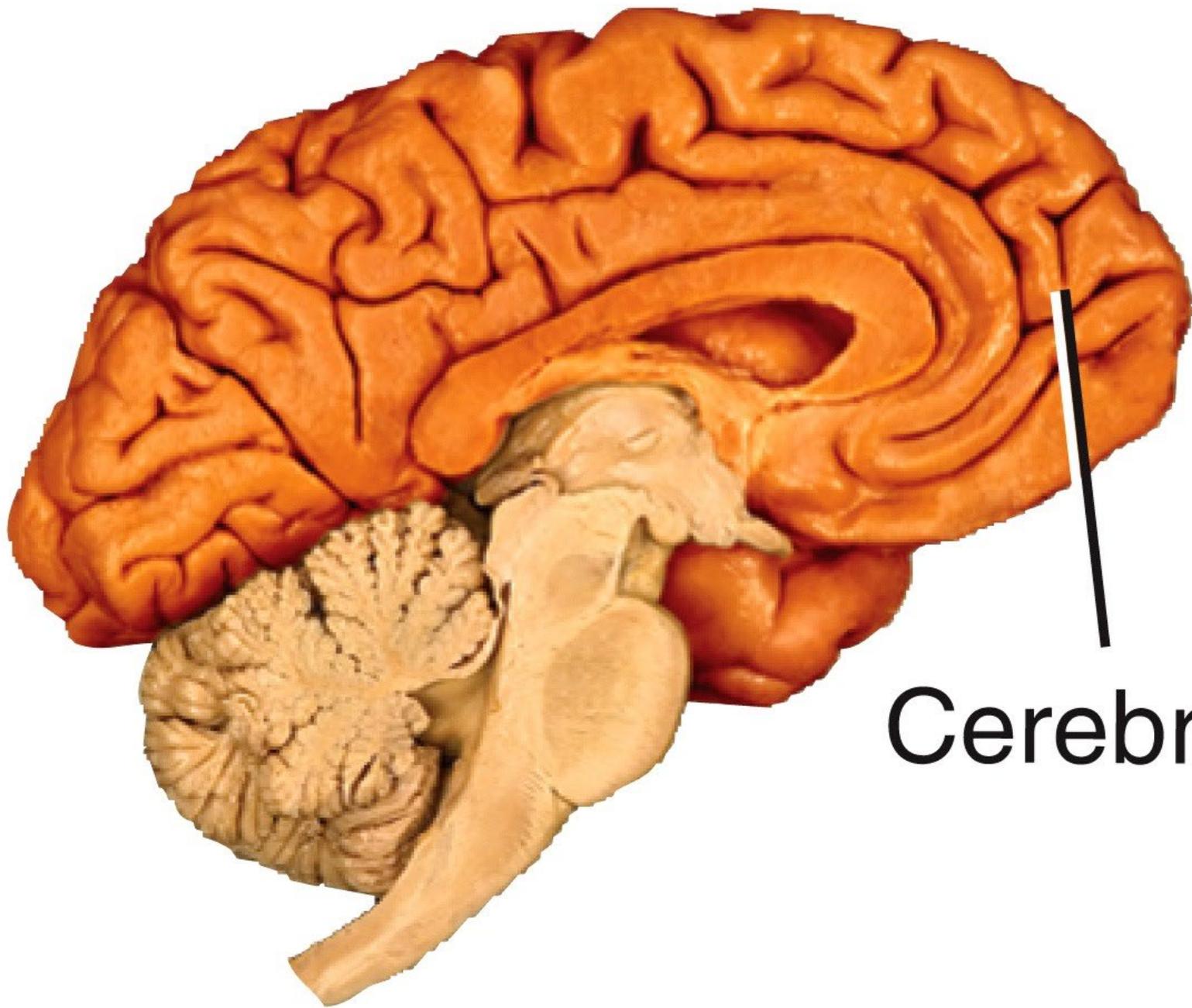
The key to understanding how our brains work lies in determining how each nerve cell or neuron continuously integrates the information it receives from other neurons via connections called synapses. For example, each pyramidal neuron (colored green) can receive tens of thousands of synapses from neurons belonging to several different brain regions. Interneurons (colored red) form local connections onto pyramidal neurons to form specific microcircuits. By using a combination of approaches including electrophysiology, microscopy, molecular biology and computer modeling, scientists are able to approach the complex puzzle of understanding how the 100 billion neurons in our brains make us who we are.

Technical Details:

The image was produced using array tomography. This technique involves collecting thousands of ultrathin serial sections of brain tissue that was fixed and stained, imaging them with a fluorescent microscope, and aligning all of them into a 3D reconstruction using a computer. The resulting image enables the detailed patterns of connectivity to be mapped between fluorescently-labeled neurons.

Credit:

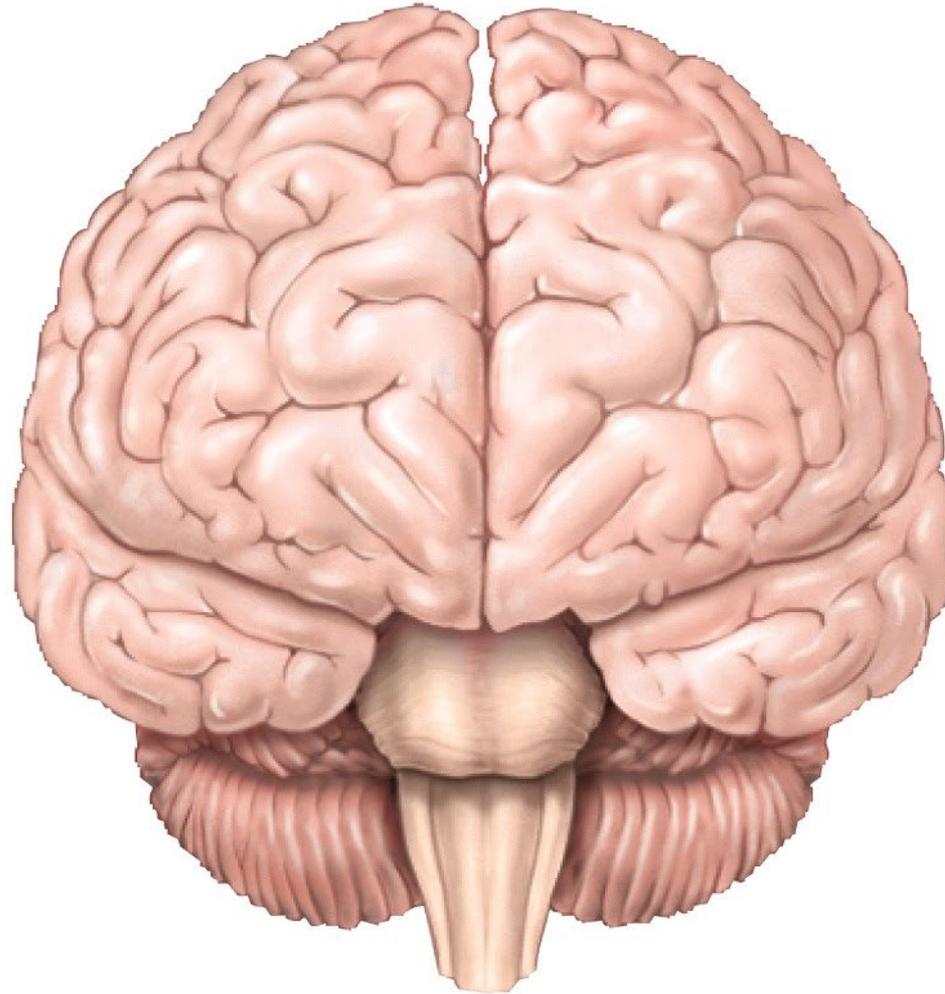
Erik Bloss, PhD and Nelson Spruston, PhD., HHMI, Janelia Research Campus



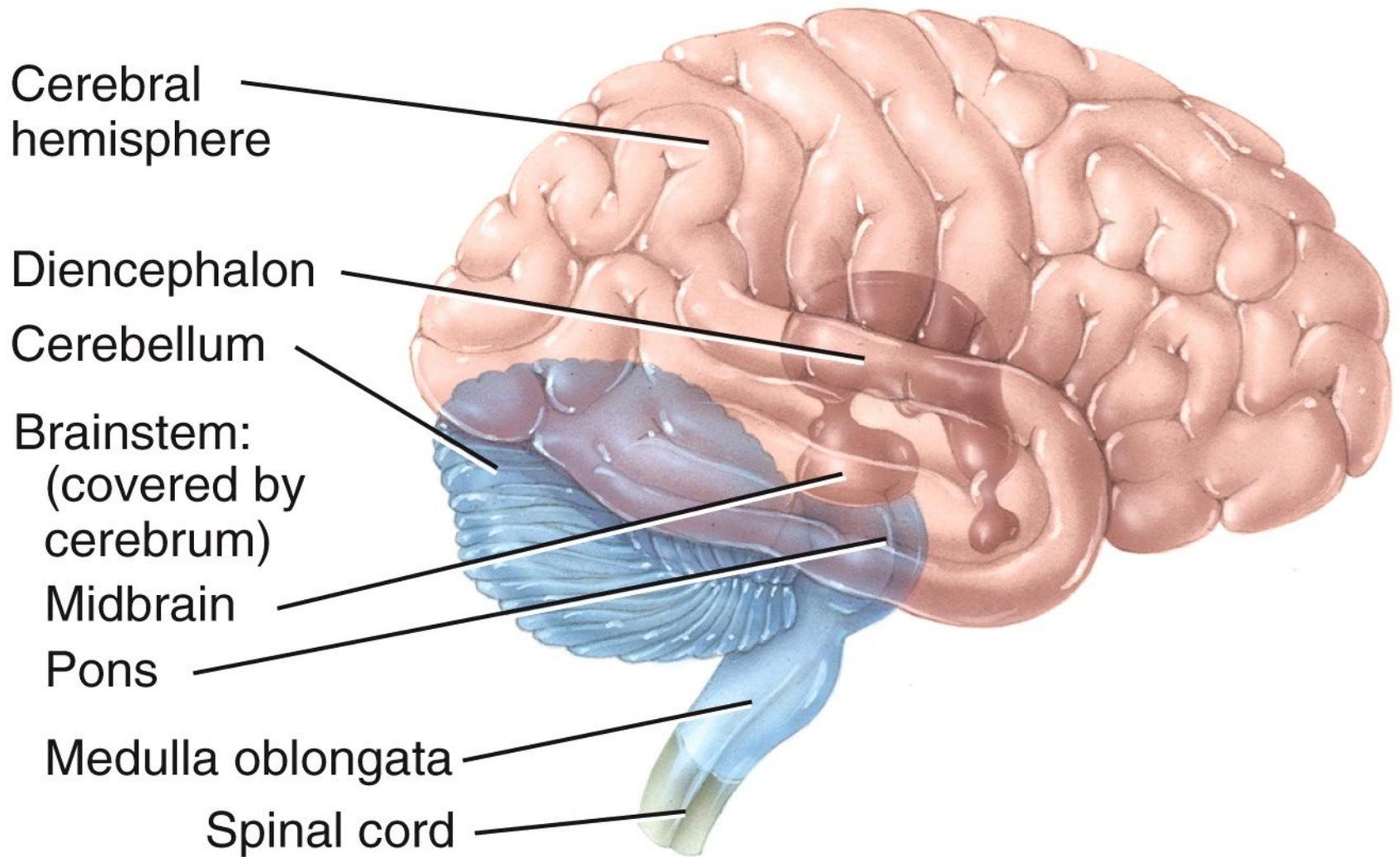
Cerebrum

Right hemisphere

Left hemisphere



Anterior view



Gray and White Matter

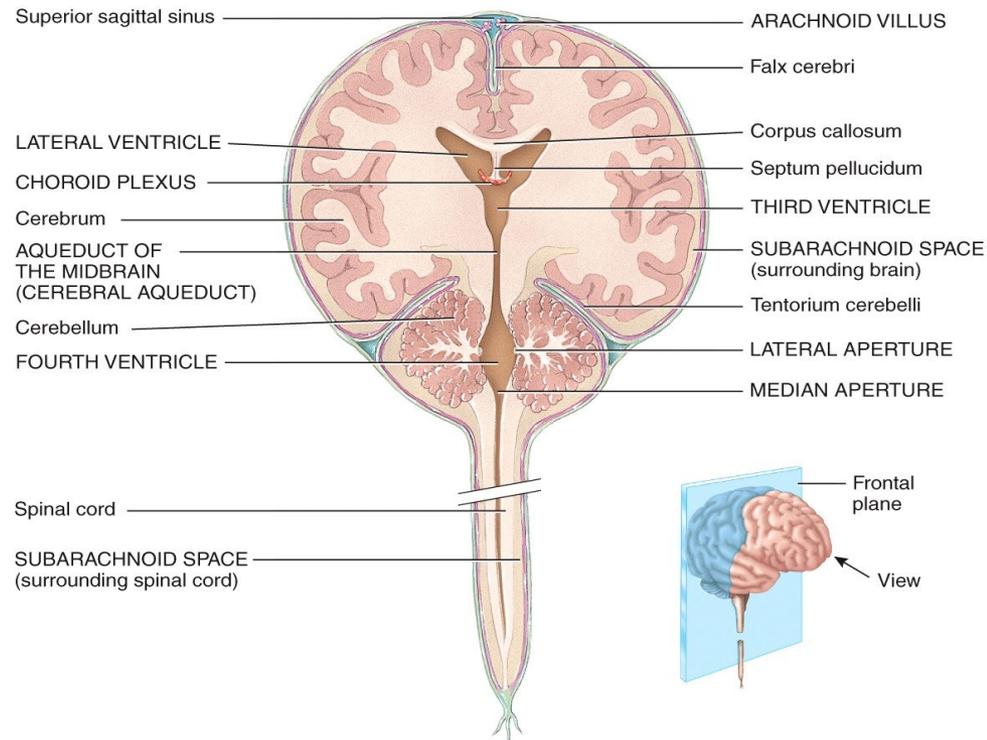
Gray matter – consists of the neuron's cell bodies, dendrites, and synaptic knobs

Dull grey-white color when fresh /// due to little myelin on the surface of the cell bodies, dendrites and synaptic knobs

Grey matter forms surface layer of cerebrum - **"the cortex" is about 4mm thick**

Cerebral cortex covers the entire superficial surface of the cerebrum (similar cortex associated with cerebellum)

Clusters of soma also form **nuclei** deep within brain (i.e. grey islands // control specific function like heart rate, sneezing, etc.)



(c) Frontal section of brain and spinal cord

Gray and White Matter

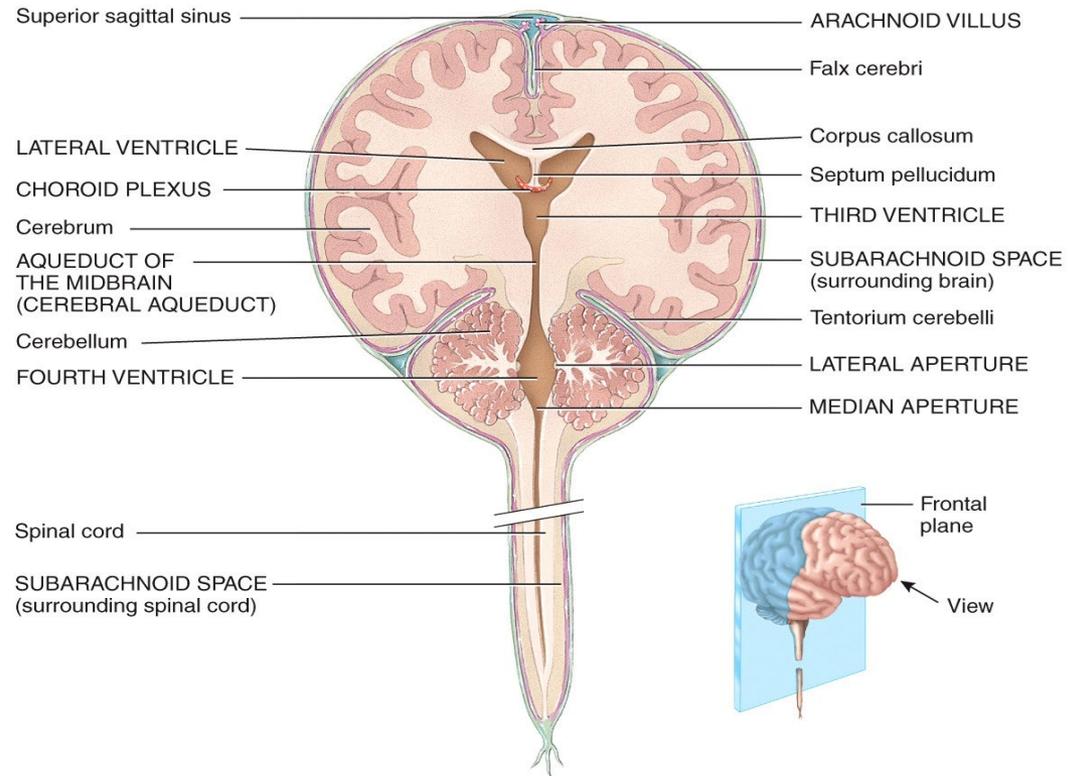
White matter = bundles of myelinated axons

Lies deep to cortical gray matter, opposite relationship in the spinal cord

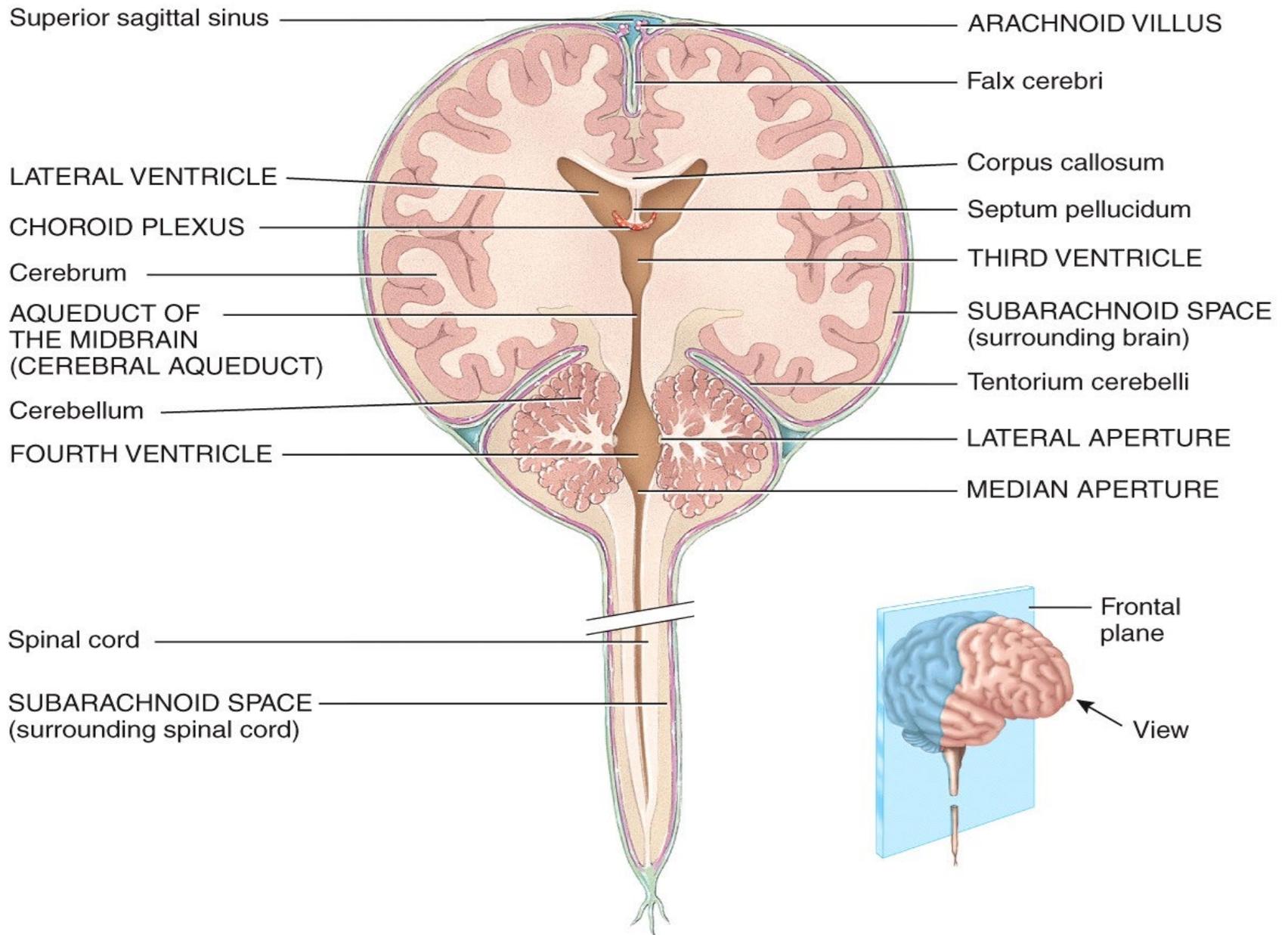
Pearly white color from myelin around nerve fibers

This myelin arranged as tracts = bundles of axons

Within cerebrum connect one part of the brain to another, and to the spinal cord



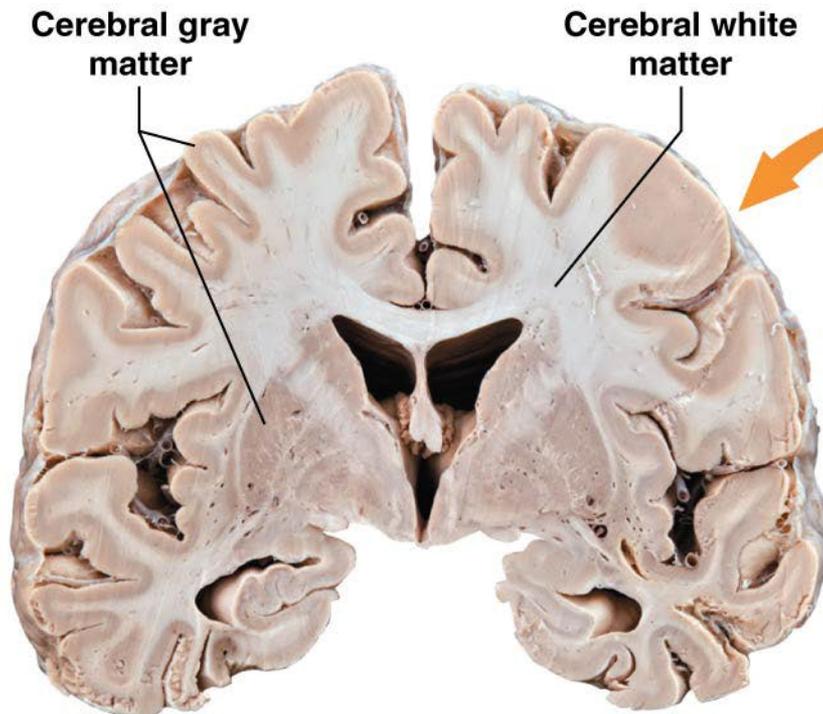
(c) Frontal section of brain and spinal cord



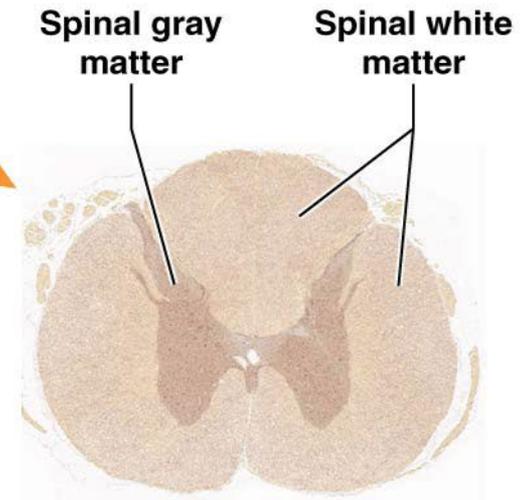
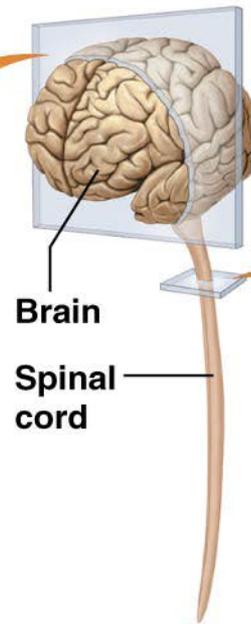
(c) Frontal section of brain and spinal cord



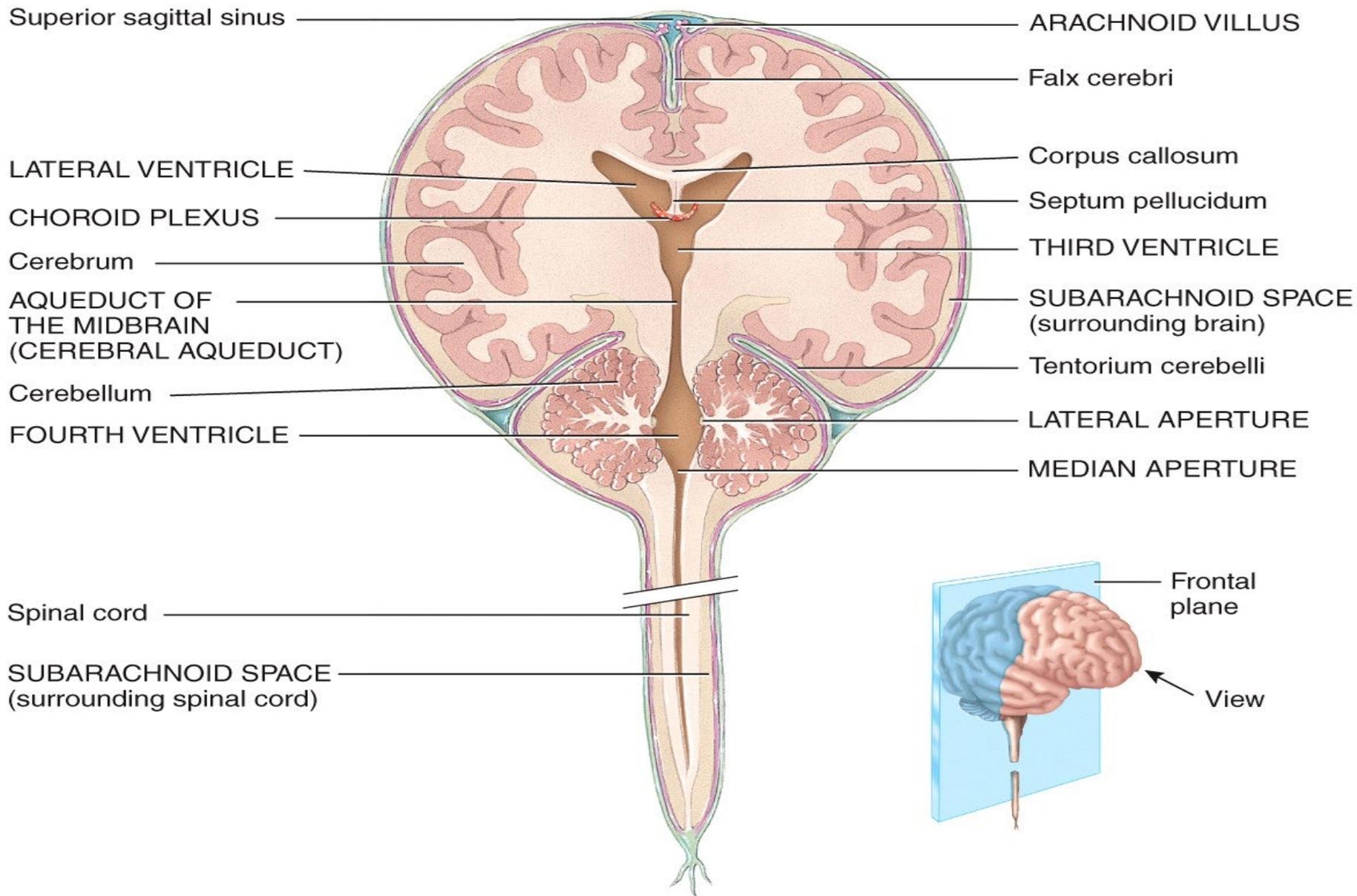
How white and gray matter in the CNS is organized in the brain and spinal cord.



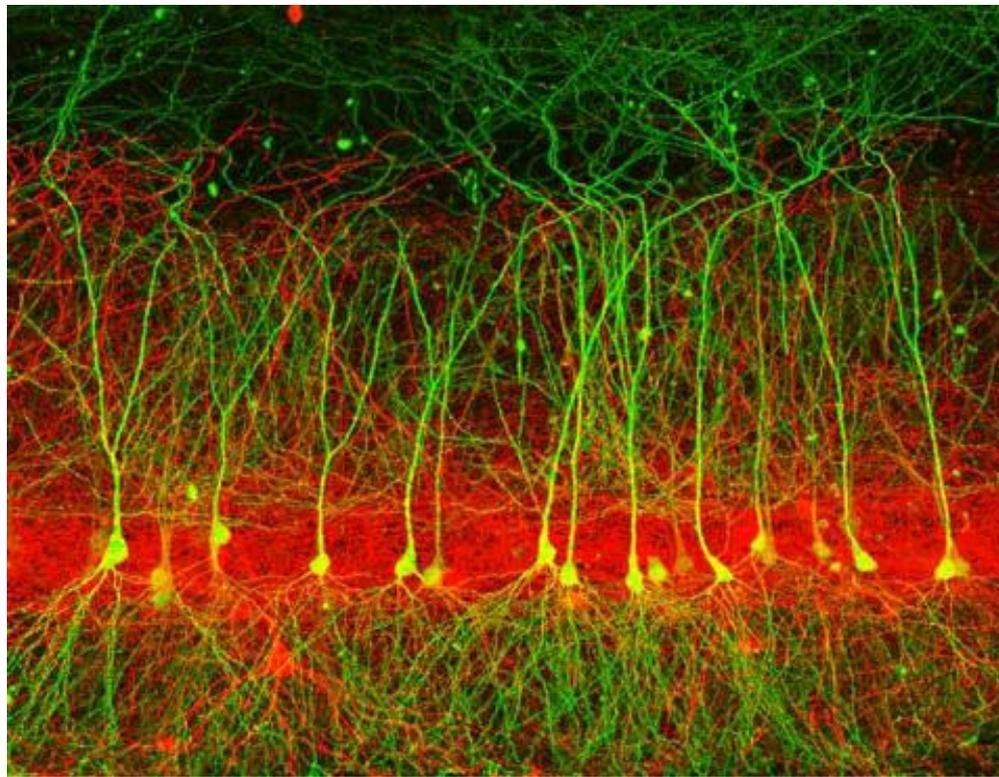
(a) Brain, frontal section



(b) Spinal cord, transverse section



(c) Frontal section of brain and spinal cord



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The key to understanding how our brains work lies in determining how each nerve cell or neuron continuously integrates the information it receives from other neurons via connections called synapses. For example, each pyramidal neuron (colored green) can receive tens of thousands of synapses from neurons belonging to several different brain regions. Interneurons (colored red) form local connections onto pyramidal neurons to form specific microcircuits. By using a combination of approaches including electrophysiology, microscopy, molecular biology and computer modeling, scientists are able to approach the complex puzzle of understanding how the 100 billion neurons in our brains make us who we are.

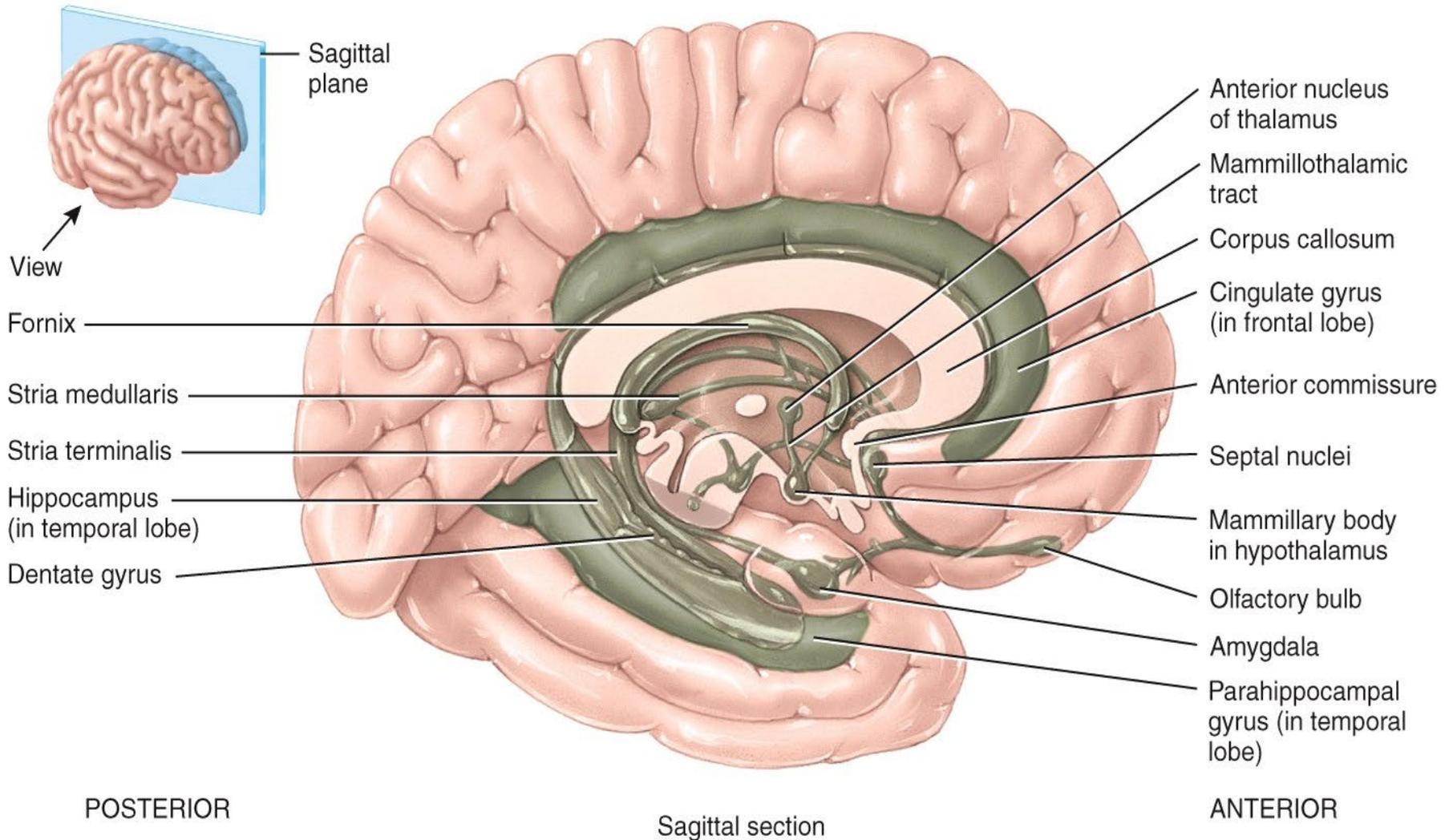
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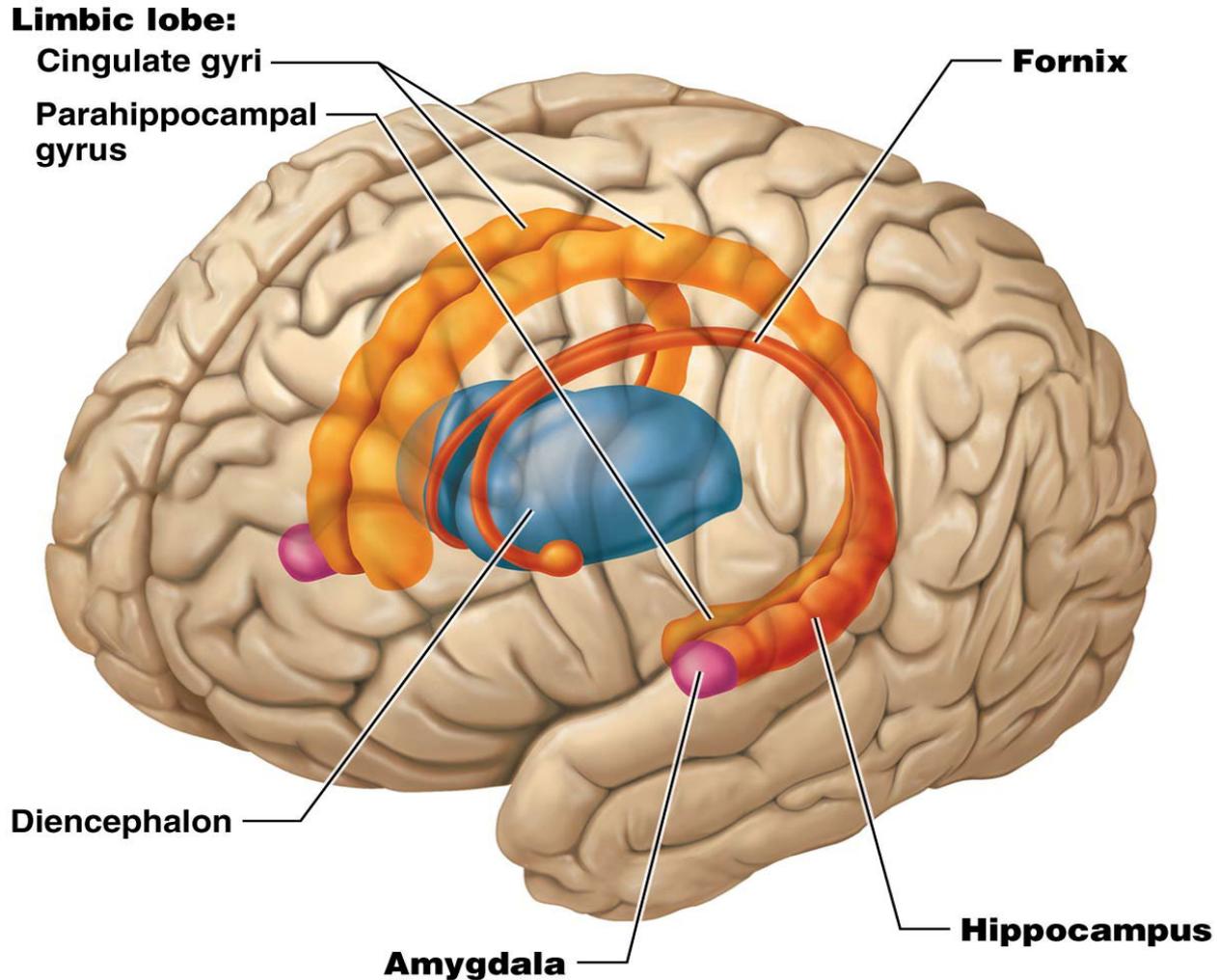
Credit:

Erik Bloss, PhD and Nelson Spruston, PhD., HHMI, Janelia Research Campus

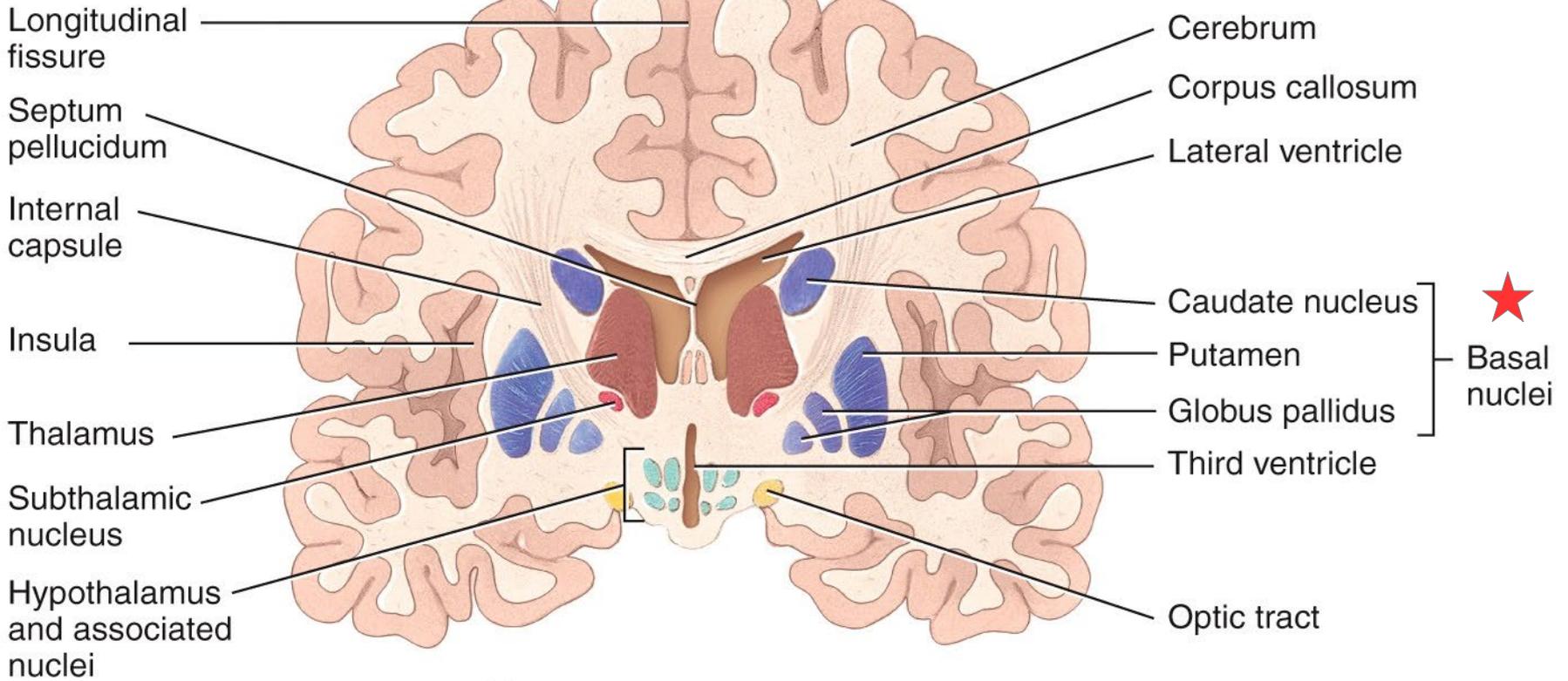
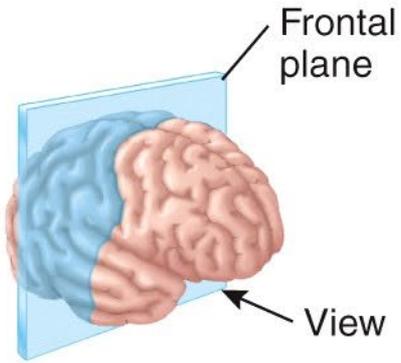
The Limbic System



Limbic System Structures (incomplete)

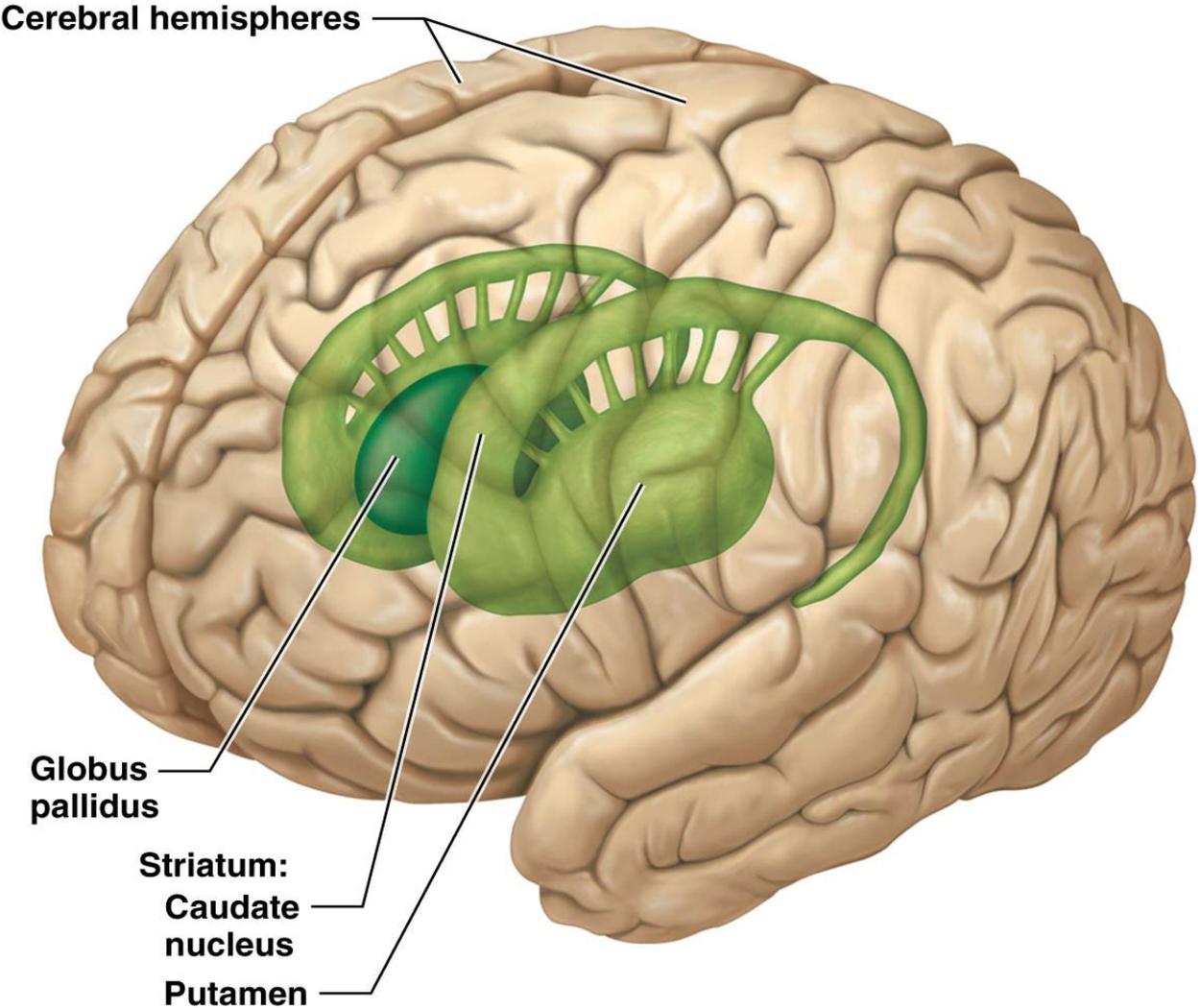


The Basal Ganglia

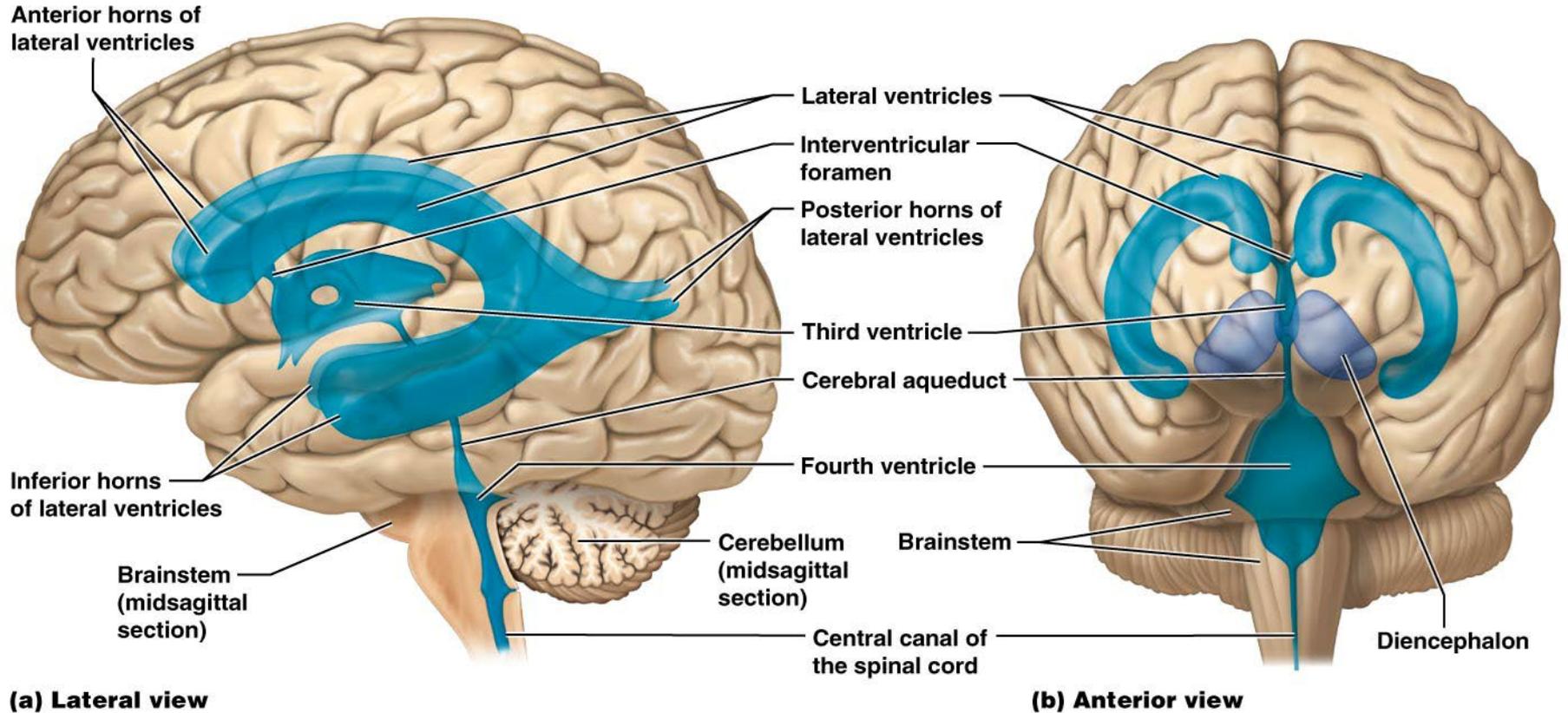


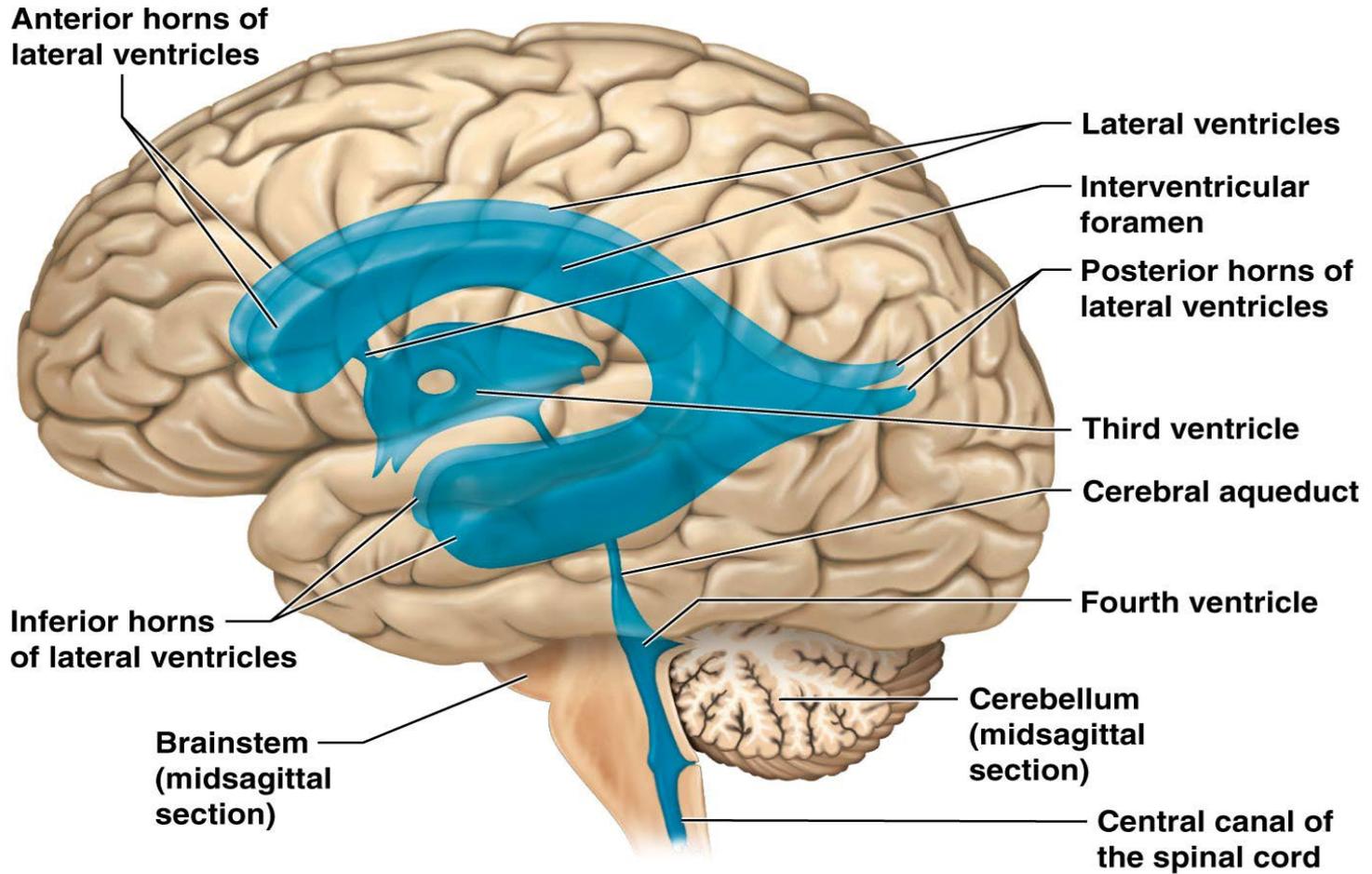
(b) Anterior view of frontal section

Structure of the basal ganglia (anterolateral view)

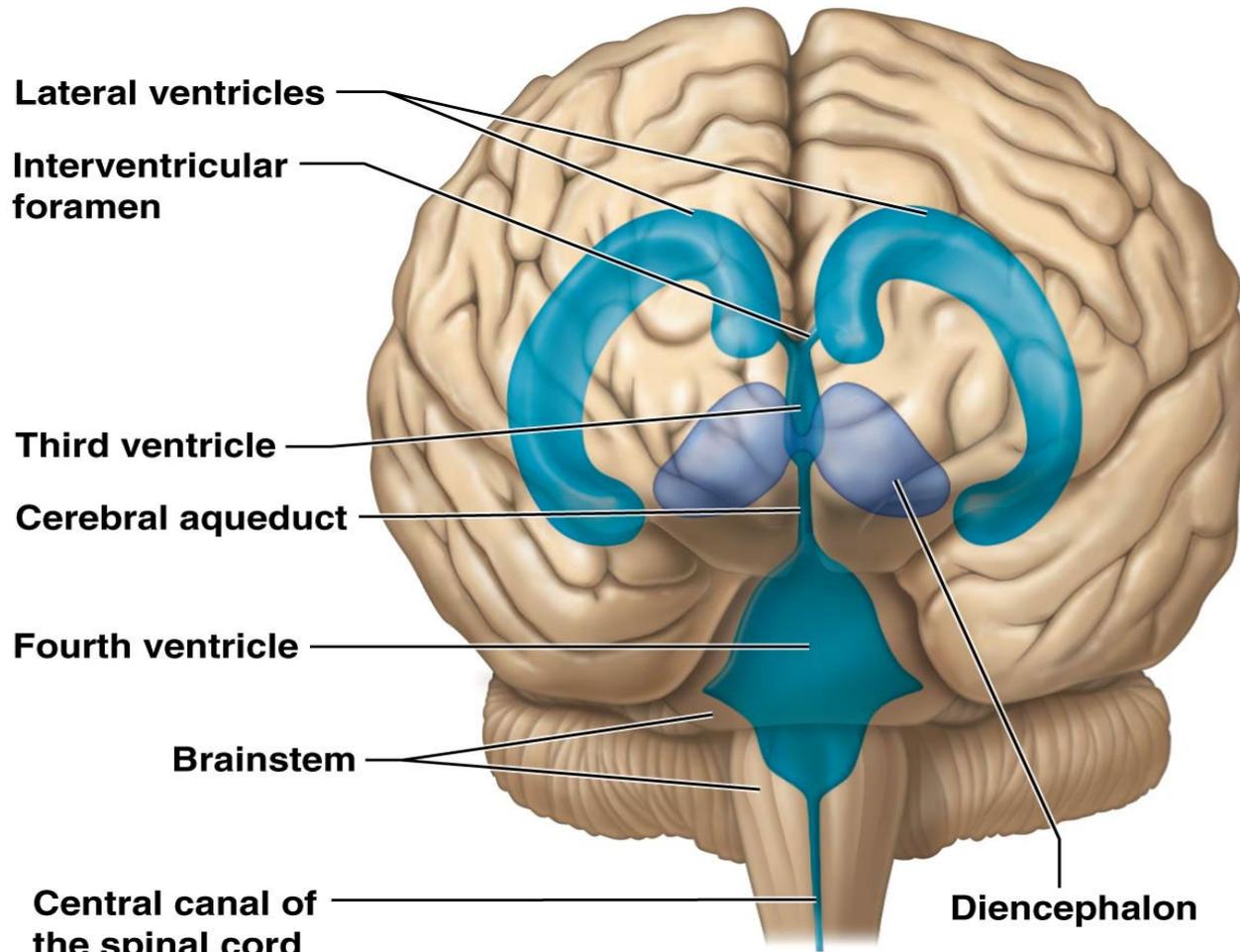


Ventricles of the Brain



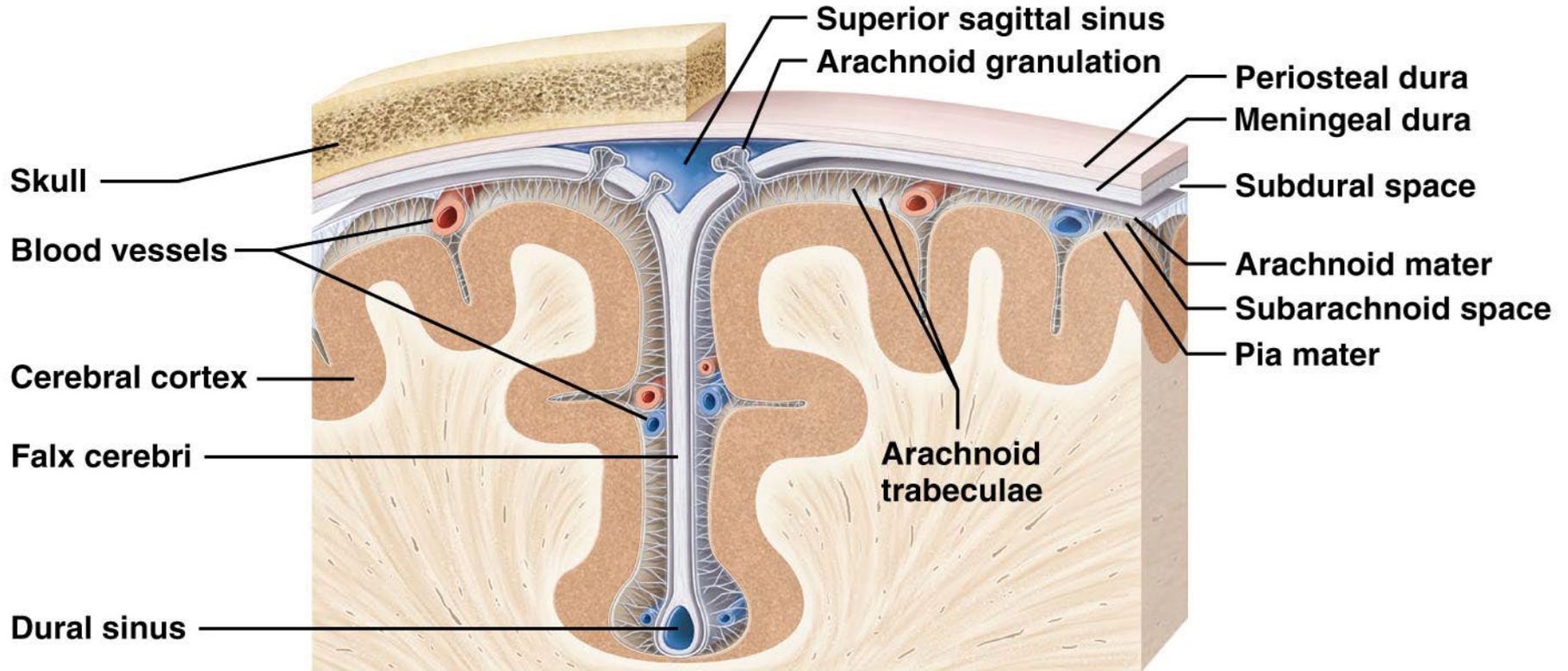


(a) Lateral view



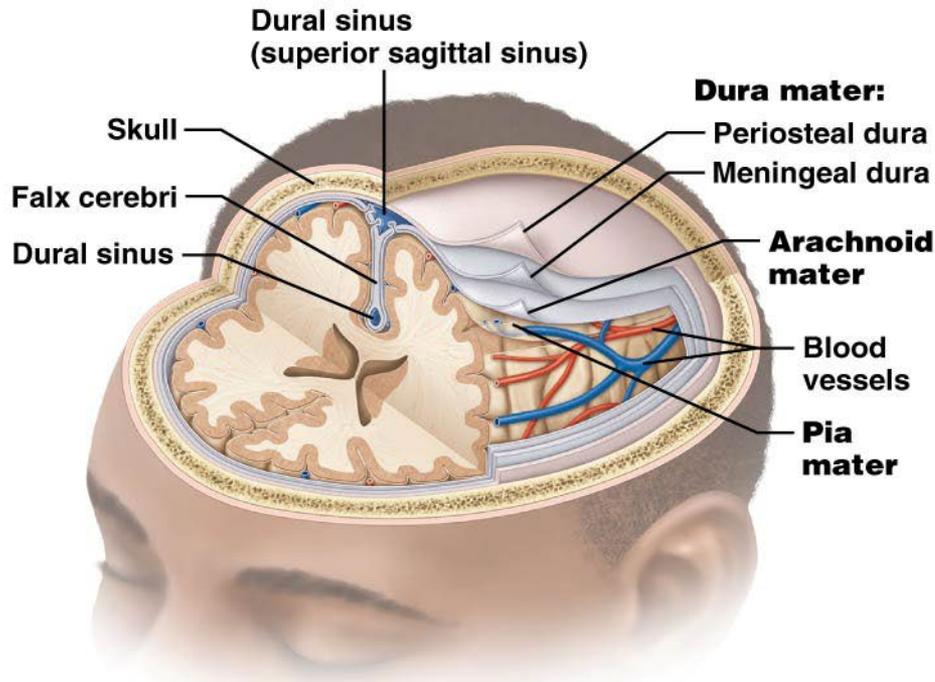
(b) Anterior view

Structure of the cranial meninges and dural sinuses.

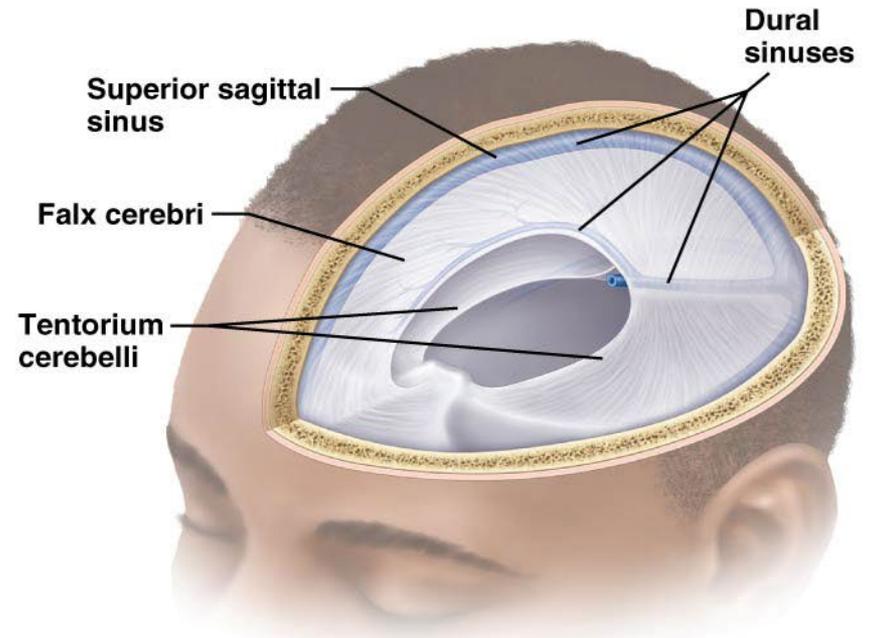


(c) Cranial meninges, frontal section

Structure of the cranial meninges and dural sinuses.

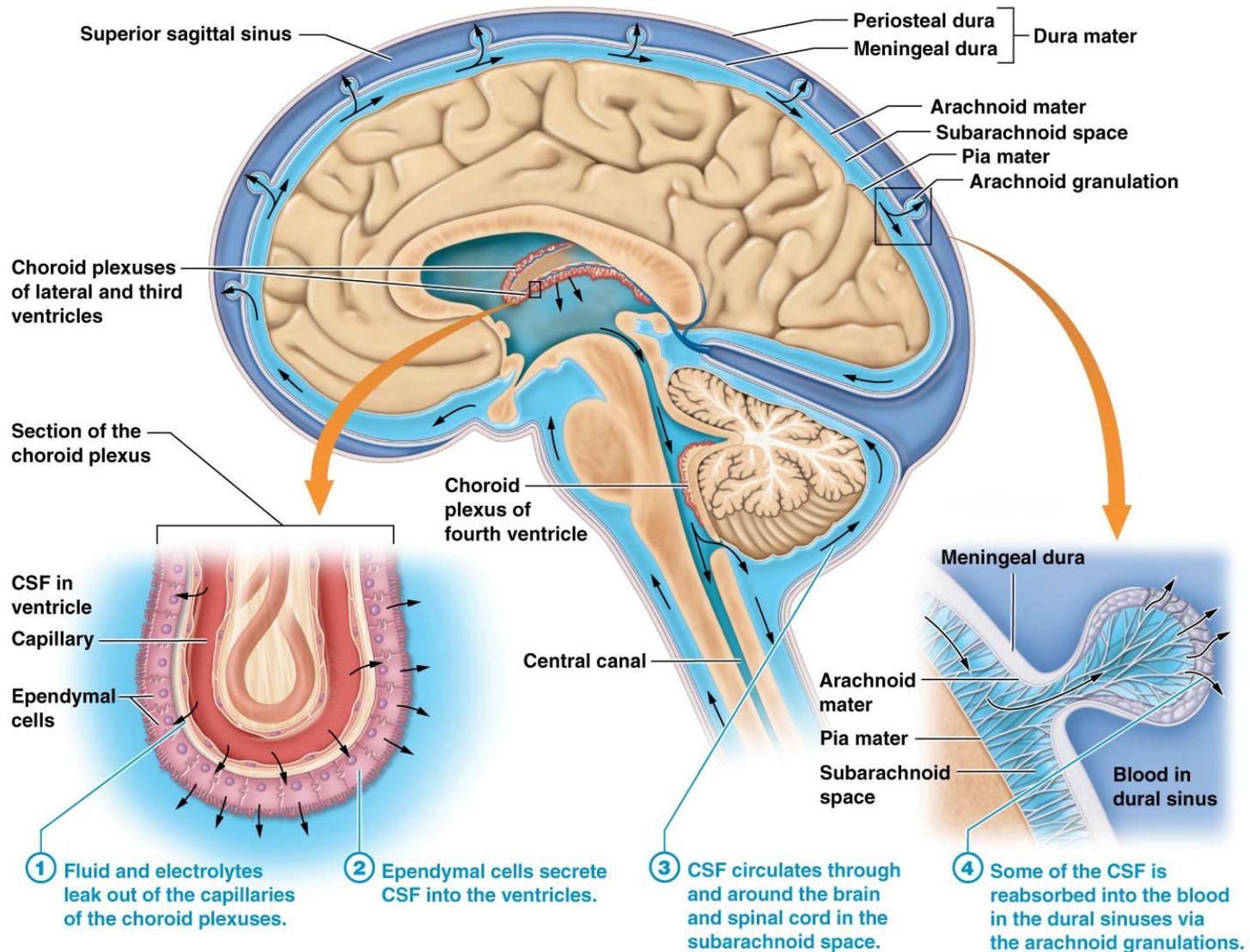


(a) Cranial meninges



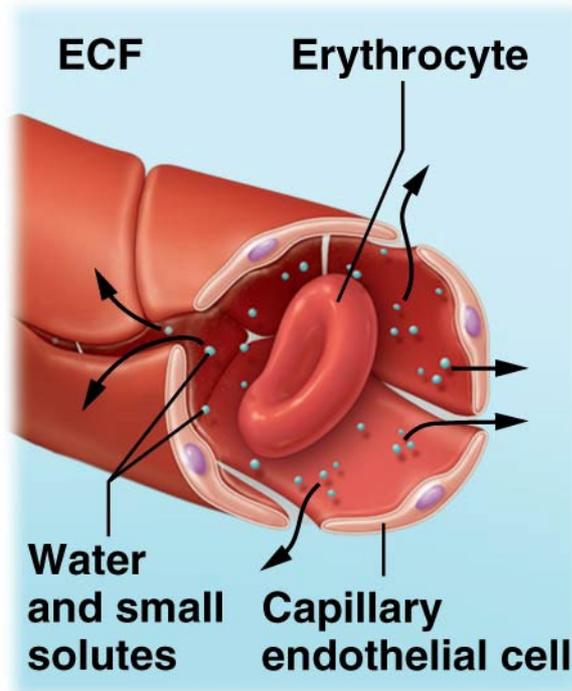
(b) Dural folds and dural sinuses

Formation and flow of cerebrospinal fluid (Blood CSF Barrier)

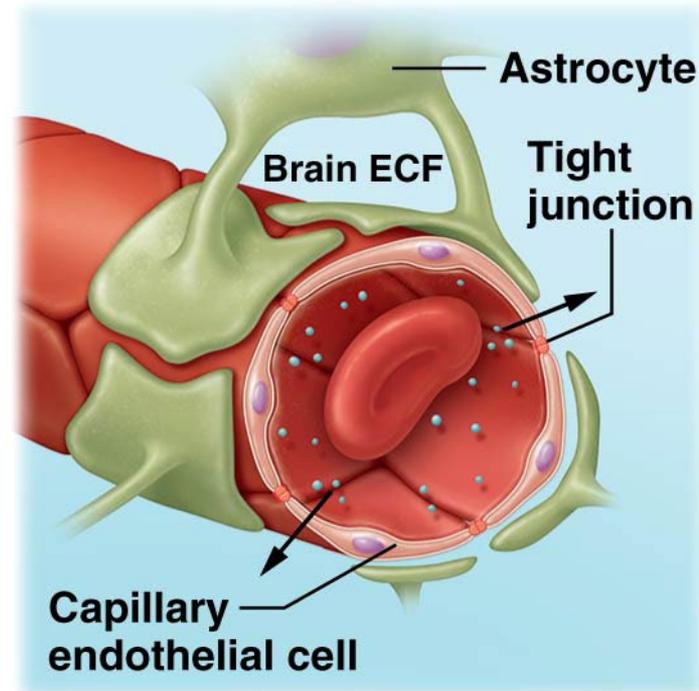




The blood-brain barrier.



A typical capillary allows water and small solutes to move from the blood to the ECF.



Astrocytes and tight junctions in brain capillaries limit the solutes that enter the brain ECF.

Note: There is a blood-cerebral fluid barrier but no cerebral fluid-brain barrier (from ventricles into interstitial fluid around brain's neurons).

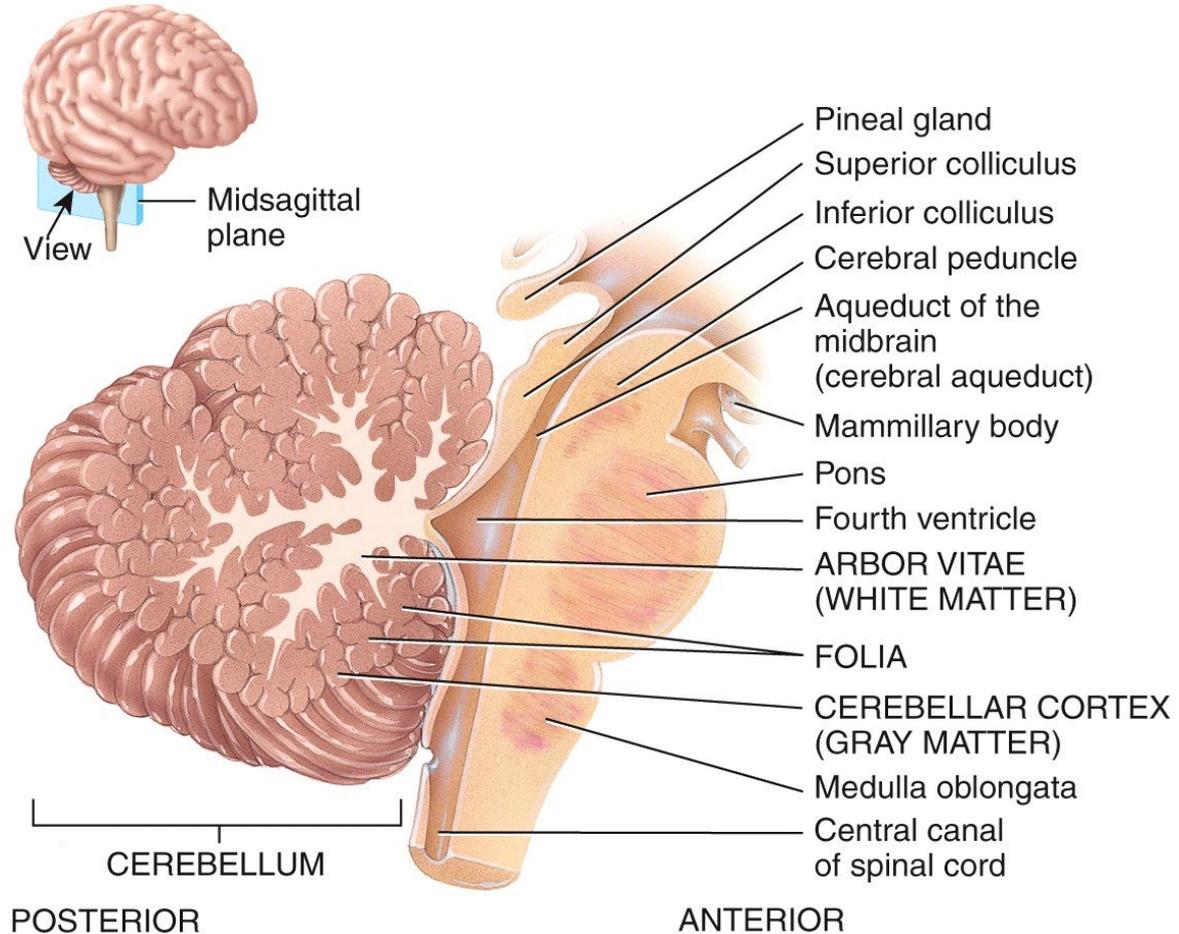
Cerebellum

Occupies posterior cranial fossa

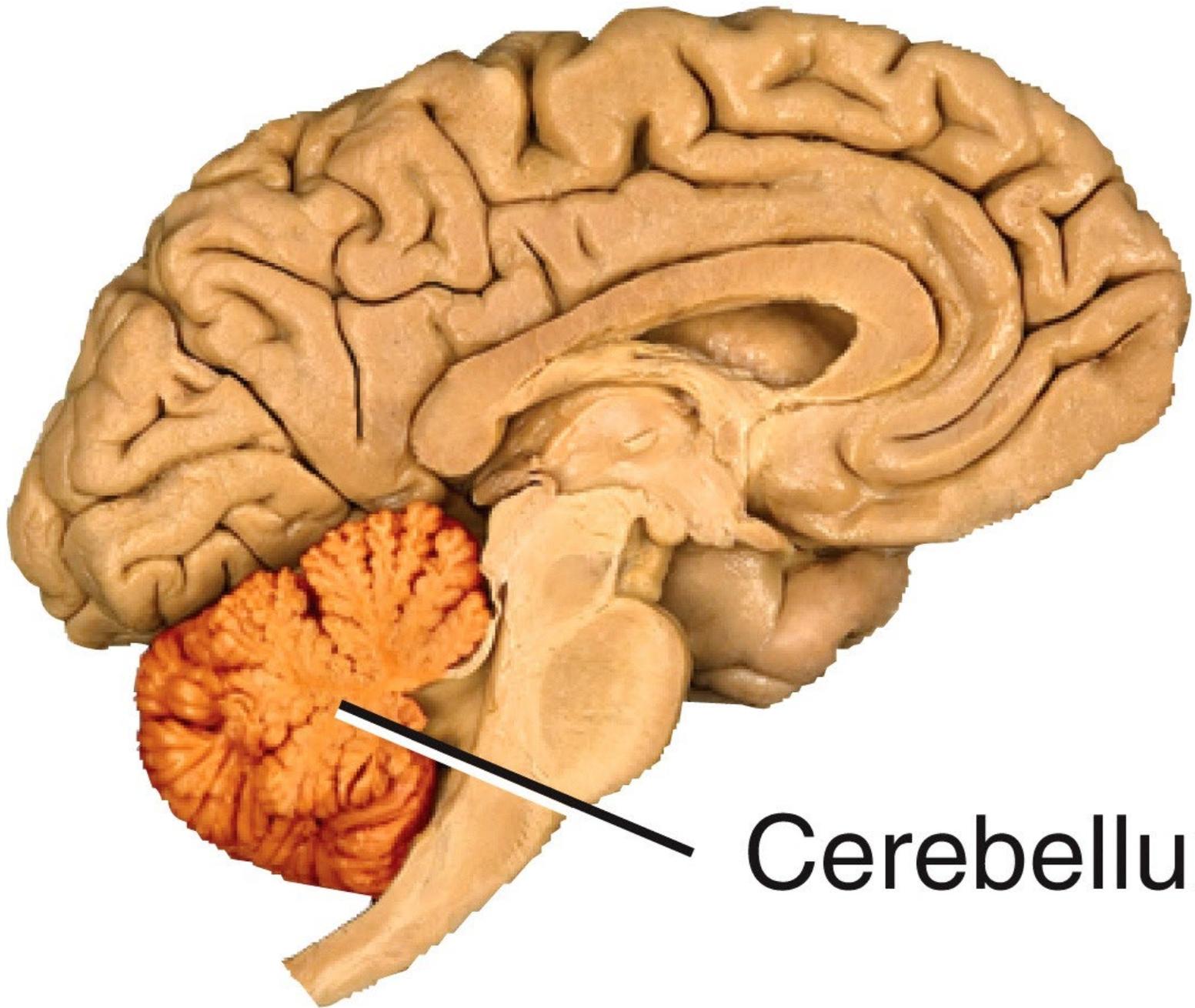
Marked by gyri, sulci, and fissures

About 10% of brain volume

But contains over 50% of brain neurons

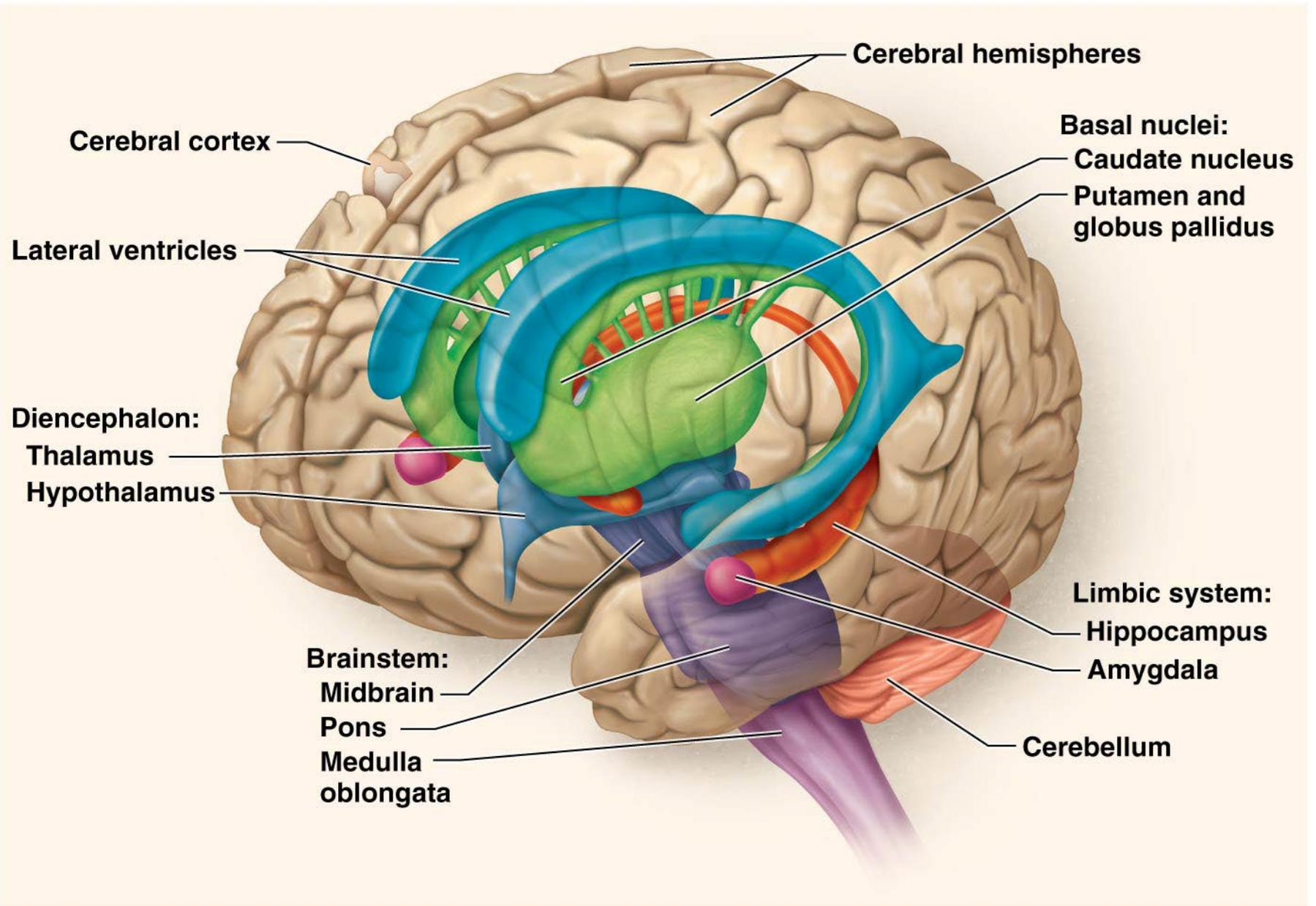


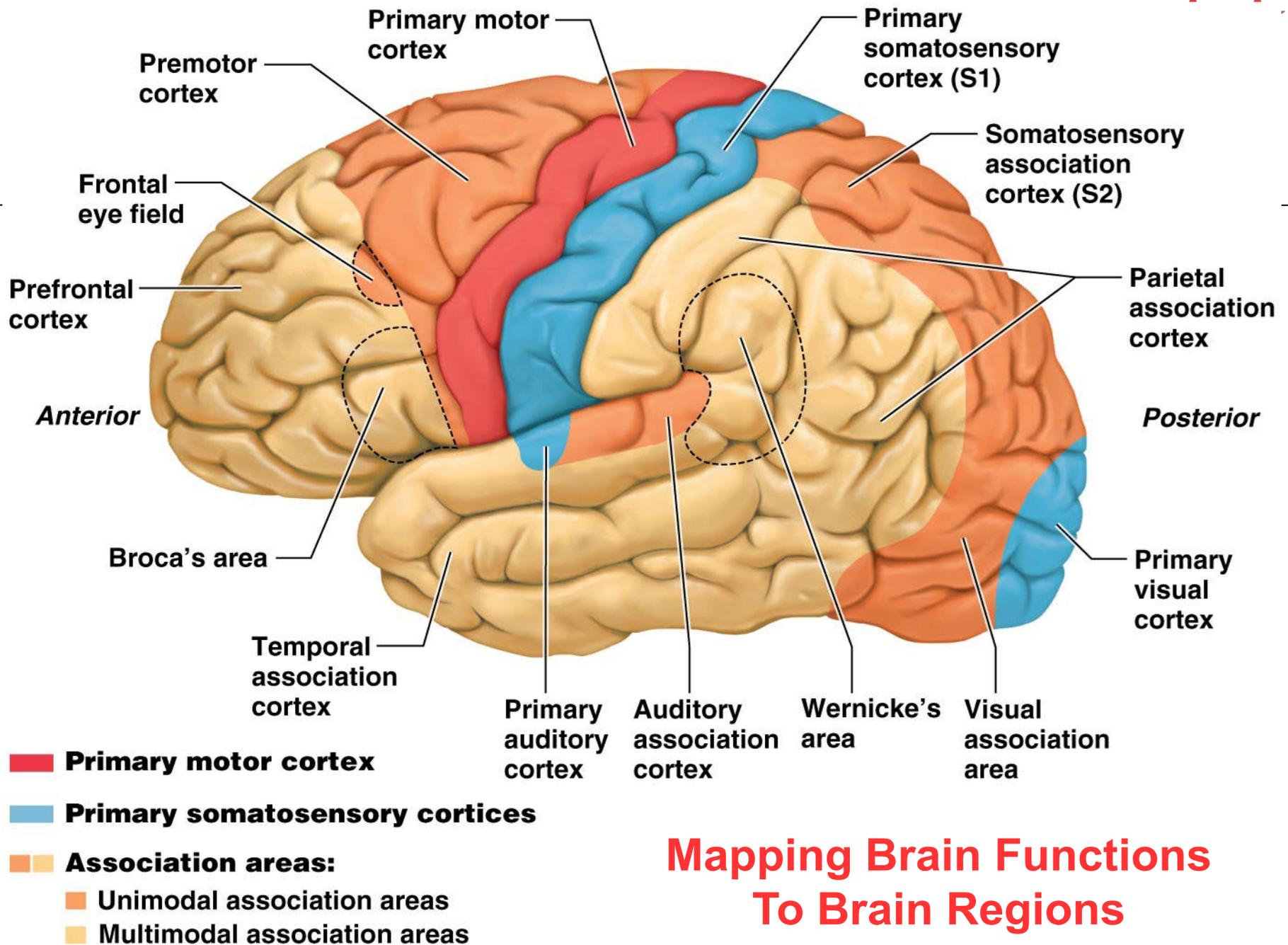
(c) Midsagittal section of cerebellum and brain stem



Cerebellum

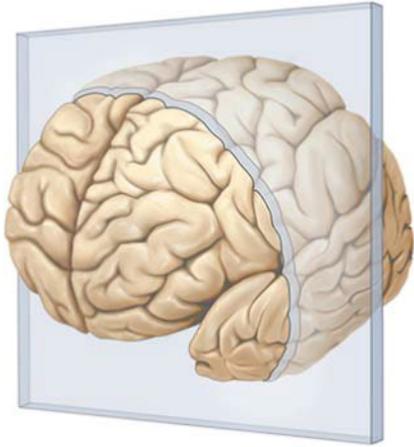
The Big Picture of Brain Anatomy.



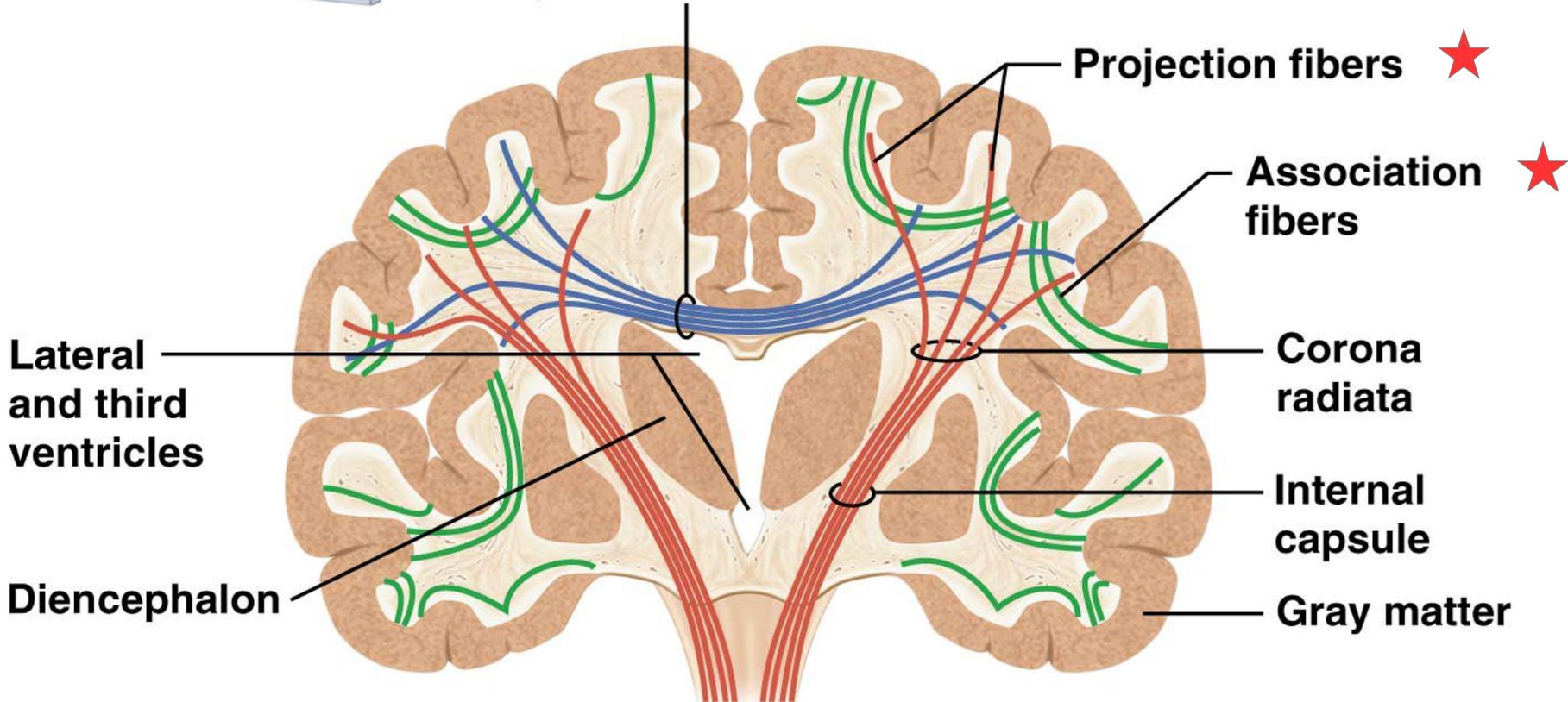


Mapping Brain Functions To Brain Regions

Association Fibers, Projection Fibers, and Commissural Fibers

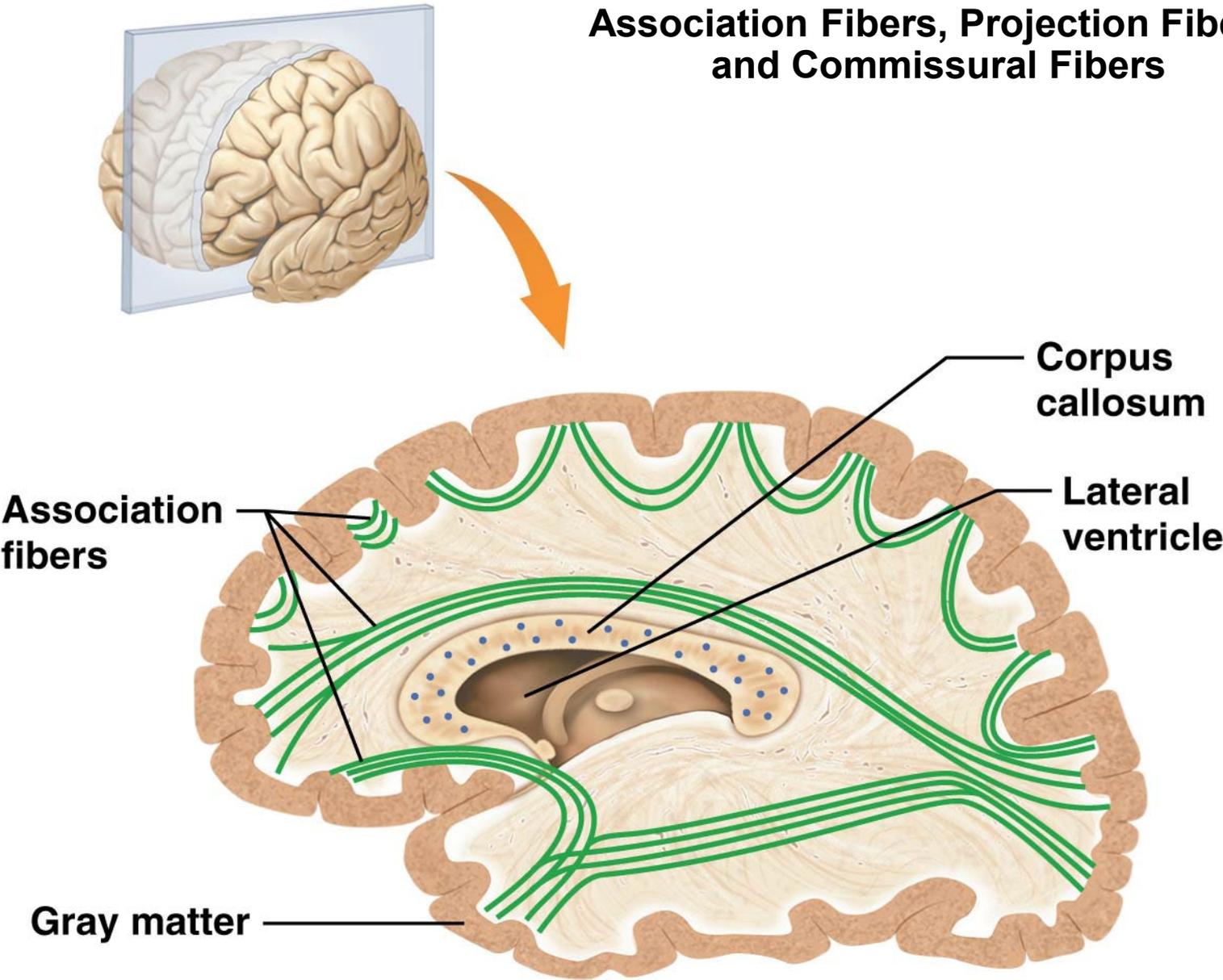


Commissural fibers of the corpus callosum ★



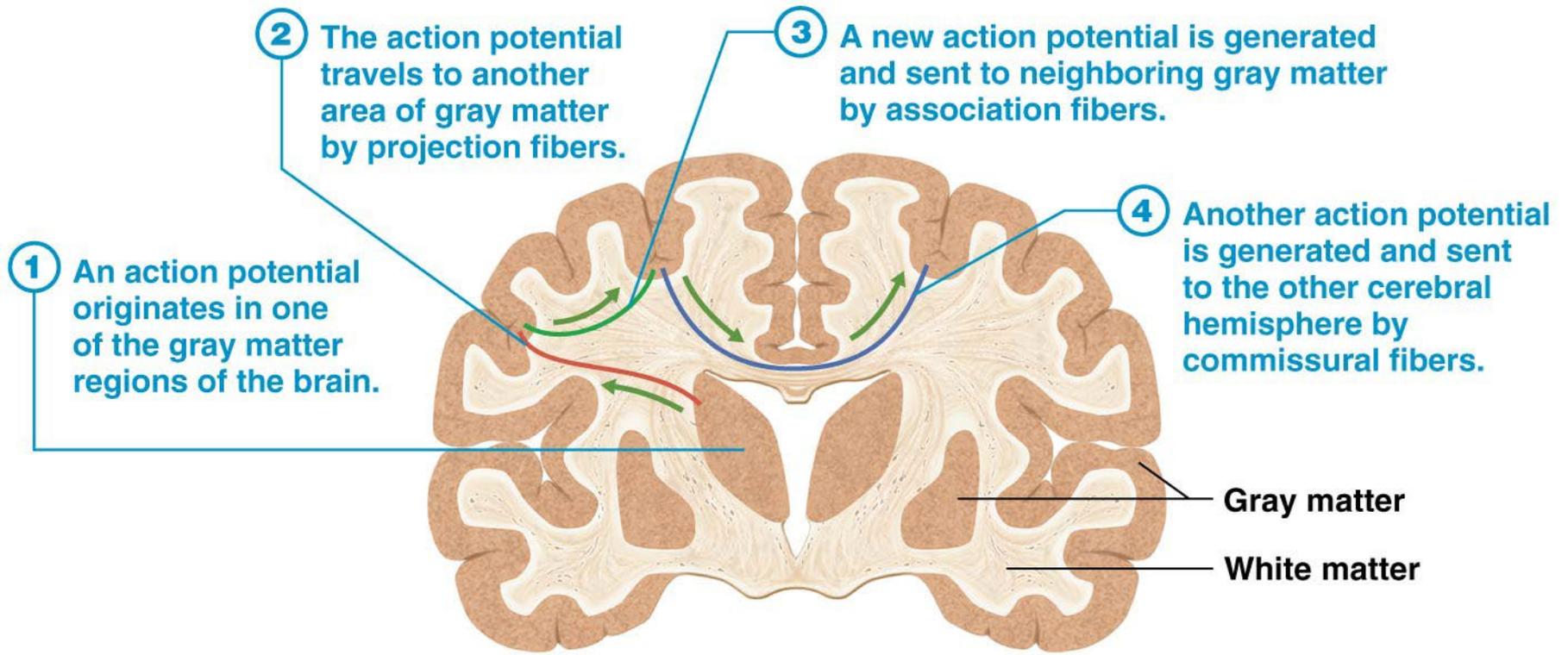
(a) Frontal section

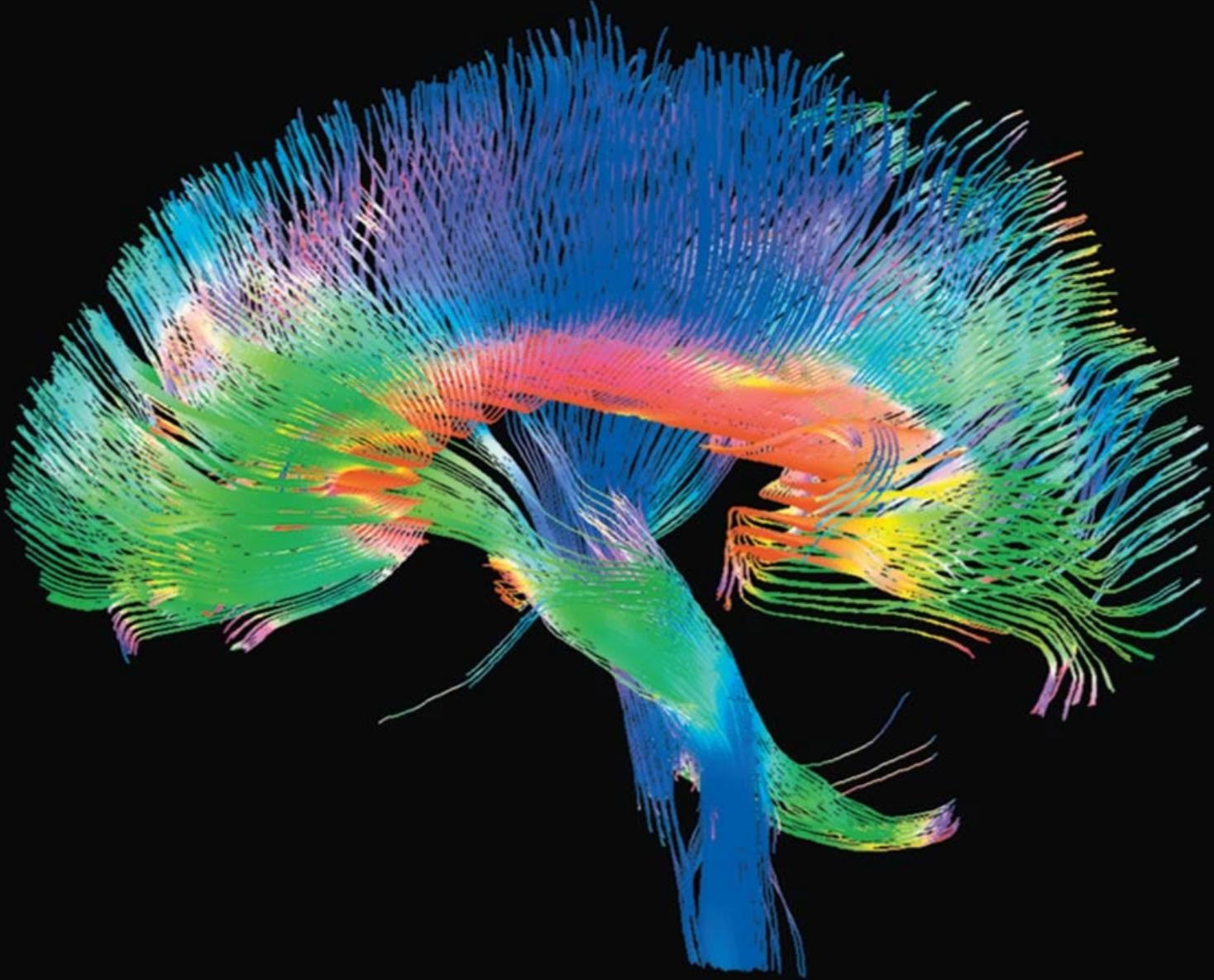
Association Fibers, Projection Fibers, and Commissural Fibers



(b) Parasagittal section

A possible pathway for conduction of an action potential in the brain.





Strange Factoids About Brain Function

Structurally, we have one brain, however. Functionally, we have many brains with different “types of memories” and different “states of awareness” (i.e. conscious, subconscious, and unconscious). This brings into questions how we reach decisions or form opinions and why! It's complicated. So how would you explain the following.....

If there is a “foul smell” in the room, then you are more likely to make a “harsh decision”.

If you sit near a container of “hand sanitizer cleaner” then your political opinions shift more toward the “political right”.

If you hold a cup of “hot coffee” then you will have a “more pleasant feeling about your mother”.

If a woman's iris is dilated, then men find her more “desirable”.