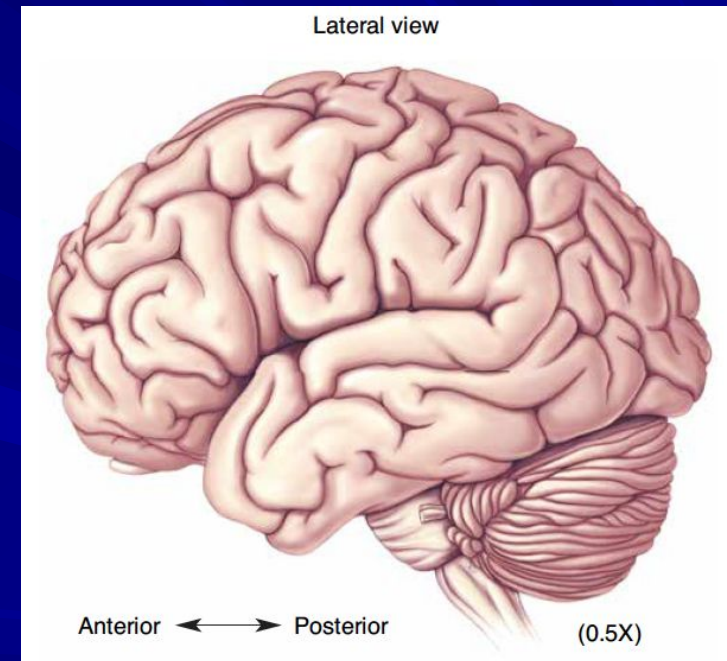
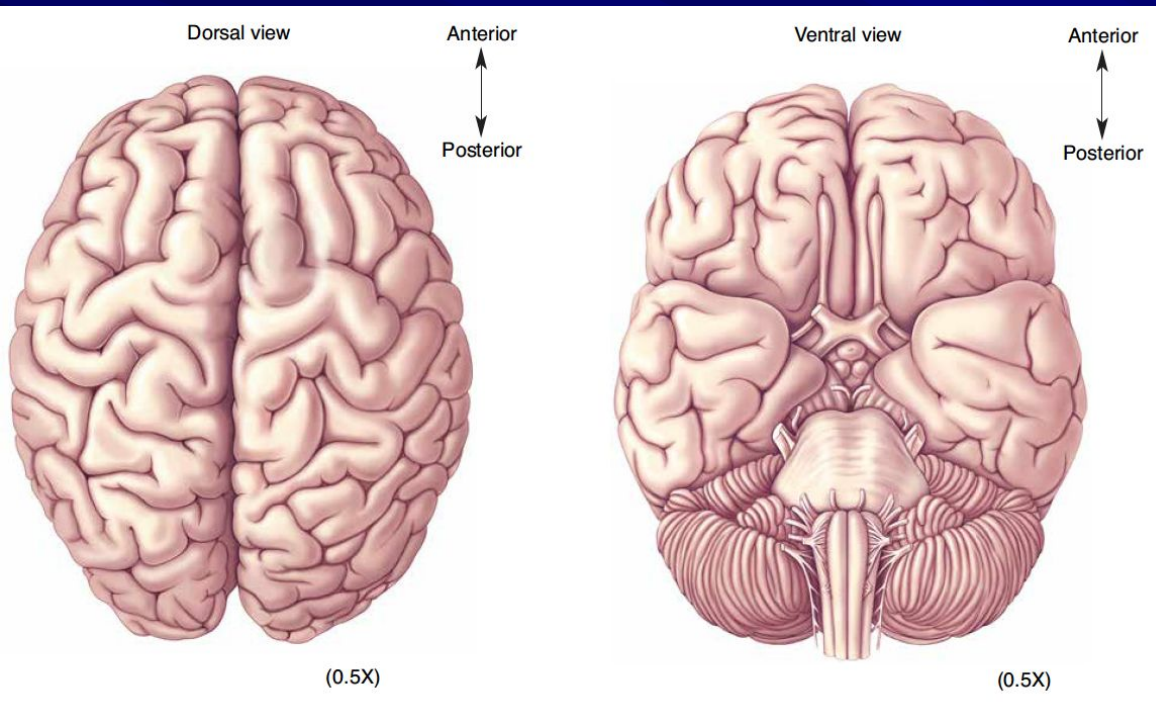


Anatomy of the human brain

- Surface anatomy of the brain

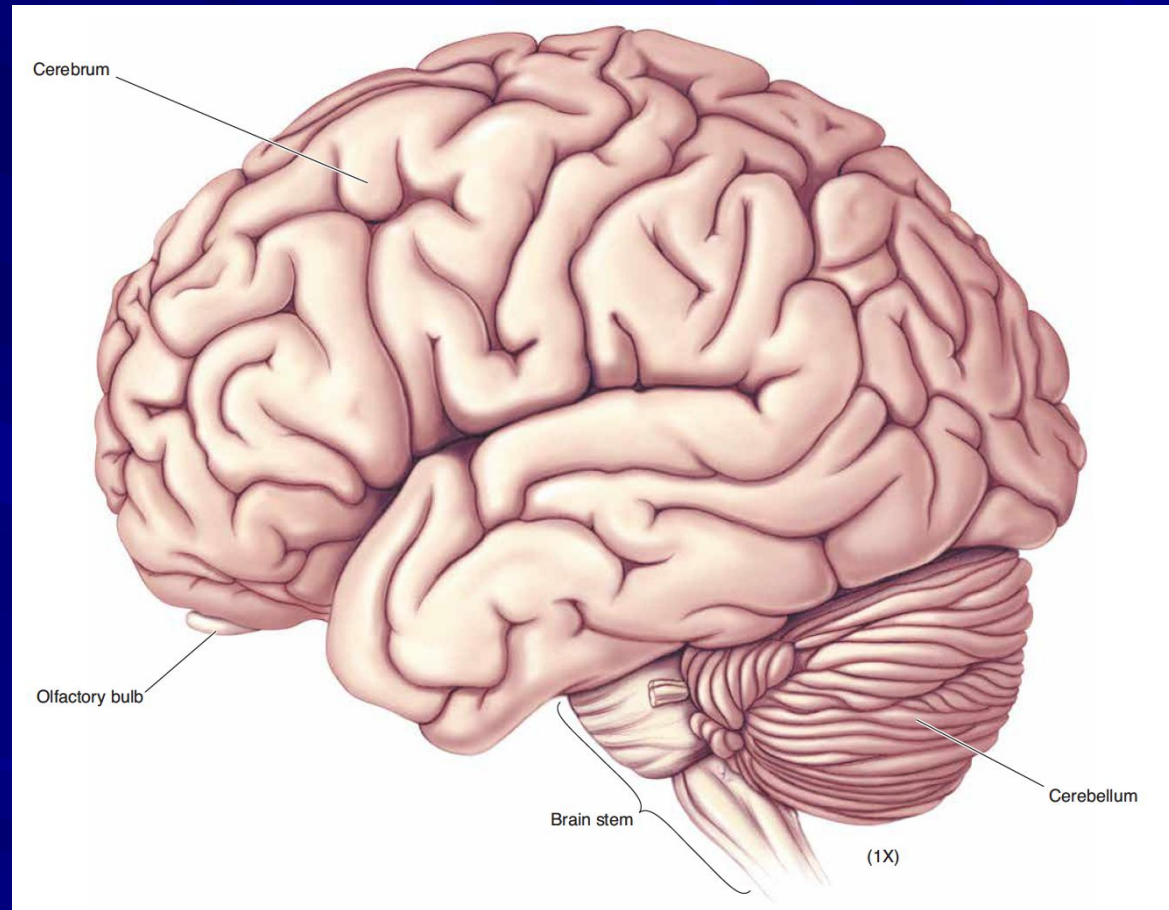


Anatomy of the human brain

The Lateral Surface of the Brain

- The three major parts:
 1. the large **cerebrum**
 2. the **brain stem**
 3. the **cerebellum**

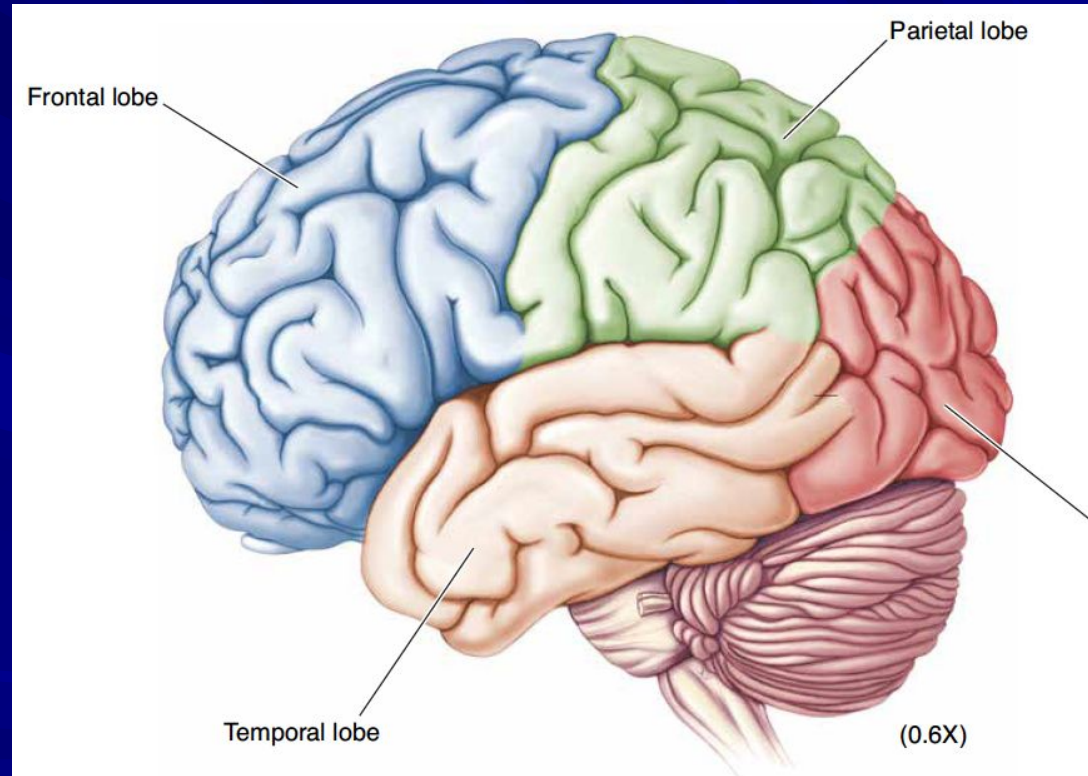
The small **olfactory bulb** of the cerebrum can also be seen in the lateral view.



Anatomy of the human brain

Cerebral Lobes and the Insula

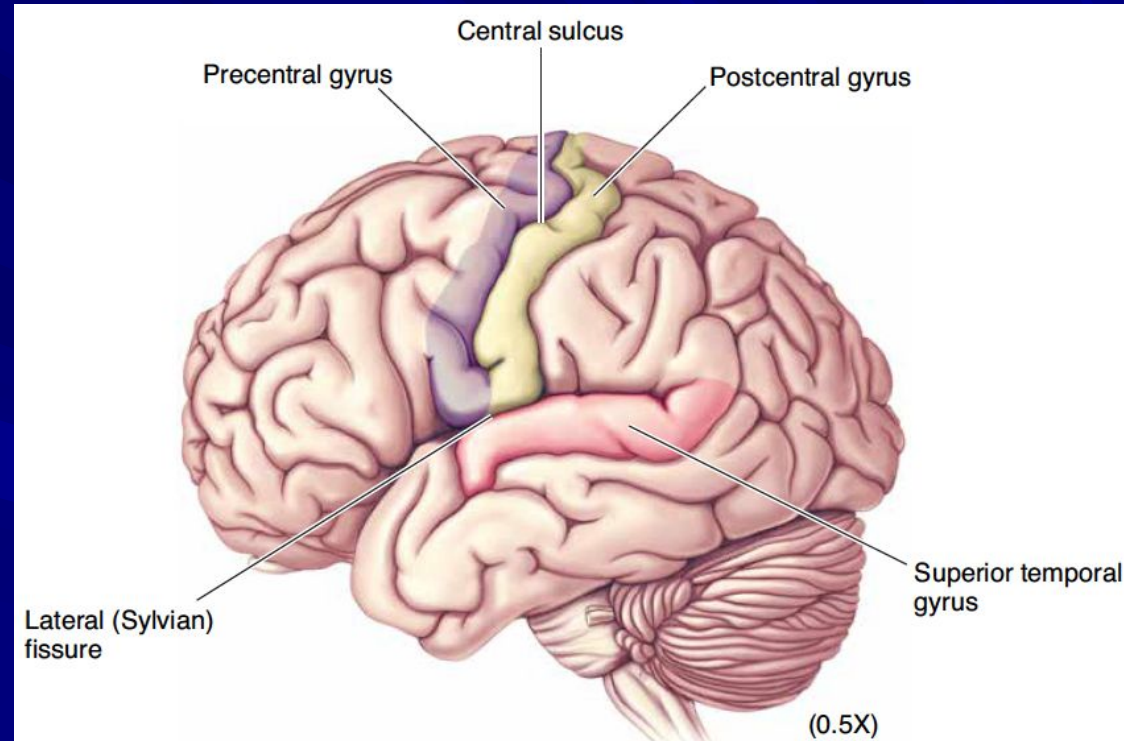
- The **central sulcus** divides the **frontal lobe** from the **parietal lobe**.
- The **temporal lobe** lies immediately ventral to the deep **lateral (Sylvian) fissure**.
- The **occipital lobe** lies at the very back of the cerebrum, bordering both parietal and temporal lobes.



Anatomy of the human brain

Selected Gyri, Sulci, and Fissures

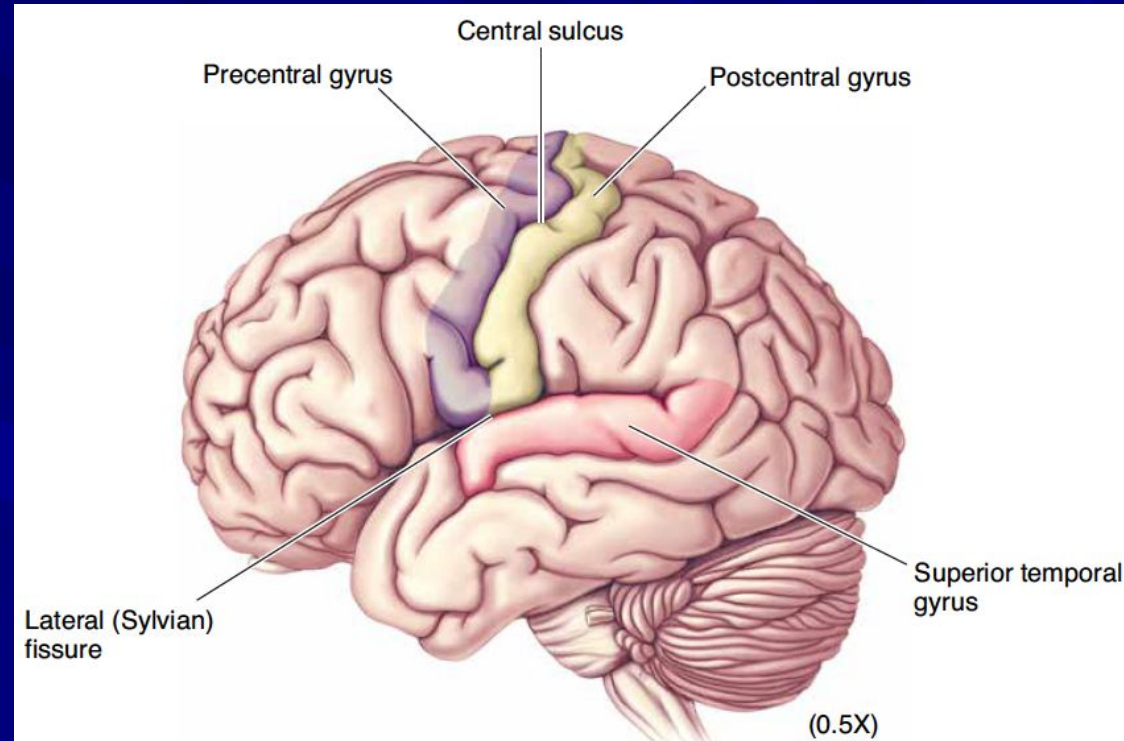
- The surface of the human cerebrum has the many **convolutions**.
- The grooves in the surface are called **sulci** (singular: **sulcus**),
- Especially deep grooves are called **fissures**
- The bumps are called **gyri** (singular: **gyrus**).



Anatomy of the human brain

Selected Gyri, Sulci, and Fissures

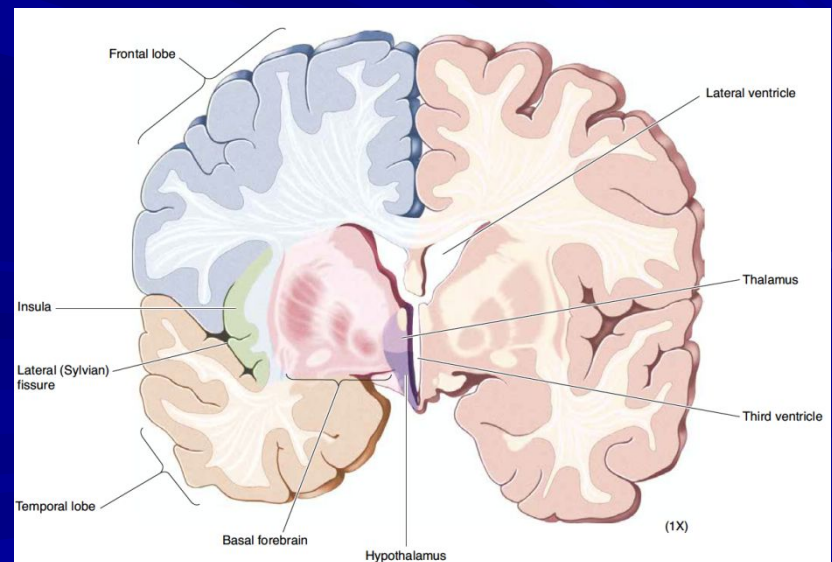
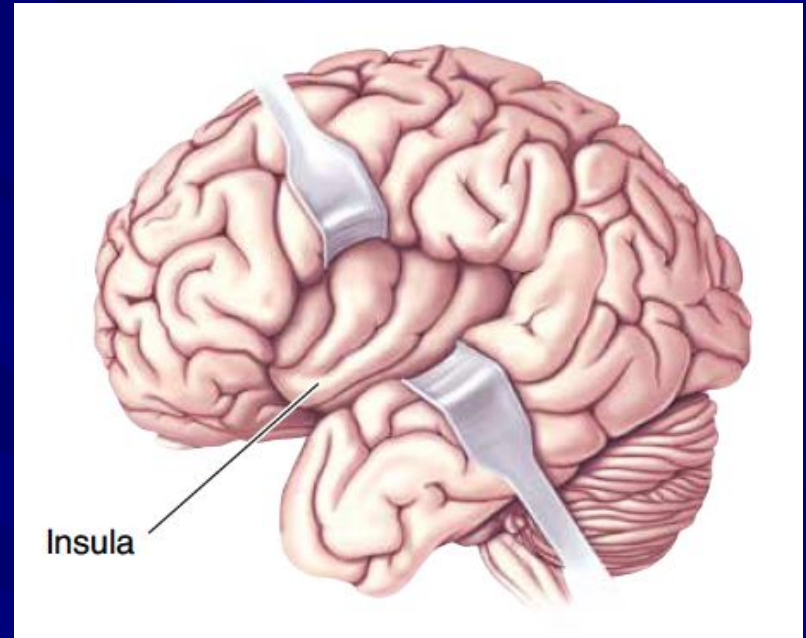
- The **postcentral gyrus** lies immediately posterior to the **central sulcus**
- The **precentral gyrus** lies immediately anterior to the **central sulcus**
- The **superior temporal gyrus** lies under the deep lateral (Sylvian) fissure



Anatomy of the human brain

Cerebral Lobes and the Insula

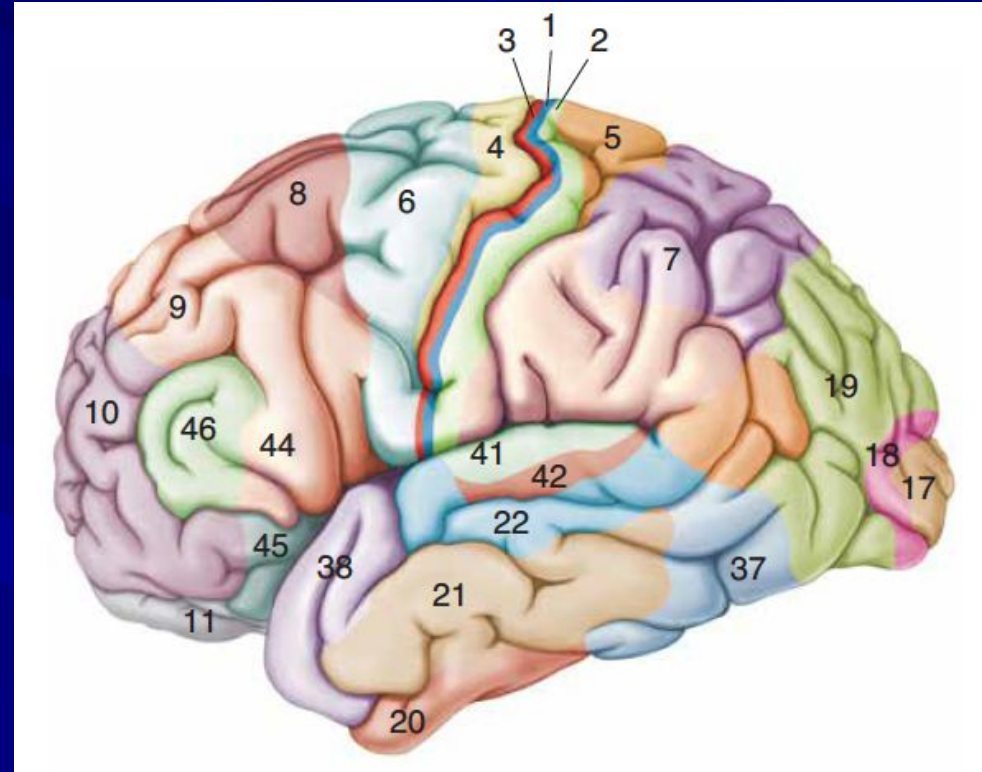
- **The insula** is revealed if the margins of the lateral fissure are gently pulled apart.
- The insula borders and separates the temporal and frontal lobes.



Anatomy of the human brain

Major Sensory, Motor, and Association Areas of Cortex

- At the beginning of the twentieth century German neuroanatomist Brodmann constructed a **cytoarchitectural map** of the neocortex.
- Each area of cortex having a common cytoarchitecture is given a number, for example, “area 17” at the tip of the occipital lobe, “area 4” just anterior to the central sulcus in the frontal lobe
- The various areas differ from one another in terms of microscopic structure and function.

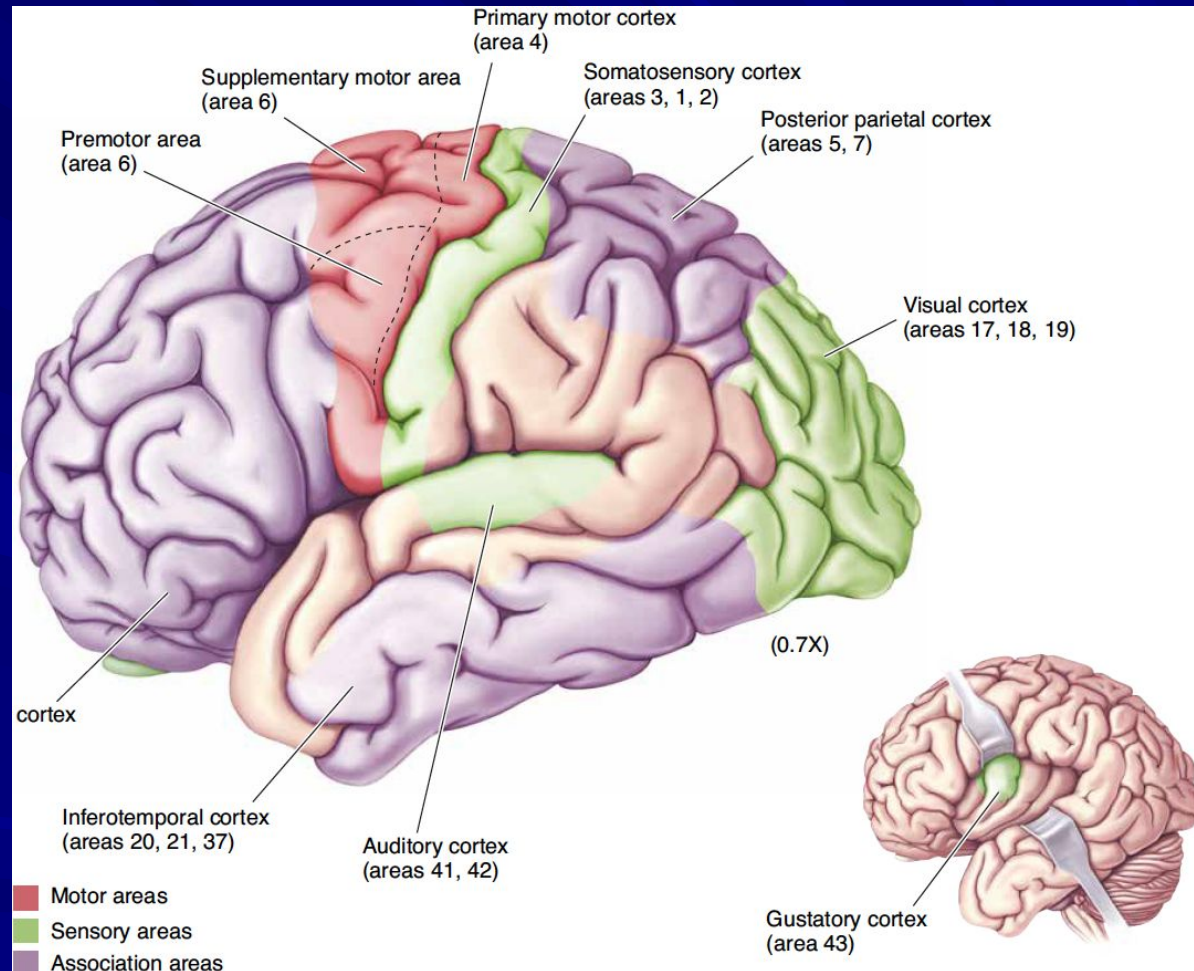


Anatomy of the human brain

Major Sensory, Motor, and Association Areas of Cortex

Sensory areas

- The **visual areas** are found in the occipital lobe
- The **somatic sensory areas** are in the parietal lobe
- The **auditory areas** are in the temporal lobe.
- On the inferior surface of the parietal lobe and buried in the insula is the **gustatory cortex**, devoted to the sense of taste.



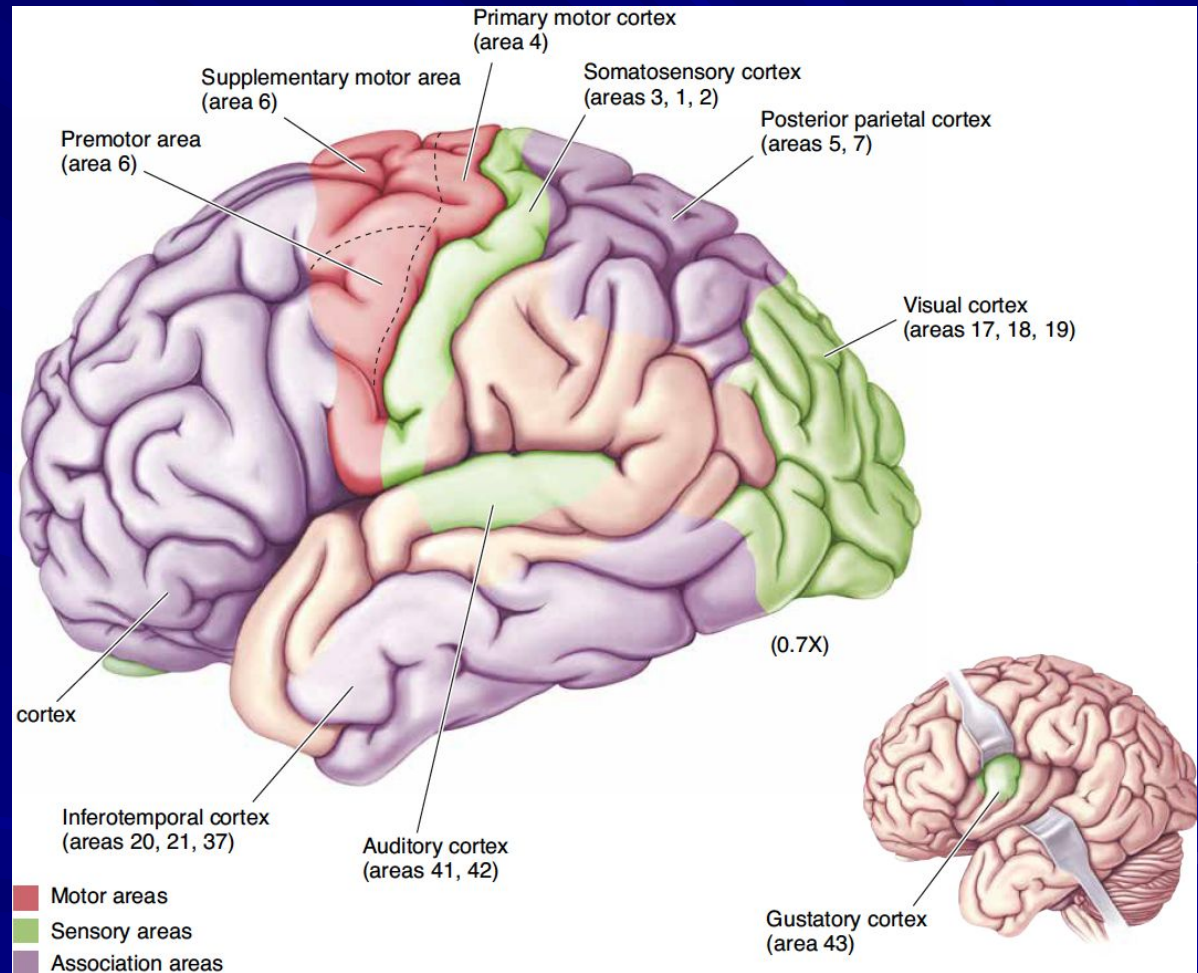
Anatomy of the human brain

Major Sensory, Motor, and Association Areas of Cortex

Motor areas

The major motor control areas lie in the frontal lobe, anterior to the central sulcus:

1. Primary motor cortex
2. Supplementary motor cortex
3. Premotor area

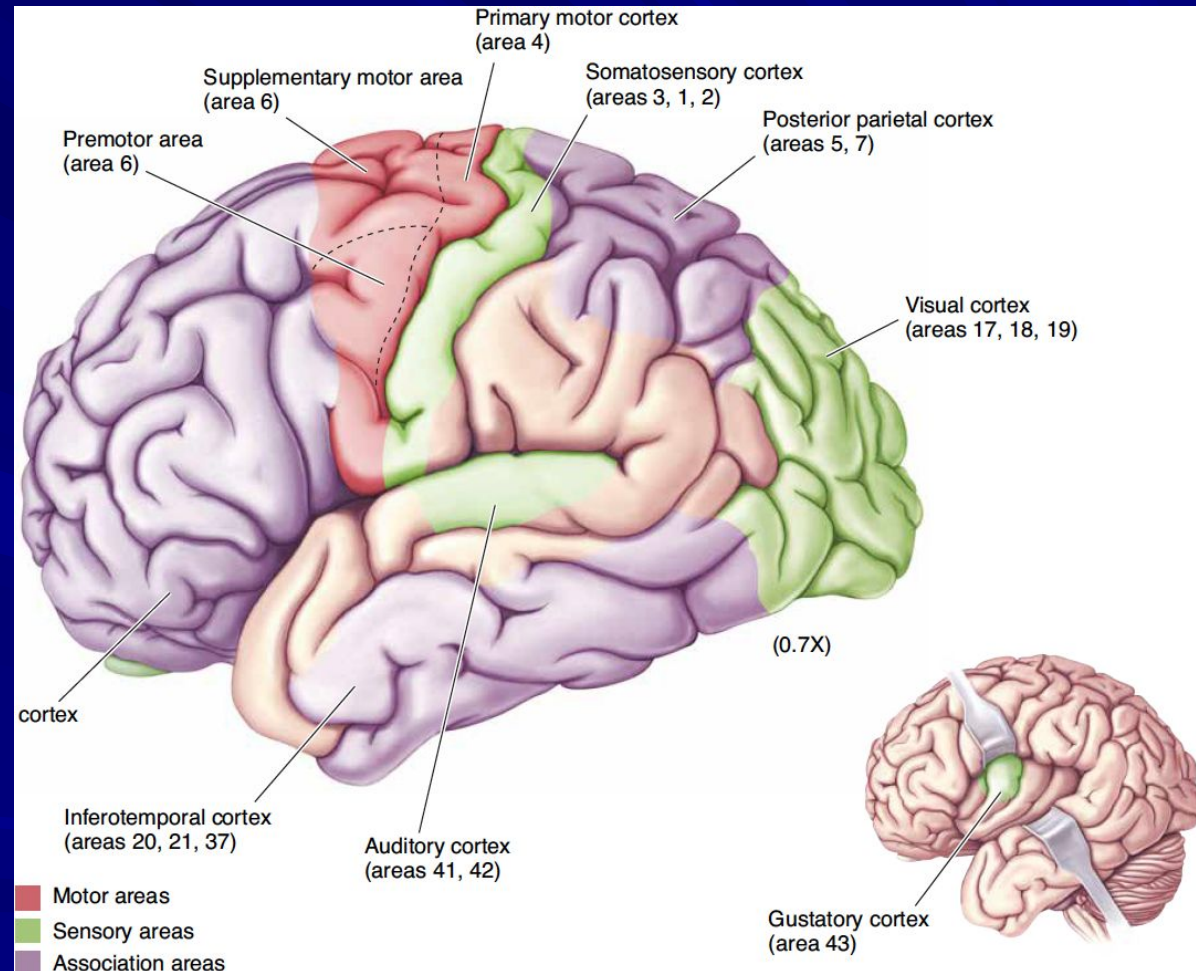


Anatomy of the human brain

Major Sensory, Motor, and Association Areas of Cortex

The association areas
Some of the more important areas are

1. the prefrontal cortex, the posterior
2. the posterior parietal cortex,
3. the inferotemporal cortex



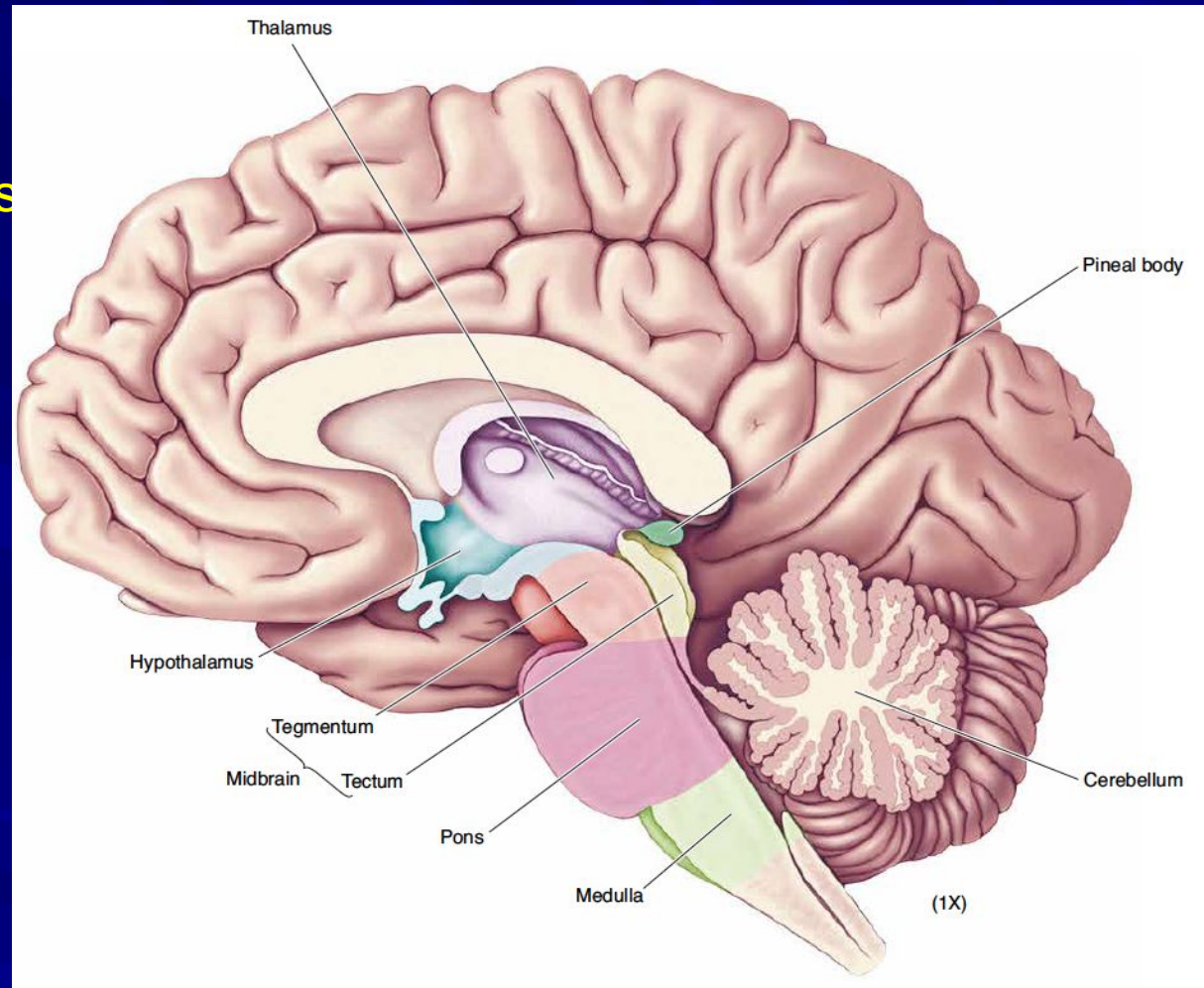


Anatomy of the human brain

The Medial Surface of the Brain

The brain stem consists of

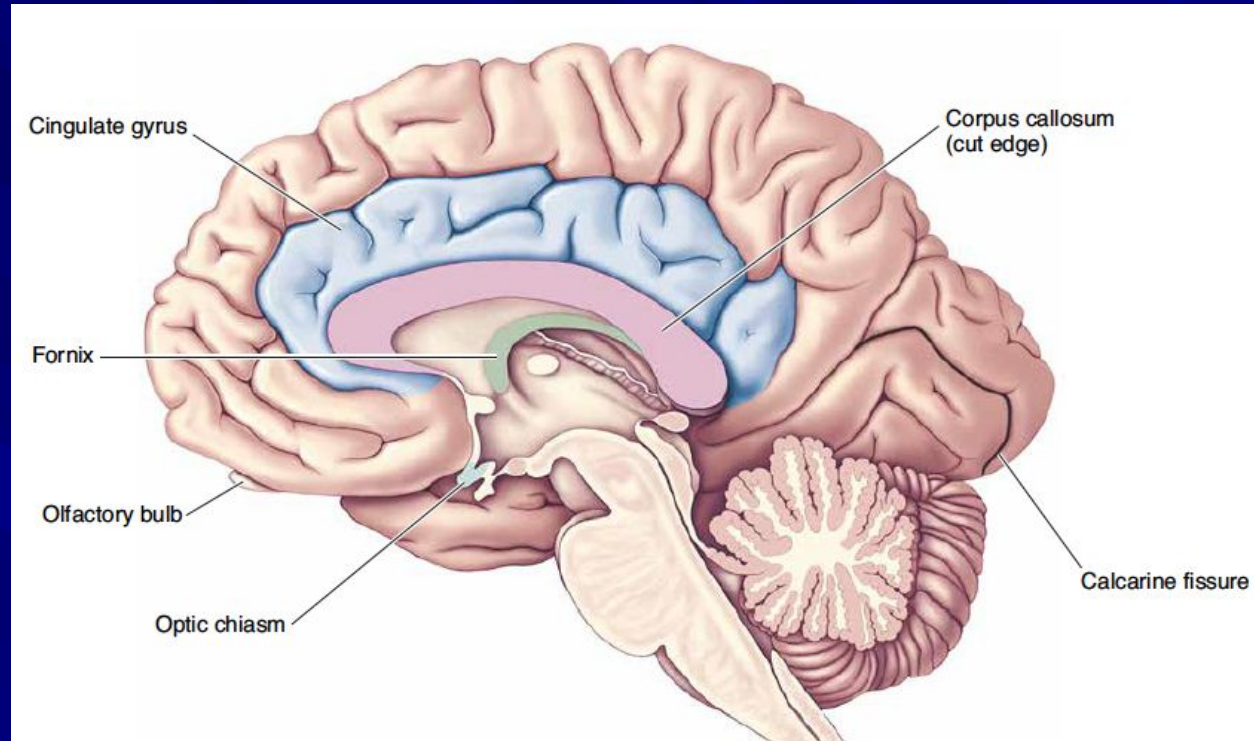
1. the diencephalon (**thalamus** and **hypothalamus**),
2. the midbrain (**tectum** and **tegmentum**),
3. the **pons**,
4. the **medulla**.



Anatomy of the human brain

Forebrain Structures

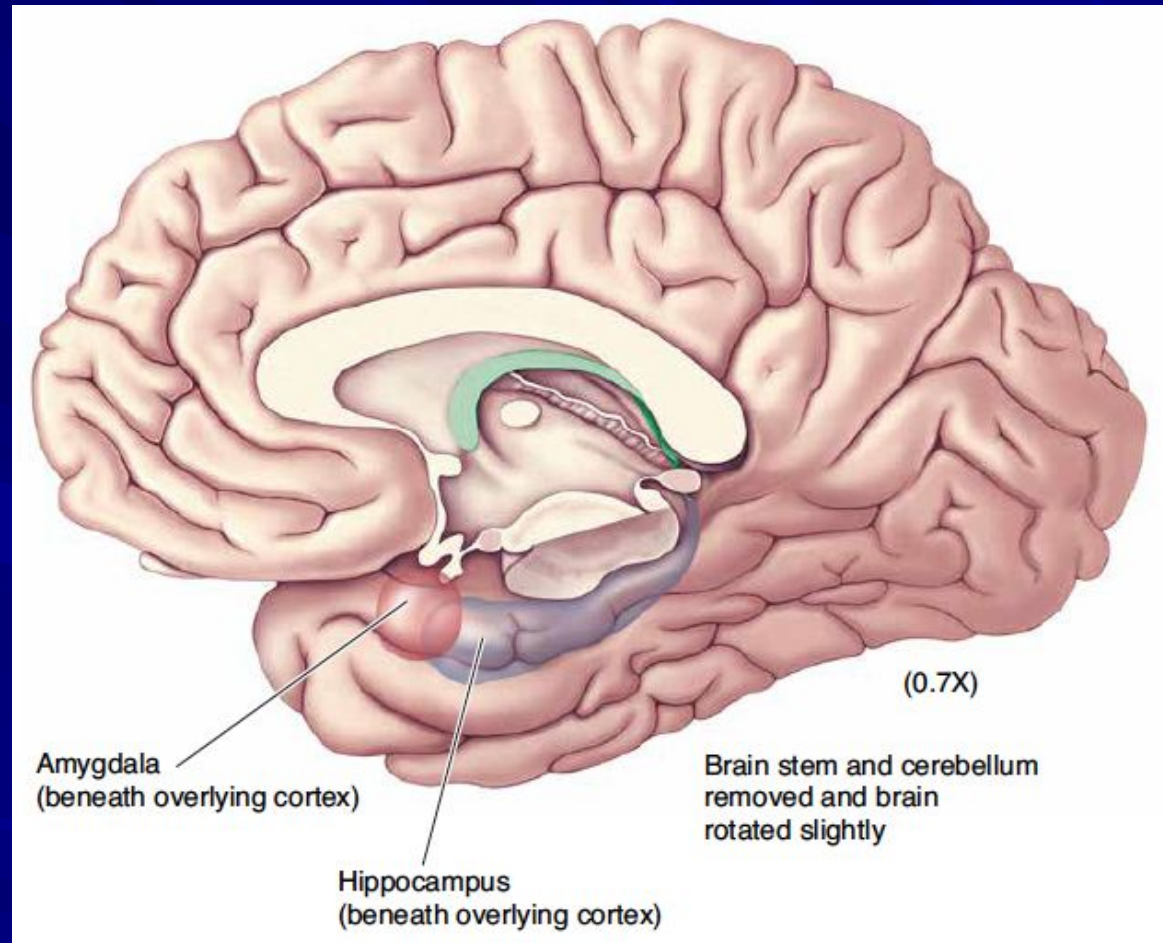
1. **Corpus callosum**
(connects the two sides of the cerebrum)
2. **Fornix** (connects the hippocampus on each side with the hypothalamus)



Anatomy of the human brain

Forebrain Structures

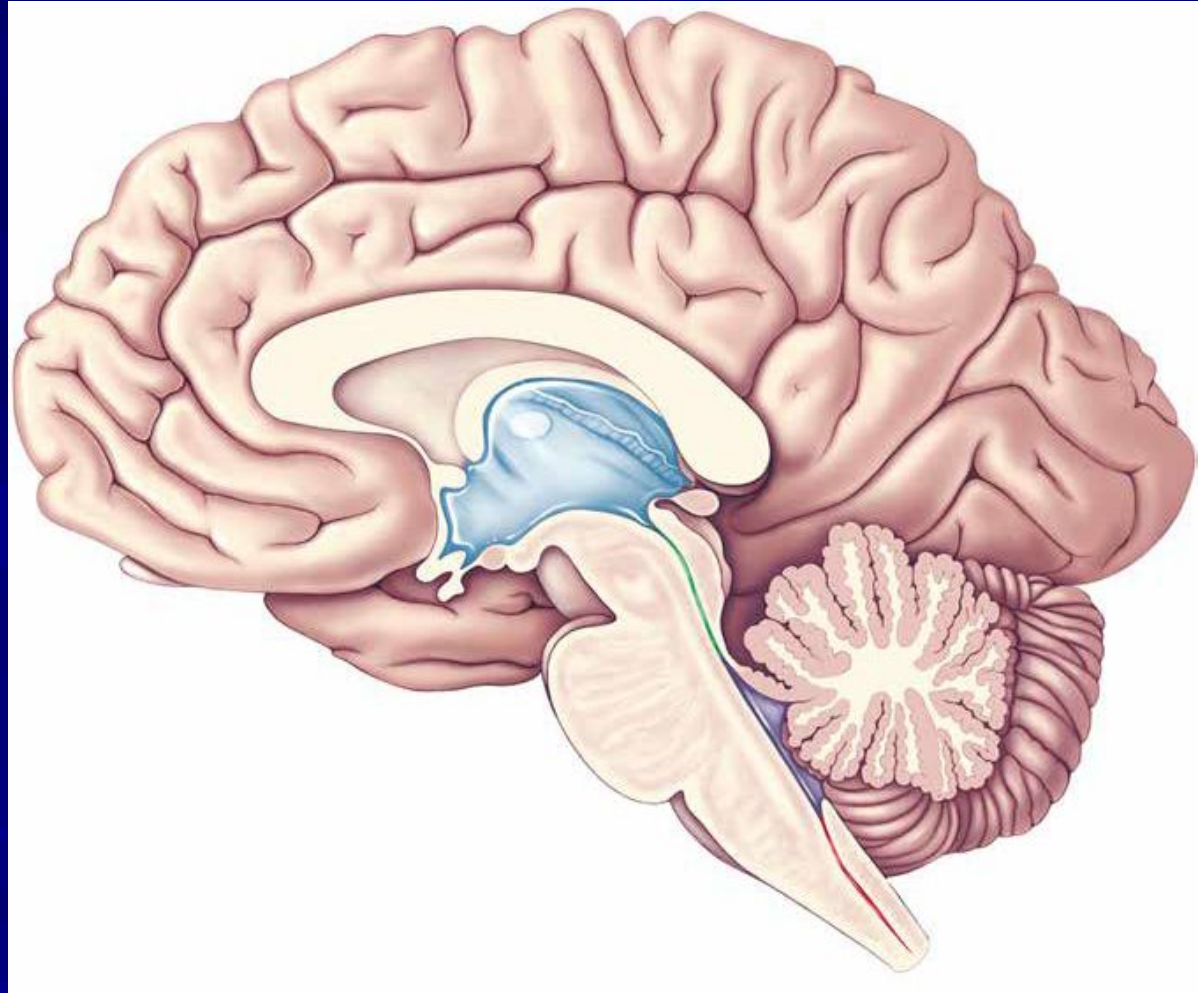
1. **The amygdala** is an important structure for regulating emotional states
2. **The hippocampus** is important for memory



Anatomy of the human brain

Ventricles

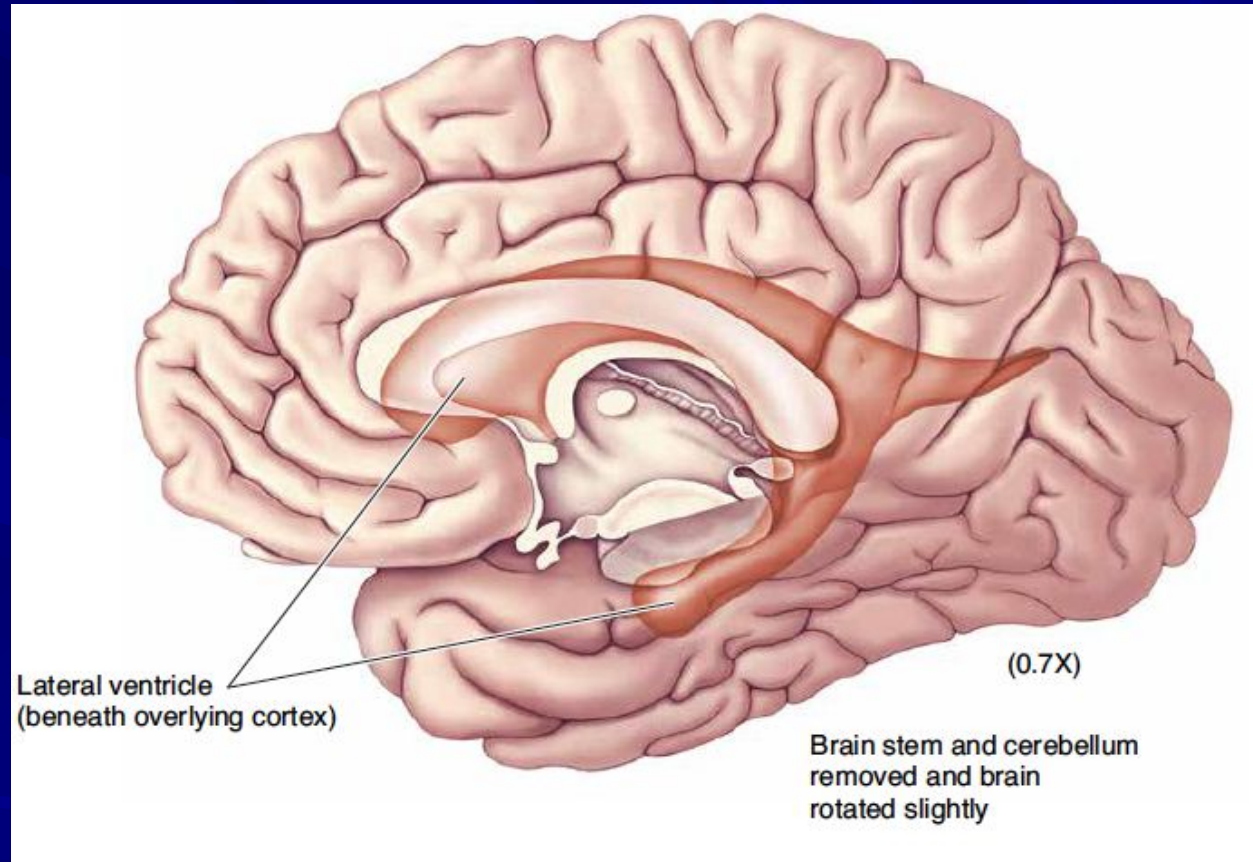
- 1.the third ventricle
- 2.the cerebral aqueduct
- 3.the fourth ventricle
- 4.the spinal canal



Anatomy of the human brain

Ventricles

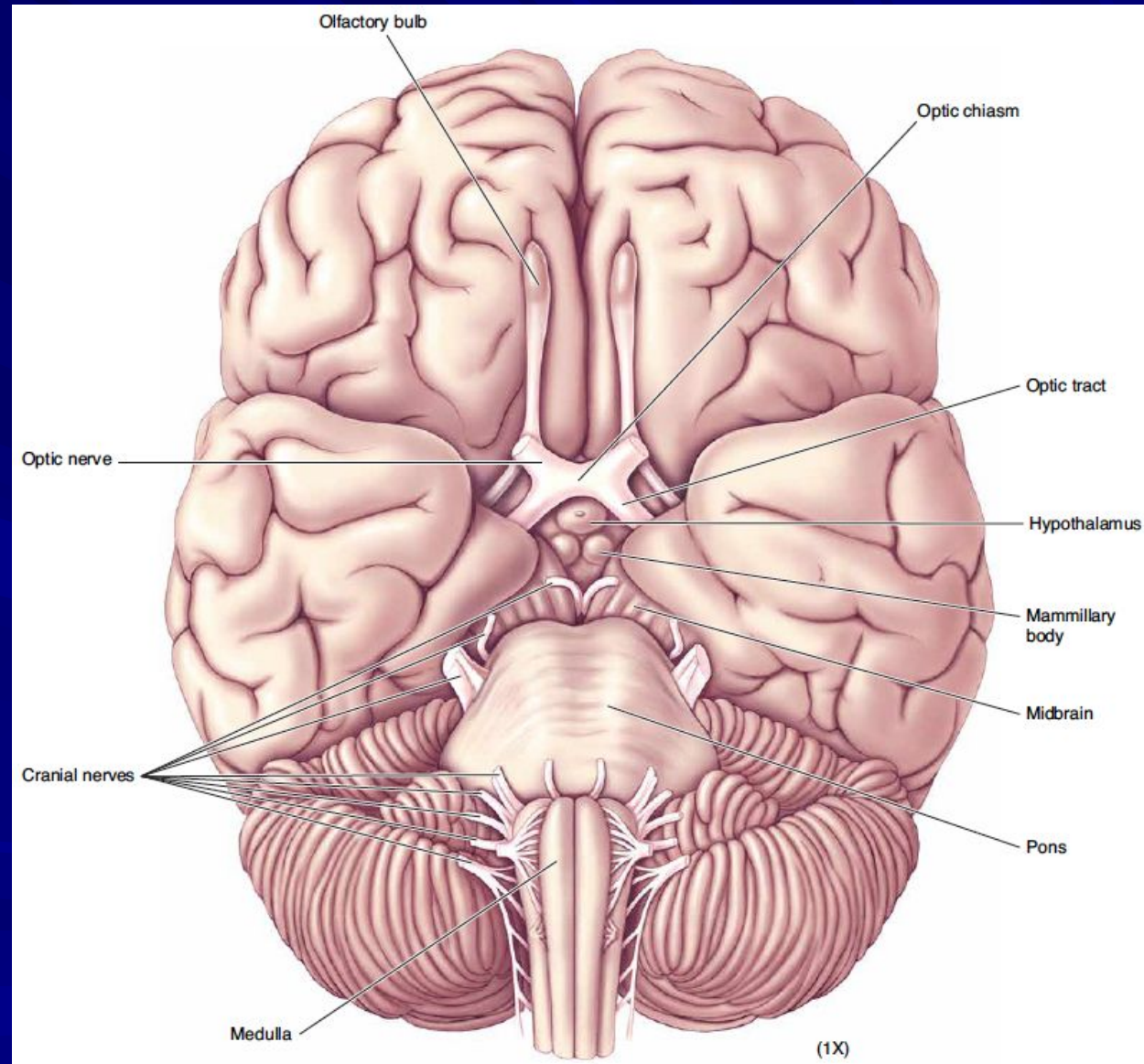
- The lateral ventricles are paired structures that sprout like antlers from the third ventricle.
- The two cerebral hemispheres surround the two lateral ventricles.



Anatomy of the human brain

The Ventral Surface of the Brain

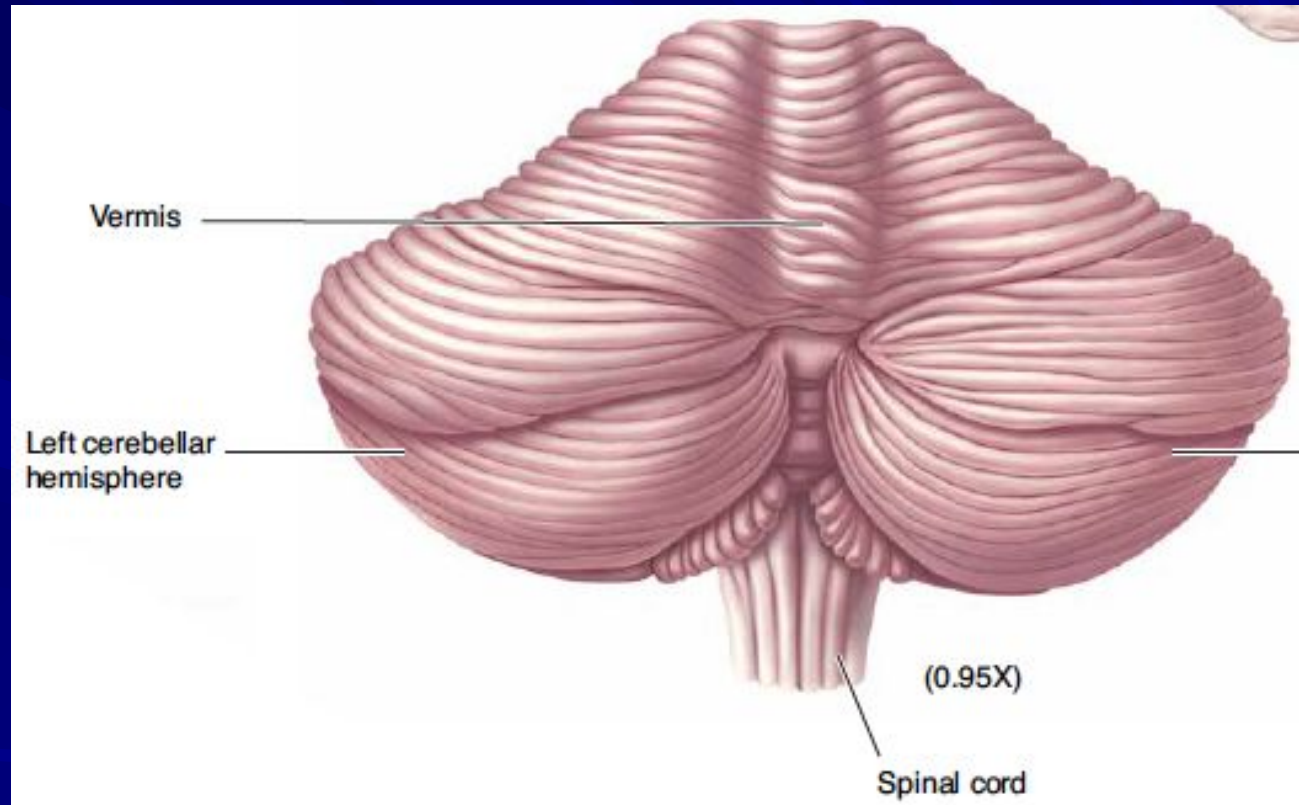
- the **cranial nerves**
- the optic chiasm
- the **optic nerves**
- the **optic tracts**
- the paired **mammillary bodies** (part of the circuitry that stores memory)
- olfactory bulbs**
- the **midbrain**
- pons**
- medulla**



Anatomy of the human brain

The cerebellum

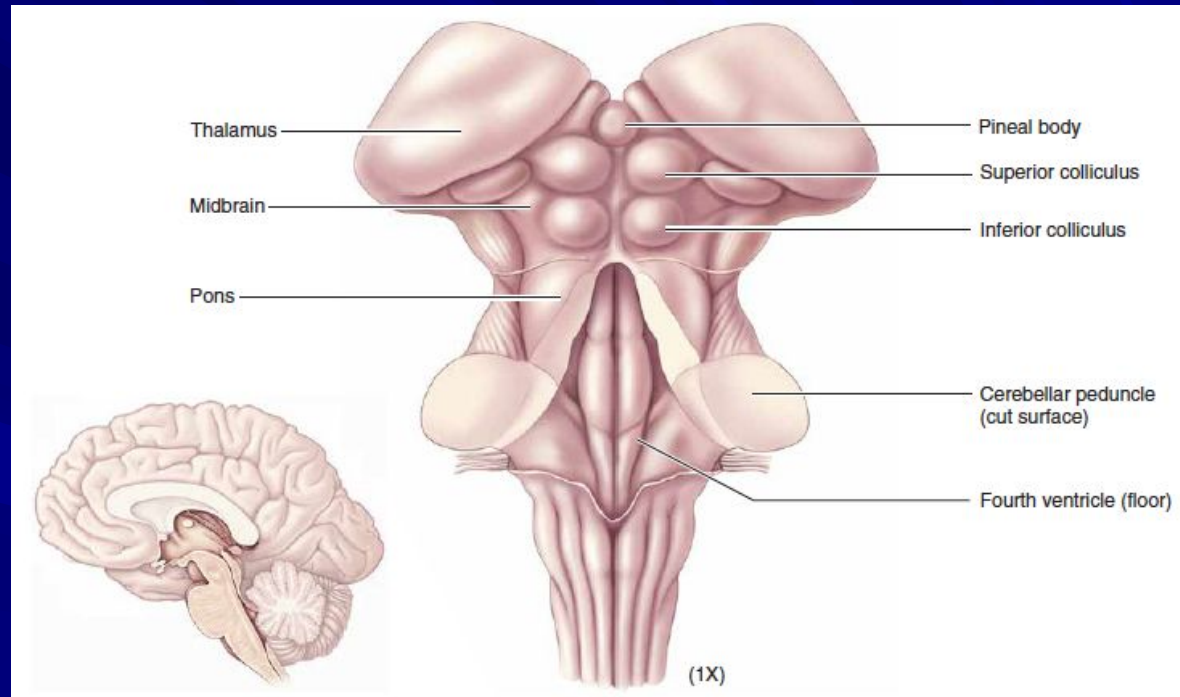
- two hemispheres
- the vermis (midline region)



Anatomy of the human brain

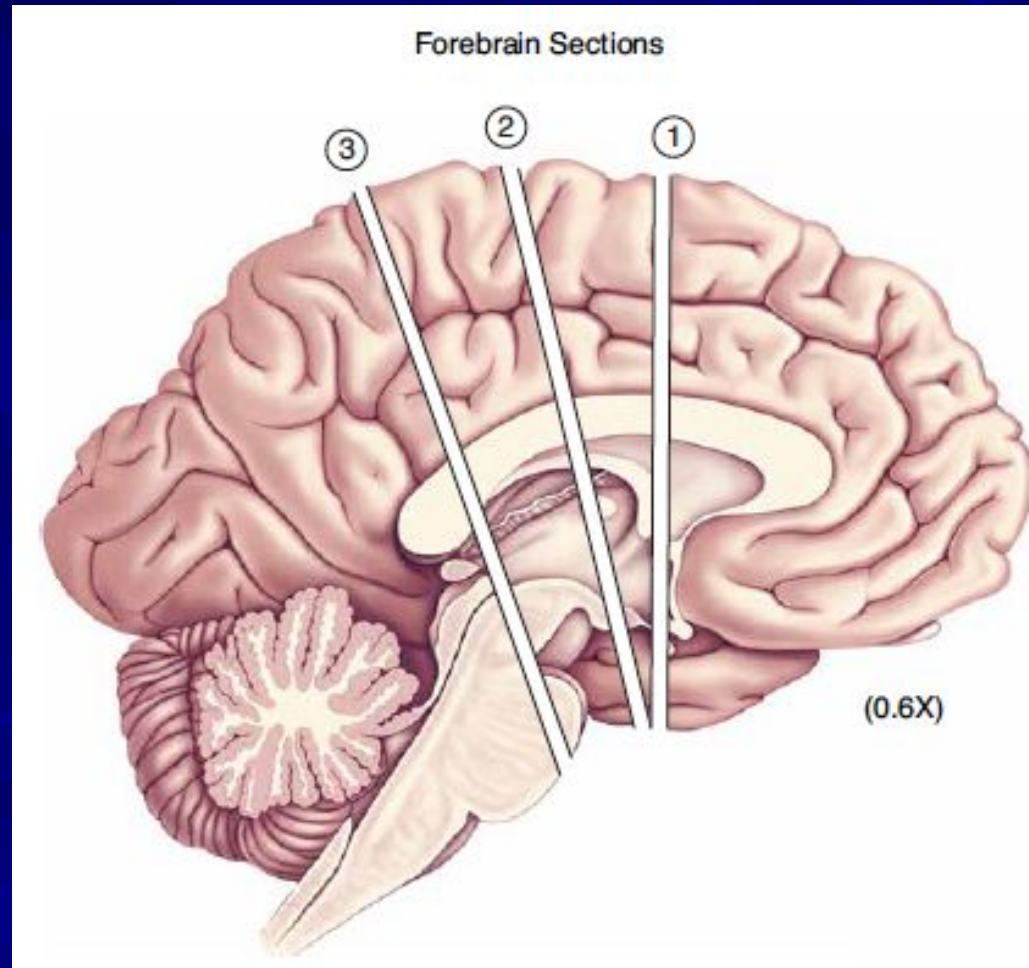
The brain stem

- **the pineal body** (involved in the regulation of sleep and sexual behavior)
- **the superior colliculus** (involved in the control of eye movements)
- **the inferior colliculus** (important component of the auditory system)
- **the cerebellar peduncles** (the large bundles of axons that connect the cerebellum and the brain stem)



Cross-sectional anatomy of the brain

Cross Section 1: Forebrain at Thalamus–Telencephalon Junction

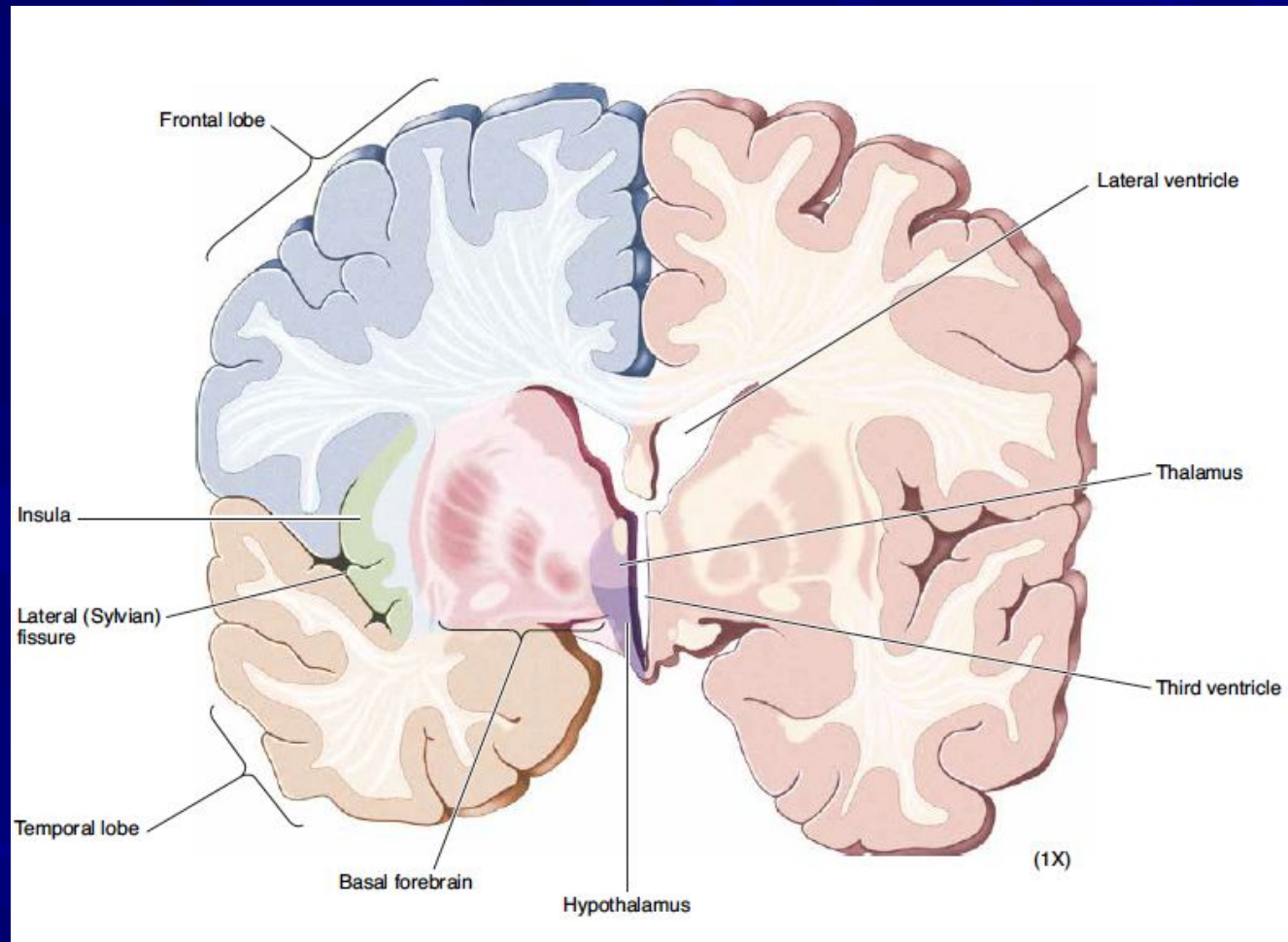


Cross-sectional anatomy of the brain

Cross Section 1: Forebrain at Thalamus–Telencephal on Junction

(a) Gross Features

- the lateral ventricles
- the third ventricle
- the thalamus
- the hypothalamus (a vital control center for many basic bodily functions)
- the insula
- the lateral (Sylvian) fissure
- the basal forebrain



Cross-sectional anatomy of the brain

Cross Section 1:
Forebrain at
Thalamus–Telencephalon
Junction

(b) Selected Fiber
Groups

1. cortical white matter

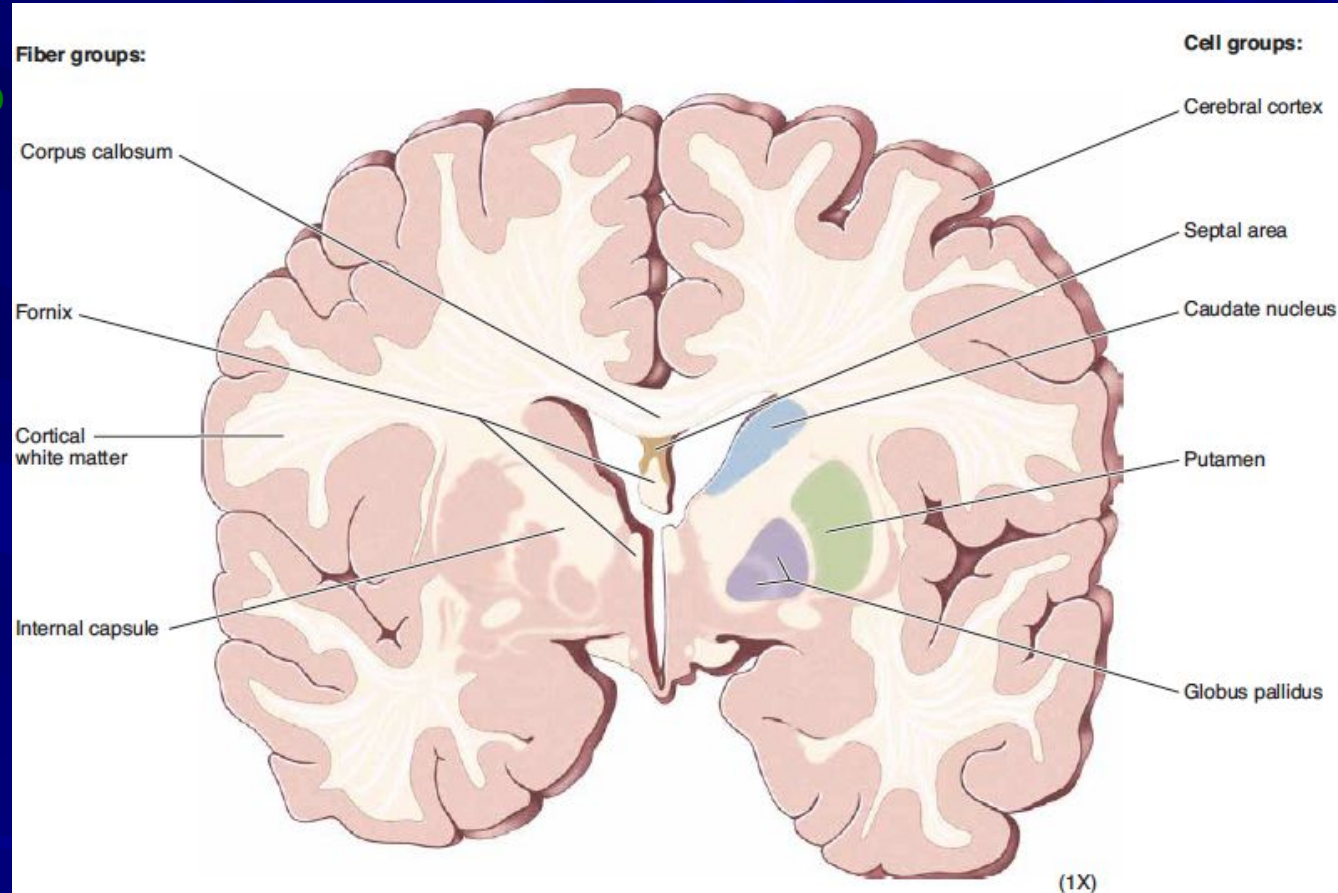
2. internal capsule

(connecting the cortical
white matter with the
brain stem)

3. corpus callosum

(connecting the cerebral
cortex of the two
hemispheres)

4. fornix



Cross-sectional anatomy of the brain

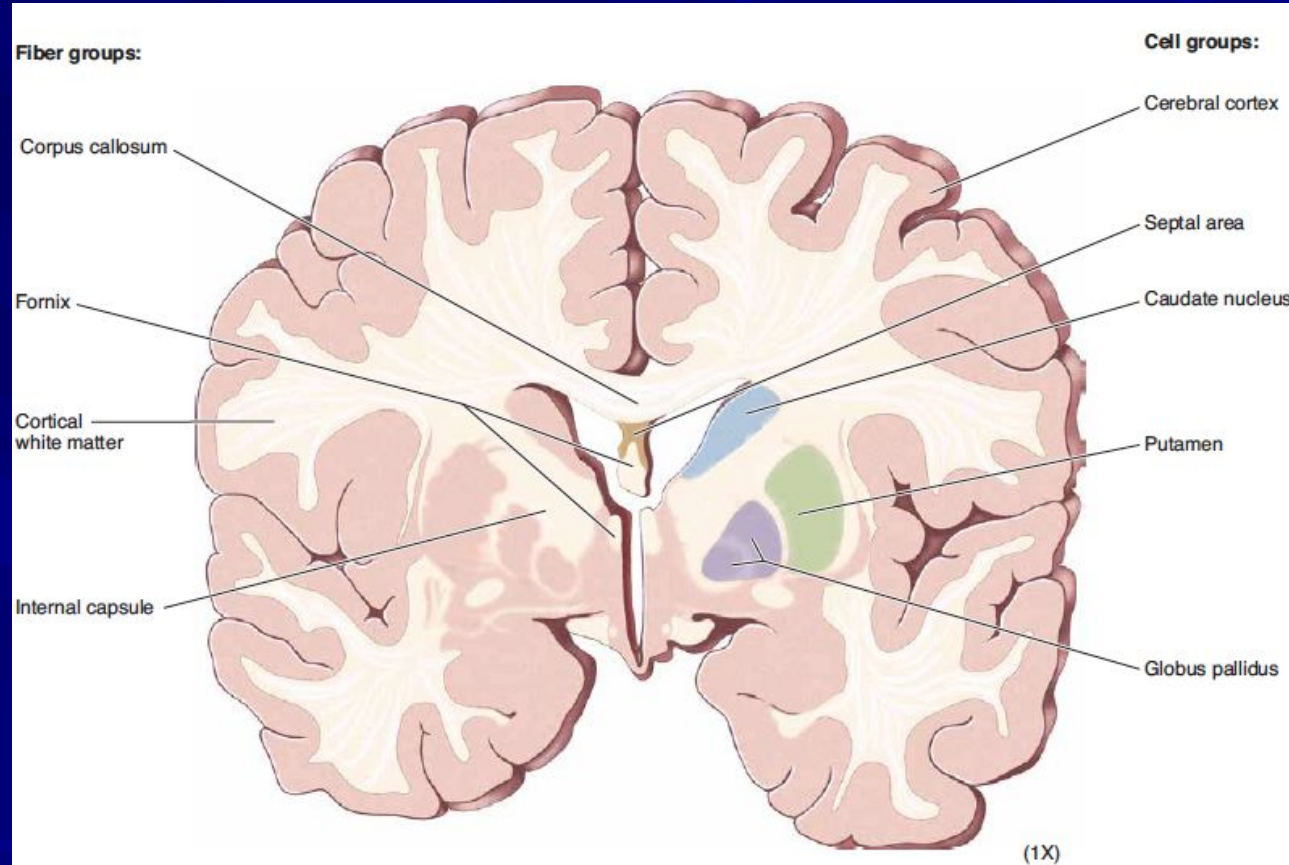
Cross Section 1: Forebrain at Thalamus–Telencephalon Junction

(b) Selected Cell Groups

- **Basal ganglia** (important part of the brain systems that control movement)

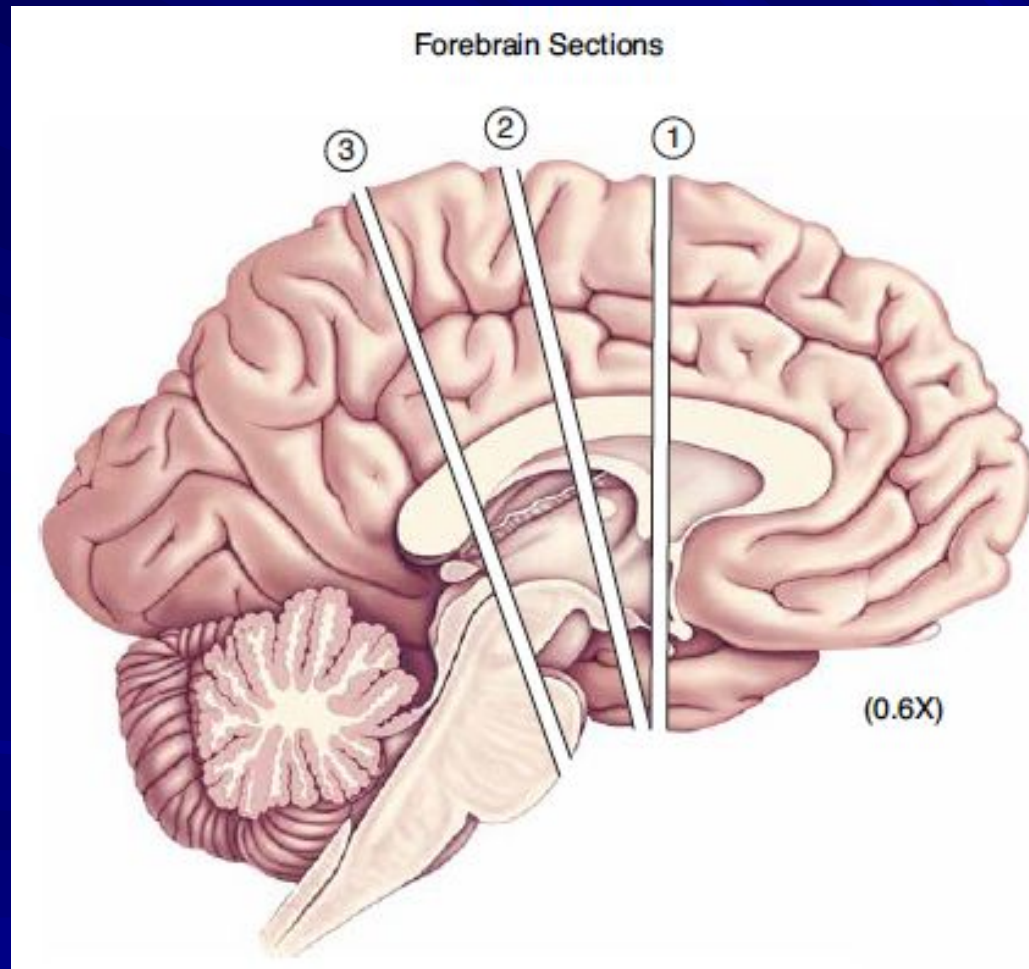
1. **caudate nucleus**
2. **putamen**
3. **globus pallidus.**

- **Septal area** (contribute axons to the fornix and are involved in memory storage)



Cross-sectional anatomy of the brain

Cross Section 2: Forebrain at Mid-Thalamus



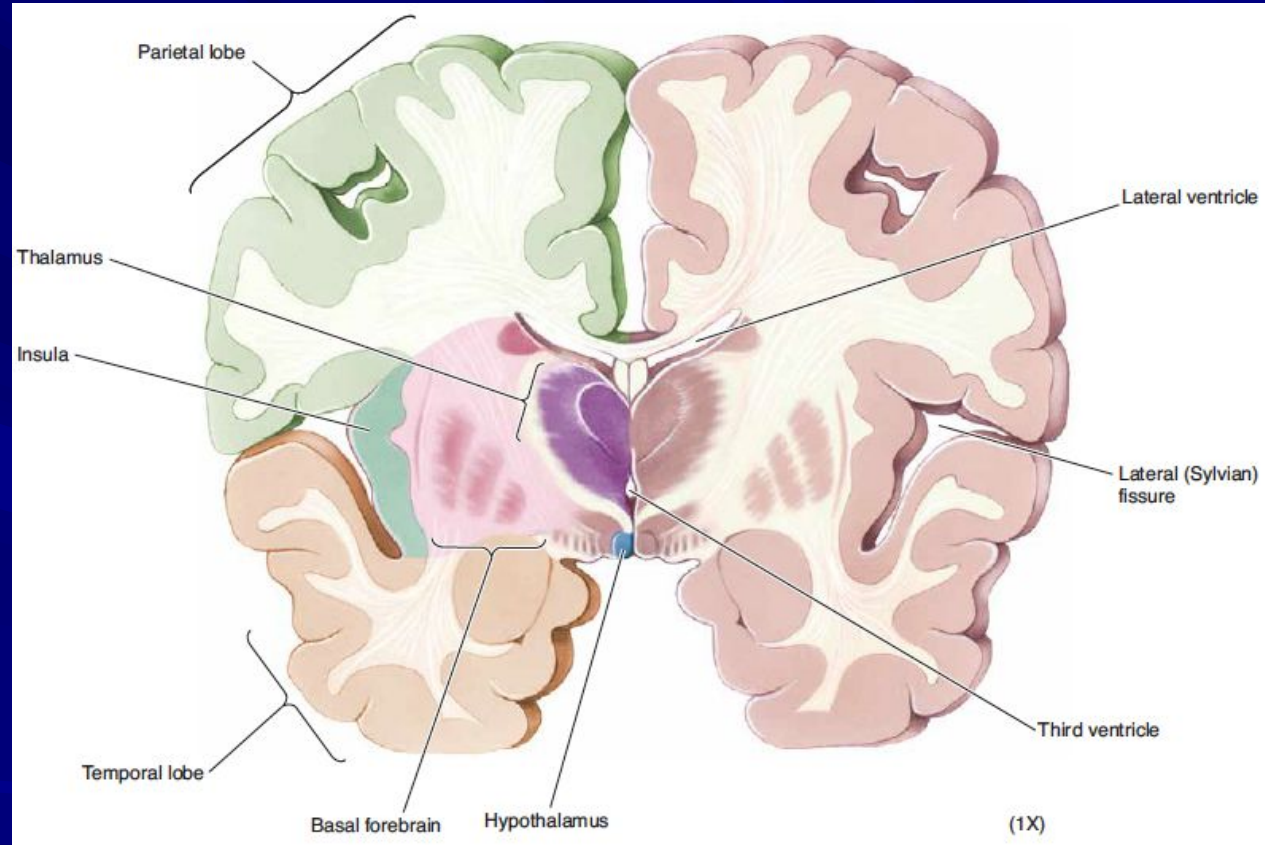
Cross-sectional anatomy of the brain

Cross Section 2: Forebrain at Mid-Thalamus

(a) Gross Features

As we move slightly caudal in the

- **thalamus**
- **hypothalamus.**
- **lateral fissure** (separates the parietal lobe from the temporal lobe).

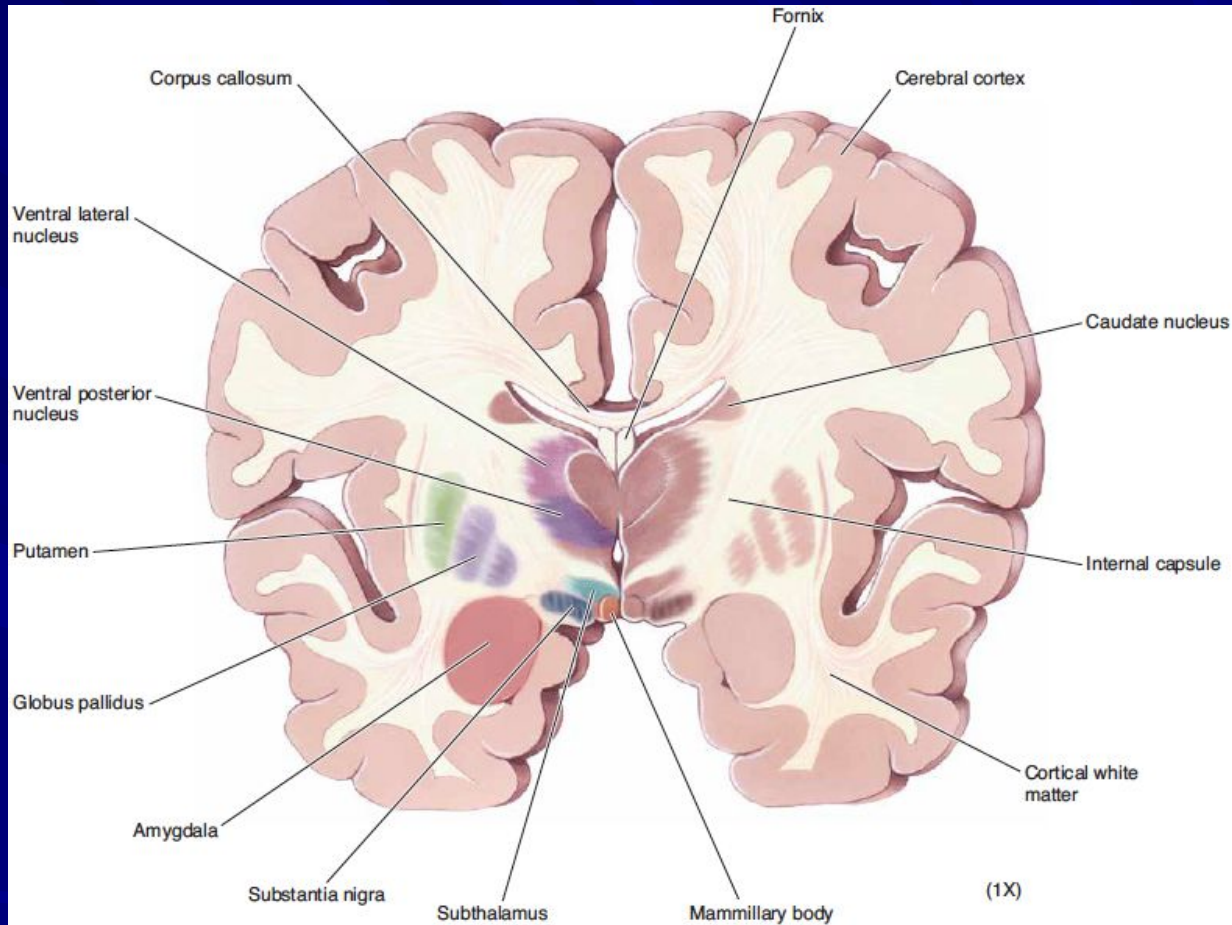


Cross-sectional anatomy of the brain

Cross Section 2: Forebrain at Mid-Thalamus

(b) Selected Cell Groups.

- the **amygdala** (involved in the regulation of emotion and memory)
- The **ventral posterior nucleus** (part of the somatic sensory system and projects to the cortex of the postcentral gyrus).
- The **ventral lateral nucleus** (parts of the motor system and project to the motor cortex of the precentral gyrus)

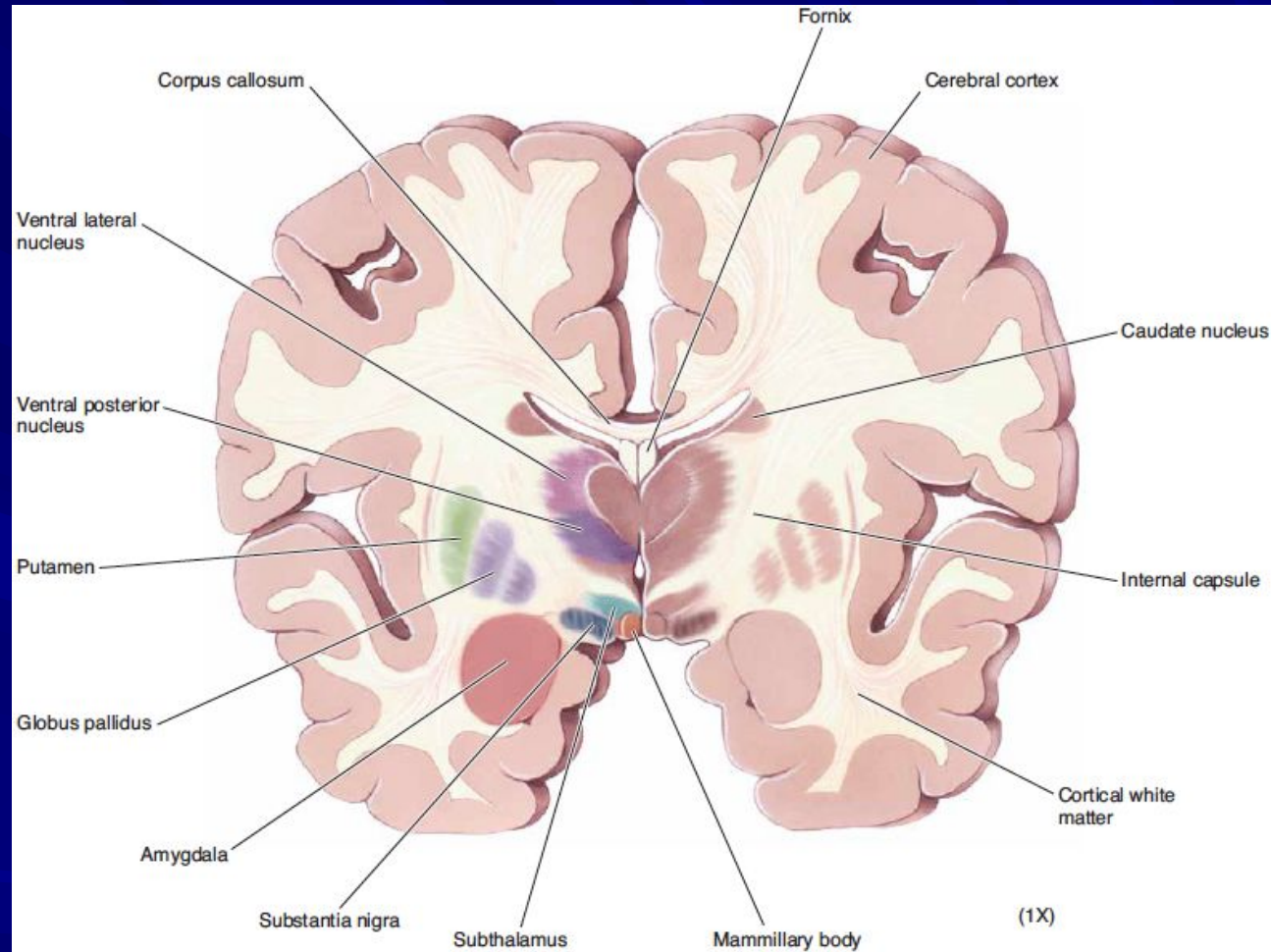


Cross-sectional anatomy of the brain

Cross Section 2: Forebrain at Mid-Thalamus

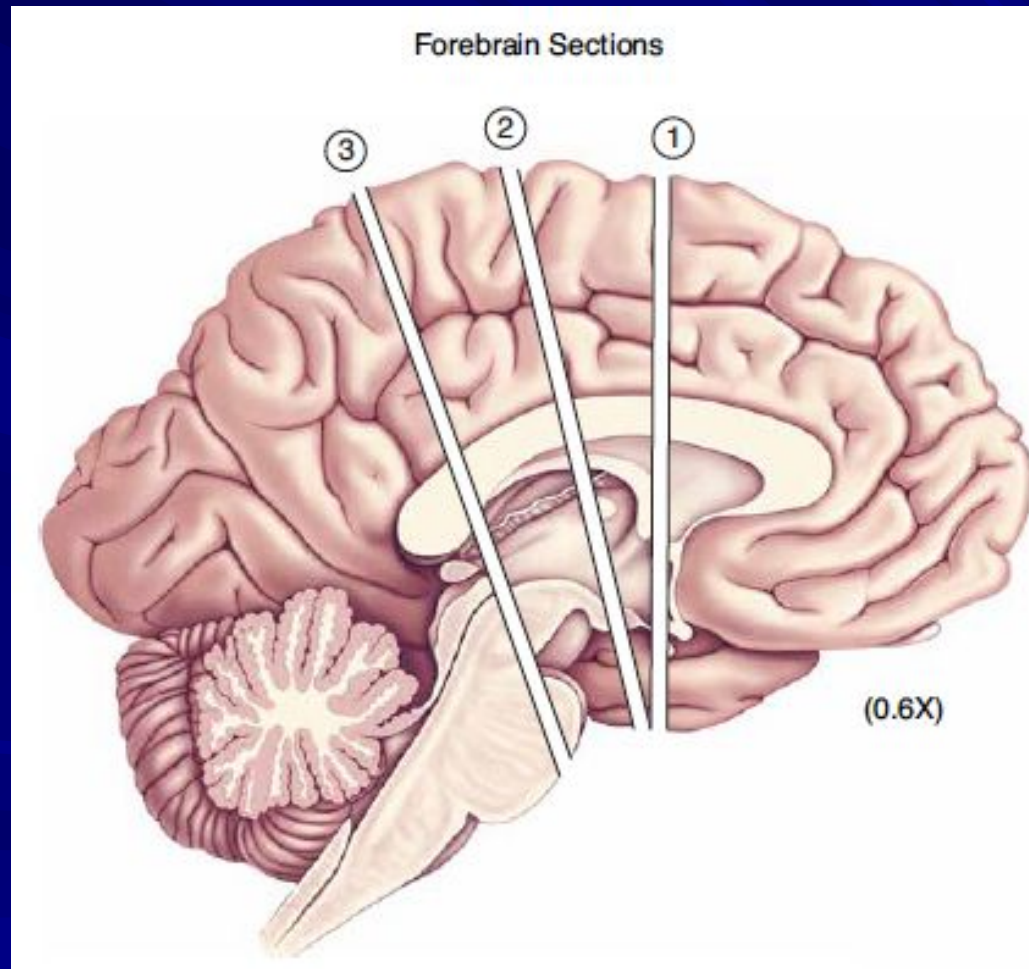
(b) Selected Cell Groups.

- the **subthalamus** (part of the motor system)
- the **mammillary bodies** (contribute to the regulation of memory)
- the **substantia nigra** (part of the motor system. Parkinson's disease results from the degeneration of this structure)



Cross-sectional anatomy of the brain

Cross Section 3: Forebrain at Thalamus–Midbrain Junction

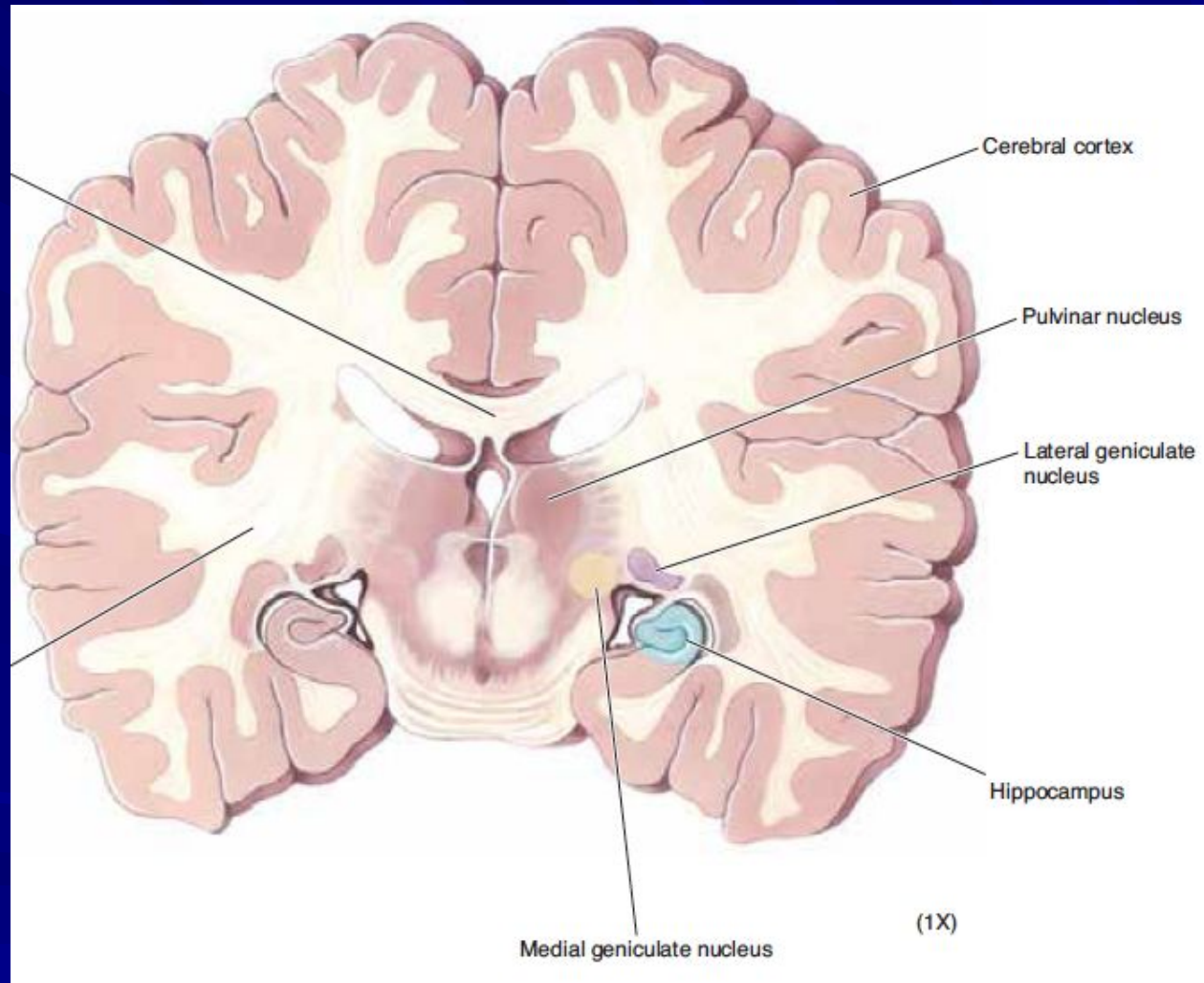


Cross-sectional anatomy of the brain

Cross Section 3: Forebrain at Thalamus–Midbrain Junction

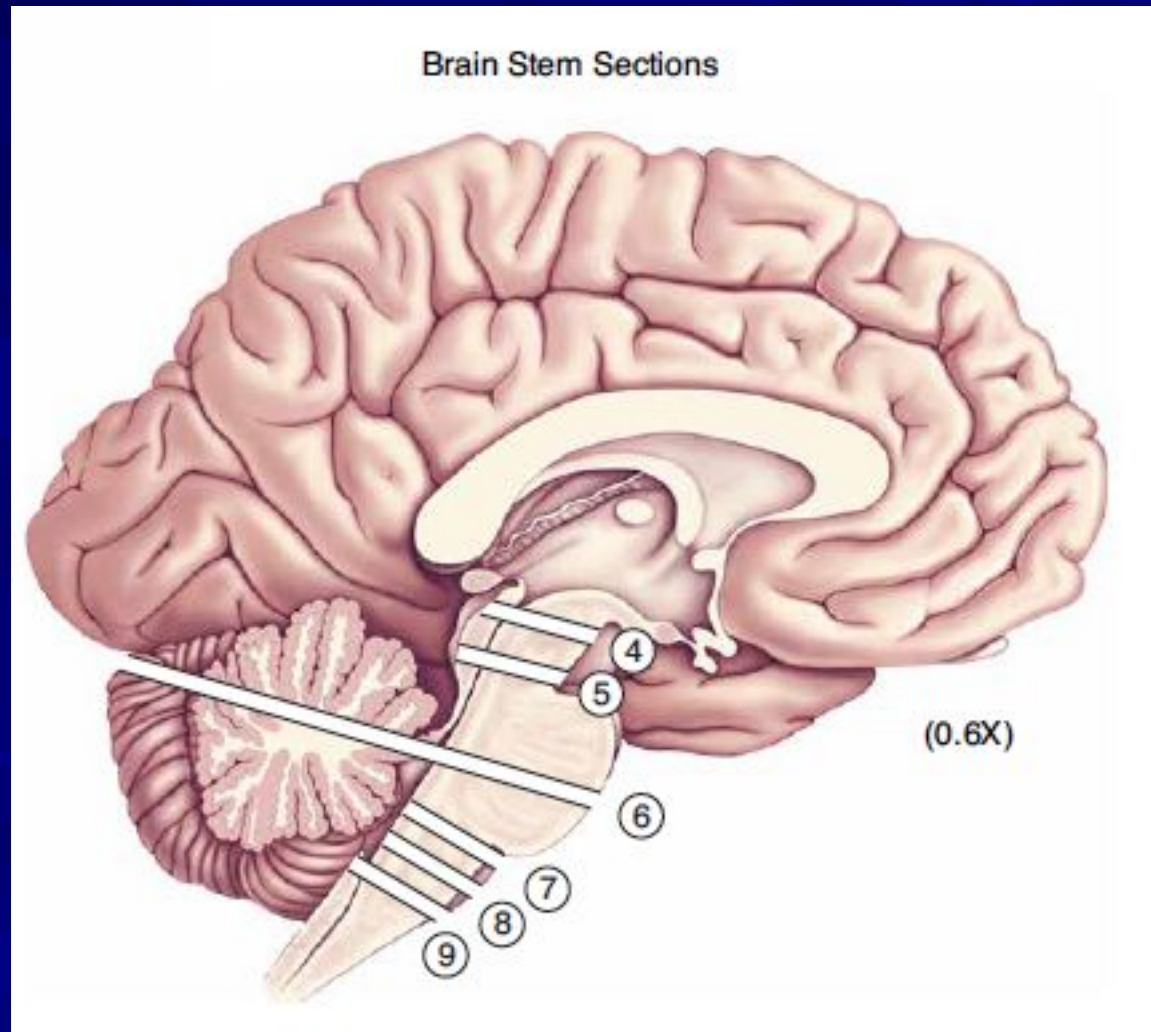
Selected Cell Groups

- the **pulvinar nucleus** (plays a role in guiding attention)
- the **lateral geniculate nucleus** (relays information to the visual cortex)
- the **medial geniculate nucleus** (relays information to the auditory cortex)
- the **hippocampus** (plays an important role in learning and memory)



Cross-sectional anatomy of the brain

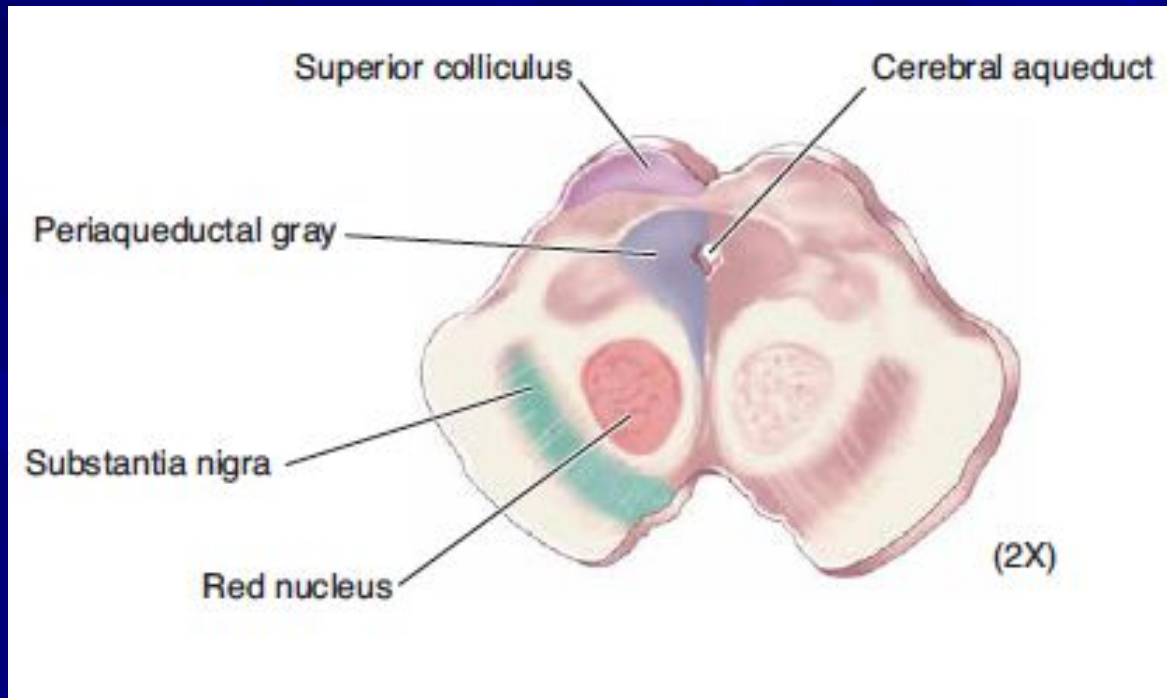
Cross Section 4: Rostral Midbrain



Cross-sectional anatomy of the brain

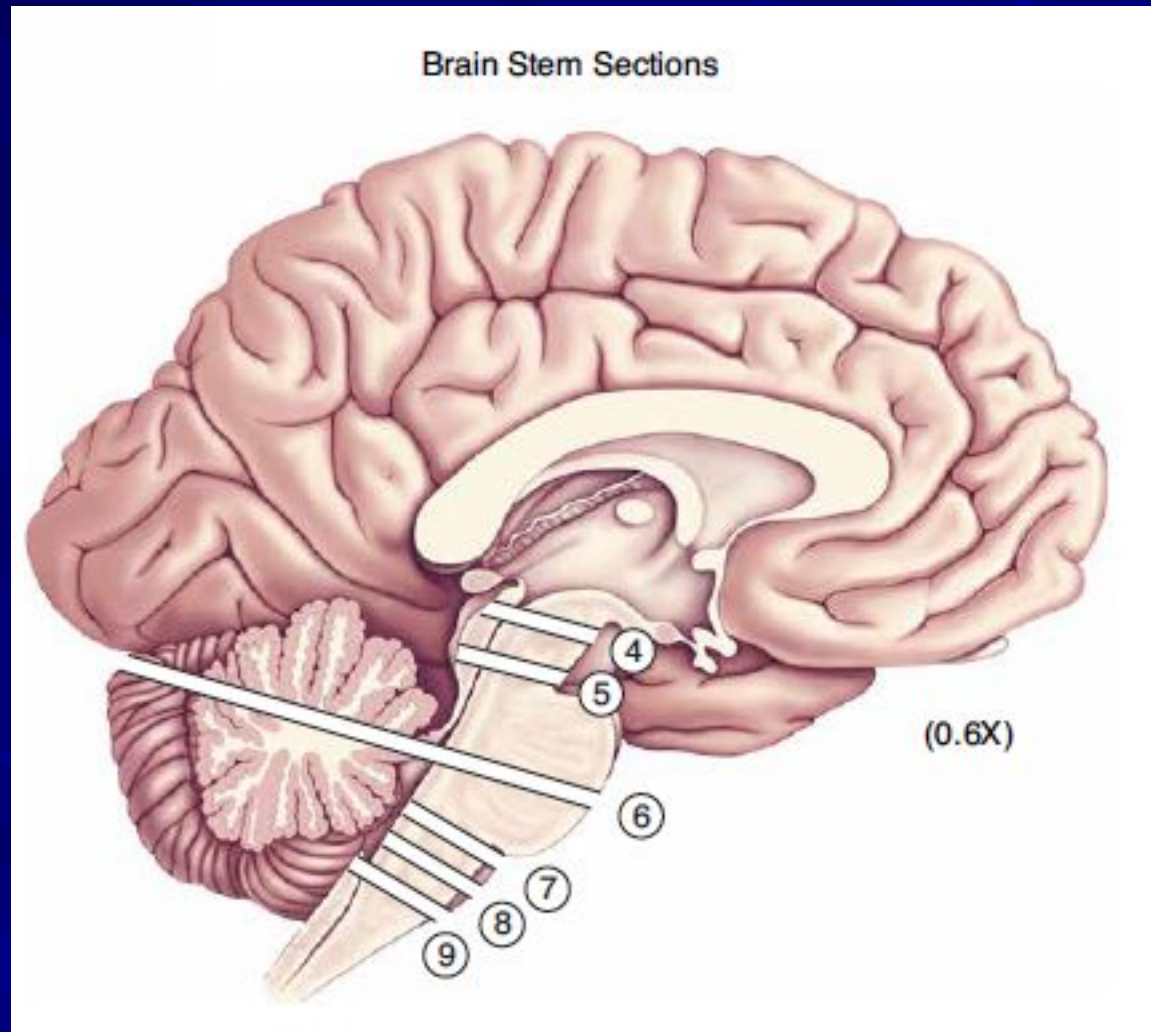
Cross Section 4: Rostral Midbrain

- the **cerebral aqueduct**
- the **tectum** (consists of the paired **superior colliculus**)
- the **substantia nigra** (part of the motor system)
- the **red nucleus** (motor control structure)
- the **periaqueductal gray** (important in the control of the somatic pain sensations)



Cross-sectional anatomy of the brain

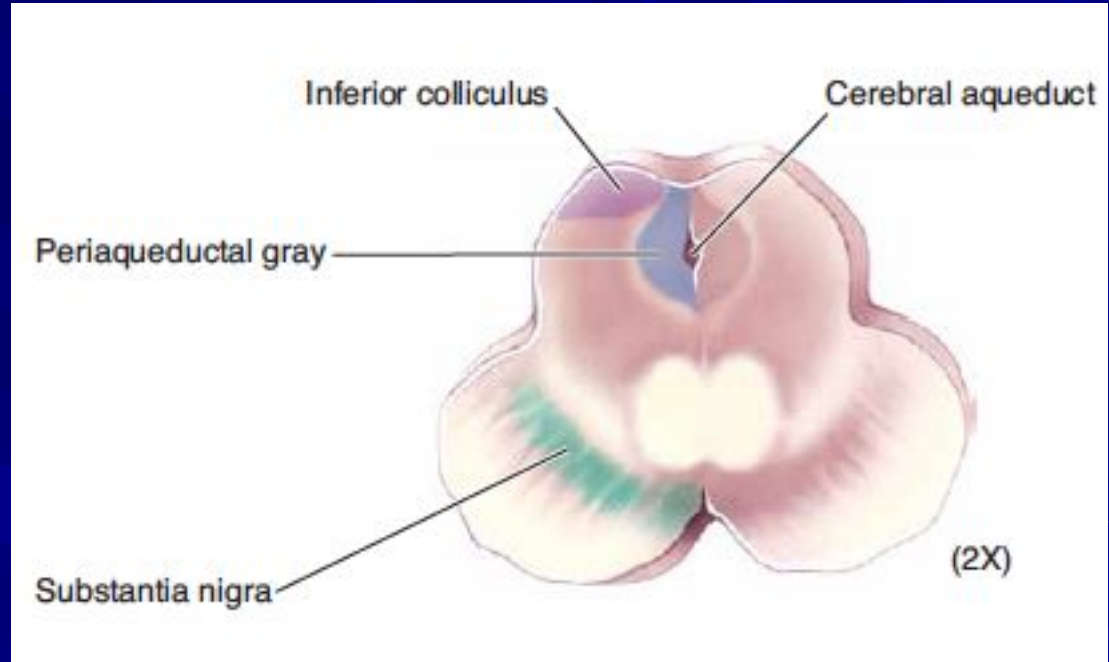
Cross Section 5: Caudal Midbrain



Cross-sectional anatomy of the brain

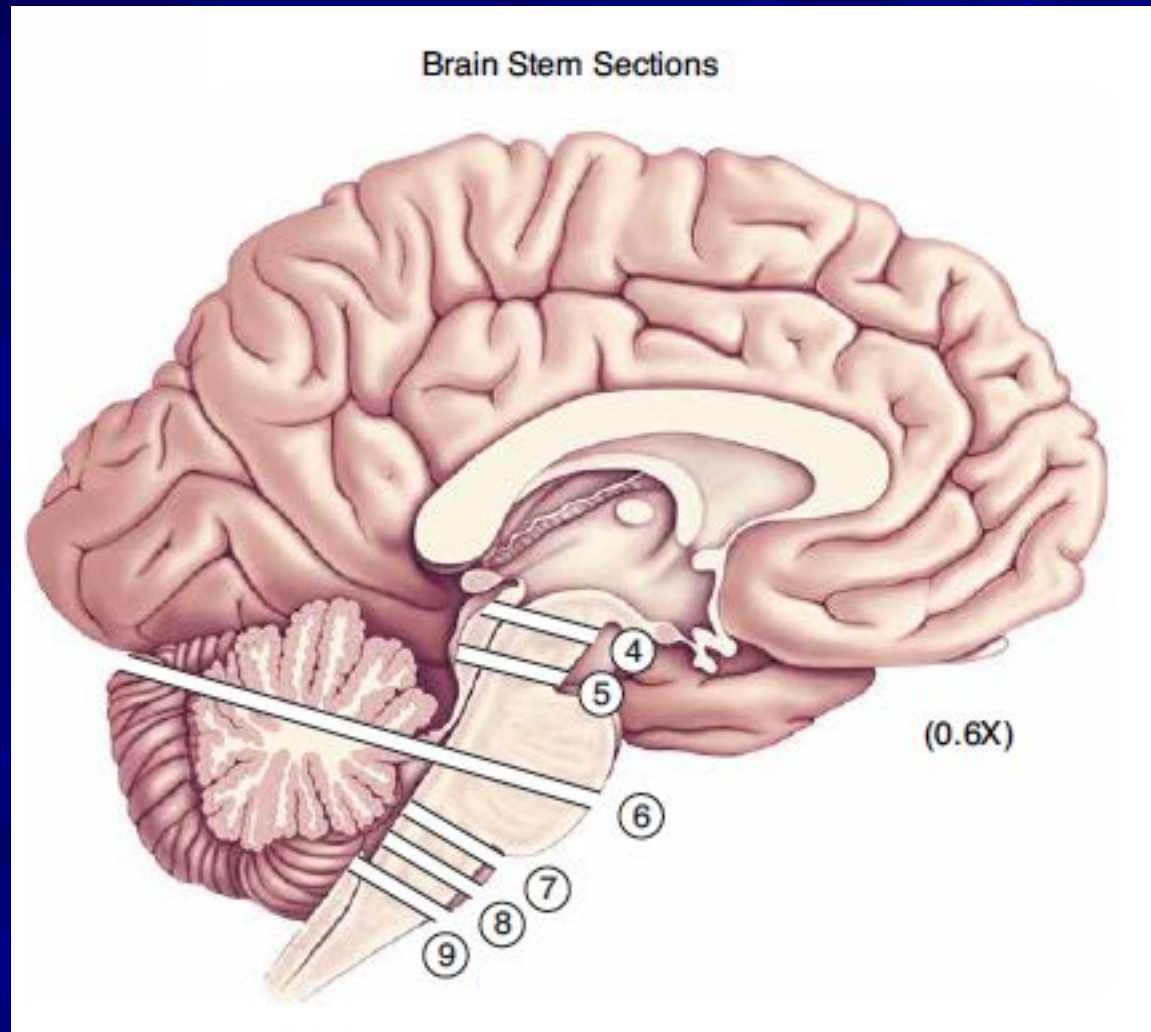
Cross Section 4: Caudal Midbrain

- the cerebral aqueduct
- the tectum (consists of the paired inferior colliculus)
- the substantia nigra
- periaqueductal gray



Cross-sectional anatomy of the brain

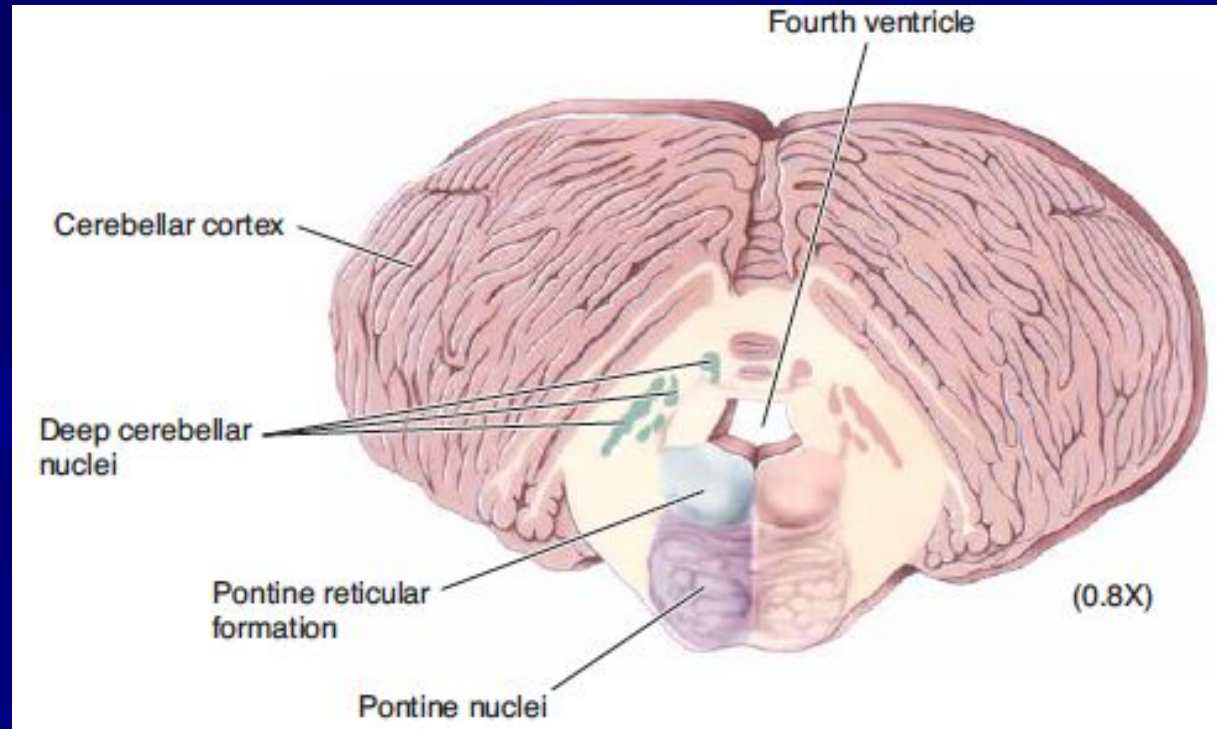
Cross Section 6: Pons and Cerebellum



Cross-sectional anatomy of the brain

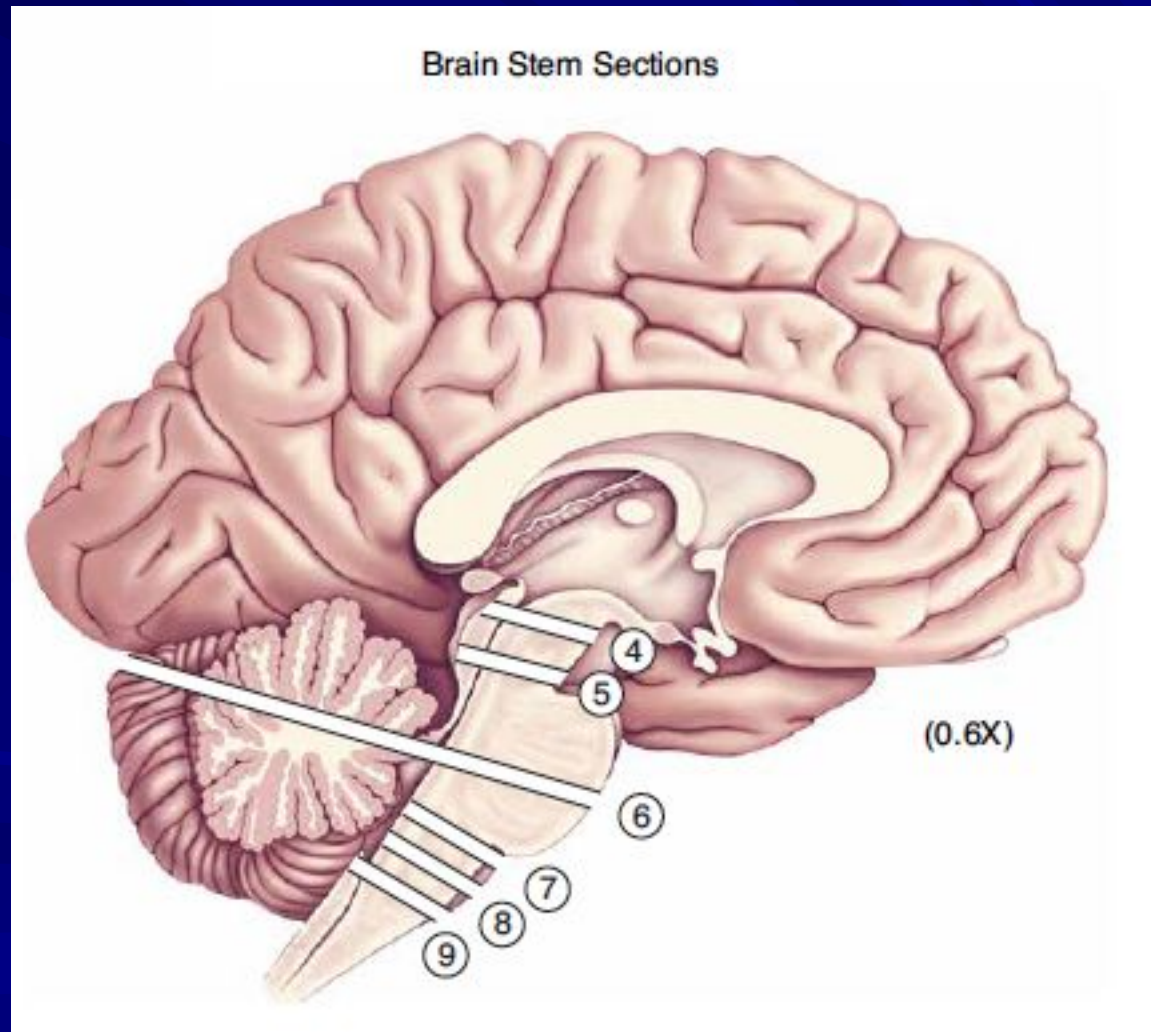
Cross Section 6: Pons and Cerebellum

- **pontine nuclei** (the input to the cerebellar cortex)
- **deep cerebellar nuclei** (the output of the cerebellum).
- **reticular formation** (regulate sleep and wakefulness, control body posture)



Cross-sectional anatomy of the brain

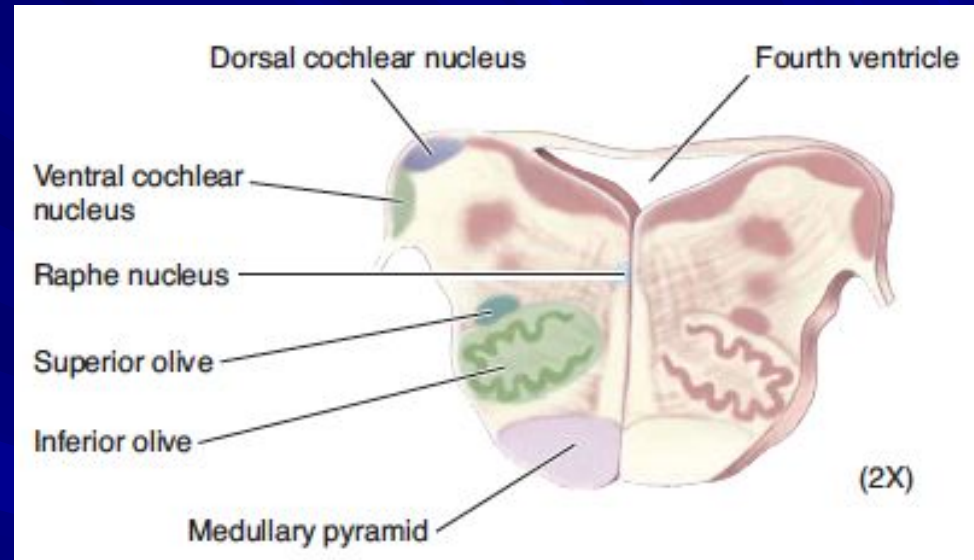
Cross Section 7: Rostral Medulla



Cross-sectional anatomy of the brain

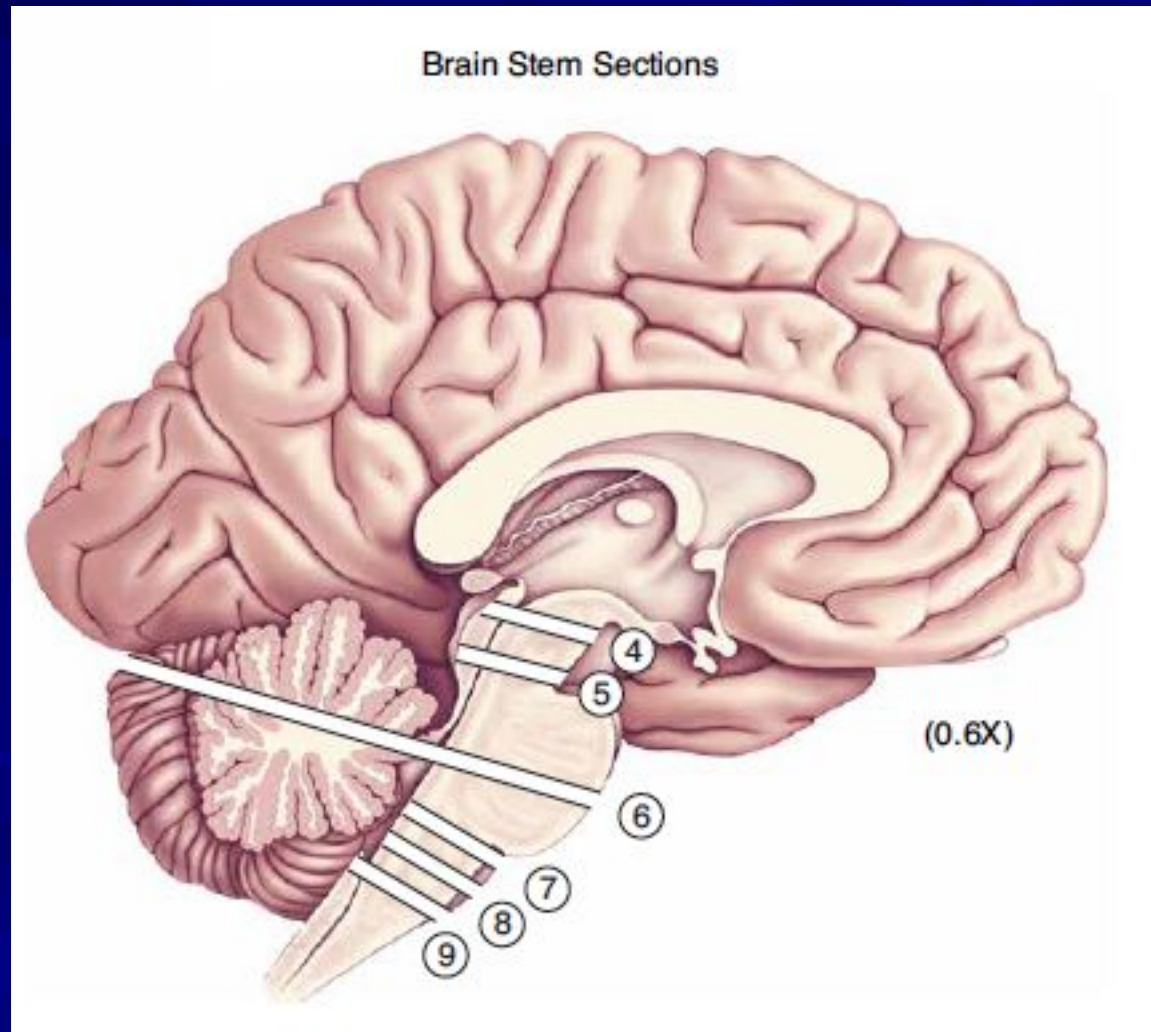
Cross Section 7: Rostral Medulla

- **Medullary pyramids** (contain the corticospinal tracts, which are involved in the control of voluntary movement)
- Several nuclei that are important for hearing:
 1. **dorsal cochlear nuclei**
 2. **ventral cochlear nuclei**
 3. **superior olive**
- **Inferior olive** (important for motor control)
- **Raphe nucleus** (important for the modulation of pain, mood, and wakefulness)



Cross-sectional anatomy of the brain

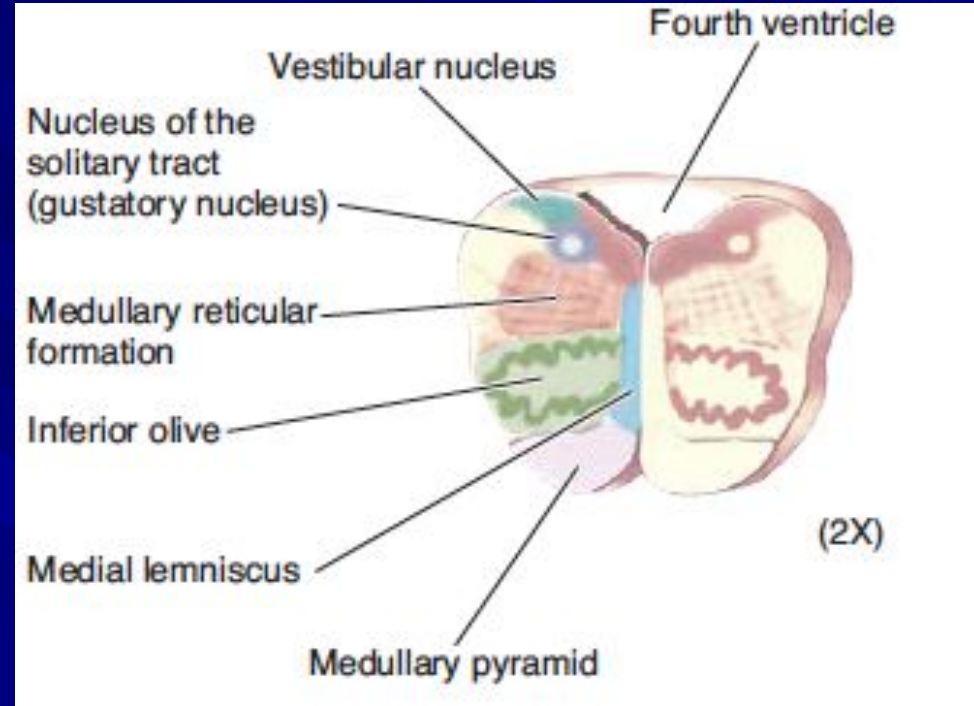
Cross Section 8: Mid-Medulla



Cross-sectional anatomy of the brain

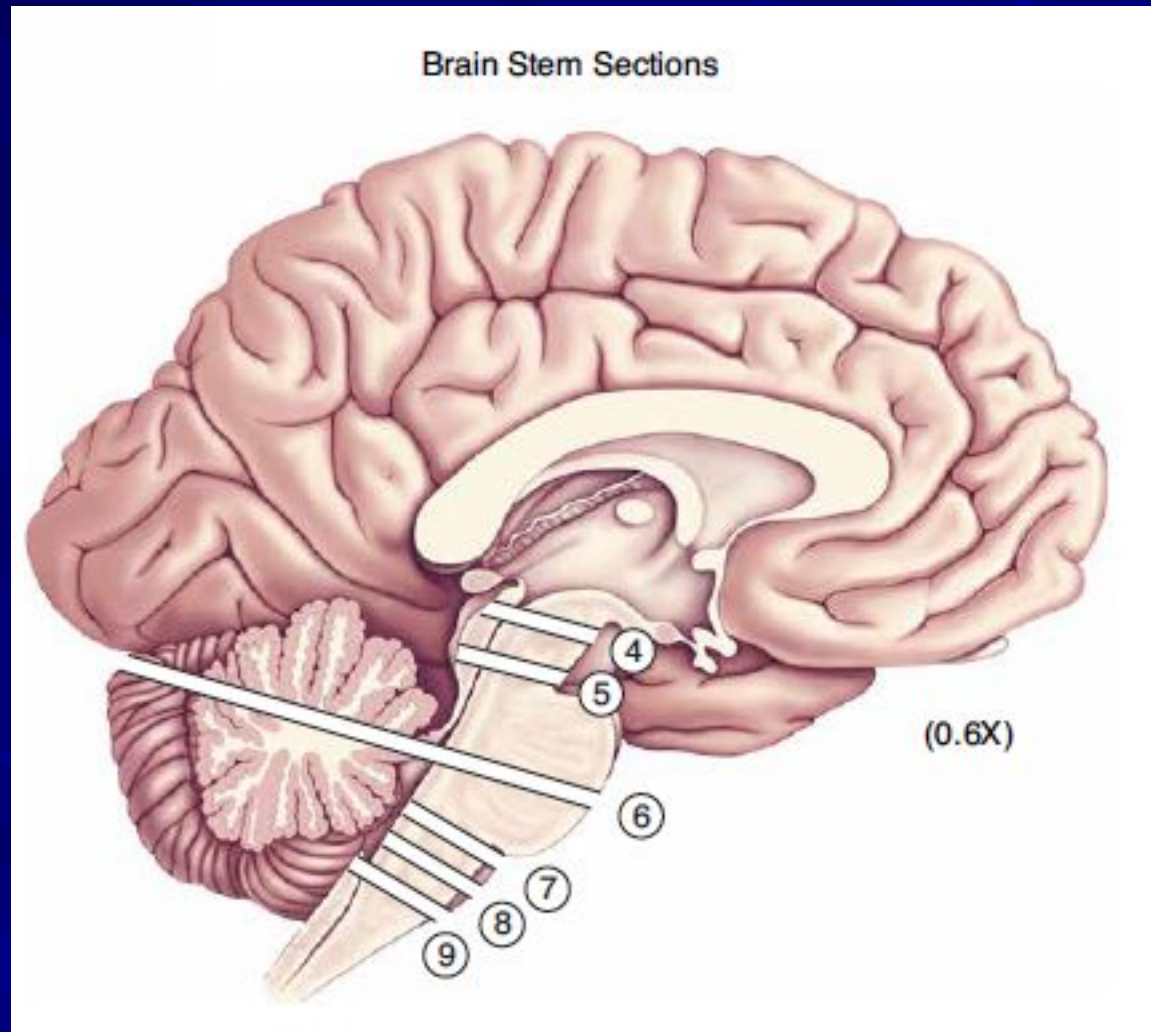
Cross Section 8: Mid-Medulla

- **The medial lemniscus** (contains axons bringing information about somatic sensation to the thalamus).
- **The gustatory nucleus** (part of the larger solitary nucleus, serves the sense of taste).
- **The vestibular nuclei** (serve the sense of balance).



Cross-sectional anatomy of the brain

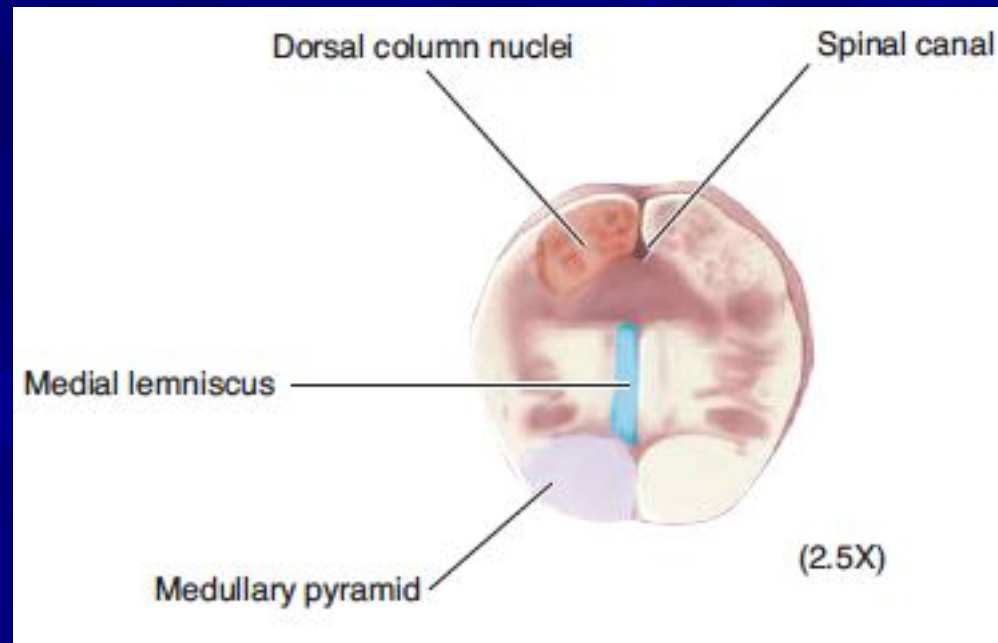
Cross Section 9: Medulla–Spinal Cord Junction



Cross-sectional anatomy of the brain

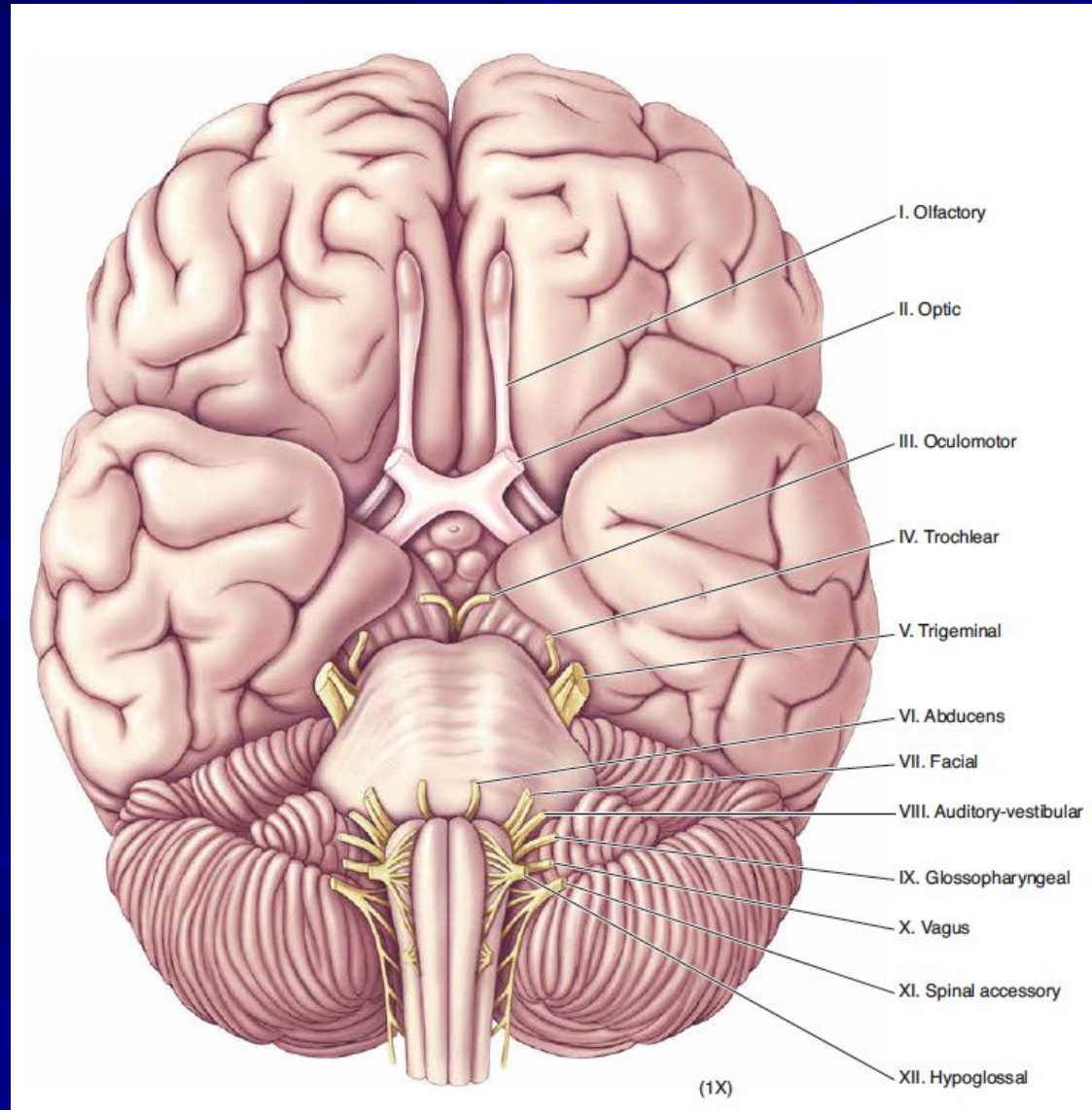
Cross Section 9: Medulla–Spinal Cord Junction

- the **dorsal column nuclei** (receive somatic sensory information from the spinal cord)
- Axons arising from the neurons in each dorsal column nucleus cross to the other side of the brain and ascend to the thalamus via the medial lemniscus.



The cranial nerves

- **Twelve pairs of cranial nerves** emerge from the base of the brain.
- Single nerve often has fibers performing many different functions.
- The first two “nerves” are parts of the CNS, serving olfaction and vision.
- The cranial nerves have associated **cranial nerve nuclei** in the midbrain, pons, and medulla





The cranial nerves

NERVE NUMBER AND NAME	TYPES OF AXONS	IMPORTANT FUNCTIONS
I. Olfactory	Special sensory	Sensation of smell
II. Optic	Special sensory	Sensation of vision
III. Oculomotor	Somatic motor Visceral motor	Movements of the eye and eyelid Parasympathetic control of pupil size
IV. Trochlear	Somatic motor	Movements of the eye
V. Trigeminal	Somatic sensory Somatic motor	Sensation of touch to the face Movement of muscles of mastication (chewing)
VI. Abducens	Somatic motor	Movements of the eye
VII. Facial	Somatic sensory Special sensory	Movement of muscles of facial expression Sensation of taste in anterior two-thirds of the tongue
VIII. Auditory-vestibular	Special sensory	Sensation of hearing and balance
IX. Glossopharyngeal	Somatic motor Visceral motor Special sensory Visceral sensory	Movement of muscles in the throat (oropharynx) Parasympathetic control of the salivary glands Sensation of taste in posterior one-third of the tongue Detection of blood pressure changes in the aorta
X. Vagus	Visceral motor Visceral sensory Somatic motor	Parasympathetic control of the heart, lungs, and abdominal organs Sensation of pain associated with viscera Movement of muscles in the throat (oropharynx)
XI. Spinal accessory	Somatic motor	Movement of muscles in the throat and neck
XII. Hypoglossal	Somatic motor	Movement of the tongue

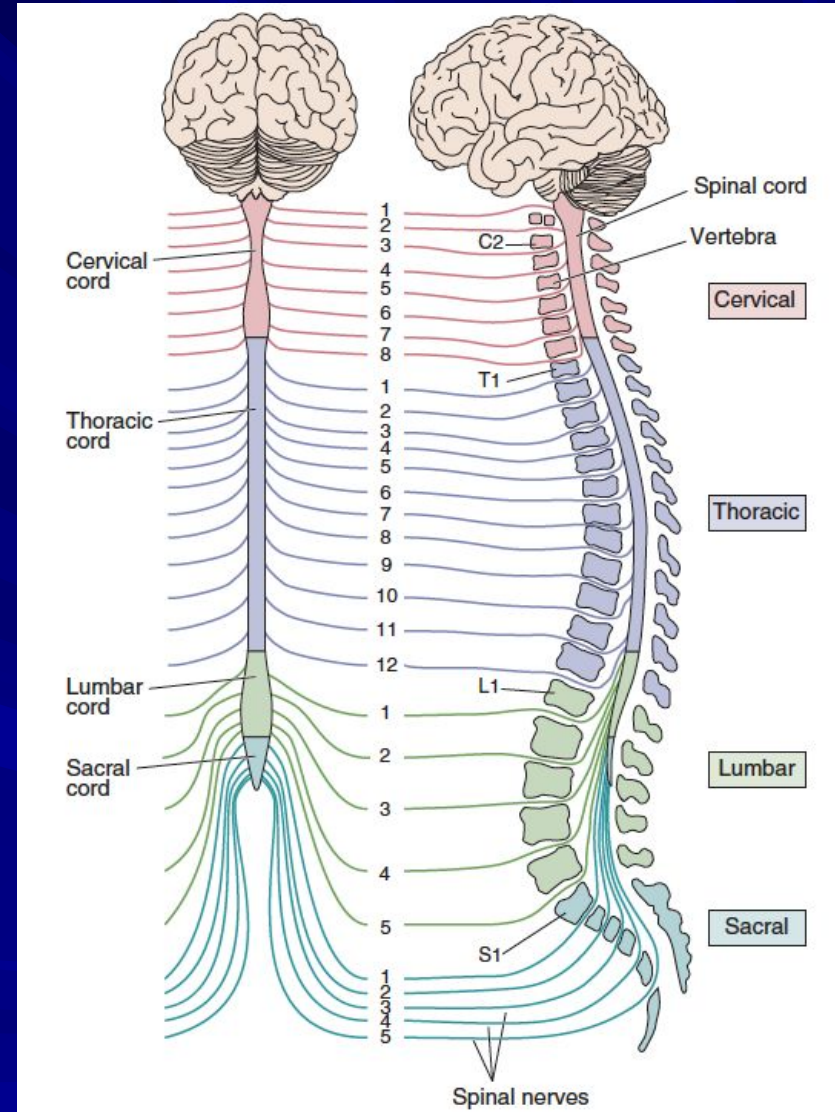
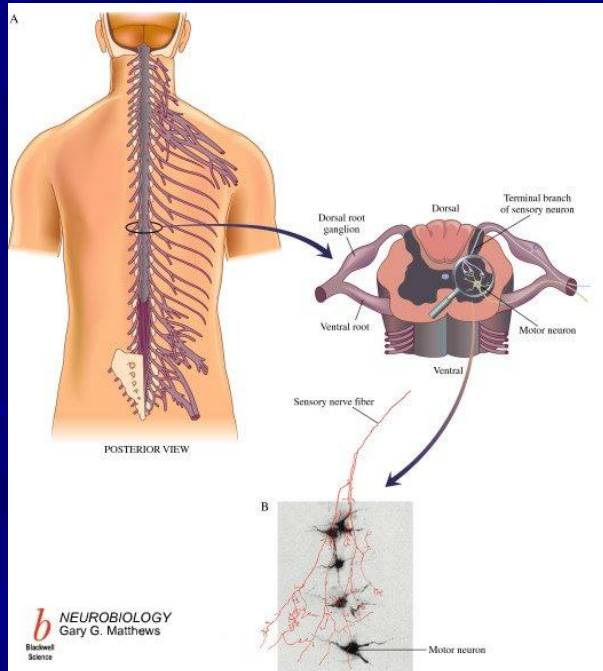


The spinal cord

Gross Anatomy

- The spinal cord is located within the **vertebral canal**
- The spinal cord has 31 pairs of **spinal nerves**
- The spinal cord consists of 31 segments

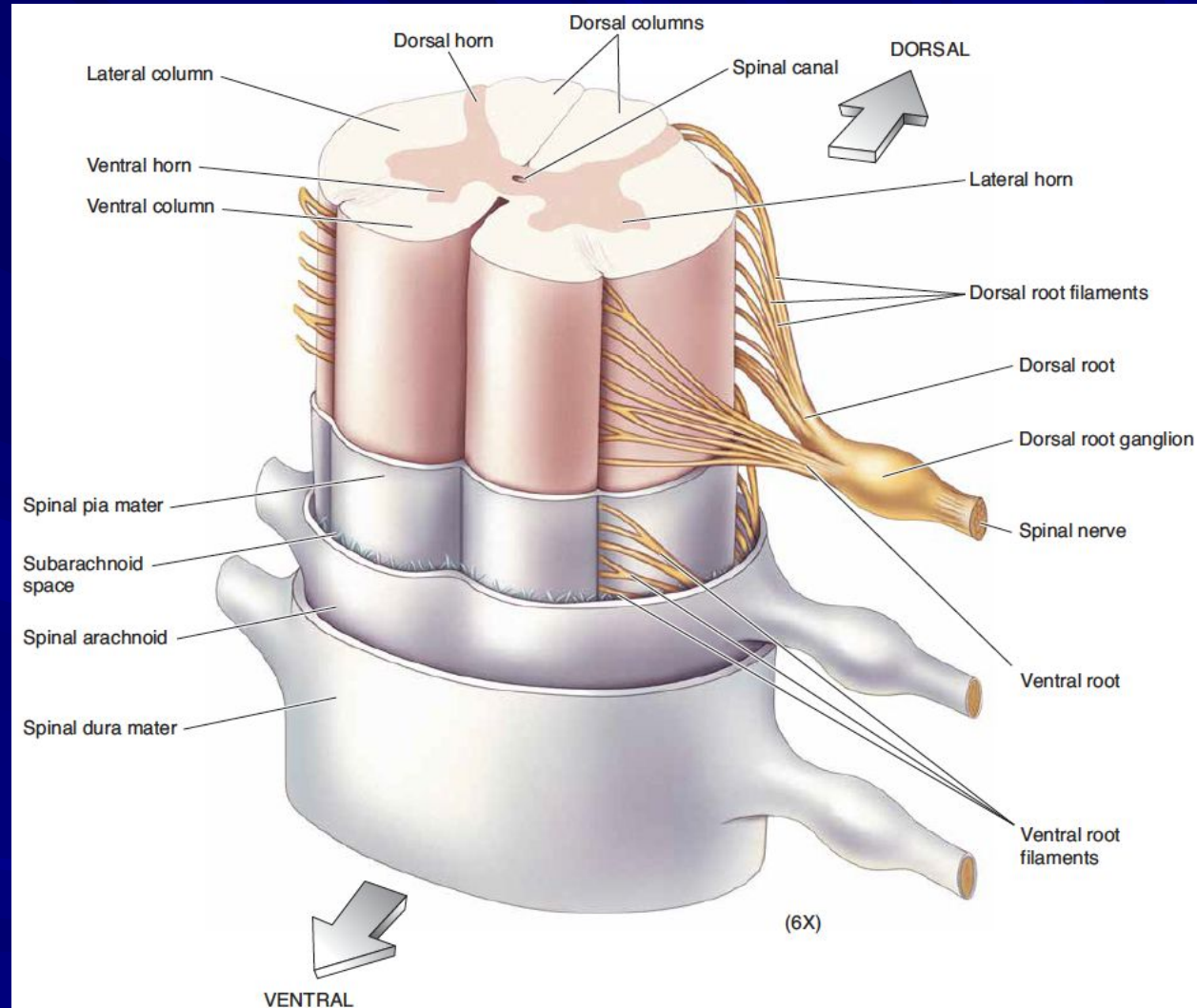
1. **cervical** – 8
2. **thoracic** - 12
3. **lumbar** - 5
4. **sacral** - 5
5. **coccygeal** - 1



The spinal cord

The Ventral–Lateral Surface

- The nerve splits into two roots.
- The **dorsal root** carries sensory axons
- Cell bodies of sensory axons lie in the **dorsal root ganglia**.
- The **ventral root** carries motor axons arising from the gray matter of the ventral spinal cord.



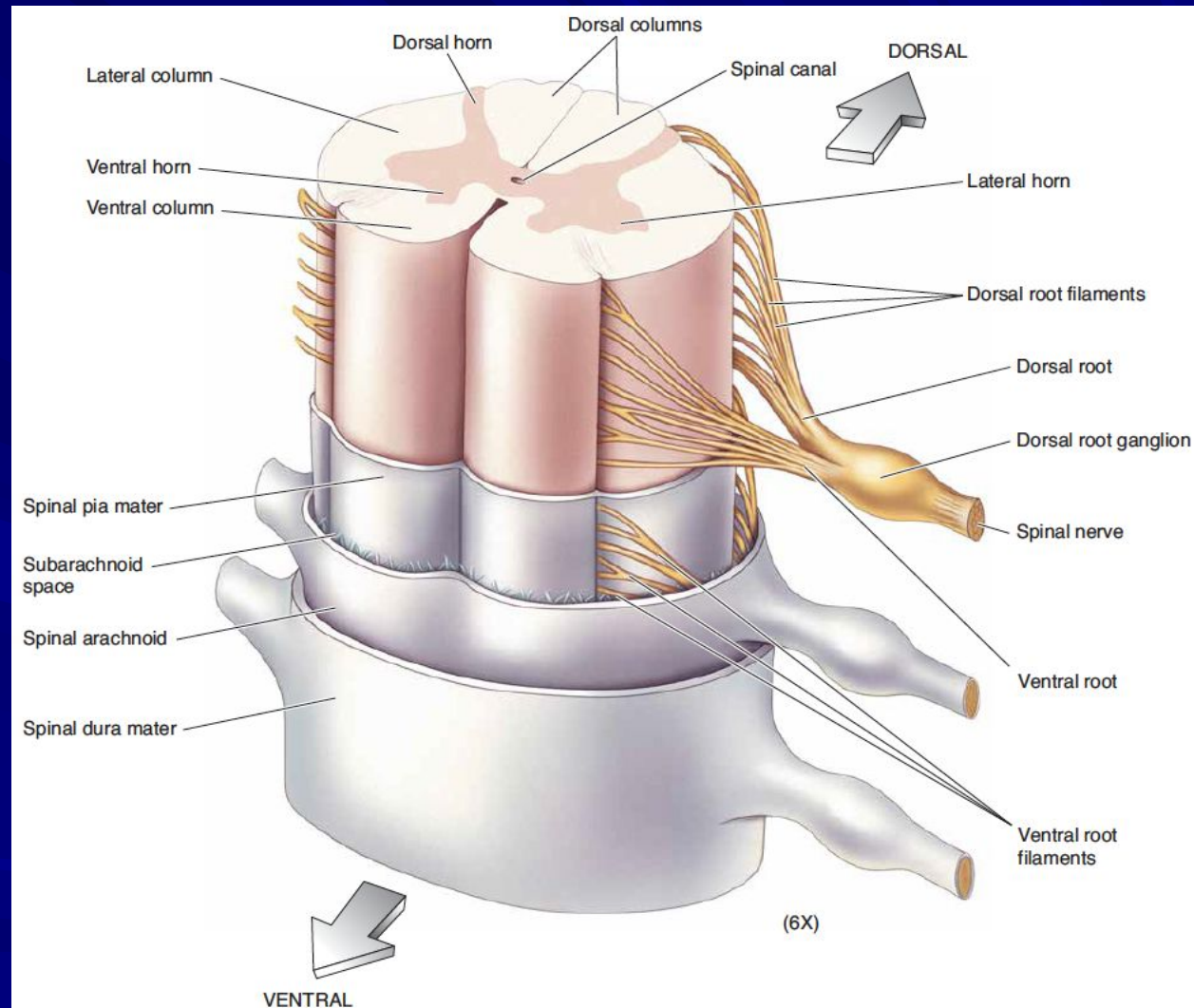
The spinal cord

The Ventral–Lateral Surface

- The butterfly-shaped core of the spinal cord is **gray matter**, consisting of neuronal cell bodies.

- The gray matter is divided into

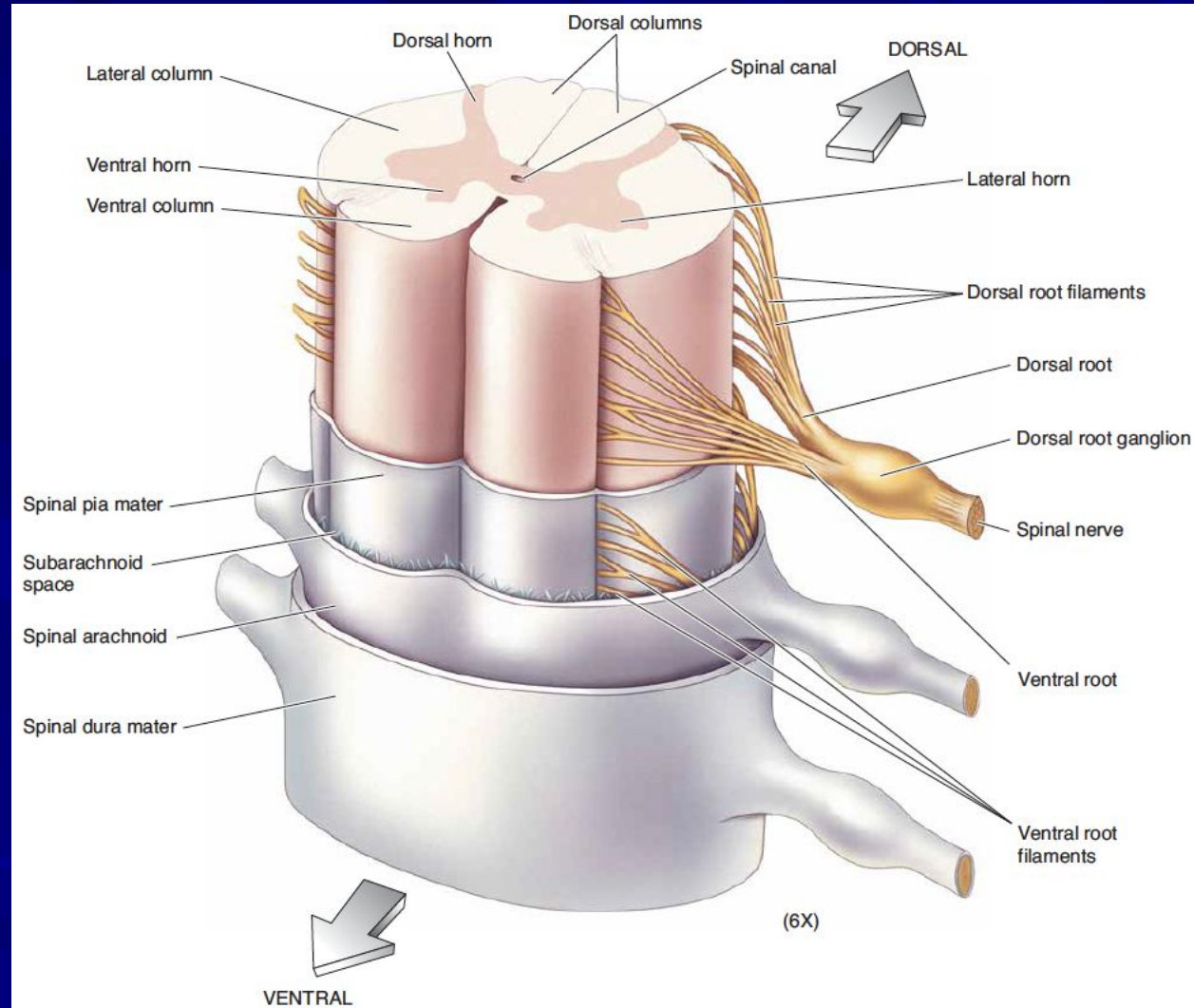
1. the **dorsal horns**
2. **lateral horns**
3. **ventral horns**



The spinal cord

The Ventral–Lateral Surface

- The white matter contains the long axons that run up and down the cord
- The white matter is divided into three columns:
 1. the dorsal columns
 2. the lateral columns
 3. the ventral columns



The spinal cord

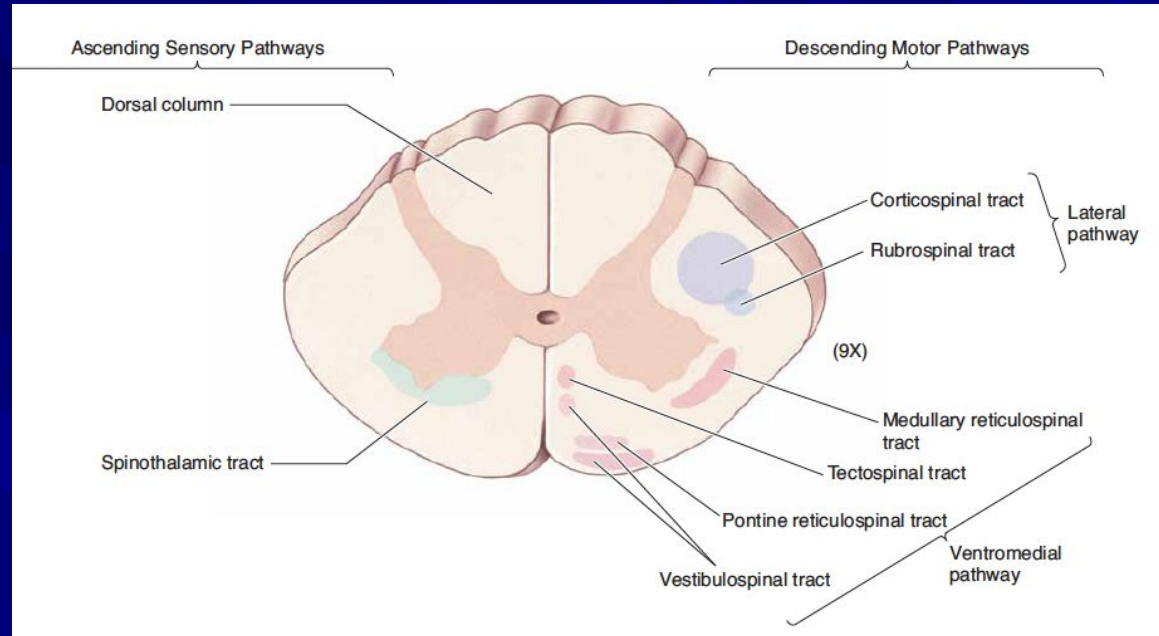
Cross-Sectional Anatomy

The white matter consists of

1. the **ascending sensory pathways**
2. the **descending motor pathways**

Ascending sensory pathways

- The entire **dorsal column** consists of sensory axons ascending to the brain.
- This pathway is important for **touch sensation**.
- The **spinothalamic tract** carries information about painful stimuli and temperature.



The spinal cord

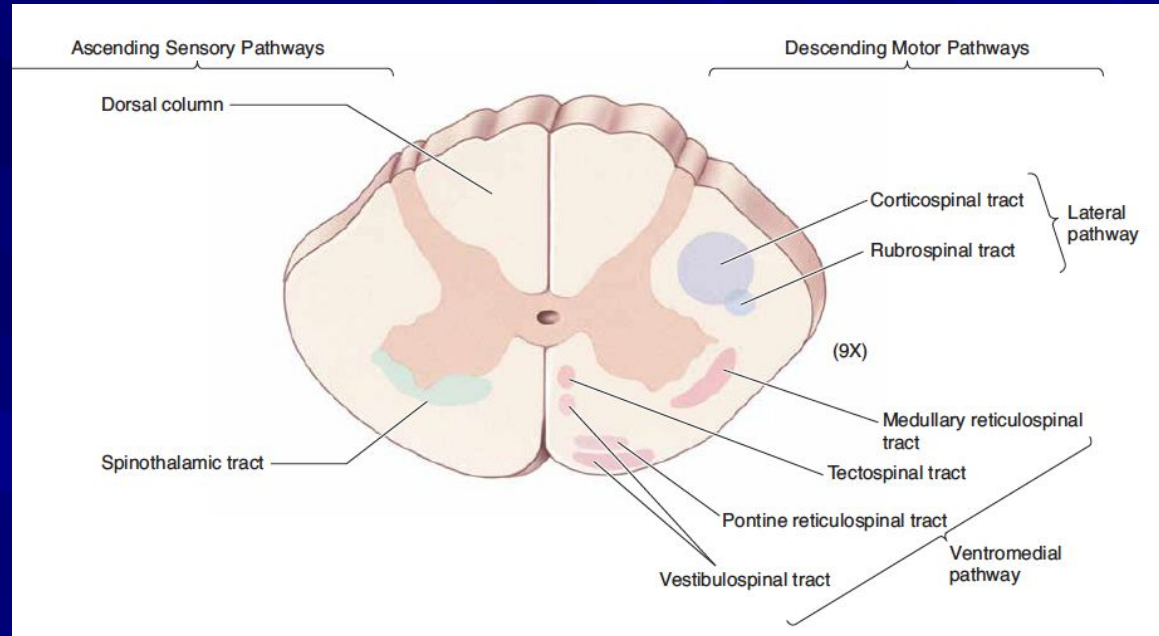
Cross-Sectional Anatomy

Descending motor pathways

- The **descending tracts** contribute to two pathways:
 1. the **lateral pathways**
 2. the **ventromedial pathways**.

- The **lateral pathway** carries the commands for voluntary movements

- The **ventromedial** pathway participates mainly in the maintenance of posture and certain reflex movements.



Cervical Spine and Intervertebral Disc Anatomy

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