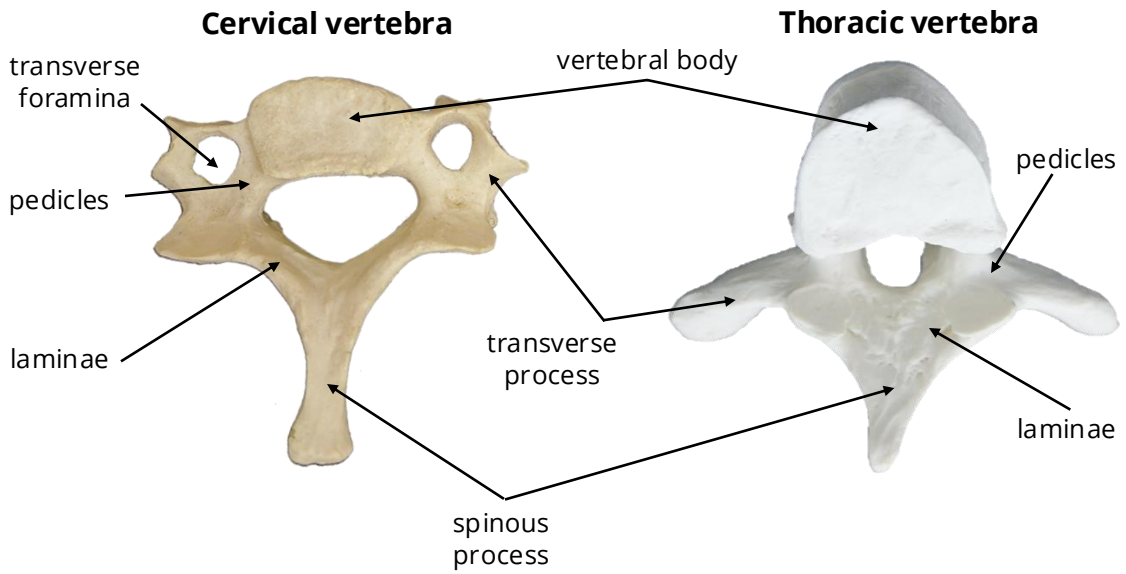
Spinal cord

Structure of the vertebra

The vertebra consists of the **vertebral body**, two **pedicles** (small foot) and two **laminae** (plate). The hole in the center of the vertebra is the **vertebral foramen**. Between each lamina and pedicle, find the **transverse process.** Between the two laminae, find the **spinous process**.

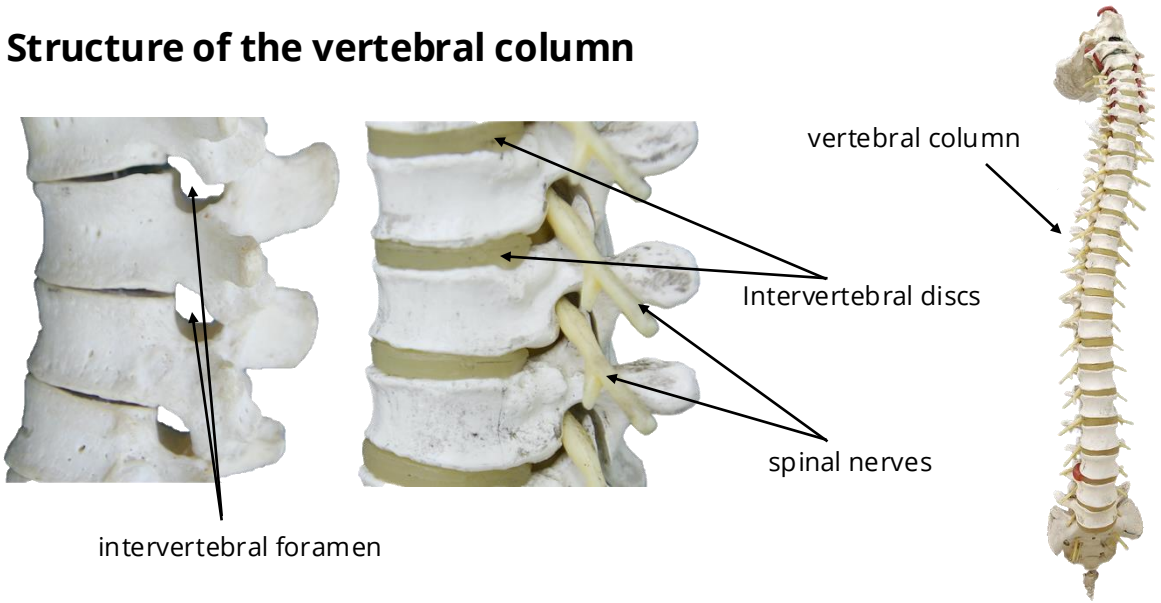
The **cervical vertebrae** (neck) are similar in structure to the other vertebrae. However, they also have holes in the transverse processes, the **transverse foramina**, through which the vertebral arteries pass.



Structure of the vertebral column

Humans have 33 vertebrae that form the **vertebral column**. When the vertebrae are placed on top of each other, the vertebral foramina form the spinal canal that contains the spinal cord. On each side, a lateral hole is formed between each pair of vertebrae, the **intervertebral foramen** through which the **spinal nerves** pass. **Intervertebral discs** separate between the bodies of the vertebrae.

Structure of the vertebral column



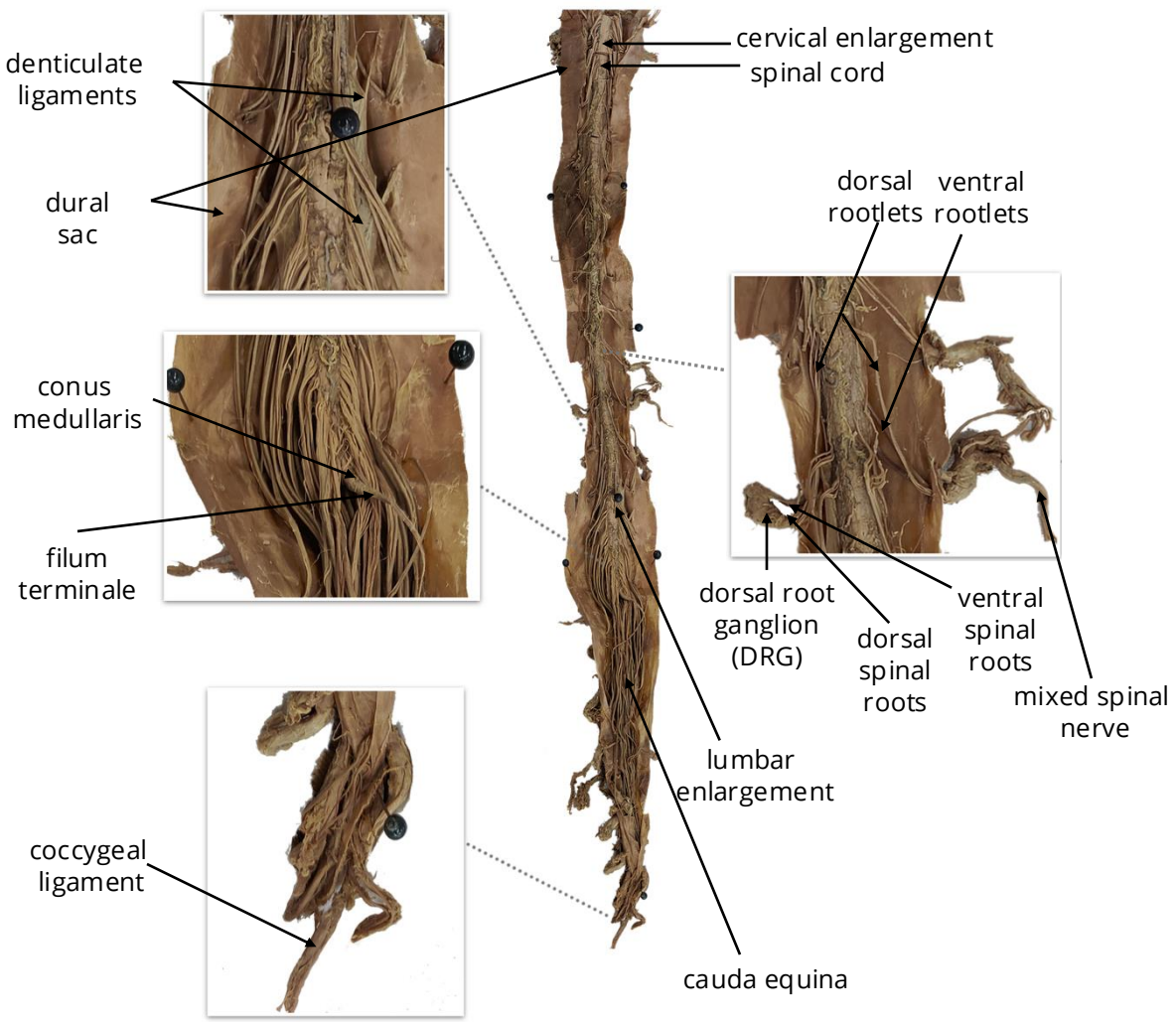
Spinal cord meninges

Three meninges cover the **spinal cord** and the brain. The most external meninx is the **dura mater** (hard). In the spinal cord, it creates the **dural sac**. While the dura around the brain is adjacent to the skull, the epidural space (between the dura and the vertebrae) is filled with blood vessels and fat. The dural sac terminates at the level of **vertebra S2** and its extension, the **coccygeal ligament**, attaches to the coccyx bone.

Make a longitudinal incision to open the dural sac. The next meninx is the **arachnoid mater** (spider's web) that is attached to the inner part of the dura (in the brain it is more distinct and resembles a spider web). The innermost meninx that covers the spinal cord is the **pia mater**. The space between the pia and the arachnoid is the **subarachnoid space** that is filled with cerebrospinal fluid (CSF). Between segments C1 and L1, notice 21 pairs of pia extensions that leave the spinal cord, penetrate the arachnoid and fixate the spinal cord to the dura, the **denticulate ligaments**. The pia mater that covers the spinal cord continues caudally in a silvery structure called **filum terminale** that continues into the coccygeal ligament.

Structure of the spinal cord

Notice that the spinal cord is wider in two places, the **cervical enlargement** and the **lumbar enlargement**. These areas include the neural matter of the upper and lower limbs respectively. The spinal cord ends at the level of vertebra L2 in the **conus medullaris**. Along the length of the spinal cord, notice **ventral rootlets** and **dorsal rootlets** that join to create the **ventral spinal roots** and **dorsal spinal roots**. Immediately after exiting the dural sac, notice a bulge, the **dorsal root ganglion (DRG)**, it contains the bodies of sensory neurons. Next to it, is the ventral root that contains the axons of motor neurons. The fibers of the dorsal root ganglion and the ventral root join to form the **mixed spinal nerve**. The dura mater also covers them and it is continuous with the epineurium of the peripheral nervous system. Notice that the rostral rootlets are shorter and horizontal, while the caudal rootlets are longer and diagonal. The lumbosacral and coccygeal spinal rootlets form a bundle that extend beyond the conus medullaris, the **cauda equina** (horse tail).

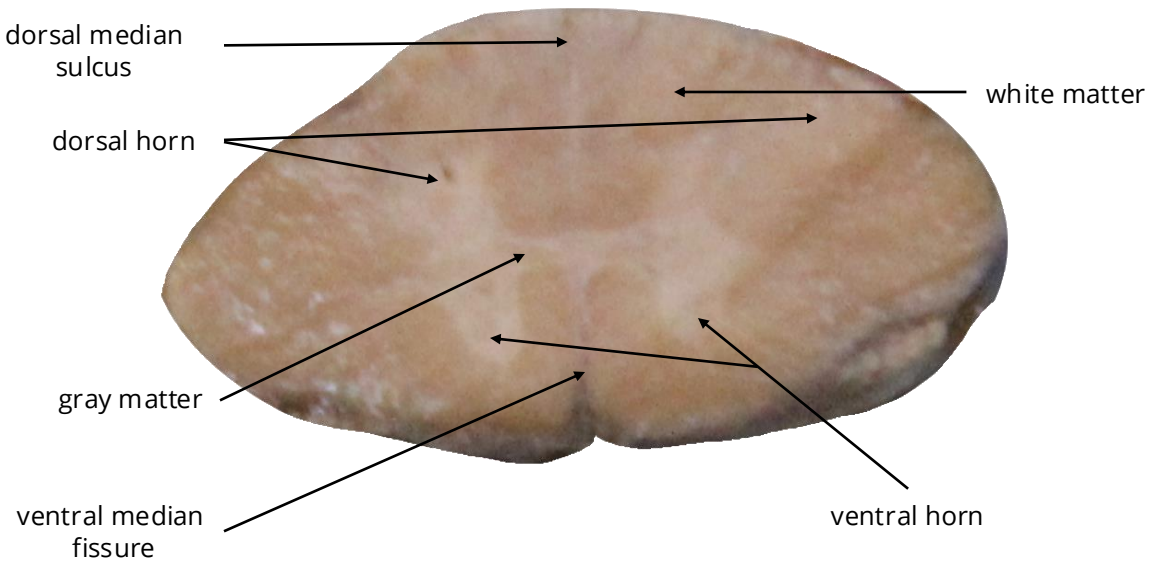


Cross section of the spinal cord

In the spinal cord, the butterfly-shaped **gray matter** is located in the center and the **white matter** surrounds it. As a result of the preservation procedures and the direction of the cut (perpendicular to the direction of the fibers), the white matter appears darker. The **ventral horn** of the spinal cord is slightly wider and it contains neural cell bodies that belong to the motor system. The **dorsal horn** of the spinal cord is narrower and it contains neural cell bodies that belong to the sensory system.

The **ventral median fissure** runs along the ventral aspect of the spinal cord and ventral to it, the anterior spinal artery.

The **dorsal median sulcus** runs along the dorsal aspect of the spinal cord and on both of its sides the two posterior spinal arteries can be found.

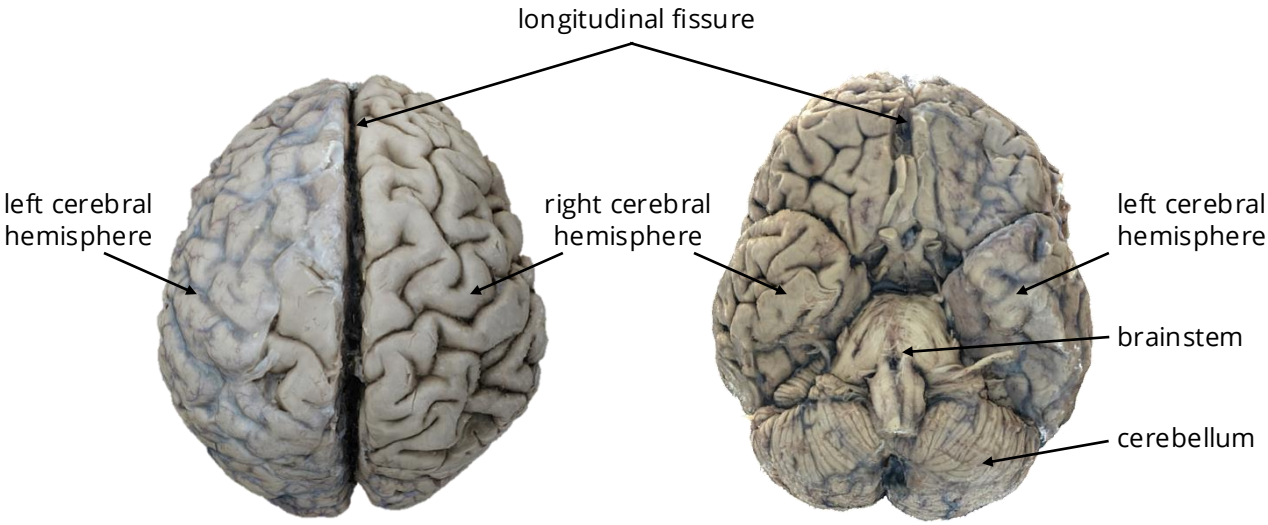


Surfaces of the cerebrum

In this lab we will study the different structures at the surface of the brain. We will look at a whole brain as well as a single hemisphere (brain cut in a mid-sagittal section).

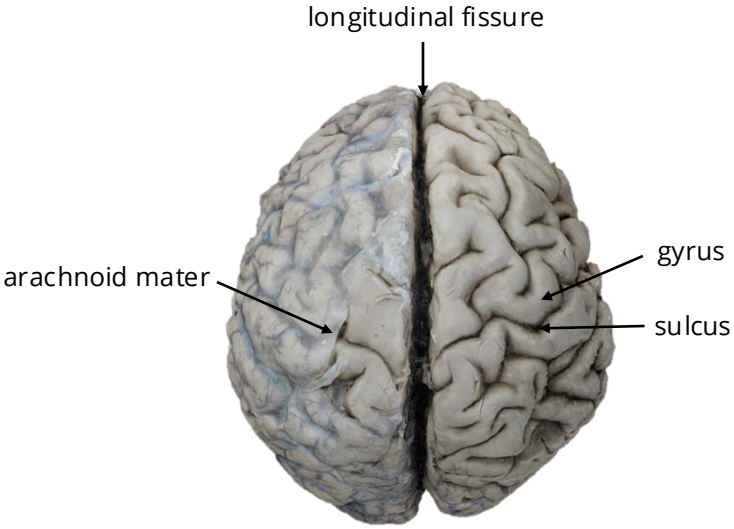
Main regions of the central nervous system

Examine the brain in front of you, it weighs about 1.5 kg and it is continuous with the spinal cord that we studied in the previous lab. Its main regions include the **cerebrum** which is divided by the **longitudinal fissure** to the **right cerebral hemisphere** and the **left cerebral hemisphere**, the **cerebellum** and the **brainstem.**



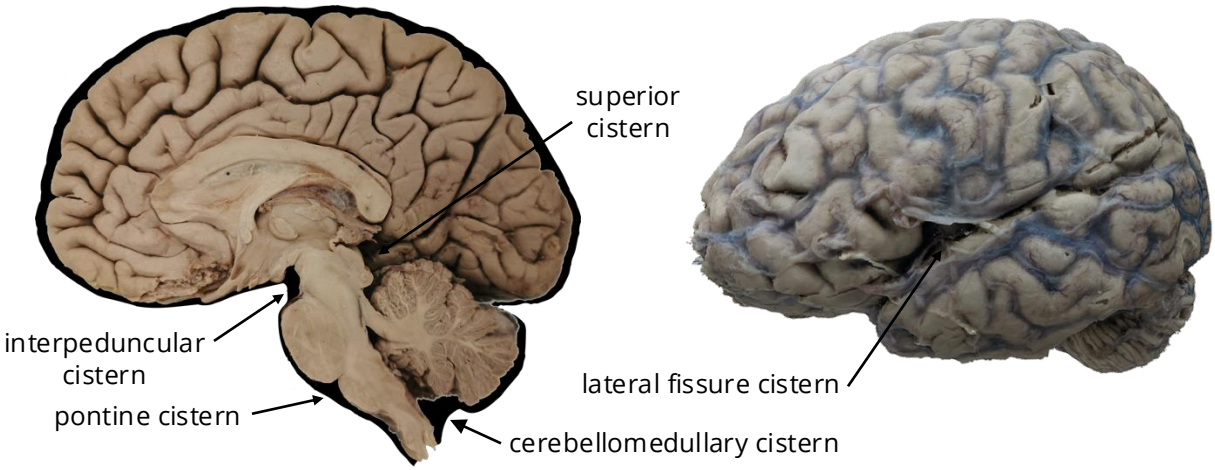
Meninges

First, we will identify the three meninges that cover the brain: dura, arachnoid and pia. The dura mater (hard) is the most external meninx, it is a thick hard membrane that is located close to the skull. Within the **longitudinal fissure**, find a fold of dura that leaves the skull and enters it, the falx cerebri (sickle). When the brain is removed, most of the dura remains attached to the skull. The translucent meninx that covers the left hemisphere is the **arachnoid mater** (spider web). In the right hemisphere, the arachnoid is removed and you can see the **gyri** (folds) and **sulci** (grooves) of the cerebral cortex. The innermost meninx is the pia mater, it is a very thin membrane that closely follows the cerebral cortex. Unlike the spinal cord, it cannot be easily seen in the brain.



Subarachnoid cisterns

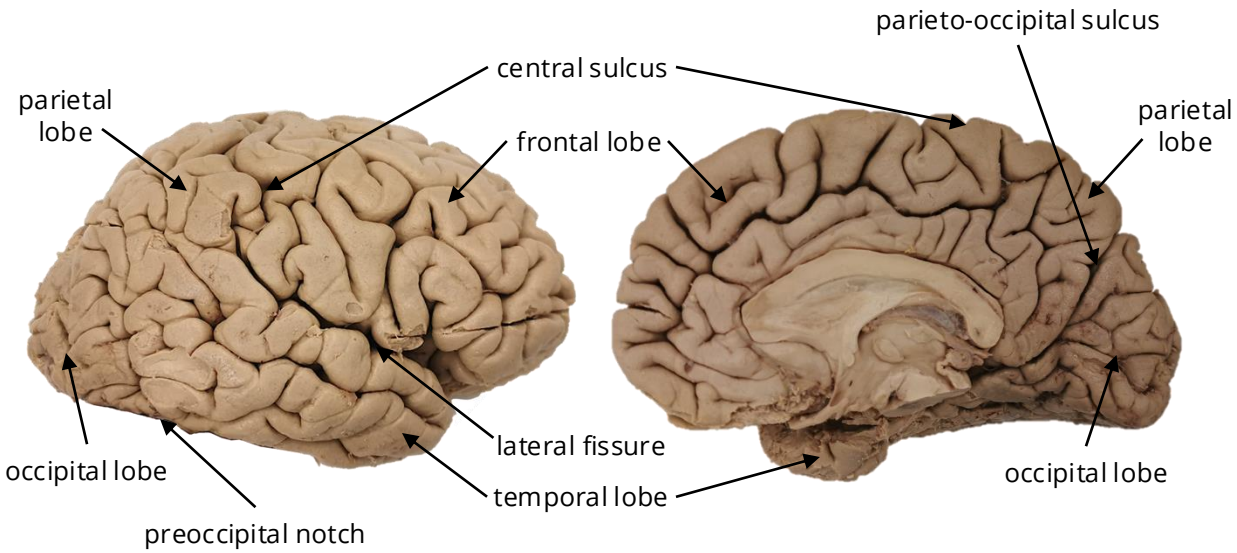
Notice that the arachnoid covers the brain superficially, it passes over the brain surfaces and does not enter into the sulci. In the living human the subarachnoid space is filled with cerebrospinal fluid (CSF). A cistern (reservoir), is an area where the arachnoid passes over a gap between structures and contains more CSF. Identify the **cerebellomedullary cistern** (cisterna magna), **pontine cistern**, **interpeduncular cistern**, **superior cistern** and **lateral fissure cistern**.



Hemispheric lobes (right hemisphere)

Clear the arachnoid from the hemisphere. Three main sulci divide the hemisphere into four lobes. In the lateral surface find the **lateral fissure** (lateral sulcus) and the **central sulcus**. In the medial surface find the **parieto-occipital sulcus**.

Anterior to the central sulcus is the **frontal lobe**. Inferior to the lateral fissure is the **temporal lobe**. Between the central sulcus and the parieto-occipital sulcus is the **parietal lobe**. Posterior to the parieto-occipital sulcus and the **preoccipital notch** is the **occipital lobe**.



Lateral surface of the hemisphere

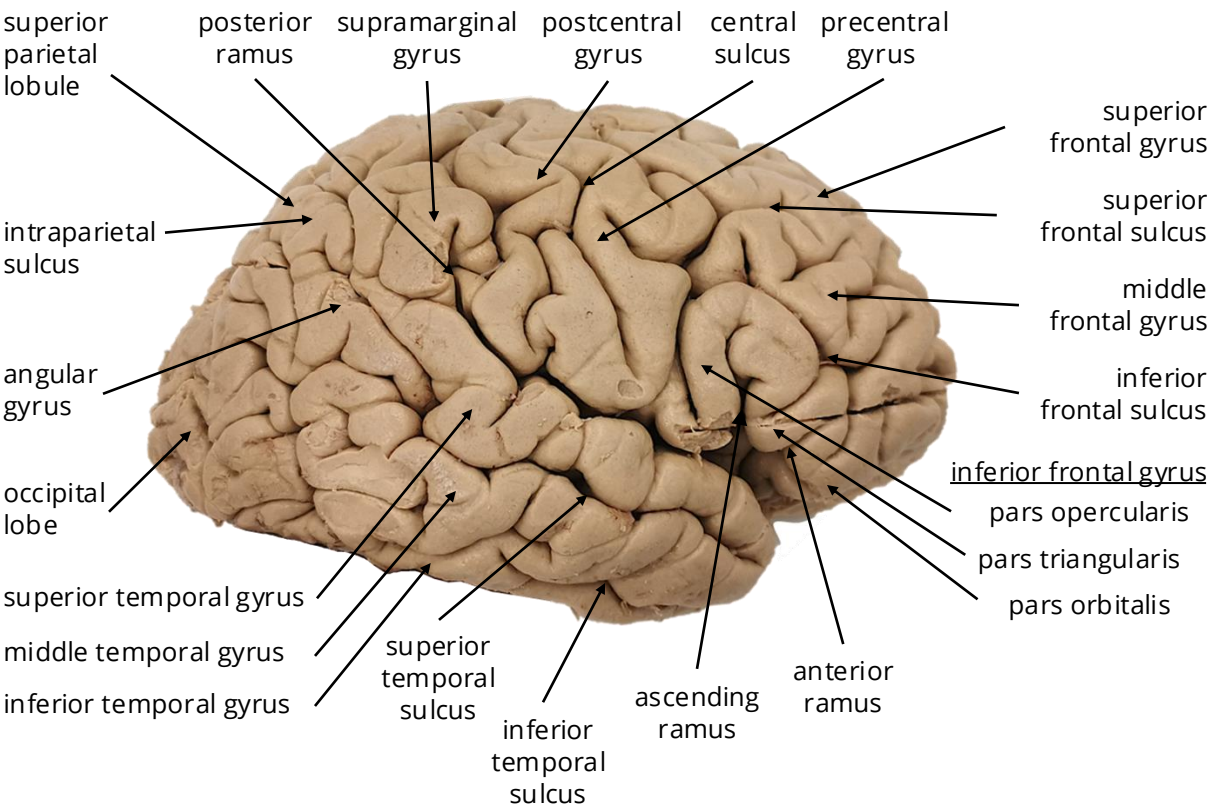
In the lateral surface, the **frontal lobe** is divided to four gyri. Anterior to the **central sulcus** is the **precentral gyrus** that contains the primary motor area. The **superior frontal sulcus** and the **inferior frontal sulcus** separate between the **superior frontal gyrus**, **middle frontal gyrus** and **inferior frontal gyrus**. The inferior frontal gyrus is further divided into three parts by two branches of the **lateral fissure**. The **anterior ramus** and the **ascending ramus** separate between the **pars orbitalis**, **pars triangularis** and **pars opercularis**.

Lateral surface of the hemisphere

The **temporal lobe** is divided to three gyri. The **superior temporal sulcus** and the **inferior temporal sulcus** separate between the **superior temporal gyrus**, **middle temporal gyrus** and **inferior temporal gyrus**.

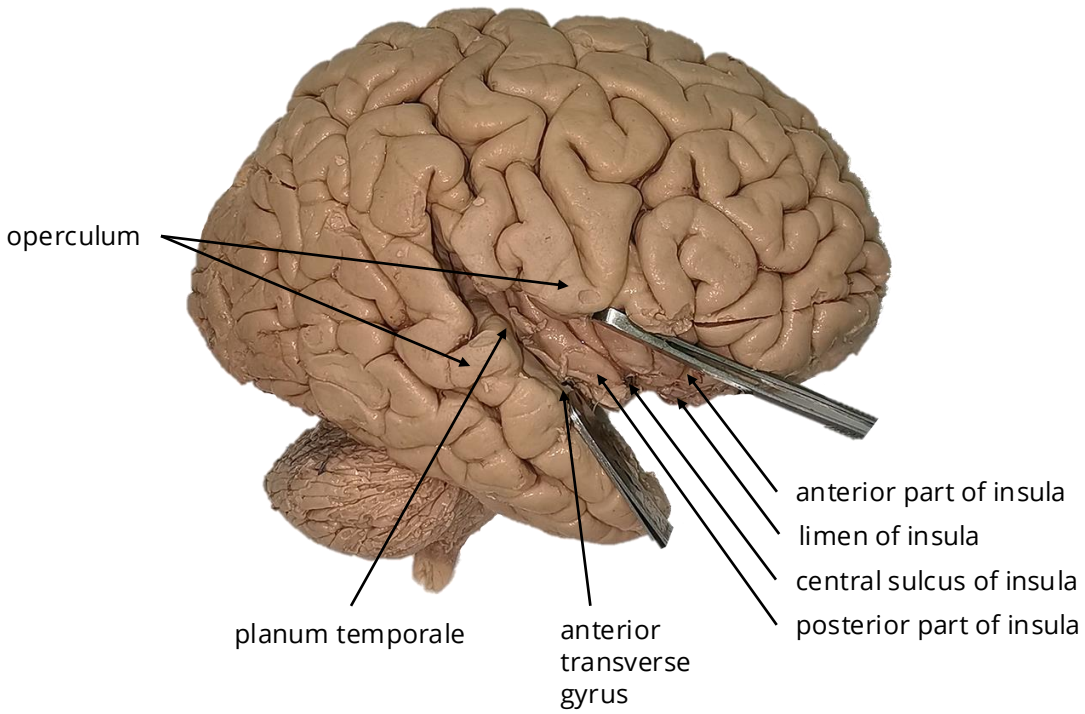
The **parietal lobe** is divided to four gyri. Posterior to the **central sulcus** is the **postcentral gyrus** that contains the primary sensory area. The **supramarginal gyrus** is located around the **posterior ramus** of the **lateral fissure**. The **angular gyrus** is located around the **posterior part of the superior temporal sulcus**. The **intraparietal sulcus** separates between the **superior parietal lobule** and the **inferior parietal lobule** (supra marginal gyrus and angular gyrus).

In the lateral surface, the **occipital lobe** is not further divided.



Structures in the lateral fissure

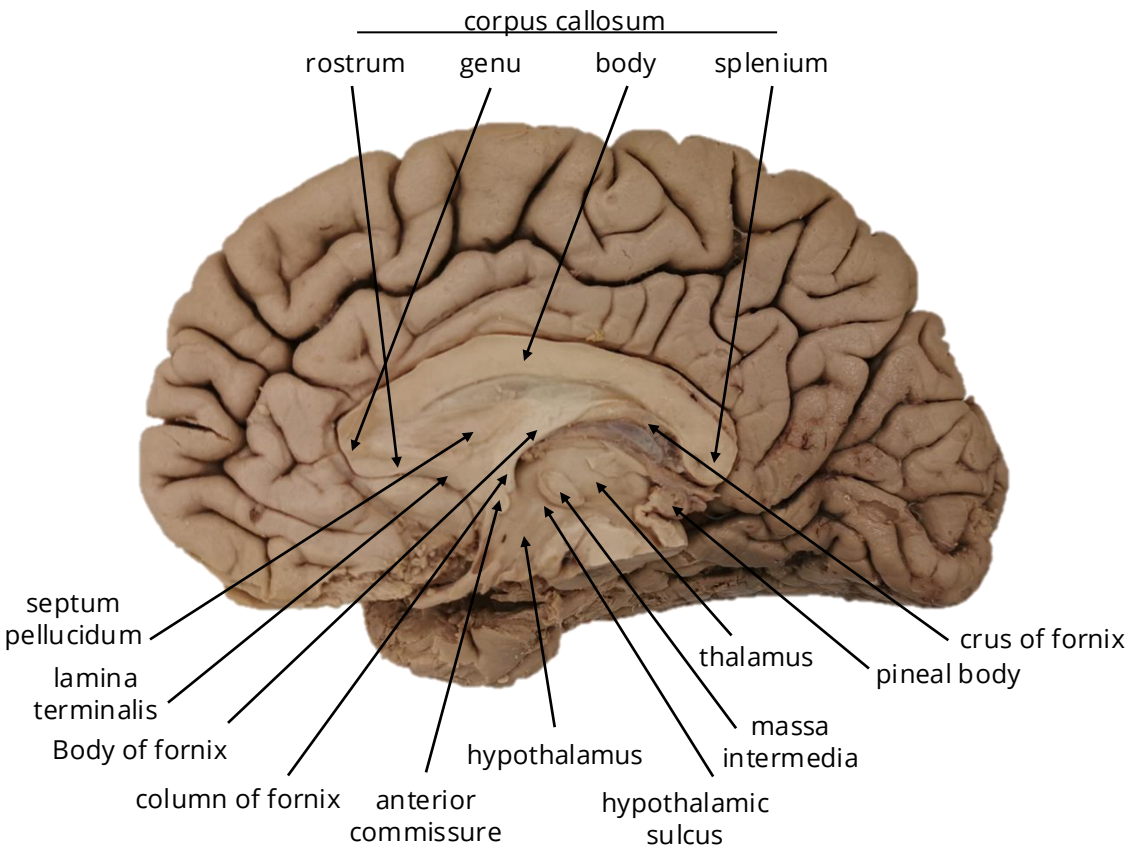
Gently spread apart the gyri on each side of the lateral fissure. Within it, find a part of the cortex that is covered by the neighboring gyri, the **insula** (island). Together, the gyri that cover it (inferior frontal gyrus, lower parts of the precentral and postcentral gyri and superior temporal gyrus) form the **operculum** (lid). The insula is divided by the **central sulcus of insula** into an **anterior part** that is composed of short gyri and a **posterior part** that is composed of long gyri. The anterior edge of the insula is the **limen insulae** (threshold). Within the lateral fissure, continuous with the superior temporal gyrus, find the **planum temporale** and the **anterior transverse gyrus** (heschl's convolution) that contains the primary auditory area.



Medial surface of the hemisphere

Subcortical structures

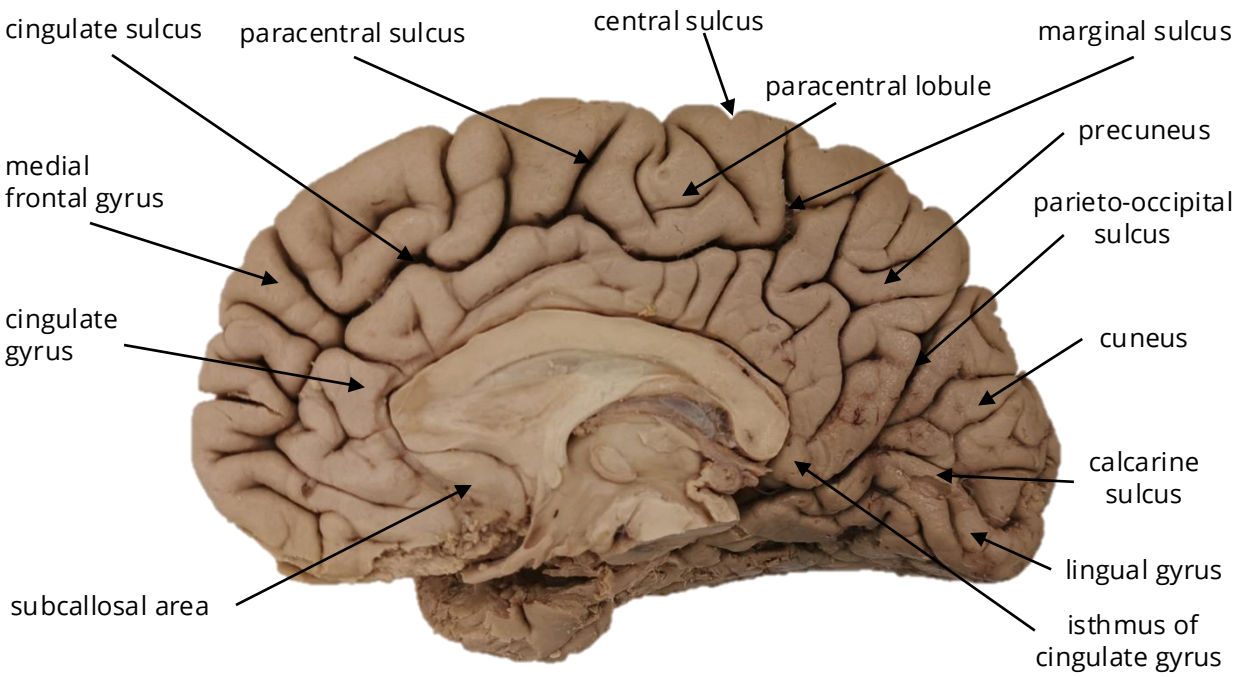
Identify the **corpus callosum**, it is a large structure of white matter that connects the two hemispheres. In the midsagittal section, it is divided to the **rostrum** (beak), **genu** (knee), **body** and **splenium** (bandage). Inferior to it, find the **fornix** (arch), it is a white matter structure of the hippocampus. The fornix is divided to the **column**, **body** and **crus** (leg). Between the corpus callosum and the fornix find the **septum pellucidum**. It is a thin sheet of neuroglial tissue that separates the frontal horns of the lateral ventricles. Continuing the line of the rostrum, find the **lamina terminalis** and posterior to it, the **anterior commissure**. Inferior to the fornix, find an oval structure, the **thalamus** (inner chamber) and in its center the **interthalamic adhesion (massa intermedia)**. Inferior to the thalamus is the **hypothalamus** with the **hypothalamic sulcus** between them. Posterior to the thalamus find the **pineal body**.



Medial surface of the hemisphere

Cortical structures

In the medial surface, the **cingulate sulcus** divides the **frontal lobe** into the **medial frontal gyrus** and the **cingulate gyrus** (belt). Its two posterior branches, the **paracentral sulcus** and the **marginal sulcus**, define the **paracentral lobule** that surrounds the part of the **central sulcus** that slightly continues into the medial surface. The area of cortex below the **genu of corpus callosum** is also called the **subcallosal area**. Follow the cingulate gyrus posteriorly into the **parietal lobe** and notice how it becomes narrow posterior to the **splenium of corpus callosum**, this area is the **isthmus of cingulate gyrus** (neck). Anterior to the **parieto-occipital sulcus** is the **precuneus** and posterior to it, the **occipital lobe.** It is divided by the **calcarine sulcus**, that contains the primary visual area, to the **cuneus** and the **lingual gyrus**.



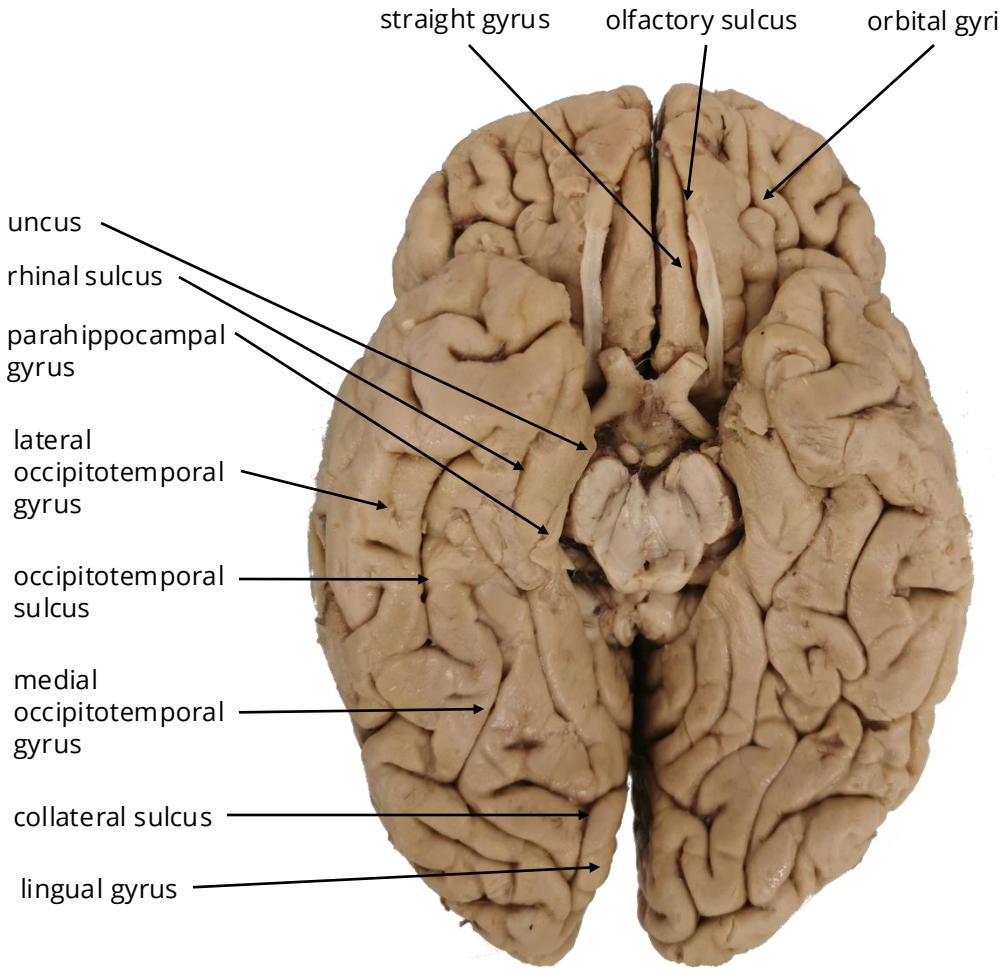
Inferior surface of the hemisphere

Cortical structures

In the inferior surface, the **frontal lobe** is divided by the **olfactory sulcus** into the **straight gyrus** (gyrus rectus) and the **orbital gyri**.

In the **occipital lobe**, the **lingual gyrus** is defined laterally by the **collateral sulcus**.

In the **temporal lobe**, the **parahippocampal gyrus** is defined laterally by the **rhinal sulcus**. Its curved anterior part, the **uncus** (hook), contains the primary olfactory area. The **occipitotemporal sulcus** divides between the **medial occipitotemporal gyrus** (fusiform gyrus) and the **lateral occipitotemporal gyrus**.

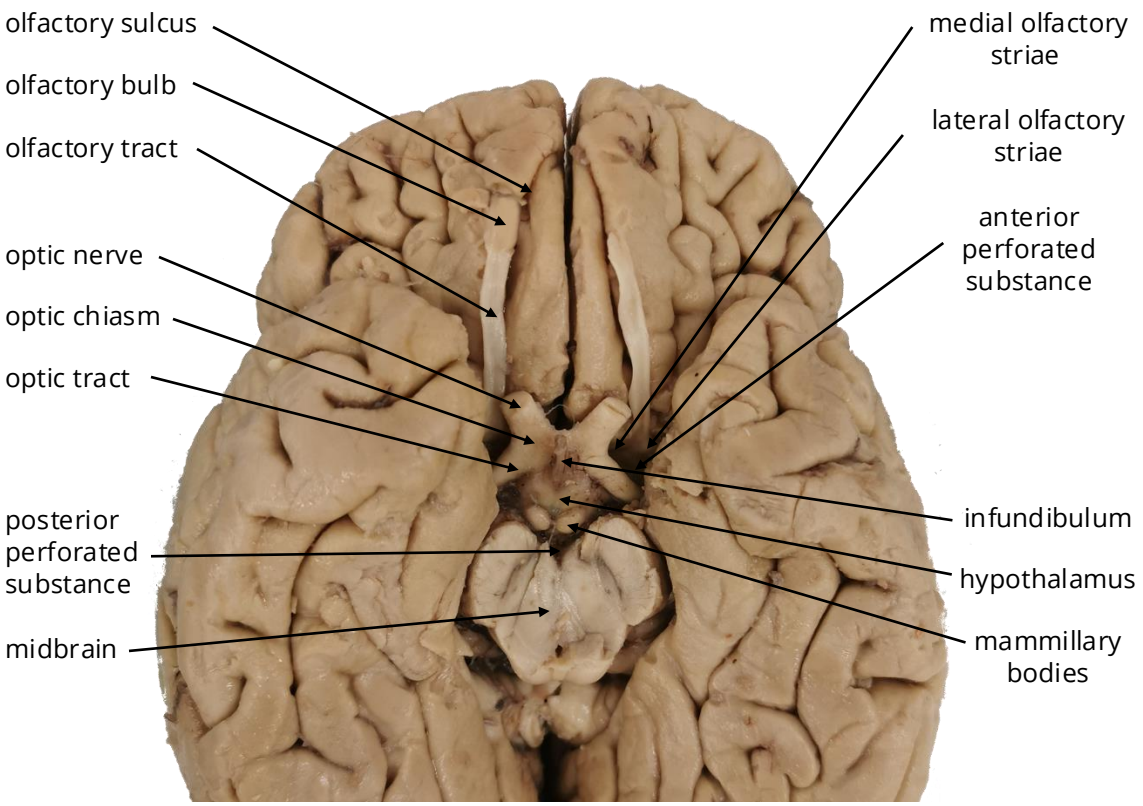


Inferior surface of the hemisphere

Subcortical structures

Aligned with the **olfactory sulcus**, find the **olfactory bulb** and the white matter coming out of it, the **olfactory tract**. At its posterior part, it splits into the **medial olfactory striae** and the **lateral olfactory striae**. Between them, find the **anterior perforated substance**.

Next, find the **optic nerve**, **optic chiasm** and **optic tract**. Gently move aside the parahippocampal gyrus and follow the optic tract posteriorly, notice how it reaches the lateral geniculate nucleus of the thalamus. Inferior to the optic chiasm, identify the **infundibulum** (funnel), it connects the hypophysis (pituitary gland) and the **hypothalamus**. Notice two protruding round nuclei of the hypothalamus, the **mammillary bodies.** Between them and the **midbrain** (that was cut in order to remove the brainstem and cerebellum), find the **posterior perforated substance**.



Cerebral white matter and basal nuclei

The white matter of the hemispheres is located deep to the cortex and consists mostly of neuronal axons. These fibers are coated with a lipid-rich (fatty) substance called myelin that gives them the light color. The white matter fibers are organized in fasciculi (bundles) that connect the various areas of the nervous system.

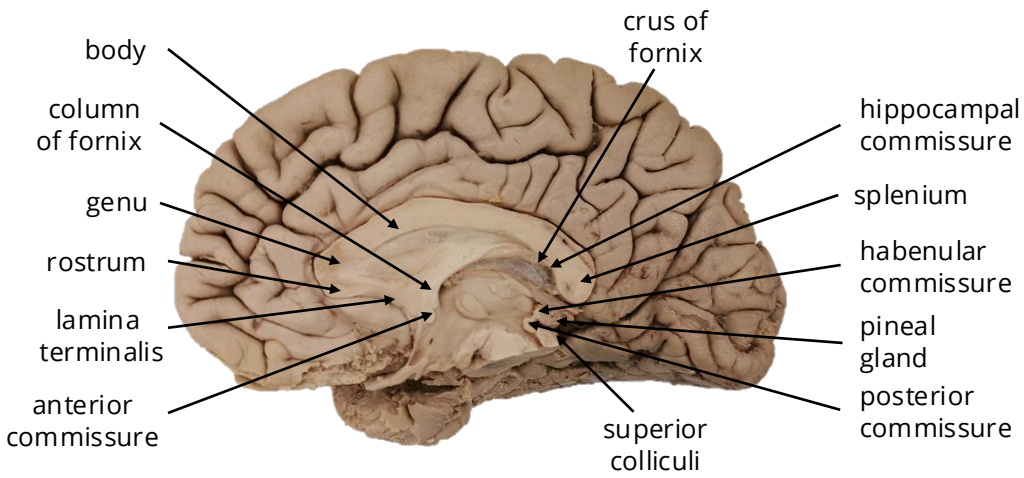
There are three main types of fibers depending on the type of areas they connect:

- Commissural fibers connect different areas between the two cerebral hemispheres.
- Association fibers connect the different cortical areas within the same cerebral hemisphere.
- Projection fibers connect the different cortical areas with subcortical structures.

Commissural fibers

We will start by examining the commissural fibers in a medial view of a midsagittal section of the hemisphere. Identify the different parts of the **corpus callosum**: the **rostrum**, **genu**, **body** and **splenium**. Find the remaining commissural systems: the **anterior commissure** is located between the **lamina terminalis** and the **column of fornix**, it connects the temporal lobes.

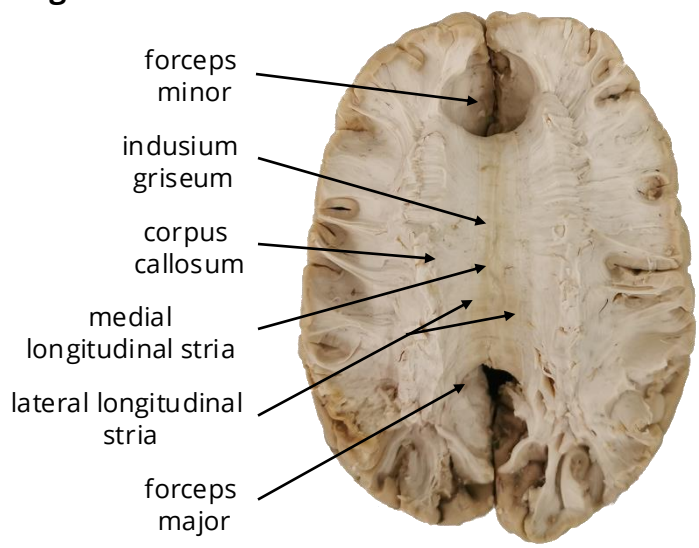
The **hippocampal commissure** is located between the **crus of fornix** of each side and it connects the two hippocampi. Since it is very thin, it is harder to see it in a midsagittal section. The **habenular commissure** is located anterior to the **pineal gland** and it connects the two habenulae. The **posterior commissure** is located inferior and anterior to the pineal gland and it connects the **superior colliculi**.



Superior view of corpus callosum

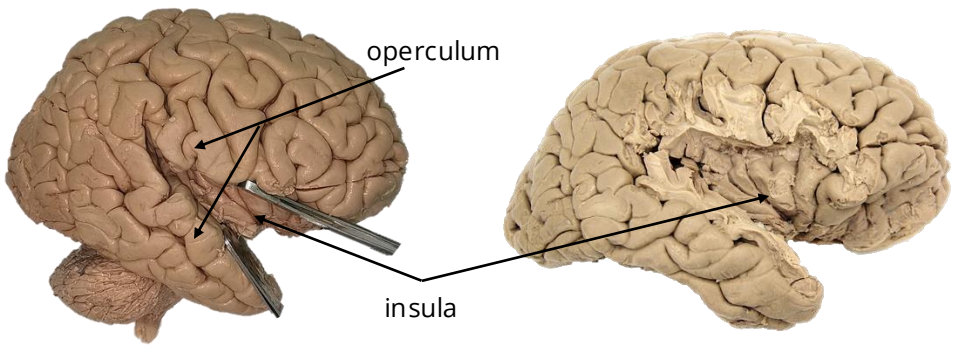
The largest commissural structure is the **corpus callosum**. Notice that its medial part is shorter than the length of the hemisphere. The fibers that connect the anterior parts of the frontal lobes form the **forceps minor** and the fibers that connect the occipital lobes form the **forceps major**.

The medial part of the corpus callosum is covered by a thin layer of gray matter, the **indusium griseum**. It is continuous with the dentate gyrus of the hippocampus. Its white matter is concentrated in two thin strips on each side, the **medial longitudinal stria** and the **lateral longitudinal stria**.

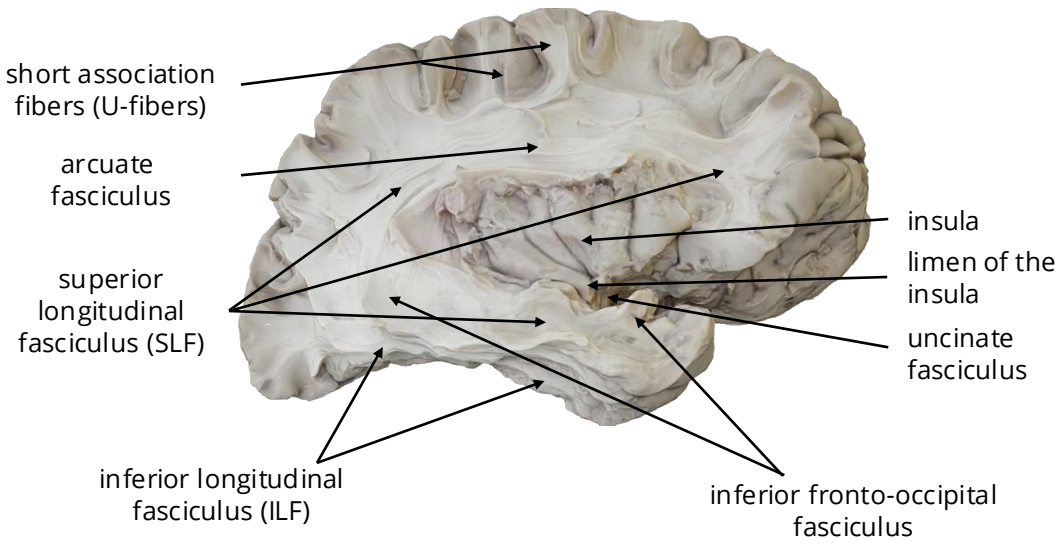


Association fiber

We will start the dissection by exposing the more superficial fibers first and then, we will continue to the deeper fibers and subcortical nuclei. We will begin by removing the cortex that covers the **insula** (island), the **operculum** (lid). Notice the thickness of the cortex (~2 mm) and the difference between it and the white matter.



Continue to remove the cortex around the **insula**. Notice the fibers that connect adjacent gyri, these are **short association fibers (U-fibers)**. The other associative fibers we will study are long-association fibers. Find a long bundle of fibers that bends around the insula and connects all of the lobes, the **superior longitudinal fasciculus (SLF)**. The fronto-temporal part of the SLF is also called **arcuate fasciculus**. Now, move to the **limen of the insula** and expose the **uncinate fasciculus** (hook) below it. It connects the anterior part of the frontal lobe with the anterior part of the temporal lobe. Find the **inferior fronto-occipital fasciculus** located above and behind the uncinate fasciculus, it connects the anterior inferior part of the frontal lobe and the occipital lobe. The **inferior longitudinal fasciculus (ILF)** connects the temporal lobe and the occipital lobe. It can be exposed by removing the gray matter from the lower surface of these lobes.



Next, proceed to the medial surface. By removing the cortex of the cingulate gyrus, expose a large structure of association fibers that connects all the lobes, the **cingulum**. Follow its fibers posteriorly where it passes through the **isthmus** (neck) and bends behind the **splenium of corpus callosum**. From there, it continues into the parahippocampal gyrus.

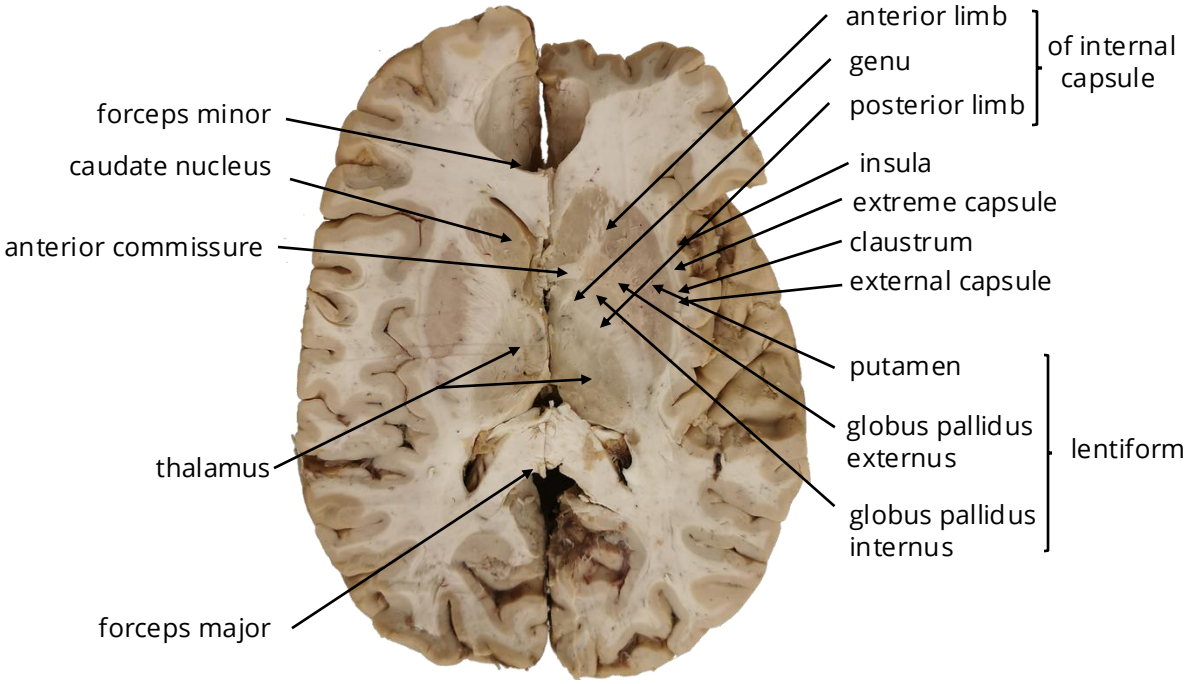
Horizontal section of the brain

For the next part of the dissection, we will use a horizontal section of the brain as a guide to the different structures we will discover as we remove the different layers from lateral to medial (note that the right hemisphere is cut lower than the left).

The most lateral is the cortex of the **insula** and its white matter. Medial to it, find the thin layer of white matter, the **extreme capsule**. Medial to it, identify the thin layer of gray matter, the **claustrum** (enclosed) followed by another thin layer of white matter, the **external capsule**. Continuing medially, find the **lentiform**. On the right, its three parts can be easily distinguished (from lateral to medial): the **putamen** (nutshell), **globus pallidus externus** and **globus pallidus internus**.

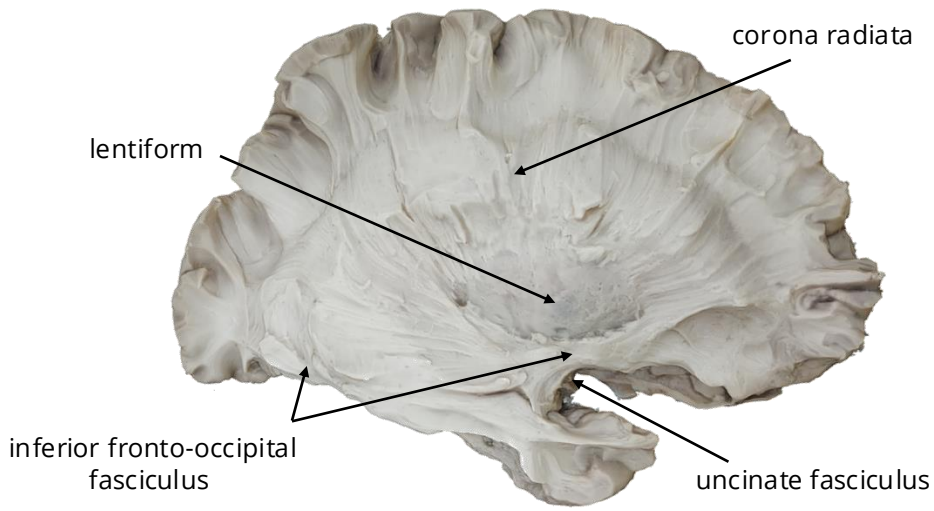
Anterior and medial to the lentiform, find the **caudate nucleus** (tail) and posterior and medial to the lentiform, the **thalamus**. between these three structures, notice the concave shape of the **internal capsule** and its different parts: The **anterior limb** is located between the lentiform and caudate and it contains cortico-pontine fibers and anterior thalamic radiation fibers that connect the thalamus and frontal lobe. The bent central part, **genu**, is located medially to the globus pallidus internus and it contains cortico-nuclear fibers. The **posterior limb** is located between the lentiform and thalamus and it contains cortico-spinal fibers and fibers that connect between the thalamus and somatosensory and association cortex.

Also identify the **anterior commissure** and the **forceps minor** and **forceps major** of the corpus callosum.



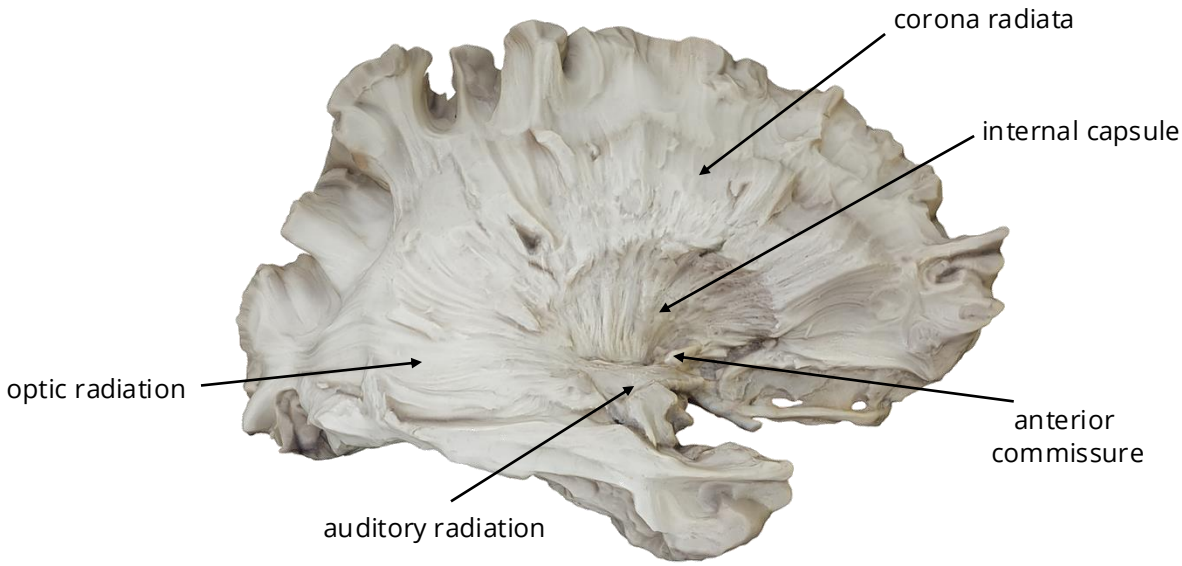
Projection fibers

Return to the hemisphere you have started dissecting. Remove the gray matter of the insula and the thin layers of the extreme capsule, claustrum and external capsule. Continue removing the white matter until you reach a large lens-shaped nucleus, the **lentiform**. Finish exposing and defining the boundaries of the lentiform and remove the remaining association fibers above it. Notice the fibers of the **corona radiata** that surround the lentiform, they connect between the cortex of the hemisphere and subcortical structure. Now that the insula is removed, the **uncinate fasciculus** and the **inferior fronto-occipital fasciculus** can be easily seen**.**



Gently separate the lentiform from the fibers that pass medially to it while keeping it intact. Once the lentiform is removed, you can see the **internal capsule** which is continues with the **corona radiata**. The fibers posterior to the lentiform (retro-lentiform), constitute the **optic radiation**, they relay visual information between the lateral geniculate nucleus of the thalamus and the primary visual area that is located in the calcarine sulcus. The fibers that pass under the lentiform (sub-lentiform), are fibers of the **auditory radiation**, they relay auditory information between the medial geniculate nucleus of the thalamus and the primary auditory area that is located in the anterior transverse gyrus. Notice a bundle of fibers that passes under the lentiform and continues perpendicular to the orientation of the corona radiata, this is the **anterior commissure.**

Next, Make a coronal section in the center of the lentiform and try to distinguish between the putamen and the globus pallidus.



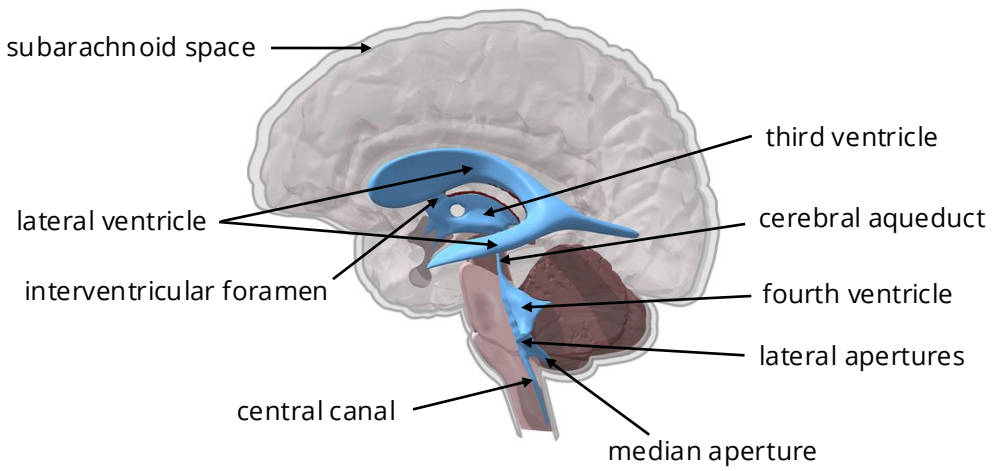
Lateral ventricles and third ventricle

Ventricular system of the brain

The ventricular system is located deep in the brain and it contains cerebrospinal fluid (CSF). Its main parts are the two **lateral ventricles**, the **third ventricle** and the **fourth ventricle**.

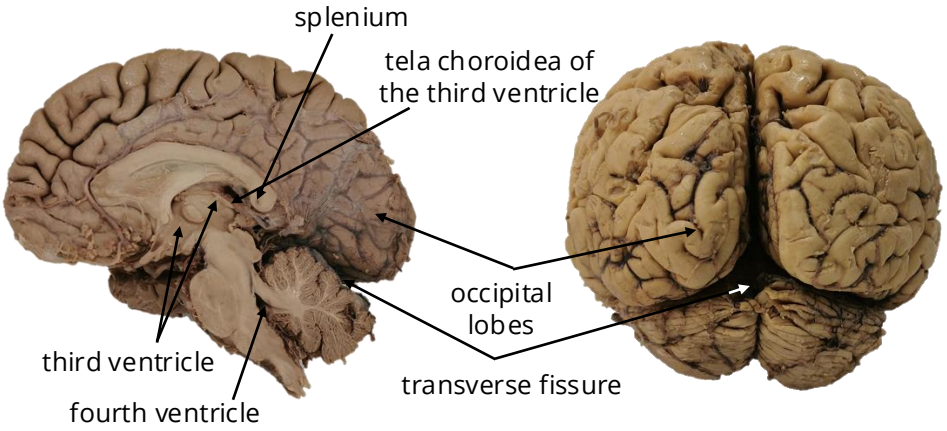
Each lateral ventricle is connected to the third ventricle through an **interventricular foramen** (of Monro). The third and fourth ventricles are connected by the **cerebral aqueduct** (of Sylvius).

Three openings in the fourth ventricle connect the CSF of the ventricular system to the CSF of the **subarachnoid space**, one **median aperture** (of Magendie) and two **lateral apertures** (of Luschka). The fourth ventricle is also continuous with the **central canal** of the spinal cord.



Transverse fissure and tela choroidea

The **transverse fissure** separates between the inferior surface of the **occipital lobes** and the superior surface of the **cerebellum**. Through the transverse fissure, pia mater and arteries enter underneath the **splenium** to the roof of the **third ventricle**, where they form the **tela choroidea of the third ventricle**. The tela choroidea is continues with the choroid plexus of the lateral ventricles and they both produce the CSF. Similar structures exist in the **fourth ventricle** which we will study in another lab.

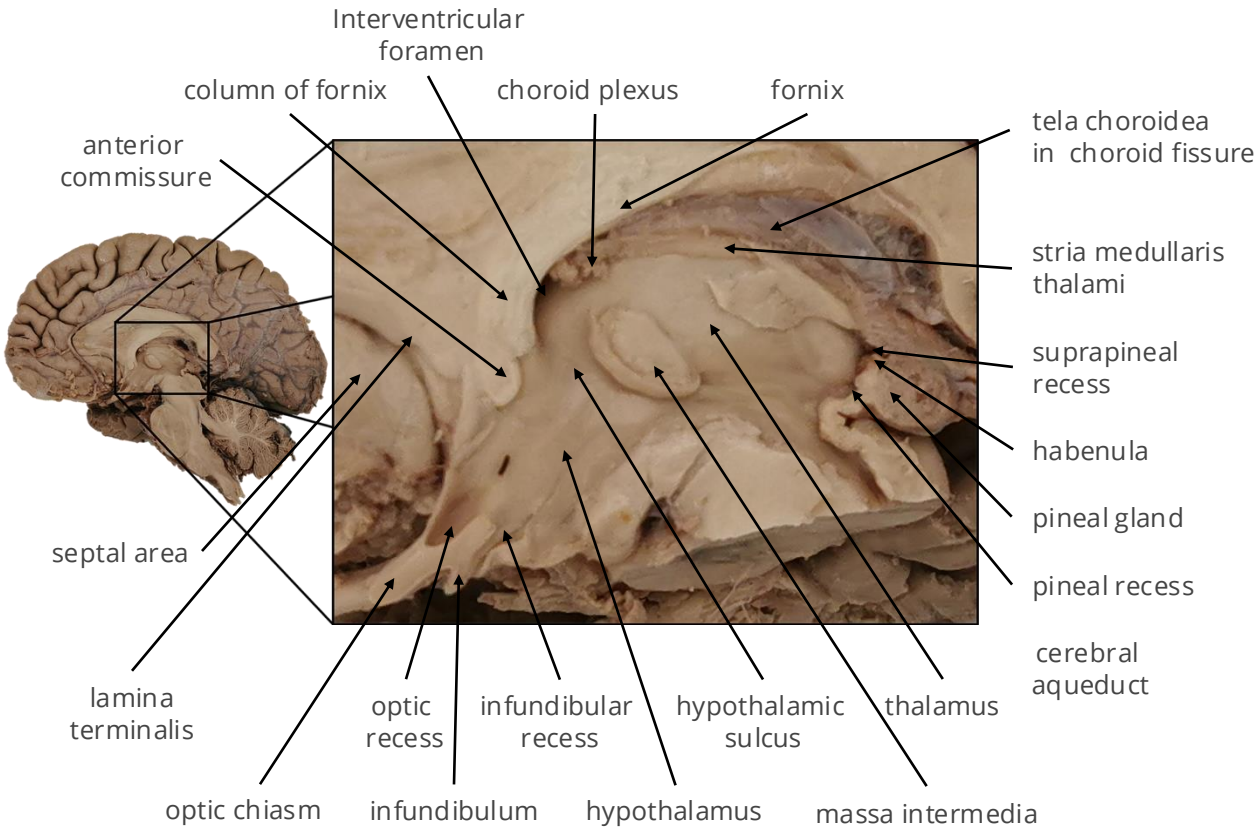


Third ventricle

Locate the oval shaped **thalamus**, its inferior boundary is the **hypothalamic sulcus** and inferior and anterior to it, is the **hypothalamus**. The **third ventricle** is the narrow space between the thalamus and hypothalamus of the two hemispheres. Along the border of the medial and dorsal surfaces of the thalamus, find a strip of white matter, the **stria medullaris thalami**. It contains fibers from the **septal area** to the **habenula**. In the center of the thalamus, find the **massa intermedia** (interthalamic adhesion). At the roof of the third ventricle, find the **tela choroidea** and above it, the **fornix**. Between the **column of fornix** and the thalamus, find the **interventricular foramen** that connects the third ventricle with the lateral ventricle.

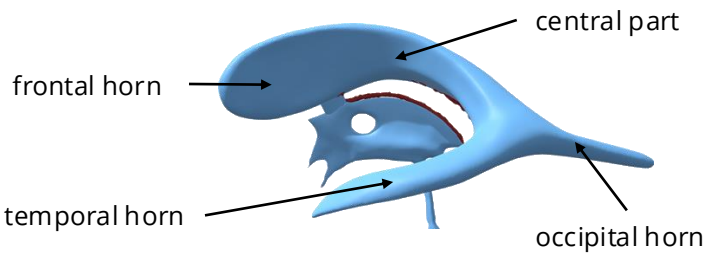
The tela choroidea is continuous with the **choroid plexus** of the lateral ventricle through the interventricular foramen and the **choroid fissure** (between the thalamus and fornix). The anterior boundary of the third ventricle is the **lamina terminalis**, between it and the column of fornix find the **anterior commissure**. Notice that of the third ventricle has four extensions (recesses). At the anterior part, the **optic recess** above the **optic chiasm** and the **infundibular recess** above the **infundibulum**.

At the posterior part, the **suprapineal recess** above the **pineal gland** and the **pineal recess** below it. At the bottom, the third ventricle is continuous with the **cerebral aqueduct** (of Sylvius) that connects it with the fourth ventricle.



Lateral ventricles

Each **lateral ventricle** consists of four parts: **frontal horn**, **central part**, **occipital horn** and **temporal horn**. For each part, we will learn the different structures that define the boundaries of the lateral ventricle.



Boundaries of the lateral ventricles

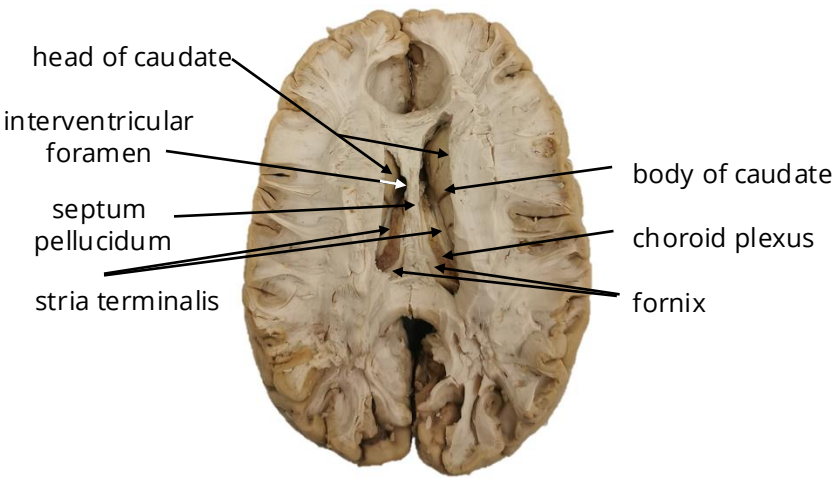
Frontal horn and central part of the lateral ventricles

Make a cut in central part of the **corpus callosum** and remove it.

This will expose the **frontal horn** and **central part** of the lateral ventricles.

The corpus callosum forms the roof and the **septum pellucidum** forms the medial wall that separates the two lateral ventricles. The frontal horn is anterior to the **interventricular foramen** and its floor is the **head of caudate**.

In the central part, the floor consists of the **body of caudate** and the thalamus (here it is covered by other structures). Between them, find the **stria terminalis** that contains fibers from the amygdala to the septal area and below it, the thalamostriate vein. In the central part of the lateral ventricle, notice how the **choroid plexus** starts at the interventricular foramen and continues posteriorly on top of the **fornix.**

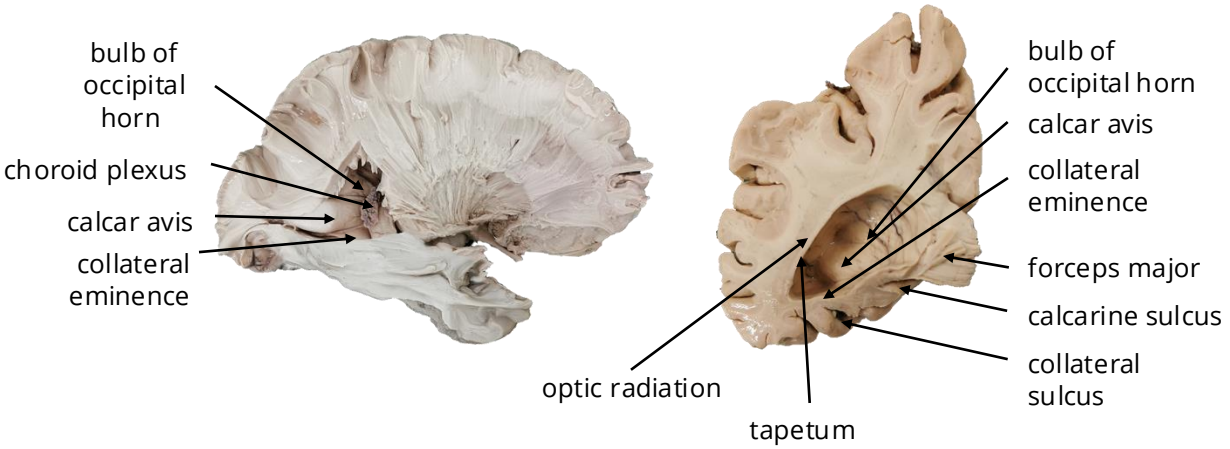


Occipital horn of the lateral ventricle

Make a cut in the posterior part of the corona radiata and reveal the **occipital horn**.

Notice that the **choroid plexus** continues into the temporal horn and does not reach the occipital horn. Also use a coronal section of the occipital horn and identify three bulges within it. The superior bulge is the **bulb of occipital horn** that is formed by the **forceps major** of the corpus callosum. The middle and largest bulge is the **calcar avis,** it is formed by the **calcarine sulcus**.

The Inferior bulge is the **collateral eminence,** it is formed by the **collateral sulcus**. The lateral wall is composed of fibers of the corpus callosum that continue downwards, the **tapetum**. Lateral to it, find the fibers of the **optic radiation**, that appears slightly darker because the cut was made perpendicular to the orientation of the fibers.

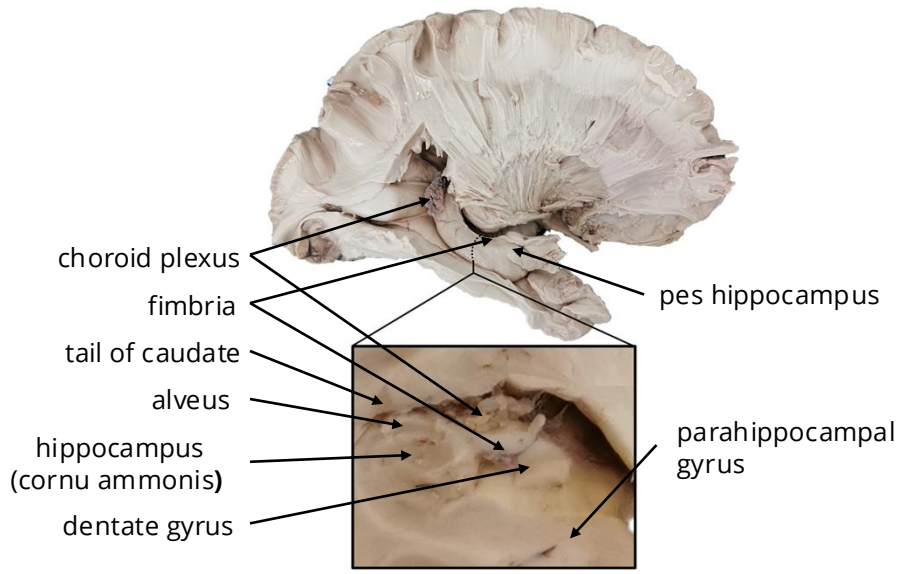


Temporal horn of the lateral ventricle

Make a cut in the white matter of the temporal lobe. This will reveal the **temporal horn**. At the floor, find a large structure, the **hippocampus** (sea horse). It is a three-layer archicortex that is continuous with the six-layered neocortex of the **parahippocampal gyrus**.

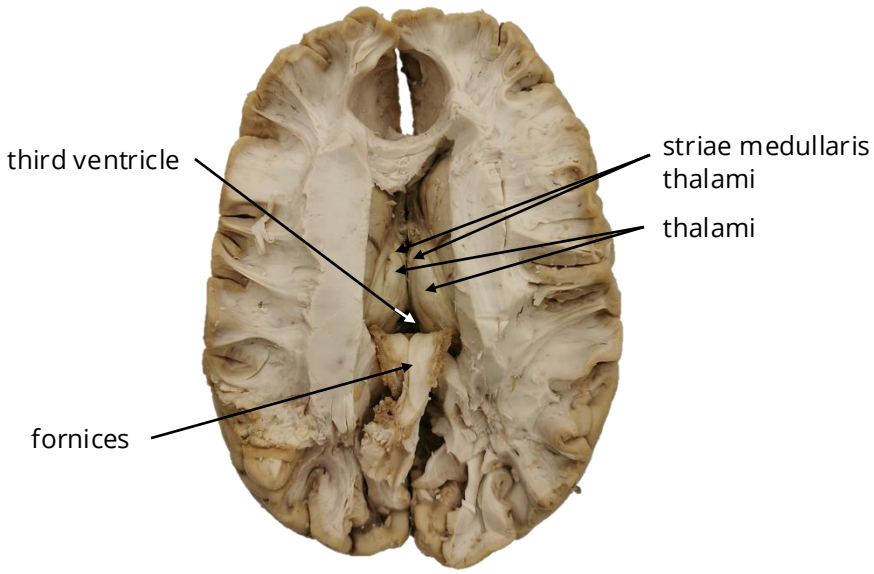
Its anterior part is the **pes hippocampus** (paw). The white matter that covers the hippocampus is the **alveus**, along its medial line notice a separated fold of white matter, the **fimbria** (fringe) which is continuous with the fornix.

Make a coronal cut in the hippocampus and notice that its cortex folds on itself, the **cornu ammonis** (horns of Ammon). Along the medial line, below the fimbria, find a row of bulges, the **dentate gyrus** (teeth), it is continuous with the indusium griseum. At the roof of the temporal horn, find the **tail of caudate**. Also notice the **choroid plexus.**



Superior view of the third ventricle

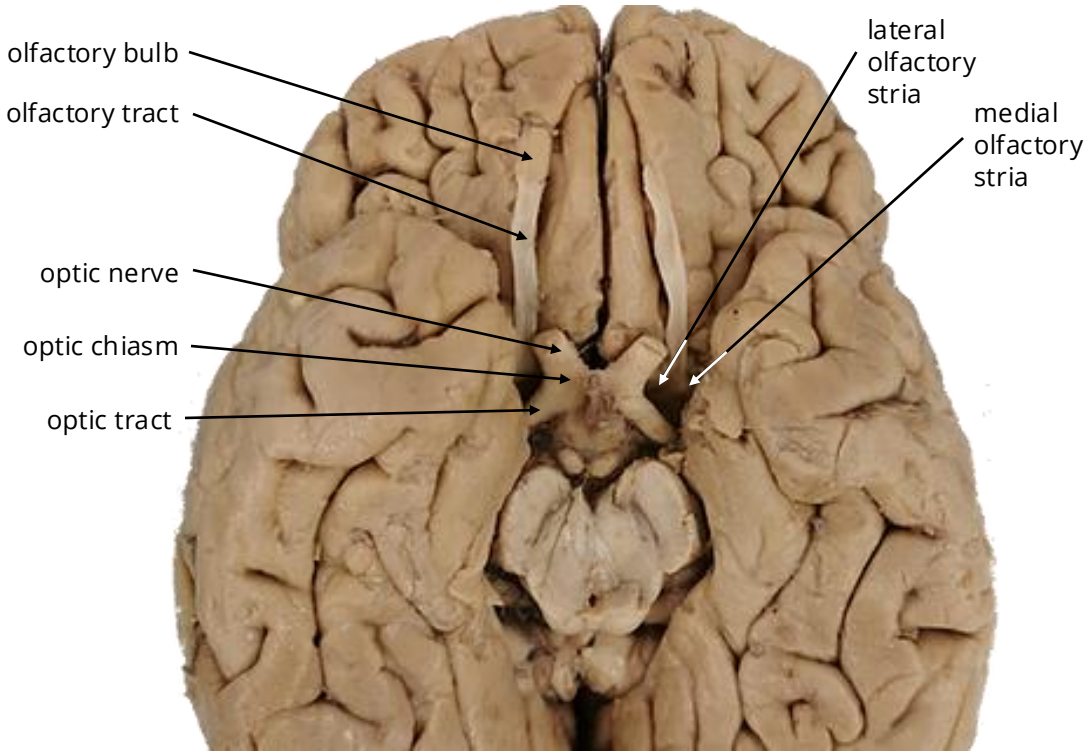
Now that we have finished examining the parts of the lateral ventricles, return to the superior view of the ventricles. Make an incision in the columns of fornix and retract the two **fornices** backwards to reveal the **third ventricle**, the narrow space between the two **thalami.** Along their medial line, find the **striae medullaris thalami**. Gently separate the thalami and peer into the anterior part of the third ventricle. Find the two columns of fornix with the anterior commissure forming an "A" shape between them.



Cranial nerves

There are twelve pairs of nerves that connect the central and peripheral nervous systems and pass through openings in the skull.

1. The **olfactory nerves (CN I)** are located at the roof of the nasal cavities and their fibers reach the **olfactory bulb**. The fibers coming out of the olfactory bulb form the **olfactory tract** that splits into a **lateral olfactory stria** and a **medial olfactory stria**.
2. The **optic nerve (CN II)** consists of the fibers from the retina of the eye. Some of the fibers of each optic nerve cross to the opposite side in the **optic chiasm**. From there, the fibers of the **optic tract** contain visual information from both eyes and reach the lateral geniculate nucleus (LGN) of the thalamus.

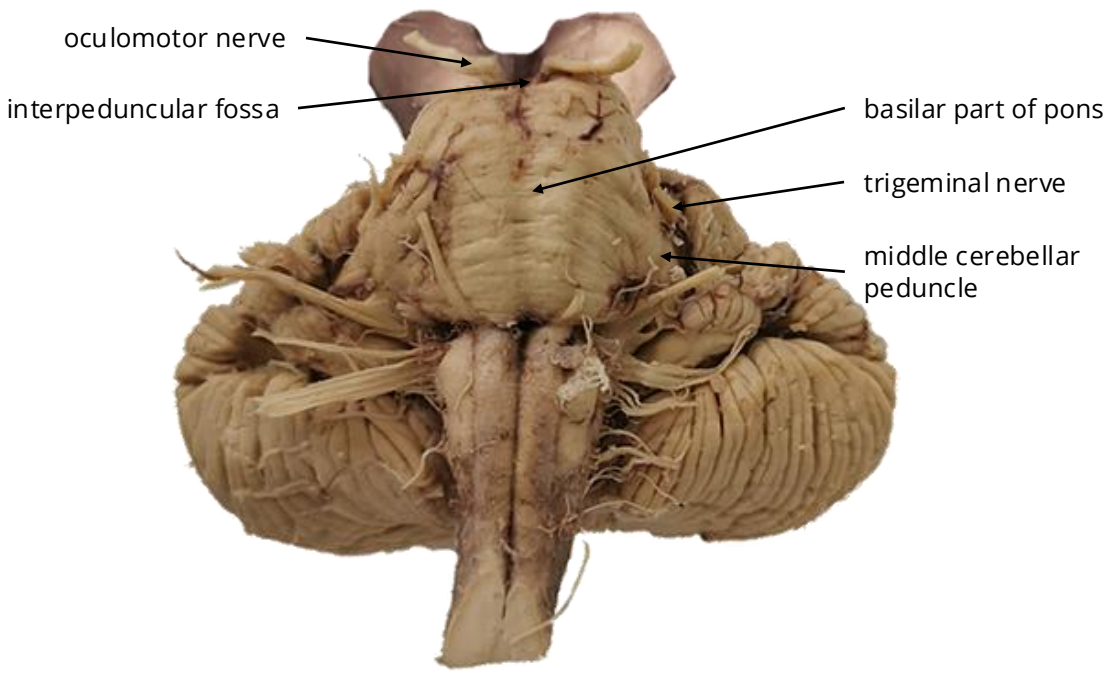


The nuclei of cranial nerves III - XII are all located in the brainstem.

3. The **oculomotor nerve (CN III)** exits at the **interpeduncular fossa** and innervates four of the ocular muscles (superior rectus, medial rectus, inferior rectus & inferior oblique), the levator palpebrae superioris (upper eyelid) and the sphincter pupillae (iris).

4. The **trochlear nerve (CN IV)** is the only cranial nerve that exits from the dorsal aspect of the brainstem, below the **inferior colliculi**. It innervates one of the ocular muscles (superior oblique).

5. The **trigeminal nerve (CN V)** exits from the pons and defines the boundary between the **basilar part of pons** and the **middle cerebellar peduncle**. It has three branches that bring sensory information from the face and innervate some of the jaw muscles.



Cranial nerves VI-VIII are located in the **pontomedullary sulcus**.

6. The **abducens nerve (CN VI)** is the most medial, it innervates one of the ocular muscles (lateral rectus).

7. The **facial nerve (CN VII)** innervates the facial muscles and brings taste information from the anterior two thirds of the tongue.

8. The **vestibulocochlear nerve (CN VIII)** is the most lateral, it has two branches that bring sensory information from the ear: auditory information from the cochlea and vestibular information from the vestibular system.

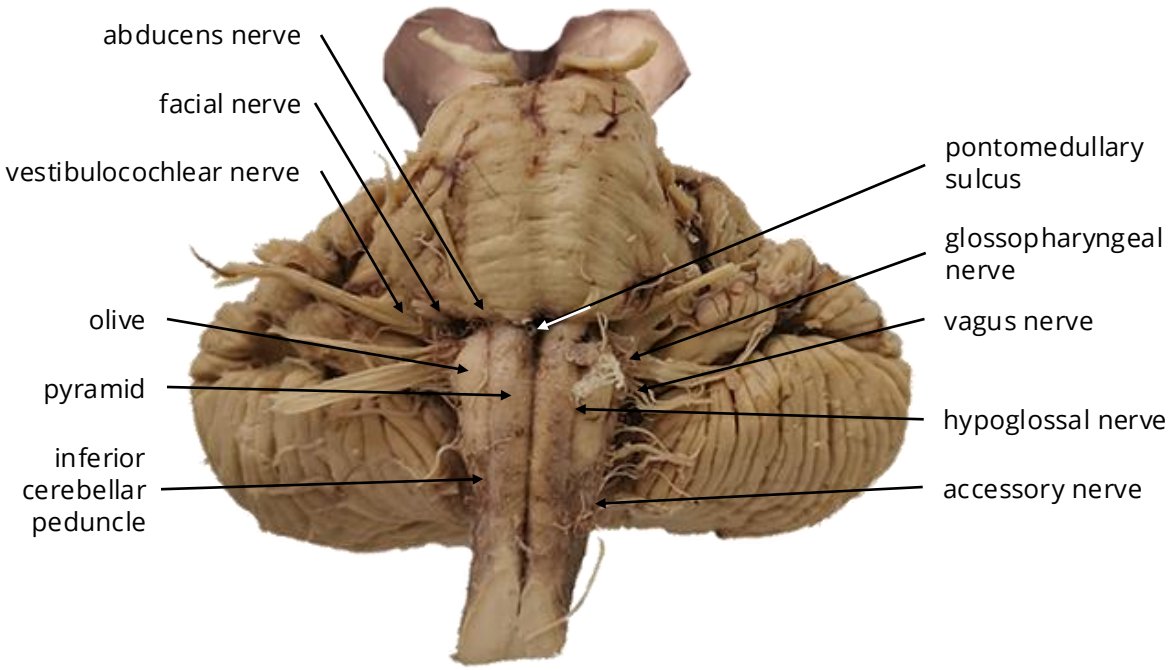
Cranial nerves IX-XI are located between the **olive** and the **inferior cerebellar peduncle**.

9. The **glossopharyngeal nerve (CN IX)** is the most superior, it brings taste information from the posterior one third of the tongue and innervate muscles in the pharynx.

10. The **vagus nerve (CN X)**, parasympathetically innervates the heart, lungs and digestive system.

11. The **accessory nerve (CN XI)** is the most inferior, it innervates the neck and trapezius muscles.

12. The **hypoglossal nerve (CN XII)** exits between the **olive** and the **pyramid** and it innervates the muscles of the tongue.

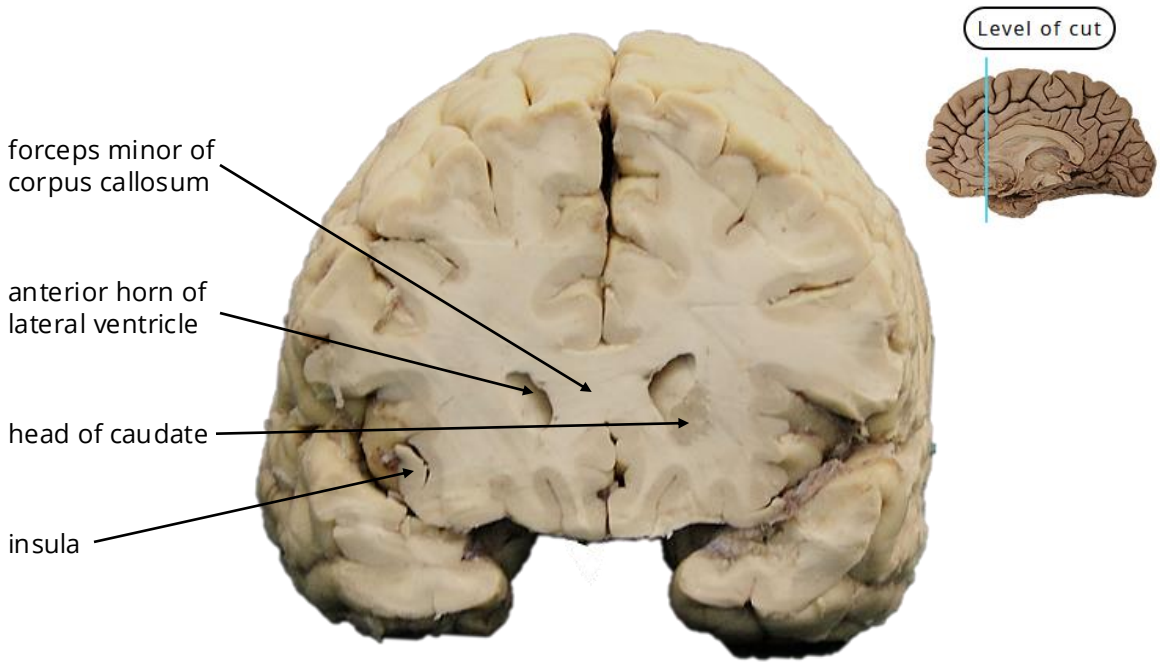


Coronal sections of the brain

Now that we have finished learning about the different structures of the cerebrum, we will examine them in the coronal sections. Using the hemisphere that has remained intact, make coronal sections according to the following instructions. After each cut identify the different structures in the anterior and posterior aspects of each section and compare them with the figures.

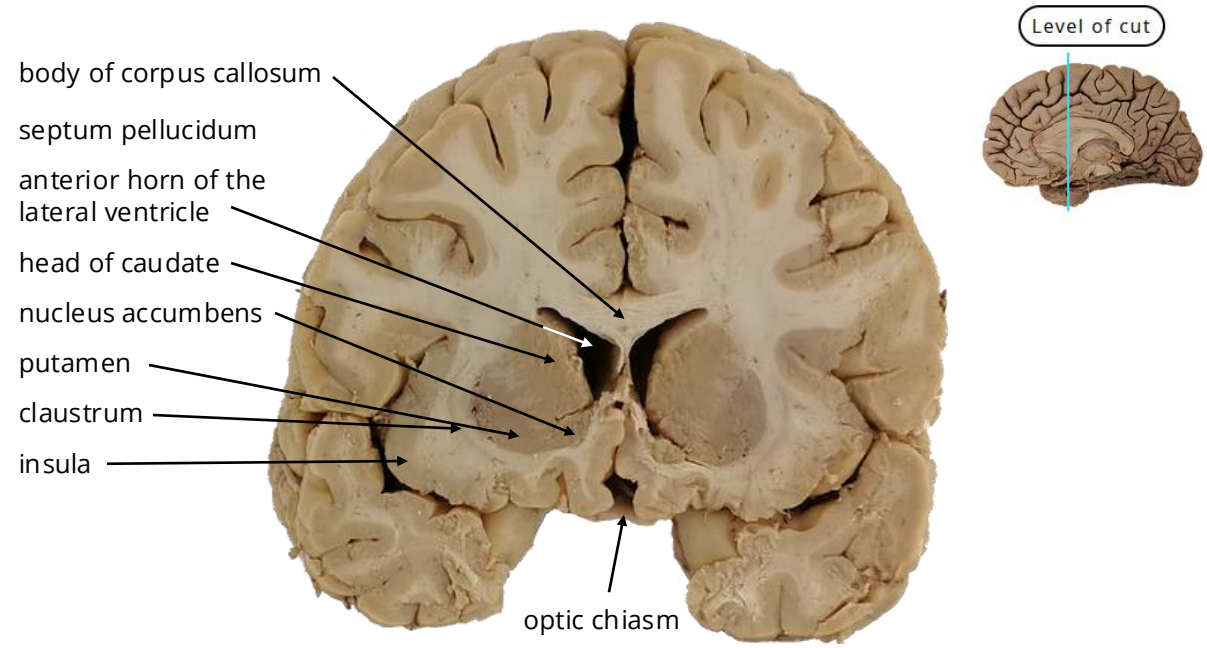
Cut through the genu of the corpus callosum

In this section, you can see the **anterior horn of the lateral ventricle**. The roof and medial wall are made of the white matter of the **forceps minor of corpus callosum** and the floor is the **head of caudate nucleus**. Notice the **insula** as well.



Cut through the optic chiasm

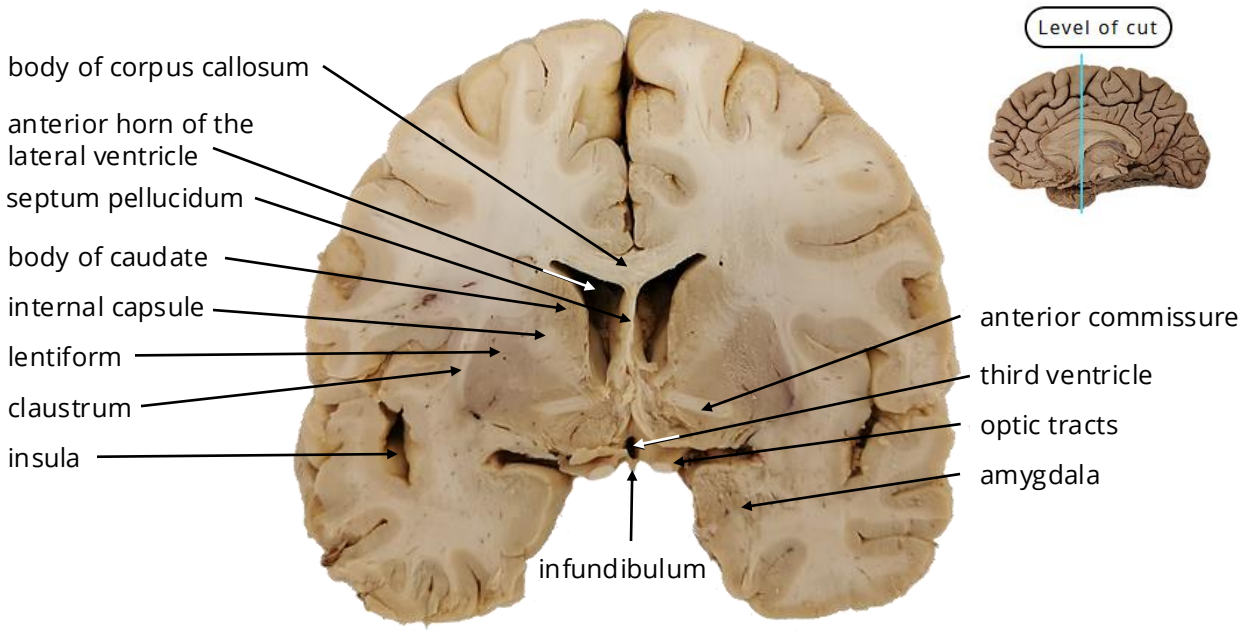
In this section through the **optic chiasm**, continue to follow the **anterior horn of the lateral ventricle**. The floor is made of the **head of caudate nucleus**, the roof is made of the **body of corpus callosum** and the medial wall is the **septum pellucidum**. In this section, you can also see the **putamen, nucleus accumbens, claustrum** and **insula**.



Cut through the anterior commissure

In this section through the **anterior commissure**, identify the **optic tracts** on both sides of the **infundibulum**. In this section, you can also see the anterior part of the **third ventricle**. In the temporal lobe, notice a gray matter nucleus, the **amygdala** (almond). In this section, the floor of the **anterior horn of the lateral ventricle** is made of the **body of caudate nucleus**, the roof is made of the **body of corpus callosum** and the medial wall is made of the **septum pellucidum**.

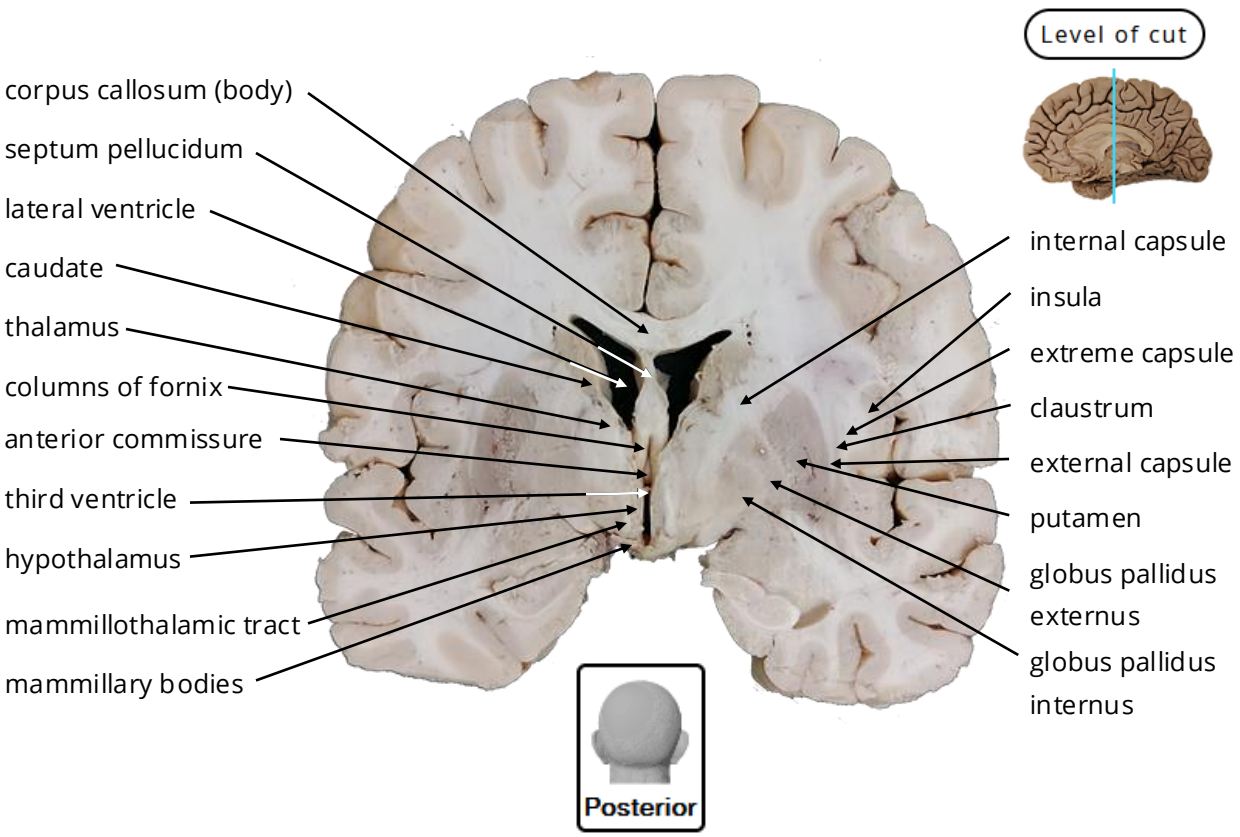
Also find the **internal capsule**, **lentiform** (putamen and globus pallidus), **claustrum** and **insula**.

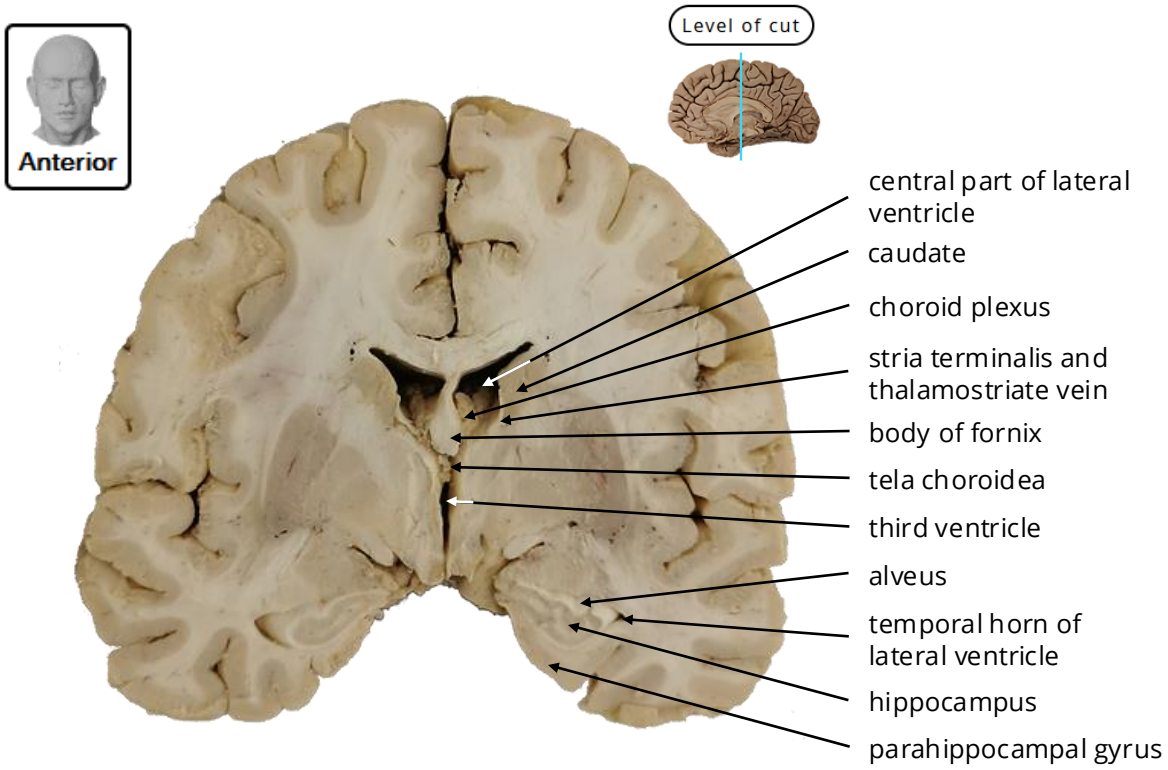


Cut through the mamillary bodies (anterior and posterior parts of the brain)

In this section, we see a posterior view of the **anterior part of the brain** and an anterior view of the **posterior part of the brain.** In the anterior part of the brain, notice the **columns of fornix** and anterior to them, the **anterior commissure**. In both parts of the brain, find the **mammillothalamic tract.** It is composed of the fibers that connect the **mammillary bodies** to the **anterior nucleus of thalamus**. In this section, you can see the **third ventricle** between the two **hypothalami** and the **interventricular foramens** that connect it with the **lateral ventricles**. In the posterior part of the brain, find the **tela choroidea** at the roof of the third ventricle below the **body of fornix** and the **choroid plexus** in the **central part of the lateral ventricle.** The floor of the central part of the lateral ventricle is the **body of caudate** and the **thalamus**. Between them, find the **thalamostriate vein and stria terminalis**. The roof is made of the **body of corpus callosum** and the medial wall is made of the **septum pellucidum**. In the temporal lobe, notice that we can now see the **temporal horn of the lateral ventricle**. At its floor, find the anterior part of the **hippocampus** (pes) covered with its white matter, the **alveus**. Notice how its cortex folds on itself and is continuous with **parahippocampal gyrus**. Identify the **optic tracts** and notice how they move laterally as we continue to more posterior sections. In this cut, you can identify the different nuclei of the l**entiform**: **putamen**, **globus pallidus externus** and **globus pallidus internus.**

Here, you can clearly see the distinction between the **internal capsule, external capsule**, **claustrum, extreme capsule** and **insula**.

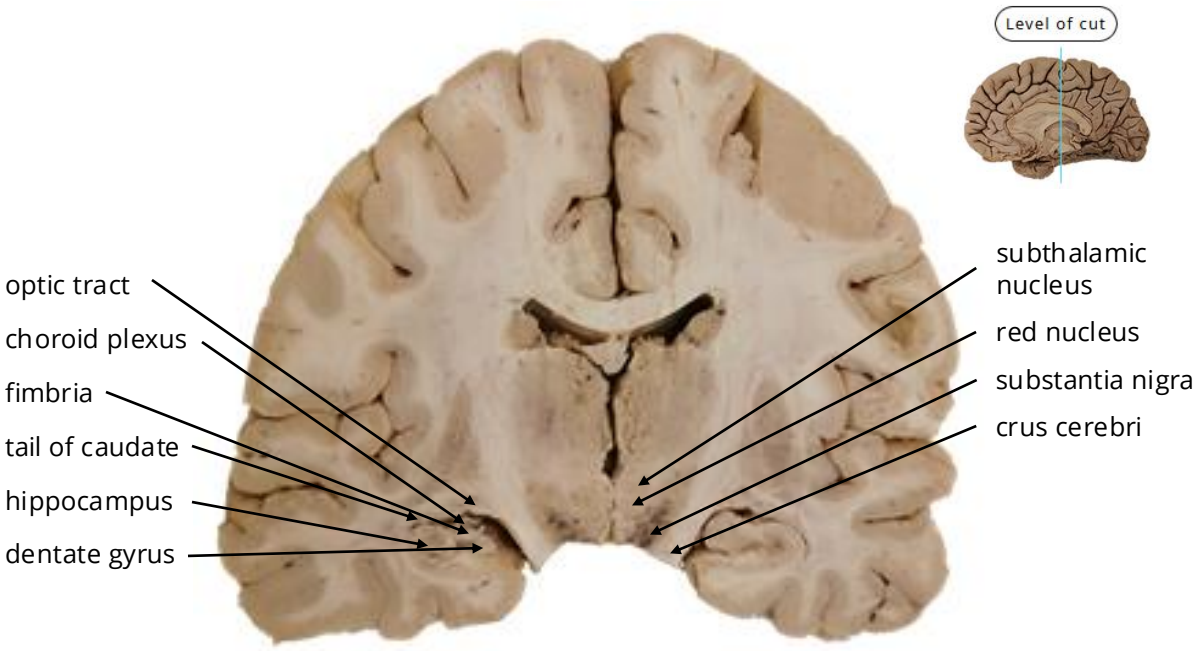




Cut through the tegmentum of the midbrain

In this section, you can see some of the structures of the **midbrain** such as the **red nucleus**, **substantia nigra, subthalamic nucleus** and the **crus cerebri**. Lateral to the crus cerebri of each side, find the **optic tract**. In the **temporal horn of the lateral ventricle,** you can see the central part of the **hippocampus** and the **alveus**. Notice a separate fold of white matter, the **fimbria**. Above it, find the **choroid plexus** and below it the **dentate gyrus**. At the roof of the **temporal horn of the lateral ventricle**, find the **tail of caudate nucleus**. Note that it is also present at the floor of the **central part of the lateral ventricle**.

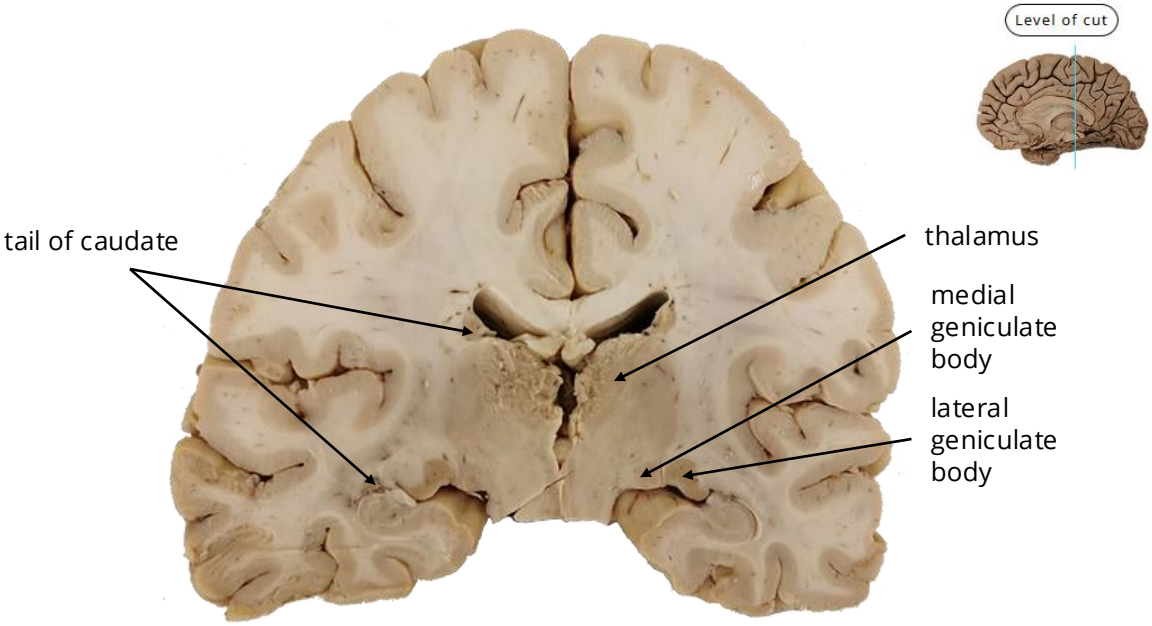
Identify the structures you have seen in the previous section that are also present here: **corpus callosum, septum pellucidum**, **body of fornix, choroid plexus, thalamus, third ventricle, internal capsule**, **lentiform, external capsule**, **claustrum, extreme capsule**, **insula** and **parahippocampal gyrus**.



Cut through the lateral geniculate nucleus

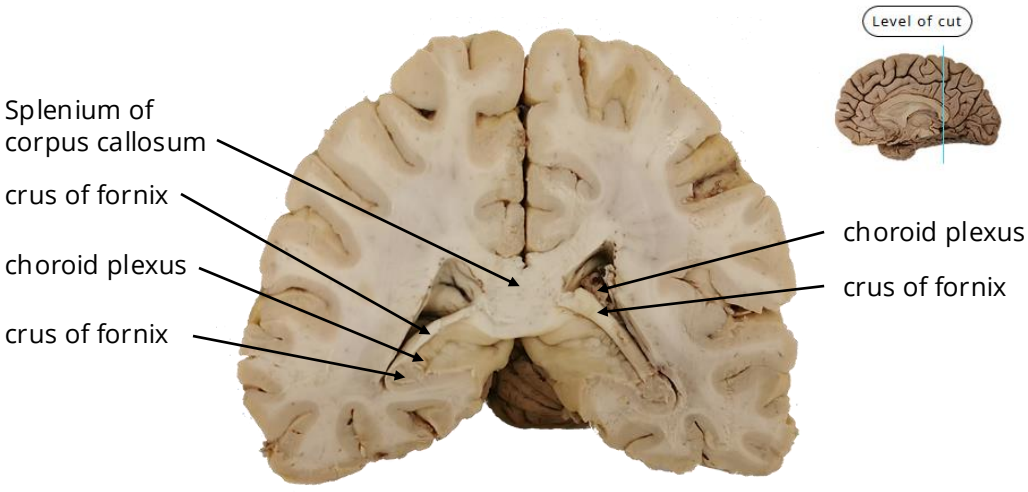
In this section, you can see the **lateral geniculate body** and **medial geniculate body** of the **thalamus**.

Identify the structures you have seen in the previous section that are also present here: **central part of the lateral ventricle, corpus callosum, fornix, tail of caudate nucleus, third ventricle, temporal horn of the lateral ventricle**, **hippocampus, alveus**, **fimbria** and **dentate gyrus**.



Cut through the splenium of corpus callosum

In this section through the **splenium** of **corpus callosum**, you can see the **crus of fornix** and how it is continuous with the **fimbria**. Identify the structures you have seen in the previous section that are also present here: **hippocampus**, **dentate gyrus and choroid plexus.**



Cut through the occipital horn of the lateral ventricle (right hemisphere)

In this section, you can see the **occipital horn of the lateral ventricle**, notice that it does not contain the choroid plexus. Find three bulges within it. The superior bulge is the **bulb of the occipital horn** that is formed by the **forceps major** of the corpus callosum. The middle and largest bulge is the **calcar avis** that is formed by the **calcarine sulcus**. The Inferior bulge is the **collateral eminence** that is formed by the **collateral sulcus**. The lateral wall is composed of fibers of the corpus callosum that continue downwards, the **tapetum**. Laterally to it, find the fibers of the **optic radiation** of the internal capsule. It appears slightly darker because the cut was made perpendicular to the orientation of the fibers.