

## 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.

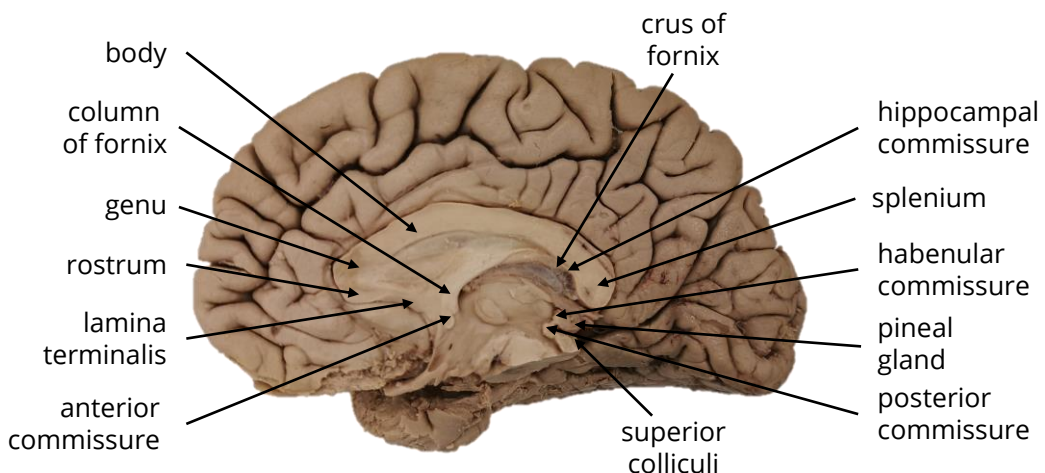
There are three main types of fibers depending on the type of areas they connect:

- 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.

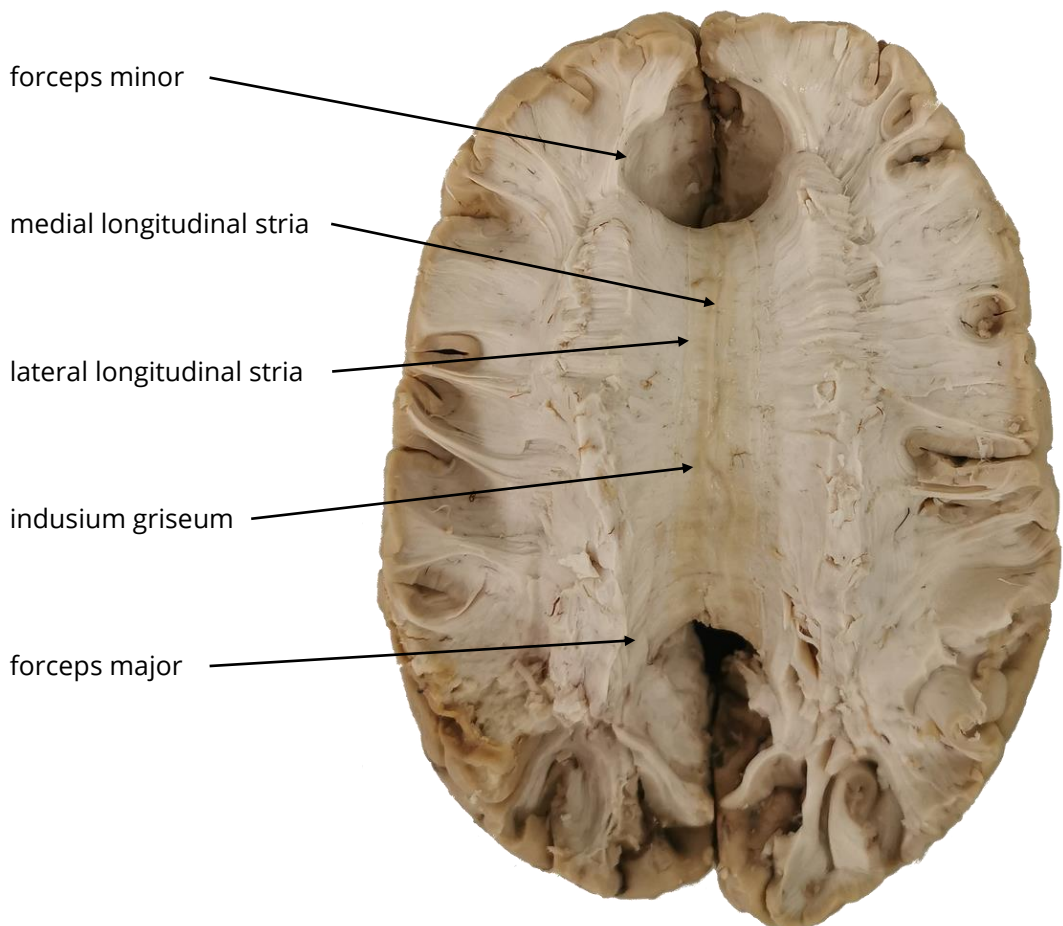
The hippocampal commissure is located between the crus of fornix of each side and it connects the two hippocampi. Since it is very thin, it is harder to see it in a midsagittal section. The habenular commissure is located anterior to the pineal gland and it connects the two habenulae. The posterior commissure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



## Superior view of corpus callosum

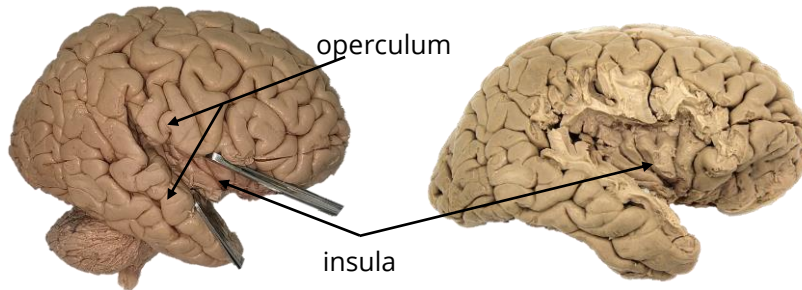
The largest commissural structure is the corpus callosum. Notice that its medial part is shorter than the length of the hemisphere. The fibers that connect the anterior parts of the frontal lobes form the forceps minor and the fibers that connect the occipital lobes form the forceps major.

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.

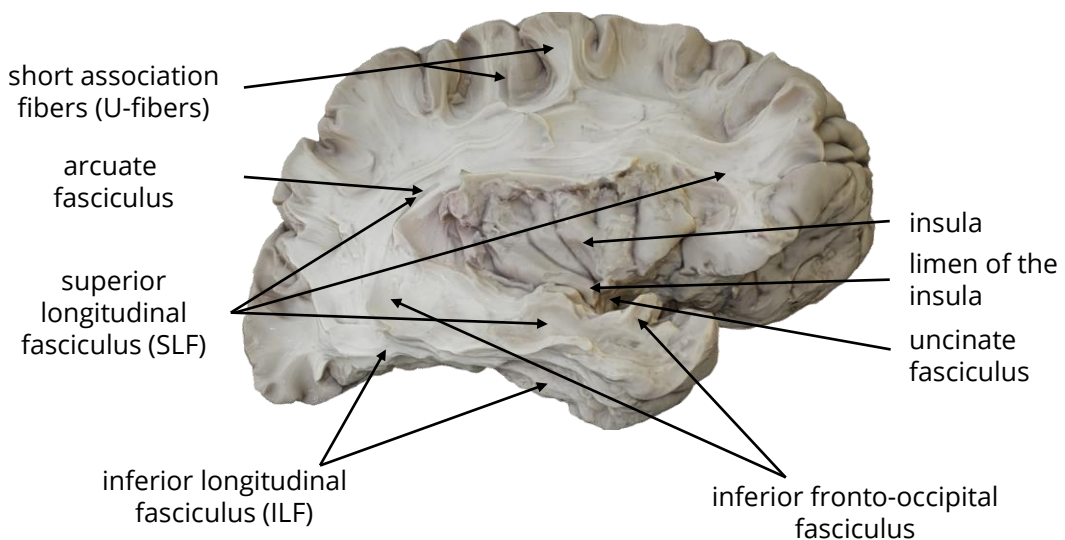


## Association fibers

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.

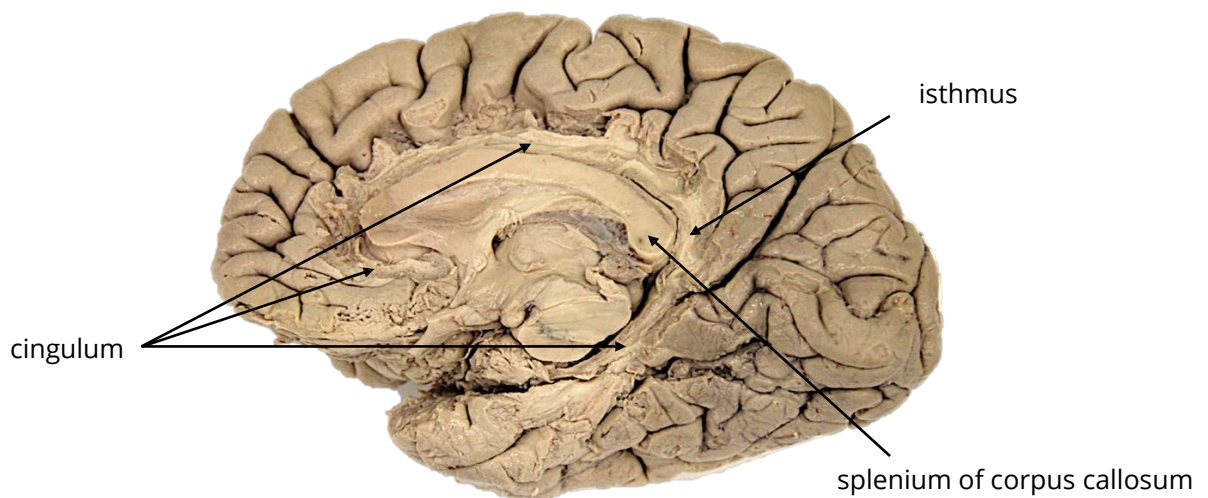


Continue to remove the cortex around the insula. Notice the fibers that connect adjacent gyri, these are short association fibers (U-fibers). The other associative fibers we will study are long-association fibers. Find a long bundle of fibers that bends around the insula and connects all of the lobes, 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.

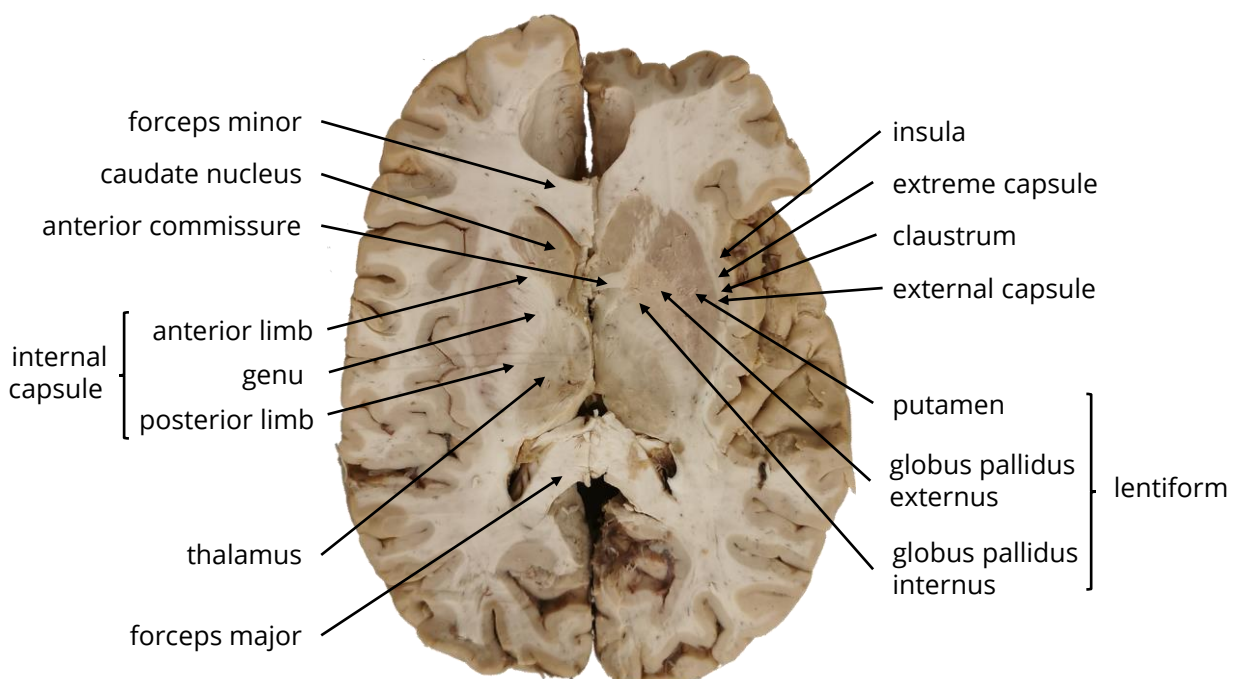
### **Association fibers in the medial aspect of the hemisphere**



## 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 three of its five 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 continuous 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.

