

Neuroanatomy

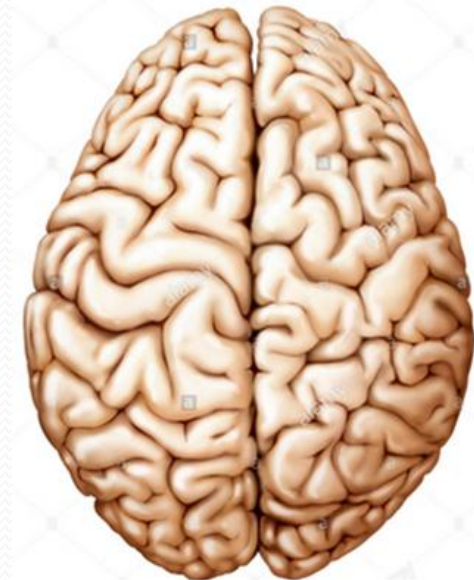
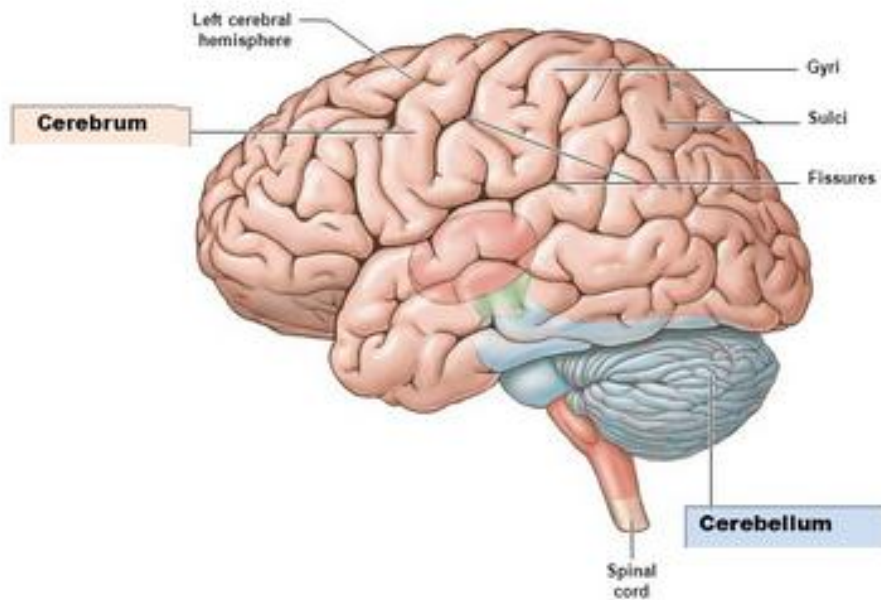
Cerebrum

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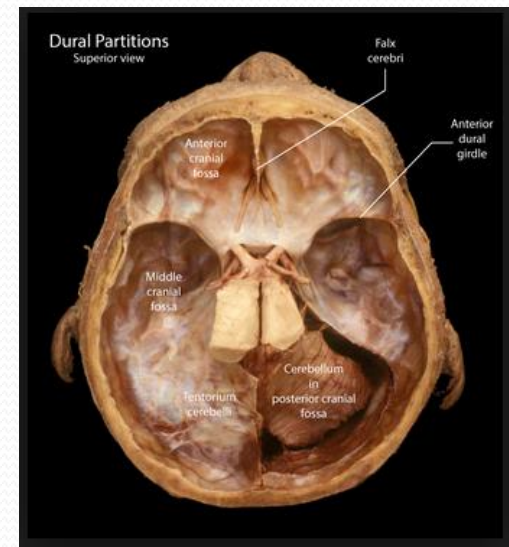
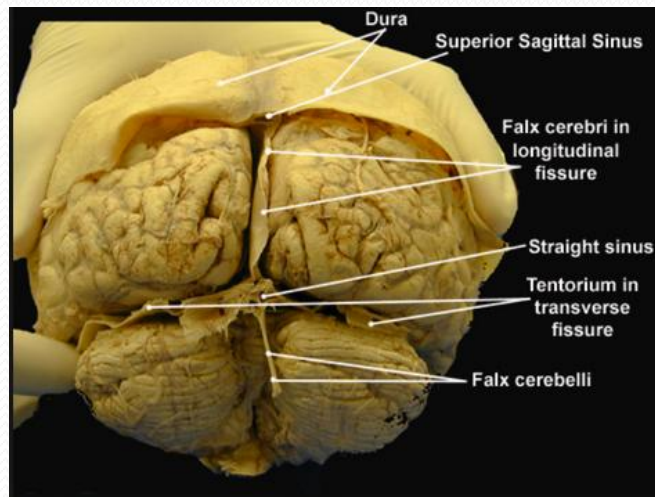
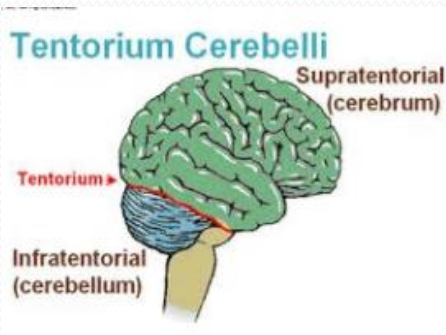
Cerebrum

- The cerebrum is the largest part of the brain fills most of the cranial cavity. It extends from the **frontal bone** anteriorly to the **occipital bone** posteriorly. Within the skull
- It consists of two **cerebral hemispheres** (left and right), separated by the falx cerebri of the dura mater, and is located above the **tentorium cerebelli** inferoposteriorly.
- **The tentorium cerebelli**
is an extension layer of the dura mater that separates the cerebellum from the inferior portion of the occipital lobes.



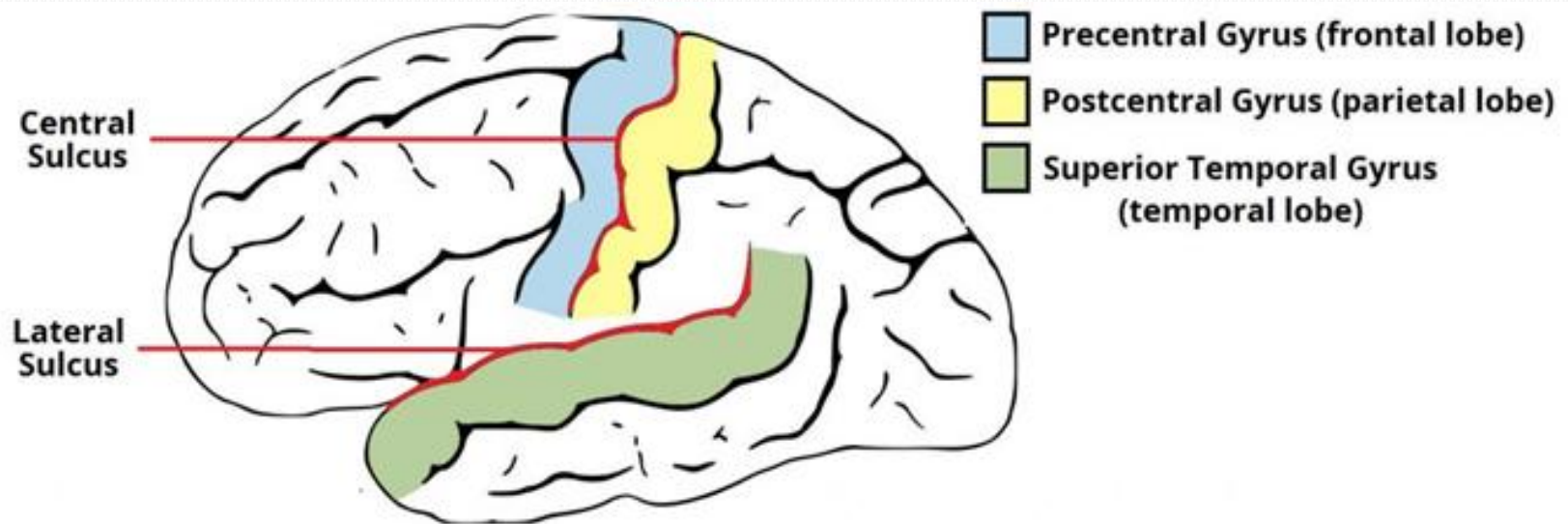
External Structure

- Falx cerebri a deep median cleft, the **longitudinal cerebral fissure**, incompletely separates the two cerebral hemispheres. Both in front and behind, the cleft is complete, but in the central part the cleft extends downwards up to the **corpus callosum** which is a large mass of white fibres joining the two cerebral hemispheres across the median plane.
- The longitudinal cerebral fissure is occupied by the following structures:
 - 1. Falx cerebri (a sickle-shaped fold of dura mater).
 - 2. Fold of arachnoid that follows the surfaces of the falx cerebri.
 - 3. Pia mater covering the medial surface of the falx cerebri.
 - 4. Anterior cerebral arteries and veins (which lie in the subarachnoid space between the arachnoid and the pia).



External Structure

Externally, the cerebrum has a highly convoluted appearance, consisting of **sulci** (grooves or depressions) and **gyri** (ridges or elevations). It is divided into two anatomically symmetrical hemispheres by the **longitudinal fissure** – a major sulcus that runs in the median sagittal plane.

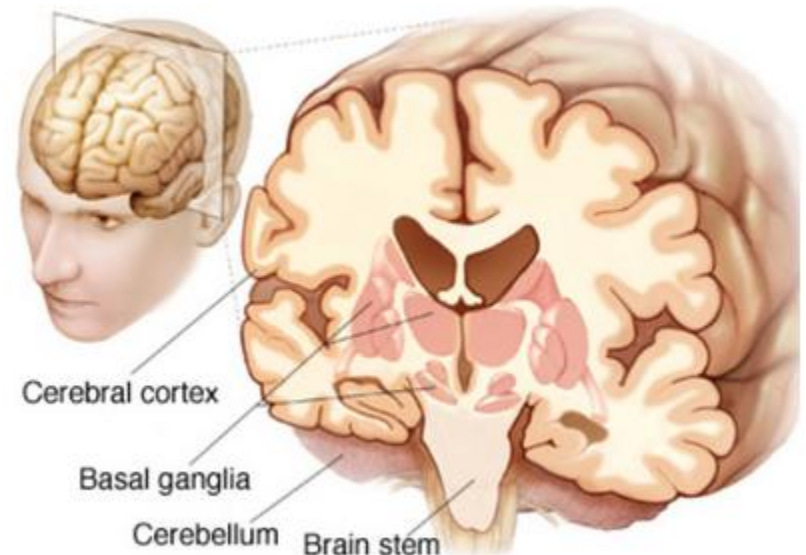
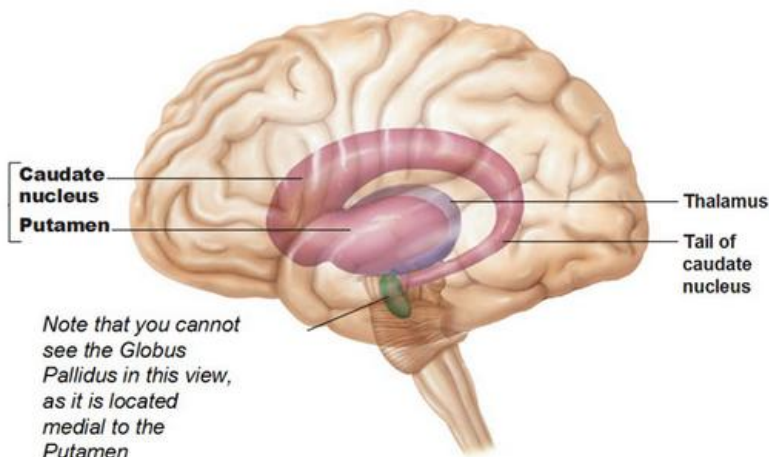


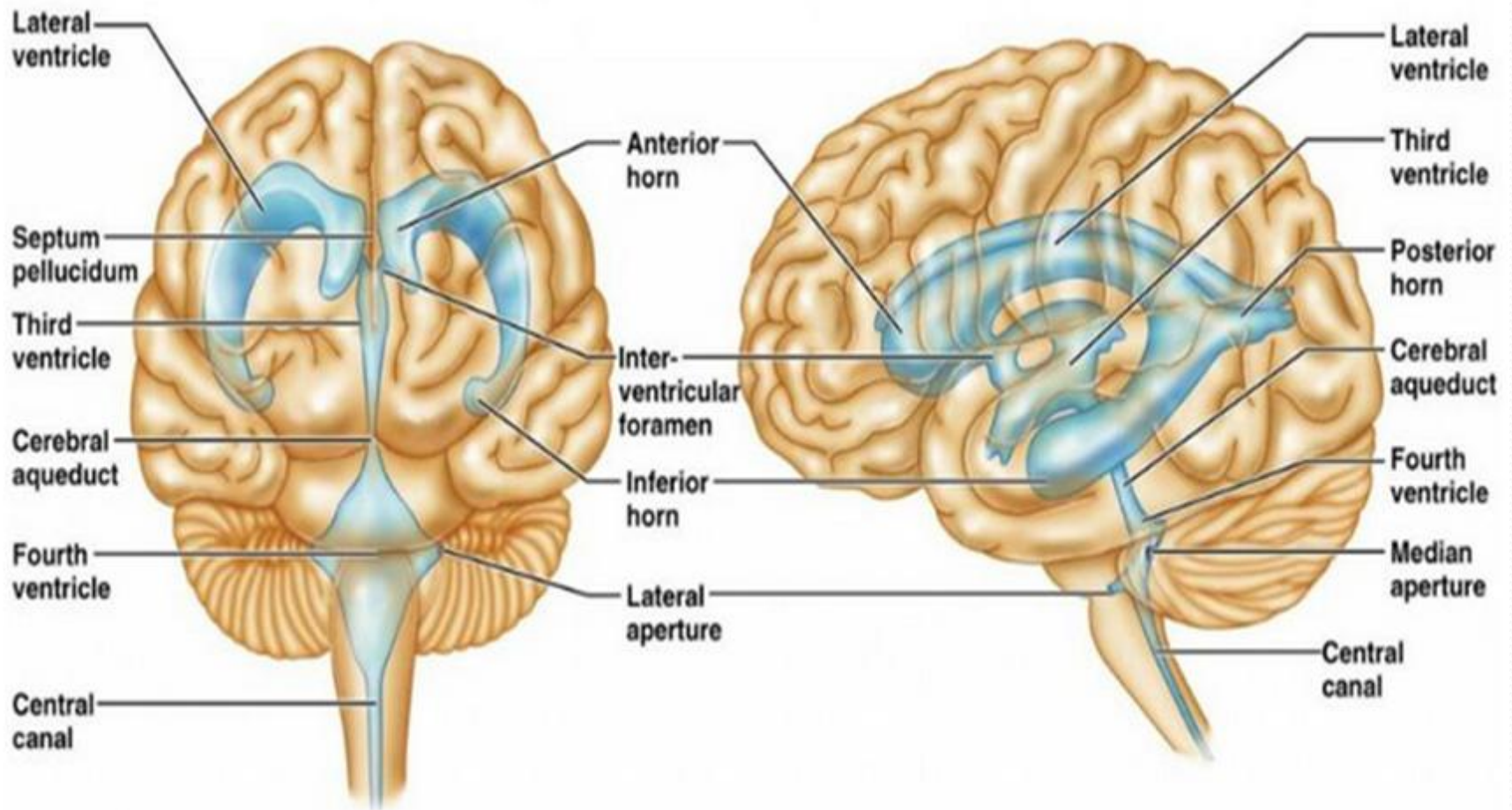
- The **falx cerebri** (a fold of dura mater) descends vertically to fill this fissure. The two cerebral hemispheres are connected by a white matter structure, called the **corpus callosum**.
- The main sulci are:
- **Central sulcus** – groove separating the frontal and parietal lobes.
- **Lateral sulcus** – groove separating the frontal and parietal lobes from the temporal lobe.
- **Lunate sulcus** – groove located in the occipital cortex.
- The main gyri are:

Cerebrum

- Each cerebral hemisphere consists of: an outer layer of grey matter called **cerebral cortex**, an inner mass of **white matter**, large masses of grey matter embedded in the basal part of the white matter called **basal ganglia/basal nuclei**, and a cavity within it called **lateral ventricle**.

Basal Ganglia





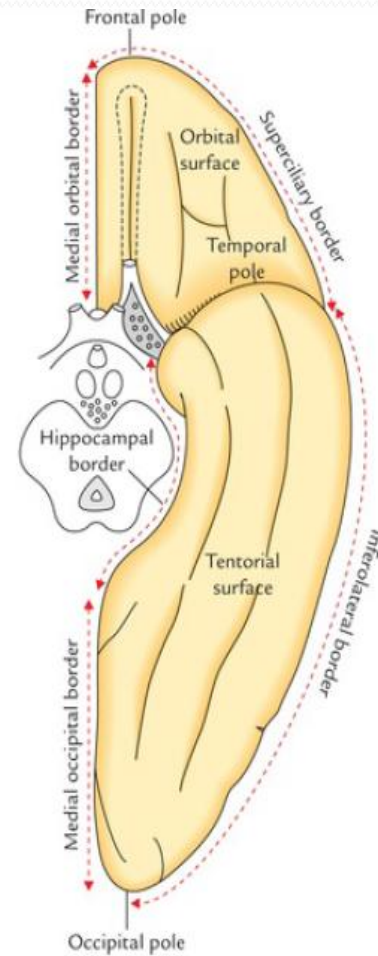
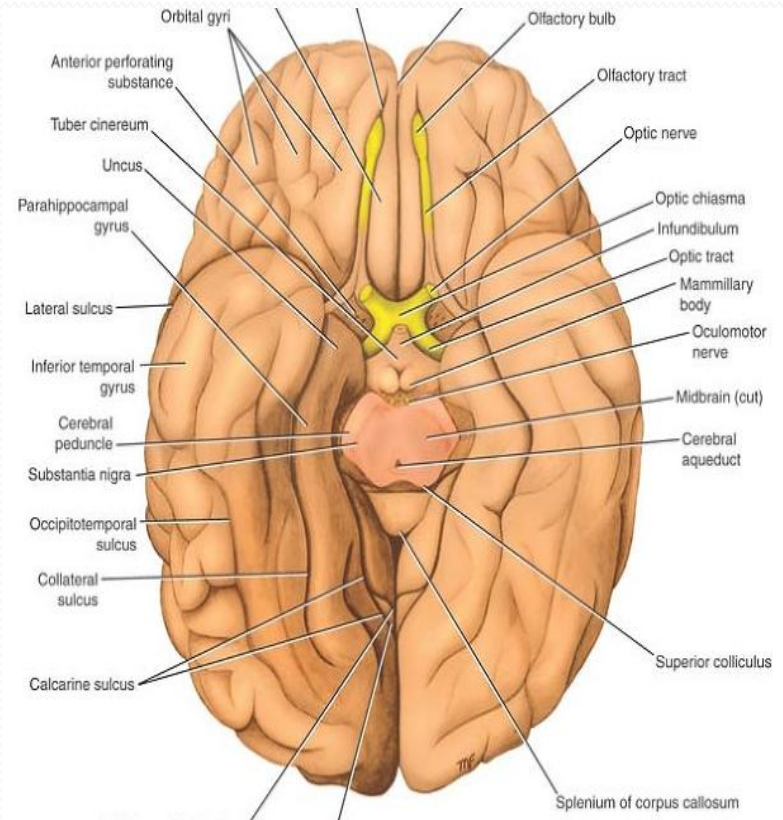
(a) Anterior view

(b) Left lateral view

External Structure

- **Surfaces**
- Each cerebral hemisphere has three surfaces – superolateral, medial, and inferior .
- 1. **The superolateral surface** is most convex and most extensive. It faces upwards and laterally and conforms to the corresponding half of the cranial vault.
- 2. **The medial surface** is flat and vertical. It presents a thick C-shaped cut surface of the ***corpus callosum***.
- 3. **The inferior surface** is irregular to adopt the floors of anterior and middle cranial fossae. It is divided into two parts by a deep horizontal groove or sulcus, the ***lateral sulcus***, viz. a small anterior part, the *orbital surface*, and a large posterior part, the *tentorial surface*.

External Structure



Inferior aspect of cerebral hemisphere showing borders, surfaces, and poles.

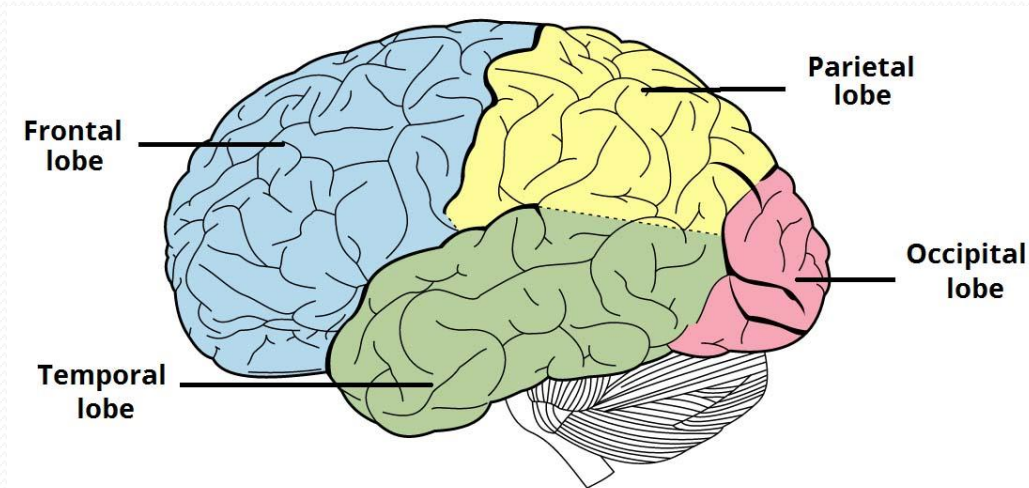
External Structure

Borders

- Each cerebral hemisphere presents six borders. superomedial, superciliary, inferolateral, medial orbital, medial occipital and inferomedial. 1. The **superomedial border** separates the superolateral surface from the medial surface.
- 2. The **superciliary border** is at the junction of superolateral and orbital surfaces. It lies just behind the superciliary arch hence its name strictly speaking, it is the orbital part of the inferolateral border.
- 3. The **inferolateral border** separates the superolateral surface from the tentorial surface. Posteriorly this
- border exhibits a notch, the *preoccipital notch* about 3 cm in front of the occipital pole. This notch is used as a useful surface landmark.
- 4. The **medial orbital border** separates the medial surface from the orbital surface.
- 5. The **inferomedial/hippocampal border** surrounds the cerebral peduncle. It is formed by the medial aspect of the uncus and parahippocampal gyrus.
- 6. The **medial occipital border** separates the medial surface from the tentorial surface.

Lobes of the Cerebrum

- The cerebral cortex is classified into four lobes, according to the name of the corresponding cranial bone that approximately overlies each part. Each lobe contains various **cortical association areas** – where information from different modalities are collated for processing. Together, these areas function to give us a meaningful perceptual interpretation and experience of our surrounding environment.



● **Frontal Lobe**

- The frontal lobe is located beneath the frontal bone of the calvaria and is the most anterior region of the cerebrum. It is separated from the parietal lobe posteriorly by the **central sulcus** and from the temporal lobe inferoposteriorly by the **lateral sulcus**.
- The association areas of the frontal lobe are responsible for: higher intellect, personality, mood, social conduct and language (dominant hemisphere side only).

● **Parietal Lobe**

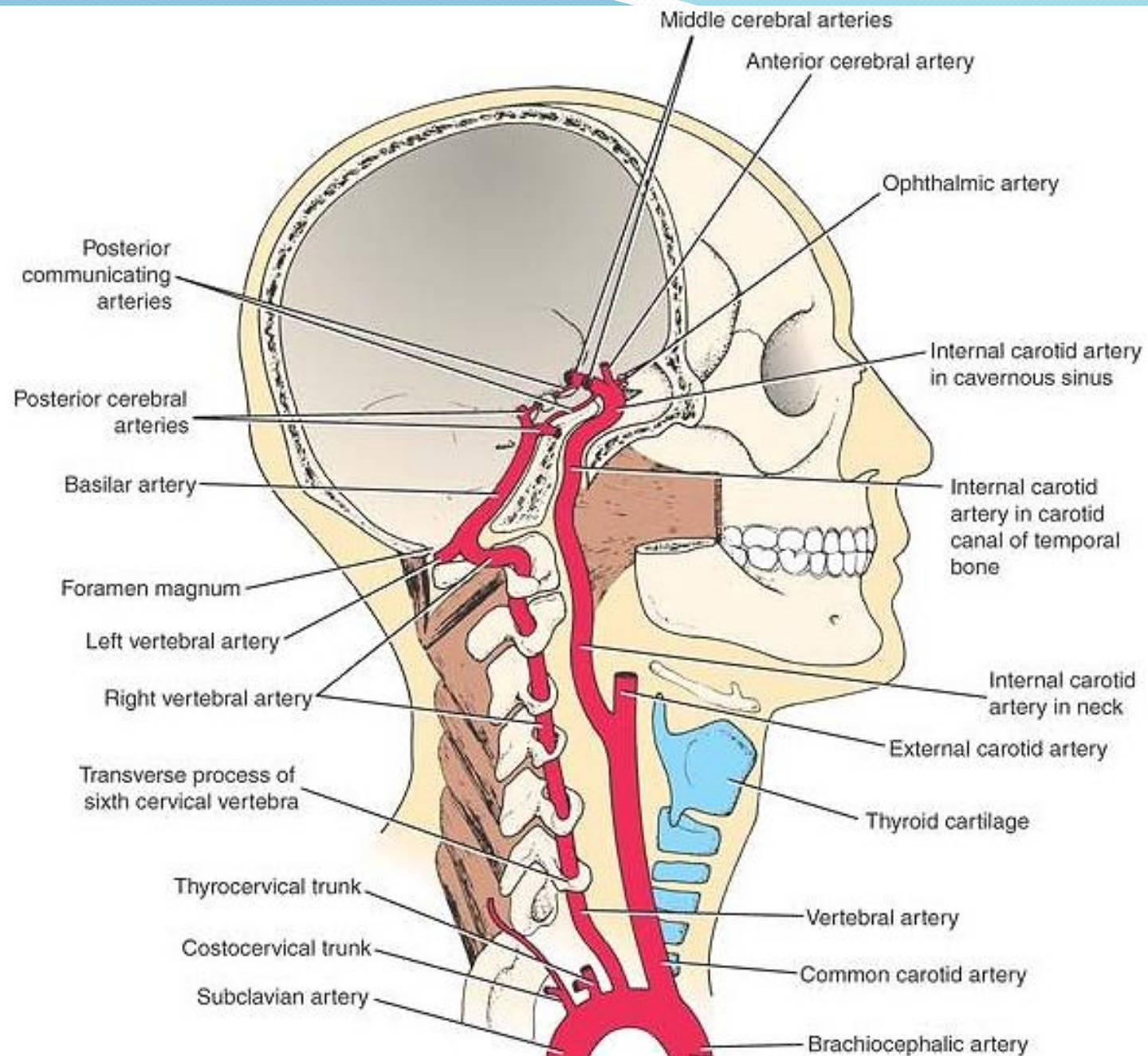
- The parietal lobe is found below the parietal bone of the calvaria, between the frontal lobe anteriorly and the occipital lobe posteriorly, from which it is separated by the central sulcus and **parieto-occipital sulcus**, respectively. It sits superiorly in relation to the temporal lobe, being separated by the lateral sulcus.
- Its cortical association areas contribute to the control of: language and calculation on the dominant hemisphere side.

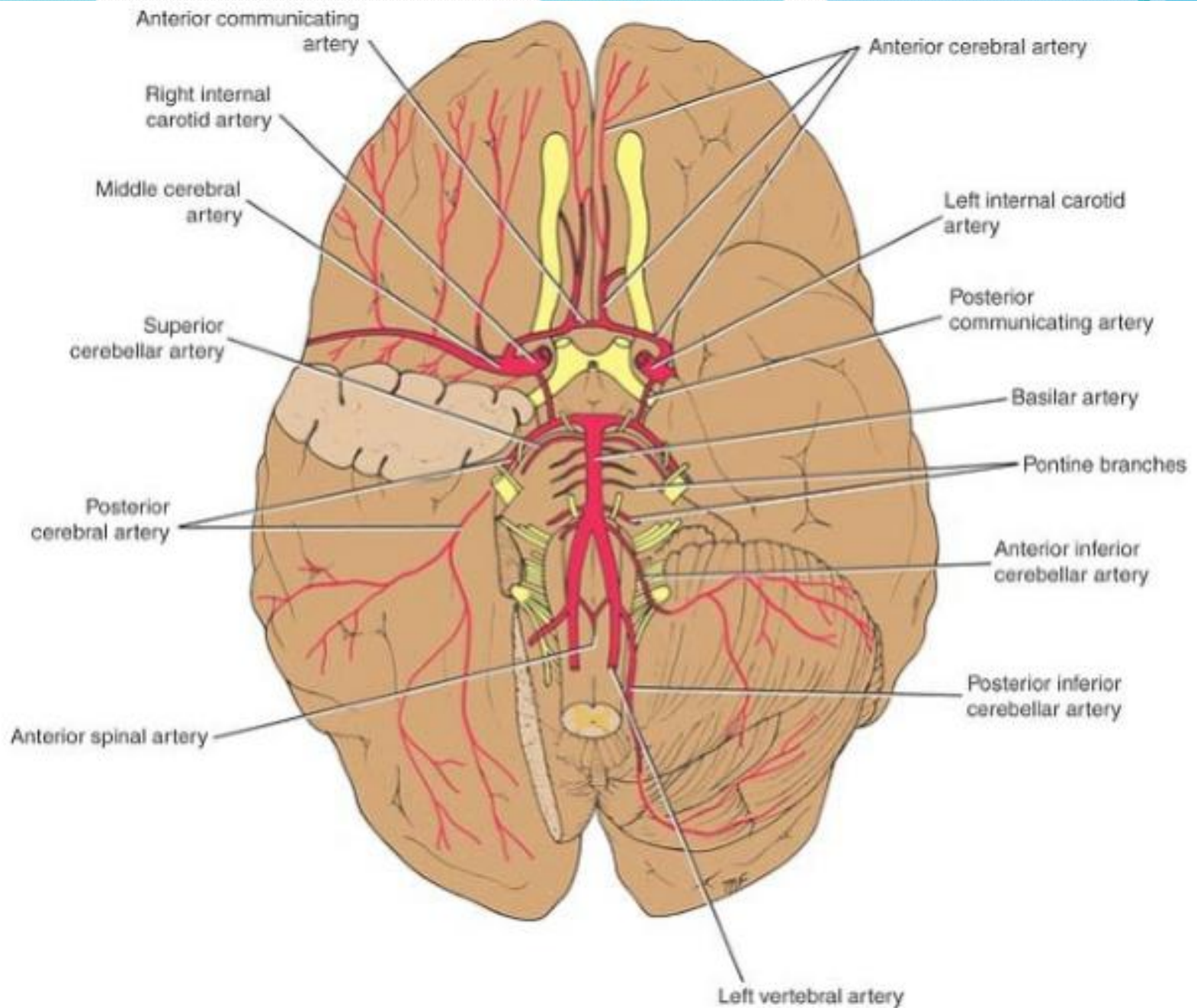
- **Temporal Lobe**

- The temporal lobe sits beneath the temporal bone of the calvaria, inferior to the frontal and parietal lobes, from which it is separated by the **lateral sulcus**.
- The cortical association areas of the temporal lobe are accountable for memory and language – this includes hearing as it is the location of the **primary auditory cortex**.

- **Occipital Lobe**

- The occipital lobe is the most posterior part of the cerebrum situated below the occipital bone of the calvaria. It rests inferiorly upon the **tentorium cerebelli** which segregates the cerebrum from the cerebellum. The **parieto-occipital sulcus** separates the occipital lobe from the parietal and temporal lobes anteriorly.
- The primary visual cortex (V₁) is located within the occipital lobe and hence its cortical association area is responsible for vision.

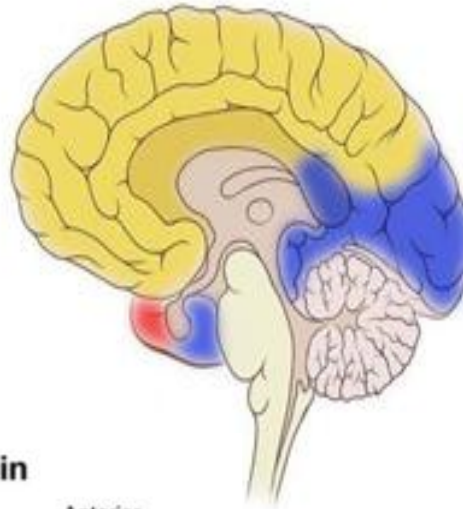




Lateral Brain

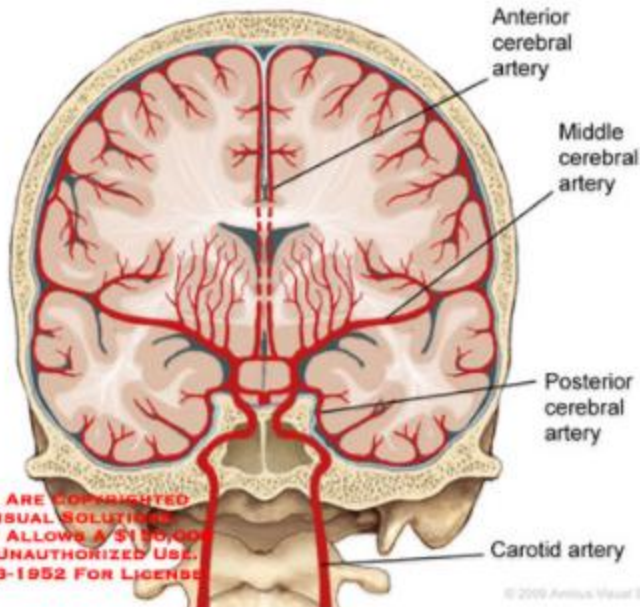


Medial Brain



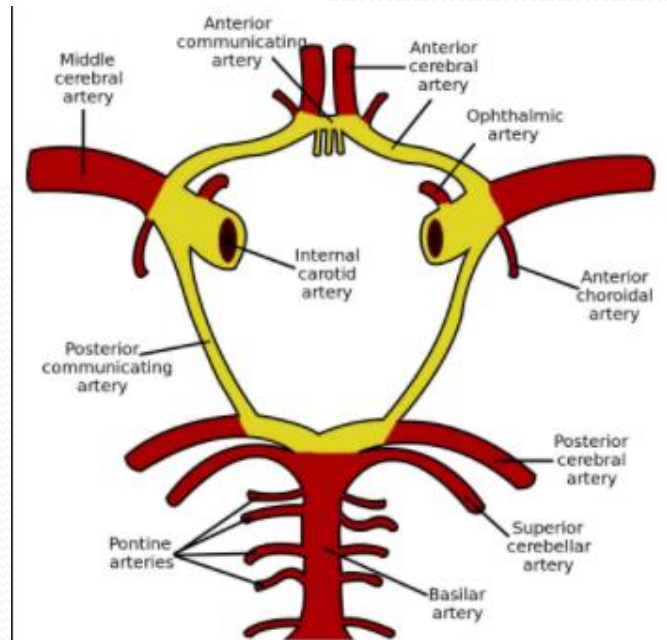
- Anterior Cerebral Artery
- Middle Cerebral Artery
- Posterior Cerebral Artery

Blood Supply to the Brain

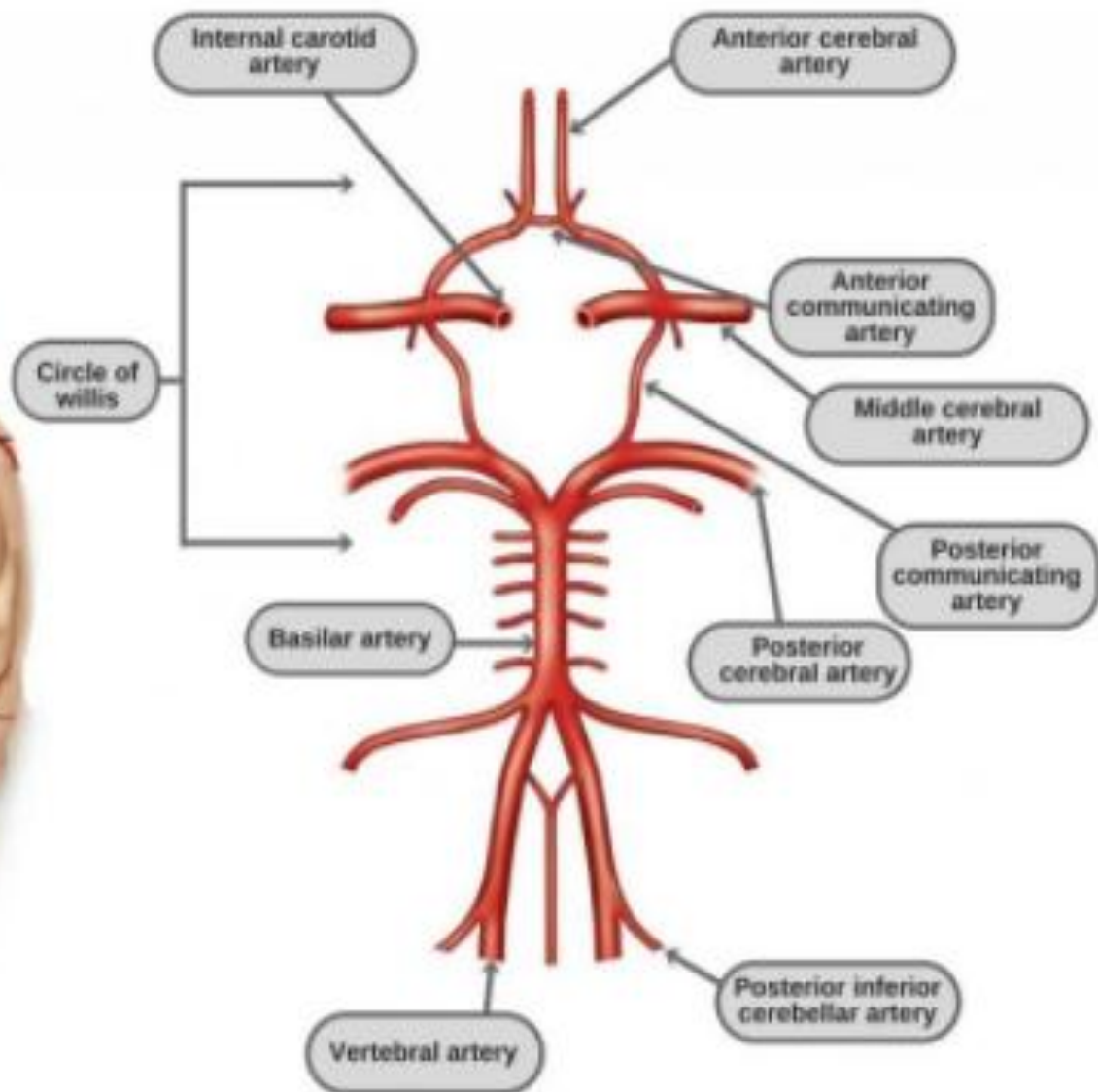
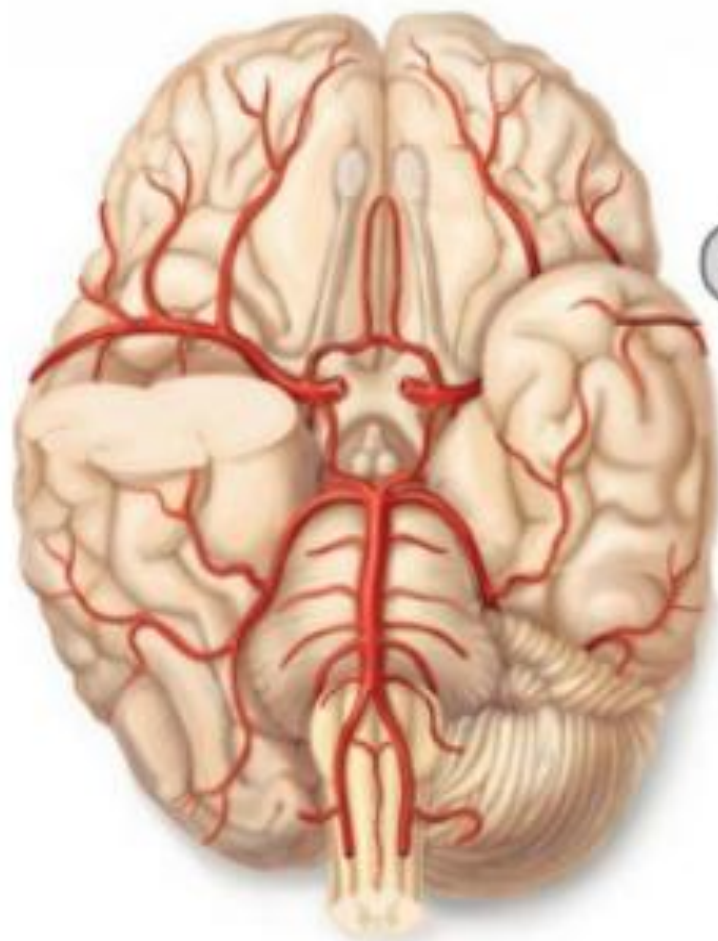


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Overview of the blood supply to the cerebrum.



Blood Supply of the Brain

- **Arteries of the Brain**
- The brain is supplied by **the two internal carotid and the two vertebral arteries**. The four arteries lie within the subarachnoid space, and their branches anastomose on the inferior surface of the brain to form the **circle of Willis**.
- **Internal Carotid Artery**
- The internal carotid artery begins at the bifurcation of the common carotid artery, where it usually possesses a localized dilatation, called the carotid sinus. It ascends the neck and perforates the base of the skull by passing through the carotid canal of the temporal bone. The artery then runs horizontally forward through the cavernous sinus and emerges on the medial side of the anterior clinoid process by perforating the dura mater. It now enters the subarachnoid space by piercing the arachnoid mater and turns posteriorly to the region of the medial end of the lateral cerebral sulcus. Here, it divides into the **anterior and middle cerebral arteries**.

• **Branches of the Cerebral Portion**

1. **The ophthalmic artery** arises as the internal carotid artery emerges from the cavernous sinus. It enters the orbit through the optic canal below and lateral to the optic nerve. It supplies the eye and other orbital structures, and its terminal branches supply the frontal area of the scalp, the ethmoid and frontal sinuses, and the dorsum of the nose.
2. **The posterior communicating artery** is a small vessel that originates from the internal carotid artery close to its terminal bifurcation. The posterior communicating artery runs posteriorly above the oculomotor nerve to join the posterior cerebral artery, thus forming part of the circle of Willis.
3. **The choroidal artery**, a small branch, also originates from the internal carotid artery close to its terminal bifurcation. The choroidal artery passes posteriorly close to the optic tract, enters the inferior horn of the lateral ventricle, and ends in the choroid plexus. It gives off numerous small branches to surrounding structures, including the crus cerebri, the lateral geniculate body, the optic tract, and the internal capsule.

4. **The anterior cerebral artery** is the smaller terminal branch of the internal carotid artery. It runs forward and medially superior to the optic nerve and enters the longitudinal fissure of the cerebrum. Here, it is joined to the anterior cerebral artery of the opposite side by the anterior communicating artery. It curves backward over the corpus callosum and, finally, anastomoses with the posterior cerebral artery. The cortical branches supply all the medial surface of the cerebral cortex as far back as the parieto-occipital sulcus. They also supply a strip of cortex about 1 inch (2.5 cm) wide on the adjoining lateral surface. The anterior cerebral artery thus supplies the “leg area” of the precentral gyrus. A group of central branches pierces the anterior perforated substance and helps to supply parts of the lentiform and caudate nuclei and the internal capsule.
5. **The middle cerebral artery**, the largest branch of the internal carotid, runs laterally in the lateral cerebral sulcus . Cortical branches supply the entire lateral surface of the hemisphere, except for the narrow strip supplied by the anterior cerebral artery, the occipital pole, and the inferolateral surface of the hemisphere, which are supplied by the posterior cerebral artery. This artery thus supplies all the motor area except the “leg area.” Central branches enter the anterior perforated substance and supply the lentiform and caudate nuclei and the internal capsule.

Vertebral Artery

- The vertebral artery, a branch of the first part of the subclavian artery, ascends the neck by passing through the foramina in the transverse processes of the upper six cervical vertebrae. It enters the skull through the foramen magnum and pierces the dura mater and arachnoid to enter the subarachnoid space. It then passes upward, forward, and medially on the medulla oblongata. At the lower border of the pons, it joins the vessel of the opposite side to form the basilar artery.
- **The posterior cerebral artery** curves laterally and backward around the midbrain and is joined by the posterior communicating branch of the internal carotid artery. Cortical branches supply the inferolateral and medial surfaces of the temporal lobe and the lateral and medial surfaces of the occipital lobe. Thus, the posterior cerebral artery supplies the visual cortex. Central branches pierce the brain substance and supply parts of the thalamus and the lentiform nucleus as well as the midbrain, the pineal, and the medial geniculate bodies. A choroidal branch enters the inferior horn of the lateral ventricle and supplies the choroid plexus; it also supplies the choroid plexus of the third ventricle.

- **Circle of Willis**

- The circle of Willis lies in the interpeduncular fossa at the base of the brain. It is formed by **the anastomosis between the two internal carotid arteries and the two vertebral arteries**. The anterior communicating, anterior cerebral, internal carotid, posterior communicating, posterior cerebral, and basilar arteries all contribute to the circle. The circle of Willis allows blood that enters by either internal carotid or vertebral arteries to be distributed to any part of both cerebral hemispheres. Cortical and central branches arise from the circle and supply the brain substance.
- Variations in the sizes of the arteries forming the circle are common, and the absence of one or both posterior communicating arteries has been reported.

- **Cerebrovascular Accident(CVA)**
- A cerebrovascular accident (also known as a stroke) is defined clinically as *“sudden loss of focal brain function lasting more than 24 hours due to either spontaneous haemorrhage into brain substance or inadequate blood supply to part of the brain i.e. ischaemia (thrombosis, embolism)”*.

- Damage to the cerebrum in this matter can give rise to a range of clinical signs. The exact nature of the functional deficit that arises depends on the specific lobe that has been affected:
- **Frontal lobe** – a diverse range of presentations, often personality and behavioural changes occur and an inability to solve problems develops.
- **Parietal lobe** – typically presents with attention deficits e.g. contralateral hemispatial neglect syndrome: where the patient does not pay attention to the side of the body opposite to the lesion.
- **Temporal lobe** – presents with recognition deficits (agnosias) e.g. auditory agnosia: patient cannot recognise basic sounds, prosopagnosia: failure to recognise faces.
- **Occipital lobe** – visual field defects: contralateral hemianopia or quadrantanopia with macular sparing.
- **Global lesions** – severe cognitive deficits (dementia), patients cannot answer simple questions such as their name, today's date, where they are etc.



CT scan of the brain, showing an infarct in the area of the middle cerebral artery.

Thanks

