Brain Surface

Neuroscience Module

Objectives for the lecture of cerebral hemispheres–

Student should be able to

describe the lobes.

describe the important sulci.

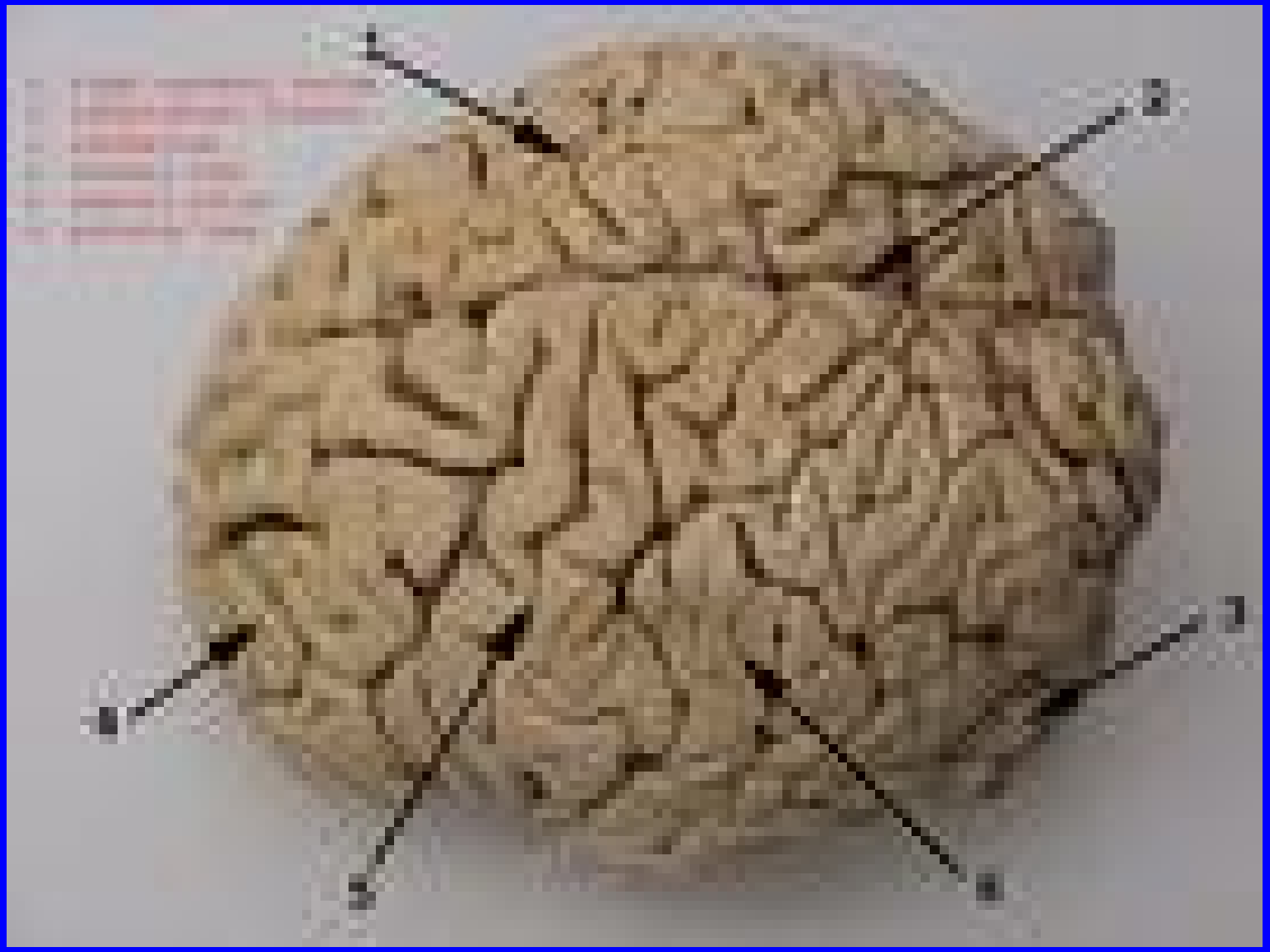
describe the important gyri.

describe the functions.

describe the clinical problems that can occur due to a lesion of the cerebral hemispheres.

describe the arterial supply to the cerebral hemispheres.

Brain Surface



Inferior aspect of cerebral hemisphere

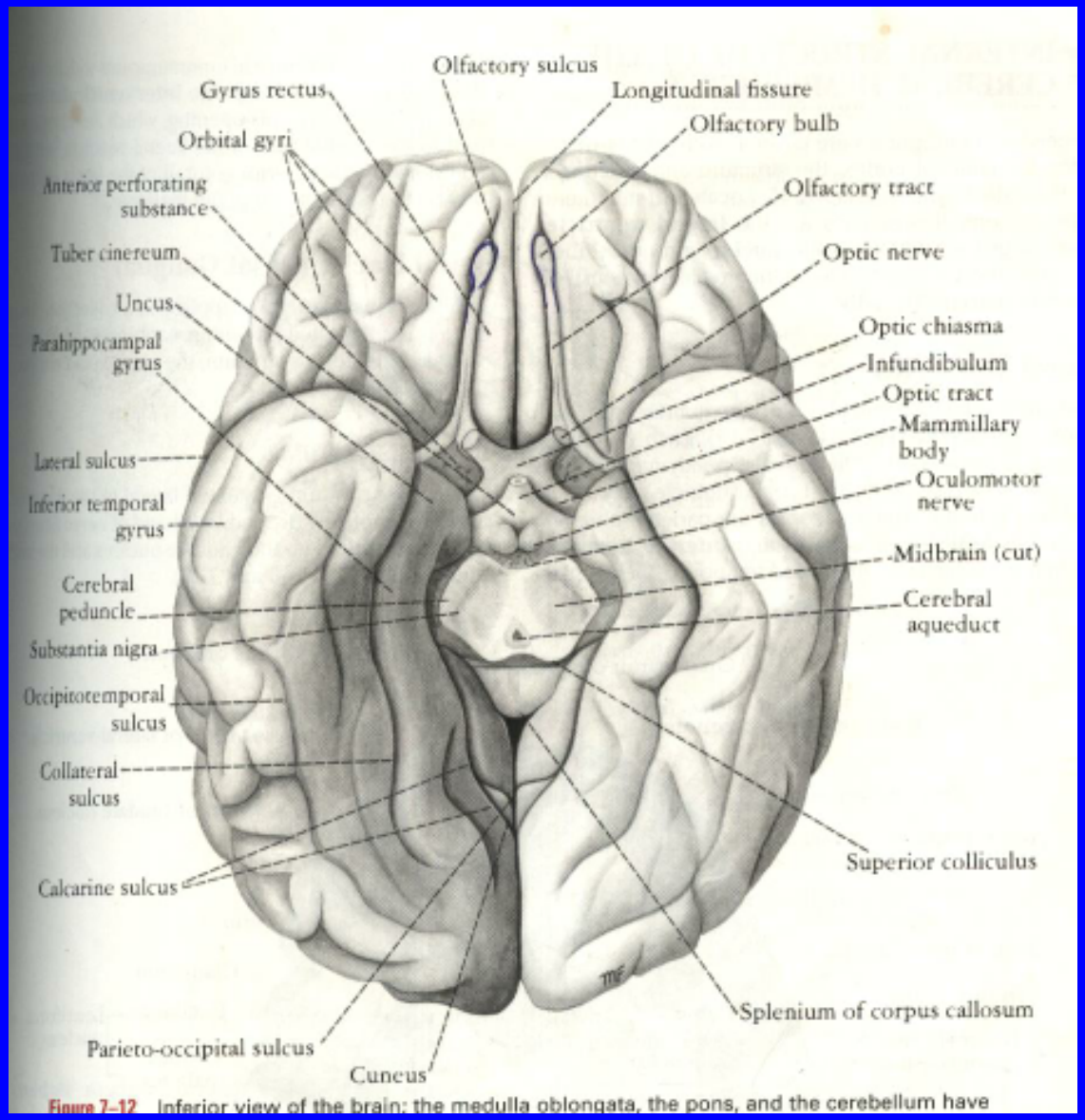
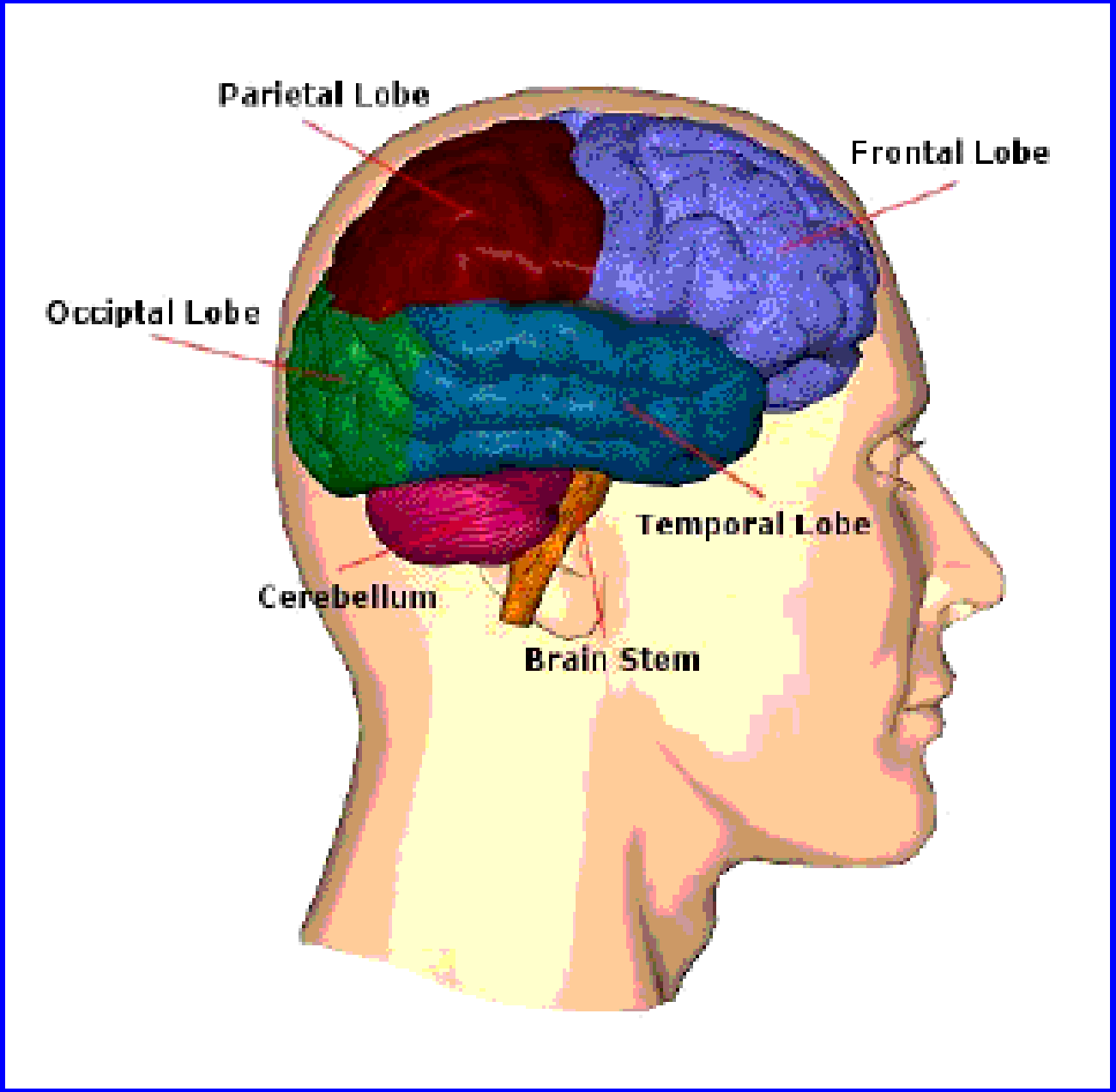


Figure 7–12 Inferior view of the brain; the medulla oblongata, the pons, and the cerebellum have

Lobes of cerebral hemispheres



Cerebral Hemispheres

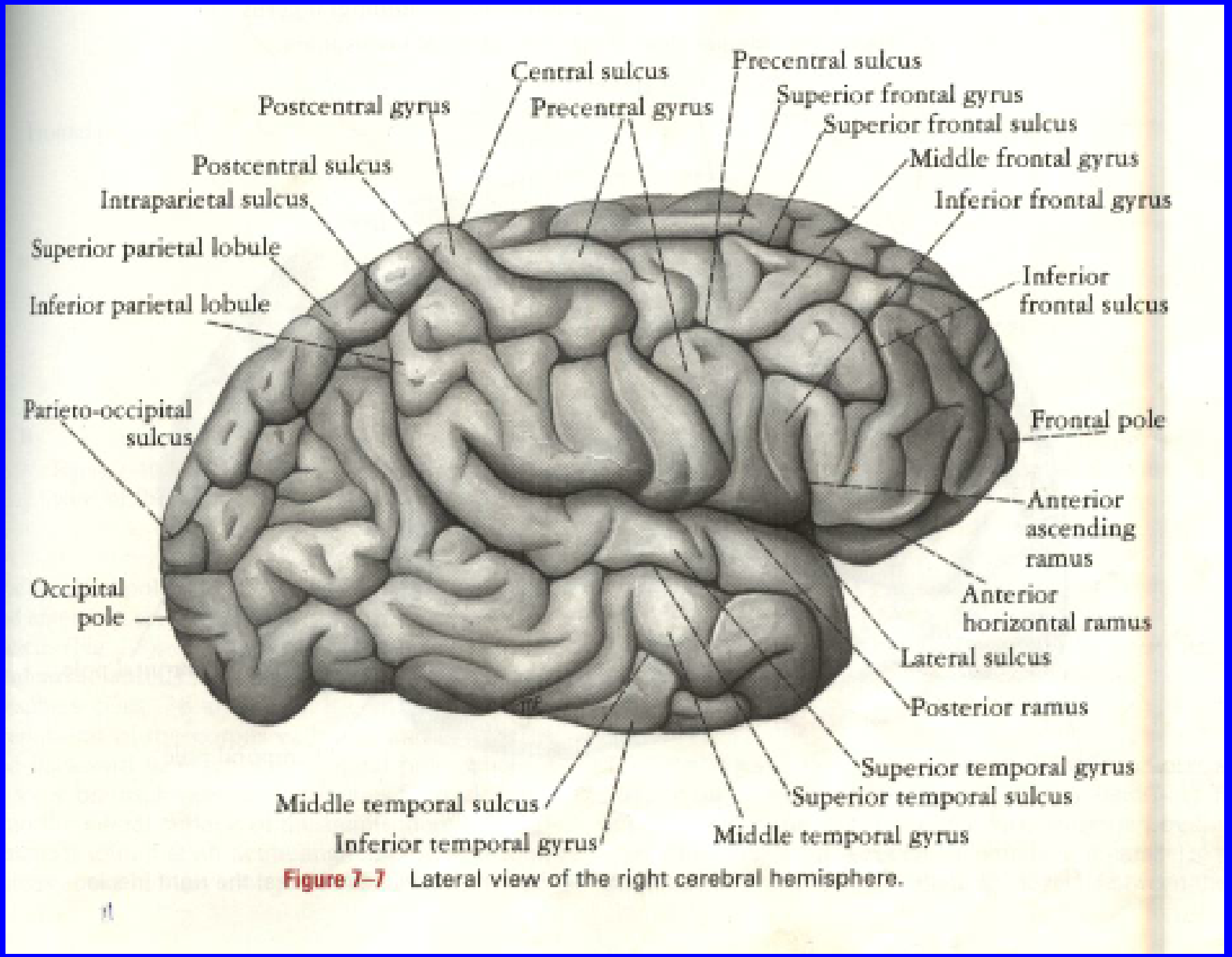


Figure 7–7 Lateral view of the right cerebral hemisphere.

Cerebrum-

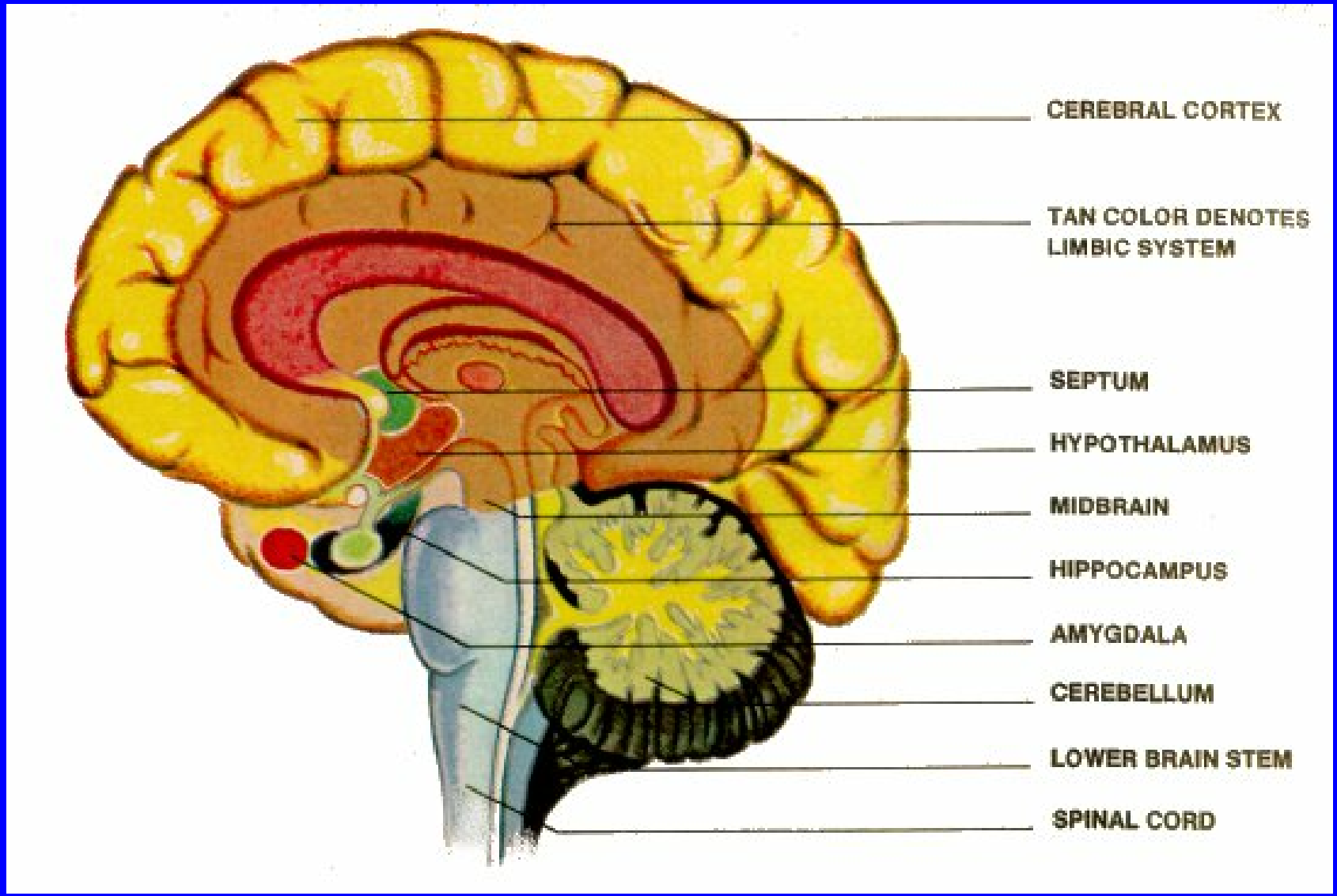
Largest part of the brain. It is a part of fore brain.

Has two cerebral hemispheres connected by a mass of white matter called corpus callosum.

Each extends from frontal bone to the occipital bone. Lies above the anterior and middle cranial fossa and the tentorium cerebelli.

These two are separated by a deep cleft (longitudinal fissure).

Vertical section of cerebral hemispheres



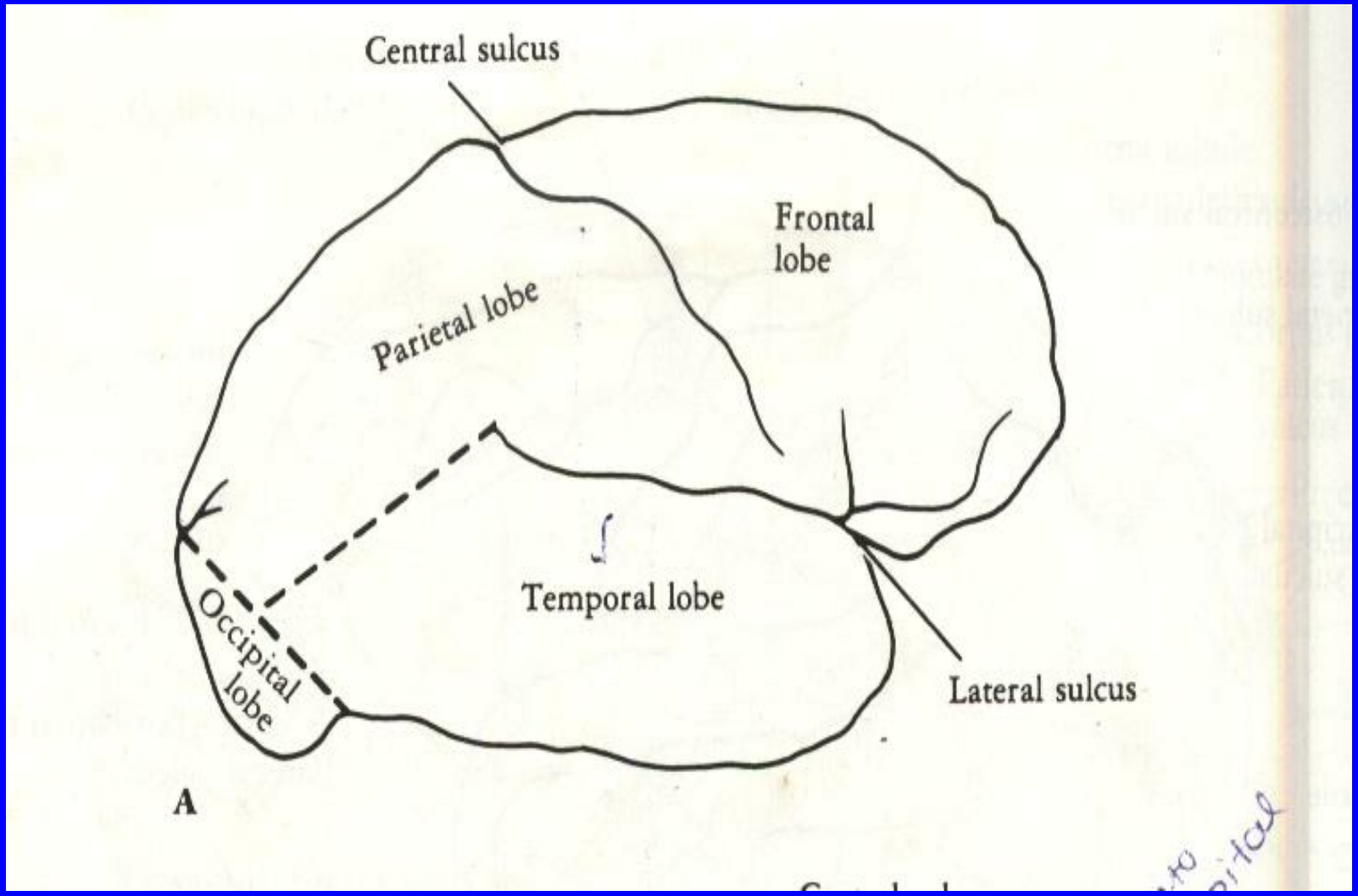
Surface layer is the cortex. It has grey matter. It is thrown into folds or gyri, separated by fissures or sulci.

Some of the large sulci divide the surface of hemisphere into lobes.

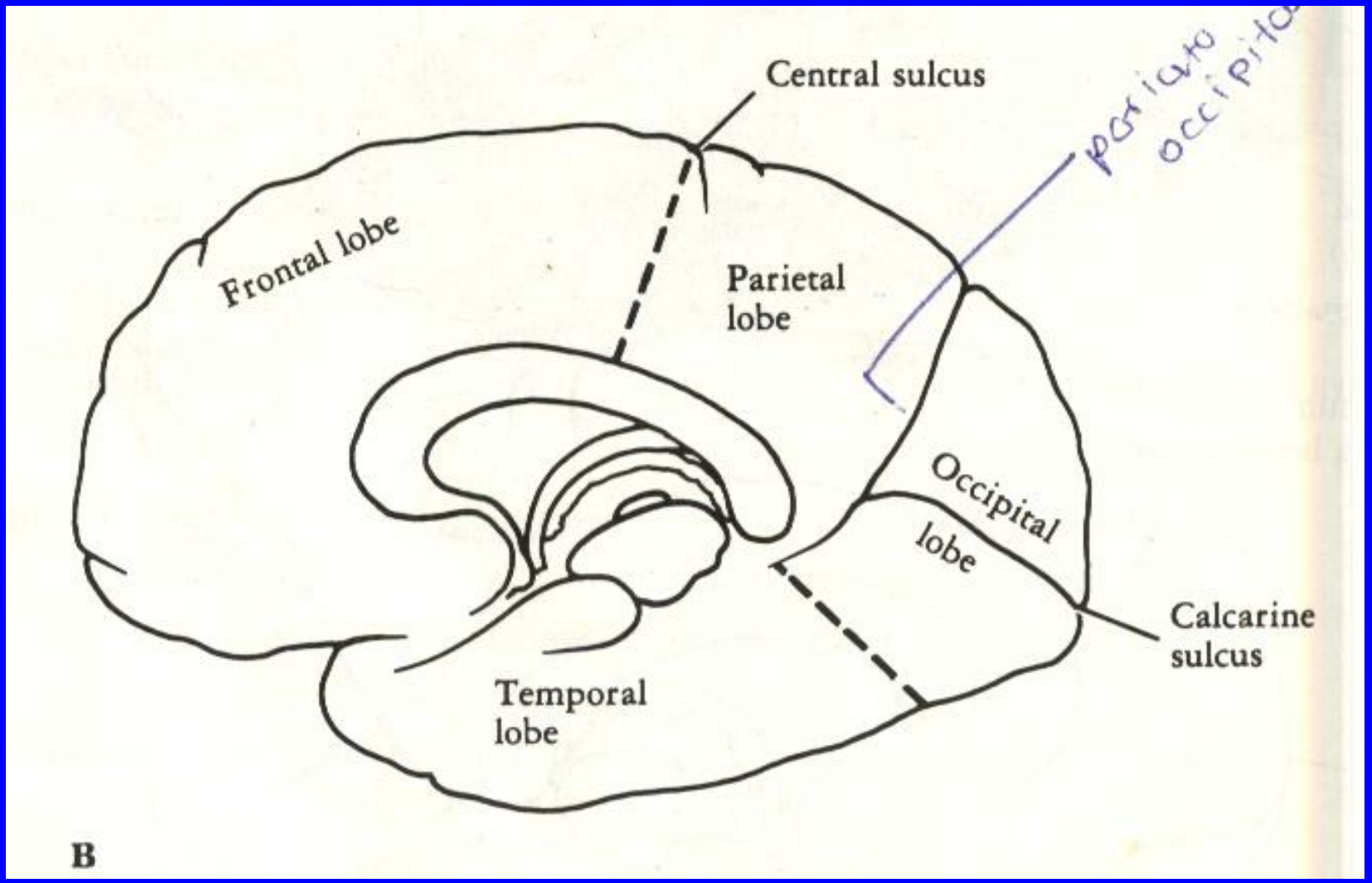
Lobes are named according to the bones of the cranium that over lies them.

There are Frontal, Parietal, Temporal and Occipital lobes.

Lobes of cerebral hemispheres



Lobes of cerebral hemisphere



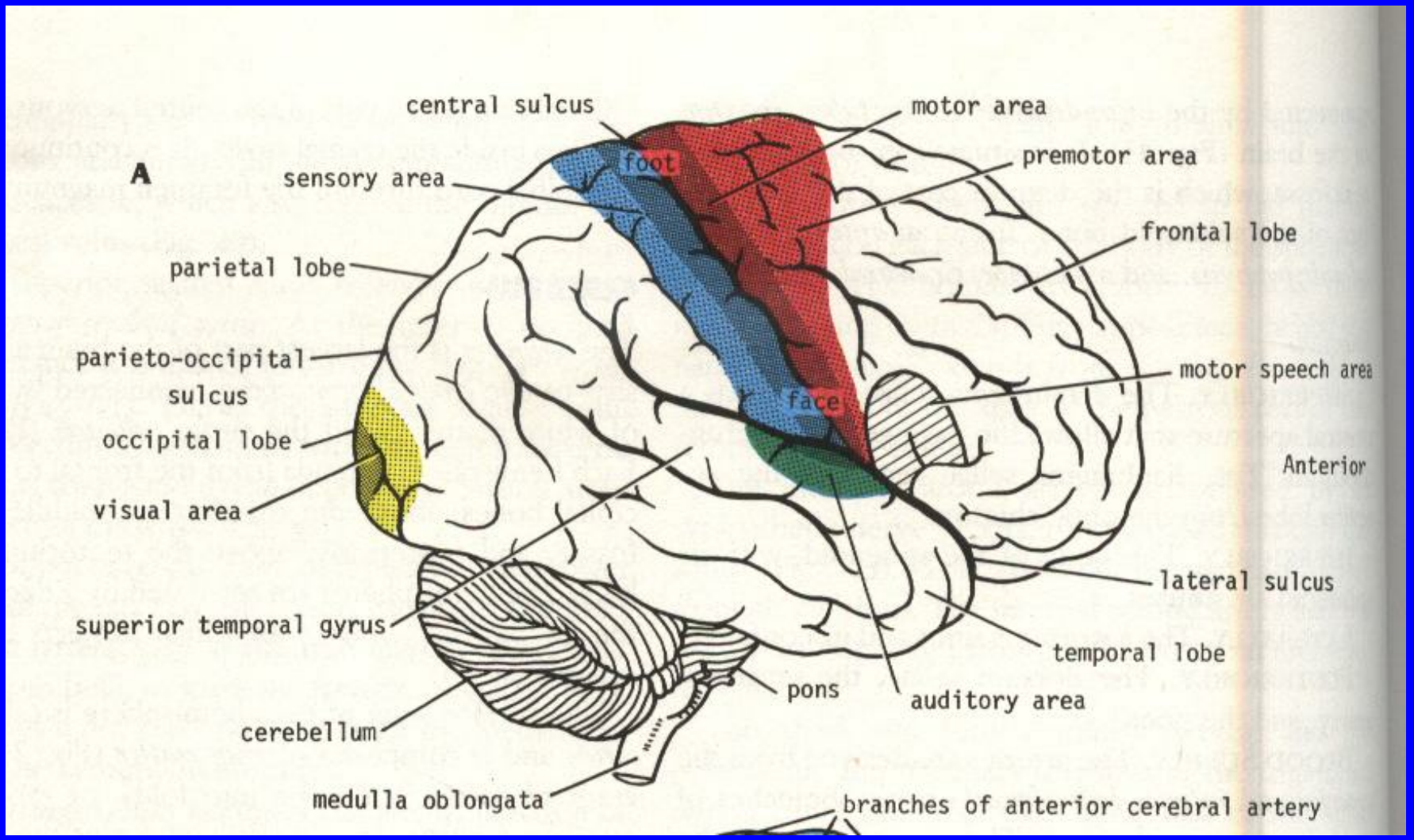
Frontal lobe –lies in front of the central sulcus and above the lateral sulcus. Covered by the frontal bone.

Parietal lobe – lies behind the central sulcus and above the lateral sulcus. Covered by the parietal bones.

Temporal lobe – lies below the lateral sulcus. Covered by the temporal bone.

Occipital lobe – lies below the parieto – occipital sulcus. Covered by the occipital bone.

Brain surfaces and important areas



Frontal lobe –

There are several important areas.

Motor cortex – lies in the precentral gyrus.

Controls voluntary movements in the opposite side of the body. Body is represented in the motor area in an inverted position.

Pre motor cortex – occupies anterior part of precentral gyrus and adjoining frontal gyri. Controls voluntary movements.

Eye motor Field – anterior to premotor area. Concerned with eye movements.

Broca's area – motor speech area. Controls movements employed in speech. Lies just above the lateral sulcus. Dominant in left hemisphere in right handed people and dominant in right hemisphere in left handed people.

Frontal lobe –

Frontal association cortex (Pre frontal cortex) –

Lateral aspect related to intellectual activity. Medial and orbital surface related to emotional behaviour and autonomic activity.

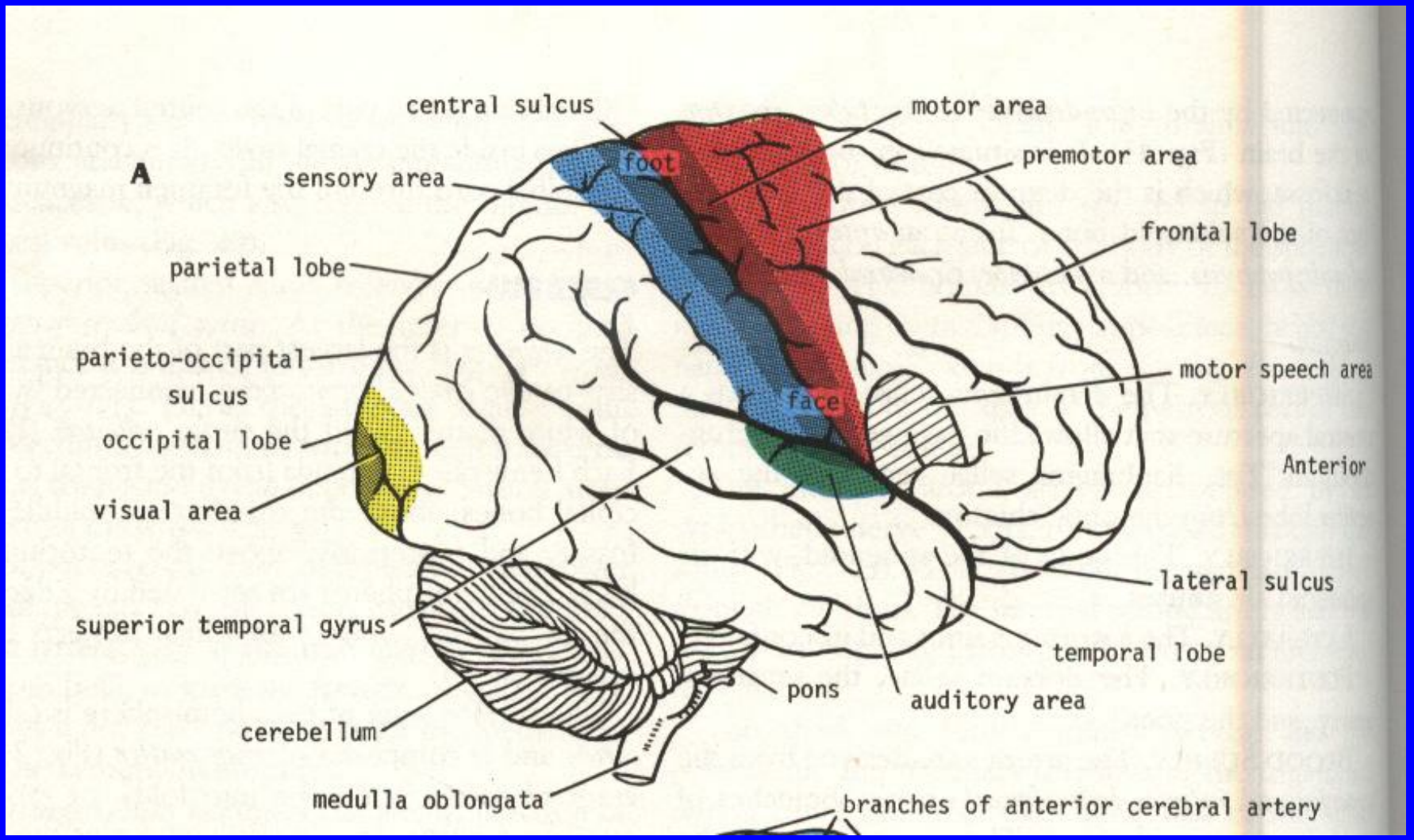
Formed by considerable part of frontal lobe.

Afferents – thalamus, limbic area and other cortical areas.

Efferents – thalamus and hypothalamus

Supplied by anterior and middle cerebral arteries.

Brain surfaces and important areas



Parietal lobe –

Somatic sensory cortex – located in the post central gyrus. This lies immediately posterior to the central sulcus. Receives impulses about pain, temperature, touch and pressure from the opposite side of the body.

Parietal association cortex – Remainder of the parietal lobe. Recognises sensory stimuli and integrate with other forms of sensory information. If damaged can cause asterognosis.

Supplied by anterior and middle cerebral arteries.

Temporal lobe –

Auditory cortex – lies in the middle of the superior temporal gyrus. It is concerned with reception of auditory stimuli.

Temporal association cortex – Area surrounding the auditory cortex. Recognition of auditory stimuli and integrate with other sensory modalities. If damage can cause auditory agnosia.

Area just behind and above this area in the dominant hemisphere is important in the sensory aspect of speech mechanism.

Other areas may play a role with regard to the memory.

Supplied by middle and posterior cerebral arteries.

Inferior aspect of cerebral hemisphere

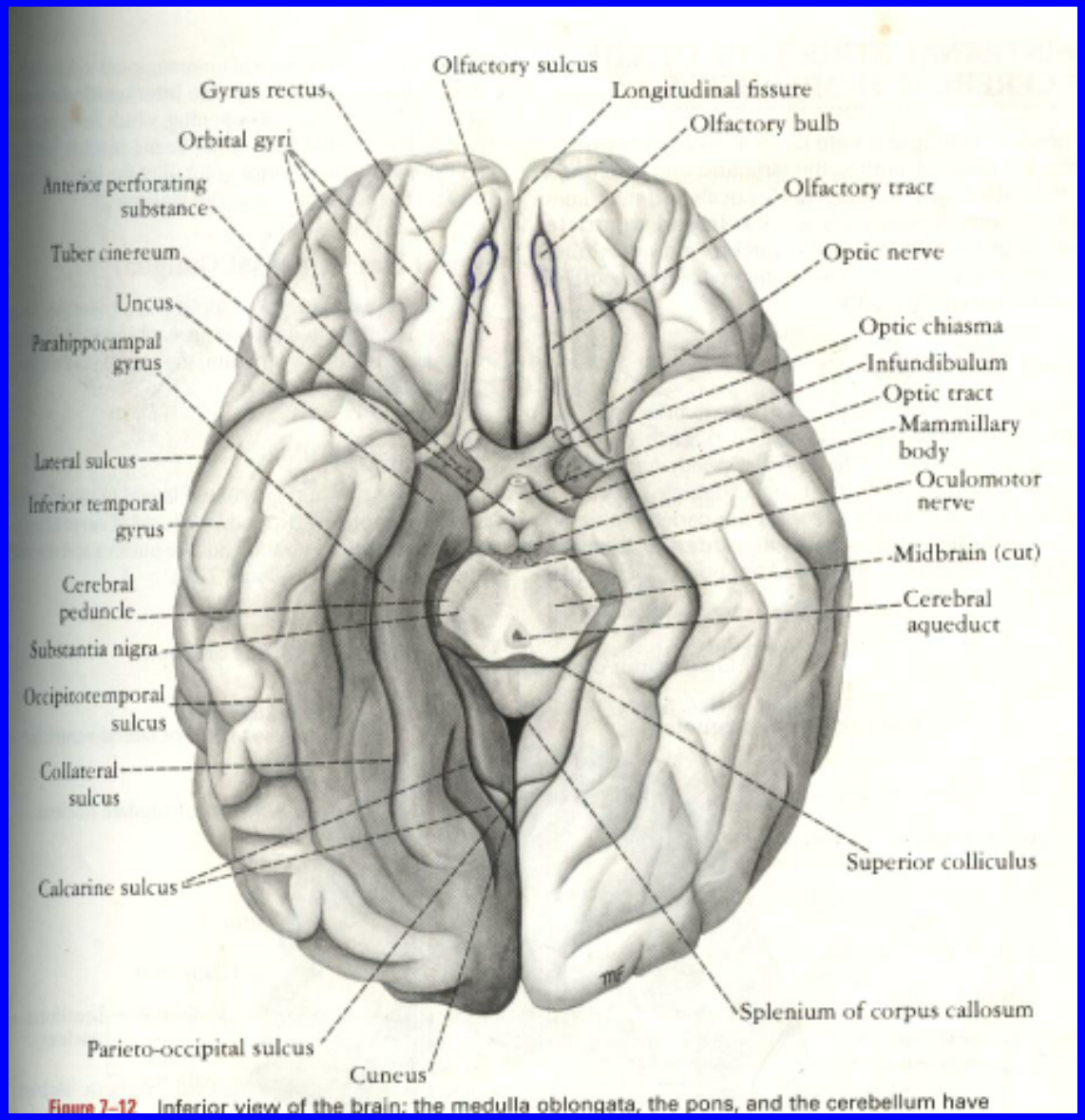


Figure 7–12 Inferior view of the brain; the medulla oblongata, the pons, and the cerebellum have

Parahippocampal gyrus –

Found in the most medial part of the under surface of the temporal lobe.

Medially it is connected with the hippocampus.

Receives cortical afferents. Sends inputs to hippocampus.

Medial and inferior aspect of cerebral hemispheres

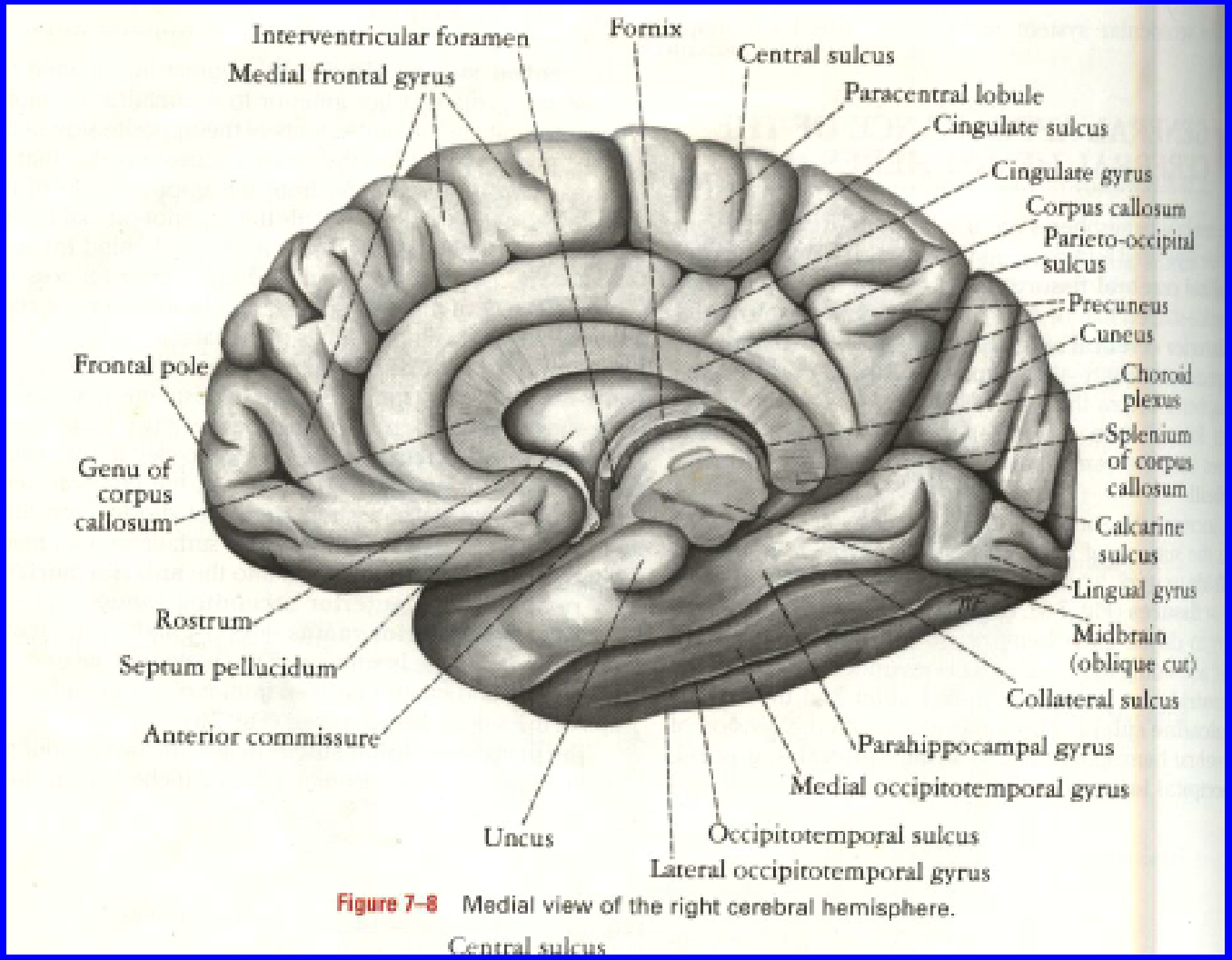


Figure 7–8 Medial view of the right cerebral hemisphere.

Central sulcus

Lateral Ventricle

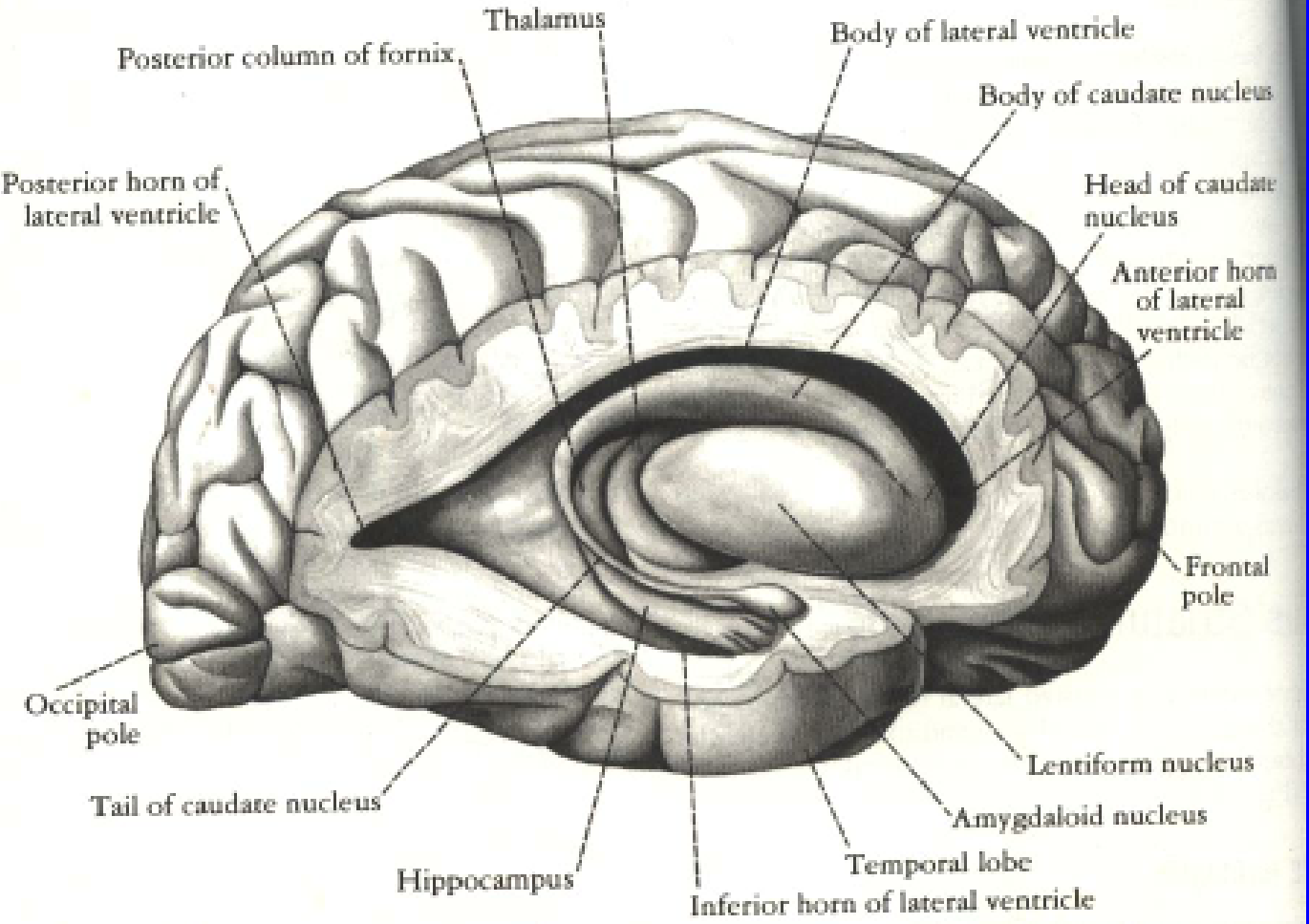


FIGURE 17-1 Lateral view of the right cerebral hemisphere dissected to show the position of the different basal nuclei.

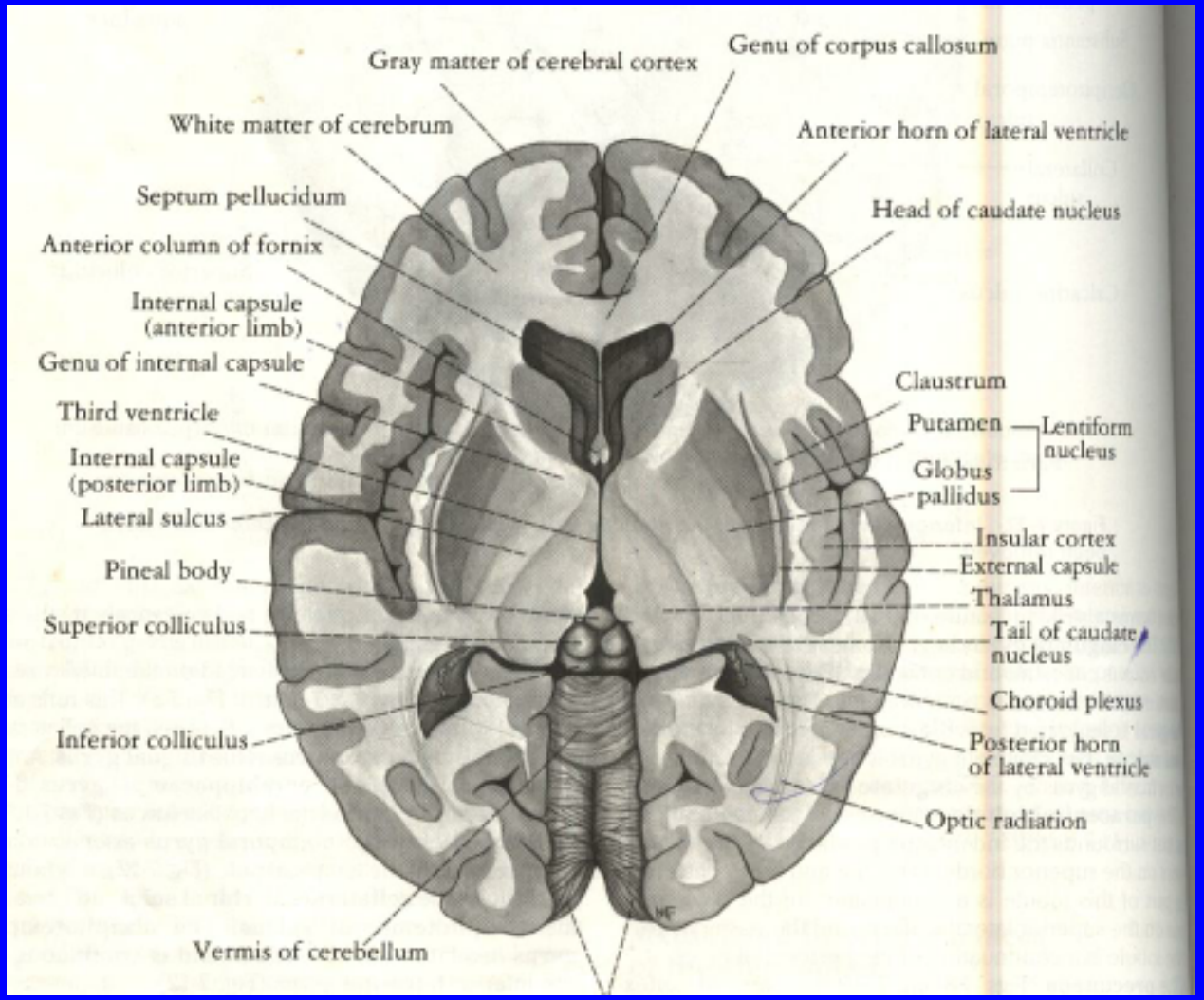
Hippocampus –

Occupies the whole length of the floor of the inferior horn of the lateral ventricle and extends into the amygdala.

It has connections with the mamillary body, thalamus and hypothalamus. This complex system is given the name limbic system.

It is concerned with emotions, behaviour and memory patterns.

Horizontal section of cerebral hemispheres



Amygdaloid nuclear complex –

Prominent temporal lobe structure.

Situated immediately rostral to the hippocampus.

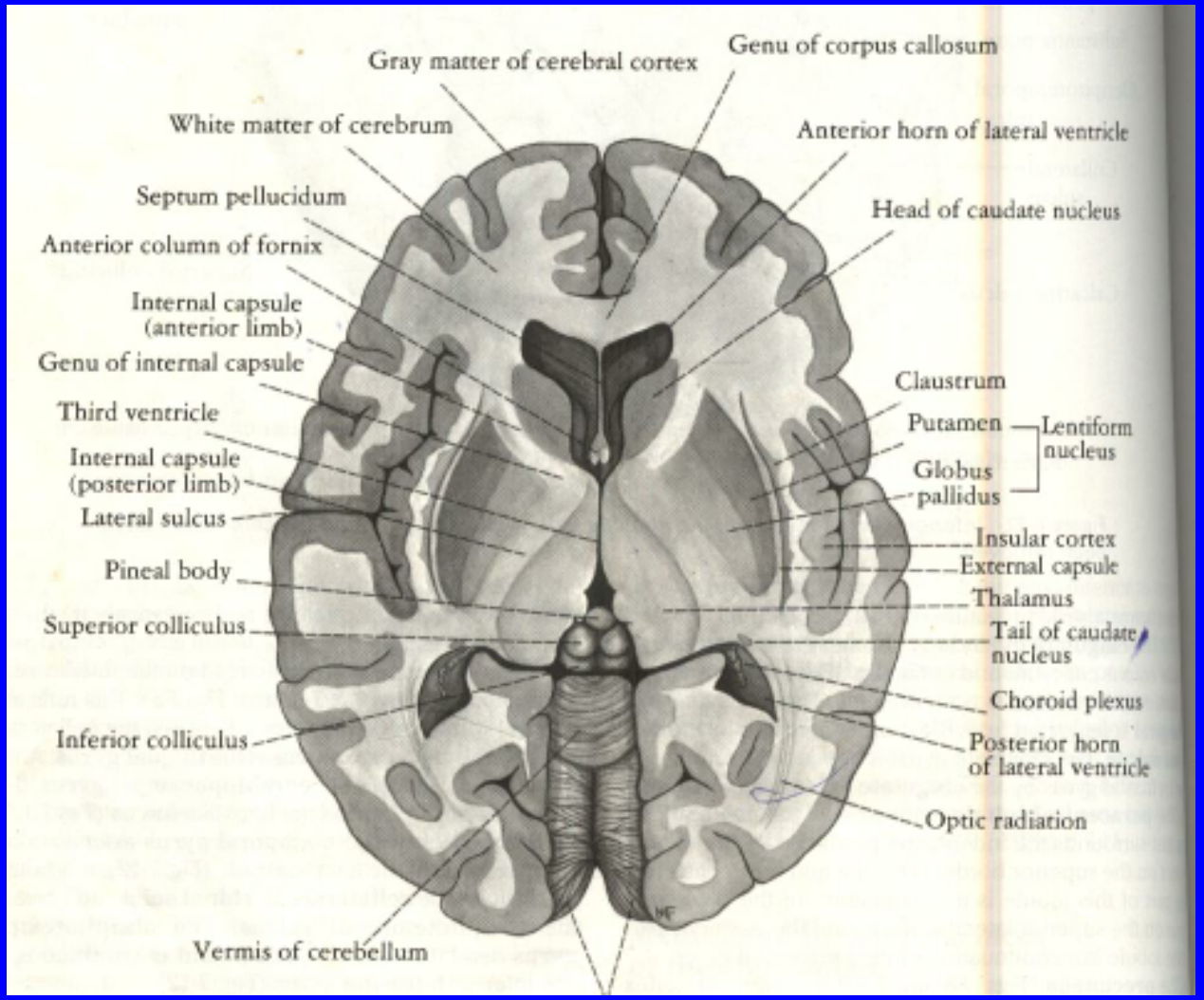
Divided into three groups of nuclei – corticomedial – receives olfactory afferents.

Central – gustatory

Baso lateral – neocortex

Amygdaloid is implicated in the control of emotional behaviour.

Horizontal section of cerebral hemispheres



Insula –

Found in the floor of the lips of lateral sulcus.

It is divided into a number of small gyri.

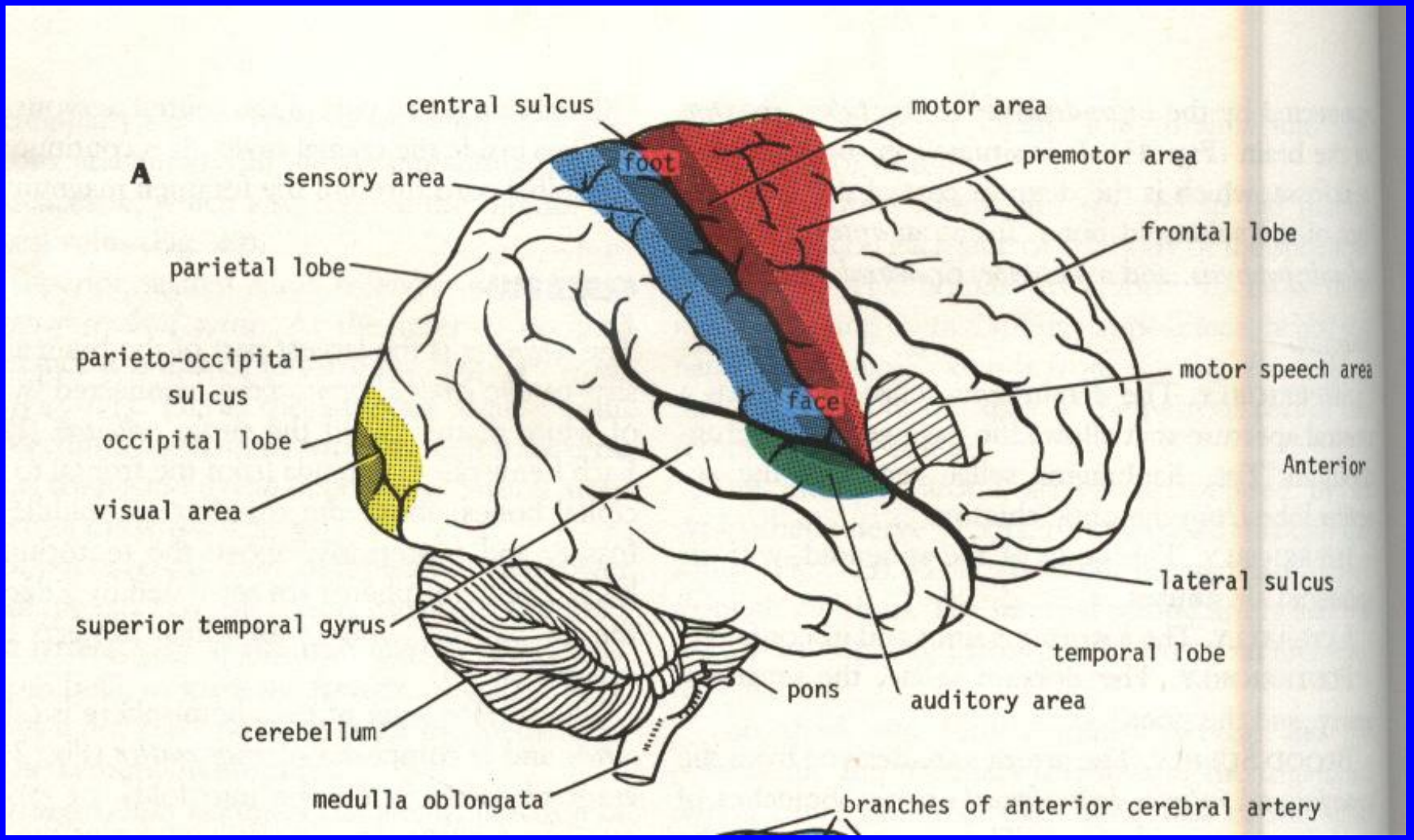
Its upper part abuts on the sensory cortex.

It is crossed by the middle cerebral artery.

Probably represents the taste area of the sensory cortex.

If stimulated can cause increased salivation, gastric movements and vomiting.

Brain surfaces and important areas



Occipital lobe –

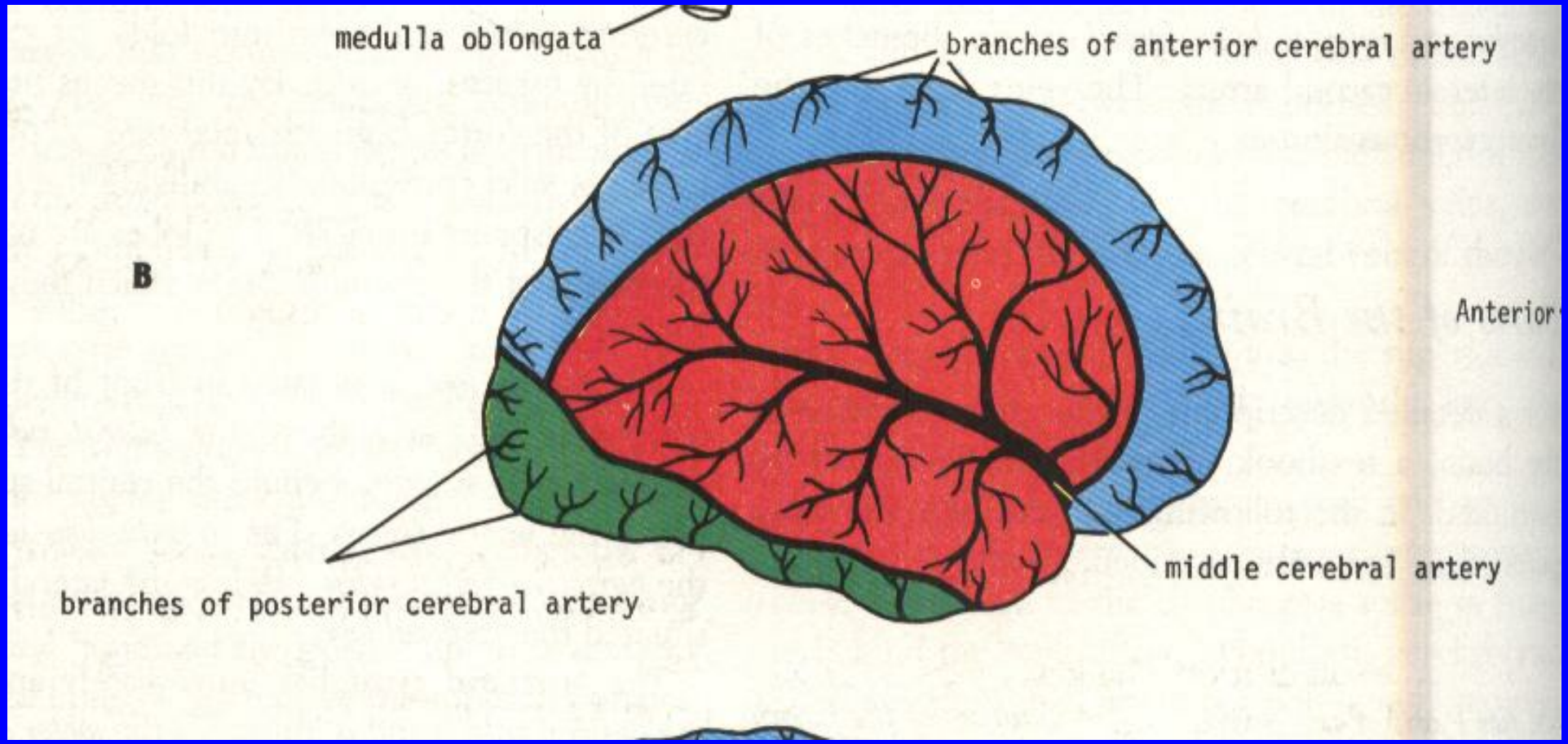
Visual cortex – Situated in the posterior pole in the medial aspect of cerebral hemisphere. Surrounds calcarine and post calcarine sulcus.

It is the receiving area of visual impressions. Concerned with the vision of the opposite half field of sight.

Occipital association cortex – lies anterior to the visual cortex. Concerned with recognition and integration of visual stimuli.

Supplied by posterior cerebral arteries.

Arterial supply to the brain



Brain surface and important areas

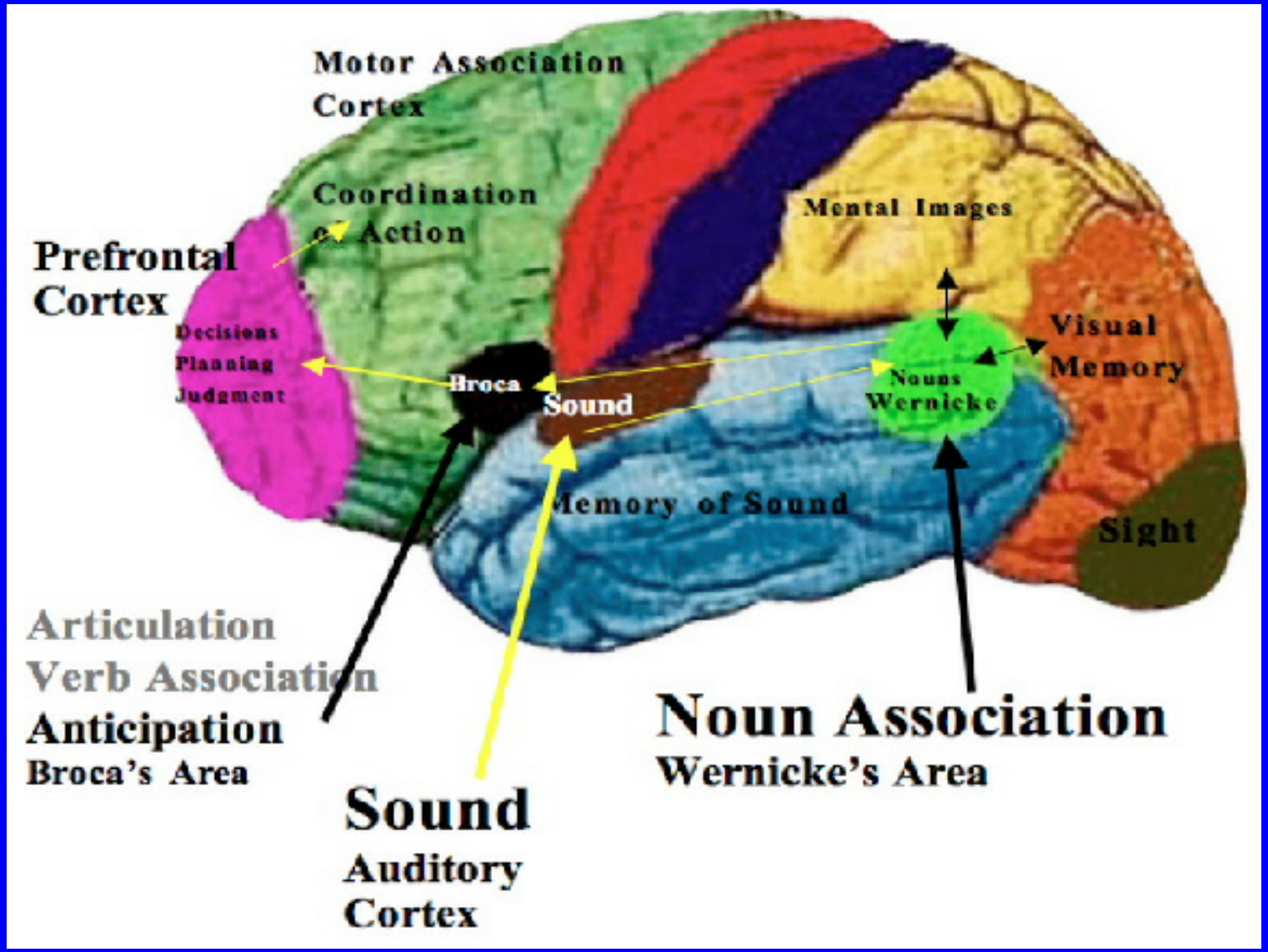
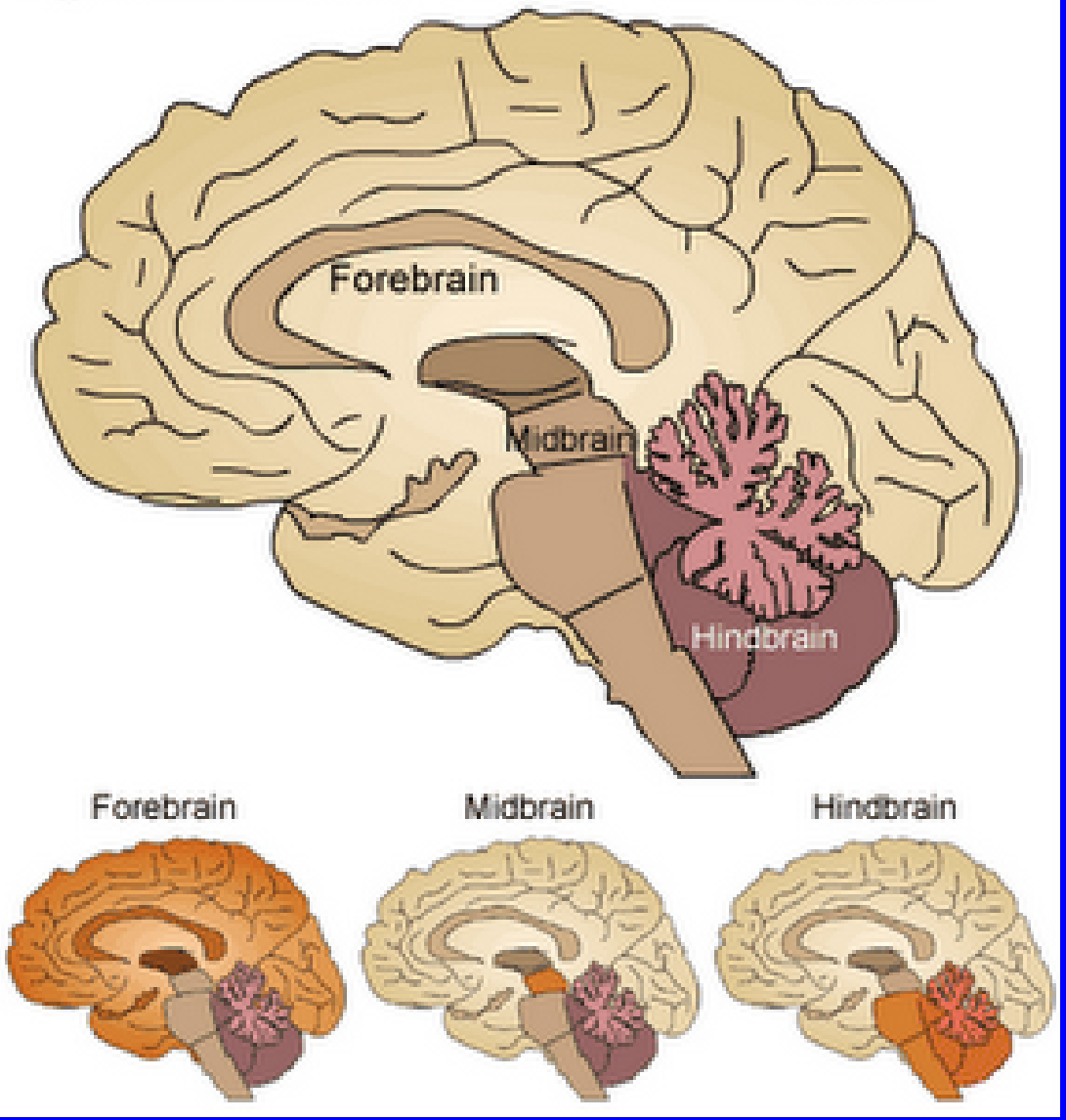
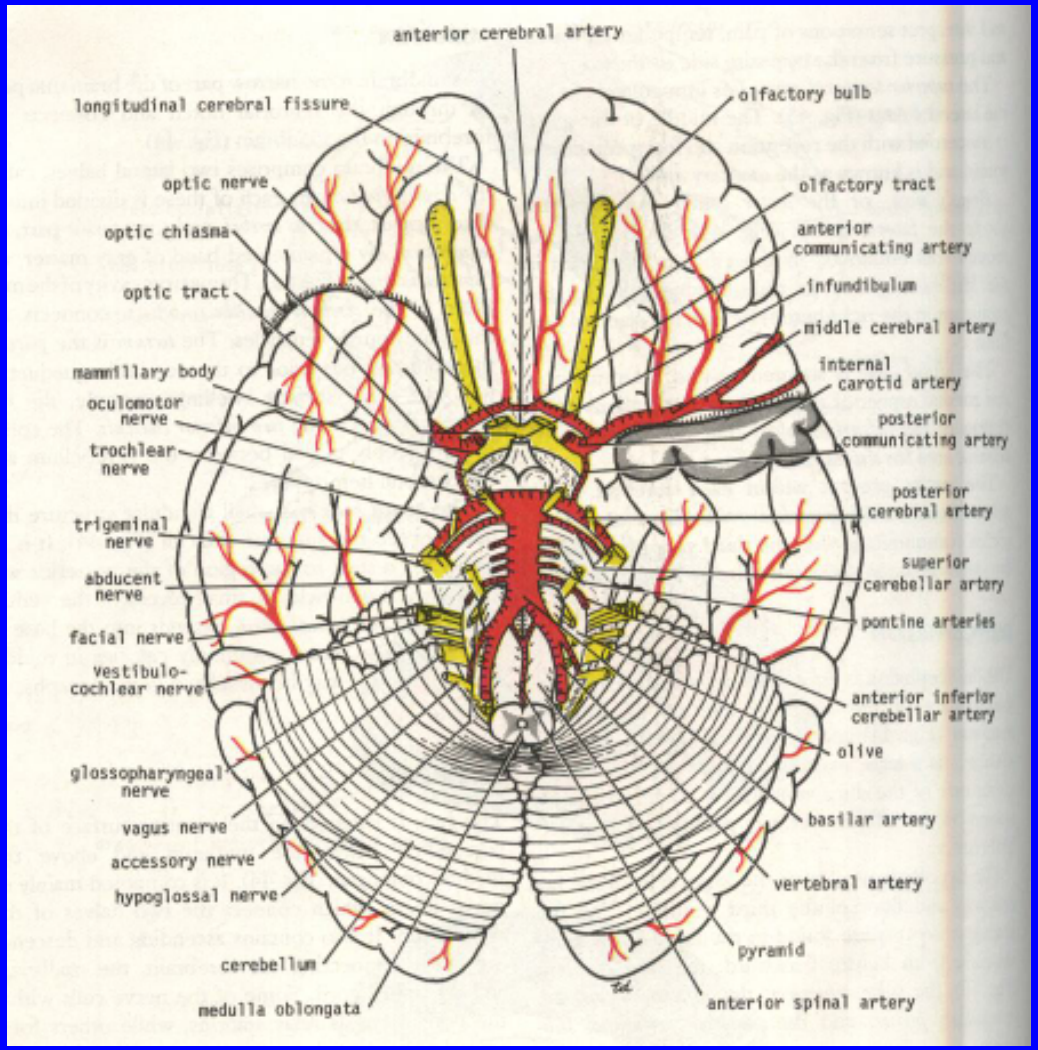


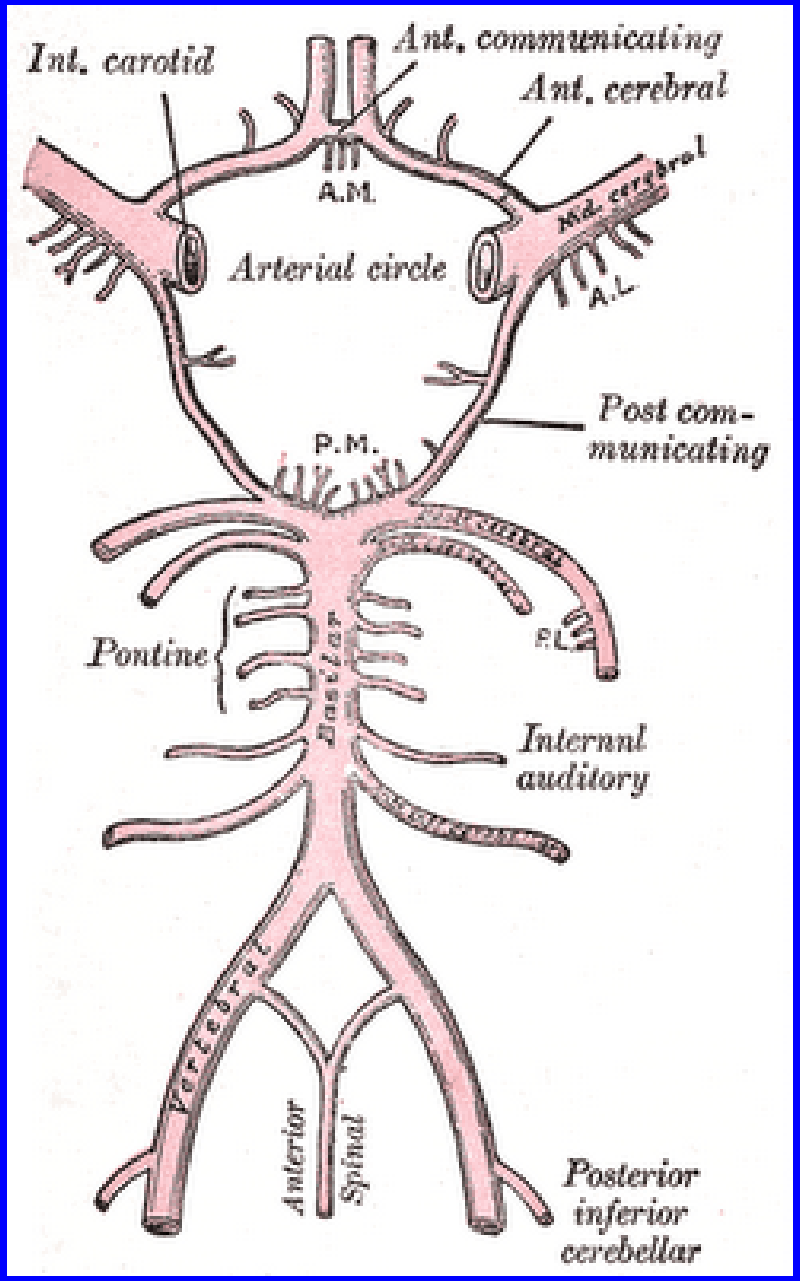
Figure AB-7: Forebrain / Midbrain / Hindbrain



Arterial supply to the brain

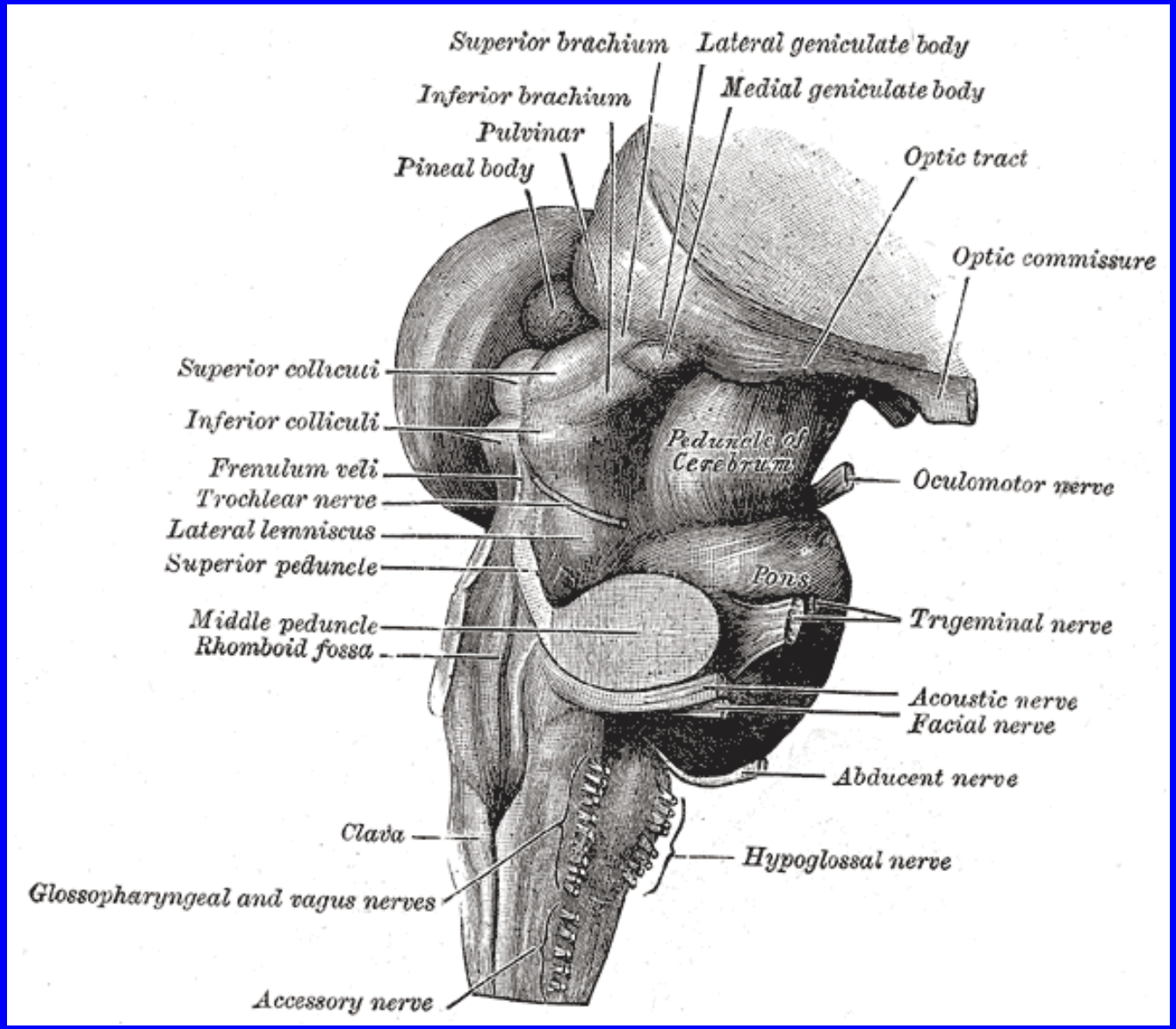


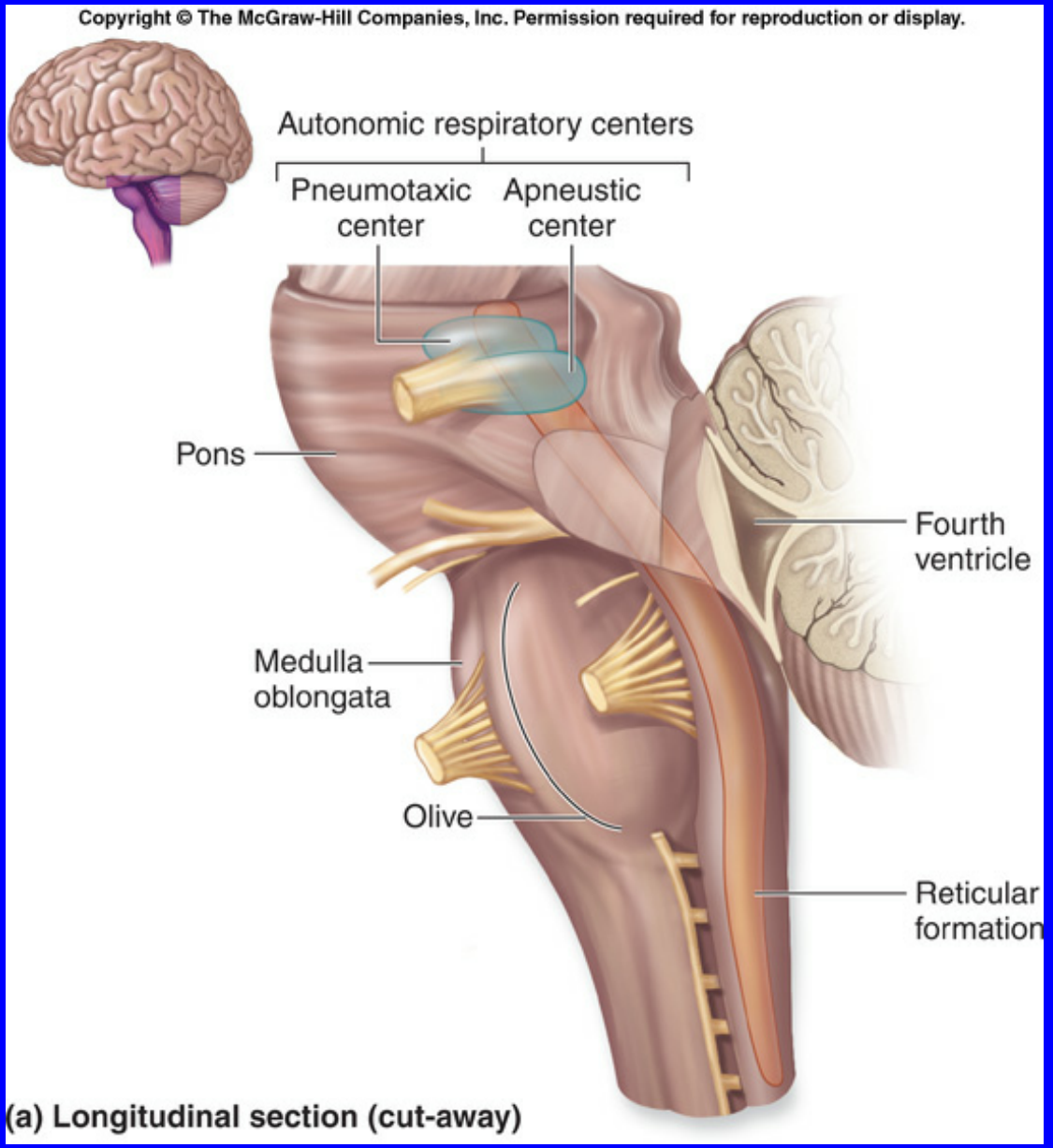
Arterial supply to the brain



The brain receives blood from two sources: the **internal carotid arteries**, which arise at the point in the neck where the common carotid arteries bifurcate, and the **vertebral arteries** (). The internal carotid arteries branch to form two major cerebral arteries, the anterior and **middle cerebral arteries**. The right and left vertebral arteries come together at the level of the pons on the ventral surface of the brainstem to form the midline **basilar artery**. The basilar artery joins the blood supply from the internal carotids in an arterial ring at the base of the brain (in the vicinity of the hypothalamus and cerebral peduncles) called the circle of Willis. The **posterior cerebral arteries** arise at this confluence, as do two small bridging arteries, the **anterior and posterior communicating arteries**. Conjoining the two major sources of cerebral vascular supply via the circle of Willis presumably improves the chances of any region of the brain continuing to receive blood if one of the major arteries becomes

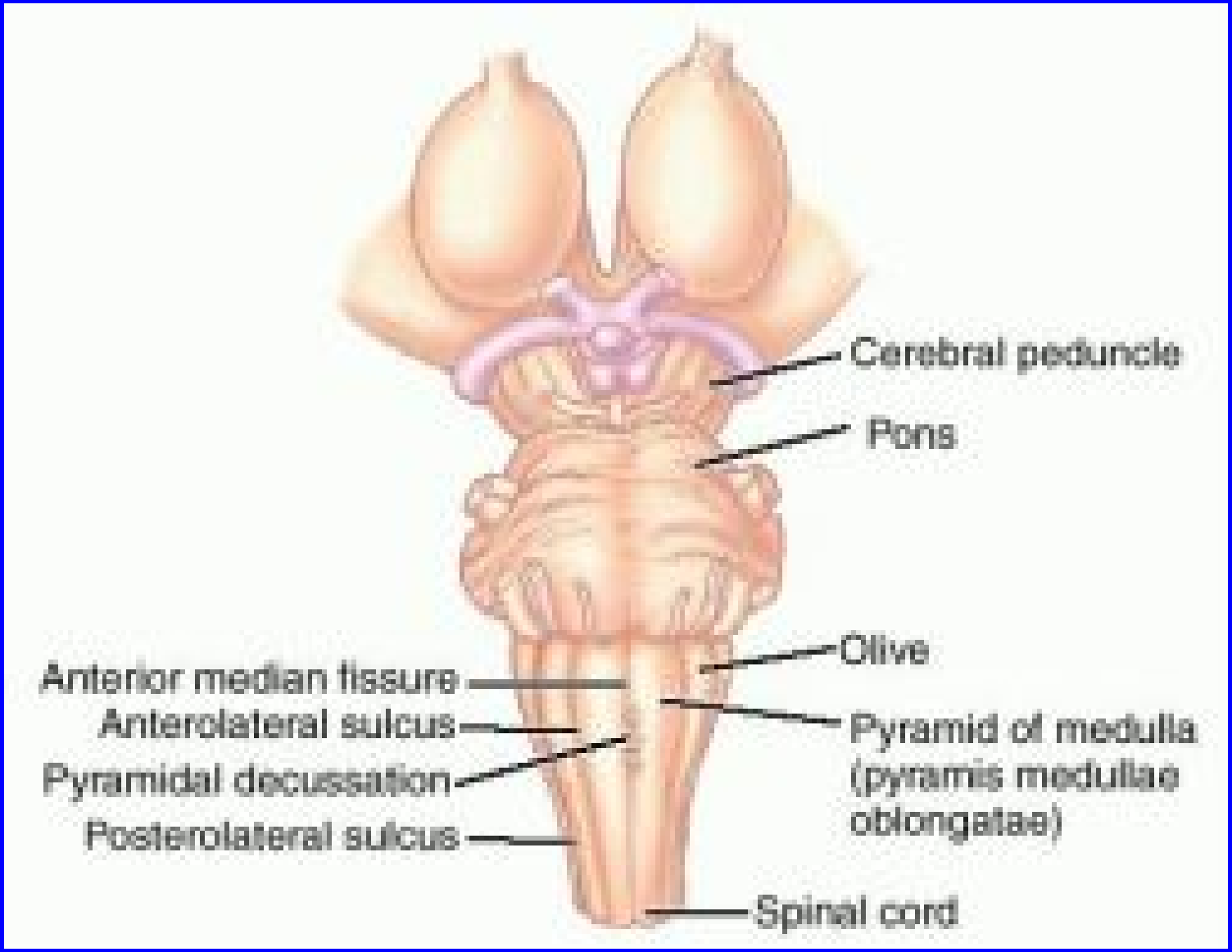
The major branches that arise from the internal carotid artery—the anterior and middle cerebral arteries—form the **anterior circulation** that supplies the forebrain (). These arteries also originate from the circle of Willis. Each gives rise to branches that supply the cortex and branches that penetrate the basal surface of the brain, supplying deep structures such as the basal ganglia, thalamus, and internal capsule. Particularly prominent are the lenticulostriate arteries that branch from the middle cerebral artery. These arteries supply the basal ganglia and thalamus. The **posterior circulation** of the brain supplies the posterior cortex, the midbrain, and the brainstem; it comprises arterial branches arising from the **posterior cerebral**, **basilar**, and **vertebral arteries**. The pattern of arterial distribution is similar for all the subdivisions of the brainstem: Midline arteries supply medial structures, lateral arteries supply the lateral brainstem, and dorsal-lateral arteries supply dorsal-lateral brainstem structures and the cerebellum (nd). Among the most important dorsal-lateral arteries (also called **long circumferential** arteries) are the **posterior inferior cerebellar artery** (**PICA**) and the **anterior inferior cerebellar artery** (**AICA**), which supply distinct regions of the medulla and pons. These arteries, as well as branches of the basilar artery that penetrate the brainstem from its ventral and lateral surfaces (called **paramedian** and **short circumferential** arteries), are especially common sites of occlusion and result in specific functional deficits of cranial nerve, somatic sensory, and motor function (see Boxes A and D).


Superior brachium
Lateral geniculate body
Inferior brachium
Medial geniculate body
Pulvinar
Pineal body
Optic tract
Optic commissure
Superior colliculi
Inferior colliculi
Peduncle of Cerebrum
Frenulum veli
Oculomotor nerve
Trochlear nerve
Lateral lemniscus
Superior peduncle
Pons
Middle peduncle
Trigeminal nerve
Rhomboid fossa
Acoustic nerve
Facial nerve
Abducent nerve
Clava
Hypoglossal nerve
Glossopharyngeal and vagus nerves
Accessory nerve



(a) Longitudinal section (cut-away)

Anterior aspect of Midbrain, Pons and Medulla



Mid brain-

Located below the cerebrum but above the pons.

Connected to the cerebellum via the superior cerebellar peduncle.

Posterior surface shows superior colliculi and inferior colliculi.

The cavity inside is aqueduct of sylvius.

Occulomotor and trochlear nerves arise from it.

Red nucleus and substantia nigra are present

Three parts – tectum, tegmentum and cerebral peduncles

Pons –

Lies below the midbrain but above the medulla.

Connected to the cerebellum via the middle cerebellar peduncle.

Cavity inside is fourth ventricle.

Anterior surface has a midline groove, that contains the basilar artery.

Transverse pontine fibres can be seen on the anterior surface.

Gives origin to trigeminal, abducent, facial and vestibulo cochlear nerves.

Medulla –

Lies below the pons but above the spinal cord.

Connected to the cerebellum via the inferior cerebellar peduncle.

The cavity inside is 4^{th} ventricle.

Anterior surface has pyramid and olive.

9^{th} , 10^{th} , 11^{th} and 12^{th} cranial nerves arise from it.

Controls activities of heart, lungs and GIT.

Cerebellum

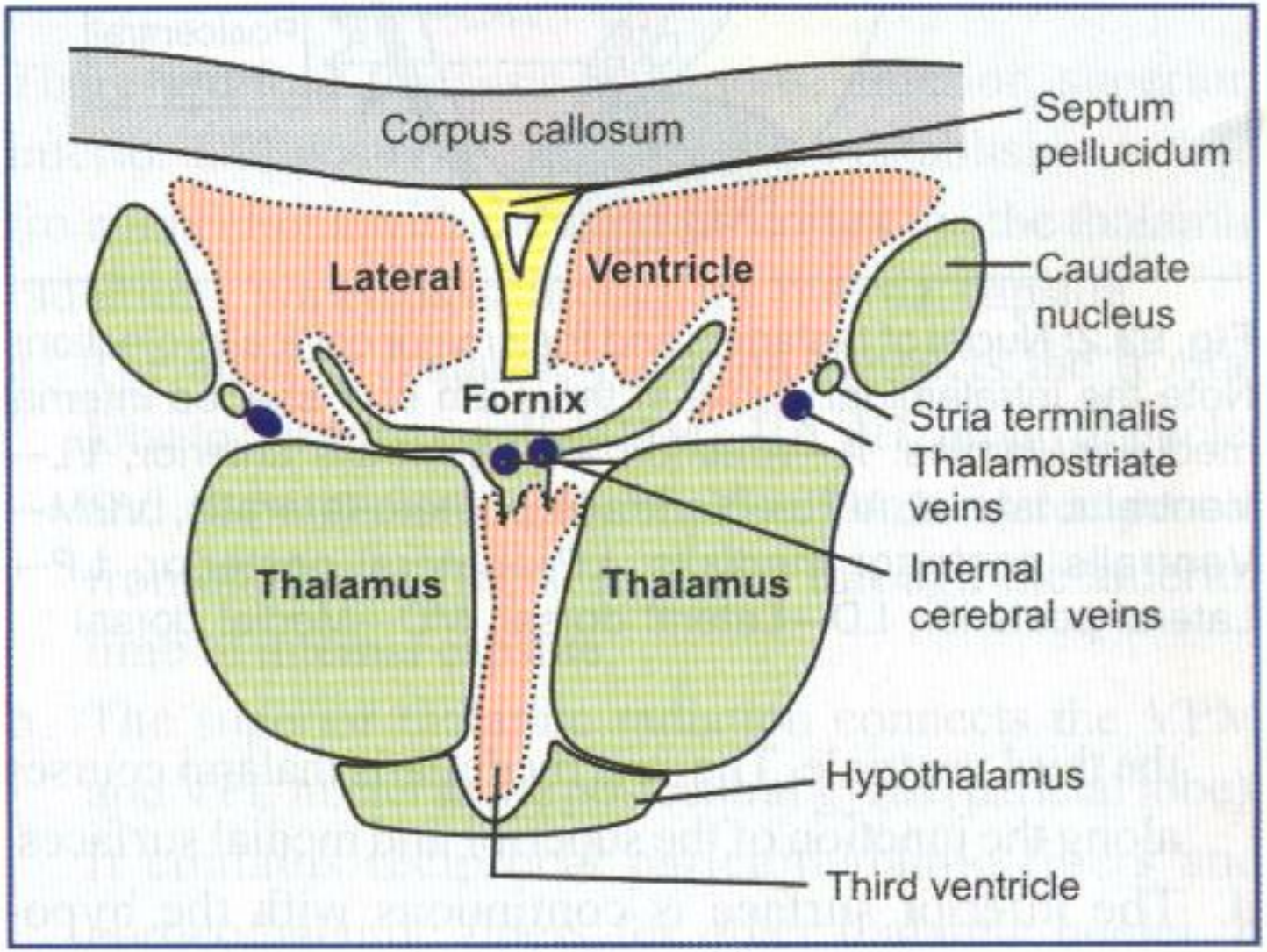
Lies posterior to midbrain, pons and Medulla.

It is connected to above by superior,middle and Inferior cerebral peduncles respectively.

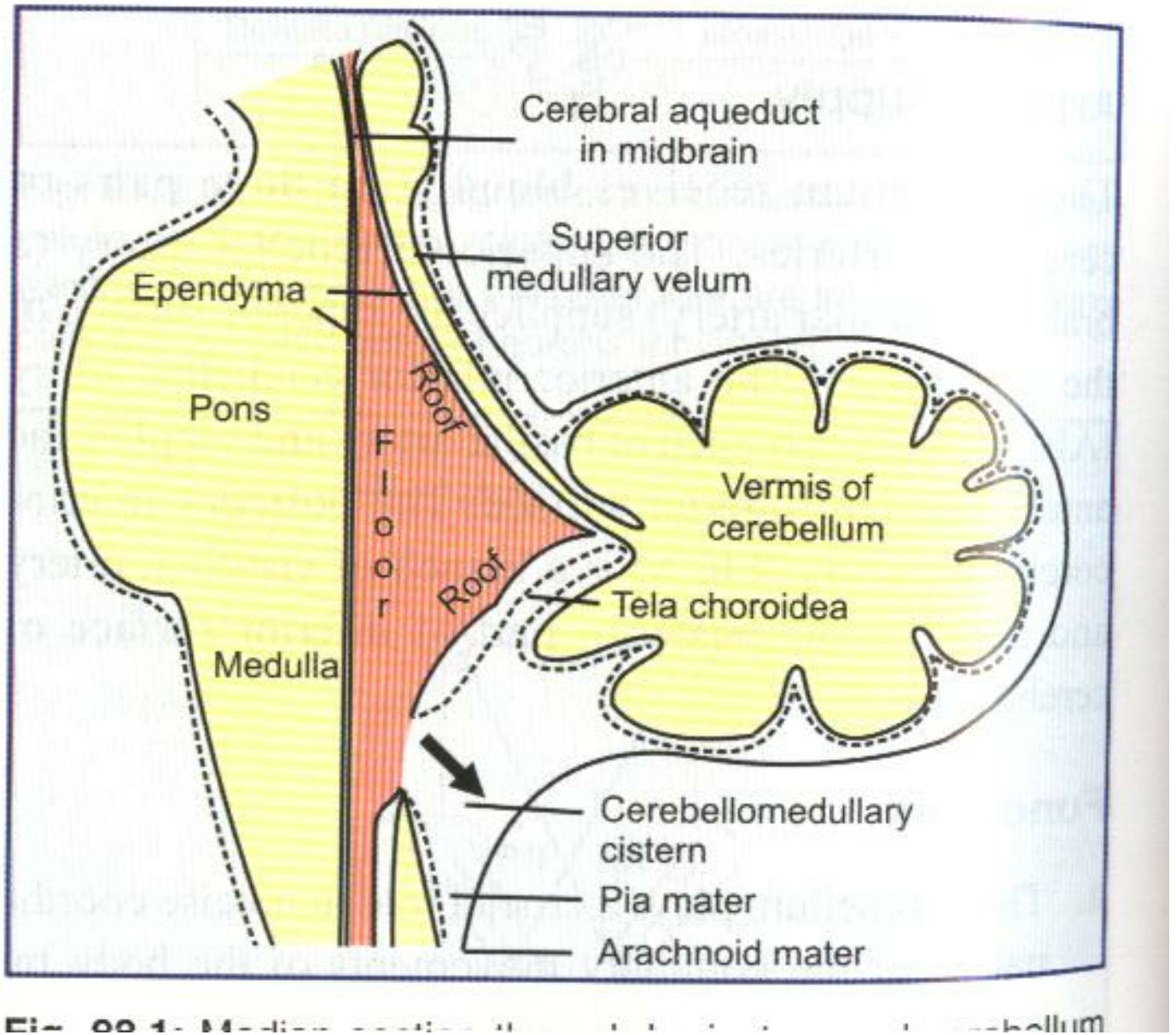
It has two lateral lobes and a median vermis.

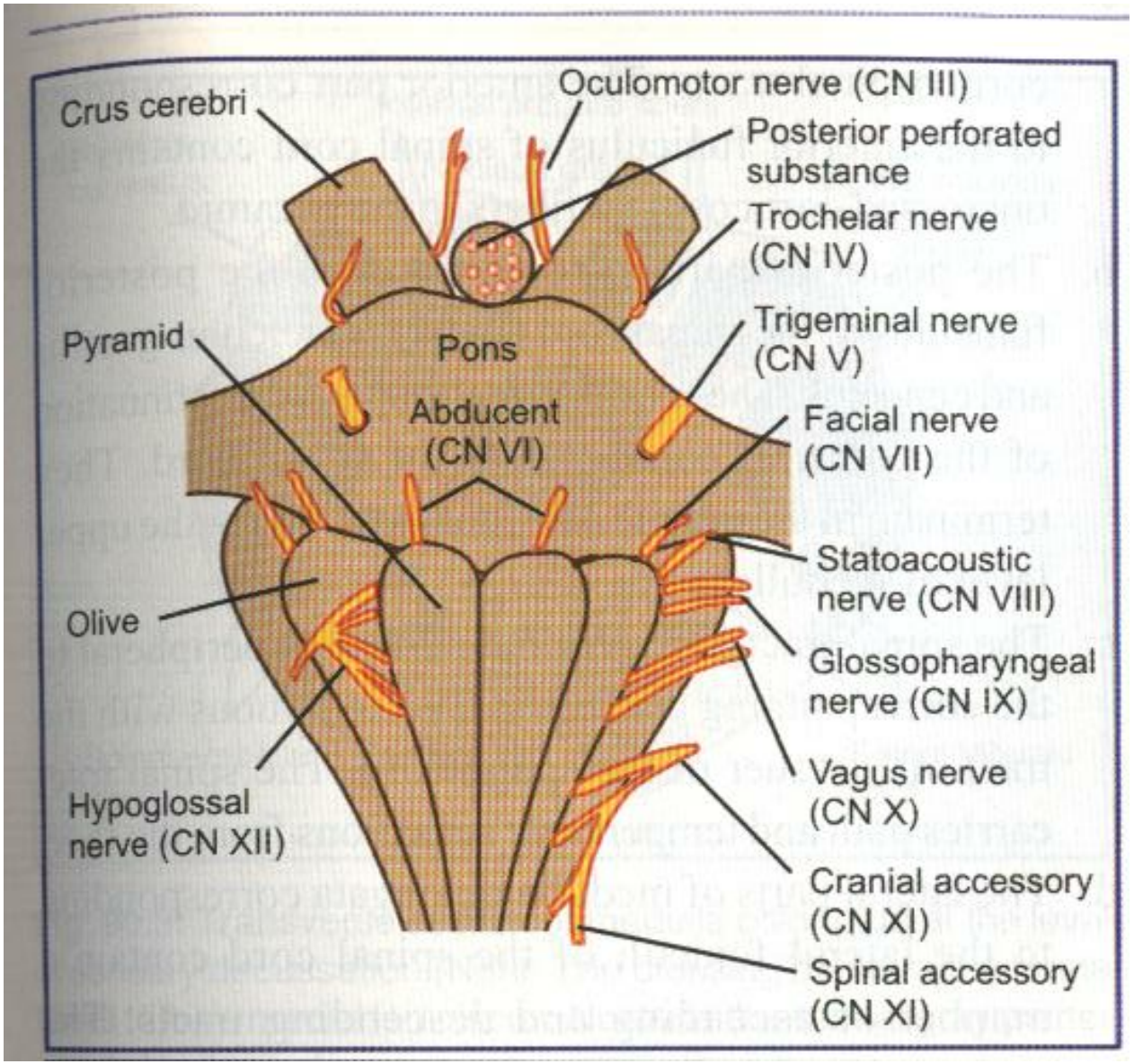
Important with regard to balance and cordination.

Ventricles of the brain



Ventricles of the brain




Crus cerebri
Oculomotor nerve (CN III)
Posterior perforated substance
Trochelar nerve (CN IV)
Trigeminal nerve (CN V)
Pyramid
Pons
Abducent (CN VI)
Facial nerve (CN VII)
Statoacoustic nerve (CN VIII)
Olive
Glossopharyngeal nerve (CN IX)
Vagus nerve (CN X)
Hypoglossal nerve (CN XII)
Cranial accessory (CN XI)
Spinal accessory (CN XI)

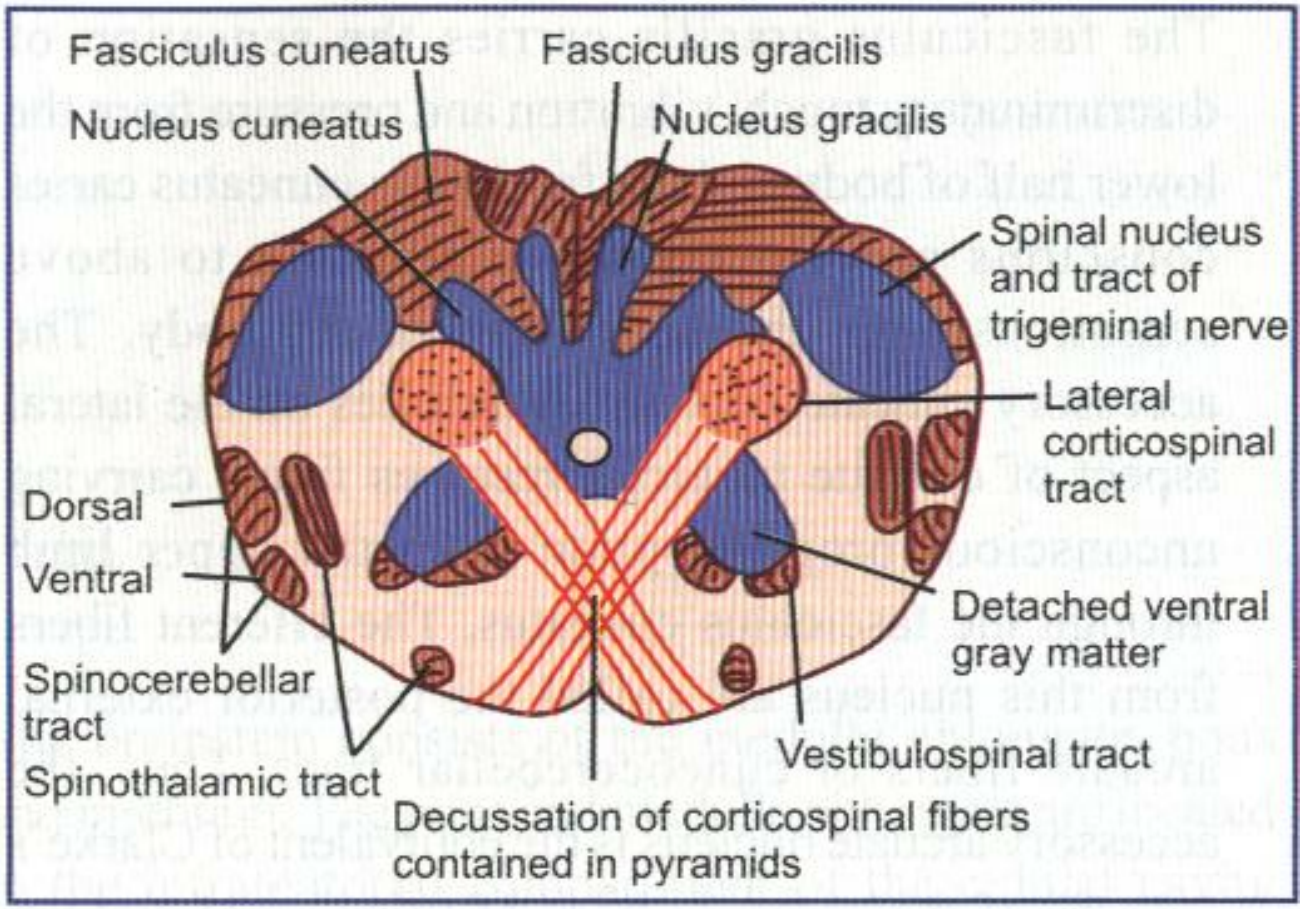
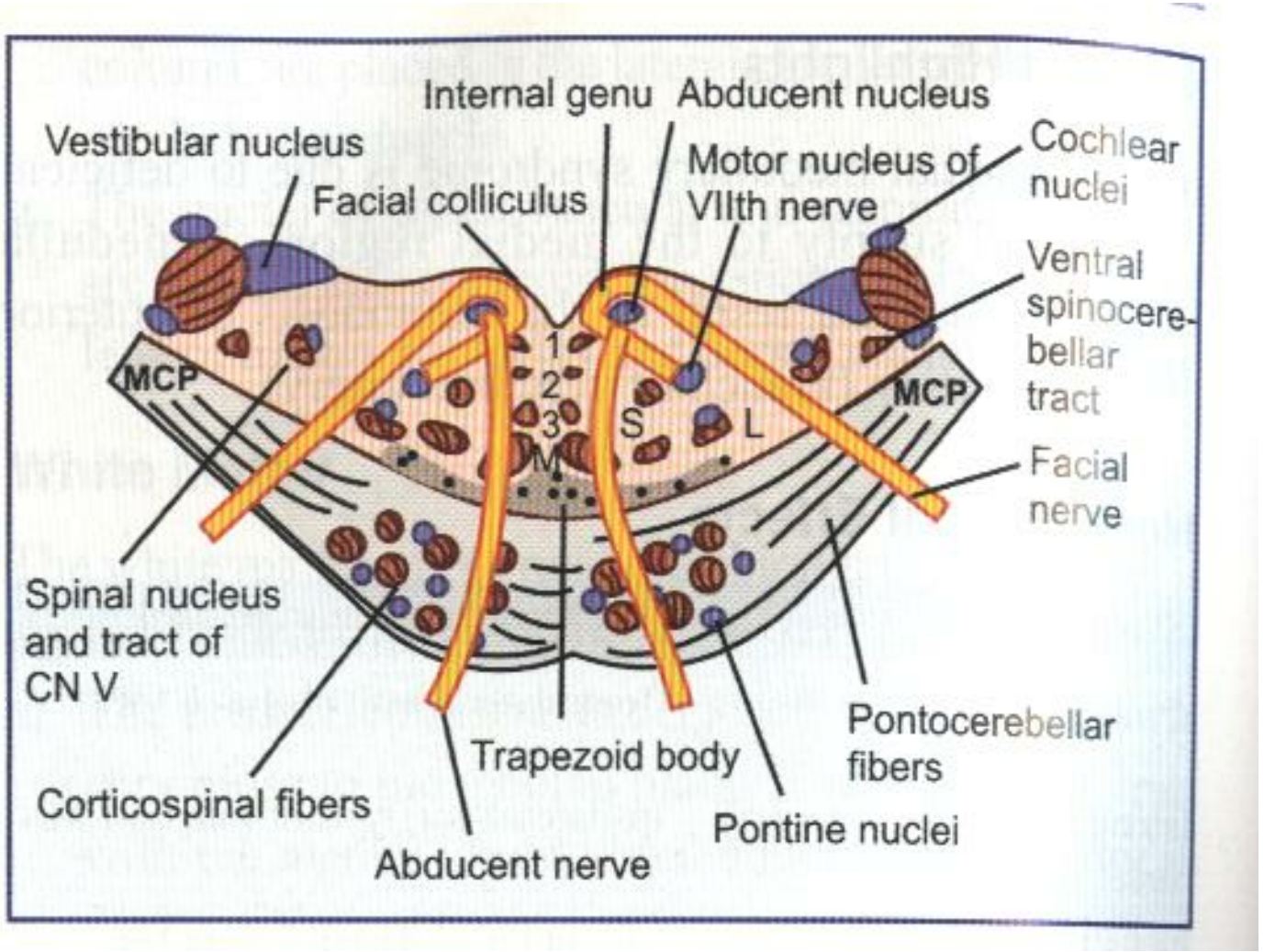
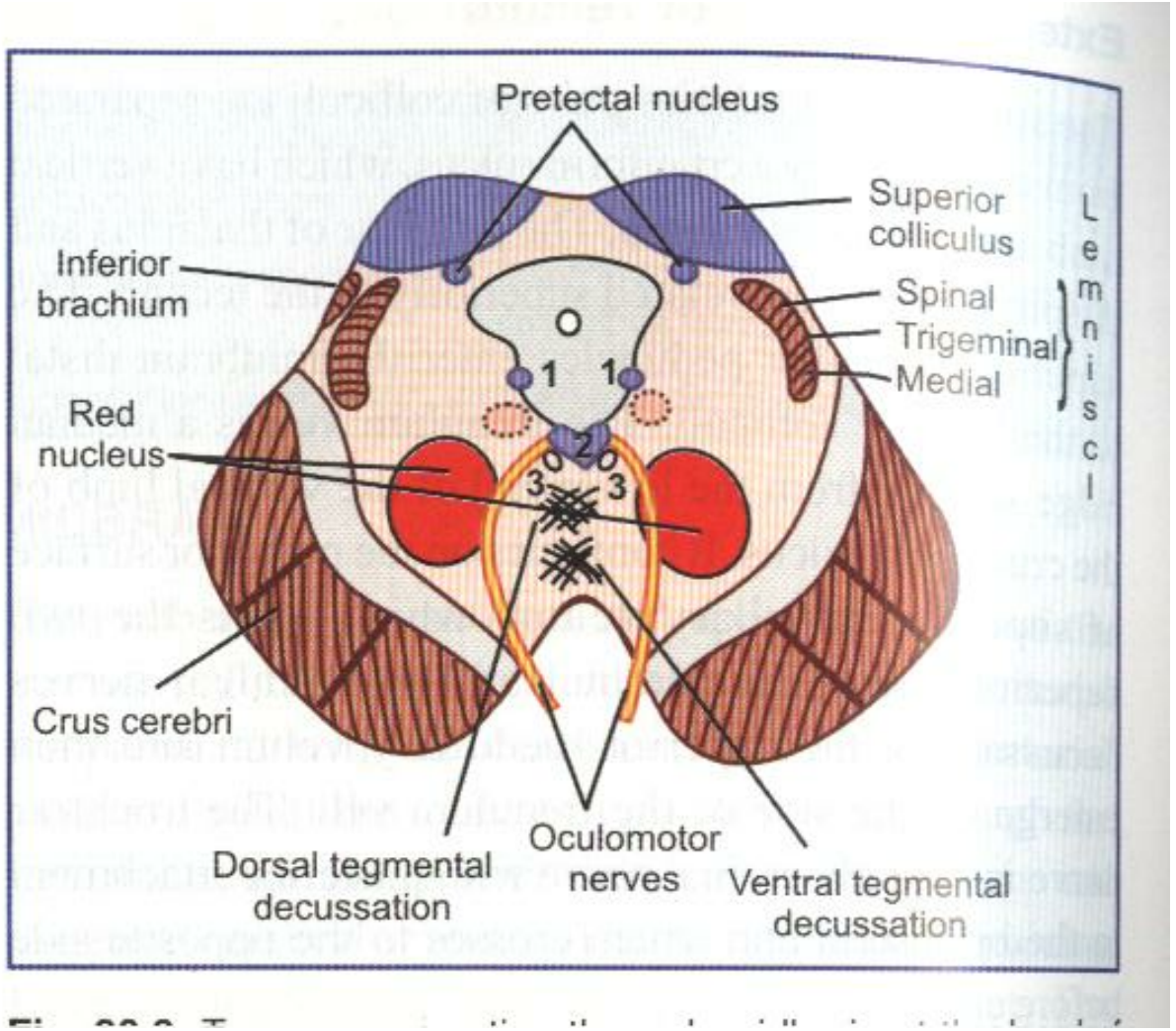
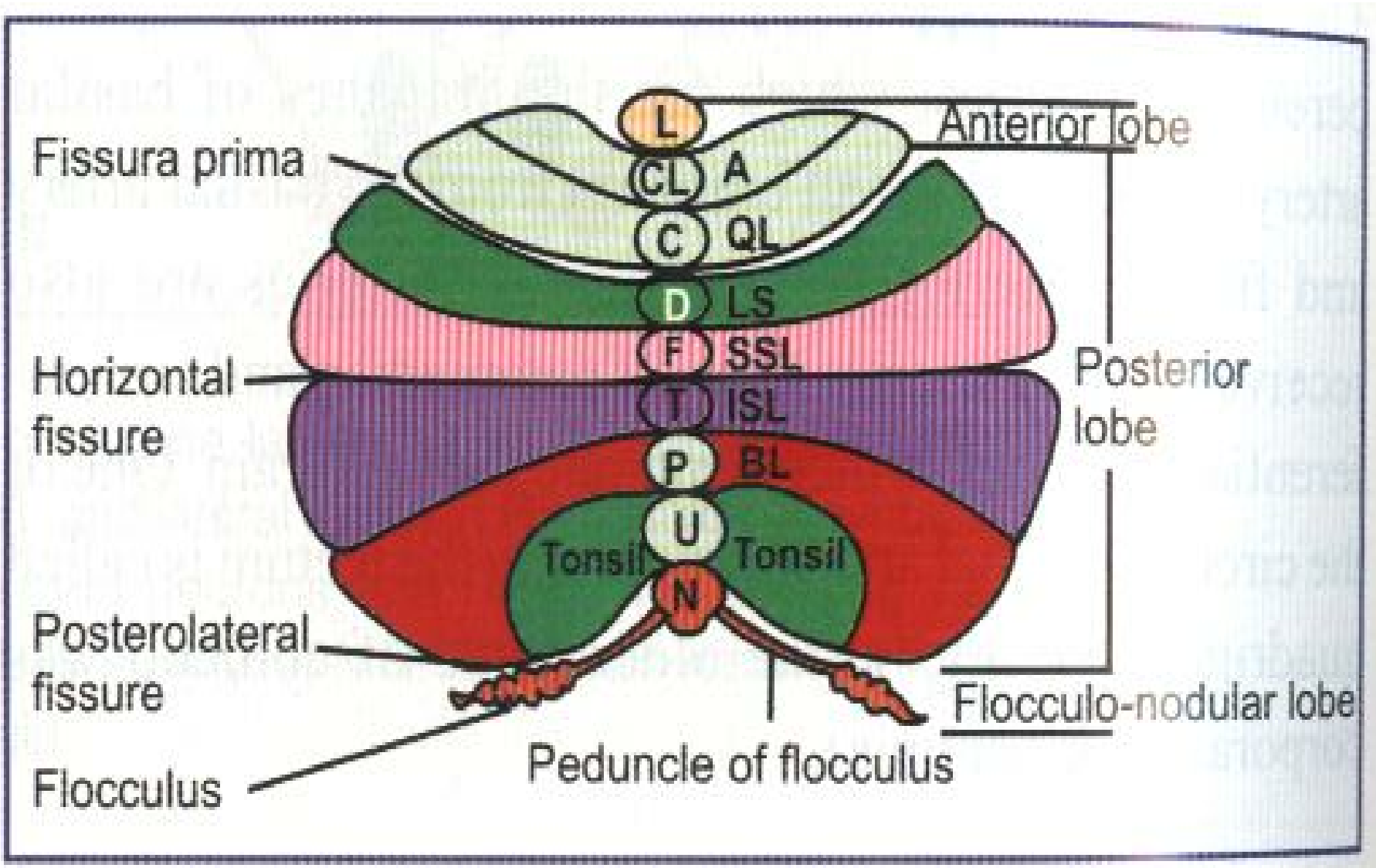


Fig. 90.2: Transverse section of medulla oblongata at the level


Internal genu
Abducent nucleus
Vestibular nucleus
Facial colliculus
Motor nucleus of VIIth nerve
Cochlear nuclei
Ventral spinocere-bellar tract
MCP
MCP
1
2
3
S
L
M
Facial nerve
Spinal nucleus and tract of CN V
Pontocerebellar fibers
Trapezoid body
Corticospinal fibers
Pontine nuclei
Abducent nerve


Pretectal nucleus
Superior colliculus
Inferior brachium
Spinal
Trigeminal
Medial
Lemniscl
Red nucleus
Crus cerebri
Dorsal tegmental decussation
Oculomotor nerves
Ventral tegmental decussation


L
CL
A
C
QL
D
LS
F
SSL
T
ISL
P
BL
U
Tonsil
Tonsil
N
Fissura prima
Anterior lobe
Horizontal fissure
Posterior lobe
Posterolateral fissure
Flocculo-nodular lobe
Flocculus
Peduncle of flocculus