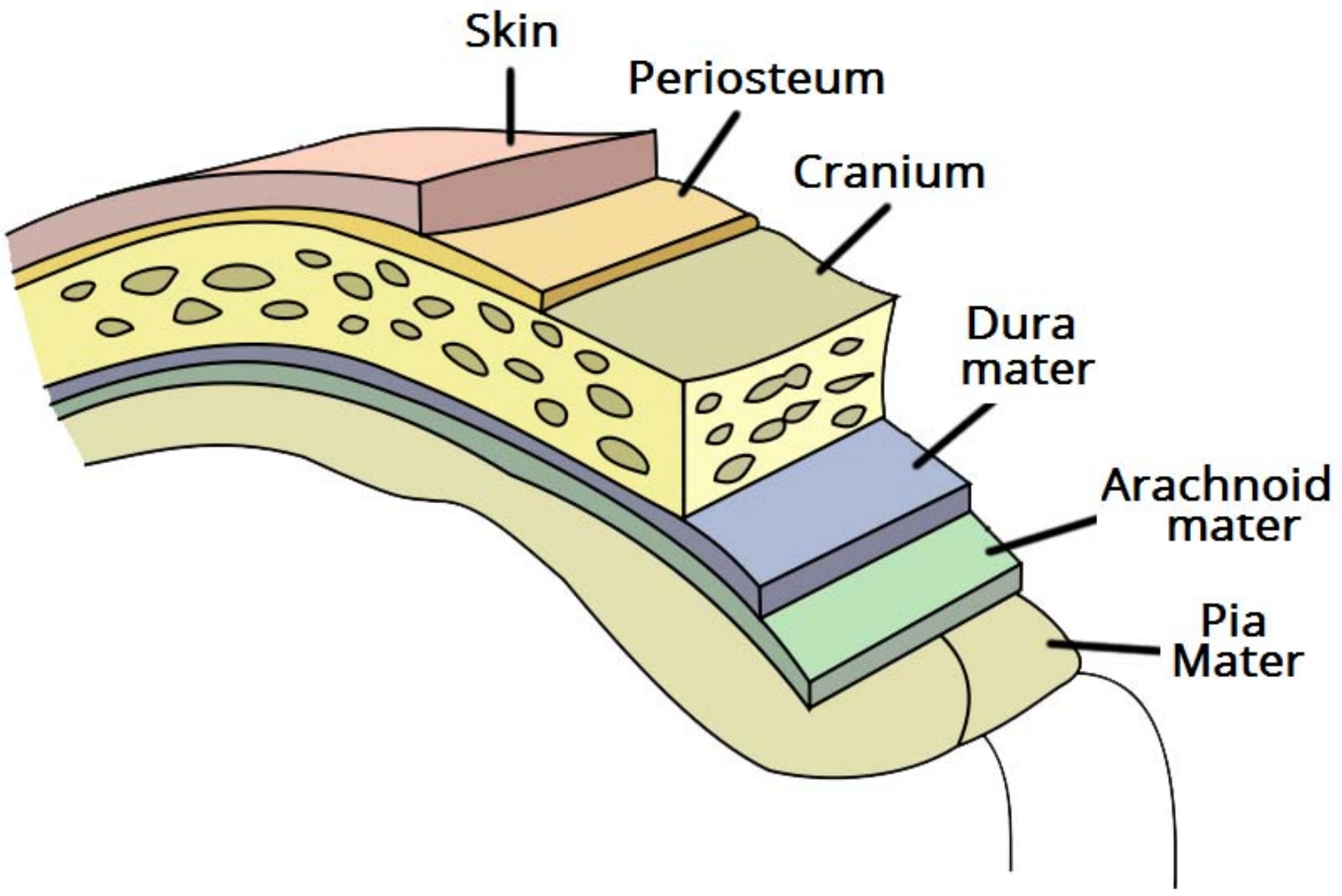
CNS ANATOMY AND ANAESTHESIA

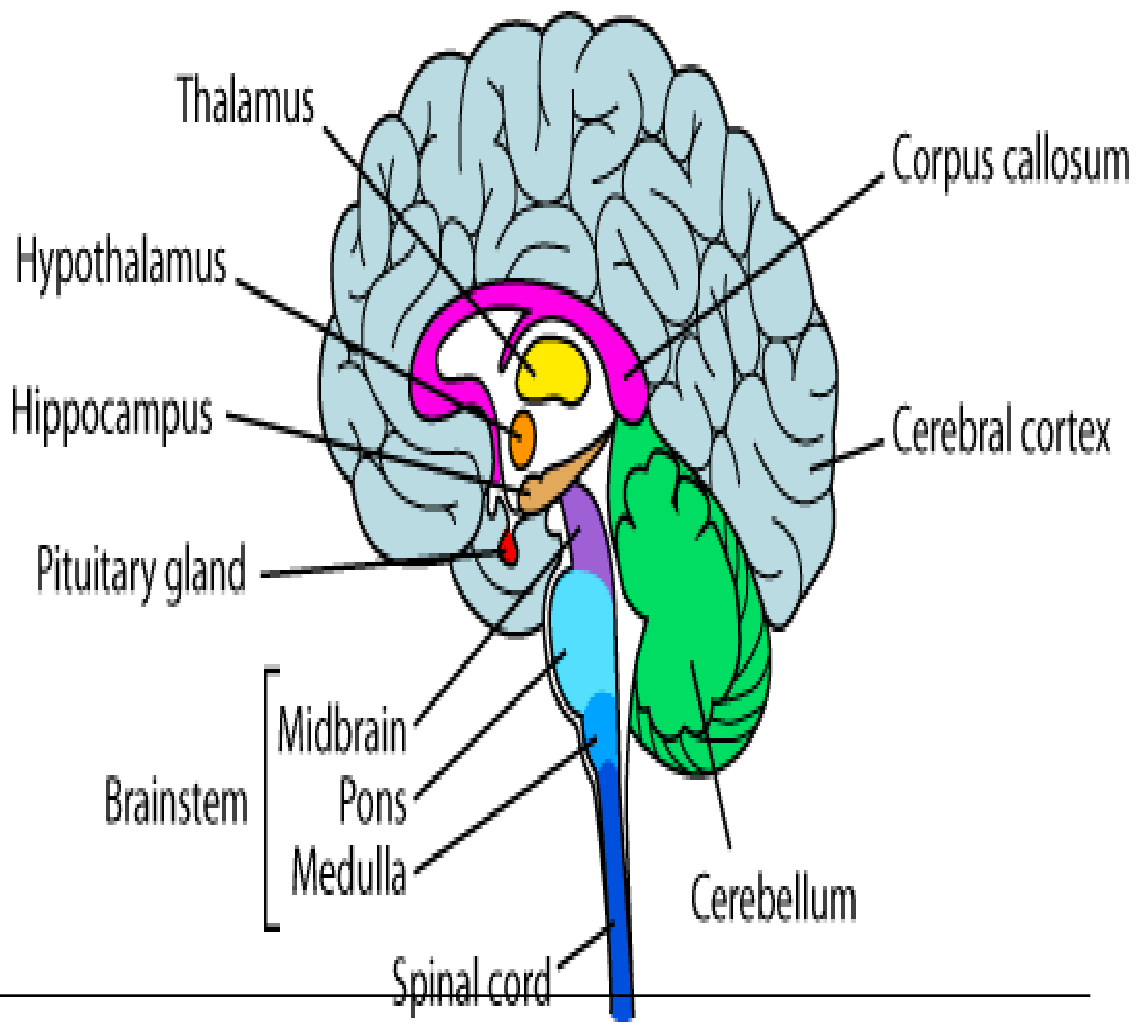
BRAIN ANATOMY

- The brain is a highly organized organ weighing about 1.4 kg (2% of total body weight) and contains about 100 billion neurons.
- It is protected by a bony covering called the skull.
- It is covered by three layers of connective tissue known as meninges:
  - Duramater
  - Arachnoid mater
  - Piamater



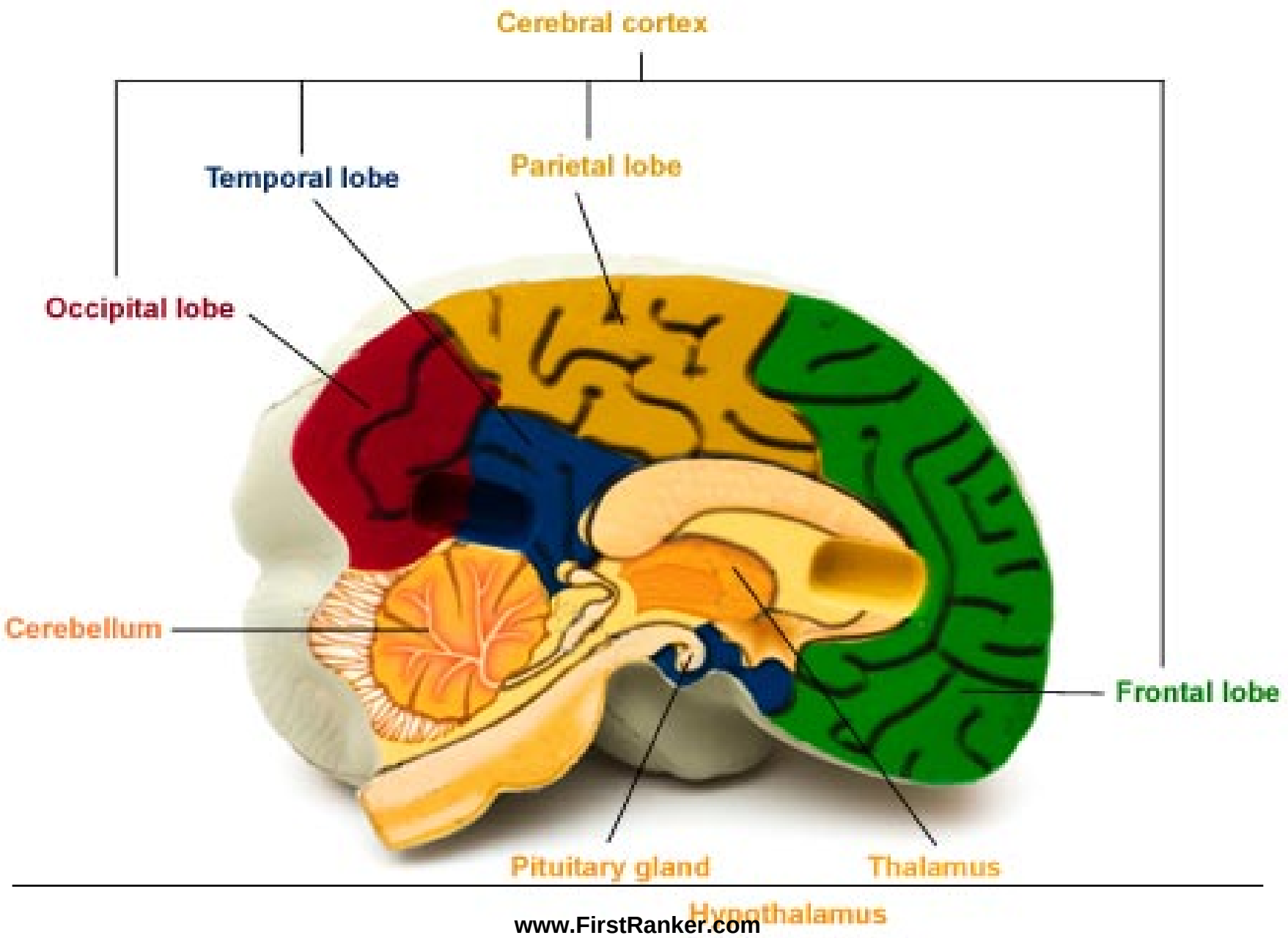
Parts of Brain

- Cerebrum
- Diencephalon
- Brainstem : midbrain, pons and medulla
- Cerebellum



Cerebrum

- Two cerebral hemispheres
- Each hemisphere is divided into four lobes – frontal, parietal, temporal and occipital
- The cerebrum is responsible for all conscious (voluntary) activities, thought, memory, intelligence, learning, personality development, judgement, vision.



Frontal lobe:

- The frontal lobes are the cerebral hemispheres anterior to the Rolandic fissure (central sulcus)

- Important areas within the frontal lobes are the motor area, Broca's speech area (in the dominant hemisphere) and the frontal eye fields

- Patients with bilateral frontal lobe dysfunction present typically with personality disorders, dementia, apathy and disinhibition

- The anterior 7 cm of one frontal lobe can be resected without significant neurological sequelae, provided the contralateral hemisphere is normal

- Resections more posterior than this in the dominant hemisphere are likely to damage the anterior speech area

Temporal lobe:

- The temporal lobe lies anteriorly below the Sylvian fissure and becomes the parietal lobe posteriorly at the angular gyrus

- Its medial border is the uncus and is of particular clinical importance because it overhangs the tentorial hiatus adjacent to the midbrain

- When intracranial pressure rises in the supratentorial compartment, uncus transgresses the tentorial hiatus, compressing the third nerve, midbrain and posterior cerebral artery described as ‘uncal herniation

- The temporal lobe has many roles including memory, the cortical representation of olfactory, auditory and vestibular information, some aspects of emotion and behaviour, Wernicke’s speech area (in the dominant hemisphere) and parts of the visual field pathway

- Seizures are common because structures in this lobe are particularly epileptogenic

- Amygdalohippocampectomy with or without temporal lobectomy may be required for intractable forms of epilepsy with proven mesial temporal sclerosis on imaging

- The anterior portion of one temporal lobe (approximately at the junction of the Rolandic and Sylvian fissures) may be resected with low risk of neurodisability

- Generally, this amounts to 4 cm of the dominant lobe or 6 cm of the non-dominant lobe

- The upper part of the superior temporal gyrus is generally preserved to protect the branches of the middle cerebral artery (MCA) lying in the Sylvian fissure

- More posterior resection may also damage the speech area in the dominant hemisphere

- Care is needed if resecting the medial aspect of the uncus because of its proximity to the optic tract

Parietal lobe:

- These extend from the Rolandic fissure to the parietooccipital sulcus posteriorly and to the temporal lobe inferiorly

- The dominant hemisphere shares speech function with the adjacent temporal lobe, while both sides contain the sensory cortex and visual association areas

- Parietal lobe dysfunction may produce cortical sensory loss or sensory inattention

- In the dominant hemisphere, the result is dysphasia

- Dysfunction in the non-dominant hemisphere produces dyspraxia (e.g.difficulty dressing, using a knife and fork) or difficulty with spatial orientation

- Impairment of the visual association areas may give rise to visual agnosia (inability to recognize objects) or to alexia (inability to read)

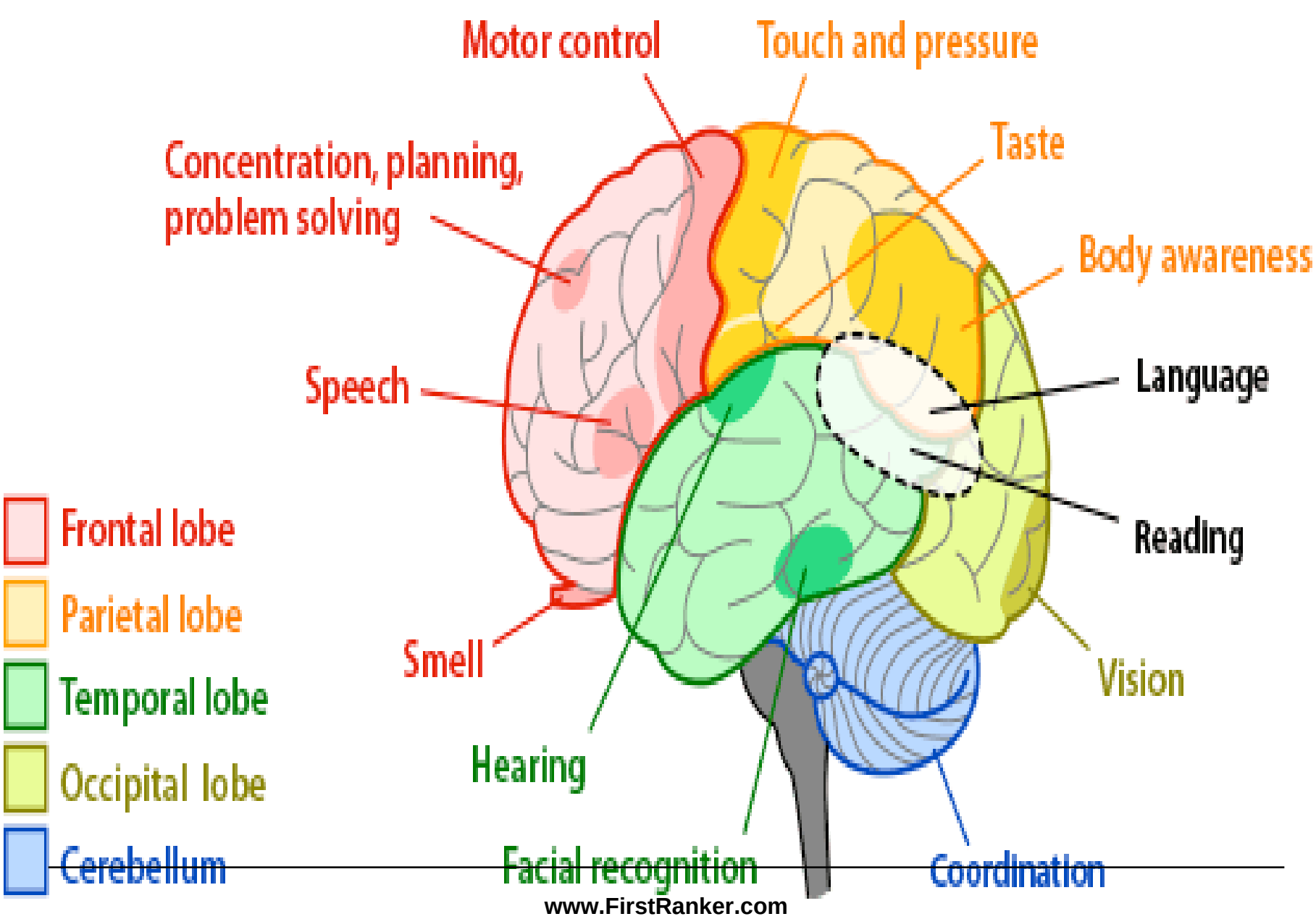
Occipital lobe:

- Lesions within the occipital lobe typically present with a homonymous field defect without macular sparing, Visual hallucinations may also be a feature

- Resection of the occipital lobe will result in a contralateral homonymous hemianopia

- The extent of resection is restricted to 3.5 cm from the occipital pole in the dominant hemisphere because of the angular gyrus, where lesions can produce dyslexia, dysgraphia and acalculia

- In the non-dominant hemisphere, up to 7 cm may be resected



Diencephalon

- Thalamus
- Epithalamus
- Hypothalamus

- The thalamus is involved in a number of functions including relaying sensory and motor signals to the cerebral cortex and regulating consciousness, sleep and alertness

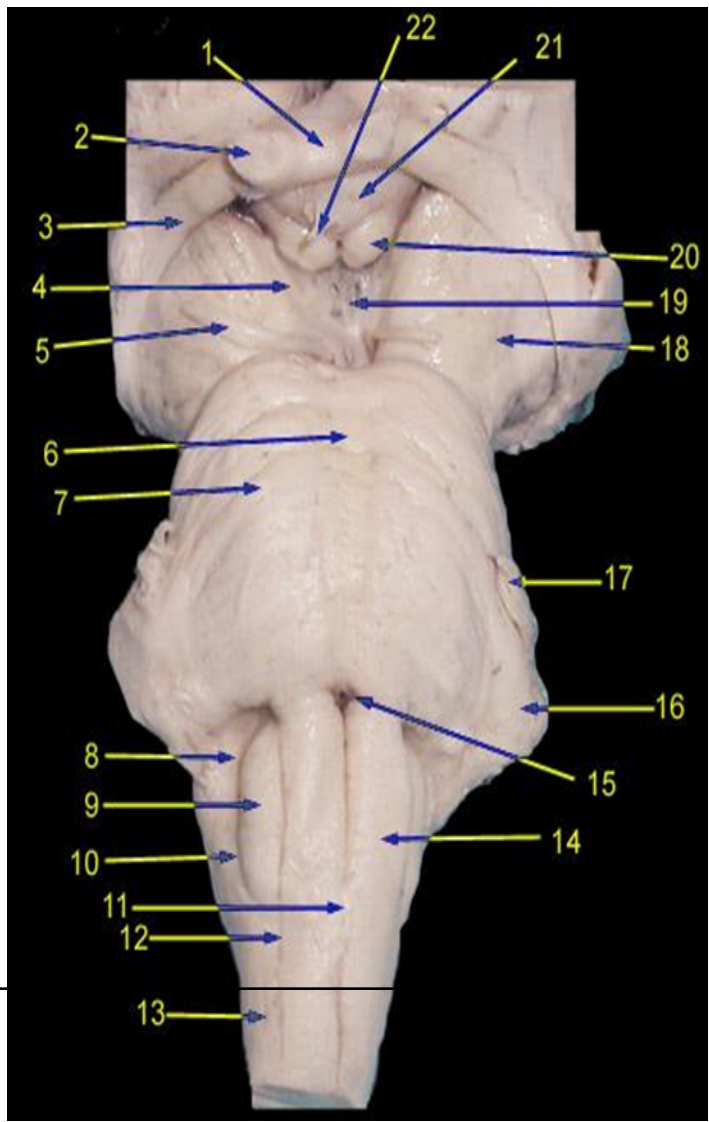
- The epithalamus functions as a connection between the limbic system to other parts of the brain.

- Other functions of epithalamus include the secretion of melatonin by the pineal gland (involved in circadian rhythms) and regulation of motor pathways and emotions

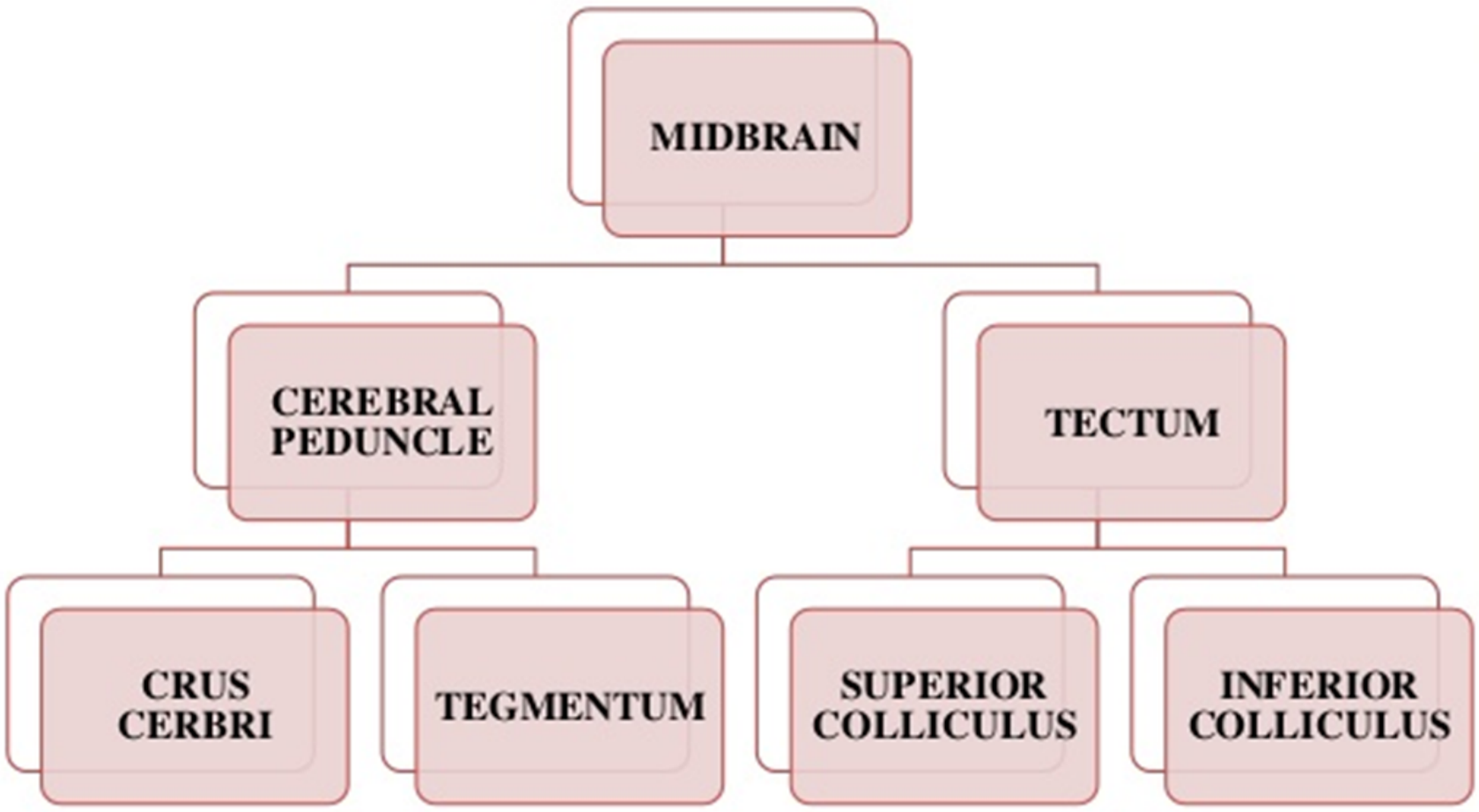
- The hypothalamus links the nervous system to the endocrine system via the pituitary gland
- It is the link between mind and body, it controls and integrates activities of autonomic NS
- It manufactures and transports releasing hormones that control the Master Gland
- It is also an important area for regulating homeostatic activities, such as hunger, thirst, sex drive, temprature and even addictions

BRAINSTEM

- Located between the cerebrum and the spinal cord
  - –Provides a pathway for tracts running between higher and lower neural centers.
- Consists of the midbrain, pons, and medulla oblongata.
- Each region is about an inch in length
- Microscopically, it consists of deep gray matter surrounded by white matter fiber tracts.



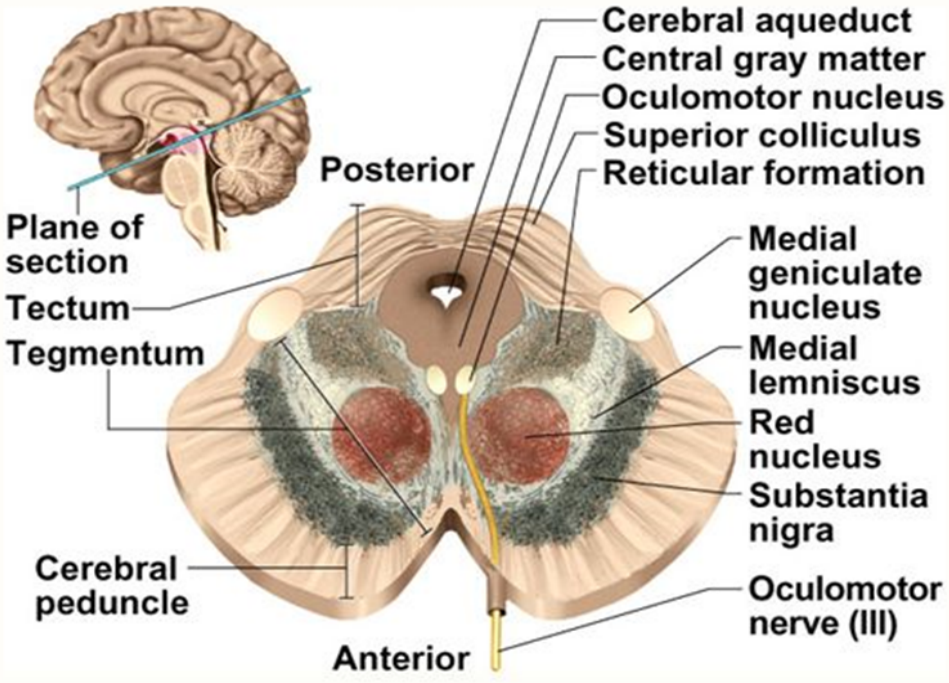
DIVISION OF THE MIDBRAIN



- Shortest brain stem, not more than 2cm in length, lies in the posterior cranial Fossa
- For descriptive purpose, divided into dorsal tectum and right and left cerebral Peduncles
- Each cerebral peduncles divide further into ventral crus cerebri and a dorsal tegmentum by a pigmented lamina

  " Substantia nigra"

Midbrain, Cross Section

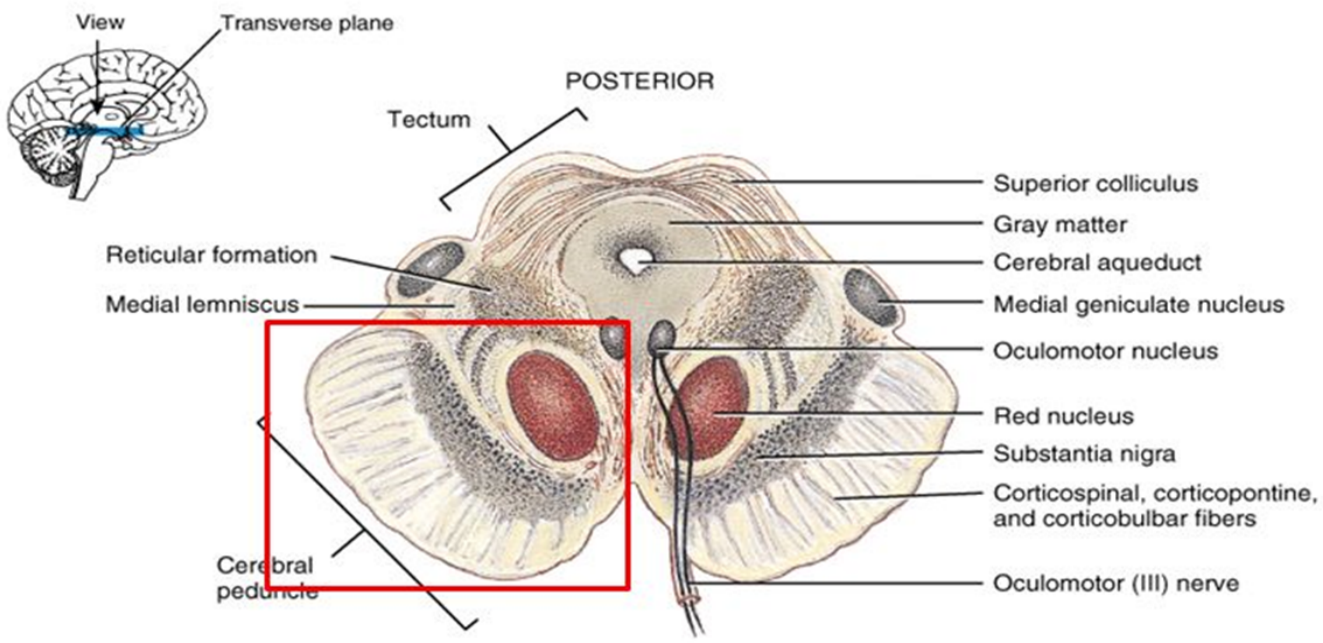


- Centers for the receipt and integration of several types of sensory information.

  -Superior colliculi – visual

  -Inferior colliculi - auditory
- Sends info to forebrain.

Midbrain in Section



- The Crus cerebri---clusters of motor & sensory fibers
- Substantia nigra---helps controls subconscious muscle activity
- Red nucleus-- rich blood supply & iron-containing pigment
  - cortex & cerebellum coordinate muscular movements by sending information here from the cortex and cerebellum

- Tegmentum contains **Reticular formation**

- Functions as **Reticular Activating System :**

- Filters background stimuli
- Regulates sleep wake cycle
- Regulates conciousness
- Maintain muscle tone

Superior colliculus

Receives afferent from

- Retina (vision)
- Spinal cord (tactile)
- Inferior colliculus (auditory)
- Occipital cortex (modulating path)

Efferent goes to

- Retina, spinal cord, brain stem nuclei, tegmentum
- Reflex movement of eyes, head and neck in response to visual stimuli

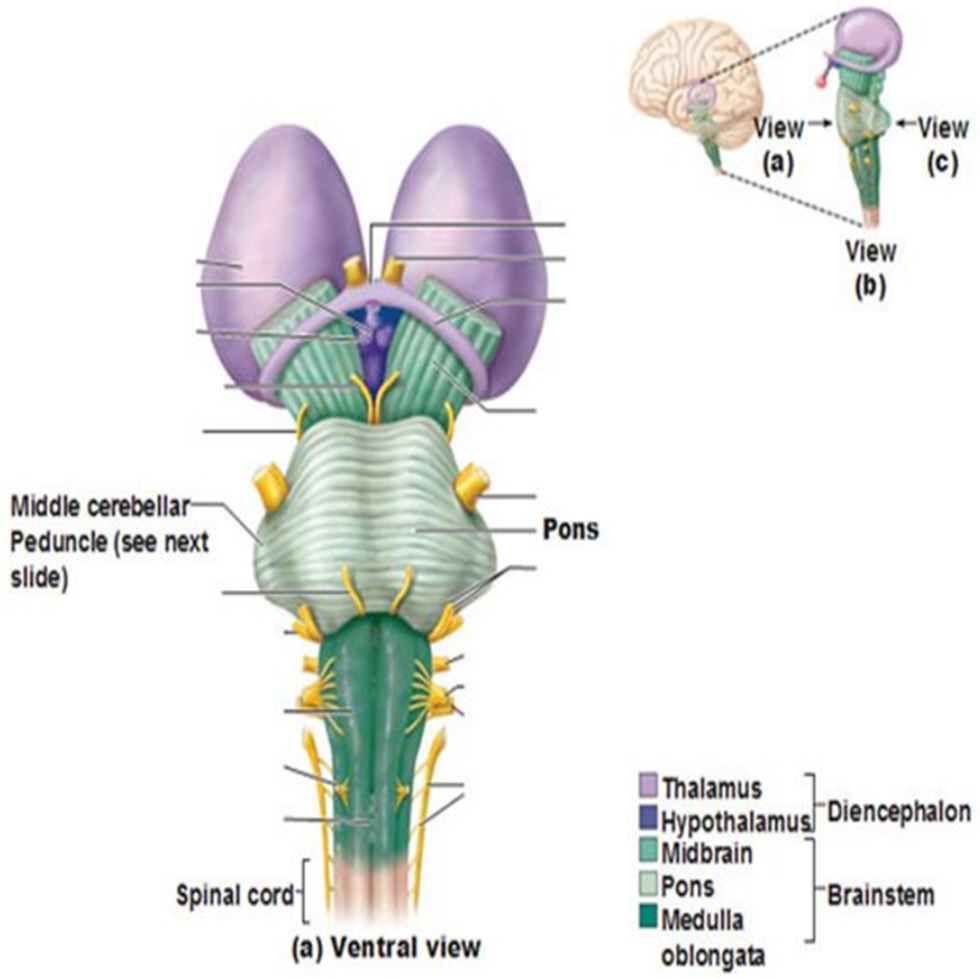
Inferior colliculus

- Receives afferent from lateral leminiscus
- Gives efferent to medial geniculate body
- Controls auditory reflex helps in localizing the source of sound

Brain Anatomy – Pons

Functions:

- **Bridge between the cerebellum and cerebrum**
- **Houses cranial nerves**
  - Trigeminal (CN V)
  - Abducens (CN VI)
  - Facial (CN VII)
  - Some of the nuclei for Vestibulocochlear (CN VIII)
- **Helps regulate skeletal muscles of breathing**



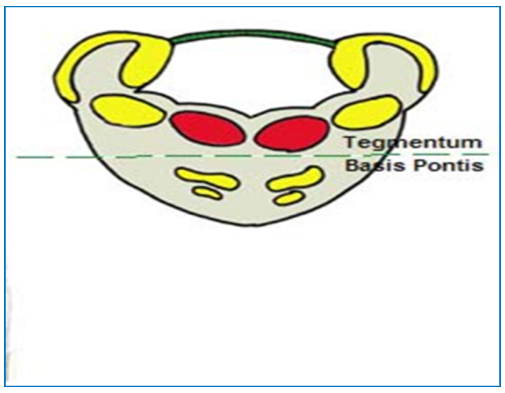
- Seperated from medula in front by a furrow in which VI, VII, VIII nerve appears
- The pons shows a **convex anterior surface** with prominent transversely running fibres i.e the middle cerebellar peduncles
- The anterior surface of pons is marked in the midline by a shallow groove **basilar sulcus** which lodges the basilar artery

- Trigeminal nerve emerges from the anterior surface, at the junction between pons and middle cerebellar peduncle

- Superior surface is related to superior cerebellar artery and Inferior surface related to anterior inferior cerebellar artery

- **Posterior surface is hidden by cerebellum** and bounded laterally by superior cerebellar paduncle

- On transverse section pons is subdivided into ventral and dorsal part



- **Ventral part of the pons** contains

Pontine nuclei:

- Recieves **AFFERENT** corticopontine fibres from frontal, temporal,parietal and occipital lobes of cerebrum of the same side.

- The **EFFERENT** fibres form the transverse fibres of pons (pontocerebellar fibers) that cross the mid line and enter cerebellum

- It has been estimated that there are about twenty million neurons in pontine nuclei.

- Most of them are glutaminergic.

- The dorsal part of the pons may be regarded as continuation of the part of the medulla behind the pyramids
- Superiorly continous with the tegmentum of the midbrain
- Posterior surface help to form floor of fourth ventricle
- The dorsal part is bounded laterally by inferior cerebellar peduncle in the lower part of the pons and superior cerebellar peduncle in upper part.

Cerebellopontine angle

Irregularly shaped potential space in the posterior fossa of brain

Anteriorly : posterior surface of temporal bone

Posteriorly : anterior surface of cerebellum

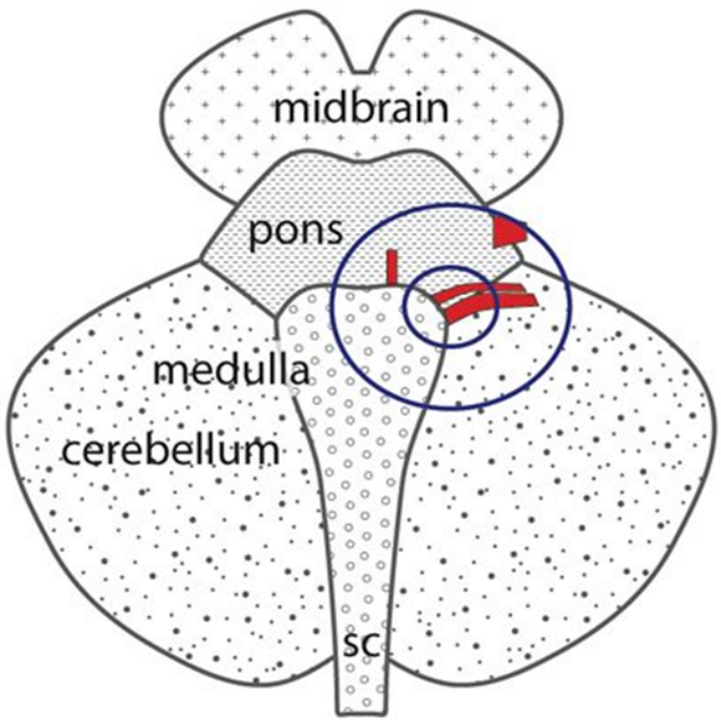
Medially : cisterns of pons and medulla and olive

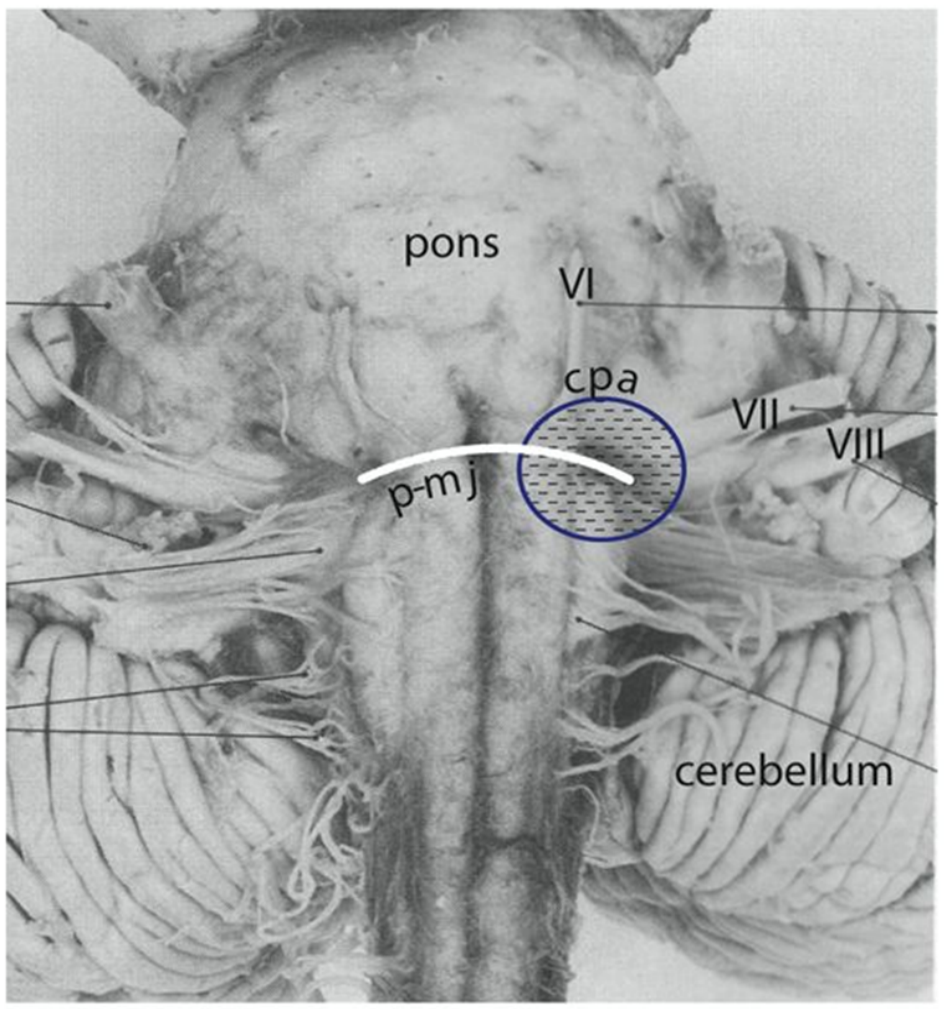
Superiorly : inferior border of pons and cerebellar peduncle

CP angle contains :

- Facial nerve (**VII**)
- Vestibulocochlear nerve (**VIII**)
- Glossopharyngeal nerve (IX)
- Nervous intermedius
- **Labyrinthine artery**

Cerebellopontine angle





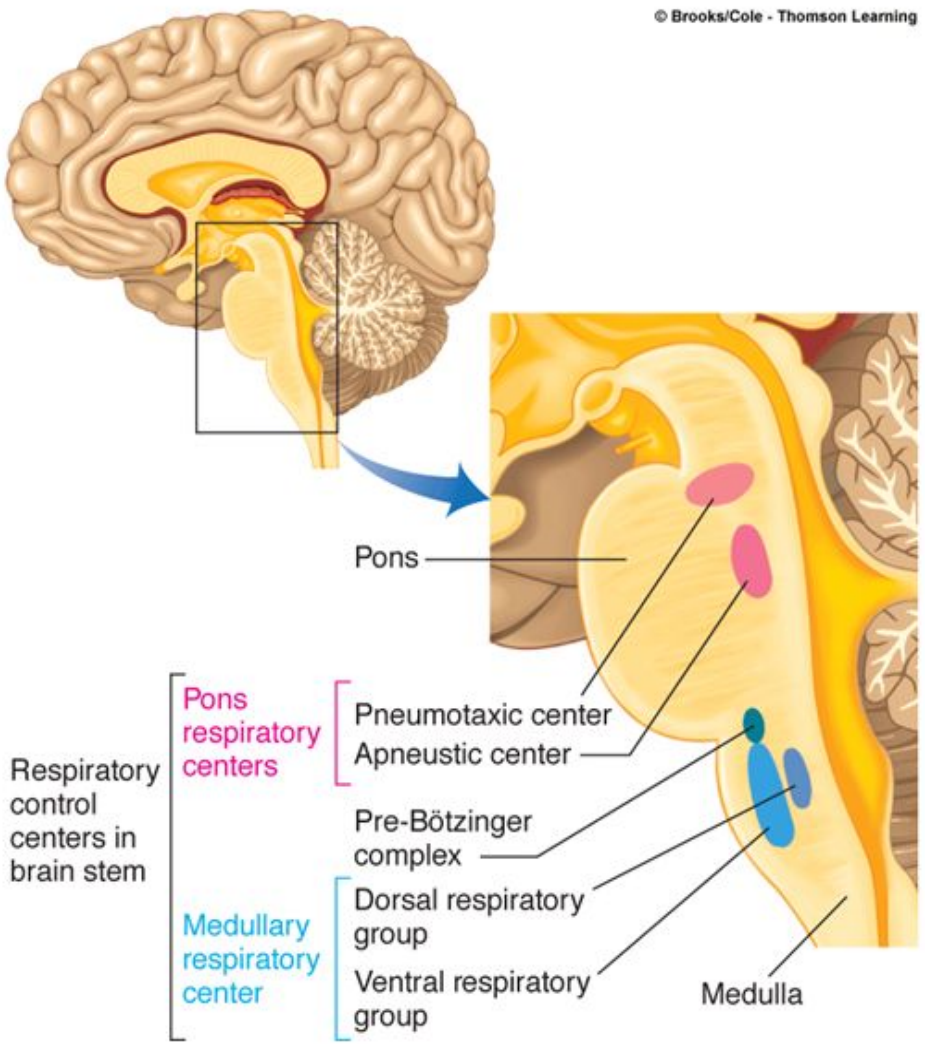
Pneumotaxic center:

- It is situated in upper Pons.
- It is formed by nucleus parabrachialis.
- Function: it controls medullary respiratory centers, particularly the inspiratory center through apneustic center. It always controls the activity of inspiratory center so that duration of inspiration is controlled.

Apnuestic center:

- It is situated in lower Pons.
- Function: this center increases depth of inspiration by acting directly on the inspiratory center.

Control of Respiration



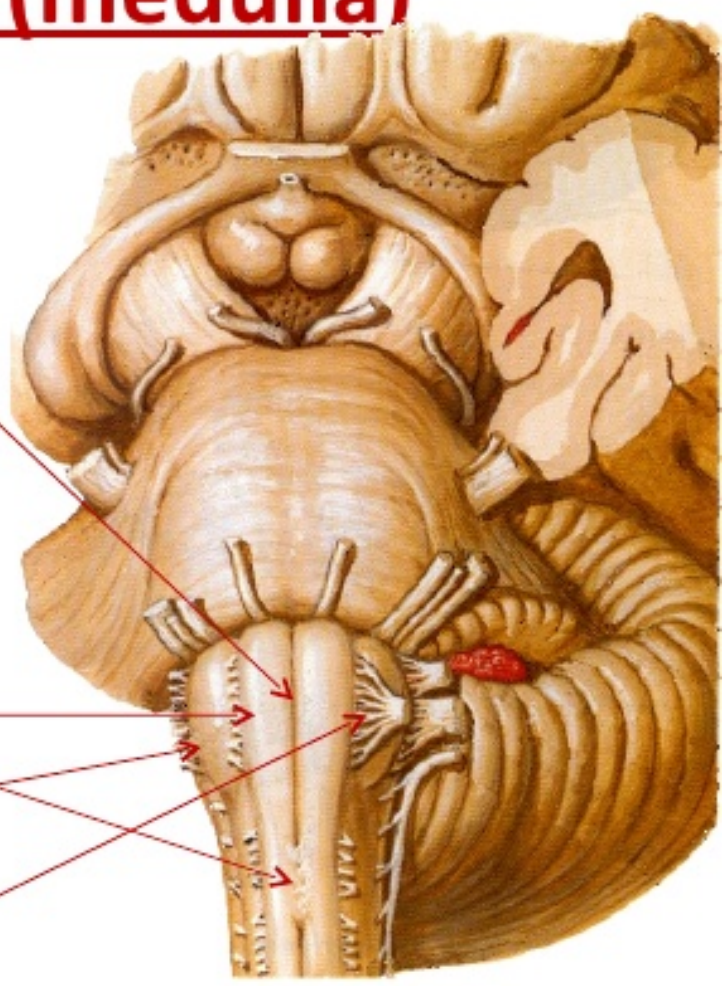
Medulla Oblongata:

- Medulla is broad above and joins with pons
  it is narrow below and continous as spinal cord

- Length is about 3cm, width is about 2cm at its upper end

- Surfaces shows series of fissures
  - Anterior median fissure
  - Posterior median fissure

THE ANTERIOR SURFACE (medulla)



- On the anterior surface of the medulla is the **anterior median fissure (Continuous with the AMF of the spinal cord)**

- **PYRAMIDS**
  (decussation of the pyramids)
  in lower portion.

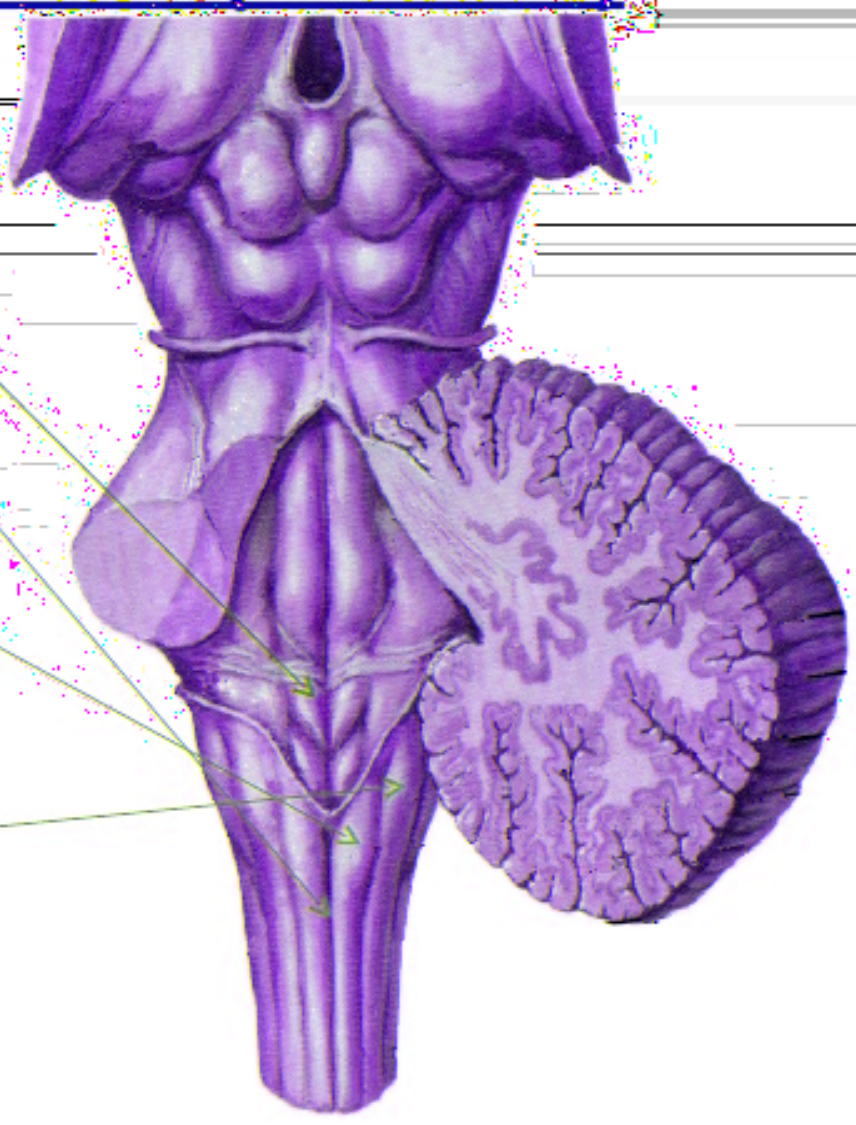
- **OLIVES (Inferior olivary nuclei lies beneath them)**
- **INFERIOR CEREBELLAR PEDUNCLE**
- **HYPOGLOSSAL NERVE (XII)**
  (groove between the pyramids & olives)

- **Bulbopontine sulcus** :
  seperates medulla and pons ventrally
  VI, VII and VIII cranial nerves arises from it.
- **Two median fissures** (ant and post) divide medulla into 2 symmetrical halves.
  Each half of medulla is marked by **2 longitudinal sulci**
  (anterolateral and posterolateral).

These 2 sulci divide each half of medulla into anterior, posterior and lateral region.

- **Anterolateral sulci** : between pyramids and olive
- **Posterolateral sulci** : between olive and inferior cerebellar peduncle

THE POSTERIOR SURFACE (medulla)



LOOR OF

CLE

OSTERIOR

S (PMS)

CLE

derlying

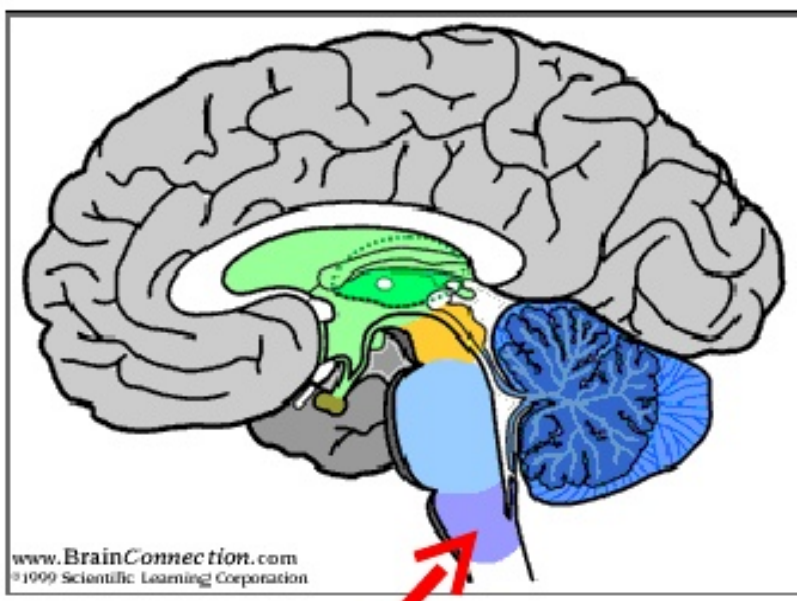
RCLE

derlying

s)

- **Superior half** : F
  THE 4TH VENTRIC
- **Inferior half** : PC
  MEDIAN SULCU
- GRACILE TUBER
  (Produced by un
  gracile nucleus)
- CUNEATE TUBE
  (Produced by un
  cuneate nucleus

The ***medulla oblongata*** lies between the ***pons*** and the ***spinal cord***. It contains centers which ***control key, autonomic body functions*** and it ***relays nerve signals*** between the brain and spinal cord. Important control centers include:



- The respiratory center – controls the rate, rhythm, and depth of breathing
- The cardiac center – regulates heartbeat
- The vasomotor center – controls blood pressure
- Reflex centers – reflex arc centers for vomiting, coughing, sneezing, hiccupping and swallowing

Lateral Medullary Syndrome (Wallenberg)

- Occlusion of posterior inferior cerebellar artery
- All structures supplied by this artery will be affected:

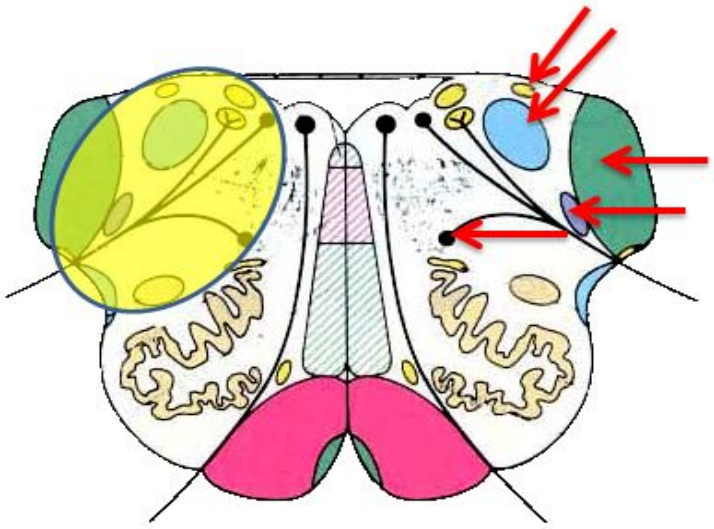
1-Nucleus ambiguous

2-Nucleus of spinal tract of trigeminal N

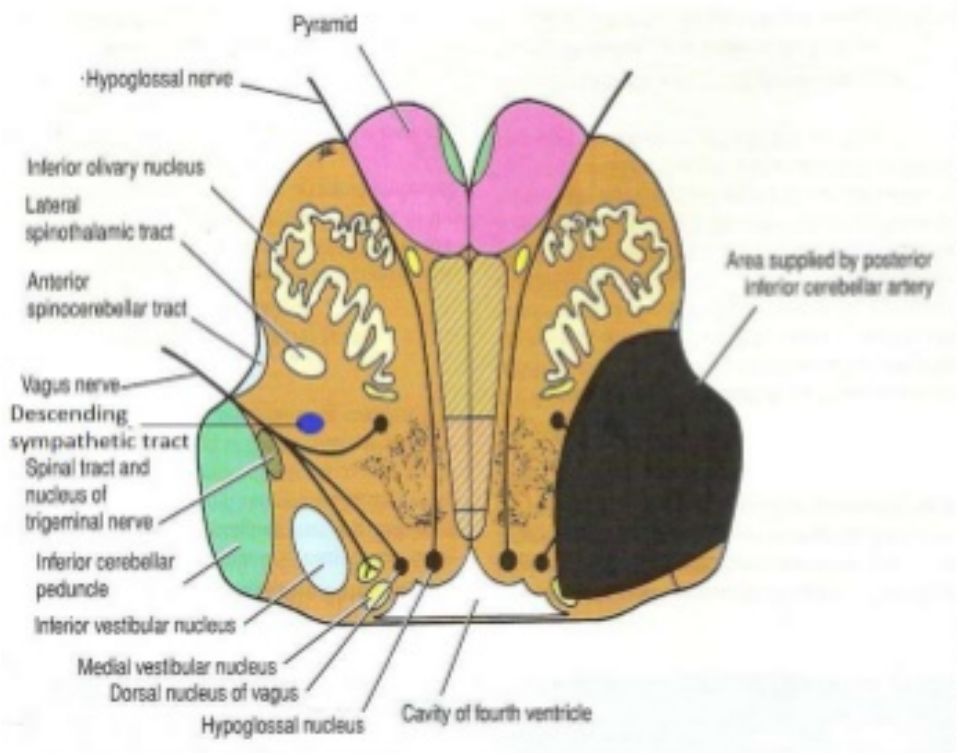
3-Vestibular nuclei

4-Descending sympathetic fibers

5-Inferior cerebellar peduncle



Lateral medullary syndrome



A. IPSILATERAL

1.Xth cranial nerve palsy

2.Cerebellar signs

3.Horner's syndrome

4.Impaired pain, temperature and touch on the upper half of face

B. CONTRA LATERAL

1.Impaired pain and temperature over the body

Cerebellum:

- The cerebellum consists of a group of midline structures, the lingula, vermis and flocculonodular lobe, and two laterally placed hemispheres

- Lesions affecting midline structures typically produce truncal ataxia, which may make it difficult for the patient to stand or even to sit

- Obstructive hydrocephalus is common

- Invasion of the floor of the fourth ventricle by tumour may give rise to vomiting or cranial nerve dysfunction

LOBES OF CEREBELLUM

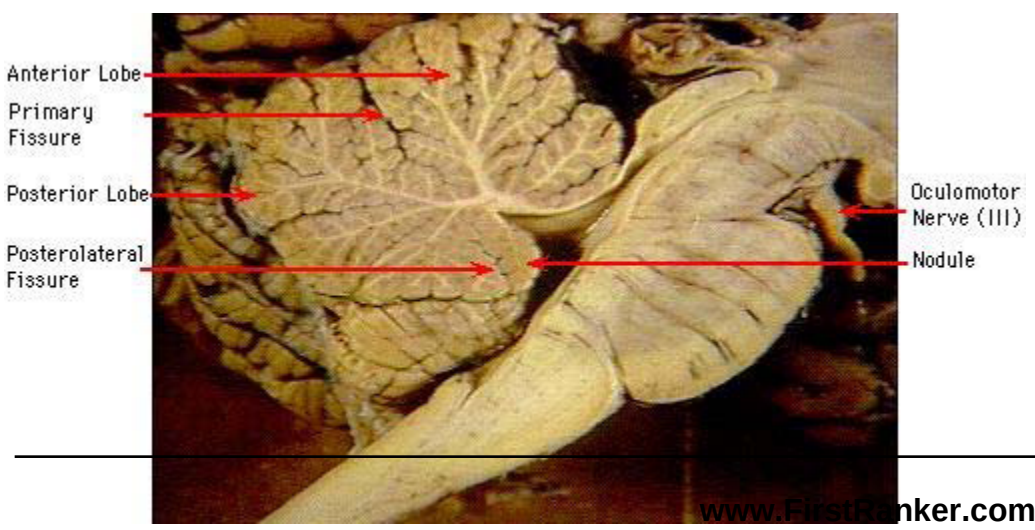
❑ Divisions of lobes

Anatomical

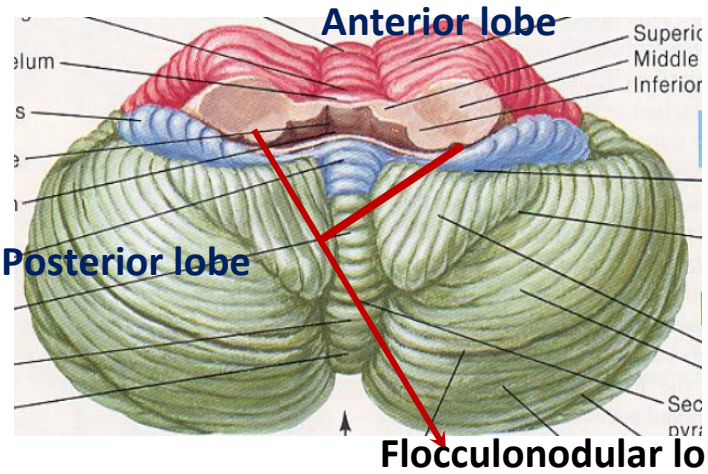
➢ Flocculonodular lobe

➢ Anterior lobe

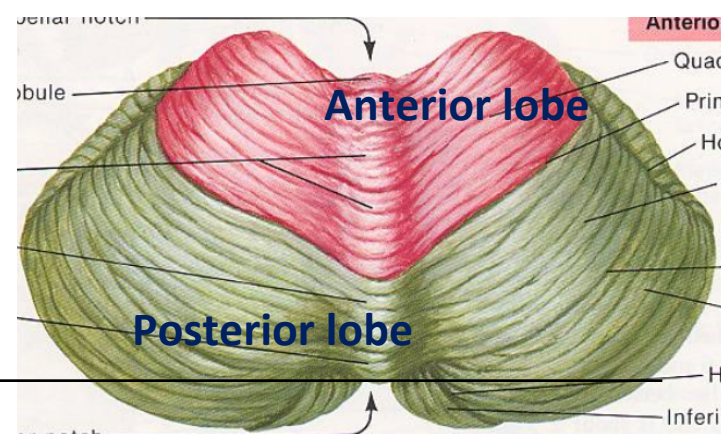
➢ Posterior lobe



Inferior surface



Superior surface

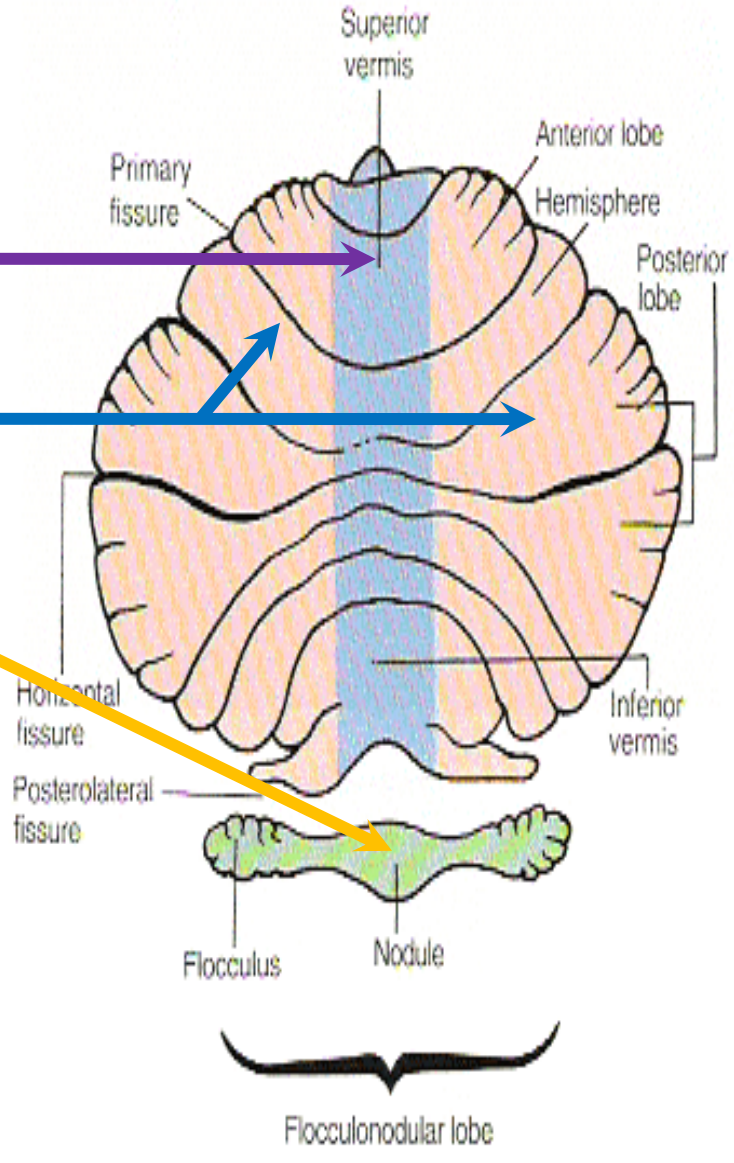


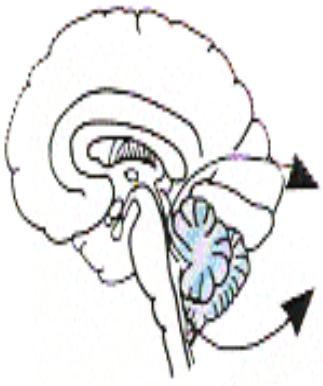
Functional(Evolutionary)

➢ Paleocerebellum

➢ Neocerebellum

➢ Archicerebellum





External features of th
• The cerebellum controls
posture and muscle tone

Archi-cerebellum

posterior lobe

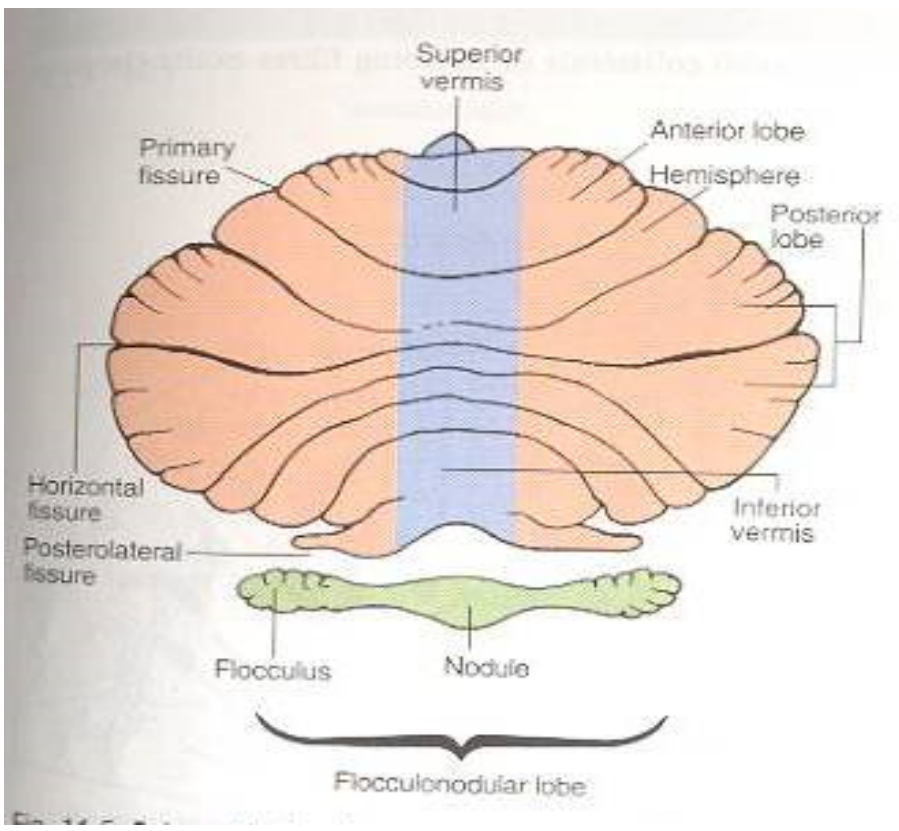
(Vestibular part)

•It is formed of the **flocculo-nodular lobe + associated fastigial nuclei**, lying on inf. Surface in front of postero -lateral fissure.

••*Embryologically*, it is the **oldest** part of cerebellum.

• It receives afferent Fibres. From vestibular apparatus of internal ear Via vestibulo-cerebellar tracts.

•It is concerned with **equlibrium**



Neocerebellum

Archicerebellum

Paleocerebellum

Paleo-cerebellum

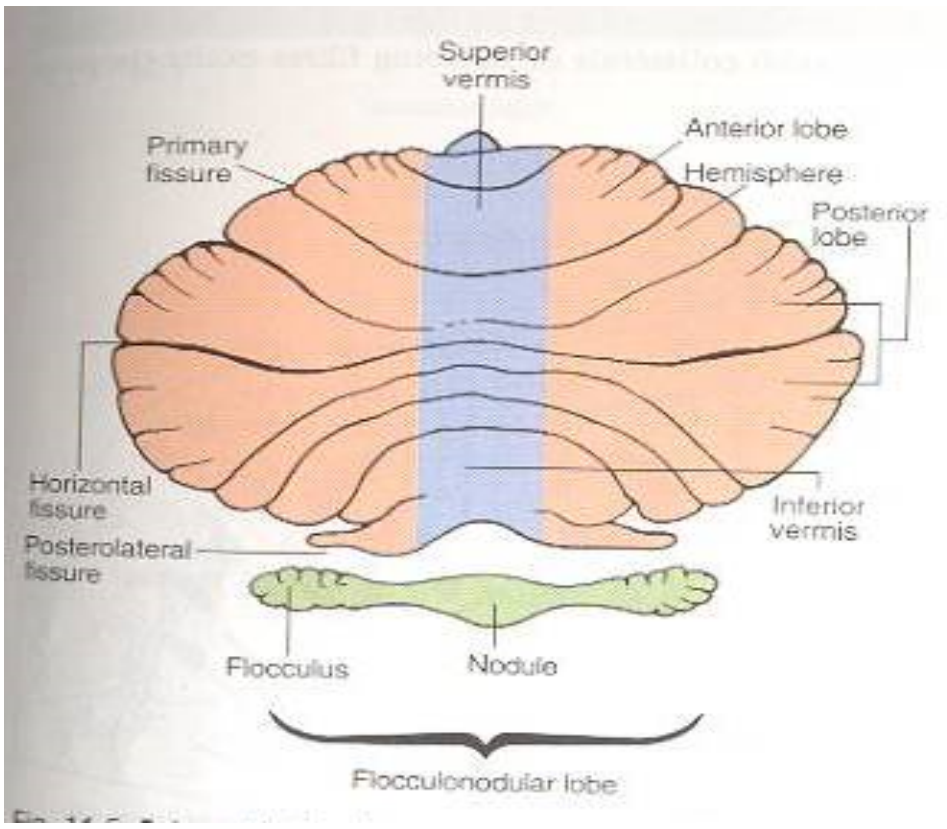
(spinal part) :

•it is formed of **midline vermis + surrounding paravermis + globose & emboliform nuclei**.

•It receives afferent proprio-ceptive impulses from Ms.& tendons Via spino-cerebellar tracts (dorsal & ventral) mainly.

•it sends efferents to red nucleus of midbrain.

•it is concerned with **muscle tone**



Paleocerebellum

Neo-cerebellum

(cerebral part)

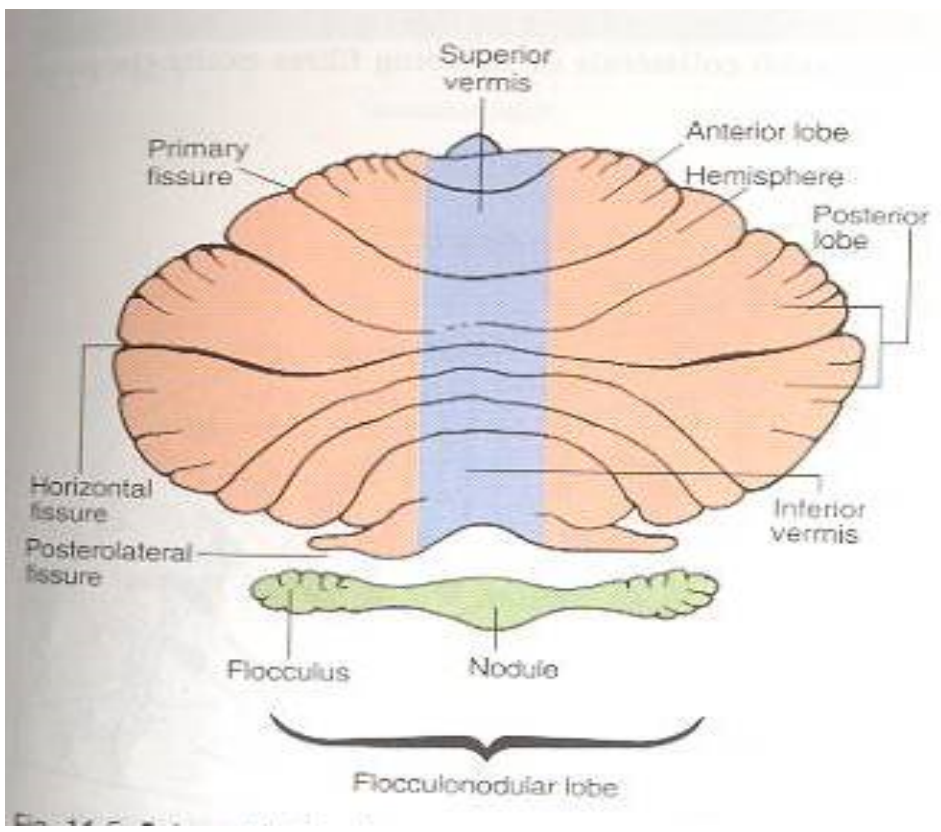
•It is the remaining largest part of cerebellum.

•It includes the most **2-cerebellar hemispheres + dendate nuclei**.

•It receives afferent impulses from the cerebral cortex+pons Via cerebro-ponto- cerebellar pathway.

•it sends efferents to Ventro lateral nucleus of thalamus.

•it controls **voluntary movements** (muscle coordination).



Neocerebellum

Cerebellar Cell Types

Purkinje Cells: (inhibitory)

If there were a brain of the cerebellum, it would be the Purkinje cells

Mossy Fibers: (excitatory)

From: - pontine nuclei *(via middle peduncle)*
- other pons / brainstem loci

To: - deep cerebellar nuclei
- granule cells

Granule Cells: *(most abundant in brain)*

From & To: cerebellar cortex… ~unipolar

Give rise to: Parallel Fibers: (excitatory)

Climbing Fibers: (excitatory)

From: - inferior olive

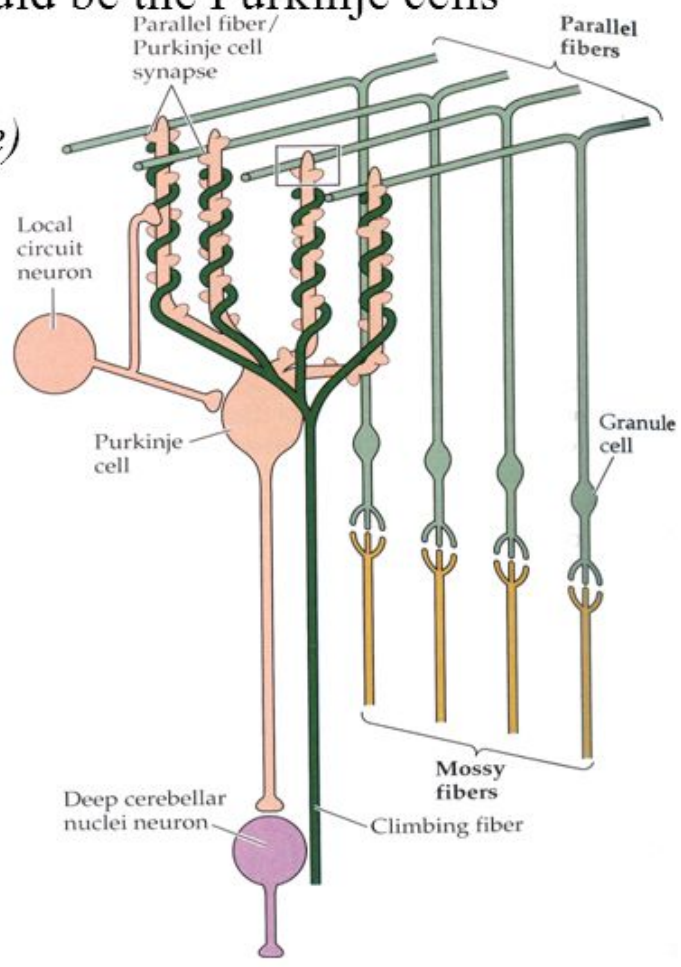
To: - Purkinje **shaft**

Local Interneurons:

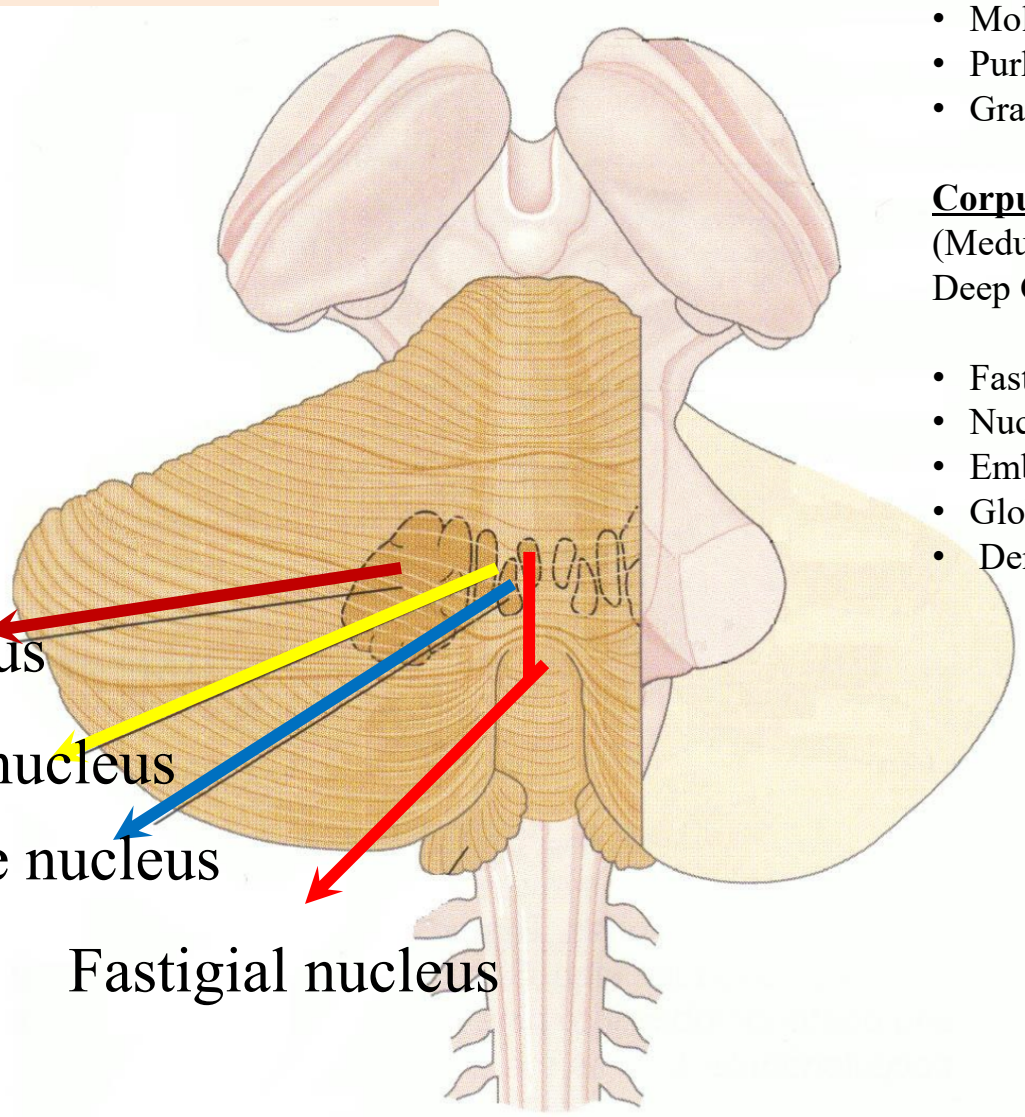
- Basket Cells
- Stellate Cells
- Golgi Cells

(inhibitory)

"control the flow of information through the cerebellar cortex"



Deep nucleuses of cerebellum



Cerebellar Cortex

- Molecular Layer
- Purkinje Cell Layer
- Granular Layer

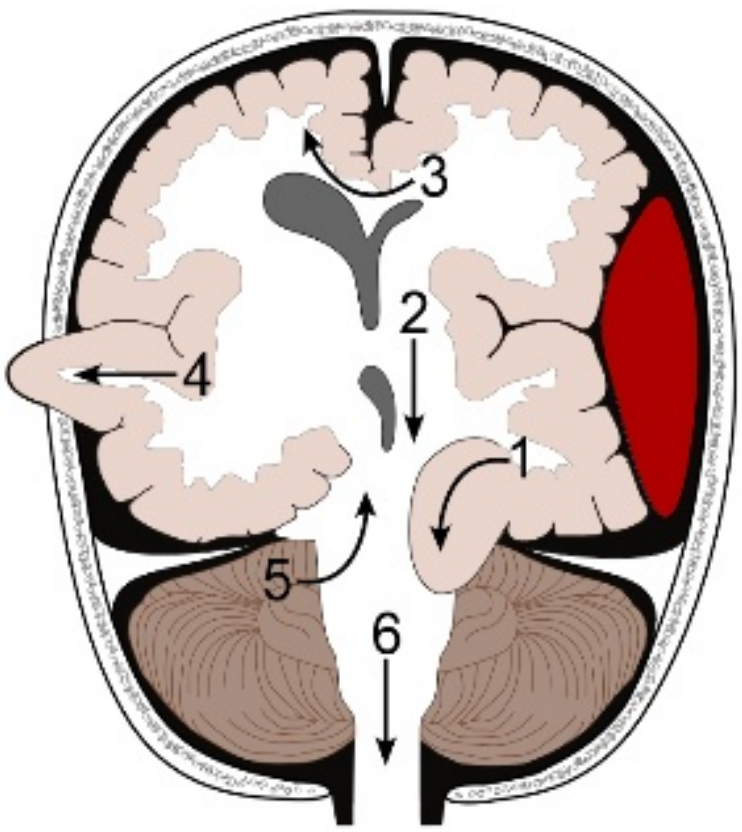
Corpus Medullare
(Medullary Center)
Deep Cerebellar Nuclei

- Fastigial Nuclei
- Nucleus Interpositus
- Emboliform Nucleus
- Globose Nucleus
- Dentate Nucleus

- Lesions within the hemispheres usually cause ipsilateral limb ataxia
- Vertigo may result from damage to the vestibular reflex pathways
- Nystagmus is typically the result of involvement of the flocculonodular lobe
- Other features associated with disorders of the cerebellum include hypotonia, dysarthria and pendular reflexes

Tonsillar/Cerebellar Herniation (6)

- Cerebellar tonsils herniate through foramen magnum
- Usually from posterior fossa mass lesion
- Compresses aqueduct of Sylvius and causes hydrocephalus
- Neck pain, vomiting, decreased mental status, bradycardia, hypertension

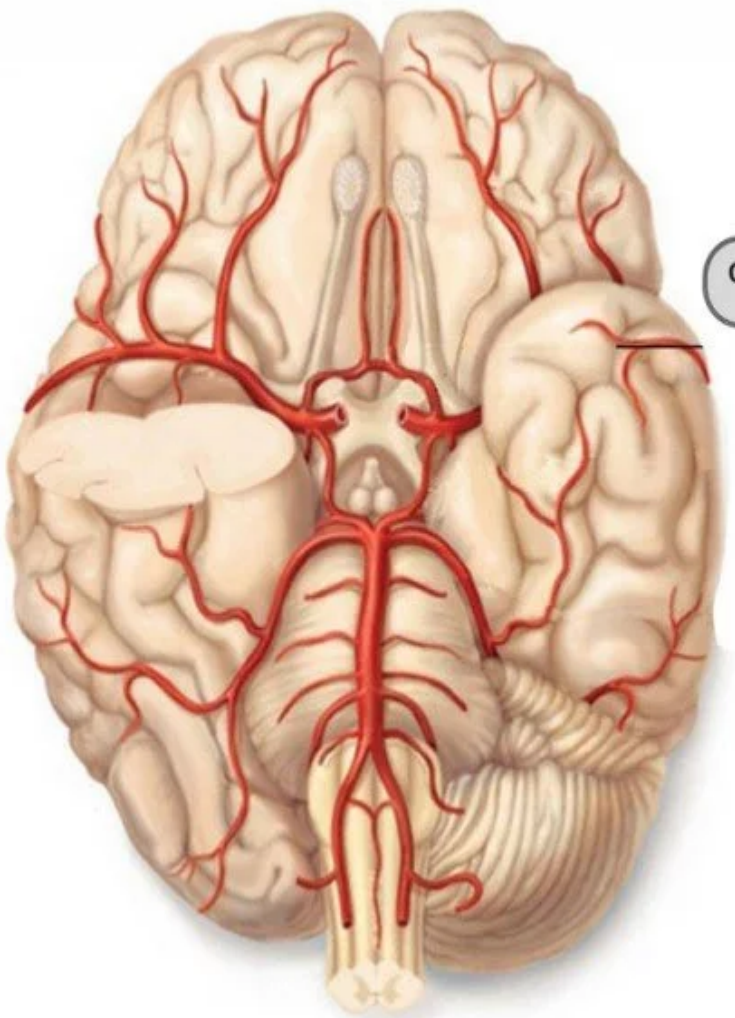


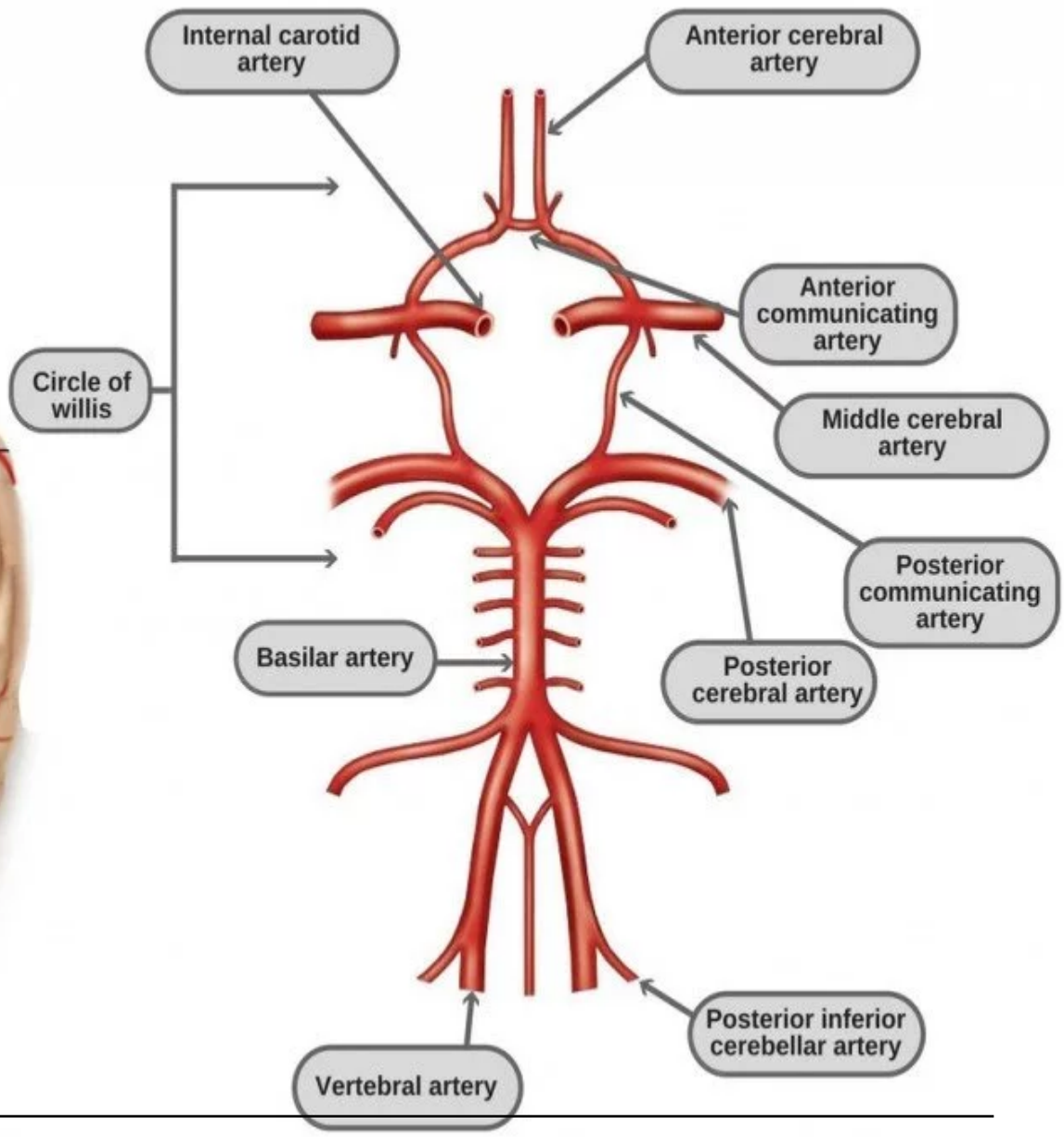
Arterial supply:

- The cerebral circulation is made up of two components

- The anterior circulation is fed by the internal carotid arteries and the posterior part is from the vertebral arteries (the vertebrobasilar circulation)

- The arterial anastomosis in the suprasellar cistern is named the ‘ circle of Willis’ after Thomas Willis





- The segment of the anterior cerebral artery proximal to the AComA is known as the A1 segment

- The distal ACA has four segments named according to their location in relation to the corpus callosum, the
  - A2 (infracallosal)
  - A3 (pre-callosal)
  - A4 (supracallosal)
  - A5 (post-callosal) segments

- The ACA supplies the orbital surface and the medial surface of the frontal lobe and the medial surface of the hemisphere above the corpus callosum back to the parieto-occipital sulcus

- The motor and sensory cortex to the lower limb are within the territory of supply of the ACA

- The MCA is divided into four segments,

  the M1 (sphenoidal)

  M2 (insular)

  M3 (opercular)

  M4 (cortical) segments

- MCA supplies most of the lateral aspect of the hemisphere except the superior frontal (supplied by the ACA) and the inferior temporal gyrus and the occipital cortex (supplied by PCA)

- PCA is divided into four segments,

  P1 (precommunicating)

  P2 (post-communicating)

  P3 (quadrigeminal)

  P4 (cortical)

- The PCA gives off three kinds of branches:

(i) central perforating branches to the diencephalon and midbrain

(ii) ventricular branches to the choroid plexus and walls of the lateral and third ventricles

(iii) cerebral branches to the cerebral cortex and splenium of the corpus callosum

- PCA supplies the inferior and infero lateral surface of the temporal lobe and the inferior and most of the lateral surface of the occipital lobe

- The contralateral visual field lies entirely within its territory

- Hypoplasia or absence of one or more of the communicating arteries can be particularly important at times when one of the major feeding arteries is temporarily occluded

- This is important for neurovascular procedures like carotid endarterectomy or when gaining proximal control of a ruptured intracranial aneurysm

- If both the AComA and PComA are hypoplastic, then the middle cerebral territory is supplied only by the ipsilateral internal carotid artery (the so-called isolated MCA)

- Cerebral vessels are different from their systemic vessels as they possess only a rudimentary tunica adventitia

- This is particularly relevant to subarachnoid haemorrhage, which causes vasospasm

- A second difference is that the tunica media of both large and small cerebral arteries has its muscle fibres orientated circumferentially

- This results in a point of potential weakness at the apex of vessel branches and may lead to aneurysm formation

- Approximately 85% of berry aneurysms develop in the anterior circulation

Venous supply:

- The general pattern for venous drainage of the hemi spheres is into the nearest venous sinus

- The superior sagittal sinus occupies the convex margin of the falx and is triangular in cross-section

- Because of its semi-rigid walls, the sinus is noncollapsable resulting in a high risk of air embolism during surgery if the sinus is opened with the head elevated

- Venous lakes are occasionally present within the diploic of the skull adjacent to the sinus, and can result in excessive bleeding or air embolus when a craniotomy flap is being turned

- The lateral margin of the superior sagittal sinus at the level of the internal occipital protuberance turns to one side, usually the right as the transverse sinus

- The straight sinus turns to form the opposite transverse sinus at this point

- The basal ganglia and adjacent structures drain via the internal cerebral veins, which lie in the roof of the third ventricle

- The internal cerebral and basal veins join to form **the great cerebral vein of Galen** beneath the splenium of the corpus callosum

- This short vein joins the inferior sagittal sinus (which runs in the free edge of the falx) to form the straight sinus

- The superior cerebral veins (usually 8–12 in number) lie beneath the arachnoid on the surface of the cerebral cortex and drain the superior and medial surface of the hemisphere into the superior sagittal sinus

- To do this, they must bridge the subdural space (hence the alternative name of ‘bridging veins’)

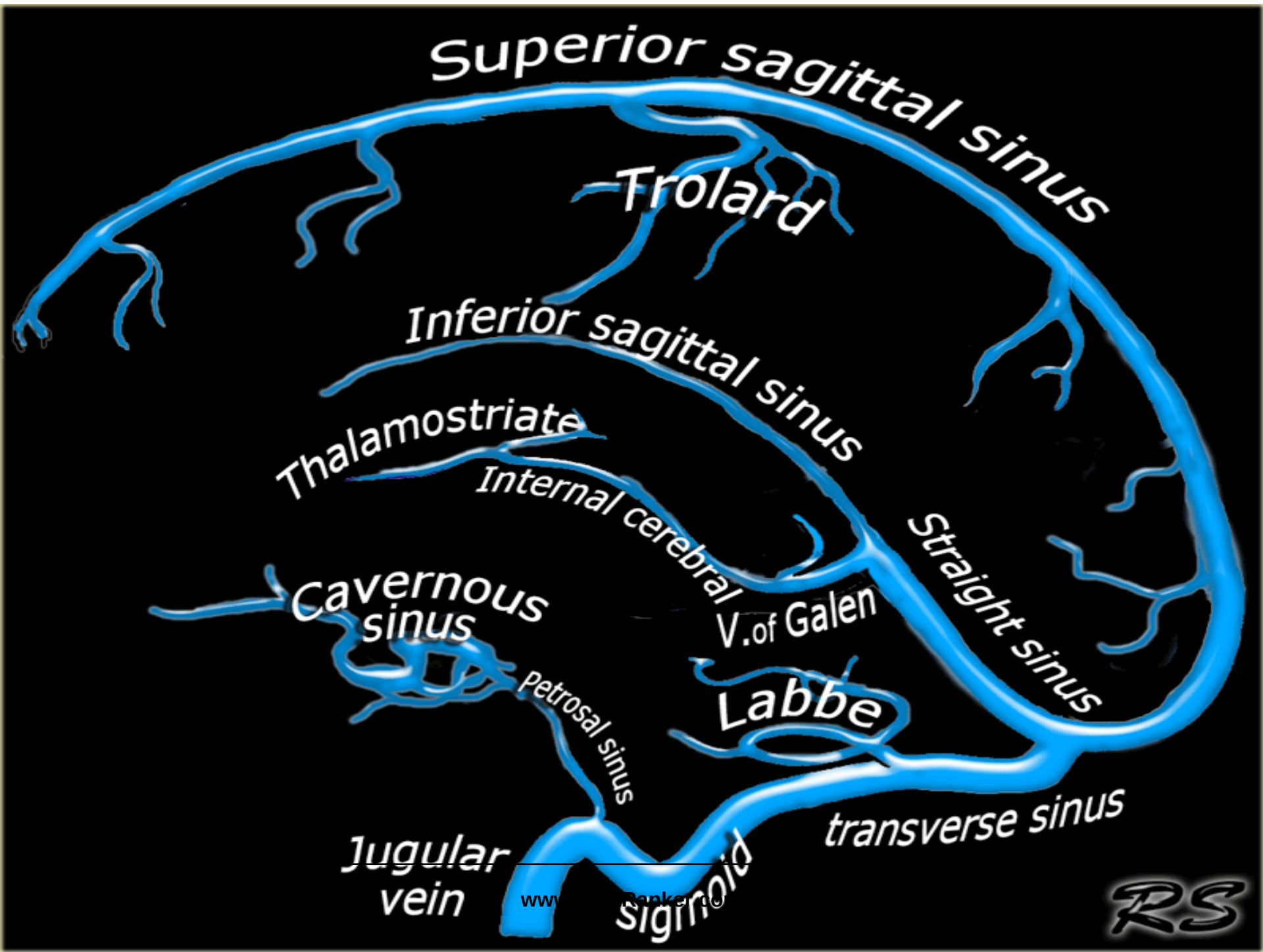
- If the hemisphere is atrophic and therefore relatively mobile within the cranium, these veins are likely to be torn by even minor head injury, giving rise to chronic subdural haematoma

- Although venous anastomoses exist on the lateral surface of the hemisphere, largely between the superior anastomotic vein (draining upwards in the central sulcus to the superior sagittal sinus – the vein of Trolard), the Sylvian vein (draining downwards in the Sylvian fissure to the sphenoparietal sinus) and the angular or inferior anastomotic vein (draining via the vein of Labbe into the transverse sinus), sudden occlusion of large veins or a patent venous sinus may result in brain swelling or even venous infarction

- As a general rule, the anterior one-third of the superior sagittal sinus may be ligated, but only one bridging vein should be divided distal to this if complications are to be avoided

- If the sinus has been occluded gradually, for example by a parasagittal meningioma, then there is time for venous collaterals to develop

- Venous-phase angiography is particularly useful in tumours adjacent to the major venous sinuses or to the vein of Galen to determine if the sinus is completely occluded and can be resected en bloc with the tumour or whether the sinus is patent and requires reconstruction



Structural Development of The Brain

- Embryonic vesicle: Forebrain (Prosencephalon)

a. Anterior portion (Telencephalon) produces Lateral Ventricles, cerebrum and basal ganglia.

b. Posterior portion (Diencephalon) produces Third Ventricle, Thalamus, Hypothalamus, post. Pituitary gland, and pineal gland

- Embryonic vesicle: Midbrain (Mesencephalon) produces cerebral aqueduct, and midbrain.

- Embryonic vesicle: Hindbrain (Rhombencephalon)

a. Anterior portion (Metencephalon): produces fourth ventricle, cerebellum, and pons

b. Posterior portion (Myelencephalon): produces fourth ventricle, and medulla oblongata

Spinal cord

- A long nerve cord that begins at the foramen magnum and ends at the first or second lumbar vertebra

- Divided into 31segments, each segment gives rise to a pair of spinal nerves (part of the PNS)

- In general, the location of the spinal nerve corresponds with the location of the effector organ

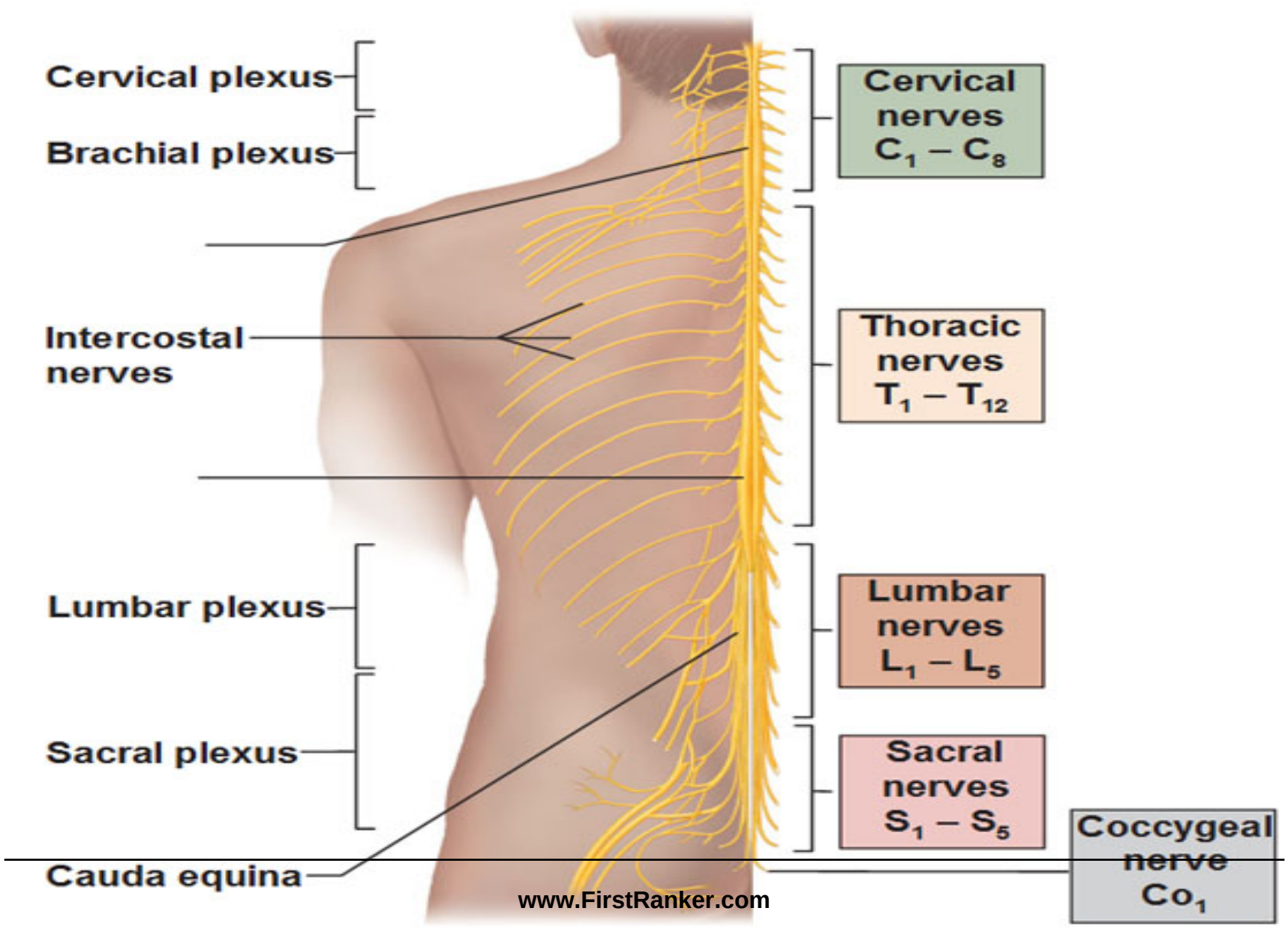
The concept of the ‘three-column’ spine, as proposed by Holdsworth in 1970

- Anterior column of the spine is formed by the anterior longitudinal ligament, the anterior annulus fibrosus and anterior part of the vertebral body

- Middle column is formed by the posterior longitudinal ligament, the posterior annulus fibrosus and the posterior wall of the vertebral body

- The posterior column is formed by the posterior arch and supraspinous and interspinous ligaments, as well as the ligamentum flavum

- Most spinal nerves form net -works called plexuses
- **C_1 to C_4** from cervical plexus which serves the head, face, and neck
- **C_5 to T_1** from brachial plexus which serves the shoulder, arm, and hands
- **T_2 to T_{11}** do not from any plexus
- **T_{12} to S_5** form lumbosacral plexus which serves the lower body and lower limbs
- **Coccygeal** nerves do not form any plexus



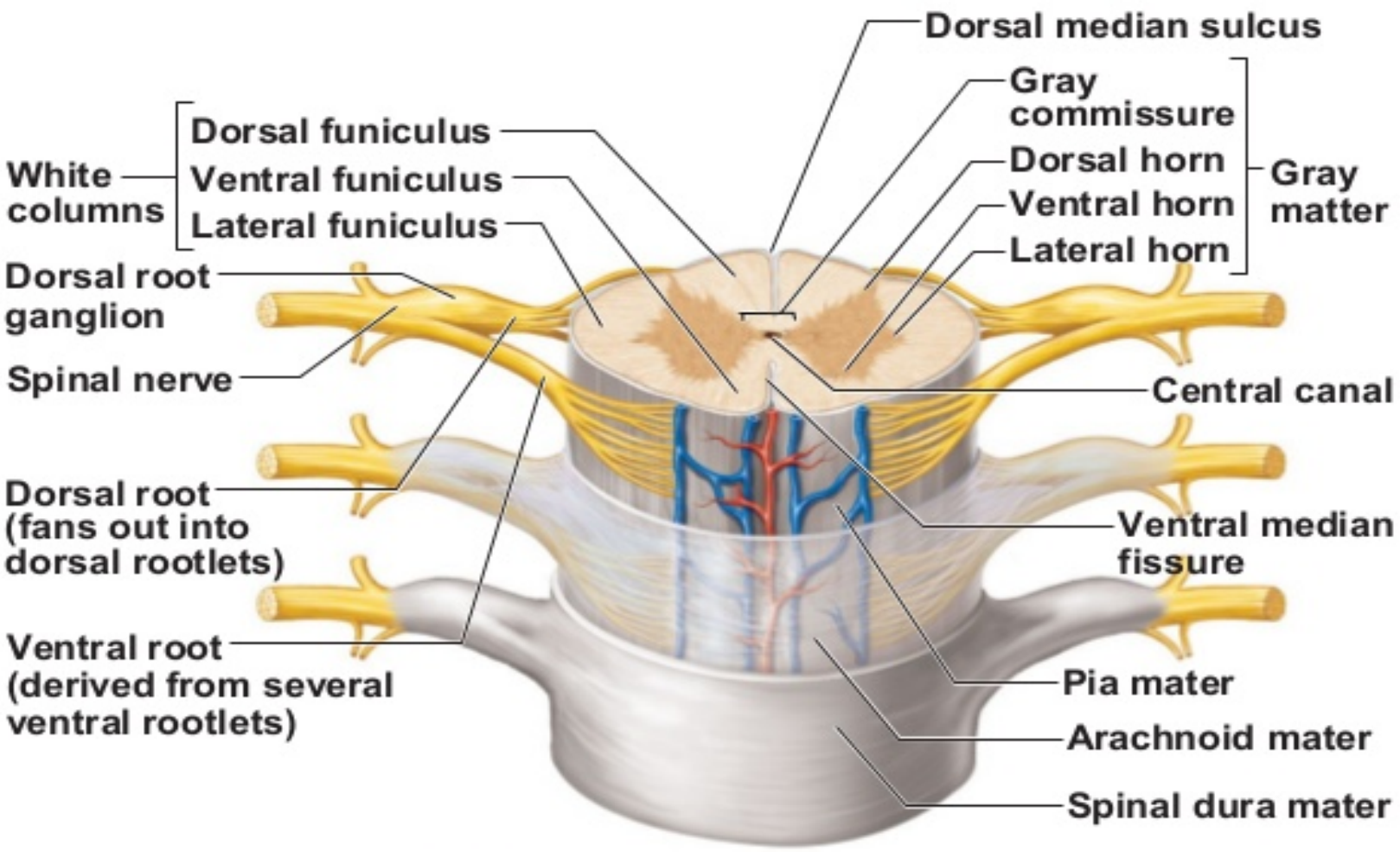
- **Cross sectional anatomy of the spinal cord:**

Two grooves divide spinal cord into right left halves

1. Ant. median fissure or groove (deep)
2. post median sulcus(shallow groove)

- The spinal cord consist of white matter surrounded by gray matter.

- Gray matter resembles a butterfly. The upper and lower wings of gray matter are called posterior horn and anterior horn respectively



(b) The spinal cord and its meningeal coverings

Figure 12.31b

- Lat. horn is located between post. and ant. horns on either side

- Central canal contains **CSF**

- The gray matter further divides the white matter into 3regains on each side.

a) The anterior column

b) The lateral column

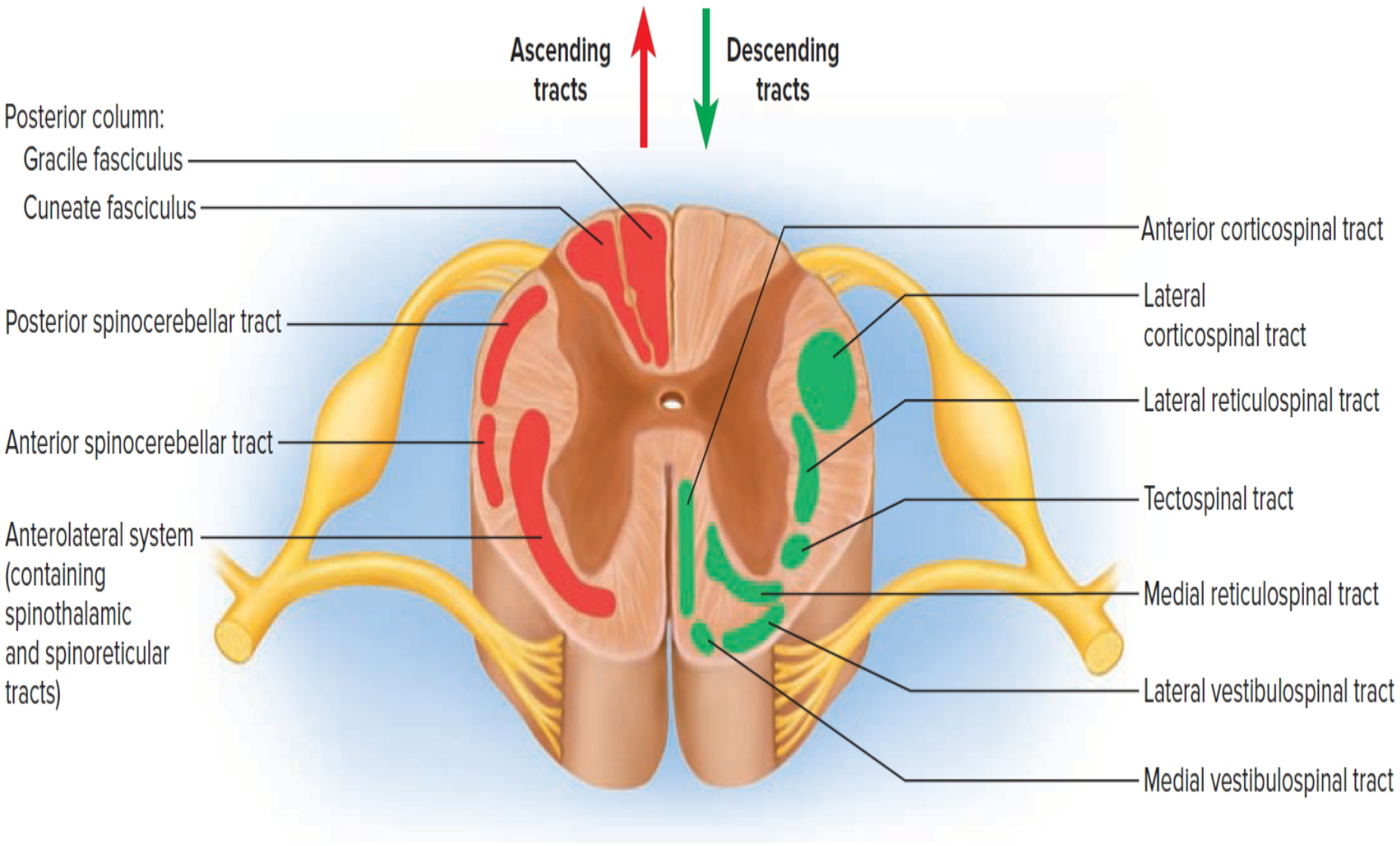
c) The posterior column

Tracts of The Spinal Cord

Tracts: The nerve tracts of the spinal cord provide a two-way communication system between the brain and the body

a) Ascending tract: conduct sensory impulses to the brain

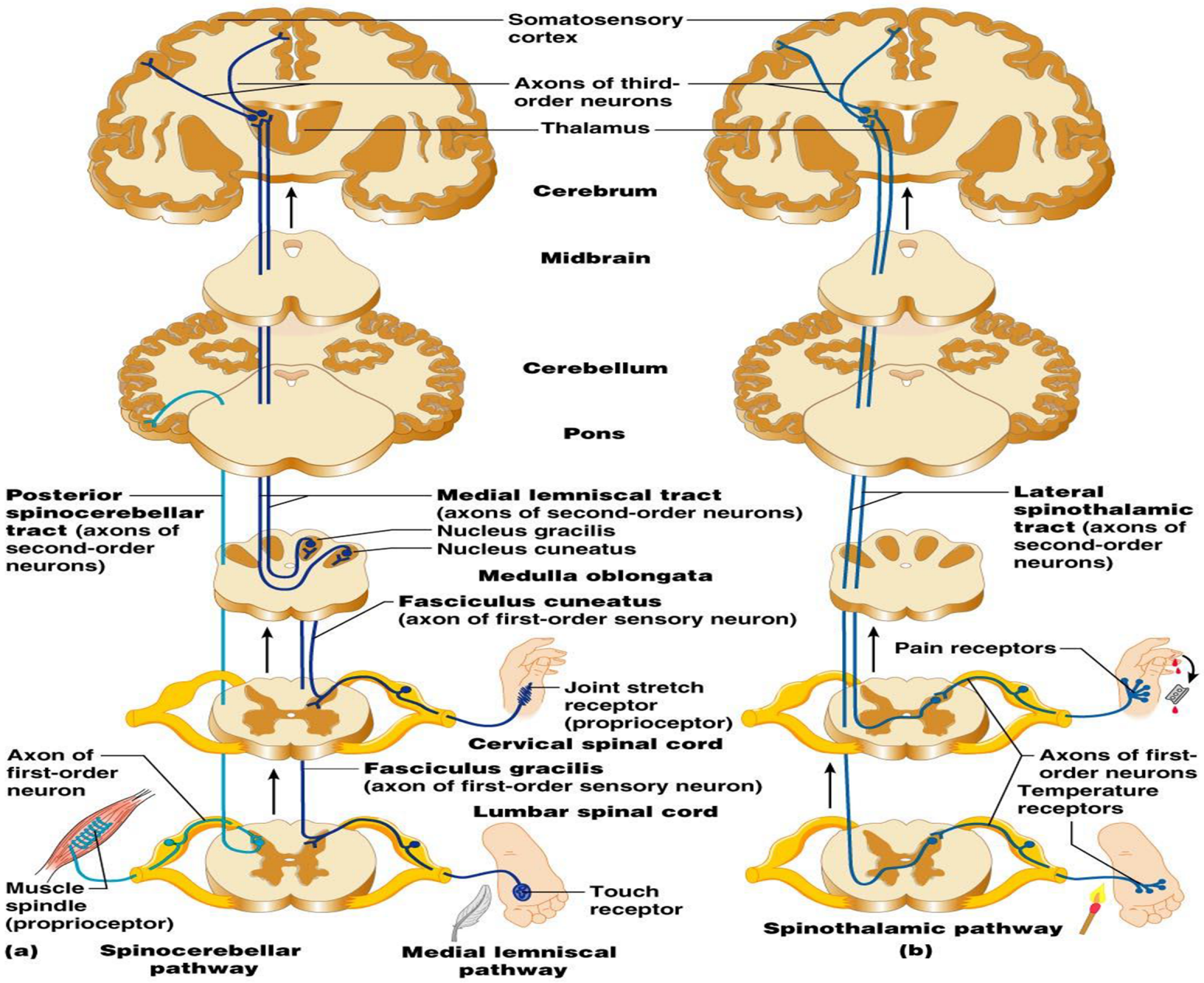
b) Descending tract: conduct motor impulses from the brain to motor neurons reaching muscles, glands, etc



Ascending Tracts

- **Fasciculus gracilis** (transmits sensory impulses from lower limbs) and **Fasciculus Cuneatus** (transmits sensory impulses from upper limbs)

- Located in posterior funiculi and conduct sensory impulses associated with senses of touch, pressure and body movement from skin, muscles, tendons, and joints to the brain.



- **Spinocerebellar tract:** conduct impulses (sensory) required for coordination of muscle movements from lower limb and trunk muscles to cerebellum

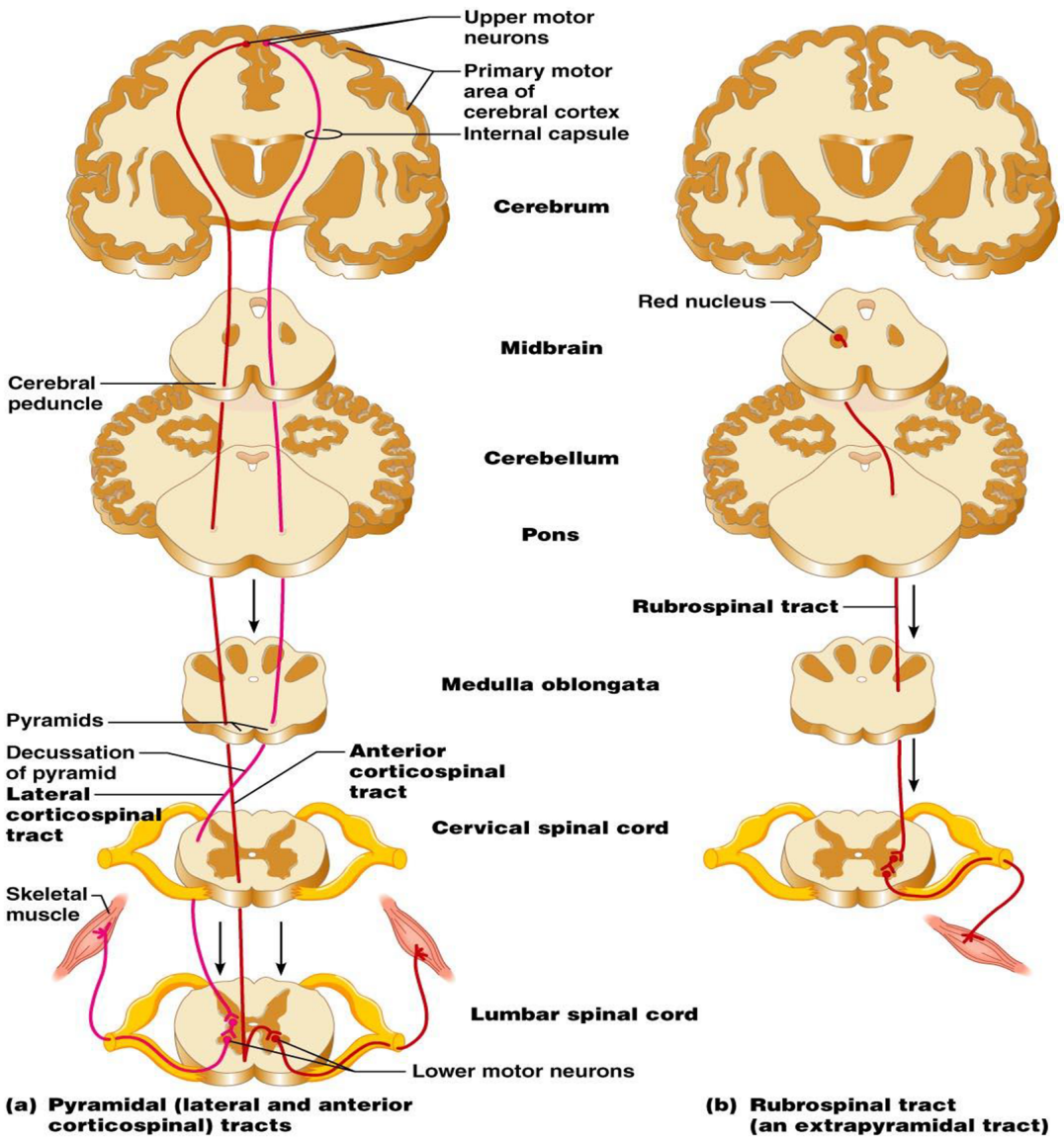
- **Spinothalamic tract:** conduct sensory impulses for pain and temperature to brain.

Descending Tracts

- **Corticospinal tract:** conducts motor impulses associated with voluntary movement from the brain to skeletal muscles

- **Reticulospinal tract:** conducts motor impulses associated with maintenance of muscle tone and the activity of sweat glands from the brain

- **Rubrospinal tract:** conducts motor impulses associated with muscular coordination and the maintenance of posture from the brain



- The adult spinal cord terminates at about the lower border of L1 as the conus medullaris

- Below this, the spinal canal contains peripheral nerves known as the caudaequina

- Lesions above this level produce upper motor neuron signs and those below it a lower motor neuron pattern

- Lesions of the conus itself may produce a mixed picture

Extrinsic spinal cord compression

- This produces symmetrical corticospinal ('pyramidal') involvement, with upper motor neuron weakness below the level of the compression (increased tone, clonus, little or no muscle wasting, no fasciculation, exaggerated tendon reflexes and extensor plantar responses), together with a sensory loss

- However if the mass is laterally placed, then the pattern may initially be of hemisection of the cord – the Brown–Sequard syndrome

- This produces ipsilateral pyramidal weakness, loss of fine touch and impaired proprioception but contralateral impairment of pain and temperature sensation

Central cord syndromes

- Syringomyelia or intramedullary tumours affecting the cervicothoracic region will first involve the pain and temperature fibre

- The result of central cord involvement is therefore a ‘suspended’ sensory loss, with a cape-type distribution of loss of sensitivity to pain in the upper limbs and trunk but with sparing of the lower limbs

Cauda equina compression

- This may result from a lumbar disc prolapse

- Usually accompanied by sciatica, which may be bilateral or unilateral and there may be weakness or sensory loss in a radicular distribution

- In addition, there is perineal sensory loss in a saddle distribution, painless retention of urine with dribbling overflow incontinence and loss of anal tone

Blood supply:

- The anterior and posterior spinal arteries form a longitudinal anastomotic channel that is fed by spinal branches of the vertebral, deep cervical, intercostals and lumbar arteries

- In the cervical region, it accompanies one of the nerve roots and is known as the artery of Adamkiewicz

- Its position is variable but is generally on the left side (two-thirds of cases) and arises between T10 and T12 in 75% of patients

- The artery of Adamkiewicz is vulnerable to damage during operations on the thoracic spine, particularly during excision of neurofibromas or meningiomas, or if an intercostal vessel is divided during excision of a thoracic disc

- Atherosclerotic disease of the radicular artery or prolonged hypotension may induce infarction of the anterior half of the cord up to mid-dorsal level, producing paraplegia, incontinence and spinothalamic sensory loss