

	External features		Internal features			
		Dorsal Surface	White matter			Grey matter:
1-MEDULLA OBLONGATA	<p>** Extends between spinal cord (below) & pons (above).</p> <p>** Shows 3 elevations on each side of anterior median fissure; from medial to lateral:</p> <ol style="list-style-type: none"> 1. Pyramid: made by the corticospinal tract which forms the motor decussation in the lower medulla. 2. Olive: made by the inferior olivary nucleus. 3. Inferior cerebellar peduncle (ICP): made by fibers connecting the medulla & cerebellum. <p>** Shows attachment of last 4 cranial nerves:</p> <ol style="list-style-type: none"> a. Hypoglossal N. (XII) → its rootlets are attached to the anterolateral sulcus (bet. pyramid & olive). b. Glossopharyngeal N. (IX), Vagus N. (X) & Accessory N. (XI) → its rootlets are attached (from above downwards) to posterolateral sulcus (bet. olive & ICP). 	<p>** Its lower part or closed medulla: shows 3 elevations on each side of posterior median sulcus:</p> <ol style="list-style-type: none"> 1. Gracile fasciculus (tract) ending in gracile tubercle (nucleus). 2. Cuneate fasciculus ending in cuneate tubercle. 3. ICP. <p>** Its upper part or open Medulla: forms the lower part of the floor of 4th ventricle.</p> <p>** It is triangular in shape; having:</p> <ol style="list-style-type: none"> 1. Base (above) separated from pons by medullary stria. 2. Apex (below) continuous with central canal. 3. Floor: On each side of the median sulcus lies an inverted V-shaped depression, the inferior fovea, separating three elevated triangles (trigones): <ol style="list-style-type: none"> 1. Hypoglossal Trigone: overlies hypoglossal nucleus. It lies medial to the fovea. 2. Vagal Trigone: overlies dorsal vagal nucleus and lies between the two limbs of the inferior fovea. 3. Vestibular Trigone: overlies vestibular nuclei and lies lateral to the fovea. <p>** The lower part of inferior fovea presents the area postrema (chemoreceptor trigger zone) which contains vomiting center.</p>	** Longitudinal fibers:		** Horizontal fibers:	<p>** Cranial nerve nuclei:</p> <ul style="list-style-type: none"> * Nuclei of the lower 4 cranial nerves (IX, X, XI & XII). * Descending nuclei from pons → spinal nucleus of trigeminal & some vestibular nuclei. ** Other nuclei: olivary nuclei, gracile & cuneate nuclei. 3. Reticular formation. <p>***The inferior olive:</p> <ul style="list-style-type: none"> * Is the largest. * It lies in the open medulla, lateral to the pyramid & appears corrugated with its hilus (where the fibers enter & leave) facing dorso-medially. <p>** Function:</p> <ol style="list-style-type: none"> 1. Relays proprioception to cerebellum: receives proprioception via the spino-olivary tract & sends olivo-cerebellar fibers that cross & pass via the ICP. 2. Relays newly performed motor information to the cerebellum (involved in motor learning): receives cortico-olivary, rubro-olivary & spino-olivary inputs & sends olivo-cerebellar output to the cerebellum. 2 & 3. The dorsal & medial accessory olives: Lie posterior & medial to the inferior olive, close to its hilus. Both send proprioceptive fibers to the cerebellum (called parolivo-cerebellar fibers) via the ICP.
			<p>* Descending tracts:</p> <p>The pyramidal tract fibers collect into the pyramid in the open medulla then 80% of fibers cross in the motor decussation in the lower level of the closed medulla to form the lateral cortico-spinal tract.</p>	<p>Ascending tracts:</p> <p>* The lateral spinothalamic tract & the ventral spinothalamic tract join to form the spinal lemniscus.</p>	<p>* Association tract:</p> <p>MLB</p>	

	External Features		Internal features	
	Ventral Surface	BACK OF PONS:	anterior part (basis pontis)	posterior part (tegmentum).
2-PONS	<p>** A bridge, one inch long, connecting the right & left cerebellar hemispheres by a middle cerebellar peduncle (MCP) on each side.</p> <p>** It extends between the medulla oblongata (below) & midbrain (above).</p> <p>** In the middle, the basis pontis projects anteriorly & shows:</p> <p>a. Sulcus (groove) for the basilar artery: in the midline.</p> <p>b. Transverse grooves: between bundles of transverse pontine fibers.</p> <p>** Gives attachment to middle 4 cranial nerves:</p> <p>* V. (trigeminal): to the junction of MCP & basis pontis, closer to upper border by 2 roots (sensory: large & lat. + motor: small & med.).</p> <p>* VI. (abducent): to lower border of pons just above pyramid.</p> <p>* VII (facial): to cerebello-pontine angle (bet. MCP & ICP) by 2 roots (motor: large & med. + sensory: nervus intermedius: small & lat.).</p> <p>* VIII (vestibulo-cochlear): to cerebello-pontine angle, lateral to VII, by 2 roots (vestibular medially & cochlear laterally).</p> <p>** Clinically: cerebellopontine angle tumor causes lesion of VII →facial paralysis + lesion of VIII →deafness & vertigo.</p>	<p>** Forms the upper part of floor of 4th ventricle.</p> <p>** It is triangular, having:</p> <p>1. Base (below):made by medullary stria.</p> <p>2. Apex (above): continuous with cerebral aqueduct of Sylvius.</p> <p>3. Floor: Shows a medial eminence (M) on each side of the median sulcus; the medial eminence overlies the abducent nucleus.</p> <p>** The lower part of median eminence is expanded to form the facial colliculus (F). The latter is produced by the motor fibers of the facial nerve looping over the abducent nucleus.</p> <p>** Lateral to the medial eminence is the sulcus limitans whose upper part shows a bluish area called locus ceruleus which is rich in norepinephrine while its lower part forms the superior fovea.</p> <p>** The vestibular area lies lateral to the superior fovea & overlies some vestibular nuclei.</p>	<p>is similar in all levels & contains:</p> <p>1. Descending pyramidal fibers: collect into separate bundles that include:</p> <p>a-Cortico-spinal fibers to the AHCs.</p> <p>b-Cortico-nuclear (bulbar) fibers to the cranial nerve nuclei.</p> <p>c-Cortico-pontine fibers to the pontine nuclei. *</p> <p>2. Pontine nuclei.</p> <p>3. Transverse pontine fibers: are the axons of the pontine nuclei. They pass to the MCP of the opposite side & to a little extent of the same side.</p>	<p>contains:</p> <p>1. White matter: including:</p> <p>* Vertical fibers (MLB & ascending lemnisci: in addition to the spinal & medial lemnisci, 2 more lemnisci are added; lateral & trigeminal).</p> <p>* Horizontal fibers (trapezoid body which is a part of the auditory pathway).</p> <p>2. Grey matter: nuclei of the middle 4 cranial nerves + superior olive.</p> <p>4. The superior olive: lies in the pons & forms part of the auditory pathway.</p> <p>3. Reticular formation.</p>

*CORTICO-PONTO-CEREBELLAR PATHWAY

**** The neocerebellum [responsible for coordination of voluntary movements] is connected to the contralateral cerebral cortex by a feedback circuit formed of 2 parts:**

A. Afferent Part [cortico-ponto-cerebellar pathway]: includes:

1. Cortico-pontine fibers: arise from the 4 lobes of cerebral cortex & thus include fronto, parieto, temporo & occipito-pontine fibers. All descend in internal capsule, then the crus cerebri(ventral part of midbrain) to end on the pontine nuclei.
2. Ponto-cerebellar fibers: the axons of the pontine nuclei form the transverse pontine fibers which pass via the MCP to the contralateral cerebellum & to a little extent the ipsilateral.

B. Efferent Part [dentato-rubro-thalamo-cortical pathway]: includes:

1. Dentato-thalamic fibers: Arise from the dentate nucleus of cerebellum & pass via the SCP, decussate & end on the lateral anterior nucleus of thalamus either directly or after relaying on the red nucleus.
2. Thalamo-cortical fibers: projects to the cerebral cortex

FOURTH VENTRICLE

**** It is the cavity of the Rhombencephalon (Hind brain).**

**** It lies between cerebellum (posteriorly) and brain stem (anteriorly).**

**** It communicates with:**

- 1.Third ventricle via cerebral aqueduct of Sylvius.
- 2.Central canal of medulla oblongata inferiorly.
- 3.Subarachnoid space via 3 foramina: one median & two lateral.

**** In sagittal section, it appears triangular in shape.**

**** Roof:**

1. Superiorly: Superior Cerebellar Peduncles (SCPs) and Superior Medullary Velum (layer of ependyma).
2. Inferiorly: Inferior Medullary Velum (layer of ependyma) covered by pia mater forming choroid plexus of fourth ventricle.

**** This part of roof has a large median foramen "Foramen of Magendie" which connects the interior of the ventricle with the subarachnoid space.**

**** Floor: (Rhomboid fossa):**

* It is formed by the dorsal surface of pons & upper part of medulla.

* It is divided by the medullary stria into a superior pontine part and an inferior medullary part

**** Lateral Boundaries:**

1. Superiorly: Superior Cerebellar Peduncles
2. Inferiorly: Inferior Cerebellar Peduncles + Gracile & Cuneate Tubercles

**** Lateral Recess: A recess from the cavity of fourth ventricle extends laterally over the surface of ICP. The lateral recess opens on each side into the subarachnoid space by a lateral aperture (Foramen of Luschka). ** The choroid plexus of the fourth ventricle lies at lower part of roof of fourth ventricle.**

	External features		Internal features			
	Ventral surface	BACK OF MIDBRAIN:	** It is traversed by the cerebral aqueduct of Sylvius which divides it into:			
3- MIDBRAIN:	<p>** Appears as 2 diverging cerebral peduncles enclosing the interpeduncular fossa. *</p> <p>** The oculomotor nerve emerges from the medial side of the cerebral peduncle.</p> <p>** 4 structures are seen to wind around cerebral peduncle:</p> <ol style="list-style-type: none"> 1. Optic tract. 2. Trochlear nerve. 3. Posterior cerebral artery. 4. Basal vein. 	<p>** Shows 4 colliculi (corpora quadrigemina): 2 sup. & 2 inf.</p> <p>** Each colliculus has a brachium:</p> <ol style="list-style-type: none"> 1. The brachium of sup. colliculus passes to lat. geniculate body (LGB). 2. The brachium of inf. colliculus passes to med. geniculate body (MGB). 	1. Tectum (dorsally).	2. 2 cerebral peduncles (ventrally).		
			<p>A. Inferior colliculus:</p> <p>** Structure: a central nucleus surrounded by fibers of lateral lemniscus.</p> <p>** Function: relays auditory pathway & auditory reflexes</p> <p>** Afferents: lateral lemniscus</p> <p>** Efferents:</p> <ol style="list-style-type: none"> 1. Medial geniculate body (MGB): which projects to auditory cortex. 2. Superior colliculus: for reflex turning of neck & eyes via the tectospinal & tectonuclear tracts <p>B. Superior colliculus:</p> <p>** Structure: alternating laminae of grey & white matters.</p> <p>** Function: reflex turning of eyes & neck in response to visual, auditory & cutaneous stimuli.</p> <p>** Afferents: LGB (vision), inferior colliculus (auditory) & spinotectal tract (cutaneous).</p> <p>** Efferents: tectospinal & tectonuclear (to III, IV, VI) both cross in the dorsal tegmental decussation.</p>	1. Tegmentum (dorsally).	2. Substantia nigra:	2. Crus cerebri or basis pedunculi (ventrally).

THE INTERPEDUNCULAR FOSSA

** Is a trapezoid depression between the 2 cerebral peduncles.

** It does not belong to the midbrain but to the hypothalamus.

** **Boundaries:**

1. Anteriorly: optic chiasma.
2. Anterolaterally: optic tract.
3. Posterolaterally: cerebral peduncle.
4. Posteriorly: upper border of pons.

** **Contents:**

1. Tuber cinereum: convex mass of grey matter (= the median eminence of hypothalamus). The infundibulum (or pituitary stalk) connects it with the posterior lobe of pituitary gland.
2. Mammillary bodies: two rounded nuclei of hypothalamus.
3. Posterior perforated substance: an area of grey matter showing small holes pierced by the central branches of posterior cerebral artery.
4. Oculomotor nerve: emerges from the medial surface of the cerebral peduncle.

** N.B: an anterior perforated substance is situated lateral to the optic chiasma & is pierced by the central branches of anterior & middle cerebral arteries.

****Red Nucleus**

**** A large nucleus in the midbrain tegmentum at the level of superior colliculus.**

**** Appears red in fresh histological sections due to rich iron content.**

**** Has 2 parts:**

1. Caudal magnocellular part:

**** Receives cerebro-rubral & cerebello-rubral fibers.**

**** Sends rubro-spinal tract, crossing in the ventral tegmental decussation, to the lateral group of cervical AHCs supplying the upper limb.**

**** Its function is facilitation of flexor tone (similar to the lateral corticospinal tract). May account for recovery of movement after lesion of the latter tract especially in monkeys.**

2. Cranial parvocellular part:

**** connects the motor cortex with the cerebellum via the inferior olive.**

**** Function: motor learning**

LEMNISCI

**** They are collections of ascending fibers in the brain stem.**

**** Each starts below at a decussation and ends above in the thalamus.**

	Start	End	Function
1. Medial lemniscus	** It starts by axons of gracile and cuneate nuclei of medulla oblongata which cross after forming the internal arcuate fibers then ascend in medulla oblongata, pons & midbrain close to the median plane	. It ends by relaying in VPLN of thalamus.	** It carries: i. proprioception (senses of position, movement & vibration). ii. fine touch (tactile discrimination, tactile localization & stereognosis).
2. Spinal lemniscus:	** Axons of laminae I, II, & IV-VIII of grey matter of spinal cord cross the midline and ascend as the lateral & ventral spinothalamic tracts. ** They get close to other ascending tracts as they ascend in medulla oblongata to form the spinal lemniscus.	** Its fibers ascend in the pons, midbrain and end by relaying in VPLN of thalamus	** It carries: i. pain and temperature sensations from opposite side of the body. ii. crude touch from opposite side of the body.
3. Trigeminal lemniscus:	** Axons of the neurons of spinal and main sensory nuclei of trigeminal nerve cross the midline and ascend in the brain stem as trigeminal lemniscus.	It ends by relaying in VPMN of thalamus.	** It carries pain, temperature & touch from opposite side of the face.
4. Lateral lemniscus:	** It starts in the pons by the axons of cochlear nuclei which cross the median plane as the trapezoid body. ** As they ascend they are joined by axons of dorsal nucleus of trapezoid body & superior olive of both sides.	** It ends in the inferior colliculus or the medial geniculate body of thalamus. ** It lies most laterally.	** It carries auditory impulses.