Glucose fuels metabolic activity in brain.

Somatic cells: Any cell of a living organism other than the reproductive cells.

Medical Neuroscience
- Leonard E. White (Coursera).

Unit 1 - Neuroanatomy
Unit 2 - Neural Signalling
Unit 3 - Sensory Systems
Unit 4 - Movement and motor control
Unit 5 - The Changing Brain
Unit 6 - Complex Brain functions

→ Mitochondria: Organelle within eukaryotic cell is responsible for producing that store chemical energy (concentrated at presynaptic terminals).

→ Deoxyribonucleic acid (DNA), ribonucleic acid (RNA) play a role in encoding the information that is needed for building proteins.

* Different views of the brain:
→ Lateral - side ways (first left then right).
→ Above - Dorsal
→ Upside down - Ventral
→ Sliced - Mid sagital.

→ Omega shape in central sulcus - sensorimotor hand region

→ Temporal processing stream - visual recognition

→ Area MT - middle temporal visual area

→ Broca's area: Speech production
→ Lateral superior temporal lobe - understanding

Cell body = soma.

(comprehension)
understanding / ___ / ___
speech

language development

language spoken or written - ['Wernicke's Area]

Parietal lobe (superior aspect of the hemisphere)

Occipital lobe (posterior side)

→ Frontal lobe (Anterior side)

→ Temporal lobe (Inferior aspect of the hemisphere)

Right hemisphere

→ Dividing line b/n frontal and parietal lobe is central sulcus

→ (a) Occipital lobe and parietal lobe division - (midsagital plane) Parieto - occipital Sulcus.

(b) Inferior aspect of hemisphere - Pre-occipital Notch

11/10/2020

→ Motor cortex of human brain stained with tissue Thionine to reveal the presence of Nissl substance which is rough endoplasmic reticulum (which is the machinery making protein within the cell).

Cell comp. * Cells present in this tissue (motor cortex).

① Neurons: Primary processors of neural signal

② Neuroglia: Support electrical and chemical functions of neurons

③ Vascular endothelium: Provides supply of blood to brain tissue.

Dendrite

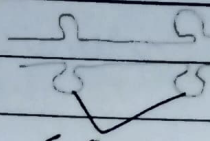
Axon

Synapses
Axon terminals

Cell body

I/p zone | conducting zone | o/p zone.

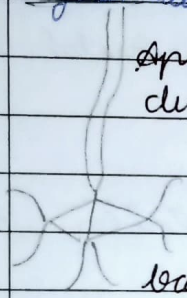
The autonomic nervous system is a control system that acts largely unconsciously and regulates bodily functions.



→ dendrite
→ provides place for synapse
→ Excitatory

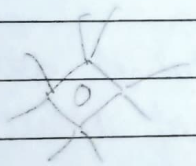
→ Not all dendrite grow spine. (smooth)
Inhibitory property.

→ Pyramidal neurons in the cerebral cortex.
↳ excitatory as it is projection neuron.



• Single long apical dendrite

→ Multipolar neuron (dendrite emanate in regular arrays)



• Many dendrite

* Axons can be very long (about 0.5 m).
↳ transmitting signal from cell body to other neurons

* Synapses: contact among neurons, between neurons and effector cells.
Note: Axon may contact other cell bodies or other axons.

* Neural Tissue

① Gray matter: (O/P and I/P zone)
→ Grey / brown in color

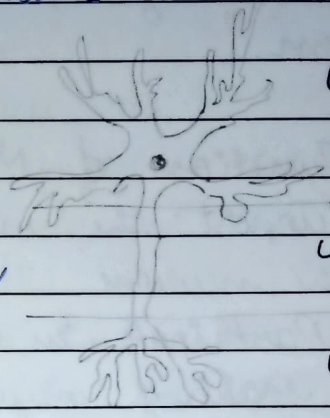
Nervous system into 2 broad categories.

① Neurons ② Neuroglia.

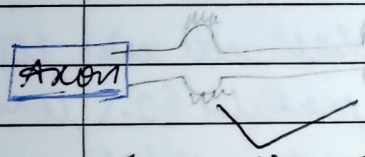
Vascular endothelium: Interface b/w blood stream and vessel wall

contains - cell body, dendrites, axon terminal, glia cells, vascular endothelium → blood supply

② White matter:
(light tan or white colour)
→ Axons are found here
→ Glia cells (those making myelin sheath).
→ Vascular endothelium
↓
(nutrients supply).



→ Button synaptic connection (en passant)
↓
in passage contact.



→ different type of synaptic connection.

* Class of neurons:

→ Afferent: Receive information (SERA)
→ Efferent: Send information

① Projection neurons: Ex: Cortical pyramidal cell
↳ projections are away from cell body (far)
→ Are excitatory.
→ They do make shorter connections to nearby neurons via axon collaterals.
∴ Dual functions.

② Interneurons: short axons project only short distance (100 µm) in CNS.
→ most are inhibitory (+ excitatory)

• DNA molecules contains genes.
• 'Pituitary gland' is located just below / inferior to the brain, in the floor of the skull' __/__/__

* Metabolism: " All chemical reactions involved in maintaining the living state of cell and the organism."

* Functions of Neuroglia (supporting cells of neurons) in CNS:
1. Support the metabolic and signalling functions of the neurons
2. Participate in neuron circuit formation and plasticity.
3. Making myelin
4. Contribution to formation of blood brain barrier
5. Participate in the inflammatory response injured neural tissue including phagocytosis of cellular debris.

Phagocytosis: " Is a process in which cell uses its plasma to swell over large particles (0.5 μm) giving rise internal compartment called phagosome" one type of endocytosis.

6. Contributes to formation of scar tissues in damaged cell of brain and spinal cord.

* Type of Neuroglia:

1. Astrocytes: → Found in grey matter
→ maintain (help) ionic balance in extracellular fluid.
→ Remove and process neurotransmitter in synaptic cleft.
→ Assisting in formation of new synapses
→ Contributes to formation of blood brain barrier and brain-ependymal (ventricular) barrier.
→ Contributes in formation of scars that fill in small spaces cleared necrotic neural tissue following injury
→ Restricted to CNS

Active research

PNS - Schwann cell } myelin

__/__/__

2. Oligodendrocytes: (white matter) → Forming myelin in CNS

Note: Myelin in PNS is formed by "Schwann cell".

→ Myelin decreases leakiness.

→ Oligodendrocytes present in antigens that influence the natural development outgrowth of axons in developing and recovering brain.

→ It is also subject to immune attack in certain diseases of the CNS Ex: multiple sclerosis.

3. Microglia: Special type of mononuclear phagocyte that reside in the CNS.

→ Derived from hematopoietic precursor cells that migrate into brain during development.

↳ forms Ramified → dormant state

Amoeboid → activated state when microglia cells are engaged in phagocytic activity.

Activated microglia secrete signalling molecules (cytokine) that modulate local inflamatory response in injured tissue.

4 Glia stem cells: (Subset of astrocytes) found in ventricles and adjacent to blood vessels

↳ hollow space where CSF flows

ventricles: 2 lower chambers of heart, which receive blood from atria and pump it into the arteries.

"Heart has its own nervous system" ✗ ?

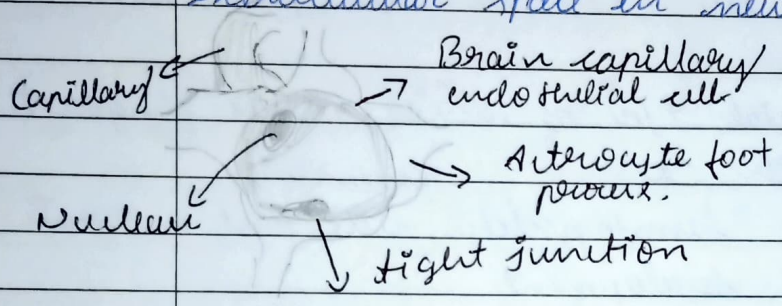
→ Can give rise to more stem cells, mature astrocytes, oligodendrocytes or even neurons

Glia stem cells → Subset of astrocyte: In subventricular zone
→ Oligodendrocyte precursor: scattered throughout white matter - polydendrocytes.

→ It exhibits key properties of somatic stem cells,
a. Proliferation - Increase number of cells
b. Self renewal
c. Potency to make all the cells of a given tissue
→ Scattered in white matter.

Include (5) Ependymal cell

(?) * Blood brain barrier: "Specialized permeability barrier between the capillary endothelium and the extracellular space in neural tissue."



→ Prevents toxins.
→ This exclude large water soluble molecules from freely diffusing into CNS, as well as pathogenic microbes and certain toxins
→ Some needed molecules like glucose, amino acids are send through capillary endothelium.
→ This also prevents the administration of many potentially useful pharmaceutical agents.
→ Throughout life blood brain barrier are pores in certain region of CNS that are involved in hormone secretion Ex: Median eminence of the hypothalamus; pineal gland.

→ First step after brain damage: Microglia are stimulated to convert from ramified to amoeboid states.
• The brain cells are protected from toxins circulating in ~~bloodstream~~ bloodstream by blood brain barrier.

pre (anatomically) : structure that is in front or anterior to another.

__/__/____

* Basic orientation in the Human brain:

23-10-2020 (Neuroscience text book)

⇒ Cell was recognised as the fundamental unit of all living organisms in early nineteenth century.

* Nervous system is divided into 2 broad categories,
① Nerve cells / Neurons
② Supportive Glia cells / Neuroglia / Glia.

⇒ Action potential = spikes = units

⇒ Presynaptic terminals = synaptic endings = axon terminals = axon boutons.

⇒ 'Bouton' - An enlarged part of a nerve fibre or cell, especially an axon, where it forms a synapse with another nerve.

* 2 categories of glia stem cells in mature brain:
① A subset of astrocytes primarily found near ventricles region called the subventricular zone (SVZ) or adjacent to ventricular zone blood vessels.

② Oligodendrocyte precursors scattered throughout the white matter and sometimes referred to as polydendrocytes

__/__/____

* Macrophages: A large white blood cells, occurring principally in connective tissue and in the bloodstream that ingests foreign particles and infectious microorganisms by phagocytosis

* Microglial cells:
→ Scavenger cells that remove cellular debris from sites of injury or normal cell turnover
→ Secrete signalling molecules - particularly wide range cytokines (produced by cells of immune system) which modulate inflammation and influence whether other cell live or die.

* Neuroanatomical terminology:
→ Anterior - front
→ Posterior - behind
→ Rostral - nose
→ Caudal - tail - lower spinal cord region
→ Dorsal - top (back and belly)
→ Ventral - bottom
→ Medial - midline
→ Lateral - side by side

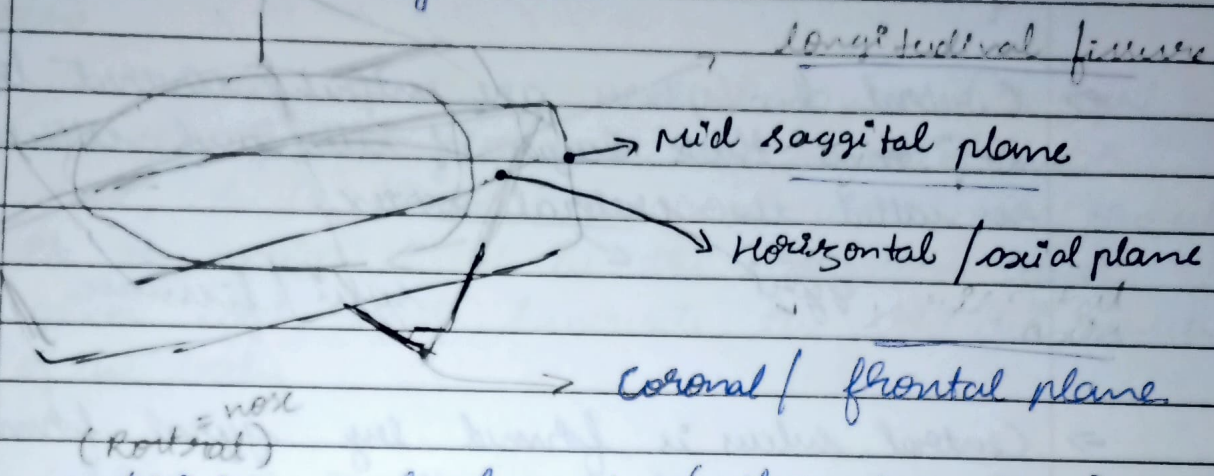
→ Anterior, posterior, superior and inferior refer to the long axis of the body - (parallel to ground)

→ Rostral, Caudal, dorsal, ventral refer to long axis of CNS.

→ Blood brain barrier is formed by endothelial cells of the capillary wall, astrocyte end-feet encircling the capillary, and pericytes embedded

in the capillary basement membrane.

-> Endothelial cell: A single layer that lines all blood vessels and regulates exchanges b/w the bloodstream and surrounding tissue



-> anterior = head side (where eyes, face)
-> posterior = behind (spinal cord).

* (w.r.t Brain stem)

↑ superior (pons is superior to medulla)

ventral ⟷ dorsal (toward back) = posterior (only w.r.t brainstem)

(towards ventral) = anterior (only w.r.t brain)

- caudal - (cauda Equina) - Inferior direction

↓ Inferior (pons is inferior to midbrain)

pre = front / anterior

25/10/2022

Week - 2

* Lateral Surface of the Brain:

(a bumpy structure)

→ Gyrus = A ridge on the surface of the brain

→ Sulcus = A depression or groove in the surface of human brain

→ Cerebral hemispheres are entirely covered by a 2-3 mm thick layer of cells and cellular process - is called the cerebral cortex.

gyri ↙ ↘ sulci / fissures.

→ Central sulcus is formed by gyral formations that harbor the somatic sensory and motor divisions of the cerebral cortex in the human brain.

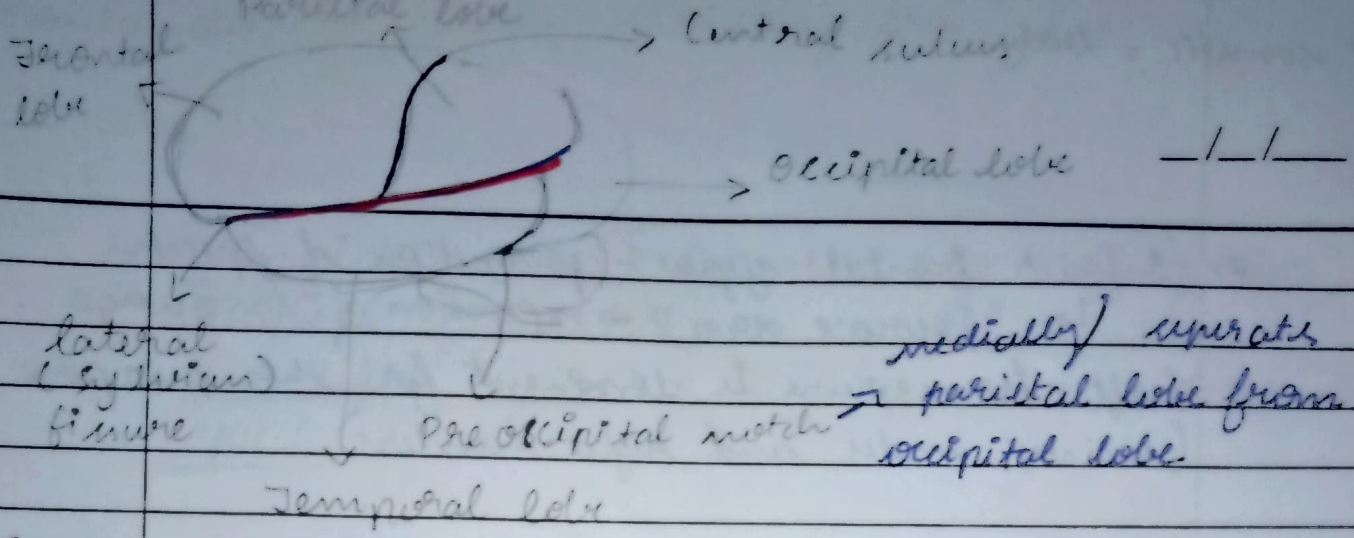
→ Frontal and temporal lobes of the cerebral hemis-phere feature 3 parallel, longitudinal gyri on their lateral aspect.

→ Lateral fissure in the left hemisphere is longer and straighter than one in the right hemisphere.

→ Calcrine sulcus and central sulcus are roughly perpendicular in the human brain.

→ The cortex of precentral gyrus is referred to as the motor cortex

→ (Postcentral gyrus is towards spinal cord; Precentral gyrus is towards face.)



medially separates parietal lobe from occipital lobe.

26-10-2020

→ The cortex of the precentral gyrus (a gyri in the frontal lobe) is the somatic 'motor cortex', which contains neurons whose axons project to the motor nuclei in the brainstem and spinal cord that innervate the striated muscles of the body.

→ Cortico spinal tract: The axons that arise from neurons in motor cortex and extent to spinal cord.

→ Cortico bulbar tract: The axon that extend from motor cortex to nuclei in brainstem.

→ Brainstem = bulbar = bulb shape

→ Lateral fissure / Sylvian fissure: Fairly straight fissure that separates frontal and parietal lobes from temporal lobe (inferior lateral)

* Gyri in frontal lobe	Sulcus in frontal lobe
(a) Superior frontal gyri	(a) Superior frontal sulcus
(b) Middle frontal gyri	(b) Precentral sulcus
(c) Inferior frontal gyri	(c) Inferior frontal sulcus

somatic = body.

__/__/__

→ Inferior frontal gyrus - production of speech.
↳ "Broca's area" → expression of language
→ Left hemisphere is dominant for this purpose (mainly males and right handers)

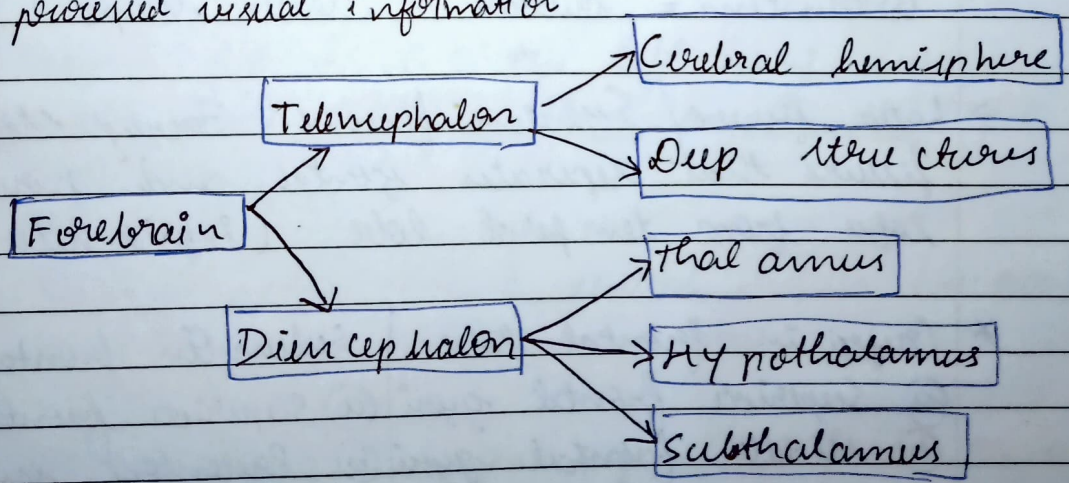
→ ∴ Damage to left hemisphere produce impairment of language expression - "Broca's aphasia"

→ In non-human primates - Posterior part of inferior frontal gyrus = mirror properties = imitation learning.

→ Superior, middle and inferior temporal gyri are parallel to the lateral fissure.
cortex with audition and language perception

→ • Superior temporal gyri
Superior temporal sulcus
• middle temporal gyri.
Inferior temporal sulcus
• Inferior temporal gyri.
highly processed visual information

Parallel gyri and sulci
same parallel gyri and sulci are found in frontal lobe



→ Insular cortex / insula is hidden beneath the frontal and temporal lobes.
(visible)
Involve autonomic functions, taste, implicit feeling, social cognition

Parietal - occipital sulcus - Anterior end

* Wernicke's Area: Posterior aspect of superior temporal gyrus.
Wernicke's aphasia - Disturbance of understanding speech

→ There is difference in structure of superior temporal gyrus in 2 hemispheres, it can be seen in pattern and length of the lateral fissure

- This can be related to language dominance of the left hemisphere
- This hemispheric difference relates to musical abilities

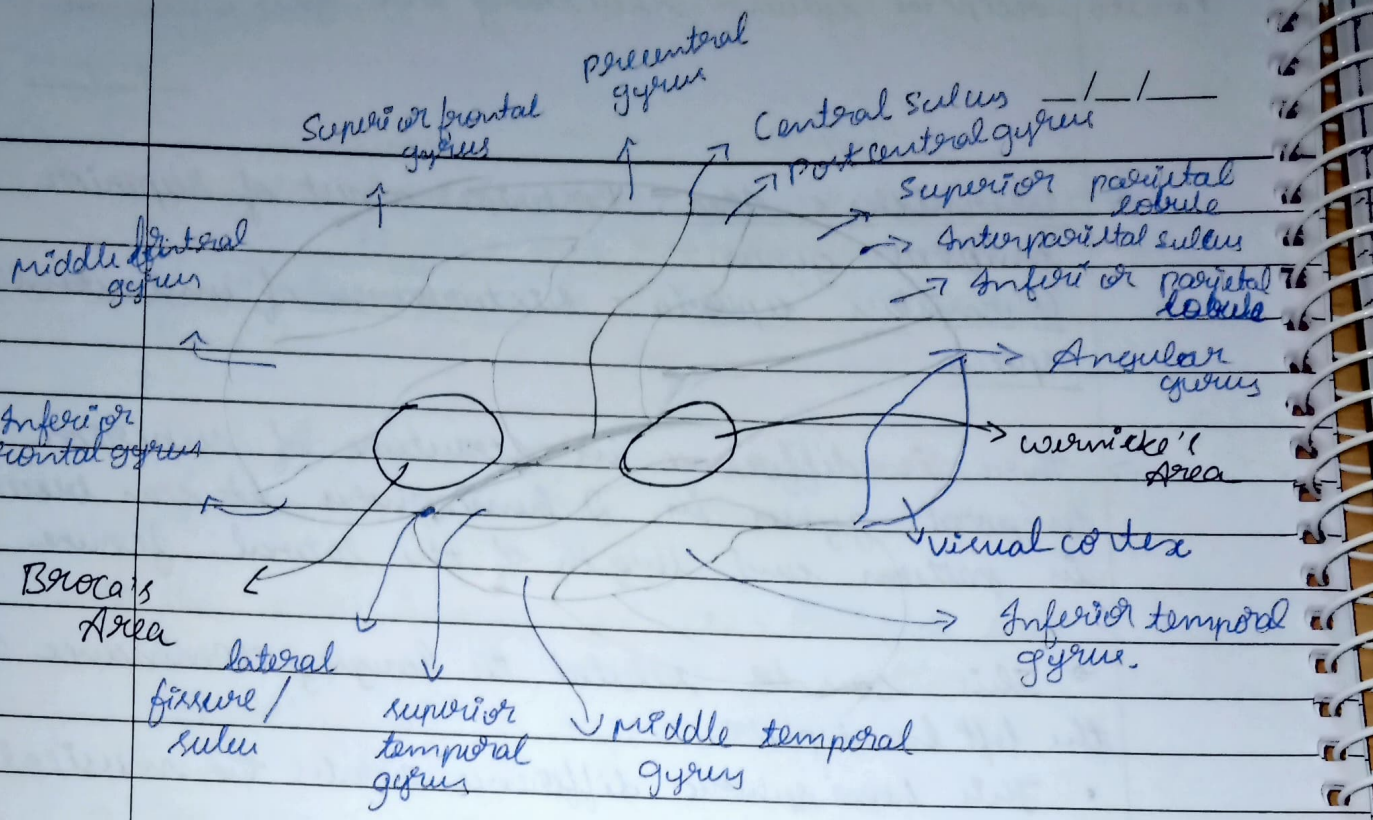
→ Post central gyri (= somatosensory cortex.) ll^l to Pre central gyri
spinal cord side ↳ somatic sensation

→ • Superior parietal lobule
• Intraparietal sulcus
• Inferior parietal lobule
• Postcentral sulcus
} somatosensory, visual, auditory, generate a neural construct of the body, vestibular signal

→ Superior parietal lobule & inferior parietal lobe has a vision tumours boundary in parasagittal plane called "intraparietal sulcus"

→ Cortical formation inferior to intraparietal sulcus include supramarginal gyrus and angular gyrus.

→ Small part of occipital lobe is visible in lateral view, is concerned primarily with vision and visualisation (even when eyelids are closed)



continue.

Types of ~~glial~~ neuroglia:

(5) Ependymal cells: (Ependymocytes")

⇒ modified type of glial cells: Forms columnar, epithelial like lining of the ventricular system in the CNS, including central canal of the spinal cord.

⇒ Apical surface of ependymal cells contain cilia, which assist in the circulation of cerebrospinal fluid.

⇒ Ependymal lining of the lateral ventricle harbors populations of reservoir cells: Have capacity to generate new brain cells.

Cingulate gyrus - prominent component of the limbic forebrain. Limbic forebrain is important in the experience and expression of emotion, regulation of attending / visceral motor activity.

Medial Surface of the Brain

Diencephalon and brainstem are visible on the medial surface of the brain (cut in the midsagital plane).

-> Just below superior frontal gyrus, a long, almost horizontal sulcus, "Cingulate sulcus", extends across the medial surface of the frontal and parietal lobes just below the superior frontal gyrus.

-> Corpus callosum - a prominent gyrus below cingulate gyrus

-> "Paracentral lobule" - caudal portion of the superior frontal gyrus

-> Inferior margin of ventral lobe is the medial aspect of the inferior gyrus called "gyrus rectus"

-> Subcallosal area - An important target for deep brain stimulation.

-> "Parieto-occipital sulcus" divides the parietal and occipital lobe.

-> Precuneus gyrus: The entire gyral formation visible in the veins of the parietal lobe.

-> Calcarine sulcus: Intersects the parieto-occipital sulcus at nearly a right angle

__/__/____

"tongue" "Cuneus"

⇒ Lingual gyrus ; Cuneus gyrus.

* **Occipital lobe = vision.**

Calcarine sulcus - receive information from the retinas - It is therefore called primary visual cortex.

* Posterior part of parietal and temporal lobe. complex aspects of vision.
↳ Injury leads to fail to recognise motion and familiar face.

* Fibre bundles are bundles of axons extending from one part of the brain to other.

3 prominent fibre bundles - Cerebral hemisphere.

① The corpus callosum: Connects the cortices of 2 hemispheres - except anterior temporal and ventral frontal lobes. (large bundle)

② Fornix: Connects the hippocampus with the hypothalamus and related ventral, midline structures. (large bundle)

③ Anterior commissure: Connects cortex in the anterior temporal and ventral frontal lobes. (+ ventral telencephalic structure).

* Calcrine sulcus ⊥ Central sulcus

• Pons is Caudal to midbrain - diencephalon)

_/_/___

The other subdivision of the brain

① Diencephalon: (4 parts dorsal to ventral)

ⓐ Pineal gland: Epithalamus (ⓐ) small strip of tissue is attached to this.

ⓑ Thalamus: (a relay station) and a largest part. cortex → brain spinal cord

ⓒ Sub thalamus: control of motor and cognitive function (small deep stimulation region for control movement.

ⓓ Hypothalamus: (related to pituitary gland.) control of homeostasis, physiological activities - survival & reproduction (small) control of homeostatic and reproductive functions.

② Mesencephalon or midbrain (caudal to thalamus)

→ Superior and inferior colliculi

→ Ocular motor function and postural adjustments → superior colliculi

→ Audition → Inferior colliculi.

③ Pons: (pons = bridge)

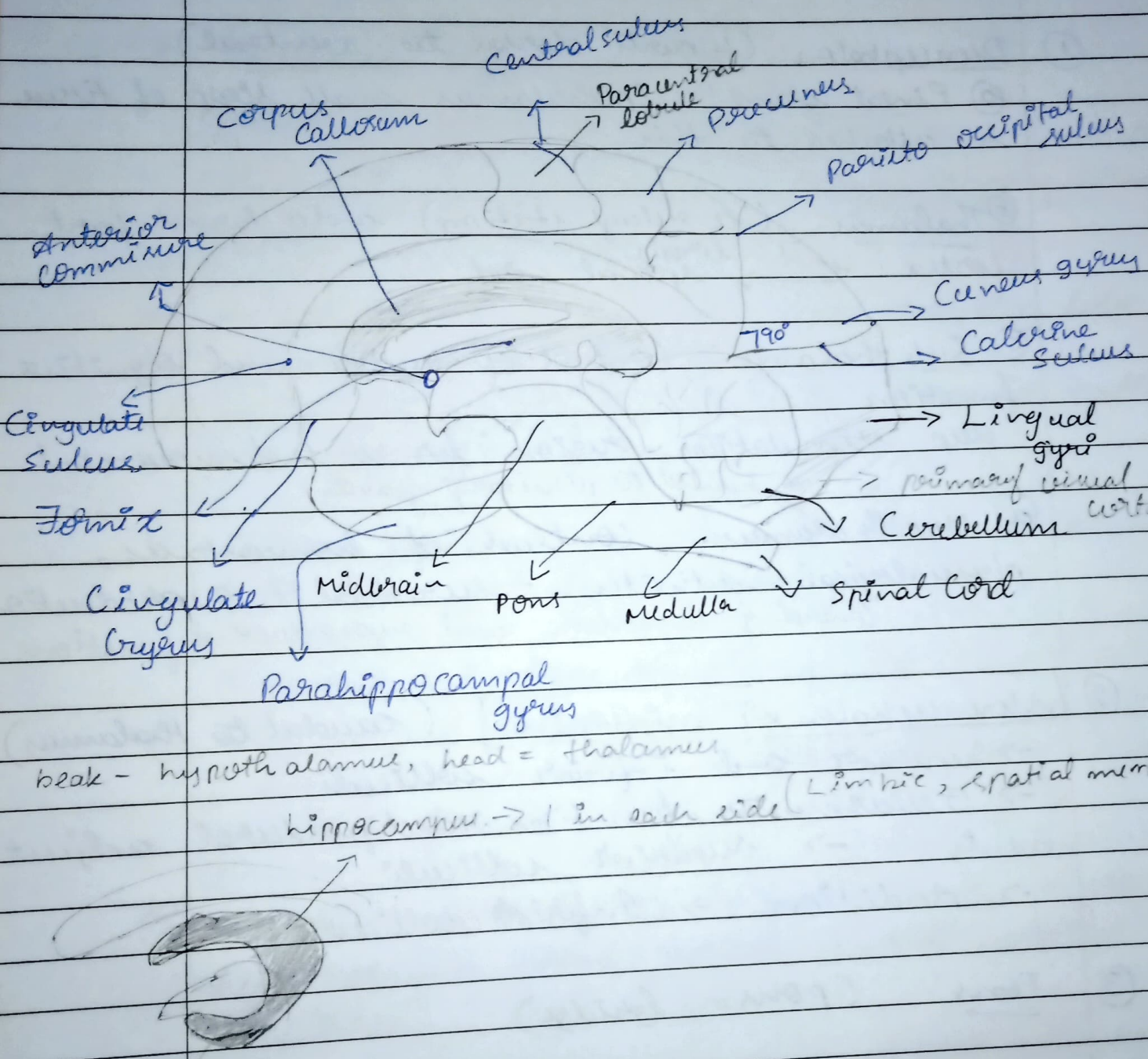
④ medulla oblongata (medulla)

* Lateral ventricle: It is a thin layer of tissue that forms the medial wall separating the 2 lateral ventricles.

* Hindbrain = Rhombencephalon.

- primary visual cortex = striati Cortex.
- Damage to this part of occipital lobe can result in blindness for some portion of the visual field.
- Posterior of parietal temporal lobe proves higher aspects of vision

⇒ Parieto occipital sulcus ⊥ Calcarine sulcus



beak - hypothalamus, head = thalamus

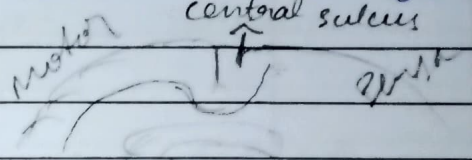
Hippocampus → 1 in each side (Limbic, spatial memory)

__/__/__

Finding the Central Sulcus

→ Central sulcus precisely divides the somatic sensory cortex of the parietal lobe from motor cortex of the frontal lobe.

→ Arachnoid mater: A tissue that helps to create a buffering space underneath it called cerebral spinal fluid.



→ Paracentral gyrus = foot

→ S shape bend = hand

→ Central sulcus is formed by growth and morphogenesis of the precentral gyrus and postcentral gyrus of the cerebral cortex in the human brain.

* 3 gyrus in ventral view:

① Parahippocampal gyrus.
② Occipitotemporal gyrus.
③ Inferior temporal gyrus.
→ posterior part is called fusiform gyrus.

→ I cranial nerve = olfactory nerve.

→ Paracentral lobule contains somatic sensory and motor representations of the contralateral foot.

- Somatic sensation → postcentral gyrus
- motor control → Precentral Gyrus.

• Commissures: Axon tracts that cross midline of the brain or spinal cord.

__/__/____

* Morphogenesis: A biological process that causes a cell, a tissue or organism to develop its shape.

* Formation of central sulcus: Is formed by growth and morphogenesis of the precentral gyrus and the postcentral gyrus of the cerebral cortex in the human brain.

"footdrop" - weak ankle :- stroke involving blood supply to the cerebral cortex = "Anterior Cerebral artery"

_/_/_

Blood Supply to the Brain (1)

Brain receives arterial supply from 2 sources:

(1) Internal carotid arteries
(2) Vertebral / basilar arteries: 2 arteries join to form basilar artery at the base of the brain.

* 8 arteries.

Supply	Cerebral artery	Group
From Anterior side of the brain — Internal Carotid (Right & left IC)	(1) Anterior cerebral artery (2) Middle cerebral artery (3) Anterior choroidal artery (4) Posterior communicating artery (5) Posterior cerebral artery.	Anterior Circulation
From Posterior side of the brain — Vertebral / Basilar	(5) Posterior cerebral artery (6) Superior cerebellar artery (7) Anterior inferior cerebellar artery (8) Posterior inferior cerebellar artery	Posterior circulation

=> Middle cerebral artery: Central and lateral cerebral hemisphere - face, language areas.
↳ Broca's, Wernicke's area

=> Anterior cerebral arteries: Medial aspect and dorsal and orbital margins of the frontal lobe; Medial aspect and dorsal margin of the anterior parietal lobe :- sensorimotor area, accessory motor area, limbic area in the medial frontal lobe, lower extremities

=> Posterior cerebral artery: Posterior parietal lobe, inferior temporal lobe, occipital lobe :- visual areas, limbic region in posterior cingulate

anterior circulation back to heart via internal jugular veins through veins of "venous sinuses"

and parahippocampal gyri.

→ Deep penetrating branches of the middle cerebral artery are usually called the lenticulostriate arteries.

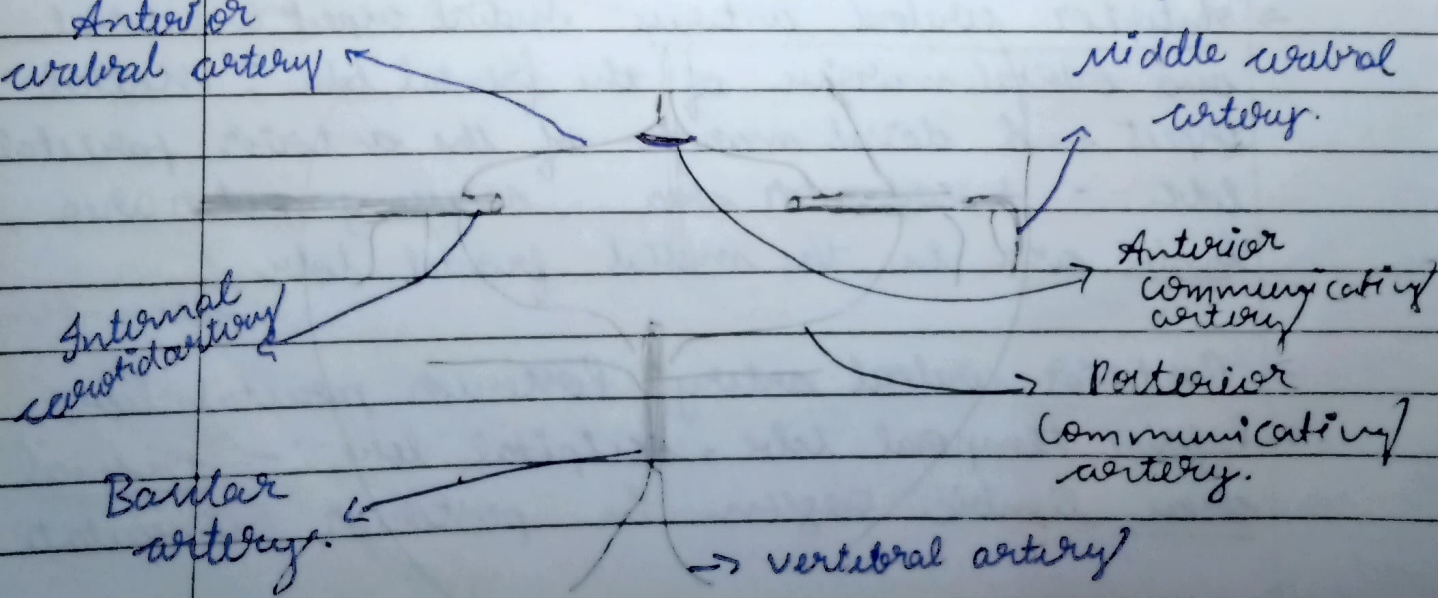
→ Anterior choroidal artery supplies the amygdala, hippocampus, the anterior part of the thalamus, part of the globus pallidus, the posterior limb of the internal capsule, and the choroid plexus of the lateral ventricle.

→ Posterior communicating and posterior cerebral arteries supply the posterior hypothalamus, most of the thalamus, and the choroid plexus of the third ventricle - all structures in the posterior deep forebrain.

* Circle of Willis:

Basilar artery joins right and left vertebral artery.

- Basilar artery joins blood supply from internal carotids in an arterial ring at the base of the brain called "Circle of Willis"



* The arterial supply of the spinal cord:
2 sources,

① The vertebral arteries

② Segmental arteries (branches of aorta).
↳ 6-10 medullary arteries.

→ An anastomotic network of vessels known as the vasocorona connects these 2 sources of supply and sends branches into a narrow zone of white matter around the margin of the spinal cord.

→ The posterior spinal artery gives rise to branches that penetrate the posterior 1/3 of the spinal cord and so supply much of the dorsal horn and the dorsal columns.

• Medullary arteries join to form a single anterior spinal artery and a pair of posterior spinal arteries.

• Anastomic network - vasocorona connects these 2 sources and supply it to white matter in spinal cord.

↳ 200 radical arteries - supply anterior 2/3 spinal cord

→ Medullary artery supply posterior spinal cord.

* CSF: Protects brain from sudden impact (also spinal cord). It is also removes waste products from the brain.

27/10/2020

	Embryonic Brain		Adult brain derivatives	Associated ventricular space.
Prosencephalon (forebrain)	Telencephalon (endbrain / outer brain)	→	Cerebral cortex	Lateral ventricle
		→	Cerebral nuclei	
	Diencephalon (between brain or through brain)	→	Thalamus	Third ventricle
		→	Hypothalamus	
		→	Retinea	
	Mesencephalon (midbrain)		Superior and Inferior colliculi, Red nucleus, Substantia nigra	Cerebral aqueduct
Rhombencephalon (Hind brain)	Metencephalon	→	Cerebellum	Fourth ventricle
		→	Pons	
	Myelencephalon	→	Medulla oblongata	Fourth ventricle
	Spinal cord		Spinal cord	Central canal

* Nervous system starts out as a simple tube and the duct of the tube remains in the adult brain as a series of connected, fluid filled spaces. These spaces, known as "ventricles", are filled with cerebrospinal fluid (CSF).

→ Spaces inside hemisphere = lateral ventricles.
→ Spaces inside diencephalon = third ventricles.
→ Space inside midbrain = Cerebral aqueduct.
→ Space inside developing rhombencephalon = fourth ventricle
→ Opening in spinal cord = Central canal.

__/__/__

* Brainstem and Cranial Nerves:

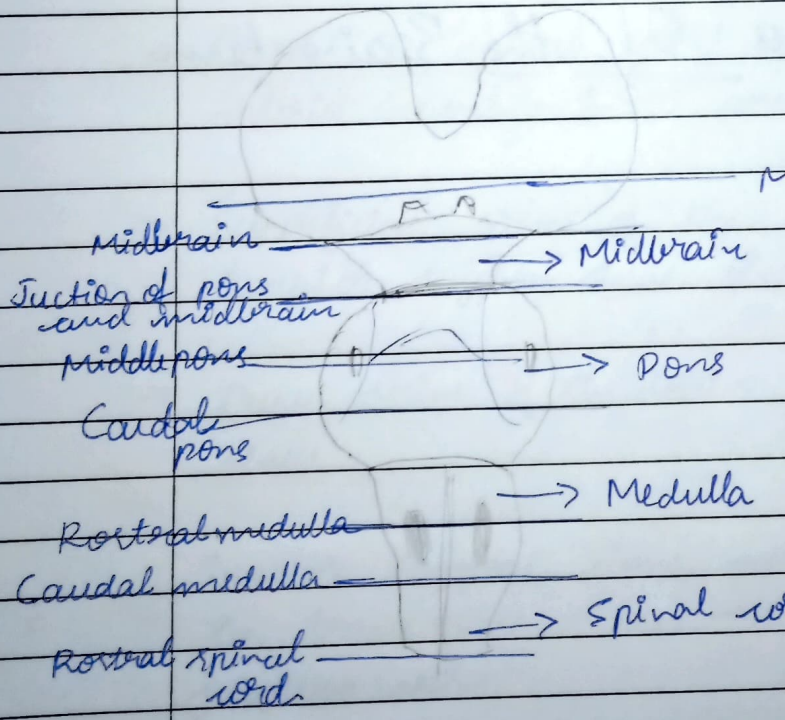
→ Brainstem = Midbrain, pons and medulla.
↳ Rostral - Diencephalon
Caudal - Spinal cord

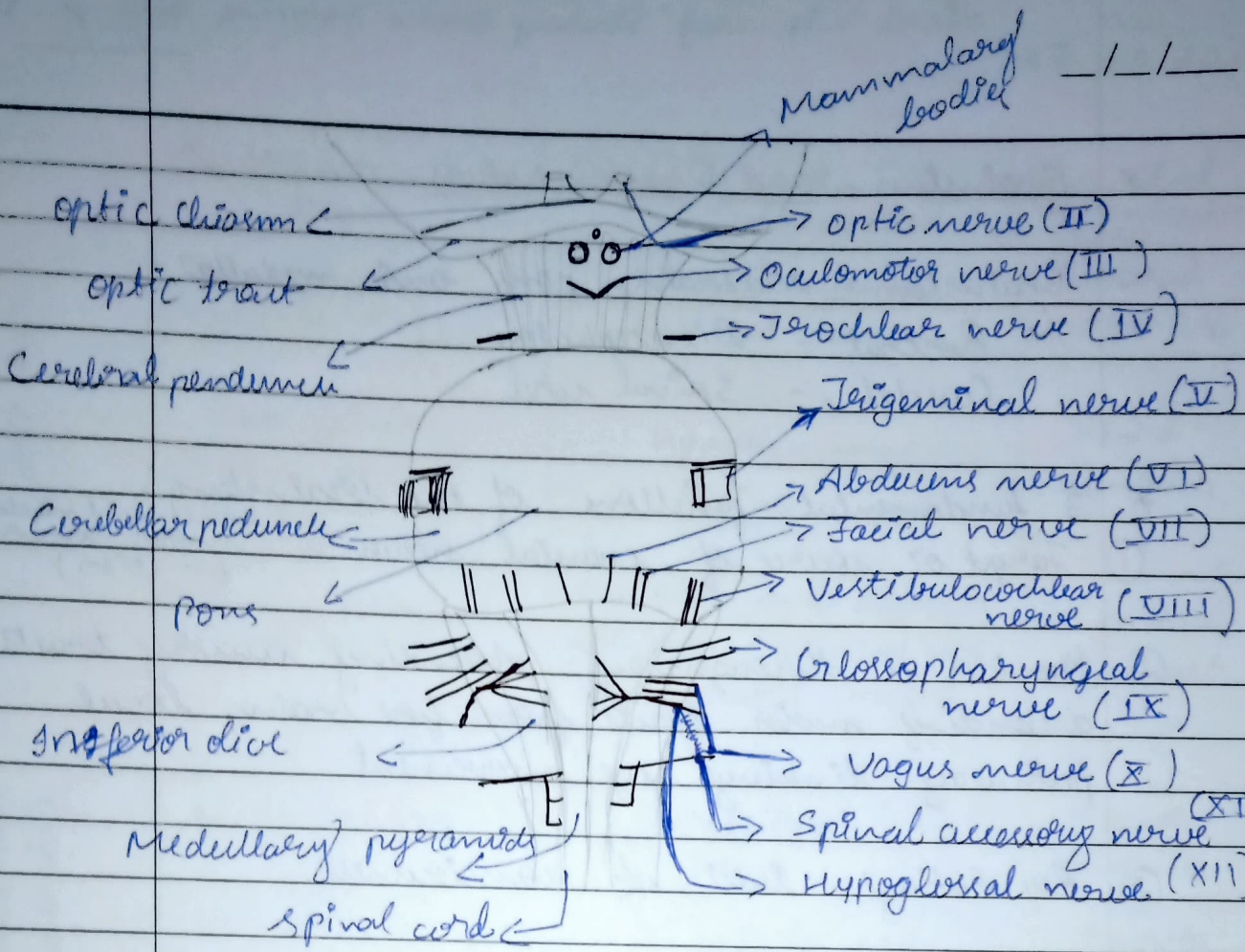
* 3 fundamental functions of the brainstem:

① Target or source of cranial nerves: (head and neck, motor sensory function)

② Provides a throughway: Ascending sensory tracts, descending motor tracts from fore brain, local pathway linking eye movement.

③ Regulating level of consciousness.





Cranial Nerves Of the Brainstem

Blood Supply to the Brain (2)

→ Anterior circulation - internal carotid arteries.
→ Posterior circulation - Vertebral arteries.

→ fore brain - cerebral hemisphere, diencephalon
→ Brainstem, cerebellum, upper portion of the spinal cord, posterior forebrain. (some deep structure)

→ Middle cerebral artery: [sensorimotor areas], upper face, language area (Broca's area, Wernicki's area)

→ Anterior cerebral artery: upper face, limbic area.

→ The posterior cerebral artery - visual areas.

→ Blood to spinal cord is supplied by vertebral arteries and 6-10 medullar artics from aorta.

→ Superficial veins of the cerebrum drain into the superior saggital sinus or cavernous sinus.

→ Deeper veins of the brain drain into inferior saggital sinus.

→ Superior saggital sinus and the straight sinus drain to transverse sinus → sigmoidal sinuses → internal jugular vein.

→ An anastomotic network of vessels known as the vasocorona connects these 2 sources of supply and sends branches into a narrow zone of

white matter around the margin of the spinal cord.

→ Vertebral artery both left and right join to form single "basilar artery" → mid brain

→ Venus drainage - Dura mater = Meninges
tough tissue outside brain surface

Venus Cynus supplies blood

* Vertebral artery
From posterior side of the brain → Cranium → Basilar (Pons) artery → Midbrain
↳ posterior inferior cerebellar artery.

* Limbic system: Deals with emotions and memory.
↳ hypothalamus, the amygdala, thalamus, hippocampus

• Anterior inferior cerebellar artery (AICA): (Posterior circulation)
Branch of basilar artery that supplies dorsolateral aspects of the caudal pons and anterior and inferior aspects of the cerebellum.

• Anterior spinal artery: Supplied by vertebral arteries and medullary arteries : Anterior aspect of spinal cord.

28/10/2020

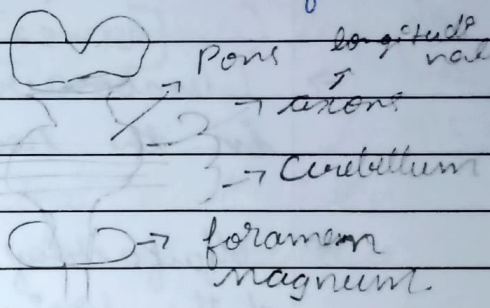
Lecture

Cranial and Spinal Nerves

→ Midbrain - white matter

→ Cranial nerve IV - Trochlear nerve is only motor nerve that exits on the dorsal (posterior) side of the CNS

→ Pons = bridge



* Types of neurons:

① Sensory neurons: Neurons that are activated by sensory i/p from environment

② Motor neurons: Part of spinal cord of CNS which connects muscle, glands and organs throughout the body. They transmit impulse from spinal cord to skeletal muscles & smooth muscles and directly influence movement
   ⓐ Lower motor neurons: Travel from spinal cord to muscles
   ⓑ Upper motor neurons: Travel brain ⟷ spinal cord.

③ Interneurons: are in b/n. Communicate b/n sensory and motor neurons and control muscle movement.

→ Cell body of primary sensory neuron lie in dorsal root ganglia or the cranial nerve ganglia.

• Inferior end of the adult spinal cord: L1 - L2

__/__/___

→ visceral motor system = Autonomic nervous system

→ Controlling cardiac, glands

[C3-T1)

→ Cervical enlargement = this is the region in the body where our arms are attached

[L1-S2]

→ Lumbosacral enlargement = this is the region in the body where legs are attached.

motor o/p and I/ps

→ Olfactory bulb is not a nerve but part of the brain.

→ infundibulum - pituitary stalk tumour in pituitary will show on cranial nerve II - (optic nerve) ∴ visual field defirit are first sign of problem in pituitary.

→ Vestibular system is the sensory apparatus of the inner ear which maintains balance (posture equilibrium).

→ 31 pair of spinal nerves, peripheral nerve / spinal nerve or segmental nerve innervate much of body part arise from here.

8 - Cervical Nerve (C1 - C8)
12 - Thoracic Nerve (T1-T12)
5 - Lumbar Nerve (L1-L5)

Medulla
Cervical Nerve
Thoracic Nerve
Lumbar Nerve
Sacral Nerve
Coccygeal Nerve

Nerve 1 and 2 are not fully attached to the brainstem.
Spinal nerve leave the vertebral column through intervertebral foramina. __/__/___

5 - Sacral Nerve - (S1-S5)
1 - Coccygeal Nerve

=> Sensory information (afferent axon ~~neuron~~ spinal nerve) enter cord via dorsal root

=> Motor commands (efferent commands) leave cord via ventral roots.

Once dorsal root and ventral root join sensory and motor axons travel together in the spinal nerve

=> Local anaesthesia is introduced into cauda equina.

=> Interior spinal cord is white matter, surrounded by grey matter.

* Spinal nerve = Peripheral nerve = Segmental nerve innervate much of the body arise from 31 pairs of spinal nerves
=> Cervical, Thoracic, Lumbar, Sacral, Coccygeal.

Nerves connected to spinal cord are spinal nerve. These nerves extend outward from vertebral column to innervate the periphery.

=> Trochlear [CN-IV] nerve arises from trochlear nucleus of the brain. It is only cranial nerve to exit from

__/__/____

Cranial Nerve	Name	Sensory/ Motor	Major function
I	Olfactory nerve	Sensory	Sense of smell
II	Optic nerve	Sensory	vision
III	Oculomotor nerve	Motor	Eye movement, pupillary constriction, upper eyelid muscle
IV	Trochlear nerve	Motor	Eye movement - downward gaze
V	Trigeminal nerve	Sensory & motor	Somatic sensation from face, mouth, cornea; muscles of mastication.
VI	Abducens motor	Motor	Lateral eye movements
VII	Facial nerve	Sensory & Motor	Facial expression, taste from anterior tongue, lacrimal and salivary glands.
VIII	Vestibulocochlear nerve	sensory	hearing & sense of balance
IX	Glossopharyngeal nerve	Sensory & motor	Sensation and taste from posterior tongue, chemoreceptor, salivary gland.
X	Vagus nerve	Sensory & Motor	Autonomic gut fn, cardiac inhibition, sensation from larynx and pharynx, vocal cord & swallowing
XI	Spinal accessory nerve	Motor	Shoulder & neck muscles
XII	Hypoglossal nerve	Motor	Movements of tongue.

Visura - Abdominal cavity.
Lacrimal gland: Produces tear. __/__/__

* Cranial nerves function
Incoming = sensory signal (enter spinal cord via dorsal root)
outgoing = motor signal (leave the spinal cord via ventral roots)

* 3 different outer motor flows (Embriology).
① Somatic motor nuclei - innervate muscles - extraocular, tongue
② Branchial motor nuclei - innervate muscle - face jaw, larynx, shoulder
③ Visural motor nuclei - Pre ganglionic parasympathetic neuron -> outward towards end visural organs

* 4 different sensory nuclei
① Special visural nuclei - taste / gustation
② General visural nuclei (general)
③ Somatic sensation (general) - skin, muscles, joints.
④ Special sensory systems - I order afferent (hearing and balance)

* Cranial nerves are nerves attached to the brain (including brainstem).
Cranial nerves are responsible sensory and motor functions of head and neck. One of these nerves targets organs in the thoracic and abdominal cavities as part of the parasympathetic nervous system.
12 cranial nerves CN - I to CN - XII

C.N	Motor			Sensory				Cranial nerve
	Somatic Motor	Branchial Motor	Visceral Motor	Special visceral	Visceral sensory	Somatic sensory	Special sensory	
	Extra ocular, tongue	face, jaw, larynx, shoulder	Para sympathe -tic	Taste	(general)	(general)	hearing, balance	
III	✓ oculomotor		✓ Edinger westphal					III
IV	✓ trochlear							IV
V		✓ Tri geminal				✓ Tri geminal		V
VI	✓ Abducens							VI
VII		✓ Facial	✓ salivatory	✓ Nucleus of the solitary tract		✓		VII
VIII							✓✓ (cochlear, vestibular)	VIII
IX		✓ A M B I G U S	✓ salivatory	✓	✓	✓		IX
X		✓	✓ Ambiguus, Dorsal motor of vagus	✓	✓	✓		X
XI		✓✓ Accessory						XI
XII	✓ Hypoglossal							XII

* Classification and location of the Cranial Nerve Nuclei

Location	Somatic motor	Branchial Motor	Visceral Motor	General sensory	Special sensory	Visceral sensory
Midbrain 3-7 (-6)	Oculomotor nucleus (III)		Edinger-Westphal nucleus (III)	Trigeminal sensory: Mesencephalic nucleus (V, VII)		
	Trochlear nucleus (IV)					
Pons 6-10 (-VIII)	Abducens nucleus (VI)	Trigeminal motor nucleus (V)	Superior salivatory nucleus (VII)	Trigeminal sensory: principal nucleus (V, VII, IX, X)		
		Facial Nucleus (VII)	Inferior salivatory nucleus (IX)			
Medulla 7-12	Hypoglossal nucleus (XII)	Nucleus ambigus (IX, X)	Nucleus ambigus (X)	Trigeminal sensory: Spinal nucleus (V, VII, IX, X)	Vestibular nuclei (VIII) Cochlear nuclei (VIII)	Nucleus of the solitary tract (VII, IX, X)
		Spinal accessory nucleus (XI)	Dorsal motor nucleus of vagus (X)			

- Edinger westpal nucleus : constrictor of pupil para sympathic neuron → nucleus is here. (visceral)

Root ganglia = Cranial nerve ganglia.
• Visceral motor system = Autonomic nervous system.

_/_/___

Brainstem and Spinal Cord

Pontocerebellar fibres forming the middle cerebellar peduncle is a defining feature of the pons.

→ Oculomotor nucleus is found in the midbrain

→ Spinal trigeminal nucleus - pain + temperature

* Early in the development of CNS neural tube give rise to dorsal and ventral identity.
→ Dorsal gray matter - Alar plate
→ Ventral gray matter establishing - basal plate

Alar and basal plates are seperated by a shallow longitudinal groove called the sulcus limitans.

→ "Groups of neurons that together subserve a particular function are called a 'system'."

→ "The structures containing neurons and axons of a particular system are collectively referred to as 'pathway'"

→ The cranial nerve nuclei lie in the tegmentum of the brainstem, as do many major ascending and descending tracts

→ The sensory nuclei are located laterally in the brainstem
→ motor nuclei are located medially

4 - Rostral medulla

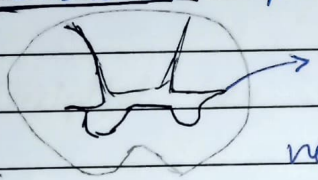
29/10/2020

→ more local circuits means more grey matter
(hands) (legs)
In Cervical, Lumbar - Sacral levels grey matter are high

→ white matter decreases as we move from midbrain (superior) to Sacral region (inferior)

→ Thoracic spinal cord

Dorsal



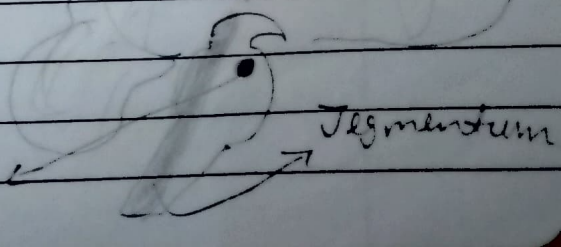
ventral.

pertensions were called lateral horn
" Pre ganglionic sympathetic neurons - out flow from nervous system viscera"

→ Sacral cord - there is no pointy pertension
↳ pre ganglionic para - sympathetic neurons"

* Cranial nerve nuclei lie in tegmentum of the brainstem

• Tegmentum: Section of brainstem that extends through the brainstem. anterior to the ventricular space of the brainstem. The tegmentum contains the reticular formation, cranial nerves, the nuclei associated with the cranial nerve as well as various ascending and descending pathways.



Forebrain

* ventricles. (hollow part)
  → "Choroid plexus" produces cerebrospinal fluid.

→ Putamen - movement of the body
Caudate nucleus - movement eyes & thoughts
Nucleus accumbens - movement of emotion and mood

* 4 principal ventricles:
  1. Lateral ventricles
  2. Third ventricles
  3. Fourth ventricles
  4. 3 narrow channels → paired interventricular foramina
     → Sigle cerebral aqueduct (midline)

* Flow of CSF:

Lateral ventricle —(Interventricular foramina)→ third ventricle —(Cerebral aqueduct)→ Fourth ventricle

→ Structurally and functionally, the caudate, putamen and nucleus accumbens are similar and they are refered to as "striatum".

30/10/2020

continued:

Lateral surface of the brain:

Temporal gyri → Superior: Cortex - Audition, lang. perception

→ Inferior: visual info. high processed.

somatosensory?

- Parietal lobe: Critical for attending to stimuli
- Temporal lobe: Recognize stimuli.
- Frontal lobe: Planning response to stimuli and in future organization of behaviour.
- Occipital lobe: All aspect of visual perception and multimodal sensory processing.

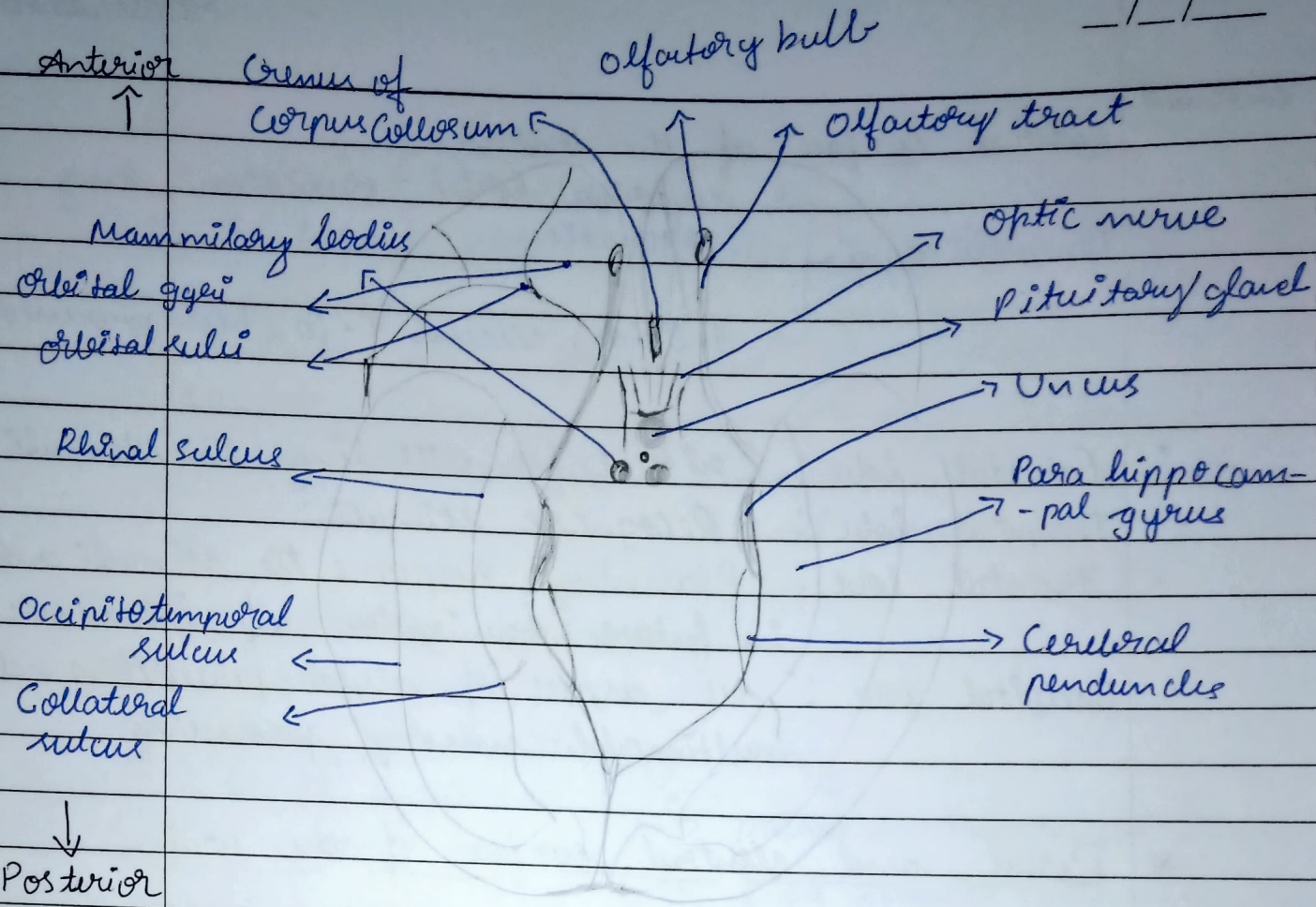
* Dorsal and ventral surface of the brain

→ Parahippocampal gyrus - consolidates memory.

→ Infundibulum - pituitary stalk.

→ Inferior surface of frontal and temporal lobes are prominent in ventral view

→ Medulla is a portion of vertico bulbar tract



Continued: Blood supply to brain:

-> Major veins (sinus) inside the brain are formed by separation of 2 "dura mater".

* Blood drainage:

- Cerebrum drain - Superior sagittal sinus / Cavernous sinus.
- Superior saggital sinus & deeper sinuses drain into the confluence of sinuses. -> transverse sinus -> (exits cranial vault) as the sigmoid sinus

31/10/2020

Continued:

Cranial and Spinal Nerves:

* Brainstem:
  - (a) Source for cranial nerve dealing with sensory and motor function (head & neck).
  - (b) Throughway to all ascending sensory tracts from the spinal cord.
  - (c) Involved in level of consciousness: Through reticular formation.

* The sensory nuclei are located laterally in the brainstem.

* Motor nuclei are located medially in brainstem.

→ Inferior olivary nucleus - Seen as inferior olive.

→ " The base of the pons is made up of a mix of cells - the pontine gray matter and transversely coursing fibres. → cerebellum via middle cerebellar peduncles "

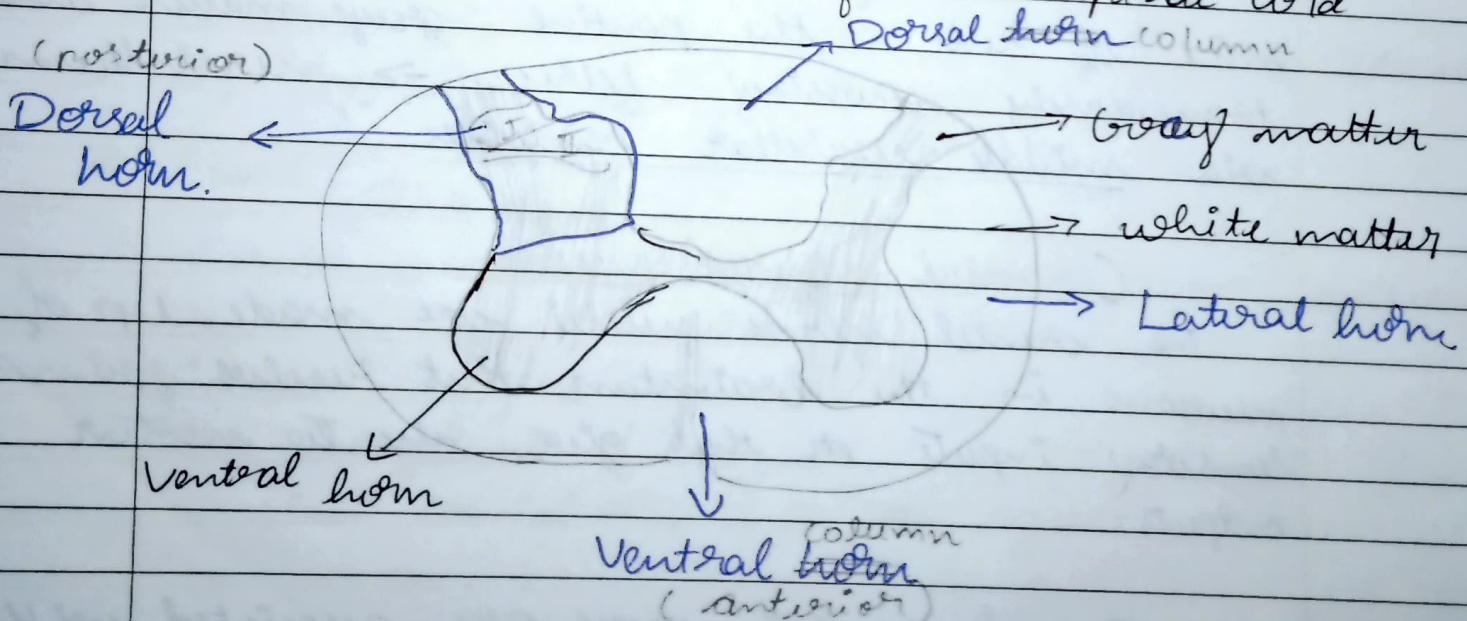
Cranial Nerve Nuclei

The cranial nerve nuclei are made up of neurons in the brainstem that receive primary sensory inputs or that give rise to motor outputs.

→ 10 sets of cranial nerves are associated with the brainstem. These nerves supply or receive signals from 16 sets of cranial nerve nuclei.

reticular system dorsally and basal structure ventrally"

* Motor neuron: Midline into ventral-lateral; exits brain laterally.
* Somatic motor neurons: sends axon ventrally
Exception: Trochlear nucleus sends axons out dorsally
* Parasympathetic preganglionic neuron (medulla & pons) send axon laterally.
* All autonomic preganglionic axons leave in the ventral roots.
* All sensory inputs enter the brain laterally.
* Histological section of the spinal cord



-> Column = white matter
-> Dorsal horn = Sensory zone } gray matter
-> Ventral horn = motor zone

→ I, II (laminae) - Rexeds scheme

→ Dorsal horn = laminae I - VI
Ventral horn = laminae VII - IX
} grey matter

→ Lateral column - Sensor and motor neurons
ex: lateral cortical spinal tract

→ Dorsal column - only sensory pathways

→ Ventral Column - Sensory and motor (along with ventrolateral/ anterolateral)
↳ pain pathway (+ temperature + postural control)

→ (white matter decrease down the spinal cord.)

→ Lateral horn is present only in thoracic region - Preganglionic sympathetic neuron

→ Dorsal column tract: Gracile tract, cuneati tract.

→ Large ventral horn in Cervical S.C
Small " Thoracic region.

more motor neuron → Large ventral horn: Lumbar cord.
bend → leg. Lumbo sacral enlargement

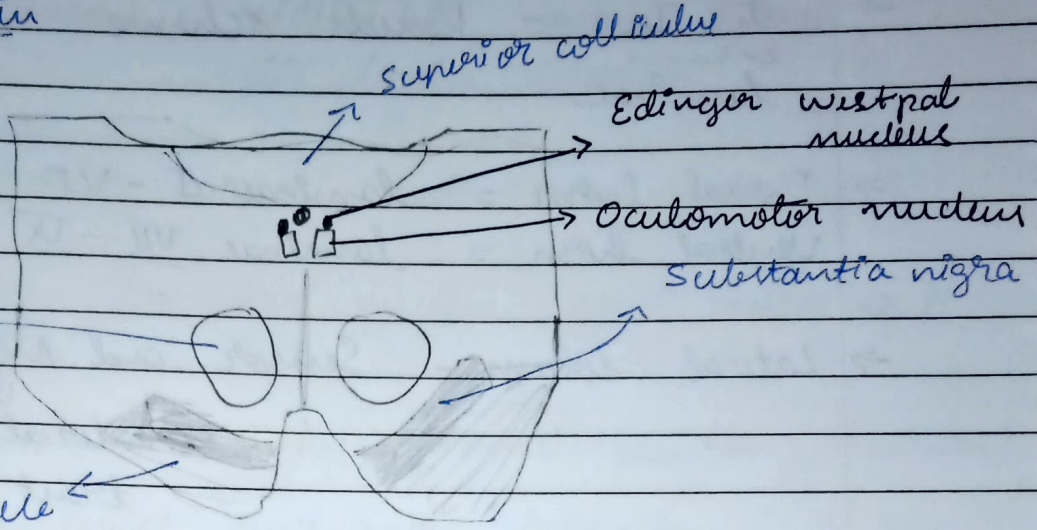
→ Sacral cord has large ventral horn

* Later column: Axon extend from the cerebral cortex to interneurons and motor neurons in ventral horn. This path is called the "lateral cortico spinal tract".
↳ convey proprioceptive signals from spinal cord neuron to cerebellum

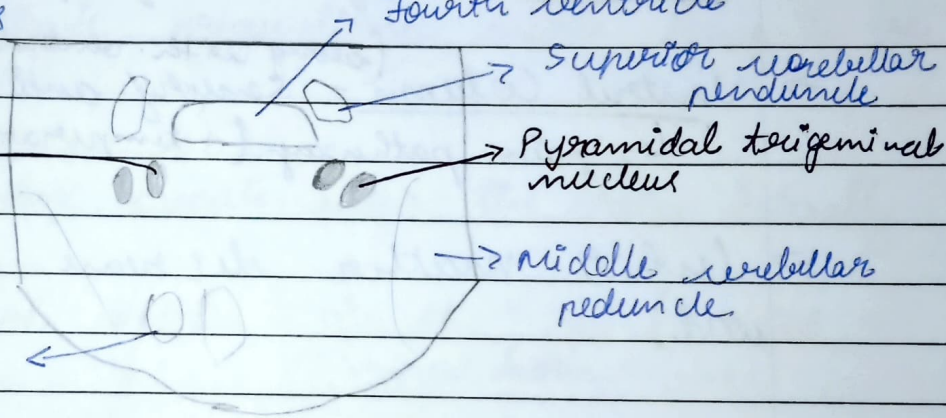
__/__/____

Internal organization of Brainstem

① Midbrain



② Middle pons



③ Lower pons: