# Control And Co-ordination

* Nervous system in Hydra
1) Hydra is a Cnidarian
2) Hydra shows Diffused nervous system primitive nervous system. Simple nervous system
3) It contain 2 types of cells
   a) Nerve cells/ Neurons
   b) Sensory cells

a) Nerve cells
1) Nerve cells are with nerve fibers
2) Nerve cells scattered throughout the body
3) They are interconnected with each other by synapse in betⁿ nerve fibers.
4) They form 'nerve net'
5) There are two nerve nets forms in Mesoglea
6) One nerve net connect with epidermis
7) Second nerve net connet with Gastodermis
8) Nerve contains nerve fibers but there is no sensory and motor neurons
9) The nerve fiber carries nerve impulses throughout the body & nervous co-ordination maintain in hydra
10) The nerve impulses do not have polarity / direction
11) Nerve impulses travelled in any direction of the body

b) Sensory cells.
1) They are scattered in body wall and tentacles
2) But in hydra sensory organs are absent
3) They are helpful for capturing of prey

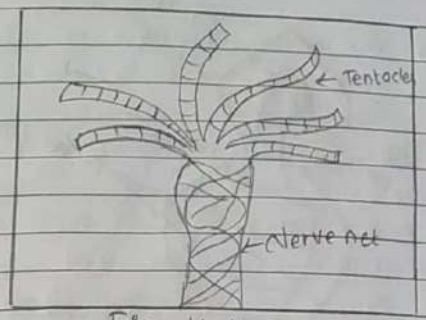

Fig - Hydra

* Nervous system in planaria
1) planaria it a flatworm
2) It belongs to phylum - platyhelminthes
3) It is primitive animal with central nervous system
4)
5) Central nervous system located at ventral side of body
6) It consist mass of cephalic / celebral ganglions
7) that Forms "U" shaped structure called "Brain"
8) It is present at anterior side of ~~brain~~ "Head"
9) Each ganglions of brain aries nine branches towards the outerside
10) Below the ganglion, pair of Ventral nerve cords / long Nerve cord present (VNS)
11) They are interconnected with each other in ladder like manner
12) Peripheral Nervous system present at later side of VNC
13) PNS consist - sensory ceu arranged in lateral cord in body
14) Pair of photosensory ~~f~~ organ i.e pair of eyes
15) It is located at ~~dorso~~ dorsal side of brain

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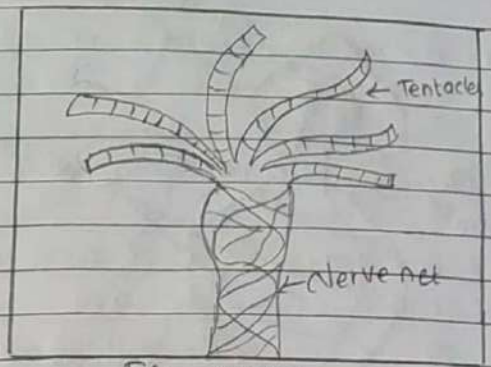

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15) It is located at ~~dorsal~~ dorsal side of brain


Fig. Nervous system in planaria / Flatworm

* Neural tissue-
It consists 2 types of cells
a) Nerve cell / Neurons
b) Neuroglial cell / Glial cell

a) Nerve cell-
1) The structural and functional unit of Nervous System is called nerve cell
2) The multiplication polar neurons shows following parts
i) Cyton (Cell body)
ii) Dendrons
iii) Axon

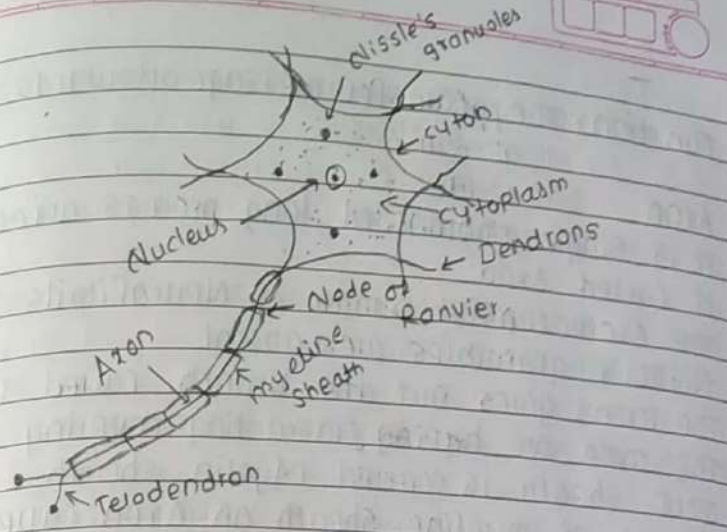



Fig :- Nerve cell

i) Cyton (Cell body)-
1) It has distinct Nucleus, Nucleolus, Nucleoplasm
2) Thin film of cytoplasm surround the nucleus
3) Around Nucleus, Neurofibrils, Nissl's granules and Riboproteins are present

Function-
1) They play important role in synthesis of enzymes required for formation of Neurotransmitter substance i.e Acetyl Choline.
2) Neurofibrils play important role in transmission of nerve impulses.

ii) Dendrons
1) They are small conical processes aries from cyton
2) They are highly branch into fine dendrities
3) Nissl's granules & Neurofibrils are present at base of dendrites

Function - They transfer message towards the cyton

iii) Axon.

1) It is single, unbranched, long process arises from cyton is called Axon
2) The Axon consist bundle of Neurofibrils
3) Nissl's granuales are absent
4) The axons gives out the branch called Telodendrons
5) The axon are having insulating covering of Mucilaginous sheath is called Myelin sheath
6) Absent of myeline sheath on Axon called Non-myelinated nerves
7) Present of myeline sheath on Axon called myelinated sheath
8) Myelinated Nerves transfer 50 times rapid impulses than Non-myelinated nerve.

Function

1) It carries message away from cyton
2) Myeline sheath helps for rapid transmission of impulses
3) The axon connect with body parts i.e Muscles, skin, glands etc.

b) Neuroglial cells (Glial cells)

1) They are supporting cells of CNS & PNS
2) They are far greater in number than neurons
3) They support Nervous system & derived from Embryonic tissue (Ectoderm)
4) The following types of Neuroglial cells present in CNS & PNS.

Central Nervous System → Oligodendrocytes, Microglia, Astrocytes, Ependymal cells

Peripheral Nerous System → Schwann cells, Satellite cells

* Central nerous system consist following types of Neuroglia-

1) Oligodendrocytes-
1) These cells have a few branches.
2) They form myelin sheath around the axon
3) Myelin sheath is a insulating cover made up by proteins and fatty substances
4) They forms white matter in CNS

Function:
It helps to quick transmission of impulses

2) Microglia-
1) They are small cells with few branches
2) They are derived from monocytes cells and acts as Macrophages
3) They are forms inner linnings of immue system defence for brain & spinal cord
4) These cells goes at the site of injury & dead neurons cell & debries & are removed

3) Astrocytes-
1) They are star shaped
2) They are most abundent glial cells in CNS.

Function -

1) They maintain Blood Brain Barrier (BBB)
2) They are responsible for secretion & absorption of neutral transmitter i.e Acetylcholine
3) They regulate electrical impulses with brain

4) Ependymal cells -

1) They are present in inner linning of ventricles of brain & central ~~spinal~~ canal of spinal cord.
2) They are responsible for secretion of CSF in ventricles of brain & Neural canal of spinal cord.

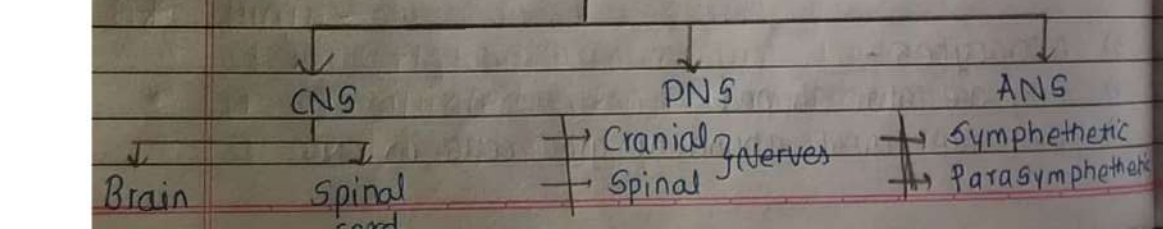
* Peripheral Nervous System consist following types of cells -

1) Schwann cells -
They are most abundent glial cells in PNS
Function.
They forms myelinated sheath around the ~~myelinated sheath around the~~ medullated Nerves of PNS.

2) Satellite cells -
They support to functions of Neurons

• Synapse -
It is a gap present in betⁿ two neuron i.e Axon of one nerve & dendron of another

* HUMAN NERVOUS SYSTEM




A) Brain

* CNS -
1) It is ectodermal in origin
2) It consist 2 parts
a) Brain
b) Spinal cord

• Meninges -
1) The brain & spinal cord externaly covered by fibrous connective tissue membrane is called meninges
2) There are 3 meninges present
i) Dura
ii) Archnoid } mater.
iii) Pia

| Dura mater | Archnoid matter | Pia mater |
|---|---|---|
| 1) It is outermost layer of meninges | It is middle layer of menings | It is innermost layer of menings |
| 2) It is Avascular layer | 2) It is vascular layer | 3) It is highly vascular |
| 3) It is thick & tough layer | 3) It is thin & transparent | 3) It is thin layer |
| 4) It is also called as "Hard Mother" | 4) It is also called as "spider web" | 4) It is also called as "soft mother" |
| 5) It is protective in nature | 5) It is protective & Nutritive in nature | 5) It is Nutritive in nature |

Brain is also called as "Encephalon"

* Sub-dural space-
The space are present in between the dura mater is called Sub-dural space.
It is filled by serous fluid

* Sub-archnoid space-
The space are present in betn the archnoid mater is called Sub-archnoid space
It is filled by CSF

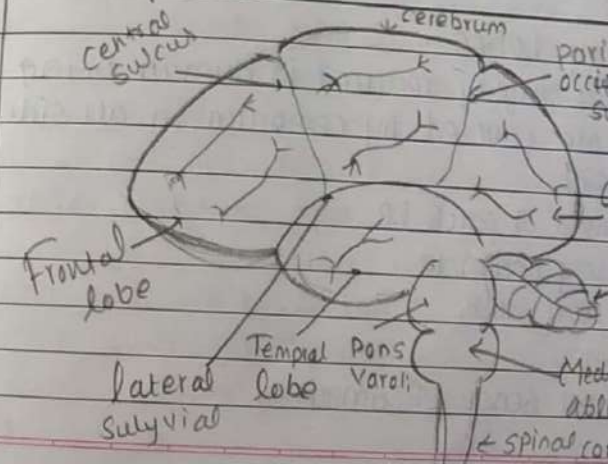
* CSF
1) Cerebro Spinal fluid
2) The fluid is present in ventricles of brain & central canal of spinal cord is called CSF.
3) It is secreated by Ependymal cells
4) In normal Adult - it's quantity are 120 ml

* Functions of CSF -
1) It protect brain from mechanical injury.
2) It is also acts as shock absorber
3) It prevent deviation of brain (dry up).
4) It regulate the temp. inside the brain
5) It maintain equillibrium pressure in the brain
6) It provide oxygen to brain
7) It helps to exchange of gases Nutrients waste material

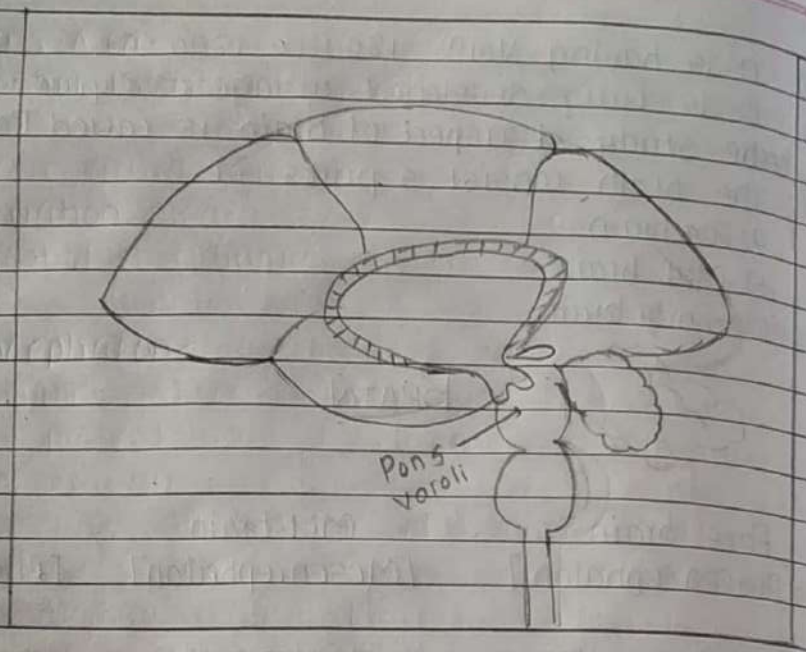
* Brain -
1) It is soft, whitish, large sized slightly flattend structure
2) It is situated in bonybox i.e cranium of skull
3) It is having average weight - 1300 - 1400 gms
4) It is having Volm 1300 to 1500 cc
5) It is fully developed at age of 6 years
6) The study of aspect of brain is called "Encephalogy"
7) The brain consist 3 parts i.e
   a) Forebrain
   b) Mid-brain
   c) Hind-brain

BRAIN

| Fore brain [Procencephalon] | Mid-brain [Mesencephalon] | Hind brain [Rhombencephalon] |
|---|---|---|
| → Olfactory lobe [Rhenecephalon] | → Cruracerebri [cerebral peduncle] | → Cerebellum, Metencephalon |
| → Cerebrum [Telencephalon] | → Quarpora [Optic chaisma] | → Pons Varoli |
| → Diencephalon [Thalamencephalon] | | → Medulla oblongata [Meyelencephalon] |



Corpus Striatum ← Largest basal nucleus at floor of cerebrum.




a)* Fore brain -
1) It is the frontal part of brain
2) It consist 3 parts -
   i) Olfactory lobes
   ii) Cerebrum
   iii) Diencephalon

i) Olfactory Lobes -
1) They are highly reduced in human ~~being~~ brain.
2) They are covered by cerebrum in all sides except ventral side.
3) It consist 2 parts i.e
   1) Olfactory peduncle.
   2) olfactory bulb
- Function:
It control sense of smell

ii) Cerebrum -
1) It is the largest part of human brain, hence is also called as "large brain"
2) It forms 85 % of brain
3) It is made up by two cerebral hemisphere
4) Cerebral hemisphere are seprated by long median fissure
5) The two cerebral hemisphere are connect with each other by the bond of nervefibers is called corpus callosum
6) The outer part of cerebrum is called cerebral corter
7) The inner part of cerebrum is called as cerebral Medulla
8) The cerebral corter consist "Grey matter" and cerebral medulla consist "white matter"
9) Grey matter made up by aggregation of cyton
10) White matter made up by aggregation of axon
11) On the surface of cerebral hemisphere the folded convolutions present called sulci / sulcus & depression present called gyri
12) With the help of sulci / sulcus the brain divides into 4 lobes
   1) Frontal lobe 2) parietal lobe 3) occipetal lobe 4) Temporal

Cerebrum

| Frontal lobe | Parietal lobe | Occipetal lobe | Temporal lobe |
|---|---|---|---|
| 1) Motor Area<br>It control voluntary activities<br>i.e action of muscles | 1. It control ~~Speech~~ of sensation ~~Touch~~, temp. pressure, Pain. | 1. It control sense of Vision | 1. Olfactory sense - Smell |
| 2) Pre-Motor Area<br>It control involuntary activities | 2. Taste [Gastatoreceptor] | | 2. Auditory Sense - Hearing |
| | | | 3. Speech & emotion. |

3) Broca's Area-
1) It control thought into speech.
2) It control sense of memory, intelligence, judgement, etc.

4) Association area-
It ~~control~~ co-ordinate sensation & movement.

iii) Diencephalon-
1) It is the part of fore brain
2) It is present below the corpus callosum & above the mid brain
3) It enclose III ventricle of brain. [Diocoel]
4) It consist 3 parts i.e
1) Epithalamus 2) Thalamus 3) Hypothalamus

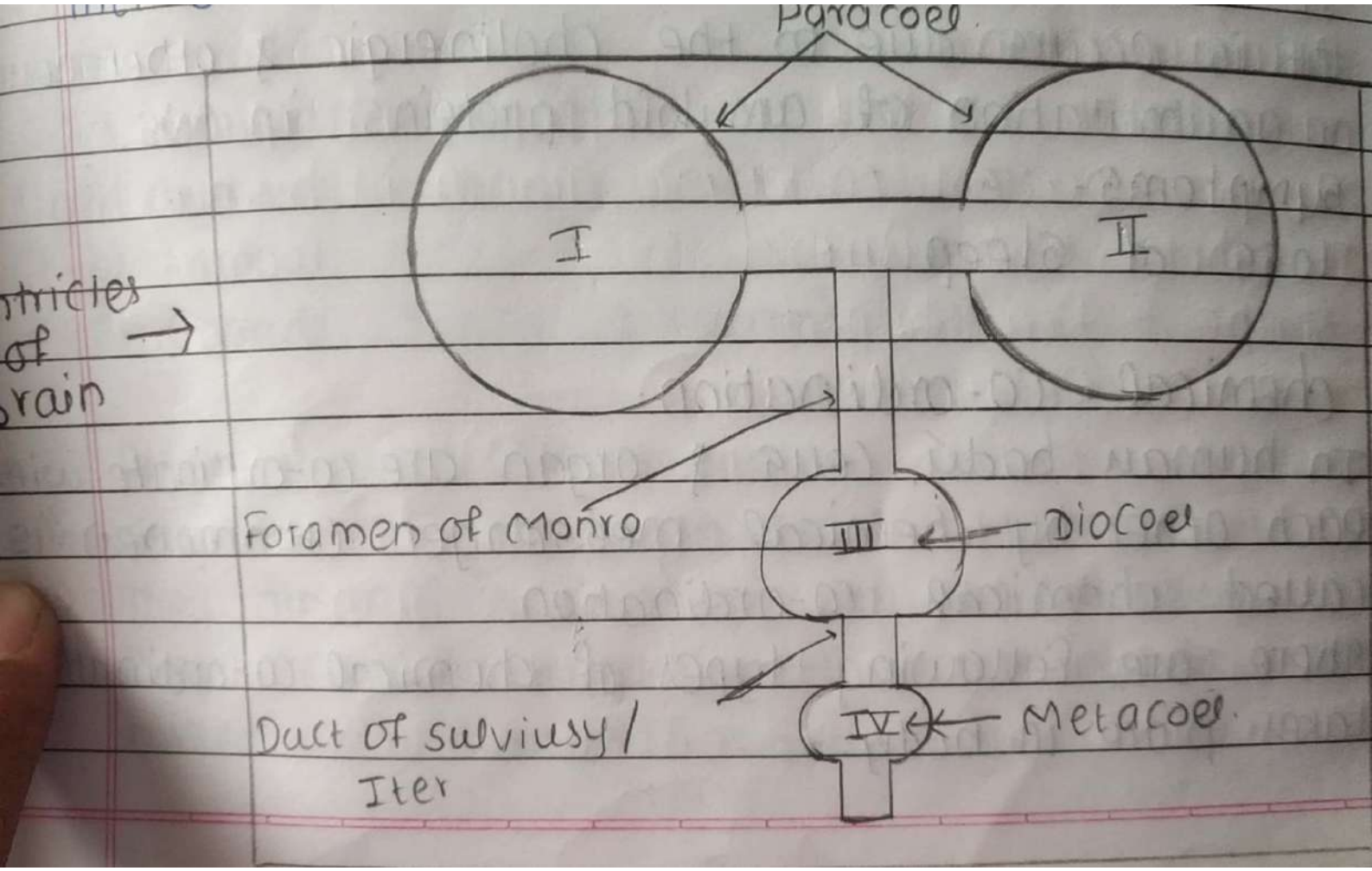
1) Epithalamus-
1) It is the roof of Diencephalon
2) It is non-~~surface~~ nervous part
3) The stalk of pineal body are attached to the Epithala
4) It secrete 2 harmones-
- Serotonin → It control Metabolic activities of brain
- Melatonin → It is sleep inducing harmone / control reproductive behaviour.

2) Thalamus-
1) It is lateral wall of diencephalon
2) It forms RAS [Reticular ~~Activing~~ Activating System]
3) RAS interconnect the brain parts.
4) It acts as Relay center for transmission of sensory impulses.
5) They mainly contain grey matter

3) Hypothalamus-
1) It is the floor of Diencephalon
2) It is richly supply by blood vessels.
* Functions-
1) It provide site for attachment of pitutory glands.
2) It maintain Homeostasis.
3) Internal equillibrium of body
4) It stimulate P.G & secrete harmones oxytocin & Vassopressin (Presin)
5) It regulate-
Heart rate, Respiration, blood pressure, Body temp. water & electrolytic balance.
6) It is centre of sleep, thrust, hunger etc.

* Ventricles of Brain-
1) The open space / cavity present inside the brain is called Ventricle of brain
2) There are 4 ventricles present in brain.
3) I & II ventricle present in cerebral hemisphere & it is called paracoel.
4) The III ventricle present in diencephalon & it is called "Diocoel"
5) The IV ventricle present in medulla oblongata & it is "Metacoel"
6) The I & II ventricle are connect with III verticle by foramen of Monro
7) III ventricle connect with IV ventricle by duct of Sylvius / Iter

b) Mid brain
1) It is the middle part of brain.
2) It is present in bet^n Dicephalon & pons varoli.
3) It consist 2 parts i.e


Paracoel
I
II
tricles
of
rain
Foramen of Monro
III
Diocoel
Duct of sulviusy /
Iter
IV
Metacoel

i) corpora quadrigemina
ii) Crura cerebri

i) Corpora quadrigemina-
1) It is also called as "optic lobes"
2) It contain 4 Coliculi
3) Upper 2 (superior coliculi) involve in visual reflex
4) Lower 2 (Inferior coliculi) involve in auditory reflex
Function - It control sense of vision & hearing

ii) Crura cerebri.
1) It is also called as "optic chaisma".
2) It is tract of ascending & descending nerve fibers of RAS (Recticular Activiting System)
3) In Crura cerebri, gray matter scattered in white matter is called as "Red Nucleus"
Function: It controlling posture & muscle tone

c) Hind brain-
1) It is posterior region of brain
2) It consist 3 parts i.e
i) Pons Varoli ii) cerebellum iii) Medulla oblongata

i) Pons Varoli-
1) It is present below the cerebrum, infront of cerebellum & above the medulla oblongata
Function - i) It co-ordinate cerebellar hemisphere
2) It co-ordinate cerebrum, cerebellum, medulla oblongata & spinal cord.

ii) cerebellum-
1) It is 2nd largest part of brain
2) 11% of weight of human brain
3) It is highly developed in human brain
4) It has outer cerebellar cortex contain grey mater
5) Inner cerebellar medulla contain white mater
6) The white matter spread in grey mater & forms tree like structure called "Arbor Vitae"
Function - 1) It maintain equilibrium of body.
2) Posture
3) Balancing orientation.
4) voluntary movement.
5) Maintance of muscle ~~tone~~ tone
6) It control activities like walking, Running, Swimming, Speaking, etc
7) It is made up by two latenal hemisphere & central vermis.

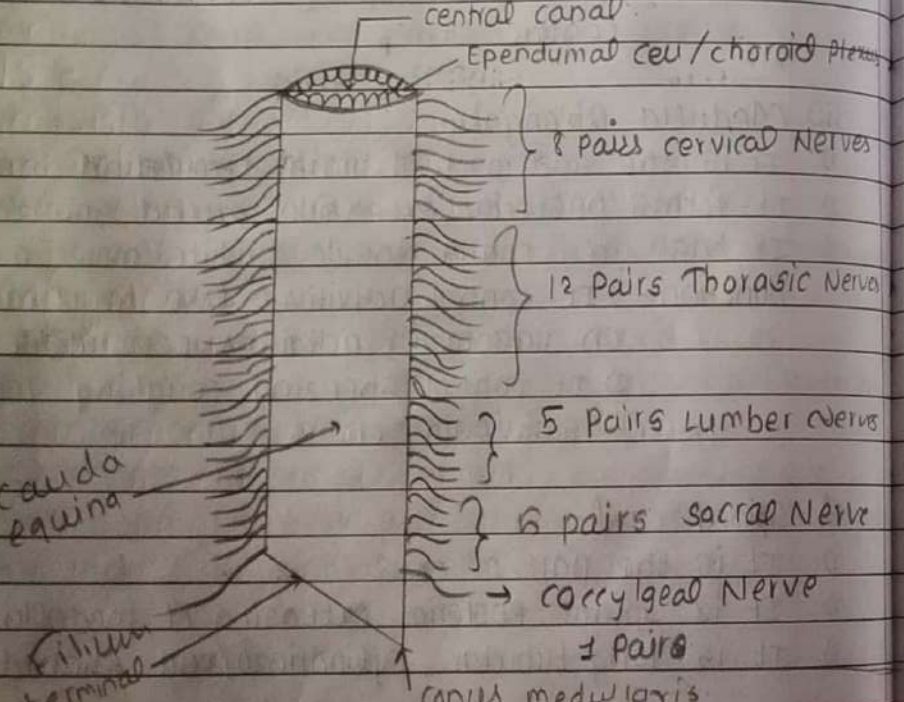
iii) Medulla oblongata-
1) It is the end part of brain stem / Hind brain
2) It forms posterior extension called spinal cord.
3) It has grey mater inside & white mater outside
Function - 1) It control activitives like heart rate, respiration, vasomotor activities, peristalsis
2) It control sneezing, coughing, vommiting, swallowing, etc

B) Spinal cord-
1) It is the part of CNS
2) It is ~~spinal~~ Posterior extension of medulla oblongata
3) It is long, tubular, cylindrical/rod shaped structure.

more than 1 hence it is called 'Deputy of brain' brain.

4) It runs throughout the neural canal of vertebral column
5) It is having length 42 to 45 cm & 2 to 2.5 cm broad
6) It is covered by meninges i.e D.M. A.M. P.M
7) Inside the pia mater the layer of ependymal cells are present & secrete CSF.
8) The tapering end of spinal cord called conus Medullaris.
9) End of Meninges on spinal cord is called Flium terminale
10) The thread like spinal nerve with filium terminale & forms horse tail like appearance is called Cauda equina
11) It arises 31 pairs of spinal nerves
12) The spinal nerve arise laterally through the opening of Vertebral column is called invertebral foramen.

$C_8\ Th_{12}\ L_5\ S_5\ Co_1$




* T.S of Spinal cord.

It shows following parts.

1) Central canal
2) Grey mater
3) White mater

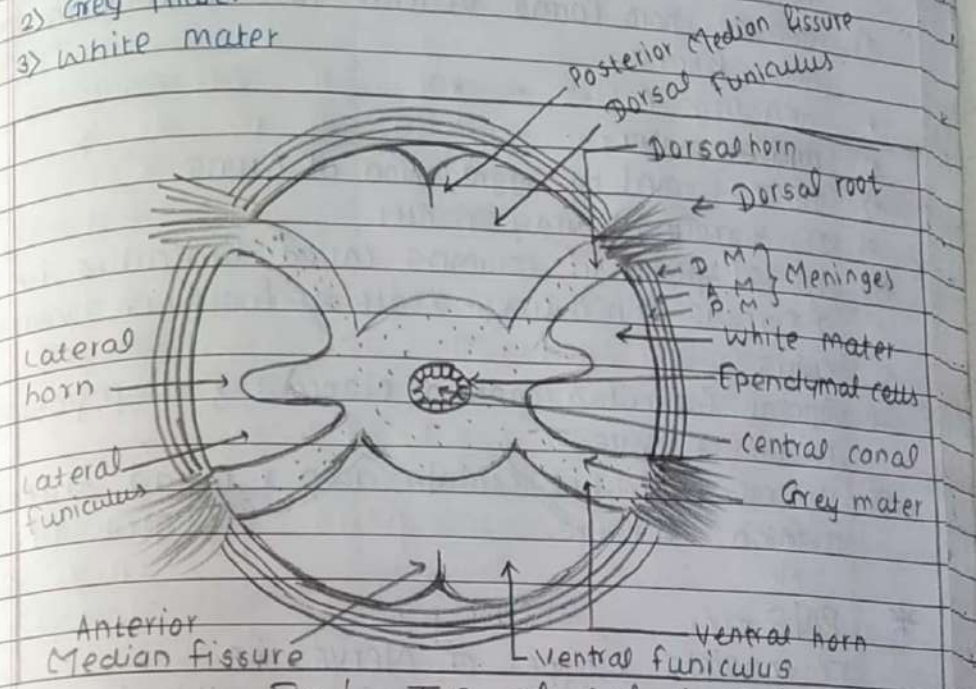



Fig :- T.S of Spinal cord

1) Central canal-
   1) The hollow cavity present inside the spinal cord is called as central canal
   2) It is internaly lined by ependymal cells / choroid plexus
   3) It secrete CSF

2) Grey Mater-
   1) It is formed by aggregation of cyton.
   2) It surrounds central canal.
   3) It is 'H' shaped / Butterfly shaped

4) It forms 2 dorsal horn, 2 lateral horn, 2 ventral horn
5) Dorsal horn forms dorsal root it contain sensory nerve fibers.
6) Ventral horn forms ventral root it contain Motor nerve fibers

3) White mater-
1) It is formed by aggregation of Axons.
2) It surrounds Gray mater
3) It is spread in columns caved funiculus i.e 2 Dorsal funiculus, 2 lateral funiculus, 2 ventral funiculus
4) Dorsal funiculus contain Narrow & deep posterior median fissure.
5) Ventral funiculus contain deep & broad anterior median fissure.

* PNS -
It consists 2 types of Nerves i.e
A) Cranial Nerves → Nerve arise from brain
B) Spinal Nerves → Nerve arise from Spinal

A) Cranial Nerves-
1) The nerves arise from brain is caved cranial nerve
2) They are sensory, Motor & mixed in nature
3) They are present in 12 ~~number~~ pairs
They are 24 in numbers.

| | Name | Nature | Function |
|---|---|---|---|
| I | Olfactory | Sensory | Sense of Smell |
| II | Optic | Sensory | Sense of vision |
| III | Occulomotor | Motor | Movement of eyeball |
| IV | Pathetic | Motor | Rotation & Movement of eyes |
| V | Trigeminal (Longest nerve) | Mixed | Sensation of touch, taste, movement of jaw |
| VI | Abducene | Motor | Movement of eyeball |
| VII | Facial | Mixed | Facial expression, Secreation of tears, Salivary secretion |
| VIII | Auditory | Sensory | Hearing & equilibrium |
| IX | Glassopharygeal | Mixed | Taste, Salivary Secretion, Swallowing |
| X | Vagus (Smallest nerve) | Mixed | Gastric & Pancreatic Secreation Gastrointestinal movement, movement of Visceral organ (Heart) |
| | Neumogastric Nerve | | |

Medulla oblongata

| | | | |
|---|---|---|---|
| XI | Spinal accessory | Motor | Movement of Head, Neck & shoulder |
| XII | Hypoglossal | Motor | Movement of Tongue. |

- Sensory Nerves ⟶ I , II VIII
- Motor Nerves ⟶ III, IV, VI, XI, XII
- Mixed Nerves ⟶ V, VII, IX, X

B) Spinal Nerves-

1) The Spinal Nerves are arise from Spinal cord
2) They are in 31 pairs → They are 62 in number
3) All Spinal Nerves are Mixed in nature
4) It is also called "Deputy of brain".

$C_8$ $Th_{12}$ $L_5$ $S_5$ $CO_1$

| Grp No | Names | pairs | Region of Origin |
|---|---|---|---|
| 1 | Cervicles Nerve | 8 pairs | Neck |
| 2 | Thorasic Nerve | 12 pairs | Thorasic cavity |
| 3 | Lumber Nerve | 5 pairs | Abdomen |
| 4 | Sacral Nerve | 5 pairs | pelvic |
| 5 | Coccygeal Nerve | 1 pair | Coccyx |

- Why all Spinal nerve are mixed in nature?

→ 1) Because they are formed by union of Dorsal & Ventral root.
2) Dorsal root contain sensory nerve fibers & ventral root contain Motor nerve fiber. ∴ Hence

- Formation of Spinal nerves

1) The all Spinal nereves are mixed in nature.
2) Because they are formed by union of Dorsal root & Ventral root.
3) Dorsal root contain sensory nerve fibers & ventral root contain motor nerve fiber.
4) The formation of spinal nerves take place in neural canal of Vertebral column.
5) they are comes out through a small opening of vertebral column. is called intervertebral foramen.
6) When they are comes out it is differenciates into 3 branches.

Intervertebral Foramen

| Ramus Dorsalis | Ramus Ventralis | Ramus Communicalis |
|---|---|---|
| 1) They are inervats in skin and Muscles of dorsal side of bodyparts | 1) It is ~~large~~ longest branch. 2) It intervates in skin & muscles of ventral/ Lateral / Anterior side of body | 1) It is short branch 2) It is connect with Symphethetic ganglions |

* ANS (Autonomic Nervous System)

1) It control the function of visceral organs.
2) It has 2 parts
   A) Symphethetic N.S
   B) Parasymphetic N.S.

A) Symphethetic Nervous System-

1) It is made up by 22 pairs of Symphetetic ganglion
2) It contain ~~cervico-sacral~~ Thoraco-Lumber Nerve fibers.

Thoraco lumber
3) It is also called as "~~cervico - sacral~~ outflow"
4) It is present at either side of vetebral column.
5) It secrete Emergency / Stress harmones i.e Adrenalin & Nor-adrenalin
6) The system control our body function when we are in fear, stress, strain, pain, pressure, anger etc.
7) the system increase - Blood pressure, Heart rate, Excreation, digestion, constriction of Blood vessels, pupils of eye dilates etc.

B) Parasymphethetic Nervous System-
1) It is made up by parasympathetic ganglion.
2) It contain ~~Thoraco - lumber nerve~~ cranico sacral outflow
3) cranico sacral Nerve
4) It is present at the either side of visceral organs
5) It secrete Neurotransmitter i.e Acetyl choline.
6) This system control our comfort, relax, pleasy etc.
7) This system decreases blood pressure, heart rate, digestion, relaxation of blood vessels, pupiles of eye are cons-

- Disorders of Nervous system.

1) Phychological disorder-
   1) It is also called as "Mental disorder"
   2) It affect on thinking, mood & behaviour of person.
   3) Some major categories of pschological disorder are
      a) Metal retardation (Intellectual disability)
      b) depression
      c) Anexiety disorder
      d) ADHD (Attension Deficit Hyperactivity disorder)

2) Parkinson's disease.
   1) It occurs due to degradation of dopamine producing neurons in CNS (Happy hormone)
   2) Symptoms -
      a) Trimer
      b) stiffness
      c) Difficulty in walking, balancing & co-ordination

3) Alzemer's disease-
   1) It is the form of dementia
   2) It is occurs due to the cholinergic & other neurons or accumulation of amyloid proteins in CNS.
   3) Symptoms-
      loss of sleep.