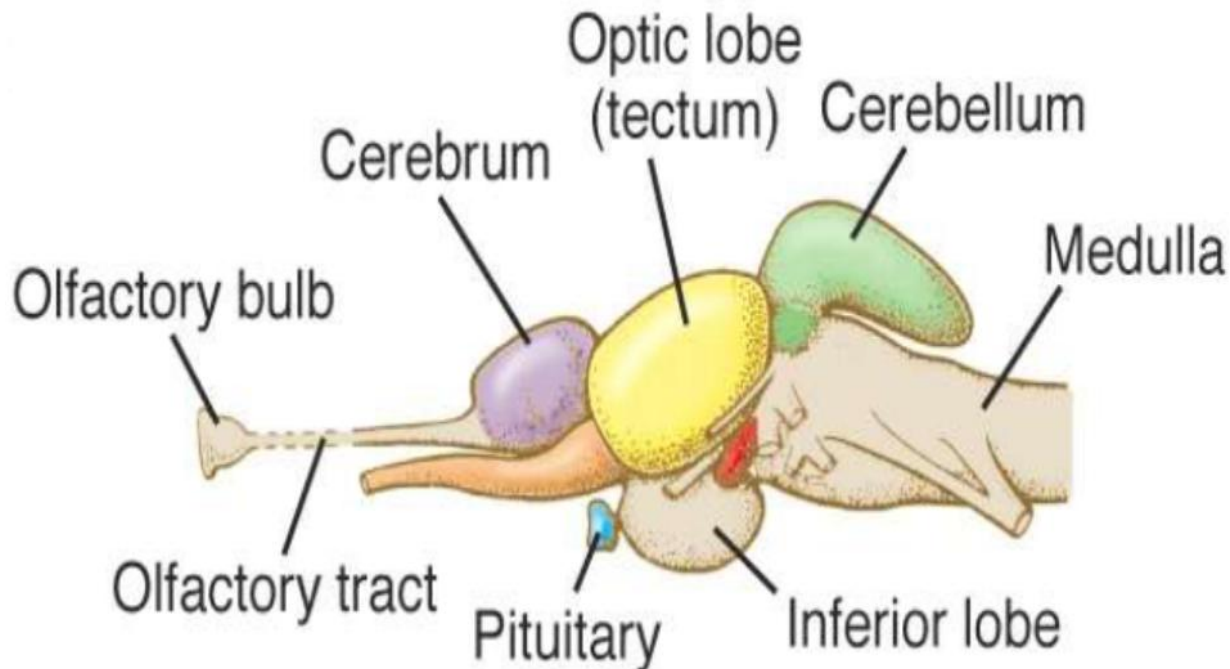
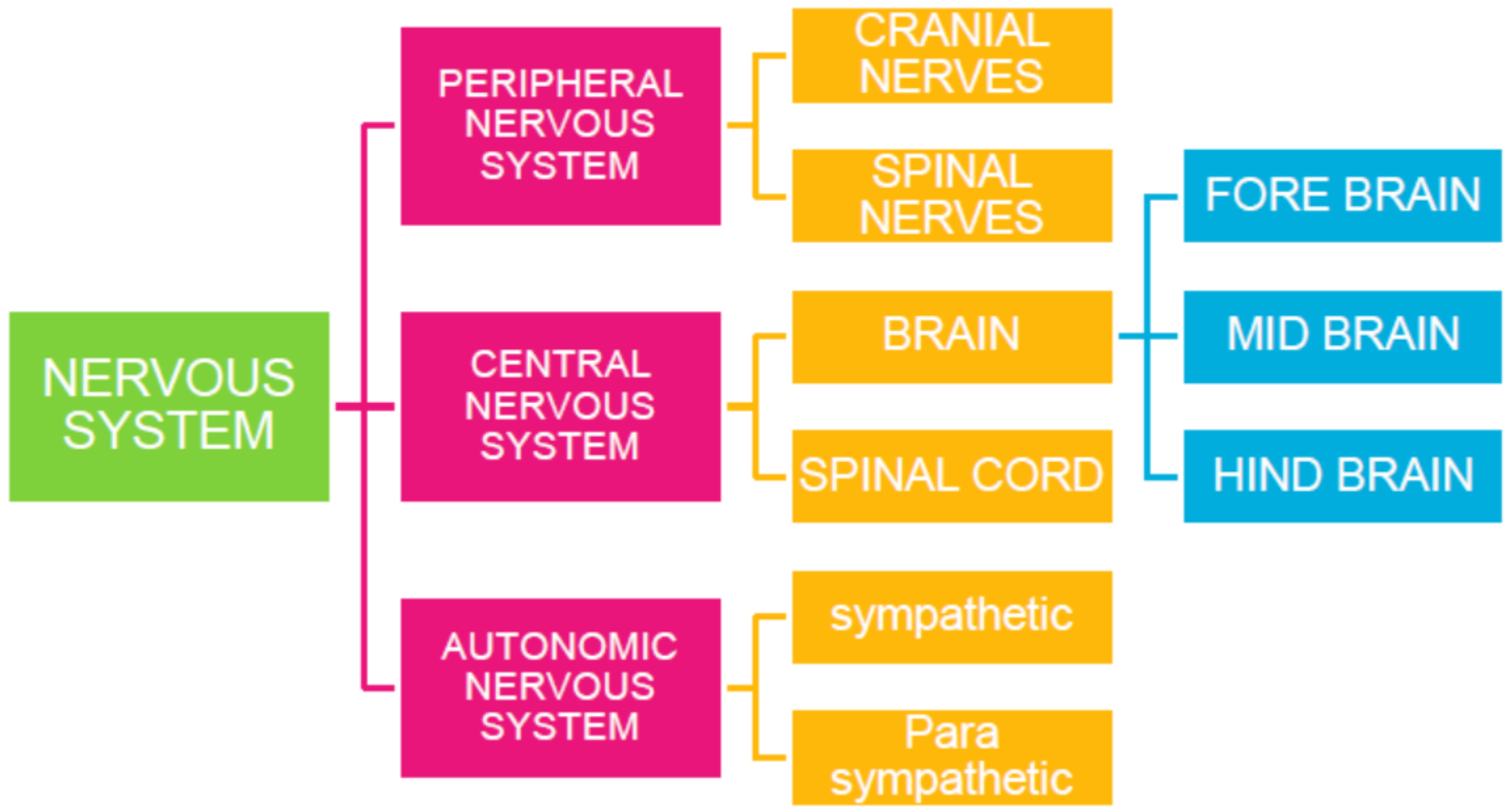


# Nervous System in Finfishes



# INTRODUCTION

- In fishes nervous system is the primary mechanism to coordinating and integrating body activities
- The stimuli are received by the nervous system through sense organs.
- Functioning of nervous system- based on the electrical properties of it's functional units-  
NEURONS
- Nervous system is derived from ectoderm
- Nervous system divisible into:
  - Central nervous system
  - Peripheral nervous system
  - Autonomous nervous system



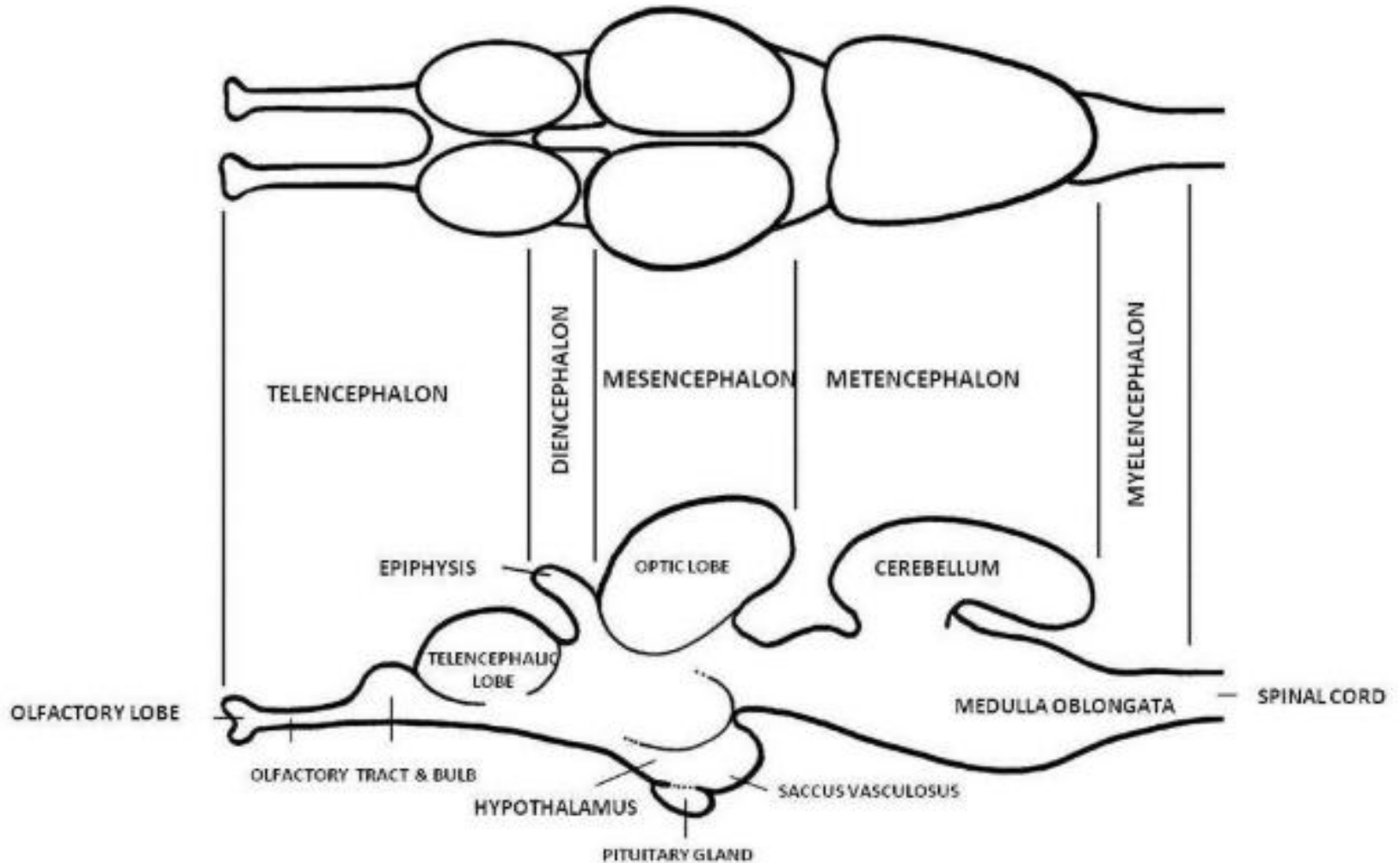
# Brain

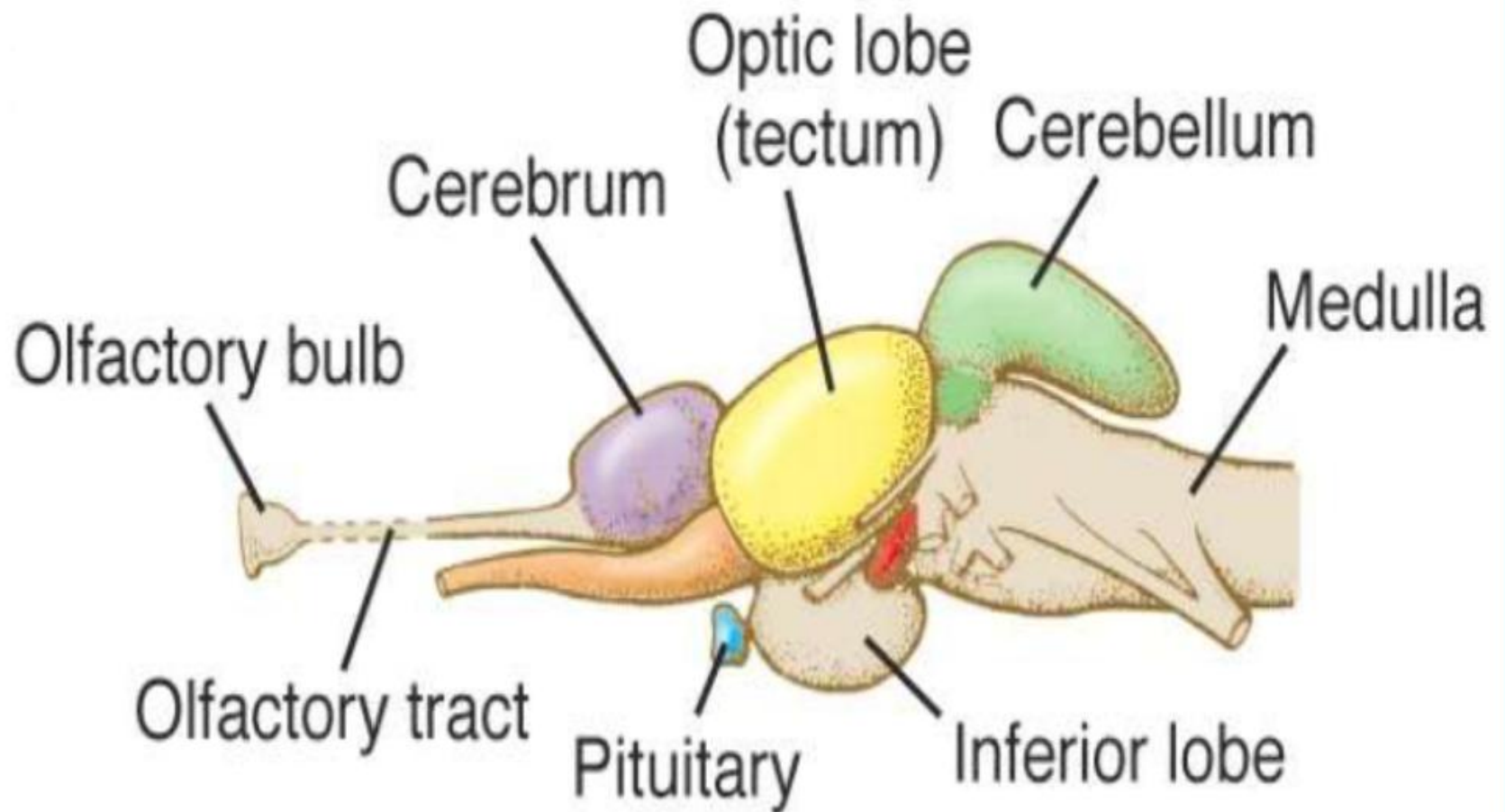
- Fish possess a well developed nervous system consisting of brain, spinal cord and the nerves whose function is to coordinate the activities of the body.
- **Brain:** shows considerable variations in its size in relation to the body in different species and does not occupy the entire cranial cavity. The space b/w cranium and brain is full of gelatinous substance.
- Fish typically have quite small brains relative to body size compared with other vertebrates. › 1/5th size of similarly sized mammal or bird.
- But, in some fishes like mormyrids and have large brains.

## **Teleostean brain is divided into three region**

- **Prosencephalon** (fore brain)
- **Mesencephalon** (mid brain)
- **Rhombencephalon** (hind brain)

# Different regions of teleost brain





**Fish Brain**



# TELENCEPHALON

- ⦿ Anterior most part of brain
- ⦿ Mainly concerned with the receptor and conduction of smell
- ⦿ The sensory receptors for olfaction project to the olfactory bulb
- ⦿ Telencephalon is divided into two principal regions:- area ventralis and area dorsalis
- ⦿ Ventral area receives secondary olfactory fibers and it is a constant structure in all bony fishes

- ① Telencephalon is plays an important role in the reproductive behavior of fishes- sexual behavior and parental behavior
- ① Studies shows telencephalon has another role in learning



## DIENCEPHALON

- ⦿ It is a median diamond shaped area between the cerebral hemisphere and the optic lobes
- ⦿ Divisible into dorsal epi thalamus , thalamus and hypothalamus
- ⦿ Epithalamus is small in elasmobranchs
- ⦿ Epithalamus consist of two parts:-  
Pineal complex and Habenular nuclei

- Two ganglios of almost equal size are present in the epithalamus and are called the habenulae.
- Habenulae receives a massive afferent input from the pineal gland and a moderate input from the olfactory region and telencephalon.
- The glandular pineal body arise from dorsal wall of diencephalon and is considered to be an endocrine gland.

- ① Thalamus send connections to the hypothalamus
- ① The diencephalon attains its maximum development on ventral side in the form of hypothalamus and infundibulum.
- ① Hypothalamus- major centre for the confluence of information coming from the telencehalon

**Hypothalamus exercises control over the endocrine system of the fish through hypophysis. It contains neurosecretory cells and their secretions are carried to the hypophysis, influencing its activities.**

# Mesencephalon

- Mesencephalon consist of dorsally situated **optic tectum** and ventral situated **tegmentum**.
- The optic tectum forms two optic lobes.
- The optic tectum projects into optocoel and forms a pair of ***torus longitudinalis*** which is a characteristic feature of all the teleost.  
**Function as a correlation centre for photostatic and gravistatic area of brain**

- ① There optic lobes composed of at least five zone differing from each other in shape and size of this cells
- ① the image formed on the retina is projected on tectum
- ① The optic tectum is associated with the reception and elaboration of the visual sensation and correlates them with the muscular responses of animals
- ① TAGMENTUM: Seen in inferior border of the third ventricle



# Rhombencephalon (hind brain)

- Lower most region of the brain
- Consist of Metencephalon and Myelencephalon



# Metencephalon

- Metencephalon consist of the cerebellum
- Cerebellum is most variable structure with in the nervous system
- Mormyrids (*Valvula cerebelli*) is hypertrophic and extends over the dorsal surface of the telencephalon
- Cerebellum has two fundamental divisions in most fishes

- > A cortical basal lobe- which receives vestibular and lateral line nerve fibers
- > A more rostrally situated body of the infundibulum , which receiving afferent nerve fibers from the spinal cord

## **FUNCTION**

- Maintain body posture in swimming by coordinating muscular activities
- In mormyrids, well developed cerebellum associated of reception of impulse from electric organ

# Myelencephalon or medulla oblongata

- ① It is the last part of brain
- ① Divisible into
  - > Somatic and visceral sensory column
  - > Somatic and visceral motor columns
- ① S.S.C carry information derived from general sensory, cutaneous, vestibular, lateral line and trigeminal nerve fibers



- ① V.S.C carries nerve fibers derived from nerves of chemo receptors
- ① V.M.C carries efferent motor nerve fibers derived from facial, glosso pharyngeal and vagus nerves
- ① S.M.C carries efferent motor nerves and supply the striated musculature of the body and thus involved in locomotion

# SPINAL CORD

- ① Spinal cord is uniform in structure through out length and extends for the whole length of the body
- ① In cross section , spinal cord shows a central canal surrounded by gray matter consisting nerve cells
- ① Filled by cerebrospinal fluid
- ① External white matter consisting nerve fibers

# PERIPHERAL NERVOUS SYSTEM

- ① The PNS, consists of nerves , ganglia& receptors.
- ① carries sensory information from special receptor organs to integrating centers of CNS
- ① Peripheral nervous system consists of two kinds nerves,
- ① Spinal nerves and cranial nerves



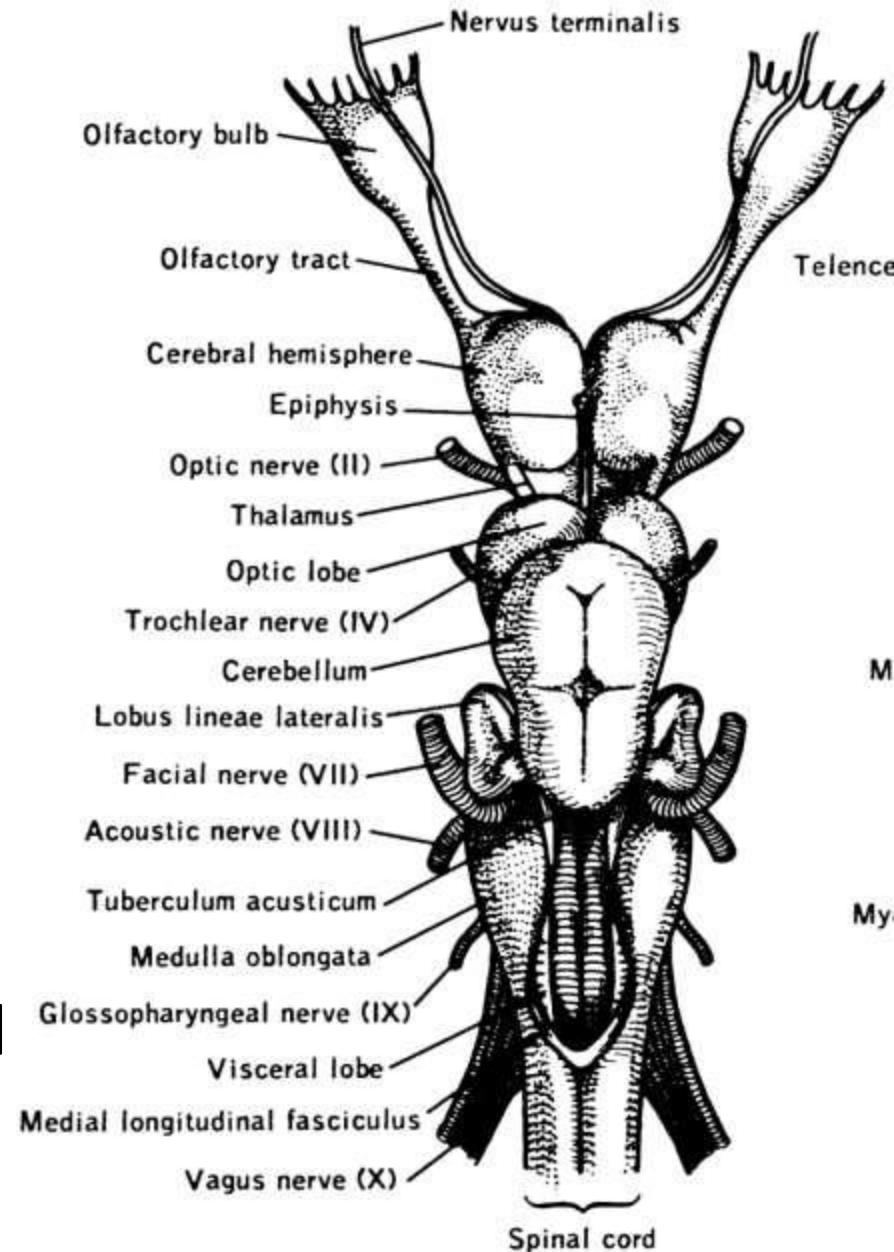
# Spinal nerves

- **The spinal nerves arise in pairs from the spinal cord and are metamerically arranged.**
- **Each spinal nerve has a dorsal and a ventral root originating from spinal cord and is of a mixed type containing both sensory and motor fibres.**
- **Both the roots join to form the mixed nerve which emerges out of the vertebral column through the inter-vertebral aperture. The dorsal root is mainly sensory while the ventral one contains motor fibres.**

# CRANIAL NERVES IN FISHES

## Ten pairs of cranial nerves in fishes:

- › First pair- Olfactory nerve
- › Second pair- Optic nerve
- › Third pair- Oculomotor nerve
- › Fourth pair- Trochlear nerve
- › Fifth pair- Trigeminal nerve
- › Sixth pair- Abducens nerve
- › Seventh pair – Facial nerve
- › Eighth pair- Auditory nerve
- › Ninth pair- Glossopharyngeal
- › Tenth pair- Vagus nerves



# AUTONOMIC NERVOUS SYSTEM

- ◎ Broadly, ANS is a part of PNS to control visceral functions
  - > i.e; It is an involuntary nervous system and function as a control system
- ◎ Divisible into;
  - > Sympathetic and parasympathetic
- ◎ In elasmobranchs, there is no sympathetic system in head

- ① The irregular sympathetic ganglia are found along the vertebral column
- ① Parasympathetic system lacks in fishes
- ① Represented by wildly branched vagus nerves
- ① These functions including heart rate, digestion, respiration etc.
- ① It helps to coordinate the activities of many glands and organs and is itself closely connected to the integrating centers of the brain



# Summary

- ① Nervous system is coordinating body activities in fishes
- ① The stimuli are received by the nervous system through sense organs.
- ① The central nervous system of Brain and Spinal cord.
- ① Brain has different regions and functions
- ① Prosencephalon mainly concerned with reception and conduction of smell

- ① Mesencephalon associated with vision
- ① Metencephalon is coordinating muscular activities
- ① Due to the vast diversity of fishes Size and complexity of brain is different in different fishes, ratio
- ① Peripheral nervous system is nerves and neurons connected with CNS
- ① Autonomic nervous system is concerned with internal environment of body