



# General concepts for Head and Neck Anatomy

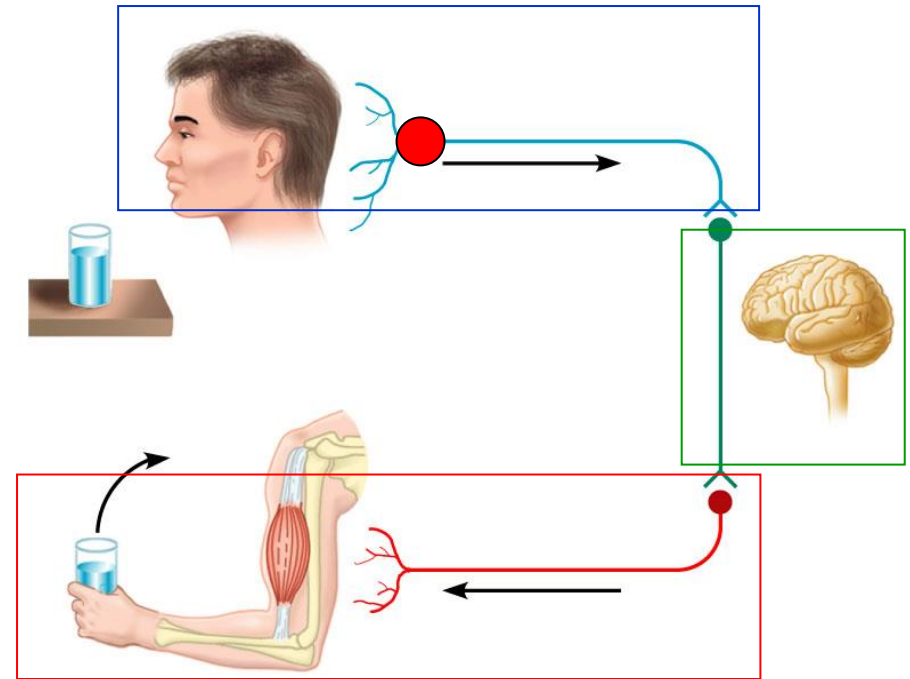
Dr. Heba Kalbouneh

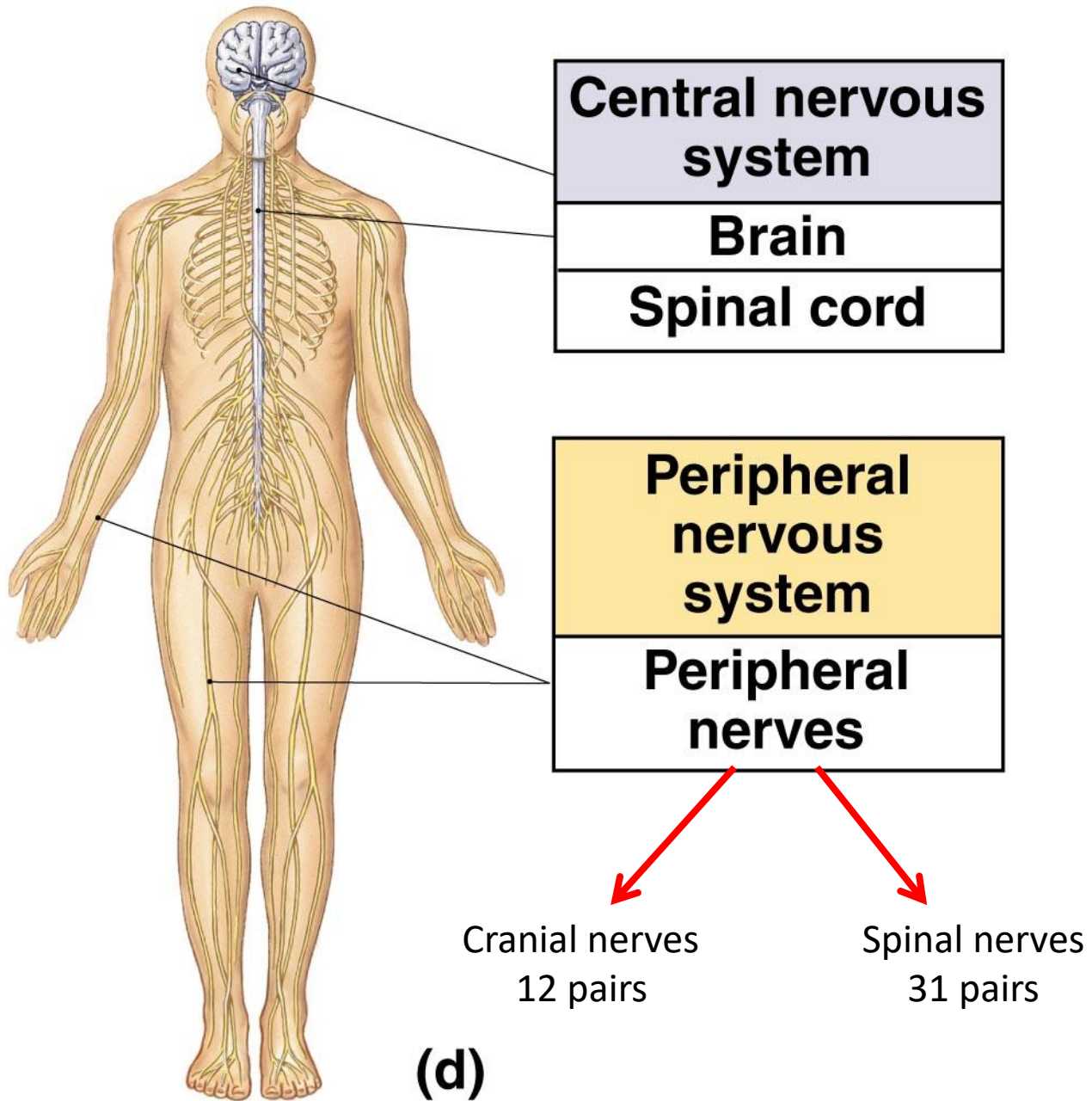
DDS, MSc, DMD/PhD

Professor of Anatomy, Histology and Embryology

# Nervous Tissue

- Controls and integrates all body activities within limits that maintain life
- Three basic functions
  1. sensing changes with **sensory receptors**
  2. **interpreting** and remembering those changes
  3. **reacting** to those changes with effectors (motor function)

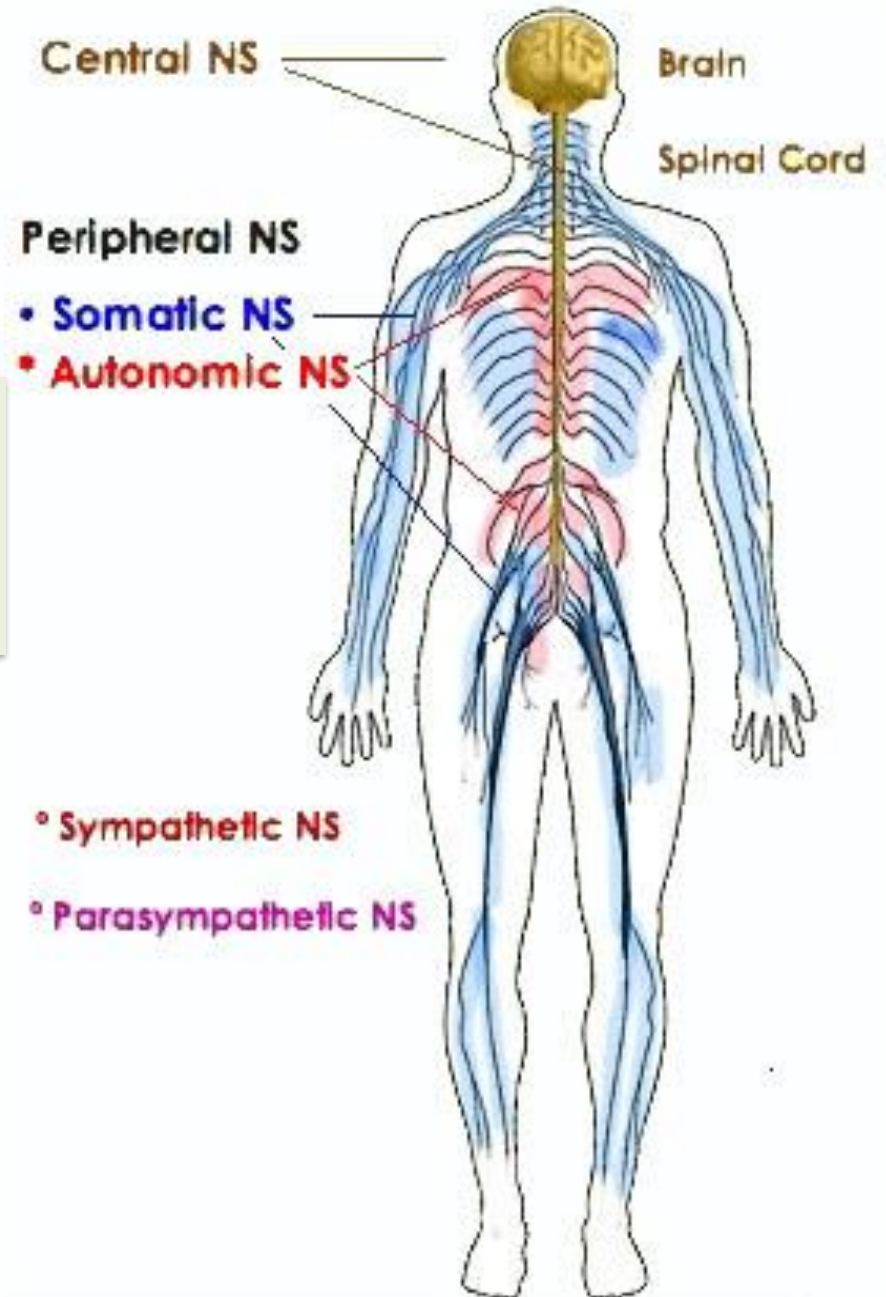




**(d)**

The PNS is divided into :

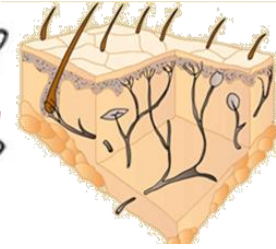
- 1- **Somatic nervous system (SNS)**
- 2- **Autonomic nervous system (ANS)**



# Sensory (Afferent) vs. Motor (Efferent)

sensory (afferent) nerve

**CNS**

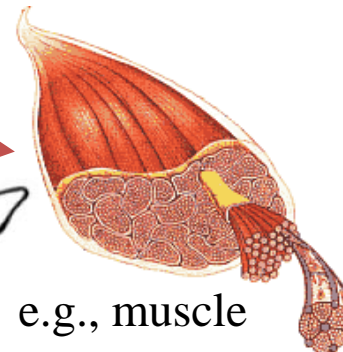
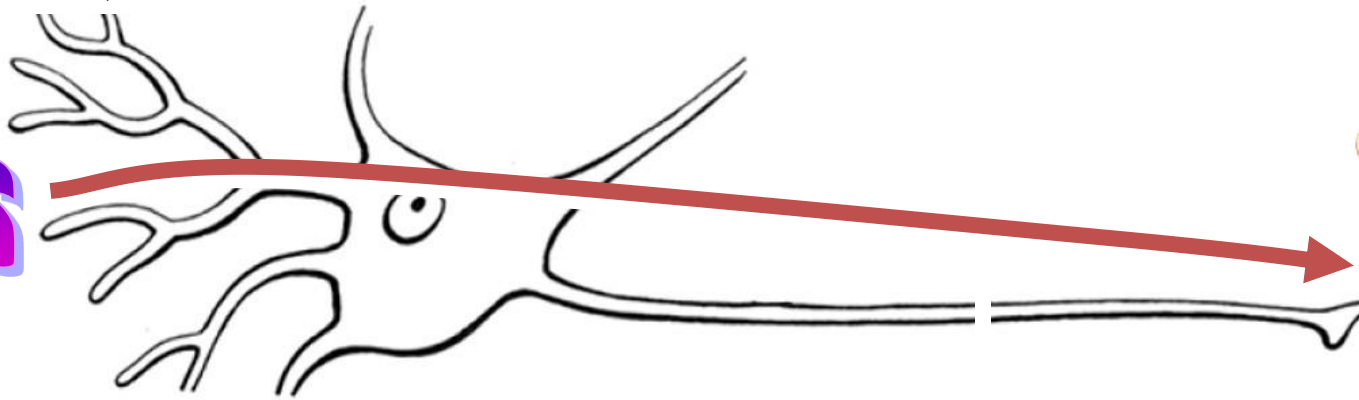


e.g., skin

(pseudo-) unipolar neurons conducting impulses from sensory organs to the CNS

motor (efferent) nerve

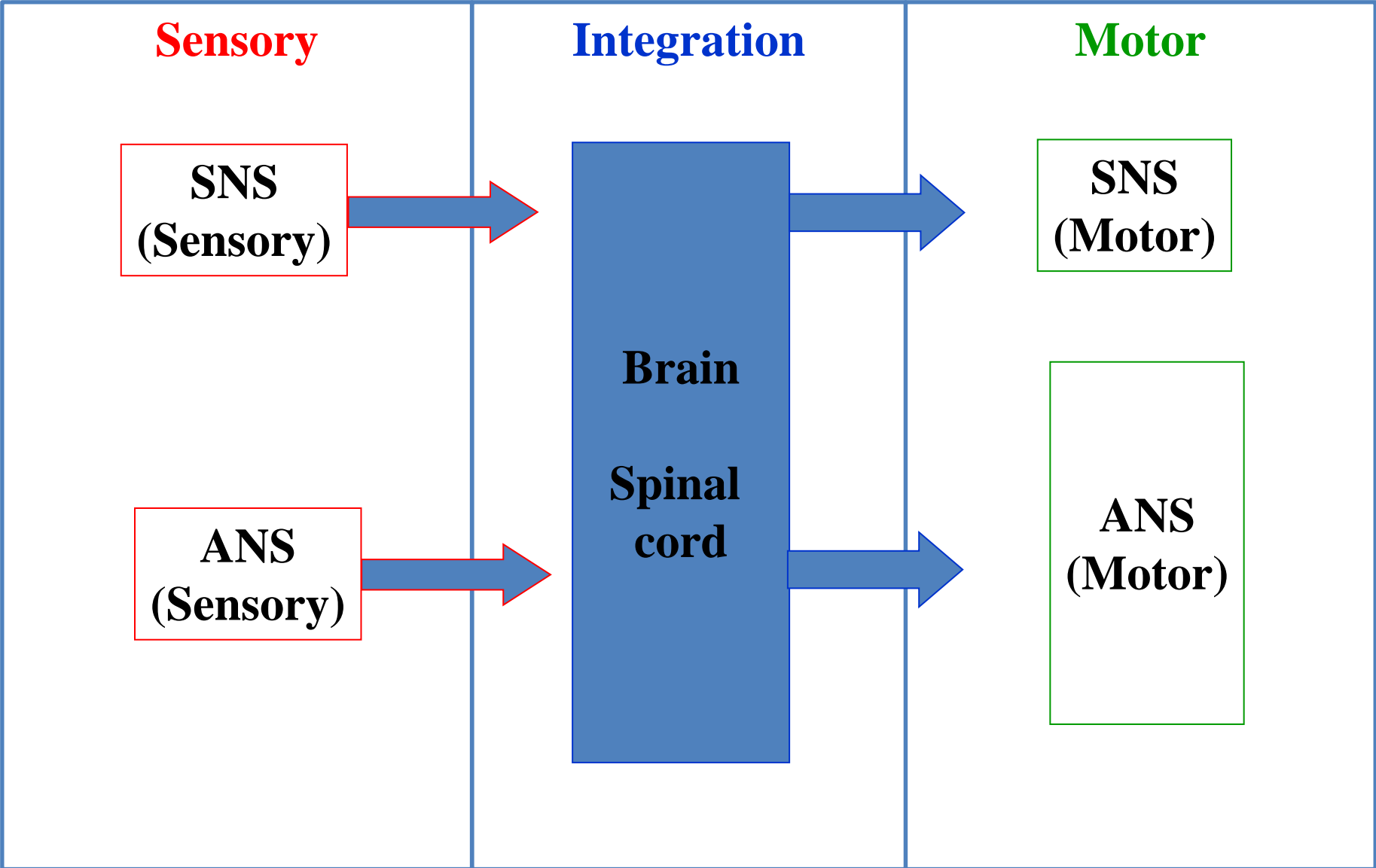
**CNS**



e.g., muscle

multipolar neurons conducting impulses from the CNS to effector organs (muscles & glands)

# Organization



## Structural classification of neurons

### 1. Multipolar neurons

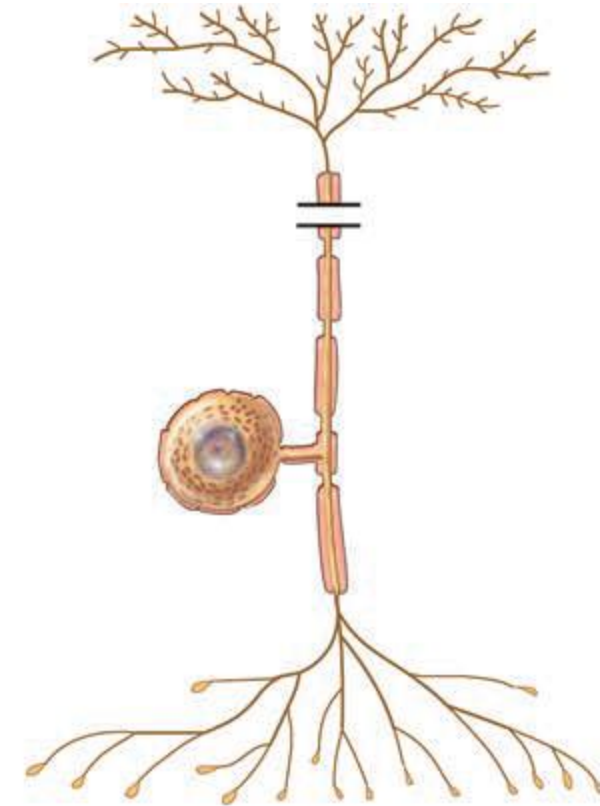
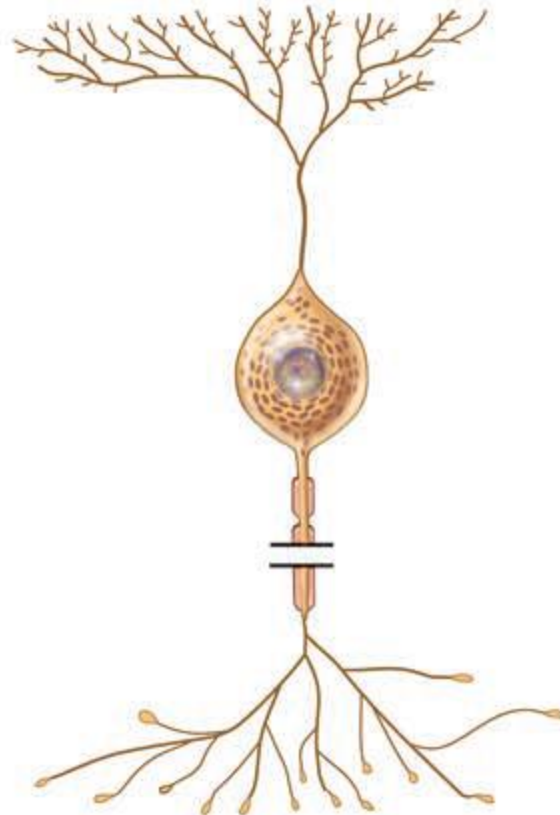
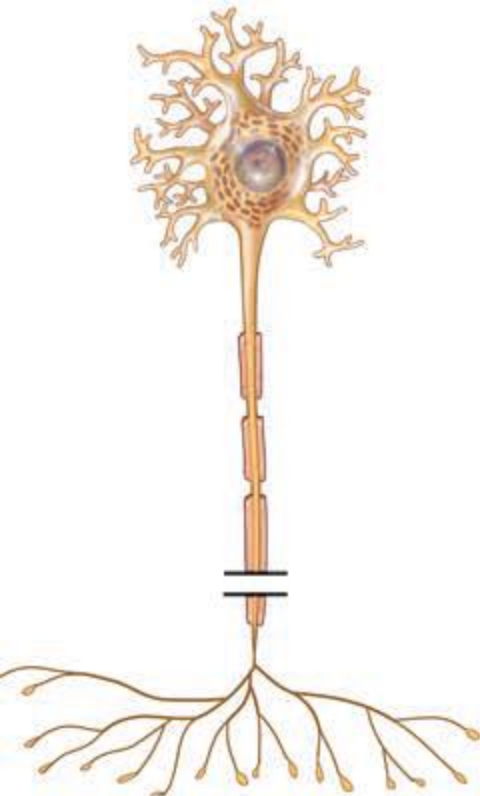
- Usually have several dendrites and one axon
- Motor neurons

### 2. Bipolar neurons

- Have one main dendrite and one axon
- The retina of the eye

### 3. Unipolar neurons (pseudounipolar neurons)

- Sensory neurons



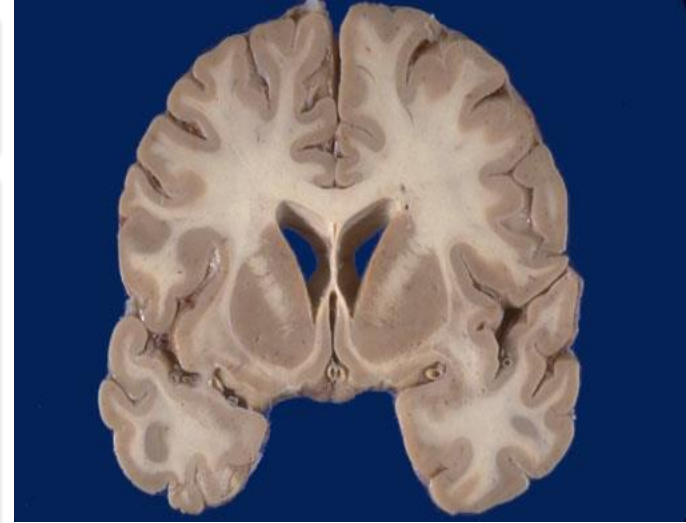


## Clusters of Neuronal Cell Bodies

1. **Ganglion** (plural is ganglia) a cluster of neuronal cell bodies located in the PNS.
2. **Nucleus** (plural is nuclei) : a cluster of neuronal cell bodies located in the CNS.



Transverse section of spinal cord



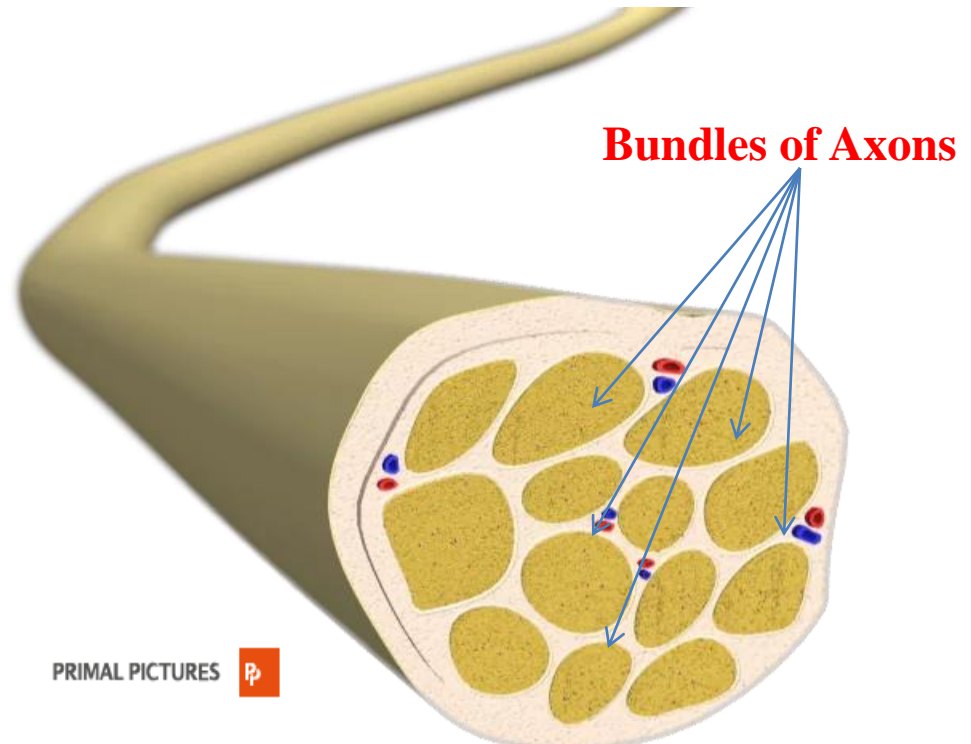
Coronal section of brain

## Bundles of Axons

A **nerve**: is a bundle of axons that is located in the PNS.

- Cranial nerves connect the brain to the periphery
- Spinal nerves connect the spinal cord to the periphery

A **tract**: is a bundle of axons located in the CNS.

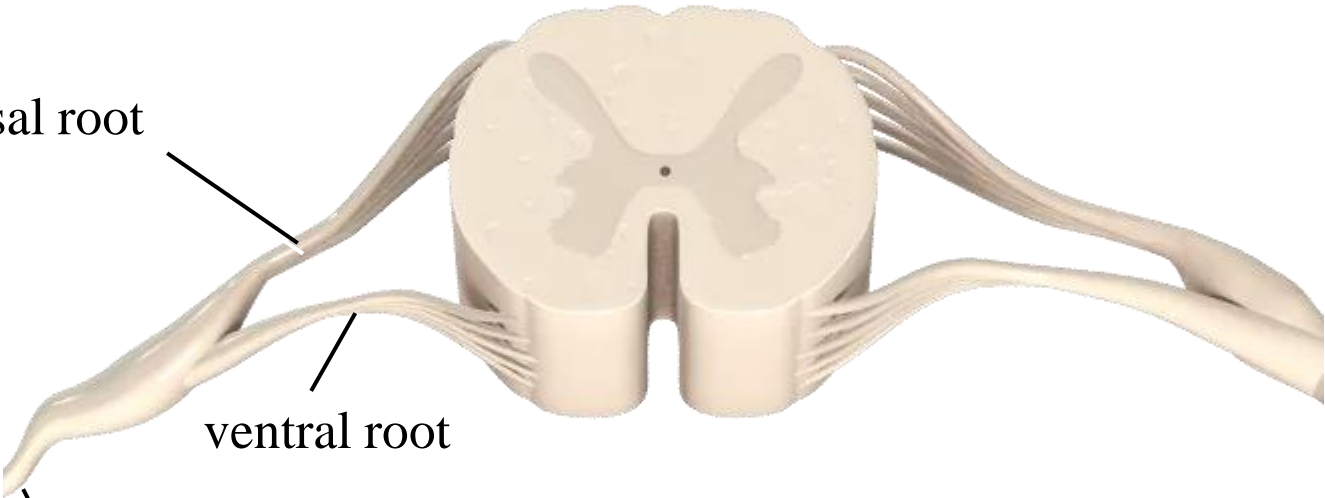




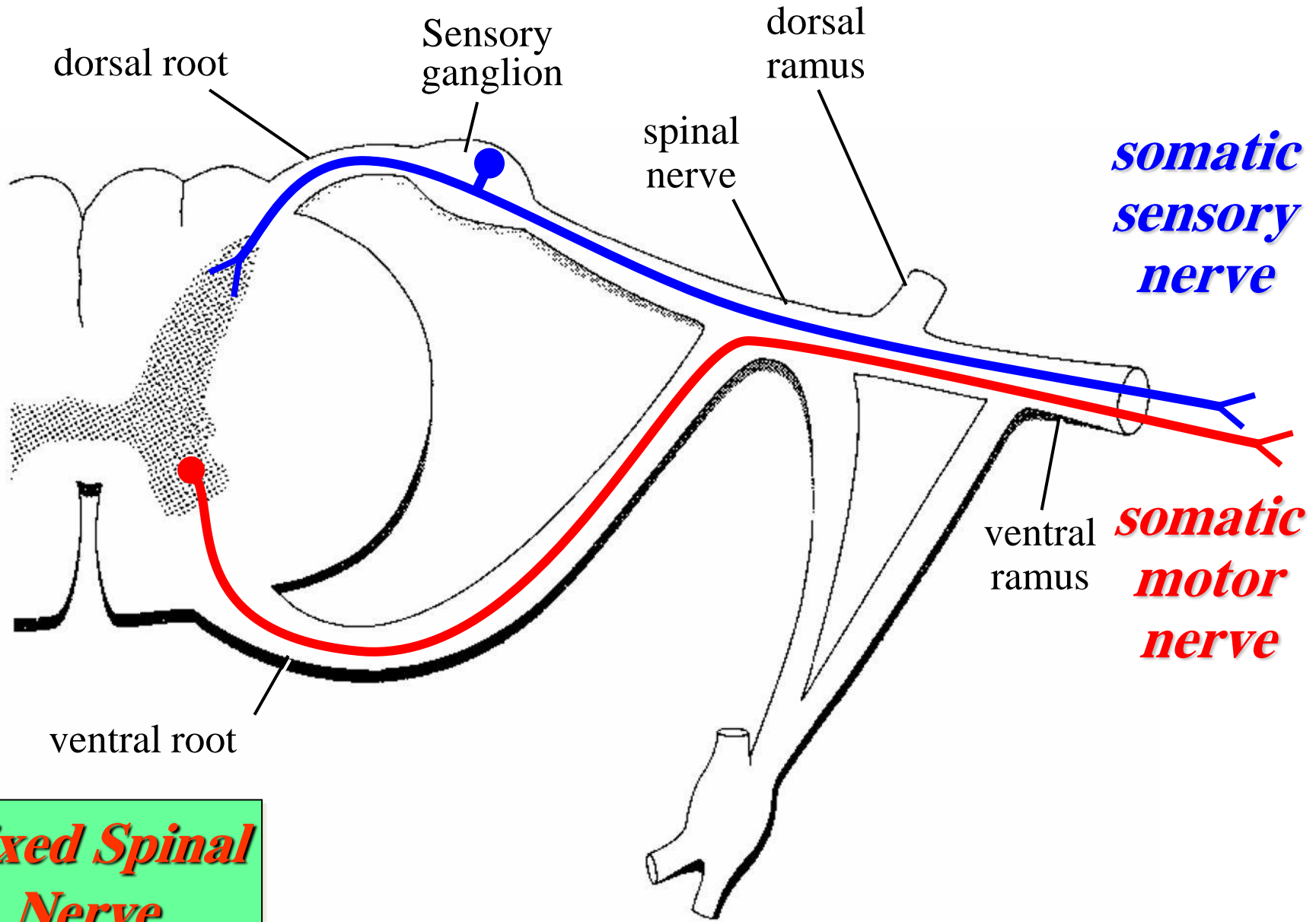
dorsal root

ventral root

spinal  
nerve

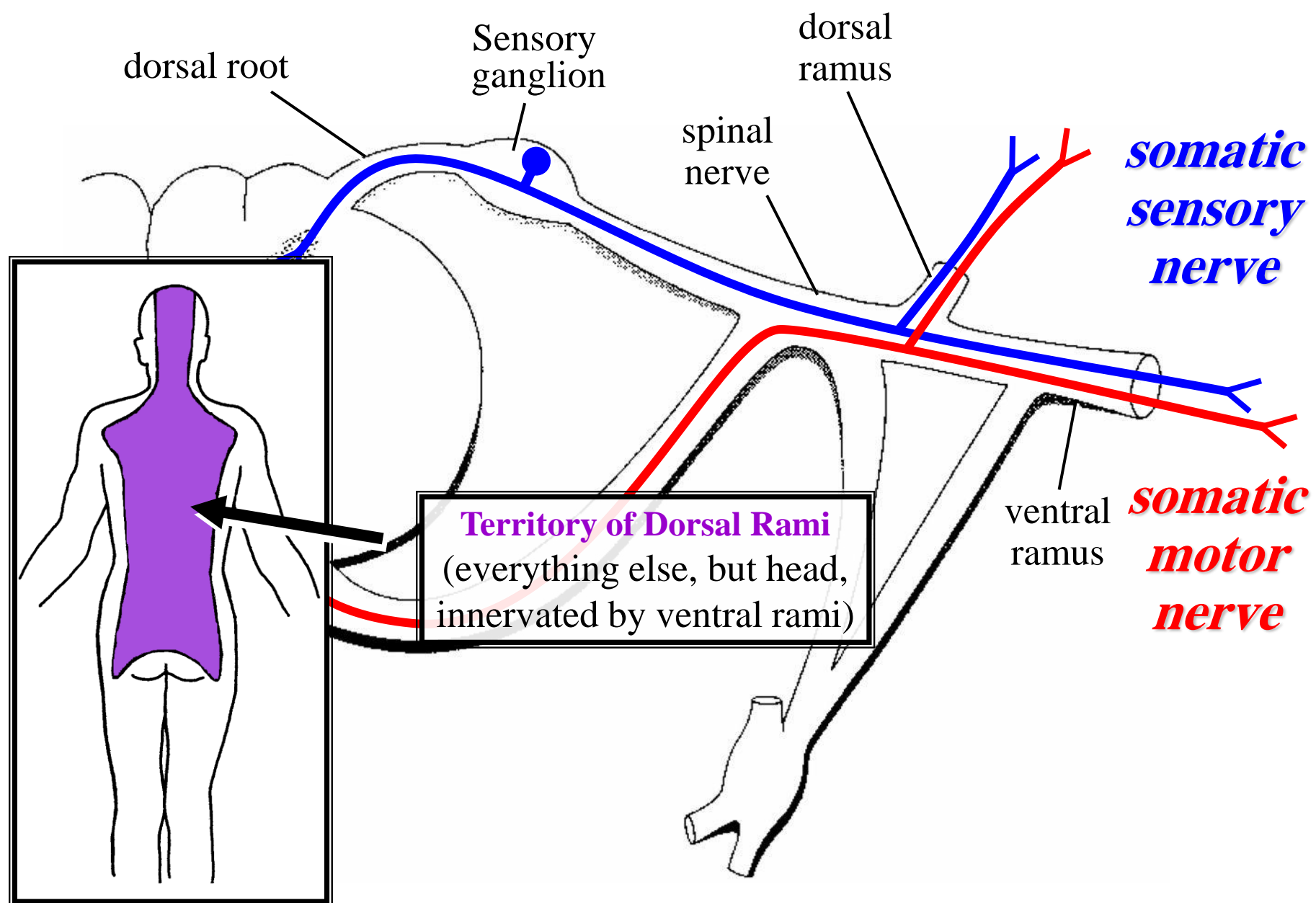


# Structure of Spinal Nerves: Somatic Pathways



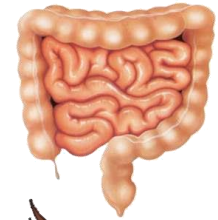
***Mixed Spinal Nerve***

# Structure of Spinal Nerves: Dorsal & Ventral Rami



# Autonomic nervous system

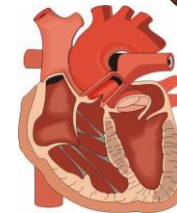
- ANS is the subdivision of the peripheral nervous system that regulates body activities that are generally **not under conscious control**
- **Visceral motor** innervates **non-skeletal (non-somatic) muscles**
- Composed of a special group of neurons serving:
  - Cardiac muscle (the heart)
  - Smooth muscle (walls of viscera and blood vessels)
  - Glands



glands



smooth  
muscle



cardiac  
muscle

# Divisions of the autonomic nervous system

- Parasympathetic division
- Sympathetic division

**Serve most of the same organs but cause opposing or antagonistic effects**

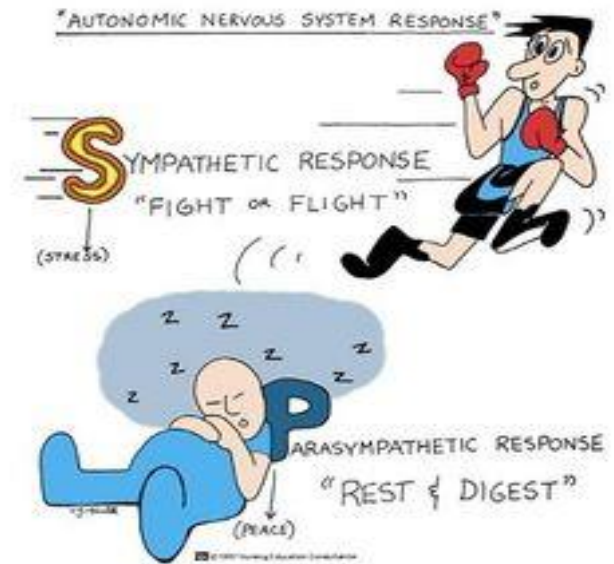


**Parasympathetic:** routine maintenance

**“rest & digest”**

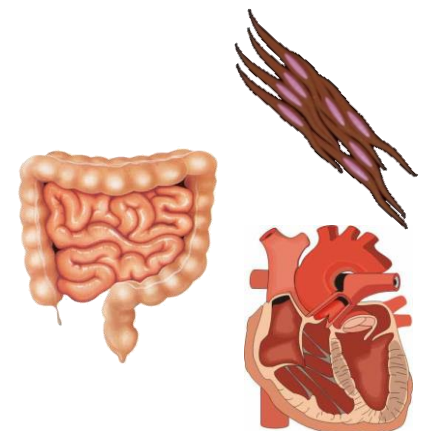
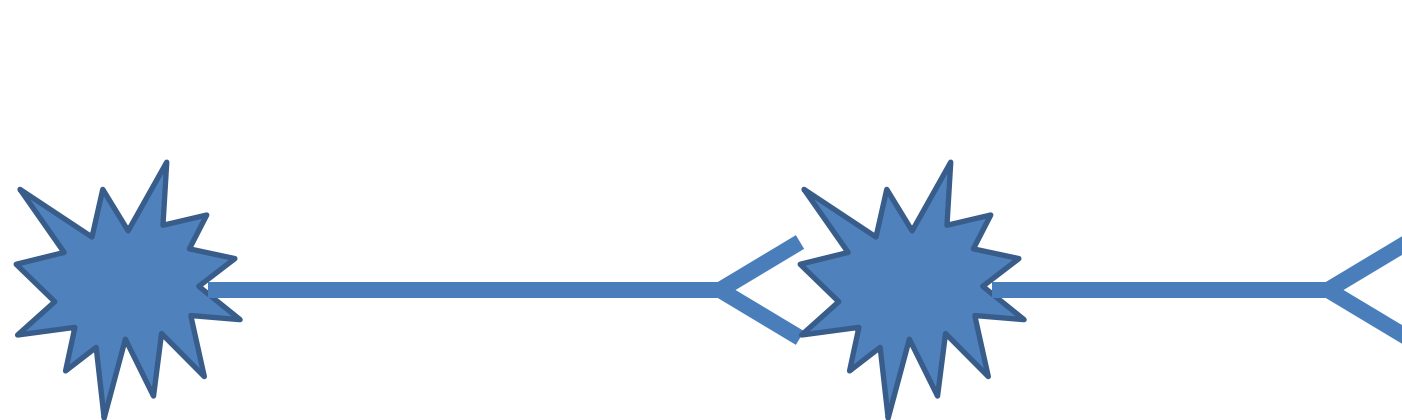
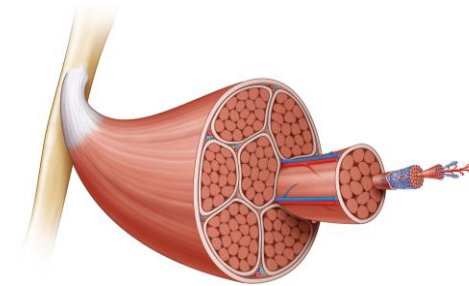
**Sympathetic:** mobilization & increased metabolism

**“fight, flight or fright” or “fight, flight or freeze”**



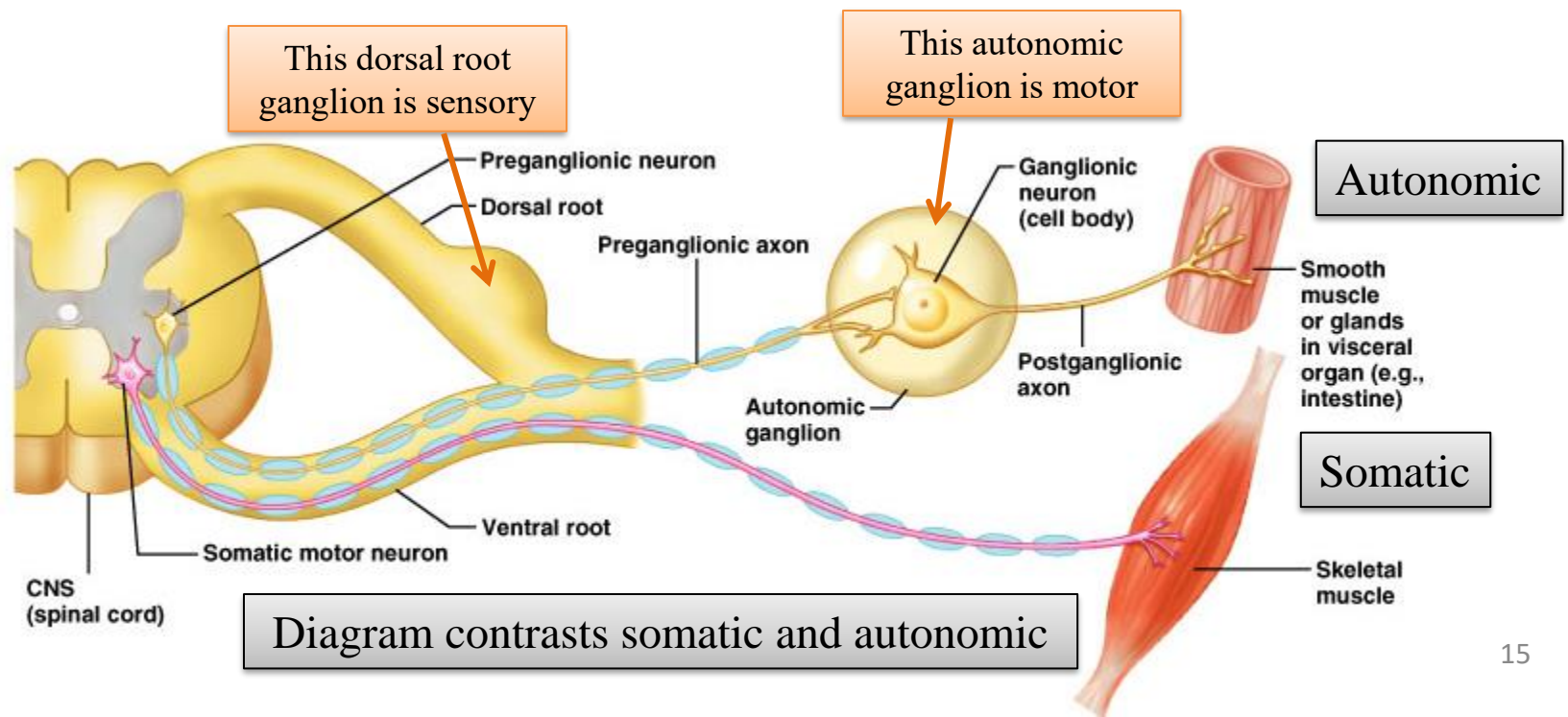
## Basic anatomical difference between the motor pathways of the voluntary somatic nervous system (to skeletal muscles) and those of the autonomic nervous system

- Somatic division:
  - Cell bodies of motor neurons reside in CNS (brain or spinal cord)
  - Their axons (sheathed in spinal nerves) extend all the way to their skeletal muscles
- Autonomic system: chains of two motor neurons
  - 1<sup>st</sup> = preganglionic neuron (cell body in brain or cord)
  - 2<sup>nd</sup> = postganglionic neuron (cell body in ganglion outside CNS)





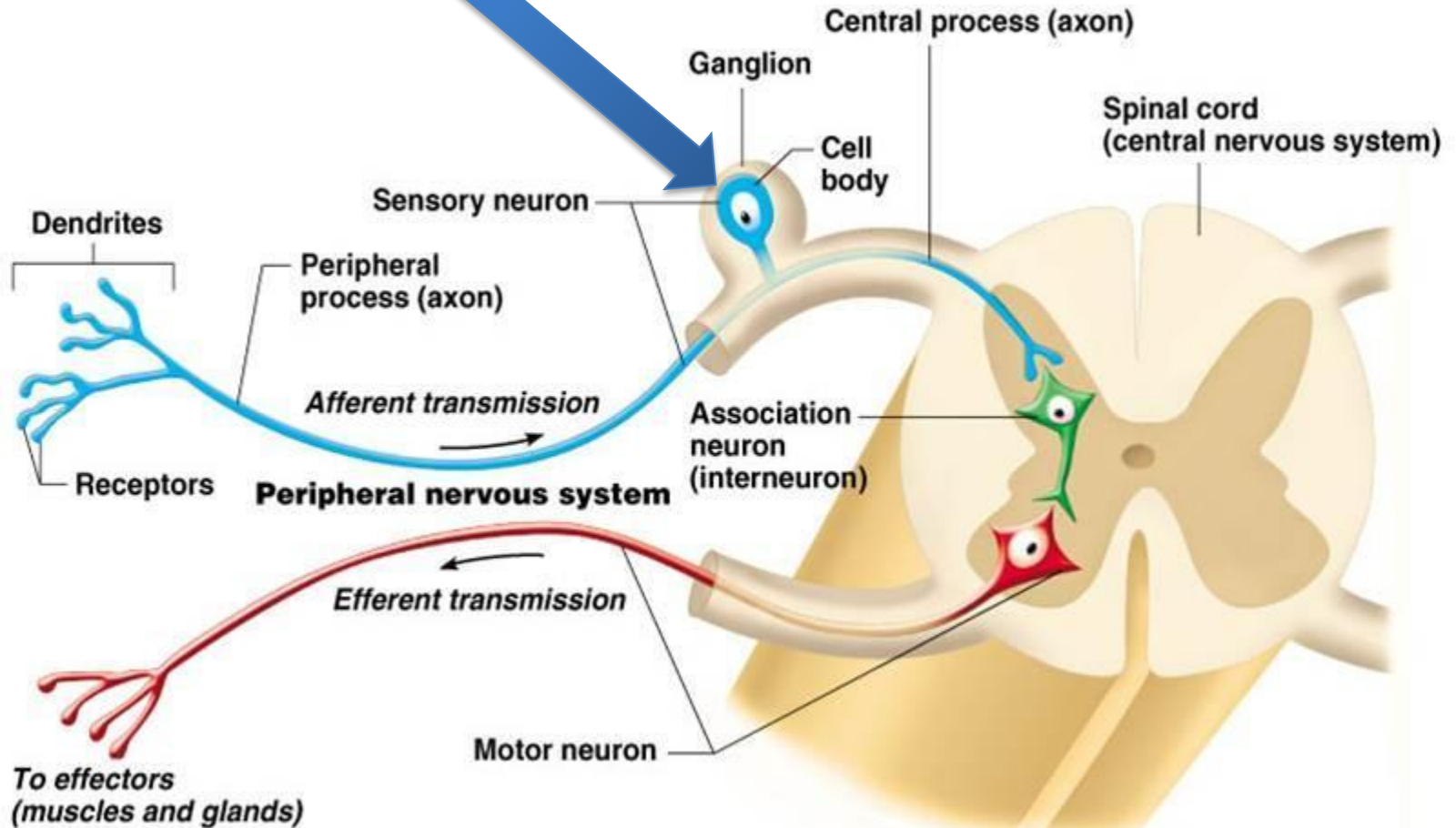
- Axon of 1<sup>st</sup> (preganglionic) neuron leaves CNS to synapse with the 2<sup>nd</sup> (ganglionic) neuron
- Axon of 2<sup>nd</sup> (postganglionic) neuron extends to the organ it serves



# Ganglia

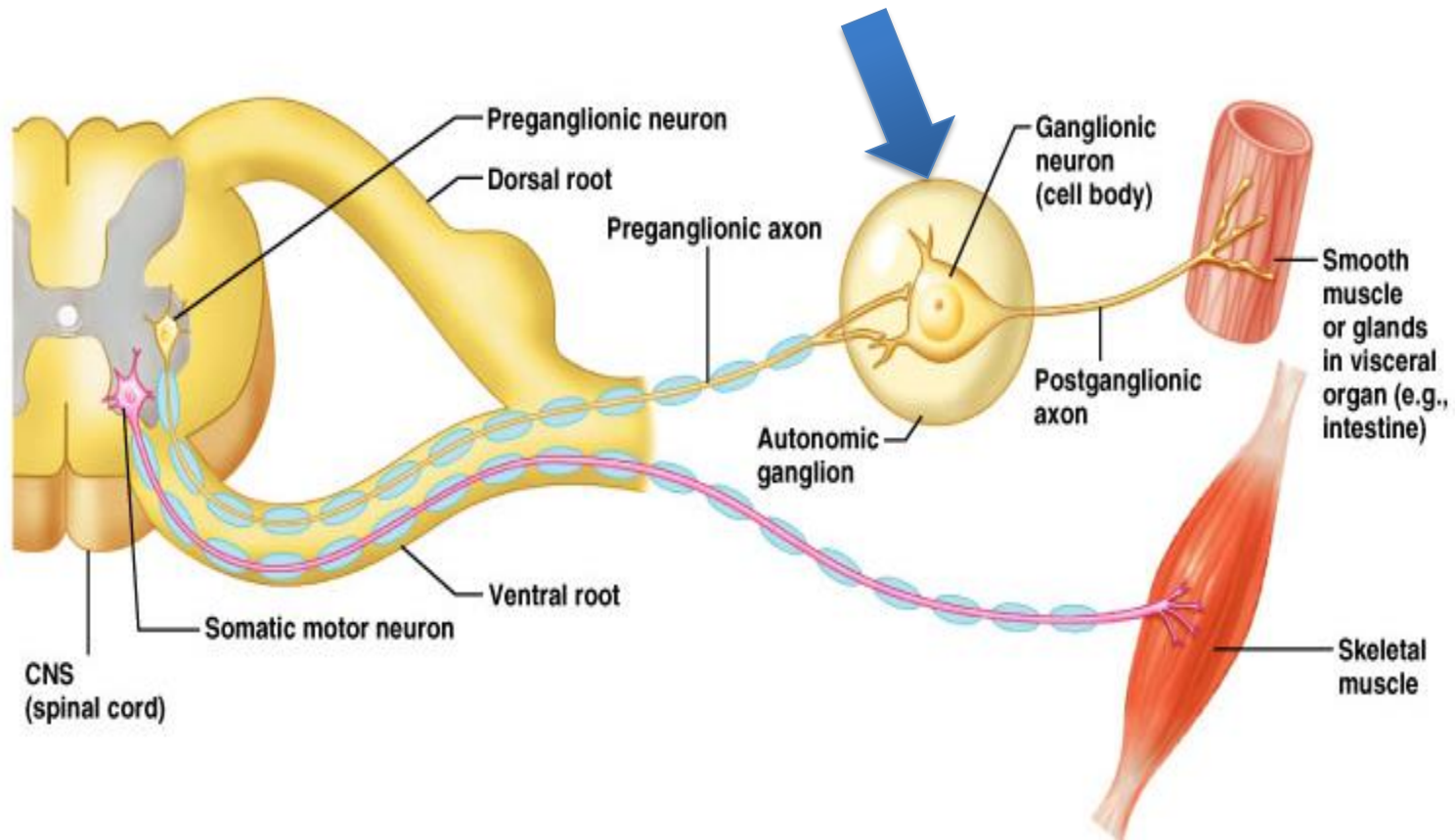
- Ganglia Are Masses Of Neuronal Cell bodies, Usually Defined As Being Outside The Central Nervous System. They Seem To Act As Coordinating Way Stations.
- Two type Ganglia:
  1. Sensory.
  2. Autonomic

# Sensory ganglion



Sensory ganglia do not receive synapses

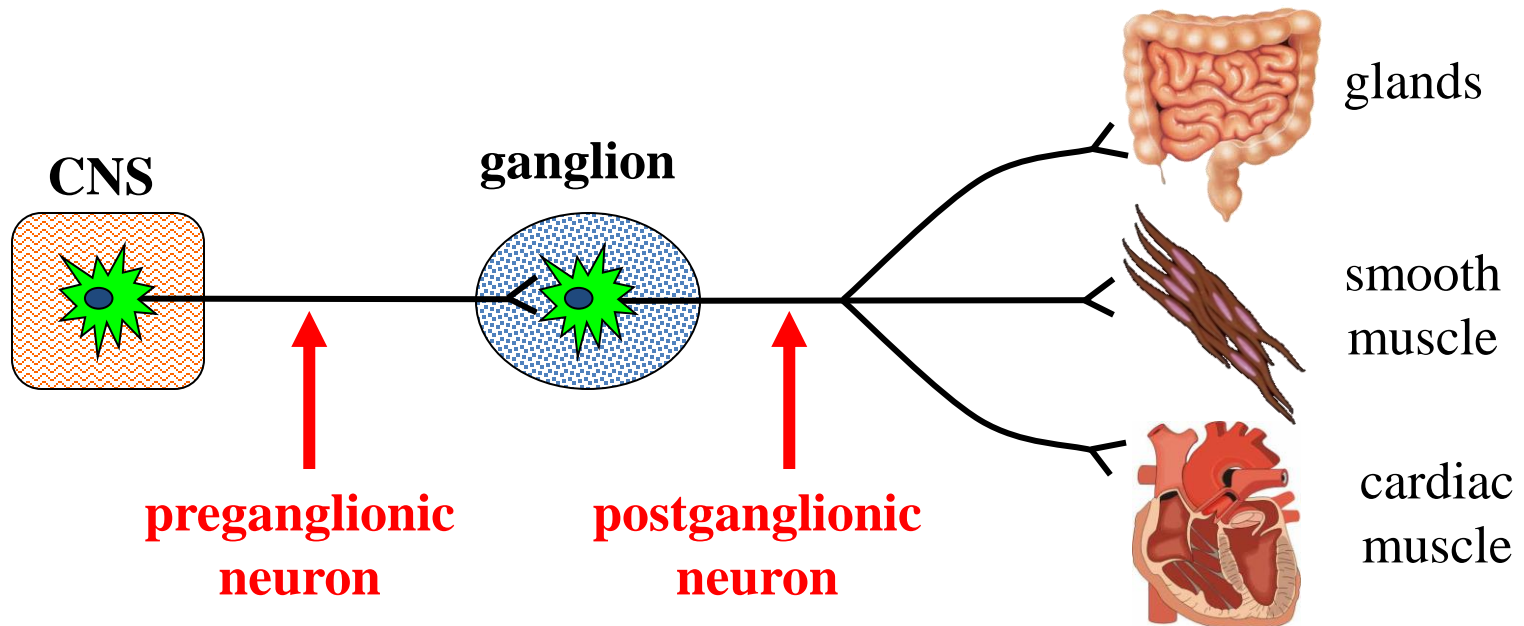
# Autonomic ganglion



Autonomic ganglia do contain synapses

## Autonomic Nervous System Similarities between Sympathetic & Parasympathetic

- Both are efferent (motor) systems: “visceromotor”
- Both involve regulation of the “internal” environment generally outside of our conscious control: “autonomous”
- Both involve 2 neurons that synapse in a peripheral ganglion
- Innervate glands, smooth muscle, cardiac muscle

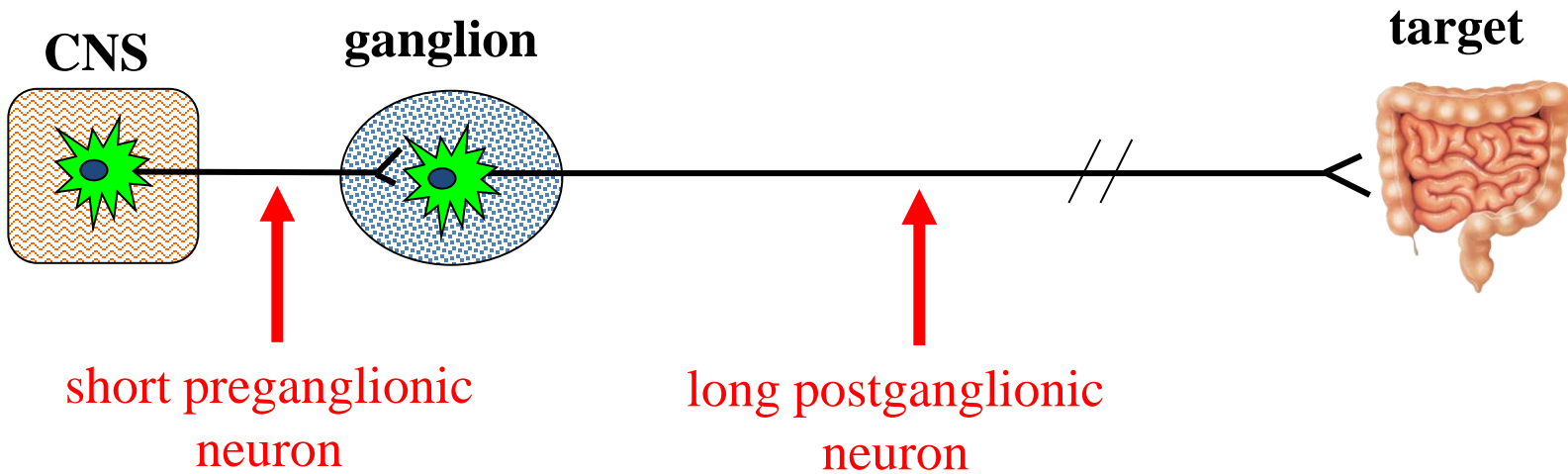


# Autonomic Nervous System

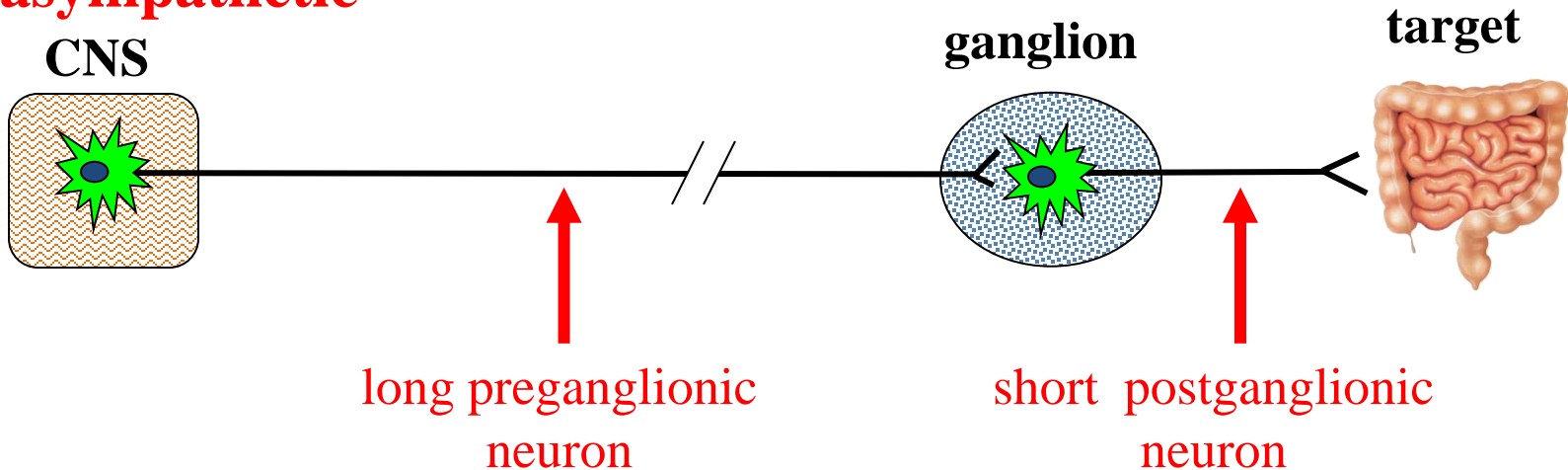
Differences between Sympathetic & Parasympathetic

## Relative Lengths of Neurons

### Sympathetic



### Parasympathetic





# Autonomic Nervous System

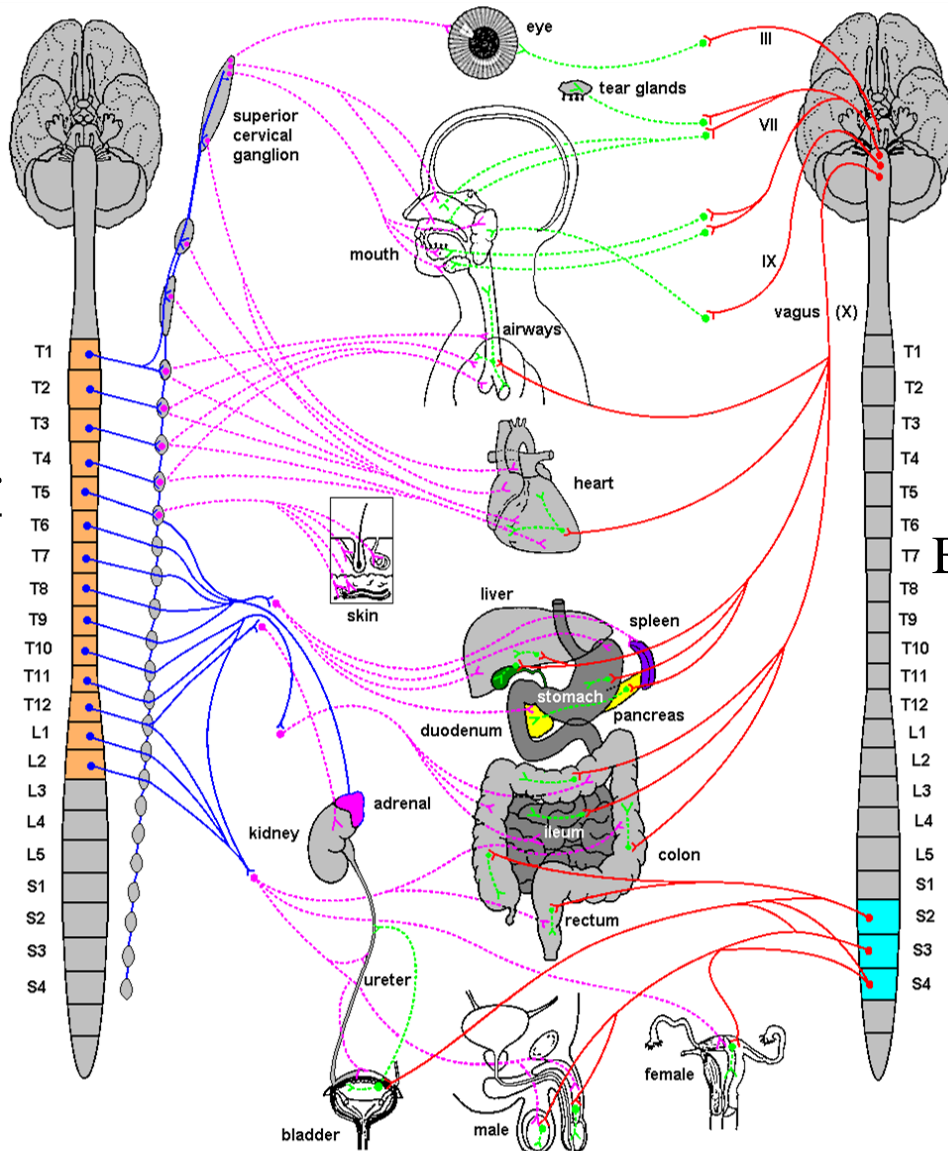
Differences between Sympathetic & Parasympathetic

## Location of Preganglionic Cell Bodies

**Sympathetic**

Thoracolumbar  
T1 – L2 levels of  
the spinal cord

vasomotor

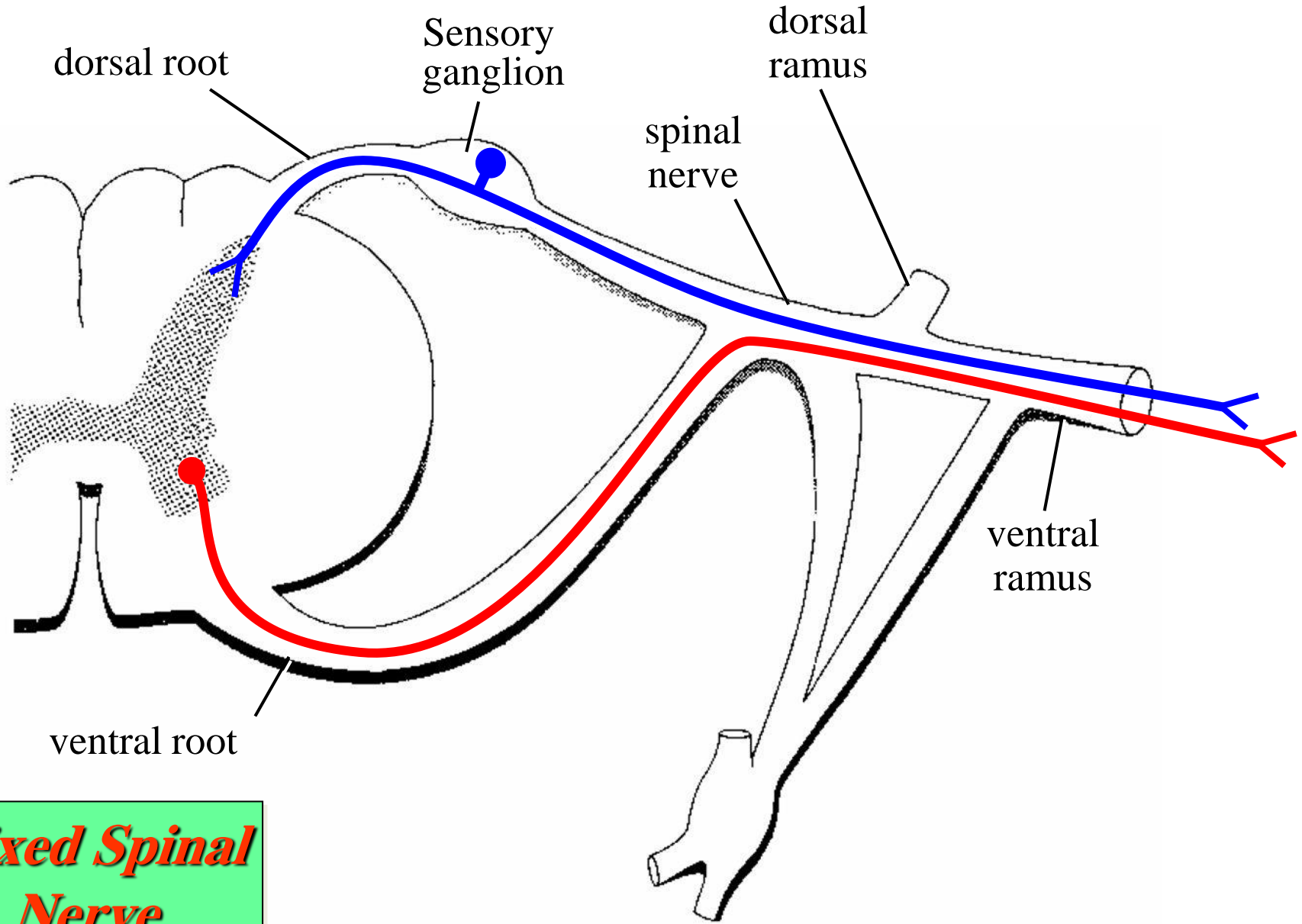


**Parasympathetic**

Craniosacral  
Brain: CN III, VII, IX, X  
Spinal cord: S2 – S4

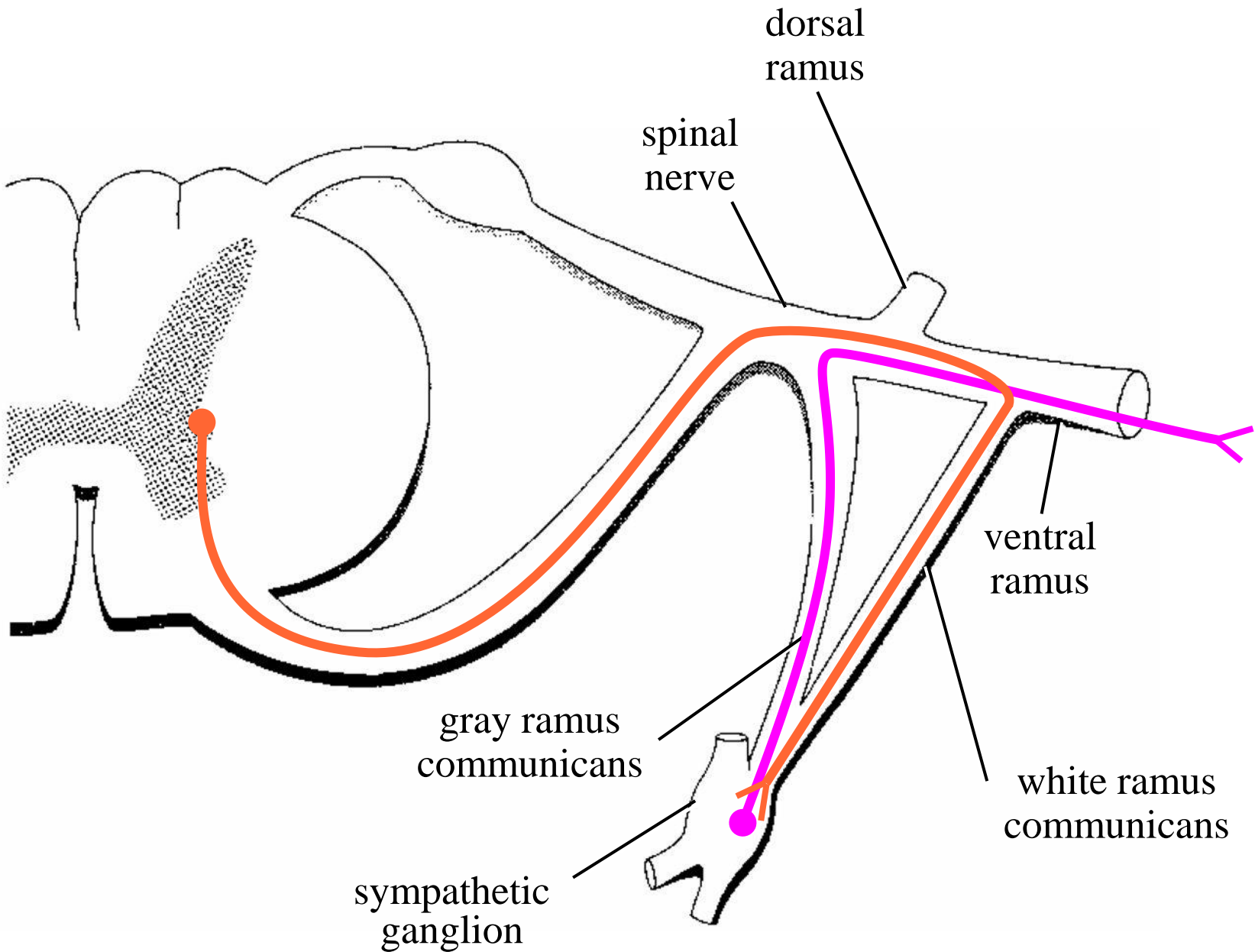
secretomotor

# Structure of Spinal Nerves: Somatic Pathways



***Mixed Spinal Nerve***

# Structure of spinal nerves: Sympathetic pathways

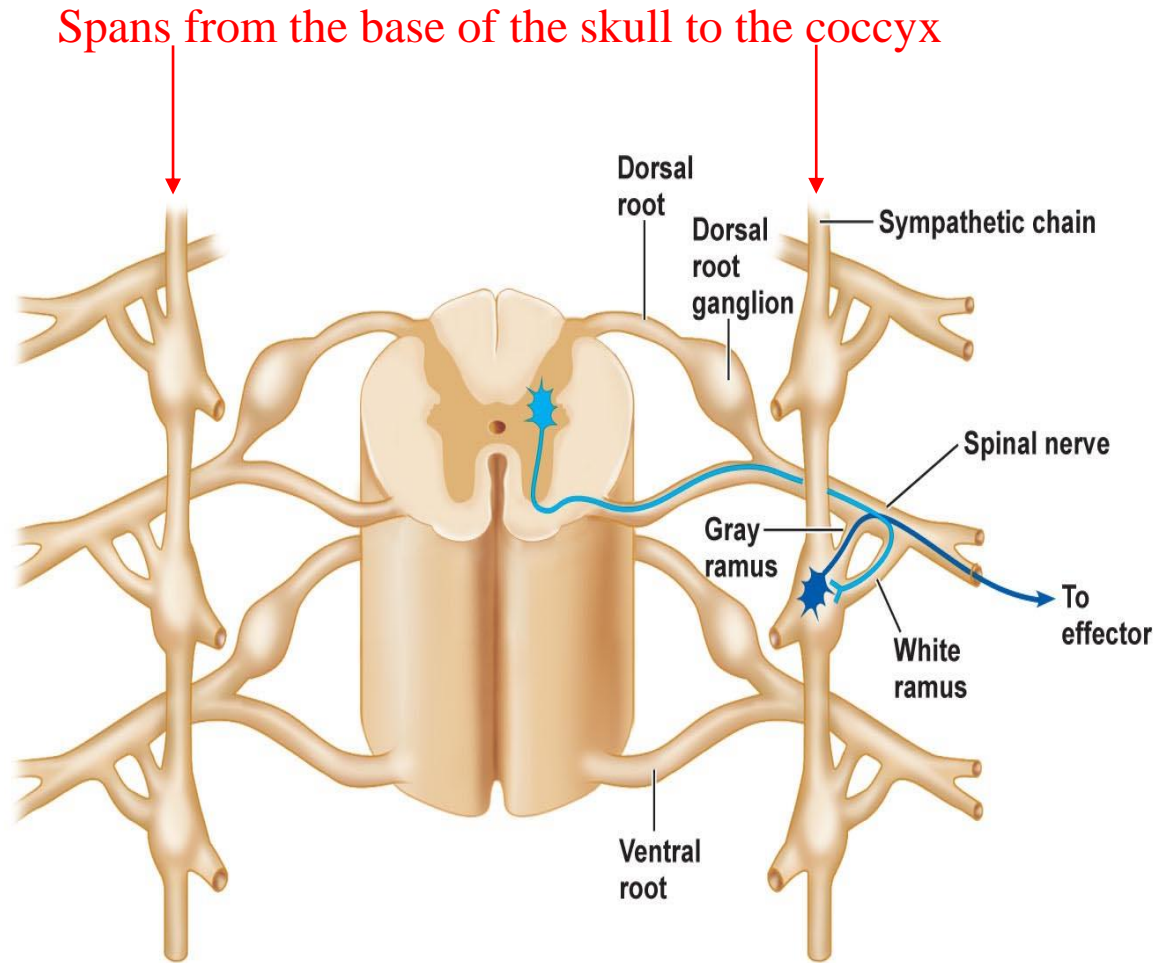


**Sympathetic ganglia** are the ganglia of the sympathetic nervous system  
They are located close to and on either side of the spinal cord in long chains

There are usually 22-23 pairs of paravertebral sympathetic ganglia:

3 in the cervical region  
(cervical ganglia)  
11 in the thoracic region  
4 in the lumbar region  
4-5 in the sacral region

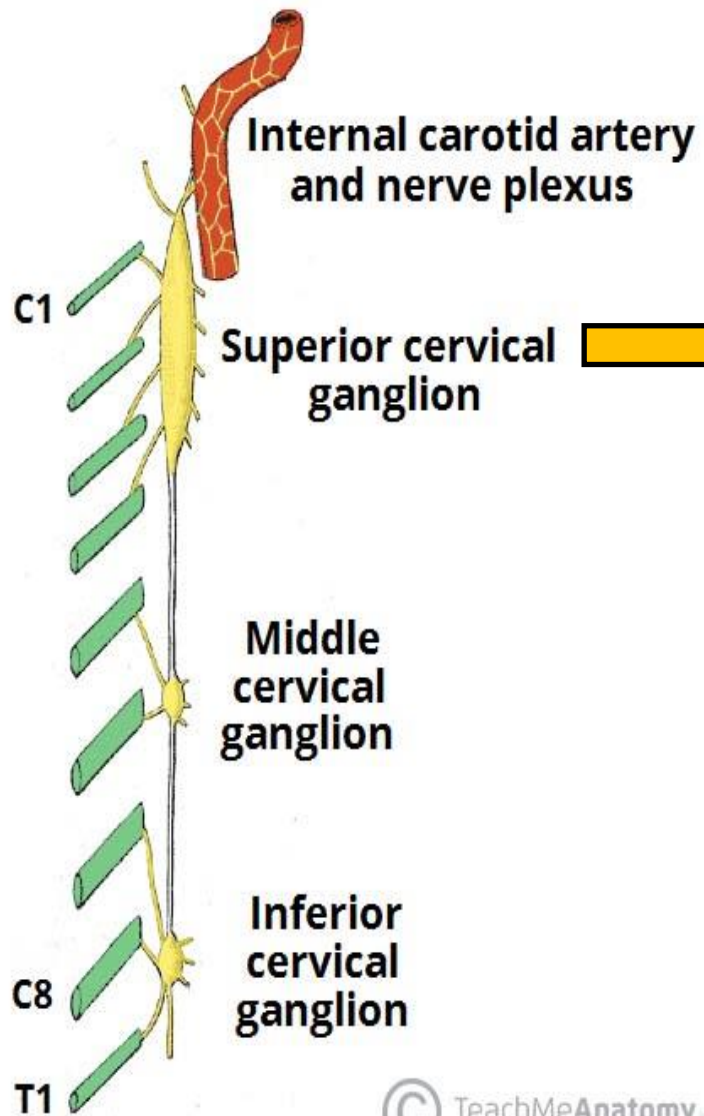
1 unpaired coccygeal ganglion



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Preganglionic nerves from the spinal cord synapse at one of the chain ganglia,  
and the postganglionic fiber extends to an effector

## Sympathetic Innervation to the Head and Neck



Internal carotid artery  
and nerve plexus

Superior cervical  
ganglion

Middle  
cervical  
ganglion

Inferior  
cervical  
ganglion

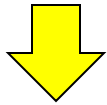
Located anterior to the C1-4 vertebrae.

The sympathetic fibers synapse with this ganglion, with post ganglionic fibers **hitch-hike** along arteries in the head and neck (and their branches) in order to reach their target organs.



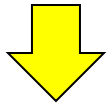
# Sympathetic Innervation to the Head and Neck

✓ The oculomotor, facial, glossopharyngeal and vagus nerves carry the parasympathetic fibers out of the brain.

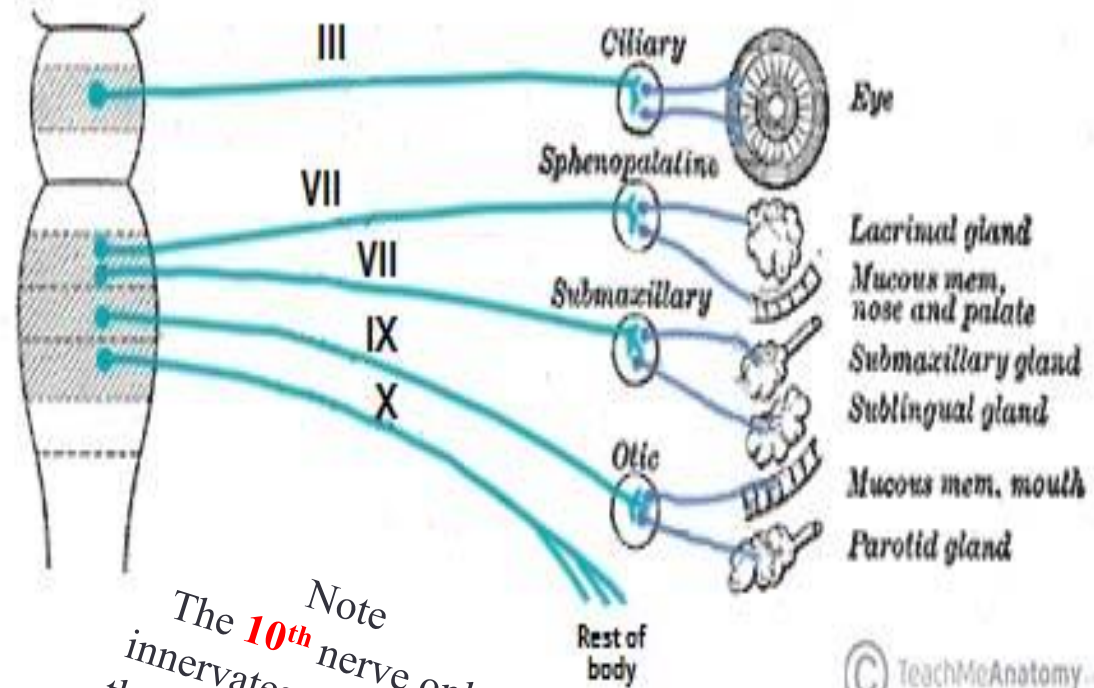


✓ Then, the parasympathetic fibers synapse in a **peripheral parasympathetic ganglion**

**Parasympathetic ganglia lie near or within the organs they innervate**



✓ From the ganglia, post-ganglionic parasympathetic fibres continue to the organs in the head and neck, providing parasympathetic innervation.

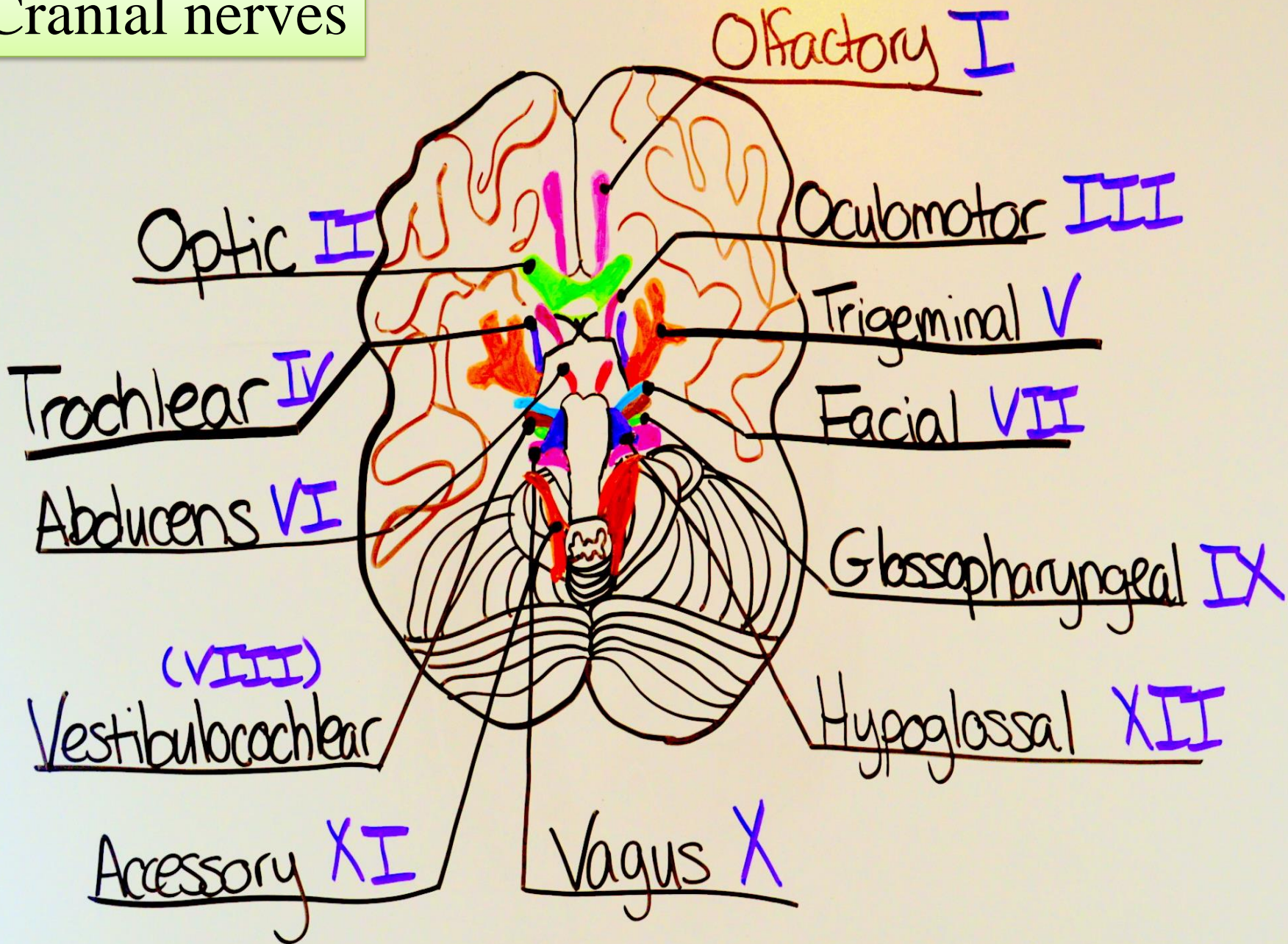


**Parasympathetic ganglia** in the head and neck:

- 1- **Ciliary ganglion** (sphincter pupillae, ciliary muscle) **3<sup>rd</sup>**
- 2- **Pterygopalatine ganglion** (lacrimal gland, glands of nasal cavity) **7<sup>th</sup>**
- 3- **Submandibular ganglion** (submandibular and sublingual glands) **7<sup>th</sup>**
- 4- **Otic ganglion** (parotid gland) **9<sup>th</sup>**



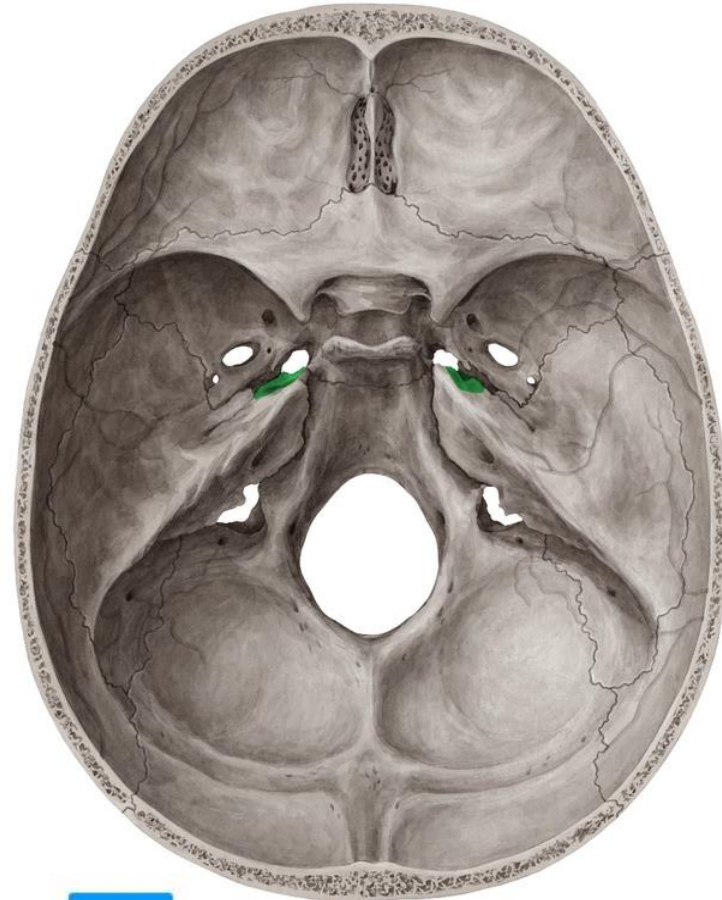
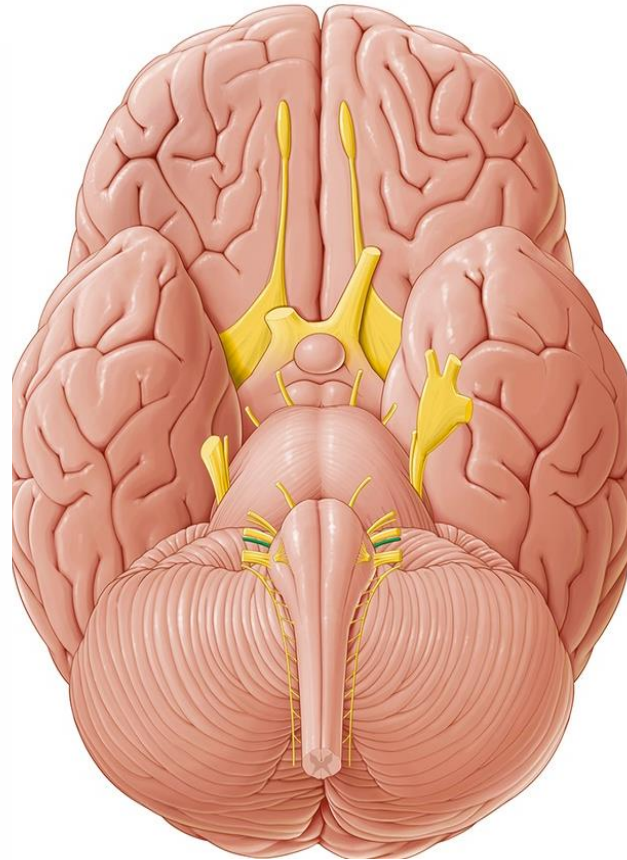
# Cranial nerves





The numbering of the cranial nerves is based on the order in which they emerge from the brain, front to back

- I Olfactory
- II Optic
- III Oculomotor
- IV Trochlear
- V Trigeminal
- VI Abducens
- VII Facial
- VIII Vestibulocochlear
- IX Glossopharyngeal
- X Vagus
- XI Accessory
- XII Hypoglossal



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## 1. Olfactory nerve

Component: sensory

Function: smell

Origin: Olfactory receptor nerve cells

Opening of the Skull: Openings in cribriform plate of ethmoid



## 2. Optic nerve

Component: sensory

Function: vision

Origin: Back of the eyeball

Opening of the Skull: Optic canal

Important



## 3. Oculomotor nerve

Component: motor

Function:

- Turns eyeball upward, downward and medially, upward and laterally
- Raises upper eyelid
- Constricts pupil
- Accommodates the eye

Opening of the Skull: Superior orbital fissure

Contains parasympathetic

Important



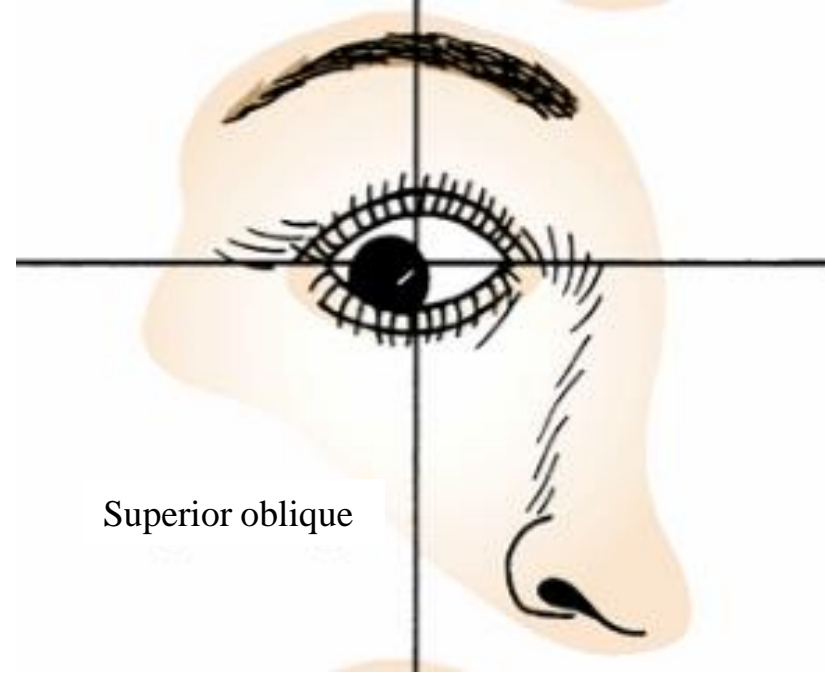
#### 4. Trochlear nerve

Component: motor

Function: Turns eyeball downward and laterally

Opening of the Skull: Superior orbital fissure

Important



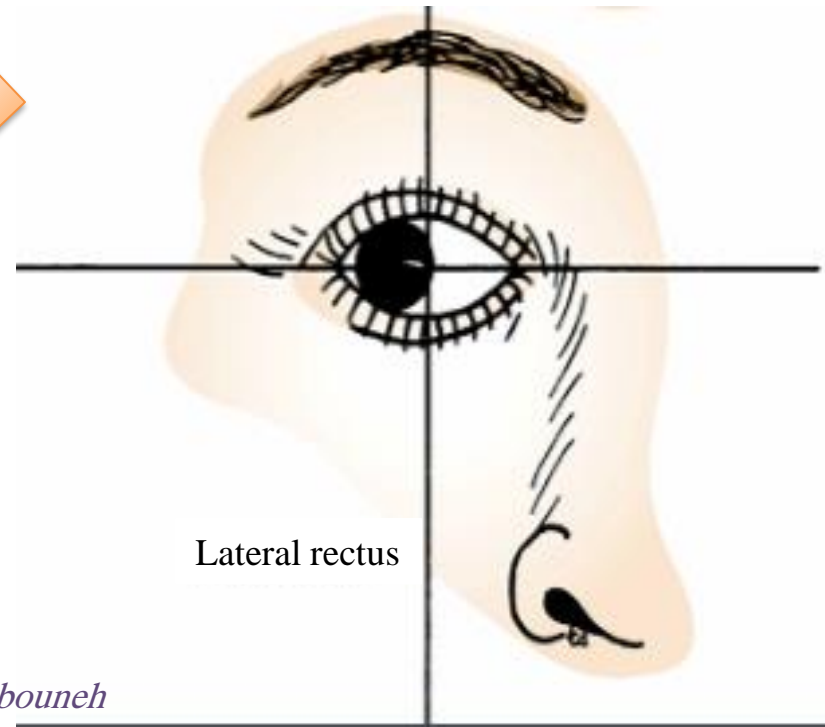
#### 6. Abducent nerve

Component: motor

Function: Turns eyeball laterally

Opening of the Skull: Superior orbital fissure

Important



Ophthalmic nerve



**5. Trigeminal Nerve**  
Component: mixed (motor and sensory)  
Function: **General sensation from the face, supplies muscles of mastication**

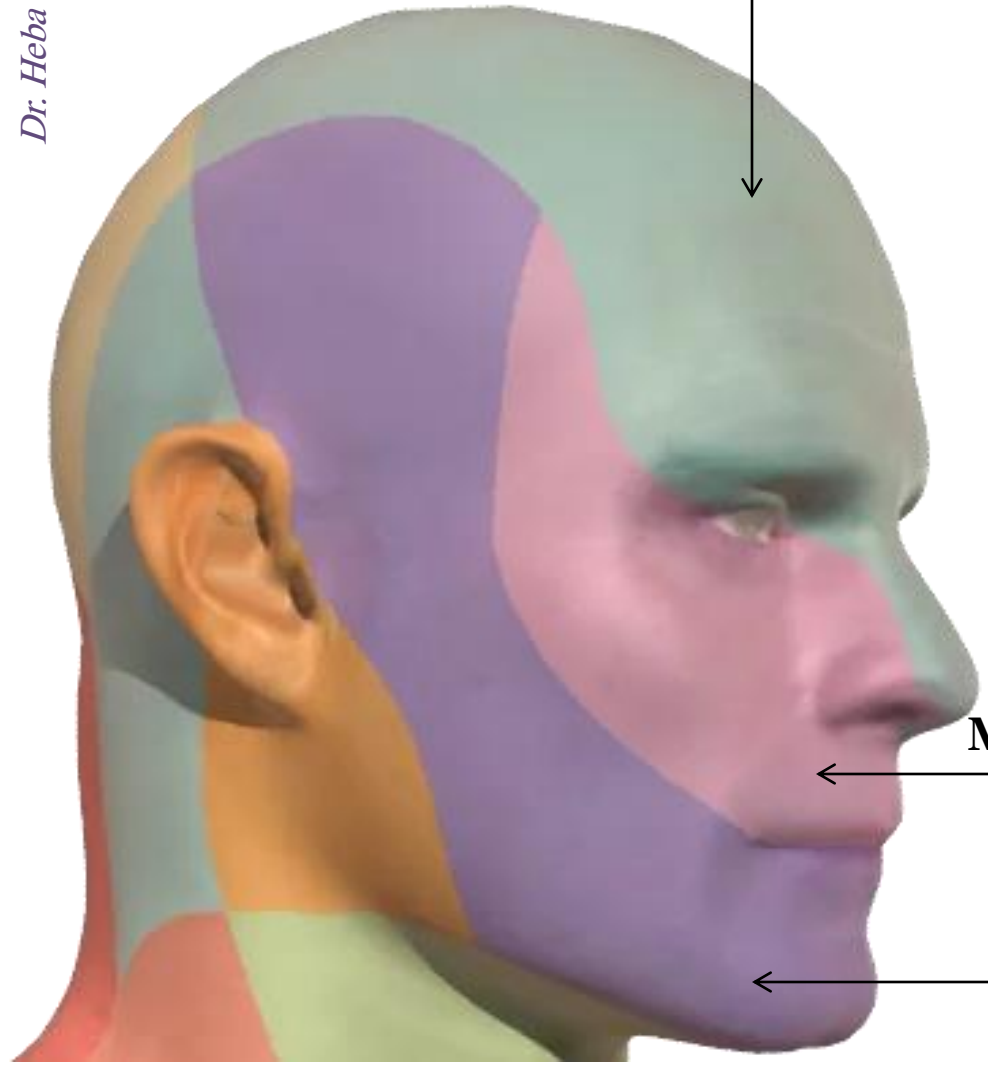
Large sensory root

Small motor root

Maxillary nerve



Mandibular nerve





## V1. Ophthalmic Nerve

Component: sensory

Function: sensation from: cornea, skin of forehead, scalp, eyelids and nose, mucous membranes of paranasal sinuses and nasal cavity

Opening of the Skull: Superior orbital fissure

## V2. Maxillary Nerve

Component: sensory

Function: sensation from: skin over maxilla, upper lip, teeth of the upper jaw, mucous membrane of the nose, the maxillary sinus and palate

Opening of the Skull: Foramen rotundum

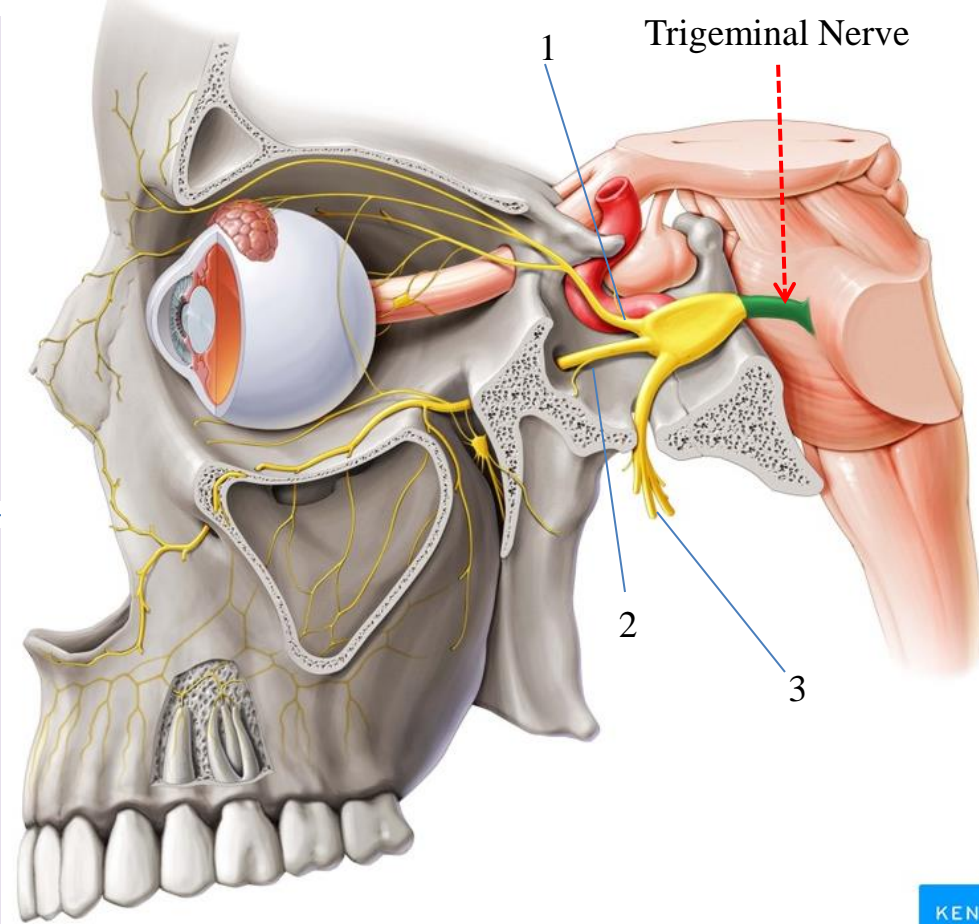
## V3. Mandibular Nerve

Component: sensory and motor

Function: sensation from: skin of cheek, over mandible and side of head, teeth of lower jaw and TMJ, mucous membrane of mouth and anterior part of tongue

Motor to: Muscles of mastication, Mylohyoid, Anterior belly of digastric, Tensor veli palatine, Tensor tympani

Opening of the Skull: Foramen ovale



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## 7. Facial Nerve

Contains parasympathetic

Important

Component: mixed (sensory and motor)

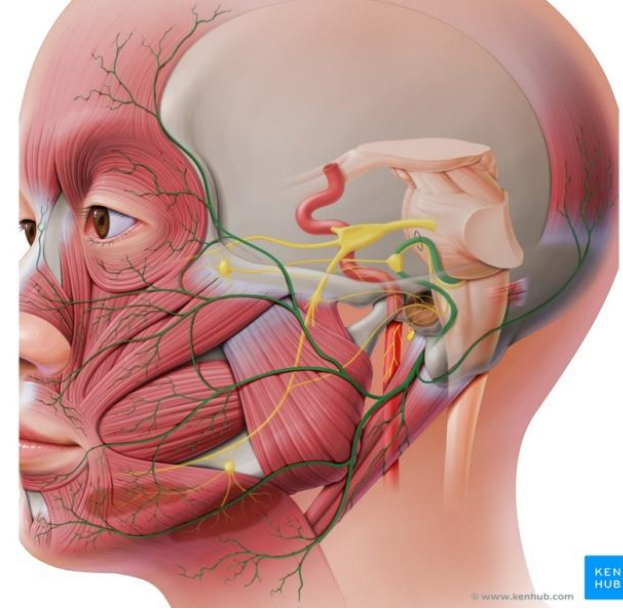
Function: taste sensation from the anterior 2/3 of the tongue

General sensation from a small area around the concha of the auricle, EAM

Motor to: muscles of the face and scalp, stapedius, posterior belly of digastric, stylohyoid

Parasympathetic to: Sublingual and submandibular glands, lacrimal gland

Opening of the Skull: Internal acoustic meatus, facial canal, stylomastoid foramen



## 8. Vestibulocochlear Nerve

Important

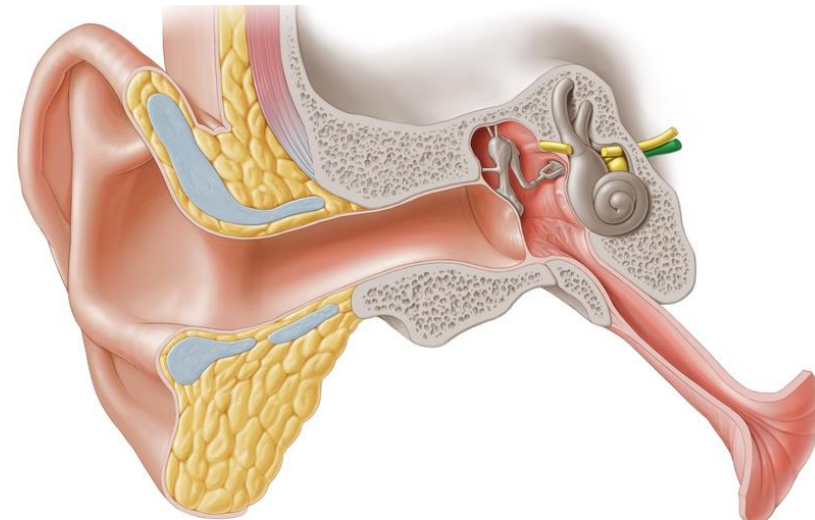
Component: sensory

Origin: Vestibular: utricle, saccule, semicircular canals

Cochlear: Organ of Corti

Function: balance and hearing

Opening of the Skull: Internal acoustic meatus





## 9. Glossopharyngeal Nerve Contains parasympathetic

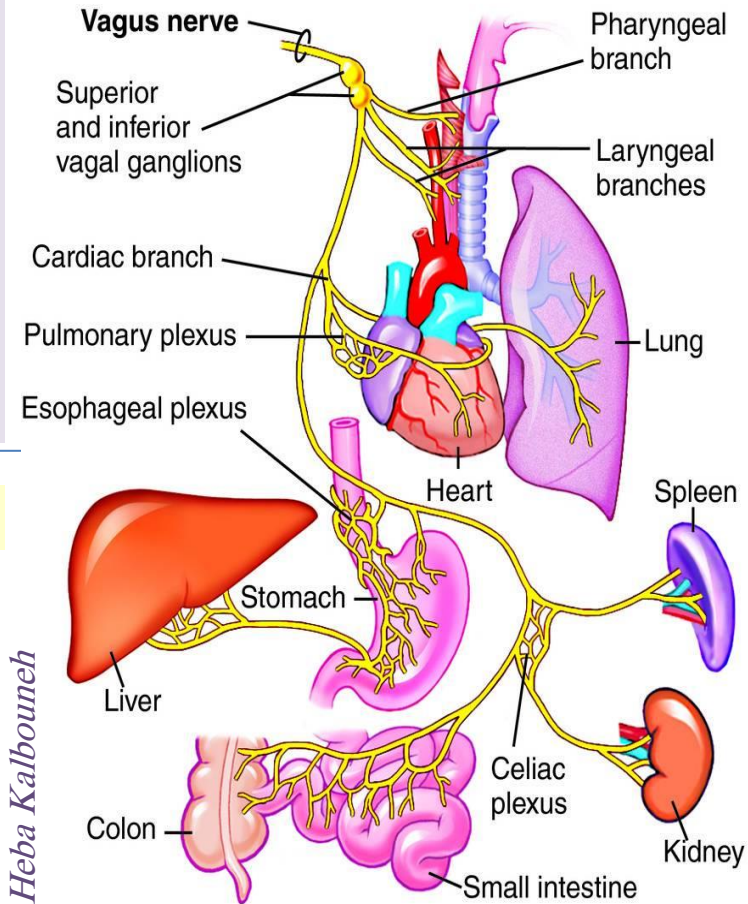
Component: mixed (sensory and motor)

Function: **General sensation and taste from post. 1/3 of the tongue and oropharynx, carotid sinus and carotid body**

**Motor to: stylopharyngeus**

Parasympathetic to: Parotid gland

Opening of the Skull: **Jugular foramen**



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## 10. Vagus Nerve

Contains parasympathetic

Component: mixed (sensory and motor)

Function: **Motor: Constrictor muscles of pharynx and intrinsic muscles of larynx; involuntary muscle of trachea and bronchi, heart, alimentary tract from pharynx to splenic flexure of colon; liver and pancreas**

**Sensory: Taste sensation from epiglottis and vallecula and afferent fibers from structures named above, General sensation from skin of EAM**

Opening of the Skull: **Jugular foramen**

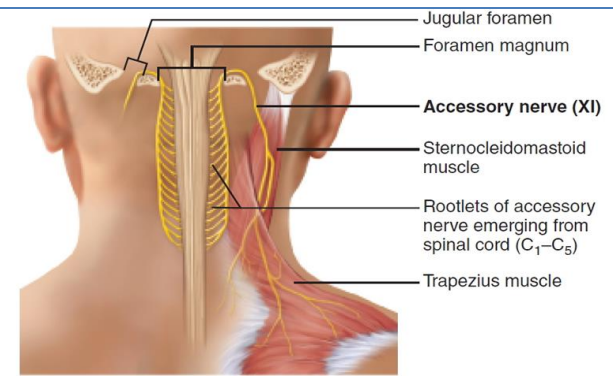
## 11. Accessory Nerve

Component: motor

Function: **Cranial root: Pharyngeal plexus (Muscles of soft palate, pharynx, and larynx)**

**Spinal root: motor to Sternocleidomastoid and trapezius**

Opening of the Skull: **Jugular foramen**



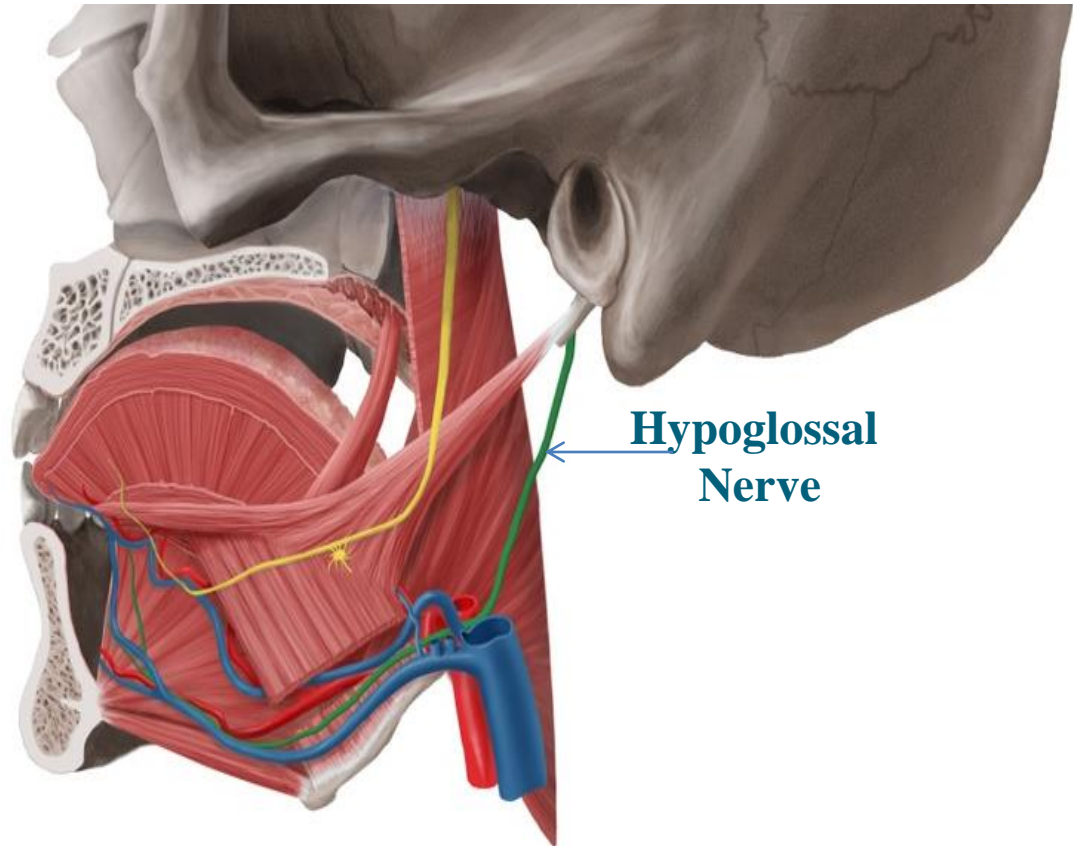
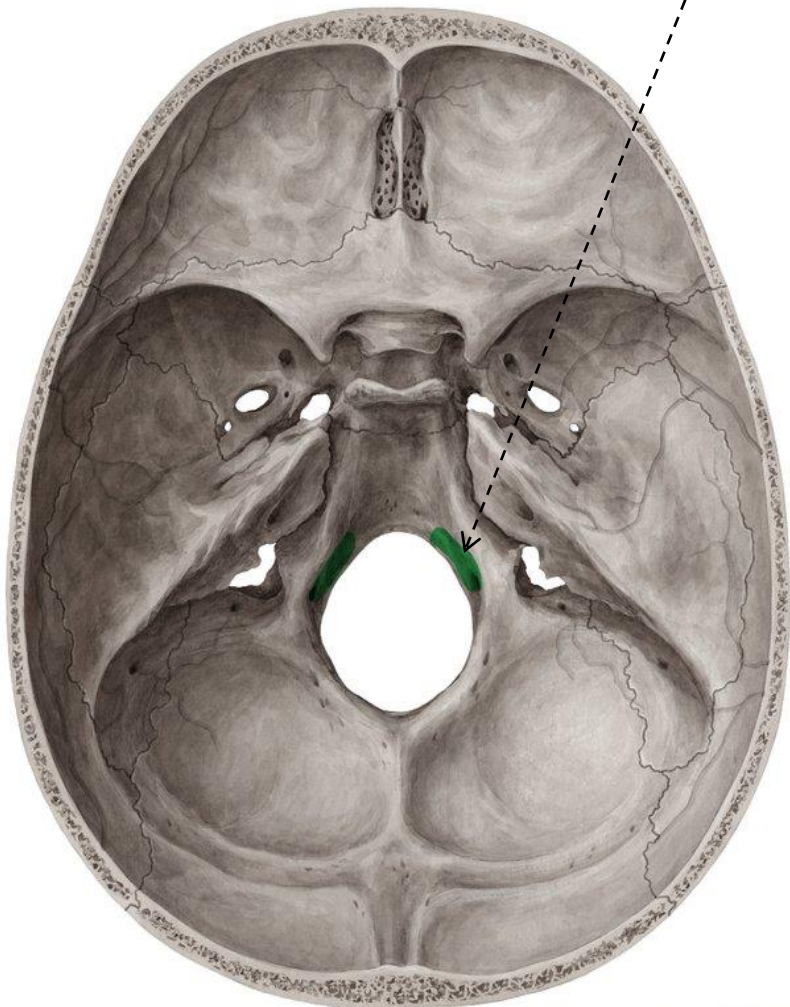
Important

## 12. Hypoglossal Nerve

Component: motor

Function: **Motor to muscles of the tongue**

Opening of the Skull: **Hypoglossal canal**

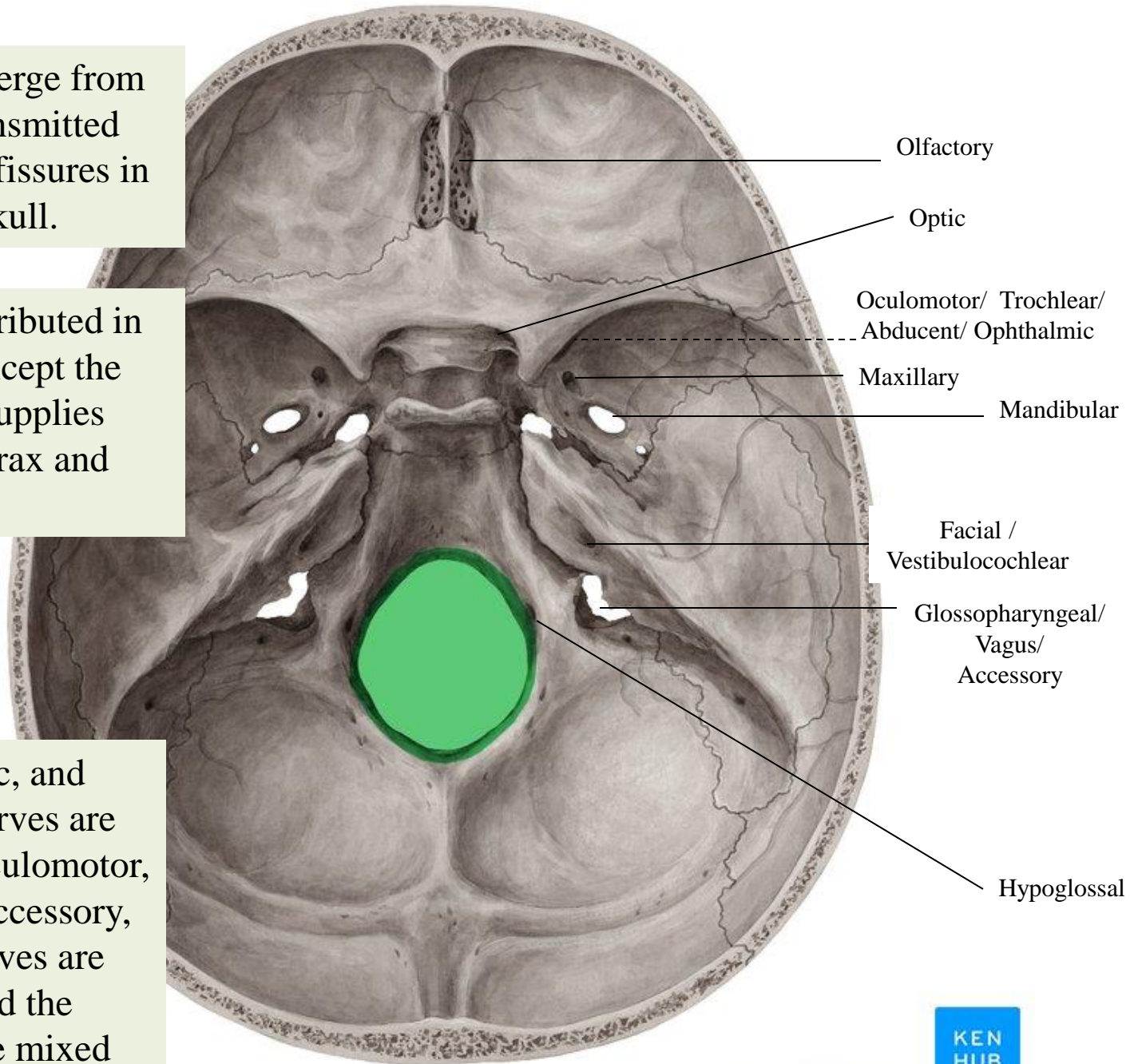




The cranial nerves emerge from the brain and are transmitted through foramina and fissures in the base of the skull.

All the nerves are distributed in the head and neck except the vagus, which also supplies structures in the thorax and abdomen.

The olfactory, optic, and vestibulocochlear nerves are entirely sensory; the oculomotor, trochlear, abducent, accessory, and hypoglossal nerves are entirely motor; and the remaining nerves are mixed



**Pure sensory:**

Olfactory  
Optic  
Vestibulocochlear

**Pure motor:**

Oculomotor  
Trochlear  
Abducent  
Accessory  
hypoglossal

**Mixed (motor and sensory):**

Trigeminal  
Facial  
Glossopharyngeal  
Vagus

**Contains parasympathetic**

**(secretomotor):**

Oculomotor  
Facial  
Glossopharyngeal  
Vagus

