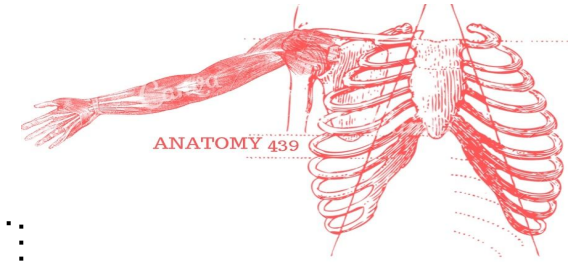
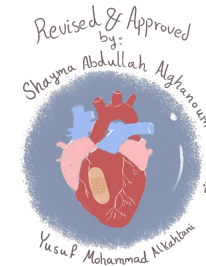


Lecture 4:



AUTONOMIC NERVOUS SYSTEM

- **Red** : important
- **Pink** : in girls slides only
- **Blue** : in male slides only
- **Green** : notes, Extra



Objectives

At the end of the lecture, students should be able to:

- ❖ Define the autonomic nervous system.
- ❖ Describe the structure of autonomic nervous system
- ❖ Trace the preganglionic & postganglionic neurons in both sympathetic & parasympathetic nervous system.
- ❖ Enumerate in brief the main effects of sympathetic & parasympathetic system

Autonomic Nervous System

The autonomic nervous system is concerned with the innervation and control of involuntary structures such as visceral organs, smooth muscles, cardiac muscles and glands.

Skeletal muscles are controlled by somatic motor

Regulation: (Controlled) by the Hypothalamus

Note: Hypothalamus controls both of Autonomic system + Endocrine system.



- Function: Maintaining the homeostasis of the internal environment along with the endocrine system.
- Location: Central nervous system and peripheral nervous system

Autonomic nervous system: Nerve cells located in both central & peripheral nervous system

Difference between somatic and visceral motor:

- Somatic motor

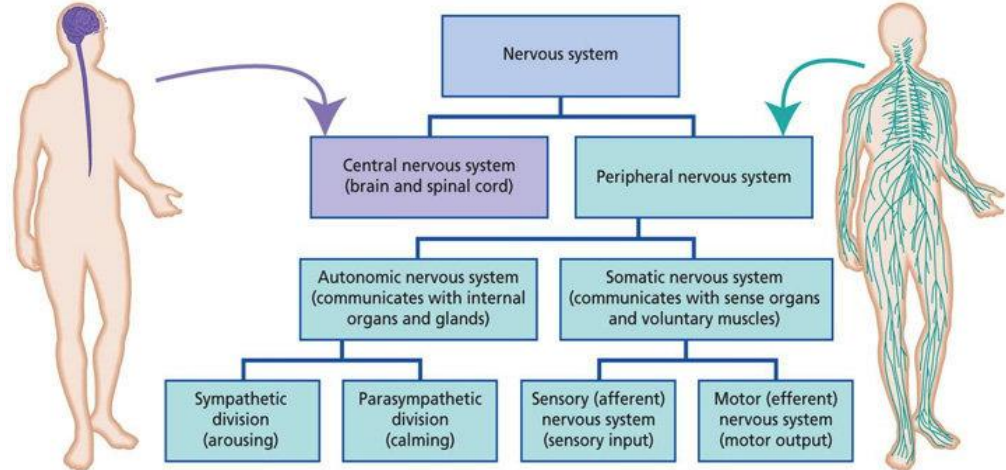
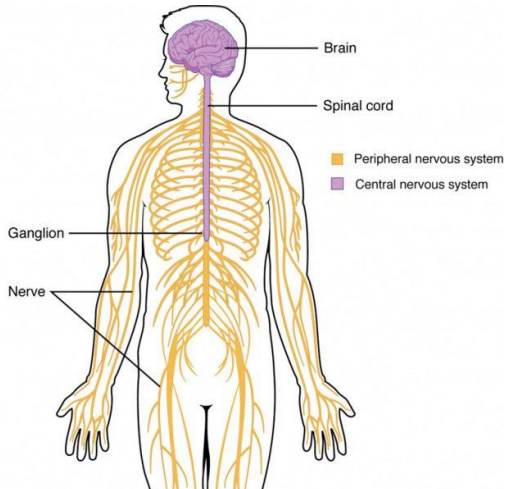
Fibers from Anterior horn cell → to target

- Visceral motor

1-Brain: from nuclei

2- spinal cord: lateral horn cell

تعدى على. Ganglion قبل توصل للـ Target



Autonomic Nervous System

Unlike the somatic nervous system, **the Efferent pathway** of the autonomic nervous system is made up of **two neurons** called as:

Preganglionic

The cell bodies are located in the brain and spinal cord (inside CNS).

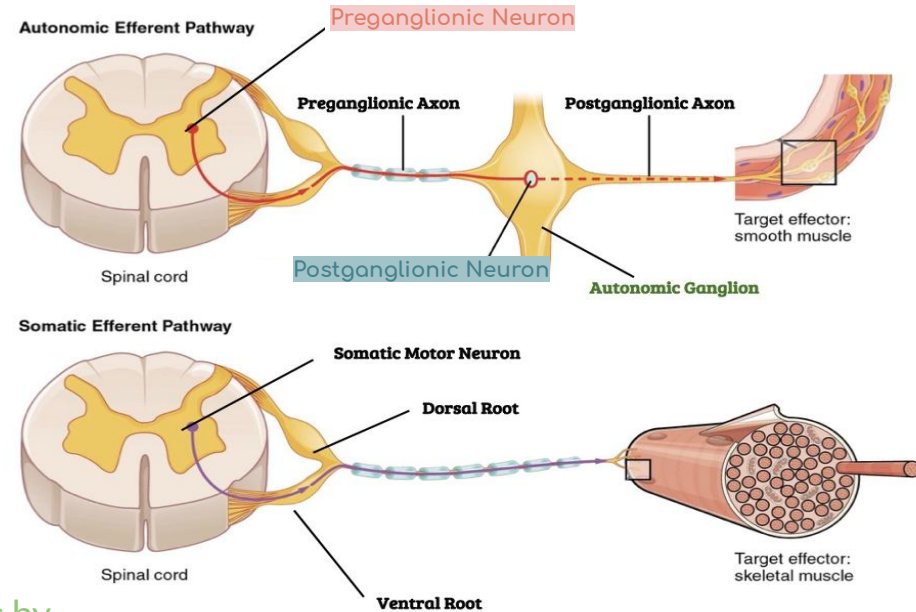
Postganglionic

The cell bodies are located in the autonomic ganglia (outside CNS).

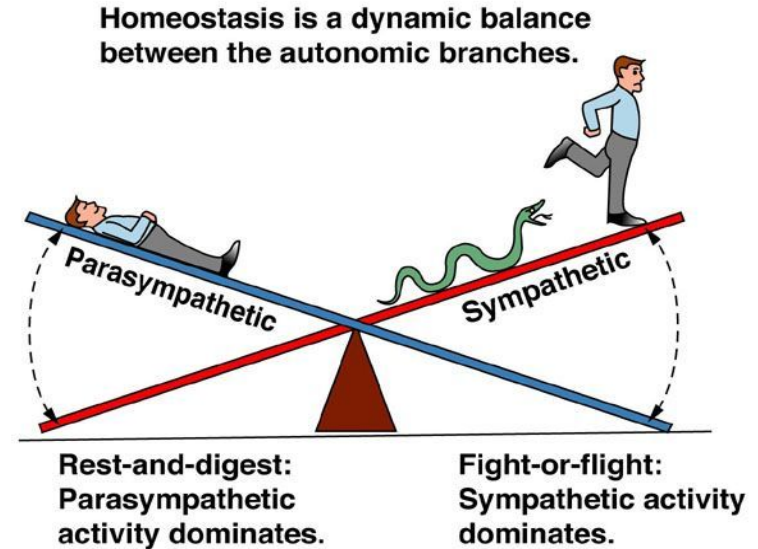
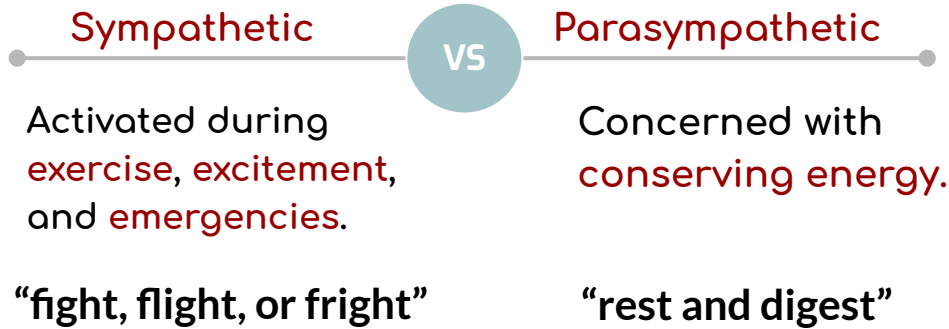
Preganglionic axons synapse with the postganglionic neurons

Note: before the fibers reach the target, it should first pass by the autonomic ganglion and synapse (interconnection).

Synapse: a junction between two nerve cells



Based on the anatomical, physiological and pharmacological characteristics, the autonomic nervous system is divided into:



Both divisions operate in conjunction with one another (have **antagonistic control over the viscera**) to maintain a stable internal environment

[For more understanding click here](#)

Sympathetic

Preganglionic neuron is in the **CNS**.

The Preganglionic fiber(axon) is **shorter**

The Postganglionic neuron is in the **PNS** and **far from the target**

The Postganglionic fiber(axon) is **longer**



Target organ

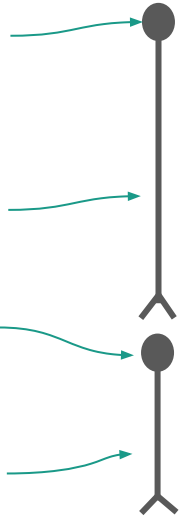
Parasympathetic

Preganglionic neuron is in the **CNS**.

The Preganglionic fiber(axon) is **longer**

The Postganglionic neuron is in the **PNS** and close to the target

The Postganglionic fiber(axon) is **shorter**

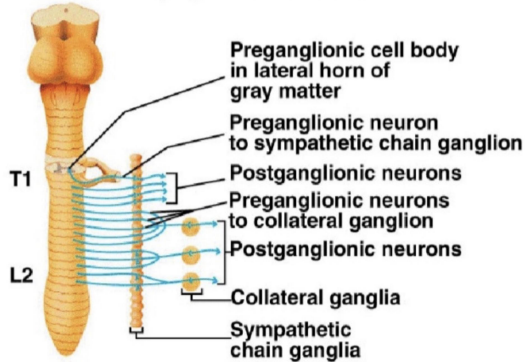


Target organ

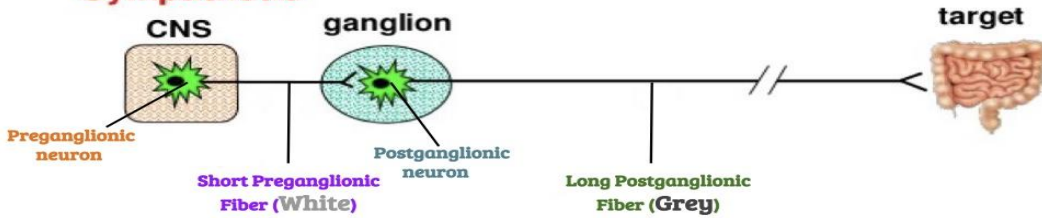
Note438: The cause of preganglionic (White) and postganglionic (Grey) fibers having different colors is the Myelin sheath that the preganglionic fibers (white) are sheathed with. Myelin helps isolate preganglionic fibers for faster transportation. (تخليه معزول اكثر ويوصل اسرع)

Sympathetic Nervous System

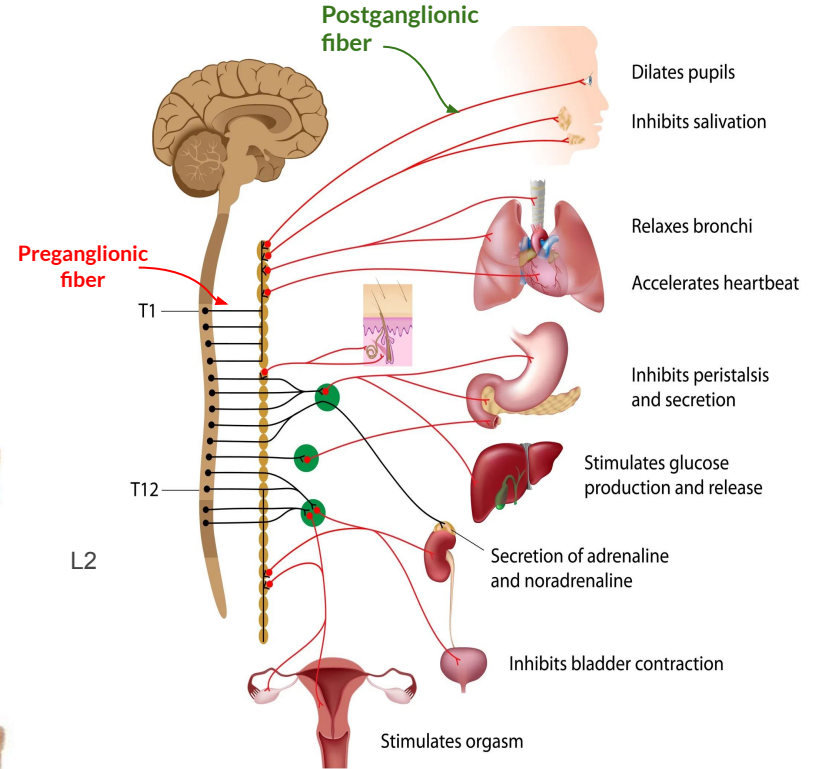
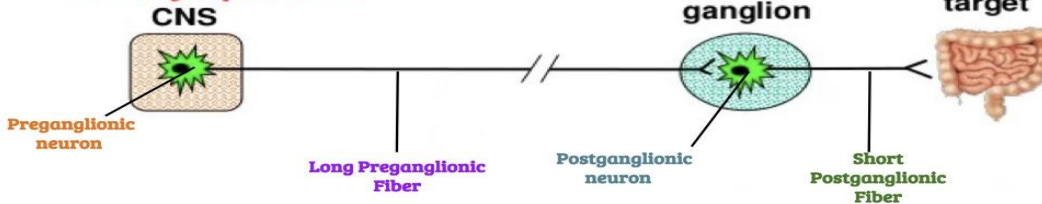
Sympathetic Division



Sympathetic



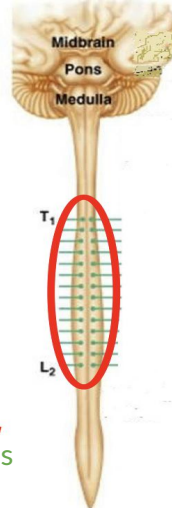
Parasympathetic



Sympathetic Division

1- Preganglionic Neurons:

located in the lateral gray horn of **T1-L2** segments of spinal cord (Thoraco**L**umbar outflow)



IMPORTANT NOTE(438): Sympathetic neurons only found in spinal cord

NOTE: as their preganglionic neurons are short, their ganglia (POSTGANGLIONIC NEURONS) are located near to the CNS (spinal cord).

NOTE: Outflow means the passage of impulses outwardly from the central nervous system.

2- Postganglionic ganglia:

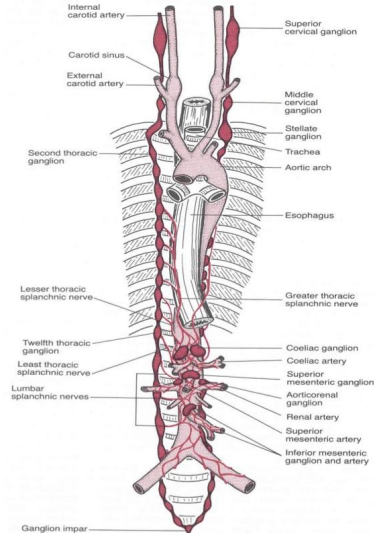
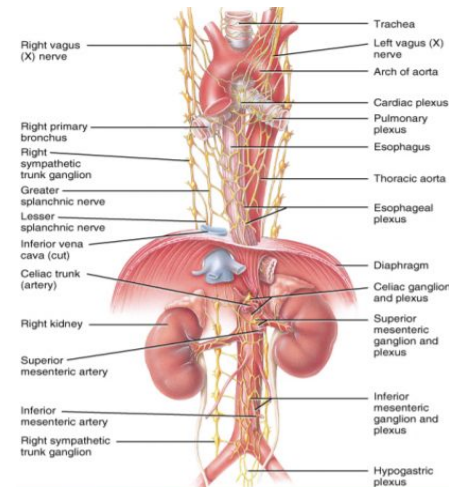
Located nearer the central nervous system as:

Prevertebral is the celiac and mesenteric

In front of vertebral column

Paravertebral forming sympathetic chain

Next to, Parallel



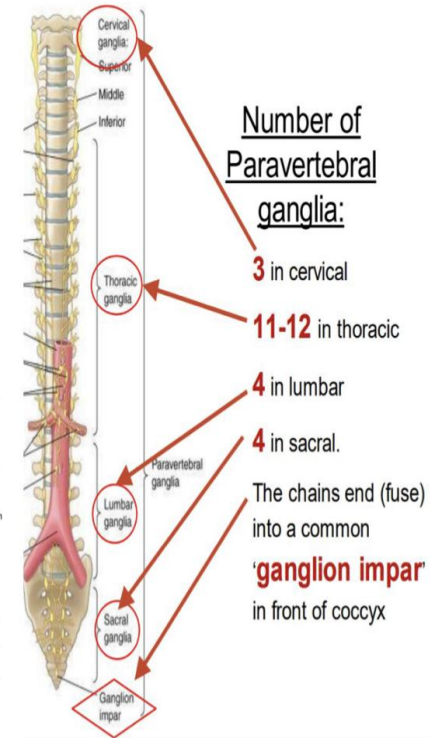
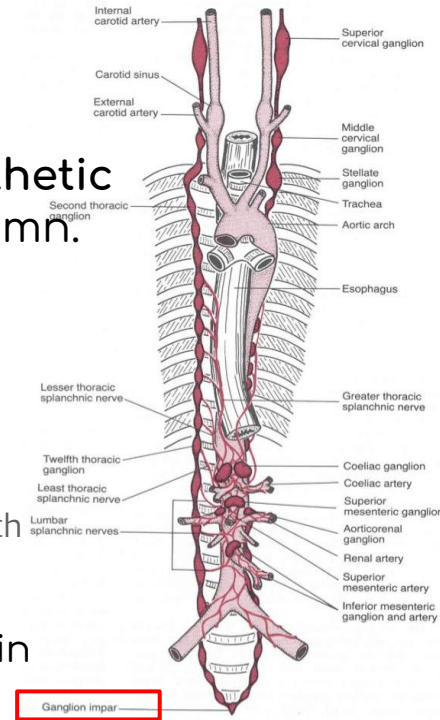
Paravertebral Ganglia

- They are interconnected to form 2 sympathetic chains, one on each side of vertebral column.

Number of ganglia:

- 3 in **Cervical** part of chain
- 11-12 in **Thoracic** part
- 4 in **Lumbar & Sacral** parts each

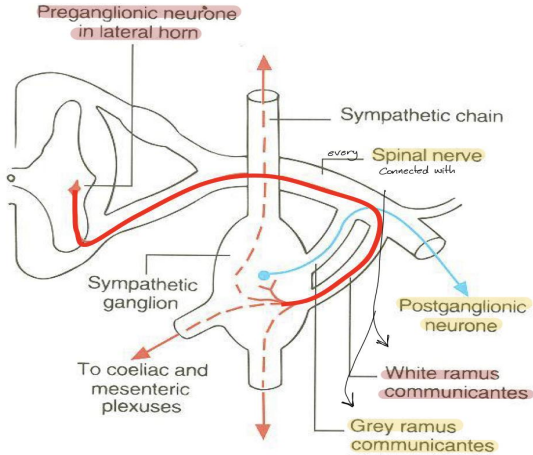
- The chains end into a common **“ganglion impar”** in front of coccyx.



Preganglionic Fibers

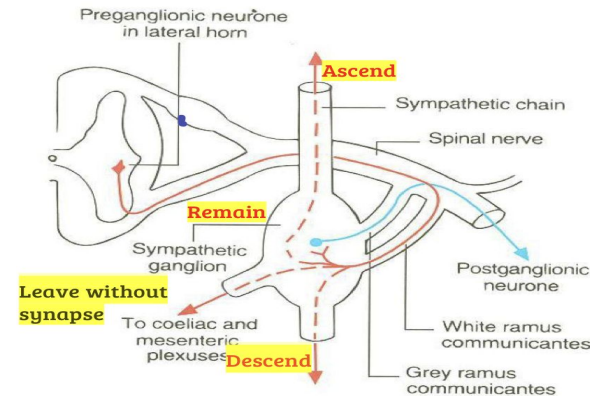
- Run in the **ventral roots** of the spinal nerve.
- Travel through the **spinal nerve**, and then join the sympathetic chain via **the White Rami Communicans**. (WRC).

*Between nerve and ganglion
*white ramus Preganglionic fibers = before relay

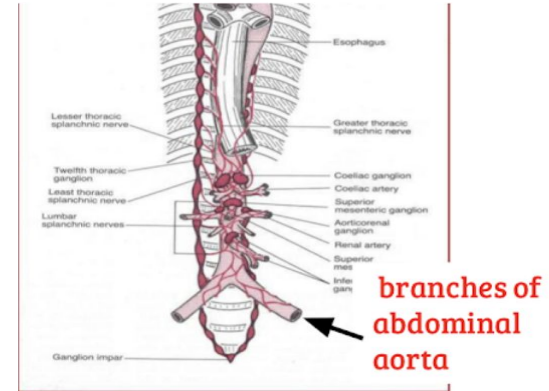


Within the sympathetic chain, these fibers may:

- 1- ascend** : to move upward.
- 2- descend** : to move downward.
- 3- remain at the same level** to synapse with neurons (postganglionic) of paravertebral ganglia located in sympathetic chain.



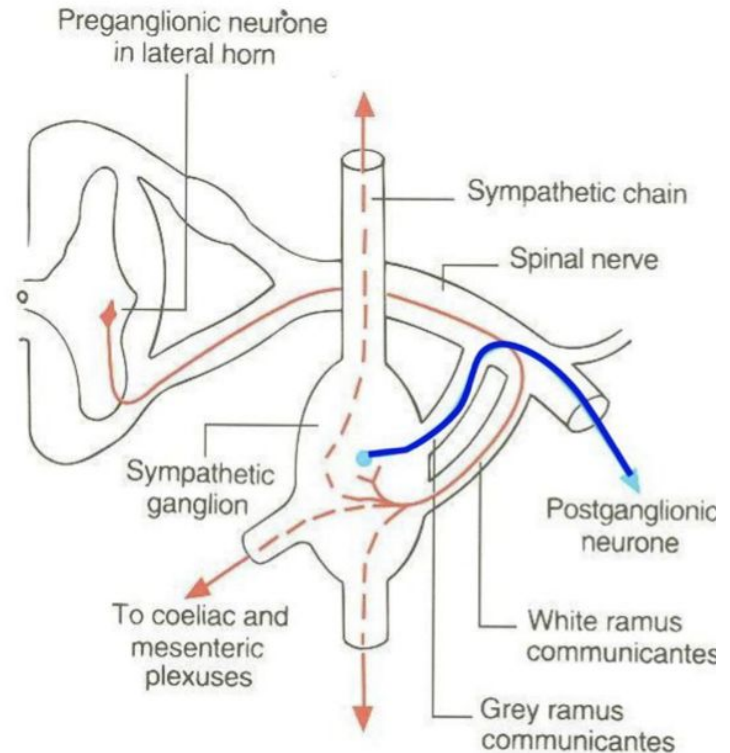
- 4- leave the sympathetic chain** (without synapse) to reach coeliac & mesenteric ganglia Preganglionic fibers surrounded by (around branches of abdominal aorta) to synapse with their neurons (postganglionic).



Postganglionic fibers

1-Fibers from the sympathetic chain: Enter again into the spinal nerve through **(Grey Rami Communicants)**, to supply structure in head, thorax + blood vessels and sweat glands.

2- Fibers from the cells of coeliac, mesenteric(superior & inferior): supply abdominal and pelvic viscera



Parasympathetic division

Preganglionic neuron

Cranial flow

Nuclei of the 3rd, 7th, 9th & 10th cranial nerves, in the brain stem (Cranial outflow)

Preganglionic fiber (axon)

carried by 3rd, 7th, 9th & 10th cranial nerves and terminate in **ciliary, pterygopalatine, submandibular, otic & peripheral ganglia**

Postganglionic neuron

ciliary pterygopalatine, Postganglionic submandibular, otic & peripheral ganglia.

Postganglionic fiber (axon)

Postganglionic axons innervate (supply) organs of the: fiber(axon) head, neck, thorax, and abdomen

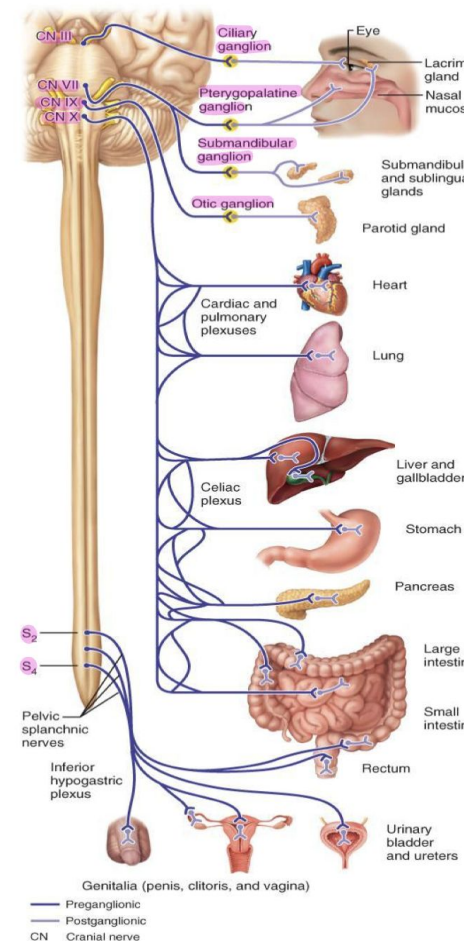
Sacral flow

The lateral gray horn of **S2-S4** segments of spinal cord (Sacral outflow)

Are carried by **pelvic splanchnic nerves** to peripheral ganglia in pelvis where they synapse.

peripheral ganglia in pelvis

innervate organs of the **pelvis and lower abdomen**



Structure	Sympathetic effect	Parasympathetic effect
Iris of the eye(pupils)	Dilates (تتوسع) pupil	Constricts pupil
Ciliary muscle of the eye	Relaxes	Contracts
Salivary glands	Reduces secretion	Increases secretion
Lacrimal gland (الغده الدمعية)	Reduces secretion	Increases secretion
Heart	Increases rate and force of contraction	Decreases rate and force of contraction
Bronchi (الشعب الهوائية)	Dilates	Constricts
Gastrointestinal tract	Decreases motility	Increases motility
Sweat glands	Increases secretion	-----
Erector pili muscles (attached to hair follicles)	Contracts	-----

MCQs

Q1) Preganglionic fibers of the sacral outflow are carried by:

- A) Ciliary ganglion B) Submandibular ganglion C) Pelvic splanchnic nerves D) Peripheral ganglion

Q2) Post ganglionic neurons synapse with:

- A) Preganglionic neuron B) Target organs C) Postganglionic fibers D) Preganglionic fibers

Q3) The cell bodies of preganglionic neurons are located in

- A) Spinal cord B) Brain C) Peripheral nervous system. D) A and B

Q4) Autonomic nervous system is regulated by:

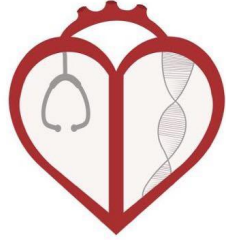
- A) Pineal gland B) Diencephalon C) Hypothalamus D) Thymus gland

Q5) The parasympathetic division is activated during:

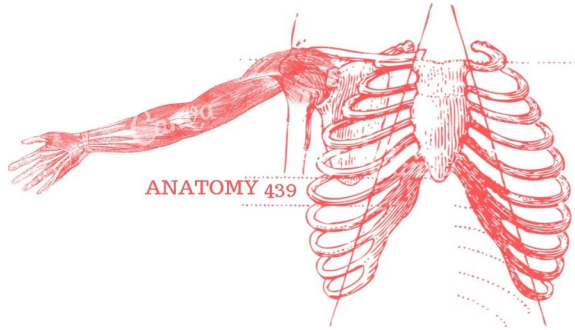
- A) Exercise B) Fear C) Conserving energy. D) Excitement

Q6) Which of the following is a parasympathetic effect:

- A) Decreased secretion of lacrimal gland B) Constriction of the ciliary muscle of the eye
C) Dilated iris of the eye D) Dilated bronchi



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