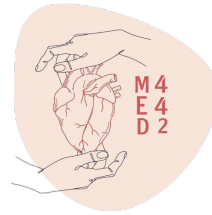
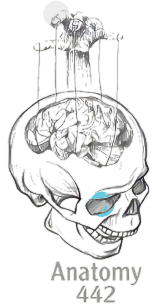


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# Autonomic Nervous System

Color index:

Main text

Lecture 4

• Red: important

Pink: in girls slides only

Blue: in boys slides only

Green: Doctors notes

Grey: Extra info





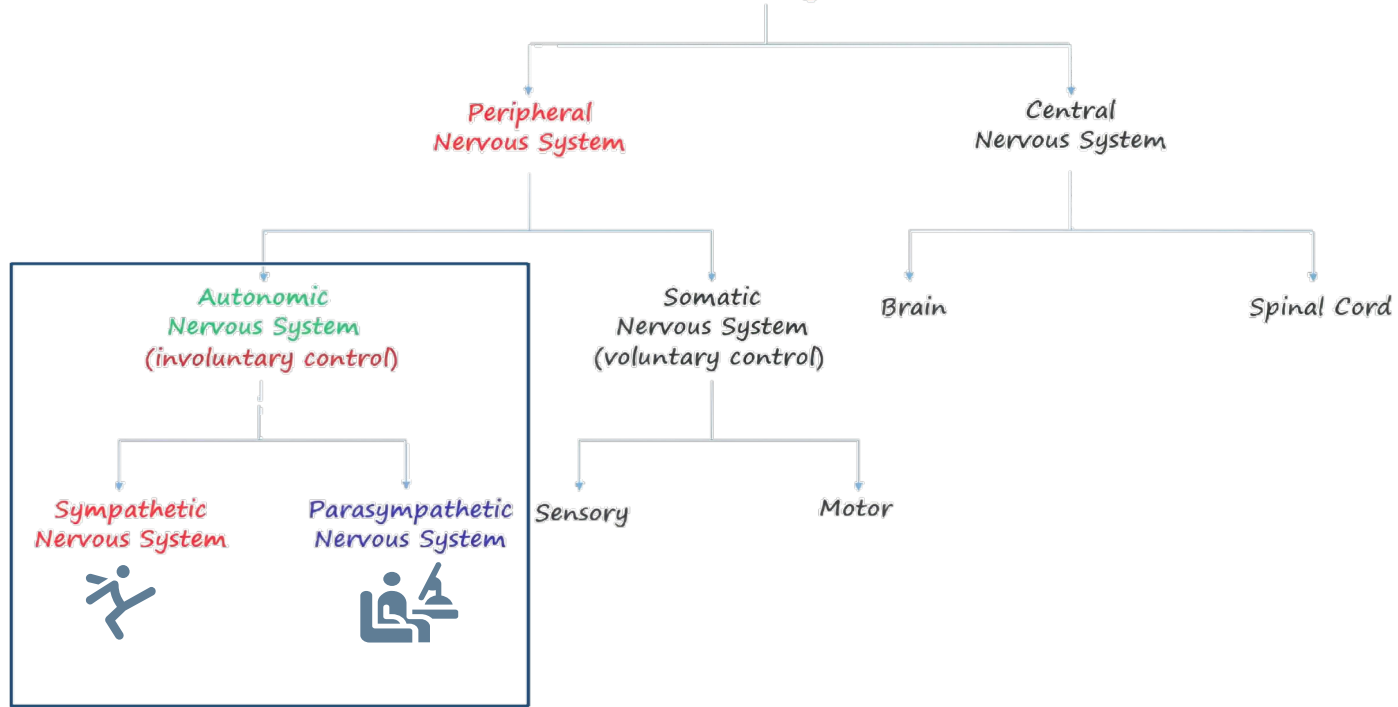
# Objectives



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.

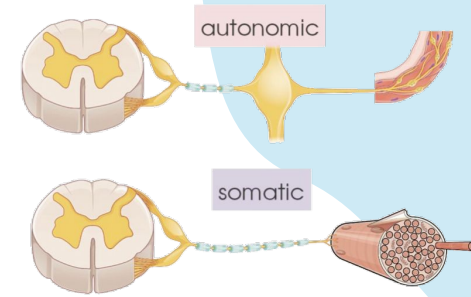
# Nervous System



We will talk about this part

# Autonomic Nervous System ●●●

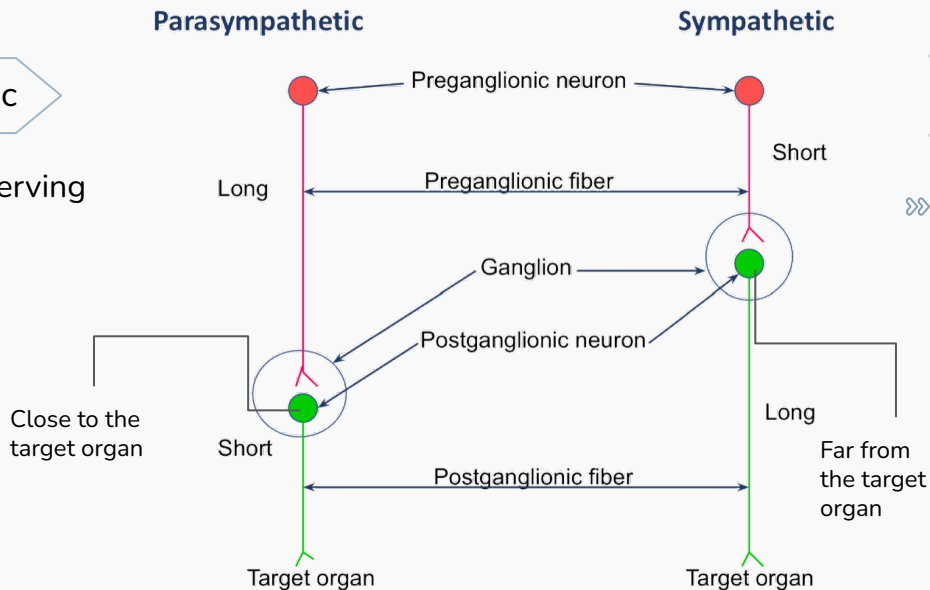
- Concerned with the innervation and control of **involuntary** structures: visceral organs, smooth & cardiac muscles and glands.
  - Along with the endocrine system, its primary function is **homeostasis** of the internal environment.
  - Located both in the central and peripheral nervous systems.
  - Regulated (controlled) by **hypothalamus**.
- Unlike the somatic nervous system, the **efferent** pathway of the autonomic nervous system is made up of two neurons called as **preganglionic and postganglionic neurons**.
- The cell bodies of the **preganglionic** neurons are present in the brain and spinal cord. Their axons synapse with the **postganglionic** neurons whose cell bodies are present in the autonomic ganglia.



## Parasympathetic

» Concerned with conserving energy.

“rest and digest”



## Sympathetic

» Activated during Concerned with exercise, excitement, and emergencies.

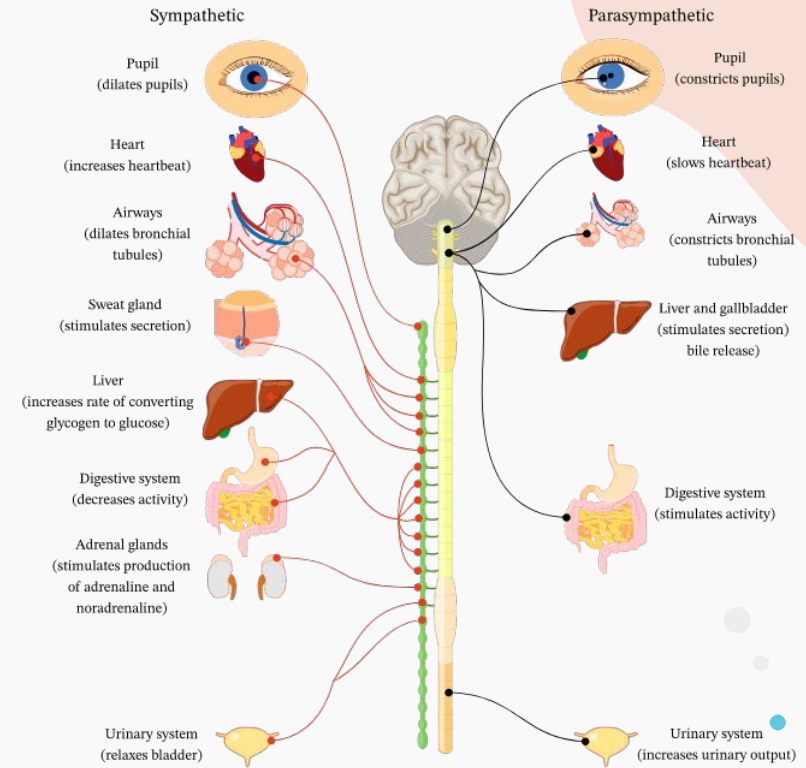
“fight, flight, or fright”



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

Note 438: 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.

	Sympathetic	Parasympathetic
Iris of the eye (pupils)	Dilates	Constricts
Ciliary of the eye	Relaxes	Contracts
Salivary gland	Reduces secretions	Increases secretions
Lacrimal gland (الغدة الدمعية)	Reduces secretions	Increases secretions
Heart	Increases rate and force of contraction	Decreases rate and force of contraction
Bronchi	Dilates	Constricts
Gastrointestinal tract	Decreases motility	Increases Motility
Sweat glands	Increases secretions	No effect
Erector Pili (Muscles attached to the hair)	Contracts	No effect



**Figure 3:** A diagram summarizing the parasympathetic and sympathetic nervous systems' effects on different organs.

Sympathetic **inhibits** gland secretions except for **sweat glands**

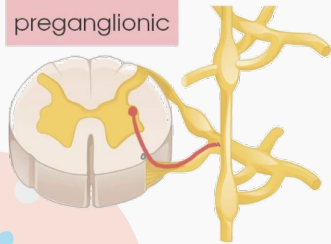
# Sympathetic Division

## 1-Preganglionic Neurons:

Located in the lateral gray horn of T1-L2 segments of spinal cord

(ThoracoLumbar outflow)

Outflow: the passage of impulses outwardly from the central nervous system



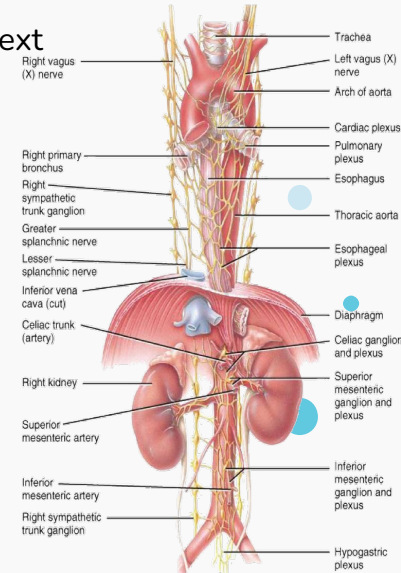
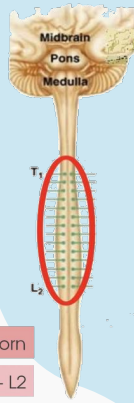
**Important Note (439):** Sympathetic neurons are **only** found in the spinal cord

## 2-Postganglionic ganglia:

Located nearer to the central nervous system as:

1- **Prevertebral** is the **celiac and mesenteric** (in front of vertebral)

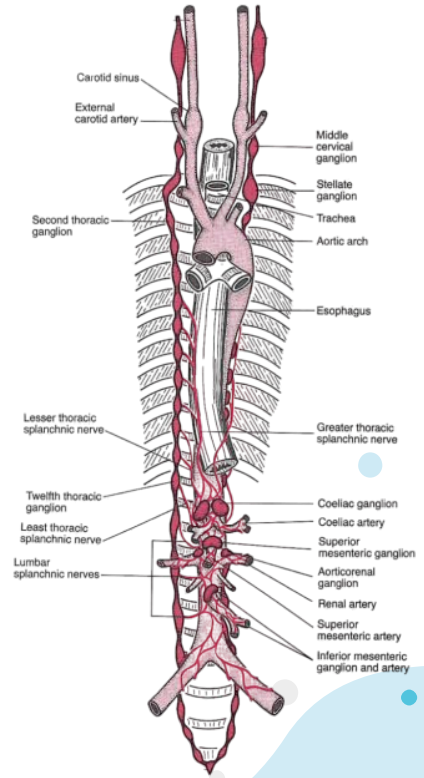
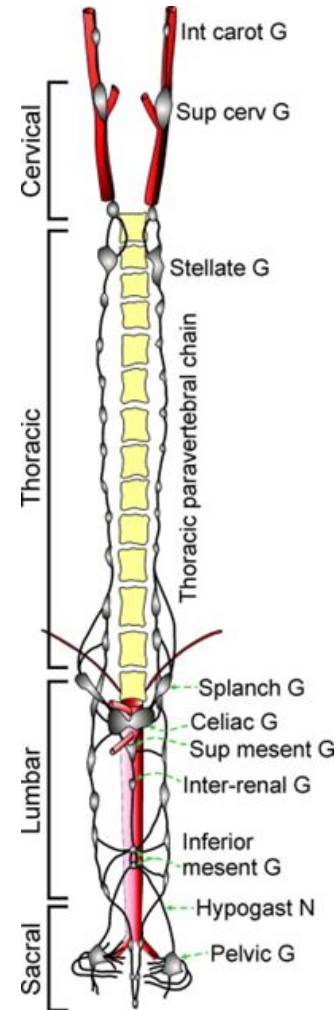
2- **Paravertebral** forming sympathetic chain (next to parallel)



# Paravertebral Ganglia

- They are interconnected to form 2 **sympathetic chains**, one on each side of vertebral column.
- Number of ganglia:  
**Three** in **cervical** part of chain  
**Eleven to twelve** in **thoracic** part  
**Four** in **lumbar & sacral** parts each.
- The chains end into a common '**ganglion impar**' in front of coccyx.

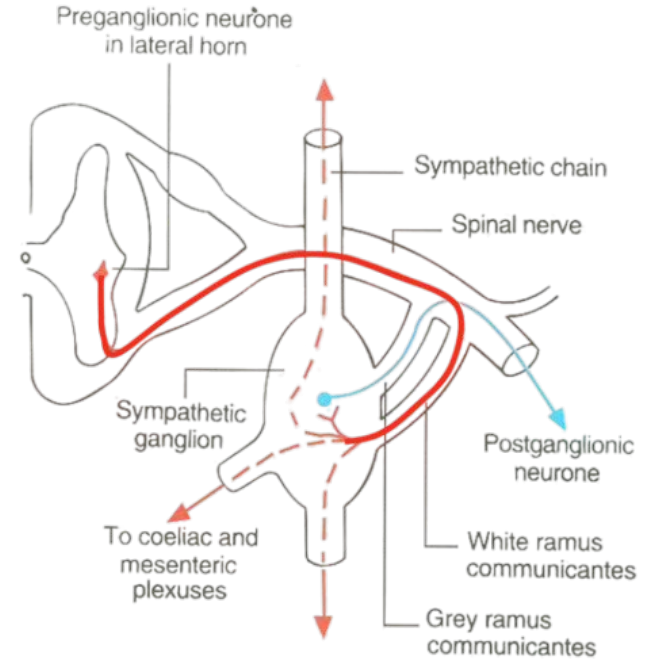
Impar means one ganglion





# 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).



# Preganglionic Fibers ●●●

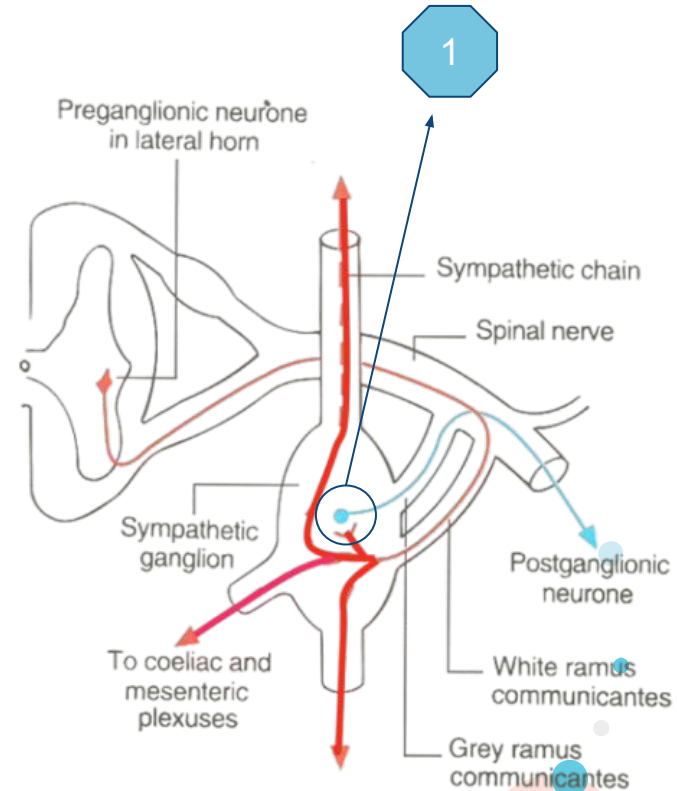
- Within the **Sympathetic Chain**, these fibers may:

1

Synapse with cells of the **corresponding paravertebral ganglion** (ترتبط مع القانقليونقائفون اللي تكون موجوده مباشره اول ماتدخل) located in the sympathetic chain.

**Postganglionic neurons** are cells of the corresponding **paravertebral ganglion**; postganglionic axons leave the sympathetic chain and join the spinal nerve (via grey ramus cumminicans) (GRC) to supply structures in **thorax + blood vessels & sweat glands**.

Check the photo on the right to have a better understanding



# Preganglionic Fibers Cont..

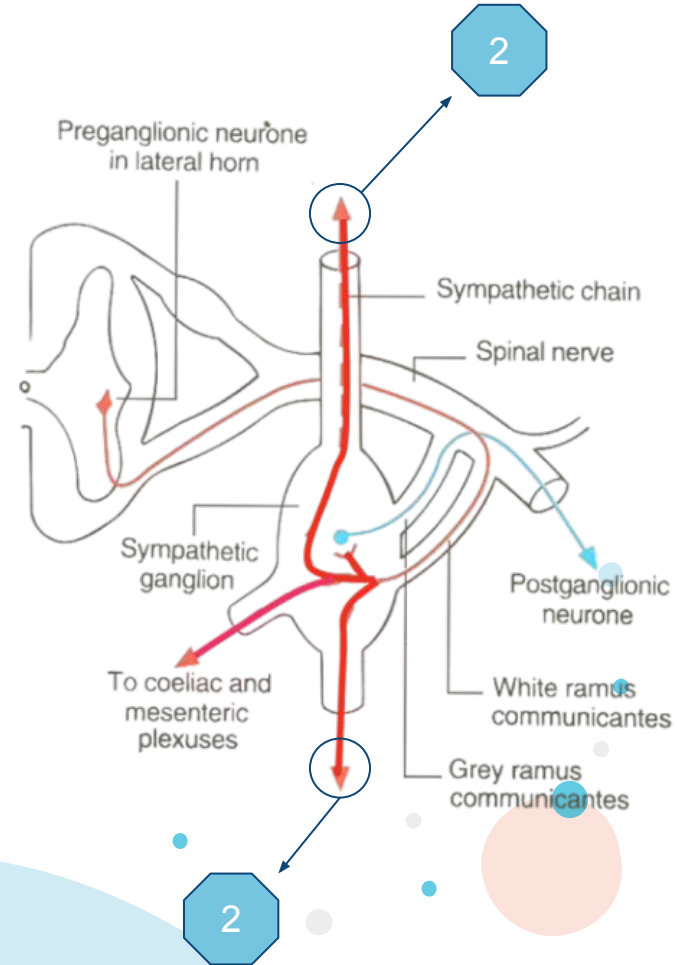
- Within the **Sympathetic Chain**, these fibers may:

2

**Ascend or descend** to synapse with neurons (postganglionic) of **paravertebral ganglia** located in sympathetic chain.

Postganglionic neurons are cells of this particular **paravertebral ganglion**: postganglionic axons leave the sympathetic chain & join the spinal nerve corresponding to this ganglion to supply structures in **head & thorax + blood vessels & sweat glands**.

Check the photo on the right to have a better understanding



# Preganglionic Fibers Cont..

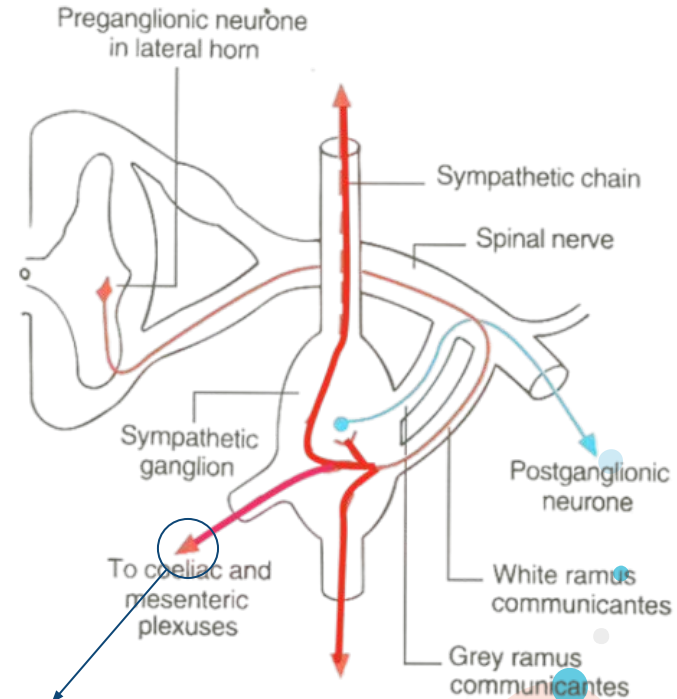
- Within the **Sympathetic Chain**, these fibers may:

3

**Leave** the sympathetic chain (**without synapse**) to reach **coeliac & superior or inferior mesenteric ganglia** (around branches of abdominal aorta) to **synapse** with their neurons (postganglionic).

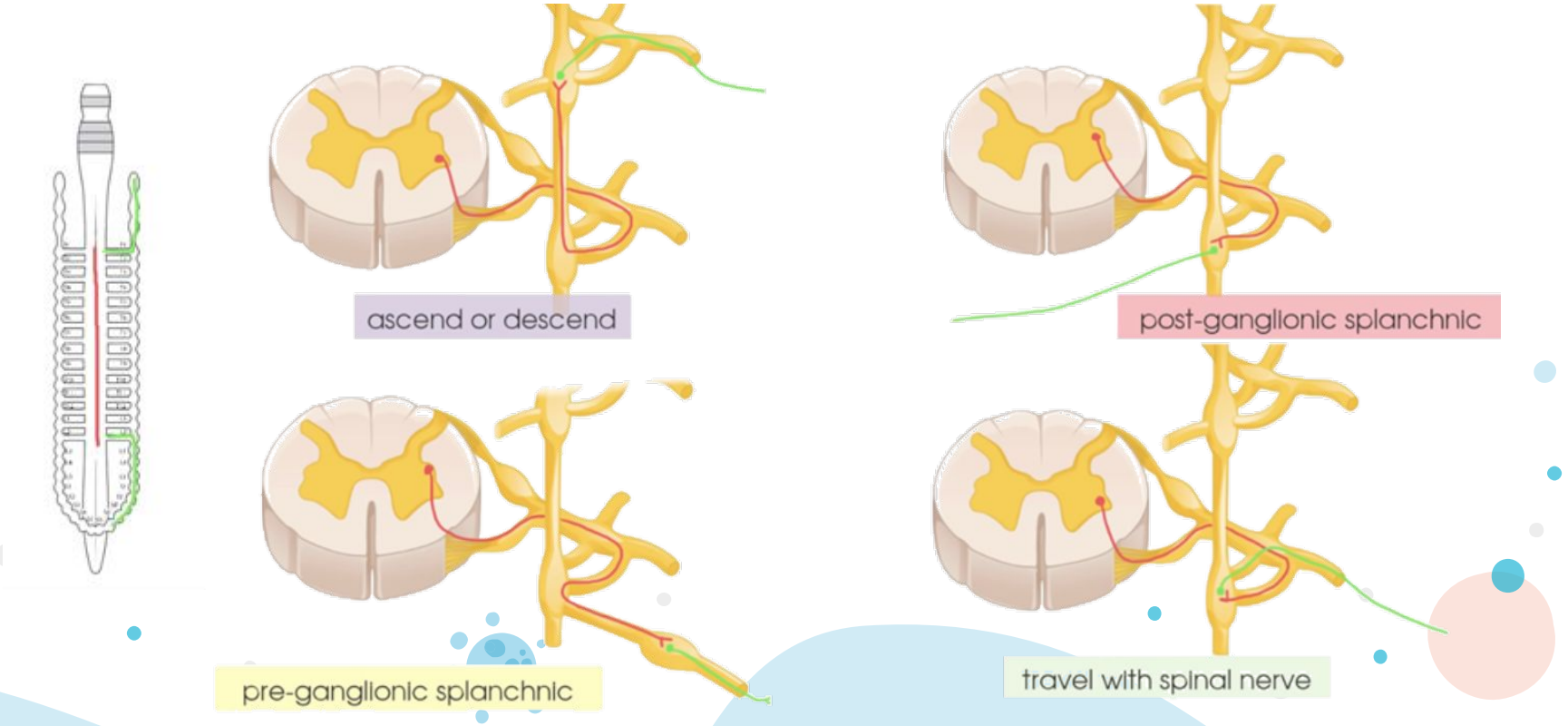
Postganglionic neurons are cells of coeliac, superior & inferior mesenteric plexuses. Postganglionic axons supply **abdominal & pelvic viscera**.

Check the photo on the right to have a better understanding



3

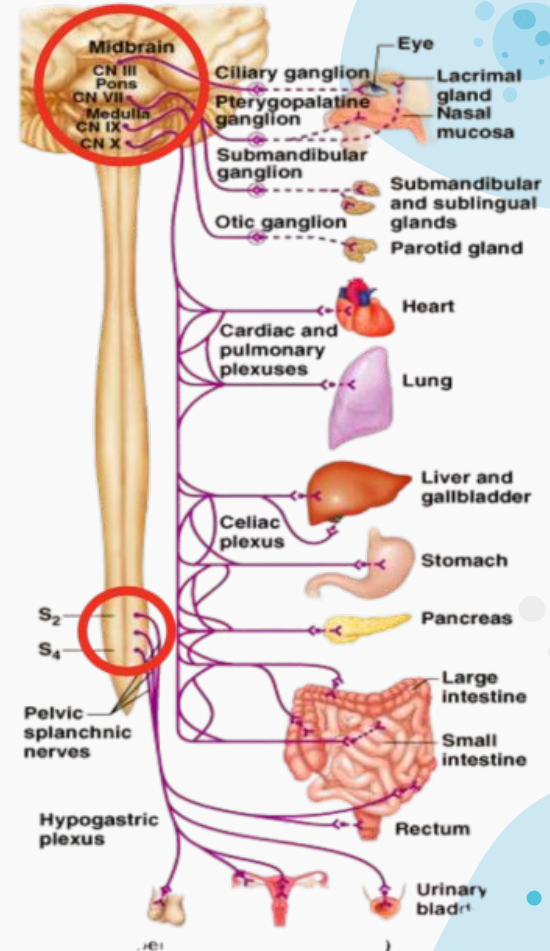
# Sympathetic Nervous System Anatomy ...



# Parasympathetic Division ●●●

## Preganglionic neurons located in:

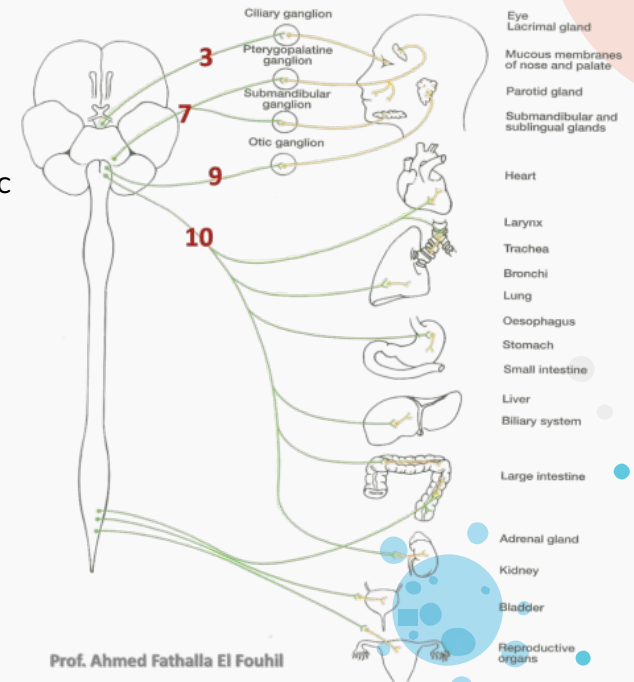
- Nuclei of the 3rd, 7th, 9th, and 10th **Cranial Nerves** of the brainstem (**cranial outflow**)
- The lateral gray horn of the S2-S4 segments of the **Spinal Cord** (**sacral outflow**)
- **Preganglionic fibers** from **cranial outflow** are carried by 3rd, 7th, 9th & 10th cranial nerves and terminate in ciliary, pterygopalatine, submandibular, otic & peripheral ganglia.
- Postganglionic fibers innervate organs of the head, neck, thorax, and abdomen.
- **Preganglionic fibers** from **sacral outflow** are carried by pelvic splanchnic nerves to peripheral ganglia in pelvis where they synapse.
- **Postganglionic fibers** innervate organs of the pelvis and lower abdomen.



# Parasympathetic Nervous System ●●●

## Preganglionic parasympathetic neurons:

- Cells located in the brainstem: Preganglionic axons **leave** the brainstem and join:
- **Third cranial** nerve to synapse with cells of ciliary ganglion. Postganglionic neurons supply **sphincter pupillae & ciliary muscles**.
- **Seventh cranial** nerve to synapse with the cells of pterygopalatine & submandibular ganglia. Postganglionic neurons supply **lacrimal, submandibular & sublingual salivary glands**.
- **Ninth cranial** nerve to synapse with cells of otic ganglion. Postganglionic neurons supply **parotid salivary gland**.
- **Tenth cranial** nerve to synapse with cells of peripheral ganglia. Postganglionic neurons supply structures in the **thorax & abdomen**.



# MCQs:

1- Where are the postganglionic ganglia of the sympathetic nervous system located?

A- Brainstem

B- Thoracic segments

C- Sacral segments

D- Sympathetic chain

2- Which of the following cranial nerves contain a parasympathetic neuron?

A- 5th

B- 7th

C- 2nd

D- 11th

3- Which of the following is a parasympathetic effect?

A- Dilated iris of the eye

B- Dilated bronchi

C- Decrease in GIT motility

D- Decreased heart rate

4- Preganglionic fibers get through sympathetic chain via:

A- Spinal nerve

B- White Ramus communicans

C- Ventral root

D- GRC

5- Where do parasympathetic fibres originate?

A- The thoracolumbar spinal region

B- The cranial and sacral regions

C- Head and Neck

D- Coeliac & Mesenteric ganglia

8- Which of the following ganglia does not contain postganglionic parasympathetic neurons?

A- Ciliary

B- Otic

C- Celiac

D- Pterygopalatine

9-C  
8-B  
7-A  
6-D  
5-B  
4-D  
3-B  
2-D  
1-D



# Team Leaders

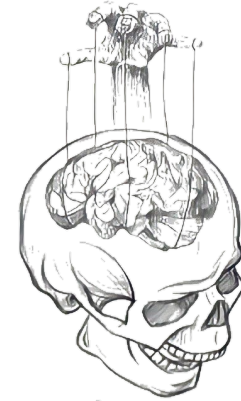


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Maha Alzahrani	Jana Alhazmi
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