

# **AUTONOMIC NERVOUS SYSTEM**

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# OBJECTIVES

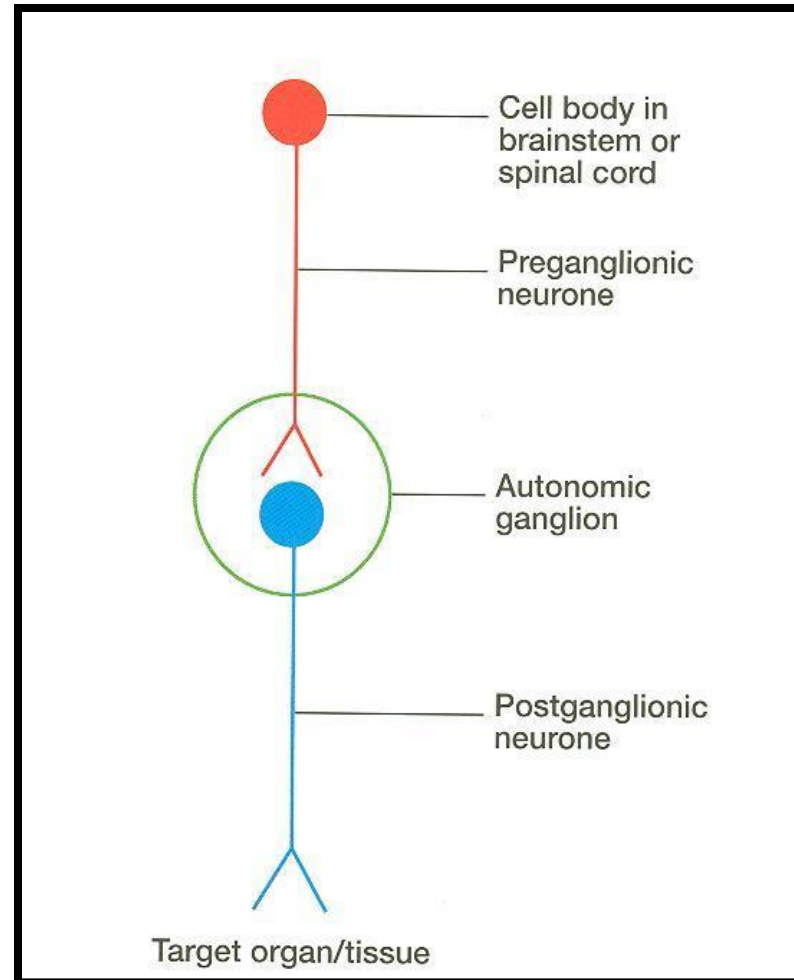
**At the end of the lecture, students should:**

- *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*

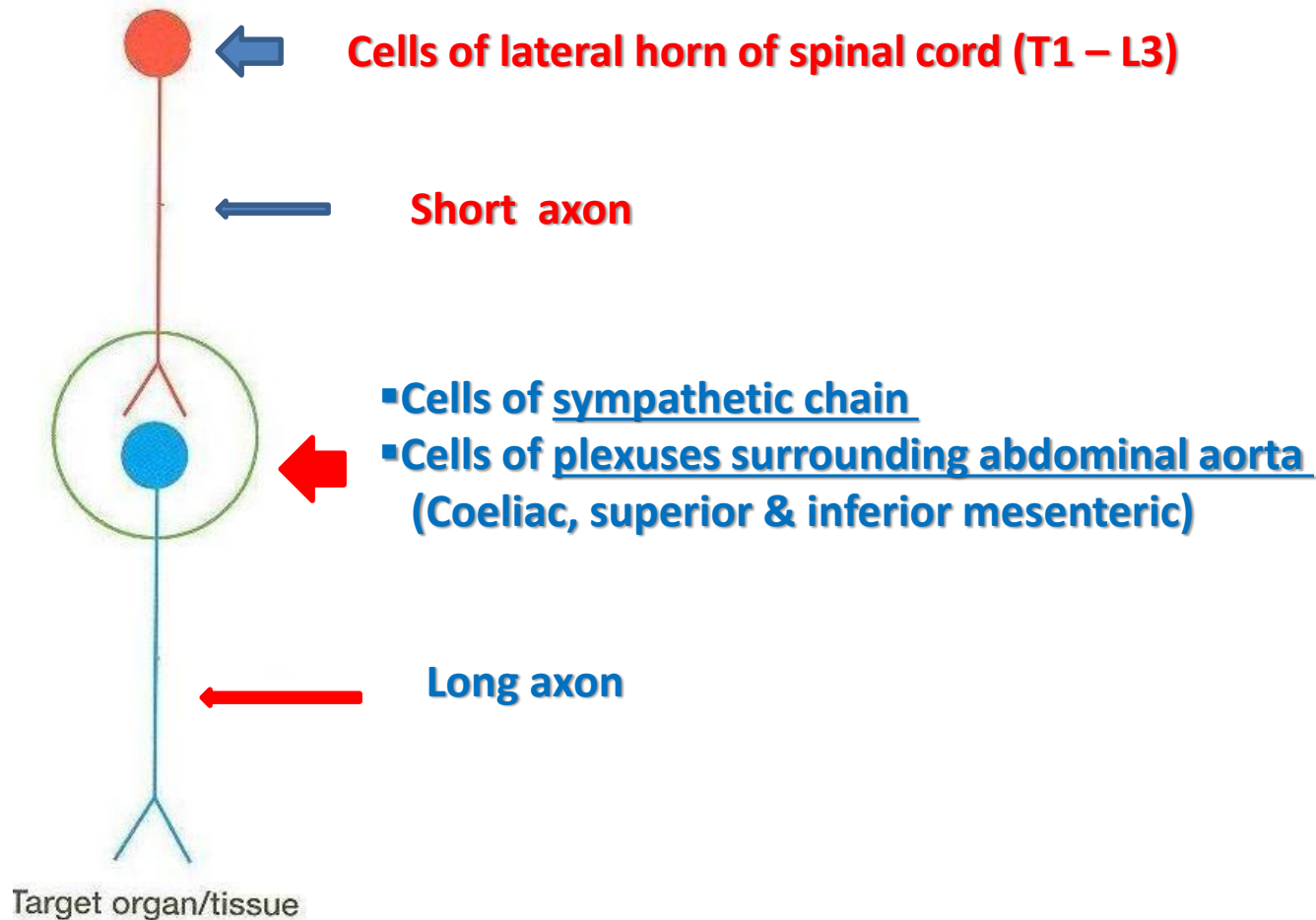
# DEFINITION

- ❖ Nerve cells located in both central & peripheral nervous system that are concerned with innervation of involuntary structures: viscera, smooth & cardiac muscles, glands.
- ❖ **Function:** maintains homeostasis of internal environment.
- ❖ **Regulation:** by hypothalamus.

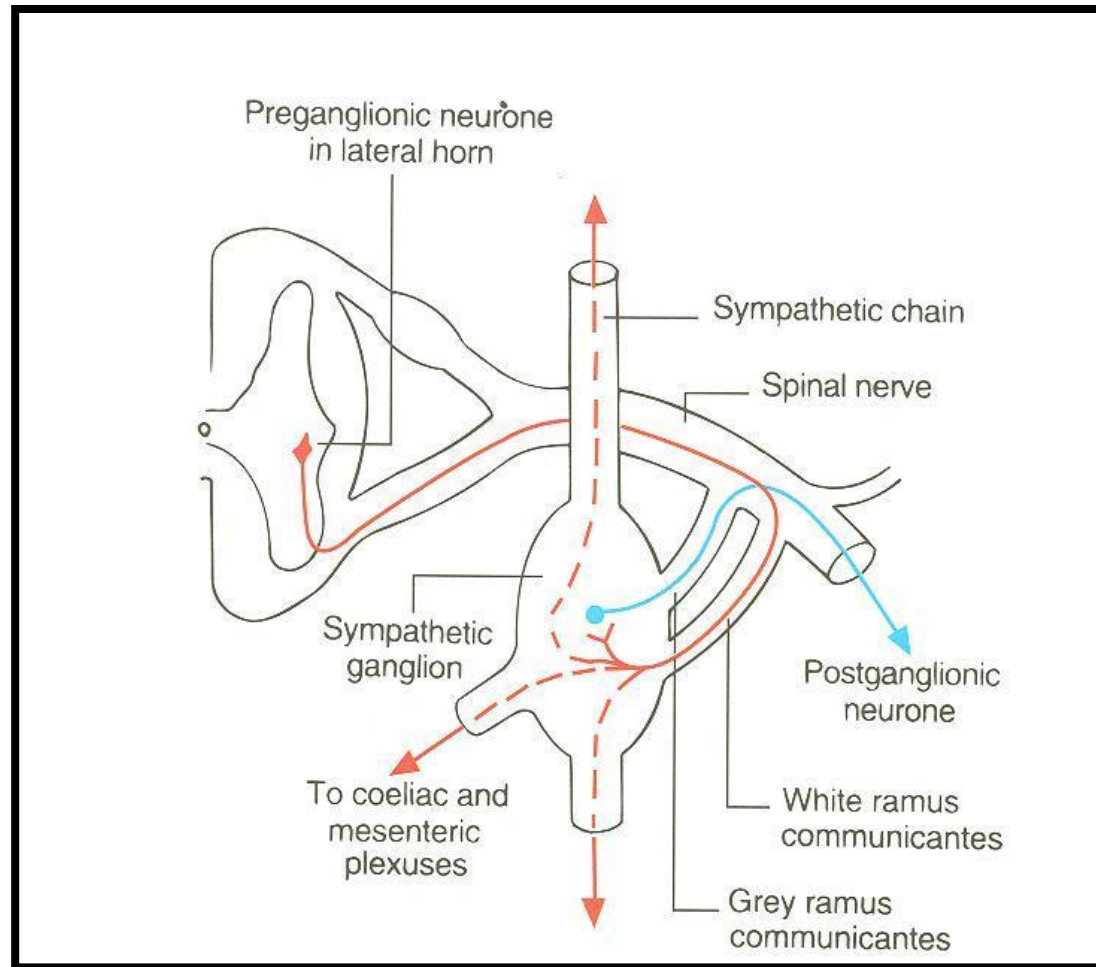
# STRUCTURE OF AUTONOMIC NERVOUS SYSTEM



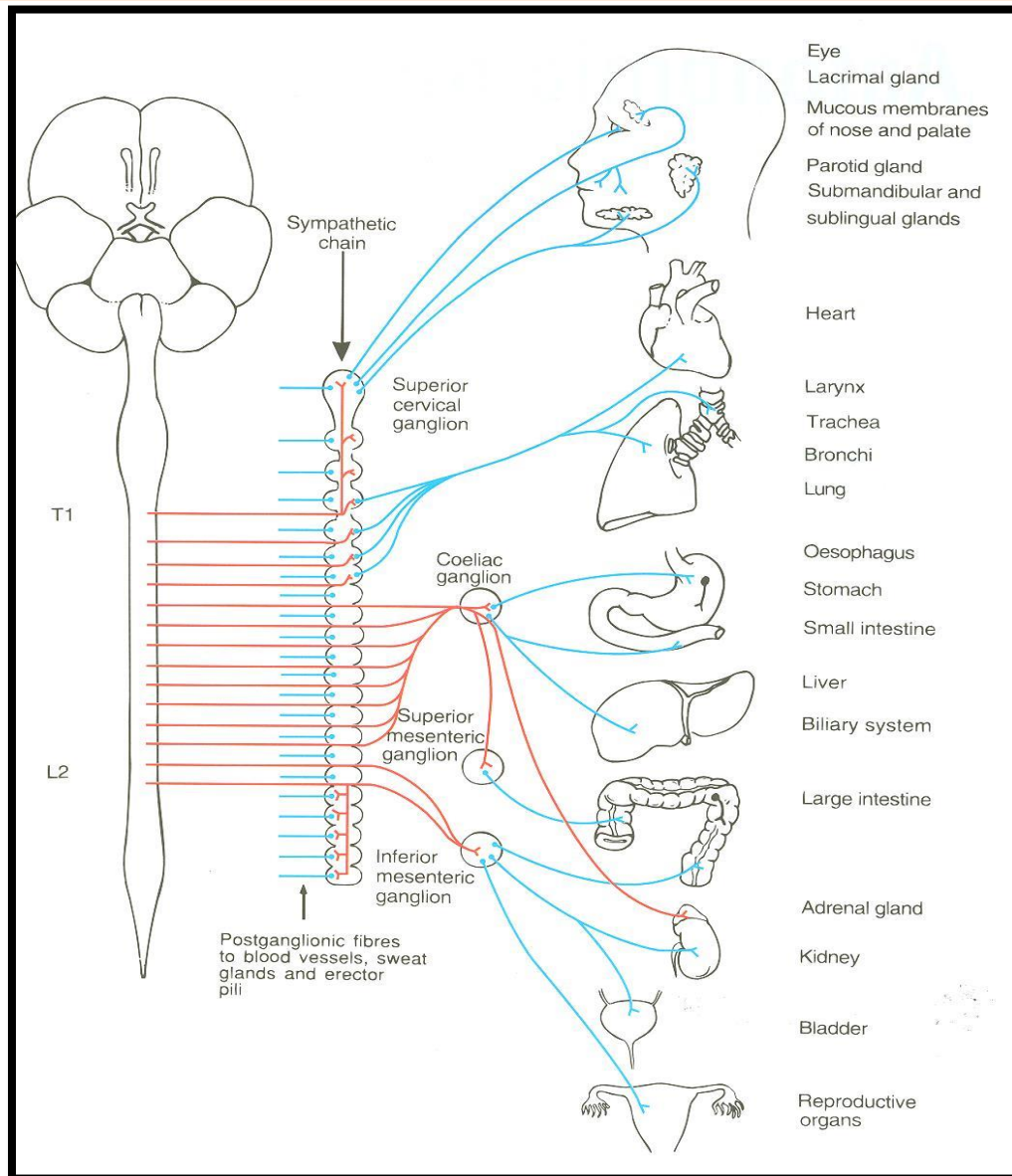
# SYMPATHETIC NERVOUS SYSTEM



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- ❑ **Preganglionic sympathetic neurons:** cells of the lateral horn of spinal cord in all thoracic + upper 3 lumbar segments.
- ❑ **Preganglionic axons** leave the spinal cord, join corresponding spinal nerves & reach the sympathetic chain (via the white ramus communicans). They either:
  1. **Synapse with cells of paravertebral ganglia** located in sympathetic chain (**postganglionic neurons are cells of paravertebral ganglia:** **postganglionic axons** leave the sympathetic chain & join again the spinal nerve (via **grey ramus communicans**) to supply *structures in head & thorax + blood vessels & sweat glands* .



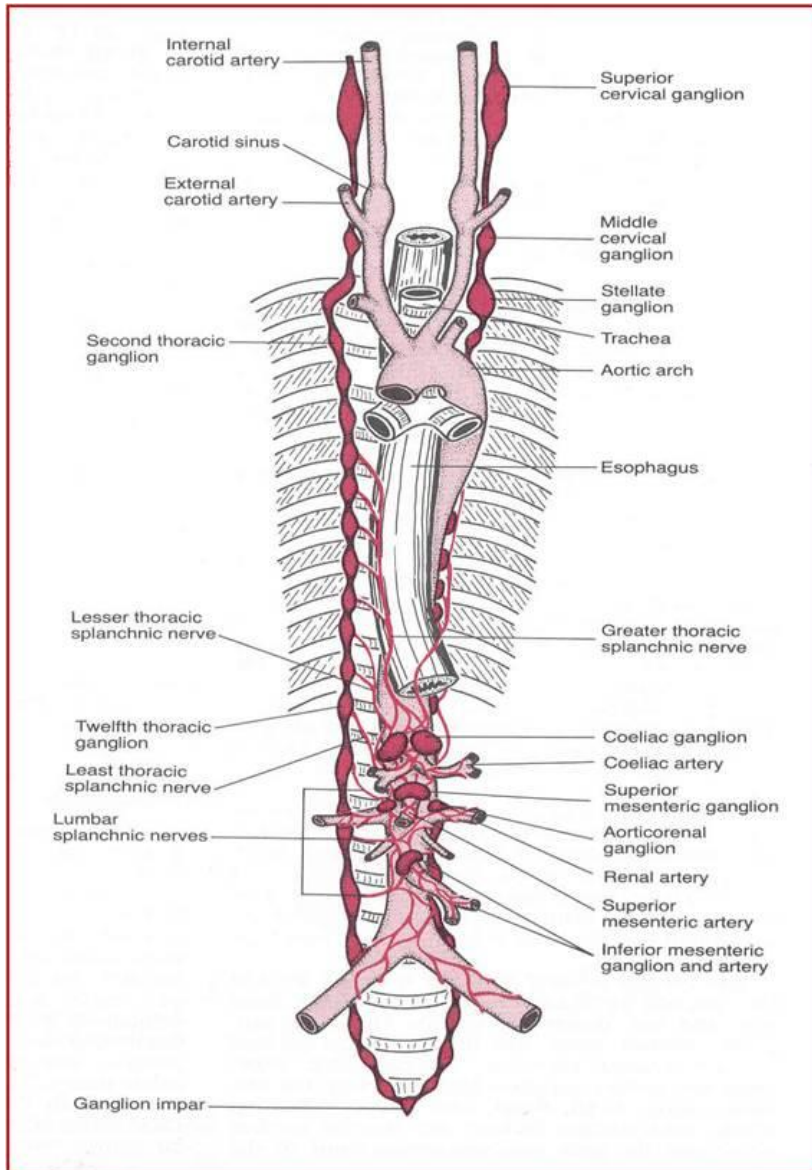
# SYMPATHETIC NERVOUS SYSTEM

2. Leave the sympathetic chain (without synapse) to reach coeliac & mesenteric plexuses (around branches of abdominal aorta) to synapse with their cells.

Postganglionic neurons are cells of coeliac & mesenteric plexuses.

Postganglionic axons supply *abdominal & pelvic viscera*.

# PARAVERTEBRAL GANGLIA



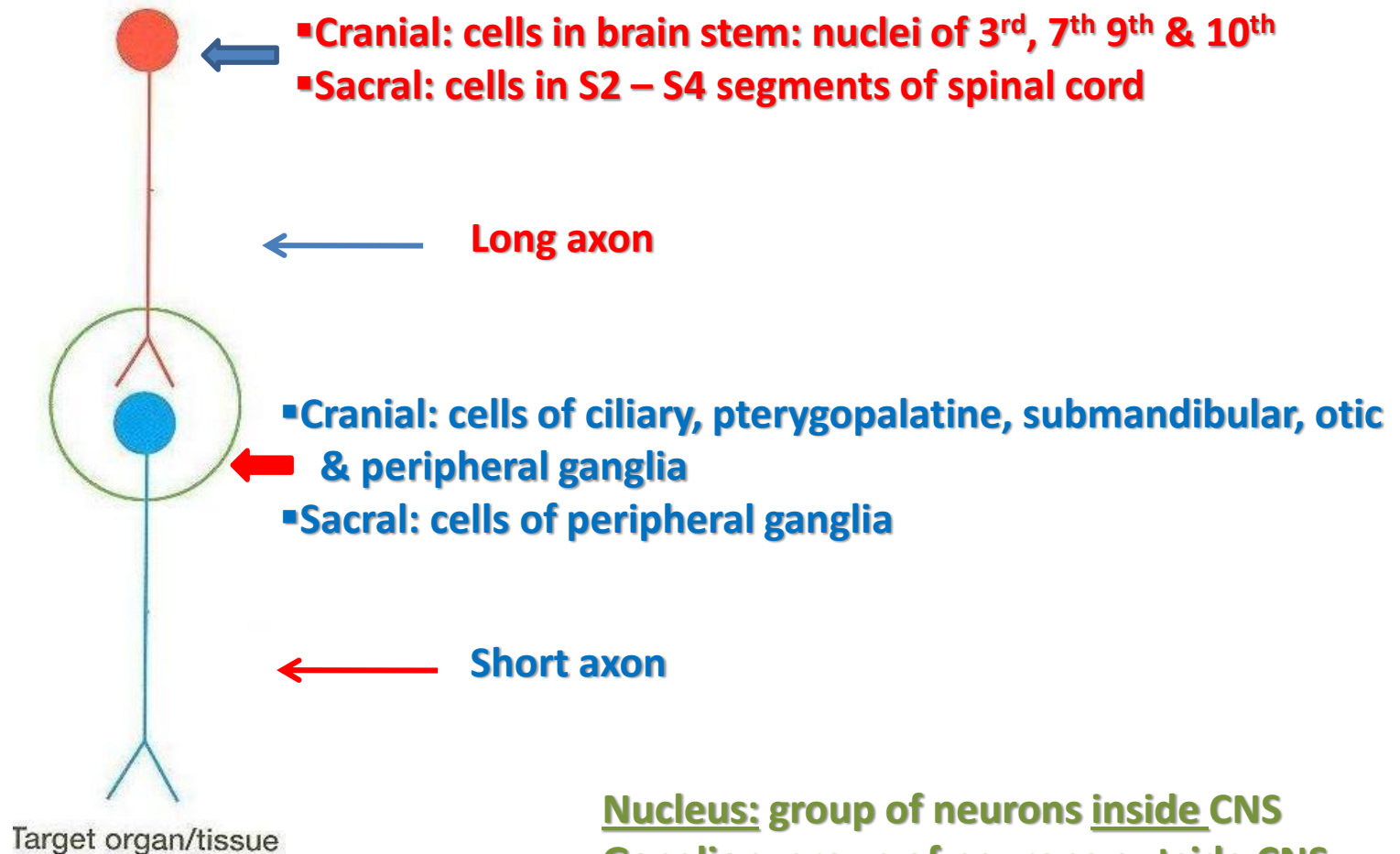
□ They are interconnected to form 2 sympathetic chains, one on each side of vertebral column.

□ Number of ganglia:

1. Three ganglia in cervical part of chain
2. Eleven to twelve ganglia in thoracic part
3. Four in lumbar & sacral parts.

□ The chains end into a common 'ganglion impar' in front of coccyx

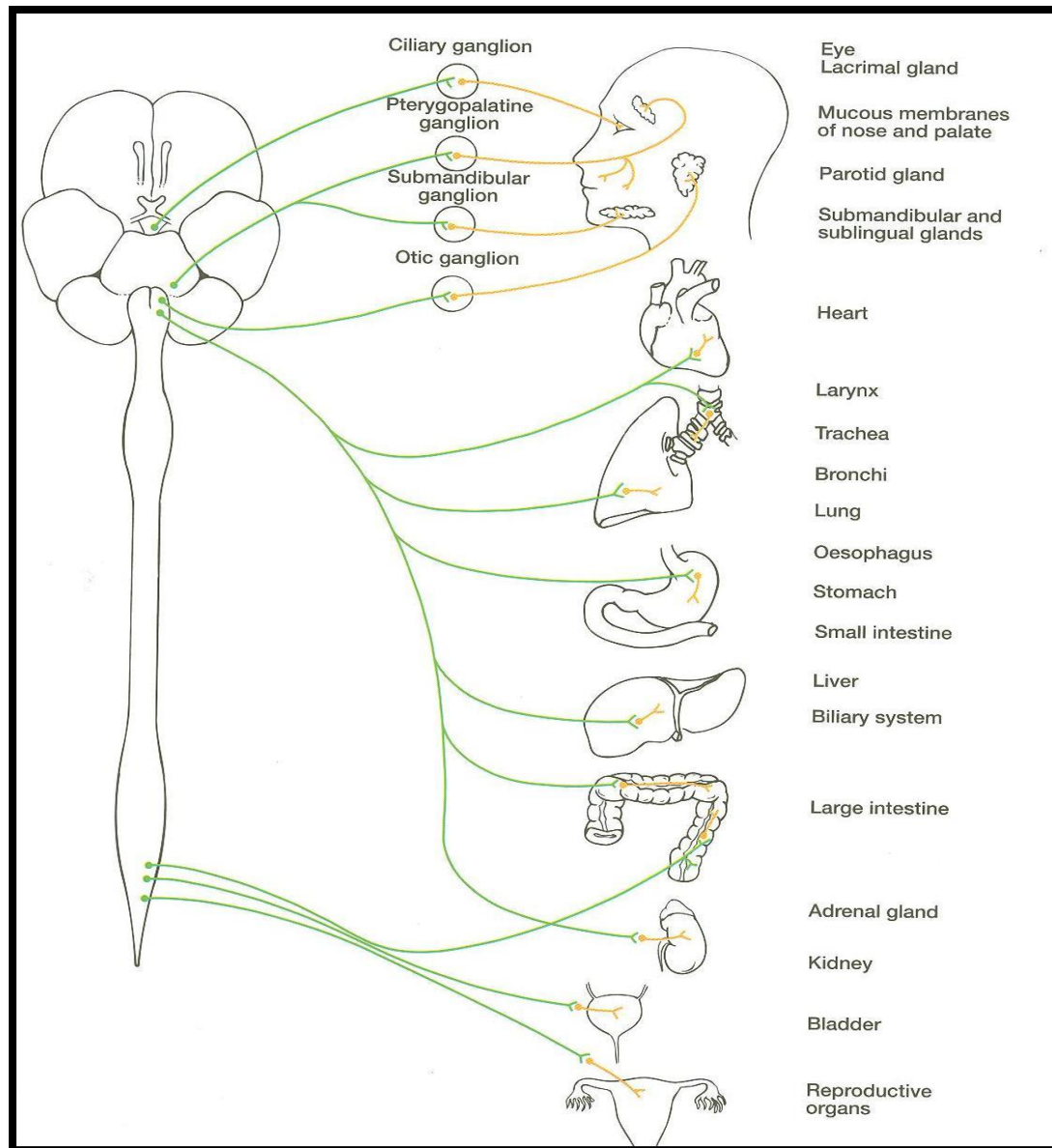
# PARASYMPATHETIC NERVOUS SYSTEM



Nucleus: group of neurons inside CNS

Ganglion: group of neurons outside CNS

# PARASYMPATHETIC NERVOUS SYSTEM



# PARASYMPATHETIC NERVOUS SYSTEM

□ Preganglionic parasympathetic neurons:

1. Cells located in brain stem: Preganglionic axons leave the brain stem, join 3<sup>rd</sup>, 7<sup>th</sup>, 9<sup>th</sup> & 10<sup>th</sup> cranial nerves & reach ciliary, pterygopalatine, submandibular, otic & peripheral ganglia (Postganglionic neurons are cells of those ganglia). Postganglionic axons supply *structures in head, thorax & abdomen.*
2. Cells located in 2<sup>nd</sup>, 3<sup>rd</sup> & 4<sup>th</sup> sacral segments of spinal cord. Preganglionic axons leave the spinal cord, join corresponding sacral spinal nerves to reach peripheral ganglia in pelvis where they synapse. Postganglionic neurons are cells of peripheral ganglia. Postganglionic axons supply *pelvic viscera.*

## Autonomic nervous system

Structure	Sympathetic effect	Parasympathetic effect
Iris of eye	Dilates pupil	Constricts pupil
Ciliary muscle of eye	Relaxes	Contracts
Salivary glands	Reduces secretion	Increases secretion
Lacrimal gland	Reduces secretion	Increases secretion
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 secretion	
Erector pili muscles	Contracts	

# QUESTION 1

At which one of the following sites are located preganglionic neurons of the sympathetic nervous system ?

1. Brain stem

2. Thoracic segments of spinal cord ←

3. Sacral segments of spinal cord

4. Sympathetic chain

## QUESTION 2

Regarding the parasympathetic nervous system, which one of the following statements is correct?

1. Its preganglionic axons are short.
2. It supplies sweat glands.
3. Its preganglionic neurons are located in the sacral segments of spinal cord. ←
4. Its postganglionic neurons are located in the coeliac & mesenteric plexuses.



The image features two large, stylized yellow roses with white and yellow petals, set against a teal background. The roses are surrounded by several green leaves. The entire scene is enclosed within a thick orange border. The text "THANK YOU" is written in a bold, blue, sans-serif font across the center of the roses.

**THANK YOU**