MEDICINE
KING SAUD UNIVERSITY

بسم الله الرحمن الرحيم

ANATOMY
TEAM 436

Autonomic Nervous System

FOURTH LECTURE

KEY

- Doctor's slides
- Notes/extra explanation
- Important
- Only on boys'/girls' slides

هذا العمل لا يغني عن المصدر الأساسي للمذاكرة

Revised By :
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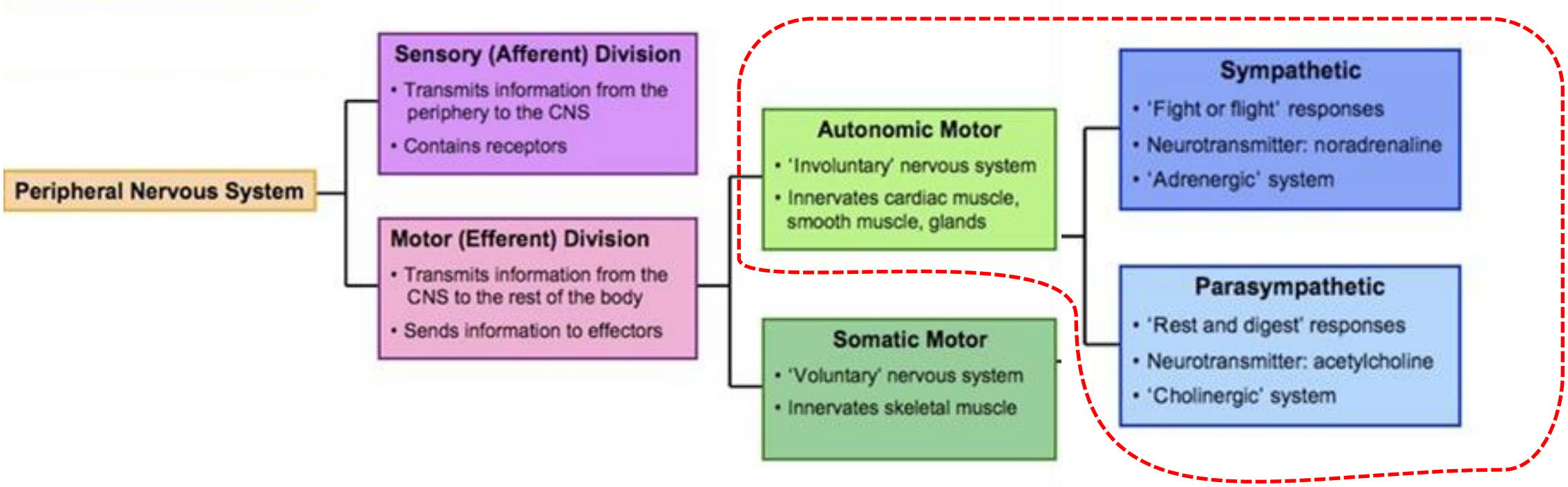
Shoag Alahmari

Objectives:

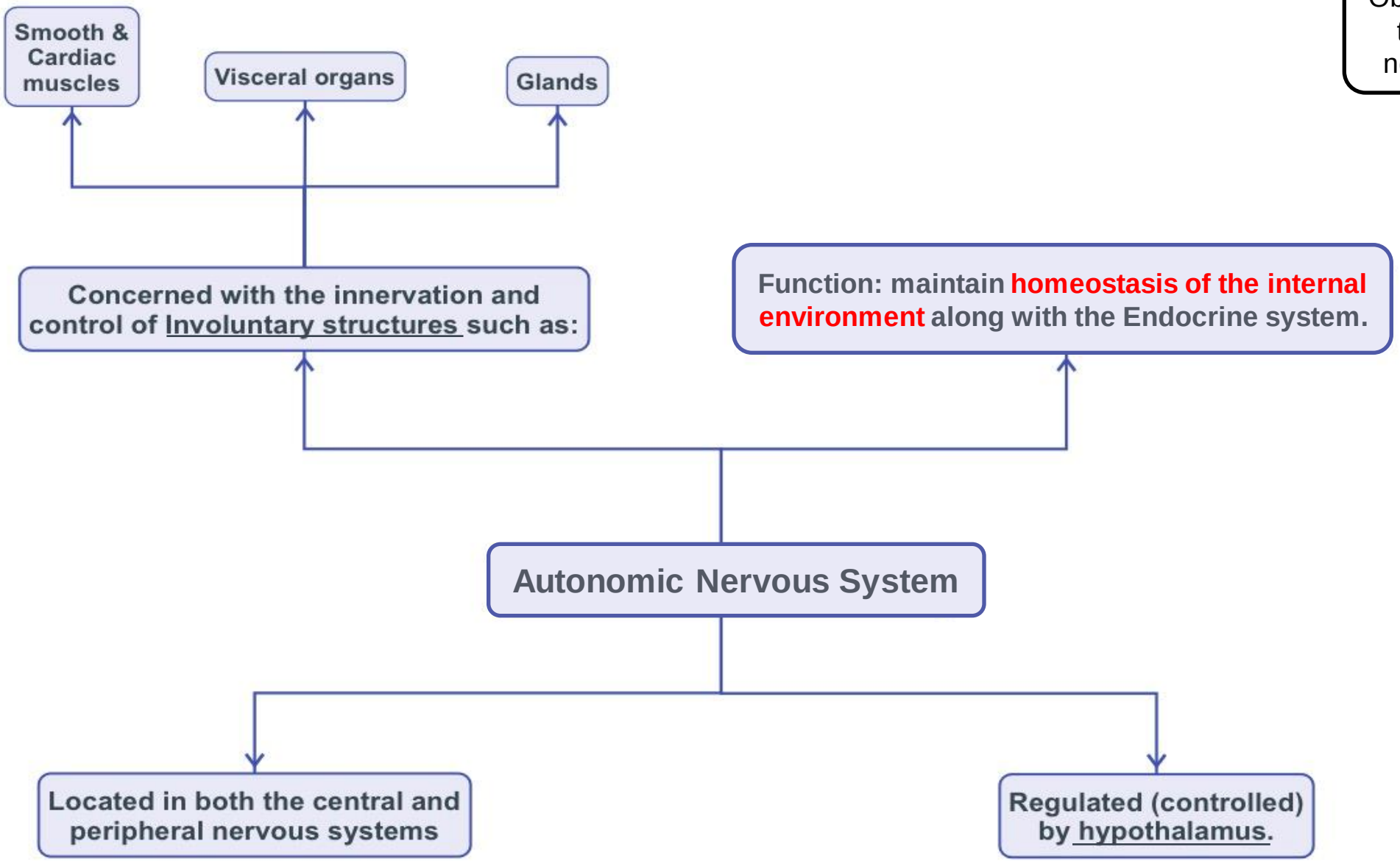
- Define the autonomic nervous system.
- Describe the structure of autonomic nervous system.
- Trace the preganglionic & postganglionic neurons in both sympathetic & parasympathetic nervous system.
- Enumerate in brief the main effects of sympathetic & parasympathetic nervous system.

Recall that..

- Group of neurons inside CNS -> Nucleus
- Group of neurons outside CNS -> Ganglion



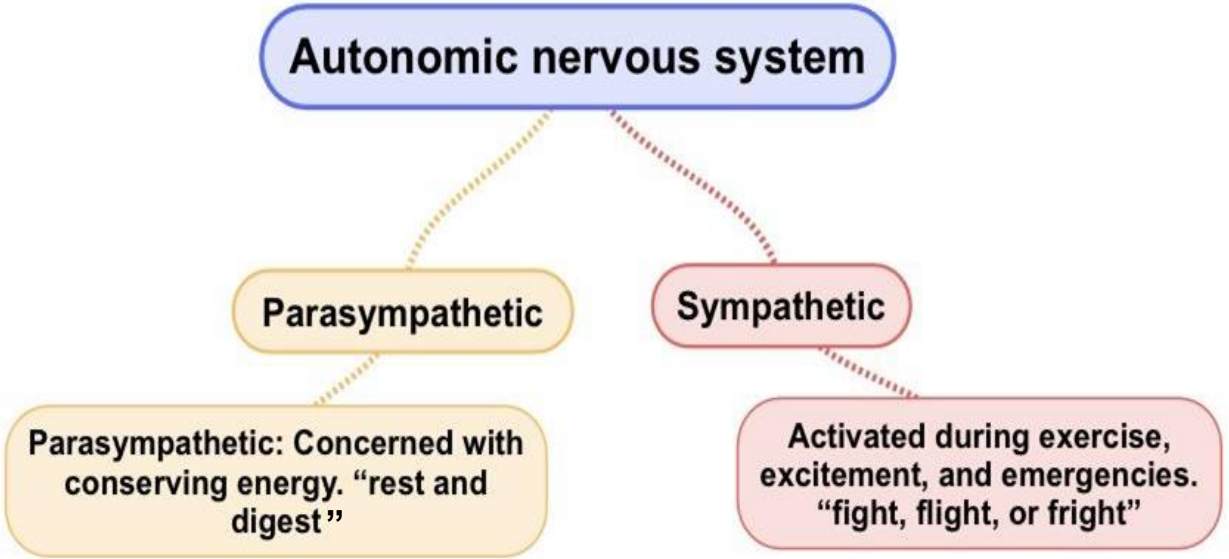
Objective 1: Define the autonomic nervous system.

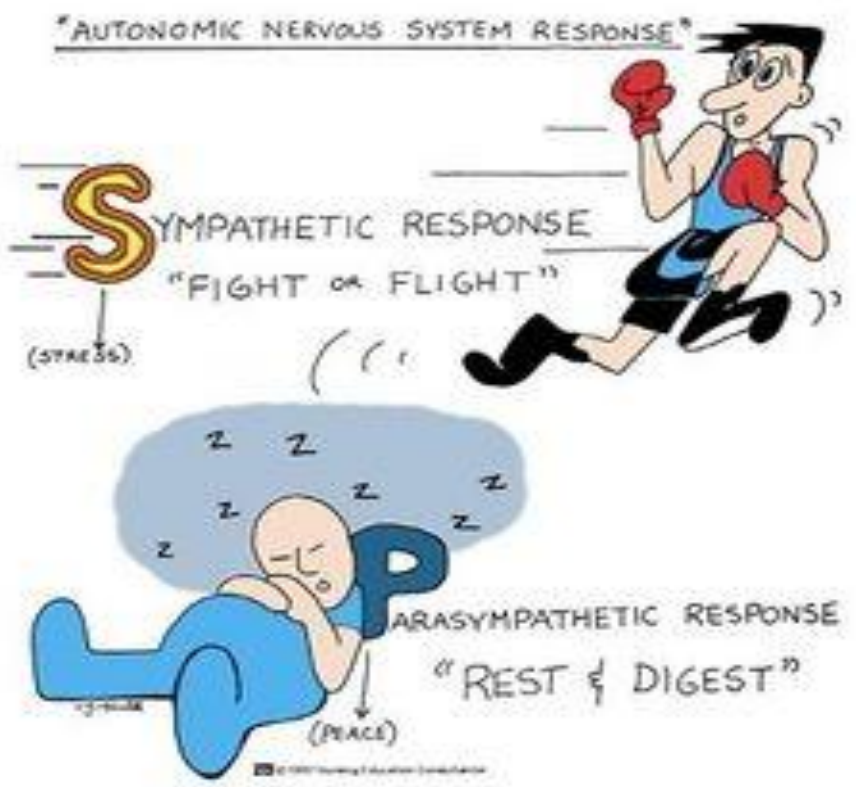


Objective 2: Describe the structure of autonomic nervous system.

The autonomic nervous system is divided according to its **anatomical**, **physiological**, and **pharmacological** characteristics into two subdivisions:

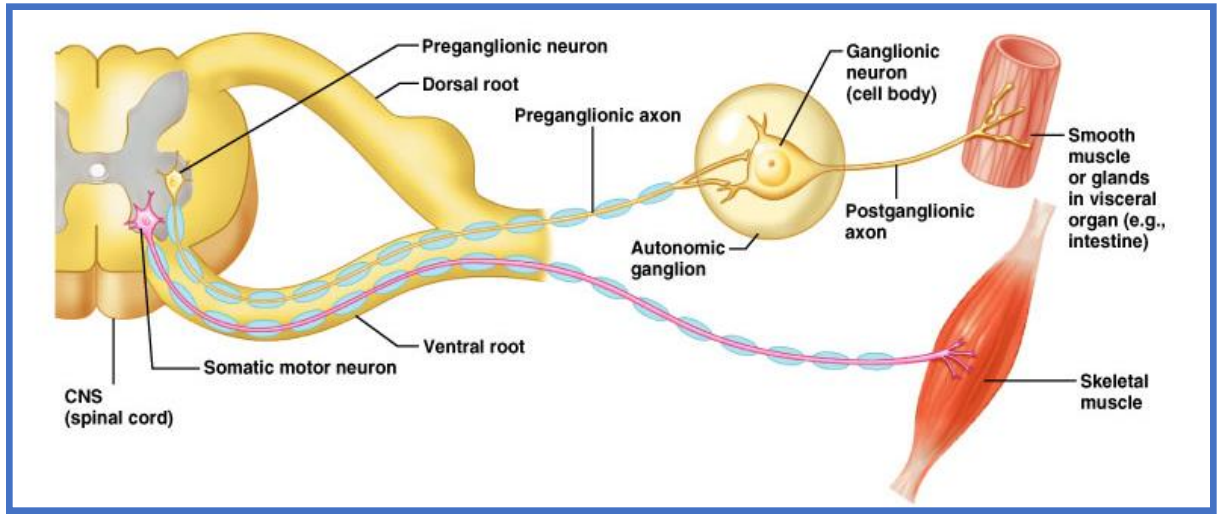
Both divisions operate in conjunction with one another (i.e. have antagonistic control over the viscera) to maintain a stable internal environment.





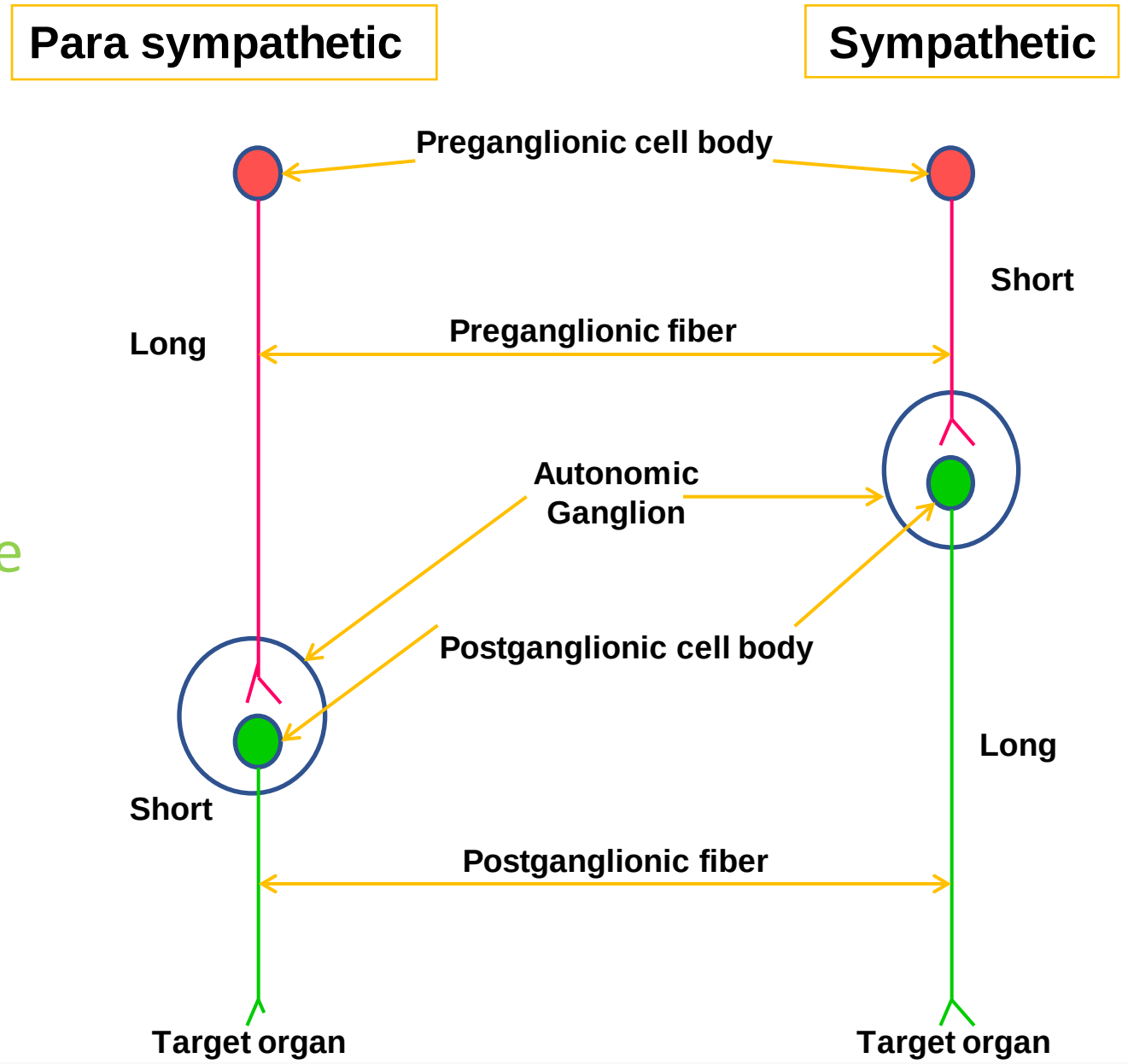
Objective 3: Trace the preganglionic & postganglionic neurons in both sympathetic & parasympathetic nervous system

- The efferent pathway of te somatic nervous system consists of one neuron.
- While, the efferent pathway of the autonomic nervous system is made up of two neurons: preganglionic and postganglionic neurons.
- The cell bodies of the **preganglionic** neurons are located in the brain and spinal cord. Their axons synapse with the **postganglionic** neurons whose cell bodies are located in the autonomic ganglia.



Objective 2: Describe the structure of autonomic nervous system.

- In the sympathetic, the preganglionic is shorter than the postganglionic.
- In the parasympathetic, the preganglionic is longer than the postganglionic

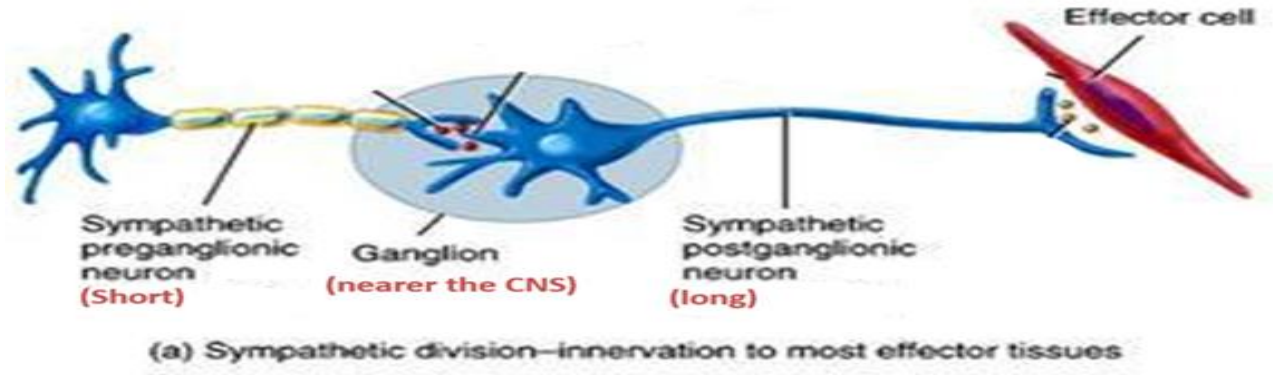


Sympathetic Division

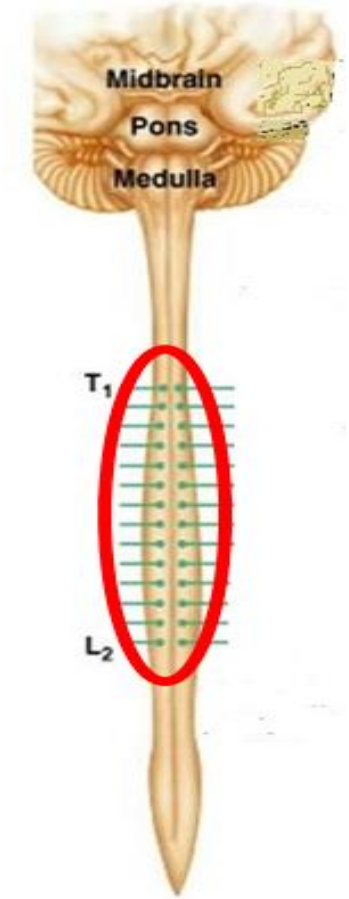
Objective 3: Trace the preganglionic & postganglionic neurons in both sympathetic & parasympathetic nervous system

(i) Neurons

- Preganglionic neurons are located in the lateral gray horn of T_1- L_2 (OR L_3) segments of spinal cord (Thoracolumbar outflow) (Outflow means the passage of impulses outwardly from the central nervous system.)
- As their preganglionic neurons are short, their ganglia are located near the CNS (spinal cord).



(a) Sympathetic division–innervation to most effector tissues



(ii) Ganglia

Objective 3: Trace the preganglionic & postganglionic neurons in both sympathetic & parasympathetic nervous system

Depending on their location with respect to the vertebral column they are divided into:

Prevertebral ganglia:

(pre means in front of)

coeliac & mesenteric ganglia (In front of the vertebrae (on the abdominal aorta))

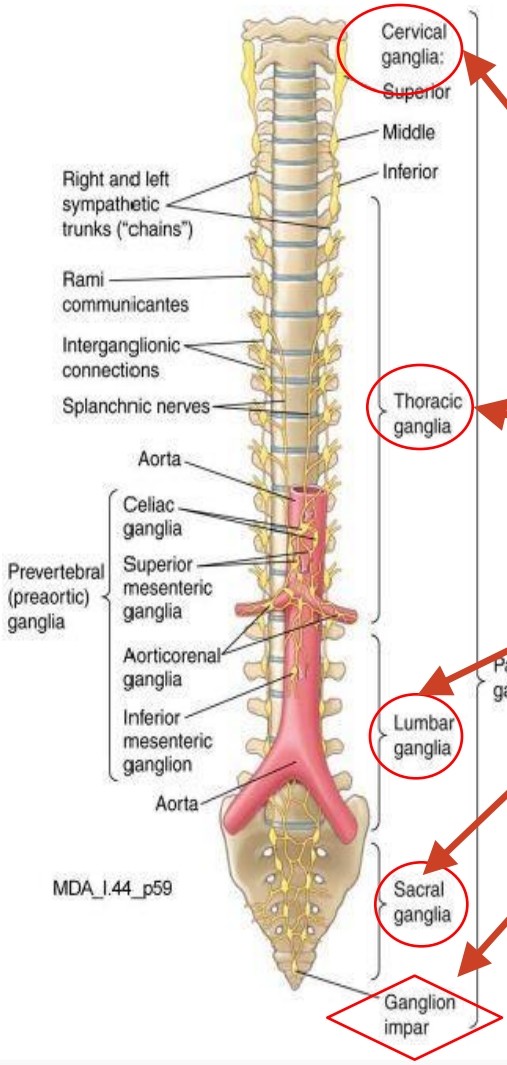
Postganglionic fibers supply:
1) abdominal
2) pelvic viscera

Paravertebral ganglia:

(para means next to)

sympathetic chain ganglia (Two interconnected chains, one on each side of vertebral column)

Postganglionic fibers supply:
1) structures in head & thorax
2) blood vessels
3) sweat glands



Number of Paravertebral ganglia:

3 in cervical

11-12 in thoracic

4 in lumbar

4 in sacral.

The chains end (fuse) into a common '**ganglion impar**' in front of coccyx

(iii) Fibers

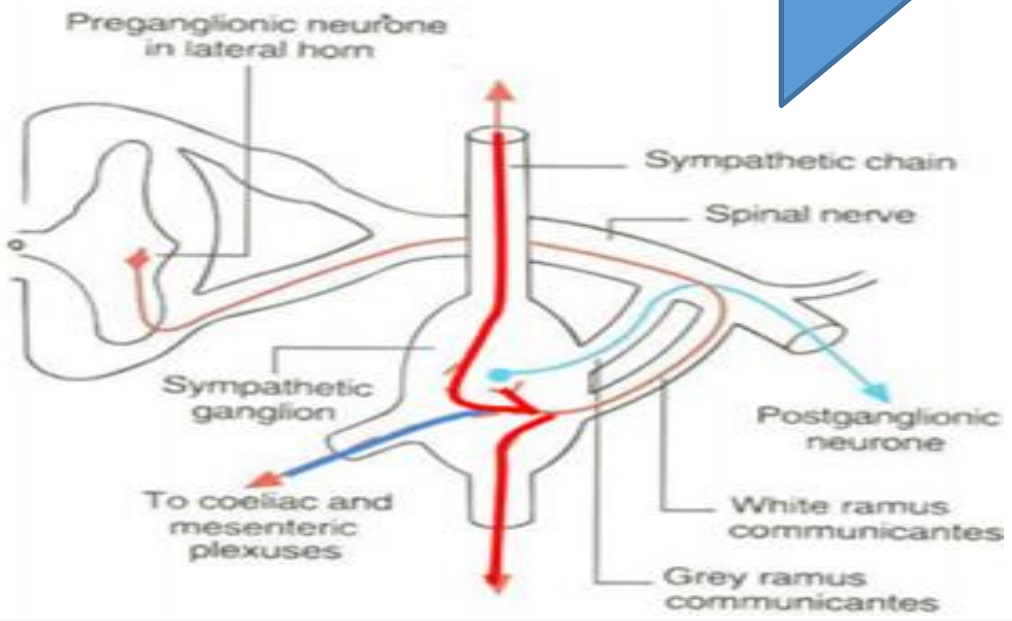
Preganglionic fibers	**Postganglionic fibers**
Cell body In **lateral horn**	Cell body In **ganglia**
Leave spinal chord, run in the ventral roots & travel through the spinal nerve, & join the sympathetic chain ganglia.	Leave sympathetic chain ganglia & enter again into the spinal nerve.
Via the **white** rami communicantes. (WRC)	Via **grey** rami communicantes (GRC)
Axon tips in **ganglia**	Axon tips in **target organ**

Objective 3: Trace the preganglionic & postganglionic neurons in both sympathetic & parasympathetic nervous system

Fibers in Sympathertic Chain Can Either:

1. Ascend, descend or remain at the same level to synapse with neurons (postganglionic) of **paravertebral ganglia** located in sympathetic chain.

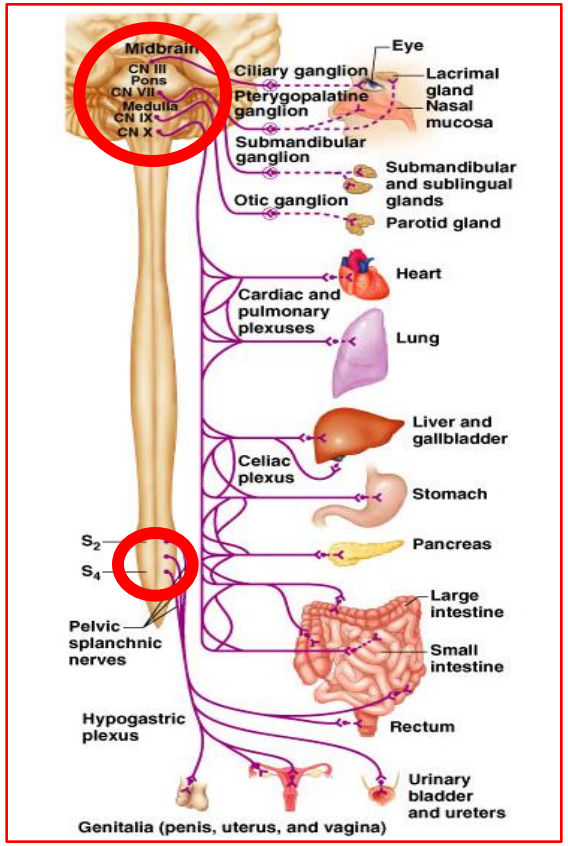
2. Leave the sympathetic chain (without synapse) to reach **coeliac & mesenteric ganglia** (around branches of abdominal aorta) to synapse with their neurons (postganglionic).



Parasympathetic Division

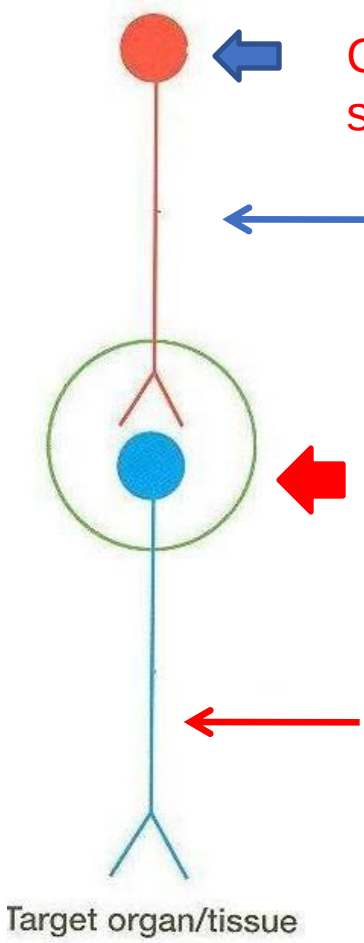
Objective 3: Trace the preganglionic & postganglionic neurons in both sympathetic & parasympathetic nervous system

1- Outflow	2- **Pre**ganglionic fibers	3- **Post**ganglionic fibers
A- Cranial outflow: Nuclei of the cranial nerves in the Brain Stem: Oculomotor (3rd) Facial (7th) Glossopharyngeal (9th) Vagus (10th)	**From**: Cranial outflow **Carried by**: 3rd, 7th, 9th & 10th cranial nerves. **Terminate in**: •Ciliary •Pterygopalatine •Submandibular •Anything has (otic) as a suffix •Peripheral ganglia	**Innervate (Supply)** organs of: Head Neck Thorax Abdomen
B- Sacral outflow: Lateral gray horn of S2-S4 segments of the spinal cord. (Cells located in 2nd, 3rd & 4th sacral segments of Spinal Cord)	**From:** Sacral outflow **Carried by**: corresponding sacral nerves. (Pelvic splanchnic nerves) **Terminate in**: Peripheral ganglia in pelvis where they synapse.	**Innervate** organs of: Pelvis Lower abdomen



- In the sympathetic division all the neurons were from the spinal chord, whereas in the parasympathetic some are from the brain (cranial) and some are from the spinal chord (sacral region).
- The sympathetic ganglia were divided into 2 types (prevertebral and paravertebral) whereas the parasympathetic ganglia are few, found in specific places and have specific names.

Review



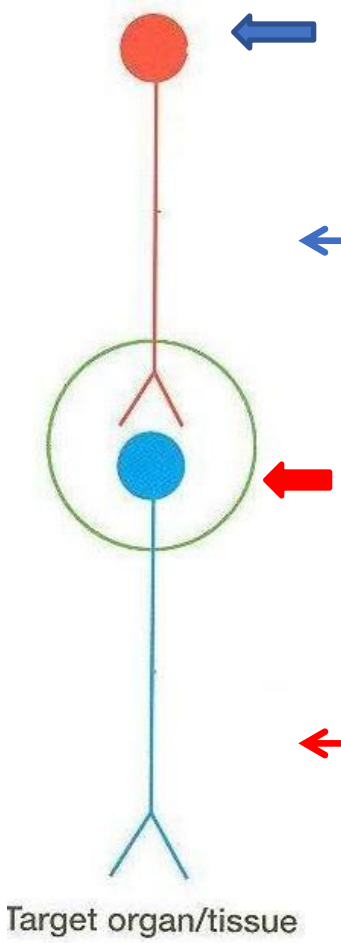
Cells of lateral horn of spinal cord (T1 – L2/L3)

Short axon

- Cells of sympathetic chain
- Cells of plexuses surrounding abdominal aorta (Coeliac, superior & inferior mesenteric)

Long axon

Sympathetic



- Cranial: cells in brain stem: nuclei of 3rd, 7th 9th & 10th
- Sacral: cells in S2 – S4 segments of spinal cord

Long axon

- Cranial: cells of ciliary, pterygopalatine, submandibular, otic & peripheral ganglia
- Sacral: cells of peripheral ganglia

Short axon

Parasympathetic

Objective 4: Enumerate in brief the main effects of sympathetic & parasympathetic nervous system.

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	

Sweat glands and erector pili muscles (attached to hair follicles) only have a sympathetic effect.

Test Yourself

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

a) **Brain stem**

b) **Thoracic segments of spinal cord**

c) **Sacral segments of spinal cord**

d) **Sympathetic chain**

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

a) **Its preganglionic axons are short.**

b) **It supplies sweat glands.**

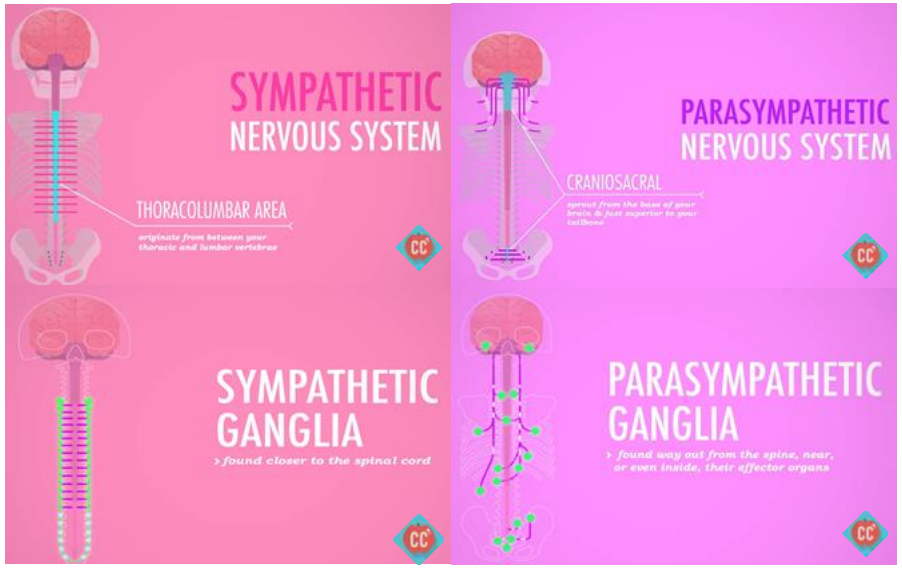
c) **Its preganglionic neurons are located in the sacral segments of spinal cord.**

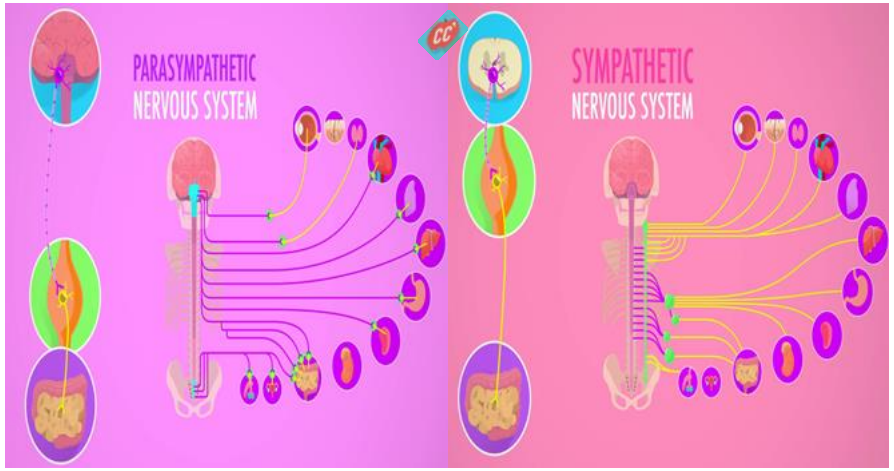
d) **Its postganglionic neurons are located in the coeliac & mesenteric plexuses.**

Answers: 1.b 2.c

(EXTRA Explanation)

- Para- means beside and that's how the parasympathetic was named: its origin is above and under the origin of the sympathetic.
- The sympathetic & parasympathetic division are made up of 2 parts: preganglia and postpanglia with the ganglion being the part that connects them.
- In anatomy nothing is random. The location of the ganglia is related to its function.
- In the sympathertic division the ganglia are close to the CNS so when someone, for exmple, is being chased by a lion they need a lot of things to work together at the same time and since the ganglion is close to the source it can send a single message far and wide.
- However in the parasympathetic division the ganglia are farther away from the CNS and closer to (or even inside) their target organ and their signals are more specific since they are only sent when your body has the time and energy to send them.
- And so the length of the pre/post ganglionic depends on the location of the ganglion. The closer the ganglion is the shorter the preganglion and the longer the postganglionic fibers are, and vice versa.





Helpful Links

- Autonomic nervous system

https://www.youtube.com/watch?v=jA1NyCE4M2g

https://www.youtube.com/watch?v=71pCilo8k4M

https://www.youtube.com/watch?v=eeQ6c5nu-ck&feature=share

- Sympathetic:
https://www.youtube.com/watch?v=zDT4f0TKj3k&feature=share

- Parasympathetic:
https://www.youtube.com/watch?v=PiM_pLLrVto&feature=share

- Quizzes

https://www.cliffsnotes.com/study-guides/anatomy-and-physiology/the-nervous-system/quiz-the-autonomic-nervous-system

http://www.proprofs.com/quiz-school/quizshow.php?title=biol-231-anatomy-physiology-ii&q=1 **

(**this quiz contains some questions outside our material)

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