Autonomic Nervous System-1

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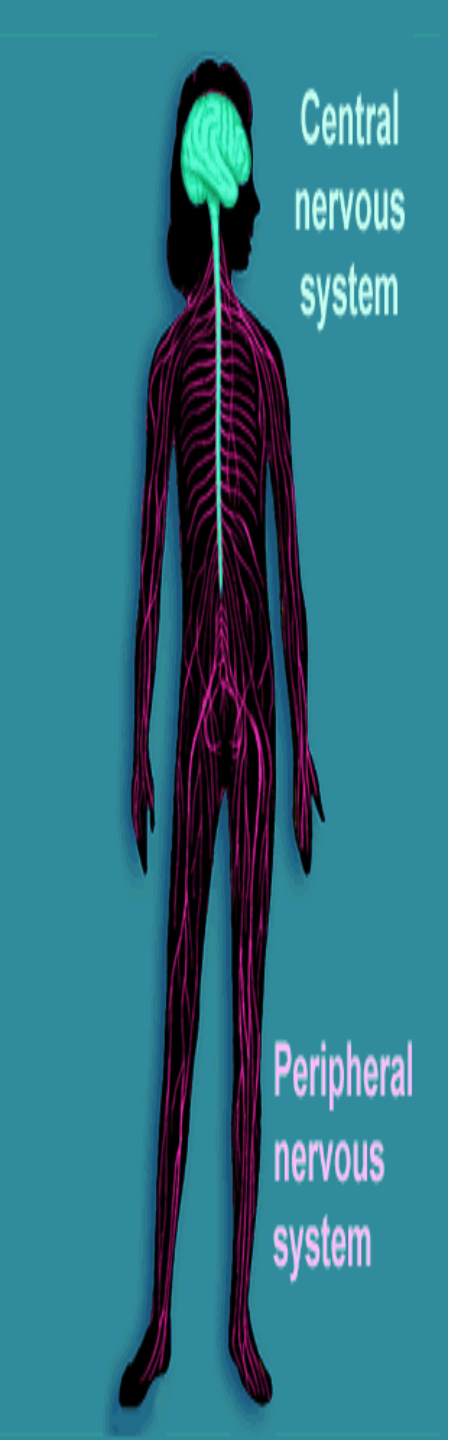
Study Objectives

- ***After studying this lecture, you should be able to:***

1- Compare and contrast the origin and function of the sympathetic and parasympathetic systems

2- Distinguish between each types autonomic ganglia.

3- Understand functions of sympathetic in general and in each region

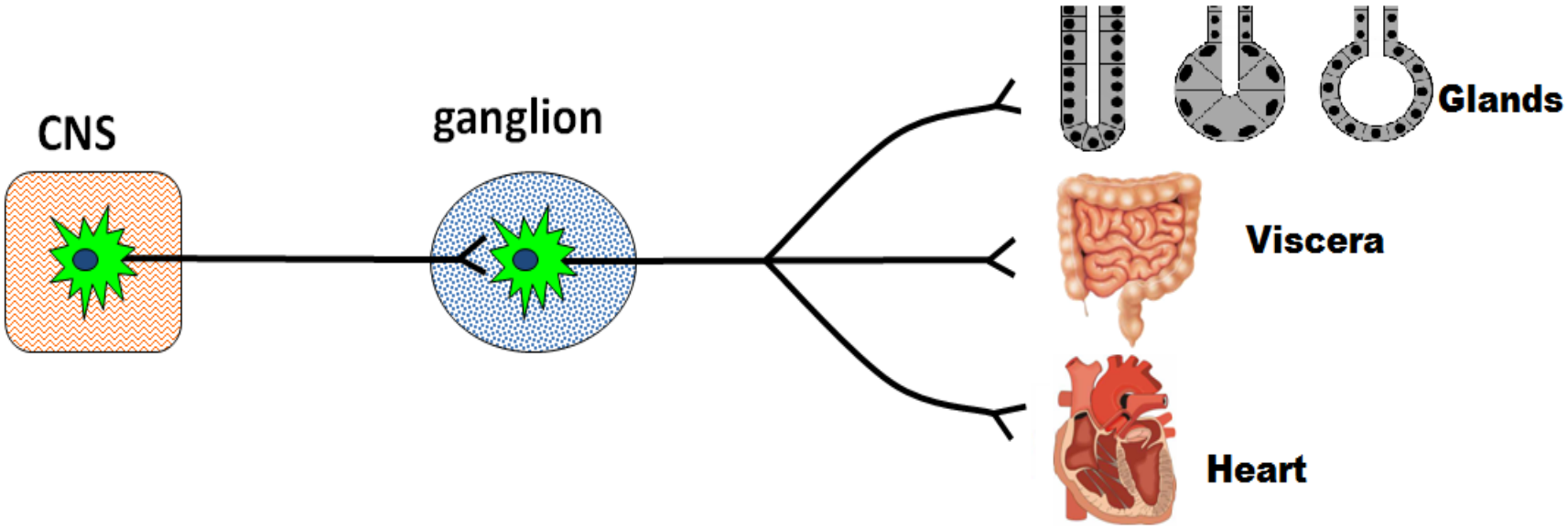


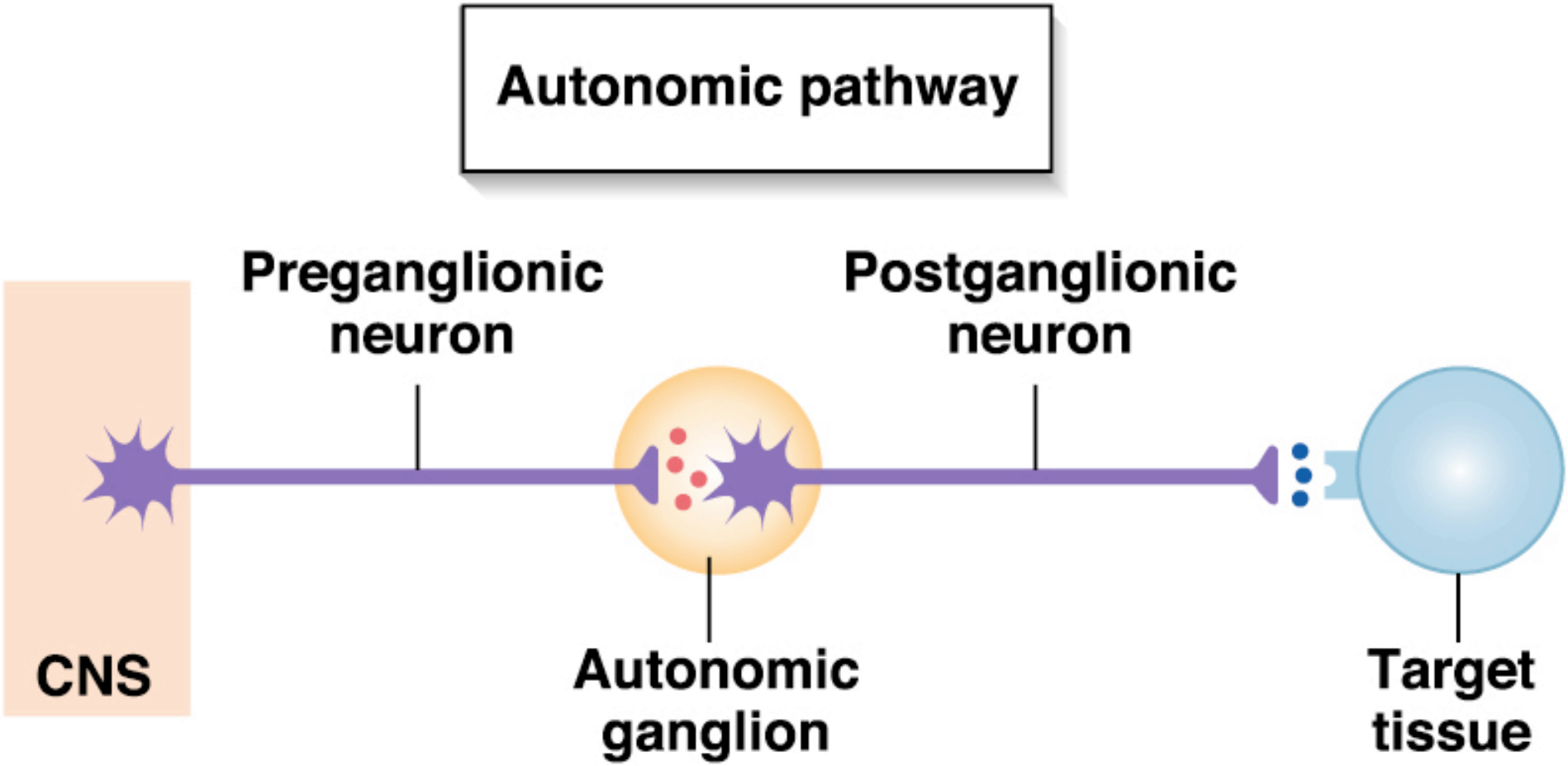
Nervous system

- Central nervous system
  - Brain
  - Spinal cord
- Peripheral nervous system
  - Autonomic nervous system
    - Sympathetic division
    - Parasympathetic division
  - Somatic nervous system

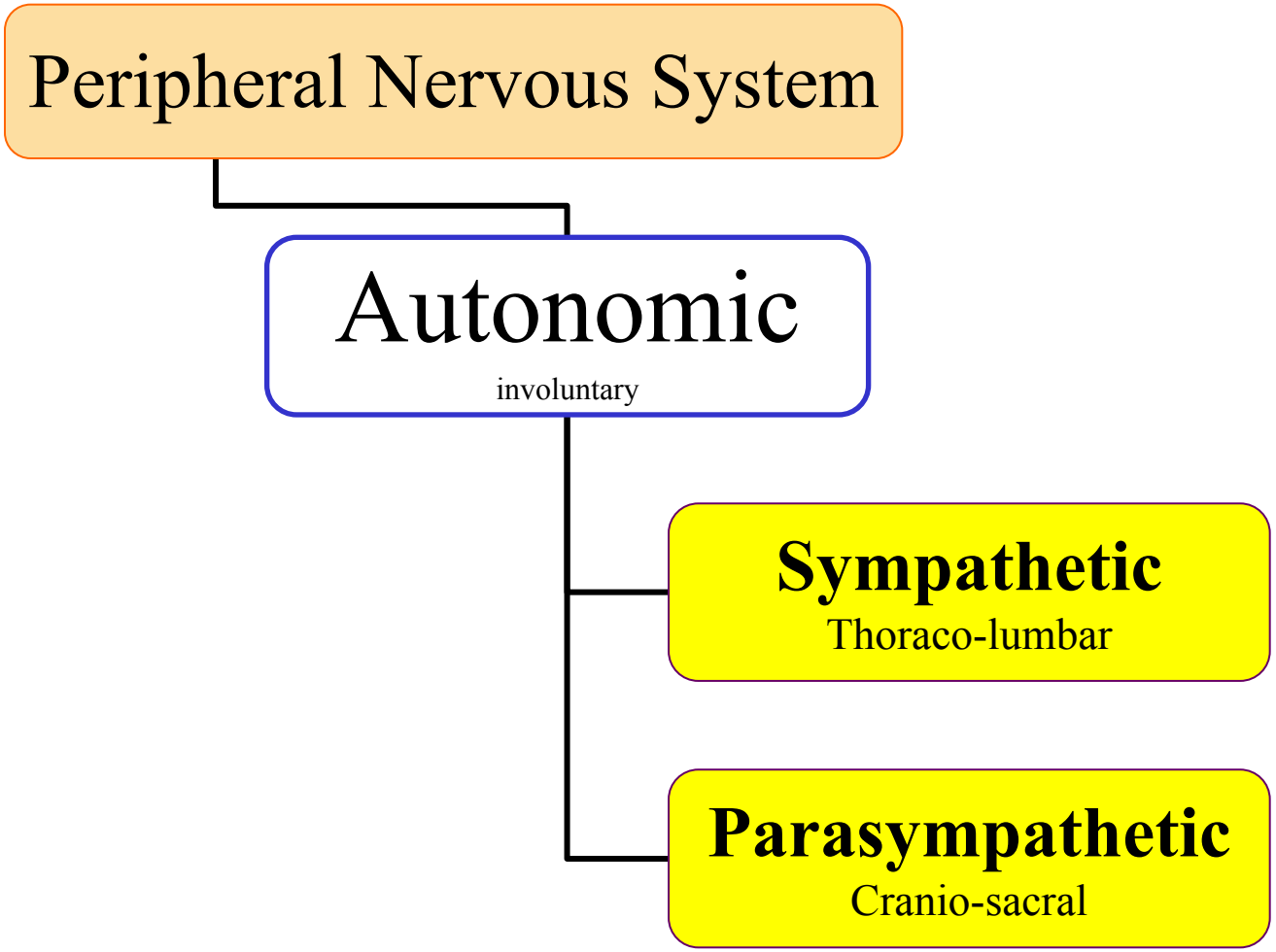
●Defintion of Autonomic Nervous System:

It is a part of the nervous system that controls the involuntary functions e.g heart, viscera and glands.




Autonomic pathway
Preganglionic neuron
Postganglionic neuron
CNS
Autonomic ganglion
Target tissue

Types of Autonomic Nervous System



1-The Sympathetic Nervous System:

***Origin:**

-It arises from the lateral horn cells (L.H.Cs) of all thoracic and upper 3 lumber segments of the spinal cord.

- So, it is called the **thoraco-lumber outflow.**

T1→ L3

2-The Parasympathetic Nervous System:

***Origin:**

-It arises from the nuclei of 3rd, 7th, 9th and 10th cranial nerves and from the lateral horn cells of the 2nd, 3rd and 4th sacral segments of the spinal cord.

-So, it is called the **cranio-sacral outflow.**

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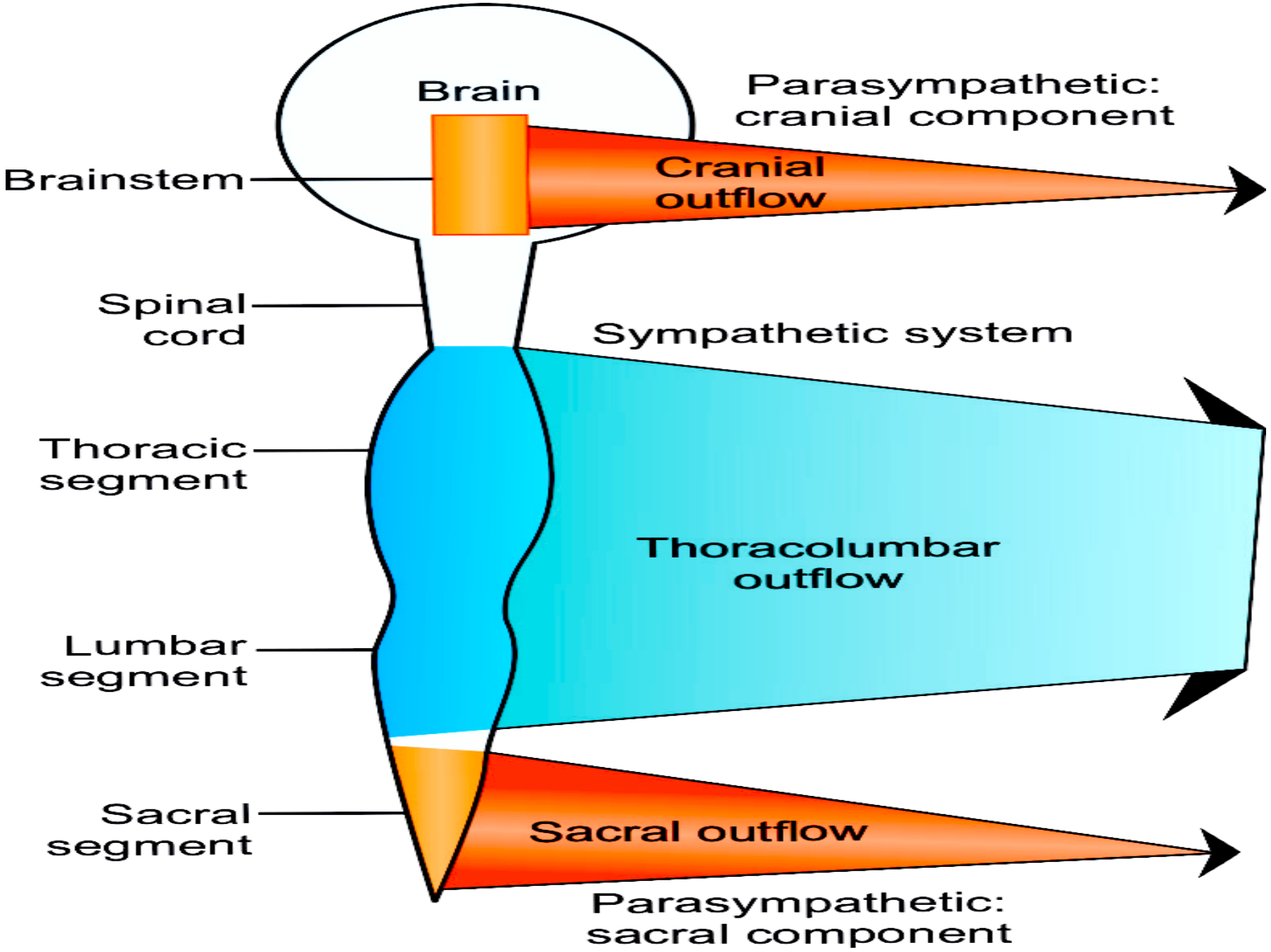
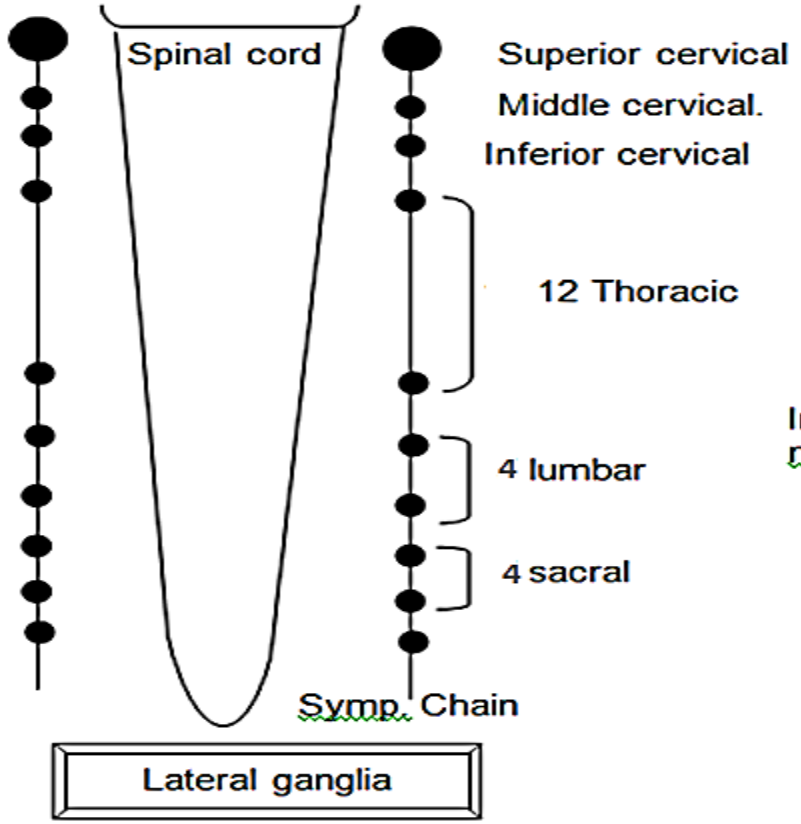
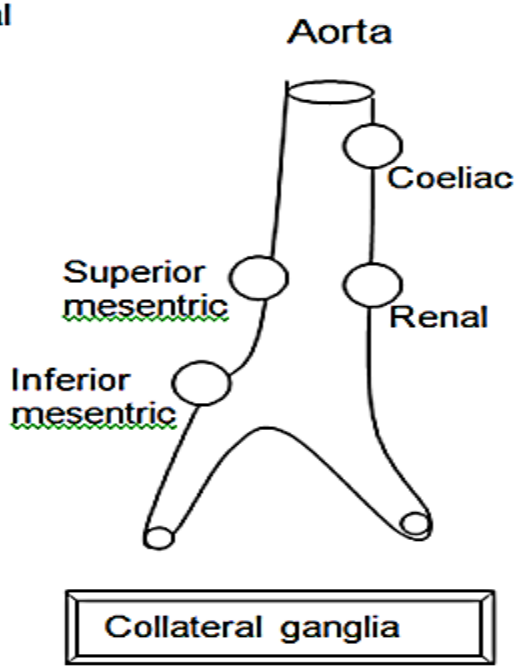

Brain
Parasympathetic:
cranial component
Brainstem
Cranial
outflow
Spinal
cord
Sympathetic system
Thoracic
segment
Thoracolumbar
outflow
Lumbar
segment
Sacral
segment
Sacral outflow
Parasympathetic:
sacral component

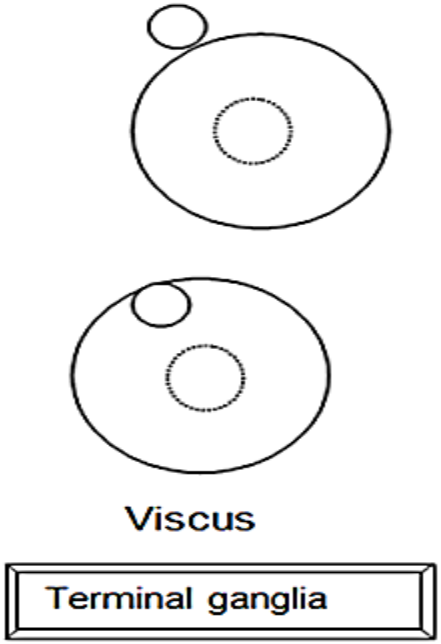
AUTONOMIC GANGLIA

- **Def.:** It is the collection of nerve cells outside the central nervous system (while collection inside is called center).

- **Types:**







1-Paravertebral (= Lateral) Ganglia

- **Site:** These are present on both sides of the vertebral column to forming 2 chains. Each chain about **23 ganglia**. They include 3 cervical, (superior, middle & inferior), 12 thoracic, 4 lumber and 4 sacral. But sometimes, the inferior cervical & upper thoracic ganglia fuse together forming "a stellate ganglion".
- **Function:** The 2 chains are also called the sympathetic chains (sympathetic trunks) because they are the **main sites** for preganglionic sympathetic neuron relay.

2-Prevertebral (= Collateral) Ganglia

- **Site:**

These ganglia are present in the thorax,

abdomen and pelvis in relation to the aorta

and its big branches and they carry the name of t
corresponding arteries e.g celiac, superior and
inferior mesenteric ganglia.

- **Function:**

These ganglia are the sites for relay of

preganglionic sympathetic neurons (from T5 to l
segments).

3-Terminal (=Peripheral) Ganglia

- **Site:** These are present near (or in the wall of) the effector organs.
- **Function:** These ganglia are the sites of relay of preganglionic parasympathetic only.

Terminal ganglia cannot be sympathetic!!!!!

Functions of the Autonomic Ganglia:

Distributing centers: i.e. one preganglionic fiber gives rise to several postganglionic fibers that distribute the autonomic impulses to many organs (this is because autonomic nerves arise from **limited origin**).

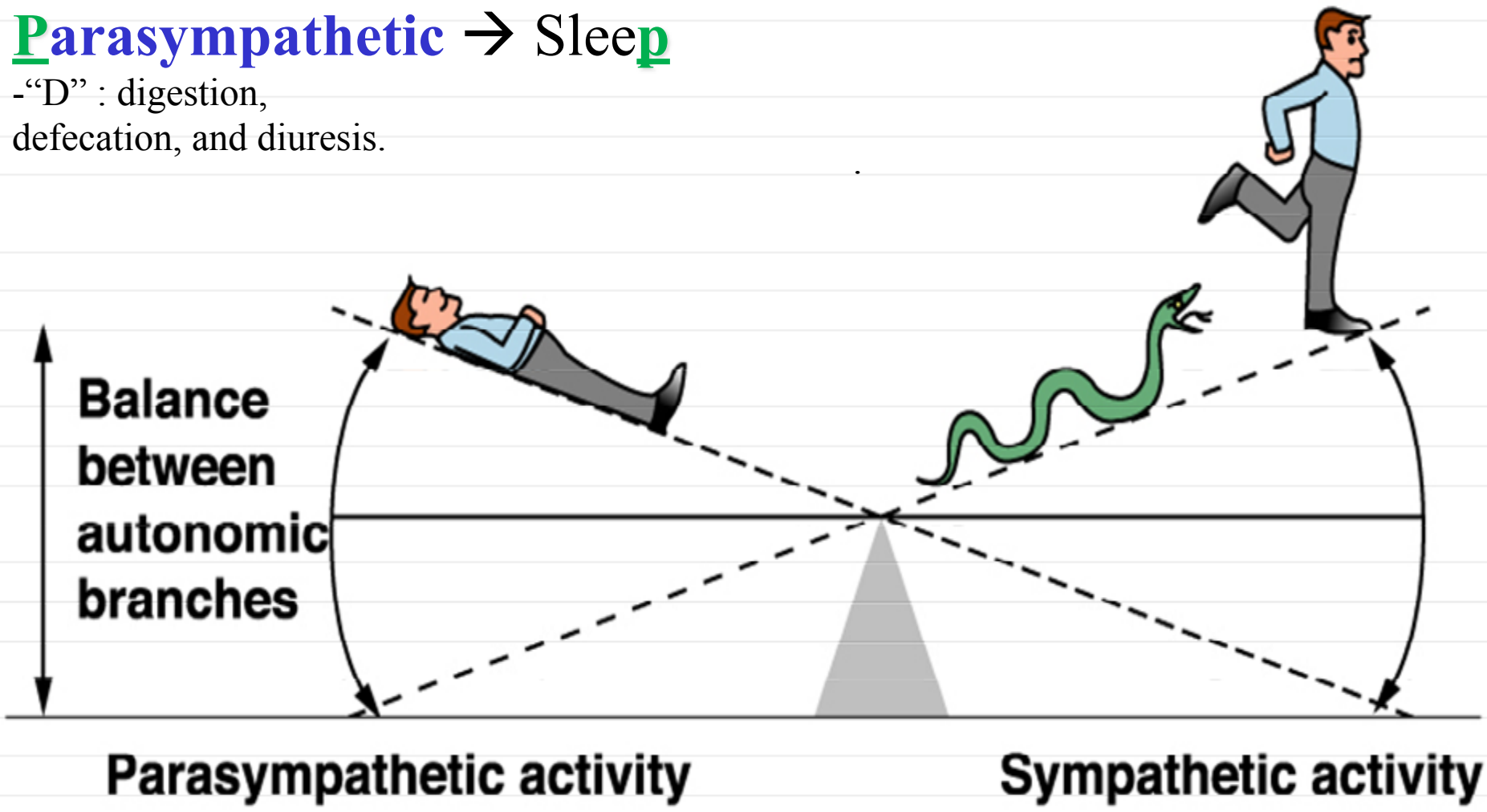
Rest-and-digest

Fight, fright, flight, emotions & muscular exercise

Sympathetic NS → stresS

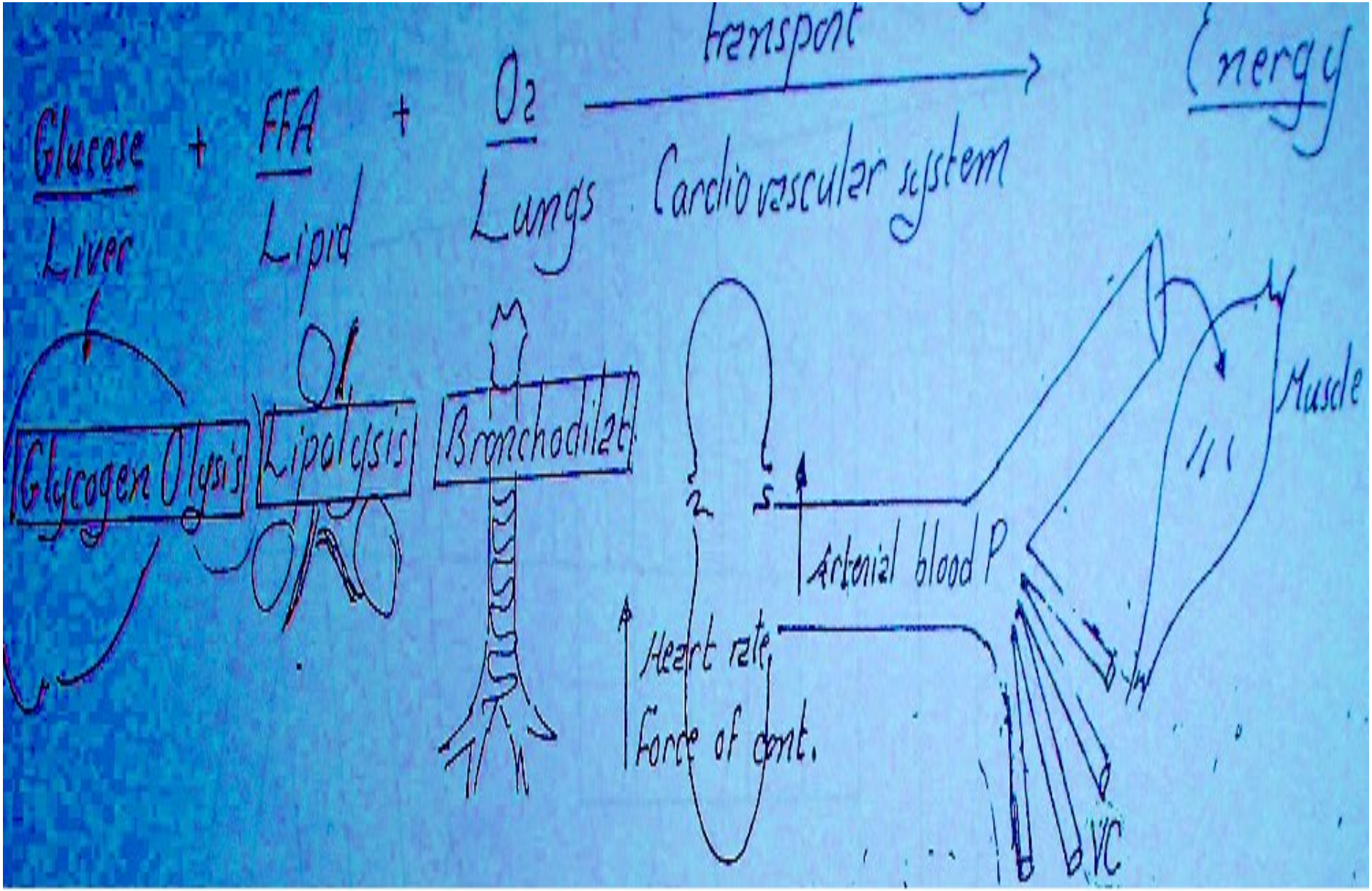
Parasympathetic → Sleep

-"D" : digestion, defecation, and diuresis.



The parasympathetic system is more active during feeding , digestion , rest & sleep

GENERAL FUNCTIONS OF ANS



General Functions of Sympathetic Nervous System (=stress response, alarm response):

- **A-Sympathetic nervous system provides energy:**

1- Increase the liver glycogenolysis →↑↑ glucose level.

2-Increase of adipose tissues lipolysis→↑↑ FA level.

3-Bronchodiltation and increase the RR→↑↑ O_2 supply.

4- Contraction of spleen →↑↑ R.B.Cs number and O_2 carriage.

5- Increase the all properties of the heart, blood pressure and heart rate.

6-Vasoconstriction of all blood vessels except coronary and skeletal blood vessels.

General Functions of Sympathetic Nervous System (=stress response, alarm response):

A-Sympathetic nervous system provides energy:

7- Increase the blood flow to skeletal muscle → better contraction, delayed fatigue and rapid recovery (= Orbelli phenomena).

B-Sympathetic nervous system increases the field of vision:

8- Pupillodiltatian and elevation of upper eye lid.

C-Sympathetic nervous system inhibits GIT and urinary bladder activities.

Sympathetic Supply to Head and Neck (Cervical Division):

A- Eyes:

-Contraction of the dilatory pupillae muscle → pupillodiltation.

-Contraction of the eyelid muscles (superior & inferior tarsal muscle) → widening of the palpebral fissure.

-Contraction of the Muller's muscle in some animals→ exophthalamus.

B-Salivary gland:

Secretion of concentrated small viscous saliva rich in enzyme (= trophic secretion).

C- Cerebral blood vessels: Weak VC. Cerebral blood flow does not decrease but it may be increase due to increase of blood pressure.

II- Sympathetic Supply to the Thorax:
2X2

1- Heart: -

- Increase the all properties of the heart (↑H.R, ↑ C.O.P & ↑ A.B.P).

- V.D. of the coronary vessels.

2- Lungs:

- Bronchodiltation due to relaxation of the plain muscles of the bronchi.

-Weak V.C of the pulmonary vessels.

III- Sympathetic Supply to Abdomen (Greater Splanchnic Nerve):

1-Liver: Increase the liver glycogenolysis →↑ glucose level.

2-Spleen: Contraction of its capsule → red blood cells → ↑O2 carriage.

3-Suprarenal medulla: ↑ adrenaline 80% and noradrenalin 20% secretion.

4-Gastrointestinal tract: Inhibition of GIT motility by relaxation of the wall of the GIT but contraction of its sphincters.

5-Blood vessels: V.C of blood vessels of stomach, small intestine and kidney.

IV- Sympathetic Supply to Pelvis (Lesser Splanchnic Nerve):

1- Urinary bladder: → retention of urine.

2-Colon and rectum: → retention of stool.

3- Genital organs: **A- In male:** *Ejaculation of semen due to contraction of the smooth muscles of epididymis, vas deferens, seminal vesicles and prostate

*Inhibition of erection of penis due to V.C of the

- **B- In female: Uterus** It is variable (inhibitory or excitatory) depending on the stage of menstrual cycle and the level of ovarian hormones.


Thanks