



PHYSIOLOGY Team 433

Lecture 8: Autonomic nervous system I, 2

- 1- Mojahed Otayf
- 2- Zeyad Rsheed
- 3- Abdullah Al Juriys
- 4- Khalid Al Nasser

- 1. Awatif Alenazi
- 2. Amal Afrah
- 3. Khwlaa Aldossari
- 4. Amani Alsulami

Color Index

- Blue = Main Topic
- Violet = sup topic
- Red = important
- Orange = Explanation

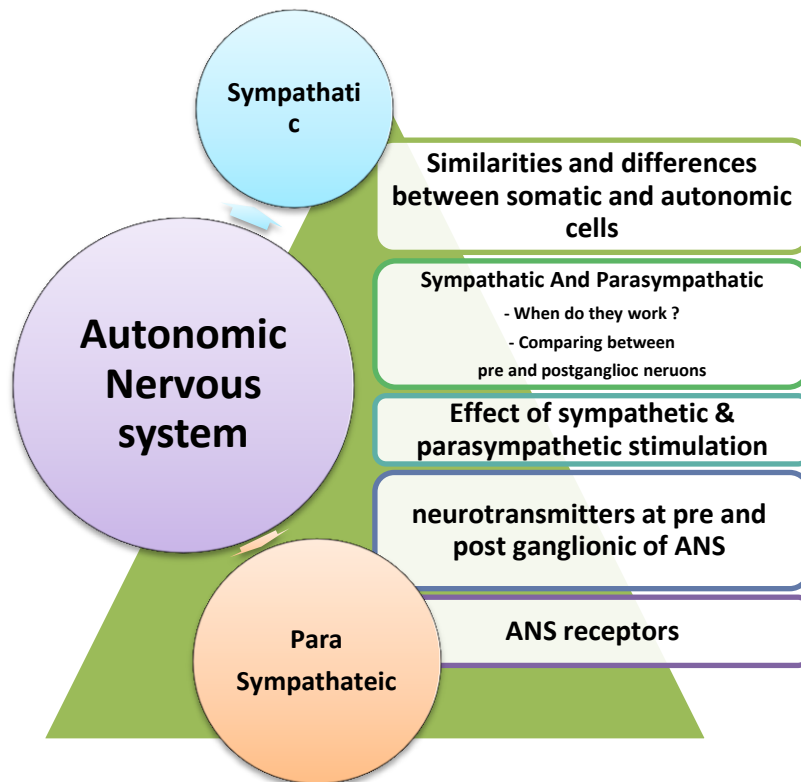
White & Black = Addition

Contact us: PHT433@gmail.com

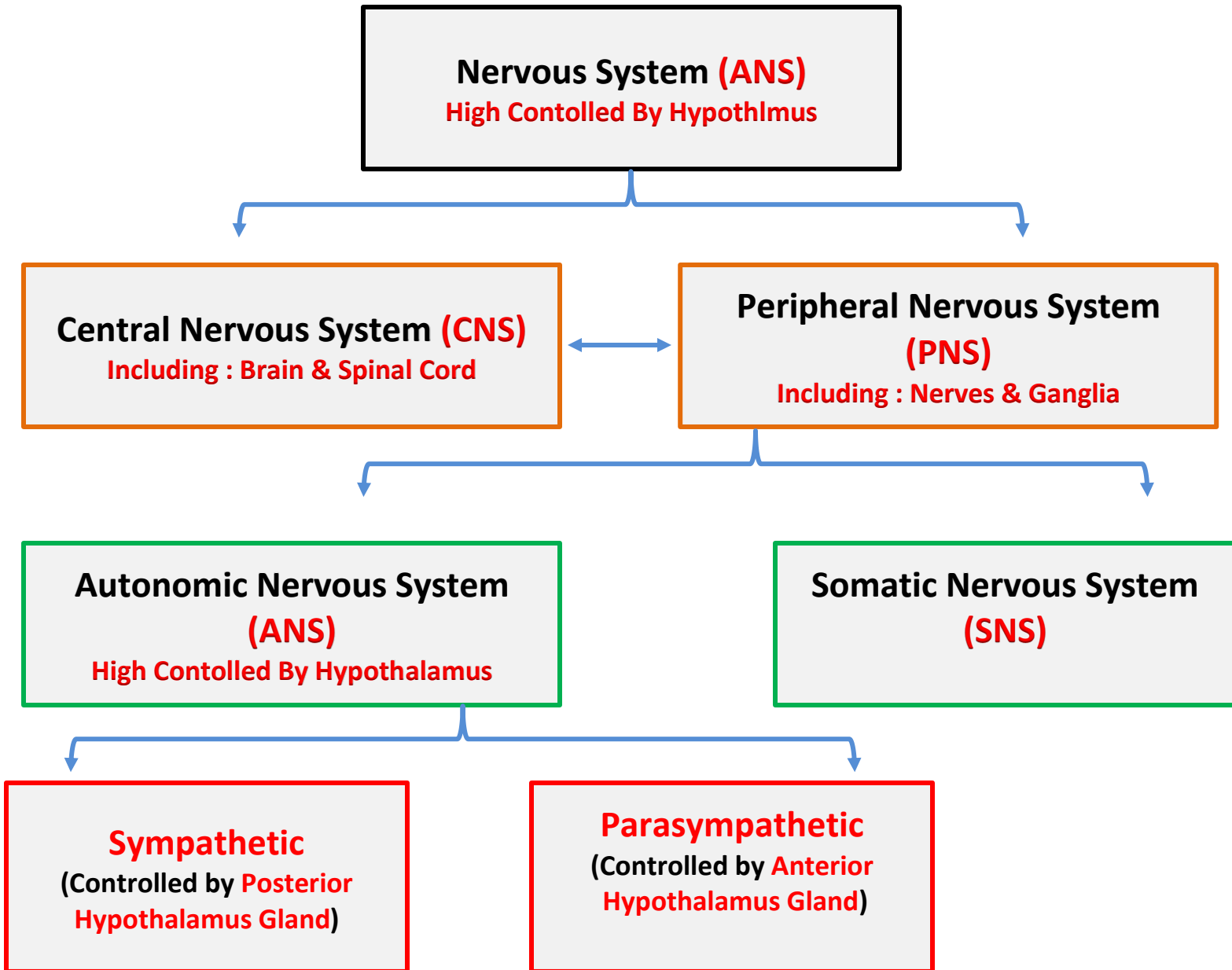
Objectives

- ✓ appreciate the anatomy of sympathetic & parasympathetic nervous system.
- ✓ explain physiological functions of Sympathetic & parasympathetic nerves in head & neck, chest, abdomen and pelvis.
- ✓ Describe neurotransmitters that can release at pre and post ganglionic of Autonomic NS.
- ✓ Describe Autonomic NS receptors.

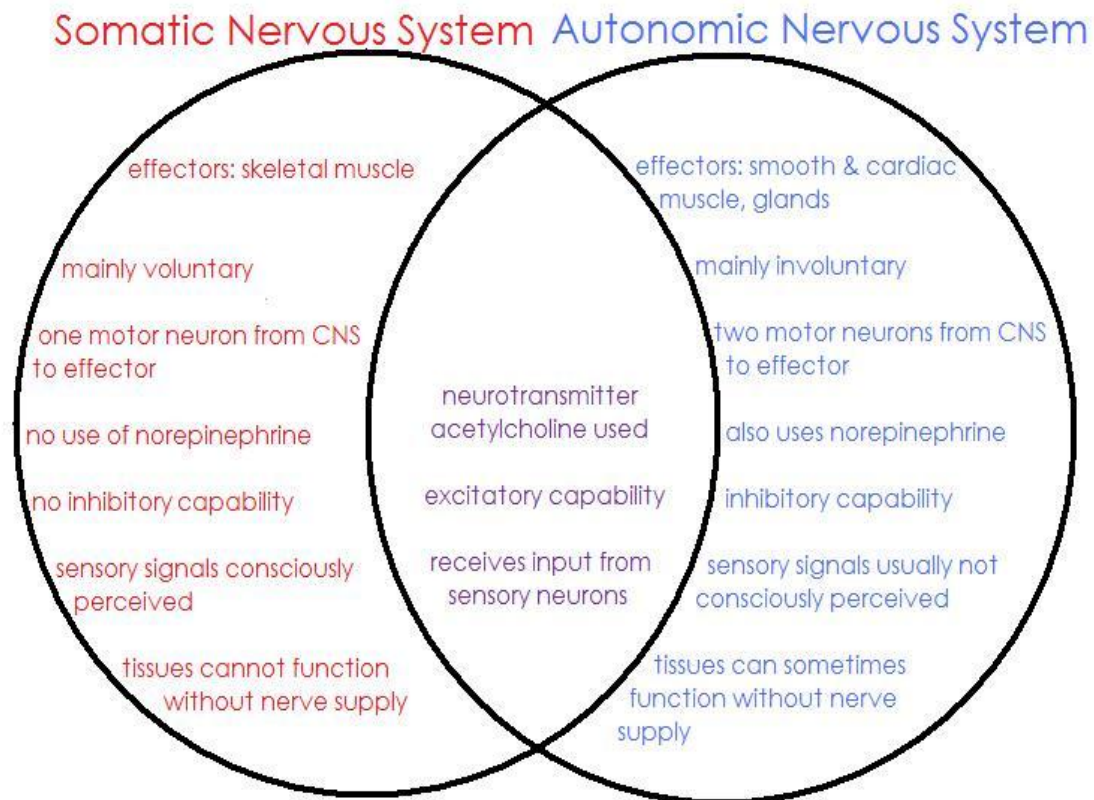
Mind Map



Nervous System



Similarities and differences between somatic and autonomic cells



- **Somatic Nervous system has one neuron.**
- **Autonomic nervous system has two motor neurons.**
- **Somatic Nervous system: Has 1 central ganglia coming from neuron inside the spinal cord**
- **Autonomic Nervous System: Has 2 Ganglias 1- Central Ganglia from inside the spinal cord. 2- Autonomic Ganglia**
- **Autonomic nervous system mainly motors function but there is one state that ANS is sensory (visceral sensory) .**

Sympathetic And Parasympathetic

When do they work ?

Sympathetic (Fight or Flight)

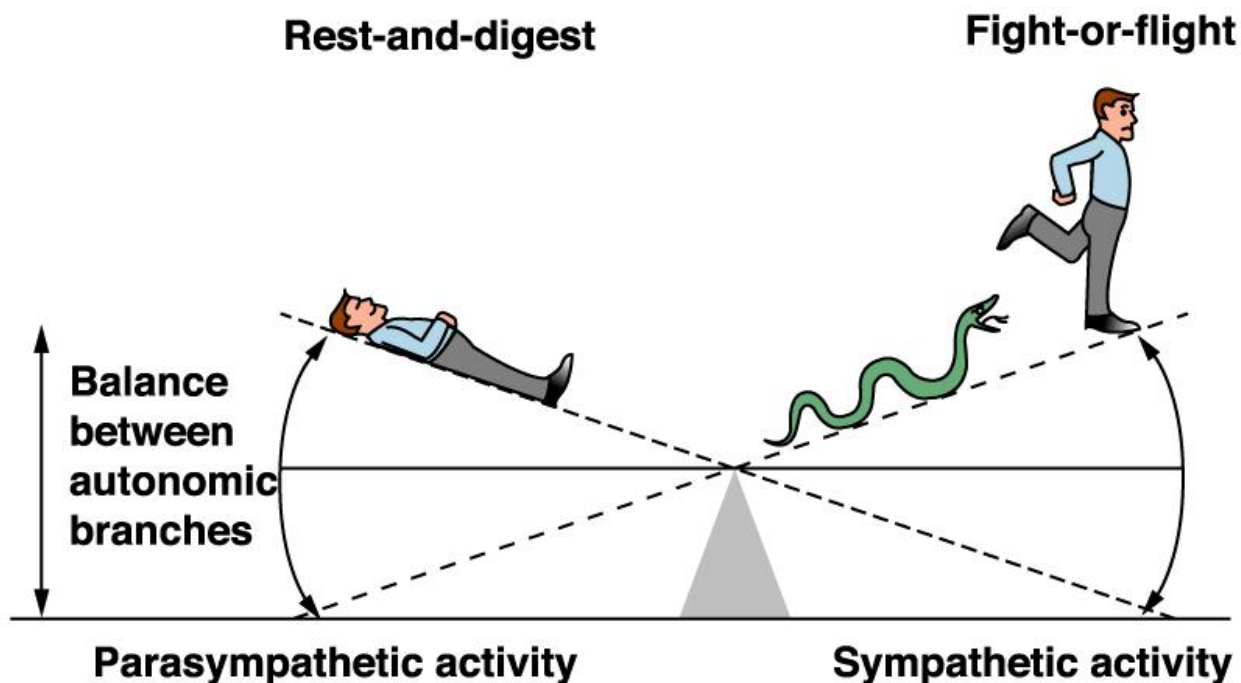
- During stress and activity
(**Physical exercise**)
- During increased mental & emotional activity
(**Worry, fear, anger ... etc.**)

So, its activation promotes mechanisms which increase energy production, accelerate metabolism

Parasympathetic (Rest and Digest)

- During system activities
- During Relaxed states
(**Feeding, digestion, rest & sleep**)

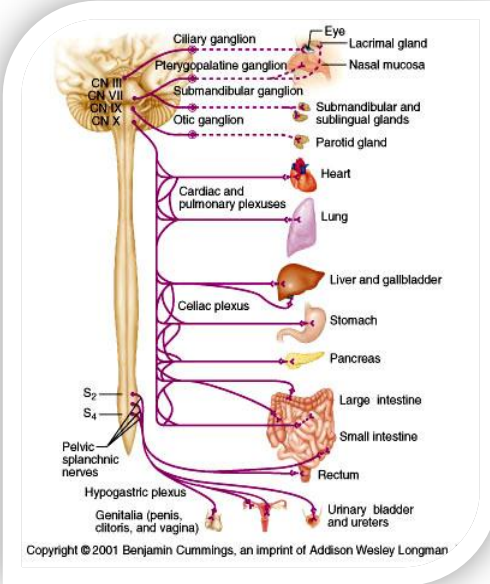
So, its activation promotes vegetative functions (nutritive, body-building, restorative functions & tissue repair)



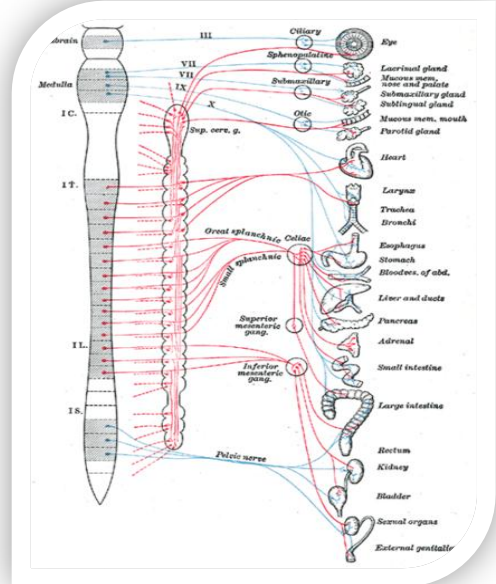


Location of Autonomic Ganglia

Parasympathetic Ganglia



Sympathetic Ganglia

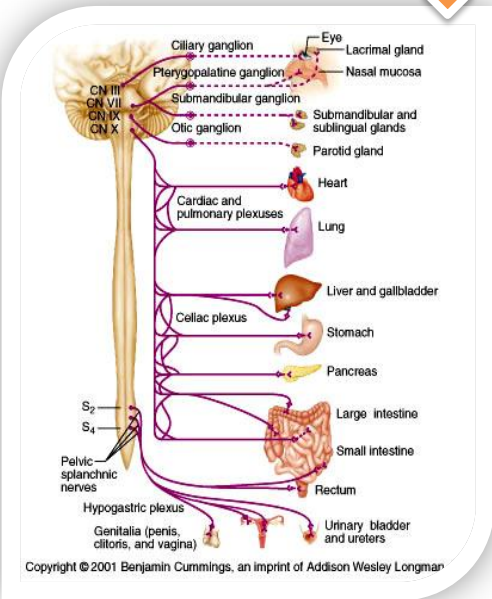


هنا لا يوجد ganglia فكل شيء يذهب للعضو مباشرة

هنا يوجد 3 important ganglia لازم يمر عليها كل شيء قبل أن يصل للعضو.

Origin of Sympathetic and parasympathetic

Parasympathetic Origin

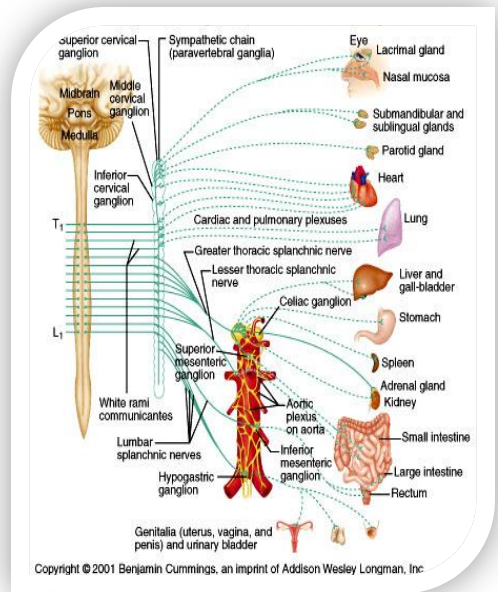


Craniosacral Cell bodies of the motor nuclei of the cranial nerves III, VII, IX and X in the brain stem

Second, third and fourth [S2-S4] sacral segments of the spinal cord

Thoracolumbar lateral horns of the spinal segments T1-L2 (Thoraco-lumber Outflow)

Sympathetic Origin



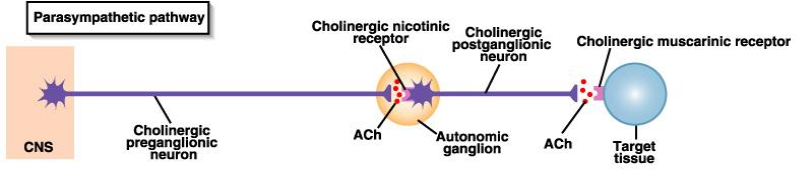


Sympathetic

	Preganglionic neuron	Postganglionic neuron
Example		
Origin & Location of Autonomic Ganglia	<p>Origin : Thoracolumbar lateral horns of the spinal segments T1-L2 (Thoraco-lumber Outflow)</p>	<p>Location of Autonomic Ganglia:</p> <ul style="list-style-type: none"> ▪ Trunk (chain) ganglia near vertebral bodies ▪ Paravertebral ganglia near large blood vessel in gut : <ol style="list-style-type: none"> 1- Celiac 2- superior mesenteric & inferior mesenteric
Size	Short	Long
Myelin sheath	Lightly myelinated	Unmyelinated
Site of Cell Body	located in the CNS	located in sympathetic ganglia

1. There is greater divergence . The ratio (pre/post) being = 1/10 ;
2. This divergence implies diffuse (generalized) actions .

Parasympathetic

	Preganglionic neuron	Postganglionic neuron
Example		
Origin & Location of Autonomic Ganglia	<p>Origin :</p> <ul style="list-style-type: none"> • Craniosacral Cell bodies of the motor nuclei of the cranial nerves III, VII, IX and X in the brain stem • Second, third and fourth [S2-S4] sacral segments of the spinal cord <p>(Craniosacral Outflow)</p>	<p>Location of Autonomic Ganglia :</p> <ul style="list-style-type: none"> • Terminal ganglia • in the wall of organ
Size	Long	Short
Myelin sheath	Lightly myelinated	Unmyelinated
Site of Cell Body	located in the CNS	located in parasympathetic ganglia

- III = 3
- IX = 9
- VII = 7
- X = 10

1. There is little divergence , the ratio of pre- to postgaglionic fibers is 1/3 .
2. This little divergence implies more specific , localized actions .

Effect of sympathetic & parasympathetic stimulation

Organ	Sympathetic	Parasympathetic
Pupil of the eye	Dilatation of pupil	Constriction of pupil
Glands	Slight secretion	Copious (larger) volume
Blood vessels	Constriction	Little or no effect
Heart	Increased heart rate	Decreased heart rate
Myocardium (Cardiac muscle)	Increased force of contraction	No effect on force of contraction
Lung	Dilatation of bronchioles	Constriction of bronchioles
Gastro-intestinal tract (GIT)	(1) Decreased motility+ constricted sphincters (therefore promotes retention) (2) Decreased Secretion	(1) Increased motility + relaxed sphincters (therefore promotes emptying) (2) Increased secretion
Urinary bladder	Decreased urine secretion	Increased urine secretion

Sphincter: the ringlike muscles surrounding and able to contract or close a bodily passage or opening

Metabolism

Sympathetic:

- 1-Increased metabolic
- 2- Catabolism dominates

Parasympathetic:

Anabolism dominates

Blood Pressure

Sympathetic:

Raised

Parasympathetic:

Little or no effect

Blood Sugar

Sympathetic:

Raised

Parasympathetic:

Little or no effect

Parasympathetic nervous system

- ❑ The cranial nerves III, VII and IX **affect the pupil and salivary gland secretion**
- ❑ Vagus nerve (X) carries fibres to the **heart, lungs, stomach, upper intestine and ureter**
- ❑ The sacral fibres form **pelvic plexuses which innervate the distal colon, rectum, bladder and reproductive organs.**

VERY Important notes are not mentioned in slides but while lecture:

- Preganglionic Neuron in both Sympathetic and Parasympathetic release only acetylcholine
- If the **post-ganglion** is **Parasympathetic** then it releases **acetylcholine**
- If the **post-ganglion** is **Sympathetic** the it releases **norepinephrine**
- **Adrenal medulla** is type of autonomic ganglion because it receives preganglionic sympathetic ganglion BUT it doesn't have postganglionic fibers

Sympathetic Neurotransmitters:

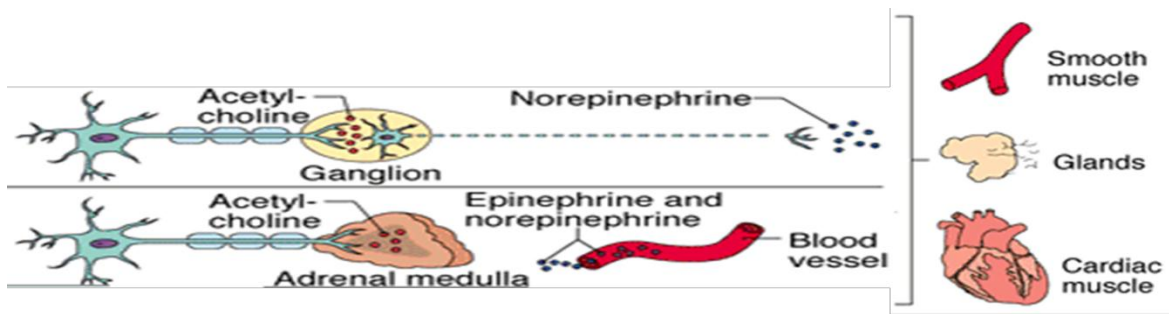
Preganglionic neurons

Postganglionic neurons

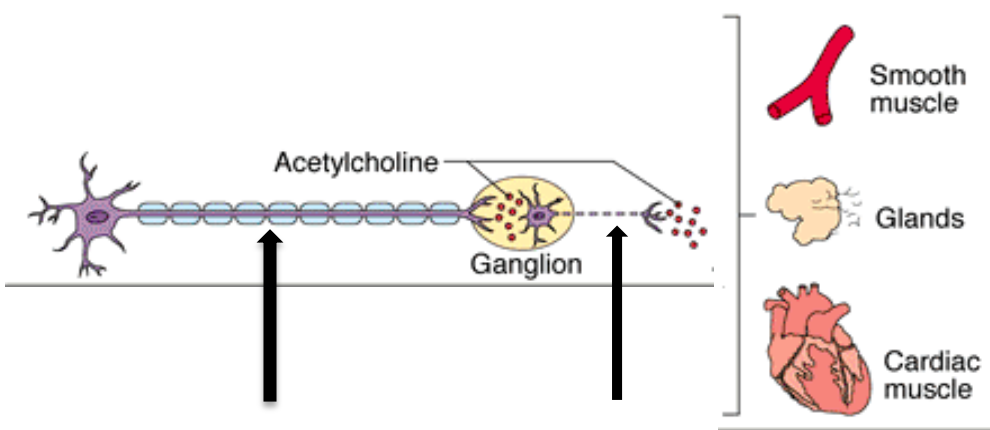
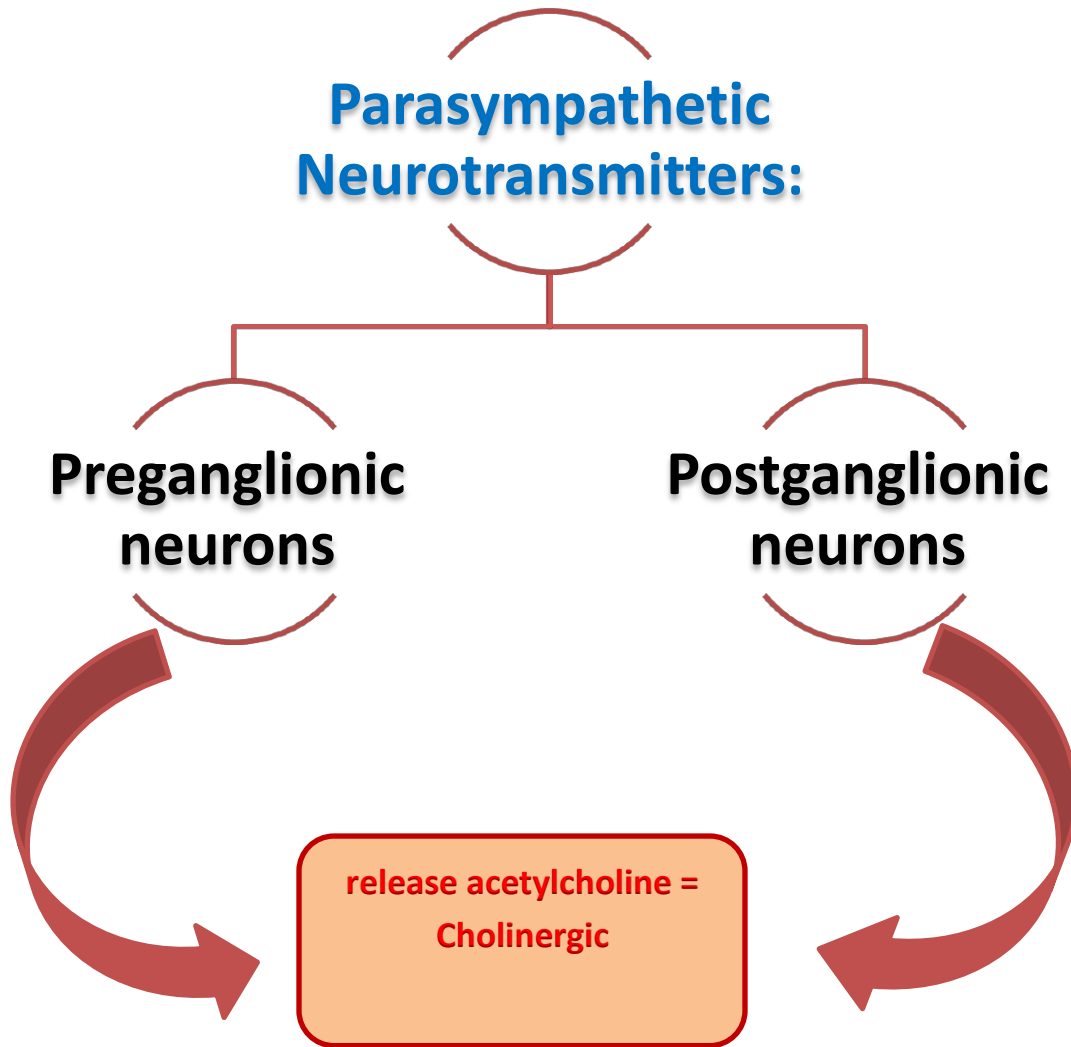
**Cholinergic =
release
acetylcholine**

**releases
norepinephrine
at target organs
ie. Adrenergic**

**Norepinephrine:
it gives the
function of the
sympathetic.**



Parasympathetic Neurotransmitters:

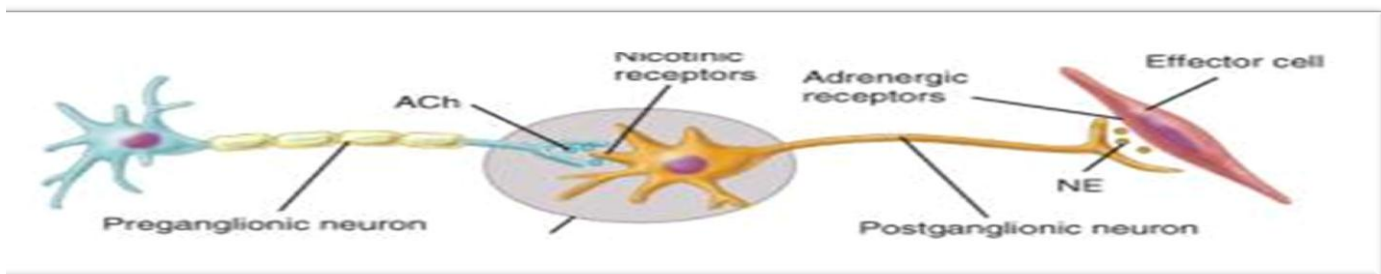


One of the unique characteristics of the Parasympathetic division of the ANS is that both the preganglionic and the postganglionic neurons are cholinergic. *

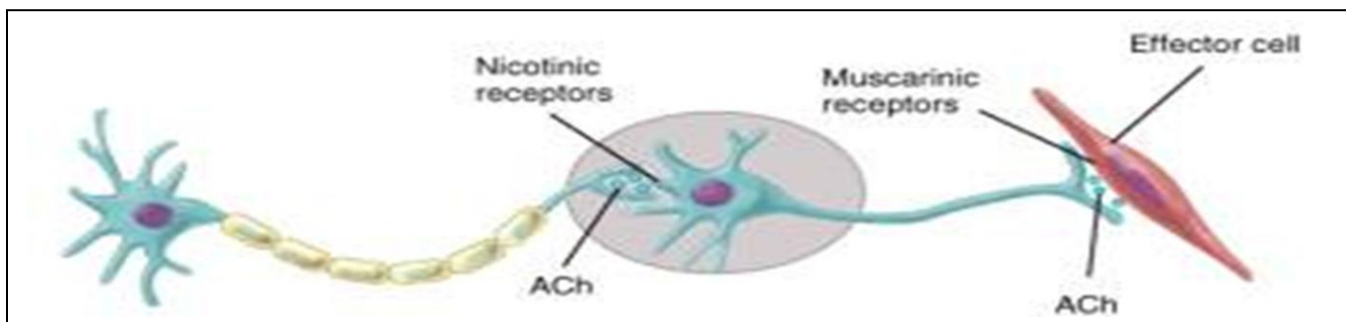
ANS Neurotransmitters:

Classified as either **cholinergic** or **adrenergic** neurons based upon the neurotransmitter released

Sympathetic



Parasympathetic



Chemical or neural transmitter

All sympathetic postganglionic release noradrenalin except sweat glands & blood vessels to skeletal muscles.

All parasympathetic postganglionic release Ach.

All preganglionic fibers release acetylcholine (Ach).

NOTEICE THAT: when we said the ADRENERGIC & CHOLINERGIC, the ANS classified According to neurotransmitter at the POSTGANGLIONIC neuron.

RECEPTORS

The parasympathetic nervous system

uses only acetylcholine (ACh) as its neurotransmitter.

The ACh acts on two types of receptors, the muscarinic(at postganglionic) and nicotinic cholinergic(at pre ganglionic) receptors. (parasympathetic receptor)

Most transmissions occur in two stages: When stimulated, the preganglionic nerve releases ACh at the ganglion, which acts on nicotinic receptors of the postganglionic nerve.

The postganglionic nerve then releases ACh to stimulate the muscarinic receptors of the target organ.

The Sympathetic nervous system

Acts on two types of receptors : α and β

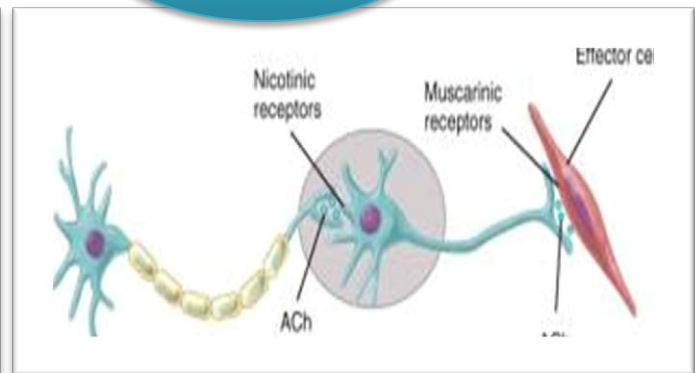
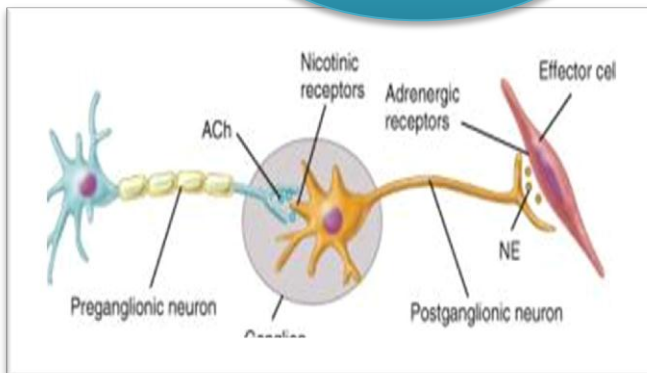
ANS Receptors

Classified into

Sympathetic

Or

Parasympathetic



What do the receptors do?

Activation of α receptors \longrightarrow smooth muscle contraction

Activation of β_2 receptors \longrightarrow smooth muscle relaxation

Activation of β_1 receptors \longrightarrow smooth muscle contraction (**especially in heart**)

SUMMARY:

- The nervous system monitors and controls almost every organ / system through a series of positive and negative feedback loops.
- The Central Nervous System (CNS): Includes the brain and spinal cord.
- The Peripheral Nervous System (PNS): Formed by neurons & their process present in all the regions of the body.
- It consists of cranial nerves arises from the brain & spinal nerves arising from the spinal cord.
- The peripheral NS is divided into Somatic Nervous system & Autonomic nervous system
- All preganglionic neurons are cholinergic that releases acetylcholine (Ach).
- Postganglionic neurons in sympathetic is adrenergic that releases norepinephrine.
- Ach acts on two types of receptors which are muscarinic and nicotinic.
- The sympathetic nervous system acts on two types of receptors; α , β

RELATED VIDEOS:

1. <https://www.youtube.com/watch?v=dOYOdJG0E0s>
2. <https://www.youtube.com/watch?v=1JTz5WQDWd4>

Multiple Choice Questions

Q1: Which of these is true about parasympathetic ?

- A- Controlled by posterior hypothalamus gland
- B- Controlled by Anterior hypothalamus gland
- C- Controlled by sup thalamus gland
- D- None of these

Q2: Which of the following will happen if parasympathetic is working?

- A- Increase in metabolize
- B- Anabolism dominants
- C- Decrease urine secretion
- D- Slight secretion of glands

Q3: Which of the following is true about sympathetic?

- A- Its autonomic ganglion is closed to spinal cord
- B- Its autonomic ganglion is closed to target tissue
- C- It has less divergence than parasympathetic divergence
- D- It is working while relaxing and digestion processes

Q4: The divergence ratio in sympathetic is?

- A- 1/3
- B- 1/5
- C- 1/10
- D- 1/7

Q5: According to sympathetic and parasympathetic axons' sizes, which of the following is true?

- A- In Sympathetic pre ganglionic neurons is longer than post ganglionic neuron
- B- In Sympathetic post ganglionic neurons is longer than pre ganglionic neuron
- C- In Parasympathetic pre ganglionic neurons is shorter than post ganglionic neuron
- D- In Parasympathetic post ganglionic neurons is longer than pre ganglionic neuron



Q6: Which of the following secrete norepinephrine ?

- A. Parasympathetic Postganglionic neurons
- B. Parasympathetic Preganglionic neurons
- C. Sympathetic Postganglionic neurons
- D. Sympathetic Preganglionic neurons

Q7: Salivary gland secretion affected by?

- A. Cranial nerves
- B. Spinal nerves
- C. Both A and B
- D. None of them

Q8: Activation of β_2 receptors lead to ?

- A. Smooth muscle contraction
- B. Smooth muscle relaxation
- C. Skeletal muscle relaxation
- D. Skeletal muscle contraction

Q9: nicotinic receptors located in?

- A. Postganglionic nerves
- B. Preganglionic nerves
- C. Only Sympathetic Postganglionic nerves
- D. Both A and B

Good Luck