



A close-up photograph of several vibrant pink roses in full bloom, set against a background of green leaves and other flowers. The roses are the central focus, with their petals showing a rich, layered texture. The lighting is soft, highlighting the delicate edges of the petals.

# **Autonomic Nervous System**

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LECTUR (1)

Functional Anatomy &  
Physiology of  
Autonomic NS

# **INTRODUCTION**

# THE NERVOUS SYSTEM

## •INTRODUCTION

- 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

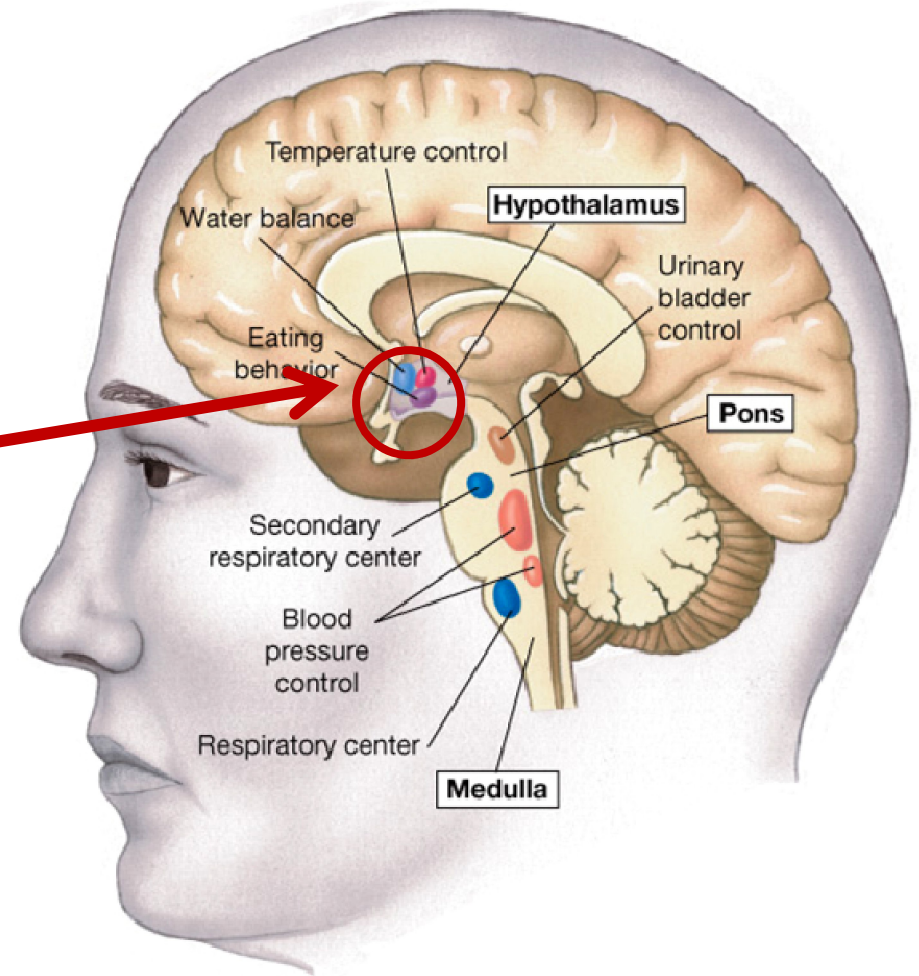
# OBJECTIVES

- **Anatomy and physiology of Autonomic Nervous System**
- At the end of this lectutre (1)the student should be able to:-
- -appreciate the anatomy of symathetic& parasympathetic nervous system.
- -explain physiological functions of Symathetic &parasympathetic nerves in head&neck,chest,abdomen and pelvis

# FUNCTIONAL ANATOMY OF THE AUTONOMIC NERVOUS SYSTEM



- ANS has two subdivisions:
- Sympathetic and Parasympathetic
- Higher (CNS) controller of ANS is the Hypothalamus .
- Posterior hypothalamus controls Sympathetic NS
- Anterior hypothalamus controls Parasympathetic NS
- These hypothalamic centers exert their effects via the motor centers of the brainstem & spinal cord .

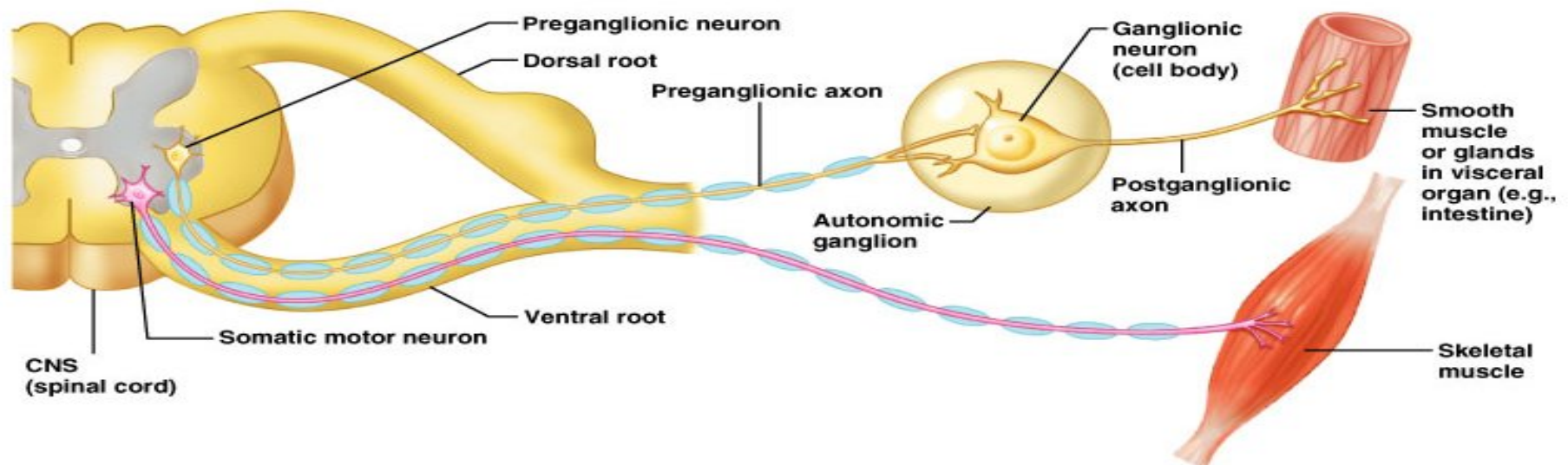


- Moreover , the hypothalamic centers are influenced by impulses from the Cerebral Cortex and Limbic System .

*Basic anatomical difference between the motor pathways of the voluntary somatic nervous system (to skeletal muscles) and those of the autonomic nervous system*

- Somatic division:
  - Cell bodies of motor neurons reside in CNS (brain or spinal cord)
  - Their axons (sheathed in spinal nerves) extend all the way to their skeletal muscles
- Autonomic system: chains of two motor neurons
  - 1<sup>st</sup> = preganglionic neuron (in brain or cord)
  - 2<sup>nd</sup> = ganglionic neuron (cell body in ganglion outside CNS)
  - Slower because lightly or unmyelinated

*Basic anatomical difference between the motor pathways of the voluntary somatic nervous system (to skeletal muscles) and those of the autonomic nervous system*



- ANS is the subdivision of the peripheral nervous system that regulates body activities that are generally ***not under conscious control***
- ***Visceral motor*** innervates ***non-skeletal (non-somatic) muscles***
- Composed of a special group of neurons serving:
  - Cardiac muscle (the heart)
  - Smooth muscle (walls of viscera and blood vessels)
  - Internal organs
  - Skin

## Sympathetic Ganglia:

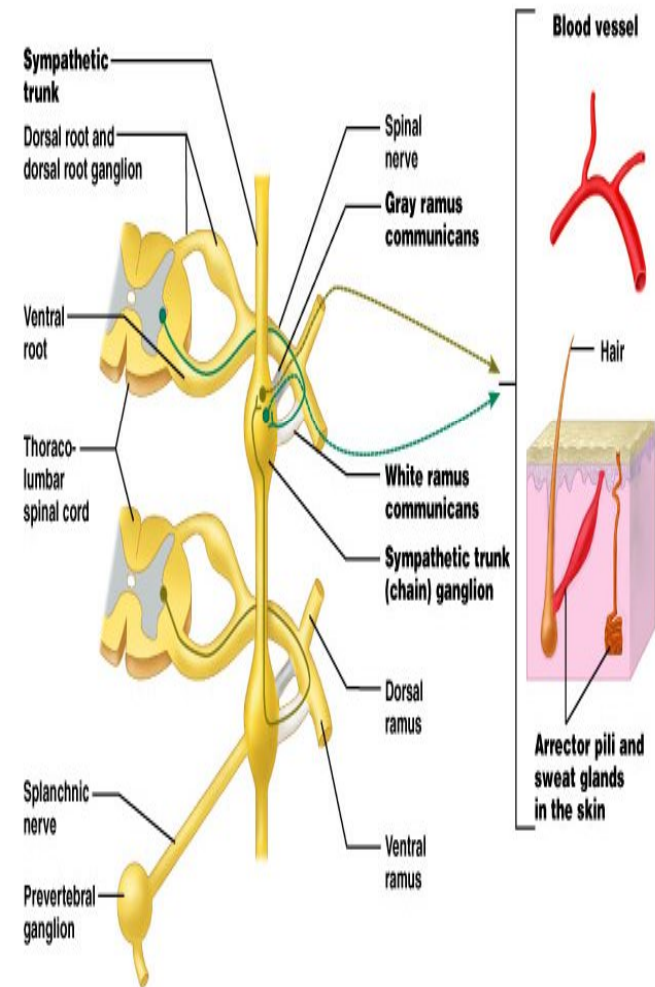
□ Trunk (chain) ganglia near vertebral bodies

□ Prevertebral ganglia near large blood vessel in gut : celiac ,superior mesenteric &

inferior mesenteric

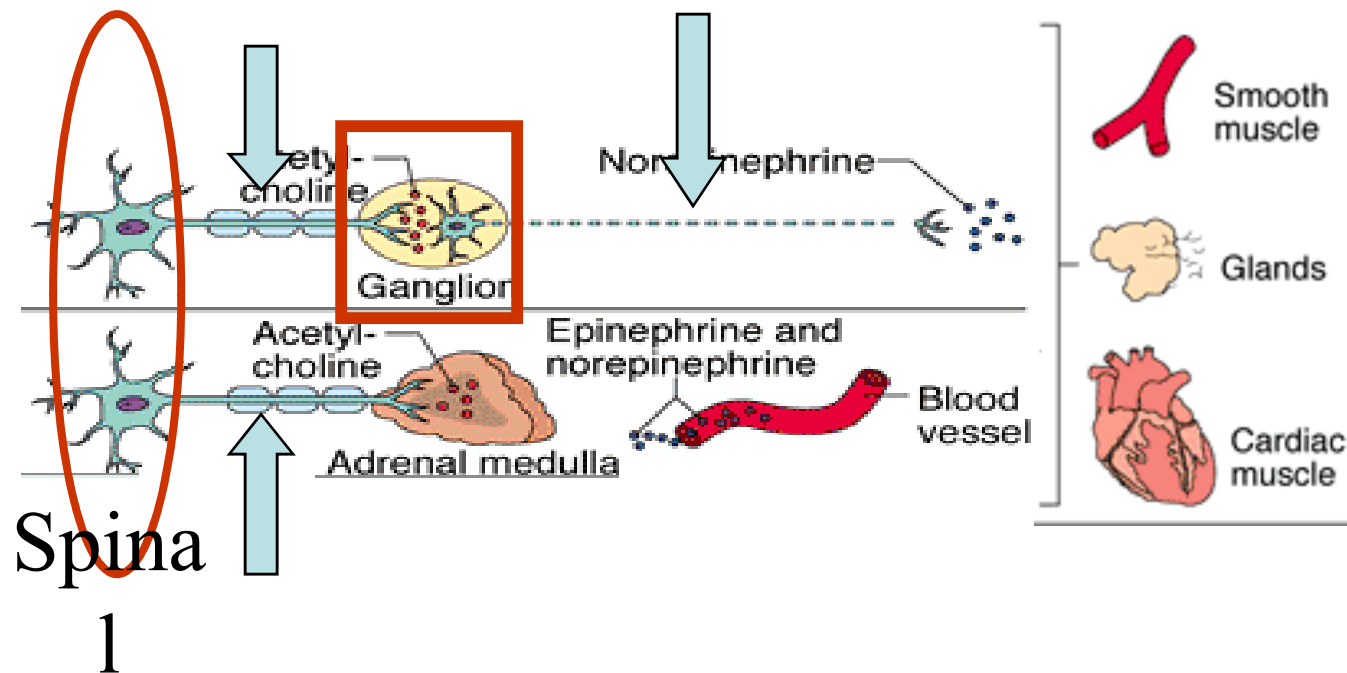
## Parasympathetic Ganglia:

Terminal ganglia in the wall of organ



# Sympathetic Innervation of Visceral Targets

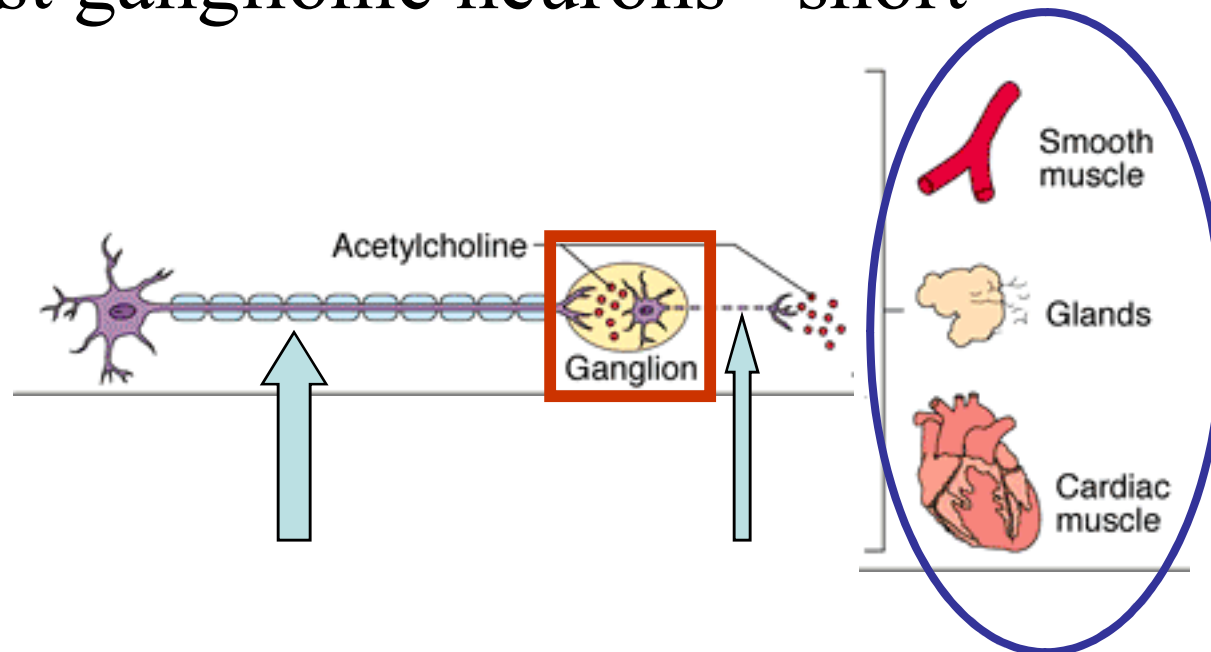
- Short, lightly myelinated preganglionic neurons
- Long, unmyelinated postganglionic neurons
- Ganglia close to spinal cord



# Parasympathetic Innervation of Visceral Targets

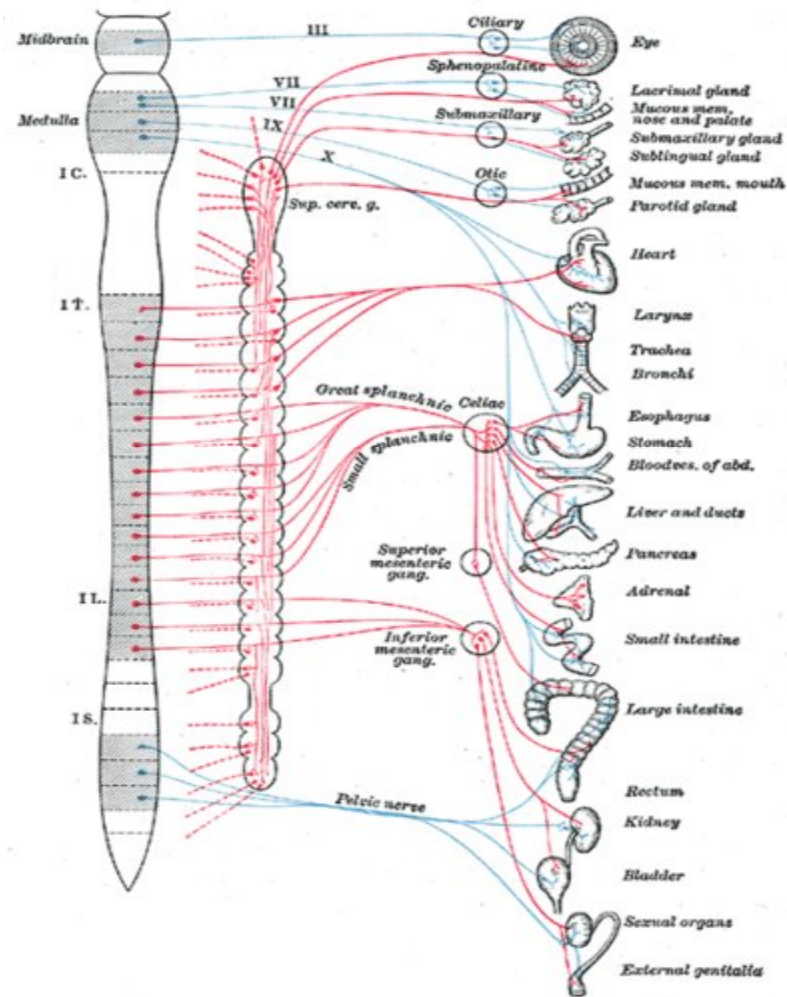
Ganglia close to or on target organs •

- Preganglionic neurons - long
- Post ganglionic neurons - short





# SYMPATHETIC & PARASYMPATHETIC NERVOUS SYSTEM ORIGIN



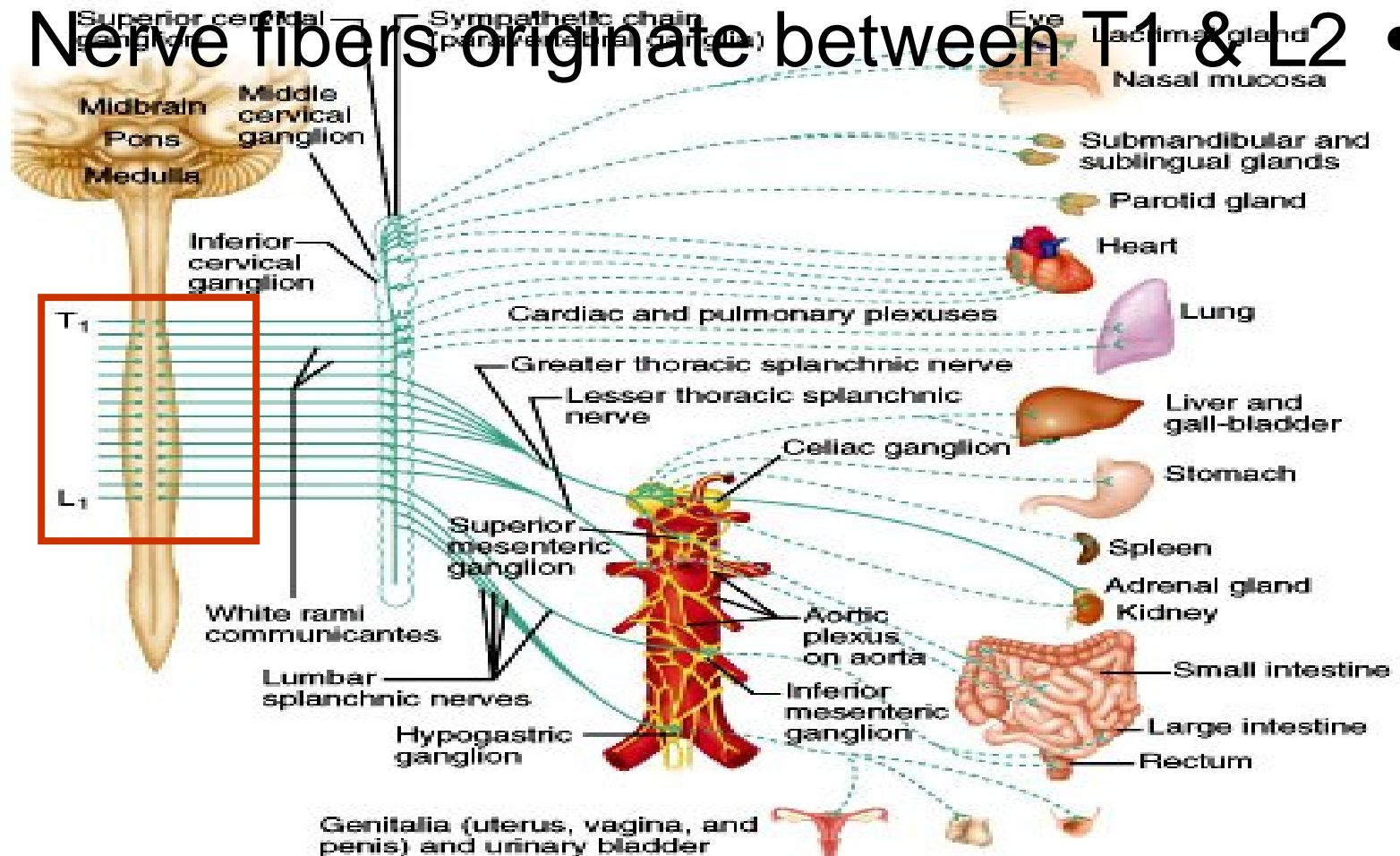
Blue= Para symp; Red symp



# Sympathetic - Origin

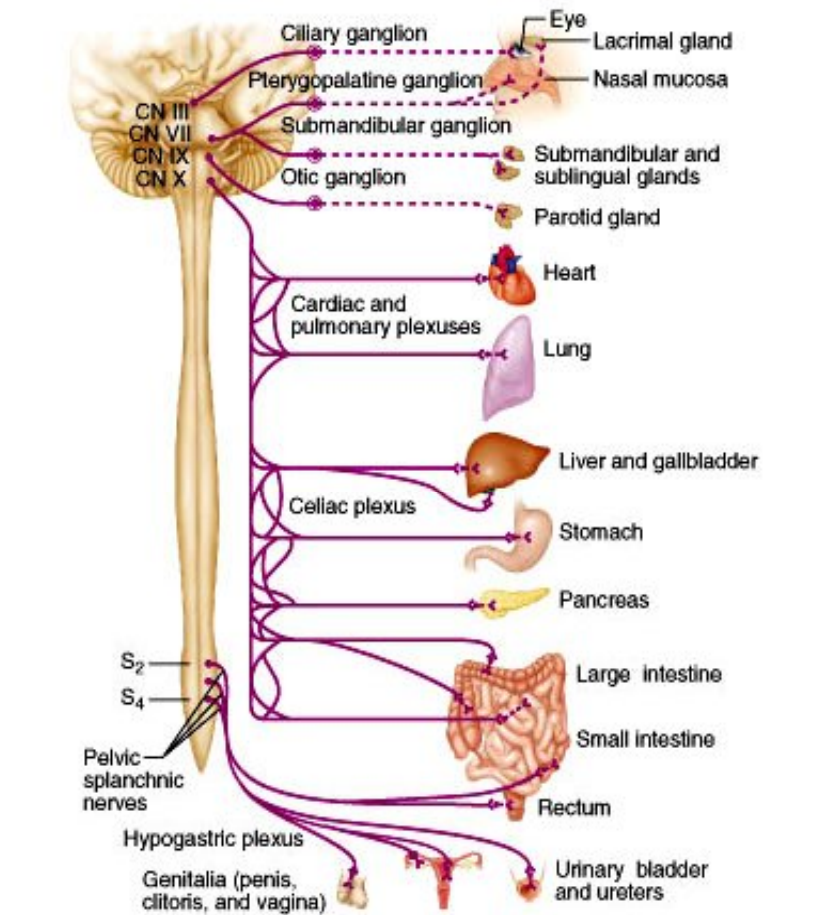
Thoracolumbar lateral horns of the spinal segments T1-L2.

Nerve fibers originate between T1 & L2



# 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
- Nerve fibers emerge from brain & sacrum cranio-sacral outflow

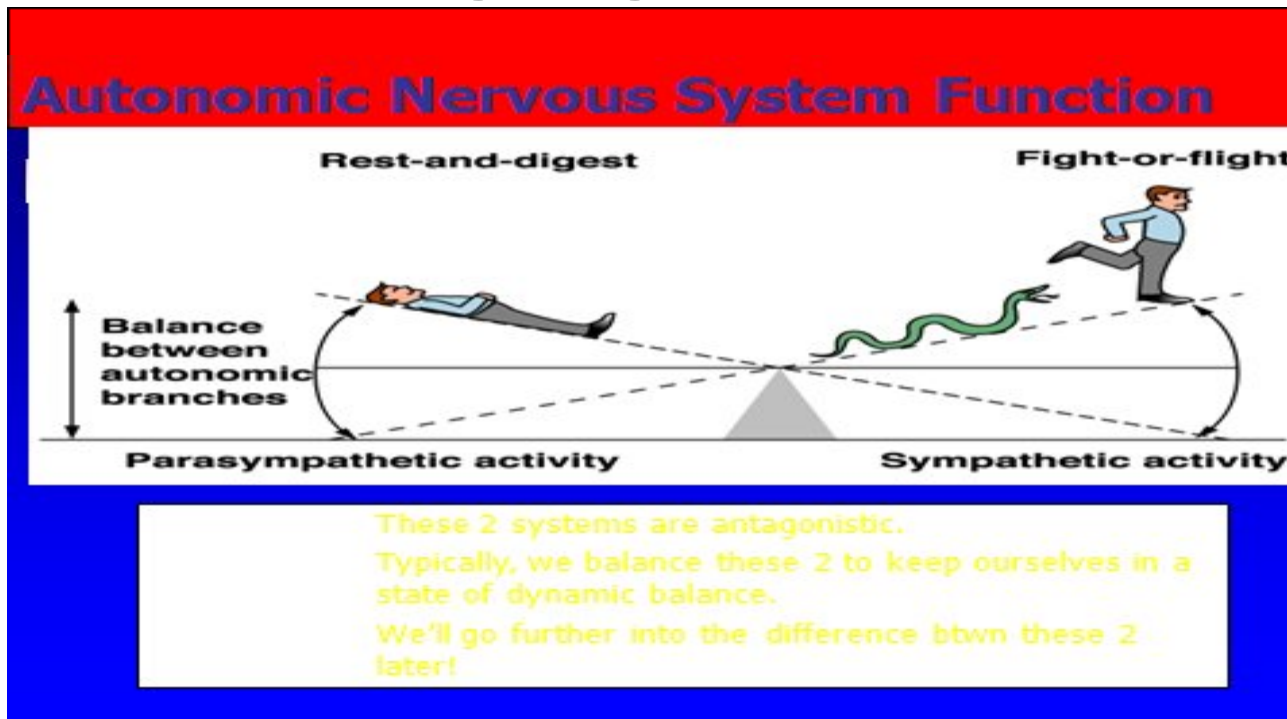


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# PARASYMPATHETIC NERVOUS SYSTEM

- ❑ 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.

# PHYSIOLOGICAL FUNCTIONS OF THE AUTONOMIC NERVOUS SYSTEM



# **SYMPATHETIC NERVOUS SYSTEM FUNCTIONS**

## **FEAR, FLIGHT OR FIGHT**

- ❑ The sympathetic system enables the body to be prepared for fear, flight or fight**
- ❑ Sympathetic responses include an increase in heart rate, blood pressure and cardiac output**
- ❑ Diversion of blood flow from the skin and splanchnic vessels to those supplying skeletal muscle**
- ❑ Increased pupil size, bronchiolar dilation, contraction of sphincters and metabolic changes such as the mobilisation of fat and glycogen.**

# **FUNCTIONS OF SYMPATHETIC NERVOUS SYSTEM**

**Bronchioles dilate, which allows for greater alveolar oxygen exchange.**

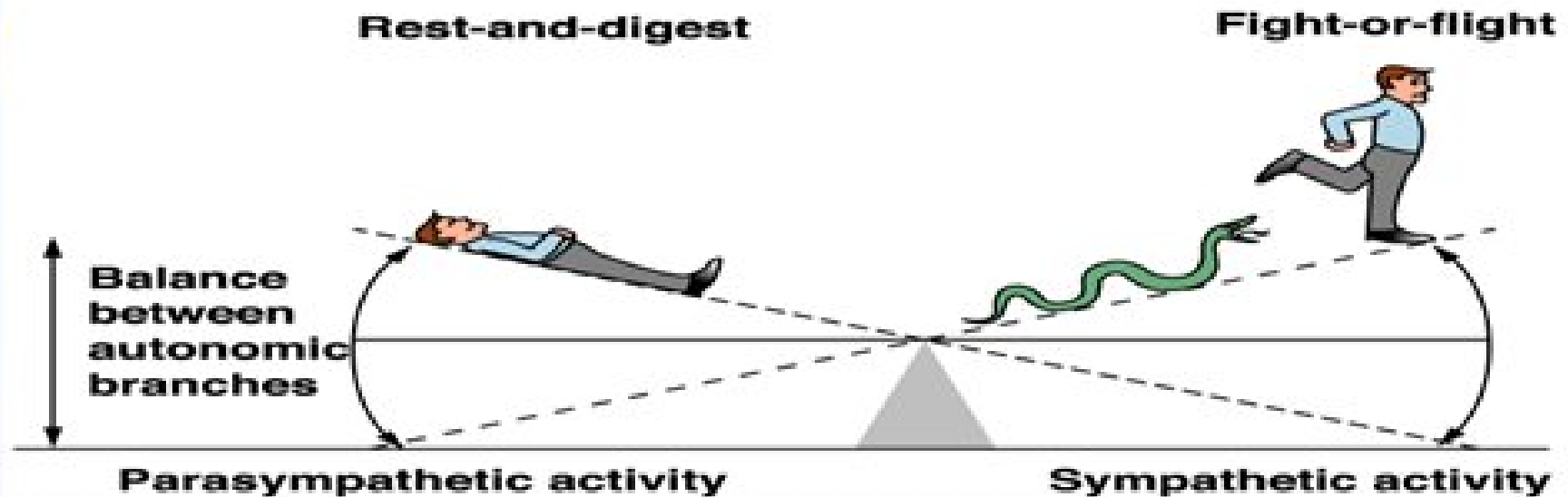
**It increases heart rate and the contractility of cardiac cells (myocytes), thereby providing a mechanism for the enhanced blood flow to skeletal muscles.**

**Sympathetic nerves dilate the pupil and relax the lens, allowing more light to enter the eye.**

# **PARASYMPATHETIC NERVOUS SYSTEM FUNCTIONS**

- ❑ The parasympathetic nervous system has "rest and digest" activity.**
- ❑ In physiological terms, the parasympathetic system is concerned with conservation and restoration of energy, as it causes a reduction in heart rate and blood pressure, and facilitates digestion and absorption of nutrients, and consequently the excretion of waste products**
- ❑ The chemical transmitter at both pre and postganglionic synapses in the parasympathetic system is Acetylcholine (Ach).**

# Autonomic Nervous System Function



These 2 systems are antagonistic.

Typically, we balance these 2 to keep ourselves in a state of dynamic balance.

We'll go further into the difference btwn these 2 later!



# THE AUTONOMIC NERVOUS SYSTEM

<b>Subdivision</b>	<b>Nerves Employed</b>	<b>Location of Ganglia</b>	<b>Chemical Messenger</b>	<b>General Function</b>
<b>Sympatheti c</b>	<b>Thoracolumbar</b>	<b>Alongside vertebral column</b>	<b>Norepinephrine</b>	<b>Fight or flight</b>
<b>Parasympat hetic</b>	<b>Craniosacral</b>	<b>On or near an effector organ</b>	<b>Acetylcholine</b>	<b>Conservation of body energy</b>

# PHYSIOLOGICAL FUNCTIONS OF THE AUTONOMIC NERVOUS SYSTEM

## The Autonomic Nervous System

<b>Structure</b>	<b>Sympathetic Stimulation</b>	<b>Parasympathetic Stimulation</b>
<b>Iris (eye muscle)</b>	<b>Pupil dilation</b>	<b>Pupil constriction</b>
<b>Salivary Glands</b>	<b>Saliva production reduced</b>	<b>Saliva production increased</b>
<b>Oral/Nasal Mucosa</b>	<b>Mucus production reduced</b>	<b>Mucus production increased</b>
<b>Heart</b>	<b>Heart rate and force increased</b>	<b>Heart rate and force decreased</b>
<b>Lung</b>	<b>Bronchial muscle relaxed</b>	<b>Bronchial muscle contracted</b>

## The Autonomic Nervous System

<b>Structure</b>	<b>Sympathetic Stimulation</b>	<b>Parasympathetic Stimulation</b>
<b>Stomach</b>	<b>Peristalsis reduced</b>	<b>Gastric juice secreted; motility increased</b>
<b>Small Intes</b>	<b>Motility reduced</b>	<b>Digestion increased</b>
<b>Large Intes</b>	<b>Motility reduced</b>	<b>Secretions and motility increased</b>
<b>Liver</b>	<b>Increased conversion of glycogen to glucose</b>	
<b>Kidney</b>	<b>Decreased urine secretion</b>	<b>Increased urine secretion</b>
<b>Adrenal medulla</b>	<b>Norepinephrine and epinephrine secreted</b>	
<b>Bladder</b>	<b>Wall relaxed Sphincter closed</b>	<b>Wall contracted Sphincter relaxed</b>

# THANK YOU

