

A close-up photograph of several large, multi-petaled pink roses in full bloom. The roses are set against a background of green leaves and some blurred blue flowers. The entire image is framed by a solid blue border.

# **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 sympathetic& parasympathetic nervous system.
- -explain physiological functions of Sympathetic &parasympathetic nerves in head&neck,chest,abdomen and pelvis

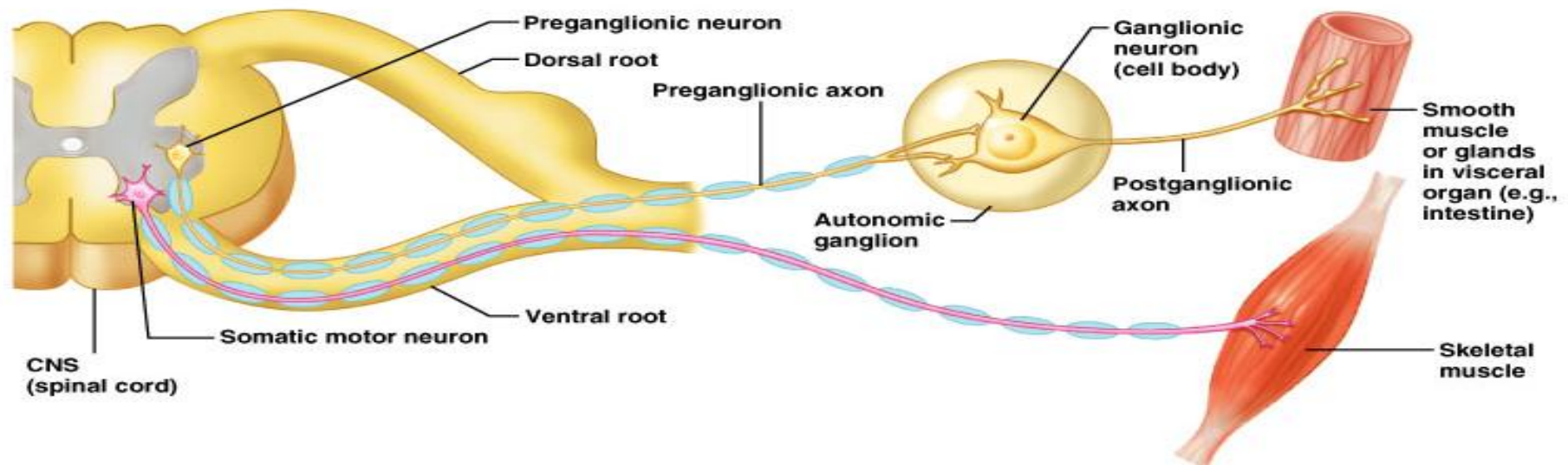
**FUNCTIONAL  
ANATOMY OF THE  
AUTONOMIC  
NERVOUS SYSTEM**

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

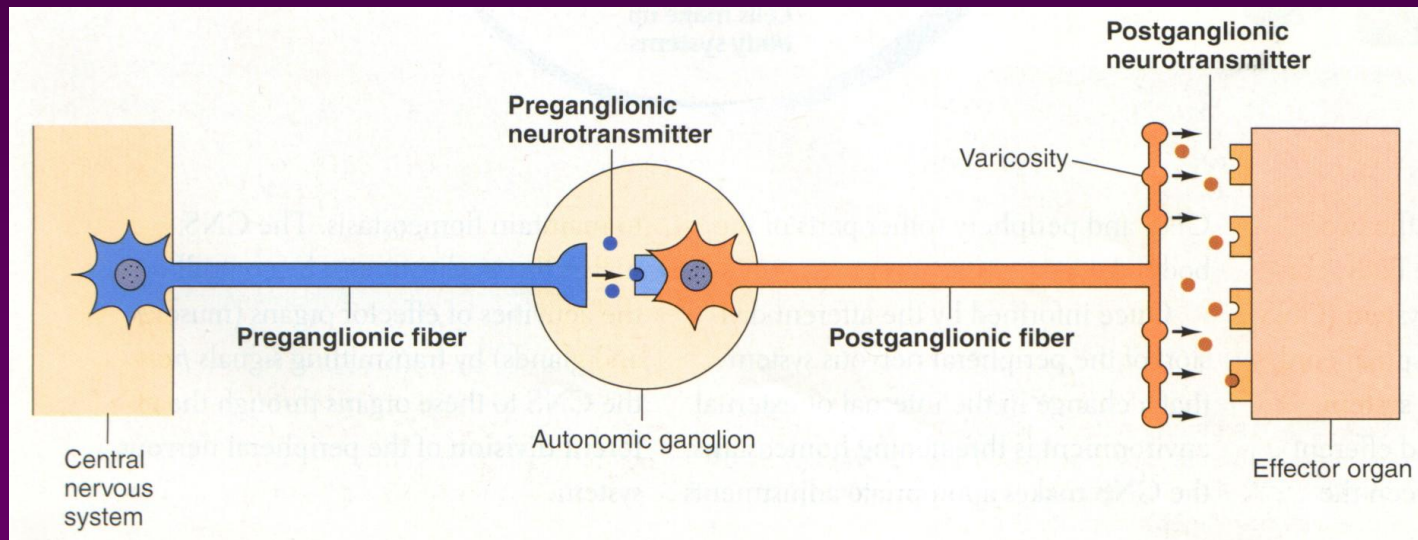
- Somatic division:
  - Cell bodies of motor neurons reside in CNS (brain or spinal cord)
  - Their axons (sheathed in spinal nerves) extend all the way to their skeletal muscles
- Autonomic system: chains of two motor neurons
  - 1<sup>st</sup> = preganglionic neuron (in brain or cord)
  - 2<sup>nd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



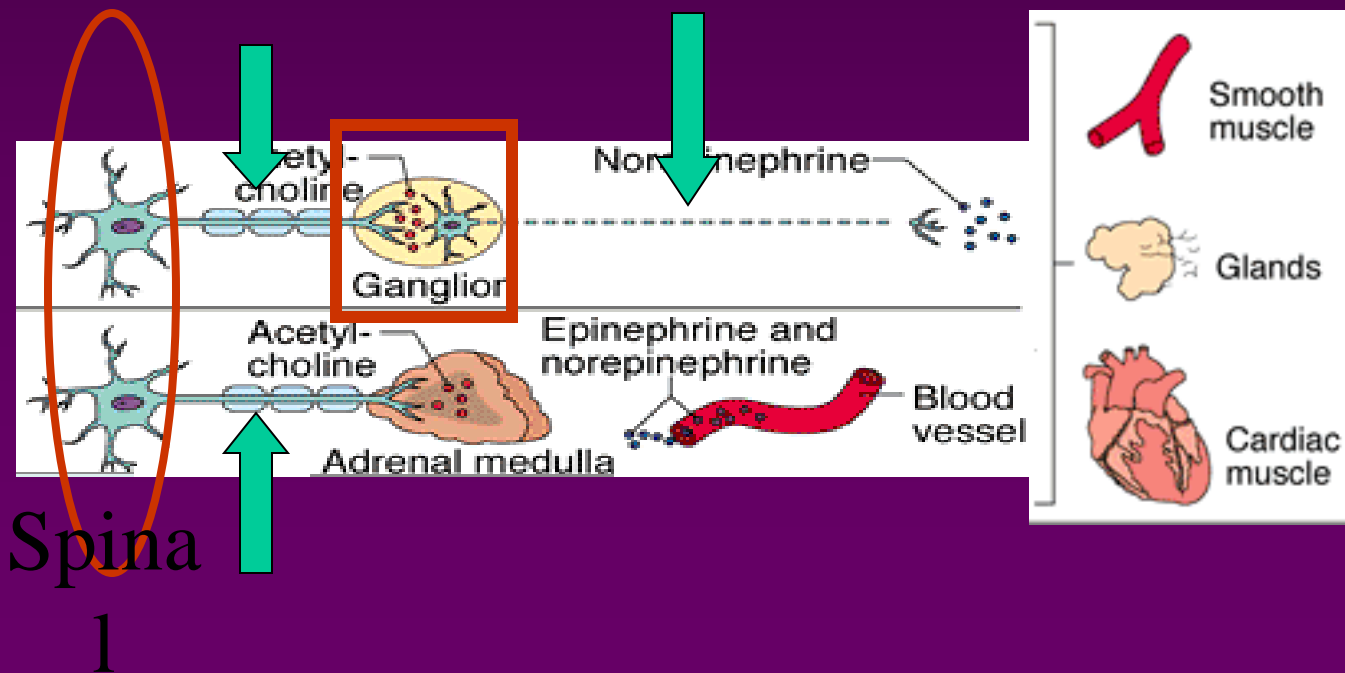
- Axon of 1<sup>st</sup> (*preganglionic*) neuron leaves CNS to synapse with the 2<sup>nd</sup> (*ganglionic*) neuron
- Axon of 2<sup>nd</sup> (*ganglionic*) neuron extends to the organ it serves



# Sympathetic

## Innervation of Visceral Targets

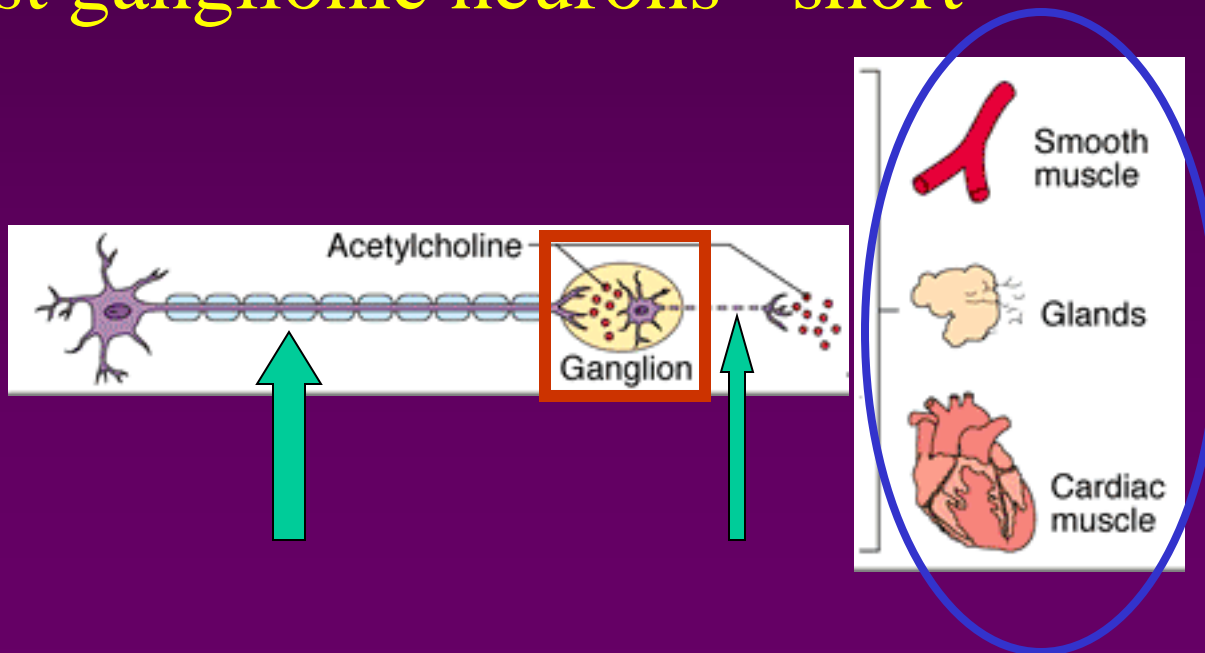
- Short, lightly myelinated preganglionic neurons
- Long, unmyelinated postganglionic neurons
- Ganglia close to spinal cord



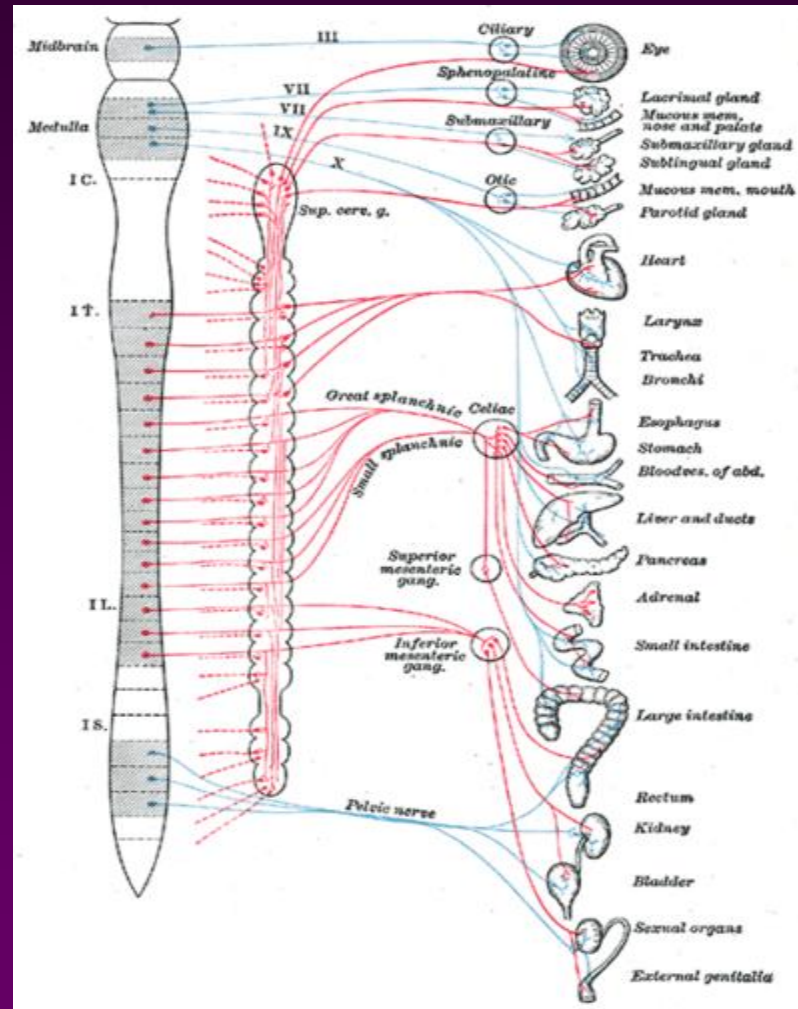
# Parasympathetic

## Innervation of Visceral Targets

- Ganglia close to or on target organs
- Preganglionic neurons - long
- Post ganglionic neurons - short



# SYMPATHETIC & PARASYMPATHETIC NERVOUS SYSTEM ORIGIN

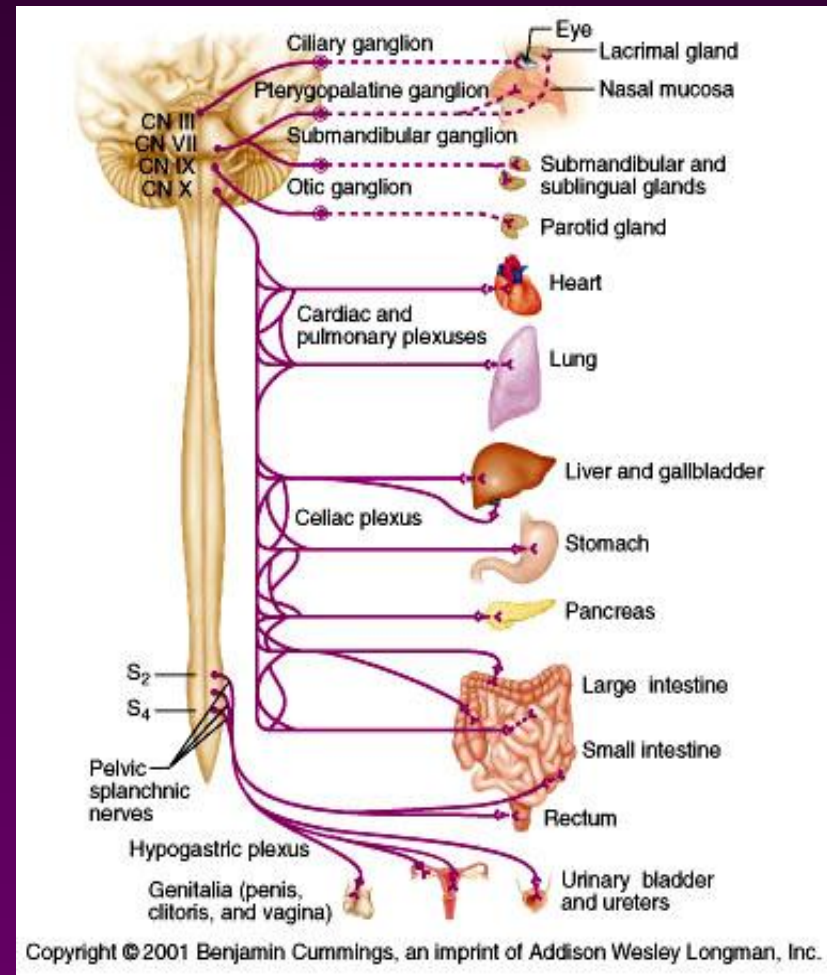


**Blue= Para symp; Red symp**



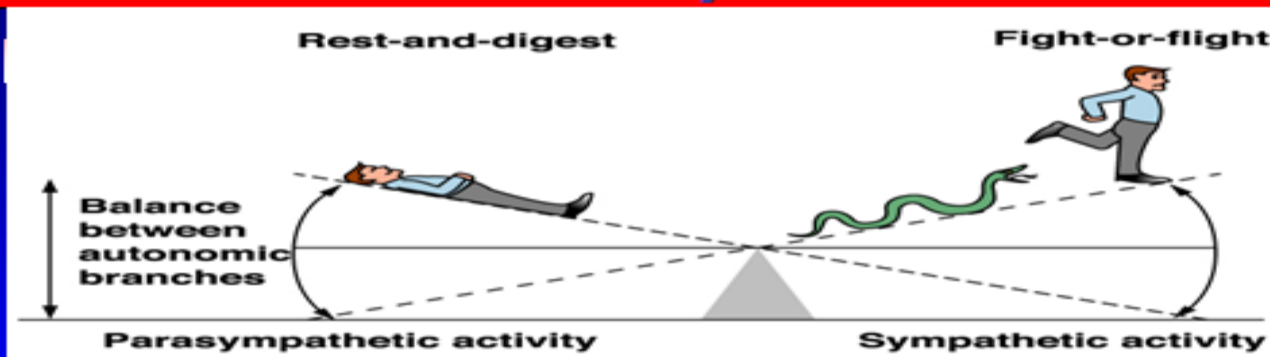
# Parasympathetic - Origin

- ❑ **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**



# PHYSIOLOGICAL FUNCTIONS OF THE AUTONOMIC NERVOUS SYSTEM

## 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>Sympathetic</b>	<b>Thoracolumbar</b>	<b>Alongside vertebral column</b>	<b>Norepinephrine</b>	<b>Fight or flight</b>
<b>Parasympathetic</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



# LECTUR (2)

## MECHANISM OF ACTIONS

The neurotransmitters &  
receptors of Autonomic NS

# OBJECTIVES

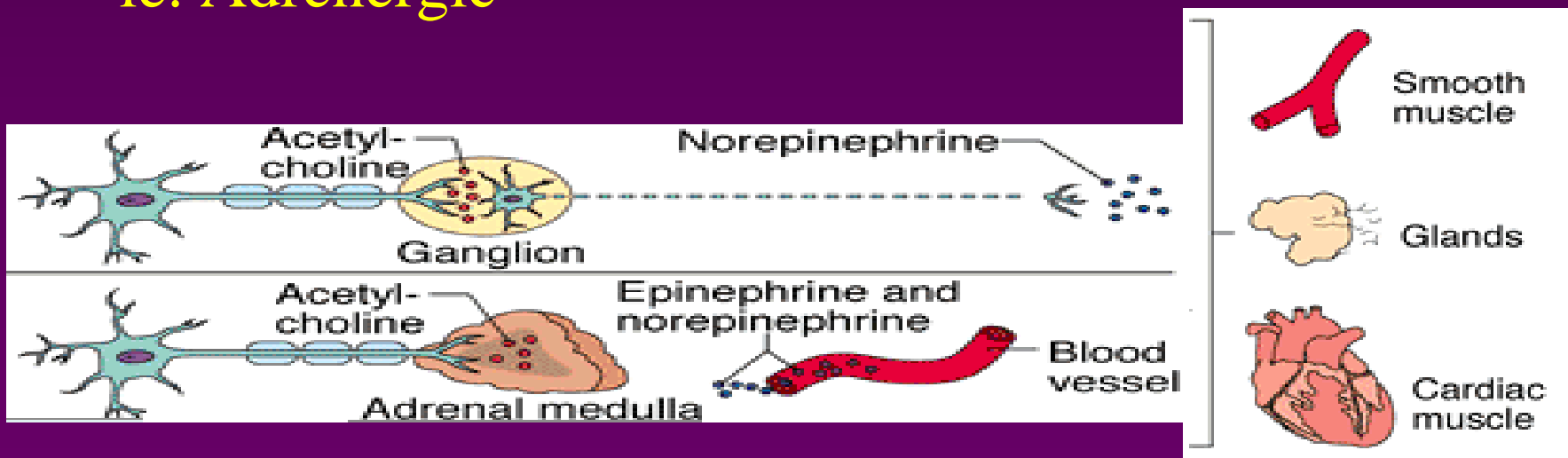
# OBJECTIVES

- describe neurotransmitters that can release at pre and post ganglionic of Autonomic NS.
- Describe Autonomic NS receptors.



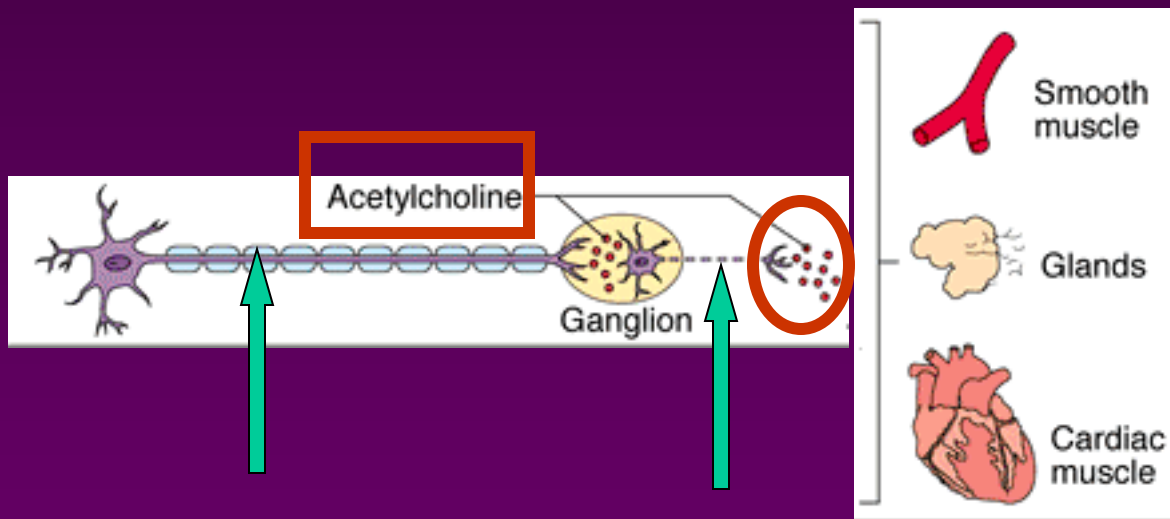
# Sympathetic Neurotransmitters

- Preganglionic neurons -
- Cholinergic = ( release acetylcholine )
- Postganglionic neurons:
  - release norepinephrine at target organs
  - ie. Adrenergic



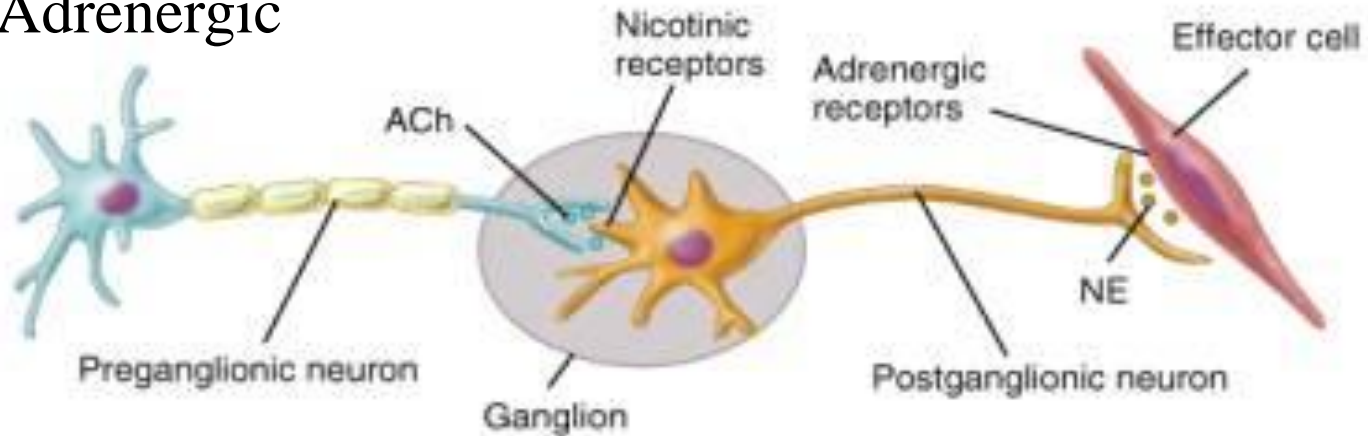
# Parasympathetic Neurotransmitters

- Pre & Postganglionic neurons release acetylcholine = Cholinergic

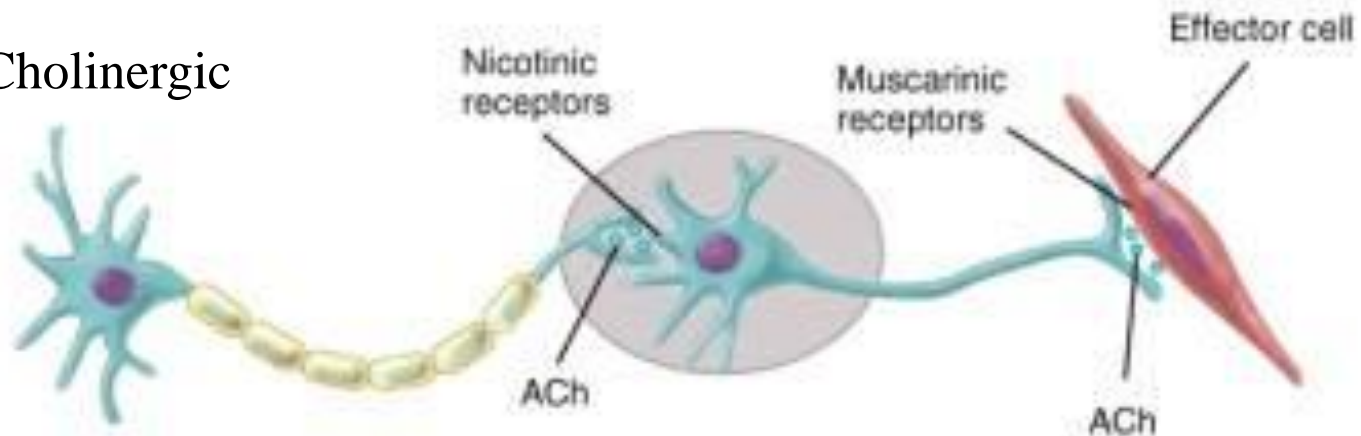


**ANS Neurotransmitters:** Classified as either cholinergic or adrenergic neurons based upon the neurotransmitter released

## Adrenergic



## Cholinergic



# Chemical or neural transmitter

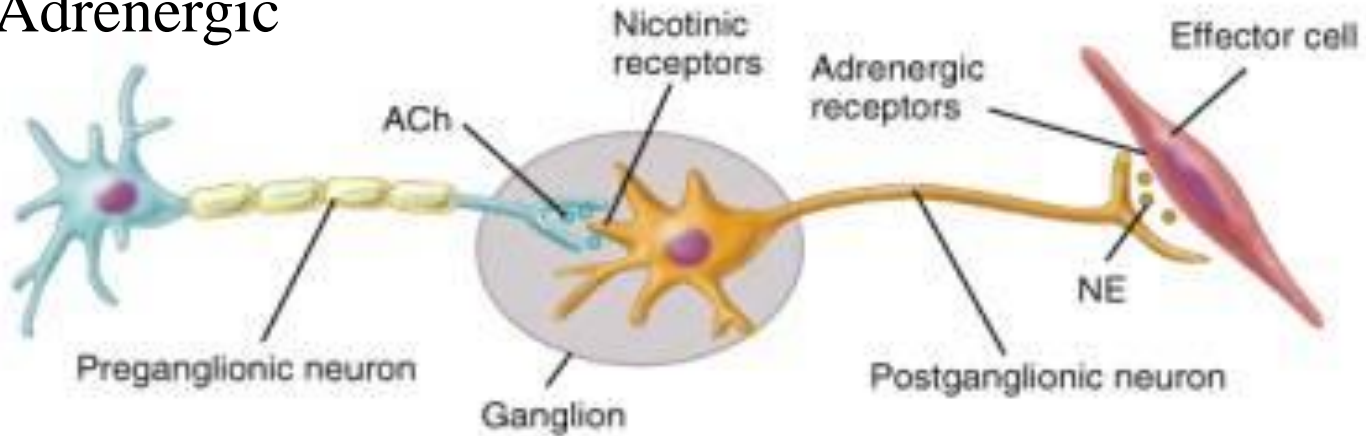
- **All preganglionic fibers release acetylcholin (Ach).**
- **All parasympathetic postganglionic release Ach.**
- **All sympathetic postganglionic release noradrenalin except sweat glands & bl vessels to skeletal muscles**

# RECEPTORS

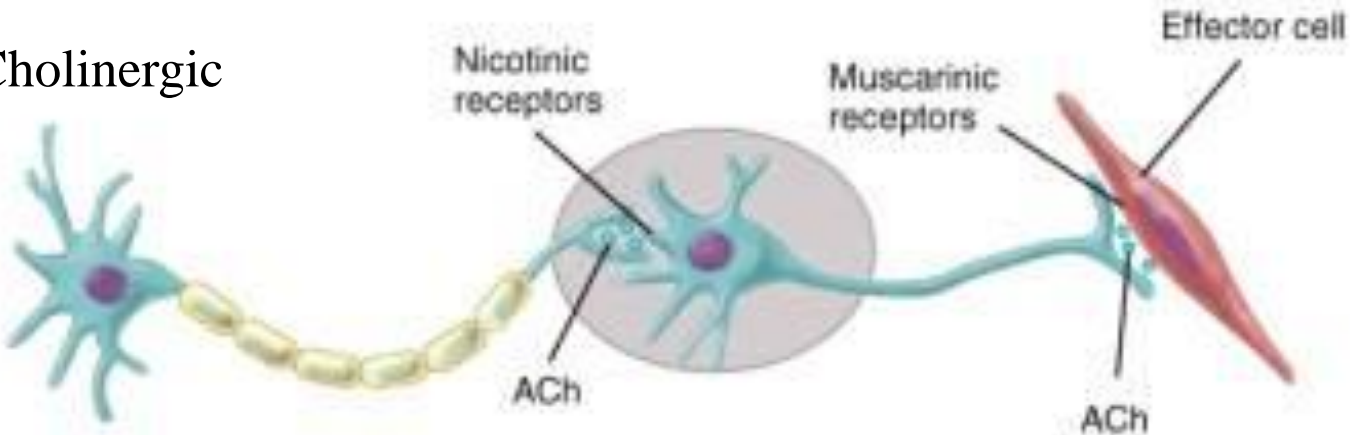
- ❑ The parasympathetic nervous system uses only acetylcholine (ACh) as its neurotransmitter.
- ❑ The ACh acts on two types of receptors, the muscarinic and nicotinic cholinergic receptors.
- ❑ Most transmissions occur in two stages: When stimulated, the preganglionic nerve releases ACh at the ganglion, 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 NS Acts on two types of receptors :  $\alpha$  and  $\beta$ .

**ANS Receptors :** Classified as either parasympathetic or sympathetic

## Adrenergic



## Cholinergic



## What do the receptors do?

Activation of  $\alpha$  receptors leads to smooth muscle contraction

Activation of  $\beta_2$  receptors leads to smooth muscle relaxation

Activation of  $\beta_1$  receptors leads to smooth muscle contraction (especially in heart)

# THANK YOU

