

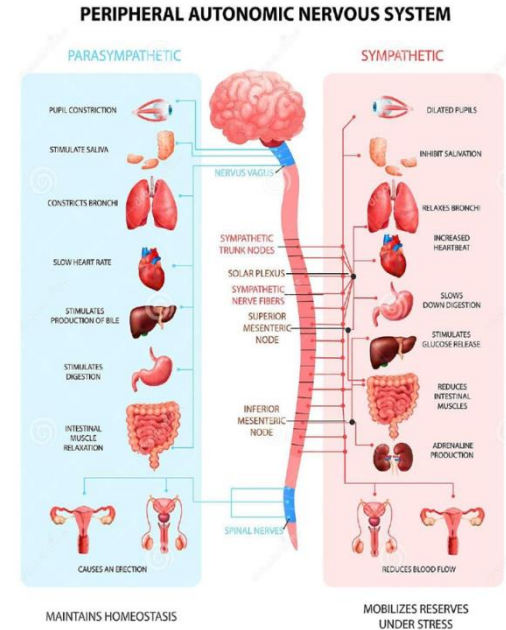


AL-Mustaqbal University College  
Department of Pharmacy  
physiology lec 4/ 2<sup>nd</sup> stage



# Autonomic Nervous system(ANS)

By: Dr. Weaam J. Abass



# **Autonomic nervous system**

**Objectives :-**

**What is the autonomic control of body ?**

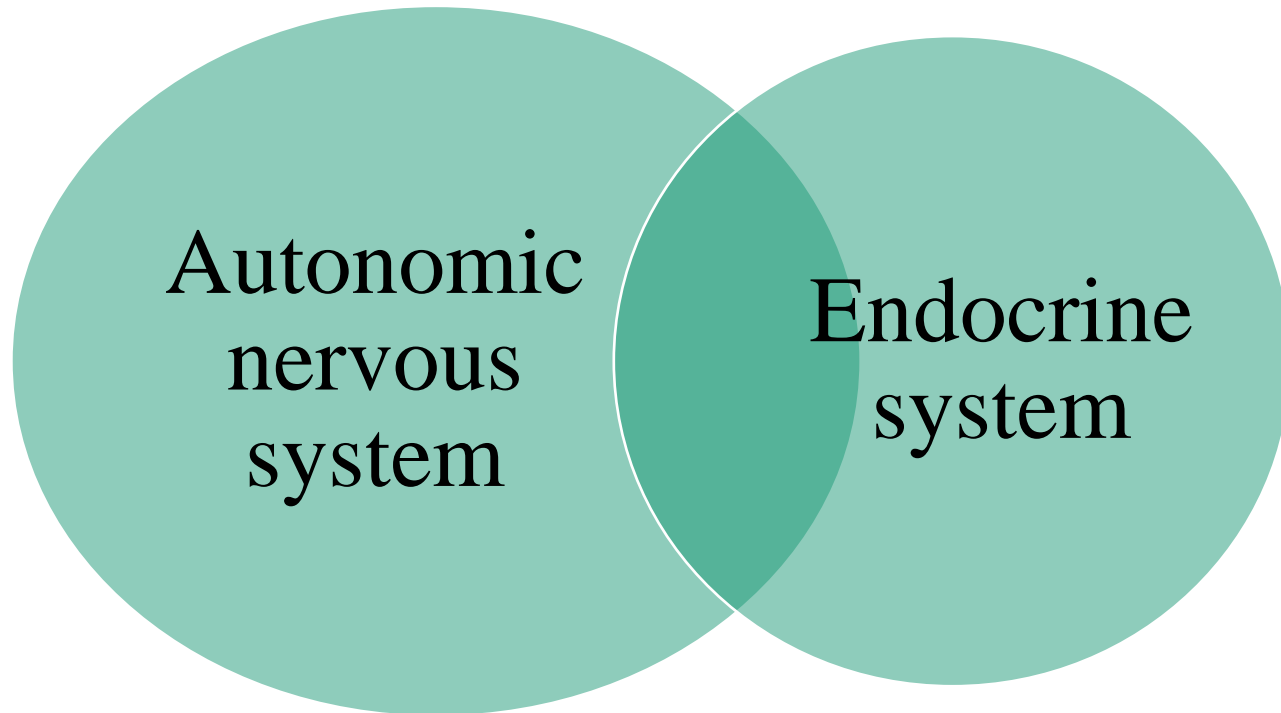
**What is the autonomic nervous system ?**

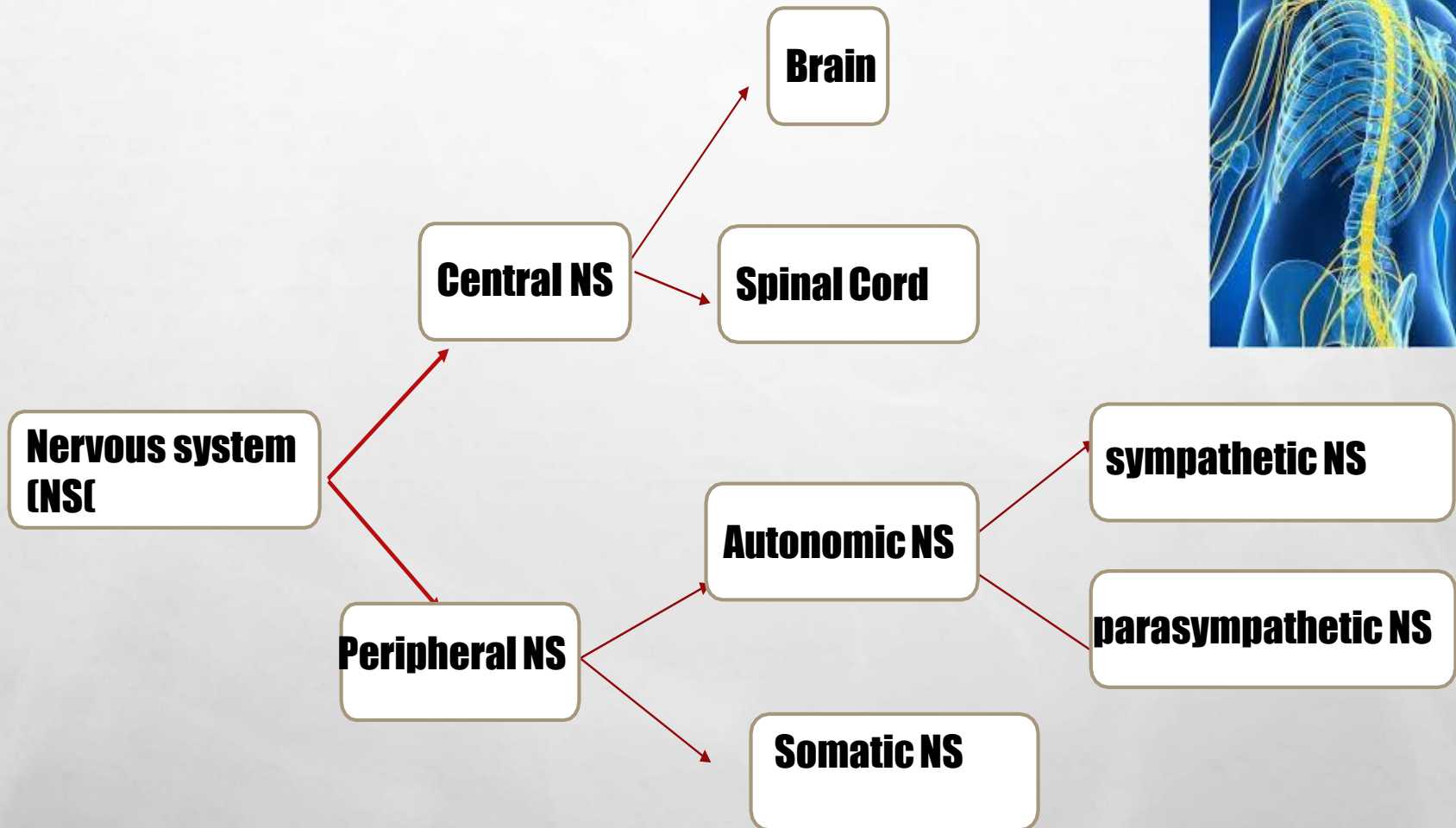
**What are the divisions of it and functions ?**

**How it operate ?**

**Regulation and disorder?**

# Autonomic control of body functions by





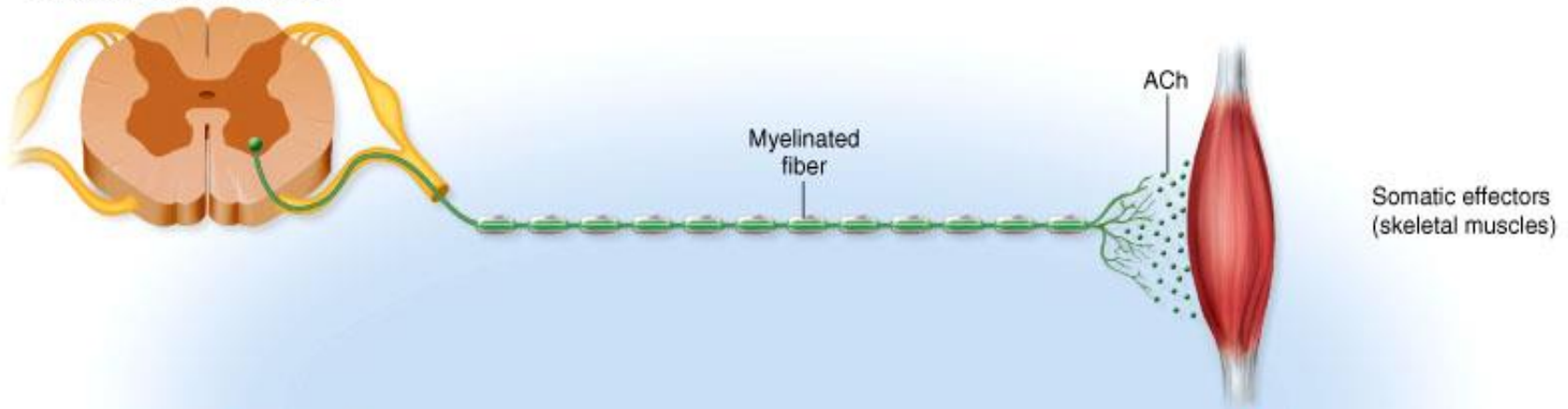
# Autonomic nervous system (ANS)

- The ANS is a part of the nervous system which innervates smooth muscles, cardiac muscles and glands
- **Control the visceral functions of the body so Responsible for “involuntary” control the function of**
  - Cardiovascular (Regulate heart rate and blood pressure)
  - Respiratory (Regulate respiratory rate)
  - Digestive (Regulate the motility)
  - Urinary
  - Reproductive functions
  - Key role in the body's response to stress.**
- **Some of which are almost controlled entirely and some partially by the ANS**

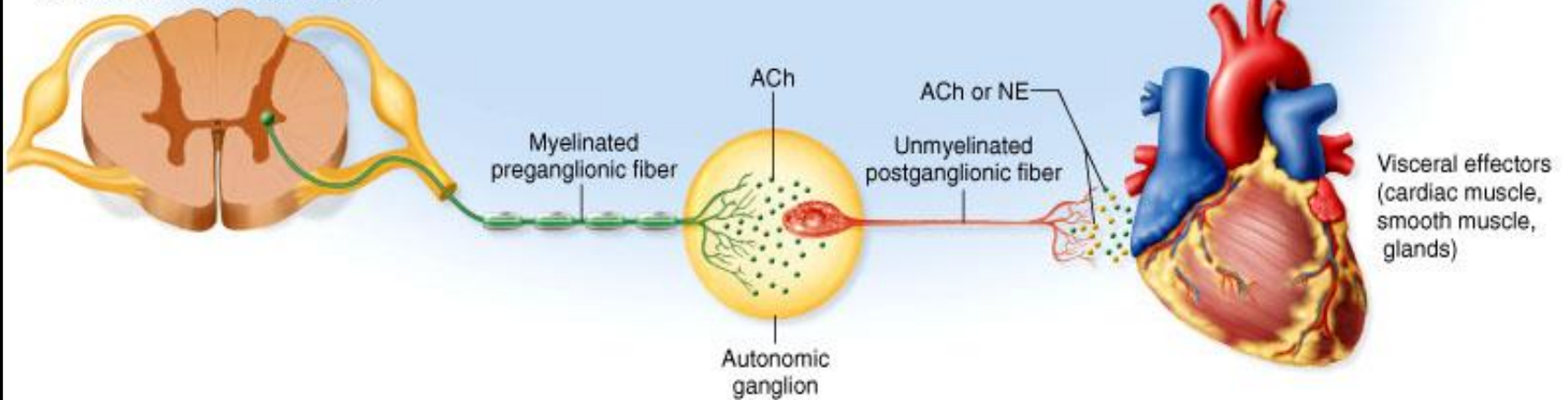
# Comparison of Somatic and Autonomic Efferent Pathways

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**Somatic efferent innervation**



**Autonomic efferent innervation**





# Comparison Somatic and Autonomic Nervous System

## Characteristics

### Somatic nervous system

### Autonomic nervous system

## Sensory Receptors

Somatic senses and special senses

Mainly from interoceptors (located in blood vessel, visceral organ, nervous system that monitor internal environment)

## Effector

Skeletal muscle

Cardiac, smooth muscle and glands

## Control of motor neuron

Voluntary control from cerebral cortex, with contribution from basal ganglia, cerebellum, brainstem and spinal cord.

Involuntary control from hypothalamus, limbic system, brain stem and spinal cord; limited control from cerebral cortex.

## Characteristics

### Somatic nervous system

### Autonomic nervous system

Location of ganglion

Motor in CNS.  
Sensory in dorsal root.

Autonomic ganglion outside CNS.

Preganglionic and sensory shared with somatic nervous system.

Neurontransmitter

Acetylcholine (ACh):  
always excitatory

Sympathetic postganglionic neurons release Norepinephrine (NE), to sweat gland release ACh. All parasympathetic postganglionic neurons release ACh.



## **Characteristics**

**Motor neuron  
(efferent) pathway**

## **Somatic nervous system**

**One motor axon  
from CNS to effector**

## **Autonomic nervous system**

**Two neuron pathway:  
One motor axon from  
CNS to autonomic  
ganglion**

**(preganglionic)**

**One motor axon from  
autonomic ganglion  
to effector**

**(postganglionic)**

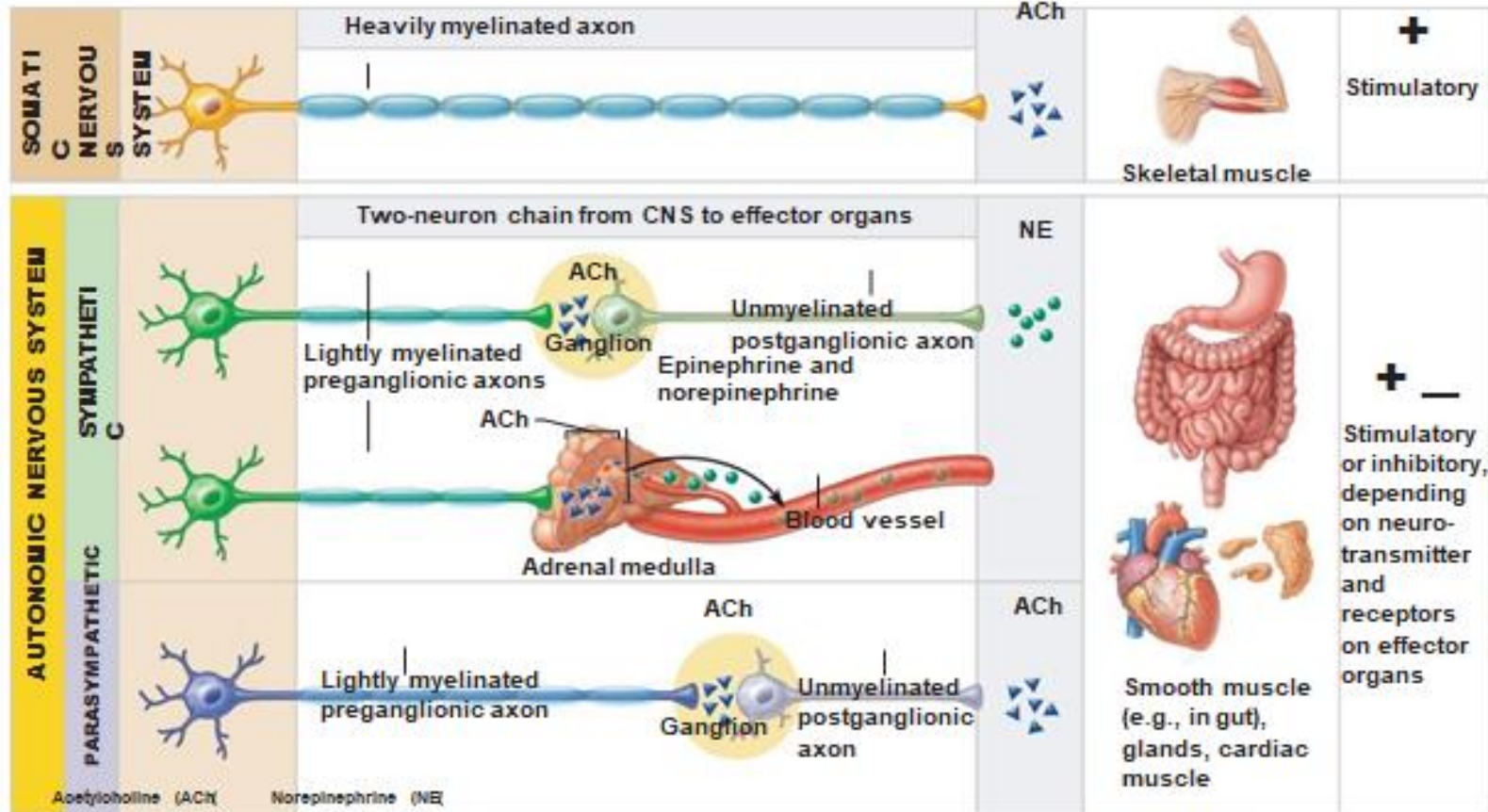
**Cell bodies in central nervous system**

**Peripheral nervous system**  
Single neuron from CNS to effector organs

**Neuro-transmitter at effector**

**Effector organs**

**Effect**



Acetylcholine (ACh)      Norepinephrine (NE)



# Autonomic nervous system (ANS)

- The ANS is operate largely **unconsciously** ,however some visceral sensation give rise to conscious recognition such as hunger , thirst, nausea, fullness of urinary bladder and rectum
- **ANS output can be influenced by many higher brain regions ??**
- **But the main areas involved in autonomic control include brain stem, hypothalamus, limbic system**
- **The ANS activated by centers in the**
  - ✓ Spinal cord,
  - ✓ Brain stem ,hypothalamus
  - ✓ Parts of cerebral cortex

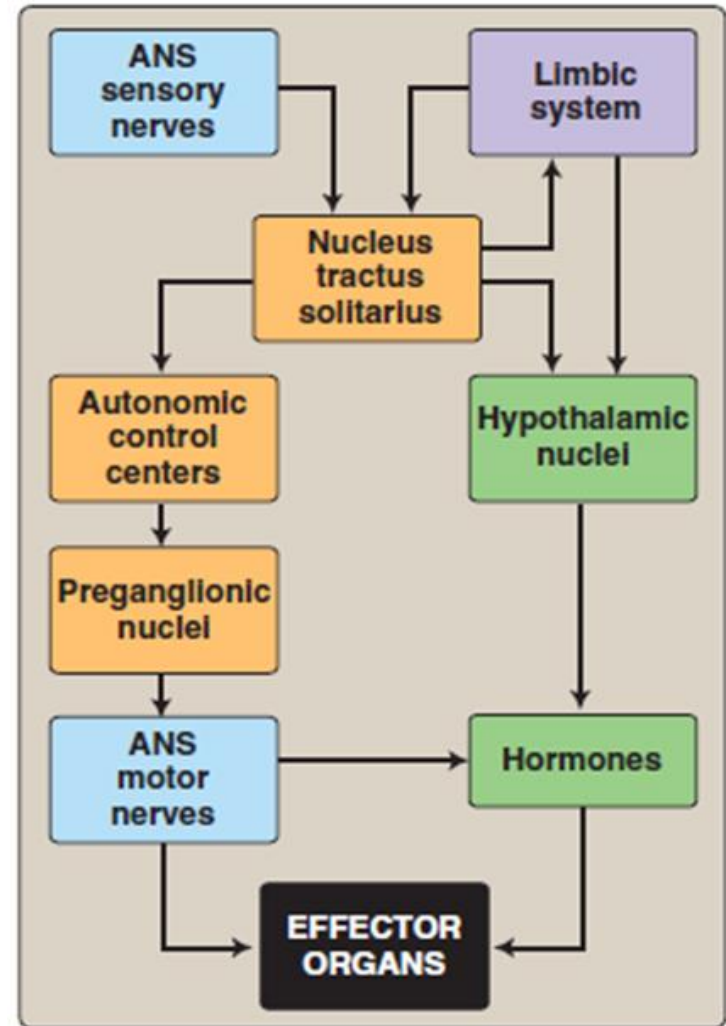


Figure 7.7  
Autonomic control centers. ANS =  
autonomic nervous system.

# Autonomic nervous system (ANS)

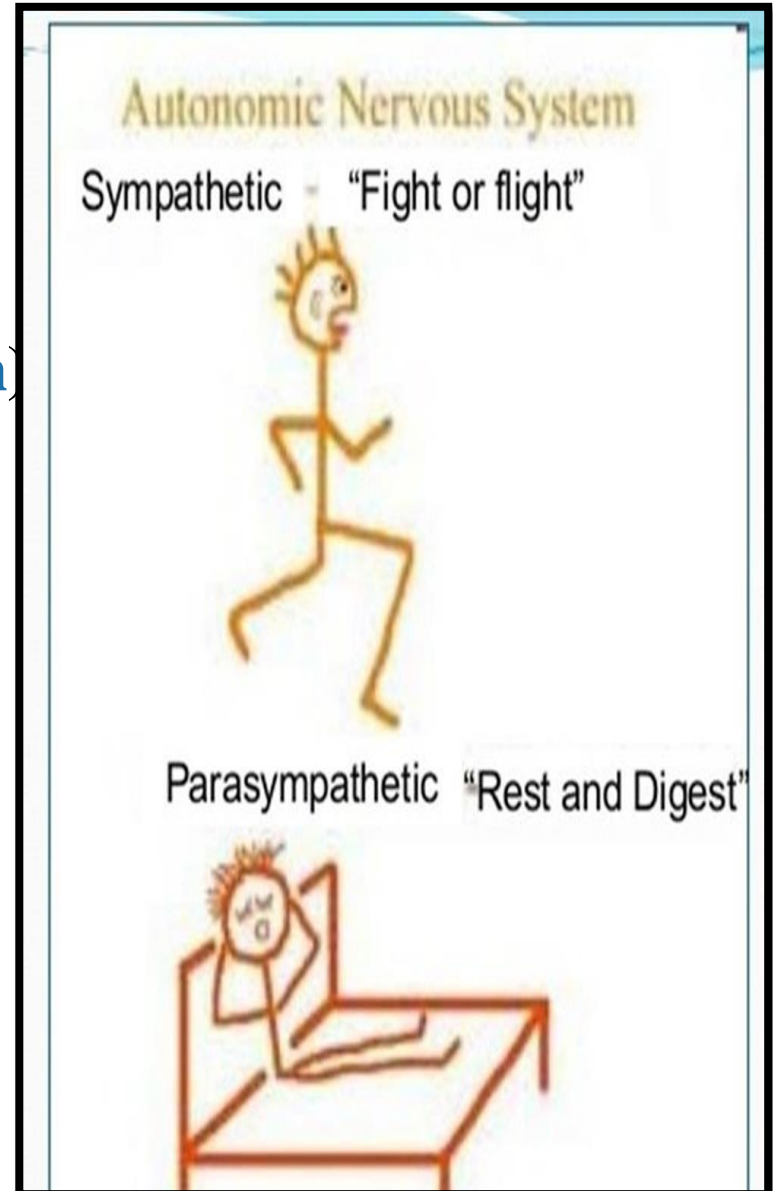
- In general, nerve impulses from one division of the ANS stimulate an organ to increase its activity (**excitation**), and another division inhibit the organ activity (**inhibition**)

- **SYMPATHETIC NERVOUS SYSTEM:**

- ◇ Allow body to function under stress (**Fight or flight**)

## PARASYMPATHETIC NERVOUS SYSTEM

- ◇ Maintenance functions (**Rest-and-digest**)
- ◇ Counterbalances sympathetic function
- ❖ **Almost all visceral organs are served by both divisions, but they cause opposite effects**





# Autonomic nervous system division

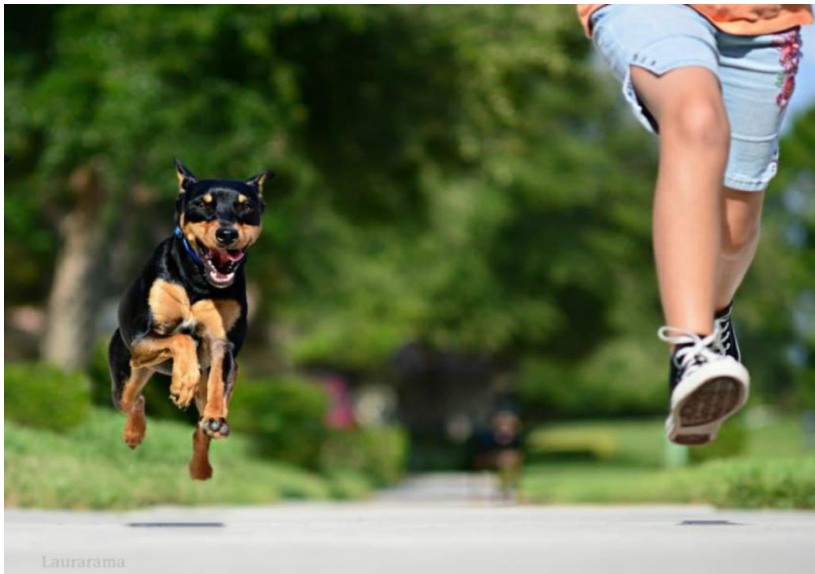
## Autonomic nervous system (ANS)

### Sympathetic

Dominated by (Adrenaline)  
(Adrenergic )

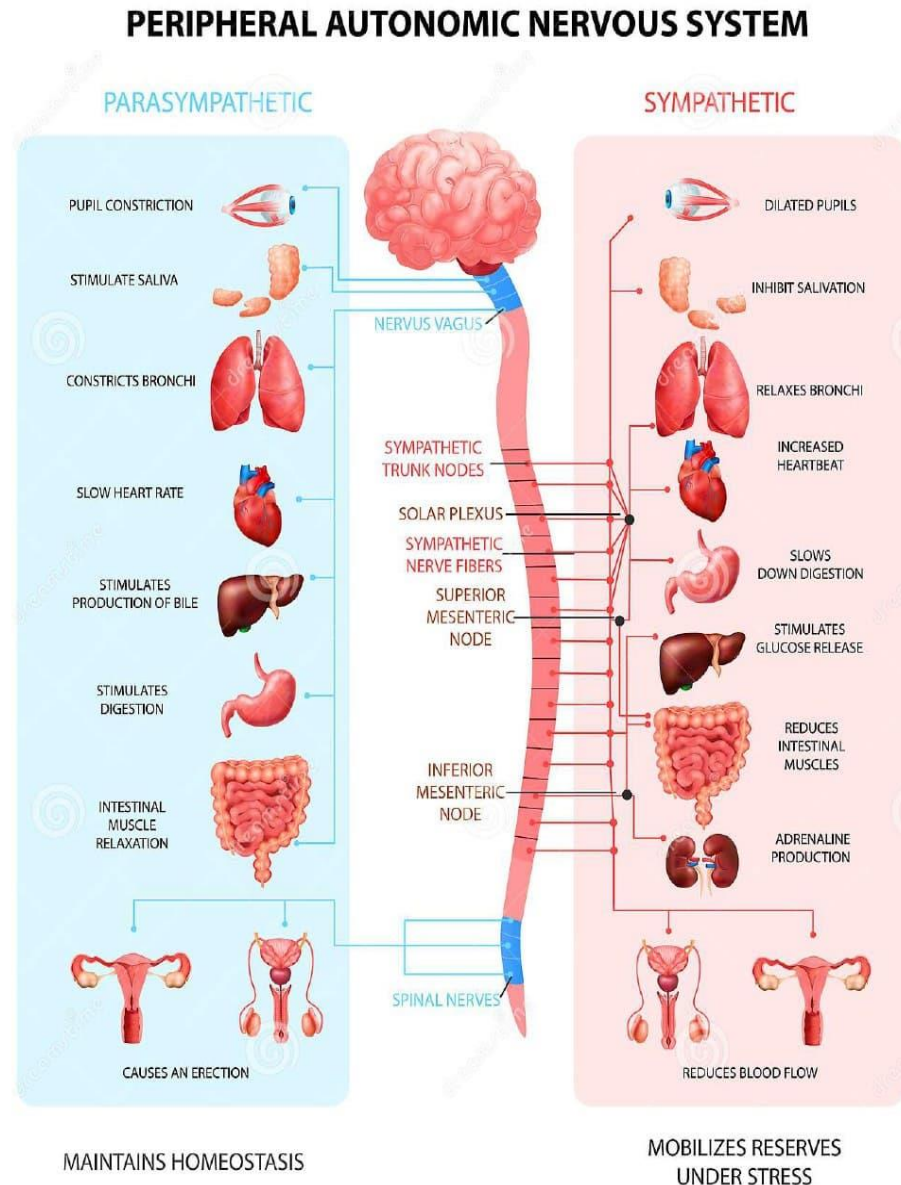
### Parasympathetic

Dominated by Acetylcholine  
(Cholinergic )



# Sympathetic Nervous System Summary

1. Lateral gray horns (T1-L2)
2. Thoracolumbar outflow
3. Ganglia
  - a. sympathetic trunk (paravertebral)
  - b. Prevertebral (collateral)
4. Preganglionic axons short
5. Postganglionic axons long



# The Sympathetic Division

- ▶ **This division of the ANS controls the fight or flight responses . This includes:**
- ▶ heart rate increases dramatically,
- ▶ blood vessels in your skeletal muscles dilate,
- ▶ blood vessels in the visceral muscles constrict,
- ▶ digestion is ceased,
- ▶ your liver increase glucose release,
- ▶ your pupils dilate, (mydriasis )
- ▶ salivary production decreases,
- ▶ sweat increases.

# Sympathetic neurotransmitters

## **Norepinephrine (NE) :**

is the transmitter released by practically **all postganglionic neurons of the sympathetic nervous system.**

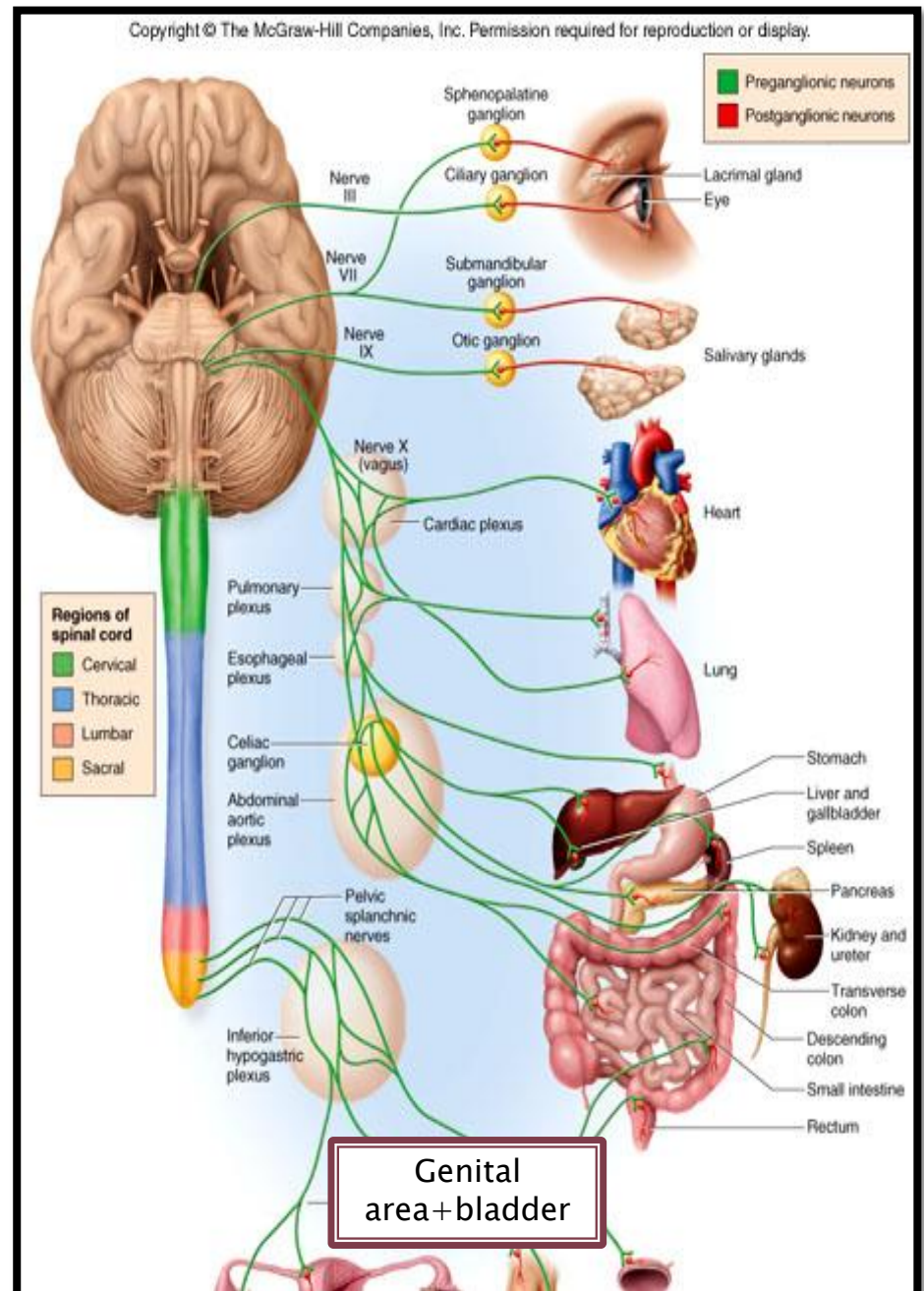
**Adrenal medulla (Gland ):** **Epinephrine** is the major transmitter released by the adrenal medulla. (The adrenal medulla also releases some norepinephrine.)

- ❖ Direct sympathetic nerve to (**adrenal medulla**) lead to secretion of **Epinephrine** to all of the effectors tissues of the sympathetic system....



# Parasympathetic Nervous System Summary

1. Lateral gray horns (S 2-4)
2. Cranial gray matter (III, VII, IX, X)
3. Craniosacral outflow
4. Terminal ganglia
5. Preganglionic axons long
6. Postganglionic axons short



# Parasympathatic division

- ▶ **This division of the ANS responsible for the rest and digest activates . This means:**
- ▶ It increase the blood flow to the digestive organs and the excretory systems while decreasing blood flow to the skeletal tissue
- ▶ The parasympathetic division is also called the Craniosacral division, because its fibers emerge from brain and sacral spinal cord.
- ▶ The parasympathetic system contain the vagus cranial nerve , which innervate the heart, liver, small and large intestines among others .

# Interactions of the ANS

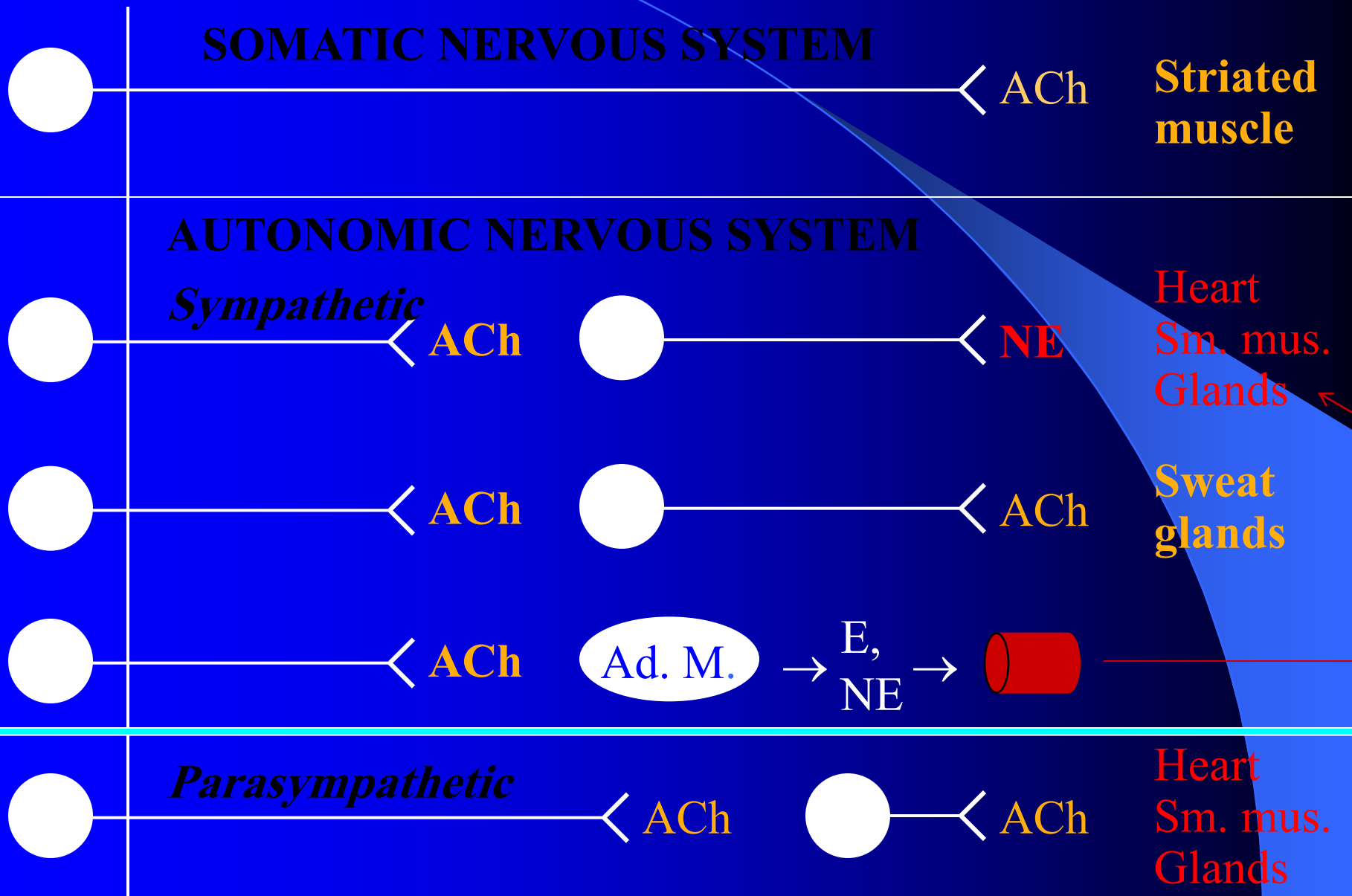
- ▶ Most visceral organs are innervated by both **types of nerves**.
- ▶ Most blood vessels are innervated **only** by **sympathetic nerves**.
- ▶ **Parasympathetic** activity **dominates** the heart and GI tract.
- ▶ Activation of the **sympathetic** division causes wide spread, long-lasting mobilization of the fight-or-flight response.
- ▶ **Parasympathetic** effects are highly localized and short lived.

# Neurotransmitters and Neuroreceptors

- **Acetylcholine** and **Norepinephrine**
- All preganglionic neurons are cholinergic
- Parasympathetic post ganglionic neurons are ( Ach ) = **cholinergic**
- Sympathetic post ganglionic neurons are ( NE ) = **adrenergic** except Sympathetic innervating sweat glands, blood vessels in skeletal muscle, and piloerection muscles are ( Ach ) = **cholinergic**



# Neurotransmitters



# Acetylcholine + Receptors

- **Nicotinic receptors**

- Nm (muscular-type or N<sub>2</sub>): skeletal muscle
- Nn (neuron-type, or N<sub>1</sub>): autonomic ganglia, CNS

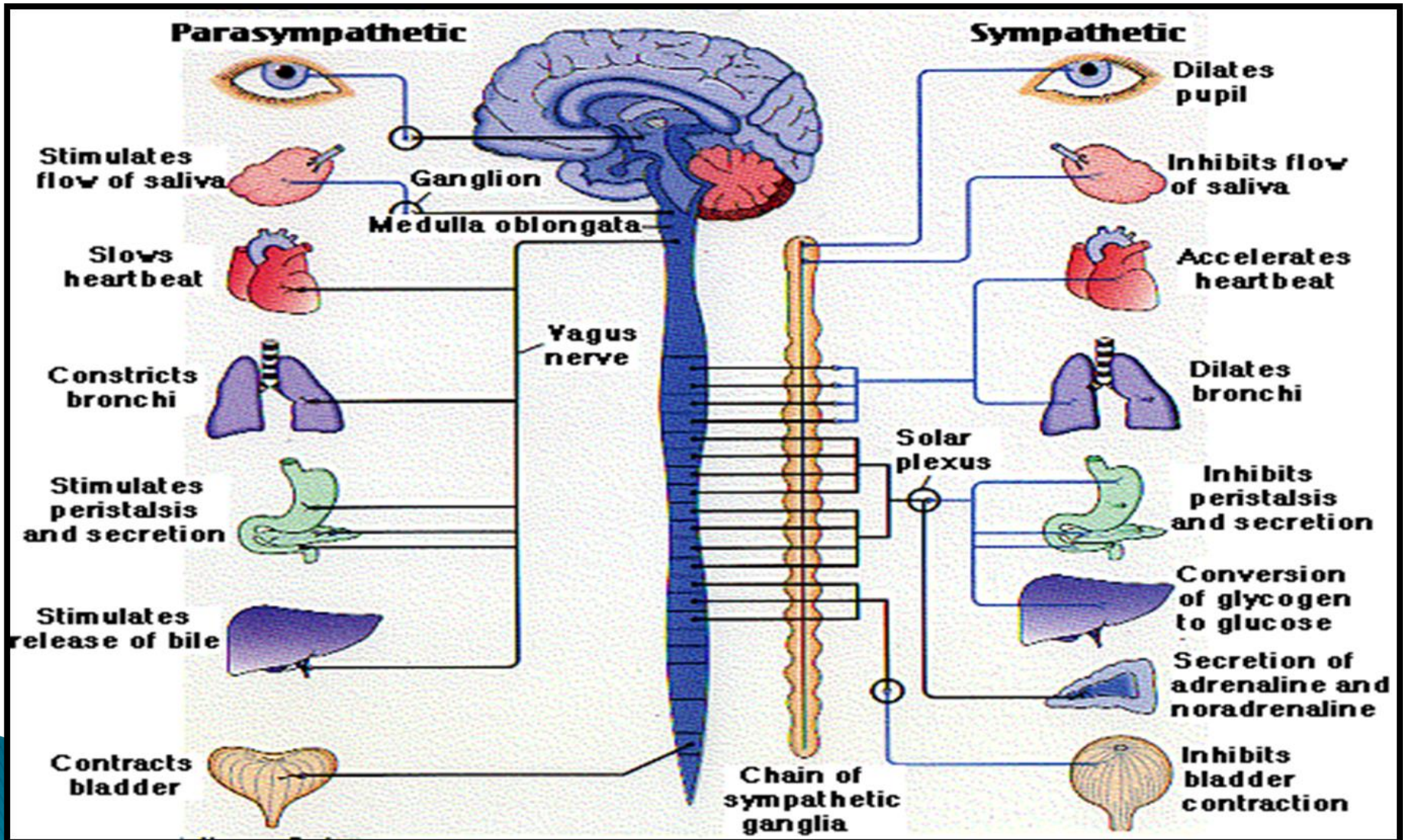
- **Muscarinic receptors**

- Postganglionic parasympathetic and a few sympathetic sites, CNS (also autonomic gang.)
- Receptor subtypes: M<sub>1-5</sub>

# Catecholamines

- Norepinephrine
  - Postganglionic sympathetic, CNS, adrenal medulla
  - Receptors:  $\alpha_1$ ,  $\alpha_2$ ,  $\beta_1$
- Epinephrine
  - Adrenal medulla, CNS
  - Receptors:  $\alpha_1$ ,  $\alpha_2$ ,  $\beta_1$ ,  $\beta_2$
- Dopamine
  - Autonomic ganglia, CNS
  - Receptors:  $D_{(1-5)}$ ,  $\alpha_1$ ,  $\beta_1$

# Regulation of autonomic nervous system activity





# ANS Efficiency

- In old age, ANS efficiency declines, partially due to structural changes at preganglionic axon terminals.
- Effects of age on ANS
  - Constipation
  - Dry eyes
  - Frequent eye infections
  - Orthostatic hypotension
    - Low blood pressure occurs because aging pressure receptors respond less to changes in blood pressure with changes in body position and because of slowed responses by sympathetic vasoconstrictor centers



Thank  
you!

