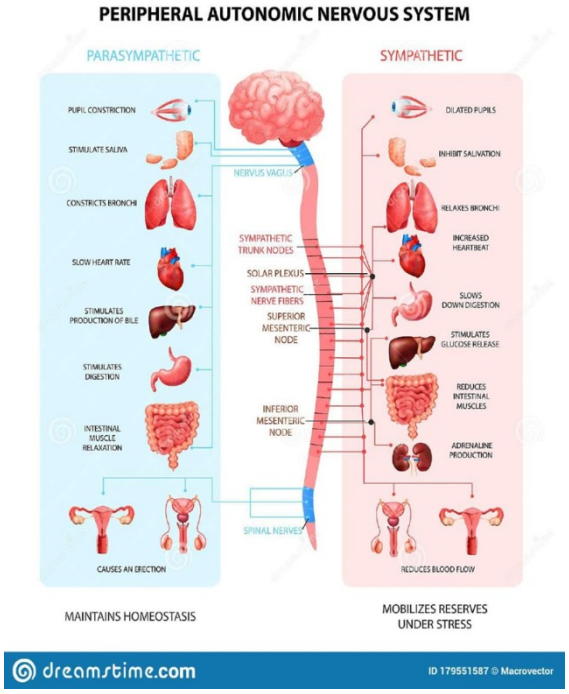
Al-Mustaqbal University
College of Pharmacy
Second stage
Physiology Lec3 Nervous system

Autonomic Nervous system(ANS)

By: Dr. Weaam J. Abass



Autonomic nervous system

Objectives :-

What is the autonomic control of body ?

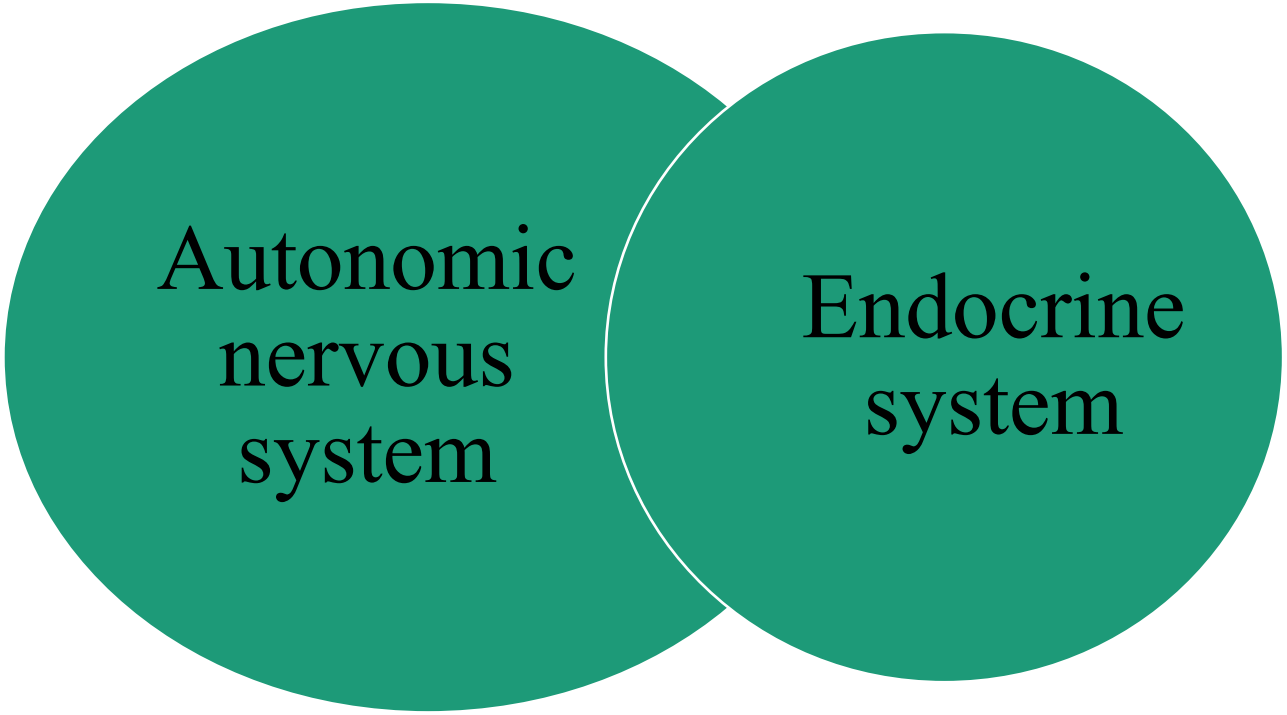
What is the autonomic nervous system ?

What are the divisions of it and functions ?

How it operate ?

Regulation and disorder?

Autonomic control of body functions by



- Nervous system (NS(
  - Central NS
    - Brain
    - Spinal Cord
  - Peripheral NS
    - Autonomic NS
      - sympathetic NS
      - parasympathetic NS
    - Somatic NS

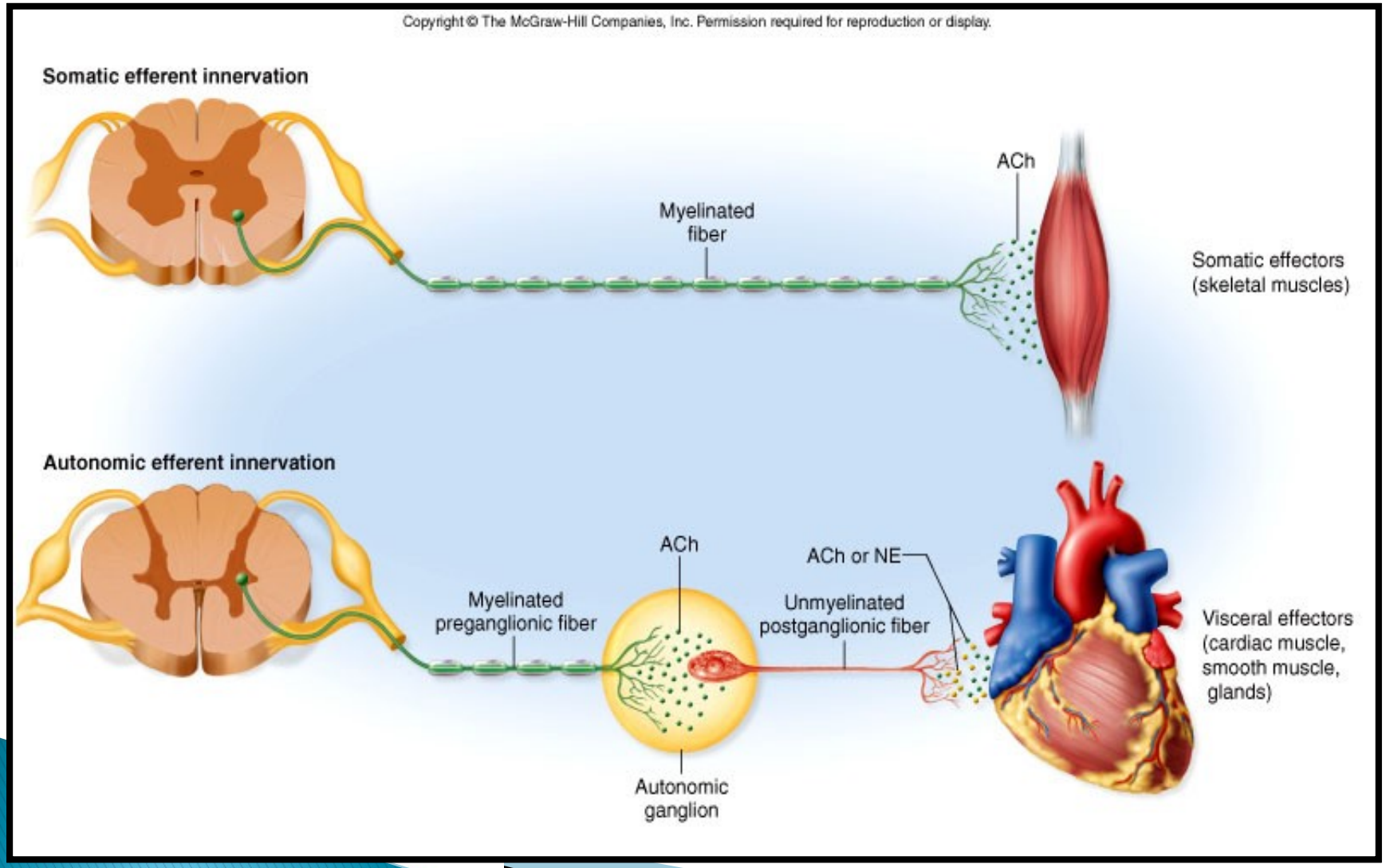
Autonomic nervous system (ANS)

- The ANS is apart of nervous system which is **innervate 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 bodies response to stress.**

- **Some of which are almost controlled entirely and some partially by the ANS**

Comparison of Somatic and Autonomic Efferent Pathways



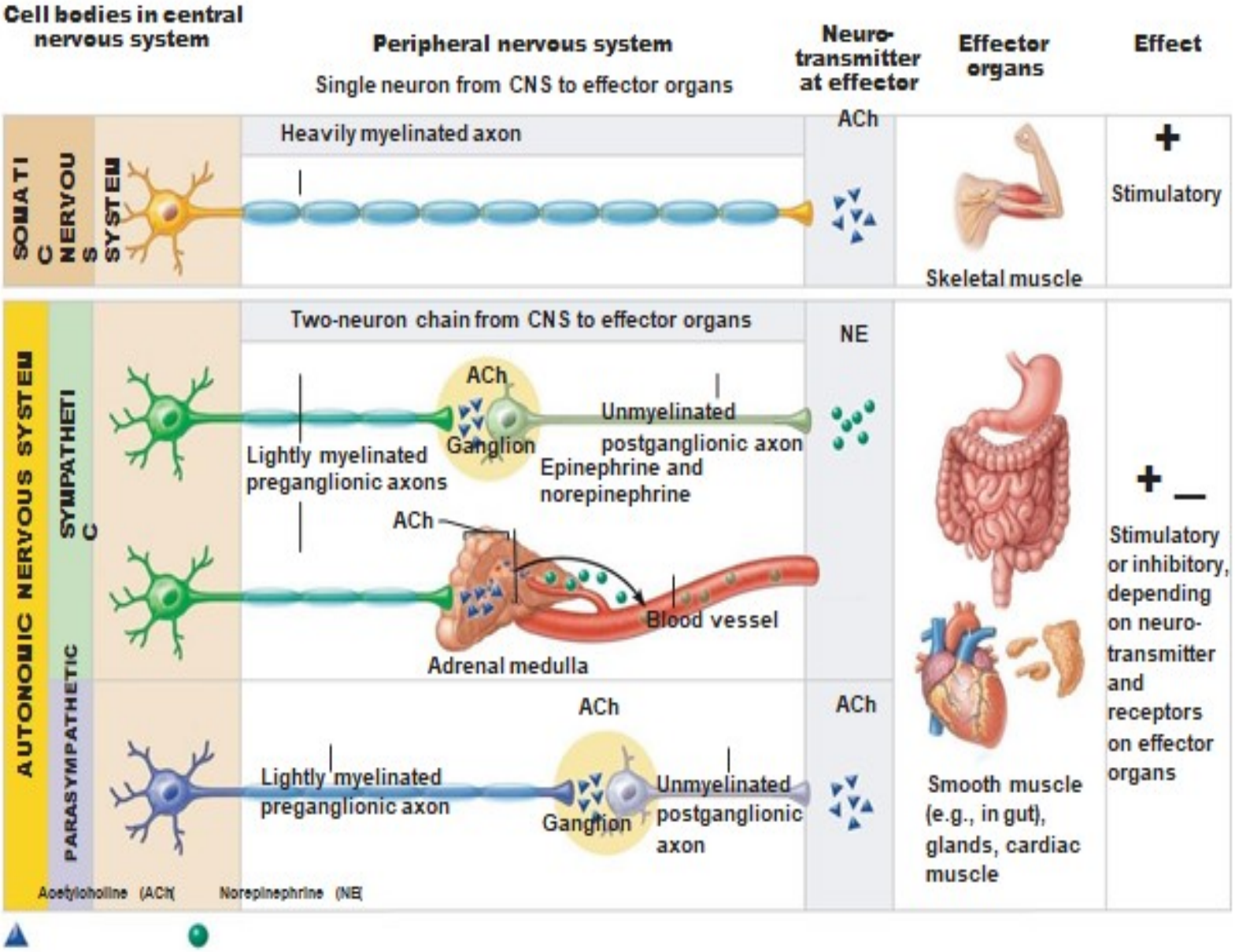
Comparison Somatic and Autonomic Nervous System

Characteristics	Somatic nervous system	Autonomic nervous system
Receptors		
Sensory neuron	Somatic senses and special senses	Mainly from interoceptors 9located 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, lymbic system, brain stem and spinal cord; limited control from cerebral cortex.

limbic

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	Somatic nervous system	Autonomic nervous system
Motor neuron (efferent) pathway	One motor axon from CNS to effector	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
SOMATIC NERVOUS SYSTEM
Heavily myelinated axon
ACh
Skeletal muscle
Stimulatory
AUTONOMIC NERVOUS SYSTEM
SYMPATHETIC
PARASYMPATHETIC
Two-neuron chain from CNS to effector organs
NE
ACh
Ganglion
Unmyelinated postganglionic axon
Lightly myelinated preganglionic axons
Epinephrine and norepinephrine
ACh
Blood vessel
Adrenal medulla
ACh
ACh
Lightly myelinated preganglionic axon
Ganglion
Unmyelinated postganglionic axon
Smooth muscle (e.g., in gut), glands, cardiac muscle
Stimulatory or inhibitory, depending on neuro-transmitter and receptors on effector organs
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**

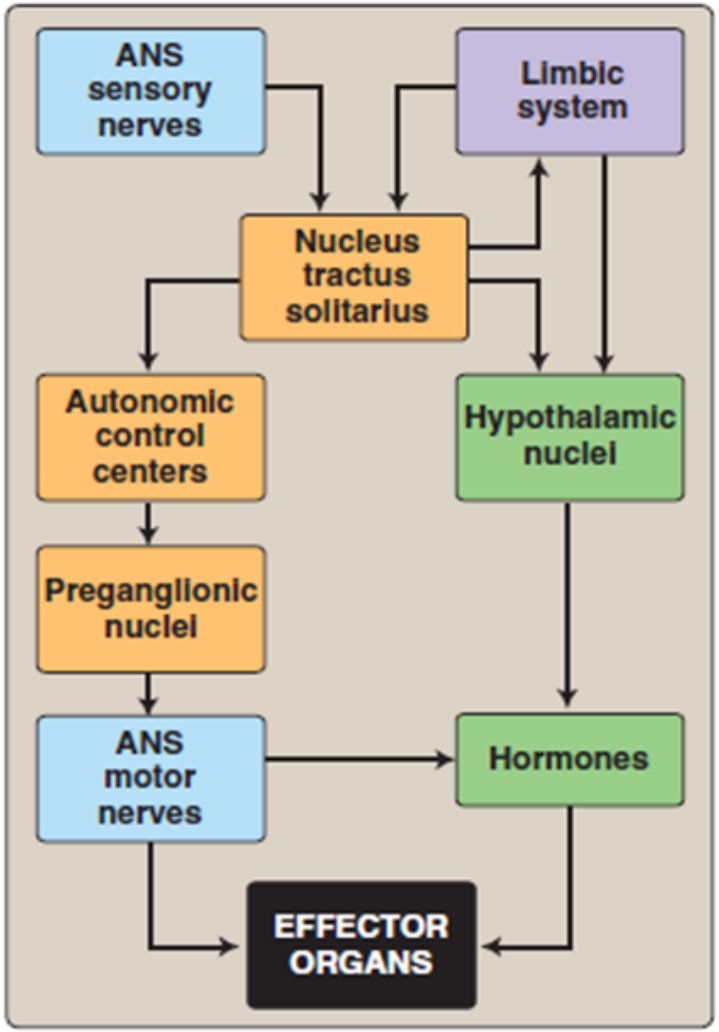


Figure 7.7
Autonomic control centers. ANS = autonomic nervous system.

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:**

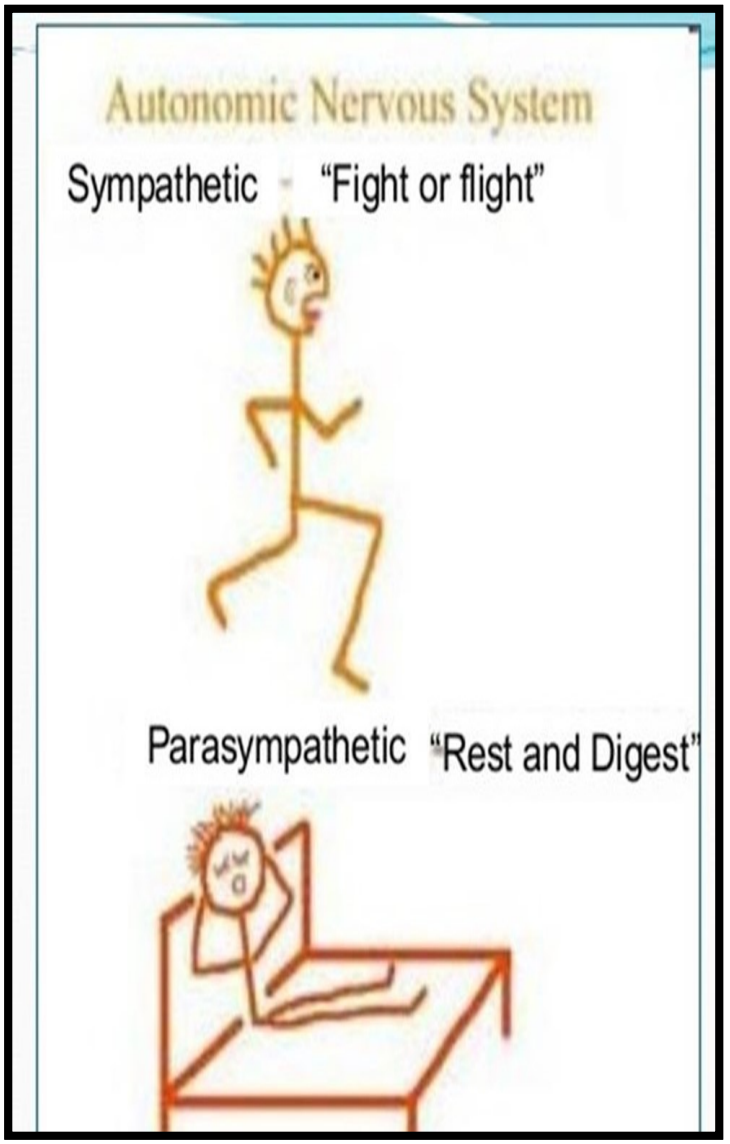
◊ Allow body to function under stress(**Fight or flight**)

PARASYMPATHETIC NERVOUS SYSTEM

◊ Maintenance functions(**Rest-and-digest**)

◊ Counterbalances sympathetic function

❖ **Almost all visceral organs are served by <u>both divisions</u>, but they cause opposite effects**



Autonomic nervous system division

Autonomic nervous system (ANS)

Sympathetic

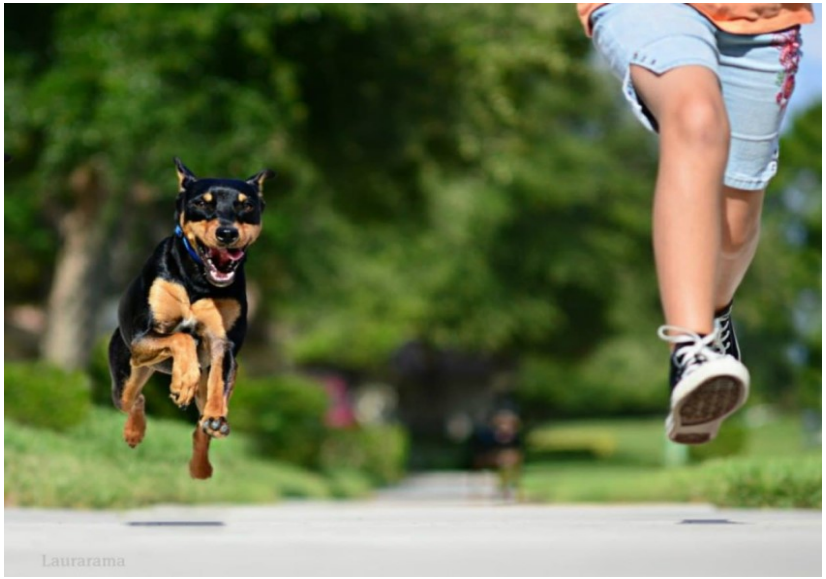
Dominated by (Adrenaline)

(Adrenergic)

Parasympathetic

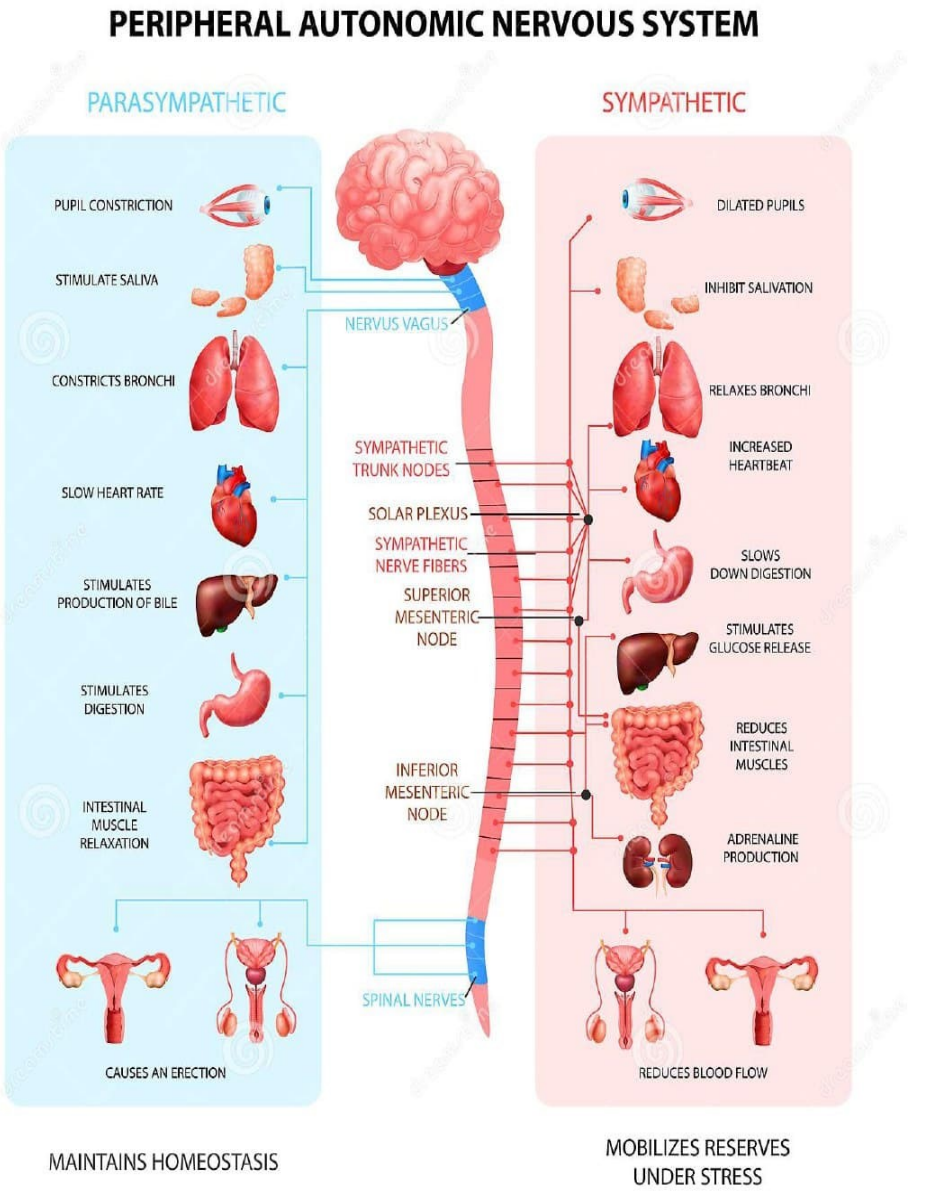
Dominated by Acetylcholine

(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**,
- Respiration increase
- 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.

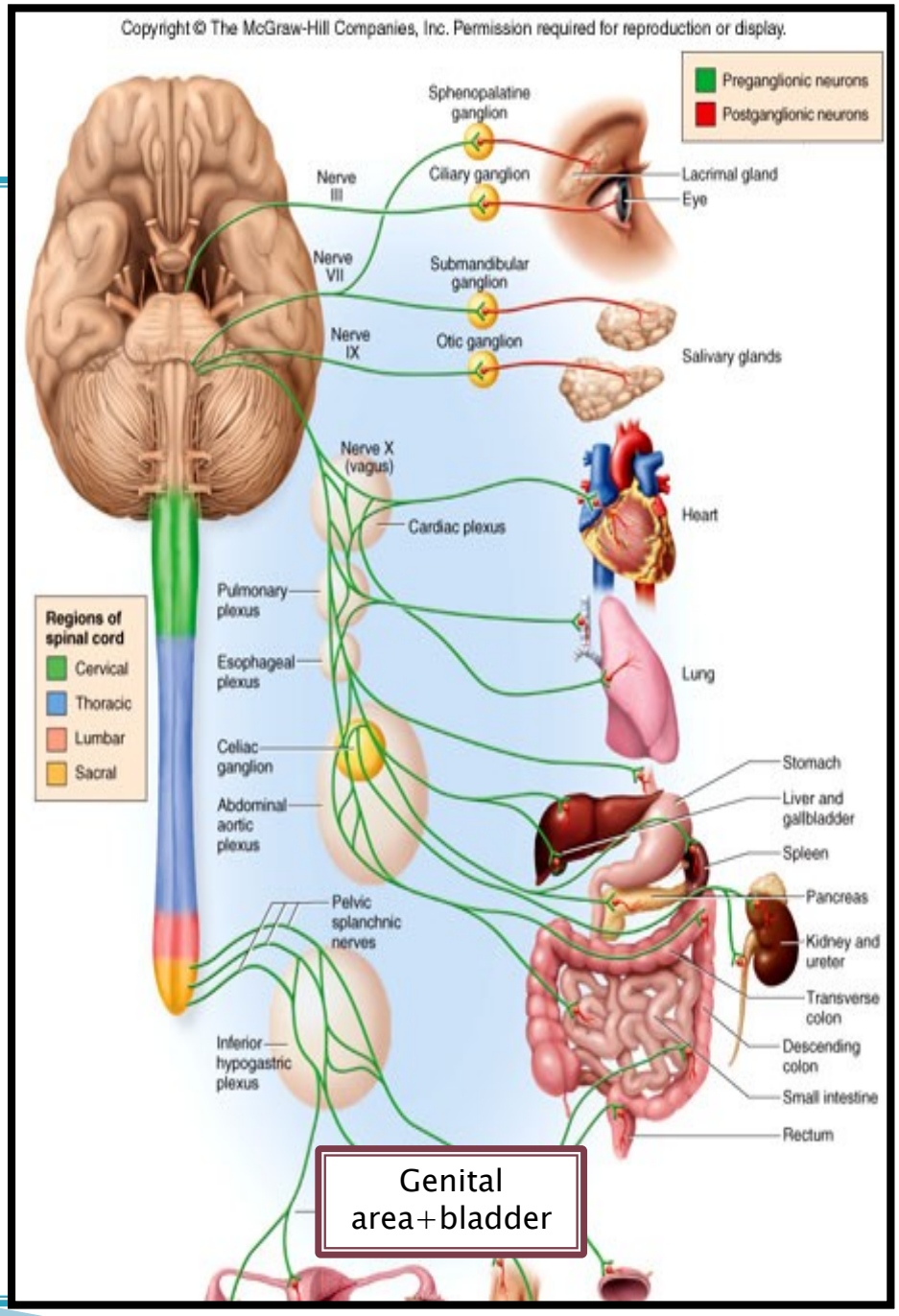
(The adrenal medulla also releases some norepinephrine.)

- 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 .

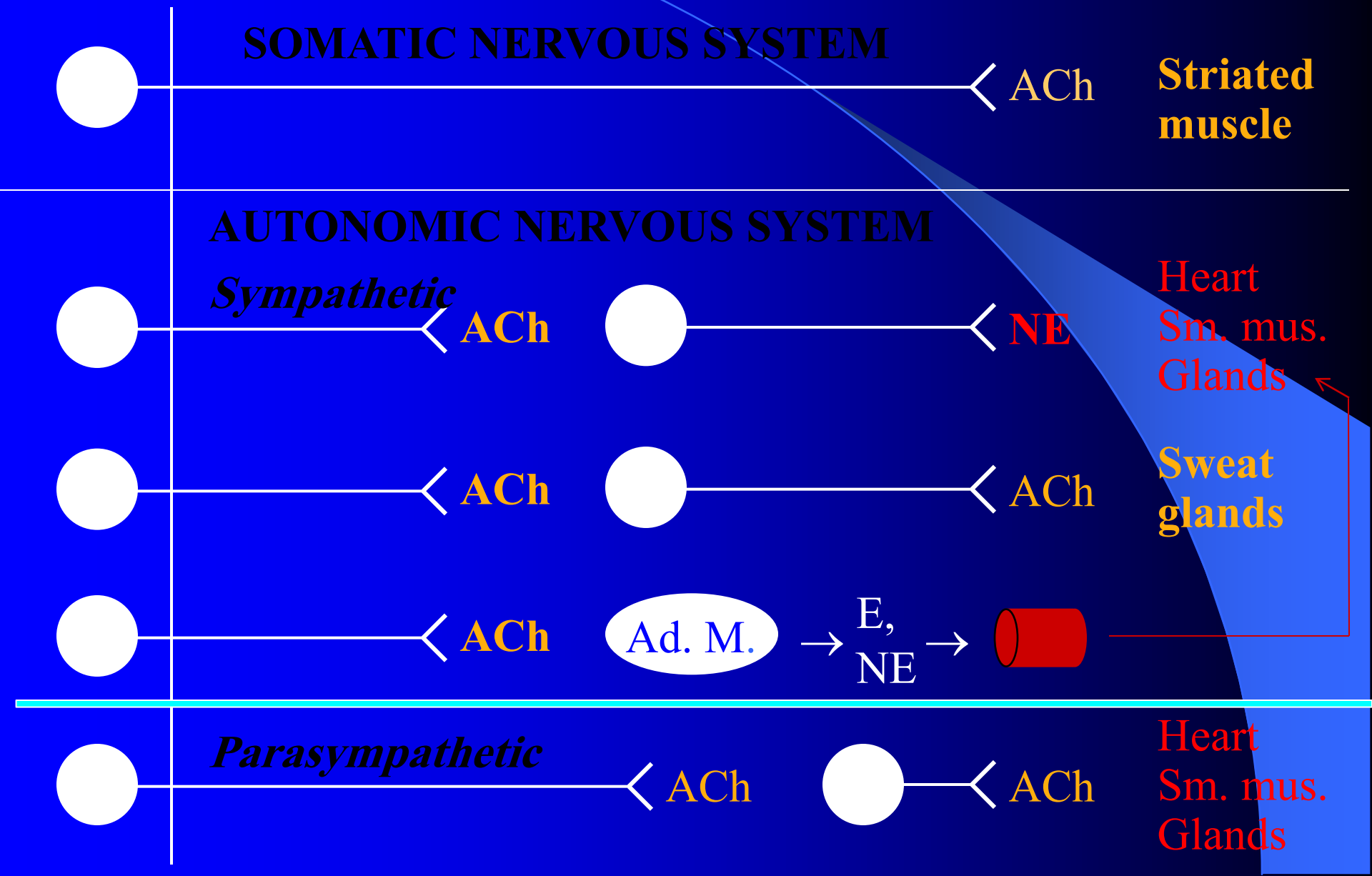
Interactions of the ANS

- 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



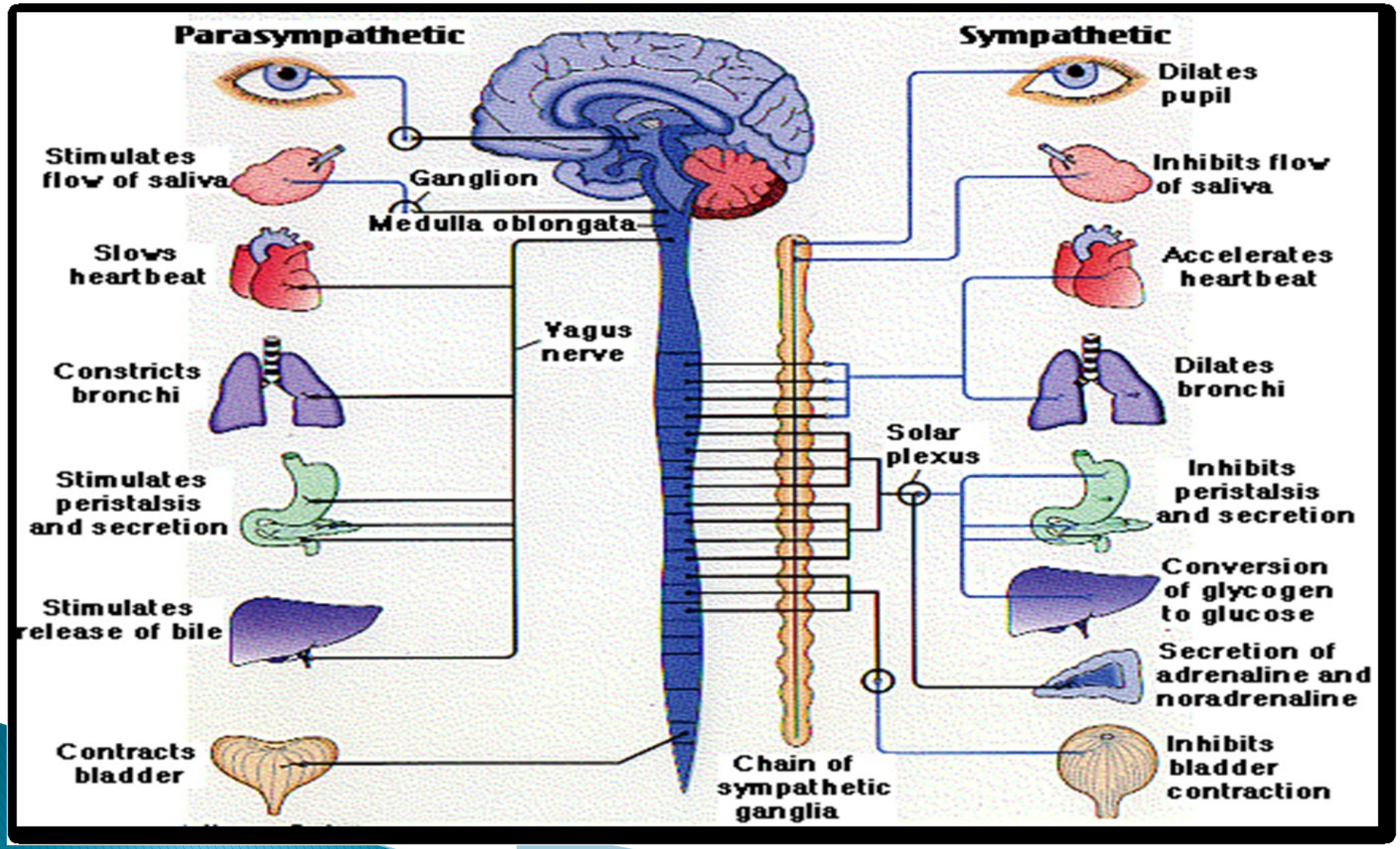
Acetylcholine + Receptors

- **Nicotinic receptors**
  - Nm (muscular-type or N_2): skeletal muscle
  - Nn (neuron-type, or N_1): autonomic ganglia,CNS
- **Muscarinic receptors**
  - Postganglionic parasympathetic and a few sympathetic sites, CNS (also autonomic gang.)
  - Receptor subtypes: $M_{1\text{-}5}$

Catecholamines

- Norepinephrine
  - Postganglionic sympathetic, CNS, adrenal medulla
  - Receptors: α_1, α_2, β_1
- Epinephrine
  - Adrenal medulla, CNS
  - Receptors: α_1, α_2, β_1 , β_2
- Dopamine
  - Autonomic ganglia, CNS
  - Receptors: $D_{(1\text{-}5)}$, α_1, β_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!