

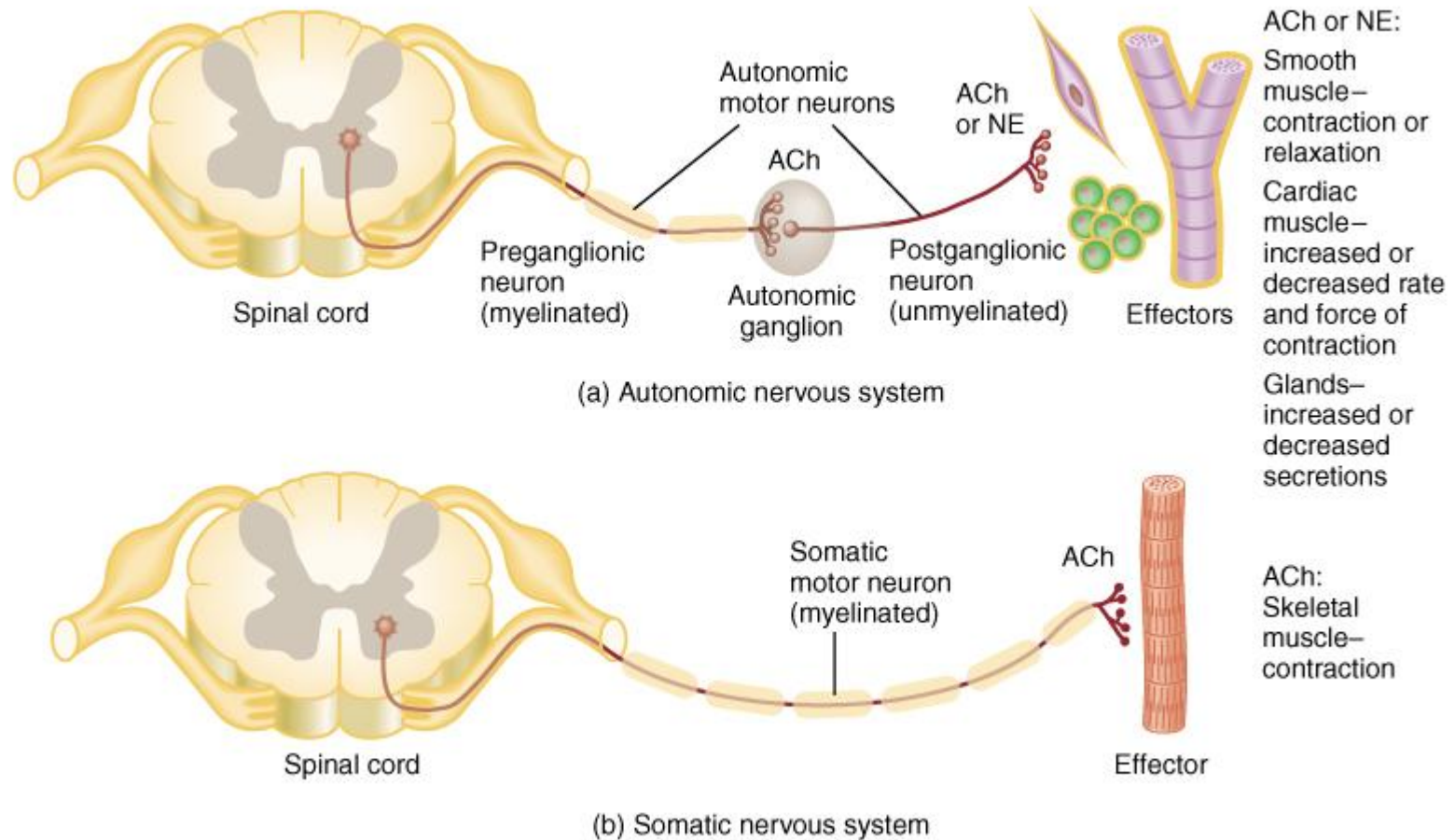
The Autonomic Nervous System

- Regulate activity of smooth muscle, cardiac muscle & certain glands
- Structures involved
 - general visceral sensory neurons
 - integration center within the brain
 - general visceral motor neurons

Autonomic versus Somatic NS

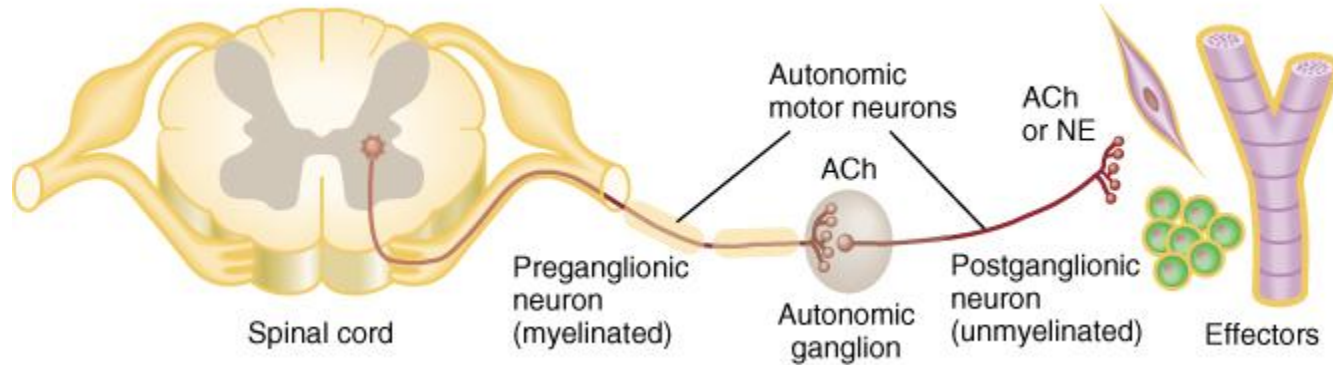
- Somatic nervous system
 - consciously perceived sensations
 - excitation of skeletal muscle
 - one motor neuron connects CNS to organ
- Autonomic nervous system
 - unconsciously perceived visceral sensations
 - involuntary inhibition or excitation of smooth muscle, cardiac muscle or glandular secretion
 - two motor neurons needed to connect CNS to organ
 - **preganglionic and postganglionic neurons**

Autonomic versus Somatic NS



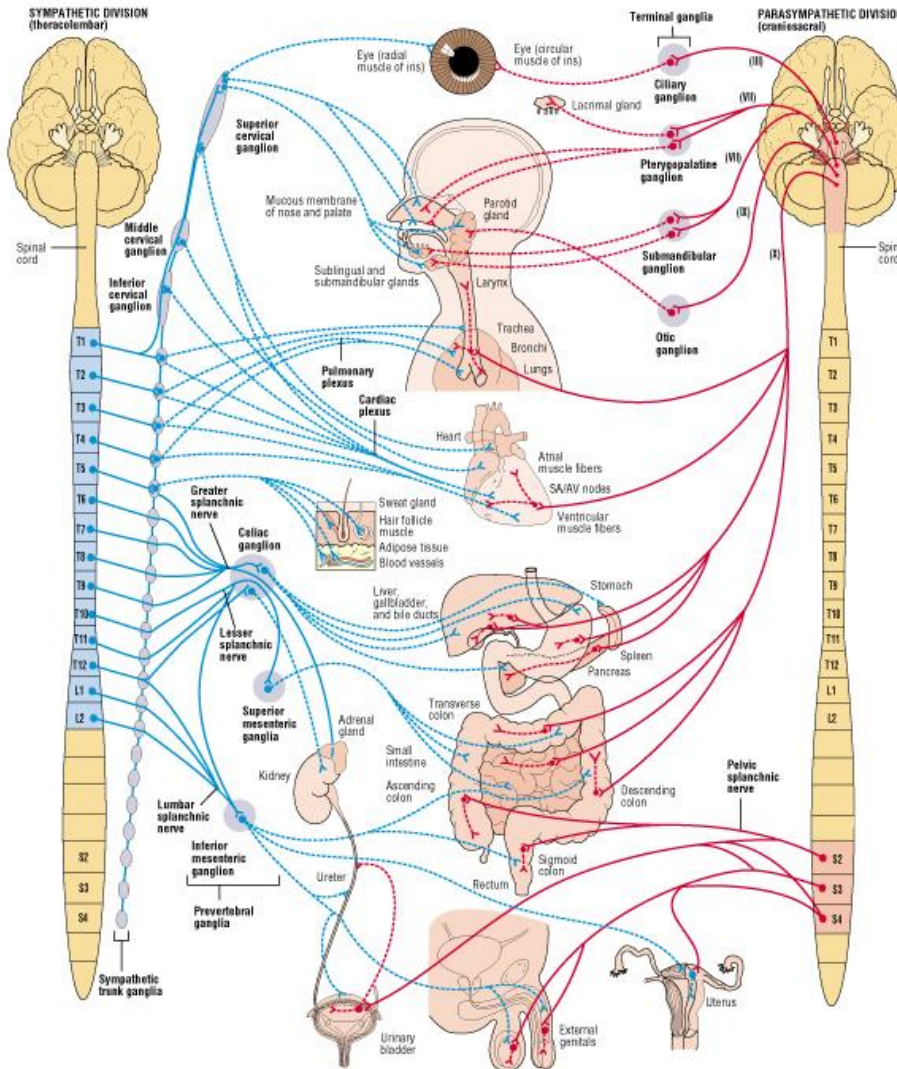
- Notice that the ANS pathway is a 2 neuron pathway while the Somatic NS only contains one neuron.

Basic Anatomy of ANS



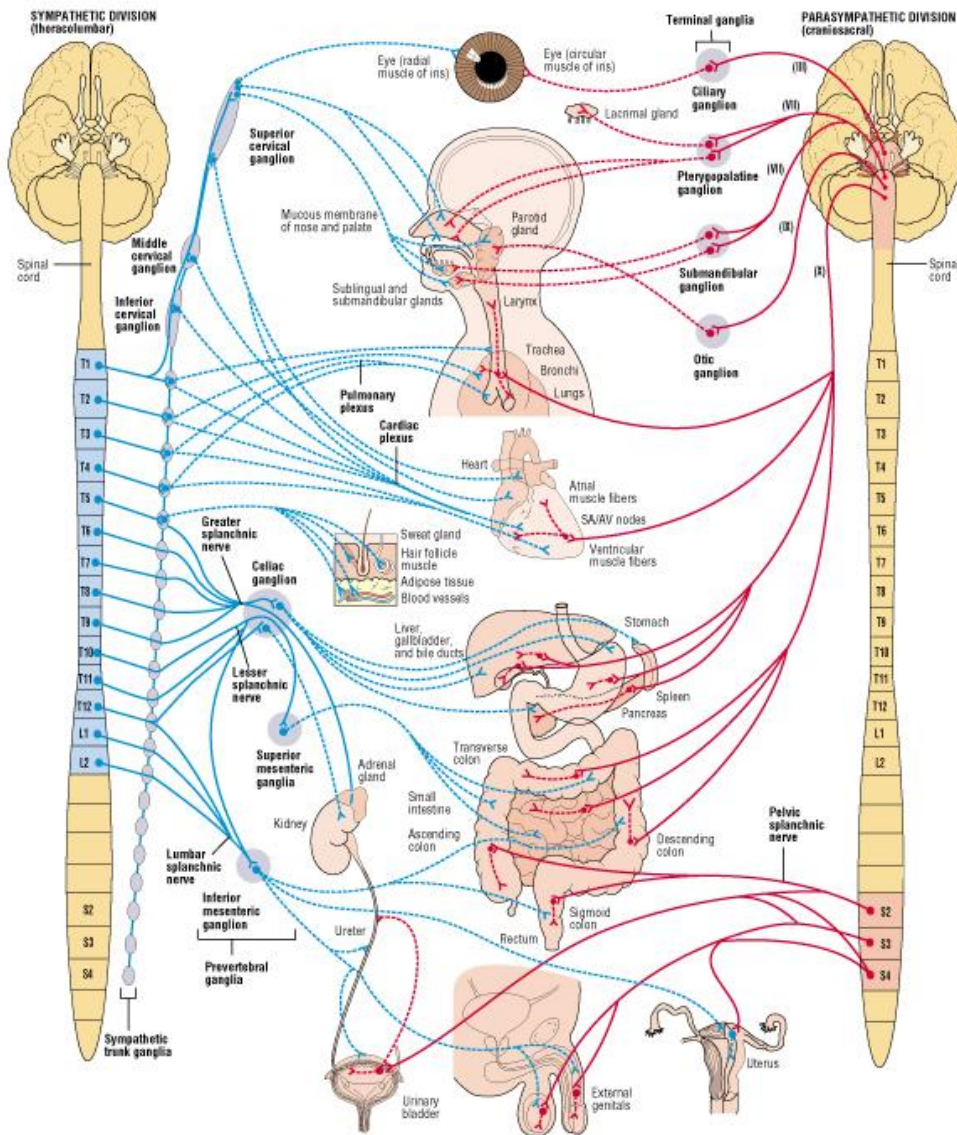
- Preganglionic motor neuron
 - cell body in brain or spinal cord
 - axon is myelinated fiber that extends to autonomic ganglion
- Postganglionic motor neuron
 - cell body lies outside the CNS in an autonomic ganglion
 - axon is unmyelinated fiber that terminates in a visceral effector

Divisions motor neurons in the ANS



- 2 major divisions
 - parasympathetic
 - sympathetic
- Dual innervation
 - one speeds up organ
 - one slows down organ
 - Sympathetic NS increases heart rate
 - Parasympathetic NS decreases heart rate

Sources of Dual Innervation



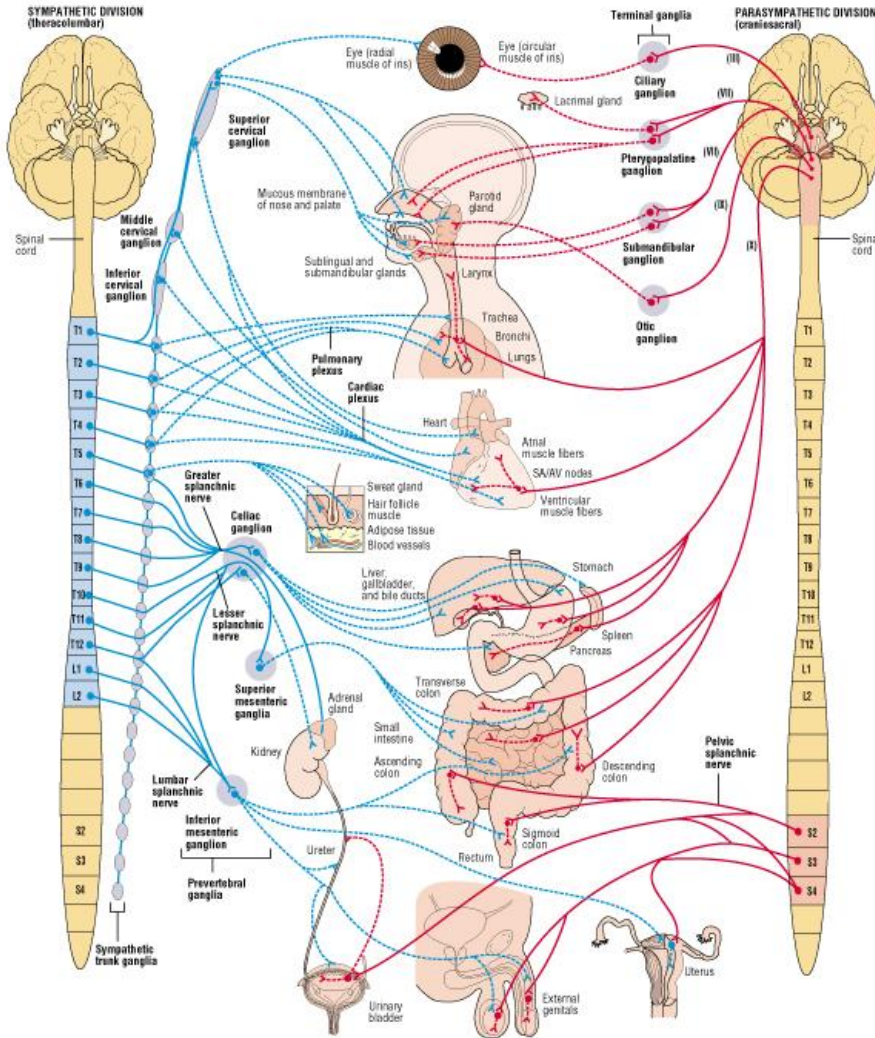
Sympathetic
(thoracolumbar) division

- preganglionic cell bodies in thoracic and first 2 lumbar segments of spinal cord

Parasympathetic
(craniosacral) division

- preganglionic cell bodies in nuclei of 4 cranial nerves and the sacral spinal cord

Locations of Autonomic Ganglia



- Ganglia contain soma of postganglionic neurons
- Sympathetic Ganglia
 - trunk (chain) ganglia near vertebral bodies
 - prevertebral ganglia near large blood vessel in gut
 - *Preganglionic sympathetic neurons are shorter than parasympathetic*
- Parasympathetic Ganglia
 - terminal ganglia in wall of organ

Circuitry of Sympathetic NS

- Divergence = each preganglionic cell synapses on many postganglionic cells
- Mass activation due to divergence
 - multiple target organs
 - fight or flight response explained
- Adrenal gland
 - modified cluster of postganglionic cell bodies that release epinephrine & norepinephrine into blood

Physiological Effects of the ANS

- Most body organs receive dual innervation
 - innervation by both sympathetic & parasympathetic
- Hypothalamus regulates balance (tone) between sympathetic and parasympathetic activity levels
- Some organs have only sympathetic innervation
 - sweat glands, adrenal medulla, arrector pili muscle & many blood vessels

Sympathetic Responses

- Dominance by the sympathetic system is caused by physical or emotional stress -- “E situations”
 - emergency, embarrassment, excitement, exercise
- Alarm reaction = flight or fight response
 - dilation of pupils
 - increase of heart rate, force of contraction & BP
 - decrease in blood flow to nonessential organs
 - increase in blood flow to skeletal & cardiac muscle
 - airways dilate & respiratory rate increases
 - blood glucose level increase
- Long lasting due to lingering of NE in synaptic gap and release of norepinephrine by the adrenal gland

Parasympathetic Responses

- Enhance “rest-and-digest” activities
- Mechanisms that help conserve and restore body energy during times of rest
- Normally dominate over sympathetic impulses
- **SLUDD** type responses = salivation, lacrimation, urination, digestion & defecation and 3 “decreases”--- decreased HR, diameter of airways and diameter of pupil
- Paradoxical fear when there is no escape route or no way to win
 - causes massive activation of parasympathetic division
 - loss of control over urination and defecation

Autonomic or Visceral Reflexes

- Autonomic reflexes occur over autonomic reflex arcs. Components of that reflex arc:
 - sensory receptor
 - sensory neuron
 - integrating center
 - pre & postganglionic motor neurons
 - visceral effectors
- Unconscious sensations and responses
 - changes in blood pressure, digestive functions etc
 - filling & emptying of bladder or defecation

Control of Autonomic NS

- Not aware of autonomic responses because control center is in lower regions of the brain
- Hypothalamus is major control center