

Autonomic Nervous System

• Functions occur at a subconscious level → involuntary

• Dual innervation: both sympathetic + parasympathetic branches innervate organs → at rest, both are active

• CNS and effector organs communicate through synapses at autonomic ganglia

Sympathetic Nervous System

- Preganglionic neurons originate in lateral horn / intermediolateral cell column (grey matter)

- Sympathetic chains: structures formed by ganglia that run parallel to spinal column

- innervation of adrenal gland:

when stimulated, the adrenal medulla releases epinephrine (adrenaline), norepinephrine and dopamine

- collateral (prevertebral) ganglia: between CNS and effector organs → not interconnected to provide routes that enable the sympathetic NS to selectively target organs + exert more discrete effects

Parasympathetic Nervous System

- preganglionic neurons originate in brainstem or sacral spinal cord

- vagus nerve (cranial nerve X): originates in medulla oblongata → innervates most of viscera

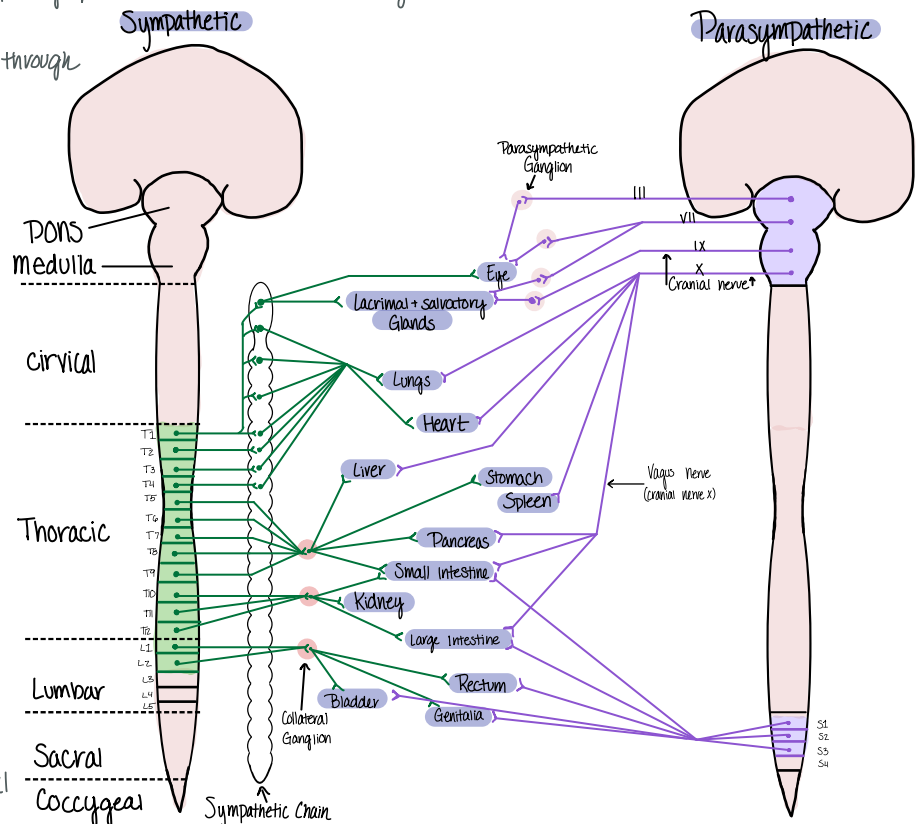
- do not join w/ the spinal nerve

Autonomic Neurotransmitters + Receptors

- cholinergic: neurons that release acetylcholine in both branches

• nicotinic receptors: located on cell bodies in both branches, chromaffin cells of adrenal medulla + skeletal muscles

- associated w/ channels that allow Na⁺ and K⁺ ions through them → cause depolarization (excitation) of postsynaptic cell



• muscarinic receptors: found on effector organs in parasympathetic NS $\rightarrow$ coupled to G proteins + second messengers; can be excitatory or inhibitory depending on target cell + transduction pathway

- Adrenergic: neurons that release norepinephrine (almost all sympathetic postganglionic neurons)

• Alpha (α) receptors: greater affinity for norepinephrine + generally excitatory (stimulate muscles to contract / glands to secrete)

• Beta (β): $\beta_1 + \beta_2 \rightarrow$ equal affinities for norepinephrine + epinephrine + excitatory; $\beta_2 \rightarrow$ greater affinity for epinephrine and produces an inhibitory response

• ~~Neuroeffector~~ junctions: synapse between efferent neuron + its effector organ

- varicosities: swellings along axons where neurotransmitters are located

- visceral reflexes: automatic changes occurring in response to changing body conditions

• major areas that regulate autonomic functions

- hypothalamus $\rightarrow$ Fight or Flight response, temp, food + water intake

- medulla oblongata + pons $\rightarrow$ cardiovascular + respiratory regulation (heart, blood vessels, breathing)

- limbic system $\rightarrow$ development of emotions (blushing, fainting, swearing)

Somatic Nervous System

• Only controls skeletal muscle through motor neurons $\rightarrow$ all voluntary

• Motor neurons originate in ventral horn of spinal cord $\rightarrow$ innervates muscle fibers

• Neuromuscular Junction: synapse where each branch of motor neuron + a skeletal muscle fiber connect

- acetylcholine (only) is released at axon terminals

- end-plate Potential: depolarization from Na^+ flowing into the muscle cell

- hormones regulate skeletal muscle metabolism; only innervation by motor neuron controls contraction $\rightarrow$ all neural communication is excitatory (for skeletal muscle to relax $\rightarrow$ decrease neural stimulation)