

AUTONOMIC NERVOUS SYSTEM

Sympathetic Nervous System: The branch of the autonomic nervous system that controls our fight or flight response. Originate between T1-L2.

1. Short preganglionic fiber synapses in the sympathetic trunk, the collateral ganglia or (in one case) directly on the adrenal medulla. Releases ACh onto the dendrites of the postganglionic neuron at the ganglion.
 - Sympathetic trunk synapses go to
 - Blood vessels, sweat glands, arrector pili of skin
 - Face: eye, salivary glands, lacrimal glands
 - Thorax: Heart, bronchioles
 - Collateral ganglia include the: celiac ganglion, superior mesenteric ganglion, and the inferior mesenteric ganglion. These axons leave the spinal cord, then travel via splanchnic nerves to their collateral ganglion in the abdomen.
2. long postganglionic fiber releases norepinephrine onto the adrenergic receptors of the target organ.
 - Heart has **Beta 1 adrenergic receptors** that respond to NE by increasing heartrate and force of each contraction.
 - bronchioles have **Beta 2 adrenergic receptors** (1 heart, 2 lungs). Many medications target these receptors for heart and respiratory problems.
 - Blood vessels of abdominal organs and skin have **alpha 1 adrenergic receptors** and constrict in response to norepinephrine; overall this increases blood pressure and decreases digestive activities
 - Digestive glands are inhibited
 - Arrector pili muscles of the skin constrict and cause goose bumps and hair stands on end.
 - The adrenal medulla is the exception to the "short" preganglionic fiber rule of the sympathetic nervous system; it travels all the way to the target organ. The cells of the adrenal medulla are actually the postganglionic neurons. They release NE and Epinephrine directly into the bloodstream. This enhances all body organs' fight or flight response and makes it last longer, too.

Parasympathetic Nervous System: The branch of the autonomic nervous system that controls our rest and digest response. Originates from the brainstem (cranial nerves) and the lateral gray matter of S2-S4.

1. Long preganglionic fiber synapses at or near the target organ.
 - Most leave via vagus – affect heart, lungs and abdominal organs
 - Some leave via oculomotor, trigeminal, facial, glossopharyngeal
 - Release ACh onto dendrites of postganglionic neuron in a ganglion found near the target organ.
2. Short postganglionic fiber releases ACh onto the target organ.
 - Oculomotor: ciliary body contracts to constrict pupil and bend lens
 - Trigeminal ophthalmic branch: lacrimal gland is stimulated to produce tears
 - Facial: lacrimal gland, salivary glands stimulated
 - Glossopharyngeal: salivary glands stimulated
 - Vagus: slows cardiac muscle, stimulates digestive glands and smooth muscle of digestive glands
 - Sacral nerves: stimulates reproductive glands and smooth muscle of reproductive and urinary organs

SUMMARY OF AUTONOMIC EFFECTS

ORGAN	PARASYMPATHETIC EFFECTS (acetylcholine released onto muscarinic cholinergic receptors)	SYMPATHETIC EFFECTS (primarily norepinephrine released onto adrenergic receptors)
Glands		
Salivary	Stimulated—cranial nerves VII, IX	Inhibited—dry mouth
Lacrimal	Stimulated—cranial nerves V, VII	Inhibited—dry eyes
Mucous	Stimulated	Inhibited
Pancreatic	Stimulated—digestive enzymes released	Inhibited
Sweat		Stimulated
Stomach Gastric	Stimulated—HCl released	
Intestinal	Stimulated	
Stress Gland: Adrenal medulla		Releases epi and norepi – enhances all aspects of fight or flight
Smooth Muscle Around Blood Vessels		
skin blood vessels		Constricted via alpha adrenergic receptors
Kidney blood vessels		Constricted via alpha adrenergic receptors, decrease urine output
skeletal muscle blood vessels		Dilated via Beta 2 adrenergic receptors
Heart blood vessels (coronary arteries)		Dilated via Beta 2 adrenergic receptors
Penis/clitoris blood vessels	Erection	
Other smooth muscle sites		
around bronchioles		Dilated via Beta 2 adrenergic receptors
around stomach and intestines	Stimulated—movement and digestion occurs	Inhibited
arrector pili	No innervations	Stimulated—goose bumps and hair stands on end
Penis/clitoris		Vaginal/penile contractions of orgasm
Cardiac Muscle	Inhibited—heart rate slows and force of heart beat lessens	Stimulated via Beta 1 adrenergic receptors—heart rate and force of contraction increases; increase BP
Adipose Tissue	Lipogenesis: Fatty acids stored as triglycerides	Lipolysis occurs, fatty acids released into bloodstream
Liver	Glycogenesis: Glucose stored in long chains called glycogen Lipogenesis	Glycogenolysis: glycogen broken down into glucose; incr. blood sugar Gluconeogenesis: fatty acids and amino acids are used to build glucose Glucose released into bloodstream Lipolysis