Autonomic Nervous system:

- Consists of **Motor Neurons** that:
  - **Innervate (**supply of nerves) smooth and cardiac muscle and glands
  - Make adjustments to ensure optimal support for body
  - Subconscious control
  - Have **viscera** as most of their **effectors**
- Different than **SNS** because
  - Has effectors (away from brain)
    - For **SNS**- skeletal muscles
    - For **ANS- cardiac muscle (Heart), smooth muscle, and glands**
  - Efferent pathways

    2 Neuron Motor Chain- so needs 2 neurons to connect to the organ
    1. **Preganglionic** neuron has a lightly myleniated axon
    2. **(Post)Ganglionic**- neuron extends to an effector organ with a soma for the response
  - Target organ responses
  - ANS→ 1 snyapse = 2 Neurons & 1 Ganglia
- **Sympathetic and Parasympathetic DIVISIONS**
  - These 2 divisions **counterbalance** each other
  - Most of the body organs have **dual ANS intervention,** which is receiving impulses from both division's neurons (usually one stimulates and the other decreases activity)
- **Interactions**
  - Both divisions' fibers **innervate most visceral organs**
  - This results in **Dynamic antagonisms** that precisely control **visceral** activity
  - **Sympathetic fibers INCREASE** heart rate and respiratory rates, and **inhibit** digestion and elimination
  - **Parasympathetic DECREASE** heart rate and respiratory rates, **allowing** digestion and elimination
- **ANS Neurotransmitter and Receptor**
  - **ACh** and **NE** are the 2 major neurotransmitters of the ANS
  - **ACh** is **released by all preganglionic** axons and all **parasympathetic postganglionic** axons
  - **Cholinergic fibers**- ACh releasing fibers!!
- **ACh Receptors**
  - All **ACh receptors** on **ALL ORGAN (EFFECTOR) cells** are stimulated by **postganglionic cholinergic** fibers
  - **ACh binding** depends on the receptor type of the target organ and can either be **inhibitory or excitatory**
    - **Thoracic**- Inhibits
    - **Abdomen**- Excites

- In **Parasympathetic~ CRANIOSACRAL**
  - Vague Nerve (aka "X") its soma extends from medulla oblongata (most pre-ganglionic parasympathetic neurons extend from here and the rest extend from sacral part of craniosacral division
- **Sympathetic- T1-L2 (THORALUMBAR)**
  - The adrenal gland (part of kidneys) is ONLY innervated by sympathetic; no post-ganglionic neuron
  - **"collateral" ganglia**- (farther away from vertebrae) **sympathetic ganglia that is unpaired and located between the chain and the organ**; sympathetic "chain" ganglia- paired, parallel to one another (these pairs can be seen on the below diagram from T1 to L2)
    - T5-L2 **splanchnic nerves** synapse with/collateral ganglia

- **SNS Neurotransmitters and Receptors**
  - **Adrenergic fibers**- sympathetic postganglionic axons that **release** NE
    - The **receptors** are of two types **(alpha or beta**)
    - **Alpha**- **NE** binds to stimulatory, 2 subclasses (blood vessels)
    - **Beta- NE** binds to inhibitory, 3 subclasses (GI tract, pancreas, adipose tissue)
  - **Neutransmitters can be excitatory or inhibitory** depending upon the receptor type
- **Sympathetic outflow**
  - From spinal cord (T1-L2)
  - **Preganglionic fibers synapse in the chain (paravertebral)** ganglia
  - Fibers from T5-L2 form **splanchnic nerves** (abdomen) and synapse with collateral ganglia
  - **Postganglionic fibers** innervate the numerous organs of the body
  - The paravertebral ganglia form part of the sympathetic trunk or chain
  - About 23 ganglia- 3 cervical, 11 thoracic, 4 lumbar, 4 sacral, and 1 coccygeal
- **Adrenal Medulla**
  - Fibers of **thoracic splanchnic nerve pass directly to the adrenal medulla**
  - A "misplaced" sympathetic ganglion
  - Part of the ANS and ENS (Endocrine)

- Upon stimulation, **medullary cells secrete Catecholamines (NE and EPI) into the blood** and can only be secreted by **Postganglionic Sympathetic**
  NE= Norpinephrine
  EPI- Epinephrine

- **Sympathetic Division's Roles and Unique Roles**
  - Fight or flight
  - Involves **E** activities- exercise, excitement, and embarrassment.. **STRESS**
  - Regulates many functions **not** subject to parasympathetic influence
    - Examples; adrenal medulla, sweat glands, **kidneys, and most blood vessels**
- **Metabolic effects of SNS**
  - Promotes metabolic effects that are **NOT REVERSED** by the parasympathetic division
    - Increase metabolic rate of body cells
    - Raise **blood glucose levels**
    - Mobilize **Fat** as an energy source
- **PNS Roles**
  - **D** activities- digestion, defection, and diureses (relaxing after a meal)
  - **Lowers** blood pressure, heart rate, and respiratory rate
  - **GI tract** activity is high
  - Warm skin, pupils contstricy (**NAP TIME)**
- **ANS Physiology**- PNS Responses
  SUDD- (Salivation, Urination, Digestion, Defecation) all **INCREASED**

The balance of the ANS sympathetic and Parasympathetic tone is regulated by feedback loops between the spinal and the brainstem, with input from the limbic system and oversight by hypothalamus.
An important thing to remember about Parasympathetic neurons is that the Vagus nerve innervates the atrium of the heart and the gastrointestinal system

Endocrine System- response occur slowly but last longer than those of the nervous system (works with the nervous system to regulate body activity)

- **Hypothalamus Role- belongs to the nervous system** but secrets hormones that **control the endocrine system**.
- **Adrena Medulla**- Part of the nervous and the endocrine system that is housed by the **adrenal cortex** which secretes many types of hormones
- **Pancreas** has endocrine and exocrine cells, **endocrine cells** secrete glucagon and insulin (talked more about later).

- **Hormones**- chemical substances secreted by cells into the blood