

The parasympathetic division of the ANS also is a two-neuron system with its preganglionic neuron in the CNS and postganglionic neuron in a peripheral ganglion. The parasympathetic division also is known as the **craniosacral division** because:

- Its preganglionic neurons are found in cranial nerves III, VII, IX, and X, and in the sacral spinal cord at levels S2-S4
- Its preganglionic neurons reside in the four cranial nuclei associated with the four cranial nerves listed previously, or in the lateral gray matter of the sacral spinal cord at levels S2-S4

Preganglionic parasympathetic axons may do one of two things:

- Exit the brainstem in the cranial nerve (except CN X, see below) and pass to a peripheral ganglion in the head (ciliary, pterygopalatine, submandibular, and otic ganglia) to synapse on the parasympathetic postganglionic neurons residing in these ganglia
- Exit the sacral spinal cord via an anterior root and then enter the **pelvic splanchnic nerves** to synapse on postganglionic neurons in **terminal ganglia** located in or near the viscera to be innervated

Axons of the postganglionic parasympathetic neurons may do one of two things:

- Pass from the **parasympathetic ganglion in the head** on existing nerves or blood vessels to innervate smooth muscle and glands of the head
- Pass from **terminal ganglia** in or near the viscera innervated and synapse on smooth muscle, cardiac muscle, or glands in the neck, thorax, and abdominopelvic cavity

CN X (vagus nerve) is unique. Its preganglionic axons exit the brainstem and synapse on terminal ganglia in or near the targets in the neck, thorax (heart, lungs, glands, smooth muscle), and abdominal cavity (proximal two thirds of the gastrointestinal tract and its accessory organs). Axons of the terminal ganglia neurons then synapse on their targets.

COLOR the preganglionic parasympathetic neurons and their axons (solid lines) arising from a cranial nerve or S2-S4 red, and color the postganglionic neuron and axon (dashed lines) in the peripheral or terminal ganglion green.

The sympathetic axons pass into the limbs, but the parasympathetic axons do not. Therefore the vascular smooth muscle, arrector pili muscles of the skin (attached to hair follicles), and sweat glands are all innervated only by the sympathetic system. ACh is the neurotransmitter at all parasympathetic synapses.

The parasympathetic system is concerned with feeding and sexual arousal and acts more slowly and focally than the sympathetic system. For example, CN X can slow the heart rate without affecting input to the stomach. In general, the sympathetic and parasympathetic systems maintain **homeostasis**, although as a protective measure, the body does maintain a low level of "sympathetic tone" and can activate this division on a moment's notice. ANS function is regulated ultimately by the **hypothalamus**. The specific functions of the parasympathetic division of the ANS are summarized in the table below.

| STRUCTURE | EFFECTS |
|-------------------|--|
| Eyes | Constricts pupil |
| Ciliary body | Constricts muscle for accommodation (near vision) |
| Lacrimal glands | Increases secretion |
| Heart | Decreases heart rate and force of contraction |
| Coronary arteries | Causes vasoconstriction with reduced metabolic demand |
| Lungs | Causes bronchoconstriction and increased secretion |
| Digestive tract | Increases peristalsis, increases secretion, inhibits internal anal sphincter for defecation |
| Liver | Aids glycogen synthesis and storage |
| Salivary glands | Increases secretion |
| Genital system | Promotes engorgement of erectile tissues |
| Urinary system | Contracts bladder (detrusor muscle) for urination, inhibits contraction of internal urethral sphincter, increases urine production |

