1.5.1

Organization of the Nervous System

Start by Watching this Video on the Autonomic Nervous System.

The human body is composed of one nervous system that can be subdivided into a **central nervous system** (CNS) and a **peripheral nervous system** (PNS) (see figure below). The brain and spinal cord make up the CNS, while the PNS is made up of any nervous tissue outside the brain and spinal cord, including 12 pairs of cranial nerves, 31 pairs of spinal nerves, and peripheral sensory receptors. The PNS can be further subdivided into the autonomic nervous system (ANS) and the somatic nervous system depending on which type of muscle it innervates and whether or not it is voluntarily controlled.

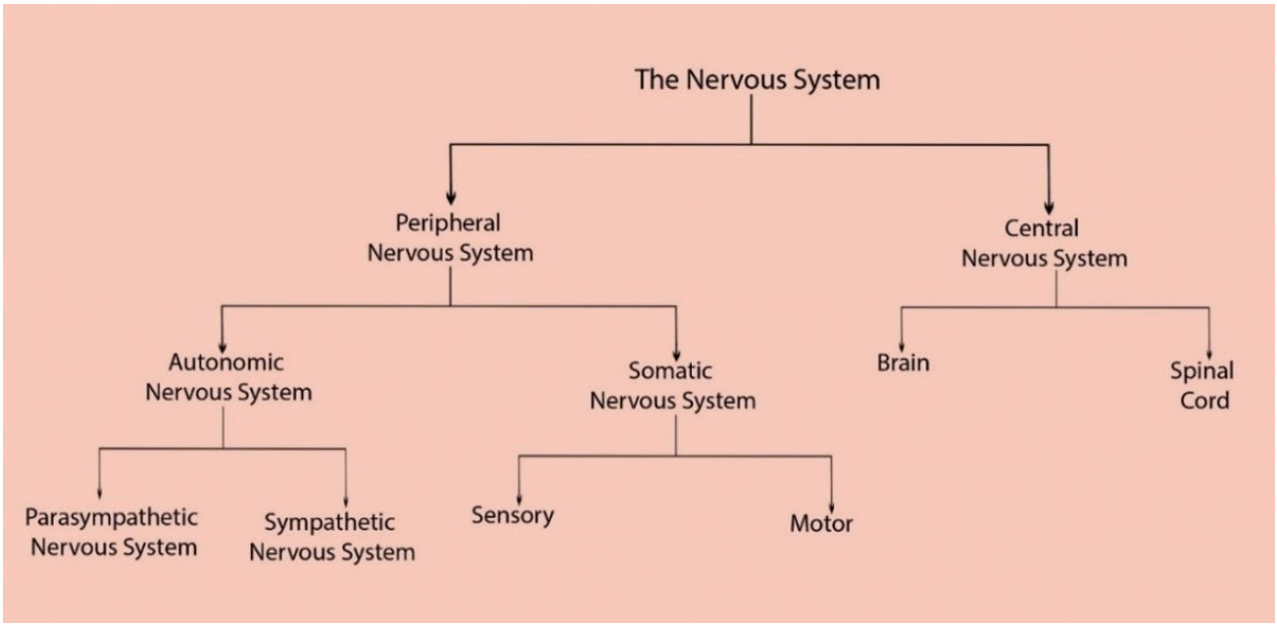

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Image by BYU-I student, 2013

The ANS can be subdivided into **sympathetic** and **parasympathetic nervous systems**. The ANS neurons innervate smooth muscle, cardiac muscle and glands. The ANS efferent neurons do not innervate skeletal muscle. It is the sympathetic branch of the ANS that is responsible for the "fright, flight, or fight" response. Consider what might happen if you were to run into a female bear with cubs while hiking. You can imagine that your heart rate would increase, you might start to hyperventilate, and you definitely would not be looking at the bear and thinking about lunch! A sympathetic response can also occur during illness or physical trauma, from anxiety, or pretty much any stressful situation. Such a response is characterized by increased heart rate and blood pressure, goosebumps, pupil (pupil dilation=**mydriasis**), bronchiole dilation, and increased blood flow to cardiac and skeletal muscles.

The parasympathetic division, on the other hand, is responsible for energy conserving **("rest and digest")** activities, including decreased heart rate, blood pressure, and respiration; constriction of the pupil (**miosis**); increased secretions

and peristalsis of the digestive tract; and increased urination. The acronym **SLUD (S**alivation, **L**acrimation, **U**rination, and **D**efecation) may be useful to remember some of the responses caused by the parasympathetic division in certain organs. Other than some sweat and salivary glands, most secretions of the body increase when the parasympathetic nervous system is activated.

The ANS innervates visceral organs - organs which are unconsciously controlled by the brain. Visceral organs contain either smooth or cardiac muscle; respective examples include the intestines and the heart. Interestingly, if a visceral organ is removed from the body and placed in an oxygenated Ringer's solution, it will continue to undergo peristalsis (wave-like smooth muscle contractions of the gastrointestinal tract) or beat without even being connected to the ANS. This is called auto rhythmicity. Why then, do you ask, is the ANS even necessary for these organs to function? The answer is, it is not. But, the ANS is necessary to regulate the activity of these organs, essentially causing them to speed up or slowdown in order to maintain homeostatic conditions in the body.

Usually, each visceral organ is innervated by nerves from both sympathetic and parasympathetic divisions, and effects of these divisions are most often in opposition to one another. This type of "wiring" is called **dual autonomic innervation**. The heart is a good example of this. It is innervated by fibers from both parasympathetic and sympathetic divisions that oppose one another. Increasing parasympathetic stimulation to the heart will decrease heart rate while increasing sympathetic activity will increase heart rate and force of contraction.