



## NERVOUS SYSTEM AND ITS MAIN FUNCTIONS

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### ABSTRACT

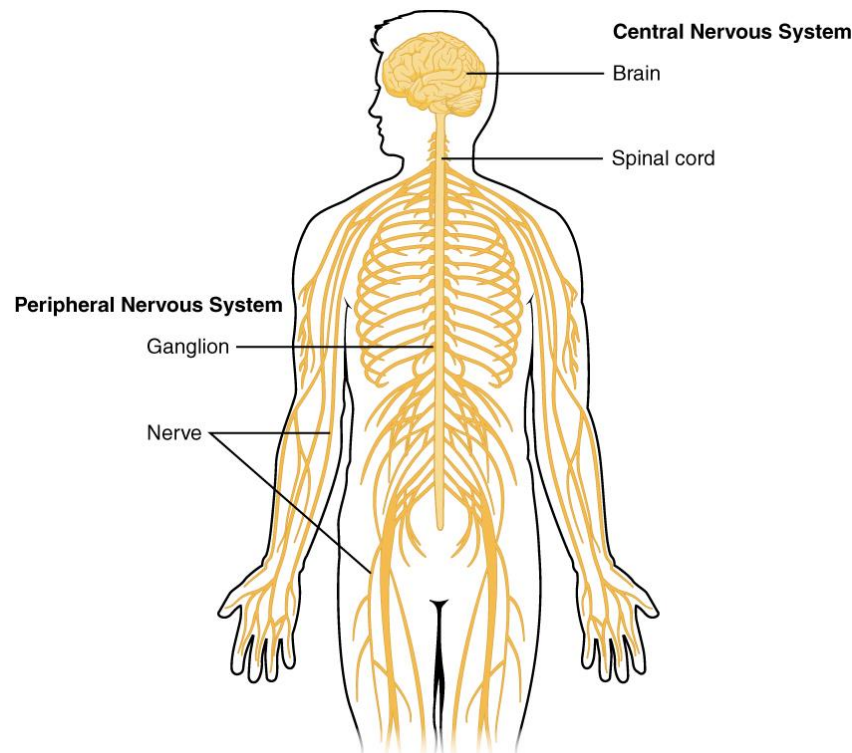
*This article provides a comprehensive exploration of the nervous system, the body's intricate communication network. From its anatomical components to its main functions, the article navigates through the central and peripheral nervous systems, emphasizing their roles in sensory perception, motor control, and cognitive processes. Key neuroscientific concepts, disorders, and contemporary research are also discussed, making it a valuable resource for medical professionals, researchers, and anyone seeking a deeper understanding of the nervous system.*

**Introduction:** The nervous system, a marvel of biological engineering, serves as the orchestrator of human functionality, seamlessly coordinating a myriad of processes to ensure optimal functioning. This article embarks on a journey through the anatomical and functional intricacies of the nervous system, shedding light on its main components and essential roles in human physiology.

The picture you have in your mind of the nervous system probably includes the brain, the nervous tissue contained within the cranium, and the spinal cord, the extension of nervous tissue within the vertebral column. That suggests it is made of two organs—and you may not even think of the spinal cord as an organ—but the nervous system is a very complex structure. Within the brain, many different and separate regions are responsible for many different and separate functions. It is as if the nervous system is composed of many organs that all look similar and can only be differentiated using tools such as the microscope or electrophysiology. In comparison, it is easy to see that the stomach is different than the esophagus or the liver, so you can imagine the digestive system as a collection of specific organs.

### The Central and Peripheral Nervous Systems.

The nervous system can be divided into two major regions: the central and peripheral nervous systems. The central nervous system (CNS) is the brain and spinal cord, and the peripheral nervous system (PNS) is everything else. The brain is contained within the cranial cavity of the skull, and the spinal cord is contained within the vertebral cavity of the vertebral column. It is a bit of an oversimplification to say that the CNS is what is inside these two cavities and the peripheral nervous system is outside of them, but that is one way to start to think about it. In actuality, there are some elements of the peripheral nervous system that are within the cranial or vertebral cavities. The peripheral nervous system is so named because it is on the periphery—meaning beyond the brain and spinal cord. Depending on different aspects of the nervous system, the dividing line between central and peripheral is not necessarily universal.

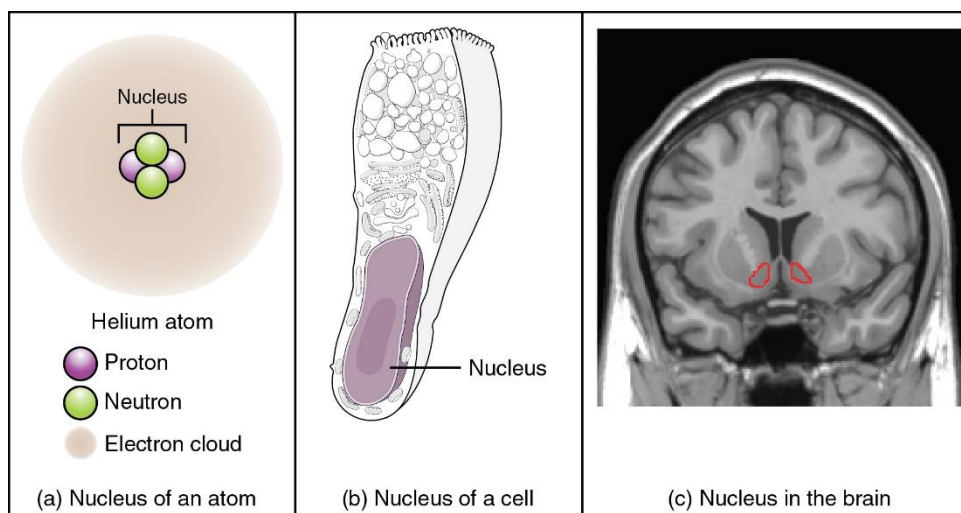


Neurons and glial cells are the two main cell types found in nervous tissue, which is found in both the central nervous system and peripheral nervous system. Glial cells are among the many different types of cells that form the supporting tissue framework for neurons and their activity. When it comes to the capacity of the brain to communicate, the neuron has a greater functional significance than the other. In order to explain the various roles of the nervous system, it is necessary to comprehend how a neuron is put together. Since neurons are cells, they have both a soma, or cell body, and extensions of the cell, which are collectively referred to as processes. An axon, or the fiber that links a neuron to its target, is one crucial process that all neurons have. The dendrite is a different kind of process that emerges from the soma. For the most part, dendrites receive input from other neurons. There are areas of nervous tissue that are mostly made up of axons, and there are other regions that are primarily composed of cell bodies. These two areas within the structures of the nervous system are frequently referred to as either white matter (the areas with many axons) or gray matter (the areas with many cell bodies and dendrites). Not every piece of gray matter is the

same as gray. Because of the blood, it may be pink or even slightly tan, depending on how long the tissue has been kept in preservation. Nevertheless, the reason white matter is white is due to the lipid-rich material known as myelin that surrounds axons. Lipids can be seen as white, or "fatty," material, similar to the fat found in uncooked chicken or beef. In fact, gray matter might have been given that hue because, in comparison to white matter, it is simply darker—hence, gray.

The central nervous system, which contains sizable areas that are visible to the unaided eye, is where the distinction between gray matter and white matter is most frequently used. A microscope is often utilized to examine peripheral structures, and artificial color is applied to the tissue to aid in visualization. That is not to say that central nervous tissue cannot be stained and viewed under a microscope, but unstained tissue is most likely from the CNS—for example, a frontal section of the brain or cross section of the spinal cord.

Neurons and axons can have their cell bodies located in distinct anatomical structures that require names, whether the tissue is stained or not. The numbers correspond to the centrality or peripherality of the structure. A nucleus is a localized grouping of neuron cell bodies found in the central nervous system. A grouping of neuronal cell bodies in the PNS is called a ganglion. It is the location of the protons and neutrons in an atom, the DNA in a cell, and the center of specific functions in the central nervous system. There's also a perhaps ambiguous use of the term "ganglion" (plural: "ganglia") with a background. A collection of interconnected nuclei in the central nervous system was formerly referred to as the basal ganglia before the term "ganglion" became used to refer to a peripheral structure. To prevent confusion, some sources refer to this collection of nuclei as the "basal nuclei."



The nomenclature used to describe axon bundles varies geographically as well. In the CNS, a collection of axons, or fibers, is referred to as a tract; in the PNS, the same structure would be referred to as a nerve. One important distinction to note between these terms is that they both apply to the same bundle of axons. The term nerve refers to those axons when they are throughout the PNS, and tract refers to them when they are in the CNS. The axons that extend into the brain from the retina are the most visible illustration of this. When those axons exit the eye, they are known as the optic nerve; however, once they enter the cranium, they are known as the optic tract. The axons stays the same except for a specific location known as the optic chiasm where the name changes. Certain roads can be considered to be in



a comparable situation regardless of the boundaries of science. Consider a street named "Broad Street" in the community of "Anyville." The road leaves Anyville and travels to "Hometown," the town across the way. The road becomes "Main Street" as it enters Hometown and crosses the separation between the two towns. That is the rationale behind the retinal axons' names. They are referred to as the optic tract in the CNS and the optic nerve in the PNS.

## Functional Divisions of the Nervous System.

Despite functional and anatomical divisions of the nervous system are distinct from one another, the nervous system can also be divided according to its functions. The same functions are shared by the CNS and PNS; however, they can be ascribed to distinct brain regions (e.g., the cerebral cortex or the hypothalamus) or distinct peripheral ganglia. Trying to fit functional differences into anatomical divisions is problematic because a single structure can occasionally be involved in multiple functions. For instance, the optic nerve transmits signals from the retina to the cerebral cortex, and it processes them for conscious perception of visual stimuli, or to the hypothalamus, which interprets them for reflexive responses of smooth muscle tissue.

The functional breakdown of the nervous system can be viewed in two ways. First, sensation, integration, and response are the nervous system's three primary functions. Second, there are two types of control over the body: somatic and autonomic, which are primarily determined by the structures involved in the response. An additional portion of the peripheral nervous system known as the enteric nervous system is in charge of a particular group of autonomic functions connected to gastrointestinal techniques.

**Basic Functions.** The nervous system is involved in producing motor responses in response to information it receives about our surroundings (sensation). The parts of the nervous system in charge of sensation (sensory functions) and response (motor functions) can be separated. However, a third function must be incorporated. Integration of sensory data with other feelings, memories, emotional state, or learning (cognition) is necessary. Integration or association areas are names given to certain areas of the nervous system. To generate a response, the integration process combines higher-level mental operations like memory, learning, and emotion with sensory perceptions.

**Sensation.** Sensation is the nervous system's primary job, which involves taking in environmental data to make sense of what is going on outside the body (or, occasionally, inside the body). The nervous system's sensory functions detect the existence of a disturbance from stability or a specific environmental event, referred to as a stimulus. Taste, smell, touch, sight, and hearing are the "big five" senses that come to mind most often. The stimuli for sight, touch, and hearing are as follows: light, taste, and smell are all mediated by chemical substances (molecules, compounds, ions, etc.); hearing is the perception of sound, a physical stimulus that mimics some aspects of touch. There are actually more senses than just those, but that list represents the major senses. Those five are all senses that receive stimuli from the outside world, and of which there is conscious perception. Additional sensory stimuli might be from the internal environment (inside the body), such as the stretch of an organ wall or the concentration of certain ions in the blood.



**Response.** Based on what the nervous system's sensory structures perceive, the nervous system responds. Muscle movements, like removing a hand from a hot stove, would be an obvious reaction, but the expression has other applications. All three types of muscle tissue can contract due to the nervous system. For instance, the movement of the skeleton is facilitated by the contraction of skeletal muscle, the movement of food along the digestive tract is facilitated by the contraction of cardiac muscle during exercise. In addition, responses involve the neural regulation of internal glands, such as the eccrine and merocrine sweat glands in the skin, which produce and secrete sweat in order to regulate body temperature.

There are a couple of kinds of responses: involuntary (such as smooth muscle contraction, cardiac muscle regulation, and gland activation) and voluntary or conscious (such as skeletal muscle contraction). The somatic nervous system controls voluntary responses, while the autonomic nervous system controls involuntary responses. These topics are covered in the section that next.

**Integration.** The nervous system receives stimuli that are detected by sensory structures and processes them there. We refer to this as integration. A person's state at a specific moment, memories of prior stimuli, and other stimuli are all compared to or integrated with the something. This results in the particular reaction that is produced. A batter does not always swing when they see a baseball pitched to them. It will be essential to take the ball's speed and trajectory into account. Perhaps the hitter wants to let this pitch pass by in the hopes of receiving a walk to first base because the count is three balls and one strike. Perhaps it would be entertaining if the batter's team had a vital lead.

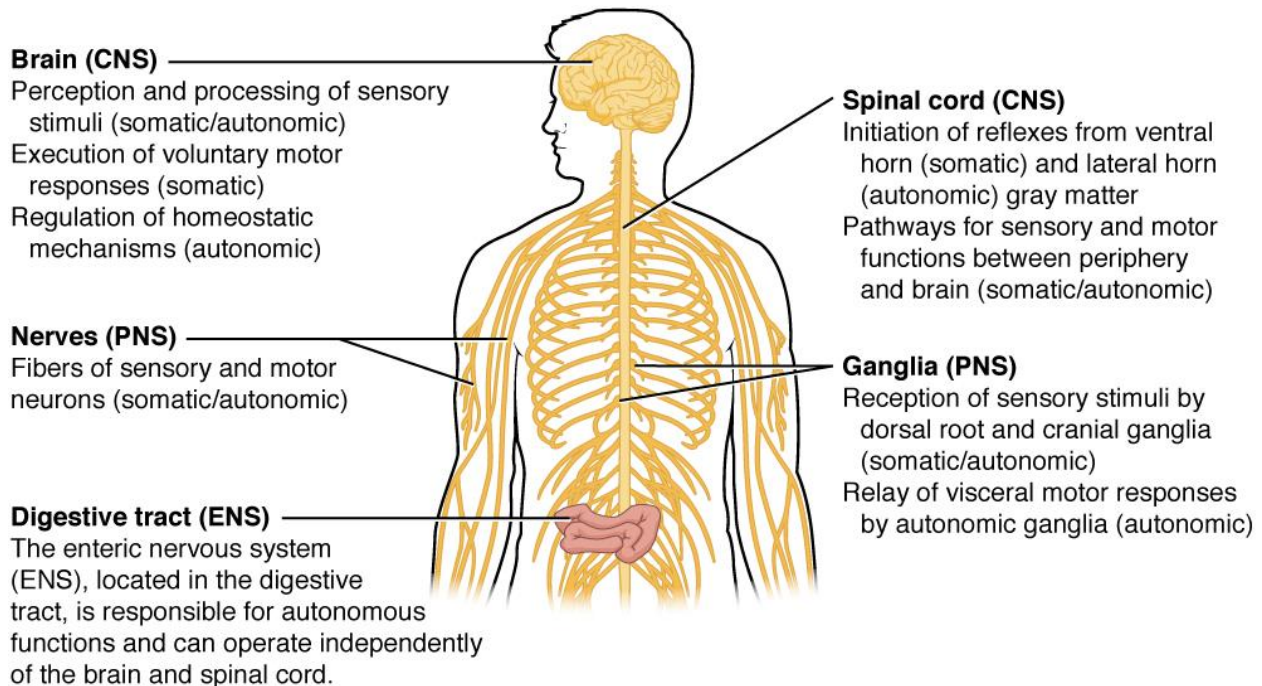
**Controlling the Body.** Most of the time, functional differences in responses allow for the division of the nervous system into two sections. Both voluntary motor responses and conscious perception are governed by the somatic nervous system (SNS). Skeletal muscle contractions are referred to as voluntary motor responses, but they are not always voluntary in the sense that you have to want to perform them. Certain somatic motor responses are reflexive, meaning they frequently occur without the conscious choice to do so. Your friend will startle you and you might scream or jump back until they jump out from behind a corner and yell "Boo!". You didn't decide to do that, and you may not have wanted to give your friend a reason to laugh at your expense, but it is a reflex involving skeletal muscle contractions. Other motor responses become automatic (in other words, unconscious) as a person learns motor skills (referred to as "habit learning" or "procedural memory").

Involuntary bodily control is the responsibility of the autonomic nervous system (ANS), which is typically employed to maintain homeostasis (the internal environment's regulation). Autonomic processes receive their sensory input from sensory structures that are attuned to either internal or external environmental stimuli. The motor output reaches glandular tissue, cardiac muscle, and smooth muscle. The autonomic nervous system's function is to maintain homeostasis by regulating the body's organ systems. The autonomic nervous system regulates the function of sweat glands, for instance. Sweating aids in body cooling when you're hot. It's a homeostatic system. But you may also begin to perspire if you're feeling anxious. That is the body's reaction to an emotional state; it is not homeostatic.

The nervous system has another division that deals with functional responses. Your digestive system's glandular tissue and smooth muscle are under the direction of the enteric



nervous system (ENS). It is independent of the CNS and makes up a sizable portion of the PNS. However, because the neural structures that comprise the enteric system are a part of the autonomic output that manages digestion, it is occasionally appropriate to think of the enteric system as a component of the autonomic system. While there are some differences between the two, there will also be a significant amount of overlap for our purposes.



## Central Nervous System (CNS): The Brain and Spinal Cord Command Center

At the core of the nervous system lies the central nervous system (CNS), comprising the brain and spinal cord. This section explores the CNS's pivotal role in processing and integrating information, governing everything from basic reflexes to complex cognitive functions.

## Peripheral Nervous System (PNS): Connecting the Body to the CNS

The peripheral nervous system (PNS) extends beyond the confines of the CNS, connecting nerves to muscles and organs throughout the body. Delving into the PNS elucidates how it facilitates sensory perception, motor control, and the relay of information between the body and the CNS.

## Neurons and Synapses: The Cellular Messengers of Communication

Neurons, the fundamental units of the nervous system, serve as cellular messengers transmitting electrical signals. This segment explores their structure, function, and the synapses where communication between neurons occurs, facilitated by neurotransmitters.

## Sensory Perception and Motor Control: Navigating the External and Internal Worlds

The nervous system's ability to perceive and respond to sensory stimuli is fundamental to human experience. This section delves into sensory perception, highlighting how the nervous system interprets information from the external environment. Simultaneously, motor control is explored, showcasing the intricate coordination of muscles in response to neural signals.

**Cognitive Processes: Unraveling the Mind's Workings.** Beyond basic functions, the nervous system plays a paramount role in cognitive processes such as thinking, memory, and



problem-solving. This portion delves into the neural mechanisms underpinning these higher mental functions, showcasing the complexity of the human mind.

Neuroscience and Contemporary Research: Unveiling the Mysteries. The article concludes by exploring the interdisciplinary field of neuroscience and its role in unraveling the mysteries of the nervous system. From neuroplasticity to neurodegenerative disorders, it addresses current research trends and cutting-edge technologies like functional magnetic resonance imaging (fMRI).

This comprehensive exploration offers a nuanced understanding of the nervous system, making it an invaluable resource for medical practitioners, researchers, and individuals intrigued by the intricacies of human physiology.

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