

Anatomy and Physiology

8. The Nervous System



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The Nervous System

Tour of the System

The nervous system is an incredibly complex system and along with the endocrine system, it has responsibility for maintaining homeostasis in the body. By doing this, it also controls other body systems in their functions.

The nervous system contains two main parts, the central nervous system and the peripheral nervous system:

The central nervous system (CNS) is the brain and spinal cord. This analyzes incoming sensory information, generates thoughts and emotions and creates and stores memories.

The peripheral nervous system (PNS) contains cranial nerves that come from the brain and spinal nerves that come from the spinal cord, or any other part of the nervous system that does not lie within the CNS. This can further be divided into two systems:

The sensory, or afferent (which means towards) component of the PNS takes information from nerve cells throughout the body to the CNS.

The motor, or efferent (which means away from) component of the PNS takes information from the CNS to nerve cells. There are two components to this, the somatic nervous system and the autonomic nervous system (ANS):

The somatic nervous system is voluntary. This controls information to muscles that are

under voluntary control. This system is in use when we pick up a pen to start writing.

The autonomic nervous system is more complicated as it is an involuntary system. This controls information to muscles that are not under voluntary control, such as the cardiac muscle and endocrine glands. This system is controlling our heart rate, or releasing epinephrine in the body.

The key cells involved in the nervous system are nerve cells, or neurons.

Information in the nervous system is created and communicated as electrical signals, created by chemical changes in neurons. These signals are nerve impulses.

This useful diagram summarizes the nervous system. The blue arrows represent information going into the nervous system (input) and the red arrows represent information going out (output) of the nervous system.

Functions

There are three main functions:

- The nervous system senses changes in the internal or external environment (changes are stimuli).
- The nervous system analyses the stimuli, stores some information about it and uses the remaining information to make decisions.
- The nervous system often responds to stimuli by starting gland secretions or muscle movements.

Components

Brain

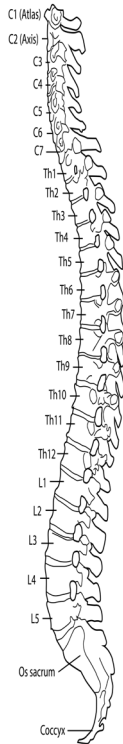
The brain is the most complex organ in the body and not only does it control other body systems, it allows us to think, communicate and feel emotions. The brain contains mostly neurons and neuroglia cells. Tissues called meninges (inflammation of the meninges causes meningitis) and cerebrospinal fluid help to protect the brain.

Spinal cord

This extends from the *medulla oblongata* in the brain. The vertebrae of the spine protect the spinal cord. Information passes through the spinal cord to and from the brain and it is the main pathway connecting the brain and PNS.

Nerves within the spinal cord can communicate information extremely quickly and like the brain, it is protected by meninges and cerebrospinal fluid.

There are 33 nerve segments in the spine, most of which emerge from above their corresponding vertebrae:



- Cervical nerve segments, identified as C1 to C8
- Thoracic nerve segments, identified as T1 to T12
- Lumbar nerve segments, identified as L1 to L5
- Sacral nerve segments, identified as S1 to S5

The spinal cord also has a special nervous response, called a reflex arc. This is when information does not enter the brain first (as there is not enough time), instead it enters the spinal cord and the spinal cord sends a message to the muscles to act.

A reflex arc occurs is when we touch something hot and we have already moved our hand away before we have 'realized' that it is hot. This response assists us in surviving.

Neurons

These vary in size from being tiny to the longest cells in the body. There are also different types of neuron, although the two main types are:

Motor neurons that communicate and control muscles.

Sensory neurons receive information from stimuli and pass this information to the CNS.

A neuron contains a cell body. This, like other cells contains the nucleus and other cell components. It also contains dendrites that extend from the cell body. These are where

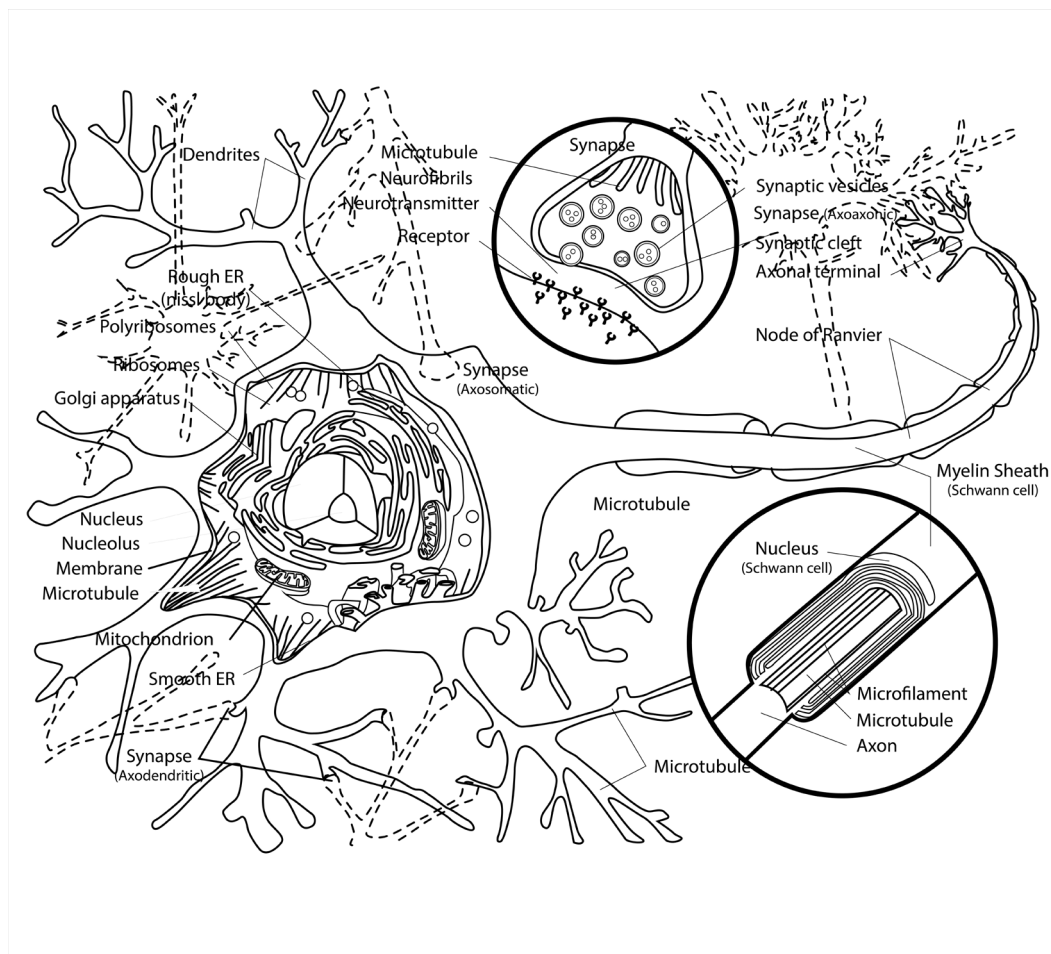
information (nerve impulses) enters the neuron.

The long axon allows nerve impulses to pass from the cell body to the terminal of the axon, located at the opposite end of the cell.

At the axon terminal are neurotransmitters. These molecules pass on nerve impulses to the dendrites of other neurons as well as muscles or glands.

Covering the axon is a special insulating sheath called a myelin sheath. This works like a cable covering, preventing information from being lost along the way. Breakdown of this myelin sheath causes disorders such as multiple sclerosis.

The diagram below shows how a neuron connects to its neighbors and shows where neurotransmitters are located at the axon terminals (in structures called synapses).



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Neuroglia

Neuroglia or glia cells are not nerve cells, but they form myelin sheath for the neurons and also support and protect neurons. There are more of these than there are neurons.

Common Diseases and Disorders

Alzheimer's disease: Although the exact causes of Alzheimer's remains unknown, a breakdown of nervous tissue in the brain is involved. Neuroscientists suggest that keeping the brain active can help to delay some of the onset of Alzheimer's.

Epilepsy: Seizures are caused by abnormal electrical signals in the brain.

Multiple sclerosis (MS): This occurs with destruction of myelin sheaths of CNS neurons. This destruction prevents nerve impulses moving through the body properly.

Parkinson's disease (PD): Usually affects people around 60 years of age and causes problems with the neurotransmitters. This results in involuntary muscle movements, such as hand tremors.

Stroke: A stroke or cerebrovascular accident (CVA) occurs when blood flow to the brain is disturbed. This creates damage to the nervous tissue in the affected part of the brain. Symptoms such as slurred speech and lack of movement in one side of the body occur because of damage to the nervous tissues.

Medical Terminology

EEG (Electroencephalogram): This shows brain waves. The brain waves are the nerve impulses generated by the nervous system. These appear as electrical information.

Epidural: This is anesthetic placed in the epidural space (just inside the vertebrae) with the use of a catheter.

General anesthesia: This removes all sensations including pain and causes unconsciousness.

Homeostasis: This is the ability of the human body to maintain a stable internal environment, when dealing with both internal and external environmental changes.

Local anesthetic: Novocain and lidocaine prevents nerve impulses passing to other neurons.

Lumber puncture: Cerebrospinal fluid (CSF) is drawn from the lumber region of the spine using a needle. Often used to diagnose in disease diagnosis.

Neurology: This is the branch of medicine for nervous system function and disorders.

Spinal anesthesia: This blocks nerve impulses from a certain point in the spine downwards. This is different to an epidural.

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