

## Chapter 9 Nervous System

**Nervous System function:** The nervous system is composed of neurons and neuroglia.  
\_\_\_\_\_ at the ends of peripheral nerves gather information and convert it into nerve impulses. When sensory impulses are integrated in the brain as \_\_\_\_\_, this is the integrative function of the nervous system.  
Conscious or subconscious decisions follow, leading to motor functions via \_\_\_\_\_.

**The Central Nervous System** is made up of the \_\_\_\_\_ and \_\_\_\_\_.

**The Peripheral Nervous System** is made up of the \_\_\_\_\_ and \_\_\_\_\_ nerves.

**Neuroglial cells** fill spaces, support neurons, provide structural frameworks, produce myelin, and carry on phagocytosis. Four are found in the \_\_\_\_\_ and the last in the \_\_\_\_\_.  
\_\_\_\_\_ cells are small cells that phagocytize bacterial cells and cellular debris.  
\_\_\_\_\_ form myelin in the brain and spinal cord.  
\_\_\_\_\_ are near blood vessels and support structures, aid in metabolism, and respond to brain injury by filling in spaces.  
\_\_\_\_\_ cover the inside of ventricles and form choroid plexuses within the ventricles.  
\_\_\_\_\_ cells are the myelin-producing neuroglia of the peripheral nervous system.

### **Neurons**

Structure: A neuron has a \_\_\_\_\_ with mitochondria, lysosomes, a Golgi apparatus, chromatophilic substance (Nissl bodies) containing rough endoplasmic reticulum, and neurofibrils.  
Nerve fibers include a solitary out going \_\_\_\_\_ and numerous \_\_\_\_\_ which bring in the impulse from the receptors.  
Larger axons in the PNS are enclosed by sheaths of \_\_\_\_\_ provided by \_\_\_\_\_ cells and are myelinated fibers. How do these cells produce this covering?

The outer layer of covering in the peripheral neurons is called \_\_\_\_\_. What is its function?

Narrow gaps in the myelin sheath are called \_\_\_\_\_ of \_\_\_\_\_.

### **Neuron Types**

By structure: Describe the three types of neurons as classified by structure.

How do they differ?

What is the most common function of each?

By function:

\_\_\_\_\_ neurons (afferent neurons) conduct impulses from peripheral \_\_\_\_\_ to the CNS and are usually what type?

(although some are bipolar neurons.)

\_\_\_\_\_ are multipolar neurons lying within the CNS that form links between other neurons.  
\_\_\_\_\_ neurons are multipolar neurons that conduct impulses from the CNS to effectors.

**Cell membrane potential:**

A cell membrane is usually polarized, with an excess of \_\_\_\_\_ charges on the inside of the membrane; polarization is important to the conduction of nerve impulses.

The distribution of ions is determined by the membrane \_\_\_\_\_ that are selective for certain ions.

\_\_\_\_\_ ions pass through the membrane more readily than do \_\_\_\_\_ ions, making the former a major contributor to membrane polarization.

**Resting potential = polarized:**

Due to active transport, the cell maintains a greater concentration of \_\_\_\_\_ ions outside and a greater concentration of \_\_\_\_\_ ions inside the membrane.

The inside of the membrane has excess \_\_\_\_\_ charges, while the outside has more \_\_\_\_\_ charges.

This separation of charge, or potential difference, is called the resting potential.

Sodium/potassium pump: What is its role?

Why don't the sodium and potassium move during the resting potential?

**Neuron Physiology:**

What is a threshold stimulus doing to the membrane?

How does all or none relate to nerve impulse transmission?

**Saltatory conduction:**

\_\_\_\_\_ fibers conduct impulses over their entire membrane surface.

\_\_\_\_\_ fibers conduct impulses from node of Ranvier to node of Ranvier, a phenomenon called \_\_\_\_\_ conduction. This conduction is many times faster.

**Synapse:**

The junction between two communicating neurons is called a \_\_\_\_\_; there exists a \_\_\_\_\_ between them across which the impulse must be conveyed.

Synaptic transmission is the process by which the impulse in the presynaptic neuron is transmitted across the synaptic cleft to the postsynaptic neuron.

When an impulse reaches the bulby synaptic \_\_\_\_\_ of an axon, synaptic \_\_\_\_\_ release chemicals called \_\_\_\_\_ into the synaptic \_\_\_\_\_.

These chemicals react with specific receptors on the postsynaptic membrane.

**Neurotransmitters:**

Neurotransmitters that increase postsynaptic membrane permeability to sodium ions may trigger impulses and are thus \_\_\_\_\_.

Other neurotransmitters may decrease membrane permeability to sodium ions, reducing the chance that it will reach threshold, and are thus \_\_\_\_\_.

The effect on the postsynaptic neuron depends on which presynaptic knobs are activated.

**Synaptic transmission:**

When an action potential reaches the synaptic knob, \_\_\_\_\_ ions rush inward and, in response, some synaptic vesicles fuse with the membrane and release their contents to the synaptic cleft.

\_\_\_\_\_ in synaptic clefts and on postsynaptic membranes rapidly decompose the neurotransmitters after their release.

Destruction or removal of neurotransmitter prevents continuous stimulation of the postsynaptic neuron.

What determines whether an impulse will continue in the postsynaptic neuron?

**Impulse processing:** How impulses are processed is dependent upon how neurons are organized in the brain and spinal cord.

Pools: Neurons within the CNS are organized into neuronal pools with varying numbers of cells.

Each pool receives input from afferent nerves and processes the information according to the special characteristics of the pool.

Facilitation: A particular neuron of a pool may receive excitatory or inhibitory stimulation; if the net effect is excitatory but \_\_\_\_\_ the neuron becomes more excitable to incoming stimulation (a condition called facilitation).

A single neuron within a pool may receive impulses from two or more fibers. This is called \_\_\_\_\_, and makes it possible for the neuron to summate impulses from different sources.

Impulses leaving a neuron in a pool may be passed into several output fibers. This is called \_\_\_\_\_ and serves to amplify an impulse.

**Nerve types:**

What is the function of the following? mixed: primary motor: sensory:

**Nerve pathways:**

A reflex arc includes a \_\_\_\_\_ receptor, a \_\_\_\_\_ neuron, an \_\_\_\_\_ in the spinal cord, a \_\_\_\_\_ neuron, and a/an \_\_\_\_\_.

Reflexes are automatic, subconscious responses to stimuli that help maintain homeostasis.

**Central Nervous System**

**Meninges:** The brain and spinal cord are surrounded by membranes called meninges that lie between the bone and the soft tissues.

The outermost layer is made up of tough, white dense connective tissue, contains many blood vessels, and is called the \_\_\_\_\_.

The sheath around the spinal cord is separated from the vertebrae by a/an \_\_\_\_\_ space.

The middle layer, the \_\_\_\_\_, is thin and lacks blood vessels and looks like a spider web.

Between these two layers is a \_\_\_\_\_ space containing \_\_\_\_\_ fluid.

The innermost layer, the \_\_\_\_\_, is thin and contains many blood vessels and nerves.

## Spinal Cord

Gray matter: Why does the gray matter appear gray?

Where is it located in the spinal cord?

White matter: White matter, made up of bundles of \_\_\_\_\_ nerve fibers (nerve tracts), surrounds a butterfly-shaped core of gray matter.

31 spinal nerves: The spinal cord consists of 31 segments, each of which gives rise to a pair of spinal nerves.

Central canal: A central canal contains \_\_\_\_\_ fluid.

## Spinal Cord Function:

Relay: What are the names of the various tracts of the spinal cord?

Where does the spinal cord relay information to?

Reflex: Recall how reflexes work and the parts of a reflex mechanism.

**Brain**: The brain is the largest, most complex portion of the nervous system, containing 100 billion multipolar neurons.

What are the divisions of the brain?

**Cerebrum** is the largest portion of the brain.

It is divided into two \_\_\_\_\_ by the \_\_\_\_\_ fissure.

A deep ridge of nerve fibers called the \_\_\_\_\_ connects the two halves.

The surface of the brain is marked by convolutions, sulci, and fissures.

The lobes of the brain are named according to the bones they underlie. What are the names of the lobes?

A thin layer of gray matter, the cerebral \_\_\_\_\_, lies on the outside of the cerebrum and contains 75% of the cell bodies in the nervous system.

Cerebral Functions: Describe the following cerebral functions:

Sensory:

Motor:

Association:

Hemisphere Dominance:

Both cerebral hemispheres function in receiving and analyzing sensory input and sending motor impulses to the opposite side of the body.  
Most people exhibit hemisphere dominance for the language-related activities of speech, writing, and reading.

Which hemisphere is dominant in 90% of the population?

What does the non-dominant hemisphere specialize in?

What are the basal ganglia?

**Ventricles and Cerebrospinal Fluid:**

The ventricles are a series of \_\_\_\_\_ within the cerebral hemispheres and brain stem.  
How many ventricles are there?

The ventricles are continuous with the central canal of the spinal cord, and are filled with \_\_\_\_\_ fluid.  
\_\_\_\_\_ plexuses, specialized capillaries from the pia mater, secrete the fluid.  
What is the function of this fluid?

**Diencephalon:**

The \_\_\_\_\_ functions in sorting and directing sensory information arriving from other parts of the nervous system, performing the services of both messenger and editor. It acts like an executive secretary for the cerebrum.

The \_\_\_\_\_ maintains homeostasis by regulating a wide variety of visceral activities and by linking the endocrine system with the nervous system. List its other functions.

Limbic system:

The limbic system, in the area of the diencephalon, controls emotional experience and expression by generating pleasant or unpleasant feelings about experiences.

**Brainstem:** The brain stem, consisting of \_\_\_\_\_, the \_\_\_\_\_, and the \_\_\_\_\_. The brain stem lies at the base of the cerebrum, and connects the brain to the spinal cord.

Midbrain: What are its functions?

Why can we say it is like a doorman to the cerebrum?

Pons: What are its functions?

Medulla oblongata: What are its functions?

Why do they say someone is “brain dead” if they only have a functioning medulla oblongata?

Reticular Formation

Where is it found?

Decreased activity in the reticular formation results in sleep; increased activity results in wakefulness.

**Cerebellum:**

Like the cerebrum, the cerebellum is divided into two \_\_\_\_\_.

How does it resemble the cerebrum in reference to its gray and white matter?

What are the functions of the cerebellum?

**Peripheral Nervous System:**

The peripheral nervous system (PNS) consists of the cranial and spinal nerves that arise from the central nervous system and travel to the remainder of the body.

What is the function of the somatic nervous system?

What is the function of the autonomic nervous system?

Cranial nerves: How many are there?

A mnemonic to remember their names: On Old Olympus Towering Tops, A Finn Visiting Germany Viewed A Hop. Can you list them in order?

Most of the cranial nerves are \_\_\_\_\_ nerves.

**Spinal Nerves:**

How many are there?

How are they named?

The root that contains the sensory neurons is the \_\_\_\_\_ root. The motor neurons arise in the \_\_\_\_\_ root.

All spinal nerves are \_\_\_\_\_ nerves.

The main branches from the spinal nerves form \_\_\_\_\_. Name and locate them.

**Autonomic Nervous System:**

What is its function?

What are the two divisions called?

In the autonomic motor system, motor pathways include two fibers: a \_\_\_\_\_ fiber that leaves the CNS, and a \_\_\_\_\_ fiber that innervates the effector.

In what structure is the cell of the second neuron located?

**Sympathetic Nervous System:**

Fibers in the sympathetic division arise from the \_\_\_\_\_ and \_\_\_\_\_ regions of the spinal cord, and synapse in \_\_\_\_\_ ganglia close to the vertebral column.

**Parasympathetic Nervous System:**

Fibers in the parasympathetic division arise from the \_\_\_\_\_ and \_\_\_\_\_ region of the spinal cord, and synapse in ganglia close to the effector organ.

**Neurotransmitters of the ANS:**

Preganglionic fibers of both sympathetic and parasympathetic divisions release \_\_\_\_\_.

Parasympathetic postganglionic fibers are cholinergic fibers and release \_\_\_\_\_.

Sympathetic postganglionic fibers are adrenergic and release \_\_\_\_\_.

The effects of these two divisions, based on the effects of releasing different neurotransmitters to the effector, are generally which, antagonistic or synergistic?

**Control of Autonomic Activity**

The autonomic nervous system is largely controlled by reflex centers in the brain and spinal cord.

The \_\_\_\_\_ system and \_\_\_\_\_ cortex alter the reactions of the autonomic nervous system through emotional influence.