Organization of the Nervous System
Major Divisions of the Nervous System

A "system of twos"
The brain and spinal cord are the most protected organs in the body. They are encased in bone (skull and vertebrae) and covered by three meninges or membranes: dura mater; arachnoid mater; and pia mater.
Cerebrospinal fluid (CSF), fills the sub-arachnoid space covering the brain and spinal cord, the cerebral ventricles (four internal chambers of the brain) and the central canal of the spinal cord.

CSF supports the CNS and provides cushioning against injury.
The brain is a finely tuned electrochemical organ with substantial nutritional requirements. Blood is supplied from three main arteries: the anterior, middle and posterior cerebral arteries (via the internal carotid and vertebral arteries).
The spinal cord is supplied by three main arteries that run longitudinally (top to bottom): the anterior and the right and left posterior arteries (all of which branch directly or indirectly from the vertebral arteries).
CNS: Blood Barriers

The CNS requires a constant environment to function properly.

Barriers, in the form of tightly packed endothelial cells lining blood vessel walls, maintain this environment by impeding passage into the CNS of:
- "foreign substances"
- proteins/other large molecules
- highly charged molecules
- hormones and neurotransmitters

Glucose is actively transported.

The barrier is weak in some areas in the brain to allow monitoring of the chemical composition of blood.
Directions in the vertebrate nervous system are described in relation to the orientation of the spinal cord in the standard anatomical position.
In humans, the directions in the cerebral hemispheres are rotated by 90° in comparison to those in the spinal cord and brain stem because of the unusual upright posture of humans. Thus, for example, the top of the head and the back of the body are both *dorsal* even though the directions are different.
Planes of Section

Sections of the brain are usually shown in one of three orientations:

- horizontal;
- frontal (coronal);
- sagittal (a midsagittal cut separates the left and right halves of the brain)

Cross-section: cut at a right angle to a long narrow structure (e.g., spinal cord)
The brain weighs about 3 lbs.

Visual inspection (lateral view) reveals three parts that are common to all mammals:

- the cerebrum – top-most, split into two cerebral hemispheres that each receive sensory input from and control motor output to the opposite side of the body.
- the cerebellum – behind/below the cerebrum, primarily a motor control center, two hemispheres each concerned with movement of the same side of body.
- the brain stem – forms the stalk from which the cerebrum and cerebellum sprout, fibers of passage, cranial nerves, basic functions (e.g., breathe rate).
Divisions are based on developmental origins; they do not sub-serve discrete functions.
The spinal cord is located in the vertebral canal and is made up of 31 segments: 8 cervical; 12 thoracic; 5 lumbar; 5 sacral; 1 coccygeal

A pair of spinal nerves leaves each segment.

The cord is shorter than the bony spinal column. The lower nerves run down the canal before exiting (cauda equina, "horse tail")
In cross section, it is apparent that the spinal cord comprises two different areas:
- inner H-shaped core of gray matter (cell bodies)
- outer area of white matter (myelinated axons)

From anterior to posterior:
- white matter decreases
- gray matter shows two enlargements (C5, L4) in the ventral horn for arms and legs
Pairs of spinal nerves are attached to the spinal cord – one on the left and one on the right – at 31 levels of the cord:
- dorsal, afferent, sensory
- ventral, efferent, motor
Spinal cord grey matter contains a number of prominent nuclear groups. The white matter is organized into different ascending and descending tracts.
Peripheral Nervous System

Somatic

The branch of the NS of which we are conscious. It provides sensory and motor innervation to all body parts except organs, smooth muscles and glands. It is involved in sensations that we are aware of such as light and pain, and our voluntary movements.

Autonomic

The branch of the NS of which we are unconscious. It regulates the visceral (organ) functions that maintain homeostasis within the body, including heart rate, blood pressure, digestion, etc. It has two efferent components in balance: sympathetic and parasympathetic.
Somatic spinal nerves innervate a particular region of skin.
Autonomic Nervous System

Second-stage neurons are far from the target

Second stage neurons are near the target organ
The Cranial Nerves

“Some Say Marry Money, But My Brother Says Big Brains Matter Most”