Gross Organization II
The Spinal Cord and PNS

Reading:
BCP Chapter 7
Major Parts of the Nervous System

A “system of twos”
The spinal cord is a long, thin, tubular bundle of nervous tissue (40-50 cm long and 1-1.5 cm in diameter) that extends from (and is continuous with) the medulla in the brain stem.

The spinal cord is enclosed in, and protected by, the bony vertebral column.
The vertebral column (and the cord within) is divided into four different regions based on location in the body: cervical, thoracic, lumbar and sacral. Vertebral bodies in each region are numbered sequentially downwards.

The spinal cord is also segmentally organized. There are 31 segments, defined by pairs of nerves exiting the cord. All spinal nerves, except the first, exit below their corresponding vertebral body: 8 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 1 coccygeal.

The spinal cord is shorter than the column; the lower nerves run down the canal before exiting (cauda equina, “horse’s tail”).
The spinal cord communicates with the body via the spinal nerves, which are part of the peripheral nervous system.

Spinal nerves exit the cord through notches between each vertebra.

Each spinal nerve attaches to the spinal cord by means of two branches or roots:

- the dorsal root brings sensory information into the spinal cord (afferent), cell bodies in dorsal root ganglion
- the ventral root carries motor information away from the spinal cord (efferent), somas in cord
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)

Spinal cord gray matter is divided into dorsal and ventral horns and each contains prominent nuclear groups. The white matter is organized into various ascending (somatosensory) and descending (motor) tracts.
The brain and spinal cord (both CNS structures) are encased in the skull and vertebral column, respectively, but do not come into contact with the overlying bones. They are protected by three membranes collectively called the meninges. In mammals, the meninges include the dura mater, arachnoid membrane and pia mater.
Cerebrospinal fluid (CSF), fills the sub-arachnoid space covering the brain and spinal cord. CSF is similar to blood except it has few proteins, red or white blood cells.

CSF is produced by a special tissue, called the choroid plexus, in the ventricles of the cerebrum. CSF flows from the ventricles into the central canal of the spinal cord and the sub-arachnoid space. Ultimately, it is reabsorbed into veins.

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, which receive input from the vertebral and internal carotid arteries.
The spinal cord is supplied by three main arteries that run longitudinally (top to bottom): the anterior spinal artery and the right and left posterior arteries (all of which arise directly or indirectly from the vertebral arteries).
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.
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 (dermatome).
Second-stage neurons are far from the target

Second stage neurons are near the target organ
“Some Say Marry Money, But My Brother Says Big Brains Matter Most”