CENTRAL NERVOUS SYSTEM – Textbook and Lecture Slides

The **central nervous system (CNS)** includes the brain and spinal cord. The brain is protected and enclosed within the skull whereas the spinal cord is housed and protected within the vertebral canal. This is the command centre of the nervous system that integrates and processes nervous information.

SENSORY NERVOUS SYSTEM

Sensory nervous system (afferent) receives sensory information from receptors and transmitting this information to the CNS. Therefore, responsible for input.

> **Somatic sensory** are the general somatic senses - touch, pain, pressure, vibration, temperature and proprioception (sensing position or movement of joints and limbs) and special senses - taste, vision, hearing, balance and smell. These are voluntary functions because we have some control over them and are conscious of them.
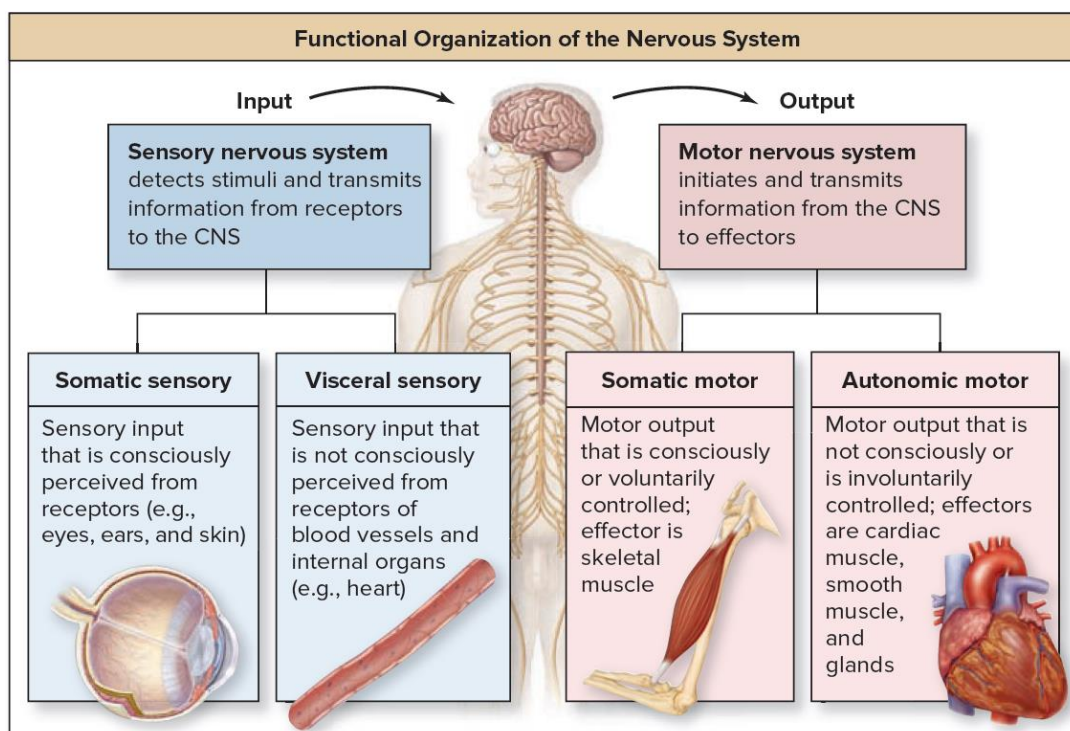
> **Visceral sensory** transmit nerve impulses from blood vessels and visceral to the CNS. These receptors detect chemical composition of blood or stretch of an organ wall. These are involuntary because we have no voluntary control over them and are not conscious of them.

MOTOR NERVOUS SYSTEM

Motor nervous system (efferent) transmits motor impulses from the CNS to effectors (muscles or glands). Therefore, responsible for output.

> **Somatic motor (somatic nervous system)** conducts nerve impulses from the CNS to the skeletal muscles, causing them to contract. Voluntary nervous system because the contractions of skeletal muscles are under conscious control.

> **Autonomic motor (autonomic nervous system)** innervates internal organs and regulates smooth muscle, cardiac muscle and glands without our control (aka the visceral motor system or involuntary nervous system)

Functional Organization of the Nervous System

Input → Output

| Sensory nervous system detects stimuli and transmits information from receptors to the CNS | Motor nervous system initiates and transmits information from the CNS to effectors |

Somatic sensory	Visceral sensory	Somatic motor	Autonomic motor
Sensory input that is consciously perceived from receptors (e.g., eyes, ears, and skin)	Sensory input that is not consciously perceived from receptors of blood vessels and internal organs (e.g., heart)	Motor output that is consciously or voluntarily controlled; effector is skeletal muscle	Motor output that is not consciously or is involuntarily controlled; effectors are cardiac muscle, smooth muscle, and glands

NEURONS

Neurons conduct nerve impulses from one part of the body to another. Neurons:

- Have a high metabolic rate and their survival depends upon continuous and abundant supplies of glucose and oxygen.
- Are typically nonmitotic (unable to divide and produce new neurons).
- Are excitable because they respond to a stimulus (exposure to a chemical, stretch or pressure change).

The **cell body** serves as the neurons control centre and is responsible for receiving, integrating, and sending nerve impulses. The cell body is enclosed in a plasma membrane and contains cytoplasm surrounding a nucleus.

The **nucleus** contains a prominent nucleolus, reflecting high metabolic activity of neurons which require the production of many proteins. Numerous mitochondria are present within this cytoplasm to produce the large amounts of ATP needed by the neuron.

Dendrites are shorter, smaller processes that branch off the cell body. Some neurons have only one dendrite, whereas others have many. Dendrites conduct nerve impulses towards the cell body (they receive input a d the transfer it to the cell body for processing). The more dendrites a neuron has, the more nerve impulses that neuron can receive from other cells.
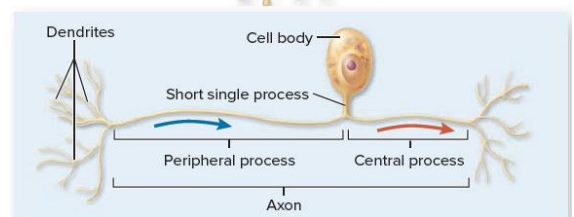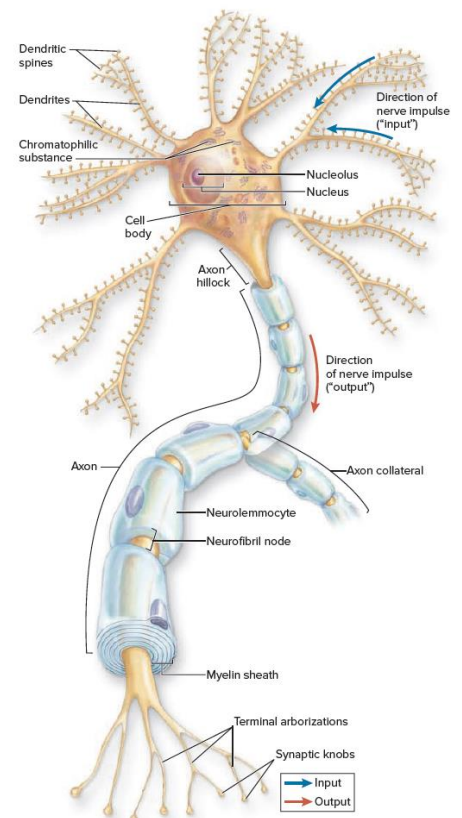
The **axon** is a longer nerve cell process emanating from the cell body to make contact with the other neurons, muscle cells or gland cells. Neurons have either one axon or no axon. Most neurons have a single axon that transmits a nerve impulse away from the cell body toward another cell (the axon transmits output information to other cells).

Unipolar neurons have a single, short process that emerges from the cell body and branches like a T.
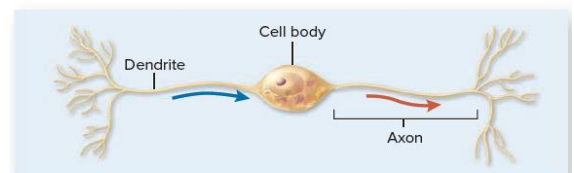
Bipolar neurons have two processes that extend from the cell body – one axon and one dendrite. Fairly uncommon but located in olfactory epithelium of nose and in retina of eye.

Multipolar neurons are the most common type of neuron and they have multiple processes with many dendrites and a single axon that extend from the cell body. Eg. Motor neurons that innervate muscle and glands.
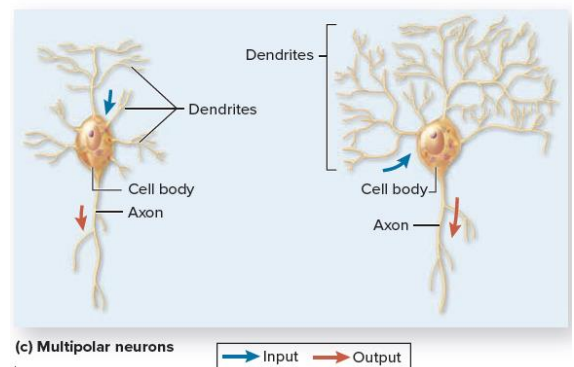
Sensory neurons or **afferent neurons** transmit nerve impulses from sensory receptors to the CNS. Specialized to detect changes in their environment (stimuli) and can be in the form of touch, pressure, heat, light or chemicals. Most are unipolar although a few are bipolar. The cell bodies of