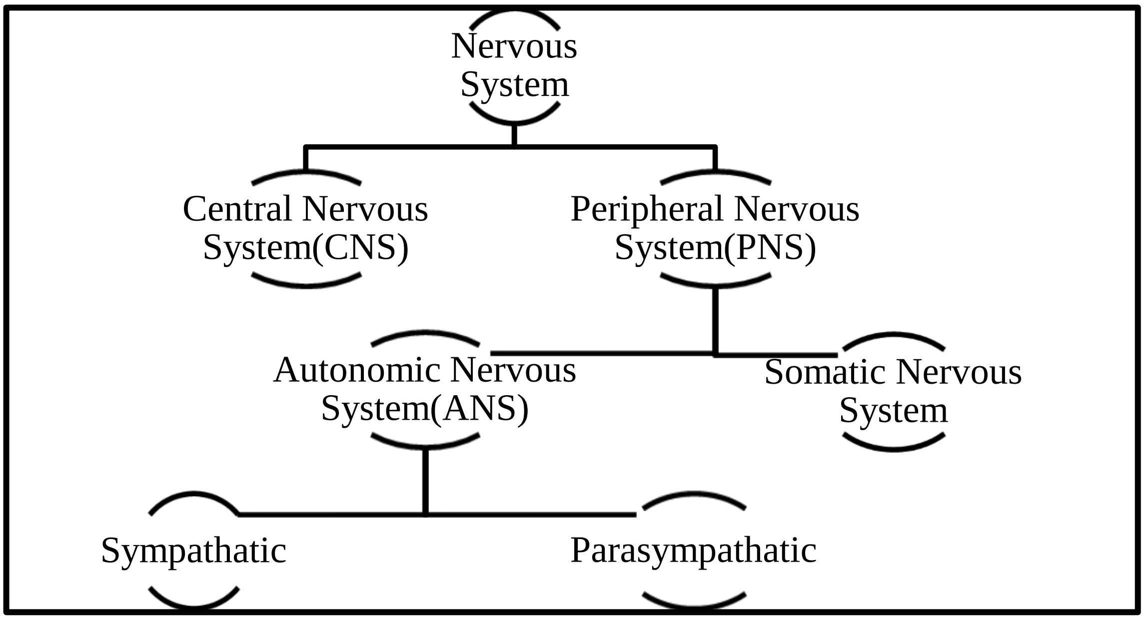
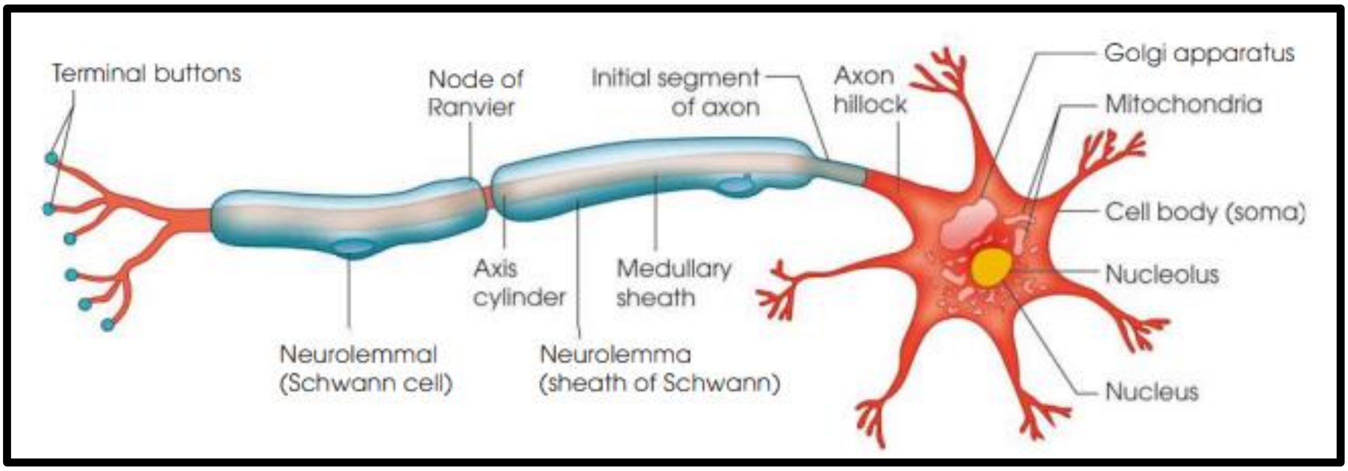
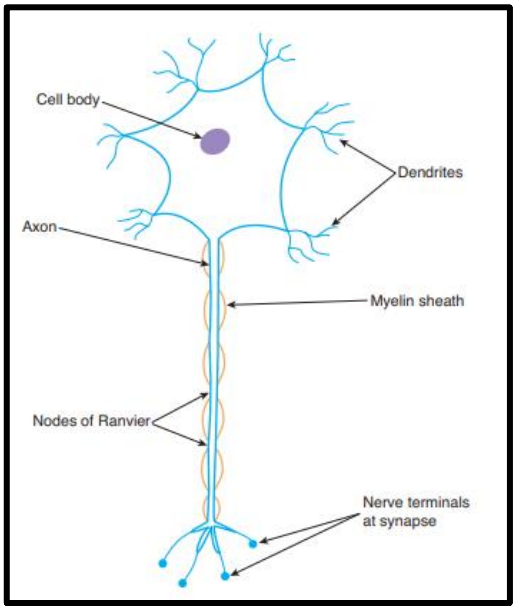
NERVOUS SYSTEM



- The basic functions of the nervous system are to acquire sensory input from both the internal and external environment, integrate the input, and then activate a response to the stimuli.
- The nervous system is divided into the central nervous system (CNS), which includes the brain and spinal cord, and the peripheral nervous system (PNS), which includes the cranial nerves arising from the brain and the spinal nerves arising from the spinal cord.
- The autonomic nervous system (ANS) is the part of the peripheral nervous system that acts to control visceral functions largely below the level of consciousness, such as heart rate, digestion, respiratory rate, salivation, perspiration, pupil diameter, micturition, and sexual arousal.
- The somatic nervous system is associated with the voluntary control of body movements via skeletal muscles.
- The nervous system is composed of nervous tissue.
- The nervous tissue consists of two elements: Nerve cell (neuron) and neuroglia.
- The neurons are the structural and functional units.
- They are specialized to respond to physical and chemical stimuli, conduct electrochemical impulses, and release chemical regulators. In addition to these functions, neurons enable the perception of sensory stimuli, learning, memory, and the control of muscles and glands.
- The supporting cells assist the functions of neurons and are about five times more abundant than neurons. In the CNS, supporting cells are collectively called neuroglia, or simply glial cells (glia = glue). Their function is support, insulation and phagocytosis.





Neuron

- A nerve cell with all its processes is called a neuron.

Neuron may consist of a nerve cell body or soma which contain the nucleus and two types of processes-axon and dendrite.

- The cell bodies within the CNS are frequently clustered into groups called nuclei (not to be confused with the nucleus of a cell). Cell bodies in the PNS usually occur in clusters called ganglia.
- Dendrites are thin, branched processes that extend from the cytoplasm of the cell body. Dendrites provide a receptive area that transmits electrical impulses to the cell body.
- The axon is a longer process that conducts impulses away from the cell body. Axons vary in length from only a millimeter long to up to a meter or more (for those that extend from the CNS to the foot). Branches of the axon help it in communicating with its target cells
- The origin of the axon near the cell body is an expanded region called the axon hillock; it is here that nerve impulses originate.
- Axon ends in numerous terminal buttons (axon telodendria).
- Neurotransmitters are released along the axon terminal into the synaptic cleft between the terminals and the dendrites of the next neuron. The neurotransmitter aids in synaptic transmission.

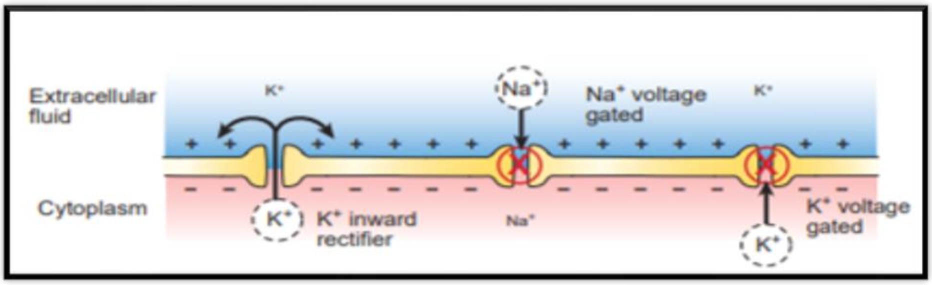
- The term nerve fibres usually refer to the axons. Nerve fibres which carry impulses to the central nervous system are termed afferent and those carrying impulses from the central nervous system to the periphery are known as efferent.
- A nerve is a bundle of axons located outside the CNS. Most nerves are composed of both motor and sensory fibers and are thus called mixed nerves. Some of the cranial nerves, however, contain sensory fibers only. These are the nerves that serve the special senses of sight, hearing, taste, and smell.
- Throughout the body, the peripheral nerves travel together, and with blood vessels, in what are known as neurovascular bundles
- Somatic nerves: carrying impulses to the musculoskeletal system, to allow voluntary movement of the body.
- Autonomic nerves: carrying impulses to blood vessels and internal organs, to effect involuntary actions, such as blood vessel constriction or dilatation. They are either sympathetic or parasympathetic.
- Enteric nerves: carrying impulses specifically to the gastrointestinal tract, to effect peristalsis and digestive secretions, and to regulate blood flow to the area during digestion.

The Cranial Nerves: The 12 pairs of cranial nerves are numbered as Roman numerals, but each has its own name too. Some of the cranial nerves are of particular importance to the dental team because they supply the oral cavity and its surrounding structures.

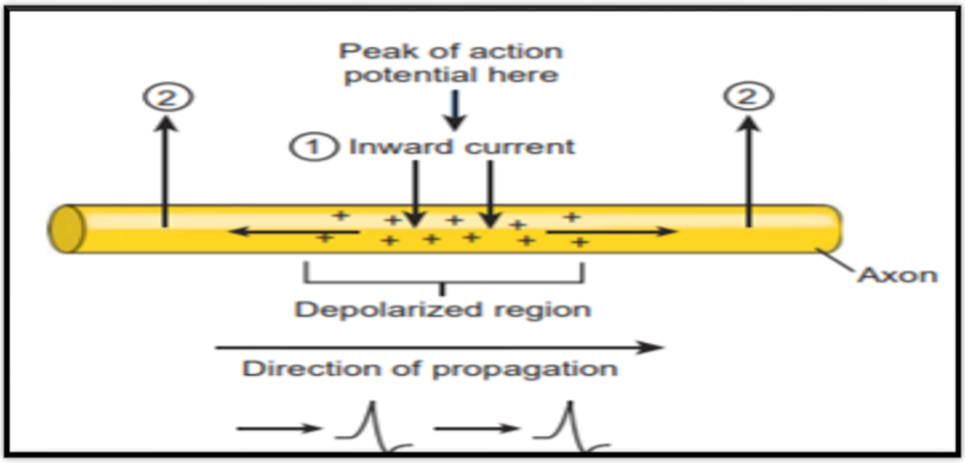
Roman numeral	Name of nerve	Nerve function
I	Olfactory	Sensory – smell
II	Optic	Sensory – sight
III	Occulomotor	Motor – external eye muscles Parasympathetic – pupil size
IV	Trochlear	Motor – external eye muscles
V	**Trigeminal**	**Sensory – pain, temperature, touch of teeth and oral soft tissues** **Motor – muscles of mastication**
VI	Abducens	Motor – external eye muscles
VII	**Facial**	**Sensory – taste from anterior two-third of tongue** **Motor – muscles of facial expression** **Parasympathetic – salivary glands**
VIII	Auditory	Sensory – hearing and balance
IX	**Glossopharyngeal**	**Sensory – taste from posterior tongue** **Motor – control of swallowing** **Parasympathetic – salivary glands**
X	Vagus	Sensory – from the abdominal region Parasympathetic – to the thorax and abdomen
XI	Accessory	Motor – neck muscles and the larynx
XII	**Hypoglossal**	**Motor – tongue muscles**

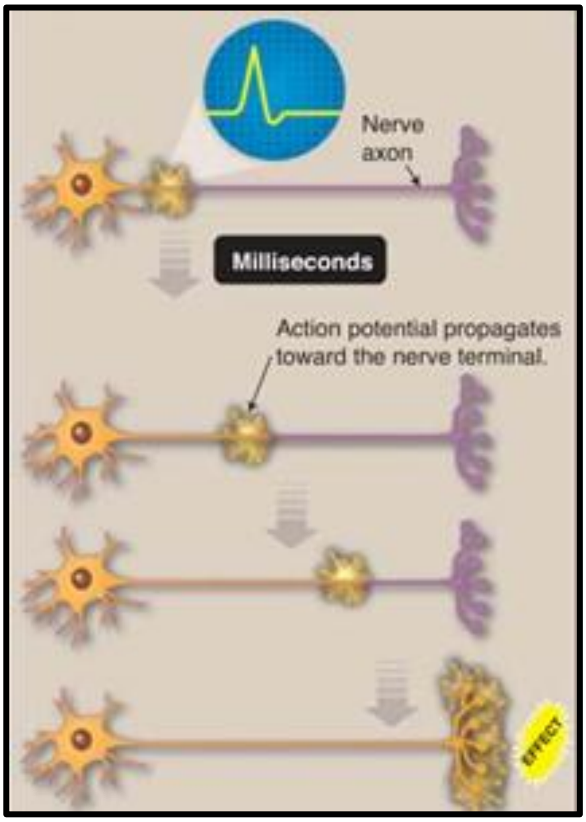
Electrical Activity in Axons:

- All cells in the body maintain a potential difference (voltage) across the membrane, or **resting membrane potential**, in which the inside of the cell is negatively charged in comparison to the outside of the cell which is positively charged.
- This potential difference is largely the result of the permeability properties of the plasma membrane. The membrane traps large, negatively charged organic molecules within the cell and permits only limited diffusion of positively charged inorganic ions. These properties result in an unequal distribution of these ions across the membrane.



- The action of the Na+/K+ pumps also helps to maintain a potential difference because they pump out three sodium ions (Na+) for every two potassium ions (K+) that they transport into the cell. Partly as a result of these pumps, Na+ is more highly concentrated in the extracellular fluid than inside the cell, whereas K+ is more highly concentrated within the cell.
- The permeability of the axon membrane to Na+ and K+ is regulated by gates, which open in response to stimulation.Net diffusion of these ions occurs in two stages: first Na+ moves into the axon, then K+ moves out. This flow of ions, and the changes in the membrane potential that result is called **depolarization** constitutes an event called an **action potential**.
- As the nerve impulse passes, the unstable depolarized condition alters and the ion channels close to sodium at the same time as the potassium ions begin to diffuse out again. The end result is the **repolarization** of the axon, and the return of the more stable membrane potential.





- The action potential is defined as rapid depolarization followed by a repolarization (return of membrane potential to rest).
- Propagated action potentials carry information through axons over long distances, but they do not transfer electrical impulses directly to other neurons, glands, or muscle cells. Communication between most nerve cells is accomplished via neurotransmitter molecules released at synapses.

Action of Local Anesthetics on Nerves:

Local anesthetics block the conduction of action potentials in sensory axons. They do this by reversibly binding to specific sites within the voltage-gated Na+ channels on the nerve cell membrane, preventing the sodium ion channels from opening, and thereby preventing the occurrence of depolarization and action potential.

Nociceptive fibers (unmyelinated C fibers) are the most sensitive to the blocking effect of local anesthetics. This is followed by sequential loss of sensitivity to temperature, touch, and deep pressure. Motor nerve fibers are the most resistant to the actions of local anesthetics.