

Nervous Tissue/System

-3 broad functions:

- 1) **Sensory input**- monitors changes in the body's internal and external environment.
- 2) **Integration**- processing and interpreting the sensory input
- 3) **Motor output**- responding to interpretation by activating muscles or glands

-**Neurology**-> study of nervous system

Organization:

Central Nervous System (CNS) - Brain and spinal cord processing, interpreting, and responding center.

Peripheral Nervous System (PNS)- Remainder of nervous system consisting of communication links, which connect CNS with muscles, glands, sensors etc.

- **Afferent (sensory) System**- the input system consisting of nerves which convey information from sensory receptors toward the CNS.
- **Efferent (motor) System**- the output system, transmits impulses from the CNS to effector organs (muscles and glands).

(afferent= toward, efferent= away)

- o **Somatic Nervous System**- conveys impulses to skeletal muscle (voluntary system~ conscious)
- o **Autonomic Nervous System**- motor nerve fibers which convey information to viscera (organs, cardiac muscles and glands) (involuntary system~ unconscious)
 - **Sympathetic Division**- increases an organ's activity in response to some stress.
 - **Parasympathetic Division**- inhibits an organ's activity or returns it to normal (normal activity = conserve energy).

Histology- 2 major types of cells

- **Neurons**- nerve cells which are specialized to conduct impulses consist of:
 - o **Perikaryon**- or cell body, location of nucleus and most cell organelles.
 - o **Axon**- long cellular extension which conducts impulses away from cell body (usually only one)

- o **Dendrite**- shorter cellular extensions which are highly branched and conduct impulses toward the cell body.
- **Neuroglial cells**- supportive or protective cells, do not carry impulses-> they insulate, nourish, protect, etc. the neurons. EX:
 - o **Astrocytes**- star shaped cells which nourish neurons by connecting them with blood vessels.
 - o **Microglial**- protect nerve cells from infection by phagocytizing microorganisms and cellular debris
 - o **Ependymal cells**- form the lining of the cavities (ventricles) within the brain and spinal cord. They secrete cerebrospinal fluid and keep it moving with beating cilia.
 - o **Oligodendrocytes**- cells which wrap around central nervous system neurons forming an insulating sheath (called myelin sheath).
 - o **Schwann cells**- insulate axons/dendrites of the neurons in the peripheral nervous system by wrapping around them crating a many layered myelin sheath of the Schwann cell's membrane. Cells which have this insulating wrapping are said to be myelinated. It takes many Schwann cells to sheath an axon; the spaces between Schwann cells are called Nodes of Ranvier.

Types of neurons by functions:

- **Sensory (afferent) neurons**- conduct impulse from receptors (sensors) to CNS.
- **Association neurons**- conduct impulses between sensory and motor neurons.
- **Motor (efferent) neurons**- conduct impulses from CNS to effectors (muscles or glands.)

Types of neurons by structure:

- **Multipolar neurons**- have one axon and many dendrites
- **Bipolar neurons**- have one axon and one dendrite
- **Unipolar neurons**- have one extension which branches into an axon and a dendrite.

Nerve- a cordlike grouping of parallel nerve cells enclosed by connective tissue wrappings.

- **Endoneurium**- encloses individual cells (neurons)
- **Perineurium**- encloses bundles of neurons (bundle=fascicle)
- **Epineurium**- surrounds bundles of fascicles

Neuron Regeneration (Repair)

- At approximately 6 months of age neurons lose the ability to divide... so if destroyed they cannot be replaced.

- However if the perikaryon is intact and if the dendrite or axon is myelinated then the cellular extensions can regenerate (in the P.N.S. only.)
- The damaged axon will grow distally through the myelin sheath (1-2mm per day); unless scar tissue blocks the path.
- The repair will be imperfect, generally because the axonal ends are not myelinated, therefore the axon may stop short or in the wrong place.

Monday review with Bridgett at 2:30 science 110?

Thursday at 4:30 Science 302

Physiology of a Nerve Impulse

Membrane Potential

- A voltage results from the separation of oppositely charged particles.. in reference to cells the oppositely charged particles are ions and the barrier which keeps them apart is the plasma membrane
- A neuron not conducting an impulse is called a resting neuron, and is polarized. Polarization means that there is a difference in charge between the outside of the plasma membrane and the inside of the cell
- This polarization is due to an excess of negative ions inside and is maintained by a sodium-potassium pump which actively transports ions across the plasma membrane
- This polarized state is called the resting membrane potential (or just membrane potential)
- When a neuron is stimulated the permeability of the cell membrane changes, the doors open, allowing ions to flow across it. This reverses the polarization, depolarization, as the inside becomes locally positive

Graded Potential

- Short lived localized changes in membrane potential
- These changes cause current flows that decrease in magnitude with distance
- They are called graded because their magnitude varies directly with stimulus strength
- If this depolarization reaches threshold at the base of the axon it will initiate an action potential (due to the presence of voltage gated ion channels)

Action Potential (nerve impulse)

- Excitability- the ability of a nerve cell to respond to a stimuli and convert them to nerve impulses
- Stimulus- anything that is capable of altering the membrane potential or permeability
- After stimulus has depolarized one spot, then that spot stimulates and depolarizes an adjacent point starting a wave of depolarization traveling from point to adjacent points along the membrane. This self-stimulating wave is said to have an action potential
- A traveling action potential is a nerve impulse
- Following depolarization and an impulse, the original resting potential is restored or repolarized by diffusion and active transport of ions (sodium- potassium pump)