

Anatomy and Physiology Lecture Notes

Fall Test 4- Chapters 11-15 on Final Exam

Nervous Tissue/System

There are 3 broad functions:

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

Neurology- the study of the nervous system

Organization:

- Central Nervous System (CNS)- brain and spinal cord processing, interpreting, and responding center
 - Peripheral Nervous System (PNS)- remainder of the nervous system consisting of communication links, which connect CNS with muscles, glands, sensors, etc.
 - o Subdivisions of the PNS:
 - Afferent (sensory) system- **input** system consisting of nerves, which convey information from sensory receptors **toward** CNS
 - Efferent (motor) system- **output** system, which transmits impulses from the CNS to effector organs (muscles and glands)
- *Afferent = toward and Efferent = exit/away*
- Somatic Nervous System- conveys impulses to the skeletal muscle (voluntary system = conscious)
 - Autonomic Nervous System- motor nerve fibers, which convey information to viscera, like organs, cardiac muscles, and glands (involuntary system = unconscious)
 - o Sympathetic Division- increases an organ's activity in response to some stress
 - o Parasympathetic Division- inhibits an organs activity or returns it to normal (normal activity = conserves energy)

Histology

There are 2 types of cells:

- Neurons- nerve cells, which are specialized to conduct impulses, consist of:

- o Perikaryon- "cell body", located in nucleus and most cell organelles
- o Axon- long cellular extension, which conducts impulses **away** from the cell body (there's usually only one)
- o Dendrite- shorter cellular extensions, which are highly branched and conduct impulses **toward** cell body
- Neuroglial (or glial) cells- supportive or protective cells, which do not carry impulses, but they do insulate, nourish, protect, etc. the neurons
Examples:
 - Astrocytes- star-shaped cells, which nourish neurons by connecting them with blood vessels
 - Microglia- protect nerve cells from infection by phagocytizing microorganisms and cellular debris
 - Ependymal cells- form a lining of the cavities (ventricles) within the brain and spinal cord; they secrete cerebrospinal fluid and keep it moving with beating cilia
 - Oligodendrocytes- cells which wrap around the **central** nervous system neurons forming an insulating sheath, called myelin sheath
 - Schwann cells- insulate axons/dendrites of the neurons in the **peripheral** nervous system by wrapping around them, creating a multi-layered myelin sheath of the Schwann cell's membrane; cells which have this insulating wrapping are said to be myelinated, but it takes many Schwann cells to sheath an axon. The spaces between Schwann cells are called Nodes of Ranvier.

Types of neurons:

By function-

- Sensory (or afferent) neurons- conduct impulses from receptors (sensors) to the CNS
- Association (or internuncial) neurons- conduct impulses from CNS to effectors (muscles or glands)
- Motor (or efferent) neurons- conduct impulses from the CNS to effectors (muscles or glands)

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 cord-like grouping of parallel nerve cells enclosed by connective tissue wrappings

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

Neuron Regeneration (Repair)

-At approximately 6 months of age, neurons lose their 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 PNS only).

-The damaged axon will grow distally through the myelin sheath (1-2 mm per day), unless scar tissue blocks its path.

-The repair will be imperfect, generally because the axonal ends are not myelinated. Therefore, the axon may stop too short or in the wrong place.

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.

-When a neuron is stimulated, the permeability of the cell membrane changes, allowing ions to flow across it. This reverses the polarization (depolarizes it) as the inside becomes locally positive.

- Excitability- the ability of a nerve cell to respond to a stimuli and convert them to nerve impulses
- Stimulus- anything which is capable of altering the membrane potential or permeability (ex: "opens the ion doors")