Chapter 11-15 Notes – Nervous System

I. Nervous System is divided into two groups:
   A. Central nervous system (_____) – brain and spinal cord (387)
   B. Peripheral nervous system (_____) – composed of nerves that connect the _____ to other _____ parts
   C. Three general functions: (387)
      1. _____ function – involves sensory _____ at the ends of _____ nerves
         a. gather _____ due to changes in and out of body
         b. monitor light, sound, temperature, oxygen
         c. convert information to _____ impulses which transmit to _____
      2. _____ function – the information is received from the peripheral nerves and become _____ (body processes this info)
         a. makes decisions based on _____ function
      3. _____ function – takes the information processed by the integrative function and carries out _____ functions
         a. carry impulses from CNS to responsive parts called _____
         b. effectors are outside the CNS and include muscles and glands

II. _____ Tissue – contains masses of _____ cells called _____**(388),** which monitor the surroundings and conduct _____ and _____ cells, which act like connective tissue
   A. Neuron structure (390-91) – vary in size, but all have a _____ body and _____ processes filled with cytoplasm called _____ fibers
      1. _____ body – contains cytoplasm, cell membrane, organelles & a network of fine threads called _____**,** which extend into the nerve fibers
      2. _____ bodies – membranous sacs similar to ER in other cells, that make _____
      3. Nucleus & Nucleolus – incapable of reproduction
      4. Two kinds of nerve fibers: (392)

a. _____ – provide main receptive surfaces of the neuron, transmits impulses toward a _____ cell body
b. _____ – specialized to conduct nerve _____ away from the _____ body

5. _____**390** cells – are neuroglial cells that surround the fibers of peripheral nerves of larger axons
   a. many layers of these cells are called _____**,** they form a myelin sheath on the outside of an axon
      - myelinated nerves are _____
      - unmyelinated nerves are _____
   b. neurilemma – surrounds the myelin sheath
6. _____**394 –** narrow gaps in the myelin sheath

B. Neuroglial Cells – fill spaces, support neurons, provide structural framework, produce myelin, and carry on phagocytosis(389-90)
1. _____ – responsible for the formation of scar tissue
2. _____ – form myelin in the brain & spinal cord
3. _____ cells – support neurons, & phagocytize bacterial cells
4. _____ cells – form epithelial-like membranes around brain parts & spinal cord

III. Cell Membrane Potential – the surface of the cell membrane is usually electrically charged or _____, with respect to the inside. This is due to the _____ distribution of _____ and is important in the conduction of muscle and nerve _____**(398 +)**

A. Distribution of ions
1. determined by _____ in those membranes
2. some allow passage of ions while some do not
3. _____ ions pass more easily than _____ ions through cell membranes, which contributes to polarization

B. _____ Potential – when nerve cells are at rest, there is more _____+ ions outside their membranes and more _____+ ions inside their membranes
1. the cytoplasm contains high numbers of _____ charged ions, including phosphate and protein

2. the outside of the cell becomes more _____ charged because more positive ions _____ the cell than enter due to the fact that _____+ ions diffuse more easily
3. the difference between the regions is called _____ _____
4. resting potential – _____ _____ _____

C. _____ Changes – changes from the environment affect the _____ potential of a nerve cell membrane
   1. if the resting potential becomes _____ (as the inside becomes less negative compared to outside), the membrane is said to be _____ **(399)**
   2. _____ (phenomena in which the amount of change in cell membrane potential is directly related to the intensity of stimulation) occurs due to stimulation which triggers _____ potential
   3. since the threshold has been obtained, an _____ potential is started

D. Action Potential
   1. since threshold potential is reached, the cell membrane changes in _____ and _____+ diffuse freely _____
   2. the membrane loses its _____ charge and becomes _____
   3. though at the same time _____+ ions diffuse _____ and the outside of the membrane becomes _____ charged which is called _____
   4. this rapid change is called an _____**(401)** potential and takes one- thousandth of a second

IV. Nerve Impulse – _____**401**, as 1 action potential occurs in one region of a nerve fiber, it triggers the rest

A. Impulse conduction
   1. _____ nerve fibers conducts impulses over the entire surface (393)

2. _____ nerves conduct impulses more _____
3. the greater the _____ of the nerve the quicker the impulse

B. All or none response
1. the entire nerve fiber responds if a stimulus of threshold intensity is applied
2. the impulses carried will all be at the same _____

V. Synapse – _____ _____ _____ (a junction between 2 neurons). The proximal neuron is the _____ neuron and the distal neuron is called the _____ neuron. There is a _____ _____ between them that the impulse must cross (407)

A. Synaptic Transmission – _____ _____
1. impulses travel from _____ to _____ body, then along the axon to a synapse
2. axons have synaptic knobs, which secrete neurotransmitters
3. a _____ is released when an impulse reaches the end of an axon
4. a nerve impulse is triggered when a neurotransmitter reaches the nerve fiber on the distal side of cleft

B. Neurotransmitter Substances
1. _____ – stimulates skeletal muscle contractions
2. monoamines, amino acids and peptides
3. they are released from a synaptic knob when an action potential causes the membrane permeability to sodium ions to increase
4. they are decomposed after they are released

C. Excitatory & inhibitory actions
1. neurotransmitters that cause increased _____ to _____ ions and thus trigger nerve impulses are _____
2. other neurotransmitters that cause a _____ in membrane permeability to sodium ions, thus causing threshold of stimulation to be raised are _____

VI. Processing of Impulses – the way a nervous system processes _____ impulses and _____ on them reflect the organization of the nerve fibers within the _____ and _____ cord (419-420)

A. _____ Pools

1. each pool receives impulse from input nerve fibers
2. these are processed and resulting impulses are conducted away

B. _____

1. each neuron may receive excitatory & inhibitory stimuli
2. a neuron is stimulated when it receives subthreshold stimuli and becomes more excitable

C. _____

1. impulses from 2 or more fibers converge on one neuron
2. this makes it possible for impulses from different sources to create additive effect upon a neuron

D. _____

1. impulses leaving a pool may diverge by passing onto several output fibers
2. divergence allows impulses to be amplified

VII. Types of neurons & nerves (394)

A. Based on _____ differences

1. _____ neurons – many nerve fibers arising from cell bodies
2. _____ neurons – only 2 nerve fibers
3. _____ neurons – single nerve fiber

B. Based on functional differences (394-96)

1. _____ neurons – carry nerve impulses from _____ body parts into _____ or spinal cord
2. _____ – located between a sensory and motor neuron, they direct incoming sensory impulses for _____
3. _____ neurons – carry nerve _____ out of spinal cord or brain

C. Types of nerves – nerves are _____
_____

1. _____ nerves – conduct impulses into brain & cord
2. _____ nerves – carry impulses to muscles or glands
3. Mixed nerves – most nerves include both

VIII. Nerve Pathways – a nerve pathway _____
_____
_____

A. Reflex Arcs – _____
_____
_____
_____**(421)**

B. Reflex Behavior - reflexes are automatic, unconscious responses to changes occurring within or outside the body
   1. they help maintain homeostasis
   2. control swallowing, sneezing, coughing and vomiting
   3. knee jerk reflex – simple reflex that employs only 2 neurons

IX. Coverings of the central nervous system

A. the brain and spinal cord are surrounded by bone (_____ & _____ column) and protective membranes called meninges

B. Meniges – have 3 layers(453-455)
   1. _____ mater -outermost layer – tough, white fibrous connective tissue with many blood vessels & nerves
   2. _____ mater – thin, weblike membrane that lacks blood vessels
   3. _____ mater – thin, contains nerves and blood vessels
   4. arachnoid space – contains _____ fluid, which occupies the space between the arachnoid and pia maters

X. Spinal Cord – _____
_____**(461-466)**

A. Structure of the spinal cord
   1. the spinal cord consists of _____ segments, each of which gives rise to a pair of spinal nerves
   2. is characterized by a cervical and lumbar enlargement
   3. has central core of _____ matter (lacks myelin), surrounded by _____ matter (_____)

B. Functions of spinal cord – provides communication between brain and other body parts by:
   1. conduct _____ impulses
      a. _____ tracts – conduct impulses from body parts and carry sensory information to brain
      b. _____ tracts – conduct motor impulses from brain to muscles & glands
   2. serve as center for spinal reflexes

XI. Brain – is divided into 3 major portions; the _____, the _____, & the _____ stem (430)

A. Cerebrum – contains nerve centers associated with _____ and _____ functions. It also is concerned with higher functions
   1. Structure of cerebrum
      a. consists of 2 _____**(432)** hemispheres connected by nerve fibers called the corpus collosum
      b. surface is marked by ridges called _____, which are separated by _____ and _____**(433)**
      c. made up of lobes (433)
         - _____
         - _____
         - temporal
         - _____
         - the insula
      d. the outermost layer is the cerebral _____ (gray matter) (433)
      e. _____ matter is beneath, which makes up bulk of cerebrum

2. Functions of cerebrum – is concerned with _____ brain functions
    a. Three functional regions of the cerebral cortex
        - _____ areas – located in frontal lobes, helps to control muscles and speech
        - _____ areas – interpret impulses from sensory receptors, deal with touch, vision, hearing, taste & smell
        - _____ areas – analyze and interpret sensory experiences (435)
    b. Hemisphere dominance - most people have a dominant hemisphere
    c. helps to determine a person's _____ and personality
3. Ventricles & cerebrospinal fluid (432)
    a. _____ – are interconnected cavities within the cerebral hemispheres and brain stem that are filled with _____ fluid
    b. cerebrospinal fluid (CSF) – a clear liquid secreted by _____ plexuses
        - surrounds _____ & spinal cord
        - _____ & protects
        - helps maintain stable ionic concentrations

B. Brain Stem – is a bundle of nervous tissue that connects the _____ to the spinal cord. It includes the _____, midbrain, pons & _____ oblongata.(443-450)
    1. Diencephalon – located between cerebral hemispheres and above midbrain
        a. composed largely of gray matter
        b. contains the thalamus
            - serves as central relay station for _____ sensory _____
        c. contains the hypothalamus
            - plays a key role in maintaining _____, includes:
                - regulating _____ rate & blood pressure
                - regulate body _____

- regulate water balance
- control hunger
- control glandular secretions
- produce substances that stimulate pituitary gland
- regulate _____

d. contains the limbic system – involved in emotional experience & _____

2. Midbrain – located between diencephalon and pons
    a. contains _____ centers associated with eye and head movements
    b. for example – responds to sounds and moves head
3. _____ – appears as a rounded bulge on the underside of the brain stem, where it separates the midbrain from the medulla oblongata
    a. transmits impulses between cerebrum & other parts of nervous system
    b. regulates the rate of _____
4. Medulla Oblongata – enlarged continuation of spinal cord extending from pons to foramen magnum
    a. controls all ascending and descending impulses
    b. controls vital reflex centers
        - _____ center – cause hr to increase or decrease
        - _____ center – _____ and _____ blood vessels
        - _____ center – acts with pons to regulate rate of breathing

C. Cerebellum – large mass of tissue below occipital lobes of cerebrum & posterior to pons & medulla oblongata (450)
1. consists of two _____ hemispheres
2. composed of _____ matter
3. functions as a _____ center for integrating sensory information concerning the position of _____ parts
4. coordinates complex _____ movements
5. maintains _____

XII. Peripheral Nervous System – consists of the nerves that branch out from the central nervous system (CNS) and connect it to other body parts. It includes the _____ nerves and _____ nerves. It can be divided into the _____ and _____ nervous system. The somatic nervous system consists of the cranial and spinal nerve fibers that connect the _____ to the skin and muscle and control _____ activities. The autonomic nervous system include the nerve fibers that connect the CNS to the _____ organs such as the heart, stomach, intestines, glands and control _____ activities. (475)

A. Somatic Nervous System

1. Cranial Nerves(483-491)

a. _____ pairs of cranial nerves connect the brain to parts of the head, neck & trunk
b. most are mixed nerves, but some are purely sensory while others are primarily motor
c. designated by number or names
   - the number indicates the _____ in which the nerves arise from the back of the brain
   - the name describes their _____ functions
d. some are _____ (control conscious) and others are _____ (control unconscious)
e. they are:
   - _____ nerves (I) – are associated with sense of _____ and contain sensory neurons (sensory)
   - optic nerves (II) – associated with sense of _____ (sensory)
   - _____ nerves (III) – connect to muscles that raise the eyelid and move the eye (motor)
   - _____ nerves (IV) – smallest nerves that carry motor impulses that move the eyes (motor)

- _____ nerves (V) – mixed nerve with 3 divisions
    - _____ – bring impulses to the brain from the surface of the eyes (sensory)
    - _____ – transmit impulses from teeth, upper lip (sensory)
    - _____ – transmits impulses to the muscles of mastication (motor)
- _____ nerves (VI) – motor nerves that supply impulses to muscles that move the eyes
- _____ nerves (VII) – mixed nerve, has sensory nerves associated with _____ and motor nerves that transmit impulses to muscles for _____ expression
- _____ nerves (VIII) – sensory nerves that transmit impulses associated with _____
- _____ (IX) – mixed nerve associated with _____ and _____. The sensory fibers carry impulses from the pharynx, tonsils and tongue. The motor functions innervate muscles that help function in _____.
- _____ nerve (X) – mixed nerve, but primarily associated with transmitting impulses to muscles associated with _____
- Spinal _____ nerve (XI) – mostly motor nerve, transmits impulses to the muscles of the _____ and _____
- _____ nerve (XII) – motor nerve that transmits impulses to muscles that move the _____.

2. Spinal Nerves – _____ pairs of spinal nerves originate from the _____ cord. They are mixed nerves that provide two-way communication between the spinal cord and parts of the arms, legs, neck & trunk. (491)
    a. spinal nerves are grouped according to the levels from which they arise, and are numbered in sequence
        - 8 pairs of _____ nerves (C1 – C8)
        - 12 pairs of _____ nerves (T1 – T12)
        - 5 pairs of _____ nerves (L1 – L5)
        - 5 pairs of _____ nerves (S1 – S5)
        - 1 pair of coccygeal nerves
    b. the spinal cord ends at L1 and L2 vertebrae
        - the lumbar, sacral, & coccygeal nerves descend beyond the cord
        - these descending nerves form the _____ _____ **(**horse's tail)
    c. each spinal nerve has a _____ and _____ root that unite and pass through the _____ foramen
    d. after passing through the foramen the spinal nerves divide into several parts
    e. the main portion of the spinal nerves combine to form complex networks called _____
        - _____ plexuses – lie deep in the neck
        - _____ plexuses – deep within the shoulders between the neck and axillae (armpits)
        - _____ plexuses – extend from lumbar region of back into the pelvic cavity

C. Autonomic Nervous System – is the portion of the peripheral nervous system that functions _____ (autonomously) and continuously _____ conscious effort. This system controls visceral functions by _____ the actions of _____ muscle, _____ muscle, and _____. Helps to maintain _____ by regulating _____ rate, _____ pressure, _____ rate, & body temperature. (513)

1. General characteristics
    a. regulated by _____ in which the sensory signals originate from _____ within the visceral organs & _____
    b. these signals are received by nerve centers within the _____, brain stem, or spinal cord
    c. consists of 2 divisions (515)
        - _____ – is concerned with preparing the body for energy-expending, _____, or _____ situations (fight or flight)
        - _____ – most active under ordinary, _____ conditions. It also counterbalances the effects of the sympathetic division & restores the body to a resting state following a stressful experience.
2. Autonomic nerve fibers – are _____ fibers
3. Autonomic neurotransmitters (523)
    a. _____ (parasympathetic)
    b. _____ (sympathetic) – is noradrenalin