Biology 47 – Human Anatomy
West Valley College - Norris

Lecture Outline – Nervous System

I. Functions - integration & control (typically associated with rapid and/or short term activities)

A. Basic Functional Model:

\[ \text{stimulus} \rightarrow \text{sensor} \rightarrow \text{afferent pathway} \rightarrow \text{integrator} \rightarrow \text{efferent pathway} \rightarrow \text{effector} \]

B. Functional Components

1. Sensor (receptor) - detects stimuli (changes) in the external and internal environment and relay to integrative centers
2. Afferent (sensory) communication line
3. Integrator (located within the CNS) - interprets incoming sensory information and coordinate appropriate responses
4. Efferent (motor) communication line
5. Effector (a muscle or a gland) – produces an action or effect (often opposing the original stimulus)

II. Cellular Components:

A. Neurons (nerve cell): functional cell, responsible for all transmission and integration
B. Neuroglial Cells: helper cells that nourish & protect the neurons (may assist with transmission)

III. Neurons

A. General Structure

1. Cell Body (Soma, Perikaryon)
   a. nucleus (with nucleolus)
   b. Nissl bodies – both fixed (RER) and free ribosomes
2. Dendrites
3. Axon
   a. axolemma - with membrane channels
   b. axoplasm
   c. axon hillock (and initial segment)
4. Axon Terminal Branches
   a. telodendria
   b. axon terminals (synaptic terminals, boutons, knobs) - with neurotransmitter filled vesicles
5. Synapse - the junction between two cells (neuron:neuron, neuron:muscle, neuron:gland)
   a. Electrical Synapses (very rare)
   b. Chemical Synapses
      i. presynaptic cell vs. postsynaptic cell
      ii. synaptic cleft
      iii. axon terminal
         - vesicle (w/ neurotransmitter)
         - presynaptic membrane
      iv. postsynaptic membrane
         - receptor
B. Physiology (in brief – FYI)
1. Nerve Impulse
   a. Graded Potential
   b. Action Potential - an all-or-none, self propagating, non-decremental, depolarization followed by repolarization

C. Neuron Types
1. Structural Divisions (anatomical)
   a. Multipolar (most common, primarily motor neurons and interneurons)
   b. Unipolar (primarily sensory neurons)
   c. Bipolar (rare, retina and olfactory epithelium)

2. Functional Divisions (physiological)
   a. Afferent (sensory) - transmits information to the CNS (from a sensor)
   b. Efferent (motor) - transmits information from the CNS (to an effector)
   c. Interneuron (association neuron) - transmits information within the CNS (fully in CNS)

IV. Neuroglia
A. Peripheral NS
   1. Schwann cells
      a. myelin sheath

B. Central NS
   1. Oligodendrocytes
      a. myelin sheath
   2. Astrocytes
   3. Microglia
   4. Ependymal Cells

V. Major Anatomical Divisions of the Nervous System
A. Central Nervous System (CNS)
   1. Brain
   2. Spinal Cord

B. Peripheral Nervous System (PNS)
   1. Nerves

C. Macroscopic Structure – Organization of Neurons
   1. Collections of Neuron Cell Bodies and Dendrites (Grey Matter)
      a. Nuclei: clusters of cell bodies within the central nervous system (CNS)
         note: grey matter is actually described several ways; grey matter forming the cortex of the cerebrum and cerebellum, grey matter forming the spinal cord grey, and grey matter forming nuclei (nuclei are deep in the brain and brain stem)
      b. Ganglia: clusters of cell bodies within the peripheral nervous system (PNS)
         note: found predominantly as part of the dorsal spinal roots (sensory neurons) and collateral ganglia (of the autonomic nervous system)
2. Collections of Axons (White Matter)
   a. Tracts: bundles of axons within the central nervous system (white matter)
   b. Nerves: bundles of axons (nerve fibers, white matter) that make up the bulk of the peripheral nervous system (nerves = bundles of axons)

VI. Structure of the Peripheral Nervous System
A. Nerve Structure
   1) Coverings
      i. Epineurium - encloses the nerve
      ii. Perineurium - encloses fascicles (bundles of axons) within the nerve
      iii. Endoneurium - encloses individual axons (nerve fibers)

B. Sensory Division (afferent) – transmits information from the periphery (sensory structures) to the CNS
   1) General (somatic or somasthetic)
      a. Cutaneous (exteroceptors)
      b. Visceral (interoceptors)
      c. Proprioceptors

   2) Special Senses

C. Motor Division (efferent) – transmits information from the CNS to the periphery (effectors)
   1) Somatic Nervous System: conscious division of sensory and motor nervous system
   2) Autonomic Nervous System: unconscious division of the motor nervous system
      a. Sympathetic Autonomic Nervous System (SANS): prepares body systems for stressful situations (i.e. fight or flight response)
       i. Preganglionic Neuron
       ii. Postganglionic Neurons
       iii. Paravertebral Ganglion Chain (sympathetic chain)
          - white ramus communicantes
          - gray ramus communicantes
       iv. Collateral Ganglia
      b. Parasympathetic Autonomic Nervous System (PANS): returns body systems to normal restful conditions (i.e. rest and digest)
       i. Preganglionic Neuron
       ii. Postganglionic Neurons

IX. Additional Key Terms
agonist   antagonist   cortex   excitatory   fissure   ganglia
gyrus     inhibitory   myelin   nerve      nucleus   presynaptic
postsynaptic potential sulcus   tract      tone