Chapter 28 Notes – Nervous Systems

28.1: **Nervous systems** receive **sensory** input**,** interpret it, and send out appropriate commands.

- **Nervous systems** are the most intricately organized data processing systems on Earth.
- The nervous system is made up of the **central nervous system (CNS),** which consists of the brain and spinal cord and the **peripheral nervous system (PNS)**, the nerves.
- The nervous system fulfills three interconnected functions, **sensory input**, (sending of signals from receptors to integration centers) **integration**, (interpretation of the sensory signals) and **motor output** (conduction of signals from integration centers to **effector cells**).

28.2: **Neurons** are the functional units of the **nervous system.**

- Neurons consist of a **cell body** from where **dendrites** and **axons** originate.
- **Gilia** are outnumbering neurons that are essential to the normal functioning of the nervous system.
- **Synaptic Clefts** and **synaptic terminals** are located at the terminus of each neuron.

Nerve Signals & Their Transmission

28.3: A **neuron** maintains a **membrane potential** across its membrane

- The neuron's **resting potential** is slightly **negative**, and the interstitial fluid surrounding the cell is **positive**.
- The **sodium potassium pump** selectively controls the movement of sodium and potassium across the membrane.

28.4 The nerve **signal** begins as a change in the membrane potential when a **stimulus** is present.

- A stimulus opens some NA^+ channels, which trigger **action potential** from **threshold**. (-50 mV) When NA^+ channels are open, K^+ channels are closed and the interior of the cell becomes more positive. The K^+ channels then open and K^+ rushes out of the axon. As the channels close relatively slowly, a brief undershot occurs in the membrane potential.

28.5: **Action potential** moves itself across the neuron's axon segments, generating an **impulse**.

- The **frequency** of each action potential leads to changes in the intensity of the stimuli.

28.6: The **synaptic cleft** is where **communication** occurs **between** the **sending neuron and** the **receiving neuron** through **vesicles** fusing with the **plasma membrane.**

- The **synapse** prevents the action potential from jumping between neurons.
- Through **ion channels** (facilitated diffusion), neurotransmitters are entered into the receiving neuron.

28.7: The many **synapses** located on the dendrites allow for complex information processing to be possible.

- A **receiving neuron's** membrane may receive signals - both **excitatory** and **inhibitory** – from many different **presynaptic neurons**.

28.8: Many **molecules** function as **neurotransmitters**.

- **Acetycholine** is in the brain and present between motor neurons and muscle cells.
- **Biogenicamines,** derived from amino acids, effect the CNS. **Epinephrine, norepinephrine, serotonin,** and **dopamine** are biogenicamines (and also serve as hormones).

28.9: **Medicines** act at **chemical synapses**, **altering** the effects of **neurotransmitters**.

- **Antidepressant medication** affects the action of **serotonin** (responsible for sleep, mood, attention, and learning).
- **Schizophrenia** may occur when tetrahydrocannibol (THC) binds to brain receptors normally used in anandamine.

The Animal Nervous System

28.10: The **layout** of the nervous system corresponds with **body symmetry.**

- **Nerve nets,** a diffuse, web like system of neurons, are present in hydra. Although the nerve net has no central or peripheral divisions, the nerve net can still control the contractions of the digestive cavity.
- **Brains** are located in a **cephalized** region of an organism. This causes **centralization.**
- **Nerve chords** control an animal's movements.

28.11: The nervous system in vertebrates contains a **brain, spinal chord, cranial nerves, spinal nerves and ganglia.**

28.12: The **peripheral nervous** system is in a **functional hierarchy**, split between the **somatic** and **autonomitic nervous systems.**

- The **somatic nervous system** carries signals to and from **skeletal muscles.**
- The **autonomic nervous system regulates** the **internal environment**, controlling **sympatetic division**, **parasympathetic division**, and **enteric division**.

28.13: The **sympathetic** and **parasympathetic** neurons oppose each other, regulating the internal environment.

- **Parasympathetic division** primes the body for activities that gain and **conserve energy** for the body.
- **Sympathetic division** prepares the body for intense, **energy consuming** activities.
- Sympathetic division allows for a **flight or fight response**.

The Human Brain

28.14: **Brains** in vertebrates develop from bulges of the **neural tube**, the **forebrain**, **midbrain**, and **hindbrain**.

- The **forebrain** divides into the **cerebrum** and the **diencephalon**.

- The **midbrain** becomes part of the **brainstem**.
- The **hindbrain** divides into the **Pons**, **medulla oblongata** (part of brainstem) and **cerebellum**.
- The **cerebrum** is the most sophisticated center of nervous activity.

28.15: The **human brain** is made up of the **brainstem, cerebellum, thalamus, basal ganglia, and the cerebral hemispheres.**

- The **brainstem** is made up of he **Pons** and **medulla.** The brainstem controls many involuntary actions, such as breathing.
- The **Cerebellum** coordinates body movement; playing a roll in learning and the memorization of immune responses.
- The cell bodies that relay information to the cerebral cortex are located in the **thalamus.** The information is sorted in the thalamus as well.
- The **Basal ganglia,** located under the **corpus callosum** contains neurons important in motor coordination.
- **The cerebral hemispheres** are responsible for the opposite sides of the body from which they are located.

28.16: The **cerebral cortex** contains a plethora of **specialized regions**.

- The **cerebral cortex** is divided into a **frontal lobe, parietal lobe, occipital lobe, and temporal lobe.**
- **Lateralization** is a phenomenon where the cortex becomes specialized.

28.17: **Injuries** and brain operations provide a greater insight into the overall function of the brain

- **Phineas Gage** had two pierced frontal lobes in his brain. People with these injuries often exhibit irrational decision-making.

28.18: **Sleep** and **arousal** are regulated by different parts of the brain**.**

- The lower the rate of metal activity, the more regular the brain waves are on an EEG (**Electroencephalogram**)
- A sleep cycle alternates between two types of deep sleep – short wave sleep / **delta waves** and **REM sleep**.
- **Dreams** occur during **REM sleep**.

28.19: **The limbic system** is involved in emotions, memory, and learning.

- The **hippocampus** is involved in both the formations of memory and their recall.

28.20: The nervous system has many **neurological disorders**, produced by changes in **brain physiology**.

- **Schizophrenia** is a severe mental disturbance where patients loose their ability to distinguish reality.
- **Depression** and **bipolar disorder** have a genetic component, yet are environmentally driven. SSRIs are now used to combat depression.
- **Alzheimer's disease** is a form of dementia. In Alzheimer's disease, certain sections of brain tissue either shrink or die.
- **Parkinson's disease** is a motor disorder where movements are slowed. Parkinson's, a progressive neurological disease, sadly has no cure. Current treatments for Parkinson's include drugs such as L-dopa, and surgery.