**Nervous System Notes Part 1: Neural Physiology**

|  |  |
| --- | --- |
| **Questions** | **Notes** |
| **List the structures found in the nervous system.**  **What is the function of the nervous system?**  **What are impulses?**  **What is the name of the cells of the nervous system?**  **What are the 3 types of neurons and what direction do the impulses travel in each?**  **What is the largest structure in the neuron?**  **What structure carries impulses from the environment?**  **What do nodes do to the speed of an impulse?**  **What are myelin sheaths?**  **What is the charge in and out of the cell in a resting neuron?**  **What 2 molecules are responsible for starting an action potential?**  p898  **What happens when the neuron becomes stimulated?**  **What is an action potential?**  **Where does the impulse travel?**  **Where does the transfer of an impulse occur?**  **What are neurotransmitters?**  **Describe the steps of transmitting an impulse from one neuron to the next.**  **What is re-uptake?**  **Compare and contrast excitatory vs. inhibitory NTs?**  **What is the effect of GABA?**  **What is glutamate involved with?**  **What are the effects of dopamine? How is it involved in addiction?**  **What does serotonin regulate?**  **When are endorphins inhibitory?**  **How do drugs interfere with NTs?**  **What is addiction?** | **I. Overview of the Nervous System**  35-2_01   * Structures: \_\_\_\_\_\_\_\_\_\_\_, spinal cord, & peripheral nerves * Function: Recognizes and \_\_\_\_\_\_\_\_\_\_\_\_\_\_the body’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in its internal and external environments * The ultimate control of all the organ systems is done by the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ system.   **A. Neurons**   * *\_\_\_\_\_\_\_\_\_\_\_\_\_* are \_\_\_\_\_\_\_\_\_\_\_\_\_\_ cells that carry electrical \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ through the body. * **Impulse = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** * Neurons are classified according to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ an impulse travels * There are 3 types of neurons: * 1) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ neurons: carry impulses from the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to the brain. * 2) \_\_\_\_\_\_\_\_\_\_\_\_\_\_ neurons: carry impulses from the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to muscles and glands. * 3) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: connect sensory and motor neurons and process impulses (found mainly in the brain and spinal cord)   **B. Structure of a Neuron (In order of the path of the impulse)**  1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: receives impulses  2. \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_: contains nucleus & cytoplasm, largest part of cell  3. \_\_\_\_\_\_\_\_\_\_\_\_: transmit impulses away from cell body  4. \_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_: covering that insulates the axon, sending the impulse faster and gives axons a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ appearance   * Neurons with axons that have myelin make up “\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_” in the brain, while neurons without myelin are called “\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_”.   5. \_\_\_\_\_\_\_\_\_\_: gaps in the myelin sheath where membrane is exposed.  Impulses jump from one node to the next  6. \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_: transmits impulse (message) to next cell  **II. Transmission of an Impulse**   * A nerve impulse is an electrical message. * At rest, no impulse is being sent. * The neuron must be stimulated (receive input) to send an impulse.   **A. Resting Neuron**   * **STEP 1:** At rest, the neuron is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ an impulse.   + inside of neuron has a net \_\_\_\_\_\_\_\_\_\_\_\_\_\_ charge (-)   + outside of neuron has a net \_\_\_\_\_\_\_\_\_\_\_\_\_ charge (+) * The cell membrane has \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, the potential to carry and electrical current because there is a difference in charge.   + The ions \_\_\_\_\_\_\_\_\_\_\_\_\_\_ (Na+) and \_\_\_\_\_\_\_\_\_\_\_\_ (K+) cause the potential * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the nerve cell membrane pumps \_\_\_\_\_\_\_\_\_\_\_\_\_ (Na+)ions \_\_\_\_\_ of the cell and \_\_\_\_\_\_\_\_\_\_\_\_\_\_ (K+) ions \_\_\_\_\_\_\_\_ the cell by means of active transport. * As a result, the inside of the cell contains more K+ ions and fewer Na+ ions than the outside.   **B. Stimulated Neuron**   * **STEP 2:** An impulse begins when a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ by another neuron or by the environment.   + The stimulated impulse must reach \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, the minimum impulse strength needed to create a new impulse (all or none) * **35-7_0335-7_02STEP 3:** At the leading edge of the impulse, gates in the sodium channels open allowing positively charged \_\_\_\_\_\_\_\_\_\_\_\_\_\_ (Na+) ions to flow \_\_\_\_\_\_\_\_\_\_\_ the cell membrane. * This \_\_\_\_\_\_\_\_\_\_\_\_\_\_ of charges is called a nerve impulse, or an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (AP).        * 48_15SaltatoryConduction_LAs the action potential passes, gates in the potassium channels open, allowing \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (K+) ions to flow \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_   + This restores the negative potential inside the axon. * **STEP 4**: The AP jumps from node to \_\_\_\_\_\_\_\_\_ along theaxon * **STEP 5**: The AP continues along the axon in one direction to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_   **C. Synapse**   * **Synapse:** the space where the axon terminal of one neuron can transfer and impulse to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_   + The small space between cells is called the synaptic cleft.   + Axon terminals contain vesicles filled with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.      * **Neurotransmitters (NTs)** are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that transmit an impulse across a synapse to another cell   + NTs fit like a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ with receptors * **Steps of Transmission**   + **STEP 6:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ reaches the axon terminal   + **STEP 7**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is released from vesicles into the synaptic cleft   + **STEP 8**: Neurotransmitter binds to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on next neuron.   + **STEP 9:** Channels open, which creates a new action potential in the next neuron * **Re-uptake of Neurotransmitters**   + Re-uptake: after the NT has done its job, it is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ into the axon terminal so it can be used again or broken down.     **III. Types & Effects of Neurotransmitters (NTs)**   * There are dozens of different NTs, but a few do most of the work. * Each NT fits with its own specific receptor.   + It won’t cause a response without the right receptor. * NTs can be excitatory or inhibitory   + Excitatory NTs \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the next neuron   + Inhibitory NTs \_\_\_\_\_\_\_\_\_\_ and impulse from being sent in the next neuron * **Major Neurotransmitters** * 1) GABA – Inhibitory   + Effects: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, calming, anti-anxiety, and sleep   + Depressant drugs like heroin, marijuana, and alcohol intensify effects of GABA * 2) Glutamate – Excitatory   + Effects: Stimulates \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ formation   + Some drugs can interfere with glutamate, causing short-term memories not to be formed * 3) Dopamine – Excitatory   + Effects: \_\_\_\_\_\_\_\_\_\_\_\_\_\_, Euphoria, Reward-centers, addiction, positive reinforcement, movement and posture   + Most addictive drugs (cocaine, PCP, heroin, opiates, marijuana, and amphetamines) work by flooding the synapse with dopamine * 4) Serotonin – Excitatory   + Effects: Sleep, \_\_\_\_\_\_\_\_\_\_\_\_, appetite, pain, body temperature   + Low serotonin linked to depression, suicide, impulsive behavior, and aggression   + Alcohol, stimulants, marijuana and hallucinogens alter serotonin levels * 5) Endorphins – Excitatory & Inhibitory   + Effects: alertness, blocks pain, happy (runner’s high), sexual arousal   + Often released after physical activity * 6) Norepinephrine – Excitatory   + Effects: alertness, energy, stress, sexual arousal * 7) Acetylcholine – Excitatory   + Effects: alertness, memory, muscle contraction, appetite, sexual arousal   **IV. Effects of Drugs**   * Many prescription and illegal drugs can alter the brain’s chemistry.   + Many drugs are \_\_\_\_\_\_\_\_\_\_\_\_\_\_ (enhancers) of certain neurotransmitters that cause many of the pleasurable sensations of drugs and lead to addiction.   + Addiction: chemical dependency on a substance as a result of it altering the brain’s chemistry after repeated use. * **Ways Drugs interfere with Neurotransmission**   + 1) Increase number of impulses   + 2) Release NT from vesicles with or without an impulse   + 3) Block reuptake or block receptors   + 4) Produce more or less NT   + :soa_014_large.jpg5) Prevent vesicles from releasing NT |

**Learning Goals**

1. Describe the function and main structures of the nervous system.
2. Describe the state of a resting neuron, including the charges inside and outside the cell.
3. Explain how an impulse is sent through a neuron, including what an action potential is.
4. Explain how an impulse is sent from one neuron to the next at the synapse, including the role of neurotransmitters.