Nervous System Worksheet

Section A: Intro to Nervous System
The Nervous System regulates and coordinates activities within the body. It detects, interprets and responds to changes that occur internally and externally. Sensory receptors gather information and send electrical impulses via sensory neurons to the Central Nervous System (CNS – spinal cord and brain). Electrical impulses are processed and generate appropriate reactions by sending electrical impulses via motor neurons to effector organs such as muscle and glands.

1. The CNS is composed of the __________________________.
2. What is the function of the brain? __________________________
3. What is the function of sensory neurons? __________________________
4. What is the function of motor neurons? __________________________

Section B: Divisions & Functions
1. The Nervous System has 3 major functions. Identify the function based on its description.
   a. _______________________: receives the stimuli and takes information to the CNS.
   b. _______________________: make decisions/process information.
   c. _______________________: the act of carrying a response to a gland or muscle.
2. The motor pathway carries information (to / away from) the central nervous system. __________
3. The sensory pathway carries information (to / away from) the central nervous system. __________
4. The (CNS/PNS) is made up of the brain and spinal cord. __________
5. The (CNS/PNS) is made up of the nerves that lead to and from the brain and spinal cord. __________
6. Which sensory division carries information from the skin, skeletal muscles and joints to the CNS? __________
7. Which sensory division carries information from the visceral organs to the CNS? __________
8. Which motor division conducts information from the CNS to the skeletal system? __________
9. The ANS is commonly referred to as the involuntary division – why would it be called this?
10. The ANS is further divided into the __________________________.
11. The (parasympathetic/sympathetic) division of the nervous system mobilizes the body in emergency situations making someone more alert. It causes a person to get the adrenaline rush in times of anxiety, anger, excitement resulting in an increased respiration rate, increased perspiration, etc…
12. The (parasympathetic/sympathetic) division of the nervous system regulates your body’s activities under “normal”/stable conditions i.e. times when your emotional state is normal
13. Identify which division and function of the nervous system. Put a check in the appropriate boxes.

<table>
<thead>
<tr>
<th>Division of the Nervous System</th>
<th>Nervous System Functions</th>
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<tbody>
<tr>
<td>CNS</td>
<td>PNS</td>
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<tr>
<td>A. Brain</td>
<td></td>
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<tr>
<td>B. Glands secrete substances</td>
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<tr>
<td>C. Getting “chill bumps”</td>
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<tr>
<td>D. Hearing a noise</td>
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<tr>
<td>E. Processing</td>
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<tr>
<td>F. Sweating</td>
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<tr>
<td>G. Picking up an object</td>
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<tr>
<td>H. Tasting something</td>
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</table>
Section C: Neuroglia
1. What are the functions of neuroglia cells?________________________________________________________

2. List 2 characteristics of neuroglia cells. _________________________________________________________

Match the neuroglia cell with the correct function:
- astrocytes
- microglia
- ependymal
- oligodendrocytes
- schwann cells
- satellite cells

3. ___________________ Cells that produce the myelin in the PNS.
4. ___________________ Cells that produce the myelin in the CNS.
5. ___________________ Phagocytes that dispose of debris such as dead brain cells and bacteria.
6. ___________________ Anchors and braces neurons with cellular projections.
7. ___________________ Cells have cilia that help circulate the cerebrospinal fluid.
8. ___________________ Cells help cushion and protect neurons in the PNS.
9. ___________________ Cells serve as a medium for diffusion between capillaries and neurons.
10. ___________________ Cells line cavities of the brain and spinal cord.

Section D: Neurons
1. What is the function(s) of neurons? ______________________________________________________________

2. Sam was diagnosed with a brain tumor. Which type of cells would be dividing uncontrollably by mitosis to form the tumor – neuroglia or neurons? __________________________

Match the parts of a neuron with the correct function.
- nodes of ranvier
- axon terminals
- axon hillock
- axon
- dendrites
- synapse
- myelin
- soma
- synaptic cleft

3. ___________________ Contains the nucleus and is the metabolic center of cell
4. ___________________ Slender fibers that conduct impulses toward the soma
5. ___________________ Junction of two neurons
6. ___________________ Space between the axon terminal of one neuron & the dendrites of another
7. ___________________ Long fiber that extends from soma and conducts impulses away from soma
8. ___________________ End branches that contain neurotransmitter storage vesicles
9. ___________________ Gaps found between the myelin sheaths
10. ___________________ Fatty material that protects fibers and speeds up impulse transmission
11. ___________________ Part of the soma that connects to the axon

12. Label the neuron.
   A. _______________________________
   B. _______________________________
   C. _______________________________
   D. _______________________________
   E. _______________________________

13. Explain how an impulse is transmitted through a neuron starting at the sensory receptors.
   ___________________________________________________________
   ___________________________________________________________
   ___________________________________________________________
Section E: Types of Neurons
In sensory (afferent) neurons, the dendrites contain sensory receptors and change information from external sources, such as light waves into electrical impulses. In motor neurons, the axons send electrical impulses to stimulate effector organs (muscles). Interneurons connect afferent and efferent neurons allowing them to communicate. Interneurons are located entirely within the CNS. Sensory neurons conduct impulses from the sense organs to the spinal cord where interneurons form ascending tracts that transmit sensory impulse to the brain for integration. Impulses are transmitted from the brain by interneurons that form descending tracts in the spinal cord. Motor neurons conduct impulses from the spinal cord to effector organs.

1. What is the function of the afferent neurons? ________________________________________
2. What is the function of interneurons? ________________________________________________
3. What is the function of efferent neurons? _____________________________________________
4. Where are the sensory receptors located on a neuron? _________________________________
5. Which neurons cause movement or action in an organ? _________________________________
6. What are ganglia? ___________________________________________________________________
7. Which neuron has ganglia in the PNS? _________________________________________________
8. Describe the path of a stimulus from sensory receptor to motor neuron. ____________________

Section F: Neuron Physiology
1. Nervous tissue possesses two distinctive properties – irritability and conductivity. Define these terms.
   a. Irritability - _____________________________________________________________________
   b. Conductivity - ____________________________________________________________________
2. Using the diagram, compare the conduction rate in an unmyelinated fiber and a myelinated fiber. Which fiber conducts an impulse faster? Explain your answer. ____________________________________________

(a) Continuous conduction
(b) Saltatory conduction
3. An inactive neuron is polarized. What is meant by polarized?

4. What causes depolarization?

5. What causes repolarization?

6. What is the function of Ca+?

7. What happens to create an action potential?

8. What is the function of the Na+/K+ pump?

9. What is threshold stimulus?

10. Where do action potentials usually originate in a neuron?

11. What’s the difference between graded potential and action potential?

12. Illustrate a polarized, depolarized and repolarized membrane.

**BONUS:**

Neurotransmitters are chemicals which carry the impulse from one neuron to the next neuron. These chemicals allow the transmission of signals across the synapse.

- Acetylcholine – stimulates muscle contractions and causes glands to secrete hormones.
- GABA (gamma-aminobutyric acid) – an inhibitory neurotransmitter; causes cells to be less excitable.
- Serotonin – an inhibitory neurotransmitter involved in mood and emotion. It brings about a sense of emotional well-being and helps to regulate sleep. (Low levels lead to depression.)
- Dopamine – controls mood and motivation. Drives our internal feelings of reward and pleasure. It has an important role in learning. (Drugs such as cocaine and alcohol increase the levels of dopamine. Schizophrenia is associated with increased levels of dopamine.)
- Norepinephrine – is released to stimulate our sympathetic nervous system and put our body into ‘high alert’. (Exercise increases the release of norepinephrine and stress decreases it.)
- Glutamate – an excitatory neurotransmitter which plays a role in memory. (Excessive amounts of glutamate due to brain damage will kill neurons. ALS results from excessive glutamate production.)
- Endorphins – an inhibitory neurotransmitter involved in pain reduction and pleasure.

http://webspace.ship.edu/cgboer/gensy/neurotransmitters.html

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**Section G: CNS - Cerebrum**

1. Label the 4 parts of the brain.
   a. __________________________
   b. __________________________
   c. __________________________
   d. __________________________

2. What are the elevated ridges of tissue on the cerebrum called? __________________________

3. The ridges are separated by shallow grooves called __________________________.

4. What are the deeper grooves called? __________________________

5. What is the bundle of myelinated fibers that allow the left and right cerebral hemisphere to communicate? __________________________
Speech, memory, logical and emotional response, consciousness, interpretation of sensation and voluntary movement are all functions of the cerebrum. Identify which lobe controls the following activities:

6. Primary motor area that allows us to consciously move our skeletal muscles. 

7. Somatic sensory area - recognize pain, temperature or touch from the skin.

8. Primary visual area.

9. Primary auditory and olfactory areas.

10. Ability to speak – Broca’s area.

11. Higher intellectual reasoning.

12. Cerebral Cortex
   a. What is the outermost cerebral cortex consists of?
   b. What is the function of the cerebral cortex?
   c. Describe what the fibers in this area.

13. Cerebral Medulla
   a. What is the innermost cerebral medulla consists of?
   b. What is the function of the cerebral medulla?
   c. Describe the fibers in this area.

14. What is the function of basal nuclei?

15. In 1861, Paul Broca, a French neurosurgeon, examined the brain of a recently deceased patient who had had an unusual disorder. Though he had been able to understand spoken language and did not have any motor impairments of the mouth or tongue that might have affected his ability to speak, he could not speak a complete sentence. When Broca autopsied the brain, he found a sizable lesion in the left inferior frontal cortex.

Ten years later, Carl Wernicke, a German neurologist, discovered an area involved in understanding language, in the posterior portion of the left temporal lobe. People who had a lesion at this location could speak, but their speech was often incoherent and made no sense. Neuroscientists now agree that running around the lateral sulcus in the left hemisphere of the brain, there is a sort of neural loop that is involved both in understanding and in producing spoken language.

- What’s the function of the Broca’s area?
- What’s the function of the Wernicke’s area?
- In which hemisphere do you find these areas?
- Do the lobes work independently of each other? Explain your answer.

Section H: Stroop Effect Lab  (adapted from http://faculty.washington.edu/chudler/words.html)

Psychologist John Stroop studied the processing of words and how these thought processes affected other mental tasks. He found that the brain must override an automatic response when it receives conflicting information or inference. This is called the Stroop Effect.

1. Use the cards that have the words in their own color. Have a partner time and record how long it takes for you to say the color of the word. Record your data. Repeat this step.

2. Use the cards that have the words in different colors. Have a partner time and record how long it takes for you to say the color of the word. Record your data. Repeat this step.

<table>
<thead>
<tr>
<th>Words in their own color</th>
<th>Time (sec)</th>
<th># Correct (c) or Incorrect (i)</th>
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<th>Total incorrect responses:</th>
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<th>Words in a different color</th>
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<th># Correct (c) or Incorrect (i)</th>
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<th>Total incorrect responses:</th>
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</table>
Section I: CNS – Diencephalon, Cerebellum & Brainstem
1. Maintains homeostasis. Control centers for regulating hunger, sleep, thirst, body temperature, water balance and blood pressure. Control pituitary gland. ______________________________________
2. Central relay station for sensory impulses traveling from everywhere else to the cerebrum. Receives all sensory impulses except smell and sends them to correct region of the cerebral cortex to be interpreted. ______________________________________
3. Contains the pineal gland which secretes the hormone melatonin. ______________________________________
4. System of pathways connects frontal lobes, temporal lobes, thalamus and hypothalamus – involved in emotions and memory. ______________________________________
5. Responsible for feelings of anger, fear, pleasure, affection and sexual interest. ______________________________________
6. Involved in learning and memory – links emotion to stored memories. ______________________________________
7. Part of Brainstem: Centers for regulating heartbeat, breathing and blood pressure. Reflex centers for vomiting, coughing, sneezing and swallowing. ______________________________________
8. Part of Brainstem: Relay station for tracts that run between cerebrum, spinal cord and cerebellum. Reflex centers for visual, auditory and tactile responses. ______________________________________
9. Coordinates muscles – integrates impulses from higher centers to produce smooth and graceful motion. Maintains normal muscle tone and posture. ______________________________________
10. Part of Brainstem: Coordinates with medulla to regulate breathing. ______________________________________
11. Functions to maintain cortex in alert conscious state. ______________________________________

Section J: PNS – Spinal Cord
1. The spinal cord provides a two way conduction pathway to and from the brain. What is the other function? ______________________________________
2. What happens to the body if the dorsal root is damaged? ______________________________________
3. What happens to the body if the ventral root is damaged? ______________________________________
4. What happens to the body if the spinal nerve is damaged? ______________________________________
5. The meninges are a connective tissue membranes composed of three layers. Identify the layer.
   a. Tough double-layered membrane is attached to the skull and forms the outermost covering of the brain and spinal cord. Forms channels called dural sinuses that collect and return venous blood to circulation. ______________________________________
   b. The middle layer has threadlike extension spanning the space to attach it the innermost membrane. The space is filled with CSF. ______________________________________
   c. The innermost layer clings tightly to the surface of the brain and spinal cord following every fold. ______________________________________
6. What forms the cerebrospinal fluid? ______________________________________
7. What is the function of the CSF? ______________________________________
8. CSF circulates through ventricles, into the central canal of spinal cord, into the subarachnoid spaces and returns to veins of the brain where it drains into the dural sinuses and returns to the blood. If the production and drainage is blocked, what happens? ______________________________________
9. What is the blood-brain barrier? ______________________________________

Section K: PNS - Nerves
1. What is a nerve? ______________________________________
2. Explain the relationship between the endoneurium, perineurium, fascicle and epineurium. ______________________________________
3. What are reflexes? ______________________________________