|  |
| --- |
| **True / False**  |

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| 1. Dendrites contain the nuclei, ribosomes, mitochondria, and other structures found in most cells.

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| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

|  |  |
| --- | --- |
| *ANSWER:* | False |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 2. Neurons receive information and transmit it to other cells.

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| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

|  |  |
| --- | --- |
| *ANSWER:* | True |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
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| 3. An afferent axon brings information into a structure.

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| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

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| --- | --- |
| *ANSWER:* | True |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
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| 4. An efferent axon carries information away from a structure.​

|  |  |  |
| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

|  |  |
| --- | --- |
| *ANSWER:* | True |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
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| 5. The greater the surface area of a dendrite, the more information it can receive from other neurons.​

|  |  |  |
| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

|  |  |
| --- | --- |
| *ANSWER:* | True |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
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| 6. Neurons are distinguished from other cells by their shape.​

|  |  |  |
| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

|  |  |
| --- | --- |
| *ANSWER:* | True |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
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| 7. Glial cells serve many functions.​

|  |  |  |
| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

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| --- | --- |
| *ANSWER:* | True |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
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| 8. Glial cells transmit information across long distances.​

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| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

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| --- | --- |
| *ANSWER:* | False |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
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| 9. Schwann cells build the myelin sheaths in the periphery of the body.​

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| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

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| --- | --- |
| *ANSWER:* | True |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 10. ​The blood-brain barrier is made up of closely packed glial cells.

|  |  |  |
| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

|  |  |
| --- | --- |
| *ANSWER:* | False |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Blood-Brain Barrier |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.02 - Summarize how the blood–brain barrier relates to protection and nutrition of neurons. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 11. ​The difference in voltage in a resting neuron is called the resting potential.

|  |  |  |
| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

|  |  |
| --- | --- |
| *ANSWER:* | True |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 12. Increasing the electrical gradient for potassium will reduce the tendency for potassium ions to exit the neuron.​

|  |  |  |
| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

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| *ANSWER:* | True |
| *DIFFICULTY:* | Bloom’s: Analyze |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 13. At the resting potential, the potassium channels are completely closed and the sodium channels are almost closed.​

|  |  |  |
| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

|  |  |
| --- | --- |
| *ANSWER:* | False |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 14. A prolonged increase in the permeability of the membrane to sodium ions would interfere with a neuron's ability to have an action potential.​

|  |  |  |
| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

|  |  |
| --- | --- |
| *ANSWER:* | True |
| *DIFFICULTY:* | Bloom’s: Analyze |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 15. Both dendrites and cell bodies are capable of producing action potentials.​

|  |  |  |
| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

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| --- | --- |
| *ANSWER:* | False |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| **Multiple Choice** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| 16. The two basic kinds of cells in the nervous system are \_\_\_\_\_.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​neurons and glia |
|   | b.  | ​dendrites and axons |
|   | c.  | ​ribosomes and lysosomes |
|   | d.  | ​neurons and axons |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 17. Santiago Ramon y Cajal demonstrated that \_\_\_\_.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​at rest, the neuron has a negative charge inside its membrane |
|   | b.  | ​neurons are separate from one another |
|   | c.  | ​neurons communicate at specialized junctions called synapses |
|   | d.  | ​action potentials follow the all-or-none law |

|  |  |
| --- | --- |
| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 18. Which scientific work did Cajal apply to his study of infant brains?​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​Charles Sherrington's study of reflexes |
|   | b.  | ​Camillo Golgi's cell staining method |
|   | c.  | ​Perves & Hadley's dye injection method |
|   | d.  | ​Galileo's invention of the telescope |

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| *ANSWER:* | a |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 19. The cell membrane is composed of two layers of \_\_\_\_\_.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​protein |
|   | b.  | ​fat |
|   | c.  | ​carbohydrate |
|   | d.  | ​plasma |

|  |  |
| --- | --- |
| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 20. Neurons differ most strongly from other body cells in their \_\_\_\_.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​temperature |
|   | b.  | ​shape |
|   | c.  | ​osmotic pressure |
|   | d.  | ​mitochondria |

|  |  |
| --- | --- |
| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 21. What do neurons have that other cells do not?​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​a plasma membrane |
|   | b.  | ​large, branching extensions |
|   | c.  | ​protein channels |
|   | d.  | ​an endoplasmic reticulum |

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| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 22. What structure is composed of two layers of fat molecules that are free to flow around one another?​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​the endoplasmic reticulum |
|   | b.  | ​a ribosome |
|   | c.  | ​a mitochondrion |
|   | d.  | ​the membrane |

|  |  |
| --- | --- |
| *ANSWER:* | d |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
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| 23. Water, oxygen, and \_\_\_\_ most freely flow across a cell membrane.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​calcium |
|   | b.  | ​positively charged ions |
|   | c.  | ​magnesium |
|   | d.  | ​carbon dioxide |

|  |  |
| --- | --- |
| *ANSWER:* | d |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Blood-Brain Barrier |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.02 - Summarize how the blood–brain barrier relates to protection and nutrition of neurons. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 24. The structure that contains a cell’s chromosomes is called the \_\_\_\_.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​endoplasmic reticulum |
|   | b.  | ​nucleus |
|   | c.  | ​mitochondrion |
|   | d.  | ​ribosome |

|  |  |
| --- | --- |
| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 25. Small, charged molecules can cross the cell membrane through \_\_\_\_.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​diffusion |
|   | b.  | ​ribosomes |
|   | c.  | ​mitochondria |
|   | d.  | ​protein channels |

|  |  |
| --- | --- |
| *ANSWER:* | d |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Blood-Brain Barrier |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.02 - Summarize how the blood–brain barrier relates to protection and nutrition of neurons. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 26. Protein channels allow \_\_\_\_ molecules to cross the cell membrane.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​large charged |
|   | b.  | ​small charged |
|   | c.  | ​large uncharged |
|   | d.  | ​small uncharged |

|  |  |
| --- | --- |
| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Blood Brain Barrier |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.02 - Summarize how the blood–brain barrier relates to protection and nutrition of neurons. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 27. Ribosomes are the part of a cell that \_\_\_\_.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​performs metabolic activities |
|   | b.  | ​breaks down harmful chemicals |
|   | c.  | ​transports proteins |
|   | d.  | ​synthesizes new proteins |

|  |  |
| --- | --- |
| *ANSWER:* | d |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 28. The endoplasmic reticulum is a \_\_\_\_.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​network of thin tubes that transport newly synthesized proteins |
|   | b.  | ​site where the cell synthesizes new protein molecules |
|   | c.  | ​structure that separates the inside of the cell from the outside |
|   | d.  | ​structure that contains the chromosomes |

|  |  |
| --- | --- |
| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 29. Dendrites \_\_\_\_.​

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|   | a.  | ​contain the nucleus, ribosomes, and other structures found in most cells |
|   | b.  | ​are branching fibers that get narrower near their ends |
|   | c.  | ​are thin fibers of constant diameter |
|   | d.  | ​are an insulating material that cover an axon |

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| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
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| 30. The branching fibers that form the information-receiving pole of the nerve cells are called \_\_\_\_\_.​

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|   | a.  | ​motor neurons |
|   | b.  | ​dendrites |
|   | c.  | ​sensory neurons |
|   | d.  | ​axons |

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| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
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| 31. The surface of a dendrite is lined with specialized junctions through which the dendrite receives information from other neurons. What are these junctions called?​

|  |  |  |
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|   | a.  | ​synaptic receptors |
|   | b.  | ​axons |
|   | c.  | ​synaptic hillocks |
|   | d.  | ​glia |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
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| 32. The tree-like branches of a neuron that receive information from other neurons are called \_\_\_\_\_.​

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|   | a.  | ​axons |
|   | b.  | ​dendrites |
|   | c.  | ​soma |
|   | d.  | ​myelin |

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| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
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| 33. Many dendrites contain short outgrowths called spines that \_\_\_\_\_.​

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|   | a.  | ​increase the surface area available for synapses |
|   | b.  | ​increase the speed of transmission |
|   | c.  | ​eliminate cell waste products |
|   | d.  | ​increase the symmetry of the cel. |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
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| 34. As compared to dendrites, axons usually \_\_\_\_.​

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|   | a.  | ​form the information-receiving pole of the neuron |
|   | b.  | ​are shorter in length |
|   | c.  | ​are covered with myelin |
|   | d.  | ​taper in diameter toward their periphery |

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| *ANSWER:* | c |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 35. The insulating material that covers many vertebrate axons is called the \_\_\_\_.​

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|   | a.  | ​dendrite |
|   | b.  | ​myelin sheath |
|   | c.  | ​cell body or soma |
|   | d.  | ​presynaptic terminal |

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| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
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| 36. Nodes of Ranvier are \_\_\_\_.​

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|   | a.  | ​gaps in the myelin of axons |
|   | b.  | ​also known as myelin sheath |
|   | c.  | ​spiny outgrowths on dendrites |
|   | d.  | ​responsible for cell metabolism |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 37. Gaps in the insulating material that surrounds axons are known as \_\_\_\_.​

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|   | a.  | ​interpeduncular nuclei |
|   | b.  | ​nodes of Ranvier |
|   | c.  | ​myelin synapses |
|   | d.  | ​presynaptic terminals |

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| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 38. A presynaptic terminal is also known as \_\_\_\_.​

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|   | a.  | ​an end bulb |
|   | b.  | ​a node of Ranvier |
|   | c.  | ​myelin |
|   | d.  | ​a spine |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
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| 39. An axon has many branches, each of which swells at its tip. These are known as \_\_\_\_.​

|  |  |  |
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|   | a.  | ​presynaptic terminals |
|   | b.  | ​efferent axons |
|   | c.  | ​afferent axons |
|   | d.  | ​intrinsic neurons |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
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| 40. Chemicals are released by axons \_\_\_\_.​

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|   | a.  | ​into the presynaptic terminal |
|   | b.  | ​into the junction between neurons |
|   | c.  | ​through the efferent terminals |
|   | d.  | ​to the mitochondria |

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| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
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| 41. Neurons typically have one \_\_\_\_, but many \_\_\_\_.​

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| --- | --- | --- |
|   | a.  | ​dendrite; axons |
|   | b.  | ​axon; dendrites |
|   | c.  | ​cell body; axons |
|   | d.  | ​dendrite; cell bodies |

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| *ANSWER:* | b |
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| 42. As a general rule, axons convey information \_\_\_\_.​

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|   | a.  | ​toward dendrites of their own cell |
|   | b.  | ​toward their own cell body |
|   | c.  | ​away from their own cell body |
|   | d.  | ​to surrounding glia |

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| *ANSWER:* | c |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
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| 43. If you were to accidentally touch a hot stove with your hand, you would quickly pull your hand away. The information carried to the muscles in your arm to make them contract was carried by \_\_\_\_.​

|  |  |  |
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|   | a.  | ​efferent neurons |
|   | b.  | ​afferent neurons |
|   | c.  | ​intrinsic neurons |
|   | d.  | ​sensory neurons |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
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| 44. If all of a neuron's dendrites or axons were contained within the spinal cord, it would be considered a(n) \_\_\_\_ neuron.​

|  |  |  |
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|   | a.  | ​efferent |
|   | b.  | ​afferent |
|   | c.  | ​intrinsic |
|   | d.  | ​Purkinje |

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| *ANSWER:* | c |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
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| 45. What type of neuron in the pons receives information only from other cells in the pons and sends information only to other cells in the pons?​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​afferent |
|   | b.  | ​efferent |
|   | c.  | ​intrinsic |
|   | d.  | ​inter-synaptic |

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| *ANSWER:* | c |
| *DIFFICULTY:* | Bloom’s: Analyze |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 46. Glial cells \_\_\_\_.​

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| --- | --- | --- |
|   | a.  | ​are less numerous than neurons in the human brain. |
|   | b.  | ​transmit information over long distances within the central nervous system. |
|   | c.  | ​occupy about ten times more space in the brain than do neurons. |
|   | d.  | ​are smaller but more numerous than neurons in the human brain. |

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| *ANSWER:* | d |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 47. What type of glia helps to synchronize the activity of axons?​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​oligodendrocytes |
|   | b.  | ​astrocytes |
|   | c.  | ​radial glia |
|   | d.  | ​Schwann cells |

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| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
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| 48. Which type of glia remove waste material in the nervous system?​

|  |  |  |
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|   | a.  | ​astrocytes |
|   | b.  | ​Schwann cells |
|   | c.  | ​oligodendrocytes |
|   | d.  | ​radial glia |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
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| 49. What type of glial cells myelinate axons in the brain and spinal cord?​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​oligodendrocytes |
|   | b.  | ​Schwann cells |
|   | c.  | ​radial glia |
|   | d.  | ​astrocytes |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 50. Which type of glia release chemicals that modify the activity of neighboring neurons?​

|  |  |  |
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|   | a.  | ​astrocytes |
|   | b.  | ​Schwann cells |
|   | c.  | ​oligodendrocytes |
|   | d.  | ​radial glia |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
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| 51. Which type of glia builds myelin sheaths around axons in the periphery of the body?​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​astrocytes |
|   | b.  | ​Schwann cells |
|   | c.  | ​oligodendrocytes |
|   | d.  | ​radial glia |

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| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 52. \_\_\_\_ in the brain and spinal cord and \_\_\_\_ in the periphery are specialized types of glia that build the myelin sheaths that surround neurons.​

|  |  |  |
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|   | a.  | ​Oligodendrocytes; Schwann cells |
|   | b.  | ​Schwann cells; oligodendrocytes |
|   | c.  | ​Microglia; oligodendrocytes |
|   | d.  | ​Radial glia; Schwann cells |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
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| 53. Glial cells whose function most closely resembles that of the immune system are called \_\_\_\_.​

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|   | a.  | ​oligodendrocytes |
|   | b.  | ​Schwann cells |
|   | c.  | ​microglia |
|   | d.  | ​radial glia |

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| --- | --- |
| *ANSWER:* | c |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 54. Radial glia \_\_\_\_.​

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|   | a.  | ​guide the migration of neurons during embryonic development |
|   | b.  | ​synchronize the activity of axons |
|   | c.  | ​wrap around the presynaptic terminals of several axons |
|   | d.  | ​build the myelin sheaths that surround and insulate certain axons |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Anatomy of Neurons and Glia |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.01 - Describe neurons and glia, the cells that constitute the nervous system. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 55. What mechanism prevents or slows some chemicals from entering the brain, while allowing others to enter?​

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|   | a.  | ​a threshold |
|   | b.  | ​a blood-brain barrier |
|   | c.  | ​an endoplasmic wall |
|   | d.  | ​a differential-drug inhibitor |

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| --- | --- |
| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Blood-Brain Barrier |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.02 - Summarize how the blood–brain barrier relates to protection and nutrition of neurons. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 56. What happens to a virus that manages to cross the blood-brain barrier and enter the brain?​

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|   | a.  | ​It is quickly destroyed by natural killer cells. |
|   | b.  | ​It gets trapped in a neuron, and then both are destroyed by natural killer cells. |
|   | c.  | ​It gets trapped in a glial cell, and then both are destroyed by natural killer cells. |
|   | d.  | ​It remains there and may cause negative effects several years later. |

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| *ANSWER:* | d |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Blood-Brain Barrier |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.02 - Summarize how the blood–brain barrier relates to protection and nutrition of neurons. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 57. Molecules that can cross the blood-brain barrier are usually \_\_\_\_.​

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|   | a.  | ​large, uncharged molecules, such as lactose |
|   | b.  | ​large, charged molecules |
|   | c.  | ​neurotransmitters, such as dopamine |
|   | d.  | ​molecules that can dissolve in the fats of the capillary walls |

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| *ANSWER:* | d |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Blood-Brain Barrier |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.02 - Summarize how the blood–brain barrier relates to protection and nutrition of neurons. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 58. The major disadvantage of a blood-brain barrier is that \_\_\_\_.​

|  |  |  |
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|   | a.  | ​many chemicals can easily diffuse into the brain |
|   | b.  | ​so much glucose is required to maintain it |
|   | c.  | ​certain required chemicals must be actively transported |
|   | d.  | ​viruses cannot escape |

|  |  |
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| *ANSWER:* | c |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Blood-Brain Barrier |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.02 - Summarize how the blood–brain barrier relates to protection and nutrition of neurons. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 59. Glucose enters the brain via which type of transport?​

|  |  |  |
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|   | a.  | ​indirect transport |
|   | b.  | ​direct transport |
|   | c.  | ​passive transport |
|   | d.  | ​active transport |

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| *ANSWER:* | d |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Blood-Brain Barrier |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.02 - Summarize how the blood–brain barrier relates to protection and nutrition of neurons. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 60. What is the main source of nutrition for vertebrate neurons?​

|  |  |  |
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|   | a.  | ​fats |
|   | b.  | ​glucose |
|   | c.  | ​sodium |
|   | d.  | ​complex carbohydrates |

|  |  |
| --- | --- |
| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Nourishment of Vertebrate Neurons |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.02 - Summarize how the blood–brain barrier relates to protection and nutrition of neurons. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 61. Why do neurons rely so heavily on glucose as their source of nutrition?​

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|   | a.  | ​Neurons lack the enzymes necessary to metabolize other fuels. |
|   | b.  | ​Glucose is the only fuel that can be used even in the absence of vitamins. |
|   | c.  | ​Glucose is not used extensively by other parts of the body. |
|   | d.  | ​Other fuels do not readily cross the blood-brain barrier. |

|  |  |
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| *ANSWER:* | d |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Nourishment of Vertebrate Neurons |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.02 - Summarize how the blood–brain barrier relates to protection and nutrition of neurons. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 62. Why does the brain need thiamine?​

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| --- | --- | --- |
|   | a.  | ​to enable glucose to cross the blood-brain barrier |
|   | b.  | ​as a source of fuel in case there is not enough glucose |
|   | c.  | ​as a building block for making proteins |
|   | d.  | ​to enable it to metabolize glucose |

|  |  |
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| *ANSWER:* | d |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Nourishment of Vertebrate Neurons |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.02 - Summarize how the blood–brain barrier relates to protection and nutrition of neurons. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 63. What leads to Korsakoff's syndrome?​

|  |  |  |
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|   | a.  | ​thiamine deficiency due to chronic alcoholism |
|   | b.  | ​glucose deficiency due to chronic alcoholism |
|   | c.  | ​viruses that manage to cross the blood-brain barrier |
|   | d.  | ​glial cells that over-reproduce and increase pressure in the brain |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Nourishment of Vertebrate Neurons |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.02 - Summarize how the blood–brain barrier relates to protection and nutrition of neurons. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 64. Korsakoff's syndrome \_\_\_\_.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​is marked by severe memory impairments |
|   | b.  | ​results from too much thiamine |
|   | c.  | ​results from lack of oxygen to the brain |
|   | d.  | ​is due to a breakdown of the blood-brain barrier |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Nourishment of Vertebrate Neurons |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.02 - Summarize how the blood–brain barrier relates to protection and nutrition of neurons. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 65. The membrane of a neuron is composed of \_\_\_\_ with \_\_\_\_ embedded in them.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​carbohydrates; purines |
|   | b.  | ​fat molecules; proteins |
|   | c.  | ​proteins; neurotransmitters |
|   | d.  | ​benzene molecules; carbohydrates |

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| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 66. What term describes the difference in voltage that typically exists between the inside and the outside of a neuron?​

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|   | a.  | ​concentration gradient |
|   | b.  | ​generator potential |
|   | c.  | ​resting potential |
|   | d.  | ​shock gradient |

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| *ANSWER:* | c |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 67. The idea that a neuron's membrane is polarized refers to a difference in electrical potential between \_\_\_\_.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​the axons and the dendrites |
|   | b.  | ​the axon hillock and the cell body |
|   | c.  | ​sodium ions and potassium ions |
|   | d.  | ​the inside and the outside of the membrane |

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| *ANSWER:* | d |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 68. The resting potential is mainly the result of \_\_\_\_.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​negatively charged proteins inside the cell |
|   | b.  | ​positively charged proteins inside the cell |
|   | c.  | ​negatively charged proteins outside the cell |
|   | d.  | ​positively charged proteins outside the cell |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 69. The resting potential of a neuron refers to the \_\_\_\_.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​net positive charge on the inside of the neuron |
|   | b.  | ​ions which rest in one place in the cell |
|   | c.  | ​movement of ions to the outside of the neuron |
|   | d.  | ​net negative charge on the inside of the neuron |

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| *ANSWER:* | d |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 70. What is the approximate resting potential of the inside of a neuron's membrane, relative to the outside?​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​-70 millivolts |
|   | b.  | ​+10 millivolts |
|   | c.  | ​0 millivolts |
|   | d.  | ​+90 millivolts |

|  |  |
| --- | --- |
| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 71. When the neuronal membrane is at rest, the potassium channels \_\_\_\_.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​permit potassium ions to pass quickly and easily |
|   | b.  | ​permit potassium ions to pass slowly |
|   | c.  | ​prohibit any movement of potassium ions |
|   | d.  | ​help to open up the sodium channels |

|  |  |
| --- | --- |
| *ANSWER:* | b |
| *DIFFICULTY:* | help to open up the sodium channels |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 72. When the neuronal membrane is at rest, the sodium channels \_\_\_\_.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​permit sodium ions to pass quickly and easily |
|   | b.  | ​are at equilibrium with potassium channels |
|   | c.  | ​are closed, so there is almost no flow of sodium |
|   | d.  | ​allow sodium to leak out as a steady, continuous drip |

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| --- | --- |
| *ANSWER:* | c |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 73. Which of the following describes selective permeability?​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​Ions can only travel in certain directions across the membrane. |
|   | b.  | ​Only certain molecules are allowed to cross the membrane freely. |
|   | c.  | ​Only certain types of stimulation will result in an action potential. |
|   | d.  | ​All molecules must pass through designated channels. |

|  |  |
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| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 74. When a neuron’s membrane is at rest, the concentration gradient tends to move sodium \_\_\_\_ the cell and the electrical gradient tends to move it \_\_\_\_ the cell.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​into; into |
|   | b.  | ​into; out of |
|   | c.  | ​out of; into |
|   | d.  | ​out of; out of |

|  |  |
| --- | --- |
| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 75. When a neuron’s membrane is at rest, the concentration gradient tends to move potassium \_\_\_\_ the cell and the electrical gradient tends to move it \_\_\_\_ the cell.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​into; into |
|   | b.  | ​into; out of |
|   | c.  | ​out of; into |
|   | d.  | ​out of; out of |

|  |  |
| --- | --- |
| *ANSWER:* | c |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 76. Electrical gradients lead to the \_\_\_\_.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​general movement of ions into the neuron |
|   | b.  | ​general movement of ions out of the neuron |
|   | c.  | ​movement of ions to areas having the same electrical charges |
|   | d.  | ​movement of ions to areas having opposite electrical charges |

|  |  |
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| *ANSWER:* | d |
| *DIFFICULTY:* | Bloom’s: Analyze |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 77. Under which conditions would the sodium-potassium pump likely be far less effective in creating a concentration gradient?​

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|   | a.  | ​if dendrites were generally longer than axons |
|   | b.  | ​if the glia-to-neuron ratio were higher |
|   | c.  | ​if selective permeability of the membrane did not exist |
|   | d.  | ​if it were an active transport system that required energy |

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| *ANSWER:* | c |
| *DIFFICULTY:* | Bloom’s: Analyze |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 78. The net effect of each cycle of the sodium-potassium pump is to \_\_\_\_.​

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|   | a.  | ​decrease the number of positively charged ions within the cell |
|   | b.  | ​increase the number of positively charged ions within the cell |
|   | c.  | ​decrease the number of positively charged ions outside the cell |
|   | d.  | ​increase the number of negatively charged ions within the cell |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 79. What is one major cause for the resting potential of a neuron's membrane?​

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|   | a.  | ​a difference in size between axons and dendrites |
|   | b.  | ​a high permeability of the membrane to water molecules |
|   | c.  | ​the refractory period of the membrane |
|   | d.  | ​the sodium-potassium pump |

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| *ANSWER:* | d |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 80. The concentration gradient refers to the \_\_\_\_.​

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|   | a.  | ​fact that the concentration of ions is greater on the inside of a neuron |
|   | b.  | ​fact that the concentration of ions is greater on the outside of a neuron |
|   | c.  | ​difference in distribution for various ions between the inside and outside of the membrane |
|   | d.  | ​negatively charged proteins inside the cell |

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| *ANSWER:* | c |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 81. Which event will increase the concentration gradient of sodium?​

|  |  |  |
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|   | a.  | ​decreasing permeability to potassium ions |
|   | b.  | ​increasing activity of the sodium potassium pump |
|   | c.  | ​increasing membrane permeability to sodium ions |
|   | d.  | ​increasing membrane permeability to chloride ions |

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| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Analyze |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 82. The concentration gradient for potassium tends to \_\_\_\_.​

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|   | a.  | ​draw potassium into the cell |
|   | b.  | ​push chloride out of the cell |
|   | c.  | ​push sodium out of the cell |
|   | d.  | ​push potassium out of the cell |

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| *ANSWER:* | d |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 83. When the neuron is at rest, what is primarily responsible for moving potassium ions OUT of the cell?​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​a concentration gradient |
|   | b.  | ​an electrical gradient |
|   | c.  | ​both a concentration gradient and an electrical gradient |
|   | d.  | ​the sodium-potassium pump |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 84. When a neuron is at rest, what is primarily responsible for moving potassium ions into the cell?​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​concentration gradient |
|   | b.  | ​an electrical gradient |
|   | c.  | ​the sodium-potassium pump |
|   | d.  | ​both the sodium-potassium pump and electrical gradient |

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| *ANSWER:* | d |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 85. When a membrane is at rest, what attracts potassium ions to the inside of the cell?​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​an electrical gradient |
|   | b.  | ​a concentration gradient |
|   | c.  | ​both an electrical gradient and a concentration gradient |
|   | d.  | ​neither an electrical gradient nor a concentration gradient |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 86. When a membrane is at rest, what attracts sodium ions to the inside of the cell?​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​an electrical gradient |
|   | b.  | ​a concentration gradient |
|   | c.  | ​both an electrical gradient and a concentration gradient |
|   | d.  | ​neither an electrical gradient nor a concentration gradient |

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| *ANSWER:* | c |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 87. Which of the following is an advantage of having a resting potential?​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​The toxic effects of sodium are minimized inside the cell. |
|   | b.  | ​No energy is required to maintain it. |
|   | c.  | ​The cell is prepared to respond quickly to a stimulus. |
|   | d.  | ​All of the ions are maintained in equal concentrations throughout the cytoplasm. |

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| *ANSWER:* | c |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 88. Ordinarily, stimulation of a neuron takes place \_\_\_\_.​

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|   | a.  | ​through hyperpolarization |
|   | b.  | ​at the synapse |
|   | c.  | ​in the mitochondria |
|   | d.  | ​in the endoplasmic reticulum |

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| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 89. What occurs when a stimulus shifts the potential inside a neuron from the resting potential to a more negative potential?​

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|   | a.  | ​hyperpolarization |
|   | b.  | ​depolarization |
|   | c.  | ​an action potential |
|   | d.  | ​a threshold |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 90. Which action will produce a hyperpolarization of a neuron?​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​applying a negative charge inside the neuron with a microelectrode |
|   | b.  | ​applying a positive charge inside the neuron with a microelectrode |
|   | c.  | ​increasing the membrane's permeability to sodium |
|   | d.  | ​decreasing the membrane's permeability to potassium |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Analyze |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 91. The neuron will produce an action potential only if the depolarization exceeds the \_\_\_\_.​

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|   | a.  | ​The neuron will produce an action potential only if the depolarization exceeds the \_\_\_\_. |
|   | b.  | ​the resting potential |
|   | c.  | ​hyperpolarization |
|   | d.  | ​the refractory period |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 92. A membrane produces an action potential whenever the potential across it reaches what level?​

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| --- | --- | --- |
|   | a.  | ​the resting potential |
|   | b.  | ​-90 mV |
|   | c.  | ​the threshold of excitation |
|   | d.  | ​the refractory period |

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| *ANSWER:* | c |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 93. What action tends to open the sodium gates across a neuron's membrane?​

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|   | a.  | ​hyperpolarization of the membrane |
|   | b.  | ​depolarization of the membrane |
|   | c.  | ​increase in the sodium concentration outside the neuron |
|   | d.  | ​passing the peak of the action potential and entering the refractory period |

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| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 94. What occurs when depolarization is less than the cell's threshold?​

|  |  |  |
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|   | a.  | ​Sodium is prevented from crossing the membrane. |
|   | b.  | ​Potassium is prevented from crossing the membrane. |
|   | c.  | ​Sodium crosses the membrane only slightly more than usual. |
|   | d.  | ​The cell will still produce an action potential. |

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| *ANSWER:* | c |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 95. Which action would depolarize a neuron?​

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| --- | --- | --- |
|   | a.  | ​decreasing membrane permeability to calcium |
|   | b.  | ​increasing membrane permeability to potassium |
|   | c.  | ​decreasing membrane permeability to sodium |
|   | d.  | ​increasing membrane permeability to sodium |

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| *ANSWER:* | d |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 96. The action potential of a neuron depends mostly on what movement of ions?​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​sodium ions entering the cell |
|   | b.  | ​sodium ions leaving the cell |
|   | c.  | ​potassium ions entering the cell |
|   | d.  | ​potassium ions leaving the cell |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
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| 97. In the normal course of an action potential, \_\_\_\_.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​sodium channel remain open for long periods of time |
|   | b.  | ​the concentration of sodium equalizes across the membrane |
|   | c.  | ​sodium remains much more concentrated outside than inside the neuron |
|   | d.  | ​subthreshold stimulation intensifies the action potential |

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| *ANSWER:* | c |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 98. Voltage-activated channels are channels for which a change in the voltage across the membrane alters their \_\_\_\_.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​permeability |
|   | b.  | ​length |
|   | c.  | ​number |
|   | d.  | ​threshold |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Action Potential |
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| 99. At the peak of the action potential, the electrical gradient of potassium \_\_\_\_.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​is the same as during the resting potential |
|   | b.  | ​pulls sodium into the cell |
|   | c.  | ​pushes potassium out of the cell |
|   | d.  | ​pulls potassium into the cell |

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| *ANSWER:* | c |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 100. When the potential across a membrane reaches threshold, the sodium channels \_\_\_\_.​

|  |  |  |
| --- | --- | --- |
|   | a.  | ​open to let sodium enter the cell rapidly |
|   | b.  | ​close to prevent sodium from entering the cell |
|   | c.  | ​open to let sodium exit the cell rapidly |
|   | d.  | ​close to prevent sodium from exiting the cell |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 101. A drug that blocks the sodium gates of a neuron's membrane will \_\_\_\_.​

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|   | a.  | ​decrease the threshold |
|   | b.  | ​block the action potential |
|   | c.  | ​cause repeated action potentials |
|   | d.  | ​eliminate the refractory period |

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| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 102. After the peak of an action potential, what prevents sodium ions from continuing to enter the cell?​

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|   | a.  | ​There is no longer a concentration gradient for sodium. |
|   | b.  | ​The sodium-potassium pump greatly increases its rate of activity. |
|   | c.  | ​All the available sodium ions have already entered the cell. |
|   | d.  | ​The sodium gates in the membrane close. |

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| *ANSWER:* | d |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 103. At what point do the sodium gates begin to close, shutting out further entry of sodium into the cell?​

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|   | a.  | ​at the peak of the action potential |
|   | b.  | ​when the threshold is reached |
|   | c.  | ​at the end of the relative refractory period |
|   | d.  | ​when the concentration gradient for sodium is eliminated |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 104. What causes potassium ions to leave the axon just after the peak of the action potential?​

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|   | a.  | ​a continuing concentration gradient and the opening of the potassium gates |
|   | b.  | ​an increase in the concentration gradient across the membrane |
|   | c.  | ​an increased tendency of the sodium-potassium pump to push potassium out |
|   | d.  | ​binding of potassium ions to proteins that leave at this time |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 105. A drug will prevent an action potential if it \_\_\_\_.​

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|   | a.  | ​lowers the threshold of the membrane |
|   | b.  | ​blocks the movement of potassium across the membrane |
|   | c.  | ​blocks the movement of sodium across the membrane |
|   | d.  | ​increases the movement of sodium across the membrane |

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| *ANSWER:* | c |
| *DIFFICULTY:* | Bloom’s: Analyze |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 106. Local anesthetic drugs attach to the sodium channels of the membrane, which \_\_\_\_.​

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|   | a.  | ​allows sodium ions to enter and stop action potential |
|   | b.  | ​prevents potassium ions from entering and stopping action potential |
|   | c.  | ​allows potassium ions to enter and stop action potential |
|   | d.  | ​prevents sodium ions from entering and stopping action potential |

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| *ANSWER:* | d |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 107. The all-or-none law states that \_\_\_\_.​

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|   | a.  | ​a neuron produces an action potential of maximal strength, or none at all |
|   | b.  | ​all neurons fire or none at all |
|   | c.  | ​all neurons in a pathway fire at the same time, or none do |
|   | d.  | ​all ions move in the same direction, or none do |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.05 - State the all-or-none law of the action potential. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 108. According to the all-or-none law, \_\_\_\_.​

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|   | a.  | ​all neurons produce an action potential at the same time or none at all |
|   | b.  | ​all of the extracellular sodium enters the axon, or none at all |
|   | c.  | ​once an axon reaches threshold, the amplitude and velocity of an action potential are nearly equal each time |
|   | d.  | ​neurons are either active all the time or not at all |

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| *ANSWER:* | c |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.05 - State the all-or-none law of the action potential. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 109. The primary feature of a neuron that prevents the action potential from traveling back from where it just passed is the \_\_\_\_.​

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|   | a.  | ​concentration gradient |
|   | b.  | ​refractory period |
|   | c.  | ​sodium potassium pump |
|   | d.  | ​phospholipid bilayer |

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| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 110. During the relative refractory period, the \_\_\_\_.​

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|   | a.  | ​sodium gates are firmly closed |
|   | b.  | ​sodium gates are reverting to their usual state |
|   | c.  | ​sodium gates are wide open |
|   | d.  | ​potassium gates are firmly closed |

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| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 111. What will *most* affect the speed of an action potential?​

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|   | a.  | ​the strength of the stimulus |
|   | b.  | ​the time since the last action potential |
|   | c.  | ​the length of the axon |
|   | d.  | ​the resistance of the membrane |

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| *ANSWER:* | d |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Propagation of the Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 112. The speed of an action potential down an unmyelinated axon is best described as \_\_\_\_.​

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|   | a.  | ​the speed of electricity, regardless of the size of the axon |
|   | b.  | ​less than 1 meter per second, regardless of the size of the axon |
|   | c.  | ​faster in thin axons than in thick ones |
|   | d.  | ​faster in thick axons than in thin ones |

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| *ANSWER:* | d |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Myelin Sheath and Saltatory Conduction |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 113. The function of a myelin sheath is to \_\_\_\_.​

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|   | a.  | ​prevent action potentials from traveling in the wrong direction |
|   | b.  | ​increase the velocity of transmission along an axon |
|   | c.  | ​increase the magnitude of an action potential |
|   | d.  | ​provide a store of nutrients for the neuron |

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| *ANSWER:* | b |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Myelin Sheath and Saltatory Conduction |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 114. In what direction does a local neuron transmit information?​

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|   | a.  | ​through its dendrites to cell body to axon |
|   | b.  | ​through its axon to cell body to dendrites |
|   | c.  | ​only toward the cell body |
|   | d.  | ​equally well in any direction |

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| *ANSWER:* | d |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Local Neurons |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 115. Which of the following describes the transmission of information in a local neuron?​

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|   | a.  | ​The signal decreases in strength as it travels. |
|   | b.  | ​The signal increases in strength as it travels. |
|   | c.  | ​The signal strength remains constant as it travels. |
|   | d.  | ​Local neurons do not transmit any information. |

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| *ANSWER:* | a |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | Local Neurons |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| **Essay** |

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| 116. Describe the structure of the blood-brain barrier and explain why it is important.​

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| *ANSWER:* | Tightly joined endothelial cells form the capillary walls in the brain, making the blood-brain barrier. This protects the brain from harmful viruses, bacteria, and chemicals that might otherwise be able to enter the brain and cause damage.​ |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Blood-Brain Barrier |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.02 - Summarize how the blood–brain barrier relates to protection and nutrition of neurons. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 117. Provide a summary of the all-or-none law of action potentials.​

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| *ANSWER:* | Once a neuron reaches the threshold of activation, the action potential is conducted all of the way down the axon without loss of intensity. Furthermore, the magnitude of the action potential is roughly the same every time and is independent of the intensity of the stimulus that initiated it.​ |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.05 - State the all-or-none law of the action potential. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 118. Describe how the brain transports essential chemicals.​

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| *ANSWER:* | The brain has several transport mechanisms. Small, uncharged molecules, including oxygen and carbon dioxide, cross freely. Water crosses through special protein channels in the wall of the endothelial cells. Also, molecules that dissolve in the fats of the membrane cross easily. Examples include vitamins A and D and all the drugs that affect the brain—from antidepressants and other psychiatric drugs to illegal drugs such as heroin. How fast a drug takes effect depends partly on how readily it dissolves in fats and therefore crosses the blood– brain barrier.​For a few other chemicals, the brain uses active transport, a protein-mediated process that expends  energy to pump chemicals from the blood into the brain. Chemicals that are actively transported into the brain include glucose (the brain’s main fuel), amino acids (the building blocks of proteins), purines, choline, a few vitamins, iron, and certain hormones. |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Blood-Brain Barrier |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.02 - Summarize how the blood–brain barrier relates to protection and nutrition of neurons. |
| *TOPICS:* | 1.1 The Cells of the Nervous System |

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| 119. Describe the key aspects of the resting potential.​

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| *ANSWER:* | All parts of a neuron are covered by a membrane about 8 nanometers (nm) thick (just less than 0.00001 mm), composed of two layers (free to float relative to each other) of phospholipid molecules (containing chains of fatty acids and a phosphate group). Embedded among the phospholipids are cylindrical protein molecules through which various chemicals can pass. The structure of the membrane and its proteins controls the flow of chemicals between the inside and outside of the cell. When at rest, the membrane maintains an electrical gradient, also known as polarization—a difference in electrical charge between the inside and outside of the cell. The neuron inside the membrane has a slightly negative electrical potential with respect to the outside, mainly because of negatively charged proteins inside the cell. This difference in voltage is called the resting potential.​ |
| *DIFFICULTY:* | Bloom’s: Understand |
| *REFERENCES:* | The Resting Potential of the Neuron |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.03 - Explain how the sodium–potassium pump and the properties of the membrane lead to the resting potential of a neuron. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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| 120. Explain the function and process of a neuron’s refractory period.​

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| *ANSWER:* | Although the electrical potential across the membrane is returning from its peak toward the resting point, it is still above the threshold. Why doesn’t the cell produce another action potential during this period? (If it did, of course, it would endlessly repeat one action potential after another.) Immediately after an action potential, the cell is in a refractory period during which it resists the production of further action potentials. In the first part of this period, the absolute refractory period, the membrane cannot produce an action potential, regardless of the stimulation. During the second part, the relative refractory period, a stronger-than-usual stimulus is necessary to initiate an action potential. The refractory period depends on two facts: The sodium channels are closed, and potassium is flowing out of the cell at a faster-than-usual rate. In most of the neurons that researchers have tested, the absolute refractory period is about 1 millisecond (ms), and the relative refractory period is another 2 to 4 ms.​ |
| *DIFFICULTY:* | Bloom’s: Analyze |
| *REFERENCES:* | The Action Potential |
| *LEARNING OBJECTIVES:* | KALA.BIOP.16.01.04 - Discuss how the movement of sodium and potassium ions produces the action potential and recovery after it. |
| *TOPICS:* | 1.2 The Nerve Impulse |

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