

Name \_\_\_\_\_ Period \_\_\_\_\_

**Chapter 28: Nervous Systems*****Guided Reading Activities*****Big idea:** Nervous system structure and function

Answer the following questions as you read modules 28.1–28.2:

- Your taste receptors for sweet, on your tongue, are directly connected to a(n) \_\_\_\_\_.
  - interneuron
  - motor neuron
  - sensory neuron
  - ganglia
- Complete the following table, which describes the three related functions of a nervous system.

	Sensory input	Integration	Motor output
<b>Description</b>	The transmission of signals from sensory receptors to the central nervous system (CNS)	Analysis and interpretation of the sensory signals and formulation of an appropriate response	The transmission of signals from the CNS to effector cells
<b>Type of neuron</b>	Sensory neurons	Interneurons	Motor neurons

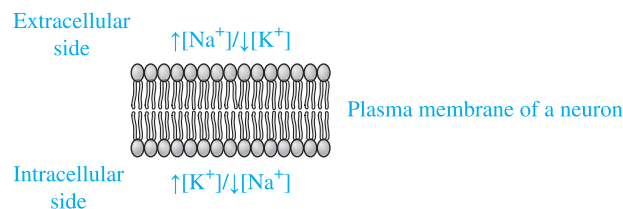
- The two divisions of the nervous system are the central nervous system and the peripheral nervous system.
- The flow of electrical signal along a neuron is in one direction. Briefly describe what this means.  
The signals that a neuron sends and receives originate in specific regions of a neuron specialized to send or receive those signals.

5. Which of the following structures of a generalized neuron receives the electrical signal?
  - a. Axon
  - b. Dendrites
  - c. Myelin sheath
  - d. Synapse
  
6. A mutation causes your Schwann cells to create a damaged myelin sheath. Briefly describe what effect you think this will have on nerve signal transmission.  
 This will delay or interfere with the efficiency of transmission because the myelin sheath is necessary for fast and efficient transmission.

**Big idea: Nerve signals and their transmission**

Answer the following questions as you read modules 28.3–28.10:

1. Briefly explain how the sodium-potassium pump works to establish the resting potential of a neuron.  
 The sodium-potassium pump works to establish a high concentration gradient for extracellular  $\text{Na}^+$  and a high concentration gradient for intracellular  $\text{K}^+$  by pumping  $\text{Na}^+$  out of the cell and  $\text{K}^+$  into the cell.
2. Sketch a diagram of the plasma membrane of a generic neuron. Label where the concentration of sodium and potassium ions are both high and low.



3. A reversal of the resting membrane potential of a neuron is referred to as a(n) action potential.
  
4. The membranes of neurons have special sodium and potassium channels that are voltage gated. Briefly explain what this means.  
 The neurons open in response to changes in voltage across the membrane of the cell.
  
5. What would happen if the signal sent to a neuron raised the membrane potential to only  $-60$  mV from its resting potential?  
 The action potential would not fire at  $-60$  mV.

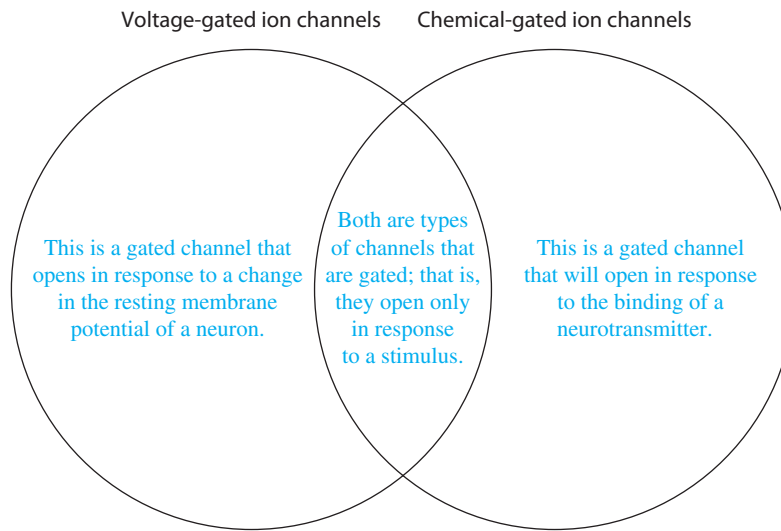
6. True or false: Action potentials can move in either direction along the axon. If false, make it a correct statement.  
False, action potentials can move in only one direction along the axon.
7. Which of the following explains why the action potential cannot cause depolarization behind it, which causes the action potential to move in the forward direction only?
  - a. The sodium channels are closed and inactivated.
  - b. The potassium channels are closed.
  - c. The sodium channels and the potassium channels are inactivated.
  - d. The potassium channels are open.
8. The authors use falling dominoes as an analogy to explain the propagation of an action potential down a neuron. Briefly explain why this is a perfect analogy.  
This analogy works because the direction of an action potential is only one way and the direction of the dominoes falling is also only one way. The signal in both cases only moves forward.
9. Briefly explain the following depiction of a nerve impulse traveling between a neuron and its target cell.

electrical → chemical → electrical

This simple illustration shows that the nerve impulse must be converted briefly to a chemical signal in order to jump the physical gap that separates a communicating neuron and its target cell.

10. Binding of a neurotransmitter to a receptor on the target cell
  - a. triggers the opening of potassium channels.
  - b. triggers the influx of sodium ions and reinitiates the action potential.
  - c. causes the action potential to stop in the target cell.
  - d. initiates additional neurotransmitter release across the synaptic cleft by the sending neuron.

11. Complete the Venn diagram that compares voltage-gated ion channels to chemical-gated ion channels.



12. List two types of chemical-gated ion channels that actually inhibit the initiation of an action potential in a target cell.

Two types of ion channels that inhibit action potentials are channels that bring  $\text{Cl}^-$  ions into the cell and channels that release  $\text{K}^+$  ions out of the cell.

13. Briefly explain how a neuron can receive both excitatory and inhibitory signals and yet still fire an action potential in the receiving cell.

The neuron will be able to fire an action potential as long as the incoming signals are collectively strong enough to bring the neuron's membrane potential to threshold.

14. Epilepsy is sometimes referred to as an electrical storm of activity in the brain. Briefly explain what role, if any, inhibitory inputs to neurons may play a role in this electrical storm.

In epilepsy, it is thought that a loss of function by inhibitory neurons leads to this electrical storm of activity within the brain.

15. Skeletal muscle cells have receptors on their surface that bind to the neurotransmitter acetylcholine.

16. Which of the following acts directly on neurotransmitter receptors at the synaptic cleft?

- a. Adderall
- b. Ritalin
- c. SSRIs
- d. Nicotine

17. Briefly explain what would happen to the signaling capability of a neuron if you added drugs that blocked both inhibitory and excitatory signals on that neuron.  
[All signaling would essentially cease.](#)
18. Briefly explain what meta-analysis is. What is the point of doing meta-analysis?  
[A meta-analysis is a type of statistical study that compiles results from multiple, related studies. These types of studies allow scientists to compare data across several different studies in order to reduce bias.](#)

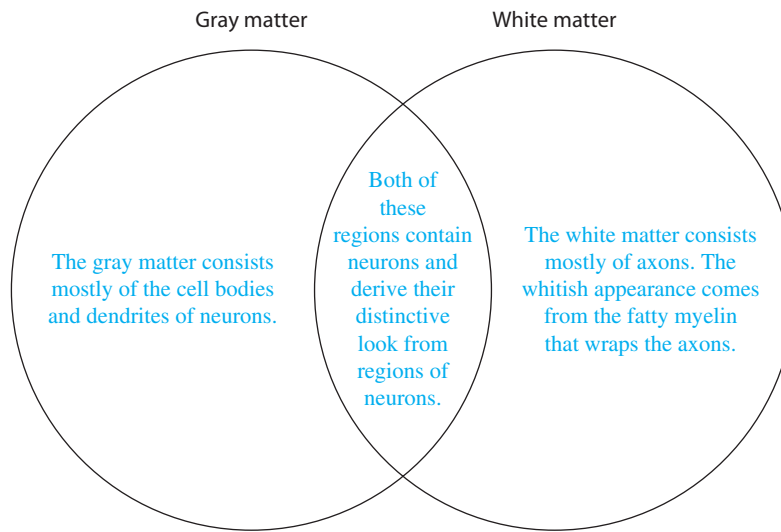
**Big idea:** [An overview of animal nervous systems](#)

Answer the following questions as you read modules 28.11–28.14:

1. True or false: The fact that neurons from different organisms function relatively similarly is a strong indication of their early evolutionary appearance. If false, make it a correct statement.  
[True](#)
2. Bilateral symmetry is a key step in the evolution of animals. Two hallmarks of bilateral symmetry include [cephalization](#) and [centralization](#).
3. Medications can have a difficult time getting to the brain. Briefly explain why this is the case.  
[The blood-brain barrier blocks many chemicals from entering the brain.](#)
4. Complete the following table, which lists and describes the major components of the CNS.

	Brain	Spinal cord
<b>Function</b>	<a href="#">The brain serves many functions, including acting as a homeostatic center, sending motor commands to muscles, acting as the center of emotion and intellect, and integrating data from the senses.</a>	<a href="#">The spinal cord relays information to and from the brain.</a>

5. Complete the Venn diagram that compares gray matter to white matter.



6. Briefly compare the sympathetic and parasympathetic divisions of the autonomic nervous system.

The parasympathetic division prepares the body for activities that conserve energy, such as digestion. The sympathetic division prepares the body for activities that require energy, such as running.

7. Which of the following neurotransmitters is used by the sympathetic nervous system?

a. Norepinephrine

b. Epinephrine

c. Acetylcholine

d. Dopamine

8. True or false: The human brain develops from three bulges of the embryonic neural tube. If false, make it a correct statement.

True

9. The region of the cerebrum most associated with higher-order thinking and emotion is the cerebral cortex.

**Big idea: The human brain**

Answer the following questions as you read modules 28.15–28.21:

1. True or false: The brain stem is the youngest portion of the brain in terms of when it evolved.  
If false, make it a correct statement.  
**False, it is the oldest portion of the brain.**
2. The structure of the human brain that passes information between the two cerebral hemispheres is the corpus callosum.
3. A stroke damages your thalamus. Briefly explain what effects this will have.  
**Your cognition would be impaired because the thalamus is a crucial relay station for sensory information to the cerebral cortex (the center of higher-order thinking).**
4. List the four lobes of the cerebral cortex.  
**The four lobes are: frontal, parietal, occipital, and temporal.**
5. Which of the following areas of the cerebral cortex is involved with processing pain from having your tooth pulled at the dentist's office?
  - a. Frontal association area
  - b. Visual association area
  - c. Somatosensory cortex**
  - d. Motor cortex
6. Briefly explain why patients recovering from a hemispherectomy illustrate neuroplasticity.  
**The hemisphere that is left is able to compensate and begin to control functions that the other side controlled.**
7. You are listening to your favorite album of Bach's Brandenburg concertos. If you were also being given an fMRI at the same time, in which lobe of your brain would you expect to see increased activity? Refer to Figure 28.16 on page 578 of your textbook for help.  
**The area of speech of the parietal lobe and the hearing area of the temporal lobe.**
8. Arousal is a state of alertness to the external environment, while sleep is when you are receiving input but not processing it.

9. True or false: The reticular formation is involved in coordinating learned muscle movements. If false, make it a correct statement.  
False, the reticular formation acts as a filter that decides what information gets relayed to the cerebral cortex for processing.
10. Which of the following brain structures is involved in forming memories specifically tied to an emotion?
- Hippocampus
  - Amygdala
  - Reticular formation
  - Corpus callosum
11. Complete the following table, which compares short-term memory to long-term memory.

	Short-term memory	Long-term memory
<b>Description</b>	A type of memory storage that allows you to recall something very soon after you learned it. It usually lasts only a short amount of time.	A type of memory storage that allows you to recall a something a long time after you experienced it. This type of memory storage is enhanced by repetition.

12. Briefly explain how studies of identical twins indicate that schizophrenia has both a genetic and environmental component.  
Studies of schizophrenia in a patient with an identical twin indicate that the other twin develops schizophrenia in roughly 50% of the cases. This indicates that the environment is an equally strong component in developing schizophrenia.
13. List four neurological disorders and the basic dysfunction associated with each one.  
Schizophrenia is a severe mental disorder characterized by a distorted view of reality.  
Bipolar disorder is characterized by severe mood swings.  
Alzheimer disease is characterized by a progressive loss of memory and cognition.  
Stroke is characterized by the loss of neurons due to a lack of oxygen. Stroke generates different consequences depending on which area of the brain is affected.

### CONNECTING THE BIG IDEAS

Use your knowledge of the information contained within this chapter's "Big Ideas" to answer this question.

Could a person who has been blindfolded be able to determine what an object is if placed in their hand? If so, what area of the brain may be involved in this?