

Name: _____

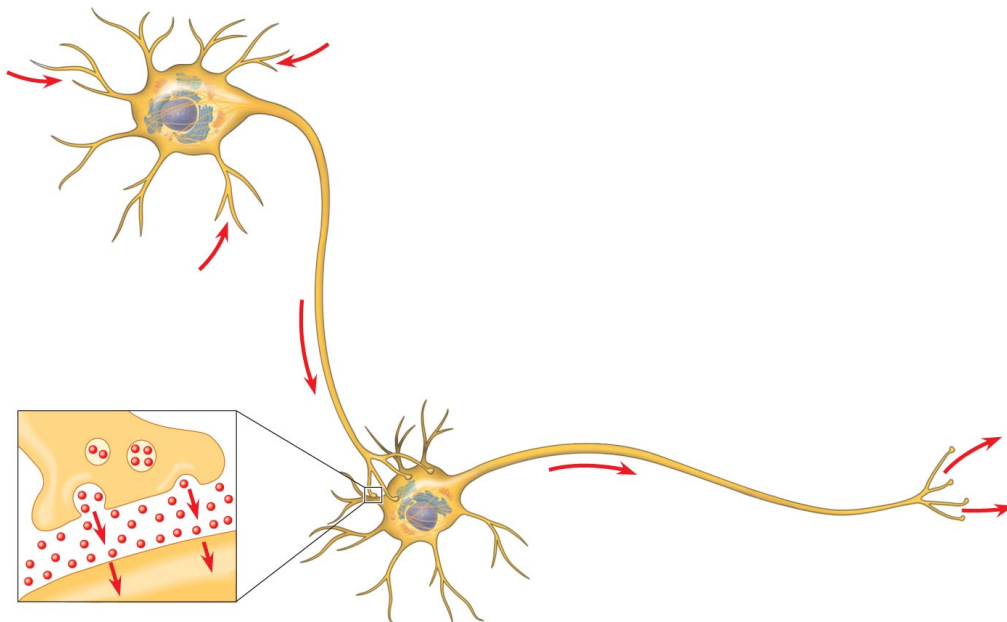
Chapter 37 Active Reading Guide Neurons, Synapses, and Signaling

Section 1

1. What is a neuron?
2. Neurons can be placed into three groups, based on their location and function.

Type of Neuron	Function
Sensory Neurons	
Interneurons	
Motor Neurons	

3. Which division of the nervous system includes the brain and spinal cord?
4. This sketch shows two neurons. Label the following elements of this figure: cell body, dendrites, axon, synapse, presynaptic cell, postsynaptic cell, synaptic vesicles, synaptic terminal, and neurotransmitter.



Copyright © 2008 Pearson Education, Inc., publishing as Pearson Benjamin Cummings.

5. What is shown in the previous figure? _____
6. What is indicated by the red arrows in the main part of the figure you labeled?
7. What are glial cells?

Section 2

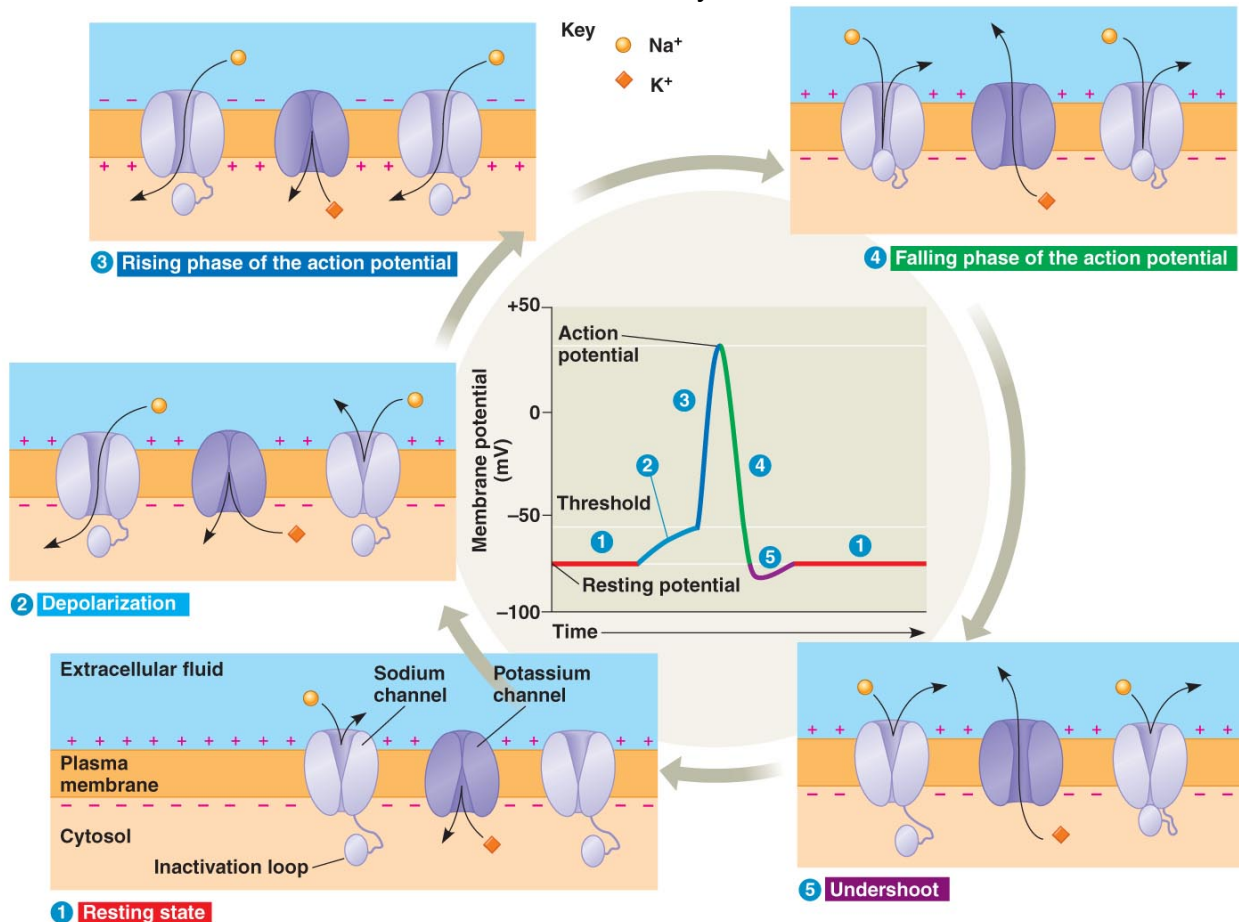
In this section you will need to recall information about the structure and function of the plasma membrane. Ions are not able to diffuse freely through the membrane because they are charged, and so must pass through protein channels specific for each ion.

8. All cells have a membrane potential across their plasma membrane. What is the typical resting potential of a neuron?
9. How are the concentration gradients of Na⁺ and K⁺ maintained?

Section 3

10. As you see in the figure above, in a resting neuron, the outside of the membrane is positively charged relative to the inside of the membrane. If positively charged ions flow out, the difference in charge between the two sides of the membrane becomes greater. What is the increase in the magnitude of the membrane potential called?
11. When a stimulus is applied, ion channels will open. If positively charged ions flow in, the membrane is said to depolarize. If depolarization causes the membrane potential to drop to a critical value, a wave of depolarization will follow. What is this critical value called?
12. What is the wave of depolarization called? _____
13. Just like toppling dominoes in a row, either the threshold of depolarization will be reached and an action potential will be generated, or the threshold will not be reached and no wave will occur. What is this response to a stimulus called?

14. Figure 37.11 in your text contains almost all you need to know about nerve impulse transmission, so it is worth some careful study time.



Copyright © 2008 Pearson Education, Inc., publishing as Pearson Benjamin Cummings.

- Refer to the Resting state figure. Are the Na⁺ and K⁺ channels open, or closed?
- What triggers depolarization? What channels open? What occurs if the depolarization threshold is reached?
- Label Stage 4 in the figure Repolarization. How is the charge on the membrane reestablished?
- Draw in another line on the graph to show what the change in membrane potential would look like if a stimulus were applied that did not reach the depolarization threshold.

15. Figure 37.12 is a closer look at what is happening along the membrane as a wave of depolarization (an action potential) travels along the length of the axon. Explain how the action potential is conducted.

16. What are the two types of glial cells that produce myelin sheaths?

17. How does a myelin sheath speed impulse transmission? Include a discussion of saltatory conduction and nodes of Ranvier in your response.

18. In the disease multiple sclerosis, the myelin sheaths harden and deteriorate. How would this affect nervous system function?

Section 4

19. When the wave of depolarization arrives at the synaptic terminal, calcium ion channels open. What occurs to the synaptic vesicles as the Ca^{2+} level increases?

20. What is contained within the synaptic vesicles? _____

21. Explain how an action potential is transmitted from one cell to another across a synapse by summarizing what is shown in Figure 37.15 in four steps.
 - 1.

 - 2.

 - 3.

 - 4.

22. There are many different types of neurotransmitters. Each neuron secretes only one type of neurotransmitter. Some neurotransmitters hyperpolarize the postsynaptic membrane. Are these excitatory or inhibitory neurotransmitters?
23. Define and explain summation.
24. A single postsynaptic neuron can be affected by neurotransmitter molecules released by many other neurons, some releasing excitatory and some releasing inhibitory neurotransmitters. What will determine whether an action potential is generated in the postsynaptic neuron?

Table 37.2 in your text lists several of the major neurotransmitters. You are not expected to know their actions or secretion sites, but you should recognize that they are neurotransmitters!

25. There is one neurotransmitter we want you to memorize. It is the most common neurotransmitter in both vertebrates and invertebrates, and it is released by the neurons that synapse with muscle cells at the neuromuscular junction. If you look ahead to Chapter 39, Figure 39.6, you will see a synapse between a neuron and a muscle cell, resulting in depolarization of the muscle cell and its contraction. What is this very important neurotransmitter?