

Nerve Cell Communication

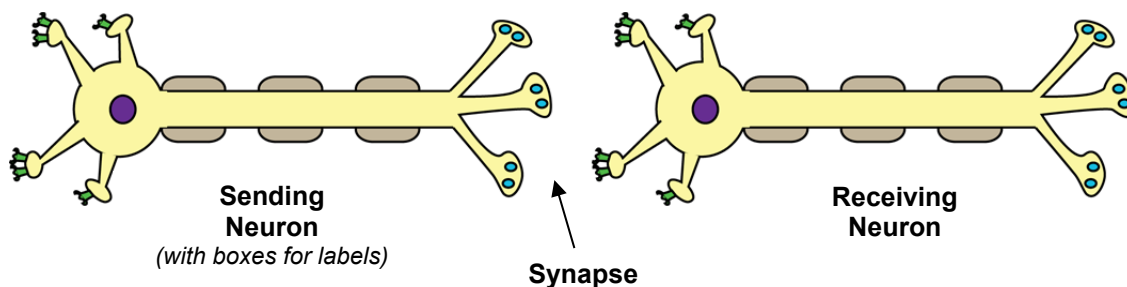
Part 1: What are the parts of a nerve cell?

1. Read the information in the **Biology Brief: Neurons**. As you read, circle the names of the structures (parts) of the neuron.

Biology Brief: Neurons

Your nervous system is made up of nerve cells called neurons. Each neuron has a large cell body that carries on most of the life activities of the neuron. Inside the cell body is a nucleus which controls the life activities of the neuron. Attached to the cell body are short receiving branches called dendrites that receive chemical signals. Receptor proteins on the cell membranes of dendrites can attach to chemical signal molecules. Also attached to the cell body is a long conducting branch called an axon. The axon conducts electrical signals called impulses over long distances. The axon is covered by a myelin sheath which acts as an insulated covering and speeds up impulse conduction. The axon ends in short sending branches called terminal branches that send messages to other neurons. Knobs on the ends of the terminal branches contain vesicles (small sacs) that store and release chemical messenger molecules called neurotransmitters. Neurotransmitters can fit into the receptor proteins on another neuron. Neurons do not touch each other. They are separated by a small gap called a synapse.

2. Obtain the following materials from your teacher:
 - Two large diagrams of neurons—a sending neuron and a receiving neuron.
 - A bag of white label cards, blue function cards, colored beads, and a pink (+/-) card.
3. Arrange the large diagrams of sending and receiving neurons on your desk so that they are separated from each other by a small gap. This gap is called a **synapse**.



4. Use the information in the **Biology Brief: Neurons** reading to place the **white structure label** cards in the correct boxes on the sending neuron diagram.
5. Call your teacher over to check your work. TEACHER INITIALS _____

Part 2: What are the functions of the parts of a nerve cell?

1. Read the **Biology Brief: Neurons** again. This time, underline the information in the reading that indicates functions of each part of a neuron.
2. Use the information in the **Biology Brief: Neurons** reading to place the **blue function cards** next to the matching white structure cards. For example, place the blue “controls life activities card” next to the white “nucleus” card.
3. Look at the beads (red, yellow, and white) in the bag. Which color of bead do you think best represents a neurotransmitter (chemical signal molecule) that would work to send a chemical message from the sending neuron to the receiving neuron? _____

Explain why you selected this bead.

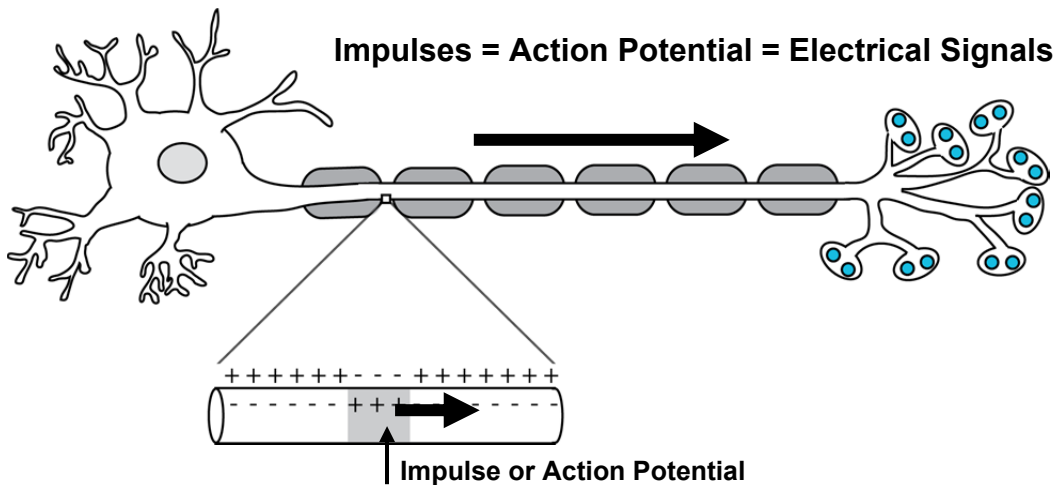
4. Add neurotransmitter molecules to your model by placing one of the colored of bead that you selected (in question 3) into each of the vesicles.
5. Call your teacher over to check your work. TEACHER INITIALS _____

Part 3: How do nerve cells communicate?

1. Use the information in the **Biology Brief: Two Types of Neuron Signals** reading to answer questions 2-14.

Biology Brief: Two Types of Neuron Signals

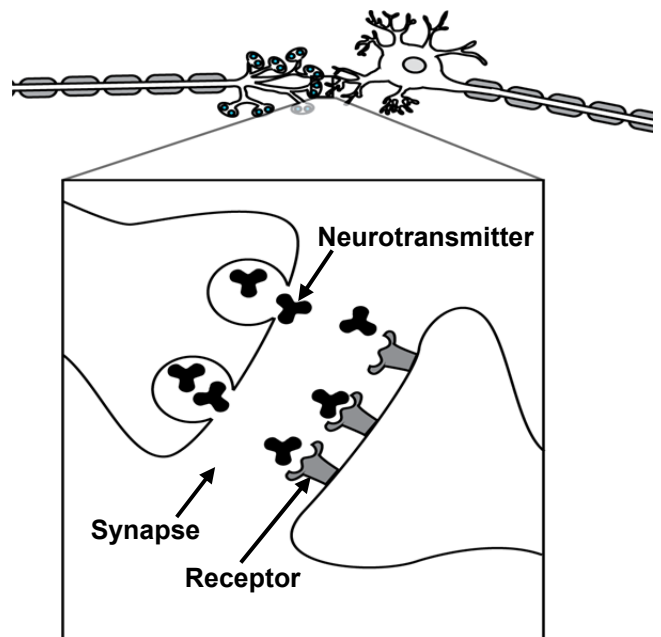
Neurons conduct electrical signals called impulses or action potentials. An impulse is an electrical signal that travels along a neuron. In a resting neuron (one that is not conducting an impulse) the outside of the neuron is positively charged. When the neuron is stimulated, an electrical change causes the outside of the neuron to become negatively charged. This electrical change is an impulse that travels very rapidly along the length of the neuron.



Neurons do not touch each other. Instead, they are separated by a tiny gap called a synapse. Impulses cannot jump this gap. When an impulse reaches the terminal branches of a neuron, it triggers the release of neurotransmitter molecules from the vesicles.

Neurotransmitters are chemical messenger molecules that diffuse across the synapse and attach to receptors on the dendrites of the receiving neuron. Receptors are like locks into which only keys that have a specific matching shape can fit. When neurotransmitters attach to receptors, it causes the receiving neuron to begin a new impulse.

Neurotransmitters = Chemical Signals

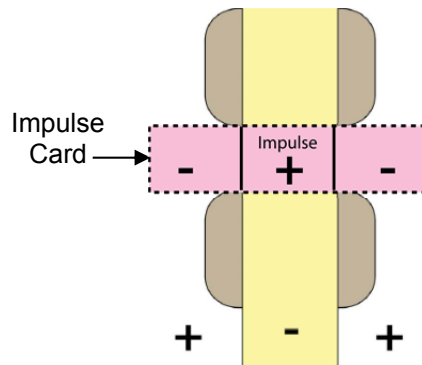


2. What are two names for the electrical signal that is conducted along a neuron called?
 _____ or _____

3. Place a pink "Impulse" card on one of the dendrites on the sending neuron model.



Slide the pink impulse card from the dendrite to the cell body, to the axon and to the terminal branches. *Hint: As the impulse travels along the axon, you should arrange the impulse card as shown in the diagram on the right.*



Stop at the terminal branches because an impulse cannot jump across the synapse (gap) that separates the two neurons in your model.

4. The outside of the neuron that is not conducting an impulse will have a _____ (negative or positive) charge.

5. An impulse (action potential) could be described as area of _____ (negative or positive) charges that travel over the outside of the neuron.

6. Why can't an impulse pass directly from one nerve cell to another?

7. When the impulse reaches the terminal branches, the vesicles release neurotransmitter molecules into the synapse. The neurotransmitter molecules then diffuse across the synapse and attach to the receptors.

- Model the release and movement of neurotransmitters by moving the red beads out of the vesicles in the terminal branches, across the synapse, and into the binding sites on receptors of the next neuron.

8. What is the chemical signal that diffuses across the synapse from a sending neuron to a receiving neuron?

9. What causes the sending nerve cell to release a chemical message into the synapse?

10. Which part of the model represents a neurotransmitter (the chemical signal that carries information across the synapse)?

11. Which part of a neuron releases the chemical message?

12. When a neurotransmitter temporarily binds to the receptor, the receptor triggers the receiving neuron to make a new impulse that travels through the receiving neuron.

- Place the pink impulse card on the neuron and move it along the axon to the terminal branches.
- When the impulse reaches the terminal branches, the receiving neuron becomes a sending neuron that releases its neurotransmitters to send messages to other neurons.

13. Which part of a neuron receives the chemical message?

14. What happens in a receiving neuron after neurotransmitters have attached to the receptors?

15. Your lab kit contains yellow beads and white beads that represent other types of molecules such as hormones or food molecules. Do you think that these molecules (yellow and white beads) could be used to carry messages from your sending to your receiving cell? Explain why or why not.

16. Some drugs, such as heroin and oxycontin, mimic the size and shape of a neurotransmitter. **Imagine** that someone added some green beads (to represent heroin molecules) to the synapse. These green beads are the same size and shape as the red beads. What might happen in the receiving neuron if heroin was present in the synapse?



Green Beads
Same size and same shape
as red beads

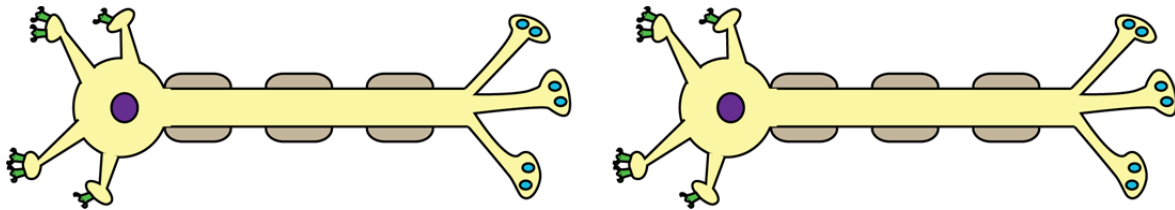
17. Some drugs block the binding of neurotransmitters to receptors. Imagine that someone plugged the receptors on your model with clay. How might this affect the receiving neuron?

18. There are **reuptake carriers** in the terminal branches that collect neurotransmitter molecules and return them to vesicles in the terminal branches so that the neurotransmitters do not remain in the synapse and continue to stimulate the receiving neuron.

- Act like a reuptake carrier by returning all of the beads to the vesicles in the terminal branches of the sending neuron diagram.

19. Some drugs, like cocaine, block the action of reuptake carriers. Imagine that someone plugged the reuptake carriers on your model with clay. What might happen in the receiving neuron if something blocked the action of reuptake carriers?

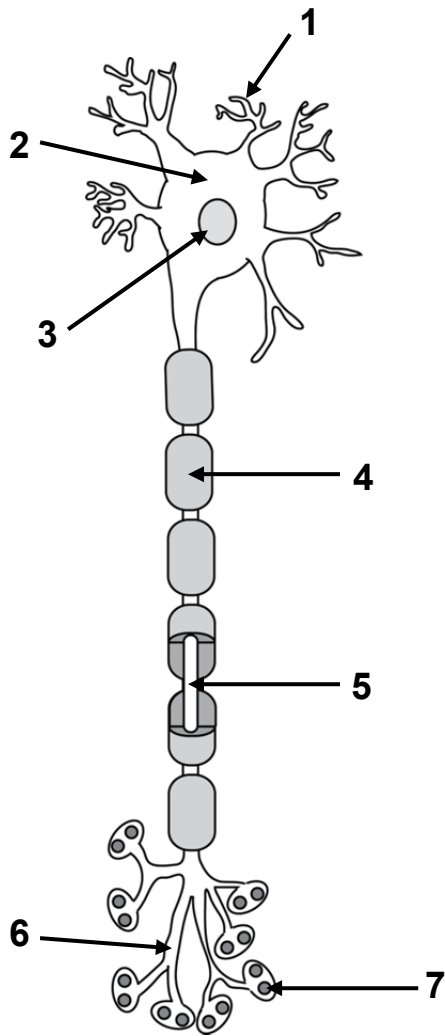
20. The diagram below shows two neurons. Draw arrows on the axons to indicate the direction that impulses would move in each of the neurons.



21. Explain why the impulses do not move in the opposite direction on the two neurons.

Part 4: Review and apply what you learned

For questions 1- 7, write the names of each of the numbered structures on the lines to the right. Refer to the information in the **Biology Brief: Neuron** if you do not remember the name of the structure.



1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

For questions 8-18, write the name of the structure or substance that answers the question. Refer to the information in the **Biology Brief: Neuron** if you do not remember the name of the structure or substance.

8. What is the electrical signal that is conducted by a neuron? _____

9. Which part of a neuron receives chemical signals from other neurons? _____

10. Which part of a neuron sends chemical signals to other neurons? _____

11. Which part of a neuron conducts electrical impulses over long distances? _____

12. Which structure forms an insulated covering for axons? _____

13. Which structure in a neuron stores chemical signal molecules? _____

14. Which structure speeds up impulse conduction along an axon? _____



15. What are the chemical signal molecules produced by a neuron called? _____

16. Which part of a neuron controls the life activities of the neuron? _____

17. What is the gap between two neurons called? _____

18. Which part of the neuron has receptor proteins attached to the cell membrane? _____

Base your answers to questions 19 through 22 on the information in the box below

People communicating	Neurons communicating
	
<p>There are billions of neurons in your brain and the branching nerves in your body. Each of these neurons can form synapses with many other neurons.</p>	

19. Which part of a neuron is like the ears of a person who is listening to a sound message?

20. What substance acts like a verbal (spoken) message to carry information from one neuron to another?

21. Do you think that a neuron can receive messages from many other neurons? Explain why or why not.

22. Do you think that a neuron can send messages to many other neurons? Explain why or why not.

23. Some neurons send chemical messages to muscle cells in your body. When a muscle cell receives the message, it contracts to produce movement. The diagram below shows a neuron that is sending chemical messages (✦) to a muscle cell.

On the muscle cell below, **draw a receptor** that could receive the chemical signal that causes the muscle cell to contract (get shorter).

