

Activity 2.2.2: The Secret to Signals

Introduction

The secrets of neuron communication have been studied by scientists for centuries. We have learned that chemical and electrical factors work together to send signals. We know that the brain and spinal cord team up to deal with all the messages that are sent around the body on a minute to minute and often a second to second basis. We also know that all body functions depend on these messages to keep us at homeostasis both physiologically and psychologically. We know a lot, but many mysteries of the brain still have to be solved before we can effectively help people with serious nervous system injuries or diseases.

Electrical messages are sent to and from the brain and the spinal cord at an amazing speed. Some of these signals can travel as fast as 250 miles per hour. It is no wonder that you are able to react to stimuli very quickly. Neurons work together to send messages in a hurry, allowing a race car driver to react while driving at intense speeds or a tennis player to return the lightning-fast serve of an opponent. We have looked at the structure of a neuron and we know that the nerve cell can generate and send an electrical signal. This signal travels down the long axon of a neuron and calls out for the next neuron in the line. Nerve cells do not actually touch one another; yet, they are able to pass signals down the line. So how does this biological relay race really happen? Let’s zoom in on the neuron and unlock the secret to these signals.

Equipment

* Computer with Internet access
* Laboratory journal
* Markers or colored pencils

Procedure

1. Complete the activity “Action Potential” found at Life Sciences/HHMI Outreach Program <http://outreach.mcb.harvard.edu/animations/actionpotential_short.swf> Follow the directions to generate an electrical impulse down the axon of a neuron.
2. Answer questions on the student response sheet as you work through the activity.
3. Note that the action potential travels down the axon until it reaches the axon terminal. But what happens next? How does this electrical information go from cell to cell? View the animation “Crossing the Divide: How Neurons Talk to Each Other” at the Genetic Science Learning Center at the University of Utah site <http://learn.genetics.utah.edu/content/addiction/crossingdivide/>
4. In your laboratory journal, summarize how neurons communicate at the synapse in one – two, well-crafted paragraphs. Your paragraph must include each of the terms listed below. Underline each term in your paragraph.
* Synapse
* Action Potential
* Neurotransmitters
* Vesicles
* Axon
* Dendrites
* Axon Terminal
* Receptors
* Second Messengers
1. Draw and label a diagram of two neurons that are passing along the “message.”
2. Read the Neuroscience for Kids page on Neurotransmitters found at <http://faculty.washington.edu/chudler/chnt1.html>.
3. Use information from the animation and the website to write a list of five trivia questions about neurotransmitters in your laboratory journal. Write the question in colored pen and the answer in a different color. One of your questions must reference the neurotransmitter dopamine or the neurotransmitter serotonin. You may need to do additional research to find out the specific function of these chemical signals.
4. Share your list with the class.

Conclusion

1. Other than transporting materials, what are two other important functions of the cell membrane?
2. Explain how neurons convey information using both electrical and chemical signals.
3. *When you learn something new, you grow new neurons*. What would you say to disprove this statement? Use information from the videos and animations to support your answer.
4. You need to have a cavity filled so the dentist injects a local anesthetic into your gums. Local anesthetics reversibly bind to Na+ channels and block the movement of sodium ions. Using what you know about signals, explain why this action can keep you from feeling pain.