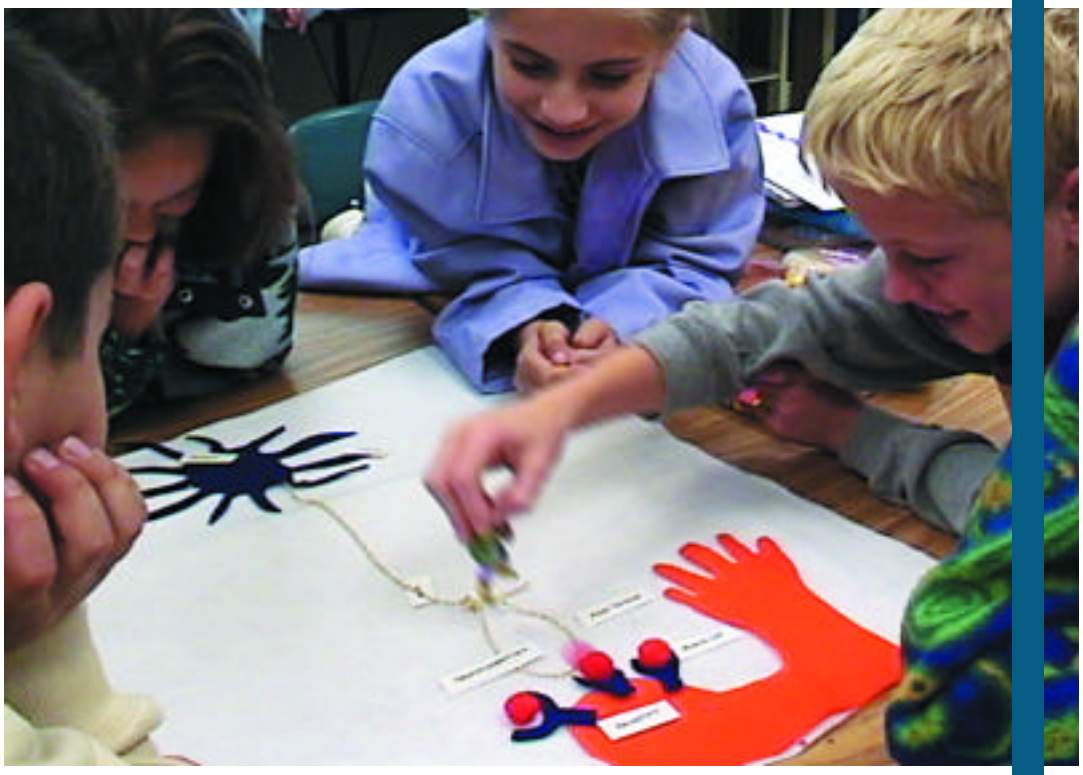
Unit 2:
Neurotransmission

GRADE 4



"I have kids participating who never would have thought of raising their hands before. And the recall of some of the children whom I never would have figured would be tracking is just amazing - what they remember from last year, what they remember from last week or last month. It's really good."
4th Grade Teacher

Neurotransmission Unit: Background Information

Neurons: Structure and Function

The human brain contains approximately 100 billion nerve cells, which are also called neurons. There are many different types of neurons in the nervous system that differ in appearance. However, all neurons have some common structural features that allow them to transmit and receive messages. The basic parts of neurons are the **cell body**, **dendrites**, **axon**, and **axon terminal**.

The cell body and dendrites function as the "receptive" part of the cell. The axon and axon terminal are involved in transmission of messages to other cells. A single neuron can cell can receive messages from thousands of other neurons. Neuroscientist have discovered a great deal about how neurons communicate with one another and believe that the intricate communication among these cells is responsible for our thoughts, memories, feelings, and sensory perception. Very little is known about how the interactions of neurons actually create our human experience. However, much is known about how nerve cells stimulate muscle cells, and thus control our movements. The basic principals involved in the transmission of messages from neurons to muscles are the same as those between nerve cells

Neurotransmission: Neurons Sending Messages

Neurons in the spinal cord directly control our muscles, and the basic concepts of neurotransmission will be introduced though this neuro-muscular communication. Neurons whose cell bodies are located in the spinal cord project their axons directly to skeletal muscles. These cells are called motor neurons and receive messages from the motor cortex, as described in general terms in the reactions time lessons. The axon terminal of the motor neuron comes in very close proximity to the muscle cell, but dose not directly contact the muscle. There is a very small space between the axon terminal and the muscle cell that is known as the **synaptic cleft.** This small region that includes the axon terminal, synaptic cleft, and adjacent part of the muscle cell is called the **synapse**.

The motor neuron gets excited electrically by receiving a series of chemical messages from the motor cortex. When a threshold level of excitation is reached in the cell body, a burst of electrical activity is produced in the axon that is propagated to the axon terminal. This burst of electrical excitation is called the **action potential**. When the action potential reaches the axon terminal, a release of chemicals (molecules) known as **neurotransmitters** is induced. The neurotransmitter molecules travel across the synaptic cleft and bind to specialized

receptors on the muscle cell. When the neurotransmitter binds to the receptor, electrical activity is induced in the muscle and this causes a complex series of biochemical events to occur within the muscle cell that results in muscle contraction and movement of body parts. This sequence of events is summarized schematically below. (This animation was created in Hyperstudio, as a part of a technology extension unit for fourth grade.)

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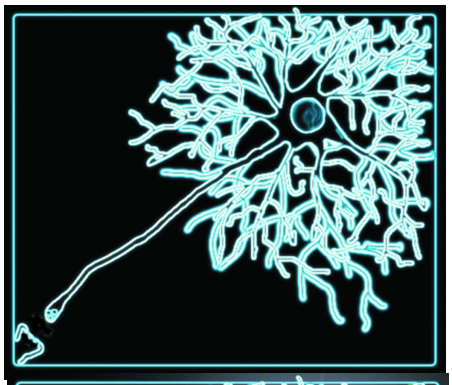

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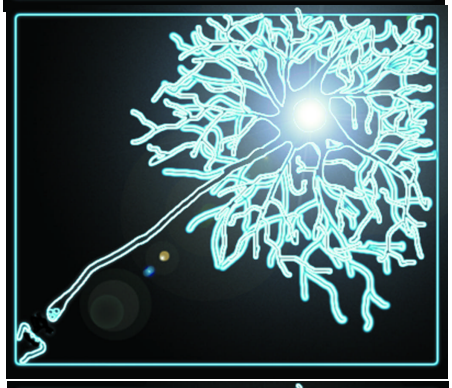

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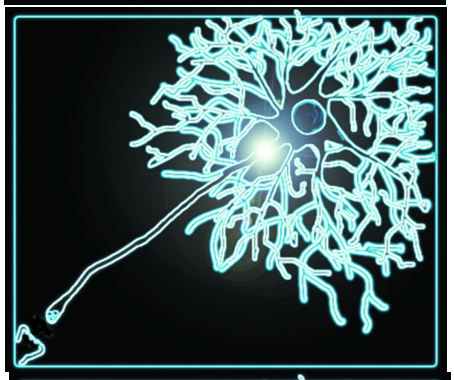

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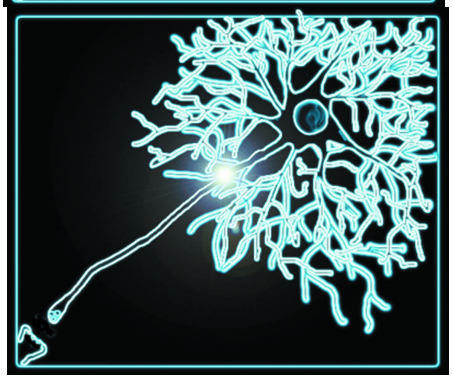

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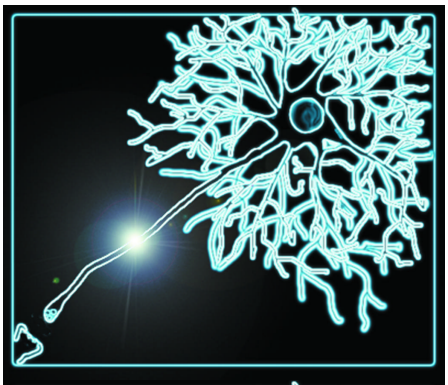

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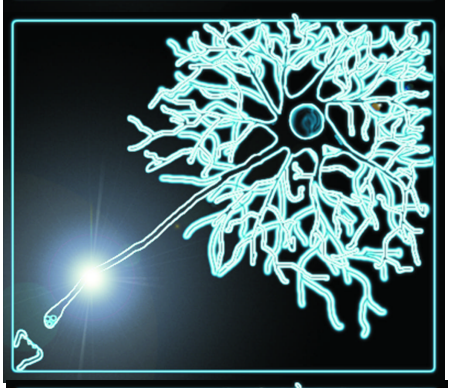

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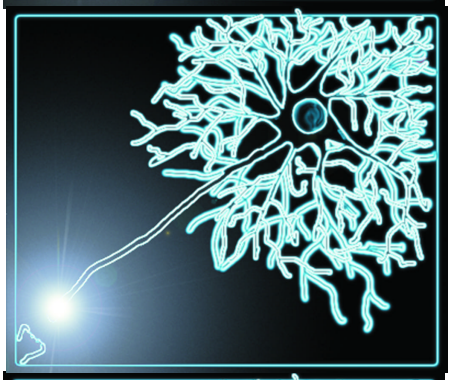

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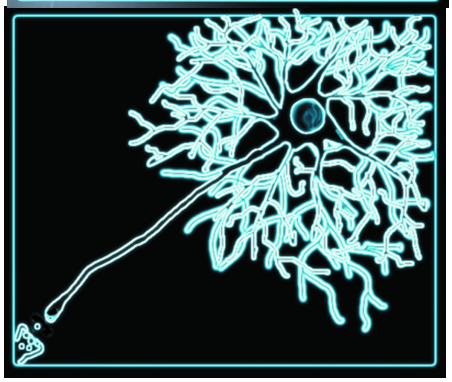

Watch that axon terminal!

Notes