**Muscle Talk: Using EMG Spikerbox**

**Topic: Movement and muscle physiology**

**Developed by:** CUNO graduate students, adapted from Backyard Brains

**Grades:** K-5 adaptable

**Vocabulary words:** muscles, motor neuron, synapse, action potential

**Materials:** EMG Spikerbox from Backyard Brains, phone/computer to connect the spikerbox for audio ( <https://backyardbrains.com/products/musclespikerboxpro> )

**Time needed: 10min (adaptable)**

Introduction (2 min): How do you move your body? How do neurons send messages to your muscle?

Activity:: Place two electrodes on bicep/forearm of the student to record EMGs!

**Summary:** This lesson is an introduction to how your brain “talks” to your muscles and instructs them to move. When your brain decides to move a muscle, neurons from an area of your brain (called motor cortex) travel through your spinal cord and connect with special cells called muscle fibers. With this experiment, you can learn about muscle physiology through electromyograms (EMGs). You will have an understanding of neuron/muscle communication, and you will listen to the electrical impulses of muscles at rest and during contraction.

**Prerequisites for Students:** None. Helpful if students understand the concept of neurons and how they project.

**Learning Goals:**

* introduce the idea of a “motor unit” which includes neurons in your brain that send long connections to your spinal cord, which then connect to special cells called muscle fibers that make your muscles move.
* Explain how action potentials (AP) are how neurons communicate and make your muscles move
* Have students understand that every movement your body makes, walking, playing basketball, involves activating thousands of these motor units at the same time! Make it fun!

**Background for instructor:**

* Movement is a complex behavior that starts in your brain
* **Make sure students know that the sticky pads connecting to the spikerbox will only hurt like a bandaid coming off. Do not put them on before telling them.**

**Set-up:** You will need an EMG spikerbox from Backyard Brains, conductive gel, applicators for gel, napkins for cleaning off gel, fully charged iPad/tablet or iPhone/smartphone with free Spikerbox app preloaded, extra 9V battery

**Lesson Outline (From Backyard Brains):** When your brain decides to move a muscle, neurons from an area of your brain (called motor cortex) travel through your spinal cord and connect with special cells called muscle fibers to make a "motor unit." A motor unit is a single motor neuron and the multiple muscle fibers it innervates. A muscle fiber is a very special type of cell that can change its shape due to myosin/actin chains sliding across each other.

A single motor neuron can synapse with multiple muscle fibers. In general, a large, powerful muscle like your bicep has motor neurons that innervate 1000s of muscle fibers, whereas small muscles that require a lot of precision, such as your eyeball muscles, have motor neurons that only innervate ~10 muscle fibers.

When a motor neuron fires an action potential, this causes a release of acetylcholine at the synapse between the neuron and the muscle (this synapse is also called the Neuromuscular Junction). This acetylcholine then causes changes in the electrical potential of the muscle. Once this electrical potential reaches a threshold, an actual action potential occurs in the muscle fiber! This action potential propagates across the membrane of the muscle, causing voltage gated calcium channels to open, which begins the cellular cascade that ultimately causes muscle contraction.

When you contract a muscle, this is the result of many muscle fibers firing action potentials and changing shape. We can record this our activity with our new Muscle SpikerBox.

**Wrap-up, final thoughts**: Visit Backyard Brains to see what other experiments you can do with the Muscle SpikerBox! https://backyardbrains.com/products/musclespikerboxpro