

### **“Too Tired to Move”**

**Purpose:** To demonstrate how a muscle stretch occurs, incorporating the presynaptic action potential, neurotransmitter release, postsynaptic receptor binding, and eventual muscle stretch. If time permits, principles such as the need for metabolites and neurotransmitter reuptake will also be included. The chief goal of the experiment the kids will conduct is to teach how muscles can get tired from overuse (by means of lack of neurotransmitter).

**Materials:** 20+ balls (e.g. ping-pong), two buckets to contain the “neurotransmitters,” 2-3 egg cartons, a buzzer, a bungee cord, two weighted blocks.

**Procedure:** Some type of action will be given; the first child must decide if this action would result in the stretch of the leg muscle exemplified. (Examples are “smelling a flower” versus “kicking a soccer ball.”) If the child decides that the leg muscle should be stretched for the scenario, he or she will hit the buzzer, signifying the beginning of an action potential. The remaining children will then run from side of the station to the other, carrying one “neurotransmitter” apiece. They will place the balls in egg cartons before returning for another. On the first run, children will only have to put a certain amount of “neurotransmitters” in the “receptor binding sites” before the muscle can stretch, which is signified when one or two children stretch the weights, connected by the bungee cord, across tape marks. (To add a competitive element, the kids can be timed by stopwatch.) During the next run, one child must measure out a certain amount of metabolites (nutrients) into a bucket before the stretch can occur. For the kids to apply their knowledge, they will be given a final run on which the muscle will be activated repeatedly. One or two children will be assigned the task of neurotransmitter reuptake; after the muscle stretches, they must take the neurotransmitters back to the original bucket one at a time. The students will discover that in order for the muscle stretch to take place, enough metabolites and neurotransmitters must be present, which becomes harder as the limited supply of neurotransmitters is depleted.

**Issues:** The ratio of neurotransmitter release to reuptake is not completely accurate; in this scenario, there are only a few more neurotransmitters being released than there are neurotransmitters returning for reuse. Additionally, neurotransmitters are portrayed as only being recycled whereas in reality they would also be produced in the cell body. Finally, the action of the muscle stretch is more complicated than is being portrayed in this scenario.

**Lesson plan:** The children will learn how a muscle stretch occurs by means of neurotransmitter binding. An additional lesson includes the necessity for metabolites to continue muscle function. The primary experiment with which to test their knowledge involves getting them to repeat a basic muscle stretch

with the additional physiological limitation of neurotransmitter supply. Children will be asked before the final run what they think makes them tired when they exercise, and they will be asked what might go wrong in this muscle stretch scenario. The final run, which incorporates neurotransmitter reuptake to a limited degree, should enforce their understanding that while neurotransmitters help muscle function continue, the repeated use of the muscle drains the supply of neurotransmitters until the muscle cannot work properly.