Washington University Young Scientist Program
Neuroscience Teaching Team Demos Overview

The Neuroscience Teaching Team program is comprised of 3 modules. The three components are designed to give a basic understanding of how the brain is organized and how it helps us interact with our environment in a number of ways.

BRAIN ANATOMY - In this module, students will be given an overview of brain anatomy

Concepts addressed:

Skull contains brain, tissue, cells
Neuron is the main kind of cell
Parts of a neuron: Cell body (with nucleus), dendrites, axon
Neurons communicate with each other and form networks throughout the brain and body to send information
100 billion neurons in your body, are very small
Spinal cord connects brain to rest of body through nerves
Nerves branch off of the spinal cord to travel to the rest of your body (such as your muscles)
Parts of the brain:
meninges, optic nerves, folding of cerebral cortex, cerebellum, brain stem, corpus callosum, blood vessels, white matter, gray matter, left and right hemispheres, frontal, occipital, parietal, and temporal cortex, visual, motor, sensory, auditory cortex, hippocampus
Spinal cord injury, brain injury/disease

Demonstration:

If possible, students will be shown a model of the brain and/or spinal cord

VISUAL MOTOR ADAPTATION - A demonstration will show students how the brain can adapt to change in visual input.

Concepts addressed:

Neural adaptation: neural, neuron, neurology, adaptation
Motor movements
Cerebellum helps your brain adapt your motor movements and learn new ones
Prisms
Scientific method as it relates to our demonstrations:
Observation, hypothesis, experiment, conclusion
Subjects, experimenters, baseline

Demonstration 1: How long does it take to adapt to prism goggles?

Students sit in two rows, each facing a partner
Each tries to touch the finger (target) of partner, then their own nose several times, first without goggles, then with goggles
After putting on goggles, students miss target, but gradually adapt to goggles and are able to touch target finger
After taking off goggles, students miss target since they have adapted goggles, gradually adapt back to normal

Demonstration 2: How does your cerebellum help you to adapt to prism goggles when throwing?

Student throws clay balls at a target without goggles, then with goggles while other students keep track of throws with chalk/marker
After putting on goggles, student misses target off to the side, but gradually hits closer to target as they adapt to glasses
After taking off goggles, student misses target off to the other side since they have adapted to goggles, gradually adapt back to normal

Demonstration 3: Is adaptation to goggles specific to one movement (overhanded throw), or does it extend to other movements (underhanded throw)? (optional)

Student throws clay balls at a target overhanded then underhanded without goggles, then the same with goggles
After student adapts overhand throw, underhand throw is off target but eventually adapts as well
Neural adaptation is movement dependent (you have to relearn each new movement)

PROPRIOCEPTION – THE 6th SENSE - Students will be introduced to the 6th sense, proprioception, and will see how it helps us to interact with our environment through a demonstration.

Concepts addressed:

5 senses
Proprioception is how brain senses where our body is in space
Muscles
Motor neurons run through spinal cord to connect muscles to brain
Connections between nerve and muscle
Muscle spindles sense muscle length
Stimulation of muscle spindles tells brain length of muscles
Triceps, biceps, Achilles tendon
Sense of balance, inner ear
Scientific method as it relates to our demonstrations:
Observation, hypothesis, experiment, conclusion

Demonstration 1: What do muscle spindles do?

Student stands with arm out to side, with eyes closed, move finger as close to nose as possible without touching it, gets very close.
Now use 'stimulator' to stimulate tricep while performing same task, student's finger ends up farther out in front of the face
Stimulator excites muscle spindles, tricks brain into thinking the muscles are longer than they really are

Demonstration 2: What is the result of stimulating the Achilles tendon?

Student stands with eyes closed, feet together, head tilted back, volunteers in front and back to catch student
Use stimulators on the Achilles tendon, volunteer falls backwards
Stimulators excite Achilles tendon, make brain think muscles longer than they really are, and that student was leaning forwards, so student compensates by pushing down with the toes, or trying to *shorten* the Achilles tendon, then they fall backwards