**Axon Guidance and Growth**

**Topic: Neuroscience Introduction and Methods used in research**

**Developed by:** CUNO Graduate students, Leslie Sibener

**Grades:** K-12

**Vocabulary words:** Axon, receptor, ligand

**Materials:** Two density towers (water, vegetable oil, Dawn Dish Soap), bottle cap, grape, metal nut, and posterboard for the activity.

**Time needed: ~10min**

**Introduction**: What is an axon? (2min)

**Axon growth:** How does an axon move? (3min)

* Talk about Ephrins (ligand) and Eph Receptors (Eph-Rs) gradients

**Show density tower example**: (5min)

* Visual representation of how gradients of Ephrins and Eph-Rs work so that axons grow to the right place.

**Summary:** This lesson is a basic introduction to on axon growth and guidance. Axons, the projections from brain cells (neurons), grows away from the cell body to make connections between areas of the nervous system that need to communicate. One of the best characterized systems in the brain of axon growth and guidance is part of the visual system. Cells in your retina--- retinal ganglion cells – have to make very precise connections to another area of the brain-- the superior colliculus. The retina compresses the visual world around you, and passes that representation to other parts of your brain, including the superior colliculus (SC). The SC maintains a topographic map of the retinal inputs. This map is created through a gradient of guidance molecules. The main point to get across is that molecular tags on projecting axons and in their target zones determine the specificity of axonal connections.

**Prerequisites for Students:** None. Helpful if students understand the concept of cells.

**Learning Goals:**

* The idea that axons have to migrate to different areas to build the brain
* The understanding that a gradient of molecules govern axon’s growth and guidance

**Background for instructor:**

* Remember to start by explaining what an axon is
* Reinforce that axons make connections throughout your brain—which is what makes it grow!
* After introducing those ideas about axon growth, talk about how axons know where to go—the chemoaffinity hypothesis (molecular tags determine the specificity of connections)
* Use the density tower to demonstrate that the higher the amount of a molecular tag (Ephrins), the further the axon travels.

**Set-up:** Use the poster board for the activity and the two density towers.

**Lesson Outline:**

* First you want to introduce what an axon is. Because the brain is made up of thousands of neurons, these neurons need to communicate with each other, which is why you have axons! These are the paths that neurons can speak to one another.
* Next, explain that axons need to grow to specific locations, or else the brain isn’t wired correctly. How do axons know where to go?
* Molecular gradients are one way that axons know where to go
* One system that uses these gradients is the projections from the retina to the superior colliculus. The retina maintains a representation of the visual world around us, and transmits that information to the superior colliculus in a gradient specific manner.
* Use the density tower to show this organization!

**Wrap-up, final thoughts**: There is a lot of information in this activity, but make sure you get the idea across that the more of a molecule there is in one location, the more the axon is repelled from that spot, and the further it grows.