Matthew Cozad, Biological Engineering

Year in School: Junior
Hometown: St. Joseph, MO
Faculty Mentor: Dr. Andrew McClellan, Biological Sciences
Funding Source: Life Sciences Undergraduate Research Opportunity Program

Effects of axotomy on calcium influx in reticulospinal neurons of larval lamprey

Matthew Cozad & Andrew McClellan

The lamprey is a prime example of the remarkable axonal regeneration that can occur in lower vertebrates. Previous studies showed that spinal cord transected lamprey recover normal locomotor behavior in about 8 weeks (McClellan, 1998). With increasing recovery time, increasing numbers of axons from injured reticulospinal (RS) neurons in the brain regenerate across the lesion site and for greater distances below the lesion. One factor that might affect axonal regeneration is the individual properties of the RS neurons. During electrical activity (action potentials) in these neurons, calcium influx occurs through voltage-gated and chemical-gated calcium channels. First, previous research demonstrated that in injured RS neurons from lamprey, action potentials are missing a component that is due to calcium influx and that is present in uninjured RS neurons (McClellan, 2003). Furthermore, it has been shown that when calcium channels and calcium influx are blocked in uninjured (normal) RS neurons, firing patterns are similar to these observed in injured RS neurons. Second, lamprey RS neurons in cell culture retract as a result of calcium influx (Ryan et al., 2004). Thus, preliminary results suggest that injured RS neurons may down regulate calcium channels to lower intracellular calcium and to allow axonal regeneration. The purpose of the project was to determine the factors that influence axonal regeneration and obtain evidence for the possible down regulation of calcium channels in injured RS neurons. A calcium indicator dye was loaded into RS neurons and the neurons were stimulated to produce electrical activity (action potentials) during which fluorescence images were captured. The calcium indicator dye allowed imaging of the levels of intracellular calcium and changes in fluorescence. However, a higher signal-to-noise ratio is needed before calcium levels can be compared in injured and uninjured larval lamprey RS neurons.