Project Title: Understanding Nerve Regeneration

Investigator: Joseph Koke

Department: Biology

Project Summary:

Understanding of the cellular and molecular biology underlying nerve tissue development and regenerative capacity after injury is key to basic understanding of development, but also to developing the clinical knowledge necessary to reverse and repair injury to nerve tissue. Much is known about the process of nerve regeneration in fish and mammals. For example, when the optic nerve of a mouse is severed, the distal portion of axons leading from the retina into the brain die and do not regenerate, while in fish, the cut axons promptly sprout new shoots (neurites) which rapidly re-enervate the brain. REP funds helped support testing the hypothesis that injury to nerve tissue results in differential gene expression and/or temporal differences in gene activation/deactivation between fish and mammals. We (I and my students) used (1) DNA microarray analysis to determine changes in gene expression resulting from cutting the optic nerve in zebrafish; (2) confocal microscopy to visually track nerve regeneration following injury, and (3) quantitative polymerase chain reaction (qPCR) to confirm the microarray findings. Our results indicate several genes of interest, and have illustrated differences between fish and mammals that may be key to understanding failure of CNS regeneration in mammals. These findings have been presented and published as indicated in this report, and have supported 3 major grant proposals (one successful, one declined, and one pending).

Publication:

Katherine E. Saul, Joseph R. Koke, and Dana M. García. 2009. Activating Transcription Factor 3 (ATF3) Expression in the Neural Retina of Zebrafish During Optic Nerve Regeneration. Comparative Biochemistry and Physiology, Part A. In Revision, 2009.

Dana M. García and Joseph R. Koke. 2009. Astrocytes as gate-keepers in optic nerve regeneration – a mini-review. Comparative Biochemistry and Physiology. Part A: Molecular & Integrative Physiology Comparative Biochemistry and Physiology, 152:135-138;. Available on line at http://dx.doi.org/10.1016/j.cbpa.2008.09.026).

Presentations:

Katherine E. Saul, Joseph R Koke. Dana M. García. 2008. Dissection of Specific Genetic Signals from a Background of Tissue repair and Inflammatory Response Noise During Optic Nerve Regeneration in Danio rerio. ISDN, June 2008 (refereed abstract).

Amanda L Mosier, Katherine E Saul, Joseph R Koke, Dana M. Garcia. 2008, Optic Nerve Re-Growth in Danio rerio. FASEB Journal, April 2008.

External Grants:

2008 Co-PI with PI Dana García, NSF $654,966, Astrocytes as Gate-Keepers for Optic Nerve Regeneration. Declined.

2008 PI Koke, Co-PI Dana García. NIH AREA $150,000. Astrocytes and Optic Nerve Regeneration in Fish and Mammals. Pending.

External Grants Awarded:
2008 Principal Investigator, NSF-MRI, $334,800, Acquisition of a Multiphoton-Ready Microscope at Texas State University.

Student Number: 6