



CALIFORNIA STATE SCIENCE FAIR 2014 PROJECT SUMMARY

Name(s) Justin E. Lehman	Project Number 34078
Project Title Stimulating Axons to Heal Nerve Damage	
Objectives/Goals The goal was to determine which growth factors, NGF and cAMP, stimulate the neurons to grow the longest axons, and the largest area of the growth cones. Abstract Methods/Materials PC12 cells, which are a tumor cell line from a rat pheochromocytoma, were maintained in culture. Cultured PC12 were grown in media that contained various growth factors either alone or in combination. Using an inverted microscope, digital photographs were taken every two days of the cells in culture. Each condition was grown on three separate culture dishes. The cells were grown over a period of 8 days. Every two days, through the microscope, ten pictures were taken per condition. From the pictures, the five largest axons were measured and the average was calculated. The length of the axons and the area of the growth cones were obtained by using ImageJ, which is a computer program that allows one to measure microscopic images. The data was entered into a standard spreadsheet to calculate averages and standard deviations. The results were graphed using a standard computer program. Results The PC12 cells grown without growth factors was the control and had the smallest average length of 3.2 microns. Secondly, cAMP had an outgrowth of 23.2 microns. Slightly less than cAMP, NGF had an outgrowth of 15.5 microns. NGF and cAMP combined produced the longest axon outgrowth at 41.3 microns. For the area of the growth cones, the control had an average of 17 microns. cAMP alone had an average area of 425 microns. NGF alone had an average area of 382 microns. Finally, NGF combined with cAMP had the greatest area of 1,022 microns. Conclusions/Discussion In conclusion, NGF and cAMP combined had the overall best results. Based on previous findings on how NGF and cAMP stimulates nerves, the data supports that the combination of the two growth factors created the longest outgrowth because they stimulated the neurons in two different ways. The purpose of conducting these experiments is to explore how we can regenerate damaged neurons to help individuals, such as people who have lost a limb. Stimulating nerves with growth factors to get them to a new location is the first step, getting them to make connections is the second step. There have not been many published articles on stimulating growth cones and this may be a new piece of the puzzle that could be explored further to help nerves make the proper connections.	
Summary Statement This project stimulated neuron axons and growth cones with growth factors, NGF and cAMP to see which condition resulted in the most growth.	
Help Received There was a lot put in to doing this project. Dr. Feinstein, my mentor, provided the lab and all the materials necessary to carry out the experiment. My parents provided some help proof reading and suggestions on editing of my poster board.	