



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Nadia Ansari	Project Number S2201
Project Title Use of Pulsed Photobiomodulation in Nerve Regeneration after Injury-Induced Peripheral Neuropathy in Danio rerio	
<p style="text-align: center;">Abstract</p> <p>Objectives The objective of my study is to examine if photobiomodulation (PBM) treatment can result in improved stress response and peripheral nerve regeneration, particularly of A delta and C nerve fiber, after caudal fin injury in wild type and mutant (Casper) Danio rerio.</p> <p>Methods 24 Danio rerio, 2 Ten-gallon tanks, 2 5-gallon tanks with gridlines, Tricaine Solution, PBM/Cold Laser Light Therapy Device, Cell culture clusters, Micropipettes, 0.1M PBS = Phosphate Buffer (pH 7.4), 0.1M PBS+ = Phosphate Buffer with 0.3 % Triton-X 100, rabbit anti-peripherin polyclonal antibody, fluorescein-conjugated donkey anti-rabbit IgG, fluorescent microscope (Nikon, E400, Melville, NY). Both wild type and Casper (a mutant for mitochondrial protein mpv 17) Danio rerio were randomized to control or PBM treatment when caudal fin was clipped and were placed in the novel tanks with grids and video was acquired. Caudal fins were clipped again after 14 days of daily or every other day PBM treatment of different durations. The fins were stained with peripherin antibody and fluorescence microscope was used to detect A delta and C nerve fiber regrowth. Video was analyzed for stress response and swimming distance.</p> <p>Results Experimental groups with PBM treatment had more growth than the control group. The group with PBM dose of 10 sec every other day had the most growth (266% more than control). Giving PBM treatment every day did not result in greater growth ($p < .0002$). Experiment group wild type showed much greater A delta and C nerve fiber regrowth than experiment Casper, which lacks the mpv 17 mitochondrial protein (536% more growth in wild type vs. mutant) ($p < .003$). PBM treatment prior to fin clip decreased stress response in both wild type and mutant D. rerio by approximately 4-fold ($p < .01$), as well as greater fin function as assessed by swimming distance (160% greater in experimental vs control, $p < .001$).</p> <p>Conclusions PBM after nerve injury results in faster recovery of fin function and faster peripheral nerve growth, with a possible mitochondrial pathway mechanism, involving the mpv17 protein. A delta and C nerve fibers are damaged in many conditions including diabetes, post-chemotherapy and autoimmune disorders, like Guillain-Barre. PBM therapy could be helpful in these conditions, affecting 20 million individuals in the US, thereby lessening dependence on pain medications and possibly improving sensory nerve regrowth and function.</p>	
Summary Statement I showed that photobiomodulation can significantly improve peripheral nerve regeneration, possibly through a mitochondrial protein mechanism.	
Help Received I received help from Dr. Guo at UCI for caudal fin clip and caudal fin staining. I independently came up with the research question, proposed to use zebrafish as the animal model for my experiment, and found published papers with various protocols, including that for staining zebrafish peripheral nerve fibers.	



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Madeline Christopher	Project Number S2202
Project Title Honeybee Food Transfer and Foraging Activity	
<p style="text-align: center;">Abstract</p> <p>Objectives My goal is to ascertain how much honeybees can store with a supplemental nectar source I provided vs. out foraging on their own. I also proceeded to observe and record the bees behavior relating to the three different concentrations of nectar sources I had provided outside the hive.</p> <p>Methods I had access to my dad's beehive we keep on our property which included the empty frames of honeycomb I used inside the hive and the external and internal feeders I used in different parts in the project. The first part of my experiment I measured how much the bees could store with a supplemental nectar source placed inside the hive. The second part of my experiment I measured how much the bees could store when they were out foraging on their own. The third part of my experiment I made three supplemental nectar sources with different concentrations and placed them equally 50 ft from the hive in different directions. I decided to use three different paints to mark the bees to see how many return to the three different nectar sources outside the hive.</p> <p>Results The results pertaining to the first and second part of my project indicated that the bees could produce more with the supplemental nectar source inside the hive than when they were out foraging on their own. The results pertaining to the third part of my experiment indicated that the highest concentration nectar source was the most popular when I recorded the bees activity every day.</p> <p>Conclusions One of the most influential factors that played a part in my experiment was the inclement weather. The cold, rainy days during the time I conducted my experiment caused the bee behavior at each source to drop. It also caused the bees to stay inside the hive in order to survive and not be able to go out and forage. At the end of my experiment, I was able to conclude that my hypothesis was correct. The bees had shown that they were able to produce more with the man-made nectar source inside the hive than when they were out foraging on their own. I was able to identify this because the frame at the end of week one was noticeably heavier than week twos results. I also had predicted that the bees would show their preference by returning to the highest concentration nectar source.</p>	
Summary Statement I observed honeybee behavior and storage relative to sugar concentrations in supplemental nectar sources.	
Help Received The hive, protective gear, and guidance inside the hive was provided by my dad.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
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Name(s) Changhyun Kim	Project Number S2203
Project Title Observing Mutualism of Vermivora cyanoptera and Psaltriparus minimus	
Abstract Objectives Mutualism is defined as a relationship between two species where each individual fitness benefits from the interaction of the other and can occur both directly and indirectly in any ecosystem. The project's main objective is to determine and identify the suspected mutualistic interaction of the Vermivora cyanoptera (blue-winged warbler) and the Psaltriparus minimus (bushtit), two birds that are commonly seen flocking together. Methods Two pairs of cameras with microphones were installed at a local marsh preserve and wetland for 95 days, one adjacent to a seasonal path and the other at a sump. V. cyanoptera and P. minimus are sighted on the marsh preserve (impacted group) while the wetland primarily inhabits P. cyanoptera (control group). Data were collected on the movement of V. cyanoptera following the chirp of another V. cyanoptera or that of P. minimus, and a T-test for two sample means was conducted to determine the significance of the results. Results The two species were observed to have a mutualistic interaction that increases the fitness of both birds ($p=6.32 \times 10^{-50}$ for sumps & $p=2.02 \times 10^{-57}$ for seasonal paths). P. minimus served as a sentinel bird to alert V. cyanoptera of potential predators, and V. cyanoptera tended the nests of P. minimus in return. Additionally, human disturbance correlated with increased V. cyanoptera activity and P. minimus sentinel calls. Conclusions The new knowledge on the P. minimus sentinel call and V. cyanoptera survival behavior allows for accurate population counts and targeted conservation practices.	
Summary Statement Through video captures and statistical analysis, I found a strong correlation of bushtits acting as a sentinel species for the blue-winged warbler.	
Help Received I designed, prepared, and conducted the field research myself. I received permission to gather data from Melissa Loebel at Madrona Marsh, and my Science Research teacher helped edit my research paper.	



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Junhee Lee	Project Number S2204
Project Title Effect of Temperature on Embryonic to Larval Development of Sand Dollars, Dendraster excentricus	
<p style="text-align: center;">Abstract</p> <p>Objectives Understanding how life responds to changes in temperature is a critical endeavor given the predicted climate changes the planet will experience in the future. The aim of this study was to investigate the effects of temperature on embryonic and larval development rate and larval morphometrics of sand dollars, Dendraster excentricus. It was hypothesized that D. excentricus cultured at 21.5°C would develop faster with greater average post oral arm length (POAL) and POAL to mid body length (MBL) ratio than those reared at 13.5°C.</p> <p>Methods Embryos were grown at 13.5°C and 21.5°C seawater and were monitored every thirty minutes for development using the microscope. Microphotographs of the larvae were taken and analyzed for their morphometrics(post oral arm length (POAL), mid body length (MBL), and stomach length) every two-three days using the software Image J.</p> <p>Results Embryonic cell division rate was significantly higher at 21.5°C than 13.5°C (ANCOVA Temp*time p<0.05, p=0.008). Larval developmental rate was also significantly faster at 21.5°C, p=0.012. The difference in MBL and the stomach length between the larvae in 13.5°C and 21.5°C increased with time. POAL was longer in high temperature larvae early in development, resulting in a large difference in the POAL: MBL ratio. This difference diminished as larval development progressed.</p> <p>Conclusions The hypothesis was partially supported because while the developmental rate of D. excentricus in 21.5°C was greater than the developmental rate of those in 13.5°C, the POAL and the POAL:MBL ratio was only significantly greater in 21.5°C early in development. These results are important because with increasing global temperatures, larvae will increase their metabolic rates and abating physical adaptations to this in later stages could adversely impact the survival of these species. These results confirm the necessity for integrative approaches for understanding the true effects of temperature changes on organismal biology.</p>	
Summary Statement This project investigated the effect of temperature on embryonic and larval development rate and larval morphometrics of sand dollars, Dendraster excentricus.	
Help Received Cabrillo Marine Aquarium provided the facility and materials used in this project. Dr. Douglas Pace from Cal State Long Beach and Dr. Andres Carrillo, Janine Rodriguez, and other staff from the Cabrillo Marine Aquarium reviewed my research plan and paper and were consulted for any questions and suggestions.	



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Elizabeth Lindholm	Project Number S2205
Project Title The Witching Hour: Diel Variations among Kelp Forest Fishes at Monastery Beach, CA	
<p style="text-align: center;">Abstract</p> <p>Objectives Through the observation and repeated sampling of kelp forest ecosystems and organism behaviors, scientists are able to piece together a more complete picture of how these ecosystems function. The results of this project could specifically help to lay out parameters for fishing regulations as well as other conservation efforts. For instance, by knowing where fish are going to be and when, resource managers will be able to more accurately describe the most efficient method for fishing them with the lowest environmental impact. These insights into fish communities may also illuminate the problems with existing laws and regulations.</p> <p>Methods In order to observe fish behavior in the context of diel variation, three dives per time period were conducted at south Monastery Beach in the exact same location each time. The time periods were morning (after sunrise), afternoon (before sunset), night (after sunset), and morning (before sunrise). Each of the twelve total dives were conducted in the same manner using SCUBA equipment and two HD Sony Vixia camcorders. In addition, a related study was conducted on the observation of latitudinal variation in kelp forest fish communities. With respect to this section, data was collected in much the same way but only during one time period (morning after sunrise) across three sites.</p> <p>Results The first and third hypotheses were supported by the results, meaning that total fish population was higher during the night and that the species behavior did change across the diel cycle. The second was not supported by the data that were collected, in turn the data showed that species diversity was highest in the morning. There are several possible explanations including the variation in predatory behaviors of marine animals in relation to light concentration and habitat usage of different species throughout the day. The last hypothesis was largely supported by the results, probably due to the mixing of southern and northern fish species to form a larger community than either one separated out.</p> <p>Conclusions These results demonstrated that fish behavior does change with time and distance and further studies can be conducted to provide a more complete view of the ecosystems.</p>	
Summary Statement I demonstrated that kelp forest fish behavior and habitat utilization changes in response to time of day and latitudinal variation.	
Help Received I designed, organized, and conducted this study on my own however for safety reasons, Frank Degnan, Tommy Dolan, Paulina Salinas Ruiz, Megan Salomonson, and Kameron Strickland assisted me during dives.	



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY**

Name(s) Roberto Mungaray	Project Number S2206
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Project Title
How Does the Composition of Pigeon Milk Affect the Growth Process of Domestic Animals?

Abstract

Objectives

To observe if pigeon milk may be used as a growth hormone alternative in the poultry industry

Methods

11 White longhorn chickens, 48 pigeons to produce milk, 24 millimeters of pigeon milk, weight scale measuring in grams, measuring tape in cm, mini refrigerator to keep the pigeon milk substance from turning bad, a variety of test tubes to collect pigeon milk, and repeat this process for 2 months.

Results

Giving pigeon milk to 11 baby chicks for 2 months, every morning and afternoon to find out how pigeon milk affects a chicken's growth rate. After week 4 there was a difference in growth than a average chicken

Conclusions

In within 2 months of conducting this experiment I conclude that my exterminated chickens grew by a 29.9% in size with a diet of pigeon milk.

Summary Statement
Using pigeon milk to substitute as a growth hormone for chickens to provide a cheap and natural solution

Help Received
In this case I went to my cousins farm where they grow chickens, ducks, and pigeons. Then built a 20 ft pigeon coop for raising over than 50 pigeons to harvest pigeon milk from only 1 single parent along with the help of my uncle



**CALIFORNIA SCIENCE & ENGINEERING FAIR
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Name(s) Sanjita Pamidimukkala	Project Number S2207
Project Title Prevention of Oxidative Stress Induced Diseases through the Effects of Curcumin on Planarial Stem Cells and Regeneration	
Abstract Objectives Curcumin is an active ingredient in the commonly used spice, turmeric, and is often taken as a dietary supplement. Several studies have focused on the multifarious effects of curcumin like its antioxidative, cancer chemo-preventative, and anti-inflammatory properties. Some studies indicate that curcumin can decrease oxidative damage and improve cognitive deficiencies in regards to aging. Curcumin may be useful in the treatment of neurodegenerative diseases such as Parkinson s disease, a direct byproduct of oxidative stress. The goal of this research was to explore curcumin s effect on planarial regeneration and stem cells as well as monitor its impacts on reactive oxygen species and oxidative stress levels. Methods First, planaria were soaked in different concentration of curcumin in the Permissible Exposure Limit assay to narrow the experimental range in further assays. Next, to narrow the range further and observe curcumin s effects on tissue development, planaria were exposed to light after curcumin pre-incubation with the knowledge that they are extremely photophobic. By testing their response to light in terms of time and locomotion, their regenerative stage could be determined quantitatively. Additionally, stem cell proliferation specifically could be monitored through the MTT assay. MTT is reduced by metabolically active cells, producing a purple dye whose concentration is proportional to the proliferation rate. Lastly, by inducing oxidative stress modeling Parkinson s disease through hydrogen peroxide in the Antioxidant and Protein ELISA assays, curcumin s ROS balancing and preventative capabilities were tested. Results Through the MTT assay(reduction from a tetrazolium salt to a purple formazan dye) it was found that cell proliferation rates were significantly higher in planaria treated with curcumin in contrast to control groups (p<0.05, data is significant). Additionally, the Photophobia assay made it clear that curcumin enhances regeneration as it improved tissue growth and response times. Lastly, planaria pre-incubated with curcumin before Parkinson s modeling oxidative stress was introduced, showed much higher antioxidant activity (p<0.005). This indicates that curcumin operates as an effective ROS imbalance preventative and Parkinson s risk reducer. Conclusions These results prove that curcumin is effective in accelerating regeneration and blocking oxidative stress-induced diseases in planaria flatworms. Many of the same genes and developmental processes that drive regeneration in planaria are present in humans, proven through several previous studies. The results hold	
Summary Statement I found that curcumin was able to accelerate stem cell production and regeneration, as well as block oxidative stress, proving effective in the prevention of diseases like Parkinson's.	
Help Received Thank you to Dr. Anuran Chatterjee from Tardis Medical for providing access to professional lab equipment that I could not acquire personally, such as a spectrophotometer.	



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Triya Roy	Project Number S2208
Project Title The Effect of a High-Sugar Diet on Drosophila melanogaster	
<p style="text-align: center;">Abstract</p> <p>Objectives Type 2 Diabetes (T2D) is a metabolic disorder that is caused by insulin resistance which results in elevated blood sugar and is associated with heart disease, obesity, and chronic inflammation. There has been widespread concern that high sugar diets (HSD) are key contributors to the hallmarks of T2D (hyperinsulinemia, insulin resistance, obesity, hyperglycemia, and inflammation). This study examined the progression of T2D by establishing D. melanogaster as a model for the disease.</p> <p>Methods In order to mimic the development of T2D, wild-type D. melanogaster were reared on standard fly mediums (formula 4-24) supplemented with sucrose, fructose, or glucose for 2 weeks until the flies were assayed. During rearing period, flies were monitored for growth and development. Terminal assays to assess the effect of a HSD included measurements of circulating hemolymph glucose, trehalose, and triglycerides.</p> <p>Results Initial experiments using purely high sugar content were toxic, so further experiments incorporated a combination of standard fly medium with various sugar contents to enable the flies to advance to adulthood. Interestingly, development was delayed in the high-sugar diets and growth was stunted when compared to the standard (control) diet. All diets produced significantly elevated amounts of circulating glucose, trehalose, and triglycerides, with fructose supplementation eliciting the most change compared to the standard diet (p-value < 0.01).</p> <p>Conclusions Fruit flies reared on a HSD had high hemolymph sugars which indicated hyperglycemia, while increased triglyceride levels and adipose growth indicated obesity and insulin resistance. Stunted growth and development indirectly signaled insulin resistance due to the interference of secreted dILPs (Drosophila insulin-like peptides) with the IGF/insulin pathway that regulates fly growth, development, and metabolism. A HSD based on fructose produced the most diabetic phenotypes amongst all the assays. This finding affirms survey-based studies associating High-Fructose Corn Syrup with obesity and associated metabolic complications in humans. This invertebrate model can be used as a baseline to investigate associated complications of T2D prior to advancing to complex mammalian models. Current study involves measuring dILP and NF-kappaB transcripts in diabetic adult flies.</p>	
Summary Statement Establish D. melanogaster as viable model for T2D in order to determine the morphological and cellular effects of a high sugar diet.	
Help Received My mentor (Dr. Inez Yuwanita) provided guidance while I independently designed experiments and collected data. She taught me how to use lab equipment at Schmahl Science Workshops.	



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Simone Sutton; Isabelle Ming Triulzi	Project Number S2209
Project Title Abundance of Sand Crabs in Relation to Core Samples	
<p style="text-align: center;">Abstract</p> <p>Objectives Our objective is to monitor the sand crabs throughout the year to indicate where in the swash zone they reside. We hypothesize that sand crabs are typically found in the deeper area of the swash zone rather than in the dryer sand.</p> <p>Methods We use the LiMPETS protocol for Sand Crabbing. We start with a 10-meter vertical transect where there are bubbles indicating Sand Crabs in that area. Our transect starts in the dry zone and ends in the swash zone of the beach. We take 10 samples, each one meter apart. We use a clam gun to go 10cm into the sand in order to collect the crabs. Next, we place the sample into mesh bags. When all 10 of the samples are collected, we use a bucket of water to find the Sand Crabs to measure their size and sex.</p> <p>Results Our data showed a strong correlation between where in the swash zone, and the population of sand crabs.</p> <p>Conclusions Based off of our data, we have discovered that our hypothesis was mostly correct. There is a correlation between ocean depth and abundance of crabs found. However, at core 6 we found that there is a decrease in the abundance of sand crabs and we hypothesize that this is due to waves crashing in that area which makes it an unsafe environment for the crabs.</p>	
Summary Statement The abundance of sand crabs in relation to where they are located along the swash zone, perpendicular to the waves.	
Help Received Hannah Sarver, Stephanie Beck, and Jane Orbuch were all a huge help in getting us started with this project and helping us continue to monitor.	



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Haidyn Washburn	Project Number S2210
Project Title Assessing the Effect of Light Pollution on Courtship Behavior of <i>Drosophila melanogaster</i>	
<p style="text-align: center;">Abstract</p> <p>Objectives Light pollution effects organisms within the ecosystem through the disruption of the circadian rhythm: the mental and physical biological responses that occur over the course of a twenty-four hour period. The objective of this experiment is to determine if nighttime light pollution adversely affects the mating behaviors of male <i>Drosophila melanogaster</i>.</p> <p>Methods Testing involved measuring the courtship behaviors of wagging and darting performed by the male <i>Drosophila</i> to attract a female. Groups consisted of a control which was exposed to a Bortle level 5 sky to mimic natural conditions and five subsequent experimental test groups that involved exposure to varying wavelengths of light for a period of 10 minutes. The first test group consisted of blue light, followed by green, amber, bright white, and warm white lights. All groups consisted of ten petri dishes each with a male and female <i>Drosophila</i>.</p> <p>Results A remarkable difference in both body waggle and darting occurred between the control group and the five test groups. The average amount of courtship behaviors per test group varied significantly corresponding to the color of the light the <i>Drosophila</i> were exposed to. The control group averaged a total of 58.1 body waggles and 9.6 darts while the test group with the least mating behaviors, test group 4 exposed to bright white light, averaged 22.3 body waggles and 2 darts.</p> <p>Conclusions Results indicate that the higher intensity of light reduces performance of mating behavior in male <i>Drosophila</i> and subsequently increases the risk of population decline.</p>	
Summary Statement This study suggests that exposure to varying wavelengths of nighttime light pollution effects the mating behavior of male <i>Drosophila melanogaster</i> .	
Help Received I aquired the <i>Drosophila melanogaster</i> from my AP Biology teacher Mr. Davin Aalto who also discussed the project setup with me.	