CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Kenneth Bevens; Dean Braza; Daniel Perez

Project Number

S2301

Project Title

Fractal Patterns: Fish Movements

Abstract

Objectives/Goals

Fish have been used as the test subject in many scientific psychological studies. They are used as a base of animal behavioral research. The objective of our project is to determine what the relation of fractal movements, commonly known as repeated movements, is to the number of fish. The goal is to shed more light as to why fish are used so commonly in animal behavioral sciences.

Methods/Materials

The experiment was conducted by filming one-minute videos of various fish species and in various numbers in order to observe their repeating movements. Each fish was observed for the whole one-minute period and the number of times that a fish repeated a movement was documented. A variety of graphs were made to find the best representation of the pattern. The materials included the fish in the fish tanks, a recording device (iPad), and graphing software (Desmos).

Results

Upon analyzing the graphs, it was found that the quadratic graph fit the pattern the best. This meant that the amount of repeated movements (fractal patterns) increased exponentially compared to the number of fish.

Conclusions/Discussion

Based on the information gathered, the conclusion had been made that fish repeat their movements more when more fish are present. Scientists have been using fish as a source of animal behavior data for decades. This experiment shows the extent of the behavior of fish which has not been seen before. Since it is now known that the amount of fractal movements increases exponentially with the increasing number of fish, scientists and mathematicians alike can now use this data to make equations regarding fish behavior and the patterns they make.

Summary Statement

The observation of fish movements in relation to fractal patterns shows that fractal patterns in fish movements exponentially increase with the number of fish.

Help Received

We obtained help from our Algebra/Trigonometry teacher, Kristina Horan. She offered advice on how to display and represent our data.

Name(s)
Titash Biswas

Project Number
S2302

Project Title
Wnt6 in Progenitor Maintenance During Hematopoiesis: A Potential Biomarker for Acute Myeloid Leukemia (AML)

Abstract

Objectives/Goals
Hematopoiesis, or blood cell development, is a strictly regulated process and the maintenance of blood progenitors requires various pathways in cells. Deregulation of these processes will result in malignancies, such as leukemia. I used Drosophila melanogaster, where hematopoietic development and functions are similar to those in vertebrate systems, as a model system of hematopoiesis. In Drosophila, hematopoiesis occurs in the lymph gland, where blood progenitors undergo a differentiation process or become quiescent. The objective of this study was to characterize the role of Wnt6 in progenitor maintenance pathways during hematopoiesis.

Methods/Materials
The fly stock, UAS-Dcr2; Hml-DsRed, domemeso-GAL4-GFP, was crossed with three different RNA interference lines to observe the RNAi phenotype, with differentiated cells marked by Hemolectin DsRed and progenitor cells by domemeso>GFP in the progeny of the cross. A Wnt6 over-expression line was also used to determine the role of Wnt6 in the progenitor maintenance pathway. Z-stack images were taken of lymphs glands dissected during larval development. Imaris software was used to create digital 3D reconstructions of each lymph gland and to count the different cell types based on fluorescence. The resulting quantitative data was analyzed for statistical significance using GraphPad Prism.

Results
RNA-interference mediated depletion of Wnt6 demonstrated a phenotype of over-differentiation and trends of decreased progenitor and intermediate progenitor populations. Overgrowth of secondary lobes and nodes of differentiated cells were also observed. Over-expression of Wnt6 resulted in a strong progenitor maintenance phenotype, indicating that Wnt6 is a crucial regulator of the progenitor maintenance pathway during hematopoiesis. This study revealed that Wnt6 signaling triggers progenitors into a G2 phase arrest and quiescence and was found to be involved in the beta-catenin mediated canonical pathway.

Conclusions/Discussion
The involvement of Wnt6 in both progenitor and intermediate progenitor differentiation processes through the G2 arrest and beta-catenin mediated canonical pathways suggests its potential as a biomarker for Acute Myeloid Leukemia, characterized by excess immature blood cells. These new developments can lead to a better understanding of the pathogenesis of relevant hematologic malignancies and can have therapeutic applications.

Summary Statement
RNA-interference mediated depletion and UAS over-expression of Wnt6 demonstrated the role of Wnt6 in the regulation of the progenitor maintenance pathways during hematopoiesis in Drosophila.

Help Received
Dr. Utpal Banerjee, my advisor, and Dr. Lauren Goins, my mentor, advised me throughout my research project and gave me access to laboratory facilities in the UCLA Department of Molecular, Cellular, and Developmental Biology.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Joshua De Leon Olivas

Project Number

S2303

Project Title

The Mitey Roach Exchange: Examining the Effects of Mite Transplantation and Removal in Gromphadorhina portentosa

Abstract

Objectives/Goals

This project investigates whether there is a stable average number of body mites on roaches and whether mites are morphologically different for males or female roaches because mites on female roaches may have special benefit from resources during the production of an egg sac. The hypothesis is that transplanting mites between roaches will have no effect on the roaches, but that the number of mites will remain stable due to limitations of resources available on the roach's body for the mites.

Methods/Materials

While monitoring general health, roaches were labeled with small pieces of duct tape, weighed, and kept in a general terrarium. Roaches were selected based on size and sex to brushed off body mites and exchange with that of another roach. After the transplant, roaches were isolated into plastic drawers, to prevent transfer of mites through direct roach contact. Roaches were observed daily for either 2 or 4 week cycles. Mites were then examined at 40x and 200x magnification under a light microscope.

Results

Roaches often rest in group huddles, regardless of temperature, which included both male and females. Most mites tend to be found near the body openings ("arm-pits") of the roaches, although some are typically present on the back. Four roaches died when in isolation after mite transplants. No roaches died in the general (non-testing) habitat. One female gave birth to a full set of babies once in isolation. A chi-squared goodness of fit statistical test was originally intended to compare observed versus expected numbers of mites, however, was used to assess probability of roach death due to mite loss.

Conclusions/Discussion

Results of this experiment refute the hypothesis that the mites have no effect on the roaches. Since the roaches were handled daily, the roach deaths were not likely due to handling, and so it is believed that the mite transplant had an effect. No roaches that were kept in isolation without a transplant died. The implications of this invertebrate study is that humans also have body mites. There is belief that these mites, which are passed maternally, are not only beneficial, but that they are actually necessary for the health of the organism. This might change the way doctors deal with the delivery of babies or in monitoring the methods of sterilizing skin when treating people for surgery.

Summary Statement

This study of transplanting roach mites discovered that the mites might play an essential role in the life of the roach, which is an idea that can be extended to the relationship of a human's personal microbiome to their overall health.

Help Received

My teacher helped me enter the qualifying fairs and provided me with space and equipment at school. I met with an entomology professor at Santa Clara University who helped me figure out a way to label the roaches with tape because markers and nail polish weren#t working.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

Panna Gattyan

Project Number

S2304

Project Title

Caenorhabditis elegans Behavioral Effects of Synapsin RNAi Silencing

Abstract

Objectives/Goals

In my project I investigate the behavioral differences that arise from the RNAi silencing of the Synapsin gene ortholog, SNN-1, in the Caenorhabditis elegans nematode worm. I predicted that the silencing of the Synapsin protein in C. elegans causes atypical, detrimental behavior.

Methods/Materials

I assayed dumpy worms (non-N2) to understand their normal behavior. I injected some with RNAi, a 19 nucleotide sequence which would silence the translation of the gene. In the same solution I also injected the worms with transforming DNA, which would transform the dumpy worms into N2 wild-type worms. Worms that became N2 after injection indicated also a successful injection of the RNAi. I assayed these worms, comparing them to the control worms which I only injected with the transforming DNA but not the RNAi. Assays include observing defecation rates and touching the worms with an eyebrow to test knee-jerk response. I used my school's microscopes and ordered the RNAi from the company Millipore Sigma. To inject the worms with RNAi, I needed to use Caltech's micro-injector, which I was not permitted to use, so my mentor Dr. Gonzalez performed the injections themselves. I used the Wormbase to find the nucleotide sequence to order, and WormBook to explore C. elegans research and experimental methods.

Results

Control worms exhibited normal behavior, defecation rates, and touch responses. The worms with the silencing of Synapsin exhibited neurological problems such as insensitivity to touch, jerky movements, inconsistent defecation, lethargy, and lack of eating.

Conclusions/Discussion

The role of synapsin (SNN-1) in the behavior and healthy functioning of the worms is not immediately fatal but does cause severe defects. As an ortholog of Synapsin, a mammalian neural gene, the study of SNN-1 in C. elegans can help further understand the genetic factors behind neurological disorders.

Summary Statement

I investigated the behavioral changes which arise in C. elegans nematode worms after I silence the SNN-1 gene (ortholog of Synapsin).

Help Received

My mentor Dr. Aidyl Gonzalez provided me with the C. elegans worms, and injected the experimental worms at Caltech. She also demonstrated to me how to properly take care of C. elegans worms.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Jules T. Hoang

Project Number
S2305

Project Title
The Effects of Temperature and Time on Bees on A. cordifolia

Abstract

Objectives/Goals
The purpose of this experiment is to observe and record the behavior of the times bees pollinate and whether temperature and time affect the number of bees throughout the day. Along with the behavior of pollinating bees, to observe the ways of how invasive plant species thrive in a chaparral environment through how much it's pollinated. Because bees have been in detrimental population decline, my experiment can provide useful information to the favorable pollination conditions of these key species.

Methods/Materials
A. cordifolia
Canon HF200
Olympus D5
Tripod

Results
The result of recording the flowers and observing the insects was temperature definitely having an effect of the amount of bee activity. However, not being dramatic because of the chaparral environment. In addition, 12pm-1pm resulted in the most bee activity.

Conclusions/Discussion
After filming A. cordifolia for nine days, I counted the number amount of bees that entered the screen for each day. The higher the temperature of the day, the number of bees increased and the colder the day, the less. In addition, the times that the bees most favored was from 12-1pm, resulting in the most amount of bees.

Summary Statement
After filming a type of invasive species for 9 days, temperature and time do have an effect on the number of pollinating bees.

Help Received
Mr. Hunt: helped develop my project by giving me different species of plants I could've used.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Grace H. Jardon

Project Number
S2306

Project Title
Epidemiology and Treatment of Spinose Ear Ticks on a California Dairy

Abstract

Objectives/Goals
The objective of these studies is to determine potential control methods for spinose ear ticks on dairies. The studies include observations on when the animals become infested, where the adult ticks live, and in vitro and in vivo analysis of treatment options.

Methods/Materials
Four separate experiments were conducted:
1) Nymph stage ticks harvested from the ears of cows were subjected to one of three treatments (Control, Mineral Oil, and CyLence Ultra ear tag piece). The ticks were observed periodically and recorded as dead or alive.
2) In order to determine where adult ticks are living (and thus laying eggs and supplying the next generation of ticks), one-liter bedding samples from four locations in 30 freestalls were sifted through a 4.75 mm screen.
3) In order to describe the pattern of infestation, primiparous animals in the fresh pen were examined for ticks.
4) Ear tags were inserted in the ears of fifty primiparious animals before calving. Cows were examined at 28-54 days after calving.

Results
1) All oil treated ticks, 74% of ear tag treated ticks, and 8% of control ticks were dead by 24 hours. The ear tag treatment incapacitated the ticks immediately.
2) Adult ticks were found in 20% of the samples in the undisturbed area in the front of the stall. No ticks were found in the other three freestall areas.
3) Only 8% of the animals had ticks in the first week of lactation. By the third week 96% of the animals had ticks. Animals on this dairy freshen with no ticks but by several weeks are close to 100% infested. This information implies that the reservoir for adults/eggs/larvae is in the freestalls.
4) The treated cows had no ticks and 25% of the control cows had ticks.

Conclusions/Discussion
The contribution of this study is threefold. First, approved ear tags and mineral oil are effective treatments for the infested cows. Second, by identifying the location of the adult ticks, a more effective system for disrupting the tick lifecycle can be implemented through raking and freestall modification. Third, Efforts to control the ticks can be concentrated in the milking herd as the animals become infested after calving.

Summary Statement
I determined the reservoir of adult spinose ear ticks is in the undisturbed bedding in the front of the stalls, animals calve without ticks and become infested within 3 weeks, and Cylence Ultra ear tags are an effective method of control.

Help Received
Dairyman: Animals and help. David Kattes (Tarleton SU) and Alec Gerry (UC Riverside): Helped understanding ticks. Mike Overton (Elanco): Statistics. Rick Peyton (Valley Vets): Introduced issue. Phillip Jardon (Elanco): Equipment and guidance. Brett Davis (Bayer): Ear tags.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Homin Key

Project Number
S2307

Project Title
Building an Effective System to Improve the Placement and Growth of Mycelium in Its Effect towards Bees and Varroa Mites

Abstract

Objectives/Goals
The objective of this project is to find the best way to place Mycelium in a bee farm environment and to see its effect on honey bees and the Varroa Mites. I implemented a Mycelium Box that was placed outside of the colony while the mycelium frame was placed inside the colony.

Methods/Materials
I used Mycelium that was obtained by a commercial product (Back to the Roots : Mushroom Farm Kit). I was also given 18 bee colonies by a local bee keeper.

Results
The Mycelium box and mycelium frame were compared. The Mycelium box showed greater number of deaths in Varroa Mites and showed a more active hive.

Conclusions/Discussion
The performance of the Mycelium box showed that Mycelium should be placed in an open environment and that the Mycelium is also effecting the activeness of the bees.

Summary Statement
I compared Mycelium's effect on the bees and Varroa mites in a close and open environment.

Help Received
I designed the Box and Frame but received supervision when testing with the Bees by Bee Keepers.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Vivian T. La

Project Number
S2308

Project Title
How Does the Temperature of Seawater Affect the Development Process of Sea Urchins?

Abstract

Objectives/Goals
If the temperature of the sea water where the development process takes place is warmer, then there is higher possibility of sea urchin embryos going through each stage of growth up to the blastula stage.

Methods/Materials
I used live Strongylocentrotus Purpuratus sea urchin, found off the Western Coasts of North America, sea water, heating plate, refrigerator, petri dishes, potassium chloride, and pipettes to perform this experiment. I extracted the sea urchin gametes (eggs and sperm) by using potassium chloride, which stimulates the gonads,the reproductive organs, to start producing the eggs or sperm. I gathered the pure form of the gametes and put 160 eggs per petri dish, which contained sea water. Each petri dish is put into a different temperature condition.(37 C, 23 C, and 4 C) The eggs are fertilized and immediately put in their assigned temperature condition. Observations are recorded about every three hours for about a week.

Results
Many of the eggs in 37 C and 23 C groups not seem to continue with cell division and stop at the 1st cleavage of the fertilization process, no further progress was recorded after the 2-celled stage.The group at 4 C forms the early pluteus one week after fertilization, meaning it has passed through the 1st cleavage/cell division, 4-celled stage, 8-celled stage, and the blastula stage (256-celled stage).

Conclusions/Discussion
Based on my data and observations, I can conclude that my hypothesis was incorrect. The group of sea urchin zygotes that went through the process of fertilization at 4 C successfully reached the blastula stage. The groups at 23 C and 37 C did not seem to continue with the fertilization process and stopped at the 1st cell division. Warming temperatures affect the process of the Strongylocentrotus Purpuratus. California, a main area where these sea urchin are found, is also having a depletion of their kelp forest due to dead zones and pollution, limiting the supply of food for the adult and developing sea urchin. With the increase of ocean acidification, many developing sea urchins cannot form their skeletal systems due to the lack of calcium carbonate available This data can provide more points that can help the sea urchin populations that live in the kelps forests and are affected by other condition caused by temperature or directly by temperature.

Summary Statement
My project is about the effects of warming temperature conditions of the development of the Strongylocentrotus Purpuratus, a type of Pacific sea urchin species.

Help Received
I designed this experiment by myself and did my own research. I received assistance from CCRM OC labs to help with my data collecting and to carry out my method for the experiment.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Haley J. Lopez

Project Number
S2309

Project Title
The Impact of a Caloric Restrictive Diet on Crickets

Abstract

Objectives/Goals
The objective of this experiment was to use crickets as models to investigate whether eating a caloric limited diet increased the lifespan of crickets compared to eating a normal or excessive amount of food. My hypothesis was that if a group of crickets were fed a deficient amount of food (referred to as Group 1), then this group would live longer than a group that was fed the normal amount and another group that was fed an excess amount (Group 2 and Group 3, respectively).

Methods/Materials
The materials used were 24 crickets, a homemade cricket home, rice, water gels, and a plastic bag. The experimental design consisted of measuring how much rice crickets ate and then figuring out what was the least amount of food crickets can be fed; the crickets were then fed at one week intervals for one month.

Results
The results indicate that Group 1 had zero crickets left by one month, Group 2 had four and Group 3 had five crickets still alive. The results did not support my hypothesis because the group predicted to have the most crickets alive actually had all of them dead by the end of the trials. On the contrary, the results showed that the group of crickets that were fed in excess (Group 3) had the most crickets alive by the end of the trials.

Conclusions/Discussion
In conclusion, the results showed that a caloric restrictive diet doesn't always extend the life of an organism. By taking my experiment and applying it to our society one can speculate that by doing a restrictive caloric diet gradually can harm a person instead of helping them.

Summary Statement
This experiment focused on how a caloric restrictive diet can impact the lifespan of crickets.

Help Received
My chemistry teacher helped me further understand the concept of a caloric restrictive diet.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Dami Olatunji

Project Number
S2310

Project Title
Biting Back: Affordable Mosquito Control

Abstract

Objectives/Goals
My research and experiment was based on creating an affordable way to mitigate the carriers of many waterborne diseases - mosquitoes. I used materials available to the impoverished civilians of third world countries. The test that I carried out at a research entomology lab was a solution to the problem posed; it involved testing traps of different colors and sizes to lure harmful female mosquitoes.

Methods/Materials
Once in the trap, I employed homemade flypaper to immobilize the mosquitoes and prevent them from laying eggs. In order to set up this experiment I built nine different prototypes of traps in three varying in color and size to see which lured in the most mosquitoes. I then took the data I received from that experiment and applied it to my phase two prototype - a red colored medium sized trap. I set up my new red only trap with the flypaper along with a control - a medium red shell, and ran the test.

Results
Student t test results showed that there was a significant difference between the amount of mosquitoes caught by the treated trap than by the shell resulting in a p value of 0.0209. The red treated trap caught 42.4%, while the shell only caught 6.06% of the mosquitoes flying in its enclosure.

Conclusions/Discussion
The data shows that my red medium sized trap, using homemade flypaper, worked and caught mosquitoes at an efficient rate of 1 mosquito every 4 minutes and 30 seconds.

Summary Statement
My project dealt with creating an enviromentally friendly and affordable solution, out of reusable materials, to control the number of mosquitoes in third world countries.

Help Received
I worked at an entomology lab called Sierra Research Laboratories, under the supervision of Dr. Bill Donahue and his team. I was sponsored by my biology teacher Victoria Acquistapace. My research paper was edited by my english teacher Rick Graham.

Name(s)
Anushka Sanyal

Project Number
S2311

Project Title
Effects on Learning/Memory of a Mutation in Da7: A Fruit Fly Homolog of the Alzheimer's Related Gene for the nAChR a7

Abstract

Objectives/Goals
The purpose of this project is to test the effects on learning/memory and locomotion of a mutation of the gene D-Alpha 7 (Da7) (specifically the P-Delta-EY6 allele - PDEY6), a Drosophila melanogaster (fruit fly) homolog of the Alzheimer's Disease (AD) related human gene that encodes the Nicotinic Acetylcholine Receptor Alpha 7 (nAChR a7). My hypothesis was that the mutants expressing the Da7 PDEY6, which impedes the production of the fruit fly equivalent of the nAChR a7, will show a significant decline in learning/memory retention and locomotion, similar to the Amyloid-Beta Arc-42 (AB-42) mutants (AD model), when compared to flies that express the corresponding wild type (WT) receptor.

Methods/Materials
Drosophila stocks and care: Da7 PDEY6 as test subject, AB-42 as positive control, WT flies as negative control, Instant Drosophila Media, Appropriate Vials/Caps, Dissecting Microscope. For Olfactory Shock Learning: T-maze (self-built), Training Chamber (self-built), Shock - 60 volts/3.75 seconds, Odors - 3-Octanol and 4-Methylcyclohexanol (MCH).

Results
1. Climbing Assay Success Rates: PDEY6 -- 61.2%, AB-42 -- 60.2%, WT -- 79.5%
2. Short Term Memory Success Rates: PDEY6 -- 49%, AB-42 -- 46%, WT -- 81%
3. Long Term Memory Success Rates: PDEY6 -- 41.5%, AB-42 -- 39%, WT -- 78%
4. P-value for AB-42, PDEY6 consistently >90%
5. P-value for WT & AB-42/PDEY6 consistently less than 10^-6

Conclusions/Discussion
1. Hypothesis proven: PDEY6 (and AB-42) populations show ~40% decline in short/long term memory, ~23% deterioration in locomotion relative to the WT populations.
2. For both short and long term memory tests: The differences between the 3-week and 4-week flies not statistically significant; Additionally, no performance impact by odor
3. Additional "loss" of long term memory compared to short term for 15% of mutants, 5% of WT flies
4. Higher impact of lack of Da7 on memory/learning than climbing, which is expected
5. For AB-42 & PDEY6: Null hypothesis rejected - Strong relationship between mutants exists
6. For WT/AB-42 & WT/PDEY6: Null hypothesis accepted - Relationship between WT and mutants non-existent
7. These conclusions provide further motivation to study nAChR a7 and its potential for AD research.

Summary Statement
I proved that the lack of the Nicotinic Acetylcholine Receptor a7 equivalent in fruit flies drives an Alzheimer's Disease-like response, indicated by AD's primary symptoms: decline in memory retention and locomotive ability.

Help Received
I want to thank my mentor, Dr. Cuellar, for her support and input whenever I had inquiries regarding biological techniques and processes. I also want to thank Schmahl Science Workshops, which provided me with the necessary equipment and lab space for this project.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Samrat Thapa

Project Number
S2312

Project Title
Effects of Different Colored Lights on Zebrafish Fecundity

Abstract

Objectives/Goals
The objective of this study is to determine the effect of different colored lights on zebra fish fecundity.

Methods/Materials
To test the effects of different color light treatments, random pairs of wild type male and female zebra fish on a 14h light/10h dark cycle were exposed to 14h dark period followed by 4h of the colored light treatment in the testing environment. The testing was done in a rapid breeding vessel. After the testing period, embryos were collected and counted. The same process was repeated twice a week, repeated numerous times under red, room, blue, and green light.

Results
Based on the data, blue and room light treatments on zebra fish promote zebra fish embryo production while red and green light negatively affect the outcome. Average amount of embryos per of each light treatment that had a successful mating was blue (15.6), room (16.2), green (2.2), red (6.3).

Conclusions/Discussion
The goal of this project was to identify whether different colored light treatments could be beneficial or disadvantageous to zebra fish fecundity. Though it is not clear why red and green light had such effects, nor why blue and room light achieved their effects, it is clear, color has an effect in embryo production. Further research could be done to understand the reason of these effects.Our experiment was repeated numerous times, but the data represented only showcases those of successful embryo production. The zebra fish may not lay eggs for a variety of reasons, therefore we did not attribute the days of no embryo production as an effect of our lighting treatment. In addition we also varied the number of pairs of zebra fish throughout the experiment, but most of the embryos were produced under a 6:6 ratio. The research data can in no way take account of every factor that was present during experimentation, but we believe that we controlled for all other variables.

Summary Statement
I found that green light is negatively affecting zebra fish fecundity.

Help Received
This experiment was done in the past, but the results created doubt. Therefore with help from Rebecca Belmonte, research student, and Dr. David Stachura, associate professor, we were able to redesign this experiment and get more precise results.