CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Pauline H. Alarcon

Project Number
S1701

Project Title
Caffeine: Friend or Foe?

Abstract

Objectives/Goals
The goal was to study caffeine's effects on the memory, reflexes, and agility. Additionally, I tested a control group with a placebo (decaffeinated coffee) to see if the belief of ingesting caffeine would still boost memory proficiency, improve physical, mental, and reflex agility. My hypothesis was that people would have greater concentration and alertness when they consumed caffeine or believed they were consuming caffeine.

Methods/Materials
The procedure I used was to test subjectsâ## physical, mental, and reflex agility before and after consuming caffeine. Testing 4 subjects each using regular coffee, black tea, and decaffeinated tea; the experimental constants were 1) a test measuring clear sweeps within 60 seconds of jumping rope; 2) playing the classic â#oFruit Ninjaâ## computer game to determine the maximum points in one game play; and 3) reading and writing from memory a paragraph (each with 3 sentences containing 46 words). The control is the subjects tested before and after caffeine ingestion. I measured the dependent variable by calculating the difference between the subjectâ##s scores before and after consuming caffeine.

Results
The results show that when given coffee: 100% improved with Fruit Ninja, 50% with jump rope, and 100% in memorization skills. When given tea, 75% improved on all tests. When given decaffeinated coffee (believing it is caffeinated): 100% improved with Fruit Ninja and memorization while only 25% improved with jump rope. These results demonstrate that physical, mental, and reflex agility improves even when people only believe they are consuming caffeine. Caffeine and even the belief that a subject is ingesting caffeine does impact the brain!

Conclusions/Discussion
I found that the subjects that were tested showed measurable results in physical, mental, and reflex agility. This confirmed my hypothesis that caffeine has an effect on the subjectsâ## abilities based on caffeineâ##s interaction with the neurotransmitters which cause the release of stress producing hormones in the body. It should be noted that the amounts of caffeine given to the subjects were limited so only the positive aspects of caffeine intake were observed. Not observed was the effect of large amounts of caffeine, consistent with the ways that coffee and other caffeine containing items can be abused and create such negative effects as extreme nervousness, racing heartbeat, and increased blood pressure.

Summary Statement
The central focus of the project was to determine whether people consuming normal amounts of caffeine would improve in their memorization skills, reflexes, and physical agility and whether other subjects tested with a placebo would also sho

Help Received
I want to sincerely thank my parents for their endless support and ability to keep me smiling, Ms. Adriatico for her superb guidance, and my 12 fabulous test subjects.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Vibhav S. Altekar

Project Number

S1702

Project Title

Engineered Chitosan Based Multi-reservoir Devices for Effective Localization to Treat a Multifaceted Set of Diseases

Abstract

Objectives/Goals

Substantial challenges of drug delivery to treat various diseases exist in our modern world. For example; the acidic environment of the stomach, combined with an array of intestinal digestive enzymes, poorly permeable mucous layer, and peristaltic shear conditions have made oral drug delivery challenging. Therefore, there is an inherent need for the development of novel micro- and nanostructured platforms for the oral delivery of proteins. As most GI pathologies are frequently expressed at localized sites of the intestine, novel strategies of localized drug delivery will prove a blessing for patients with GI and inflammatory bowel diseases, such as Crohn#s disease for which current preventative medications include anti-inflammatory drugs, steroids, immune system suppressors, biological therapeutics, and antibiotics.

Methods/Materials

I utilized microfabrication techniques such as photolithography and etching to create my oral drug delivery devices. The methodology I utilized to accomplish my engineering goal was to microfabricate microdevices using a series of photolithography and reactive ion etching. Using this technique, more than 500,000 microdevices were fabricated within 2 hours. The advantage of this technique is that photolithography controls the size and shape of the microdevice and etching controls the depth of the reservoir. This ensures that a drug or dye of different dosages can be loaded into the devices with ease by just varying the reservoir volume. The microdevices were composed of chitosan: an FDA approved, naturally occurring polymer, well known for its mucoadhesive property as the microdevice material property to target the excess mucus produced at sites of inflammation. It also invokes specific binding/adhesion for longer retention time.

Results

Through my results I was able to see that dye was released at different time points, thus confirming the finite creation of time dependent drug delivery devices.

Conclusions/Discussion

Unlike current micro- and nanoparticulate systems that require cumbersome synthesis steps to introduce multiple drugs, chitosan microdevices will be fabricated with multiple reservoirs to load multiple antioxidant enzymes with ease. Further, the unidirectional release from these reservoirs should achieve a highly localized enzymes concentration in close proximity to the intestinal cells and result in an increase of enzyme permeation.

Summary Statement

I have microfabricated drug delivery devices that can localize in a specific area and exhibit controlled release of drug.

Help Received

Used lab equipment at UCSF under supervision of Dr. Hari Chirra

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Sidharth Bommakanti

Project Number

S1703

Project Title

The Effectiveness of Eucalyptus globulus Extract as an Insect Repellent

Abstract

Objectives/Goals

This project was created in order to further understand the specific compounds in eucaplytus globulus extract that cause its insect repellent properties, how those components differ between three different age groups, and how those differences affect the plants ability to display insect repellent properties. Experiments were conducted to identify which age group most dominantly exhibits insect repellent properties, and what individual components were responsible for causing those properties.

Methods/Materials

Leaves were harvested from 3 Eucalyptus globulus trees, one set of coppice leaves from a stump cut a year ago and leaves from 2 different young trees <6 in in diameter, estimated to be less than 6 years old. 50 mg of crushed leaves were weighed into tubes. 1.5 mL of hexane was added to each tube and tubes vortexed briefly and then sonicated for 15 min. An autosampler was used to inject 0.5 µL of sample into the 50° C injector port which was ramped to 270° C in 12° C/s increments and held for 3 min. Volatilized metabolites were separated using an Agilent 7890 gas chromatograph, controlled by Agilent GC/MS MassHunter Acquisition software.

Results

Experiments were conducted to identify which age group most dominantly exhibits insect repellent properties, and what individual components were responsible for causing those properties. ∂-cadinene, nerolidol-2, geraniol, and L-alpha terpenol were identified as compounds most directly responsible for the insect repellent properties of the eucalyptus plants. The chemical compounds were identified via Gas Chromatography/ Mass Spectrometry analysis.

Conclusions/Discussion

The results of the GC/MS analysis and bacterial testing confirm and further elucidate the insect-repellant properties of the Eucalyptus Globulus plant. Structural analyses revealed the presence of multiple terpenes in all Eucalyptus Globulus leaves. A proposed mechanism of action involves the carbon skeleton of terpenes, which is said to have an effect on the olfactory genes OR43B and OR83B. This prevents insects from sensing the smell of prey and causes them to fly away without noticing the prey#s natural odor.

Summary Statement

Analyzing the effectiveness of Eucalyptus Globulus extract as an insect repellent based on its specific chemical components.

Help Received

Used lab equipment at Lawrence Berkeley National Lab of Stefan Jenkins

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Gloria R. Castaneda

Project Number

S1704

Project Title

Synthesis of Biodegradable, Monodisperse PEG Microspheres for Controlled Protein Release

Abstract

Objectives/Goals

Polymeric microspheres are small spherical particles that have the potential to be used for coordinated release of therapeutic factors for regenerative medicine. Droplet microfluidics is one method that can be used to fabricate polymeric microspheres as it allows control over size and composition to rapidly synthesize monodisperse microspheres. We hypothesized that by changing the characteristics of microspheres, the microspheres would have different release profiles.

Methods/Materials

To achieve different release characteristics, we regulated the sizes by varying channel size (50µm, 100µm, 150µm, and 200µm) and the polyethylene glycol (PEG) concentration (7.5%, 10%, and 12.5%) of the spheres. Model protein fluorescein isothiocyanate labeled bovine serum albumin (FITC-BSA) and fibroblast growth factor (FGF), an important angiogenic growth factor, were encapsulated in the microspheres. Release from spheres was collected and quantified over a period of 14 days. The bioactivity of FGF was examined through a cell viability assay on adipose-derived stem cells (ADSCs).

Results

No significant trend based on microsphere size was found, but different PEG concentration resulted in distinct release profiles: 7.5% PEG microspheres resulted in maximal protein release and 12.5% in minimal protein release when compared to controls. However, fluorescence microscopy of FITC-BSA-loaded microspheres suggested that the majority of protein remains enclosed. Additionally, 7.5% PEG microspheres encapsulated with FGF led to increased ADSC proliferation on all days, indicating that FGF remains bioactive after release.

Conclusions/Discussion

Further examination of the properties of monodisperse PEG microspheres will allow us to fine tune the fabrication of the spheres to achieve both a controlled-release and high-release system for therapeutic angiogenesis.

Summary Statement

We hypothesized that by independently manipulating the size and PEG composition of microspheres, release from the microspheres can be altered.

Help Received

My mentor, a graduate student at Stanford Medical School, supervisde me throughout my project. He helped me learn the appropriate skills for this project, such as sterile technique and fluorescent imaging, until I was able to perform the experiments and maintain the cells I used in my project on my own. I

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Nathan R. Fennacy

Project Number

S1705

Project Title

Can Pluerotus ostreatus Digest and Remove Di(2-ethylhexyl) Phthalate from Soil?

Abstract

Objectives/Goals

Can Pleurotus Ostreatus (Oyster Mushrooms) digest and remove Di(2-ethylhexyl) phthalate (DEHP) from soil?

Methods/Materials

In Part 1 the Oyster Mushrooms were prepared and a mushroom spawn with running mycelium was prepared for mushroom growth. In Part 2 DEHP was spiked into two out of the three thanks of soil. The mushrooms were then inoculated into 2 out of the three tanks, one with DEHP one without. This lasted for 12 days. 30 gram samples were taken on Day 1, 2, 4, 6, 8, 10, and 12. All the samples were then taken to Agriculture and Priority Pollutants Laboratories Incorporated (APPL Labs) where they were went through sonicfacation (Method 35) for 3 rounds. The extracted compound is then boiled down to a 1mL sample. It was then tested for Di (2-ethylhexyl) phthalate down to the parts per billion.

Results

Results were extremely varied but the overall average in the tank with DEHP and Oyster Mushrooms was lower when compared to the tank with pure soil and DEHP. The results, though, when compared to day to day results where to varied to confirm any positive effects caused by the mushroom.

Conclusions/Discussion

My hypothesis, that if mycelium of Pleurotus Ostreatus is introduced into 1 gallon of soil (8.3 kilograms) and spiked with 300 milligrams of Di(2-ethylhexyl) phthalate (DEHP) at 60 degrees F (15 degrees C), then the mycelium and the fruiting bodies of Pleurotus Ostreatus will digest and remove the DEHP from the soil, was not supported. The results showed a large variation of trends, like the DEHP with Pleurotus Ostreatus had an over-all range from 11975.4 ppb of DEHP to 7801.6 ppb of DEHP. Results showed that the overall average for the DEHP tank vs. the DEHP with Pleurotus Ostreatus was 10727.5 ppb to 11229.6 ppb, respectively.

Summary Statement

My project test the digestive properties of Pluroteus Ostreatus when introduced to soil spiked with Di(2-ethylhexy) phthalate.

Help Received

Father helped with printing out foam core, Dr. Leonard Fong helped with lab testing at APPL Labs.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Christina Huang

Project Number

S1707

Project Title

Biological Properties of a Novel 3D Scaffold for Use in Transplantation to Treat Stroke

Abstract

Objectives/Goals

New advances in stem cell therapies have promising implications for victims of many diseases, especially post-stroke patients who suffer from physical, cognitive and emotional impairments due to the death of brain cells during stroke. Transplanting neural stem cells into stroke infarct cavities can facilitate neurogenesis following injury. However, direct transplantation of cells into the stroke infarct cavity has resulted in dramatic death of transplanted cells and little reduction in lesion size. More obvious improvement may be achieved with the aid of 3D matrices that deliver necessary cells to the site of injury and protect them during the transplant. A novel combination hyaluronic acid and fibrin gel is proposed here as a 3D scaffold for use in transplantation therapies. The gel is designed to resist degradation in vivo while stimulating the survival and proliferation of neural stem cells.

Methods/Materials

The viability of cells was measured using a LIVE/DEAD Viability/Cytotoxicity Assay from Invitrogen. Degradation, which plays a large role in how effective 3D scaffolds are, was determined by measuring the presence of fibrinolytic factors with absorbance. Proliferation was observed by marking newly synthesized DNA with an EdU Assay. The results of the combination gels were contrasted with those of the commonly used fibrin gel.

Results

Neural stem cells cultured in these gels were shown to have a 3-fold increase in survival, and a 1.5-fold higher level of proliferation. The combination gels were especially resistant to degradation, lasting up to three times longer than the fibrin gels.

Conclusions/Discussion

These results suggest that this novel gel would be beneficial in recovering motor skills affected by neuronal loss during stroke by serving as a replacement extra-cellular matrix, which is lacking in the stroke infarct cavity. Specifically, it highlights the interaction between fibrin and hyaluronic acid and their potential for use in conjunction to increase cell survival and proliferation. Furthermore, the success of this formulation emphasizes is a promising precursor to future therapies to replace lost brain cells and return normalcy to the lives of disabled stroke patients.

Summary Statement

A novel formulation of a biodegradable 3D scaffold is tested in conjunction with neural stem cells to determine its potential in relieving stroke-induced disabilities.

Help Received

Used lab equipment at UCI under the supervision of Dr. Lisa Flanagan.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Shomik Jain

Project Number
S1708

Project Title
The Effect of Bisphenol A on Lactuca saliva var. Longifolia

Abstract

Objectives/Goals
The purpose was to test the effects of Bisphenol A (BPA) on Lactuca sativa var. Longifolia, and whether or not BPA could make its way into the plant. My hypothesis was that BPA will be absorbed by Lactuca sativa var. Longifolia, and it will have an effect on the plant height, mass, and overall health.

Methods/Materials
4 experimental groups were set up, and each group was watered with different levels of BPA. Group 1, the control, was watered with DI H(2)O (no BPA). Group 2 was watered with the amount of BPA a water bottle leaches (7.5 x 10^-7 g BPA/ 1 L DI H(2)O Solution). Group 3 was watered with the amount of BPA a water bottle left in the sun leeches (7.5 x 10^-6 g BPA/ 1 L DI H(2)O Solution). Group 4 was watered with 0.1 g BPA/ 1 L DI H(2)O Solution. Plant height was measured every class for 53 days, and plant mass was measured at the end. The amount of BPA that was absorbed by the plant was measured with an ELISA assay.

Results
The control plants had an average height of 18.49 cm, an average mass of 5.960 g, and 430 picograms (pg) BPA/g plant. Plants exposed to the amount of BPA a water bottle leeches had an average height of 28.34 cm, an average mass of 20.830 g, and 2700 pg BPA/g plant. Plants exposed to the amount of BPA a water bottle left in the sun leeches had an average height of 26.89 cm, an average mass of 19.299 g, and 6100 pg BPA/g plant. Plants exposed to 0.1 g BPA / 1 L DI H(2)O Solution had an average height of 15.4 cm, an average mass of 1.710 g, and 34000 pg BPA/g plant, and 2 plants from this group died.

Conclusions/Discussion
For plant height, mass, and BPA levels, there were statistically significant differences between group means as determined by an ANOVA. T-Tests between the control and the other groups were statistically significant.
An explanation for varying plant heights and masses is that BPA acted as a plant hormone at trace levels. The control group may have gotten BPA from plastic tubes used in the extraction procedure.
Bisphenol A was absorbed by Lactuca sativa var. Longifolia, and it had a significant effect on plant height, mass, and health. Plants in all groups were able to take up and store measurable levels of BPA in their leaves. Further research with BPA and its effects on plants are needed to determine if there are any significant health risks for humans.

Summary Statement
This project tested the effects of Bishpenol A (BPA) on Lactuca sativa var. Longifolia, and whether or not BPA could be absorbed and stored by the plant.

Help Received
Used plate reader at Santa Clara University under supervision of Dr. Katy Korsmeyer. Project Advisor: Mrs. Cathy Messenger

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Andrew Jin; Steven Wang

Project Number

S1709

Project Title

Development of a Novel Computer-Aided Framework for the Discovery of Synergistic Chemotherapy Combinations

Abstract

Objectives/Goals

Drug discovery requires approximately 13 years of research and $1 billion to introduce a new treatment for patients. Combination therapy is promising, but current trial-and-error drug screening methods are expensive, time consuming, and often identify combinations too toxic for clinical use. Therefore, our goal was to create a novel interdisciplinary approach that rationally guides and accelerates the discovery of safe, synergistic drug pairs.

Methods/Materials

We analyzed 1.6 billion gene expression values from the Cancer Genome Project to construct molecular signatures predictive of resistance and sensitivity to eight common chemotherapy agents. We then computationally screened the Connectivity Map dataset (7,000 genomic profiles) to discover secondary drugs that synergize by knocking down resistance genes and increasing expression of sensitivity genes. In parallel, we used gene set enrichment analysis (GSEA) to elucidate synergy mechanisms. We also devised an innovative machine learning methodology, training neural networks to predict synergy through assessment of a drug combination's molecular and chemical properties. Finally, predictions were validated with LDH cell viability assays conducted on MCF-7 human and 4T1.2 mouse breast cancer cells.

Results

After computationally screening 10,563 potential anti-cancer drug combinations, we identified 40 as synergistic. Rigorous in vitro validation confirmed our top five predictions. Although individual administration of doxorubicin (10 uM) and adiphenine (120 uM) killed only 40% and 5% of cancer cells respectively, simultaneous dual therapy yielded 79% inhibition. Moreover, prior exposure to NS-398 nearly doubled the inhibition level of mitomycin C from 36% to 67%. Additionally, GSEA and pathway analysis revealed highly enriched gene sets that explain possible synergy mechanisms.

Conclusions/Discussion

Through integration of biological experimentation with bioinformatics, statistical, and machine learning analyses, we discovered five synergistic drug pairs, three of which are novel. Additionally, our neural network predicted synergy with an accuracy rate of 87%, offering an 18% to 27% improvement over existing prediction models. On average, our discovered dual therapies are also two to four times more synergistic than current combinations researched, allowing for enhanced efficacy, prevention of drug resistance, and significant toxicity reductions.

Summary Statement

We developed a novel computational framework with rigorous in vitro validation to accelerate the drug discovery process of synergistic chemotherapy combinations that enhance efficacy, prevent drug resistance, and reduce toxicity.

Help Received

Used lab equipment at City of Hope under the supervision of Dr. Draganov and Dr. Lee; received mentoring from Dr. Beck (Harvard Medical School); Mr. Spenner provided feedback and sponsored our project.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Austin Jones; Ian Jones

Project Number
S1710

Project Title
The Effect of Electronic Cigarette Vapor on Calcium Levels in Mice

Abstract

Objectives/Goals
This project investigates the effects electronic cigarette vapor can have on mice#s blood calcium levels. Nicotine from conventional cigarettes is known to have adverse effects on bone health in humans, but it is unknown whether electronic cigarettes can have similar effects. Because they contain nicotine and are used by many as an alternative (or in addition) to traditional cigarettes, this project#s objective is to discover whether the vapor can cause problems for the mice#s calcium levels.

Methods/Materials
Mice, E-cigarettes, syringes, microcapillary tubes, habitats for mice, plate reader
Pumped 15 syringes of vapor into treatment aquarium everyday. Left vapor in habitat for 15 minutes. Took blood directly after. Froze blood for storage. Analyzed samples with plate reader.

Results
We analyzed our results using a one-sided T test in which we compared the control group to the treatment group. The p value including the unmarked black mice was 0.29, while the p value while omitting them was 0.25. Both values are greater than 0.05. Therefore, our results were not statistically significant, even though the treatment group showed a definite upwards trend in blood calcium levels in the mice throughout the week. However, the trend was not great enough to justify the results as statistically significant, as opposed to a chance occurrence.

Conclusions/Discussion
Our experiment showed that electronic cigarette vapor did not have a statistically significant effect on the mice#s blood calcium levels. However, there was an increase in their calcium levels by the end of the week of testing, which was not shown by the control group (whose blood calcium levels fluctuated). Additionally, the mice in the treatment group displayed significant behavioral changes, including response and recognition of the vapor, and a subdued nature during blood sampling as compared to the control group.

Summary Statement
We tested whether electronic cigarette vapor has an effect on the blood calcium levels in mice.

Help Received
Went to Amgen to use the plate reader.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Alyah Kanemoto

Project Number
S1711

Project Title
The Effect of Monosodium Glutamate on Planarian Photoreceptor Regeneration

Abstract

Objectives/Goals
The objective of this experiment was to observe the effect of Monosodium glutamate on the rate of planarian photoreceptor regeneration.

Methods/Materials
75 planarian were used over the course of three weeks. First, a serial dilution was conducted in order to obtain proper concentrations of Monosodium glutamate. Next, I identified the planarian photoreceptors and auricles prior to decapitating the head of each planarian to stimulate the regenerative process. Lastly, each planarian was subjected to a phototaxis assay where each individual was evaluated on its ability to maneuver to the darker portion of the petri dish over the course of 90 seconds. I used this phototaxis assay in order to confirm the function of the planarian photoreceptors.

Results
Based on the phototaxis assay, it appears Monosodium glutamate does have an effect on planarian photoreceptor regeneration. The majority of my control planarian demonstrated their innate negative phototaxis response by maneuvering away from the light source. In contrast, the Monosodium glutamate exposed planarian exhibited movement to and from the light source, indicative of a positive and negative phototaxis response. Though an effect was witnessed due to the Monosodium glutamate exposure, the molecular reasoning behind the effect remains unknown.

Conclusions/Discussion
Monosodium glutamate appears to have an effect on planarian photoreceptor regeneration, although the molecular mechanisms behind this observed effect remains unknown. To further understand the effect of Monosodium glutamate the experiment can be tailored to encourage more refined results.

Summary Statement
The effect of Monosodium glutamate on the rate of planarian photoreceptor regeneration.

Help Received
My uncle for his guidance, my mom and dad for their support, Mr. Center for providing me with materials, and Mrs. Kelly and Mr. Ryan for being my mentors.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Talar Kassabian

Project Number
S1712

Project Title
Quest for Longevity

Abstract

Objectives/Goals
The purpose of my project is to test if antioxidants can counteract the effects of free radicals.

Methods/Materials
I will place 15 male flies in cultures with the different experimental concentrations of H2O2 only, acai only, and concentration combinations of both, in addition to the control culture. To measure the effect of my variables I will keep track of the dead flies on a daily basis.

Results
My results show that the hydrogen peroxide shortened the life span, while the acai powder helped lengthen the life span of the flies except for the highest concentration of acai. When peroxide and acai were combined the lifespan of the flies decreased in comparison to the control group, except for the combination on 4.5% acai and 0.5% H2O2, but when compared to the different corresponding concentrations of H2O2 the flies lifespan increased.

Conclusions/Discussion
According to my data it is clear show radicals do decrease the lifespan of fruit flies. According to my data the flies with 1.5%, and 3% acai had longer lifespans, however the flies with 4.5% acai had shorter lifespans, which rejects my hypothesis of all concentrations of acai being beneficial. Since only one combination (4.5%acai+0.5%H2O2) had a longer lifespan than the control groups, while the rest had shorter lifespans, my hypothesis was rejected.

Summary Statement
Can antioxidant counteract the effects of free radicals.

Help Received
Teacher helped put project together; Mother helped handle flies; Father helped put together boar.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Natasha Kohli; Kosha Patel

Project Number

S1714

Project Title

The Effect of Radiations on Planaria in Lieu of Human Skin Cells

Abstract

Objectives/Goals

This experiment was conducted to discover the effects of five different types of radiation on the regeneration process of planarians. Over 50% of planarian genes are parallel to those of humans, and especially parallel skin cells. Based on previous experimentation, radiation has been proven to entice mutations in the planarians and stunts in their growth, thus slowing down their regenerative processes.

Methods/Materials

110 Planarians were cut into 5 mm. halves and then kept under observation during their regeneration process for 10 days. A group of 10 planarians were exposed to a single type of radiation for 5 minutes, followed by another group of 10 planarians that were exposed to a single type of radiation for 10 minutes, each day. A total of 110 planarians were exposed to radio waves emitted from a cellular device, microwaves emitted from a microwave oven, infrared waves emitted from a kitchen stove, visible light emitted from a light bulb, and UVC light emitted from a UVC Light to replicate sunlight.

Results

After exposing the planarians to radiation emitted from radio waves, microwaves, infrared rays, visible light, and UVC rays, we discovered the planarians continued to somewhat react in the expected manner. While the planarians exposed to visible light, microwave, and radio wave radiation grew at a slower rate and developed to a smaller size, the planarians exposed to UVC and infrared radiation could not withstand the radiation and disintegrated almost immediately. However, all of the planarians affected by the heat of the radiation experienced mutations in the form of darkened cells and a fatter appearance.

Conclusions/Discussion

This amount of exposure to radiation is similar to that which humans experience on almost a daily basis, which should spark concern for human health because of the negative consequences experienced by the planarians. Planarians regenerate their bodies, while humans regenerate their liver, skin, and eye cells, which can be subject to mutations when exposed to these common amounts of radiation. Humans living in the common household without caution often come in contact with cell phones, microwave ovens, light bulbs, sunlight, and kitchen stoves, which can cause the development of cancerous cells.

Summary Statement

Regenerating planaria were exposed to different radiations in place of human skin cells to depict the effect of radiation emitted by common household items.

Help Received

None.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Mikayla Konefal; Zoe Sekeres; Alexis Thomas

Project Number

S1715

Project Title

Going Green While You Clean

Abstract

Objectives/Goals

We wanted to test the claims that major name-brand detergent companies put on their bottles. We wanted to see if the "greener" washing detergents actually yield a a less harmful effect on plant life and worm life.

Methods/Materials

Materials:
-Bait Worms -Young Pea Plants -Clothing Detergents (2 regular and 2 #green#) -Identical Party Cups -Soil -Water -Foil -Stereomicroscope -Spray bottles -Graduated Cylinder -Sharpie pens-Camera -Masking tape

First, we calculated through proportions how many mL of detergent we needed to create a 10% and 25% concentration for each detergent (we used Tide, All, Method, and Seventh Generation). After we measured these amounts, we mixed them with water in our pre-labeled bottles. We had designated plants and worms to each bottle and we watered every other day. We made sure to keep the plants and worms in the same, appropriate area and make observations. At the end of our two week experiment, we took our experiment plants and worms for observation at our biology class lab.

Results

The "greener" detergents were Seventh Generation and Method. The "regular" detergents were Tide and All. The plants from the "regular" detergents were dried out, but still had a few hydrated sprigs left. The worms were slower in reaction but showed no tissue damage. The plants from the "greener" detergents were in a noticeably worse condition as their leaves were dried out, bases were deteriorating, and their worms had slower reactions and worse physical damage. The worst detergent on both worms and plants was Method and the best was All.

Conclusions/Discussion

Our results contradicted our hypothesis because the "greener" detergents ended up causing more harm. We made the hypothetical situation of dumping grey water into the earth and seeing what would happen. The point of this experiment is to prove that even if these detergents claim to be "greener", they are still concentrated chemicals that have an environmental impact.

Summary Statement

To see if "environmentally-friendly" detergents caused less environmental harm in the form of grey water.

Help Received

Freshman Biology Teacher (Ms. Coleman) provided lab equipment and advice, Current Chemistry teacher (Ms. Gluckmann) helped guide and regulate our project's progress, All parents helped purchase materials and provide rides, Sacramento Science Fair provided trifold.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Alicia Lai

Project Number

S1716

Project Title

Radioprotection of BNL CL.2 Liver Cells after Exposure to Sedum formosanum

Abstract

Objectives/Goals

The purpose of this experiment is to test the efficacy of Sedum formosanum (SFEA), or Alfred Stonecrop, as a radioprotector by inhibiting apoptosis from occurring and enhancing DNA repair process in BNL CL.2 nude mice liver cells exposed to ionizing radiation. Radioprotector is a great area of interest for research studies because successfully developing a nontoxic radioprotector offers advancement in many areas of life. It can protect humans from nuclear radiation during wartime, prevent fatigue, hair loss, and other side effects of radiotherapy for cancer patients, and protect flight attendants from harmful cosmic radiation. SFEA, a plant used in traditional Chinese medicine system to treat various ailments, grows along the coastline of Taiwan and in areas of high exposure to radiation. Despite the high exposure to radiation, it is still able to maintain healthy growth, which suggests that it might obtain radioprotective qualities.

Methods/Materials

The experiment procedure began by exposing BNL CL.2 cells with dosage of ionizing radiation and SFEA. Then, the percentage of cells in the apoptosis state, or cell death, was determined by conducting flow cytometery test. The changes in the expression of apoptotic proteins (caspase-9 and caspase-3), anti-apoptotic protein (Bcl-2), and DNA repair protein (RAD50) were determined with western blot test.

Results

In the flow cytometry test, SFEA was able to decrease the apoptotic cell percentage after the liver cells were irradiated. For the western blot test, SFEA decreased the expression of apoptotic proteins, caspase-9 and caspase-3, and increased the expression of DNA repair protein, RAD50, and anti-apoptotic protein, Bcl-2.

Conclusions/Discussion

The results of both flow cytometry test and western blot test showed that SFEA, a nontoxic extract, was able to decrease the percentage of apoptotic cells, regulate apoptotic related proteins, and increase DNA repair protein expression. All these qualities suggested that SFEA served as a radioprotective agent on the cellular level.

Summary Statement

The project tests whether Sedum formosanum, a plant native to Taiwan, is able to serve as a radioprotector by inhibiting apoptosis from occurring and enhancing DNA repair process in BNL CL.2 liver cells after being irradiated.

Help Received

Chien-Cheng Chen, a professional laboratory technician, offered assistance and supervised all experimental procedures for my project. The lab equipments were provided by HungKuang University in Taiwan.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Karley J. Lassley

Project Number
S1717

Project Title
Detrimental Effects of Commercial Fertilizers on Rana catesbeiana

Abstract

Objectives/Goals
The purpose of this experiment is to analyze the detrimental effects of commercial fertilizer on Rana catesbeiana. Rana lay their eggs in large clumps to ensure some will survive in their dangerous environment. Aquatic ecosystems have several necessary pieces to the puzzle. If even one piece is off, then the entire biological equilibrium will be skewed.When fertilizers run-off into surface water, eutrophication occurs. It results in explosive growth of algae and aquatic death. The run-off can alter pH levels causing more ammonia to exist in the free form, which is poisonous to aquatic life.

Methods/Materials
Test includes 3 independent variables at 2 different strengths and a control group. Cut ends off water bottles and drill 3 holes in the lid. Invert bottles in plastic cup; add sterilized soil, sterilized rocks and fertilizer. Pour water slowly into bottle over soil, rocks and fertilizer to produce run off solution. Repeat test replacing % of fertilizer. Set run off test solutions aside. Pour distilled water in 70 cups, place cups in container. Fill storage container with warm water. Add fish tank water heaters . Add frog eggs to each Test cup.Measure 15ml of run off solution and add to each cup with frog eggs. Repeat with stronger solution. Check each test container for Nitrite, Nitrate, and ph levels record in data book to develop base line levels. Observe each test cup for Frog egg hatch rate and observe any abnormalities to egg sac.

Results
The hypothesis was incorrect; the triple 15% solution had less of an effect on eggs than the K-mag 15% solution. The Fertilizers: Triple 15-15-15, K-mag, and Ammonium sulfate 25% solutions indicated that the run-off of this strength is dangerous to Rana hatch rate. The 15% solution of Ammonium sulfate was also dangerous having a negative effect on hatch rate. 15% of Triple and K-mag did allow a small amount of eggs to hatch. The control group only allowed 38% of Rana eggs to hatch, possibly due to testing window, and Rana development

Conclusions/Discussion
In conclusion, the fertilizers all cause adverse effects to the aquatic environment. These dilutions would be harmful to aquatic life. Research and testing indicate that fertilizers are not safe for biological equilibrium of aquatic ecosystems. Agriculturalists must find ways to cause greater absorption of nutrients into the soil. That way any run-off will not overly increase the nutrients in the environment.

Summary Statement
This investigation is designed to emphasize the harmful effects on commercial grade fertilizers on aquatic environments and organisms with in them, such as rana catesbeiana

Help Received
Mother helped with photos. Patty Cardoso supplied fertilizers. Blue lobster farms supplied frog eggs

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Vincent Lok

Project Number

S1718

Project Title

Effects of Pesticides on Mitochondrial Activity and DNA Levels in Mouse Myoblast Cells

Abstract

Objectives/Goals

The focus of this project was to determine whether pesticides permethrin, carbaryl, and imdacloprid, affected mitochondrial activity and mitochondrial DNA levels in C2C12 mouse myoblast cells.

Methods/Materials

Cells were treated with dosages of pesticide with similar concentration to the LD50 and LD25 toxicity in rats for 24 hours. The mitochondrial activity was measured as the basal and maximal oxygen consumption rates (OCR) in the mitochondrial stress test. To determine the amount of mitochondrial DNA, the ratios of mitochondrial DNA to nuclear DNA were determined from treated samples by amplification using live Polymerase Chain Reaction.

Results

The LD50 permethrin treatment significantly reduced the basal OCR ($p = 0.04$) but not the maximal OCR. The LD25 permethrin treatment and carbaryl and imidacloprid treatments did not have significant effects on basal and maximal OCR. All the pesticide treatments did not affect mitochondrial DNA levels except for the LD50 imidacloprid treatment, which significantly affected the mitochondrial DNA levels ($p = 0.05$).

Conclusions/Discussion

Permethrin and carbaryl affected the mitochondria#s ability to make ATP not by lowering amount of viable mitochondrial DNA, but by affecting the electron transport chain.

Summary Statement

I investigated whether pesticides adversely affected the mitochondria.

Help Received

I used lab equipment at Gonda Center under the supervision of Dr. Laurent Vergnes.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Mimi Lu

Project Number
S1719

Project Title
Inhibition of Jak2 and PKC Induces Synergistic Apoptosis in Glioblastoma

Abstract

Objectives/Goals
The Epidermal Growth Factor Receptor (EGFR) signaling pathway is commonly mutated in glioblastoma, a type of brain cancer (Huse & Holland, 2010). I investigated combination treatments of clinically feasible drugs to induce apoptosis in glioblastoma in vitro (cultured cell lines) by inhibiting proteins in the EGFR signaling pathway.

Methods/Materials
Cell Culture: Immortalized (LN229) and primary (GBM34) cell lines were provided by the Weiss Lab at the University of California, San Francisco. The cell lines were cultured using Dulbecco#s Modified Eagle#s Medium (DMEM) and harvested for cell viability assays, fluorescence activated cell sorting (FACS) analysis, and western blotting.
Cell Viability Assay: Cells were stained with the chemical compound WST-1 and analyzed using a microplate (ELISA) reader. Data was analyzed using Microsoft Excel.
Fluorescence Activated Cell Sorting (FACS) Analysis: Cells were stained with the antibody Annexin V-FITC and analyzed using a BD FACS Calibur flow cytometer. Data was analyzed using FlowJo and Microsoft Excel.
Western Blotting: Protein was extracted from cultured glioblastoma cell lines. Proteins and their phosphorylated counterparts were detected using specific antibodies and recorded on autoradiography film.

Results
The chemical compound PP242 induces apoptosis, or programmed cell death, in cultured glioblastoma cells by inhibiting the key proteins Jak2 and PKC. Due to metabolic liabilities, PP242 is unable to be used in the clinic, but the combination treatments of the clinically feasible drugs Tarceva + AZD1480 and Lapatinib + Ruxolitinib successfully inhibit the same significant proteins as PP242 and mimic its cytotoxic effects.

Conclusions/Discussion
Each drug alone is only able to block a single portion of the pathway, but when combined, the combinations of Tarceva + AZD1480 and Lapatinib + Ruxolitinib inhibit Jak2 and PKC and induce cell death. Thus, this dual blockade of Jak2 and PKC by the two drug combinations may offer a novel treatment for glioblastoma, an incurable brain cancer.

Summary Statement
My project involves the investigation of how combination drug treatments induce apoptosis in glioblastoma, a type of brain cancer, through the inhibition of proteins in the EGFR signaling pathway.

Help Received
Used lab equipment at the University of California, San Francisco under the supervision of Dr. William Weiss and Robyn Wong.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Melissa V. Maffei

Project Number
S1720

Project Title
The Effect of Carbon Dioxide on Elodea

Abstract

Objectives/Goals
My objective was to find out how increasing carbon dioxide levels affect the freshwater plant, Elodea.

Methods/Materials
I set up three tanks. Each tank had a layer of soil, then gravel on top and 10 liters of purified water. Six elodea stalks were nestled in each tank and given a period of time to adjust to the environment before the introduction of carbon dioxide. Tank #2 and tank #3 each had one carbon dioxide pump, which were on for 12 hours per day and 24 hours per day, respectively. From the point of carbon dioxide introduction, the experiment was 2 weeks long, and this was the period where I collected the data. The height of each stalk was measured daily with a ruler and the pH of the water in each tank was tested daily with pH test strips.

Results
The Elodea in tank #1 experienced small growth throughout the experiment. The pH of the water remained constant until near the end of the experiment when it rose to 8 (day 13).The Elodea in Tank #2 experienced continued growth throughout the whole experiment. The pH or the water dropped slightly to 6 (day 5).The Elodea in tank #3 experienced growth at first but then gradually declined in health. The pH of the water dropped to 6 near the beginning of the experiment (day 2), then dropped to 5 near the end (day 12). This indicates that increasing carbon dioxide levels affect the growth and health of the elodea plant by affecting photosynthesis and water pH.

Conclusions/Discussion
My results support my hypothesis. The carbon dioxide lowered the pH of the water and affected the height of the elodea. The Elodea in tank #2 were the most healthy and experienced the most growth. Carbon dioxide levels in tank #3 made the water pH to low for the Elodea to survive. This data suggests that too much carbon dioxide may negatively affect freshwater ecosystems.

Summary Statement
My project is about the effect of different levels of carbon dioxide on Elodea, a freshwater plant.

Help Received
Father helped waterproof glass tanks

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Macy Matsukawa; Edward Segura; Esmeralda Suarez

Project Number

S1721

Project Title

The Alcoholic Effect on Bovine Biological Catalysts

Abstract

Objectives/Goals

To determine if different durations of alcohol exposure will affect a bovine liver's rate of enzymatic reaction.

Methods/Materials

Three consecutive trials were carried out. Every trial consisted of seven different durations of alcoholic exposure, which was the independent variable of the experiment. The alcoholic exposure ranged from five minutes to thirty minutes all running concurrently throughout the individual trials. Each portion of liver that was exposed to the alcohol weighed .030kg. The rate of enzymatic activity was measured by the oxygen volume produced by the reaction between the catalase discs and the hydrogen peroxide over a two minute period. The following variables were controlled: the amount bovine liver, hydrogen peroxide, time, water, isopropyl alcohol (50% concentration) and catalase discs. The control groups was a catalase solution in which the liver had no exposure to alcohol.

Results

The liver with no alcoholic exposure, the control group, had a constant enzymatic reaction that lasted the complete testing period. By the end of the enzymatic reaction, the oxygen volume for the control group reached 17ml, as opposed to the liver that was exposed to the alcohol for a 30 minute period which had an enzymatic reaction that only lasted 70 seconds and produced an oxygen volume of 9ml. The rate of enzymatic activity was found to be inversely proportional to the exposure time of the bovine liver to isopropyl alcohol. The enzymatic activity of the bovine liver decreased as the alcohol exposure time increased.

Conclusions/Discussion

According to our data, our hypothesis was supported. The longer the bovine liver was exposed to the alcohol, the lower the rate of enzymatic activity. The metabolism of alcohol predominately occurs within the liver, producing free radicals as a by-product, molecular fragments that contain oxygen. Oxygen is highly electronegative and craves electrons and as a result, free radicals interfere with proteins by denaturing their conformation; thus, inhibiting enzymes by interfering with molecular bonds. The production of these free radicals explains why the rate of enzymatic activity decreased as alcoholic exposure increased. This experiment supports our understanding of how the consumption of recreational alcohol, a damaging chemical, interferes with the function of the liver by denaturing the dehydrogenase enzymes involved in the metabolism of alcohol.

Summary Statement

To determine the effects of alcohol exposure on enzymatic liver functions.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Guadalupe Melgarejo

Project Number

S1722

Project Title

Native vs. Foreign: Which Plant Is More Resilient against Eucalyptus Leachate?

Abstract

Objectives/Goals

Does Eucalyptol, which is secreted in eucalyptus leaves, affect the development of native and foreign plants and potentially result in the elimnnation of native species in an ecosystem?

Methods/Materials

Using crushed eucalyptus leaves in two different aqueous concentrations, along with water as a control, soaked in paper towels seeds from domestic sources and from Australia were placed and germination rates recorded.

Results

I found that the domestic seeds were largly inhibited in germination and in growth among the survivors while the single Australian seed (Swan River Daisy)was considerably moreactive in growth and the germination rate was found to be 100%.

Conclusions/Discussion

The eucalyptus leaves containing eucalyptol inhibited the germination and growth of the seeds found domestically in the United States while the Australian seed had greater growth and percent germination in comparison.

I would conclude the Australian seed has developed resistance to the inhibiting affects of the eucalyptus leachate (eucalyptol) over time which would explain its' higher rates of survival and growth.

Summary Statement

Eucalyptus chemicals will inhibit domestic plant growth and germination far more than native Australian plants that have developed resistance to the Eucalyptus chemicals llike eucalyptol.

Help Received

Mr. Callaway, my Biology teacher, acted as my advisor.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Matthew S. Moser

Project Number
S1723

Project Title
The Effects of Auranofin on Adult and Larval Mosquitoes

Abstract

Objectives/Goals
The purpose of my experiment was to test the effects of auranofin on the survival rate of adult and larval mosquitoes.

Methods/Materials
To determine the effects of auranofin on the adult stages of mosquitoes, I set up 12 containers into four groups of three. In each of the containers I put 14 mosquito pupae, three small cups filled with water (one for the pupae and two for females to lay eggs), and a cotton ball containing a mixture of auranofin and sugar water (for food). The concentrations of the auranofin-sugar water mixture varied depending on the group. The groups were: Control, Low, Medium, and High concentrations.

Results
To determine the survival rate of larval mosquitoes, I put four different instar stages into a 24-well plate that were exposed to varying concentrations of auranofin and a control. Each treatment group had four replicates. The adult mosquitoes given the medium dose had the highest mortality. Female mosquitoes had a higher percent mortality compared to the male mosquitoes. The highest concentration of auranofin caused the highest mortality only in the first instar stage after 2 days.

Conclusions/Discussion
I found that the medium dose of auranofin had the highest mortality rate on the adult mosquitoes, especially the female mosquitoes. I believe this is the result of a #Goldilocks# effect. The high dose may have been too strong and was distasteful for the mosquitoes, while the low dose was too weak and wasn#t strong enough to kill all the mosquitoes. I also found that the auranofin at the highest dose killed the first instars and not the second, third or fourth instars within 24 hours. The reason why might be because the first instars are much smaller than the older instars and are more sensitive to the drug.

Summary Statement
My experiment was designed to see whether auranofin had an effect on both the adult and larval mosquitoes.

Help Received
Mother provided the drug; UCSF supplied lab equipment; Marin Sonoma Mosquito & Vector Control District supplied the mosquitoes/mosquito larvae

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Lillian Ohara; Samantha Pearlstein

Project Number

S1724

Project Title

The Effect of Over the Counter Pharmaceuticals on Brine Shrimp and Algae Growth

Abstract

Objectives/Goals

The objective of this experiment was to determine the mortality rate of the brine shrimp and the growth rate of algae in different concentrations of over-the-counter (OTC) pharmaceuticals. In this experiment, the goal was to determine whether OTC pharmaceuticals pose a risk to aquatic organisms.

Methods/Materials

The control showed the lowest mortality rate (2 brine shrimp dead/day) and the highest growth rate in algae (0.03 cm/day0. The results of the study revealed that any of the OTC concentrations had an effect on the mortality of brine shrimp and algae growth. The highest concentration of pharmaceuticals resulted in the highest mortality rates in the brine shrimp (20 dead/day) and a lower algae growth rate (0 cm/day).

Results

The control showed the lowest mortality (2 brine shrimp/day) and the highest growth rate in algae (0.03 cm/day). The results of the study revealed that any of the OTC concentrations had an effect on the brine shrimp and algae growth. The highest concentration of pharmaceuticals resulted in the highest mortality rates in the brine shrimp (20 brine shrimp dead/day) and a lowest algae growth rate (0 cm/day).

Conclusions/Discussion

Supporting the hypothesis, the algae showed no growth rate and brine shrimp had higher mortality rates (10 times higher) in higher concentrations of pharmaceuticals compared to the control tests. Tests with brine shrimp in increasingly high concentrations of pharmaceuticals also showed to have higher mortality rates. The control had the lowest mortality rate for brine shrimp (2 dead per day) and the highest growth rate for algae (0.03 cm per day). The algae control tests looked visually greener and the brine shrimp control tests were more active compared to the other tests.

Summary Statement

This experiment tests the effect of over-the-counter pharmaceuticals on the growth rate of algae and mortality rate of brine shrimp.

Help Received

Parents helped pay for supplies and drive to necessary locations; Teacher helped narrow focus on choice of project and answered questions when needed.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Yana D. Petri

Project Number

S1725

Project Title

Synergetic CCD Effects of Ingestion of Bacillus thuringiensis d-Endotoxins on the Health of Honey Bees Apis mellifera L.

Abstract

Objectives/Goals

Pollination accounts for $15 billion in agricultural value and 1/3 of the U.S. food supply. Since 2006, Colony Collapse Disorder has been responsible for anomalous bee losses. GM Bt crops are viewed as potential culprits of CCD. Pollen of Bt plants contains d-endotoxins, encoded by B. thuringiensis cry-genes that are lethal to pests. Bt impact on pollinators remains unclear. The goal of the study was to quantify the synergetic effects of Bt d-endotoxins on bee health and investigate the connection between GM plants and CCD. I hypothesized that bees fed with Bt d-endotoxins will exhibit lower (1) food consumption, (2) survival, and deteriorated (3) olfactory associative learning.

Methods/Materials

In a 3-replicate study, 30 bees were selected from a hive and transferred into 2 groups of 15 insects. Cultured B. thuringiensis was allowed to produce d-endotoxins according to the methods of mass production. A Bt suspension was prepared in concentrations similar to those consumed by a nurse using hemocytometer spore counting. Control was fed with sucrose solution, while treatment groups received a Bt solution for 3 days. Mortality and amount of solution consumed per bee were measured. After the assay, conditioning of the proboscis extension reflex (PER) and extinction were performed.

Results

According to Pearson chi-squared test, mortality in Bt-treated groups (15.6%) was not significantly different from that of control (6.7%). Food consumption in treatment groups, verified by Student t-test, did not decrease. However, extinction % PER in control groups was significantly lower (2-proportion z-test, $Z = 3.2$, $P = 0.0012$) than that of Bt-treated groups. Bees treated with d-endotoxin exhibited a prolonged PER, demonstrating a lack of extinction process, which elucidated modifications in bee memory.

Conclusions/Discussion

Prolonged PER in Bt-groups indicated that d-endotoxin has an adverse effect on bee learning and adaptability. In the field, lack of behavioral flexibility might prompt a bee to return to depleted food sources, negatively impacting foraging behavior. My analysis is supported by previous studies and a discovery that reveals that the amount of Bt d-endotoxins ingested by bees might be underestimated due to accumulation of toxins in the hive. I conclude that pollen from GM plants adversely affects bee memory and suggest that Bt d-endotoxins have a link to CCD.

Summary Statement

I investigated the synergetic effects of Bt d-endotoxins on bee health and determined that pollen from GM crops has a negative impact on bee memory and a connection to Colony Collapse Disorder caused by modifications in foraging behavior.

Help Received

The study was conducted in a school laboratory under the supervision of Mrs. Fallon. Mrs. McCarty gave insights into statistical analysis; beekeepers Alan Henninger, Shane Harris, and Alysa Sakkas provided live bees; father encouraged and purchased materials.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Lauren Polyakov

Project Number
S1726

Project Title
A Worm's Life: A Study of the Effects of Magnetism, UV Light, and Temperature on Regeneration of Lumbriculus variegatus

Abstract

Objectives/Goals
To determine whether exposure to magnetism, UV radiation, or colder temperature affect the regenerative abilities of Lumbriculus variegatus.

Methods/Materials
Four environments were constructed: magnetism, UV light, cold temperature, and control. Lumbriculus variegatus were purchased and measured. For each environment, 10 were cut in one-half and one-third/two-third segments and placed in test tubes labeled head or tail. Daily temperature measurements recorded. Worms length and mortality were measured weekly. Materials include: Neodymium magnets, microscope, water, cooler, UV light, test tubes, scalpel, infrared thermometer.

Results
Survival rates for groups: control 80%; cold temperature 50%; magnetism 35%; UV light 20%. Growth rate averages for 1/2 cut worms: UV Light environment 7.2mm; magnetism 5.4mm; cold temperature 3.9mm; and control group 4.6mm. Growth rate averages for 1/3 and 2/3 cut worms: magnetism 7.4mm; UV light 7.8mm; cold temperature 4.3mm; and control 8.3mm.

Conclusions/Discussion
Worms exposed to cold temperature and control regenerated better than those exposed to magnetism and UV light. Few worms survived exposure to UV light and magnetism and regenerated better compared to worms in cold temperature and control. Findings confirm prolonged exposure to magnetism and UV light negatively affects worms# ability to regenerate. The results indicate that lowering the temperature improves regeneration. Increasing the temperature likely harms it.

The part of the worm severed affects its ability to survive and regenerate. One-half cut worms survived and were able to regenerate themselves more favorably compared to when 1/3 of the worms# posterior was cut off, only 32.5% of the worms survived and regenerated. No worms cut 1/3 from posterior end survived for four weeks in either the magnetism, UV light, or the control group environments. All 1/3 cut worms in the cold temperature group survived and regenerated.

Overall reducing the average environment temperature improves worms# regeneration. Worms in cold group did not grow as much as some of the worms in the other environment but survived and regenerated at a very high rate. This compares favorably to the control group (50% overall rate, 80% for 1/2 cut and 20% for 1/3 cut groups) and the magnetism group (35% overall rate, 50% for ½ cut and 20% for 1/3 cut) and the UV light group (25% overall rate, 30% for 1/2 cut and 20% for 1/3 cut).

Summary Statement
Whether magnetism, UV radiation, or colder temperature affect regenerative abilities of Lumbriculus variegatus.

Help Received
Father helped buy supplies and build UV light environment. Microscope provided my teacher at my high school.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Nathaniel L. Powers

Project Number

S1727

Project Title

Physiological and Morphological Effects of Reduced Serum Concentration on Chinese Hamster Ovary Cells

Abstract

Objectives/Goals

Chinese Hamster Ovary (CHO) cells are commonly used in the biotechnology industry to produce recombinant proteins for therapeutic protein medication. Serum is expensive, so many companies adapt their cell lines to use less serum in the media. This experiment tests the effects of reduced serum concentration on the CHO cells.

Methods/Materials

Materials: Chinese Hamster Ovary cells producing CTLA4-ig24 construct, Fetal Bovine Serum, DMEM/ F-12 Media, Carbon Dioxide Incubator, 10x Penicillin Streptomycin, Trypan Blue, Trypsin, Phosphate Buffer Saline, 25 cm2 T-flasks, 5ml - 1ml Serological Pipettes and Electric pipettor, Dissolved Oxygen Probe, pH Pen, .45um Filter Units.

Methods: Cells were incubated in the T-flasks with 5ml of media with either 10% or 8% serum for 3-4 days, before exchanging the media. Media exchange included trypsinizing the cells to create a cell suspension, and taking 2ml of that cell suspension to continue the cell line, leaving room for new cells to grow. Viability tests were conducted on the cells using 10% media during the final physiological tests, and pictures were taken to document morphological changes over time between cells using 10% and 8% serum.

Results

Viability tests with Trypan Blue and the Dissolved Oxygen Probe were used to prove that the cells were indeed living, as some cells kept the Trypan Blue at bay, showing that they were living, and the oxygen content in the media went down each day of testing, showing that the cells using 10% serum were respiring. The pictures do not document significant change in cell morphology between 10% and 8% serum.

Conclusions/Discussion

The cells do not show significant change in morphology as they adapted to the 8% serum change. The only notable difference includes increased clumping when the cells were trypsinized. Due to this, I accept the null hypothesis that there was no morphological change in the cells using less serum when compared to cells using 10%. For future work, extra time would be taken to reduce the concentration to a lower amount, and to keep the cells living long enough so that the physiological tests could be done on cells using both the 10% and the 8% serum media.

Summary Statement

I reduced the amount of nutrients (the amount of serum added to media) the Chinese Hamster Ovary cells could utilize and tested the effects of this on their morphology and physiology.

Help Received

Dr. Subhash Karkare donated supplies and taught sterile techniques; Dr. Nikki Malhotra provided lab report proofreading and access to lab supplies; Used lab equipment at Thousand Oaks High School under the supervision of Dr. Malhotra; Received donations from Sigma-Aldrich and Fisher Scientific.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Aiswarya S. Sankar

Project Number

S1728

Project Title

Reducing Neuronal Hyper-excitation in Autism: Various Herbs' Ability to Increase Inhibition in the Roots of A. thaliana

Abstract

Objectives/Goals

Several symptoms of autism spectrum disorder are the result of a high excitatory to inhibitory neuron signaling ratio. Currently benzodiazepines are the most popular drug used to normalize an excitable cortex, however it has several adverse effects such as myorelaxation. My goal is to find an herbal extract that can increase signal inhibition at the GABA-A receptor without these effects and to identify which of two groups of chemicals in these extracts, valepotriates and flavonoids, is the more powerful inhibitor.

Methods/Materials

The plant species Arabidopsis thaliana was used as a model organism as it has been experimentally verified that the AtGLR receptor family in A. thaliana has a similar primary sequence and secondary structure to the GABA-A receptor. Arabidopsis seeds were grown in plates with the negative control, the solvent of the extracts, and in plates with each of the extracts. During the 12 day growth period, pictures were taken under a dissecting microscope and primary root length was measured on Adobe Illustrator.

Results

Each of the six extracts elicited root length inhibition as compared to the negative control. By day 12, average primary root length of seeds grown with an extract was 7.59 mm as compared to the control length of 19.74 mm. Delayed germination times among seeds grown with an extract were noticed; by day 5, all seeds grown in the negative control had germinated, however only 34.5% of seeds grown with an extract had germinated. Root metacutinisation (a process in which the exodermis browns and encases the root during periods of inactivity) was noticed for 50% of seeds grown with Valerian extract. Finally in 50% of seeds grown with Passion Flower and 30% of seeds grown with Valerian, the radicle failed to pierce the seed coat while the hypocotyl and the cotyledon emerged.

Conclusions/Discussion

T-tests showed statistically significant root length inhibition as compared to the negative control for 4 out of the 6 extracts. Valepotriates were not shown to be a more powerful inhibitor than flavonoids. These results are promising as they suggest that extracts from Catnip, Valerian, St. John's Wort, and Skullcap do increase neuron signaling inhibition. Further tests would include comparing the results with that of benzodiazepines and testing on the GABA-A receptors in C. Elegans.

Summary Statement

I determined that extracts from Catnip, Valerian, St. John's Wort and Skullcap inhibit root length growth of Arabidopsis thaliana; therefore, these extracts look promising in normalizing neuronal hyper-excitation in autism.

Help Received

I would like to thank my parents for paying for my materials and supporting me, and my mentor Ms. Fallon for supervising my project and providing me with lab supplies.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Catherine Stimson; Natalie Usher

Project Number
S1729

Project Title
Effects of Sodium Hypochlorite and Chloramine on Pimephales promelas and Escherichia coli

Abstract

Objectives/Goals
The objective was to prove sodium hypochlorite is a more effective water disinfectant than chloramine, a product that forms when ammonia and sodium hypochlorite react.

Methods/Materials
12 fathead minnows were placed in 6 separate .5 gallon tanks (2 for chloramine, 2 for sodium hypochlorite, and 2 for the control) and a dose response experiment was conducted using chloramine, and sodium hypochlorite. The concentrations of chemicals started at 0.0 mg/L and slowly increased to 1.0 mg/L.
20 LB agar plates were poured and set. From a standing culture of E. coli, serial dilutions were conducted until there were a small number of cells present. Then the cells were streaked across the surface of the plates that were pre-infused with the chemicals in concentrations of .1, .2, .5, and 1.0 mg/L. The plates were then incubated at 37 degrees Celsius overnight.

Results
The experiment found that chloramine was both more effective and less toxic compared to sodium hypochlorite in the fish section of the experiment, thus disproving our hypothesis. In regards to the E. coli section of the experiment it was found that chloramine was more effective in stopping bacterial growth at higher concentrations therefore being the better disinfectant.

Conclusions/Discussion
In conclusion, though both chemicals are effective at killing bacteria, chloramine is more beneficial at sustaining aquatic life when compared to sodium hypochlorite.

Summary Statement
The hazardous effects as well as the effectiveness of two common and controversial water disinfectants were examined.

Help Received
Teachers helped in obtaining sodium hypochlorite and E. coli cells.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Marcus P. Talke

Project Number

S1730

Project Title

The Effect of Caffeinated Drinks on Heart Rate and Cognitive Function in Adolescent Boys

Abstract

Objectives/Goals

The Food and Drug Administration (FDA) is investigating the safety of caffeine and its nervous system stimulating effects on adolescents. The aim of this study was to evaluate the effects of caffeinated drinks on heart rate and cognitive function in adolescents.

Methods/Materials

Ten adolescent boys consumed 10 ounces of commercially available drinks containing 0 mg, 58 mg, and 96 mg of caffeine, in a random order. Heart rate was measured electronically using a pulse oximeter. Cognitive function was evaluated using a Digit Symbol Substitution Test (DSST). Heart rate and DSST were measured before and twenty minutes after consumption of the drinks. Data are in mean ± standard deviation. Changes in heart rate and DSST were analyzed using ANOVA and paired t-test.

Results

Heart rate values were 71±15 beats per minute (bpm) and 71±16 bpm (P=0.99), 70±14 bpm and 72±12 bpm (P=0.94), and 67±13 bpm and 71±15 bpm (P=0.94) before and after consumption of 0 mg, 58 mg and 96 mg of caffeine, respectively. Respective DSST scores were 44±8 and 45±6 (P=0.24), 45±11 and 47±10 (P=0.002), and 44±13 and 47±13 (P=0.14).

Conclusions/Discussion

Caffeine did not have a statistically significant effect on heart rate in adolescent boys. Although, 58 mg caffeine increased DSST scores, the lack of DSST dose response suggests a Type I error and thus, no significant caffeine induced effect on cognitive function.

Summary Statement

The aim of this study was to evaluate the effects of caffeinated drinks on heart rate and cognitive function in adolescents.

Help Received

UCSF supplied me with a pulse oximeter that electronically measures heart rate.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Nathan S. Tudor

Project Number
S1731

Project Title
Electroculture: Effects of DC Voltages on Radish Growth

Abstract

Objectives/Goals
It is hypothesized that radish seeds which are induced with DC voltages will experience a higher growth rate.

Methods/Materials
5 pots, a bag of soil, a packet of radish seeds, four 9V batteries, copper wire, an 80 milliliter measuring spoon, and a ruler with a centimeter side.

Fill the pots with soil. Label control the pot A, and label the experimental pots B through E. Plant ten seeds in each pot. Water with 80 mL of tap water. Use the copper wire and 9V batteries to run electricity into the experimental group of plants. Water the plants again when soil is dry. Continue process for three weeks. Randomly pick one stalk from each pot. Take the average length of the experimental group stalks and compare it against the control.

Results
In two of the three experiments, the plants which received electricity had shorter stalks than that of the control group.

Conclusions/Discussion
The results of this experiment supports some past research, but does not support other past research. Past research showed that plants grown with electroculture had longer, stouter, more resilient stalks. The radishes in this experiment had little difference between them. Past experiments showed that electrified plants experience accelerated germination and growth, which did occur in this experiment.

The limiting factors of this study were as follows: watering from external sources such as the weather and garden sprinklers, the depth of wires in soil not being consistent, water draining differently in the pots which had not been disturbed by wires, and different amounts of soil in different pots. In the future, these problems could be solved by keeping the plants in a controlled environment from the beginning, getting more materials so that wires did not have to be moved around so much, and measuring the amount of soil more carefully.

This experiment is significant because, while it did not fully enhance the plants' growth, it showed that there is some merit to electroculture.

Summary Statement
Using electrical voltages from batteries in an attempt to bolster the growth of plants.

Help Received
Mother helped arrange board

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Daniel S. Yang

Project Number

S1732

Project Title

Novel Prediction of Anticancer Drug Chemosensitivity in Cancer Cell Lines: Evidence of Moderation by microRNA Expression

Abstract

Objectives/Goals

MicroRNAs are known to regulate gene expressions through mRNA degradation and translation inhibition, and expression levels of certain genes that code for drug-metabolizing enzymes, drug transporters, or drug targets can modulate chemosensitivity or response to anticancer drugs. The objectives of this study are (1) to investigate miRNA expression as a prognostic biomarker of drug chemosensitivity; (2) to understand the mechanism by which miRNA and gene expressions influence chemosensitivity, and (3) to develop an improved prediction model of drug chemosensitivity, specifically for HSP90 inhibitors applied to human cancer cell lines.

Methods/Materials

A novel moderation model integrating the interaction between miRNA and gene expressions was developed to examine if miRNA expression affects the strength of the relationship between gene expression and chemosensitivity. Comprehensive datasets on miRNA expressions, gene expressions, and drug chemosensitivities were obtained from National Cancer Institute's NCI-60 cell lines including nine different cancer types. A workflow including steps of selecting genes, miRNAs, and compounds, correlating gene expression with chemosensitivity, and performing multivariate analysis was utilized to specifically test the proposed model.

Results

The drug chemosensitivity model identified 12 significantly-moderating miRNAs: miR-15b*, miR-16-2*, miR-9, miR-126*, miR-129*, miR-138, miR-519e*, miR-624*, miR-26b, miR-30e*, miR-32, and miR-196a, as well as two genes ERCC2 and SF3B1 which affect chemosensitivities of Tanespimycin and Alvespimycin--both HSP90 inhibitors. A bootstrap resampling of 2,500 times validates the significance of all 12 identified miRNAs.

Conclusions/Discussion

This study is the first analysis of NCI-60 datasets to examine the moderation, as opposed to the direct, effect of miRNA on drug chemosensitivity. The results confirm that miRNA and gene expressions interact to produce an effect on drug response. The lack of correlation between miRNA and gene expression themselves suggests that miRNA transmits its effect through translation inhibition rather than mRNA degradation. The moderation models consistently achieve higher adjusted R^2 than the baseline gene and miRNA models. The results have the potential of using miRNAs not only as prognostic biomarkers for cancer treatment outcome but also as interventional agents to modulate desired chemosensitivity.

Summary Statement

This project developed a novel "moderation" model of drug chemosensitivity and investigated if microRNA expression moderates the relationship between gene expression and drug chemosensitivity, especially for HSP90 inhibitors on cell lines.

Help Received

My teacher supervised the project and my parents helped me on the background research.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Alec Mesropian

Project Number
S1799

Project Title
Cavity Charisma: The Future of Dental Fillings

Abstract

Objectives/Goals
To determine whether adding synthesized amounts of a calcium carbonate paste to a detoxified cavity will cause the organic filling and composure of a tooth without the need for an inorganic filling because of the properties of the paste. Secondly, to determine what solution causes the least damaging cavity and fills to the most durable standard possible after it was hypothesized as being the sugar solution.

Methods/Materials
First, nine molars were gathered from dental professionals and exposed to a sugar solution, carbonated drink solution, and white vinegar in order to create cavities over seven months. Once the teeth with cavities were removed from the liquids, they were disinfected, rated for cavity severity, filled with a calcium carbonate paste, assessed again, and then evaluated for durability using human saliva and chewing tests with mouth models. Dentists and oral surgeons were consulted in order to develop a standardized scale of one to five(one= terrible, five=exceptional). Three trials were done.

Results
The hypothesis was proven correct, the sugar solution created the smallest and least harmful cavity that was able to be filled well and remained strong against the durability tests in the experimental procedure because of its compact nature. It seems as though a natural filling is plausible, but can only work well with relatively small cavities, such as those created by the sugar solution. The fillings increased in severity, due to width and depth from the sugar solution to the white vinegar and to the carbonated drink solution. Also, the fillings were not able to compact itself well enough into the larger cavities and tended to ooze out during durability and rating tests.

Conclusions/Discussion
The conclusion of this experiment provides valid evidence that a more organic and harmless tooth filling can be used to complete the same job as most silver amalgam and white resin fillings at a fraction of the cost. For instance, most silver amalgam fillings range from $75 to $100, while white resin fillings range from $150 to $300. The fillings composed in this experiment did not exceed a price of $50. This project may be improved by experimenting with different teeth, solutions, and pastes with incorporated stem cells to rebuild tooth tissue and rehabilitate damaged teeth more extensively.

Summary Statement
This project is meant to determine whether naturally composed dental fillings made of a calcium carbonate paste are viable replacements for inorganic dental fillings currently used to fill cavities.

Help Received
Dr. Stella Baghdasarian and associate oral surgeon aided in developing a rating scale and in consulting.