CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Braeden C. Benedict

Project Number

S1201

Project Title

Development of an Electroencephalography (EEG) Device for Evaluation of Mild Traumatic Brain Injury

Abstract

Objectives/Goals

This project aimed to develop and test a low-cost device potentially capable of detecting sports-related concussions based upon brain wave data collected from a simple electroencephalography (EEG) headset.

Methods/Materials

The device was built by integrating a Mindflex game EEG headset with an Arduino microcontroller to process brain wave data. The microcontroller was programmed and housed inside an electronics box along with an LCD and a biofeedback LED array. Data for eight brain wave frequencies was collected and analyzed. Sixty-one healthy baseline subjects were tested while at rest and twenty-eight of those subjects were again tested after physical activity to study its effect on EEG readings. For each subject, brain wave activity was recorded both while the subject was in a state of attention and in a state of relaxation/meditation. Five subjects who received concussions were tested after injury and over subsequent days to track their recoveries.

Results

Experimental results showed that concussions significantly influenced brain wave activity. The brain wave patterns for concussed subjects while relaxing/meditating were significantly altered compared to when the same subjects did not have concussions. They were also significantly different than the majority of other non-concussed subjects. In addition, the amplitude of beta and alpha waves for each concussed subject appeared to be lowered as a result of the brain injury. As the subjects recovered, these wave amplitudes increased toward normal levels. An additional finding was that baseline subjects who had previously sustained a concussion months or years before the study also displayed lower beta wave amplitudes and altered brain wave patterns while relaxing/meditating when compared to baseline subjects who had never received a concussion.

Conclusions/Discussion

The results of this project were supportive of the original goal. This device may ultimately provide a simple, affordable, and rapid sideline concussion diagnosis. Research also suggested that concussions have long-term effects in children, even after original clinical symptoms have long subsided.

Summary Statement

This project developed and tested a low-cost EEG device capable of detecting concussions in athletes.

Help Received

My parents supported me and bought the necessary materials. My research advisor, Mr. Peter Starodub, advised me on the research process. Portions of Arduino code were adapted from published work by Eric Mika. Dr. Vernon Williams at the Sports Concussion Institute also encouraged my efforts.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Conner R. Bennett

Project Number
S1202

Project Title
Quantification of Zoo Enclosure Space Use and Nervous-Frightened Response by Endangered Chacoan peccary

Abstract

Objectives/Goals
This study seeks to measure enclosure space utilization by the San Francisco Zoo's four Chacoan peccary and statistically quantify the animals nervous-frightened response to the miniature steam-powered train horn sound.

Methods/Materials
The modified Spread Participation Index (SPI) (Plowman, 2003) was calculated to determine the animals use of the unequal enclosure space sections. Chi-square statistic analyzed the relationship between the train horn sound and the animals nervous-frightened response. The SPI is expected to indicate imbalanced enclosure utilization while the train horn sound and Chacoan peccary back hair standing-up is not independent.

Results
The SPI was 0.267112. An SPI of 0.0 shows an even distribution of space use and 1.0 indicates the animals staying in one quadrant. The chi-square statistic was 271.85; DF=1; 0.05 significance level; ($p < 0.01$) and supported rejecting the null hypothesis.

Conclusions/Discussion
The SPI indicates the animals do not use the enclosure space equally. With 2,172 observations, quadrant 2 had the lowest utilization, 7 percent. The animal's daily range area in the wild is nearly 180 times the size of its zoo habitat. The chi-square results show an association between the train horn sound and nervous-frightened behavior. The hair stood up 36 times and 32 times (89%) were in response to the train horn sound. Adding a small water pool to quadrant 2 may produce more even space use; building a Plexiglas sound wall where the train passes the enclosure could reduce the number of hair-up responses; and, further research is needed in these areas.

Summary Statement
Chacoan peccary zoo enclosure space utilization and, back hair-up response to the zoo's train horn sound were statistically quantified and recommendations were made.

Help Received
Dr. Julie Woodruff provided encouragement and general guidance via email. I have never met or spoken with Dr. Woodruff. My parents proofread my presentation, drove me to the zoo, and were the timers.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Gianna G. Chien

Project Number

S1203

Project Title

EMIT: Does iPad Use in Patients with Implantable Cardiac Rhythm Devices Cause Electromagnetic Interference?

Abstract

Objectives/Goals

The goal of this study is to determine if the iPad with embedded magnets can cause electromagnetic interference in patients with Implanted Cardiac Rhythm Devices (ICRDs), which include pacemakers, defibrillators, and loop recorders.

Methods/Materials

This study is approved by the Internal Review Board of Dignity Health. Human subjects with ICRDs were studied. The iPad 2 's effects were studied with its cellular data on and off, on the ICRD's original programming settings, and again on the most sensitive programming settings. Subjects held the iPad 2 at reading distance, then on their chests to mimic falling asleep while using the iPad. Variables collected included the device manufacturer, model, patient sex and Body Mass Index

Results

A total of 30 patients were studied including 25 subjects with defibrillators, four with pacemakers, and one with a loop recorder. The main finding of this study is that, in 7 out of 25 subjects with defibrillators (28%), magnet mode was triggered by the iPad 2. This indicates suspension of anti tachycardia therapy. No effect was seen in pacemakers or loop recorders. No over sensing due to cellular data was noted.

Conclusions/Discussion

The iPad 2 can trigger magnet mode in defibrillators and therefore suspension of anti tachycardia therapy. Other devices with embedded magnets are likely to cause similar interference. With the aging of the United States population, it has been projected that there will be an increase in ICRD placement. As new electronic products that utilize magnets are produced, a new public health issue arises and should be addressed. Manufacturers should consider that magnets can potentially stop ICRDs from performing the function for which they were designed. This can lead to failure to deliver lifesaving shocks or even death.

Summary Statement

My project investigates whether or not iPad use is safe in patients with Intra Cardiac Rhythm Devices (ICRDs).

Help Received

Used father's office. He provided the materials. Representative from device companies worked with the programmer. Advisor, Teri Kozik, advised in data analysis. Mother helped with board.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Kevin Huang

Project Number

S1204

Project Title

The Effect of Cancer Stem Cells and the Tumor Microenvironment on Tumor Growth and Invasion

Abstract

Objectives/Goals

The purpose of this experiment is to investigate how cancer stem cells and the tumor microenvironment can affect tumor growth and alter the effectiveness of different therapies.

Methods/Materials

I created a mathematical model incorporating a two-species cell lineage model (with cancer stem cells and terminally differentiated cells) into the Cellular Potts Model. Properties like motility, adhesion energies, growth, and the cell cycle are accounted for in each cell. Feedback mechanisms act upon cancer stem cells, influencing self-renewal and differentiation probabilities. The simulation was coded in XML and Python and run with CompuCell3D.

Results

The model was very accurate, with simulated tumors closely resembling in vitro tumor spheroids. When the cell cycle length of cancer stem cells was made longer, tumor growth slowed down drastically, and the tumor did not grow to be very large. When the responsiveness of cancer stem cells to positive feedback was lowered, no discernible change in tumor growth was recorded. However, when the responsiveness of cancer stem cells to negative feedback was decreased, tumor growth increased dramatically. Increasing the concentration of negative feedback in the tumor did not alter tumor growth.

Conclusions/Discussion

The results present an opportunity for quiescence therapy - inducing extended quiescence, or longer G0 phases, in cancer stem cells could rapidly halt tumor growth.

Some have suggested using positive feedback inhibitors to control tumor growth. This was modeled by decreasing the responsiveness of cancer stem cells to positive feedback, but its effects were negligible.

The importance of negative feedback in preventing uncontrolled cell proliferation was also demonstrated. However, when differentiation therapy was applied by increasing the concentration of negative feedback, tumor growth was almost completely unaltered. This suggests that differentiation therapy must be used in combination with other therapies to successfully eradicate the tumor.

The cancer stem cell hypothesis explains why cancer has been such a difficult disease to cure. Clearly there will be no #silver bullet# in the war against cancer, but mathematical models can help to elucidate more of cancer#s weaknesses.

Summary Statement

I incorporated a two-species cell lineage model into the Cellular Potts Model to study tumor evolution and the effects of different therapies on tumor growth.

Help Received

I would like to thank Dr. John S. Lowengrub for mentoring my project and allowing me the opportunity to work with him. The time he spent to answer my questions and give me advice was invaluable.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Tina Huang

Project Number

S1205

Project Title

Creation of 3D Printed Microstructures to Investigate Cancer Cell Migration

Abstract

Objectives/Goals

One of the most difficult questions of cancer biology is how cancer spreads.Understanding the physical behavior and nature of cancer cells helps answer that question.A cost and time efficient, biomimetic drug screening platform does not exist, therefore hampering the process of drug screening for medicine.My goal was to create a 3D biomimetic microstructure that could be an alternative to the costly, inefficient, and inaccurate models currently used in in vitro cell study, replacement of animal models in testing, and tissue engineering.

Leveraging the latest microscale 3D printing technology to mimic the structure of blood vessels in the human body, I created a novel 3D biomimetic drug-screening platform and used it to test, monitor, and analyze cancer and normal cell behavior.

Methods/Materials

I first designed a honeycomb design that imitated the structure of human blood vessels and used Matlab software to convert it into .dat files. I needed to optimize material as well as procedure, so creating the structures themselves then required extensive synthesis and testing of various PEGDA (polymer) percentages with varying percentages of photosensitive initiator and UV light absorber.

I then seeded normal (10T½) and cancerous (Hela) cells onto honeycomb-structured structures of differing widths (4, 8, 16, and 32-pixels wide) to simulate different sizes of blood vessels. For a period of five hours, images were taken every five minutes of each microstructure. Images were then processed and analyzed using Fiji, a scientific image analysis software.

Results

My research showed that the fastest cancerous (Hela) cells were the largest cells, as well as the cells grown in the narrowest channels. The slowest cancerous cells were also the smallest cells#grown from the widest channels.

Conclusions/Discussion

These results demonstrate the feasibility of the cancer-drug screening platform I created. This in vitro platform for cancer drug screening is versatile and cost-efficient: one structure can be created within seconds. In addition to being a cost and time efficient, structurally accurate drug-screening platform to test cancer drugs, this model provides great value to researchers in understanding cancer biology, migration, and metastasis. It can potentially replace animal models in early-stage drug testing, act as a

Summary Statement

I designed and created novel 3D printed biomimetic microstructures and used them to test, monitor, and analyze cancer cell migration.

Help Received

Used lab equipment at UCSD under supervision of Dr. Paul Qu

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Kevin Liu

Project Number

S1206

Project Title

Rescue of Mice Receiving Lethal Irradiation by Stem Cell Transplantation: A Potential Cure for Leukemia

Abstract

Objectives/Goals

1. To test the hypothesis that a newly isolated stem cell line has the potential to differentiate into hematopoietic stem cells by using this line of stem cell to rescue lethally irradiated mice with stem cell transplantation.
2. To confirm the viability and regeneration of the transplanted stem cells in recipient animal.

Methods/Materials

1. Recipient GFP(-) mice, will be irradiated with a lethal dose of radiation to destroy their residential bone marrow cells. Stem cells will be prepared from GFP(+) mice and injected intravenously into the recipient mice immediately after irradiation. Survival and erythrocytes regeneration will be observed and compared between the group of stem cell treated and un-treated mice.
2. DNA samples will be extracted from peripheral blood withdrawn from stem cell treated mice and will be used as templates for PCR detection of the donor cell specific GFP gene. DNA samples extracted from un-treated mice will be used as negative control.
3. PCR conditions will be optimized in order to improve the sensitivity and specificity for detection of the donor cell specific GFP gene. The following parameters will be tested: descending amount of template DNA, ascending number of PCR cycle and ascending annealing temperature.

Results

1. The survival for lethally irradiated mice with stem cell transplantation was significantly improved.
2. Sensitivity and specificity for detection of donor cell specific GFP gene in recipient mice was significantly improved by higher annealing temperature and higher number of PCR cycles with least amount of template DNA.

Conclusions/Discussion

1. Survival is significantly improved and erythrocyte function is restored in the stem cell treated mice whose bone marrow cells have had been destroyed by lethal irradiation. This result implies that this type of stem cells may have the potential to substitute bone marrow cells in curing leukemia.
2. Viability and regeneration of the transplanted stem cell in the recipient mice is confirmed by PCR using template DNA extracted from the blood of recipient mice.
3. Sensitivity and specificity for detection of donor stem cells specific GFP gene in recipient mice is significantly improved by higher annealing temperature and higher number of PCR cycles with least amount of template DNA. It is determined that annealing at 64 0C with reaction cycles set at 36, yields the best results in terms of specificity and sensitivity.

Summary Statement

Stem cells have potential to be used in leukemia treatment

Help Received

Used lab equipment at Stanford University under the supervision of Dr. Ke-Jung Huang

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Vick C. Liu

Project Number

S1207

Project Title

A Completely Home-Made Microfabricated Device for Blood Cell Sorting and Morphology Analysis

Abstract

Objectives/Goals

The goals are: 1) to develop a cookie-baking like method to fabricate micro-devices (with feature size of 10 µm) at home; 2) design, fabricate, and test a homemade micro-device for blood cell sorting and morphology analysis.

Methods/Materials

The micro-device was completely fabricated using household appliances (such as a handheld UV lamp, oven). A simple soft lithography process was developed at home. The channel device (50 µm deep) that contains 10~30 µm pore structures to fractionate various blood cells based on size difference was designed using AutoCAD software and the channel pattern was then printed on a transparency. The pattern was converted from the transparency to a photoresistor (SU-8) using a UV lamp. After development, a SU-8 mold was obtained to replicate PDMS (silicone) microchannels using a baking oven.

The devices were tested in a hematology lab with human blood samples. The blood was treated with New Methylene Blue before loading into the device. A microscope was used to obtain cell images.

Results

The microchannel devices with 10-30 µm pore size microstructures were successfully fabricated at home using a cookie-making method. The test with human blood samples showed that the device successfully separated RBCs, WBCs, and plasma into different compartments. It allowed me to see morphology of various blood cells including sickle cells, lymphocytes, neutrophils, eosinophil, etc, some of which are clear indications of a sick person's health status.

Conclusions/Discussion

Making a micro-device with feature size as small as 10 µm (1/10 of a typical human hair diameter) at home sounds impossible because microfabrication typically requires very expensive and sophisticated industrial equipment. I developed a simple and low cost technique to make this micro-device at home using household appliance. This method allows one to replicate hundreds of micro-devices at a cost of 50 cents each. As a demonstration, I successfully made microchannel devices with filter structures of 10~30 µm for blood cell morphology analysis. The device presents a more practical way of blood cell analysis compared to using blood smears. In addition, the device is reusable, cheap to build, and easy to make.

Summary Statement

My project is about the development of a novel microfabrication method to make home-made microdevices for blood cell sorting and morphology analysis.

Help Received

Used lab equpment for test at Iris Diagnostics under the supervision of Dr. Liu.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Anna Lundmark; Valerie Lytle

Project Number

S1208

Project Title

A Quantitative Analysis of the Effects of Controlled Exercises on Insulin-Dependent Diabetes Mellitus

Abstract

Objectives/Goals

Type 1Diabetes, or diabetes mellitus, is a genetic disease where the body#s immune system destroys the insulin-producing cells of the pancreas, or beta cells. In a person with type 1 diabetes, there is a complete deficiency of the insulin hormone. In order to deal with this defect, patients must give themselves doses of insulin in order to manage their blood sugar. Therefore, since one of us has type 1 diabetes and is constantly exercising, we wanted to find a quantitative relationship between the amount of exercise expended as measured by its duration and carbohydrate intake with the blood glucose levels in teens with type 1 diabetes.

Methods/Materials

For this study, we found three teenagers who are diagnosed with type 1 diabetes who were willing to participate in the study. Then, we tracked their blood glucose levels in 30-minute intervals before and after aerobic exercise. The carbohydrate and insulin intake was kept constant. (An apple was used as the carbohydrate to be taken before the exercise.) In addition, the basal rate or lantus dosage, insulin given over a 24-hour period, was also kept the same. This process was conducted three separate times for each participant. Then, the results were analyzed and compared to one another.

Results

The results of this study showed that on average, the blood glucose level of teens with type 1 diabetes significantly decreased after 30 minutes of exercise. For instance, the blood glucose level dropped by about 20 mg/dl. This means that the exercise did some of the work that insulin would normally have to do for the body. In other words, the exercise was able to break down some of the glucose in the body, and lower the level of sugar in the blood of these diabetic teens.

Conclusions/Discussion

Therefore, these data show that our hypothesis that exercise will decrease the amount of sugar in the blood by 5 mg/dl in type 1 diabetic teenagers is almost correct. Instead of decreasing by 5 mg/dl, the blood glucose levels decreased by about 20 mg/dl. With this knowledge, teens with type 1 diabetes can consider exercising to help regulate their sugar levels if they are too high. Also, this means that if a type 1 diabetic teen were to have a low blood glucose level, they should exercise with caution. In conclusion, exercise does in fact have the capacity to aid the insulin in breaking down the sugar in the blood of teens with type 1 diabetes.

Summary Statement

This experiment studies whether or not the blood glucose levels in teens with type 1 diabetes will decrease after exercise if the carbohydrate and insulin intake are kept constant.

Help Received

This project was conducted under the guidance of Ms. Adriatico.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Andrew Q. Ninh

Project Number

S1209

Project Title

Two Discrete Stochastic Cellular Automata Models of Cancer Stem Cell Proliferation

Abstract

Objectives/Goals

The objective was to try to create a general model (using set parameters) of cancer stem cell (CSC) induced tumor growth by combining discrete mathematical models, automata theory, and principles of cellular automaton to create a Java program. This program would in turn produce both custom mathematical models as well as growth visualizations.

Methods/Materials

The mass-action and spatial discrete mathematical models and CSC automata theory were turned into a Java program (on the BlueJ IDE) which models CSC growth, which was graphed on Mathematica. Visual depictions of the automata arrays of the mass-action and spatial Turing machines were created using Mathematica's ArrayPlot function.

Results

After results were averaged from thousands of trials using the law of large numbers, the differentiated cancer cell populations followed the standard Gompertzian growth curve with the mass-action model reaching a lower carrying capacity at a faster rate while the spatial model reached a higher carrying capacity at a slower rate; the cancer progenitor cells exhibited a gradual Gompertzian growth curve; and the CSCs remained at a lifelike percentage of total cells and exhibited a von Bertalanffy growth curve.

Conclusions/Discussion

Cellular automaton, discrete mathematical models, theoretical computer science, and programming was used in creating mathematical models as well as automaton visualization of the progression of solid CSC-induced tumor growth over time. Automata-based modeling of tumors is useful in that automaton "rules" may be potentially substituted by boolean structures of genes, thus bridging bioinformatics and individualized tumor modeling.

Summary Statement

Cancer stem cell (CSC) induced tumor growth is modeled using theoretical computer science and the tumor growth is visualized using cellular automata, potentially helping with creating individualized models of csc-induced tumors.

Help Received

Professor Komarova of UC Irvine introduced me to the mass-action and spatial models (which I used in a different project) that I applied in my research.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Swetha Revanur

Project Number

S1210

Project Title

Multi-Dimensional Genomic Data Analysis of Hidradenitis Suppurativa (Acne Inversa) and Associated Comorbidities

Abstract

Objectives/Goals

Hidradenitis Suppurativa (HS) is a debilitating chronic skin disease marked by large, painful cysts. There is very little research being conducted on HS (1% prevalence yet no treatment/cure exists). I performed a novel multi-dimensional genomic data analysis of HS and its comorbidities (Crohns Disease, Down Syndrome, Rheumatoid Arthritis (RA), Squamous Cell Carcinoma (SCC), and Hypothyroidism) as they are better understood than HS itself. I analyzed gene, pathway, and microRNA relationships between the diseases to shed light on HS.

Methods/Materials

I compiled a collection of data sources for every dimension. After I acquired a pre-curated data set from every database, I performed data cleansing. I utilized Microsoft Excel functions to remove duplicates, extra lines, and standardize the format. I analyzed these curated sets for each disease and dimension.

Results

Genes IL6, IL10, and TNF seem to play an active role in all comorbidities. Alzheimers Disease pathway plays a major role in some comorbidities. These diseases seem to have a strong genomic correlation. There are few common pathways with HS marker genes between HS and Down/Hypothyroidism. Certain miRNAs directly influence HS marker genes and several diseases.

Conclusions/Discussion

HS has a strong correlation with SCC and RA, a moderate correlation with Crohns and a relatively weak link with Down and Hypothyroidism. hsa-miR-214, hsa-miR-31, and hsa-miR-7 can be identified as biomarkers of HS since they influence HS marker genes. My study also provides a rationale for why HS is seen more often in women by utilizing links with estrogen regulation.

Summary Statement

A novel multi-dimensional (microRNA, gene, pathway) analysis of Hidradenitis Suppurativa and its commorbidities

Help Received

Parents helped with project board. Advisor provided support and encouragement.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Jamilex Rodriguez

Project Number
S1211

Project Title
Breath Capacity in Singers

Abstract

Objectives/Goals
The lung capacities of singers and non-singers, were compared in liters, by using a wet spirometer. The participants were asked their age, gender, years of singing experience, genre of music, lung disease and height. The results were averaged and demonstrated a difference of one-third of one liter in the lung capacities of the singers and non-singers. The singers capacities being 0.3 liters greater than the non-singers. This minimal difference indicates that other factors, other than singing, determine the lung capacities of singers.

Methods/Materials
The experiment required the use of a wet spirometer, the tips of balloons as a mouth piece, gloves, three gallons of water, and a note book to record the data. The Cal Poly Pomona choir, Cal Poly's ensemble singers and the Los Angeles Children's Choir from Pasadena were the people used in the sample. A wet spirometer requires three gallons of water to function. After the survey, each participant breathed and then exhaled into the spirometer. This device measured the maximum amount of air a person can expel from their lungs, also known as, vital capacity.

Results
There is 0.28 liter difference in the average of the lung capacities of the singers and the non singers. The singers with the highest lung capacities were the tallest participants. Therefore, the height of the person determined their lung capacity, because the chest cavities of the tall participants had more capacity, then the cavity of the short person.

Conclusions/Discussion
The experiment disproved the hypothesis. The age, gender, and average vital lung capacity of the singers and non-singers were compared. It was found that singers do actually have a greater lung capacity from non singers.

Summary Statement
If a singer uses his or her diaphragm properly, then the volume of his or her lungs will be no different from a non singer.

Help Received
California State Polytechnic University, Los Angeles Children's Chorus, and I-Poly High School (Participants)

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Onkar S. Sandhu

Project Number

S1212

Project Title

iPhone Acquired Heart Rhythm: Is It Reliable for Clinical Diagnosis?

Abstract

Objectives/Goals

To validate an iPhone acquired heart rhythm could be reliable for clinical diagnosis of cardiac arrhythmias.

Methods/Materials

Materials: General Electric 12-Lead Electrocardiogram, Electrodes for Electrocardiogram, Electrocardiogram gel, AliveCor Heart Monitor iPhone case, AliveCor iPhone Application.
Methods: 105 consecutive patients in a mixed unselected cardiac out-patient population first underwent a conventional 12-Lead ECG. Within minutes, each patient underwent a Lead 1 ECG rhythm recording using iPhone based AliveCor Application. IPhone ECG rhythm strips were uploaded to the HIPPA secure AliveCor Server for subsequent interpretation by two experienced ca#rdiologists blinded to the rhythm diagnosis of the 12-lead EKG.

Results

A total of 105 patients were studied. Of these, 92 had normal sinus rhythm, 9 had atrial fibrillation, 2 had a junctional rhythm, and 2 had a paced rhythm by a 12 lead electrocardiograph. An 83.8 percent correlation, 14.3 percent indeterminate, and a 1.9 percent different diagnosis rate from the AliveCor heart monitor compared to the 12 lead EKG was obtained. For sinus rhythm, an 88 percent correlation, an 11 percent indeterminate rate, and a 1 percent different diagnosis rate for AliveCor recordings was recorded. For atrial fibrillation, 67 percent accordance, a 22 percent indeterminate, and an 11 percent different diagnosis rate was from AliveCor recordings were noted.

Conclusions/Discussion

The 83.8 percent correlation supports the hypothesis that the AliveCor Heart Monitor can be used for clinical diagnosis. Furthermore, the AliveCor Heart Monitor could be used for community screenings worldwide. Our findings suggest the AliveCor Application can be used to recognize previously undiagnosed atrial fibrillation, allowing early initiation of anticoagulant to prevent stroke. The 16.2 percent of all cases that had either an indeterminate or inaccurate diagnosis from the AliveCor heart monitor compared to the 12 lead EKG indicates a substantial portion of patients with technical errors, preventing any interpretation of the AliveCor electrocardiograph. We find that the most common cause of indeterminate rhythm by AliveCor is the presence of baseline artifacts. These artifacts are produced buy a combination of movement, muscle tremor, and poor contact. We found use of alcohol swabs and electrode gel on patient hands and AliveCor sensors limit baseline artifacts.

Summary Statement

Determining whether an iPhone acquired heart rhythm is reliable for clinical diagnosis.

Help Received

105 patients were gathered, tested, and diagnosed using lab equipment at California Heart Medical Associates under the supervision of Dr.Sanjay Srivatsa and Dr.Bipin Joshi.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Divya Siddarth

Project Number
S1213

Project Title
Weighty Matters: Risk Factors for Obesity in Children and Adults

Abstract

Objectives/Goals
This project will determine the risk factors for obesity in children and adults. The risk factors I will examine are lifestyle factors such as eating habits, physical activity levels, and screen (TV/computer) viewing time, as well as ethnicity, gender, and family income level. In addition, I will investigate if the predictors of obesity differ across age groups. I will also examine, in the obese group, which of these factors predict medical problems such as diabetes and hypertension.

Methods/Materials
Data were obtained from the National Health and Nutrition Examination Survey 2009-2010, completed by 7431 participants. I used multivariable logistic regression models to determine which lifestyle factors were associated with obesity. I also performed stratified analyses within different age groups (children, adolescents, young adults, middle-aged adults, older adults and seniors). Frequency tables and chi-square tests were used to determine the association of obesity with medical problems such as diabetes and hypertension, and logistic regressions were used to determine which risk factors predicted these medical problems within the obese group.

Results
For children, screen viewing time was the most significant risk factor of obesity, while for adolescents, eating fast food was the most significant predictor. For the other age groups, activity levels - both lack of vigorous or moderate physical activity and engaging in sedentary activities - were significantly associated with obesity. Within the obese group, sedentary activity levels were a significant risk factor for both diabetes and hypertension.

Conclusions/Discussion
This is one of the first studies to examine the relationship of obesity to lifestyle factors, in addition to gender, ethnicity, and income levels, using a nationally representative sample. The major finding that obesity is independently associated with different lifestyle factors in different age groups can be used to develop evidence-based public health care policy and programs that target obese children, adolescents, young, middle-aged and older adults. These findings also reinforce the importance of educating children and adolescents, as well as adults, to take greater responsibility in preserving their health and mitigating future problems by practicing positive lifestyle behaviors.

Summary Statement
This study identified the most significant modifiable risk factors of obesity for different age groups, and demonstrated that a 'one size fits all' approach cannot be used when addressing the obesity epidemic.

Help Received
N/A

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Vanessa Sierra

Project Number
S1214

Project Title
Got Balance?

Abstract

Objectives/Goals
This experiment was performed to discover whether a T- Band improves an individual's balance when it is worn on the wrist like stated in their advertisement.

Methods/Materials
I tested the balance of people standing on one leg using a force plate. Each person did three trials. The first trial is without any bands; this is the control. Next, I have them put on a rubber band as a second control. For the final trail, they put on the T- Band. All my data is collected by using a Lab Quest2, allowing me to visually see the results on graphs.

Results
The result of my experiment is that any improvement by the T- Bands is due to chance.

Conclusions/Discussion
T- Bands do have a greater effect on one's balance than a rubber band, yet after analyzing the results with a Chi- square, it is not statically significant proven to work. The claim it has of encountering electromagnetic waves with negative ions to improve balance is not matched with the results of the experiment I performed.

Summary Statement
My project's purpose is to find out whether a T- Band improves an individual's balance while wearing it on the wrist.

Help Received
Teacher Riccardo Magni helped me get a hold of materials used and provided supervision.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Anna T. Thomas

Project Number

S1215

Project Title

Evaluating the Prevalence of Noncoding Repeat Expansions in Amyotrophic Lateral Sclerosis

Abstract

Objectives/Goals

Though no treatments for amyotrophic lateral sclerosis (ALS) currently exist, evidence suggests that the disease is strongly rooted in genetic origins. Recently, expansions of CAG (glutamine coding) repeats in several genes, including NIPA1, ataxin 2, and c9orf72, have been linked to ALS incidence, raising the possibility of a broad role for repeat expansions in ALS susceptibility. Repeat expansions in c9orf72, the most common abnormality linked to ALS as of yet, are in a noncoding region of the gene. The likely mechanism of action of these noncoding repeat expansions occurs via accumulation of toxic RNA foci, resulting in sequestration of various RNA binding proteins and general disruption of the transcriptome. I chose to investigate six candidate genes previously linked to neuromuscular disorders - NOP56, JPH3, DMPK, ATXN8, PPP2R2B, and ATXN10 - for a possible link between noncoding repeat expansions in the genes and ALS susceptibility.

Methods/Materials

Polymerase chain reaction, gel electrophoresis, and capillary electrophoresis were used to amplify and determine the repeat lengths of the genes of interest in 730 ALS patients and 700 control patients. In addition, this study presents an automated technique, developed in Java, of inferring allelic repeat number from fragment analysis data. This method has been successfully applied to analyze more than 4,000 individual data points for genotyping and can also be utilized for other applications of electropherograms, which are used widely in molecular biology.

Results

Receiver operating characteristic analysis and Fisher#s exact test revealed a significant association between ataxin 8 repeat length and ALS. Ongoing and future work includes investigating other genes for associations with ALS, refining and expanding the automated electropherogram analysis, as well as utilizing TALENs to induce these repeat expansion mutations in cell culture models in order to test the RNA foci hypothesis.

Conclusions/Discussion

This study has both identified a novel gene candidate associated with amyotrophic lateral sclerosis incidence and introduced a new technique of automating fragment analysis based genotyping. These findings can prove instructive in characterizing the genetic interactions which lead to ALS, paving the way for potential diagnostic methods such as genetic screening to identify ALS as early as possible.

Summary Statement

This study has both identified a novel gene candidate associated with amyotrophic lateral sclerosis incidence and introduced a new technique of automating fragment analysis based genotyping.

Help Received

Research performed during internship at the Gitler Lab at Stanford University

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Catherine D. Wright

Project Number
S1216

Project Title
Am I Right? An Investigation of the Link between Handedness and Sidedness

Abstract

Objectives/Goals
Many facilities are designed for right-handed people. Does this affect which side of the body people use for everyday activities other than writing, or does the writing hand determine sidedness? This project predicts that if subjects are right-handed, then they will use the right side of their body to perform other tasks; if subjects are left-handed, then they will use the left side of their body.

Methods/Materials
56 subjects were tested (28 right-handed, 28 left-handed) on 4 categories of sidedness: handedness, footedness, eyedness, and earedness. Handedness was tested by instructing the subject to pick up a cup, use a pair of scissors, knock on a door, & toss a ball. The hand used was observed/recorded. Footedness was tested by instructing the subject to step over a rope, step on a coin, & kick a ball. The foot used was observed/recorded. Eyedness was tested by instructing the subject to look through a tube & look into a hole. The eye used was observed/recorded. Earedness was tested by instructing the subject to listen through a wall & listen to an object. The ear used was observed and recorded.

Results
Of the 28 left-handed subjects, 57% were predominantly left-sided in all 4 categories, 22% used their left and right sides equally, & 21% were predominantly right-sided. Of the 28 right-handed subjects, 93% were predominantly right-sided in all 4 categories, 7% used their left and right sides equally, & 0% were predominantly left-sided. Of the 56 subjects, 75% predominantly used the side of their body used for writing to perform other tasks, 14% used both sides equally regardless of handedness, & 11% predominantly used the side of their body not used for writing to perform other tasks.

Conclusions/Discussion
The data did support the hypothesis. Results showed that 75% of the subjects used the side of their body that they write with to perform other tasks in all 4 categories. This was more evident in right-handed subjects (93%) than with left-handed subjects (57%). This experiment could be conducted differently by testing a broader range of subjects on a broader range of tasks that revealed a subject's sidedness. Gender or age groups could also be tested to identify gender or age related factors. The information gathered from this experiment could be helpful in understanding how left and right-handed people use products/facilities, which could be used to improve future designs.

Summary Statement
This project tests the correlation between left/right handedness and left/right sidedness.

Help Received
Mother and father helped construct display board.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Anin Sayana

Project Number

S1295

Project Title

A Novel Strategy to Inhibit Metastasis of Alveolar Rhabdomyosarcoma through the PAX3-FOXO1 Fusion Gene, HSP70, and PERK

Abstract

Objectives/Goals

Rhabdomyosarcoma (RMS) is the most common soft tissue sarcoma, and 5-year survival rates for children have remained at 20% despite efforts to uncover chemotherapeutic agents. Two variants of this disease are alveolar and embryonal RMS (aRMS and eRMS), the former associated with an aggressive malignant phenotype. Previous research has identified the PAX3-FOXO1 fusion gene in aRMS but not eRMS, which is responsible for increased cell proliferation. This research aims to inhibit the development of aRMS by exploiting PAX3-FOXO1 and cooperating pathways including HSP70 and PERK.

Methods/Materials

To target PAX3-FOXO1, shRNA sequences were determined through modeling and research input. Following the infection of aRMS cells with shRNA, PAX3-FOXO1 and downstream target protein expression were determined through western blotting. Viability assays of shRNA-infected aRMS cells were also conducted. To analyze the effects of the inhibition of the protein chaperone HSP70, a cell viability assay was conducted on aRMS and eRMS after treatment with HSP70 inhibitor MAL3-101. Finally, changes in the expression of PERK and downstream proteins after treatment with MAL3-101 were tested with a western blot, and qPCR determined the expression of the CHOP over a 12 hour MAL3-101 timecourse, the apoptotic protein downstream of PERK.

Results

PAX3-FOXO1 expression, as well as targets ALK, FGFR4, Met, and IGF1R, decreased after the application of PFhp-210 (PAX3-FOXO1 hairpin 210), but not the individual FOXO1 and PAX3 proteins. Viability assays of PFhp-infected aRMS cells demonstrate significantly decreased but continued survival rates. MAL3-101, a HSP70 inhibitor, decreases cell viability in four aRMS cell lines, but not the eRMS line. Finally, for eRMS, CHOP transcript levels did not increase over the 12 hour timecourse of MAL3-101 treatment. However, CHOP in aRMS line grew to 34.9, 28.2, and 9 times the original level after 4, 8, and 12 hours, respectively.

Conclusions/Discussion

This research elucidates the pathways responsible for aRMS survival and development. The PAX3-FOXO1 protein may act through PERK by activating a phenomenon with IGFR1 known as the unfolded protein response, which causes stress in the endoplasmic reticulum and stimulates PERK. HSP70, a chaperone protein, may be involved in the unfolded protein response through PERK since chaperones aid in the folding of proteins.

Summary Statement

My research identifies novel cellular pathways in alveolar rhabdomyosarcoma, which eventually may lead to new therapeutic solutions for this cancer.

Help Received

Dr. Amit Sabnis, pediatric oncologist from UC San Francisco for his guidance, supervision and mentorship; Dr. Trever Bivona from UC San Francisco, Mr. Rod Wong from Bellarmine College Prep, and my parents for their support.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Sierra Manning; Mattie Peters

Project Number
S1296

Project Title
Intelligence of Purebred vs. Mixed Breed Canines

Abstract

Objectives/Goals
To test the intelligence of the different kinds of canines: purebreds and mixed breeds.

Methods/Materials
There were four tests performed on the dogs. 1.)For the first test, we placed a treat under a coffee can in front of the dog. The dog got an A on the test if it managed to retrive the treat, a B if the dog showed interest in the can initially, but gave up, and a C if the dog ignored the can. 2.)For the second test, we dropped a treat on a table above the dog's line of sight. The dog got an A on the test if it continued to look at the table where the treat dropped. The dog got a B if it looked at the ground, and then looked back at the table. The dog got a C if it looked at the ground. For the third test, we placed two chairs on the ground in front of the dog, leaving a small space in between them. We then dropped a treat on the other side of the chairs so that the dog was able to see it. If the dog immediatley ran around the chairs to get the treat, it got an A. If the dog hesitated, but then ran around the chairs to get the treat, it got a B. If the dog tried to get through the small space between the chairs or didnt know to go around the chairs, it got a C. 4.) For the fourth test, we tested how many spoken commands the dog knew. If the dog knew more than 25 commands, it got an A. The dog recieved a B if it knew 10-25 commands. If the dog knew less than 10 commands, it recieved a C. Materials: Dogs, dog treats, large can, low table or tray, large cushion or towel, and a couple of chairs.

Results
Overall, mixed breed dogs are smarter than purebred dogs. Mixed dogs scored 463 and purebred dogs scored 417.

Conclusions/Discussion
In our experiment, we wanted to determine if purebred dogs or mixed breed dogs are smarter. We tested twenty-six dogs of all different breeds: thirteen purebreds and thirteen mixed breeds. We performed four intelligence tests on each dog. The first test involves placing a treat underneath a can and observing whether or not the dog knew the treat was still there and if it was able to retrieve the treat. This test was designed to determine if the dog understood that an object continues to exist, even though it is not able to be seen. In the second test we dropped a treat on a table that was above the dogs# eye level. We placed a towel on the table so that the treat did not make a sound as it was dropped.

Summary Statement
Testing the intelligence of the different kinds of dogs to determine if purebreeds of mixed breeds are more intelligent.

Help Received
Mother helped with research.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Carly J. Murray

Project Number
S1297

Project Title
Does Man's Best Friend Have a Paw Preference?

Abstract

Objectives/Goals
My objective was to discover if canines have paw dominance or are ambidextrous.

Methods/Materials
I used a sample of 10 dogs, enough treats for each dog a total of 15 times, a leash, and adhesive tape. I performed a total of 3 tests. Each was performed five times on each dog. First was a lead (the foot that takes the longer stride when the animal is cantering) test. The second test was which foot the dog stepped out with first from a standstill. The third and final test required a small piece of adhesive tape to be placed on the top of the dog's nose; which ever foot the dog used the most to attempt to remove the tape was recorded.

Results
My results were that the majority of the dogs preferred their left paw over their right.

Conclusions/Discussion
In conclusion, dogs do have a paw preference. Most dogs prefer their left paw over the right.

Summary Statement
My project is questioning if dogs are like humans and have a preference in which paw they use the most.

Help Received
I had no help.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Sean G. Laput

Project Number

S1298

Project Title

The Effect of Sodium Intake on the Urinary Calcium Excretion in Mice Using Colorimetric Assay and HPLC

Abstract

Objectives/Goals

The objective was to investigate the correlation between sodium intake and urinary calcium excretion in mice using and comparing two different methods: colorimetric assay and HPLC.

Methods/Materials

Six mice were used, three as the control and three as the experimental group. In a period of ten days, both groups were given 0.35% w/w sodium diet (standard) during the first five days. For the last five days, the control was maintained with the standard diet while the experimental was given 7.4% w/w high sodium diet. Calibration curves for calcium quantification were obtained via colorimetric assay and HPLC. Urine was collected every 24 hours and was measured for calcium content using a Calcium Colorimetric Assay Kit (BioVision Inc.).

Results

Two out of three mice in both groups exhibited consistent results. Two of the control mice displayed a steady decrease in urinary calcium concentration (UCa) over the ten days. In contrast, two of the experimental mice showed a significant increase in UCa after the switch to the high sodium diet.

Conclusions/Discussion

The results obtained from the experimental group support my hypothesis on the positive correlation between an increased sodium intake causing increased calcium excretion via urine. Based on the results from the control group, it is speculated that a low, standard sodium concentration allows better renal and intestinal (re)adsorption of calcium ions in the mice over time, which would explain the decreasing UCa in their urine. This data suggests an explanation on studies investigating patients with hypertension due to a high sodium diet and their susceptibility to osteoporosis.

Summary Statement

I am studying the effect of a high sodium diet on the urinary calcium excretion in mice over a period of ten days using a colorimetric assay kit and HPLC.

Help Received

Father provided transportation; Mother helped maintain mice; Dr. Malhotra provided general support and guidance; Dr. Cauchon assisted in HPLC operation and analysis; Dr. Tannaci provided necessary chemicals; Used lab equipment at Amgen under supervision of Dr. Mytych..

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Anjali Lobana

Project Number
S1299

Project Title
Vitamin D Deficiency and Obesity

Abstract

Objectives/Goals
In recent studies, scientists have inferred to an inverse correlation between Vitamin D Deficiency and Obesity. The goal of this project is to recreate and reaffirm this hypothesis and understand which factors contribute to the relationship.

Methods/Materials
In order to test the hypothesis, data was collected from a group of 46 people. The data collected included gender, age, weight, height, Vitamin D level (from blood test), Vitamin D supplement usage, daily milk consumption, and daily sun exposure. Obesity was based on the Body Mass Index(BMI) scale. Subjects were categorized into three groups: normal, overweight, and obese based on BMI. After collecting the data, a point system was created to take into account intervention factors such as Vitamin D supplement intake, milk consumption, and sun exposure to help arrive at a more complete picture of the phenomenon.

Results
After reviewing the factors of the different groups it was determined that the Vitamin D levels did not vary significantly among the three groups. Though, it was noticed that the mean Vitamin D level in the obese group is lower by 17% than the normal; and the variability in obese group is lower as well. Their mean and standard deviations were: 28.9 ± 15.2 for normal, 29.9 ± 14.3 for overweight, and 23.9 ± 5.8 for obese. Additionally, when the intervention such as Vitamin D supplement, milk consumption, and sun exposure were taken into consideration, it was noticed that although subjects from the obese category had some of the most intervention, they were unable to get their Vitamin D levels as high as those in the normal group.

Conclusions/Discussion
It was apparent that there was an inverse correlation between Vitamin D levels and BMI. Additionally, there is a direct relationship between Vitamin D levels and number of supplement takers in each group. Moreover, a direct relationship is also seen for the number of minutes spent in the sun per day. There was a weaker direct relationship between cups of milk per day and vitamin D levels, and a non-conclusive relationship between age, gender and their vitamin D levels. It is also concluded that data on more subjects are needed to better understand the factors and their relationships.

Summary Statement
In this study I saw several factors that contribute to a correlation between Obesity and Vitamin D deficiency.

Help Received
Cousin helped me use Microsoft Excel.