cells were stimulated using LPS or PMA/Ionomycin, and then an ELISA test was run to find the presence of the cytokines in each sample. Separate two-way ANOVAs were run for the IFNγ and the TNFα samples which reported statistical evidence that supported the hypothesis at $F (11, 48) = 44.66, p < 0.001$ and at $F (11, 48) = 5.66, p < 0.001$, respectively, rejecting the null hypothesis. Post-hoc Tukey Tests found statistical significance between all samples except for the presence of TNFα in the 0 nM concentration of cadmium chloride under the LPS stimulation. However, visual representation of the sample means on an Interaction Plot did not support the hypothesis which stated the presence of cytokines would be greater in the highest heavy metal concentrations. The experiment concluded that the presence of both cytokines is greatest in the lead (II) chloride samples under both simulations and that there is not any specific trend between the concentrations.

EFFECTS OF HOMOCYSTEINE, AN ALZHEIMER’S DISEASE RISK FACTOR, ON B-AMYLOID METABOLISM

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Mentor: Kumar Sambamurti, Department of Neurosciences, Medical University of South Carolina
Advisor: Rebecca Heiss

The accumulation of the β-amyloid (Aβ) protein in the brain as senile plaques is a signature trademark of Alzheimer’s disease (AD). The mechanism of Aβ accumulation and deposition is a subject of intense study and has been considered as the basis for most drug development efforts in the field. However, we still have a poor understanding of the degradation pathways that are responsible for maintaining Aβ homeostasis in healthy people. In this study, extracts of a popular neuronal cell line (SH-SY5Y) have been used to characterize the Aβ degrading pathways in vitro. This study focuses primarily on the effects of homocysteine (HCY), an amino acid known to increase vascular dementia susceptibility, on the degradation of Aβ. The studies revealed that HCY vastly conserves Aβ, causing a substantial buildup of the molecule. Further testing shows that HCY prevents degradation by inhibiting two pools of proteases, thiol and aspartyl proteases at low pH, as well as metallo and serin proteases at neutral pH. After specific testing, this lab determined that HCY primarily prevents Aβ degradation through inhibition of matrix-metalloproteases. These results yield significant insight into the pathology of AD. By understanding the proteases responsible for Aβ degradation,
significant progress could be made towards producing a synthetic pharmacological agent capable of destroying the Aβ plaques.

THE EFFECT OF INDIGO, AZO DYES, AND BLONDE HAIR DYE ON FUTURE GENERATIONS OF DROSOPHILA

Almeera Lateef
Spring Valley High School

Carcinogenic chemicals are put into everyday products that are used by many people. These products could be affecting the health of humans. Some of these products are fabric and hair dyes. The purpose of this study was to see if fabric and hair dyes cause any mutations or changes in sex ratio in Drosophila, with these chemicals prevalent in the dyes. It was hypothesized that the dyes would instigate mutations or changes in sex ratios in future generations of Drosophila. Indigo, azo dye, and blonde hair dye were placed in separate bottles. Each treatment had two culture bottles and the control had two culture bottles. Two nanoliters of a dye were placed in their respective culture bottles. The flies were scored for two to four times over a one and a half week period, depending on how much growth occurred in the culture bottles. The bottles were watered whenever the culture medium seemed dry. The same steps were repeated for F2. A Chi-square analysis showed that the data in F1 was significantly different: Chi-square=(3,n=8)=47.79 p=2.34908\times10^{-10}. Similar results were shown for F2: Chi-square=(3,n=8)=69.89 p=4.505\times10^{-15}. This supports that these dyes are having some type of effect on the flies when exposed to the dyes in their culture bottles. The sex ratios of the Drosophila in all the treatments changed a significant amount, some to the point where one sex was two times more prevalent than the other sex.

THE EFFECT OF UNSATURATED, OMEGA FAMILY FATTY ACIDS ON THE ZONE OF INHIBITION OF ESCHERICHIA COLI IN SPINACIA OLERACEA CULTURES

Azalfa Lateef
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Food pathogens, such as Escherichia coli and Salmonella, are present on the surfaces of processed foods, causing pathogenic outbreaks throughout the world. Omega fatty acids are proposed to potentially minimize or possibly annihilate pathogens found on the surfaces of processed foods. It was hypothesized, that the higher the concentration of Omega-3, the larger the zone of inhibition. Two
concentrations of Omega-3 were made, the first one was 50% and the second one was a 25% concentration. An inoculating loop was dipped into E.coli K12 and then onto spinach, which was then streaked on the agar. Zone of inhibition disks were soaked into the concentrations and then placed on the top of the agar plates, which were then incubated at 37 °C for 24 hours. The zones of inhibition were then measured in cm. ANOVA and Tukey tests were conducted, which showed the three yield rates were significantly different, F(2,123)= 178.91, p<0.001. The hypothesis was supported because the p-value was lower than the alpha value,.05. Concentration 1 (M=5.696, SD= 1.430) produced a larger zone of inhibitions than Concentration 2 (M= 4.140 SD= .841). Both of them had an effect on the zone of inhibitions when compared to the Control (M=2.000, SD=0.000). In conclusion, the experiment indicated, that the Omega-3 fatty acid, did prevent the E.coli from growing when the Omega-3 fatty acid concentration was higher.

DESIGNING A LONG RANGE TASER TO REPLACE RUBBER BULLETS
Edward Leber
Academic Magnet High School

In this thesis, the researcher sought to design a long range taser to replace rubber bullets in military usage and riot control. The rubber bullet has long been used to incapacitate targets, but has major negative implications on the victims shot with it. This report contains five chapters, including an introduction, review of past literature on both rubber bullets and stun guns, in depth explanation of the researcher’s methods, a presentation of findings, and a concluding discussion chapter.

THE EFFECT OF 17B–ESTRADIOL ON THE FECUNDITY AND SEX RATIO OF DROSOPHILA MELANOGASTER
Crystal Lee
Spring Valley High School

The most potent naturally occurring estrogen, 17β–estradiol has been found in insecticides, drugs, natural compounds, and industrial sewage worldwide. Estradiol is a sex hormone that is necessary for reproductive organ growth. However, high levels of estradiol have been shown to be correlated with conditions such as breast cancer, gynecomastia, and the premature close of the epiphyses. The purpose of this study was to observe how exposure to estradiol affected Drosophila melanogaster sex ratios and fecundity. It was hypothesized that as the amounts of estradiol
exposure increased, the number of offspring and number of male flies would increase as well. The experiment was accomplished by raising Drosophila melanogaster in fly medium mixed with 20 mL of 1.0 mg/L, 10.0 mg/L, 25.0 mg/L, and 50.0 mg/L of estradiol concentrated solutions. Data were statistically analyzed using Chi-square contingency tables at α=0.05, revealing that estradiol did not significantly affect sex ratio for the first generation; χ² (4, N=10) =4.4516, p=0.3483. However, estradiol did significantly affect the sex ratio of the second generation; χ² (4, N=10) =12.104, p=0.0166. In the second generation, the population of flies also increased. Therefore, the estradiol did affect the sex ratios and fecundity of Drosophila melanogaster.

DEVELOPMENT OF NOVEL FLUORSCENT SENSORS FOR HYDROGEN SULFIDE
Francis Lee (Jeong Mok Lee)
Dutch Fork High School

At physiological levels, H2S is engaged in diseases, such as arterial and pulmonary hypertension, Alzheimer's disease, gastric mucosal injury, and liver cirrhosis. Therefore, it is very meaningful to create novel fluorescent sensor for detection and imaging of intracellular hydrogen sulfide (H2S). If the organic dye is synthesized according to intermolecular charge transfer (ICT) properties, the color dye would successfully detect the hydrogen sulfide in human body.

Synthesis of a Noble Fluorophore, DCP
DCP, a noble fluorophore for sensing H2S, was obtained from the two step reactions. Commercially available starting compound, acenaphthalenequinone (AQ), was reacted with malonitrile in acetonitrile by Knoevenagel condensation to give acenaphthylenylidene malononitrile (ACN), which is successively transformed to DCP by the base-catalyzed nucleophilic ring expansion reaction. DCP is suitably designed to have structural requisition, i.e. pi-conjugation system (benzene), working as a structure where electron can be transferred and electron-withdrawing CN group.

The two step reaction from acenaphthalenequinone (AQ) with high yield gives a noble fluorophore, 3-oxo-3H-phenalene-1,2-dicarbonitrile (DCP), which shows suitable spectroscopic properties, longer wavelength emission spectra in the range of visible range and fluorescent.

DCP is a potentially used in the detection of biomolecules such as amino acids with amine and thiol functionality in the living body. In further study, DCP will be tested in bio-sensing and bio-imaging for dihydrogen sulfide (H2S).
The purpose of this experiment was to test the efficacy of polyurethane, PORON® performance urethane, and ForceBloc® polyethylene foams at reducing impact from head-to-head impact trauma in order to potentially utilize subject materials in a viable protective headgear for soccer players. It was hypothesized that the polyethylene foam would perform the best at reducing impact as it is already being manufactured by the market’s leading soccer protective headgear brand, Full90™.

A boxing dummy was fitted with a foam sample around its head and tilted to the minimum angle required to fall and strike a Vernier Force Plate with what would symbolize its frontal bone. The maximum force value and impulse of the each trial’s force function were statistically analyzed with two ANOVA tests at α=0.05 to determine if there were any statistically significant differences between the performances of the select materials in each aspect. There was sufficient statistical evidence to reject the null hypotheses that there were no differences between each of the four test groups for the maximum force values F(3,116)=87.85 p<0.001 as well as the impulse values F(3,116)= 15.72 p<0.001. Post-hoc Tukey Tests were conducted to see which of the differences between each of the test groups were statistically significant from each other. The maximum force Tukey Test concluded that the differences between all of the four treatments were statistically significant (p<0.05) except for the polyurethane foam and the ForceBloc® polyethylene foam (p>0.05). The results from the impulse Tukey Test indicated the differences between the PORON® performance urethane foam and the other three treatments as being statistically significant (p<0.05). Therefore, from this statistical evidence, it can be concluded that the PORON® performance urethane would not be a viable alternative to the polyethylene already being utilized in today’s headgears and that polyurethane would be a homologous alternative to the polyethylene.
The rapid rise of carbon dioxide and other greenhouse gases (GHG) in the Earth’s atmosphere has caused an imbalance in many natural ecosystems. A meta-analysis suggests that earthworms are contributing to the rise in greenhouse-gas emissions due to increased rates of nitrogen and carbon cycling. This study emphasized the importance of studying belowground interactions. An important industry that greatly contributes to GHG levels is agriculture, which relies heavily on the use of fertilizers. The purpose of this research was to address the ongoing rise of GHGs, particularly CO2, in the agriculture industry. Three different soil amendments were tested (Miracle-Gro All Purpose Plant Food with Eisenia foetida, Miracle-Gro Organic Choice Blood meal fertilizer with E. foetida, and E. foetida) to determine which would reduce CO2 emissions and be agriculturally productive. 25 trials were performed for each soil amendment using Brassica rapa (Wisconsin Fast Plants). The plant height and number of flowers of the B. rapa were statistically analyzed with an ANOVA, and CO2 emissions were analyzed with a general linear model. The number of flowers (F(3,90)=2.4, p=0.073) and the CO2 emissions (F(3,93)=1.62, p=0.189) were not significantly different between the control and experimental groups. There was a significant difference in the plant heights, F(3,91)=7.52, p<0.05. However, the post-hoc Scheffé test did not detect any differences; descriptive statistics showed differences between the control and independent variables. The results suggest that the three amendments tested are inappropriate for field use.

THE EFFECT OF SWIMMING DISTANCE ON RESPIRATORY FATIGUE
Carl Lobitz
Spring Valley High School

This study was conducted in order to determine the difference in respiratory fatigue associated with varying distances of the freestyle stroke. Its ultimate goal was to test whether a sprinting, short, distanced event or a paced, long, distanced caused more respiratory fatigue proportional to the distance swam. It was hypothesized that the 200 yard (182.88 meters) distance of freestyle would cause the most respiratory fatigue proportional to the distance swam and that as the distances of
the event decreased so would the respiratory fatigue. In this experiment, 11 experienced swimmers had their at-rest vital lung capacity measured at-rest and after swimming 50, 100, 150, and 200 yards using spirometers. The post-swim measurements taken via Vernier spirometer were compared to the at-rest vital capacity to determine the total fatigue experienced. These were then set proportional to the distance swam. The data were analyzed using an ANOVA test, and then further analyzed by a Tukey test. It was concluded that the 200 yard swim caused the most respiratory fatigue overall, but the least per yard. This conclusion supports the notion that as one participates in greater amounts of physical activity, one would experience more respiratory fatigue, but sprinting and engaging in a more rigorous activity for short times causes more respiratory fatigue in comparison to the distance swam.

SPECIFIC INTERACTIONS BETWEEN 10-FORMYLTYRATYHYDROFOLATE DEHYDROGENASE AND APOPTOTIC PROTEINS JNK 1/JNK 2 IN FOLATE METABOLISM IN VITRO
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Advisor: Bhuvana Parameswaran

Science has extensively publicized the significance of appropriate dietary folate intake in the past several decades. Grain product fortification with folic acid was initially intended to reduce the rate of neural tube defects in the embryos of pregnant women. However, despite its success, the influence of folate fortification on diet, other than the intended target, is unknown. Therefore, it is important to understand the possible and potential side effects that folic acid supplementation can have on the remaining populations that consume fortified products. Recent research has shown that the once thought to be harmless vitamin, folic acid, does indeed cause certain potentially harmful side effects. The most prominent negative side effect of folate consumption is the possibility of increasing the potency of tumors as well as influencing metastasis. Curiously, a folate binding protein called 10-Formyltetrahydrofolate Dehydrogenase, FDH, has shown to reverse metastasis and cause cell death. In order to understand the role of folate in humans and the molecular pathways that FDH might take to bring about apoptosis in cancer cells, an investigation into the interactions of FDH and apoptotic proteins JNK 1/JNK 2. This was achieved by crosslinking FDH antibodies to sepharose beads followed by co-immunoprecipitation with JNK in order to potentially pull down the binding
proteins. The preliminary Western Blot analyses indicate that there is an interaction between FDH and JNK 2. Whether this indicates a role in apoptosis still needs to be determined.

THE EFFECT OF MONOLAYERS FORMED BY HEXADECANOL AND OCTADECANOL ON THE RATE OF EVAPORATION OF WATER
David Long
Spring Valley High School

As water becomes a scarcer resource, ways to conserve it are becoming more and more important. One way to conserve our most precious resource is to reduce the amount of water which is allowed to evaporate while it is being stored. The purpose of this research was to determine if monolayers formed by hexadecanol or octadecanol could be applied in a meaningful way to water storage systems. If a strong retardation of evaporation could be detected, then the monolayer could be used on water storage systems in order to reduce water loss, especially in arid climates where evaporation causes a staggering loss of water from open water storages. It was hypothesized that the octadecanol by itself would reduce evaporation most significantly, but hexadecanol would also slow evaporation of the water as compared to the control group. The methods for this research included three test groups. Each group contained 15 jars which were all prepared using the same method. The first group had no monolayer added to 100 mL of water in a 16 OZ glass jar, the second had 0.5 grams of hexadecanol added to the 100 mL of water, and the final group had 0.5 grams of octadecanol to the 100 mL of water. A packet of 6.0 grams of CaCl2 was then taped to the inside of the jars’ lids. The jars were then sealed and left at room temperature for twelve days. Then each packet of calcium chloride was removed from the jars, and their masses were recorded. After collecting the data, a minuscule variation in the mean of the change of mass of the CaCl2 was detected. After performing a one-way ANOVA on the change of the mass of the CaCl2 at $\alpha = 0.05$, the results showed that there were not any statistically significant differences between any of the means. The insignificant differences meant that each of the three types of monolayers allowed only negligible differences in the average evaporation of water during the 12 days of the study.
Today, biologists have become increasingly dependent on bioinformatics tools to interpret their data. The number, variety and complexity of these bioinformatics tools have increased dramatically and the tools have become more and more computationally complex, expensive and resource intensive. An increasing trend is to model the complex bioinformatics tasks as workflows. A number of systems already exist, but many of them require advanced computer knowledge before they can be used efficiently. In order to simplify the learning curve for new users, we have developed a new Bioinformatics Semantic Workflow Design System (BSWDS) to facilitate the execution of complex bioinformatics tasks. Using our BSWDS biologists will create a semantic workflow that mirrors the biological concepts and their relationships instead of mirroring the computer processes. A new graphical user interface (GUI) was also developed to provide the users the flexibility to compose, execute, and check the workflow. The GUI lacked undo and redo functionalities, which are a vital part of providing a usable environment. These functionalities were added using the Eclipse IDE with the Google Web Toolkit (GWT) plugin, as well as the Smart GWT library. Providing undo and redo functions will help create a more streamlined and user-friendly GUI by allowing users to undo and redo actions instead of starting their workflow from scratch each time they make a mistake. Overall this will help provide a simpler computer environment for biologists to use in their research.

The research involved in this project demonstrates the lubricity of the engine and fuel efficiency when comparing different biodiesel blends in a commercially available diesel engine. The project tests the consumption of biodiesel at various RPM measures using a load-free experimental method. Results obtained through this experimentation will allow consumers and commercial gas companies to better understand the benefits and problems involved with running straight petroleum
diesel fuel compared to biodiesel blends. Extension studies are planned to analyze the environmental impacts, longevity of the engine, as well as the economic factors involved for consumers. The project began with the titration of waste and virgin vegetable oil in order to measure initial free fatty acid level concentration. Next, sodium hydroxide and methanol were mixed with the oil so that the mixture undergoes trans-esterification and produces biodiesel and glycerol. After separation of the biodiesel and glycerol with several washes, the biodiesel was successfully synthesized. The fuel then undergoes acid number tests, clarity tests, and yeast/mold tests before running in the commercial engine. The fuel is then blended with diesel to produce the various blends for testing. The fuel is then run through a Hatz Diesel engine on a mounted tabletop at 1 RPMs, 2.5 RPMs and 3 RPMs for 30 minute runs. The engine block was measured for exothermic temperature readings in order to understand the lubricity of each fuel blend while fuel filters, valves and exhaust were all examined for buildup. The fuel is drained and quantified for fuel consumption analysis.

ECOLOGY AND SYSTEMATICS OF MARINE MEIOFAUNA: USING PCR TO IDENTIFY FOOD CONSUMPTION
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Advisor: Rebecca Heiss

This study tested a PCR technique to determine what sea creature it was that flatworms were consuming. In order to identify the food that meiofaunal flatworms are eating, primers were created from the predator’s DNA sequences. The identification of these prey items increases information known on the meiofaunal food chain. PCR application can be used in future studies to further analyze this food chain. This study confirms a PCR technique to identify meiofaunal flatworm’s diets by amplifying prey sequences where there is an abundance of predator DNA present.
Shin splints account for 20% of running injuries making them one of the most common running related problems. Many treatments and prevention methods have been tested, but no cures have been found for shin splints. Foot strike patterns are the way a runner’s foot hits the ground while running. There are 3 types forefoot strike mid-foot strike, and heel strike. While not having been considered by many, it has the potential to significantly reduce the amount of running related injuries. For this experiment, girls from the Spring Valley cross country team were asked to jog down 40 meters of a 100 meter straightaway and over a force plate, so that the pressure readings could be taken. The largest force reading was taken from each trial to perform a statistical analysis. It was concluded that there was no significant difference in the force exertions between the foot strike pattern groups, F(2,18)=1.49 p=.251. From these results, it can be concluded that using a specific foot strike pattern does not reduce the amount of pressure placed on the lower leg. This disproves previous theories that state that a forefoot strike pattern is more beneficial for preventing shin splints than other foot strike patterns.

BRANDING BLUFFTON: A CASE STUDY

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Branding is the business strategy of creating an image or slogan to differentiate a product, idea, or even a destination (Aaker, 1991). One notable example of branding a destination is the marketing campaign “What happens in Vegas, stays in Vegas.” The goal of this research is to develop a destination brand for Bluffton, a small, fast growing town in South Carolina. The purpose of the brand is to attract new businesses, residents and tourists, and differentiate Bluffton from its larger neighbor, Hilton Head Island. The first step in brand development is a qualitative investigation into the core values of Bluffton. This is accomplished by interviewing 30 decision-makers, who have a vested interest in how the town is branded, such as town council members, local business owners, and long term residents. The goals of the interviews are to determine the interviewee’s vision of Bluffton’s future, as well
as strategies Bluffton can implement to attract new businesses and residents. Next, charrettes, a group planning activity, are conducted for Bluffton-area volunteers. During the charrettes, focus groups answer questions about the perceived personality of Bluffton, how they envision the future of Bluffton, and comment on the strengths of Bluffton through appreciative inquiry. The interviews were transcribed, and the charrette-generated responses were analyzed to identify keywords and recurrent themes. The characteristics that distinguished Bluffton and should be included in the destination brand are: The charm and uniqueness of Bluffton’s ‘Old Town,’ the natural environment surrounding Bluffton, Bluffton’s accessibility to major tourist locations, and the connectedness between the allure of its past, with the economic opportunities of its future. Based on the results of the first step, an advertising firm will synthesize the results into a brand. Residents will be shown the proposed brand, and a final survey will be sent to existing residents, visitors, businesses in Bluffton, as well as potential residents, visitors, and businesses to determine if the branding achieved its goal: differentiating Bluffton, and making it more attractive and desirable destination.

BIOCHEMICAL CHARACTERIZATION OF ALPHA-SYNUCLEIN CONTAINING PROTEIN AGGREGATES IN A YEAST MODEL FOR PARKINSON’S DISEASE
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Mentor: Renee Chosed, Department of Biology, Furman University
Advisor: Jenny Salazar

Parkinson’s disease is a neurodegenerative disease caused by an over expression of the protein alpha-synuclein. This over expression causes protein clumps called aggregates to be formed in the neurons of the brain. This causes loss of motor control, coordination and tremors. These aggregates were thought to be the sole cause of Parkinson’s disease until patients were discovered without having the aggregates in the neurons of their brains. Recent research has indicated the existence of smaller, soluble protein clumps named toxic oligomers. These toxic oligomers would be too small to be seen under the microscope, but would give a new possibility as to what causes Parkinson’s disease to develop. This research sought to distinguish between the aggregates and toxic oligomers. This was done by cloning the alpha-synuclein gene into yeast plasmids, using procedures similar to those done by the Liniquist Lab at MIT. After the gene was cloned into the cells, the yeast were allowed to grow, and samples were taken. Finally, alpha-synuclein was extracted from the yeast in order to analyze the yeast cells further. The samples were analyzed using Western Blot techniques as well as Colloidal Blue staining.
THE RELATIVE EFFECTIVENESS OF GERANIUM, CITRONELLA, LEMON GRASS, AND LEMON EUCALYPTUS OILS AT REPELLING MOSQUITOES

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The purpose of this experiment was to determine which essential oil out of lemon grass, lemon eucalyptus, geranium, and citronella was the most effective at repelling mosquitoes. These four oils were chosen as these oils appeared frequently in my research. It was hypothesized that if the oils were swabbed onto the inner cone of a trap, the oils would have varied effectiveness at repelling. The null hypothesis stated that if the essential oils were added, there would be no difference of mosquitoes attracted. Hatching chambers were constructed of 2 L bottles. The mosquitoes hatched from dehydrated. The mosquitoes matured and traps were constructed from 500 mL bottles and the baited. Each essential oil was applied to the entrance of one trap, with a trap left over for control, which were labeled and put in a large aquarium with the hatching chambers. The aquarium was covered with a screen. The mosquitoes entered the traps and were counted. The results were that few mosquitoes entered traps. Two mosquitoes in the control, one mosquito in lemon grass, lemon eucalyptus, and citronella oils, and zero mosquitoes in the geranium oil trap. The results were analyzed using an ANOVA single variable test and there was no significant difference between the oils, likely because of the small amount of mosquitoes that actually entered the traps. The data failed to support my hypothesis of the oils varying in effectiveness and failed to reject my null hypothesis of no difference between the amount of mosquitoes in each trap.
SCREENING OF GENES THAT MIGHT BE ESSENTIAL FOR CRANBERRY EXTRACT MEDIATED PROTECTION AGAINST ALZHEIMER'S DISEASE IN CAENORHABDITIS ELEGANS
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Mentor: Yuqing Dong, Department of Biological Sciences, Clemson University
Advisor: Stephen Kaczkowski

In recent studies, cranberries (Vaccinium macrocarpon) along with other nutraceuticals have been shown to promote healthy living and reduce the effects of aging and stress in various model organisms. Our lab’s findings have suggested that supplementation of cranberry extract (CBE) at an optimum concentration not only increases the lifespan of the worms, but also helps them survive under various stresses. CBE supplementation was tested to see how it may affect worm populations at different ages and to observed its effects improved cognition skills in aged worms. In the same study we have shown that CBE supplementation increases lifespan and stress resistance by acting through the insulin/IGF signaling pathway via DAF-16 and components of p-38 MAP kinase pathway. Here we observed that CBE helps combat the progression of Alzheimer's disease (AD) in transgenic worms in which this disease has been modeled. We saw delayed paralysis in CBE treated nematodes that occurred due to AD mediated pathology. We further investigated the pathways that might be involved in bringing about this protective phenomenon by conducting a small RNAi screen. We knocked down daf-16 and hsp 16.2 expressions and checked if they were involved by carrying out a paralysis assay. We found out that neither gene was essential for CBE mediated protection against AD.

THE EFFECT OF CELL DENSITY ON HYDROGEN GAS PRODUCTION OF CHLAMYDOMONAS REINHARDTII VIA SULFUR DEPRIVATION
Hannah McCall
Spring Valley High School

Currently, the availability of fossil fuels, which constitute two-thirds of the pollution in earth’s atmosphere, is rapidly decreasing. Hydrogen energy is an ideal alternative fuel because it is clean and reliable. When Chlamydomonas reinhardtii is deprived of oxygen (O2), the enzyme Fe-hydrogenase is expressed and recombines electrons and protons, yielded by photosystem II (PSII), to form hydrogen gas (H2). In order for H2 to be produced, C. reinhardtii must also be deprived of sulfur because a lack of sulfur results in damaged D1 proteins, lowering PSII activity,
which then, in turn, causes a decrease in O2 production. Since the small amount of O2 produced can be consumed by the algae, there is no excess O2 to inhibit the expression of Fe-hydrogenase. The purpose of this experiment was to maximize the amount of H2 produced by C. reinhardtii. It was hypothesized that as the density of C. reinhardtii increased, the amount of H2 produced would also increase. The cell densities used were 3 million cells/mL, 6 million cells/mL and 9 million cells/mL; these densities were measured with a hemacytometer. To carry out this experiment, C. reinhardtii cultures were grown in a freshwater medium. When the cultures reached the needed cell densities, they were centrifuged and re-suspended in TAP-S medium, containing no sulfur. The H2 production of each culture was measured via water displacement. An ANOVA test F(2,31)=1.71, p=0.179 at α=0.05 was conducted. Because p=0.179>α=0.05, the null hypothesis that the means of each of the three groups are equal was unable to be rejected. However, there is a graphical correlation such that as the cell density of the C. reinhardtii culture increases, the amount of H2 produced also increases, suggesting that higher densities of C. reinhardtii produce more H2 than lower densities do.

THE EFFECTS OF POLLUTANTS ON PYROCYSTIS FUSIFORMIS
Melissa McClure
Dutch Fork High School

Oceans are becoming more polluted every year. Polluted oceans are detrimental to human health so more efforts to clean the oceans must be made. To aid in research that relates to marine pollution, scientists use bio-indicators such as bioluminescent algae. Pyrocystis fusiformis is a large unicellular bioluminescent dinoflagellate that can be used for such a purpose. By studying more about how pollution affects the environment, scientists can limit marine pollution. In this study, antifreeze was hypothesized to diminish the bioluminescent of the algae the most.
To analyze the effects of various pollutants on pyrocystis fusiformis, it was grown in 125 ml Erlenmeyer flasks purposefully polluted with common pollutants such as motor oil, antifreeze (ethylene glycol), and acrylic paint. Each experimental flask contained 50 ml of algae, 70 ml of seawater, and 5 ml of the given pollutant. Each control flask contained 50 ml of algae and 70 ml of seawater. Motor oil was hypothesized to diminish the bioluminescence of the second most while acrylic paint the least. The bioluminescence is influenced by the pH of algae’s surroundings. Antifreeze (a base with pH 9.5 to 10.0) affected the pH the most. Pyrocystis fusiformis bioluminesced when the pH decreased to 5.7.
The results of these findings may give scientists an idea of how best to save bioluminescent algae (and other species) from population decline. Algae are
essential to both local and global ecosystems. They are the primary food sources for many organisms and also produce a majority of the world’s oxygen.

**DESIGN OF A LAPAROSCOPIC SURGERY SIMULATOR**
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Mentor: David Kwartowitz, Department of Bioengineering, Clemson University  
Advisor: Jenny Salazar

Laparoscopic surgery is a relatively new method for performing surgery. As surgeons cannot physically see the area they are operating on with this method, practice is necessary to ensure the accuracy of the surgery. A major problem in this budding field is the lack of simulators to practice for pediatric patients. Pediatric laparoscopy is still limited, and the anatomy varies widely in children. Practice needs to be specific to a child’s size, so a pediatric simulator was necessary. As this simulator is much smaller than most, it gives a better replica of a child’s size, which will allow more precision. A lot of research went into the size and usefulness of this product, and the size is now an average infant’s size. SolidWorks, which is a program that is used to design models, allowed confirmation of this size before the actual product was created. After creation, it was determined that this product successfully allows laparoscopic surgery simulation. With many replaceable parts the simulator also allows many different types of surgery to simulate. Therefore, this simulator can mimic many aspects of the human body. This is necessary because multiple surgeries can be practiced on one simulator. Different pieces can be added in to replicate organs and different tops can be added to replicate the different ports necessary for the respective surgeries.

**VISION-BASED CONTROL OF A QUADROTOR**
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Governor's School for Science and Mathematics  
Mentor: Yue Wang, Department of Mechanical Engineering, Clemson University  
Advisor: Elizabeth L. Bunn

This project considers the problem of implementing vision-based control for the Parrot AR.Drone 2.0 quadrotor. Quadrotors are flying robots that have four rotors connected to a central hub. In this project, the quadrotor incorporated two cameras, a front-facing one and a bottom-facing one, and a set of navigational sensors including a gyroscope and an accelerometer. The two cameras were used to analyze
the quadrotor’s environment and perform tasks such as line following. To accomplish this, OpenCV was used for image processing. Images captured by one of the cameras were passed to OpenCV to find contours, detect optical flow (relative motion of the scene and camera) and track objects. This data was parsed by an autonomous control program that gave the control system a point. Based on point, the controller sent horizontal and rotational velocity commands to the quadrotor and used the quadrotor’s other sensors for corrective control.

THERMAL CONDUCTIVITY OF SPARK PLASMAS SINTERED ZNSE NANOPowDER

Eric McLean
Governor's School for Science and Mathematics
Mentor: Jian He, Department of Physics & Astronomy, Clemson University
Advisor: David Whitbeck

Zinc Selenide (ZnSe) is a wide band gap semiconductor well known for its potential applications in blue-green emitters in optoelectronics and also spin-filters spintronics. The physical properties of ZnSe are sensitive to its characteristic size. In this work we focus on the thermal conductivity of nanostructured ZnSe. ZnSe nanopowders are hydrothermally synthesized in Prof. C.-J. Liu’s lab in Taiwan and then spark plasma sintered (SPSed) at 840 C for 5 minutes. The as-sintered pellet has a packing density of 5.12 g/cc, as compared to the theoretical density of 5.23 g/cc. X-ray diffraction, scanning electron microscopy, and energy dispersive X-ray spectroscopy measurements are conducted to probe the phase, micro-morphology and composition. In addition, the thermal conductivity is measured on a bar cut from the sintered pellet as a function of temperature between 15 K and 300 K. The measured thermal conductivity data has been compared with those of single crystalline and micro-grained polycrystalline samples in order to gain insight on the grain boundary scattering.

THE EFFECT OF LATHERIN ON THE GROWTH AND DEVELOPMENT OF CANDIDA ALBICANS FUNGUS AND ESCHERICHIA COLI BACTERIA

Veronica McLean
Spring Valley High School

Latherin was chosen for study because of its possible antibiofilm capabilities. Further studies in antibiofilm and antimicrobial agents are vital to strengthening defenses against biofilms and unwanted growths in the human body. The purpose of
this project was to determine the effect of latherin on the growth and development of Candida albicans fungus and Escherichia coli bacteria. This was important because it could demonstrate that horses have natural antimicrobial properties in the latherin in their sweat and saliva, which could be instrumental in further research regarding antibiotics and other antimicrobial agents for members of the Equidae family. It was hypothesized that if latherin was applied to C. albicans fungus or E. coli bacteria, than the growth of the fungus or bacteria would be inhibited. The experiment was performed by applying latherin in the form of saliva to C. albicans fungus and E. coli bacteria in petri dishes, and measuring the zone of inhibition around the latherin. A control group was tested without latherin. No difference was discovered between the Control and Experimental groups 1 and 2. There was no zone of inhibition in any of the plates, thus the hypothesis was not supported. This could be a result of multiple sources of error, including possible contamination.

THE COMPARISON OF HIGH SCHOOL STUDENTS JUNG TYPOLOGY TEST WITH THEIR MATHEMATICS CAPABILITIES

Caroline McManus
Spring Valley High School

Science, technology, engineering, and mathematics (STEM) careers are on the rise in the world and there has been much controversy over stereotyping the type of people that are generally better at these careers. This experiment’s purpose was to investigate those stereotypes, and show the correlation between personality type and mathematics ability. The Myers Briggs Personality Test has been proven to be a strong indicator of a person’s personality type. The experiment composed the Myers Briggs four letter combination personality type to math scores. Students were given a random number as to keep all data confidential. They were asked to give their gender, age, and current math class. Each student completed the Jung Typology Test, which is a shortened version of the Myers Briggs Test. Students then took a Geometry level test composed of fifteen questions to test their ability in the subject. A linear regression graph was used to calculate a correlation, followed by t-tests between each of the pairs of personality types. There was no significant difference found. A slight difference was shown between intuition and sensing; (t(df)=31, p=.0191).
THE EFFECT OF ALLIUM SATIVUM EXTRACT AND AZADIRACHTA INDICA EXTRACT AS A NATURAL BACTERIAL AGENT ON THE ZONE OF INHIBITION ON ESCHERICHIA COLI K-12

Pranathi Meda
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The purpose of this research was to see which of the two extracts, Allium sativum and Azadirachta Indica extract, would inhibit the most amount of E.coli K-12 growth. Azadirachta indica, known as neem, is found in the Mahogany family, and is known to have many medicinal properties. The parts of the tree that are used in medicinal treatments include the leaves and fruit. Allium sativum, known as garlic, is renowned throughout the world for its distinctive flavour as well and its remedial properties. The bulbs are the most frequently used part of this plant. Escherichia coli is part of the family Enterobacteriaceae, are known to be anaerobic gram-negative rods that live in the intestines of humans and animals. It was hypothesized that the zone of inhibition resulting from the .2% concentrated Azadirachta indica extract applied petri-dishes would have a larger zone of inhibition than the petri-dishes containing the four concentrations (.2%, .4%, .6%, .8%) of the Allium sativum extract. The petri-dishes, inoculated with Escherichia coli K-12, contained disks soaked in specific concentrations. They were incubated for 48 hours at 37 degrees celsius. An ANOVA was conducted at alpha = 0.05, and the null hypothesis was rejected, F(7, 232)=2.61, P=0.013. A Tukey test was conducted to see which extract varied most from the other and the result contained one significant difference between the .2% concentrated Allium sativum and the .6% concentrated Allium sativum.

DETERMINING THE SUBSTRATE SPECIFICITY OF THE GLYCOSIDASE ACTIVITY OF NEISSERIA GONORRHOEAE BY AMIDASE C

Jamal Merritt
Governor's School for Science and Mathematics
Mentor: Christopher Davies, Department of Biochemistry, Medical University of South Carolina
Advisor: Scott Page

Neisseria gonorrhea is an incredibly antibiotic-resistant bacteria that causes gonorrhoeae. N. gonorrhea is a gram-negative bacteria. During cellular division, it uses the enzyme amidase c to cleave the bonds in its peptidoglycan layer. The N terminal domain of Amidase C cuts the bond connecting L-alanine and N-acetylmuramic acid. The C terminal domain shows glycosidase activity and is
shown to cut the bond connecting N-acetylmuramic acid and N-acetylglucosamine. The direction of the cut is unknown. Finding the specific area where the N terminal domain performs its hydrolase activity will help in the development of drugs against gram negative bacteria like N gonnorhea by targeting their AmiC-NTD protein. By purifying Amidase C from E-coli and incubating the protein with insoluble peptidoglycan, we were able to run the sample over the High Performance Liquid Chromatography and find that the N terminal domain of Amidase C cleaves the bond in the direction of N-acetylglucosamine to N-acetylmuramic acid.

THE EFFECTS OF VARYING FRESHWATER LEVELS ON THE POPULATION OF CLADOPHORA AEGAGROPILA
Paige Mewborn
Dutch Fork High School

This project tested the effects of varying freshwater levels on the population of Cladophora aegagropila or marimo moss balls. The freshwater was altered in three ways, affecting a sample of the population in numeric value. Data was collected and analyzed based on the number of moss balls remaining after eight weeks. The Cladophora aegagropila is a specific type of algae, whose population is large at the bottom of Lake Akan in Japan. Because of a hydroelectric power plant built on the Akan River in 1920, water levels have decreased significantly. This loss of water negatively affected the population. The people living in the area at the time did not realize this effect until 1940, after most of the population died out. The people released a campaign to help recover the population, but the success was small. The purpose of this project is to determine the optimal water level at which the marimo population can sustain. To test this, six ecozones were filled with room temperature tap water; two ecozones with 500 mL, two ecozones with 1000 mL, and two ecozones with 1500 mL. The pH of each ecozone was checked, making sure that the pH of 6.8 is achieved. Five Cladophora aegagropila were placed in each ecozone. The ecozones were observed every other day, for color and size. The water was changed in each ecozone every eight days. The data was collected by measuring the circumference of each marimo ball and observing the number of marimo balls and their color.

THE EFFECTS OF SUPEROXIDES ON THE AFLATOXIN PRODUCTION IN ASPERGILLUS PARASITICUS
Isabelle Mikell
Hammond School
Aspergillus parasiticus is a toxic fungus that contaminates our food and environment by secreting a liver carcinogen, aflatoxin, resulting in 16,600 new cases of aflatoxin-induced liver cancer per year in the United States and an annual loss of $276 - $709 million to US agriculture. In an attempt to understand why the fungus makes this deadly toxin, a study was conducted to test the hypothesis that aflatoxin synthesis reduces the load of superoxide radicals in Aspergillus cells and hence addition of superoxide radicals would increase aflatoxin synthesis. To test this hypothesis, the effect of increased superoxide on aflatoxin synthesis was investigated. Superoxide radicals in the growth medium were elevated by addition of hydrogen peroxide. The levels of superoxide (the independent variables in the experiment) were measured using dichloro-dihydro-fluorescein-diacetate assay and the resultant aflatoxin levels (the dependent variables in the study) were monitored using thin layer chromatography. The results showed that aflatoxin synthesis increased upon elevating superoxide radicals in the fungal cells. The study suggests that novel chemicals that reduce superoxide radicals accumulation in cells can be used to inhibit aflatoxin synthesis in these toxic fungi.

A STUDY ON THE EFFECTS OF ER:YAG LASER BEAM-SHAPING ON BIOLOGICAL TISSUE
Jonah Miller
Governor's School for Science and Mathematics
Mentor: Eric Johnson, Department of Electrical Engineering, Clemson University
Advisor: David Whitbeck

Recently, lasers have been adapted into tools used for clinical surgery. The Er:YAG laser (Erbium-doped Yttrium Aluminum Garnet) is especially popular because its wavelength lies at the water absorption peak, enabling it to make accurate ablations without causing excess damage to the surrounding tissue. However, the ability of this laser to cut remains limited. In this study, the shape of the Er:YAG laser was altered using optics to create a "necklace beam" shape. The laser was fired at the sample tissue both with and without the optic. Experiments were conducted on soft tissue (gelatin), and hard tissue (antler). Afterwards, the beam was focused using a 40 mm lens and fired at the antler to determine the effects of a more powerful beam on the sample. The results were analyzed after experimentation, and the necklace beam was found to be viable for ablating hard tissue, but less suitable for cutting softer tissue.
THE CORRELATION BETWEEN ATTACHMENT STYLE AND FACIAL EMOTION RECOGNITION IN 9TH GRADE MAGNET STUDENTS
Lindsey Miller
Spring Valley High School

Human-to-human relationships have been shown to be a vital component of one’s physical, mental, and emotional well being. There is a large variation of how individuals behave in relationships, which can be accounted for by attachment style, a key component of relationships. Emotion recognition also plays a huge role in the health of a relationship. By finding the correlation between attachment style and emotion recognition, insight on one’s emotional health may be obtained. The purpose of this study was to find the correlation between facial emotion recognition and attachment style. It was hypothesized that secure attachment would be associated with a greater level of facial emotion recognition and that insecure attachment would be associated with a much lower level of facial emotion recognition. This was done by administering two tests to 9th grade magnet students, one identifying participants’ level of facial emotion recognition, and the other identifying participants’ attachment style. Data were statistically analyzed through the use of a correlation test and linear regression t-tests at α=0.05. Results displayed no correlation between facial emotion recognition and attachment style. However, significant negative correlations between secure and ambivalent attachment (r=6.77, p<0.001), and also between secure and avoidant attachment (r=7.54, p<0.001) were found. It was concluded that there was no relationship between facial emotion recognition and style of attachment. It was also concluded that individuals were likely to possess either insecure attachment or secure attachment, and rarely show signs of ambiguity.

THE EFFECT OF THE ANTIBACTERIAL PROPERTIES OF CERUMEN ON THE REPRODUCTION OF EVOLVING PATHOGEN AND NOSOCOMIAL INFECTION, STAPHYLOCOCCUS EPIDERMIDIS.
Alyssia Mitchell
Spring Valley High School

Staphylococcus epidermidis grows on human skin, respiratory, and mucous membrane surfaces. It is responsible for device related infections that often infect the bloodstream. The purpose of this experiment is to find a cost efficient cure for the device related infection, staphylococcus epidermidis. Due to its strong resistance to antibiotics, a medicine has not yet been found to rid the patient of this infection. It was hypothesized that if staphylococcus epidermidis was treated by cerumen
suspended in a 3% glycerol bicarbonate buffer solution for 24 hours, then the optical
density of the bacteria would be higher than if the staphylococcus epidermidis was
treated for 48 hours or 72 hours. The method of conducting the experiment was to
extract cerumen from human subjects with an earwax hook and suspend it into 3%
glycerol bicarbonate buffer solution. Treatment disks were placed into the solution
and then onto the bacteria. After the prescribed time, the optical density was found
and recorded. Using a Scheffé test it was found that there was no significant
difference between the control and the 24 hour, 48 hour, and 72 hour treatments.
However, there was a significant difference between the means of the 24 hour
treatment and the 72 hour treatment and the 48 hour treatment and the 72 hour
treatment. The difference in these means led to the conclusion that cerumen
suspended in a 3% glycerol sodium bicarbonate buffer does not have an effect on the
reproduction of staphylococcus epidermidis.

DETERMINING THE EXISTENCE OF SUPERSYMMETRY THROUGH MONTE
CARLO EVENTS OF PROTON COLLISIONS

Neil Monga
Governor's School for Science and Mathematics
Mentor: Milind V. Purohit, Department of Physics & Astronomy, University of
South Carolina
Advisor: Mark A. Godwin

The ATLAS detector at the Large Hadron Collider in Geneva, Switzerland, has been
delivering data from proton collisions that implies that the total final energy in
many of these collisions does not equal the total initial energy of the particles
collided. This means that the Standard Model needs to be revised. However, to
understand what particles were missing requires simulation since technology has
not advanced far enough to detect these energies. Through the use of PYTHIA, a
high-energy simulation software, Fourteen Monte Carlo events were performed.
The decays of proton collisions in seven qualified events were examined, plotted on
histograms using ROOT, and were compared to standard decay models proposed by
supersymmetry. These missing particles had an energy almost equal to the most
ergetic detected jet. In comparison to the energy of the system, the total missing
energy of these particles was measured to be approximately eighty percent of the
total energy. Since technology has not advanced far enough for any particle collider
to detect possible supersymmetric particles, this data must then wait until a
detector or collider has the capability of being able to create and detect
supersymmetric particles
Dental hygiene is important, and sometimes very expensive. Scientists are always trying to find new, easier ways to cure common infections. The purpose of this experiment was to do just that, create a new, easy way to cure oral thrush, a mucosal infection that causes inflammation and discomfort. It was hypothesized that fresh Aloe vera would have the largest zone of inhibition on Candida albicans, the bacteria that causes oral thrush, when compared to bottled Aloe vera. After streaking the plates and applying the treatments, the plates were left to incubate for a day. The fresh Aloe vera showed a significant difference from the control and bottled Aloe vera groups, rejecting the null hypothesis $F(2,87) = 4.41, p = 0.015)$. The fresh Aloe vera was shown to have the greatest, and only, effect on Candida albicans.

Heat shock proteins (HSPs) play an important role in the way plants respond to environmental stress. A new HSP gene, HSP 26.8 from Creeping bentgrass, will be cloned for this experiment. The objective of this research is to understand the expression profile of the HSP 26.8 by promoter-GUS reporter gene analysis in transgenic Arabidopsis plants. GUS staining assay in transgenic plants will allow the visualization HSP 26.8 gene expression in various plant tissues and at different plant developmental stages as well as in response to environmental stress. The HSP 26.8 promoter sequence was released from the T-Easy vector and placed in front of the GUS reporter gene. The recombined gene construct was then moved into Agrobacteria and used for Arabidopsis transformation by floral dip.
THE EFFECT OF ORGANIC FERTILIZER (MOLASSES) COMPARED TO COMMERCIAL FERTILIZER (MILORGANITE) ON THE GROWTH OF LETTUCE PLANTS
Margaret Mullins
Heathwood Hall Episcopal School

The purpose of this project is to determine the effect of different fertilizers on the growth of lettuce plants. The hypothesis was if lettuce plants were treated with a molasses fertilizer, a commercial fertilizer (Milorganite), and no fertilizer and tested to see which helps the plant flourish the most, then molasses will provide the best nutrition for the plant, making it grow the best. The individual variable is the different fertilizers, and the dependent variable is the lettuce plants health based on the height. Fifteen plants were divided into three groups of five. One group was given a molasses fertilizer, one group was given a commercial fertilizer (Milorganite), and the last group was not given anything to keep it as a control group. The height of every plant was taken every day for twenty days. The results showed that by the end of the experiment the plants treated with the molasses fertilizer has grown the best, second was the plants treated by the commercial fertilizer, and last the plants who prospered the least was the control group. The heights were averaged together for every group and put into Microsoft Excel. An ANOVA test was conducted to average and analyze the results, and it was concluded that the results were not statistically significant because the F-critical value was higher then the F-value.

Lance Murphy
Spring Valley High School

The degeneration of articular cartilage, cartilage in joints such as the knees and the hands, is a prevalent problem. A potential way of solving this problem can be seen in hydrogels which are linked polymer chains of which 99.9% of their weight can be given by water when water swollen. The purpose of this experiment was to find a suitable replacement for articular cartilage by testing the compressive strengths of different hydrogels. The hydrogels used in this experiment were the poly(2-acrylamido-2-methylpropanesulfonic acid) (PAMPS)/ poly(acrylamide) (PAM)
double-network hydrogel, the PAMPS single-network hydrogel, the PAM single-network hydrogel, and the PAMPS/PAM composite hydrogel. These hydrogels were chosen because of the different structures they have. The PAMPS/PAM double-network hydrogel has more dense interlinked polymer chains than the PAMPS/PAM composite hydrogel which has more dense interlinked polymer chains than the single-network hydrogels. The hydrogels were prepared in eight-millimeter molds, and they were measured using the Bose machine at USC. The hydrogels were tested for compressive strength to represent the ability of the gel to withstand the compressive forces found in the joint. Because the compressive strength could not be measured, the slopes of the modified stress-strain curves were evaluated and a One-way Anova test was run. With a p-value<.05, it was determined that there was a significant difference between the groups. The PAM single-network hydrogel was the strongest of the four, followed by the PAMPS single-network hydrogel, the PAMPS/PAM double-network hydrogel, and the PAMPS/PAM composite hydrogel, in that order.

SYNTHESIS, STRUCTURE DETERMINATION, AND OPTICAL PROPERTIES OF RARE-EARTH (RE) SILICATES (RE= EU, Y, LA, SM, IN)
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Mentor: Hans Conrad zur Loye, Department of Chemistry & Biochemistry,
University of South Carolina
Advisor: Phelesia Jones-Cooper

Fluorescent lighting used today incorporates elemental mercury which is both inefficient when compared to other lighting technologies and overexposure can result in death. Rare-earth phosphors, such as europium, are characterized by their partially filled 4f orbitals which allow for small but essential transitions between these energy levels in order to emit light. Rare-earth containing inorganic compounds have the potential to aid in the development of new solid state lighting technologies, such as fluorescent lights and light emitting diodes (LEDs). Through this investigation, new rare-earth silicates, K3RESi2O7 (RE=Eu, Y, Sc), K5Y2FSi4O13, K5RE4F(SiO4)4 (RE= Y, La), Sm4.66(SiO4)3O, and K5In3Si7O21 were synthesized using both solid state and flux crystal growth methods. Reactions with a potassium fluoride flux yielded clear and colorless hexagonal, monoclinic, and tetragonal crystals. When employing the solid state method, a stoichiometric ratio of reactants was ground together and heated yielding the powdered form of K3EuSi2O7 and K3YSi2O7. The fluorescence spectrum of K3EuSi2O7 powder indicated a red emission at 612 nm, which is similar to the emission of Eu2O3 at
608 nm. Our ability to synthesize this compound rather easily through various methods could aid the manufacturing of the product on a larger scale.

THE EFFECT OF PH LEVELS OF 5, 7, 9, AND 10 ON THE RATE OF METAMORPHOSIS OF AEDES ALBOPICTUS MOSQUITOS
Caroline Nassab
Heathwood Hall Episcopal School

This study investigated the effect of pH levels of 5, 7, 9, and 10 on the rate of metamorphosis of Asian Tiger Mosquitos, Aedes albopictus. This knowledge could help predict, or possibly control, mosquito populations to prevent them from becoming a public health issue. Fifty mosquito eggs were placed into each of twelve mosquito chambers, there were 3 chamber per each pH range. An equal amount of a solution of rabbit food and distilled water was added to each chamber, and then the pH was altered using ammonia to make an alkaline solution and vinegar to make an acidic solution. The mosquitos in each chamber were counted every day for 3 weeks. An ANOVA test shows a statistically significant difference between the rates of metamorphosis among the different pH levels for the egg, larva and pupa stages because the f value was greater than the f critical value. The results from the adult stage show that there was not a statistically significant difference; this may be due to the fact that at the end of 3 weeks every chamber had a pH of 7. The pH of 7 had on average, 0.5 adult mosquitos on day 21 while the pH of 5 had 0.2 adult mosquitos; the pH of 9 had 0.4 adult mosquitos; and the pH of 10 had 0 adult mosquitos. These results reject the hypothesis that, if mosquitos are exposed to pH of 10, or a more alkaline pH in water, then their rate of metamorphosis from egg to adult will be increased.

THE SHORT-TERM EFFECTS OF HEAD IMPACTS ON STUDENT ATHLETES
Tyler Nguyen
Dutch Fork High

In recent years, increasing awareness of head injuries is occurring in contact sports, especially in football and lacrosse where contact is most prominent. Many young players are generally not taught the correct way to tackle, or taught the incorrect way, causing a myriad of head injuries in most cases. The purpose of this study is to be able to quantify a concussion by counting the number of hits a player receives, and directly correlate that to the amount of concussive symptoms. The qualification of a hit or impact is given an operational definition to standardize contact made by
the players. A positive correlation is predicted that as the number of impacts a player executes/receives increase, the severity of concussive symptoms will increase. The methodology involved the Dutch Fork High School Varsity Lacrosse team. Ten players from the team were monitored during practices as well as games, and the number of times the players received/made hits were counted. Once the practice or game was over, a section of the SCAT2, or Sports Concussion Assessment Test 2, called the General Symptoms Checklist, was conducted on each player. This a list of symptoms rating them on severity on a scale of 1 to 6. The numbers and scores from the assessment were analyzed and used to determine which symptoms were common right after contact, practices and games. It is anticipated that through this study, correlating the number of hits student players receive to the level of concussive severity will aid in eventually preventing and treating athletes with concussions and other head injuries. Through this experiment it is hoped to shed light on the short-term effects of head impacts on student athletes of contact sports.

ELECTROPORATION OF FLUORESCENT PLASMIDS IN CIONA INTESTINALIS
Bailey Nicolas
Governor's School for Science and Mathematics
Mentor: Heather Evans-Anderson, Department of Biology, Winthrop University
Advisor: Jennifer Taylor

Ciona intestinalis, confirmed to be the closest living invertebrate relative to vertebrates, are widely used as model organisms to study developmental genetics and evolution. Ciona intestinalis is emerging as a popular model organism because its basic genome is relatively streamlined across the species and has not undergone the duplications seen in vertebrates. Genetic screens, germline transgenesis, microinjection of mRNA and plasmid DNA, and electroporation of plasmid DNA are routinely used when studying gene expression, gene function, and also control of protein production in Ciona. They are commonly used for cardiac studies, however, their hearts are clear, making it difficult to accurately observe them and quantify measurements. The purpose of this research was to improve Ciona as a model organism for cardiac studies by making them take up fluorescent DNA marker plasmids. Marker plasmids, pMiCiTnlG and pMiCTniGCiprmG, which specifically target heart muscles were obtained from CITRES Lab in Japan. Dechorionated embryos were electroporated with these plasmids using .05 kV, 1.00 μF x 1000 (capitance). The electroporations received volts between 48-49 V and the time constants ranging between 6-36 ms. It will be important to successfully incorporate the GFP-expressing plasmids to facilitate studies of cardiac injury and treatment.
DETERMINING THE CORTICAL EXCITABILITY OF MEDITATORS USING TRANSCRANIAL MAGNETIC STIMULATION (TMS)

Jessa Norton
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Mentor: Donna Roberts, Department of Biomedicine, Medical University of South Carolina
Advisor: Gary L. Salazar

The goal of the experiment was to use Transcranial Magnetic Stimulation (TMS) to determine the effects of meditation on the cortical excitability of meditators. After reviewing published imaging studies, we hypothesized that subjects who underwent meditation would have higher cortical excitabilities because they were concentrating heavily on breathing in and out. We recorded Motor Evoked Potentials (MEPs) over a range of TMS intensities for ten experienced meditators and ten non-meditators. The ten meditators performed twenty-minute periods of meditation and the ten non-meditators performed twenty-minute periods of rest. TMS recruitment curves (RCs) were then created by plotting the MEP values over a range of TMS intensities. The slope of the RCs reflected changes in cortical excitability. The meditators showed a decreasing RC slope after twenty-minute meditation periods in comparison with their RC slope before meditation. The meditators also showed decreased cortical activity after the twenty-minute periods. Although the functional significance of motor cortex activation during meditation is unknown, perhaps motor systems play a role in a more complex circuit activated during meditation.

X-RAY RADIATION DOSE RESPONSE OF ARTICULAR CARTILAGE

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Governor's School for Science and Mathematics
Mentor: Delphine Dean, Department of Bioengineering, Clemson University
Advisor: K. Sris

One of the methods for treating cancer is radiation therapy, which destroys both unhealthy and healthy cells. Furthermore, radiation therapy may potentially damage the body. Articular cartilage absorbs the pressure applied by joints which would otherwise cause pain. Arthritis occurs due to weakened cartilage that no longer absorbs as much pressure. This makes it difficult for patients to move. This project focuses on the effects of radiation on articular cartilage and targeting the cellular or physical changes within the cartilage. The changes could occur either in the cellular matrix or the cell chondrocytes. A porcine foot was dissected and
samples of cartilage were extracted to test with doses of two Gray. The samples’ elastic modulus was tested with the use of an Atomic Force Microscope before and after radiation. The media, which holds the samples, was changed and the old media was placed in a tube on zero, one, three, five, and seven days. The media analyzed a Dimethylene Blue Assay which showed the amount of glycosaminoglycans released into the media. Lastly, the samples received a Hematoxylin & Eosin staining which examines the chondrocytes. The research showed that the articular cartilage weakened after radiation. Also the glycosaminoglycan count inside the media was higher on the first day for the radiated samples than the control samples. More research must be conducted to examine the changes to the cartilage to help prevent cartilage weakening from radiation.

THE ABSORBENCY OF SIX BRANDS OF PAPER TOWELS
Jordan Nwanagu
Heathwood Hall Episcopal School

The purpose of this experiment is to determine, which of six paper towel brands has the best absorbency. This will be to determine whether a paper towel of the same size will have the same amount of water it can absorb. The independent variables were the paper towel brands used and the dependent variable was the amount of water absorbed by the paper towels. After the testing, results show that Brawny had the highest absorbency per 11 inch by 6 inch sheets. With a mean of 22.8 mL, Brawny has the highest absorbency.

STRUCTURAL HEALTH MONITORING IN PLATE-LIKE STRUCTURES USING PIEZOELECTRIC WAFER ACTIVE SENSORS
Bailey Oedewaldt
Governor's School for Science and Mathematics
Mentor: Lingyu Yu, Department of Mechanical Engineering, University of South Carolina
Advisor: Stephen Kaczkowski

Structural Health Monitoring with Piezoelectric Wafer Active Sensors (PWAS) provides an effective and affordable in-situ method for damage detection and provides a proactive method of damage detection in aging aerospace structures. The Piezoelectric Wafer Active Sensors use changes in the symmetric and anti-symmetric LAMB wave modes to detect damage. These wave modes were measured
on a pristine steel plate and graphed. Varying types of damage were then simulated on steel plates, and the graphs created from changes in the waveforms were compared to the pristine case graphs. These graphs provide a highly visual comparison that allows Piezoelectric Wafer Active Sensors to be used to detect damage between routine system checks and can thus prevent undetected damage in plate-like structures.

**UTILIZATION OF NON-WOODY BIOMASS AS A LOCAL FUEL SOURCE**  
Abraham Oh  
The Center for Advanced Technical Studies

Biomass pellets today are seeing increased use and recognition throughout the world. Commercially available pellets are commonly made from local hard and soft woods in the area; sometimes agricultural waste, such as corn stover, is also used. However mass production of woody biomass pellets requires trees to be cut down while the non-woody biomass is obtained as a waste product. Many experiments have been conducted to determine the best source for local biomass pellets from local flora, mainly in other countries such as Ireland. Biomass selected in the midlands regional area of South Carolina for this study includes corn stover, bamboo, pine straw, and hydrilla. The efficiency of non-woody biomass was tested against woody biomass that is commercially sold to create a study that provides a local alternative to woody biomass. The biomass was torrefied for various time intervals due to initial moisture content. After blending and sifting the biomass, pellets were made with a ratio of five grams of biomass and three grams of paraffin wax binder. The pellets were placed into a modified paint can so that the pellets would heat up a 250 mL beaker of distilled water that is suspended through the lid. The change in temperature of the water was used to determine the specific energy of the pellets. All of the non-woody biomass showed to have higher specific energies than the wood pellets.
Lipid rafts are domains in the cell membrane characterized by having higher cholesterol concentrations than other domains. Because certain proteins are suggested to consistently partition in rafts, it is hypothesized that rafts facilitate proteins’ activity. Literature suggests that Ras proteins anchor in the raft phase. However, previous research conducted with a planar model membrane shows that the N-Ras protein actually has no significant preference for the liquid-ordered (raft) phase over the liquid disordered (non-raft) phase of the membrane. Unpublished experimental data shows that N-Ras prefers to anchor in the raft phase over the non-raft phase at higher membrane curvatures. The hypothesis here is that the same will hold true for the H-Ras protein. A theoretical approach was used. Because biological systems proceed towards thermodynamic equilibrium, computations to minimize the free-energy and entropy cost of a system can be used to see which processes will most likely occur. A computer program was created using Fortran to create a model membrane and measure the ratio of the mole fractions of the anchors associated with N-Ras and H-Ras in the liquid ordered phase to the mole fraction of these anchors in the liquid disordered phase (Xlo/Xld). First, the effect of curvature on N-Ras was computed and compared to experimental data to validate the theory. Then, computations were carried out for H-Ras. The data strongly confirmed the hypothesis by showing that H-Ras has a significant preference for the liquid ordered phase over the liquid disordered phase in more highly curved membranes. This supports the contentious raft hypothesis by showing that H-Ras would prefer to partition in rafts in curved membranes (which are more realistic than planar membranes). This is also significant in showing that proteins’ anchors (rather than the protein as a whole) play the major role in determining where the proteins anchor as the experimental data (which took into account the entire protein) agreed with the theory (which took into account only the anchors).
Concrete is the most common and most efficient building material today. However, some of the materials used in concrete (Portland cement, gravel, sand, and water) are not as easily found in developing countries. The purpose of this experiment is to determine if crushed container glass will be an effective replacement for gravel and or sand, the aggregates in concrete. The hypotheses of this experiment are: 1) Adding crushed container glass to the traditional concrete mixture will increase the flexural strength of concrete; 2) Replacing the sand component of concrete with crushed container glass will increase the flexural strength of concrete; Experimental 3) Replacing the gravel component of concrete with crushed container glass will increase the flexural strength of concrete. The null hypothesis is that the glass will have no effect or an adverse effect on the flexural strength of the concrete. To test these hypotheses, a total of 30 samples of concrete using glass in place of or in addition to the usual aggregates were tested against 10 control samples using a testing method adopted from industrial methods. The unit of measure will be pounds per square inch (psi). The experiment Groups of this test will be: control (Portland cement, gravel, sand, and water), Experimental Group One (Portland cement, gravel, sand, water and glass), Experimental Group Two (Portland cement, glass, sand, and water), and Experimental Group Three (Portland cement, gravel, glass, and water). The testing platform consisted of two lower support beams laid on their wider axis and on a separate deck, a piece of wood laid on its thinner axis. Each concrete sample was placed on the two support beams and the third piece of wood was centered on the sample and applied force to the concrete. The control Group had an average flexural strength of 6.2 psi. Experimental Group one’s average was 4.3 psi. Experimental Group two’s average was 2.8 psi. Experimental Group three’s average was 0.6 psi. After the testing, none of the hypotheses were supported by the data. Therefore, the null hypothesis was unable to be rejected. Even though the data did not support the original hypotheses, the concrete with gravel replaced with glass could be an effective building material for light building support. However, Experimental Group Three (no sand) was a very ineffective load-bearing material and would not be suitable for construction.
Patients that have End Stage Renal Disease are greatly encouraged to get a kidney transplant rather than having life-long dialysis treatment. There are many steps to obtaining a kidney transplant: medical suitability, interest in transplant, referral to a transplant center, first visit to center, transplant workup, confirmation as a successful candidate, being put on a waiting list or identify living donor and receiving the transplant. However, all of these steps can be a barrier. The surveys sent to Georgia, South Carolina and North Carolina will be analyzed and categorized to get their opinion on women’s barriers they may face.

A STUDY OF THE AMOUNT OF BACTERIA THAT LINGERS ON DIFFERENT CUTTING BOARD MATERIALS
Sonali Parmar
Heathwood Hall Episcopal School

The purpose of this study is to determine whether the type of cutting board (wood, glass, rubber, and plastic) is associated with the amount of bacterial colonies that are present. This study is beneficial to chefs or anyone working in the kitchen who might be concerned about keeping working conditions safe and sterile. The hypothesis was, “If a wooden cutting board is contaminated with a ground turkey nutrient broth, then the amount of bacteria on the wooden cutting board will be greater compared to the amount of bacteria on the plastic, glass, and rubber cutting boards.” The null hypothesis was, “If a wooden cutting board is contaminated with a ground turkey nutrient broth, then the amount of bacteria on the four boards will not differ from each other.” Wood, glass, rubber, and plastic cutting boards were contaminated with a ground turkey and nutrient broth solution. Each cutting board had its own control group, which was spread with nutrient broth. The boards were then washed with 100 mL of sterile water and the rinse water was plated. The dishes were placed in the incubator for 24-48 hours. The results of this experiment contained significant variation among each trial. After running several ANOVA tests it was determined that the differences in bacterial growth were not statistically significant. Therefore, the null hypothesis was accepted.
KRUPPEL-LIKE FACTOR KLF4 DEFICIENCY DECREASES FIBROBLAST CONTRACTION
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University of South Carolina School of Medicine
Advisor: Jennifer Taylor

There are over 51 million surgeries in the United States annually which makes the skin recovery process a concern among many Americans. Wound healing takes place after any cut or burn to the skin. Contraction by cells called fibroblasts is critical to the wound closure process. In addition, it has been shown that the expression of Kruppel-like factor 4 (KLF4), a transcriptional factor, “in mouse hair bulge stem cells plays an important role in cutaneous wound healing” (Li et al., 2012). However, it is unclear which specific cells at the wound site are affected by KLF4. We hypothesize that KLF4 promotes wound healing by regulating fibroblast function since it has been previously shown to affect the control the function of pulmonary fibroblasts (Jean et al., 2013). To test this hypothesis, we performed a contraction gel assay using fibroblasts purified from the skin of KLF4 knockout mice. Using a combination of 1:4 and 1:1 cell to gel ratios as well as 0.5 mL and 1mL gel volumes, optimal conditions for future contraction assays were determined. The assay showed that the 1:1 ratio and 1mL volume combination most clearly demonstrated the effect of KLF4 knockout on fibroblast contraction. The contraction assay at 1:1 ratio and 1mL volume revealed that KLF4 deficiency decreases contraction, confirming that KLF4 regulates the function of fibroblasts in contraction, a critical component of wound healing. In the future, these findings could be used to identify therapeutic strategies to accelerate wound recovery by targeting the KLF4 in fibroblasts

EFFECT OF DIFFERENT CONCENTRATIONS OF LEMON JUICE AS FACIAL ASTRINGENT AGAINST PROPIONIBACTERIUM ACNES
Tulsi Patel
Dutch Fork High School

People of all ages are afflicted by extensive skin acne. Current medications such as tetracycline and benzoyl peroxide can harm sensitive skin and be costly. Lemon juice is a home remedy that can be effective against acne due to its acidity. Other home remedies that have been previously researched include turmeric, tea tree oil, and lavender oil due to excellent antimicrobial properties. Remedies against acne
target bacteria in the sebaceous glands. This study will test the effects of lemon juice as a facial astringent by applying different concentrations of lemon juice to Staphylococcus aureus, a bacterium of the skin known to cause acne. The nutrient medium will be prepared to mimic skin conditions via maintaining skin pH, oil levels, and temperature. Using the Kirby-Bauer disk diffusion method, the effectiveness of the remedy will be quantified by the radius of inhibition. This study will ideally yield an effective treatment for acne due to the controlled environment of bacterial growth.
THE EFFECT OF DIFFERENT INTENSITIES OF UVB LIGHT VS DIFFERENT INTENSITIES OF FULL SPECTRUM GROW LIGHTS ON THE GROWTH RATE OF RAPHANUS SATIVUS

Will Pertile
Heathwood Hall

The purpose of this project was to ascertain if different intensities of UVB and the grow lights effected the height of Rapid Radishes. This topic is important because it helps agriculturists know how to protect their plants from harm. The hypothesis examined is if the level of the intensities are increased/decreased, then it will positively/negatively affect the plants height. To do this project one must buy 200 rapid radish seeds, set up 2 tables with correct lights and intensities in each, prepare seeds, make sure to have 33 cells per plant group, fill soil ⅔ way full in each cell, put 2-3 seeds per cell, add fertilizer, dampen soil, use water-lick system with wick and all, make sure water system is working, check growth height every 1-3 days, and one must do this for about 20 days or until plants are fully grown. The results of this experiment proved that the hypothesis proposed was supported and that the data collected rejected the null hypothesis proposed. The 100% and 50% grow light plant groups had the tallest plants but the 50% grow light plants had the lowest germination rate out of all the plants. The 100% and 50% UVB plants weren’t as tall as the other two grow light groups. Additionally, the 100% UVB plants died before any of the other group's plants did. That is all the facts about the data collected in this experiment. One can conclude that the different intensities of the lights do affect the plants growth rate.

THE PURIFICATION AND CHARACTERIZATION OF MAZF, A BIOLOGICAL SCISSOR IN ESCHERICHIA COLI

Ashley Peterson
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Mentor: Tzuen-Rong Tzeng, Department of Biological Sciences, Clemson University
Advisor: Lance Riddle

The goal of this research is to purify and characterize MazF so that its mRNA cleaving properties can be used to develop a more effective treatment against human proliferative diseases. MazF is a bacterial toxin found in various kinds of bacteria, e.g. Escherichia coli, Bacillus subtilis. It is typically produced along with the anti-toxin MazE during the lag and log phases of bacterial growth. However, when MazE is not present during the stationary phase, MazF has the ability to inhibit mRNA translation by cleaving mRNA at the ACA sequence. This induces
apoptosis and can be used to help control cell proliferation in diseases such as cancer. In this experiment, the mazF gene was amplified through PCR with specific primers and run through a gel electrophoresis in order to validate the presence of the gene. The plasmid was electroporated with electrocompetent cells in order to transform JM109 E. coli cells and maintain the plasmid. Then the electroporated bacteria was first cultured on LB + Ampicillin plates to ensure that only successfully transformed cells could survive. After being transferred to LB plates and then back to LB + Ampicillin plates again, the mazF plasmid was extracted and purified in order to determine the transformation efficacy and eventually verify the function of the gene.

ANALYZING THE ROLE OF NEUROPILIN 2 AND ITS ISOFORMS IN THE EPITHELIAL MESENCHYMAL TRANSITION PROCESS BY SHORT-HAIRPIN RNA TECHNIQUE

Kendell Peterson
Mentor: Robert Gemmill, Department of Medicine, Medical University of South Carolina
Advisor: Bhuvana Parameswaran

Neuropilin 2(NRP2) is a membrane bound protein that is a receptor for ligands, which are signal triggering molecules. The induction of NRP2 is important in the EMT process, as it is crucial to the conversion of non-aggressive tumors to aggressive tumors. To analyze its role in EMT the endogenous Neuropilin 2 must be knocked down. The knockdown of the cell’s own NRP2 gene insures that the only NRP2 present is from a Neuropilin gene containing vector. The RNA molecule shRNA is used to knockdown the NRP2 gene. However, shRNA cannot distinguish between the endogenous gene and the exogenous so mutations must be made in NRP2 that would make the exogenous gene resistant to shRNA knockdown. To accomplish this result QuikChange site- mutagenesis technique was employed. PCR analysis of NRP2a and NRP2b clones was done to check for the mutant DNA. The clones that contained the DNA were sent out to be sequenced. Western blot analysis was also done on genetically modified cell lines that contained the mutant NRP2 to check if the cells contained NRP2 in the exogenous region, but not in the endogenous. Out of the six clones that were sent out to sequencing four of them were correct. The mutants were identified on the gel and the cell lines generated exogenous NRP2.
THE EFFECT OF SAND, WATER, OR CONCRETE ON THE THERMAL CAPACITY OF A SOLAR HEAT CAPTURING DEVICE

Payton Phillips
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The purpose of this research project was to analyze the effectiveness of water, sand, and concrete as thermal storage materials in a solar heating device; to explore the possibility of supplying inexpensive heat to a room. Tests were conducted to determine which material would store the most thermal energy and release the most energy as heat. The device was designed to be placed against a window, which allowed the materials to capture the sun's energy as heat during the day. The device consisted of four separate twelve by twelve inch boxes and was surrounded with insulation except for the window side. Fans on the back of the device pushed air through each box continuously. A temperature probe was placed in front of each intake and output opening exiting into the room. The purpose of this design was to allow measurement and comparison of the input and output air temperature. The temperature was measured every fifteen minutes for nine days. Data were averaged and analyzed using a one-way ANOVA test(=0.05). The mean of the change in temperature (ºC) for the control was 0.662, concrete 0.778, sand 0.785, and water 1.136. The results showed water had the greatest change of temperature and held the heat energy the longest during the time when it was not exposed to sunlight. This experiment provides validation of an inexpensive solar heat capturing device and tested materials that can provide an efficient way to heat a room finding water to be the most efficient material.

THE DISCREPANCIES IN BALLERINAS' ACTUAL AND PERCEIVED KNEE HYPERMOBILITY

Kathryn Phipps
Dutch Fork High School

Hypermobility in ballet is aesthetically desirable for dancers and choreographers as they are obsessed with the lines dancers' bodies make. Unfortunately, however, the hypermobile knee joint is more susceptible to injury, especially in the already strenuous physicality of dance. Dancers may be overextending their knees to try to obtain more desirable lines, which could be leading to the high knee-injury rates seen in dance. Therefore, it was hypothesized that ballerinas would overestimate their knee hypermobility. Ballerinas manipulated a Vici doll to measure their perceived hypermobility and their actual hypermobility was measured with a goniometer. Through statistical analysis of discrepancies between these
measurements, with considerations of demographic information collected in a questionnaire, it was expected that this study would reveal a psychological bias towards the hyperextended line. The information from this study could lead to further studies looking at the psychology of dance rather than solely on the physiology of the technique.

SURVEY DESIGN TO EFFECTIVELY MEASURE TECHNOLOGY INTEGRATION IN SOUTH CAROLINA SECONDARY SCHOOLS
Franklin Piedade
Governor's School for Science and Mathematics
Mentor: Laura McKinney, New Carolina
Advisors: Robert Fletcher, Jeff Wisdom

Technology is in widespread use throughout South Carolina’s secondary classrooms, but whether or not it is used effectively is unclear. New Carolina, a thinktank in South Carolina, sought to uncover student’s opinions regarding the use of technology in the classroom. This research developed and tested a survey for this purpose. The results of this small survey are intended to be used as a test trial of a much larger survey aimed at all of South Carolina’s high school students. The research included designing test questions for an online survey as well as design of the suggested methodology of presenting the results. The trial was conducted with a small sample of students from the South Carolina’s Governor’s School for Science and Mathematics, with whom the researcher had immediate access. Despite the small sample, the response rate was 69%. This compares to an accepted average response rate of 30%, also noting that the accepted valid number of responses is 45. The research also indicated that the best way to detail results is through graphical analysis. This trial survey provides insight regarding survey response rates and response times, albeit likely a best case scenario.
Knowledge about antibacterial agents is starting to reach new people and places, which sparks a search for easy and efficient filtration systems. The purpose of this experiment was to find a safe and efficient process to purify drinking water by using vinegar, hydrogen peroxide, and sodium percarbonate saturated in a coffee filter. It was hypothesized that filters soaked in sodium percarbonate would have significantly less amount of colonies than compared to the control group not affected by the chemicals. The data collected for this experiment were obtained by counting the colonies of Bacillus cereus grown after a day of incubation. A one-way ANOVA test was performed, showing that the three filters were statistically different compared to the control group, rejecting the null hypothesis \( F(3,116) = 357.51; \) \( p<0.001 \). In conclusion, the study indicates that all of the chemicals the coffee filter was saturated in had a positive effect towards controlling bacterial growth.

The purpose of this project is to determine the specificity of Iron-Oxide nanoparticles functionalized with GM3 towards the adhesin molecule on E. coli 13762, which causes bloody diarrhea in newborn piglets and calves. The bio-functionalized nanoparticles form aggregates in the presence of E. coli 13762, acting as a competitive inhibitor for the pathogen and cell interaction. Results of this research will determine if the use of Iron-Oxide nanoparticles as a non-antibiotic approach to microbial infections is effective. The optimal ratio between nanoparticles and bacteria will be determined eventually through serial dilutions of E. coli 13762 and nanoparticle. By looking at each dilution under the microscope to observe aggregation induced by the bio-functionalized nanoparticles we can compare the ratios to find the best one. Calculations of the CFU/mL and a Live/Dead assay will be used to eventually determine the inherent toxicity of the nanoparticles, and a mixed culture assay will determine the specificity of the bio-
functionalized nanoparticles. In attempting to find the optimal ratio no aggregation was present at the dilutions, however, we do expect to find the best ratio. The preliminary research on toxicity shows that the nanoparticles are not toxic because there was no reduction in the concentration of the cells. This implies that the Live/Dead and luminescence assays may indicate the non-toxicity of the nanoparticles. It is expected that E. coli 13762 will show specificity in the mixed culture assay that will be developed.

THE EFFECT OF ENVIRONMENTAL AND TRADITIONAL CARPET CLEANERS ON RED WINE CARPET STAINS
Samantha Piper
Heathwood Hall Episcopal School

The purpose of this research is to compare the ability of eco-friendly cleaners with respect to traditional cleaners on red wine carpet stains. The experiment is carpet squares stained with shiraz (red wine) which is then cleaned with two traditional cleaners and two environmental cleaners. The independent variable is the type of cleaner, whether it is a traditional or environmental cleaner. The dependent variable is how clean the two different types of cleaner make the carpet square after the stain is cleaned. The results conclude that traditional cleaners do not perform better than environmental cleaners. All of the cleaners were successful though at clearing a majority of the stain.

THE EFFECT OF DISCHARGE ON SPECIFIC CONDUCTANCE FROM THREE DIFFERENT SITES WITHIN THE SANTEE RIVER BASIN
Madison Pobis
Spring Valley High School

Water quality is classified based on numerous factors, but many of the factors cannot always be continuously monitored in every part of a given watershed. Two of the most commonly collected data points include streamflow, or discharge, and specific conductance. Finding a correlation between some of these common variables could help scientists more closely monitor water quality without specialty testing, labs, or expensive equipment. The purpose of this experiment was to determine if there was a statistically significant correlation between discharge and specific conductance values at various sites in the Wateree watershed. It was hypothesized that there would be a significant correlation between discharge and specific conductance and that the resulting regressions would be able to determine an
approximate value of specific conductance. Using the National Water Information System, data from August, September, and October 2012 for both discharge and specific conductance were used to create quadratic regressions for each of the three sites selected. The hypothesis that discharge and specific conductance were significantly correlated was found to be significant at the Wateree and Enoree river sites, $F(2, 91)=80.05, p=<0.01$, $F(2, 91)=132.08, p=<0.01$, but not at the Broad river site. It was found that only the observed and predicted values at the Enoree river site did not show a significant difference, $F(1,183)=0.01, p=0.939$ at $\alpha=0.05$, which supported that the regression was a valid predictor. Thus, an accurate regression was found to predict conductivity at the Enoree site, but these regressions should not be used as a determinant for water pollution.

OPTIMAL FORAGING THEORY WITH WRITING SPIDERS (AURANTIA ARGIOPE)

John Price
Greenville Technical Charter High School

This experiment will test the Optimal Foraging Theory; it states that an organism will feed on the prey that produces the most calories, while taking the least amount of time. Cannibalism is very prominent in the wild with spiders, technically a spider's sibling has all the nutrients that the spider needs to survive and grow. This theory will be tested by placing a spider with different prey than it would face in wild, including one of its siblings. This will prove what the spider's optimal prey would be, whether it is a fruit fly, mealworm, or its sibling. This can be done by separating the spiders I have in captivity into their own containers and adding different prey: flightless fruit fly, mealworm, and one of its siblings. If the spider eats the sibling over the other prey, then that would be its optimal prey.

THE EFFECT OF COLOR ON THE PERCEPTION OF FLAVOR IN VANILLA ICE CREAM

Olivia Price
Heathwood Hall

The purpose of this experiment was to investigate whether or not altering the physical appearance of vanilla ice cream had an effect on the perceived flavor. The results from this study could be hugely beneficial towards consumer affairs. The color of food has a large impact on people's flavor perception; it is a visual element that makes it such a valuable marketing tool. Thus proving that the results from
this experiment can service many businesses that promote food or drink. This study uses live simulation, in which humans observed the ice cream and took a pre survey based on observation, then after completing the pre survey they then tasted the ice cream and took a post survey. The color of the ice cream was manipulated and accuracy was measured. The hypothesis was that the color of the vanilla ice cream would effect the perception of flavor. Colors that had several possible flavors, such as red or blue, were more difficult to perceive. In conclusion, this experiment will benefit consumer affairs by illustrating that the color of a substance is important because it can affect their sales and growth as a business. If their product looks unappealing in color then people will be reluctant to purchase it.

SONAR FOR THE VISUALLY IMPAIRED
Matthew Quan
Heathwood Hall

This project studies the effectiveness a device that the visually impaired may use in place of a blind cane to detect physical obstructions such as chair legs and tables. In the past many visually impaired have used white tipped canes to detect objects in their surroundings. But the problem with the canes is they cannot be used to detect elevated objects such as a chair. The device constructed consists of a sonar sensor coupled to an Arduino Uno Prototyping Board. Sensory data was interpreted to the user via pulses from a TENS unit (Transcutaneous electrical nerve stimulation). This is the first recorded device that uses a TENS unit to interpret sensory data. For this experiment test subjects walked towards the various sides of a chair and a face of a wall with a sonar device connected to their arm. They were asked to stop when they could feel a pulse in their arm that was created by small electrical pulses that came from a TENS unit. The results show that the TENS unit was able to transmit the sensory data to the test subjects well. The front of the chair had a 96% detection rate. The back of the chair had a 92% detection rate. The side of the chair had a 46% detection rate, and the wall had an 84% detection rate.
THE EFFECT OF A FERMENTING YEAST MOSQUITO TRAP ON THE CAPTURING OF MOSQUITOES IN COLUMBIA, SOUTH CAROLINA
Nicolas Quan
Heathwood Hall Episcopal School

Female mosquitoes are not only a nuisance for their bites that leave itchy bumps on your skin, but also for their possibility of transmitting diseases to you. Because of both of these problems, mosquito traps are used to capture mosquitoes and specifically mosquitoes carrying malaria or yellow fever such as Anopheles gambiae and Aedes aegypti respectively. There are many commercial mosquito traps, but they can be expensive and are not environmentally friendly. In this study, the use of a cheaper and more environmentally friendly mosquito trap using fermenting yeast was investigated to see if the trap could catch mosquitoes, and if it would be a good alternative to the commercial traps. The fermenting yeast mosquito traps were created from one-liter bottles, and solutions of sugar, water, and yeast were placed inside. Over the course of nine days, the yeast fermented in the sugar water, producing carbon dioxide to attract mosquitoes. The results for all nine of the days showed that no mosquitoes were caught; however, some fruit flies were caught. It was concluded that the fermenting yeast trap does not work for catching mosquitoes in Columbia, South Carolina, but does work as a fruit fly trap. Mosquito species in other areas could respond to the fermenting yeast and be caught with this trap, but not the ones in Columbia, South Carolina.

MARKER ASSISTED SELECTION FOR RED COLORATION IN PEACH [PRUNUS PERSICA]
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Governor's School for Science and Mathematics
Mentor: Ksenija Gasic, School of Agriculture, Forestry & Environmental Sciences, Clemson University
Advisor: Jennifer Brown

Red skin coloration, or blush, is an important trait for fresh market peaches. High red skin coloration is appealing to the consumer’s eye and the anthocyanin compound associated with blush provides flavor and nutrients important in daily human diet. Blush is quantitatively inherited and presents practical challenges in selection. To overcome the limitations of traditional breeding in developing high blush peach cultivars, application of molecular marker(s) associated with the blush development via marker-assisted selection (MAS) is evaluated. Previous research reported a major QTL locus, Blush.Pp.ZC-3.1, is associated with the blush in peach.
There are four functional alleles at blush locus that determine high, moderate, and low blush phenotypes. Two single nucleotide polymorphism (SNP) sites flank the blush QTL, SNP_IGA_341962 and SNP_3_12878608, distinguish each functional allele and were tested for early determination of blush phenotypes. Two of the function alleles, a and b, are hypothesized to relate to the high blush phenotypes and low blush phenotypes, respectively. These two SNPs were converted into Cleaved Amplified Polymorphic Sequence (CAPS) markers, B1 and B2, respectively, and tested for their MAS potential in peach. Allele a is hypothesized to be AA in B1 or TT in B2, being associated with a high blush. While allele b is hypothesized to be GG, with a lower blush, in the blush segregating F2 progeny. The markers were also tested on peach germplasm to evaluate their potential to predict level of blush. Further research will be necessary in order to determine whether these markers may become a useful molecular tool for identifying the level of blush prior to the phenotyping methods currently used at peach tree maturity.

EFFECT OF VARIOUS ELECTROLYTES ON THE ELECTROLYSIS OF WATER
Jacob Rabinovitch
Greenville Technical Charter High School

Electrolysis is a general term used to describe the process in which an aqueous solution or compound is decomposed into the elements that comprise it. In the case of water, this is done by passing an electrical current through the liquid in order to decompose $\text{H}_2\text{O}$ into the diatomic gasses Hydrogen ($\text{H}_2$) and Oxygen ($\text{O}_2$). However, the actual process is more intricate with regards to the voltage, current, type of electrodes, and perhaps most importantly, the electrolyte. Pure water by itself does not ionize freely, which is necessary in order for ions to travel to the oppositely charged electrode. Because of this, another substance needs to be added to the water in order to enable the solution to conduct electricity. My experiment tests various ionic salts and substances in order to observe the effects that each has on the quantity of gas that is synthesized in a given time under constant conditions, such as electrode type, voltage, amperage, measure of added substance, and measure of distilled water.
A MORE CREDIBLE ARTIFICIAL INTELLIGENCE PROGRAM
Edwin Rachwal
Dutch Fork

This project deals with designing a basic artificial intelligence program that is able to obtain more credible websites for a user who does not wish to be bothered with results from websites such as Twitter or Facebook. Artificial intelligence programs such as Watson of IBM and Siri of Apple have revolutionized the AI world, but we are still a long way away from AI units being able to 100% function and “think” like humans. This program will assist people who are working on school projects, for example, and need to find credible and useful information that will aid them in completing their task. The user interface for this project will be fairly simple and will consist of solely a field in which to type what the user is looking for and an area that will display the results of the search after invalid sources have been filtered out.

THE COMPARISON OF THE MINIMUM INHIBITORY CONCENTRATIONS OF ALLIUM SATIVUM, TRACHYSPERMUM AMMI, AND HYDRASTIS CANADENSIS ON ENTEROBACTER AEROGENES.
Teebro Rahman
Spring Valley High School

As humans continue to use antibiotics to fight off bacterial infections, bacteria are quickly evolving to gain stronger resistances to many of the antibiotics we use. An alternative is needed that is cost-effective, has potent antibacterial properties, but one that does not cause the bacteria to gain resistances quickly and render it ineffective. The purpose of this experiment was to find botanical alternatives to many of the common antibiotics we use in today’s society. So, 3 different plant extracts were compared, using minimum inhibitory concentration tests. The plant extracts were made into 3 different standard solutions e.g. 100%, 25%, and 6.25% for each of the 3 plant types, and then compared with each other along with a control group to find the lowest concentration of each plant extract that contained bactericidal properties. 10 trials were done for each of the 10 treatments. This was done by applying 0.3 mL of a treatment to a microtiter well and then inoculating it with bacteria, and counting the subsequent colonies. The lowest concentration with a statistically significant mean colony count was considered to be the MIC. An one-way ANOVA was performed, F(9,91)=2.01, p=.047, and since P-value < alpha value(.05), a significant statistical difference among treatment types was detected. However, post-hoc analysis Scheffe tests could not find any specific significant
differences for E. aerogenes colonies among treatment types, therefore no minimum inhibitory concentrations could be conclusively determined in this study.

THE DESIGN AND EX-SITU TESTING OF A PROTOTYPE CHOPPED LASER REFLECTIVITY TOOL FOR USE IN ULTRA-HIGH VACUUM

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Advisor: Clyde J. Smith

Traditional diamond growth involves high-pressure and high-temperature techniques which are both complex and expensive to implement. As part of an effort to explore new growth methods which utilize lower pressures and energetic ions, flexible techniques for monitoring growth are required. Laser reflectivity is one candidate method to measure diamond growth rates and structural changes in an ultra-high vacuum environment. In particular, laser reflectivity has the advantage of providing measurements without breaking vacuum or removing the growth substrate. In order to implement this method in-situ, baseline tabletop measurements of the behavior and interactions of a He-Ne laser and associated equipment were made ex-situ. The experimental set-up included a mechanically chopped He-Ne laser which was reflected from materials under various conditions such cleaned and dosed surfaces, different metals, surfaces under heat application, and measurements with artificially introduced light pollution. The chopped laser reflected from these surfaces was detected using a photodetector plus lock-in amplifier set-up. The lock-in-measured voltages gave peak voltage values consistent with non-interference from light pollution. Additionally, the set-up gave voltage vs. time plots which were time-stable and insensitive to ambient conditions at a level which warrants a transition of the design for future testing in-situ. If successful, this will provide a low-cost, non-destructive method for tracking diamond and other thin film growth.
A COOL LOOK AT EFFICIENT ROOFING
Samuel Rennick
The Center for Advanced Technical Studies

The research involved in this project attempts to answer the fundamental question, if dark colors absorb heat then why are the roofs on almost all of South Carolina houses black? The project focuses on the differences in the thermodynamic properties of various roofing materials. This study will enable consumers to make informed decisions concerning potential savings in utility costs for cooling homes in the hot summer months, while reducing the stress on the cooling system of a house and indirectly eliminating greenhouse gas emissions. The project began with a proof of concept experimentation using a small foam board house with black and white interchangeable roofs. Sixteen minute trials were conducted using high intensity lamps and multiple temperature probe recording devices in the scale house. Each trial begins with one minute with no lamps on to obtain a baseline temperature for the house interior, attic space, and roof surface temperature. Results from these tests show that white-colored roofs reach a significantly lower maximum temperature than compared to black-colored roofs. The next experimental phase consisted of building large, interchangeable wood roof pallets to fit a wood scale-model home. A black asphalt shingle roof, white shingle roof, galvanized steel roof, and a white metal roof where constructed. Experimental trials were designed using two 1,200 Watt halogen lamps to act as an indoor, controlled sun. The experimental trials consisted of a five minute base temperature acquisition, a nine hour interval under the lamps and a four hour cool-down interval. The trials have so far concluded that the white metal roof is up to 40% cooler than the black shingled roof.

THE GENE HSF-1 IS REQUIRED FOR CBE MEDIATED PROTECTION AGAINST ALZHEIMER’S DISEASE IN CAENORHABDITIS ELEGANS
Logan Richardson
Governor’s School for Science and Mathematics
Mentor: Yuquing Dong, Department of Biological Sciences, Clemson University
Advisor: Stephen Kaczkowski

Aging remains an unavoidable process associated with numerous medical complications such as Alzheimer’s disease (AD), Parkinson’s disease (PD), and Huntington’s disease (HD), but certain Nutraceuticals have been found to reduce the effect of aging and stress in various model organisms. Recent studies from our lab have suggested that cranberry extract (CBE) at an optimum concentration has
an anti-aging and anti-stress effect in the nematode model system Caenorhabditis elegans. CBE supplementation acts through the insulin/IGF-signaling pathway via DAF-16 and components of p-38 MAP kinase pathway. In our study, we observed that CBE can ameliorate the symptoms of Ab1-42 mediated toxicity in transgenic Caenorhabditis elegans where Alzheimer's disease was modeled. There was a delay in Alzheimer's disease mediated paralysis in CBE treated nematodes. Using an RNAi feeding library, various genes were silenced in worms including hsf-1. A paralysis assay was carried out to check to see if the genes were involved. hsf-1 was found to be essential for CBE mediated protection against AD.

THE EFFECT OF SCARIFICATION WITH 3% HYDROGEN PEROXIDE SOLUTION, 3% HYDROCHLORIC ACID SOLUTION, OR 3% ISOPROPYL ALCOHOL SOLUTION ON THE SEEDS GERMINATION RATE OF WISCONSIN FAST PLANTS (BRASSICA RAPA)

Isabelle Robinson
Heathwood Hall

This study investigated the effect of scarification with 3% hydrogen peroxide, 3% hydrochloric acid, and 3% isopropyl alcohol, on the germination rate of Wisconsin fast plant seeds. This study is beneficial for gardeners and botanist that desire to know what chemicals negatively affect germination rate of Wisconsin fast plant seeds. This investigation could make an impact in what gardeners or botanist use for the planting of Wisconsin fast plant seeds. The motivation in doing this project was to discover how seed growth can be influenced by outside chemicals. The problem that was being studied was the rate at which a Wisconsin Fast Plant seeds germinated in regard to the liquid that the seed was presoaked in. In order to make progress in solving our problem the seeds were soaked the seeds in 3% hydrogen peroxide, 3% hydrochloric acid, and 3% isopropyl alcohol solutions, and then they were planted. The amount of seeds germinated was then measured every day for the next week. The hypothesis was, if a Wisconsin fast plant seed was scarified in 3% hydrochloric acid, then the germination rate would be more negatively affected than if the seed were scarified in 3% hydrogen peroxide, or 3% isopropyl alcohol. The results, supporting the hypothesis, indicate that the only liquid that affected the germination rate of the Wisconsin fast plant seeds was 3% hydrochloric acid. This was also the conclusion of the experiment. These results will prove beneficial to a small group of people, if they are beneficial at all.
ANALYZING THE PROFITS OF BITCOIN MINING IN RESPECT TO POOL CONTRIBUTION
Derek Rodriguez
Dutch Fork High School

Recent years have shown the rise of cryptographically enforced currencies, the most notable of these being bitcoin. Instead of relying on a central organization to regulate the currency to ensure its functionality, anonymous computer systems work together in the form of pools to verify transactions by processing their respective cryptographic hashes to verify the integrity of the transaction. Computers that verify these transactions are rewarded with a payout in bitcoins. This research will consist of using an application-specific integrated circuit (ASIC) to verify bitcoin transactions in these pools to determine the relationship between the payout system of the pool and the workload contribution that the specific ASIC grants to the server. The hypothesis based on current theoretical information is that there should be a zero-order correlation between contribution and data, because larger pools with more processors must divide payout rewards into smaller portions, whereas smaller pools spend more time working on the hashing and less time queuing for a new transaction. Therefore, over extended periods of time, change in the percentage contribution should not affect the net bitcoin revenue of the ASIC. However, analyzing the data using Pearson's product-moment correlation produces an r-value of -0.35, and visualizations suggest a negative correlation, which does not agree with the current hypothesis.

THE EFFECT OF WHITENING PRODUCTS ON THE COLORATION OF TEETH
Sharmila Samuel
Greenville Technical Charter High School

Many people use whitening products in hope of whiter smiles, but not all products work the same way. One brand of whitening strips may white faster compared to another whitening strip based on the amount of hydrogen peroxide used. In this experiment, the effectiveness of different over-the-counter teeth whitening products will be tested. The products will consist of whitening strips, whitening paste, and home-made whitening. Each brand contains a different amount of hydrogen peroxide, which has the most effect on the quality and time of the whitening. To test this, teeth will be stained and the chosen whitening product will be used to remove the stain. The products will be used for approximately two weeks, close to the approximate amount of time required to use these products to see results. After the
UNDERSTANDING THE IN VIVO ROLE OF FZLC IN BACTERIAL CELL DIVISION THROUGH A LONG TERM GROWTH COMPETITION
Maddie Sansbury
Governor's School for Science and Mathematics
Mentor: Erin Goley, Department of Biochemistry, Johns Hopkins University
Advisor: Jennifer Taylor

Understanding the mechanisms behind cell division allow for multiple improvements to be made in the biochemical field. Caulobacter Crescentus, an aquatic bacterium is a distinct example of asymmetric cell division. Caulobacter Crescentus divides using a Z ring composed of the GTPase FtsZ. FtsZ is known to localize the inner membrane division protein, FzIC, to mid-cell. FzIC is thought to tether FtsZ to the cell wall but is not necessary for cell division. When FzIC is removed from Caulobacter Crescentus, the cells maintain proper function and morphology. The exact mechanism FzIC plays in cell division is unknown. To better understand the role FzIC plays in Caulobacter Crescentus cells, we conducted a long term growth competition assay. This was used to test whether cells containing FzIC had a growth advantage over cells lacking FzIC (ΔfzIC). Based on previous experiments, our hypothesis was that over a long period of time, wild type cells would eventually out compete the ΔfzIC cells. Our results did not support our hypothesis and showed that there is no significant difference between wild type cells and ΔfzIC cells. Perhaps, one explanation for this result is that FzIC works with another protein in the cell. If this were the case, removing only FzIC would have no effect but removing FzIC and another protein would cause a change in the cell. In the future, after a better understanding is reached, knowledge of the divisome will better help us asses known issues with cell division.
THE EFFECT OF LEPTIN RECEPTOR ANTAGONIST ADMINISTRATION ON RAT SKELETAL MUSCLE METABOLIC GENE REGULATION
Mathias Schreiner
Governor's School for Science and Mathematics
Mentor: James Carson, Department of Exercise Science, University of South Carolina
Advisor: Bhuvana Parameswaran

In 2010, the obesity epidemic claimed the lives of almost 80,000 Americans and was the 7th leading cause of death in the country. A better understanding of leptin's role in obesity should bring scientists closer to identifying therapies that successfully prevent or treat the condition. Leptin regulates metabolism and hunger, and increases proportionally to adiposity. Leptin receptor antagonists (LRA) block the activity of the leptin receptor (Ob-R). The purpose of this study is to determine the effects of LRA on skeletal muscle metabolic gene expression. We hypothesize that rats injected with LRA will have lower expression of skeletal muscle metabolic genes than rats given placebo treatment. Male rats were injected with either leptin antagonist or a vehicle every day for 16 days. A subset of rats were removed from the antagonist treatment and sacrificed ten days later. A leptin injection was administered to all treatment groups 45 minutes before sacrifice. Muscle was harvested for analysis during sacrifice. mRNA levels of mitochondrial biogenesis (PGC1) and glucose transport (GLUT4) genes were measured by quantitative PCR. LRA administration significantly increased rat body weight, p<0.02. Removal from antagonist treatment normalized body weights to control levels. Increase in fat weight accounted for much of the overall weight increase, p<0.05. Muscle: weight ratios were significantly lower in LRA-treated mice than in other groups, p<0.01. A better understanding of the leptin receptor's role could eventually lead to better treatment options for patients.

CLOT OR NOT? COMPLICATIONS OF WARFARIN AND ANTIBIOTICS
Anna Scott
The Center for Advanced Technical Studies

Many patients are on the blood thinner warfarin and antibiotics at the same time. This could be potentially dangerous to the patient if they are not closely monitored by a doctor. Depending on the antibiotic, the blood could become too thin or too thick leading to excessive bleeding or a clot. These issues would cause the patient to stay in the hospital for a longer time period to keep them safe. Information will be collected from many patients who have been prescribed warfarin. If patients are
over the age of 18, have been on warfarin for greater than 48 hours, and their INR (blood thickness) is in range, they will be included in research. The patients that are collected will then be separated into two groups, one with patients just on warfarin and the other with patients on warfarin and antibiotics. No significant data has been collected yet. After looking at the patient information, the expected outcome is when patients are on warfarin and antibiotics, their medication dosage will be adjusted. If the dosage is not adjusted quickly enough, it is expected that the patient will stay in the hospital longer because the blood is out of range.

SYNTHESIS OF AG-AU-AG CORE-SHELL-SHELL NANOPARTICLES
Olivia Sequerth
Governor's School for Science and Mathematics
Mentor: Jamie Lead, Department of Environmental Health Services, University of South Carolina
Advisor: Kurt C. Wagner

Nanoparticles are now being used in a wide range of products due to their unique physical and chemical characteristics. Silver nanoparticles are one of the most popular due to their antimicrobial properties. With the amount of silver nanoparticles increasing in use, it is useful for us to look at the environmental impact they have, which, in the majority of cases, has shown to be toxic. To lessen their impact without stopping their production completely, we synthesized a silver nanoparticle that consisted of a three layer structure. A silver core was coated with a gold shell and capped with a second silver layer. The gold layer has a low solubility in water and so should reduce the risk of the nanoparticle completely dissolving and reducing the release of ions into the environment. The experiment started with the creation of a silver seed particle, which would later become the core, using a mixture of silver nitrate, sodium borohydride, and disodium citrate dihydrate. The concentrations were varies to produce a range of sizes until we could produce them with the same consistently. Next, we added a gold layer and then another silver layer of a different isotope so that we would be able to detect whether the gold layer prevented the silver core from dissolving into the environment. The AFM, UV-Vis, and DLS were used to determine the size, absorbance peak, and images of the nanoparticles throughout the process.
EFFECT OF SALINITY ON THALASSIA TESTUDINUM GROWTH
Ryann Shealy
Dutch Fork High School

Thalassia testudinum is a marine grass that grows along the coast of the Gulf of Mexico. It is the main food source of many different species of endangered turtles, which are key animals in the ecosystem's food web. Climate change melts glaciers which causes the salinity of the ocean to decrease. If this change in salinity affects Thalassia testudinum, then it could negatively affect the several populations and disturb the ecosystem. It is hypothesized that as the salinity increases or decreases, the growth of Thalassia testudinum will decrease. Thalassia testudinum was grown in varying salinities between 0.00 ppt and 60.0 ppt and a pH of 8. If the results show that the growth of Thalassia testudinum is decreased by salinity change, then global climate change could affect the ecosystem through Thalassia testudinum. If these results were concluded, then it would create a greater awareness for global climate change.

THE EFFECT OF THE ADDITION OF ZINC SULFATE HEPTAHYDRATE ON INHIBITING THE REPLICATION OF COLIPHAGE T4(T4R+)
Nigam Sheth
Spring Valley High School

Recently there has been great talk about Zinc as a natural alternative to today's harsh, chemically manufactured antiviral drugs. Its a relatively new field of antiviral medicine but shows great promise from studies. The purpose of this experiment was to observe if zinc sulfate heptahydrate could inhibit the replication of the Coliphage T4(T4r+) virus. It was hypothesized that the zinc sulfate heptahydrate would inhibit the replication of the virus, because it would deem cell membranes impermeable to the viral sheaths. The methods used in this experiment were to prepare 32 petri dishes with nutrient agar and culture E.Coli B on each plate as a medium to observe the inhibitory effects of the zinc sulfate heptahydrate. The dishes were then infected with the virus, given a prescribed amount of zinc, and overlayed with an agarose solution to develop plaques, which is how the inhibition was quantified. The control dish received all the aforementioned procedures except for the addition of zinc sulfate heptahydrate. By finding a correlation coefficient it was found that 92.73% of the inhibition was due to the zinc sulfate heptahydrate. A regression analysis was also done finding a strong negative correlation in the number of plaques per dish with a higher concentration of zinc sulfate.
heptahydrate. Therefore, it can be concluded that zinc sulfate heptahydrate had significant power to inhibit the replication of Coliphage T4(T4r+).

ROLE OF NRF2 TARGET GENES IN RESPONSE TO THYMIDYLATE SYNTHASE INHIBITORS IN HUMAN COLON CANCER
Paul Shim
Governor's School for Science and Mathematics
Mentor: Franklin Berger, Department of Biological Sciences, University of South Carolina
Advisor: Jennifer Taylor

Thymidylate synthase (TS) is involved in the de novo synthesis of thymidine-5'-monophosphate (TMP) and is the target for the chemotherapeutic agent, 5'-fluoro-2'-deoxyuridine (FdUrd). The effectiveness of FdUrd chemotherapy is often hindered by the development of drug resistance commonly associated with increased levels of TS. It has recently been shown that NF-E2 related factor (Nrf2), a master regulator of antioxidant response, is involved in resistance to chemotherapy including FdUrd. In this study, we examined the expression levels of several Nrf2 target genes in various colorectal cancer cell lines that have developed resistance to FdUrd. In most of the cell lines in which the levels of TS were increased, the levels of the Nrf2 target gene expression were downregulated. Resistance to chemotherapy tends to correlate with an increase in TS levels but a decrease in Nrf2 levels. Further studies will allow us to determine if Nrf2 target gene downregulation is mechanistically linked to FdUrd resistance.

DEVELOPMENT OF A SYSTEM TO ANALYZE CHANGNING THIN FILM SUBSTANCES ON A REFLECTING SURFACE
Andrew Shore
Governor's School for Science and Mathematics
Mentor: Chad Sosolik, Department of Physics & Astronomy, Clemson University
Advisor: Clyde J. Smith

Diamonds can be grown by various methods using large force and/or energy. One method of doing this is bombarding a surface with highly charged ions in an ultra-high vacuum environment to promote the formation of carbon into the sp3 or diamond-hybridized form. The purpose of this study is to understand the optimal mechanics of designing a system to analyze the change of a thin film on a surface, with the ultimate goal of analyzing carbon films. The design was created in steps,
starting with the testing of the He-Ne laser using a Michelson interferometer, then the effectiveness of a photodetector using an oscilloscope, and finally a chopper wheel and lock-in amplifier were added in replacement of the oscilloscope to find the most effective frequency and number of slits on the chopper wheel. The system was evaluated by creating a series of voltage vs. time graphs to analyze the system with a nearly continuous data stream. A comparison with a plain sample (control), water film, and ethanol film was used to see how different films evaporated. Each film, and the control, was then heated to see how temperature affects the change in film over time. Results show that the film does alter the voltage reading and that heat speeds up the reaction but can also lower the output voltage due to warping of the reflecting material. This process will be used in situ to analyze the change of films on surfaces without having to break vacuum or otherwise contaminate the sample.

THE EFFECT OF VANITY AND HEALTH MOTIVATION ON WEIGHT LOSS
Rachel Shroyer
Spring Valley High School

Obesity is now almost classified as an epidemic. The purpose of this research was to discover how to motivate obese or overweight individuals to lose more weight. This will help decrease the obesity rates around the world. It was hypothesized that if a person’s motivation to lose weight was vanity based, then they would lose more weight than a person whose motivation to lose weight was because of health. A questionnaire was developed asking the age, gender, and primary motivation for each new patient admitted to Waistlines, a weight loss clinic. All patients that started the program after January 2013 were asked to participate. Body mass index (BMI) and blood pressure were collected every two weeks for three months. The primary motivation in the questionnaire was categorized as either health or vanity. All but two males were motivated by health. There was no significant BMI difference between health or vanity, F(2,65)= 1.64, p=0.203. However, there was a slight difference in BMI that suggested that health-motivated participants had a lower BMI than vanity-motivated participants. The results suggested that both males and females are most likely to lose weight for health reasons.
THE EFFECT OF MOTOR OIL CONCENTRATION ON THE COLONY COUNTS OF PSEUDOMONAS FLUORESCENS AND PSEUDOMONAS PUTIDA
Rakib Siddique
Spring Valley High School

The use of natural agents to break down hydrocarbons, known as bioremediation, became of increased relevance in several studies after its proven efficiency as an alternative cleanup method for the 1989 Exxon Valdez oil spill. The purpose of this research was to determine the concentration of motor oil at which the most bacterial growth occurred as evidence that the bacteria were able to utilize petroleum hydrocarbons as an alternative source of nutrition. It was hypothesized that more colonies would grow in petri dishes containing relatively light concentrations of motor oil. Each petri dish, with exception to those in an unpolluted control group, contained either a light or heavy concentration of motor oil mixed with non-nutritive agar and was then randomly inoculated with either Pseudomonas fluorescens or Pseudomonas putida. It was found that the colony counts were significantly different for the petri dishes that were incubated with Pseudomonas putida; F(2,28)=97.63, p<0.05, and a Scheffe test showed there were significant differences between pairs control versus light concentration, control versus heavy concentration, and light concentration versus heavy concentration. It was also found that colony counts were significantly different for the petri dishes incubated with Pseudomonas fluorescens; F(2,26)=159.81, p<0.05, and a Scheffe test showed there were significant differences between pairs control versus light concentration and control versus heavy concentration. Future research evaluating the potential of bioremediation can study the effect of environmental factors, such as temperature and nutrients, on the ability of various organisms to consume petroleum hydrocarbons.

THE EFFECTS OF CRANBERRY ON SILENCING SKN-1 AND PMK-1 PATHWAYS IN THE AGING OF C. ELEGAN WORMS
Ronak Sitapara
Governor's School for Science and Mathematics
Mentor: Yuqing Dong, Department of Biological Sciences, Clemson University
Advisor: Stephen Kaczkowski

One of the best model organisms to study aging, stress response, and age related pathologies is the Caenorhabditis Elegan due to its short lifespan and ease of handling. These nematodes are used as model organisms to study numerous age related pathologies including protein build up that leads to Alzheimer’s Disease.
In this study, it was observed that Cranberry extract (CBE) protects the worms against A-beta mediated paralysis as well as what pathways might play a key role in this process. RNAi mechanisms were used to silence certain genes of interest and a paralysis assay was performed to check for the progression of the paralysis phenotype. This assay involved an observation of the worms every 2 hours to see the progression of paralysis, and this would provide an idea about the rate of paralysis. Previously, it was hypothesized that skn-1 and pmk-1 mediated pathways played a key role in this process. The study showed that these factors were not involved in this protection process provided by CBE.

**THE EFFECT OF POMACEA DIFFUSA SNAIL MUCUS ON THE INHIBITION OF ESCHERICHIA COLI**

Adiv Sivakumar
Spring Valley High School

Infections are a common occurrence with wounds because various pathogens find an open wound to be a fitting breeding ground. More feasible and abundant sources of protection against such infections would be quite helpful to medical institutions and people around the world. The purpose of this study was to see if snail mucus could serve as a potential inhibitor of E. coli. It was hypothesized that if Pomacea diffusa snail mucus is smeared on dishes of E. coli, then the snail mucus would inhibit the growth of the E. coli. This experiment was carried out by having 2 groups: the control group with no treatment and the independent variable group with the snail mucus treatment. Each group had 5 petri dishes each divided into 4 zones cultured with E. coli bacteria. The mucus treatment was applied to the independent variable group, and all the petri dishes for both groups were incubated for at least 24 hours. The dishes were then taken out to determine the zones of inhibition of the E. coli for the treatment and to calculate the average for each group. A t-test was conducted to compare the averages of the two groups and see if there was a significant difference. Because the p-value (0.4370) was greater than α (0.05), the null hypothesis that the sample means were equal was not rejected. The mucus treatment did not significantly inhibit the E. coli growth.
ROLE OF QUANTUM EFFECTS IN THE INTRAMOLECULAR PROTON TRANSFER IN 10-HYDROXYBENZO[H]QUINOLINE
Michael Slattery
Governor's School for Science and Mathematics
Mentor: Sophya Garashchuk, Department of Chemistry & Biochemistry, University of South Carolina
Advisor: Phelesia Jones-Cooper

When 10-hydroxybenzo[h]quinolone (HBQ) is in an excited state, proton transfer within the molecule is possible. Our research aims to replicate the proton transfer studies of Lee et al. using HBQ. The primary focus of the investigation was to verify the theoretical predictions of proton transfer. The structure of this heterocyclic system, HBQ, was most suitable for the study of excited state intramolecular proton transfer. The state of the molecule during the proton transfer was studied using computer simulations. In this study, proton transfer was found to occur when the molecule was in a triplet electron spin configuration and tunneling occurred when using deuterium. We concluded that tunneling was dependent on energy as well the mass of a transferred particle. Furthermore, the proton transfer only occurred in an excited state. Future experiments are projected that will involve more in depth investigation on the tunneling effects.

THE CORRELATION BETWEEN LEVEL OF SPIRITUAL/RELIGIOUS STRENGTH AND LEVEL OF PERCEIVED SOCIAL SUPPORT IN VETERANS DIAGNOSED WITH POST-TRAUMATIC STRESS DISORDER
Dorothy Smith
Spring Valley High School

Throughout history, the number of men and women diagnosed with post-traumatic stress disorder (PTSD), a disorder caused by enduring a traumatic event, "outside the range of usual human experience," has rapidly increased (Chamberlin, 2012). As a result of current wars, twenty to thirty percent of veterans return with PTSD. Because there is no definite cure for PTSD, the correlation between two known variables, such as religious strength and perceived social support, is important to know for application and manipulation. It was hypothesized that there would be a positive correlation between the two variables. Surveys were compiled using the Multidimensional Scale of Perceived Social Support and the Duke University Religious Index and distributed to 30 veterans with the diagnosis of PTSD and 57 without. Of the fourteen correlation coefficients
found between the subscales of the survey, three showed a significant correlation; perceived social support (PSS) and religious strength, \( r (30) = -0.402, p < 0.02 \), PSS from friends and non-organizational religious activity, \( r (30) = 0.514, p < 0.02 \), and PSS and intrinsic religiosity, \( r (30) = -0.487, p < 0.02 \). It was also found that veterans with the diagnosis of PTSD have significantly lower levels of PSS and of religious strength than those without. \( (z (57, 30) = 2.335, p < 0.02 \), and \( z (57, 30) = -4.410, p < 0.02 \), respectively) Because of the insignificant/unexplained correlations, it was concluded that the hypothesis was only somewhat supported by the data and further research is necessary.

THE EFFECT OF SCARIFICATION WITH 3% HYDROGEN PEROXIDE SOLUTION, 3% HYDROCHLORIC ACID SOLUTION, OR 3% ISOPROPYL ALCOHOL SOLUTION ON THE SEED GERMINATION RATE OF WISCONSIN FAST PLANTS (BRASSICA RAPA)
Carter Smith
Heathwood Hall Episcopal School

This study investigated the effect of scarification with 3% hydrogen peroxide, 3% hydrochloric acid, and 3% isopropyl alcohol, on the germination rate of Wisconsin fast plant seeds. This study is beneficial for gardeners and botanist that desire to know what chemicals negatively affect germination rate of Wisconsin fast plant seeds. This investigation could make an impact in what gardeners or botanist use for the planting of Wisconsin fast plant seeds. The motivation in doing this project was to discover how seed growth can be influenced by outside chemicals. The problem that was being studied was the rate the a Wisconsin Fast Plant seeds germinated in regard to the liquid that the seed was presoaked in. In order to make progress in solving our problem the seeds were soaked the seeds in 3% hydrogen peroxide, 3% hydrochloric acid, and 3% isopropyl alcohol solutions, and then they were planted. The amount of seeds germinated was then measured every day for the next week. The hypothesis was, if a Wisconsin fast plant seed was scarified in 3% hydrochloric acid, then the germination rate would be more negatively affected than if the seed were scarified in 3% hydrogen peroxide, or 3% isopropyl alcohol. The results, supporting the hypothesis, indicate that the only liquid that affected the germination rate of the Wisconsin fast plant seeds was 3% hydrochloric acid. This was also the conclusion of the experiment. These results will prove beneficial to a small group of people, if they are beneficial at all.
Eutrophication is the excessive load of nutrients within a body of water, causing excessive phytoplankton growth, while killing the other organisms that inhabit the environment. Cyanobacteria are a type of phytoplankton that thrive in eutrophic waters. Cyanobacterial blooms produce toxins which make the body of water uninhabitable for other organisms. Current methods of inhibiting cyanobacterial growth are often expensive and cause more harm to the environment. The purpose of this experiment was to find an environmentally friendly method for reducing cyanobacterial blooms and improving water quality by using natural plant extracts. It was hypothesized that the highest amount of Rosmarinus officinalis extract (5 mL) would be the most efficient for inhibiting cyanobacterial growth. Microcystis aeruginosa was inoculated into bowls and was grown for 13 days. The rosemary and thyme extracts were then prepared by adding 10.95 g of each herb into 500 mL of distilled water and boiling it for about 35 minutes. Each amount of extract (0 mL, 1 mL, 3 mL, and 5 mL) was then pipetted into their respective test tubes containing the Microcystis aeruginosa and were grown for an additional two days. Then the %Absorbance of each test tube was measured using a spectrophotometer. Data were statistically analyzed at alpha equal to 0.05 with an ANOVA. There was not enough evidence to suggest that there was a difference between the means of each amount of the extracts, F(7, 97)=1.095, p= 0.373, therefore the hypothesis was not supported.

STATEWIDE OCCUPATIONAL TRENDS IN SOUTH CAROLINA INFORMATION TECHNOLOGY
Kayla Sommers
Governor's School for Science and Mathematics
Mentors: Karl McCollester, IT-oLogy
Advisor: Robert Fletcher and Jeff Wisdom

From 2010 to 2012, the total number of jobs in the United States grew by 2.5%, to 130 million, while wages for these jobs grew by 3.1%, to $45,790. This study focused on whether the same growth rates held true in the IT job market of the United States and, more specifically, in South Carolina. In the U.S., IT job growth outpaced overall job growth, increasing at 7.6%, leading IT jobs to rise as a percentage of total jobs, from 4.8% to 5.1%. While IT wage growth slightly trailed that of the overall job
market, growing at only 2.1% percent, IT wages remained significantly higher than
the average wage by 52.6%. In South Carolina, researchers examined the three
largest Metropolitan Statistical Areas (MSAs): Charleston, Columbia, and
Greenville. Findings from this research, in summary, revealed that (1) the MSA
with the greatest IT job increase was Charleston, which grew at 5.9% to 10,284; (2)
the MSA with the greatest IT wage increase was Greenville, which grew by 6.9% to
$59,361; and (3) the MSA with the greatest percent of IT jobs in the state was, for
all three years, Columbia, however, its lead declined from 26.3% to 23.3%.

EFFECT OF FREE TUBULIN ON VOLTAGE-DEPENDENT ANION CHANNEL
DURING RESPIRATION IN CANCER CELLS
Gina Song
Governor's School for Science and Mathematics
Mentor: John J. Lemasters, Department of Drug Discovery & Biomedical Sciences,
Medical University of South Carolina
Advisor: Bhuvana Parameswaran

Two mechanisms of cellular respiration are glycolysis and mitochondrial
metabolism. In the Warburg phenomenon, proliferating cells, including cancer cells,
mostly generate ATP through increased aerobic glycolysis and not through
mitochondrial oxidative phosphorylation. Since previous research has shown that
free tubulin regulates VDAC’s conductance and mitochondrial metabolism in cancer
cells, the hypothesis of this research states that high free tubulin in cancer cells
blocks VDAC and suppresses respiration in the Warburg metabolism and that
reversal of tubulin inhibition of VDAC will have an anti-Warburg effect that
enhances respiration and decreases glycolysis. The aim of this research is to
determine the role of free tubulin for Oxygen Consumption Rate (OCR) and
Extracellular Acidification Rate (ECAR) using a XF Seahorse Analyzer in
increasing or decreasing respiration in cancer cells in the presence or absence of
drugs that stabilize or destabilize microtubule polymerization. The HepG2 cells
were treated with three different drugs: 10µm Nocodazole, 10µm Colchicine, and
10µm Paclitaxel respectively. The results indicate that the tubulin drugs had no
effect on Oxygen Consumption Rate and Extracellular Acidification Rate. Therefore,
closing VDAC had no effect on respiration. These results indicate that proliferating
cells shut out oxidative phosphorylation by a different mechanism. For future
research, one could consider altering the drug dosage concentration for each
microtubule destabilizer and stabilizer or using different tubulin drugs to see if they
have a different effect on HepG2 cells.
EFFECT OF ACONITIUM NAPELLUS, SULPHUR, AND PHOSPHORUS AS HOMEOPATHIC REMEDIES ON STREPTOCOCCUS PNEUMONIAE
Morgan Sox
Dutch Fork High School

This experiment is studying the effects of common homeopathic remedies, Aconitium napellus, Sulphur and Phosphorus on Streptococcus pneumoniae, a bacteria commonly associated with community-acquired pneumonia. Homeopathy is used as an alternative to damaging and costly antibiotics in order to aid the body in curing itself; however it is a common belief that effects from these remedies are a result from the placebo effect. This experiment either disprove or accepted the hypothesis that as the dose of homeopathic medicine increases, the amount of bacteria left remains unchanged. If the remedies had a positive effect on the bacteria then the Streptococcus pneumoniae will not continue to expand. The methods of this experiment include the application of these homeopathic remedies to the bacteria in varying quantities: the recommended dose, half of the recommended dose and twice the recommended dose. The number of bacteria colonies were counted using one of the following: Gram Stain, Incubator, Hemocytometer, or Spectrophotometer. If the bacteria in the petri dishes diminished or stopped increasing and the T-test stated that the results are statistically significant, then it would be safe to conclude that the used homeopathic remedies did not only treat the body, but also affect the bacteria and further aid the curing process. However if the bacteria continued to increase and the results of the T-test concluded statistical irrelevance, then it can be concluded that the homeopathic remedies used rely solely on aiding the body and/or the placebo effect.

Keywords: Streptococcus Pneumoniae, Homeopathy, Aconite, Sulphur, Phosphorus

USING SIMON AS AN EFFECTIVE SCREENING TOOL FOR COGNITIVE IMPAIRMENT
Rose Steptoe
Dutch Fork High School

Cognitive impairment is a growing problem in the U.S. as the population of the elderly increases. Cognitive impairment has many indicating tests with varying levels of accuracy and efficiency; however, there may be other tools that are faster or more sensitive. This study focused on the use of the Simon Game, a game which tests memory while simultaneously incorporating spatial and learning skills, as a screening tool for cognitive impairment. Simon was administered to 100
participants over the age of 65, with a brief, standardized explanation before the screening. All patients were also administered the Mini Mental Status Examination (MMSE), a current, widespread screening tool used to test for cognitive impairment. All patients’ Simon scores were compared to their MMSE scores, and then the correlation between the two was determined. It was hypothesized that the Simon game scores and MMSE scores of the 100 participants would have a positive correlation. A positive correlation would indicate the potential of Simon as a screening tool.

DOES INDIVIDUAL AND ENVIRONMENTAL SIMILARITY AFFECT PROBLEM SOLVING SKILLS?

Hunter Street
Greenville Technical Charter High School

The effect of surrounding similarity does not improve or decrease the amount of problem solving skills taking place in a classroom. While similar clothing might improve the interaction and treatment of fellow students, as other studies have concluded, decreasing the amount of stimulation and increasing individual similarity has no affect. Therefore, I have concluded that problem solving skills is a combination of personality and idea construction during the time of mental development.

DOCTOR-PATIENT CONNECTION FROM A MOBILE APPLICATION TO A WEB SERVICE: CONNECTIONMD

Adaya Sturkey
Governor's School for Science and Mathematics
Mentor: Tom Finnegan, Center for Innovation & Entrepreneurism, Medical University of South Carolina
Advisor: Elizabeth L. Bunn

The goal of this project was to create a system that connects a smart phone glucometer mobile application to a database and display the information on a web service that is accessible by physicians. The mobile application, which this system was based upon, is an existing application that has a corresponding external device used to gather the information for the application. Microsoft SQL Server was used to create the four-table database. Microsoft Visual Studios was used to create the web service, which consisted of five separate web forms. A business plan was created consisting of five major components. All of the components of the project
were not finished and there are still several projections for the project for the future.

THE EFFECT OF THE ANGLE OF ATTACK OF THE GOLF SWING ON THE TOTAL DISTANCE THE BALL TRAVELS
William Sullivan
Spring Valley High School

Every golfer is on a constant quest to hit the golf ball farther. There are many factors that influence the total distance the ball travels. This research focused on the effect of changing the angle of attack. The purpose of this experiment was to discover the angle of attack that would produce the most distance. The angle of attack is the angle relative to the ground of the club head path at impact. This experiment tested angles of attack of -6 degrees, -3 degrees, 0 degrees, 3 degrees, and 6 degrees. It was hypothesized that 6 degree angle of attack would produce a greater total distance than any of the other four angles. Three different participants were used and each participant hit ten shots for each angle of attack. The data for each shot was recorded with a Vector Pro launch monitor device. The 6 degree (M = 260.1, SD = 13.8) and 3 degree (M = 253.5, SD = 10.6) angles of attack yielded more distance than the 0 degree angle of attack (M = 245.1, SD =11.1), which averaged longer than the -3 degree angle of attack (M = 229.4, SD = 12.3), and the -6 degree angle of attack (M = 213.7, SD =11.1) averaged the shortest total distance. Their was a statistical difference from each angle of attack, (F(4,145) = 75.77, p < .001). Tukey tests were performed and it was found that the 3 degree and 6 degree angles of attack produced the farthest distance.

HOW HOMEMADE REPELLENTS AFFECT BLATELLA GERMANICA ACTIVITY
Caleb Thomas
Dutch Fork High School

What this project is attempting is to find a cheap alternative to professional exterminators, of which the price most homeowners are unwilling to pay. This project plans to conduct experimentation on the cockroaches and the effectiveness of homemade repellents, such as mint, bay leaves, garlic, to determine which cheap repellent is the most effective. This will be done by creating a controlled environment in which the cockroaches can't escape, and in which to reach food, the cockroaches must cross a line of repellent that is drawn across the walls, ceiling,
and floor of the environment. The effectiveness of each of the repellents is based on
the percentage of cockroaches that cross the repellent within a certain amount of
time. So far the data collected has shown that garlic clearly does not work as a
repellent, as all of the cockroaches crossed the line. Experimentation has not begun
with mint and bay leaves, as supplies are currently being mailed to the research
center. Conclusions cannot be deduced from the results so far, as it is not yet clear
which repellent is the most effective at repelling.

CO-CRYSTALLIZING PYRIDYL BIS-UREA MACROCYCLES WITH ALCOHOL
GUEST MOLECULES
Graham Tindall
Governor's School for Science and Mathematics
Mentor: Linda Shimizu, Department of Chemistry & Biochemistry, University of
South Carolina
Advisor: Phelesia Jones-Cooper

The organization of molecules within a crystal can determine their physical
properties including melting point and solubility as well as their optical and
electronic properties. Shimizu et al. has identified a disk like macrocycle that stacks
on top of one another to form vertical, crystalline columns. These columns are
packed close together and one might expect that the crystals would be non-porous,
but they have been found to absorb gas in a gas absorption test. It was proposed
that these columns move apart in order to absorb the gaseous particles and guest
molecules that contain a hydrogen bond donor. The purpose of this investigation
was to determine if this macrocycle could organize aromatic alcohols by forming co-

crystals. The synthesis and purification conditions of the macrocycles were
optimized and then different crystallization conditions were tested with a series of
alcohol containing guest molecules. Solid state analysis of the co-crystals will reveal
more about the optical, electrical and porosity that this compound. It will also
exhibit and provide insights into relationships between the crystalline structure
and the optical properties.
THE EFFECT OF DIFFERENT SOIL TYPES ON THE SOUND PRESSURE OF A SOUND WAVE
Prithvi Tippabhatla
Spring Valley High School

Nowadays, engineers are now able to design more stable buildings that are less likely to collapse if an earthquake were to hit. The rationale of this experiment is that the integrity of a building can be affected greatly by the stability of its foundation. If a building has a weak foundation, it will topple easily and be susceptible to various types of damage. By using soils that utilize their natural characteristics to slow propagation, a building can be assured to have a sturdier foundation upon which the structure and framework is built. It was hypothesized that if peat soil was placed in a box through which sound waves were propagated, then the highest sound pressure values would be exerted. The method of testing was to place each of the soils in an acrylic box through which 1200 Hz sound waves were propagated. Data was collected at ten second increments. Using an ANOVA test (followed by a Tukey test), it was found that the sandy soil, not the peat soil, exerted the largest sound pressure values. At a confidence interval of 90%, F(3, 36), p ≥ 0.05, so it can be concluded that the hypothesis is to be rejected. In conclusion, this experiment confirmed that the soil with the largest sound pressure values were exerted from the sandy soil.

FUNCTIONAL CHARACTERIZATION OF OSMIR408: A RICE MICRORNA POTENTIALLY INVOLVED IN PLANT RESPONSE TO ENVIRONMENTAL STRESS
Jensen Tomberlin
Governor's School for Science and Mathematics
Mentor: Hong Luo, Department of Genetics & Biochemistry, Clemson University
Advisor: K. Sris

Plant microRNAs (miRNAs) are a category of endogenous non-coding RNAs that impact biological processes, including plant responses to environmental stresses and plant development. The purpose of this research project is to subclone the rice microRNA gene OsmiR408 into a binary vector, and then transform it into Arabidopsis via Agrobacterium mediated transformation for future analysis. To do this, a 1066 bp of genomic DNA fragment containing full-length cDNA of the OsmiR408 was subcloned into an expression vector, and transformed into Agrobacterium via electroporation. The results show that the 1066 bp of DNA fragment was successfully subcloned into the binary vector, pHL651, and the vector
was transformed into Agrobacterium. The chimeric vector containing the OsmiR408 was delivered into Arabidopsis plant using the floral dip approach. In this research, DNA ligation, DNA digestion, E. coli and Agrobacterium transformation, colony PCR, plasmid DNA isolation, gel electrophoresis and floral dip transformation techniques were used to conduct the experiments, and determine the results.

COMPARING MØLLER SCATTERING, MOTT SCATTERING, AND ELASTIC ELECTRON-PROTON SCATTERING
Michael Tuten
Governor's School for Science and Mathematics
Mentor: Steffen Strauch, Department of Physics & Astronomy, University of South Carolina
Advisor: Mark A. Godwin

This research focused on determining a more accurate proton charge radius. The goal was to use GEANT4 simulation software to design an experiment to measure the radius of the proton, and then perform said experiment in the future to measure the radius. The experiment was set up in the following manner: A particle beam consisting of millions of electrons, positrons, and muons was aimed towards a liquid hydrogen target, and was set so that each particle obtained a momentum of 100 MeV/c2. A fraction of these particles reacted with the protons within the target, and scattered at various angles. Multiple detectors are positioned around the target, measuring the scattering angle and energy of the scattered particle. Scattered particles with energies of 10 MeV or more were of interest and were the focus of data analysis. For particles of interest, the scattering angle and energy data were sent to ROOT data analysis software, which graphed the data and made it interpretable. After interpreting the data, it was found that the simulated data did not agree with theorized data, leading to the conclusion that further modifications need to be made in order to accurately simulate the experiment. These steps may include the use of a different physics package, or a change in the program itself. The research was successful in determining what future action needs to be taken.
A STUDY OF HYPERBRANCHED POLYMERS AS A LESS TOXIC ALTERNATIVE TO COREXIT IN THE ALGAL SPECIES DUNALIELLA

Reagan Ulmer
Governor's School for Science and Mathematics
Mentor: David Ladner, Department of Environmental Engineering & Earth Sciences, Clemson University
Advisor: Kurt C. Wagner

This research intends to test the toxicity of hyperbranch polymers, of molecular weights 1200, 1800, 10000, 70000, and 750000. The polymers were compared to the toxicity of Corexit, a dispersant used in the Deepwater Horizon oil spill of 2008. We performed these tests on Dunaliella, which is a standard saltwater algal species. If hyperbranch polymers prove to be less toxic than Corexit, then they may be able to replace Corexit as the preferred dispersant. To test toxicity, a spectrophotometer was used to measure the optical density of the algae in solution. There was also a group of controls since the dispersants would cause optical disturbance of their own, one of the controls was just algae and media. Since different levels of dispersant would affect the algae differently, several different dispersant to oil ratios were tested; 1:25, 1:50, and 1:100. Each sample was tested in triplicate to minimize error. Each dispersant was also tested with no oil, keeping the different ratios but the second number was the amount of distilled water. The optical density values over the growth period of the algae will show the toxicity of the algae’s environment, whether hyperbranch polymers or Corexit hinder algal growth more. This research is in conjunction with a project testing the effectiveness of the different dispersants in oil.

WIRELESS ENERGY SENSING USING INDUCTIVE COILS

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Governor's School for Science and Mathematics
Mentor: Guoan Wang, Department of Electrical Engineering, University of South Carolina
Advisor: Clyde J. Smith

The goal of the research is to sense wireless energy using constructed inductive coils hooked up to a measurement device, which in this case is an oscilloscope. The inductive coils are created by wrapping magnetic copper wire around a cylindrical object such as a soda can. One inductive coil is placed into a breadboard, with wires connecting it to the oscilloscope. A base line wave is then recorded and a second inductive coil is brought near to the first without touching. The goal is to see if there
is a noticeable change in the wave, and to see how adding turns to or changing the
diameter of, the secondary coil affects the change in the wave. This can be applied
eventually to wirelessly charge devices or to sense a change in a circuit remotely

PORTABLE THERMAL ENERGY STORAGE IN ZEOLITE ADSORBENT BEDS
Aaron Vincent
The Center for Advanced Technical Studies

This study’s objective is to determine the feasibility of the development of an
efficient adsorption thermal energy storage system. It is through the reversible
process of adsorption in which excess thermal energy can be stored and released for
heat. In this study, water was chosen as the adsorbate and different zeolite
adsorbents will be tested to determine the effect of pore size on the amount and rate
of energy release from the device. Zeolite 3A, 4A, 5A, and 13X will be used as
adsorbents. Preliminary tests conducted utilizing zeolite 13X as a control
determined that the adsorbent bed device that produces the least heat loss to the
surroundings is constructed of Sharkbite PVC and 1 inch thick rubber insulation.
This device was used to conduct the remaining tests to determine the effect of pore
size on the energy release from the device. It was hypothesized that the energy
density would be greater as the pore size of the zeolite approaches the size of a
water molecule (3Å ~ 3Å). While zeolite 13X had the highest average energy
density of 118.5 kWh/m3, it was determined that more data needs to be collected to
strengthen the results. This type of technology is desirable due to the reverse
process of desorption, which allows the material to be used again and again with no
loss of thermal storage efficiency. With the development of such a renewable energy
storage device, excess energy can be stored until needed, such as in the solar
industry.

ANALYSIS OF SYNERGISTIC BEHAVIOR OF BIOCIDES AGAINST BIOFILMS
IN DRINKING WATER SYSTEMS
Himabindu Vinnakota
Spring Valley High School

Biofilms are responsible for up to sixty percent of all infections in humans. In fact,
biofilms are up to 1000 times more resistant to antibiotics than planktonic, or free-
floating, bacteria. Several mechanisms are thought to create this resistance,
including an altered bacterial metabolic state, the formation of persister cells, and
poor penetration of the matrix when antimicrobial treatments are performed on
biofilms. Hence, the need to find methods of effectively preventing and inactivating harmful biofilms is great. Biocides, such as hydrogen peroxide and copper sulfate have succeeded in achieving what antibiotics alone failed to do in eradicating biofilms in water. It was then hypothesized that using a combination of biocides, instead of a single one, would be more effective in eradication. The biofilm was grown in a pilot system developed by researchers that mimicked water’s path through plumbing. Hydrogen peroxide, sodium hypochlorite, and free nitrous acid were studied individually and in combination. Heterotrophic plate count (HPC) was used to analyze the presence of bacteria in the drinking water. Residual biocide material was also analyzed using the iodometric method. Lack of significant growth in the biofilm reactor inhibited the results of the experiment. The results recorded were inconclusive among the six treatments with p-values greater than the α value of 0.05. In conclusion, the hypothesis was refuted. These results will be further analyzed to better the design of the reactor and test different biocide treatments.

EMOTIONAL ANALYSIS THROUGH ART: SADNESS

Kylie Walker
Dutch Fork High School

Since psychological concepts have been analyzed, psychologists have been trying to define emotions. In recent years the need of these definitions has increased, especially in the behavioral and social sciences. This study analyzes the relationship between the subject’s emotional state and the presence sadness imagery in their drawings. One-hundred subjects ages 14-18 of various ethnicities, class difficulty and gender are involved in this study. The participants were then asked to draw their perception of sadness. These drawings were then evaluated according to the colors, themes and line elements that correlate with sadness. After the subjects completed their drawings they took the Emotional State Questionnaire (EST-Q) in order to determine whether the subjects possess high levels of sadness. It was hypothesized that those who have a higher score of sadness on the EST-Q would produce drawings with increased sadness imagery. This connection can be analyzed with techniques of art therapy. Art therapy is the contemporary psychology field that combines psychotherapy and visual arts to help individuals cope with mental and emotional issues. The findings from this study have the potential facilitate professionals when helping their clients cope with their emotions.
THE ALLELOPATHIC POTENTIAL OF IPOMOEA BATATAS ON THE GROWTH OF DIGITARIA SANGUINALIS
Sara Wallam
Spring Valley High School

Allelopathy is the ability of plants to affect the growth and development of other plants by releasing allelochemicals into the environment (Ayeni & Kayode, 2013). The purpose of this experiment was to research and test allelopathy and to determine the allelopathic potential of I. batatas, sweet potato, on the inhibition of D. sanguinalis, crabgrass. Sweet potato plants have allelopathic potential because they contain allelochemicals such as phenolic compounds. It was hypothesized that sweet potato aqueous extracts would inhibit the growth of crabgrass plants and seeds, and root solutions would be the most inhibitory. Sweet potato leaves, stems, and roots were used to make leaf, stem, and root solutions of different concentrations. These solutions were tested on crabgrass seeds and plants for two weeks. The seeds’ seed lengths and plants’ dry masses were measured. Two one-way ANOVA tests were conducted. Both null hypotheses were rejected because $F (9, 890) = 326.88, p < 0.05$ and $F (9, 790) = 540.65, p < 0.05$. It was determined that there were significant differences between the dry masses and seed lengths of the crabgrass plants in the difference solutions. The results of the Tukey tests showed that all the plants in the solutions were significantly different from the control plants, indicating that crabgrass was inhibited by all of the sweet potato solutions. It was determined that stem solutions were most inhibitory. These results were significant because it was concluded that sweet potato was an effective plant to use to inhibit the growth of crabgrass. This information could be used to make natural herbicides to inhibit weeds.

THE EFFECTS OF SIGNIFICANT WAVE-HEIGHT ON THE EFFICIENCY OF A LINEAR GENERATOR BUOY
Zachary Wallick
Spring Valley High School

Linear generators are an effective way to harness transverse ocean wave energy into usable power for electrical appliances. However, significant wave heights are constantly changing with varying weather systems and tides. Because of this, it is necessary to develop an accurate model of the relationship between the wave height, and the relative efficiency of a linear generator designed for harnessing the wave energy. Therefore, in this experiment, a constructed linear generator, utilizing Faraday’s law for magnetic induction, was monitored for voltage propagated when
the piston was attached to a peg with a specific radius distance from the axle on an AC gearmotor. The radius, at a certain distance from the center, dependent on the intended wave height, was representative of a sinusoidal wave function. The radius measurements used, which determined the amplitude of the model waves, were one, two, three and four centimeters, comparable to significant wave-heights of two meters, four meters, six meters, and eight meters, respectively. For each radii, 30 trials were conducted. The gearmotor which powered the rotation of the point of attachment, and, therefore, the linear generator, had a speed of 10 rotations per minute. Thus, each modeled wave had a constant period of six seconds. The hypothesis that as the model significant wave-height increases, the voltage generated by the linear generator would increase, but experience lower increases after a certain level, resembling a logistic function, was rejected. It was found that a linear function more closely resembled the correlation of the wave amplitude and voltage produced, $t(118) = 16.89, p < .001$.

EDUCATIONAL CORAL REEF GAME
Kevin Wang
Governor's School for Science and Mathematics
Mentor: Jijun Tang, Department of Computer Science & Engineering, University of South Carolina
Advisor: Elizabeth L. Bunn

It is often said that people learn better when having fun. Educational video games are designed to be both fun and informative. However, many educational video games are neither fun nor informative. ReefQuest, the game that we created, attempts to be both fun and informative by using the Unity 3D engine to developing an educational coral reef video based on the commercially successful game FarmVille. The game is based on material from the marine biology class at the University of South Carolina. The educational value of the game was then studied by having people play this game and fill in a survey about what they had learned. The results from out pilot study show that, in the same amount of time, people who learn about coral reefs through this game perform better on a test than people who used traditional methods, such as by reading.
HOW THE AMERICAN SHAD (ALOSA SAPIDISSIMA) REACTS TO BEING INTRODUCED INTO THE BROAD RIVER

Tal Wanish
Dutch Fork High School

Overfishing for American shad, Alosa sapidissima, is a problem that has been getting a lot of attention in recent years. Hunted for their oils and farmed for their young to be used as baits, the numbers of the American shad had declined rapidly, and many fish hatcheries in the United States have been focusing on reintroducing the shad and strengthening their numbers in various rivers around the country. This project studies the conditions of the Broad river, things such as turbidity, water temperature and pH, and will compare them with the vitality of shad later to see if it can work as a habitat for these fish. To find these measurements I will be using a dissolved oxygen meter and a water pH meter to get the required data. I will record the data myself and send a copy to my mentor at the Bears Bluff National Fish Hatchery in Bears Bluff, South Carolina. This experiment will provide evidence as to whether or not the Broad river is a good area to try and reintroduce the American shad, what factors may be affecting the vitality of the fish, and how quickly the population of the fish can grow to reach its previous size.

THE EFFECT OF AGE AND GENDER ON TIME PERCEPTION

Matt Watford
Heathwood Hall Episcopal School

The purpose of this project was to determine the effect of age and gender on time perception. First human consent forms were gathered from the test subjects, the testing room was set up to specific requirements, and the subjects were tested in a silent room for 2.5 minutes. After that, the subjects wrote down how much time they estimated has passed. This project has 41 pieces of data that were analyzed and that were put into the graphs and ANOVA analysis. In the real data five groups were tested including: males, females, teens, 30 year olds, and 50 year olds. Those groups were subdivided into two bigger groups that were: males and females together and then teens, 30’s, and 50’s. The independent variables were the age and genders of the test subjects and the dependent variable was how long they perceived the test to be. For the males and females, the F, .54, was less than the F-Critical, 4.41, meaning the two groups being tested weren’t statistically different and they two variables did not make that much of a difference. For the second group of tests the F, 1.43, was also less that the F-critical, 3.55, meaning the two groups were not statistically different. This data and analysis does not support my hypothesis that
was: a.) If the subject is male, then they will think the time passes by faster. b.) If the test subject is older, then they will think time passes by faster than the younger test subjects.

THE EFFECT OF AMBIENT TEMPERATURE ON THE EFFICIENCY OF A FUEL CELL
John Weiss
Heathwood Hall

The purpose of this research is to determine the efficiency of a fuel cell with an ambient temperature of 22.4° and 40.1° Celsius. The procedure involved the process to electrolysis using AA batteries to separate hydrogen and oxygen from water. Then the electrons from the hydrogen were used to power a small motor with electricity. Voltage, current, and time readings were taken during each of the two sections of the procedure, and each section was done ten times. A series of equations were done to get ten efficiency readings. Then all ten efficiency readings were averaged to create an average efficiency. This was done for the fuel cell under each temperature.

The fuel cell proved to be just as efficient for both temperatures, despite the massive difference in current readings. The average efficiency was determined to be 32.2% for both temperatures. The voltage readings proved to be about the same for both temperatures, but the current readings were significantly higher for the increased temperature. Therefore, all calculated data points for this temperature were significantly higher due to bigger, small numbers. It is important to recognize that when you multiply many different small numbers together, the product can vary, and the current readings were the smallest numbers. Although the calculated data was higher at 40.1°, the average efficiency was the same as room temperature. This is possible because two numbers generated a percentage created from a quotient. This is the same reason that 8/4 is the same as 100/50.
Mobile medication adherence applications are mobile apps that remind users when to take their medication. A product was developed that connects users with their respective doctors, which allows both of them to keep track of the medication. During the development of this product a .NET web service was used to connect a database in Microsoft SQL Server to web forms in Microsoft Visual Studios. The resulting app, iRX Tracker, was then analyzed financially and pitched to potential investors and customers. The medication adherence app market is already consists of hundreds of similar apps. Therefore, to introduce this application a business plan was developed to distinguish the app’s functions.

The purpose of the study was to determine a ratio of diagonal to horizontal truss members that caused the bridge to best support a load. It was hypothesized that if the ratio were increased, then the truss would be better able to support the load because the load would be distributed over a longer distance of the member material. The bridges were modelled using West Point Bridge Designer 2013. 8 bridge trusses were tested in this manner. These ratios were \( \frac{2}{3} \), \( \frac{3}{4} \), 1, \( \frac{7}{6} \), \( \frac{4}{3} \), \( \frac{3}{2} \), \( \frac{5}{3} \). Of these 8, the 5 that underwent the least stress were constructed using wood and nails. The ratios selected were \( \frac{3}{4} \), \( \frac{7}{6} \), \( \frac{4}{3} \), and \( \frac{5}{3} \). These were subjected to destructive testing using an AMT Structural Stress Analyzer 1000 and the maximum supported load was collected. The data showed that the more extreme ratios tended to support the load less well, while the more moderate trusses performed better. The ratio that supported the load best in the computer program was 1. The ratio that supported the load best in the destructive testing was \( \frac{4}{3} \). The hypothesis was not supported by the data collected. It was concluded that a higher ratio worked better for the destructive testing because the materials for the member were much lighter and therefore the truss did not undergo as much stress to
supporting its own weight. Possible sources of error included variation in construction and the use of a small sample size.

HEART MODEL FOR IMAGE-GUIDED ASD REPAIRS
Savanah Whitten
Governor's School for Science and Mathematics
Mentor: David Kwartowitz, Department of Bioengineering, Clemson University
Advisor: Jenny Salazar

Congenital heart disease occurs in 1076 out of 100,000 live births. Atrial Septal Defects (ASD), defects resulting in a hole between two of the atrium, account for 10% of these conditions. Currently, the standard method for fixing this defect is a transcatheter occlusion procedure. This procedure involves sending a catheter into the heart to fix the issue. Although this method fixes the problem, the patient is exposed to copious amounts of radiation from fluoroscopy. This exposure increases the likelihood of medical conditions associated with radiation for these patients in the future. To reduce the amount of exposure to radiation, and improve the surgical technique overall, an image-guided navigation system has been created. In order to test this image-guided navigation system, a phantom heart was created to emulate a human heart. Because a child's body is smaller, and radiation dose is cumulative, children are at greater risk from this exposure. Therefore, the phantom heart was created on the scale of a child's heart. This human heart model can be used for testing how long it takes to run the catheter through the body. Further investigation and a series of mock clinical experiments will be performed to design procedures for inserting devices into the heart while minimizing fluoroscopy use.

THE EFFECT OF POLYETHYLENE, POLYVINYL CHLORIDE, POLYPROPYLENE, AND POLYSTYRENE FOAM ON THE PH LEVEL OF SALTWATER
Austin Wiesehahn
Spring Valley High School

The purpose for experimentation was to observe if plastic pollution has an effect on ocean acidification. It was hypothesized that when polyethylene, polyvinyl chloride, polypropylene, and polystyrene foam are placed in test tubes filled with saltwater, then the pH level of the saltwater would become more acidic. Rectangular strips of plastics were placed into separate test tubes with 10 milliliters of saltwater and set under a UV lamp. The results of this experiment were collected by using a pH
probe after the two week time period. The null hypothesis that the pH of the control, polyethylene, polyvinyl chloride, polypropylene, and polystyrene foam were the same was rejected \((F(4,145)=39.69, p<0.001)\). This indicates that the four variables were statistically significant compared to the control group. Tukey post test showed that all of the household plastics used had an effect on ocean acidification.

**THE EFFECT OF ORIGINAL AND BLACK AND WHITE PAINTINGS AND PAINTING STYLES ON EYE MOVEMENTS AND FIXATIONS OF THE SUBJECTS PERCEIVING THEM.**

Mary Wilgis
Heathwood Hall

In this experiment is the effect of original and black and white paintings and painting styles on eye movements and fixations of the subjects perceiving them. This information could benefit the both artists and Ophthalmologists by providing insight into how the eye perceives black and white versus colored images, as well as images of varying styles. It was hypothesized that there will be a difference between color and black and white images with respect to eye movement and fixations of the subjects perceiving them. It was also hypothesized that there will be a difference between painting styles with respect to eye movement and fixations of the subjects perceiving them. This was accomplished by first gathering human subjects. These subjects were then asked to sit in front of a computer in a controlled environment and observe a set of fifty randomized images. The images that the subjects were exposed to included twenty-five black and white images and twenty-five original, colored images, and one white image. Within the original image category there were five Modernism, five Impressionism, five Baroque, five Surrealism, and five Expressionism images. These same images were converted to black and white for the contrasting category. The subjects’ eye movements and fixations were measured by software and computer systems, which were provided by Sensory Motoric Instruments, including SMI BeGaze™, SMI iView X™, and RED500. The revisits, average fixation (ms), average first fixation (ms), and average number of fixations was determined for each image using SMI BeGaze™. Also, a gridded AOI was created for each image. This data was analyzed using excel. Because none of the P-values were >0.05, the null hypothesis failed to be rejected, therefore the hypothesis was not supported.
THE EFFECT OF RADIOFREQUENCY EMFS EMITTED BY APPLE IPAD MINI© ON THE POPULATION GROWTH OF LEMNA MINOR

David Williams
Heathwood Hall

With the recent surge in the widespread use of electronic devices that emit non-ionizing radio frequency radiation, many people have become concerned with the possible harmful effects of exposure to these radio and microwave frequency electromagnetic fields (EMFs). A large number of studies have been conducted recently to assess whether adverse health effects to humans can result from the use of mobile phones, but only a small number of studies have been conducted to assess the effects on plants. Previous studies suggest that exposure to EMFs can have negative effects on plants. In this experiment, it was hypothesized that if Lemna minor are exposed to radiofrequency EMF waves emitted by an Apple Ipad mini© continuously for 12 days, their population growth would be significantly less than that of Lemna minor not exposed to radiofrequency EMFs. The effects of exposing Lemna minor to radiation of power density 191.0 microwatts/m2 at a frequency of 5 GHz was determined by exposing Lemna minor continuously to these levels of radiation from an Apple Ipad mini© connected to a 5 GHz Wi-Fi network. Radiation from the Apple Ipad mini© was measured using an Extech© 3.5 GHz EMF meter. 8 petri dishes, each starting out with 20 fronds, were assigned to the exposure group and the control group and population growth (number of fronds) was measured for each dish every day over a period of 12 days. Based on measured values of population growth, it was determined that there was no statistically significant difference in population growth between the exposure group and the control.

BISB THERMOELECTRIC MATERIAL: SYNTHESIS, CRYSTAL STRUCTURE, MICROSTRUCTURES, AND TRANSPORT PROPERTIES

MeKhayla Williams
Governor's School for Science and Mathematics
Mentor: Jian He, Department of Physics & Astronomy, Clemson University
Advisor: David Whitbeck

Thermoelectric materials can be used in direct electrical power generation from waste heat, and also vice versa in heat management. Heat management is the ability of a compound to cool a solid state surface. Bismuth Antimonide is one of a few thermoelectric materials that work at temperatures below room temperature for spot size solid state refrigeration. We in this project adopted a Spark Plasma Sintering (SPS) technique to synthesize Bismuth Antimonide alloy at a nominal
atomic ratio of 88:12. The packing density, micro-morphology, composition, phase structure, and crystallinity of the as-sintered sample have been analyzed using an x-ray diffraction chamber and a Scanning Electron Microscope, followed by the measurements of electrical resistivity, thermopower (i.e., Seebeck coefficient), and thermal conductivity between 15 K and 300 K. The thermoelectric figure of merit, ZT, has been obtained. The ZT has been used to determine how productively Bismuth Antimonide turns waste heat into electrical power.

THE EFFECT OF USING SODIUM HYPOCHLORITE VS. SODIUM PERCARBONATE BLEACH TO INTERFERE WITH THE DETECTION OF BLOOD RESIDUE BY A BLUESTAR MAGNUM LUMINOL TEST

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This study is relevant to the field of forensic science. The purpose of this experiment was to determine the ability of a luminol test to detect blood residue on denim that was washed using chlorine bleach vs. that washed in oxygen bleach. Three test groups each contained 20 swatches of blood stained denim fabric were used. As a control, one test group was washed using water only. The second group was washed using Clorox while the third group was washed in OxiClean. After a double rinse cycle for each group the fabric was allowed to dry for 48 hours. A luminol solution was then applied to each swatch and the chemiluminescence reaction was photographed using a Nikon d3200 camera. A positive light reaction was noted in all three groups; however, there was a notable difference between the Clorox cleaned and the OxiClean bleach cleaned groups. Due to a chemical cross reaction between luminol and Clorox bleach, this group of fabric squares displayed a stronger and longer lasting chemiluminescence, when compared to the other two groups. This finding supports the alternate hypothesis that there that there will be a difference in a luminol test’s ability to detect blood stains on denim that is cleaned in oxygen bleach vs. chlorine bleach. The results of this study have implications to the field of forensic science in that it demonstrates that crime scene investigators can detect cleaned latent blood stains on denim using luminol.
MOLTEN CARBONATE RETENTION EFFECT STUDY OF MIXED ELECTRIC AND CARBONATE ION CONDUCTOR FOR CO2 SEPARATION

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Advisor: Kurt C. Wagner

In this paper, it is demonstrated that a silver-carbonate CO2 permeation membrane with a silver matrix surface modified by a coating of Al2O3 can improve the flux stability over a long period of time. The flux densities of CO2 and O2 maintained >90% of its original value for the 130 hours of testing. Much longer compared to the old membrane with dropped to around 33% of its original value after only 60 hours of testing. Overall, surface modification of a silver matrix using an Al2O3 coating is a viable method to fabricate stable silver-carbonate mixed electric and carbonate ion conductor membranes to electrochemically capture CO2 from flue gases.

THE EFFECT OF TRIHALOMETHANES (THMS) ON THE LIFE-CYCLES AND COLOR OF ARTEMIA

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The objective of this project was to test the effects of Trihalomethanes (THMs) on the species Artemia in order to see if the species could be used as an indicator for THMs since THMS are a common pollutant found in freshwater, and Artemia are freshwater shrimp that are extremely sensitive to environmental change. The hypothesis was that "If the amount of Trihalomethanes in the water was above 80 ppb, then the Artemia will change physically." For the methods, five ten-gallon tanks were prepared, with twenty Artemia in each tank, then 0 g of chloroform, .00756 g of chloroform, .01512 g of chloroform, .02268 g of chloroform, and .03024 g of chloroform were placed in each tank respectively, since chloroform is one of the chemical forms of TMHs, and is soluble in water at 20 degrees Celsius. Qualitative data was collected every two days for a month, and the Artemia were fed 2 g of food every two days. The predicted results were that increased exposure to chloroform will have a harmful effect on the shrimp, which may include color change, weight change, or death. It was predicted that the chloroform would have an effect on the shrimp, since the shrimp are very sensitive to environmental change, which would allow the chloroform to easily effect the shrimp physically.
DETECTING ALLERGENIC PROTEINS THAT TRIGGER ASTHMA IN INDOOR ENVIRONMENTS
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The goal of this research is to develop effective means to remove multiple allergenic proteins from the indoor environment. The hazardous allergenic proteins attach to dust and other fine particles and can be inhaled when airborne as “bioaerosols,” which trigger allergies, asthma, and other respiratory diseases. Asthma is increasing in prevalence and is the most common chronic illness among children. The research on indoor allergens will not only aid general allergy sufferers, but also reduce the frequency of clinical emergences caused by increased asthma symptoms with indoor allergens. The base of the project worked with proteins such as cat and dust mites allergens. Household dust was sampled and the proteins were extracted through a biochemical technique called ELISA. In ELISA, an unknown amount of antigen is affixed to a surface, and then a specific antibody is applied so that it can bind to the antigen. This antibody is linked to an enzyme, and in the final step a substance is added so the enzyme can convert to some detectable signal, most commonly a color change in a chemical substrate. After the proteins were extracted, they were then analyzed with a plate reader. Through comparing the dust samples to the standards, the amount of allergens in the samples were shown. The dust samples were taken from different locations to find signs of allergens. It is believed that homes with pets or non-organized pre-schools are more likely to have allergens present.

USING COCAINE TO CREATE A CONDITIONED PLACE PREFERENCE IN MICE
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Many people who become addicted to drugs, such as cocaine, check into rehabilitation centers seeking help to rid themselves of the cravings associated with the addiction. After leaving rehab, many return to the same places they were in
before entering rehab. It is thought that a large percentage of those who relapse do so because the environment in which they once used the drug has conditioned the brain to crave the drug when they return to that environment once more. If animals are given rewarding drugs they will also produce a strong preference to an environment. In order to test the degree to which an animal will make these conditioned place preferences to drugs, mice were injected (intraperitoneally) with a rewarding drug in one environmental compartment of a box and a control in a distinctively different but adjacent compartment of the same box. Animals were then allowed to choose the environment in which they would like to spend time. Results indicate that the mice typically spend more time in the compartment where they received the drug suggesting they’ve now associated the pleasant “high” feeling with a particular compartment. This mimics what occurs in humans and may help scientists to better understand the human tendency to relapse.

FALLING OBJECTS, FALLING PEOPLE – AN ANALYSIS OF THE DYNAMICS OF FALLING
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Vibrations associated with human falls have characteristics that are markedly different than vibrations associated with certain dropped objects. To quantify these differences, a series of experiments were performed that used acoustic sensor data to record and monitor various patterns of vibrations. Objects such as basketballs and bags filled with Kinects were used initially and the resulting data were recorded using four sensors. Applied mathematical software programs written from MatLab received and plotted the data on acceleration versus frequency diagrams. A total of five locations were used to record data on dropped objects and on vibrations from a person jumping. The results from these five locations were compared to each other to determine similarities and differences associated with these vibrations. Differences in the signals of human jumping and falling objects were recorded with the goal of minimizing what the computer deems as a fall. In the future this recorded data will help prevent an overload of information so that the computer program can quickly assess whether or not a given signal is associated with an actual human fall. The end goal of this work on human fall analysis is to allow the elderly live independently for a longer period of time.
THE EFFECT OF DISKS LARGE HOMOLOG 1 (DLG1) AND DISKS LARGE HOMOLOG 5 (DLG5) GENES ON ADIPOGENESIS IN MESENCHYMAL STEM CELLS

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Mesenchymal Stem Cells are adult stem cells able to differentiate into several cell lineages. Because of their multipotency, these cells show high potential for use in stem cell therapy. Adipogenesis, or the creation of fat cells, occurs through Mesenchymal Stem Cells. The differentiation of MSCs are known to be regulated by interactions with extracellular mediators and previous research has found that the activation of the Wnt (wingless-related integration) signaling pathway inhibits adipogenesis in MSCs. Two genes, disks large homolog 1 (DLG1) and DLG5, identified by a high-throughput screen, were seen to play some role in adipogenesis in MSCs and were therefore studied in this project in order to further understand the differentiation process and the role of the Wnt signaling pathway. Human bone marrow derived MSCs were cultured and subjected to siRNA treatment in order to destroy the mRNA of the DLG1 and DLG5 genes. Adipogenesis was then induced and differentiation was determined after 14 days. Quantitative PCR was also performed in order to ensure the effectiveness of siRNA treatment and to determine the role of the genes in the Wnt signaling pathway. According to the results obtained, DLG1 inhibits adipogenesis, while DLG5 showed no inhibition. However, the siRNA treatment of DLG5 proved to of no effectiveness and therefore the function in adipogenesis cannot be determined by this study. Also, both DLG1 and DLG5 showed no role in the Wnt signaling pathway. To further characterize these two genes and their role in adipogenesis in MSCs and in the Wnt signaling pathway, this study and its projects should be repeated. To further investigate, in vivo studies in animals should also be performed.

THE EFFECT OF BALLET SHOE TYPE ON GROUND FORCE REACTION

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In recent years, the number of lower-limb injuries such as shin splints has been steadily increasing in athletes especially ballet dancers. Many factors contribute to this growing problem, but the shoe the dancers wear could possibly effect the
ground force reaction. It has been shown that decreasing ground force reaction does decrease one’s risk for lower limb injury. In this experiment, 20 dancers were tested using four different types of footwear: flat ballet shoes, brand new pointe shoes, broken in pointe shoes, and dead pointe shoes. It was hypothesized that the brand new pointe shoes will have the most ground reaction; therefore wearing brand new pointe shoes will give the dancer the highest risk for lower extremity injury. An ANOVA test showed that there was a significant difference between the five groups $F(100)=64.34 \ p<0.001$. A Tukey test showed that there were statistically significant differences in all of the treatments except for barefoot vs. flat shoes, barefoot vs. broken in pointe shoes, and flat shoes vs. broken in pointe shoes. The dead pointe shoes had the least ground force reaction, and the brand new pointe shoes had the greatest ground force reaction. Therefore, it was concluded that brand new pointe shoes do pose a greater risk for lower extremity injury in dancers.

THE EFFECT OF COPPER(II) SULFATE (CUSO4) MOLARITY INCREASE ON PARAMECIUM CAUDATUM CONCENTRATIONS

Ali
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As a result of increased industry, copper ion levels in lakes have been increasing. This increase demands research on its impacts on freshwater habitats. This experiment was done to isolate its impact on an essential freshwater organism, Paramecium caudatum, which helps in maintaining bacterial levels in lakes. It was hypothesized that if copper(II) sulfate (CuSO4) molarity was increased in P. caudatum cultures, then the resulting P. caudatum concentrations would be lower than what resulted from cultures with lesser to no CuSO4. The procedures involved adding CuSO4 to culture dishes to make different solutions: 0.0065 M, 0.0125 M, and 0.0188 M solutions, as well as having a control with no CuSO4. The culture dishes were then each inoculated with P. caudatum and after a day were sampled. The results maintained that treatments with CuSO4 had 0 P. caudatum/ml, while the control trials had a mean of 9.93 P. caudatum/ml. An ANOVA and Tukey Test were used to compare the different treatments to each other. The ANOVA test showed that at least one of the treatments was different from the others, $F (3,9) = 10.49, \ p < 0.05$. The Tukey Test showed that those differences were between the control and the other treatments. As a result, CuSO4 was found to have a significant negative impact on P. caudatum populations. Thus, precautions must be taken to help ensure the survival of these essential organisms as they help ensure the stability of freshwater ecosystems.
END
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