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**Virginia
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The Virginia Academy of Science (VAS) is the fifth largest state, region, or city academy of science in the U.S.; it was founded in 1923 to promote the civic, academic, agricultural, industrial, and commercial welfare of the people of Virginia. Exemplary programs have included Flora of Richmond and Vicinity, Published, 1930, the first comprehensive multidisciplinary studies of the James River Basin and the Great Dismal Swamp, volunteer research assistance to Virginia in the instance of the kepone pollution disaster, and leadership in establishing the Science Museum of Virginia.

Fall Undergraduate Research Meeting:

The focus of this meeting is support of undergraduate student research. Specific details about the 2021 Fall Undergraduate Research Meeting, including the location and date will be made available on the VAS website (www.vacadsci.org) during the summer.

The Virginia Junior Academy of Science

VJAS is a national model for the new and renewing state junior academies and has been ranked among the top three in the nation for over two decades. Through VJAS and other programs, VAS annually reaches over 40,000 Virginia middle and high school students. Hundreds of volunteers make it possible for Virginia secondary students to experience these activities.

VJAS General Session

A TACT-ful Chemical Musical presented by Tidewater Alliance of Chemistry Teachers.

George W. Jeffers Memorial Lecture

NASA's Future with our Earth, the Moon, Mars, and Beyond. Ron Shaneyfelt, Educator-in-Residence NASA-Langley Research Center.

Contributors and Supporters

The Virginia Academy of Science notes with appreciation the contribution and support of hundreds of individuals and dozens of organizations to the success of its 90th Annual Meeting and of the 71st Research Symposium and Annual Meeting of the Virginia Junior Academy of Science.

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Animal Behavior and Genetics

First Place:

The Effect of Ultraviolet Radiation Duration on the Regeneration Rate of *Dugesia tigrina*

Miyabi Saito

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Thomas Jefferson High School for Science and Technology

The purpose of this experiment was to determine the effect of ultraviolet radiation on the regeneration rate of *Dugesia tigrina*. The *D. tigrina* were cut at the neckline to separate the head from the body. Only the body was used to measure the regeneration rate. The bodies were radiated for 5 levels, 0, 50, 150, 250, and 350, with zero being the control with multiple trials for each level. A device was created to increase the accuracy of the timing. The major finding of the experiment was that a significant difference existed between the regeneration rates of the control group and the exposed *D. tigrina*. No outliers were found. The ultraviolet radiation exposure causes pyrimidine dimers in the DNA of the organisms, which is shown to affect regeneration rate. An ANOVA test result showed that the experimental hypothesis, that planaria exposed to different levels of ultraviolet radiation duration would have a different average time for full regeneration, was supported. The null hypothesis was rejected. Recommendations for further study include exposing regenerating planaria to ultraviolet radiation daily to determine whether such a pattern of exposure will have a greater or lesser effect on regeneration, or to use a higher-intensity UV bulb to determine if a significant difference in regeneration rate will occur.

Second Place:

The Behavioral Effects of Various Ratios of Chewing Tobacco to Media on *Drosophila melanogaster*

Christina Good

Central Virginia Governor's School for Science and Technology

The purpose of this study was to determine if culturing the model organism *Drosophila melanogaster* in chewing tobacco would induce behavioral effects similar to those found in *Drosophila* when exposed to free-base cocaine or nicotine. The flies were cultured in vials containing 5%, 10% or no chewing tobacco for a week or more, after which, a geotactic climbing assay was performed. The fly vials containing one fly each were

dropped down a pipe and videoed for a minute or until they reached a height of 7 cm. A Chi-Squared Test of Independence, which was performed on whether the flies did or did not reach the specified height, resulted in $\chi^2=2.6587$ and a p-value=0.2879 ($\alpha=.05$). Therefore, the null hypothesis was supported; and the original hypothesis, that chewing tobacco would affect locomotor behaviors, wasn't. After observation of the flies, it was noted that the flies' pupae appeared smaller. An ANOVA was conducted to look for statistical significance between 15 randomly selected pupae lengths taken from each concentration vial. This resulted in a p-value of .00015 ($\alpha=.05$). A Tukey test was then performed on the means which were .120, .119, .114 for the control, 5%, and 10% groups, respectively. The Tukey test showed a difference between the control and the 10% concentration and between the 5% and 10%. This data supports the alternate hypothesis that there was a difference in pupae lengths between concentration groups. In conclusion, chewing tobacco had an insignificant effect on *Drosophila melanogaster*'s locomotor behavior, but had a significant effect on their growth and reproduction.

Third Place:

The Effect of Pesticides on the Learning Capabilities of *Planaria*

Christina Lee

Mountain Vista Governor's School

The experiment took place at the Lee Residence where 160 brown planaria were split into two test groups to be exposed to pesticides either acutely or developmentally. The acute group was exposed to 1/8 dilutions of pesticides twice and developmental group was regenerated in 1/25,000 dilutions of pesticides. The pesticides used were Bifenthrin, Carbaryl, and Gamma-cyhalothrin. Classical conditioning was utilized and the average response ratings (ARR) were recorded on a scale of zero to three. The first null hypothesis was there would be no difference in ARR of the planaria exposed to pesticides (both acute and developmental) and the control planaria in spring water. The alternative hypothesis was if planaria were exposed to pesticides acutely or developmentally then the planaria will have lower ARR than planaria which we not exposed. The null hypothesis was rejected with a p-value<0.01 using two-sample t-tests comparing the control to all pesticide groups. The second null stated there would be no difference in ARR between the acute and developmental group. The second alternative was if the planaria we exposed to pesticides developmentally ARR would be lower than the acute groups. The null was supported with a p-value<0.05. This suggests that pesticides adversely affect the learning capabilities of planaria, and may contribute to hyperactivity.

Honorable Mention:

Exploring the 'French Paradox': Resveratrol Chemically Entails Cardio Protection, Genomic Stability and Longevity

Paul Girgis

Godwin High School

This study evaluated the antioxidant potential of resveratrol, and how it influences the growth and development of *C. elegans*, a nematode providing a novel model for research in molecular genetics. The development of the nematode pharynx, a model heart, was particularly examined. It was anticipated that resveratrol would advocate cardio protection through activation of the heart health gene Fut-1, and genomic stability through the silencing of oxidative-stress inducing Cep-1. Also, it was predicted that resveratrol would mediate the silencing and reversing the growth-inhibitory effects of RRF-3, a gene which hinders pharyngeal development. It was further expected that resveratrol would react with pure cholesterol, a substance necessary for nematode survival. These hypotheses stated that resveratrol chemically operates on cholesterol and genetically promotes heart health, while also representing a stimulus for the expression of certain genes that enhance genomic stability. By incorporating resveratrol into medium on which bacterial nourishment and *C. elegans* grew, the effects of the molecule were examined. *C. elegans* was provided bacterial feeding strains of *E. coli* (OP50) inserted with plasmids containing suppressed homologues of mammalian genes concerning heart health (Fut-1) and genomic stability (Cep-1; RRF-3). It was found that resveratrol both advocated the expression of cardiac health advocate Fut-1 and to an extent dissolved pure cholesterol. Also, resveratrol worked towards silencing harmful genes Cep-1 and RRF-3, potentially through the process of DNA-methylation. As acquired data was overall deemed statistically significant, the majority of the aforementioned hypotheses were supported. Results suggest resveratrol promotes cardiac health and genomic stability, hence, which were measured in terms of longevity.

Honorable Mention:

Variations in Ultrasonic Vocalizations Emitted by *Rattus norvegicus*

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The purpose of this study was to correlate ultrasonic vocalizations emitted by *Rattus norvegicus* (brown rats) with situations in which the animals were placed. Domesticated brown rats are social animals and 'speak' by producing vibrations in the vocal folds of the larynx, producing squeals of frequencies around two kHz, or by tightening the vocal cords producing high frequency, ultrasonic chirps between 20 kHz and 80 kHz. In this study, rat sounds were recorded with an ultrasonic sound detector, which documents frequencies from 20 kHz, just outside of human hearing range, to 200 kHz, as they were put in various common laboratory conditions. This technique effectively allowed for data collection which demonstrated patterns in duration of each syllable, mean amplitude, mean pitch, mean frequency, mean frequency modulation (FM), mean amplitude modulation (AM²), mean Weiner entropy, mean pitch goodness, mean frequency, variance pitch, variance FM, variance Weiner entropy, variance pitch goodness,

variance mean frequency, and variance AM. These patterns were then used to develop the RatSpeak software for decoding rat vocalizations.

Other Papers Chosen for Presentation

The Effect of Cold Temperature on the Courtship Latency of Adult *Drosophila melanogaster*

Alexis Brown

Central Virginia Governor's School for Science and Technology

The purpose of this experiment was to determine if cold affects the courtship latency of *Drosophila melanogaster* (commonly known as the fruit fly). The study was conducted at a local high school in the winter of 2011 in the lab. Virgin wild-type fruit flies were separated into a control and experimental group. The control group was kept at room temperature (25°C), while the experimental group was exposed to three treatments of 15°C for ten minutes with 24 hour recovery periods in between treatments. Both groups were then observed for their courtship latency, which is the time it takes for a male to initiate a courtship behavior upon introduction to a female. The courtship latencies were analyzed using a two-tailed two-sample T-test, which did not support the original hypothesis; if two groups of *Drosophila melanogaster* are exposed to 15°C and 25°C, then the courtship latencies of the two groups will differ. On average, the experimental group did have a shorter courtship latency than that of the control group, with an average of 13.67 minutes compared to 16.37 minutes. However, the T-test results indicated a p-value of 0.183 in comparison to an alpha value of 0.05. In this study, cold did not have an effect on the courtship latency of *Drosophila melanogaster*.

The Effects of Various Colors of Dawn Dishwashing Liquid on *Halyomorpha halys* (Stinkbug)

Margaret Eastham

Mountain Vista Governor's School

In this experiment, the stinkbugs found in the attic of a residence in northern Virginia are tested to determine what colors they are most attracted to. It is speculated that the agricultural pests are most attracted to lighter colors, specifically yellow. Glass jars of Dawn Dishwashing Liquid were infused with color and placed on a lit surface, then left in the darkness of the attic to lure in stinkbugs. The null hypothesis stated that vials containing clear and yellow Dawn dishwashing liquid will attract the same number or less stinkbugs than the ones containing red and blue dishwashing liquid. After conducting a Chi Square test on the data, it appeared that color of the vial had no effect on which one the stinkbug chose, causing the null hypothesis to be accepted. There were twelve degrees of freedom, making the research viable. The p-value was 0.0065, meaning that the data collected caused the null hypothesis to be rejected. This was an imperative experiment, as the stinkbugs were a destructive pest that invaded this

non-native area, wreaking havoc on crop yields and having a significant impact on their gross income. Not only was this a problem for farmers and their customers, but the entire local economy as a whole.

The Effect of Chocolate on Memory Retention

Rachel Hagy
Wakefield High School

The effects of chocolate on memory retention can have significant impact on today's study habits. Previous studies suggest that the consumption of chocolate is linked to the dilation of cerebral blood vessels, allowing more oxygen to flow freely to key areas of the brain, therefore increasing general alertness. The objective of this experiment was to evaluate the above statements with a very basic level of observation and testing, not using any advanced technology, such as MRIs. Test subjects were administered study guides with 20 terms and definitions on them, to study for five minutes. In order to investigate the effects of chocolate on memory retention, the test group was given a single serving of chocolate to consume while attempting to absorb vocabulary terms. After the five-minute study period, test subjects took a twenty-item matching quiz on the words they had memorized. The quiz, like the study period, was five minutes long. Three trials as described above were performed over the duration of three days. During the testing, it was found that the majority of the control group (who had consumed no chocolate while studying) had the tendency to complain and moan about the difficulty of the quiz, answer fewer questions, and become more focused on counting down minutes on the clock rather than use their remaining time to continue working. The majority of the test group seemed more focused at their task, answering more questions and getting more correct. This suggests that the intervention of chocolate during studying may be linked with increased capacity to focus, and therefore, absorbing and retaining more information.

The Effect of Gene Type on G-C Content

Beverly Hammock
Deep Run High School

In 1952 two scientists, Hershey and Chase, discovered that all organisms contain a genetic material called DNA that takes the shape of a spiral staircase. They also found that it contains four bases that pair in specific patterns, adenine to thymine, and cytosine to guanine. The purpose of this project was to determine if G~C content can suggest a gene type. If different housekeeping and tissue-specific genes are tested, then they will have around the same GC content because housekeeping and tissue-specific genes cannot be differentiated by their content. DNA sequences were entered into an online calculator and the G~C content was calculated and graphed for each level of the independent variable. In every occasion the null hypothesis was rejected when the Housekeeping Genes were compared to Tissue-specific, Other,

Leptin, and Bone Morphogenetic Protein 7 Genes ($t = 6.8658 > 2.776$; $t = 6.0802 > 2.776$; $t = 9.9303 > 2.776$; $t = 17.2877 > 2.776$ at $df = 4$; $p < 0.05$). When Tissue-specific Genes were compared to Bone Morphogenetic Protein 7 Genes and Leptin Genes were compared to Bone Morphogenetic Protein 7 Genes the null hypothesis was also rejected ($t = 3.2269 > 2.776$; $t = 5.0479 > 2.776$ at $df = 4$; $p < 0.05$). However, when Tissue-specific Genes was compared to Other Genes and Leptin Genes, the null hypothesis was accepted ($t = 0.2502 < 2.776$; $t = 1.6513 < 2.776$ at $df = 4$; $p > 0.05$). Also, when Other Genes was compared to Leptin Genes and Bone Morphogenetic Protein 7 Genes the null hypothesis was also accepted ($t = 1.4181 < 2.776$; $t = 2.7122 < 2.776$ at $df = 4$; $p > 0.05$). The findings were consistent with related research, in that the G~C Content affected the overall function of the gene, which suggested that there was a significance between the G~C Content in the different type of genes. However, the findings were not related to the research in that a difference was not shown between a Housekeeping and a Tissue-specific gene.

A Weight Distributions Effect on a Horse's Jump

Leah Kasmark
Shenandoah Valley Governor's School

Weight distribution may have an effect on a horse's leg angles while jumping. The purpose of the study was to determine if a rider's weight distribution on a horse affects jump posture over a fence. Horses were put through trials where they were filmed jumping while the rider positioned their weight either forward or in the middle of the horse. The two situations were analyzed by comparing the means of the population which yielded that when weight is positioned forward the front angles on the horse are more acute, while when the weight is centered the hind end angles become more acute. The researcher concluded that the horse uses the leg angles to help counteract the rider's weight. For example, when the weight was placed forward the horse used tighter angles to compensate for the extra weight on its front end.

The Correlation Between Equine Pastern Bone Angles and Navicular Syndrome

Kellsie Mullikin
Mountain Vista Governor's School

Through the careful observations of specified regions of equine conformation, it has been determined that the original hypothesis was correct in that if the difference in hoof and pastern bone angles between diseased horses and healthy horses were tested, then the angles of the healthy horses would be less than the angles of the horses that had been diagnosed with podotrochilitis. The focus of this research was the angles at which the pastern bones were set with respect to the ground. Letters and e-mails were sent to seventy-five different magazines asking them to publish a call for conformation photos of horses that had been previously diagnosed. The angles were derived from photos received through the mail. The angles were taken from both the healthy and the diagnosed group's front legs. There was a clear ten-degree difference among the two

groups. The horses that had been previously diagnosed had both pastern bone angles and hoof angles set at much higher angles than the general horse population average of fifty degrees. This is a significant difference and could indeed be an aspect of the disease development, putting constant strain in the navicular bone area. This should give some insight to potential equine breeders and buyers; horses that have high pastern bone angles have been shown to have navicular tendencies and should not be considered for breeding or purchasing for competition use. This research should give insight as to the true cause of navicular syndrome, being that there is a pattern among conformation.

The Effects of Different Concentrations of 2-Phenylethanol on the Number of Ladybugs (*Hippodamia convergens*) Added

Seth Olinger
Godwin High School

The purpose of the experiment was to find an optimal concentration of 2-Phenylethanol to attract *Hippodamia convergens*. 2-Phenylethanol is a common ingredient in lures for beneficial insects; this experiment attempts to refine its current use to prevent excess chemical use. Filter paper disks saturated with 0%, 0.5%, 1%, 5%, or 10% 2-Phenylethanol were placed into 25 containers. 10 *Hippodamia convergens* were placed in 25 other containers. The containers were placed against each other for 3 minutes. After the experimental time, the number of ladybugs attracted to the baited chamber was counted. This was repeated with each concentration, with the control being 0% 2-Phenylethanol. It was hypothesized that 1% 2-Phenylethanol would attract ladybugs just as well as higher concentrations. The results revealed that 1% 2-Phenylethanol did attract ladybugs as well as the higher concentrations. A t-test was performed, revealing that 1% 2-Phenylethanol performed significantly better than 5% and 10%. In comparison with the control, only the data from the 0%, 0.5%, and 1% solutions were significant. The results did support the research hypothesis. It is believed that the results are due to the high concentrations (0.5% and 1%) permeating through both chambers, preventing the ladybugs from finding a specific source. This lowered the number of ladybugs in the baited chambers. This research could lead to further studies that investigate the effectiveness of 2-Phenylethanol as an attractant for other insects, and the effectiveness of a bait solution comprised of 2-Phenylethanol mixed with other plant volatiles.

Pre-mating Changes in Population Ecology of the Eastern Red-spotted Newt (*Notophthalmus viridescens*)

Travertine Orndorff
Blacksburg High School

Baseline knowledge of population ecology is important to monitor the health of a species. To study changes in population ecology in preparation for the breeding season,

Red-spotted Newts (*Notophthalmus viridescens*) were captured in a mountain pond in Montgomery County, Virginia on five occasions from October to December 2011. Each newt was photographed for re-identification via spot patterns to estimate population size using mark recapture methods. On all but the first occasion, mass, length, sex, reproductive condition, and number of spots was recorded for each individual. Population size was estimated to be $2,544 \pm 204$ using the Weighted-mean method (Begon, 1979). Using the unique spot pattern to identify individuals for mark recapture population estimations (Grayson and Wilbur, 2009) was again shown to be a valid method. The ratio of males to females captured was approximately 7:1. This ratio did not vary significantly between sampling periods or among locations within the pond. A steady increase was observed in mean calculated Body Mass Index (BMI) of males over the course of the study but did not vary significantly among sampling sites. Mean BMI of females did not vary significantly. There was a direct correlation between length and mass of males in all observation periods, and for females in the last two observation periods. Results show that ecology of the newt population was not static. The Red-spotted Newt is a widely distributed solidly established species. Recent declines in other amphibian species places increasing importance on monitoring changes in amphibian health. Monitoring protocols must account for the likelihood of significant changes in ecological variables in a population over a short time period.

Identification of IKK Kinase Beta Inhibitors through Structure Based Virtual Screening

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Inflammation is a short-term friend, long term foe. While short-term inflammation protects the body from infections, injuries and other harmful stimuli, prolonged inflammation contributes to the pathogenesis of chronic diseases, including Alzheimer's, cancer, diabetes, and heart attack. I κ B kinase beta (IKK β) enzyme acts as a central coordinator of inflammatory responses. It activates the pro-inflammatory transcription factor NF- κ B. Overexpression of IKK β has been found in many chronic diseases and hence, inhibition of aberrant activation of IKK β is a promising therapeutic target. Unlike the traditional drug discovery process, structure based virtual screening help speed up drug development, making more efficient use of time and money. This method relies on the knowledge of the three- dimensional structure of the protein. As there has been no experimental structure reported for the IKK β , this study was focused to model the three-dimensional structure of IKK β protein kinase domain and identify suitable inhibitors. Twenty models of IKK β were generated using Swiss PDB Viewer and fold recognition servers and validated using PROCHECK, ERRAT and VERIFY3D software. Top three structures were chosen based on validation scores. Ten potential inhibitors were selected from Pubchem database.

Docking studies were carried out using HEX software. I found that the model constructed with the template 2HAK and the natural product dihydrobetulinic acid docked with higher affinity and with lower docking energy. The positive

experimental results suggest that the modeled IKKb protein kinase domain structure is of high quality and dihydrobetulinic acid is a potential lead candidate against diseases related to elevated IKKb activity.

The Effect of Constant Magnetic Fields on Multiple Generations of *Drosophila melanogaster*

Justin Tsui
Godwin High School

Magnetic fields (MFs) have been shown to affect the process of DNA replication and cause negative effects on many organisms. This study exposes various masses of ferrite magnets to *Drosophila melanogaster* over multiple generations and measures the count of adult offspring. Knowing that strong magnetic fields affect organisms, especially during developing stages, a hypothesis was created. The hypothesis states that if multiple generations of flies are exposed to CMFs with twelve grams of ferrite, then it would yield the least number of offspring that become adults. The control of this experiment is not exposed to any magnetic fields produced from the ferrite. The adult fruit flies were given seven days to lay eggs in their vial before being put into the fly morgue. Data for this study was statistically significant between the control versus twelve grams (180 mT) of ferrite which yielded a t-value of 10.2859. Twelve grams (180 mT) of ferrite versus four grams (130 mT) of ferrite was also found to be statistically significant with a t-value of 8.4971. This study can be extended to use a different MF, such as electromagnetic fields, or recording other negative effects such as decreased lifespan and larval weight.

Identification of IKB Kinase Beta (IKKB) through Structure Based Virtual Screening Radha

Venkateson
Grafton High School

Inflammation is a short term friend, long term foe. While short-term inflammation protects the body from infections, injuries and other harmful stimuli, prolonged inflammation contributes to the pathogenesis of chronic diseases, including Alzheimer's, cancer, diabetes, and heart attack. IkappaB kinase beta (IKKb) enzyme acts as a central coordinator of inflammatory responses. It activates the pro-inflammatory transcription factor NF-kappaB. Overexpression of IKKb has been found in many chronic diseases and hence, inhibition of aberrant activation of IKKb is a promising therapeutic target. Unlike the traditional drug discovery process, structure based virtual screening help speed up drug development, making more efficient use of time and money. This method relies on the knowledge of the three-dimensional structure of the protein. As there has been no experimental structure reported for the IKKb, this study was focused to model the three-dimensional structure of IKKb protein kinase domain and identify suitable inhibitors. Twenty models of IKKb were generated using Swiss PDB Viewer and fold recognition servers and validated using PROCHECK, ERRAT and VERIFY3D software. Top three structures were chosen based on validation scores. Ten potential inhibitors were selected from Pubchem database. Docking studies were carried out using HEX software. I found that the model constructed with the template 2HAK and the natural product dihydrobetulinic acid docked with higher affinity and with lower docking energy.

The positive experimental results suggest that the modeled IKKb protein kinase domain structure is of high quality and dihydrobetulinic acid is a potential lead candidate against diseases related to elevated IKKb activity.

Animal and Human Science

First Place:

Marisa Shotwell
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Thomas Jefferson Middle School

The Effects of Different Antibiotics on *Staphylococcus epidermis* in a Simulated Surgical Suture study.

The materials for the study were seven *heterozygous* Netherland Dwarf rabbits and their offspring, monitoring equipment, and veterinary laboratory facility. All live-born kits' vital signs were recorded during infancy at approximately four- and twelve-hour intervals. At the time of death three *homozygous* live born, two *heterozygous* stillborn, and two *homozygous* stillborn kits were preserved at 4°C. *Postmortem* examination and *necropsy* were performed including digital x-rays and visual observations. Each cadaver was then preserved in *formalin* solution and submitted to a commercial laboratory for *histopathology* using fixed wax slides of the lungs, liver, intestines and the cervical vertebrae. All data, vitals and observations were compared to determine a cause of death for each kit. Vital monitoring showed the live born *homozygous* dwarfs to grow at a significantly lower rate, and have lower heart, respiratory, and reaction rates. All *homozygous* kits showed cervical spinal compression (*stenosis*). Although there was mild *autolysis* (decomposition) in all kits there was no *histopathological* evidence for cause of death. This indicates a possible failure to develop fully in stillborns (*dysgenesis*) and *cervical stenosis* and *metabolic* disorder as the cause of death in live-born *homozygous* kits. In surgery many types of prophylaxis are used but bacterial infections still occur. One common infection is *Staphylococcus epidermidis*. This experiment tested the toxicity of different antibiotics on *Staphylococcus epidermidis* (*S.Epi*), a gram-positive, non-pathogenic bacteria that when growing forms small white colonies. Plates were prepared using pig skin, surgical staples, and a scalpel, to perform the incision. After the introduction of *S.Epi*, the plates were incubated for 24 hours before being re-plated and measured using the isolation streaking method; the third quadrant of colonies was then analyzed. The hypothesis was that Vancomycin would be most effective at killing the *S.Epi* because it is a commonly prescribed medication to treat Staph infections. The hypothesis was rejected as Moxifloxacin was shown most effective at killing bacteria leaving an average count of about 2 colonies per disk. Vancomycin followed with 4 colonies and Penicillin with 5. A blank control disk averaged 9 colonies per disk. Beta hemolysis occurred in both Control plate 1 and a Vancomycin plate 2. Another disk was prepared showing perfect circle diffusion for each antibiotic. These measurements supported the results as well, showing, Moxifloxacin with the highest kill radius measurement of 1.3cm to the outer edge. While Moxifloxacin was most effective, it would not normally be the only antibiotic used when trying to fight an infection.

Second Place:

Homozygous Achondroplasia in the Netherland Dwarf Rabbit:
II. Stillborn Versus Liveborn Neonates

Rhiannon Edwards
Gildersleeve Middle School

The purpose of this project was to investigate the cause of death in live-born and stillborn neonate Netherland Dwarf rabbits with *homozygous achondroplasia*. Because human ethical concerns limit sample size, these dwarf rabbits are potential valuable medical research models, comparable to *knock-out mice* but already expressing the *achondroplasia phenotype*. This would add understanding of entire body system effects, with cell cultures and molecular

Third Place:

The Effect of Oil Pulling on Plaque and Gingivitis

Nidhi Kumar
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George H. Moody Middle School

“Oil Pulling” is a daily hygienic habit which is believed to be both preventive and curative of diseases pertaining to the mouth, heart, and lungs. It is described as the “The Best Drugless Therapy” and a cure for most diseases like headaches, bronchitis, tooth pain, intestinal heart and kidney diseases, and sleeplessness. The Oil Pulling therapy with vegetable oil has been used extensively as a traditional Indian folk remedy for many years. Also, the modern version of Oil Pulling was coined by a Ukrainian Physician, Dr. F. Karach during 1990 after swishing oil in the mouth for a month, curing himself from a chronic blood disease.

The purpose of this experiment was to determine the effect of oil pulling on reducing the Plaque and Gingivitis. Oil Pulling or oil swishing was a procedure that involved sipping, sucking, and swishing two teaspoons full of oil in the mouth for 10 minutes, every morning before brushing the teeth. The experiment was conducted on ten human subjects of the same age group for exactly 30 days. The results of oil pulling process showed a significant reduction in the plaque and gingival score, mainly noticed at the third recording period with a plaque score of 0.74 from the initial reading of 1.15 and a gingival score of 0.05 from the initial reading of 0.14. This alluded that there was a direct relationship between the oil pulling process and the reduction in the scores. It was also believed that the pulling healed cells, tissues and gums at once by removing the germs in the mouth which caused the destruction of healthiness of human teeth.

To conclude, the hypothesis was supported by the data saying that if the oil pulling process was followed for at least 30 days, then it would reduce the Plaque and Gingivitis. To move further, this experiment should be conducted with different oils and different age groups before any final conclusions could be made to show its success.

Honorable Mention:

The Effect of Different Colored Lights on the Rate of Cone Cell Recovery

Eric Duong

George H. Moody Middle School

Highly sensitive light receptors in the back of the cornea called cone cells are responsible for color vision. Other light receptors, rods, are more sensitive to light and help sight in dimmer light but cannot detect different colors. According to the trichromatic theory of color vision, there are three main classes of cone cells that are used to see color; one cone detects reddish light, another detects greenish light, and another detects bluish light. When irradiated with light of a certain color for an extended period of time, the cone cells corresponding to the color lose sensitivity and an inverted afterimage is created. The opponent-process theory of color vision states that each cone receptor is linked to form three antagonistic color pairs: blue and yellow, red and green, and black and white. When one member of a pair is fatigued, the opposite color member is perceived in the afterimage.

The purpose of this experiment was to determine which standard cone cell recovered from fatigue the quickest. Subjects were tested by focusing on red, green, and blue spotlights on a whiteboard. After 30 seconds, the colored lights were turned off, exposing the subjects' eyes to the whiteboard which allowed for the inverted afterimage to be seen and for the duration of the afterimage to be reported and recorded. The results showed that red light had the fastest mean recovery time of 4.75 seconds and that green light had the slowest mean recovery time of 8.65 seconds. The data did not support the hypothesis that if blue light is tested, then the negative afterimage will disappear from sight the slowest. Based on the slow mean recovery time of green light, green light is most likely stimulated the most on a daily basis.

Honorable Mention:

The Effect of PACERS on Knee Pain of Middle Schoolers

Isabel Parks

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Gunston Middle School

The purpose of this project was to determine the impact that running the Progressive Aerobic Cardiovascular Endurance Run (PACER) had on knee pain and/or injuries of middle school students, particularly middle school girls. The researcher chose this topic because the researcher noticed students at Gunston Middle School often complained of knee pain; some students even began to wear knee braces in the weeks after the students ran the PACER. The hypothesis for this experiment was that middle school students, particularly female students, who run the PACER would experience greater knee pain in weeks they ran the PACER than in weeks they did not run the PACER. The researcher handed out surveys to two classes for four weeks. The researcher then compared the data of boy's and girl's knee pain, as well as knee pain in PACER weeks versus non-PACER weeks. At the end of this experiment, the researcher found that the data supported the hypothesis, because both the number and the percentage of boys and girls

experiencing knee pain were higher in PACER weeks than non-PACER weeks. When the PACER was run, the percentage of girls experiencing knee pain was 85%. The percentage of girls experiencing knee pain dropped dramatically to 45% when the PACER was not run. When the PACER was run, the percentage of boys experiencing knee pain was 54.55%. The percentage then dropped to 38.10% when the participants did not run the PACER. In the future, this experiment could benefit physical education instructors, coaches, athletes, and athletic trainers by promoting awareness of the effects of PACERs on teenage knees, particularly in females.

Honorable Mention:

The Effect of Different Antacids on the Neutralization of Hydrochloric Acid's pH Level

Gabrielle Rockey

George H. Moody Middle School

Victims of Esophagitis, heartburn, and other problems caused by an excess amount of HCl (hydrochloric acid) are always scouting medicine aisles trying to find that perfect antacid that fits all of their requirements. Which antacid would that be, and do the different active ingredients contained in the antacid brands affect their performance and efficiency? The purpose of this experiment was to determine which type of antacid (independent variable) would neutralize hydrochloric acid best (dependent variable). HCl is a substance naturally produced by the stomach that is highly acidic and potentially dangerous. It has a pH of 1 and is necessary in the digestive system to digest food properly. Antacids are bases that help prevent heartburn, peptic ulcers, and other health issues. Neutralization is a process performed when an acid and a base demolish each other's properties to produce water and salt. 800 ml of hydrochloric acid diluted to .6 molar, pH paper with a scale ranging from 1-14, and the 4 different types of antacids (Maalox, Alka-Seltzer, Tums, and Pepto Bismol) were all collected for the start of the experiment. For each of the 40 trials the appropriate amount for an adult dosage was crushed and placed in a container concealing 20 ml of diluted HCl. 10 minutes were given for the antacid to dissolve and react with the stomach acid. After time was up, the pH paper was used to test the new pH value of the HCl. My hypothesis was that if Tums was used then it would neutralize the acid best. After repeating the experiment multiple times, the results were evident. Alka-Seltzer neutralized the HCl best with a mean of 5.6, while Pepto Bismol was the least effective with a mean of 1.7. The experimental results do not support my hypothesis because Alka-Seltzer ended up neutralizing the HCl to a lesser level of acidity. Perhaps Alka-Seltzer was more efficient because it contained multiple active ingredients, was very fast at dissolving, and is a highly recommended antacid that doctors suggest to patients with these symptoms.

Other Papers Chosen for Presentation

The Effect of Sports Drinks on the Pulse Rate after Exercise

Suraj Bala

George H. Moody Middle School

Research has been done previously to find the effect of sports drinks on the performance of cyclists. Commercial sports drinks have been preferred by all competitive and recreational athletes. The manufacturers of sports drinks have claimed that the electrolytes found in the sports drink replace water and electrolytes lost to sweat and enhance and boost their performance and endurance. The purpose of this experiment was to determine the effect of sports drink vs. water on the pulse rate while exercising. The hypothesis was that if the individuals were to consume sports drinks and water, then the individuals who consumed sports drinks would have a lower pulse rate during exercise. The sports drink tested in this experiment was Gatorade. The drink was prepared for each subject, measured out accurately, and consumed. Then they waited for 20 minutes, and their resting pulse rate was recorded. Then the subjects were asked to exercise for 5 minutes and their pulse rate after exercising was recorded. Similarly water was substituted for Gatorade, and the test was conducted on all the subjects on a different day.

The results of the experiment were that the subjects who had consumed Gatorade had an average resting pulse rate per minute of 66.4 BPM before exercise and 71 BPM after 2 minutes of rest after exercise. The subjects who had consumed water had average resting pulse rate per minute of 67.7 BPM before exercise and 71.4 BPM after 2 minutes of rest after exercise. The subjects who had consumed Gatorade had average pulse rate of 106.3 BPM after five minutes of exercise, and who had consumed water had average pulse rate of 120 BPM after five minutes of exercise. The results indicate that this hypothesis was true and should be accepted. If this experiment were to be conducted again, an electronic pulse monitoring device could be used. Also the number of test subjects should be increased, and a separate study of boys and girls should be conducted to provide more accurate and valid results.

The Effect of Different Disposable Contact Lenses on the Level of Eye Dryness

Logan Brown

George H Moody Middle School

In 1508 Leonardo Da Vinci presented a method of changing corneal focus by immersing the eye in a vessel of water. Da Vinci's method was not thought to elicit an awareness for vision correction, however it did , and in 1888 Adolf Wick formed contact lenses made from blown glass. Wick's lenses were uncomfortable and could not be worn for more than a few hours. Numerous scientists and inventors continued to develop the manufactured article and finally in 1949, the first enduring contact lenses were marketed. Today, contact lenses are still being enhanced and still cause adverse clinical effects if not taken care of correctly.

The purpose of this project was to determine if different disposable contact lenses would affect the level of eye dryness in a subject. Four contact lenses were worn for a period of five days. The eye dryness level was collected from the phenol red thread test after the contact lenses were removed. After every trial, the experimenter also took the McMonnies Dry Eye Questionnaire. The results indicated that the Acuvue Oasys contacts lenses kept the eyes the moistest with an eye dryness level mean of 9.25 mm and the Freshlook Color Blends kept the eyes the least moist with an eye dryness level mean of 6.6mm. The data supported the research hypothesis that if Acuvue Oasys contact lenses are worn, then the wearer will experience little eye dryness.

Based on the data received in this research, there appears to be a direct correlation between the design of the contact lenses and the levels of eye dryness. Before it can be concluded that the sole cause of eye dryness levels was the design of the contact lenses, a survey will need to be made to determine the eye dryness levels of other individuals who wear contact lenses.

Pulse After Running

Tessa Danehy

Hines Middle School

Abstract missing

The Effect of Emanating Light Bulb Heat on Night Bug Attraction

Jane Geiger

George H. Moody Middle School

When Thomas Edison created the first light bulb in the late nineteenth century many uses and questions have arisen as a result. When people use light bulbs to illuminate the outside of their houses, stores, and other buildings, a few unexpected friends gather around those lights. Moths, beetles, and small gnats can be found circling the outside bulbs during most any time of the year and the purpose of the researcher's experiment was to deduce why exactly the bugs gathered. Was it purely for light during the darker hours of the day or was it to enjoy a source of heat when the night temperatures drop? For this experiment, the researcher hypothesized that night bugs were most attracted to the heat produced from the different light bulb types and, therefore, felt bugs would gather mostly around incandescent bulbs, from which ninety percent of the energy used goes to emanating heat. For eight consecutive nights, the researcher placed four different lights outside in close location to one another, all containing a different type of light bulb: incandescent, halogen, LED, and compact fluorescent. Twice in the space of thirty minutes, the number of bugs at each bulb type was recorded and then at the end, averaged to find the nightly average for each bulb. At the closing of the eight nights, the numbers of bugs per bulb type were added together, then averaged to find an overall average of bugs found at each bulb type. Out of all of the bulbs, the LED bulbs had the most bugs present every night, proving that night bugs are attracted to the light of the bulb, rather than the heat being produced by the bulb. Therefore, after more in depth research, the experiment's data was similar to other information found by the scientists on the same topic. Scientists have found that the reason moths come to the bulbs is because of their own particular species type and individual habits.

The Effect of Solution on the Regeneration Time of *Planaria*

Molly Hunold

George H. Moody Middle School

Planaria are small, bilateral flatworms currently playing a role in scientific research at the Massachusetts Institute of Technology. There, researchers discovered the gene, *notum*, which is responsible for *planaria*'s ability to regenerate lost body parts and may play a key role in human tissue repair. The purpose of this experiment was to determine

if solution had an effect on the regeneration time of planaria. The levels of independent variable were distilled water, pond water, tap water, and brackish water. First, one planaria was removed from the dish and placed onto a sheet of plastic using a pipette. It was cut in half using a knife, so that there was a head and tail. The head was placed into the distilled water solution, while the tail was set aside for no further use.

Overall, distilled water produced the best results only taking on average 8.9 days to regenerate. The research hypothesis, if the planaria are placed into the pond water solution, then regeneration time will be the least, was not supported as pond water took 9.3 days to regenerate.

Based on the findings in this experiment, planaria living in distilled water regenerated the fastest. However, due to the fact that the planaria used in this experiment were coming from a lab setting, these results may be inconsistent with the results that would occur if the planaria used came from a creek or pond.

The Effect of Different Levels of Exercise on the Amount of Time it Takes for Carbon Dioxide Output Levels to Change

Olivia Justis

George H. Moody Middle School

After exerting a significant amount of energy, it is necessary to both inhale a great amount of oxygen and exhale a great amount of carbon dioxide. The higher a person's heart rate is, the more they breathe in order to supply their body with enough oxygen to survive. Exercising is a common cause of increase in heart rate. Every time a human being exhales, carbon dioxide is released into the air. The purpose of this experiment was to determine which level of exercise caused carbon dioxide output levels to change at the fastest rate.

Fifteen human subjects were asked to walk, run, and sit for two minutes and then breathe into a respirometer until the pH indicator liquid changed color, signifying that there had been a significant change in carbon dioxide output levels. The results from this experiment indicated that exerting more energy, specifically running, caused carbon dioxide output levels to change at the fastest rate with a mean (average) of 13.6 seconds. After walking, the mean was 14.13 seconds, and the control, sitting, caused CO₂ output levels to change at an average (mean) of 31.86 seconds. The data collected supported the hypothesis that stated, if participants are asked to walk, run, and sit, then the carbon dioxide output levels will change at a faster rate after participants run. Based on the data collected for this experiment, there appears to be a direct correlation between the intensity level of exercise and the rate in which carbon dioxide is exhaled. However, it cannot be conclusively determined that exercise level was the sole reason for the amount of time it took for carbon dioxide output levels to change at the rate in which they did. Before a legitimate reason(s) can be concluded, additional studies will need to be completed in order to come to a consensus.

The Effects of Brands of Popcorn on Amount Unpopped

Anna Lujan, Rebeca Mercado, and Sarah Young
Gunston Middle School

The group decided to test the brands of popcorn to discover which brand of popcorn performed the best and satisfied its consumers with its impressive amount of popcorn. Aren't you tired of finding unwanted amounts of unpopped kernels at the bottom of the bag? The researchers were too! The goal of the experiment was to figure out which brand of popcorn has the least amount of unpopped kernels. First a bag of popcorn was popped. Then it was weighed before opening and again after opening. Opening the popped bag released the water vapor that was trapped inside the kernels before being popped. Afterwards the bag was emptied one kernel at a time as the researchers counted. Lastly the unpopped kernels were counted. This was repeated five times for each brand (five brands for a total of 25 bags). For Orville Redenbacher the amount of kernels popped was 375/409 or 91.7% popped. For the Organic brand the amount of kernels popped was 356/463 or 76.9% popped. For the Homemade Jolly Time the amount of kernels popped was 328/436 or 75.2% popped. For Pop-Secret the amount of kernels popped was 286/326 or 87.7% popped. For the Safeway popcorn the amount of popped kernels was 368/448 or 82.1% popped. Based on the data, Orville Redenbacher had the highest percentage of popped kernels making it the best brand to buy.

The Art of Balance

Miles McAllister Gildersleeve Middle School
Abstract missing

The Effect of Gender on the Stroop Effect

Bailey McGrew
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Manchester Middle School

This experiment was conducted to discover more in-depth information regarding the human brain and its processes, and mostly whether or not gender has an impact on the Stroop Effect. Experiments relating to this phenomenon continue to increase our knowledge on the human mind and the effects gender has on it. This experiment was performed by instructing 50 participants, 25 boys and 25 girls, to first read color words that were printed in coordinating color ink, and then read color words that were printed in non-correlating ink. The correlating time was then subtracted from the non-correlating time, and the difference was recorded. The highest time for the boys was 58.8 seconds, while the highest for the girls was only 38.7. When the average boys' time of 31.468 is compared to the girls' average of 21.148, it is clearly shown that the performance of girls was much better.

The Effect of Tommy John Surgery on the Effectiveness of Pitchers James McGuire and Andrew Roy
Gunston Middle School

It was hypothesized that if a baseball player received Tommy John surgery their pitching performance would improve. The researchers chose this experiment because of an interest in baseball, and now Tommy John Surgery is an instrumental part of the game, so naturally the researchers were curious to see the effects of the surgery. The original hypothesis was not supported. The procedure was simple. The researchers found fifteen players who had the surgery and then sorted them into groups according to their age and major league experience. Then the researchers found fourteen players that never had the surgery to compare to the players that had the surgery. The researchers then found the baseball performance statistics for both groups of baseball player and calculated mean, median and range. It was discovered that pitching performance, on average, declined after the surgery, based on the statistics ERA (3.6 versus 3.82), WHIP (1.22 versus 1.29) and BAA (.225 versus .234). The data did not support the hypothesis. The players that did not have the surgery, on average, improved their pitching performance and their careers overtime. Overall, the sought-after discovery was made. This knowledge let the researchers to the belief that baseball pitchers should not have the surgery unless absolutely necessary.

The Effect of Height on Reaction Time in Humans

John Neary
Tuckahoe Middle School

During many sports, athletes must react with amazing speed. A goalkeeper must react to and save a soccer ball coming to him in less than a second. The experimental question was, would a taller person be less likely to react with the amount of speed that a shorter person would? This experiment was conducted to find if height has an effect on reaction time. The experimenter wanted to know if someone who is tall would have a quicker reaction time than someone who is short. The experiment was conducted by having the experimenter dropping a meter stick, for each subject to catch. The subject used his or her thumb on one of the meter stick and his or her other four fingers on the other side of the meter stick. Then, the point at which the subject caught the meter stick was converted to reaction time using the equation, $y = \sqrt{x/980} * 2$, with x being the point at which the meter stick was caught and y being the reaction time. The alternative hypothesis was that a taller person would have a slower reaction time than a person who is shorter. The null hypothesis was that height does not have an effect on reaction time. The medium height group actually had the lowest average reaction time. It had an average of 0.173 seconds. The short and tall groups had averages of 0.197 seconds and 0.189 seconds, giving the short height group the highest reaction time. However, the subjects in the short height group also had the highest variability. After a t-test was conducted, it was found that the difference between the short height group and the medium height group was statistically significant (0.0323). However, the difference between the medium height group and the tall height group was not statistically significant (0.1271). At the end, the alternative hypothesis the height has an effect on reaction time was rejected and it was found that height does not have an effect on reaction time.

The Effect of Different Antacids on the Neutralization of Hydrochloric Acid's pH Level

Gabrielle Rockey
George H. Moody Middle School

Victims of Esophagitis, heartburn, and other problems caused by an excess amount of HCl (hydrochloric acid) are always scouting medicine aisles trying to find that perfect antacid that fits all of their requirements. Which antacid would that be, and do the different active ingredients contained in the antacid brands affect their performance and efficiency? The purpose of this experiment was to determine which type of antacid (independent variable) would neutralize hydrochloric acid best (dependent variable). HCl is a substance naturally produced by the stomach that is highly acidic and potentially dangerous. It has a pH of 1 and is necessary in the digestive system to digest food properly. Antacids are bases that help prevent heartburn, peptic ulcers, and other health issues. Neutralization is a process performed when an acid and a base demolish each other's properties to produce water and salt. 800 ml of hydrochloric acid diluted to .6 molar, pH paper with a scale ranging from 1-14, and the 4 different types of antacids (Maalox, Alka-Seltzer, Tums, and Pepto Bismol) were all collected for the start of the experiment. For each of the 40 trials the appropriate amount for an adult dosage was crushed and placed in a container concealing 20 ml of diluted HCl. 10 minutes were given for the antacid to dissolve and react with the stomach acid. After time was up, the pH paper was used to test the new pH value of the HCl. My hypothesis was that if Tums was used then it would neutralize the acid best. After repeating the experiment multiple times, the results were evident. Alka-Seltzer neutralized the HCl best with a mean of 5.6, while Pepto Bismol was the least effective with a mean of 1.7. The experimental results do not support my hypothesis because Alka-Seltzer ended up neutralizing the HCl to a lesser level of acidity. Perhaps Alka-Seltzer was more efficient because it contained multiple active ingredients, was very fast at dissolving, and is a highly recommended antacid that doctors suggest to patients with these symptoms.

The Effects of Different Antibiotics on *Staphylococcus epidermis* in a Simulated Surgical Suture

Marisa Shotwell
Thomas Jefferson Middle School

In surgery many types of prophylaxis are used but bacterial infections still occur. One common infection is *Staphylococcus epidermidis*. This experiment tested the toxicity of different antibiotics on *Staphylococcus epidermidis* (*S.Epi*), a gram-positive, non-pathogenic bacteria that when growing forms small white colonies. Plates were prepared using pig skin, surgical staples, and a scalpel, to perform the incision. After the introduction of *S.Epi*, the plates were incubated for 24 hours before being re-plated and measured using the isolation streaking method; the third quadrant of colonies was then analyzed. The hypothesis was that Vancomycin would be most effective at killing the *S.Epi* because it is a commonly prescribed medication to treat Staph infections. The hypothesis was rejected as Moxifloxacin was shown most effective at killing bacteria leaving an average count of about 2 colonies per disk. Vancomycin followed with 4 colonies and Penicillin with 5. A blank control disk averaged 9 colonies per disk. Beta hemolysis occurred in both Control plate 1 and a Vancomycin plate 2. Another disk was

prepared showing perfect circle diffusion for each antibiotic. These measurements supported the results as well, showing, Moxifloxacin with the highest kill radius measurement of 1.3cm to the outer edge. While Moxifloxacin was most effective, it would not normally be the only antibiotic used when trying to fight an infection.

The Effect of Color of Text on Number of Digits Memorized

Sarah Steele,
Manchester Middle School

Abstract:

In this experiment, the goal was to possibly improve teaching strategies and hopefully reading comprehension. During my approach, I had 20 people memorize as much of a two-hundred-digit number as they could. There were seven trials per person, with seven different colors including red, orange, yellow, green, blue, purple, and black. The darkest colors (in general) did the best. Black had the overall highest mean, which differed from my original hypothesis that green would have the highest mean. However, conforming to my original hypothesis, red did have the overall lowest mean. I concluded from these results that dark colors are best for memorizing things, especially black and purple. On the other hand, though, light or bright colors such as yellow, green, and red are not suggestible.

Can You Take It?

Marisa Sydnor
Thomas Jefferson Middle School

Abstract:

Smell plays a role in taste. The purpose of the experiment is to find the effect of smell on taste. Food items from five different flavor profiles were tested.(sour, bitter, sweet, salty, and spicy). The hypothesis was that if the nasal passage is blocked, then the participant will not be able to identify what is being tasted. All of the tested foods were chopped and blended to eliminate differences in texture and then placed into different cups to rinse out the participant's mouths between tastes. Water was poured into separate cups. The participants were asked to taste the different foods with their noses plugged and try to identify the foods. 75% of the participants were correct and 25% were incorrect when identifying the sweet item. 50% were correct and 50% were incorrect for the sour food. 75% were correct and 25% were incorrect for salty and spicy category. Finally, 25% were correct and 75% were incorrect for the bitter tasting food. The hypothesis was rejected because the participants were still able to determine what was being eaten.

The Effect of Salinity on the Survival Rate of *Daphnia pulex*

Sahana Tharakan

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George H. Moody Middle School

The outer covering of the *Daphnia pulex* is clear making it easy to see internal organs like the heart. They are the most common species of *Daphnia* and live in most freshwater bodies, not saltwater. Salinity is the measure of sodium chloride in the water. About 97% of earth's water is the saltwater oceans. The purpose of this experiment was to determine how salinity affects the survival rate of *Daphnia pulex*. Six saline solutions (0%, 0.1875%, 0.375%, 0.75%, 1.5%, and 3%) were made, and then 10 milliliters of each were put into corresponding petri dishes. Twenty *Daphnia pulex* were placed in the water after this was done. After 12 hours, the number of *Daphnia pulex* still alive was recorded. The results indicated that as the salinity increased, the number of *Daphnia pulex* alive decreased. In the 3% saline solution, an average of 0 *Daphnia pulex* were alive, and in the 0% saline solution, a mean of 19 *Daphnia pulex* were still alive. The data supported the hypothesis that if the amount of salt in the solution is increased, then the survival rate of the *Daphnia pulex* will decrease.

Based on the data collected, there seems to be a link between the salinity of the water and the survival rate of the *Daphnia pulex*. Before it can be concluded that *Daphnia pulex* cannot live in any very salty conditions, additional tests should be run to collect more data.

The Effect of Washing Time on Hand Germs

Valerie Young
George H Moody Middle School

Abstract:

Hospitals have been reminding the public to wash their hands all the time, such as after meals, to prevent diseases from spreading and to reduce the number of bacteria in the world. This began the study on the components of washing hands by CDC, the Center for Disease Control and Prevention. The type of germs found on hands have been researched into many times. That being said, scientists are trying to find the most effective way to eliminate germs, and they are trying to find various new methods to remove germs by washing hands.

The purpose of this experiment was to determine if washing time had an effect on the amount of germs left. The four independent variable were 5 seconds, 10 seconds, 20 seconds, and 30 seconds. Each of these variables were tested 15 times. The experimenter's hypothesis was that if a person washes their hands for thirty seconds, then the amount of germs will decrease. The hands were washed fifteen times for the various times, using soap each time. A timer was used to calculate how long the hands were being washed, and a scanner was used to see the percentage of germs left after each washing. At the end, the biggest decrease in germs was after thirty seconds of washing, the average being twenty percent of germs left on the hand. The lowest

decrease in germs was after five seconds of washing the hands, the average being eighty percent of germs still left on the hands. According to the results, the hypothesis was supported because most of the germs were gone after washing for thirty seconds. Based on the information collected from the experiment data, it is better to wash hands for longer, like thirty seconds, instead of for five seconds. More trials can be conducted, to test if it was actually the time that affected the percentage of germs left on the hands, or if it was the brand of soap that affected it.

Behavioral Sciences

First Place:

The Effect of Gender on Self-Control

Morgan Thweatt

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Manchester Middle School

This experiment was conducted to test the effect gender has on self-control levels in teenaged children. The hypothesis stated that if boys and girls were tested for self-control, the boys would demonstrate higher self-control levels. To test self-control, teens were situated in an environment that promotes boredom (absolute silence and no distractions) and were confronted with a cupcake. They were to try to wait as long as possible before eating their cupcake. The results of the experiment revealed that the boys had more self-control, as their average time before eating the cupcake was greater than the girls. The hypothesis was proven correct.

Second Place:

The Effect of Testing Medium on Testing Performance

Kristina McKean

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George H. Moody Middle School

The amount of time people spend using the internet and other forms of technology is increasing rapidly every year. In 2009, North American adults spent 12 hours a week online, double the amount of time spent in 2005. Even North American children aged two to eleven experienced an increase of 60 percent of the average amount of time spent online from 2004 to 2009, when the amount of time spent online per week became 8 hours. With all of this rapid growth, there has not been much speculation on the possible effects of technology. According to an experiment conducted by the University of California, Los Angeles (UCLA) research team, internet activity changes

the patterns of neural activation in the brain, or the way the neurons in the brain connect and communicate with each other. On the other hand, asthenopia, or eye strain, can be provoked by reading print, showing that not only computers can cause damage to the human body. The purpose of the research project was to determine if testing medium affects testing performance in students. 10 seventh grade students at Moody Middle School in the same class were asked to participate in the experiment. Two multiple choice tests were created, one on paper and one electronic, on similar obscure literary figures. Students took the electronic test on the first day, and the paper test on the second day. The hypothesis was that if the paper test was used, then the testing performance would increase. According to a t-test, there was no correlation between testing medium and testing performance, creating a null hypothesis. ($t=0.78$, $df=18$, $p<0.05$) The lack of diversity among the subjects may have been a major cause of the lack of statistical significance in the results. All of the subjects were in possession of a laptop provided by the school, so they all had a high level of computer access. An improvement for this experiment would be to test a larger group of students of a more diverse population. This way, more than just the people who have regular computer access would be tested.

Third Place:

The Effect of Different Forms of Communication on Memory

Brannon Linder

George H Moody Middle School

Memory is a very important part of a person's everyday lifestyle. Absolutely everything that a person does revolves around learning and memorizing. Learning is a process which is accomplished by the five senses gathering information by the environment around it, in this experiment, sight and hearing. Seeing is the procedure in which light travels through the eye where the retina in the eye detect the light and sent this information to the brain to be further processed. Hearing is another process where sound travels through the ear where, to put it simply, vibrates the malleus, the incus, and the stapes and later transmits this information to the brain. Memory in itself happens when a learning experience is formed when neurons in the brain fire together to produce a particular sensation so that they can be repeated again, or remembered. Also, every person on the Earth has their own particular learning style that allows them to understand information a certain way best. The purpose of this experiment was to find the effect of different forms of communication on memory.

Four modes of communication were tested in this experiment: Audio, Video, Face-to-Face, and Reading. In the beginning, the experimenter created a script and assessment on sets of information. In each trial, a subject was given one of these information and they was then tested using the assessment sheets. This procedure was repeated ten times for each group, and the results were then recorded and placed into a chart and graph.

The results derived from this experiment showed that the control group, Face-to-Face showed that has the highest mean of number of questions answered correctly, which was 6.7. This shows that the hypothesis for this experiment was supported.

Honorable Mention:
Sweet as Sugar, Tough as Nails

Gabrielle Birenbaum
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Thomas Jefferson Middle School

This experiment examined the effect of the identified gender of an infant on the number of passive, aggressive, or neutral words chosen to describe the baby. The hypothesis was that if participants were shown a picture of a baby and asked to choose words to describe the baby, then 50% of the words chosen would be passive in nature when told the baby was a girl, 50% of the words chosen would be aggressive in nature when told the baby was a boy, and 50% of the words chosen would be neutral in nature when not told the gender. Sixty participants were shown a picture of a baby and asked to choose six words from a list of eighteen. Six of the words were passive, six were aggressive, and six were neutral. The results showed that over 50% of chosen words were passive when told the baby was a girl, and over 50% of chosen words were neutral when not told the gender of the baby. Only 13.33% of chosen words were aggressive when told the baby was a boy. The experiment revealed that the words categorized as passive and neutral are commonly used to describe babies of their corresponding genders. It also showed that being told a baby is a boy does not necessarily result in the use of aggressive adjectives.

Honorable Mention:

The Effect of Color on Taste Perception

Amanda Orndorff
Manchester Middle School

In this experiment, the object was to find out if the color of a food or drink item has any effect on taste perception. Past experiments have shown that if the flavor and color of a food or drink do not match, then the brain will confuse the two and think it tastes like a flavor that corresponds with the color. The experiment tested the effect of different color and flavor drinks on the flavor the participants thought the drink to be. The yellow-colored drink trials came out very successful. The best drink in that group was Cup D, which was the cup with the corresponding colors and flavors (yellow, lemon). The Cup that did the worst was Cup E, which did not have corresponding colors and flavors. The

drink was colored yellow but the real flavor was orange. Most people said it was lemon, proving that the color can change how you perceive the drink/food to taste. The hypothesis was supported with the statement, when a drink's color does not correspond with the flavor of the drink, then the flavor of the drink guessed by the participants will not be the right flavor, but a flavor that does correspond with the color.

Honorable Mention:

The Effect of Toothpaste Flavor on Time Spent Brushing Teeth

George Walker

Tuckahoe Middle School

The experiment tested the effect of the toothpaste flavor given to a child on the amount of time that a child brushed his teeth and whether or not he would choose the specific flavor again. The results acquired can help parents get the best toothpaste flavors for their children. To perform the experiment, 15 children, of both genders, from five to nine years of age were gathered on five different days. On each of the five separate days, the children brushed their teeth with one certain toothpaste flavor. The five toothpaste flavors were "Oral-B Stages Bubble Gum," "Crest Complete Multi-Benefit Cinnamon," "Colgate Total Enamel Strength," "Oral-B Stages Fruit Blast," and "Colgate Sparkling White Mint Zing Paste." The children were timed with a stopwatch and asked whether or not they would choose this flavor again. The children were timed without being told, and they were not told what was being tested for in the experiment. The amount of time they spent brushing their teeth was measured in seconds. The hypothesis formed was, "if children from ages five to seven brush their teeth with Oral-B Stages Bubble Gum toothpaste and if children from ages eight to nine brush their teeth with Colgate Sparkling White Mint Zing Paste toothpaste, then on average they will brush their teeth longest." After the experiment was complete, it turned out that the children flavors were the ones that the children said they liked best. The "Oral-B Stages Bubble Gum" flavor was the children's favorite and averaged the longest time spent brushing teeth. The toothpaste flavors with the shortest average time spent brushing teeth were "Crest Complete Multi-Benefit Cinnamon" and "Colgate Total Enamel Strength" toothpastes. The children said that they hated these flavors.

Other Papers Chosen for Presentation:

The Effect of Volume of Background Music on Short-Term Memory

Emma Burd, Ingrid Jacobsen, and Elizabeth Thompson
Gunston Middle School

The purpose of the experiment was to find out if trying to memorize something that involves short-term memory would be affected by background music with lyrics. It was very interesting to see how people's short-term memory was affected by the volume of music that was playing. The goal of this project was to find the effect of volume of music on short-term memory. The hypothesis was that if the volume was increased then the short term memory decreased. The control was no music, and the independent variable was the volume of music (no, low medium, high). The dependent variable was the short-term memory, or the score the volunteer received in Memory (the matching game). In this experiment, thirty test subjects participated. Each test subject had thirty seconds to memorize eight pairs of cards from the game "Memory." Each time, the test subjects memorized the cards for thirty seconds, and then played the game, Memory, while the volume of music changed or increased in volume. The results of the experiment did not support the hypothesis. The average scores were 5.9 (no volume), 6.2 (medium volume), and 6.8 (high volume), so the test subjects did better with louder music. Many kids now study with background music. Based on the experiment, kids have the potential to study with music on, and kids can focus on a task while listening to music. If people are studying for something involving short-term memory, it could help to study with background music.

How Does Exposure to Distraction Affect Recall in Teachers

Jordan Chapman
George H Moody Middle School

The Effect of Various Influences on the Color Preferences of Second Grade Students

Abstract not submitted

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Manchester Middle School

The influences a young child faces in their environment can determine the challenges they may face as an adult. Knowing who children are most influenced by gives people a greater understanding of how their minds work, so that the children can be more effectively taught essential life skills. This experiment was conducted to discover which type of influence has the greatest effect on the color preferences of second grade

children. It was hypothesized that if the child's color preferences are influenced, then Teen influence will have the greatest effect on their preferences. One hundred twenty five children were asked to choose a color, red or blue, to be their control color. Influential speeches were made by Adult, Teen, Peer, and Bandwagon influencers in order to sway the children's color preferences. Each child was asked to choose between their control color, and the designated color of the influencer. For each type of influence, the percent of students who changed their color preference from their control was calculated. Teen Influence had the greatest effect on the students' preferences, with 86% percent of the children choosing the designated color of Teen Influence, green, rather than their control color. Peer Influence was the second most effective type of influence, with 84% of the students switching from their control color to the designated color of Peer Influence, orange. Adult Influence was the third most effective type of influence, with 80% of the students switching from their control color to the designated color of Adult Influence, yellow. Bandwagon Influence was the least effective type, with 78% of the students switching from their control color to the designated color of Bandwagon Influence, purple. Also, 73% of the students were influenced by every influence type. It can be concluded that Teen influence was the most effective type of influence because the highest percent of students were influenced by the Teen's speech.

The Effect of Smell on Taste for 7th Grade Girls

Avery Finkelson
Tuckahoe Middle School

This project's purpose was to figure out different relations between smell and taste. The purpose of the experiment was to test whether smell affects taste in seventh grade girls. In the case that it does, food should be prepared with smells that are appealing to young girls so it will be eaten. The hypothesis was that if the girls were tested to see whether or not the smell of a chocolate chip cookie affected the taste of the cookie, then most of them would prefer the cookies with no added scent. Ten seventh grade girls tasted a cookie beside each of the four different scents and rated the cookie from 1-4, 1 being bad-tasting and 4 being good-tasting. The results of the experiment supported the hypothesis. The cookie that was preferred the most was the one with no additional scent. The average rating for the cookie with no additional scent was 3.6. The other levels of the independent variable were new car air freshener (2.6 average), garlic (2.9 average), and rose candle wax (2.5 average). People have become familiar with the smell of a chocolate chip cookie. When it smells different, people will not be comfortable with a different scent matched with the food.

What Will You Be When You Grow Up?

Bay Gates

Thomas Jefferson Middle School

Forty years ago, at the beginning of the Women's Rights movement, gender roles in the job market were very defined. Children were aware of male and female roles in society, and it affected their dreams of what they would be when they grew up. This experiment was conducted to see if gender bias toward career options still exist in young children. Even today, many children's shows have a male main character. This experiment was done to compare gender bias between girls and boys.

The hypothesis was that if five-year-old boys and girls were asked questions that require them to choose the gender of a person that would grow up to hold a particular job, then boys would show more gender bias in their responses. Ten children (five girls and five boys) were asked eight sets of questions; four regarding traditionally female careers, and four regarding male careers. Each child had to choose the gender of the person they thought would grow up to have that career. The responses were combined and charted to see if any biases were apparent.

The hypothesis that boys would show more bias was rejected. Although both boys and girls showed bias regarding particular careers, girls showed more bias overall. 21 gender bias responses were recorded for the girls, while only 17 were recorded for the boys. A response was considered biased if the male was chosen for a traditionally male career, or the female was chosen for a traditionally female career. Choosing the opposite sex, or both was not considered a gender bias response.

The Effect of Color on Memory

Meredith Hynes

Tuckahoe Middle School

The purpose of this research study is to determine the impact, if any, of color on short term memory and how color might add to the learning process. This project was interesting because most people don't notice how fast the brain and eyes work, within second surroundings are seen and the brain has processed it. Also, what was interesting is color can improve memory and improved memorization can help improve learning. An experiment was designed to test the effect of color on the ability of a person to remember information. A series of flash cards was made with pictures colored in red, blue, yellow and black and white. People tend to associate certain colors with certain objects like red with an apple. This may make the pictures easier or more difficult to remember. As a result, all of the flashcards were created so each picture was not in a

color that most people associated. For example, one of the flash cards was a blue dog. Twenty people, middle school aged to adult, were shown the flash cards in sets of 10 for a limited amount of time and then were required to write down what objects they remembered from the different sets of flash cards. Based on this research, the hypothesis was that color has an impact on short term memory recall.

Of all the colors tested (red, yellow, blue, and black and white), red was recalled the most with an 8.05 average.

The Effect of Gender on Eyewitness Testimony

Dylan Lackey
Manchester Middle School

Sight, memory, and human perception greatly affect the way that humans observe behavior and situations. Sight works along with the brain to control ones memory. Memory can occur in long term and short term. The objective of this experiment was to research the accuracy of eyewitness testimony in males versus females. The research used was a behavioral approach to record how human perception can skew the account of observation in males and females. Each gender has unique qualities that aid in memory and retaining information. In this experiment on human observation, the memories of 50 males and 50 females are tested. After watching a short video, each human was to answer five questions about different points of the video. The goal of each subject was to answer all five questions correctly and recount as much of the actual video as possible. If an answer deviated from the video in any way then it was counted as incorrect. The control of the experiment was the correct answers for each test question.

The results of the experiment showed many differences in male and female subject scores. In the control a set of fifty perfect scores of five were used. The key results include the means for three different variables. Male subject variables had an overall mean of 2.78. Female subjects had an overall mean of 2.96. The control mean had a score of 5.00. In conclusion, one can state that the females had slightly more proficient observation skills than the male subjects, proving the hypothesis true.

The Effect of the Time of Day on the Speed of Cars

Ben Martin
Gunston Middle School

The purpose of the experiment was to find out the effect of the time of day on the speed of cars. The goal of this project was to see if it is safer to drive at certain times of the

day. Also the researcher could find out when most people speed, therefore helping police decide when more policemen should be on watch. The steps the researcher took in conducting this experiment were pretty straight forward. The researcher observed how many cars out of 40, sped at certain times of the day. The times the researcher chose were 6:00 AM, 9:00 AM, 12:00 PM, 3:00 PM, 6:00 PM, and 9:00 PM. What the data showed was that around 6:00 AM and 9:00 PM more cars drove over the speed limit. The researcher observed that less cars sped in the middle of the day and more during the morning and night hours. The only major difference between the two times of day was the light. Drivers probably feel that there is less of a chance that they will be caught speeding when it is dark, or less police officers will be looking. What the researcher could conclude from this experiment was that it was safer to drive when it was light out. Not only because less people would be speeding, but visibility was a lot better which was a given when someone drove during the daytime. Also this information would inform police that instead of having officers looking for people speeding during the day, they should look at night.

The Effect of Leg Length on Acceleration

Jack McGolrick
George H Moody Middle School

Abstract not submitted

The Effect of Age on Memory

Dzemila Mujcic
Tuckahoe Middle School

The objective for this experiment was to find out if age affects memory. Many scientists say that age does affect memory. When you age, your memory gets worse and worse because the brain begins to lose cells in the front of the brain that are important to memory. Because of this neurotransmitter, called acetylcholine, are produced (Cutler, 1996). To do this, an experiment was conducted. 25 household items were laid across the living room floor. The participants in this experiment had 30 seconds to look at the 25 items and remember as much as they could. After 30 seconds to remember the household items, they had one minute to write down however much they've memorized. The hypothesis was not supported by the results from this experiment. For middle school students, the mean, median, and mode were 12 items and the range were 7 items

remembered. The mean, mode, and median for high school students were 11 items and the range were 4 items remembered. For adults, the mean and median were 13 items, the range was 6 items, and the mode was 12 items remembered. The results showed that adults remembered more items than middle and high school students did. Middle school students remembered more than high school students. High school students might have remembered the least amount of items because of new technology

What is the Effect of Brand Recognition on Taste Preference?

Hayley Roy
Thomas Jefferson Middle School

The purpose of this experiment was to test the effect of brand recognition on taste preference is. This experiment was done to find out if the different brands of similar product would have an effect on which product a subject would choose. The hypothesis was that if there were a choice between Giant Cola and Coca Cola then Coca Cola would be chosen. To do this experiment two days were needed. On day one 16 subjects tasted a cup of Coca Cola and Giant cola and chose which one that was preferred. On day two the cups were labeled Coca Cola and Giant Cola. The difference was that the one cup was labeled Coca Cola was filled with Giant Cola and the one labeled Giant Cola was filled with Coca Cola. On day one 50% chose Giant Cola and 50% chose Coca Cola. On day two 56% chose the cup labeled Coca Cola (actually containing Giant Cola) and 44% chose the cup labeled Giant Cola (but actually containing Coca Cola). It was showed how advertising actually did affect the subjects.

The Effect of Prior Knowledge of Testing on Male and Female Middle School Students' Ability to Recall Objects in the Environment

Brooke Tannehill
Thomas Jefferson Middle School

Who has the better ability to recall their surroundings? Boys or girls? Are both genders better at remembering things if they are aware they will be tested? The purpose of this experiment was to find the effect of prior knowledge of testing on male and female middle school students' ability to recall objects in the environment. Both males and females were tested in this experiment. For the procedure, 20 students were instructed to go in a room (each at separate times) and sit in a designated spot for 45 seconds.

When the time was up, each student was asked to leave the room and then will be asked questions about the room, this was the “unaware” portion of the ability to recall. The process was repeated but the next time the student was informed that they would be asked ten questions pertaining to the room in which they were sitting. This was the “aware” portion of the ability to recall. After recording the number of questions each student answered correctly, the results were tallied and averaged. For the girls, the “unaware” mean score was 7.1/10 questions correct. The next result for the girls was an “aware” mean score was 6.1/10 questions correct. For the boys, the “unaware” mean score was 6.9/10 questions correct. Subsequently for the boys, the “aware” mean score was 5.1/10 questions correct. It was found that prior notification of the recall questioning had a negative effect on the ability to recall objects for both males and females, more so for the boys. My hypothesis was partially correct. The girls did out perform the boys; however, both male and female performed worse with prior notification.

The Effect of Grade Level of Girls on the Percentage of Bullies, Bystanders and Victims

Nicole Thomas
Manchester Middle School

For this project 93 6th, 7th and 8th grade girls were given a 34 question survey which identified whether they can best be describes as a bully, bystander or a victim. The hypothesis for this project was partially rejected. 27% of 8th graders identified with the traits of a bully, with 18% identifying with a victim. 24% of the 31 7th graders surveyed identified with the traits of a bystander, however only 15% of 7th graders identified with the traits of a victim. In 6th grade a hefty 25% identified with the traits of a bully and only 16% identified with the traits of a victim.

Given the results of this experiment one can conclude several things. One of them being that the higher percentages of bullies in 6th and 7th grades comes from the repressed feelings of anger or sadness girls at that age tend to feel. The purpose of this experiment was to expose bullying in middle school. With new technology and the dramatic incline of suicide rates among teens it's apparent that bullying is on the rise. The importance of teaching tolerance early is reflected in this experiment. Also, the importance of teaching middle school students how to safely intervene in bullying situations is crucial. Lastly empowering victims and providing them the help that they need to thrive is something that is becoming very important. Bullying is on the rise in middle school among both girls and boys, it has to stop.

The Nose Knows Smell, but How About Taste?

Haben Yosief

Thomas Jefferson Middle School

Have you ever wondered why the wonderful flavors in a meal can't be tasted when you have a cold or a stuffy nose? Is it because the sense of smell is blocked? The goal of this project was to examine the effect of varying acidity levels of fruits on the ability to taste the flavors in a food without using the sense of smell. In this experiment, ten seventh graders were blindfolded, and their noses were plugged before they were asked to drink five samples of different pureed fruits. The students were asked to identify the fruits used in each sample. The five fruits used were: strawberry, mango, kiwi, lemon, and grape. The hypothesis was that if a person tasted fruits of varying acidity levels without the use of the sense of smell, then the most acidic fruit, lemon, would be correctly identified more often than mango, kiwi, strawberry, and grape. The results of this experiment supported the hypothesis, as lemon was correctly identified by seven out of ten volunteers. Strawberry was correctly identified four out of ten times. Mango was correctly identified three out of ten times. Kiwi was correctly identified three out of ten times. Grape was correctly identified two out of ten times. The results showed that the more acidic the fruit was, the more often it was correctly identified with the exception of grapes, most likely because familiar grape flavors are often artificial.

Botany

First Place:

"Micro Light Sight": The Effect of Saccharin Concentration on the Phototactic Movement of *Volvox globator*

Alexander Monahan and Jonathon Towne

Thomas Jefferson High School for Science and Technology

Saccharin, a chemical in artificial sweeteners, has been deemed safe for humans, yet the impact of this substance on aquatic organisms is unknown. A prior study found

saccharin remained in tap water in miniscule amounts even after filtration, causing angst in the scientific community. Could the remaining saccharin affect small aquatic organisms, such as *Volvox globator* (abbreviated *V. globator*), if the chemical is leaked into the environment? Volvox are aquatic algae that exhibit phototactic movements, which are cellular movements designed to optimize growth and physiological conditions. Would saccharin affect the phototactic movements of *V. globator*? The purpose of this study was to determine the effect of saccharin concentration on the phototactic movement of *V. globator*. Although several types of phototactic movement exist, speed, the most common type of phototactic movement, was measured in this study. The *V. globator* were exposed to various saccharin concentrations, ranging from 0.0 to 0.5%. The speed of each Volvox was then calculated and recorded. Experimental results showed no statistically significant variation ($p > \alpha$) in Volvox phototactic movement, suggesting that saccharin leaked into watershed systems may not be an environmental hazard for small aquatic organisms at the base of the trophic pyramid.

Second Place:

The Effect of Algae-based Fertilizers on Corn Growth

Austin Gillies

Ocean Lakes High School

A problem facing alternative energy research in biofuels, particularly biodiesel derived from algae, was the cost of the conversion process. A proposed method of reducing costs was to sell the byproducts of the conversion as a fertilizer. The experiment's purpose was to investigate the use of algae as a fertilizer additive to improve the growth of plants, particularly corn (*Zea mays*). The algae genera *Scenedesmus* and *Desmodesmus* were selected for their fast reproductive rates and high lipid levels. The research hypothesis was that adding algae to the fertilizer would increase growth, while the null hypothesis stated that if the type of fertilizer was changed then there would be no effect on corn growth. For the experiment, eight rows of corn were planted. Two rows of seed only served as controls, and the rest were combinations of commercial fertilizer and algae. During the experiment, fertilizer was applied twice based on the amount of nitrogen needed by the soil. Damage from geese and Hurricane Irene resulted in the removal of harmed plants from the experiment. Results showed that changing the type of fertilizer affected the corn growth, with the best mix producing 65g more biomass per plant than the commercial fertilizer alone. An ANOVA test at a 0.05 level of significance gave a p-value of .000525, showing a statistical difference between variables. The experiment found that a 1:2 mix of algae to commercial fertilizer was optimal and produced the most biomass. Additional research could further investigate the effects of the byproduct algae.

Third Place:

The Effects of Different Agricultural Techniques on the Growth Rate and Fresh Weight of Various Plants

Connor Brogan
Godwin High School

This experiment investigated the effects of hydroponic and aquaponic systems on the health and growth of various types of plants in order to determine which system would produce the heaviest and fastest growing plants. The results of this experiment may help to decrease land degradation by possibly displaying how this space and fuel efficient alternative cultivation techniques produce heavier, faster growing plants than do traditional techniques. It was hypothesized that if pea and broccoli plants were grown using varying agricultural techniques, than they would grow the tallest and fastest in aquaponic systems. To conduct this experiment, eighteen pea and broccoli plants were placed into separate hydroponic and aquaponic systems, after being allowed to germinate for two weeks, and their heights were measured bi-daily for thirty-two days. Additionally, nine pea plants and eighteen broccoli plants were transferred to a soil-filled bin, to serve as control groups. It was found that the control groups, for both peas and broccoli, generally yielded the heaviest plants, as well as the highest growth rates. However, these results contradict modern research, which display that the experimental groups should have produced weights and growth rates equal to, or greater, than those of the control groups. This indicates that outside variables, like constant fluorescent lighting or below tolerable temperatures, probably influenced the results of this experiment. Future researchers should better control the nutrient levels in each system, as well as their water temperatures and test the system in varying environments.

Honorable Mention:

The Effect of Varying Amounts of Potassium Permanganate (KMnO₄) on the Chlorophyll Content of Stressed *Solanum lycopersicum*

Julianna Keeling
Godwin High School

The purpose of this study was to determine the effect of different potassium permanganate (KMnO₄) concentrations on the chlorophyll levels of stressed tomato plants. The chlorophyll level indicated the plants overall health. Ethylene secreted into the atmosphere by stressed plants disabled the pigment chlorophyll necessary for

photosynthesis. The rationale of this experiment was to determine if KMnO_4 could increase the lifespan of tomato plants by oxidization of ethylene produced from the stressed plant. A research hypothesis was formulated that if the quantity of KMnO_4 increased up to a certain point, then the stressed tomato plant would be healthier than the plants given less KMnO_4 when subjected to the same adverse growing conditions. Tomato plants grew for four weeks and were then introduced to stressful environmental conditions for nine days. The plants were exposed to KMnO_4 treatments of 0 g, 1.0 g, 2.0g, and 3.0 g. The control group was 0 grams because it simulated how plants would normally react in a stressed environment. The results revealed that exposure to KMnO_4 significantly increased the chlorophyll content of stressed plants. A t-test revealed that the data was significant for 0 g vs. 1.0 g, 0 g. vs. 2.0 g, 0 g vs. 3.0 g, 1.0 g. vs. 2.0 g, 1.0 g vs. 3.0 g, and 2.0 g vs. 3.0 g. The results supported the research hypothesis. It was thought that the results were due to the oxidizing role of KMnO_4 which removed atmospheric ethylene and gave the plant greater chlorophyll content and improved health. Future studies may involve experimentation with light exposure, relative humidity, temperature, as well as investigations with different oxidizers other than KMnO_4 .

Honorable Mention:

The Effect of Different Seed Dormancy Breaking Techniques on the Growth of *Abelmoschus esculentus*

Bhargav Sathish
Godwin High School

The purpose of this experiment was to find the effects of seed dormancy breaking techniques on okra seed growth. Recently, freezing seeds has been used in the farming industry to increase the yield of crops over a shorter period of time. Okra seeds were treated with either no dormancy breaking technique had an incision made in them, injected with H_2O or frozen. The plants were allowed to grow for 10 days, and the plant heights were measured every day. The control used in this experiment was no dormancy breaking technique. It was hypothesized that okra seeds injected with H_2O would grow faster than seeds with an incision in them, frozen seeds and seeds without a dormancy breaking technique. The results revealed that seeds that were frozen grew the tallest. A t-test was done, and it revealed that the data was significant for Incision vs Control, Freeze vs Control, Injection vs Control, Injection vs Freeze and Incision vs Freeze but not significant for Injection vs Incision. The results did not support the research hypothesis. It is believed that the results are due to the fact that the seeds injected in H_2O may have had their embryos damaged in the process, which therefore kills the seed. Okra seeds are also very sensitive to cold, and this could explain why the frozen seeds grew the fastest. This research could lead to future studies that investigate

the optimum seed dormancy breaking technique and how seed dormancy breaking techniques affect other plants.

Other Papers Chosen for Presentation:

The Effect of Different Cipher Codes on the Length of Time a Brute-force Attack Will Take to Break Through

Danny Anderson
Hanover High School

The purpose of this experiment was to determine if applying electricity to a pea plant while it is growing will stimulate plant growth. During the completion of the experiment, thirty cups were labeled and separated into three groups: the first group was comprised of cups one through ten, the second group was cups eleven through twenty, and the third group was cups twenty-one through thirty. Each cup was filled with one cup of soil and had two pea seeds placed in them. In cups eleven through twenty, a AA battery was connected to a wire by both ends and part of the wire in the middle was exposed before being placed in the soil. In cups twenty-one through thirty, a nine-volt battery was connected in a similar fashion. In cups one through twenty, which served as the control group, the cups were left with no batteries connected. The results for the control group ranged from four centimeters to twenty-nine centimeters in height, with an average of 11.1 centimeters and two plants not germinating. The height of the plants with AA batteries ranged from two centimeters to thirteen centimeters with an average of four centimeters and five plants not germinating. The plants with nine-volt batteries had a range in height of three to fifteen centimeters with an average of 2.1 centimeters and seven plants not germinating. The plants in the control group grew the highest and had the most germination. Therefore, the electricity did not stimulate plant growth, because the plants with electricity did not grow as high as the plants without electricity. This was likely because electricity interrupted the growth cycle of the plants and stunted growth.

Thigmotropism on Sweet Pea Tendrils

Marwa AwadBahr
Wakefield High School

Plants are thought of as immobile, but the tendrils of a vine, such as Sweet Peas, actually move in response to touch. The purpose of this experiment is to determine the effect of thigmotropism on Sweet Pea tendrils. Thigmotropism is the directional response of a plant organ to touch or physical contact with a solid object. This directional response is generally caused by the induction of some pattern of differential growth; a clear example of thigmotropism is the coiling that occurs in some tendrils. In this experiment, 20 Sweet Pea plants were planted and after they grew tendrils a pencil was used as stimuli in order to test how they respond to thigmotropism over different time durations. It was hypothesized that the tendril that touches the stimuli for a longer time duration will have the greatest affect and the tendril will start to curl faster around the pencil. So, after the plants were planted and grew tendrils, every morning over five weeks observations were conducted on the tendrils before and after touching the stimuli. The different time durations were one minute, two minutes, four minutes, six minutes, eight minutes, and ten minutes. There were two control groups in the experiment, a positive and a negative control, and they were a plant with tendrils constantly touching the stimuli and a plant that had no stimuli; some tendrils were also tested for over 24 hours once a week. The tendrils that were tested over one to two minutes touching the stimuli took more time to start curling, but the tendrils that were constantly touching the stimuli and the one that was touching the stimuli for a whole day (24 hours) took the least time to start curling around the pencil. The hypothesis was accepted which concludes that the sweet pea tendrils tend to start the curving process if touched by a stimuli for 24 or more hours. If the experiment was to be extended, different independent variables such as testing the tendrils with other kinds of tropism would be preferred to make a better conclusion on how tendrils tend to start curling and for how long.

The Effect of the Number of Nodes on a Coleus Plant on How Much Water It Needs to Survive

Madeleine Donovan
Yorktown High School

The experiment tested the effect of the number of nodes on a coleus cutting on how much water it needed to survive. Ten seven-cm cuttings were propagated with one node, 10 cuttings were cut to have two nodes, 10 with three, and 10 with four. They were then each placed in individual Dixie cups, and each filled with four tbsp (10 g) of vermiculite. The Dixie cups had been previously drilled with holes in the bottom to fit a strip of t-shirt cloth that would absorb the water from the jars. The cuttings were then placed in the cups, 2.5 cm from the bottom. The cups were placed on the lip of the jars filled with 50 mL of water. The cuttings were tested for three weeks. The amount of water absorbed (in mL) was measured and the 50 mL of room temperature (18-22° Celsius) water in each jar was replaced every day.

It was hypothesized that the cuttings with fewer nodes would need less water in order to survive. It was assumed the cutting would have less biomass to sustain and therefore would need less water. The hypothesis was not supported by the data. It was concluded that all the independent variable levels - plants with one, two, and three nodes - and the control - cuttings with four nodes - absorbed on average the same amount of water. The averages over all three weeks in order of number of nodes were 1.27, 1.29, 1.27, and 1.34 mL of water daily. An Analysis of variance table of statistical analysis of the data showed the probability factor was 0.99, so the number of nodes had no significant effect on the amount of H₂O needed. However, a qualitative analysis of the cuttings showed that the plants with more nodes were healthier than those with less. Once a week each cutting was measured based on a color chart, and it was concluded that overall, the levels with more nodes had more vibrant shades of green and purple, meaning they were healthier.

The Effect of Compost Composition on *Lumbricus terrestris* Preference and *Vigna radiata* Growth

Alexa Dzienny
Godwin High School

Abstract not submitted

Effect of Different Colors of Light on Growth of Annual Ryegrass

Price Gillock
Shenandoah Valley Governor's School

One of society's pertinent issues is to optimize conditions for plant growth. The purpose of this study was to determine if different colors of light cause annual ryegrass to grow faster as opposed to ryegrass grown under white light. Four groups of ten plots each were placed under their respective boxes, which were designed to let in a specific color of light: white, "pale blue," "pea green," and "flame." The plants grew for twelve days, and four plants per plot were randomly selected to be measured. An ANOVA analysis and Tukey test were used to evaluate the data, and the examination showed that there was no significant difference among or between the means of the four populations of ryegrass. The similarity between growths of the plants could be attributed to excess background light and filter inefficiency. It was concluded that when ryegrass is exposed to a wide range of light frequencies, there are no visible adverse effects on its growth.

The Effect of Light Color on Plant Growth

Paul Landini
Washington-Lee High School

The question that this project addresses is: what color of light benefits plants the most? The purpose of this experiment was to determine how light color affects a plant's growth and health. Four groups of 20 Wisconsin Fast Plants were grown under four light colors for ten days to determine which color was most beneficial to a plant's growth. After ten days, the plants grown under white light grew to an average height of 6.06 centimeters, the plants grown under red light grew to an average height of 7.19 centimeters, the plants grown under blue light grew to an average height of 7.08 centimeters, and the plants grown under green light grew to an average height of 0.30 centimeters. The ANOVA test results stated that these results were statistically significant; the p value was 1.74×10^{-31} . The T-test p value between the red light and blue light plants was 0.65, so there is no significant data between those two groups. This shows that red light and blue light apparently benefit a plant the most; however, how far each plant's stem drooped was also measured. Although the plants grown under the red light grew the tallest, only four of the twenty plants grew strong stems. Most of the plants grew very weak stems. The plants grown under blue light all grew very weak stems. The plants grown under white light all grew strong stems except for two that grew weak stems. All of the plants under green light grew strong stems. This shows that although blue and red light made their plants grow taller than the green and white light plants, the white and green light plants produced stronger stems. The color that had the best effect on its plants was the white light. This is because although the plants grown under white light grew about one centimeter shorter than the red light plants, they produced more plants with strong stems than the red and blue light plants did. Therefore, the data supports the hypothesis and white light is the best light color to grow plants under. Other scientists have also hypothesized that white light is better for plants and have had their hypotheses supported.

Iodine-based Decontamination of Bacterially Infected Hydroponic Systems

Jason McAleese
Godwin High School

Abstract not submitted

Cabbage Collards and Music

Djurdje Mitrovic and Desmond Yelverton
Appomattox Regional Governor's School for the Arts and Technology

Abstract:

The exposure of music to plants, such as the Brassica Oleracea (Cabbage Collard) plant, can have a significant impact on the plant growth over a period of time. Previous experiments with plants (not the Cabbage Collard) have shown that plants exposed to Classical music grow larger and aesthetically look healthier than plants exposed to other genres of music. Previous studies also suggested that higher frequency sounds stimulated plant growth more effectively than lower frequencies. This research project involves the analysis of the effect of exposure of various genres of music to Cabbage

Collard plants. Eight Cabbage Collard plants were placed in identical environments, receiving the same amount of water and sunlight. They were then divided into four groups of two, each of which was exposed to a different genre of music, except for the control group; one group was exposed to Rock music, one to Rap music, and one to Classical music. After four weeks of exposure to music (except the control group), the Classical music group demonstrated the greatest height in centimeters, (even more so than the control group) at 15.30 cm, which thus concluded that Classical music stimulates Cabbage Collard plants substantially and confirmed the hypothesis that Cabbage Collard plants that are exposed to Rock, Rap, and Classical music will grow at a different rate than that of a Cabbage Collard not exposed to these genres of music.

The Effect of Sound on the Germination of Grass

Caitlin Mullenax
Shenandoah Valley Governor's School

Sound waves have been known to act as stimulants when they were administered to plants. The purpose of this experiment was to determine how varying frequencies of sound affected the germination processes and growths of grass seeds. Seeds were placed in a plastic growing container, and they were then suspended above a speaker that delivered monotonous sound waves of different frequencies ranging from 0 Hz to 2000 Hz. The volumes of these frequencies were kept constant; however, they were loud enough to be heard outside of the room that the apparatus was contained in. The germination processes and heights of the groups that contained 0 Hz, 500 Hz, and 2000 Hz were monitored. There was no significant difference among the heights of the plants. There was a significant difference among the plants when ANOVA and Tukey tests compared the number of days that the plants took to germinate; however, the group that contained 2000 Hz and silence was the only group without a significant difference in any aspect of the experiment. The analysis of the experiment showed that low frequencies elongated the amount of time that plants took to germinate; therefore, higher frequencies can be used to enhance and quicken the germination processes of plants.

The Comparison of High-Pressure Sodium and Light Emitting Diode Growth Lights for Bean Growth

Troy Smith
Mountain Vista Governor's School

Indoor growing has developed the potential to change the future of the agricultural world. However, methods are needed to increase efficiency. Studies are being conducted on the effectiveness of Light Emitting Diode (LED) grow lights in comparison to High Pressure Sodium (HPS) grow lights in order to search for solutions to this

problem. This particular study took place over a period of seven weeks focusing on the height of the green bean plants in each group. The experiment consisted of fifteen repeated trials for both light sources. The plants were kept at near consistent temperatures and humidity though slight variations could have caused some differentiation between the control and experimental groups. Measurements were taken each week in order to make an analysis of growth under each condition. The original hypothesis of this experiment was rejected, and it was shown that the previously used High Pressure Sodium grow light produced taller green bean plants. It has been an ongoing study to decide whether the LED light source is an effective and energy efficient replacement for the less energy efficient HPS light source. Previous studies have shown evidence to support these claims, however, this study provided evidence against. Future studies and possible applications of this research could help to provide a better understanding of how to create an effective and efficient indoor growing environment, which could eventually provide viable methods for indoor agriculture worldwide and in space.

The Effect of Organic and Synthetic Pesticides on the Growth of Mold on Tomatoes

Anna Sutton
Mountain Governor's School

This experiment was conducted to determine the growth of common tomato molds *Botrytis cinera* and *Sclerotinia sclerotiorum* on three varieties of *Lycopersicon lycopersicum* with the use of organic and synthetic pesticides. Organic pesticides are made using products derived from nature. Synthetic pesticides are made artificially. The hypothesis was that *Lycopersicon lycopersicum* treated with an organic pesticide would not be more vulnerable to mold growth than those treated with a synthetic pesticide.

There were nine *Lycopersicon lycopersicum* plants in all. Three were treated with 10.67 ounces of an organic pesticide (Ortho Elementals Garden Disease Control), while three more were treated with 5.33 ounces of a synthetic pesticide (Ortho Max Garden Disease Control). The remaining three were not treated and served as the control. The *Lycopersicon lycopersicum* were taken off the vine and put into paper bags to control temperature and humidity. Mold growth was observed and recorded over a period of three weeks. The results were that 87.5 percent of the organic group molded, 42.8 percent of the synthetic group molded, and 100 percent of the control group molded.

The hypothesis was rejected; therefore, synthetic pesticides were more effective at controlling *Botrytis cinera* and *Sclerotinia sclerotiorum*.

The Effect of Auxin on Pinto Bean Plants

Olivia Taylor
H-B Woodlawn Secondary Program

This project measured the effects of auxin on pinto bean growth. The hypothesis was that the plants would grow taller with higher concentrations of auxin. Using a topiary spray in concentrations of 0.02%, 0.04%, and 0.06% to the bean plants, height was measured every day under the same conditions for each plant. After five trials, data showed that plants given the 0.02% solution grew an average of 0.44 cm per day, plants receiving the 0.04% solution grew an average of 0.69 cm per day, plants receiving the 0.06% solution grew an average of 0.91 cm per day, and plants receiving no auxin grew an average of 1.28 cm per day. Hypocotyls of plants receiving auxin grew up to two times larger in diameter. Plants receiving auxin showed signs of mutation of the lateral bud. The results of this project indicated that auxin had a negative effect on the height of pinto bean plants, but a positive effect on the thickness of the hypocotyl.

The Effect of Allelopathic Chemicals from *Helianthus annuus* on the Germination of *Vigna radiate*

John Yi
Godwin High School

Abstract not submitted

The Effects of Vertical Orientation on Plant Growth

Benjamin Youngstone

Appomattox Regional Governor's School for the Arts and Technology

Abstract not submitted

Chemical Science A

First Place:
The Effect of Different Supplements on the Stability of Dopamine

Sara Cliborne
George H Moody Middle School

An essential neurotransmitter such as dopamine is one that humans need to function. Dopamine tells the body to move our hands, arms, legs, and head. It is also the main contributor to experiencing physical pleasure and pain and emotional response. Without dopamine, it would be almost impossible to function. Parkinson's disease (PD) is a disease where a loss of dopamine cells is prevalent. These patients are prescribed a medication called Sinemet that helps to play the role dopamine would in the brain.

The purpose of the experiment was to determine the effect of different supplements on the stability of dopamine. The hypothesis was, if vitamin C was tested then it will stabilize dopamine the longest. Both the supplements, vitamin B6 and vitamin C, were pulverized with a mortar pestle and diluted in distilled water. Hydrogen peroxide was added to the solution. Then the solution was poured into cuvettes and measured by the UV-VIS (Ultraviolet-Visible Spectrometer). Throughout the experiment it was noticed that both vitamins were not water soluble and had a unique odor. The standard deviation of the experiment was within range of the standard, meaning there was very little variance in the data. The mean of vitamin B6 was 1.04 cm^{-1} . However, vitamin C didn't stabilize sinemet the longest; it had a mean of 0.79 cm^{-1} . Lastly, the control had a mean of 1.03 cm^{-1} . Vitamin B6 is a synthesizer of neurotransmitters and helps to regulate homocysteine levels. Homocysteine is an amino acid that destroys dopamine carrying cells in the nervous system.

In conclusion, some improvements are using the pure substances, instead of the vitamins because the binding agents were not water soluble. Also, using human subjects would be easier due to chemicals and enzymes in the body that no solution can mimic. Therefore, the goal of this experiment was to improve the effectiveness of Sinemet as an alternative for PD patients.

Second Place:

The Effect of Different Fruits and Vegetables on the Rate of Ascorbic Acid Deterioration

Deeksha Chaturvedi

George H Moody Middle School

Abstract:

Ascorbic acid, also known as vitamin C, is an antioxidant like vitamin E, beta-carotene, and many other plant-based nutrients. Vitamin C is a water-soluble vitamin and is needed for healthy skin; it also improves the functioning of enzymes. Ascorbic acid is found in various fruits but broccoli, tomatoes, and clementines have particularly high levels of the vitamin. The ascorbic acid levels in food will slowly deteriorate but few fruits have such abundant sources of vitamin C that they will still provide adequate amounts of the vitamin. Recently, there has been emphasis on eating vitamin rich foods, but if the vitamin contents are decreasing, then are the foods with the highest vitamin contents really the most beneficial? Asking this question prompted the researcher to conduct this investigation. The purpose of this experiment was to determine the effect of different fruits and vegetables on the rate of ascorbic acid deterioration.

Based on the prior research stating that clementines contain large amounts of ascorbic acid, it was hypothesized that if clementines are used, then the rate at which ascorbic acid will deteriorate will decrease. The experimenter prepared an iodine-starch solution to measure the amount of ascorbic acid in tomato, broccoli, clementine, and the control/tablet. When levels of the ascorbic acid were added to the iodine starch solution it changed the iodine and the ascorbic acid; the iodine starch solution turned clear when there was enough ascorbic acid for all of the iodine to react with. The results indicate that the control/tablet had the slowest rate of deterioration (1.64 drops per day). The hypothesis was not supported by the data. Based on the research, there appears to be a correlation between the amount of ascorbic acid in a fruit/vegetable and the rate of deterioration. However, further research must be conducted in order to prove this point.

Third Place:

Arsenic in Apple Juice

Zephren Collinson
Kenmore Middle School

Arsenic is a heavy metal that is toxic to the human body in large quantities. People can get arsenic in their bodies in many ways, but one is through ingesting it. The purpose of the experiment was to measure the inorganic arsenic content of different apple juice brands and to determine whether the arsenic content was enough to cause harmful effects. The hypothesis was that trace amounts of arsenic would be present but not be enough to cause immediate harm. The method used was to pour the samples into clear vials and then add a series of three reagents. After the third reagent was added, the vial was shaken, and a test strip was inserted into the cap. After ten minutes the test strip was removed and compared to the color card. Based on the color comparison, the level of inorganic arsenic was determined. The data recorded was that distilled water had the least amount of arsenic with 2 parts per billion (ppb), the commercial brand had the middle amount with 14ppb and that the organic brand had the most by far with 180ppb. The hypothesis was accepted as a lethal dose of arsenic in an adult is 70-200mg, which cannot be attained from drinking the apple juice, unless it was imbibed in great quantities repeatedly.

Honorable Mention:

The Effect of Antacids on the pH Level of Acids

Emma Bilski
Manchester Middle School

An experiment was conducted to see which type of antacid was really the most effective when it comes to reducing stomach acid. In order to test this, the recommended amount of the antacids Tums, Maalox, and Alka Seltzer were placed into 8 ounces of the acids; coffee, orange juice, and vinegar. Each acid had its pH read before the acids were placed in, and ten minutes after the acids were placed in. This was repeated for a total of 25 trials. The antacid that appeared to work most effectively was Alka Seltzer. Alka Seltzer managed to change the pH levels in each of the acids by a larger percentage than either Tums or Maalox. This is mostly likely because it's prominent fast acting ingredient, sodium bicarbonate (baking soda), works more quickly and efficiently than the fast-acting ingredient in Tums (carbon) or Maalox (magnesium).

Honorable Mention:

The Effect of Different Types of Water on the Amount of Iron Oxide Produced

Audrie Corral

George H. Moody Middle School

Iron and water are both very common, everyday things that humans come across every day. However, when iron (Fe) and water (H₂O) chemically react, they form something called rust, or iron oxide. Rust is a major problem for anyone that works with any metal. It can make structures very weak and unable to hold its own weight, causing it to deteriorate. However, measures can be taken to prevent metals from corrosion. For example, carbon can be pumped into iron to produce steel, a metal more resistant to corrosion. The purpose of this experiment was to investigate different types of water and their effects on steel. To explore this concept, four different types of water (rainwater, filtered water, salt water, and tap water) were poured into 40 cups with each group having 10 cups for 10 trials. Then, 40 steel nails with a length of 3.175cm were placed in each cup for a period of 7 days. Measurements were made using an electronic scale. The final results of this experiment indicated that the group that received salt water weighed the most. However, the group that received rainwater weighed the least, meaning it produced the least amount of rust. The data recorded also supported the hypothesis made prior to experimenting. It stated that if rainwater, filtered water, salt water, and tap water were used in the experiment, then the group receiving salt water would produce the greatest amount of rust.

From the data and results gathered from the experiment, a conclusion could be made stating that salt water enhances corrosion of metals. However, further research and study must be made fully prove this idea.

Honorable Mention:

The Effectiveness of Different Salts and their Concentration on the Freezing Point Depression of Water

William Deng

George H. Moody Middle School

Abstract not submitted.

Other Papers Chosen for Presentation:

The Effect of Different Compounds on their Aqueous Solubility

Slavina Ancheva and Selam Tesfay
Gunston Middle School

Does the aqueous solubility of a drug really determine how strong it is? This experiment took a look at the many things people can find in their very own kitchens and compares those chemicals' solubility levels. The results were as surprising to the experimenters as they will be to everyone reading! The goal of this project was to find the effect of the type of compound on how soluble it was. The researchers put a certain amount of each compound in an aluminum plate and added water. Later, they placed these six dishes in the oven and after 10 minutes they took them out, drained them, and measured the remains of the compounds. The hypothesis was that the table salt would be the most soluble, since it was the most basic out of all the compounds. After the experiment was performed, it turned out that this hypothesis was incorrect; table salt was not anywhere close to being as soluble as sugar! 78% of the table salt was left after being placed in the oven, compared to a mere 39% that sugar. Many of the properties found in the items we used can also be found in drugs in the real world.

Protecting the Pigment

Nicole Ardaiz
Swanson Middle School

Several variables contribute to the "aging" process of paintings such as dirt, grime, soot and smoke collection; varnish layer aging; aging of painting material; pigment change, and physical damage. This project investigated two variables that can affect the aging process by observing the effect of different types of light and paper on the fading of the pigment. It was assumed that the combination of UV-light/copier paper would result in the most pigmentary change. Four copier boxes were set up with three equal pieces of copier and multimedia paper each, with each illuminated with white light, yellow (incandescent) light, UV-light, or no light for a total of 100 hours. Pigmentary changes were recorded at 5-hour increments using Behr Painting color pallets. The hypothesis was partially supported by the data. The light and paper combination that faded the most was the UV-light paired with the multimedia paper, which faded 1 unit. The light and paper combination that faded the least was the no light paired with the copier paper, which faded 1/3 of a unit. The data from the "No Light" box captured the effect of paper alone on pigmentary change. Delta changes due to the exposure of light in each category showed that the light effects were similar between the copier and multimedia papers. This project shows how art pieces that contain pigment can be preserved by displaying them away from sunlight and using white light for illumination.

The Effect of Different Types of Wood on their Burning Time

Anish Bachhu

George H Moody Middle School

Wood is an important part to our society. It has many uses. It is used for houses, furniture, paper products, tools, and weapons. Wood is made out of a tissue that is hard and fibrous and is found in many trees. Wood is very important to mankind. It produces heat, light, and sound energy. Its most important aspect is that it produces oxygen.

When a tree is still living it produces as much oxygen in one season, as 10 people inhale in a year. The purpose of this project was to find out which type of wood would burn the longest. Therefore, that type of wood would produce the most heat, light, and sound energy. Five different types of wood were used to find out which type of wood would burn the longest. It was hypothesized, that the wood that was the densest out of all the other different types of wood would burn the longest. Therefore, Oak wood the densest of all the other woods would burn the longest. Each type of wood went through 10 trials each. All of the different types of wood used a dimension of 7.5 cm. x 1 cm. x 0.5 cm. Each type of wood was placed on the barbecue grill and used the same of fire starter to start the fire. Each type of wood went through the same process, to get the most accurate results. The hypothesis made was supported by the data found from the experiment. Oak wood the densest wood of all had a burning rate of an average of 5:00 minutes. Based on the Law of Conservation of Mass the wood went through a chemical change when burned, and that nothing was created or destroyed. Before this experiment can be concluded it should use bigger pieces of wood to burn for more accurate results.

The Effect of Type of Liquid on Strength of Hair

Xianoyan Bai

George H Moody Middle School

Water is a universal solvent and is neither acidic nor alkaline. Soap is alkaline, while vinegar and orange juice are both acidic. Hair is remarkably strong, and healthy Caucasian can support between 50 grams to 100 grams. In an experiment, it was found that when acid is used on hair, break load would decrease (Wickett et al., 2007).

The purpose of this investigation was to find the liquid that may best improve the strength of hair. Based on the experiments, it was believed that if hair is soaked in soap, then the strength would increase. Twenty strands of hair were placed in each liquid, water, soap, vinegar, and soap, and were soaked for three days. Then, paper clips were hooked on to each strand of hair one at a time until the strand of hair broke. That process was repeated until all the strands of hair was tested. The results showed that water-soaked hair had a mean of holding 161 grams, vinegar having a mean of 168 grams, orange juice having a mean of 166 grams, and soap having a mean of 203 grams. The data supported the research hypothesis because the soap-soaked hair had the highest mean. The data from this experiment agreed with the information that said when acid is used on hair, break load would decrease. Soap showed to be the best liquid for improving hair strength out the four liquids.

The Effect of Different Types of Liquid on Chicken Bones

Shreoshee Barua
Kenmore Middle School

Sugar and starch in beverages cause tooth decay. Keeping liquids inside the mouth for a long period of time causes the process of tooth decay to move faster. The purpose of the experiment was to determine which beverage would show the signs of tooth decay first in a chicken bone. The hypothesis was that orange soda would show signs of decay first followed by coffee and lastly milk. Three cleaned chicken bones were soaked in 200mL of each liquid: orange soda (Fanta), milk, and coffee. Observation of the bones was recorded every day for a week. The chicken bone soaked in coffee showed signs of decay first then milk or Fanta. The hypothesis that Fanta would show the signs of decay first was rejected.

What is the Effect of Candle Wax Type on Melting Time?

Alice Bell
Thomas Jefferson Middle School

There are many types of candle wax, and each has its own merits. But candles that are burned for light should be long-lasting. Which type of wax has the longest burning time? This project looked at which types of candle wax (beeswax, paraffin, and soy wax) took the longest to melt 17.8 centimeters. The goal of this experiment was to find the effect of candle wax type on the burn time. The candles were marked at seven inches, lit, and timed until the top of the candle reached the 17.8 centimeters mark. Pictures were taken at equal time intervals. The hypothesis was that the soy candle would take the least time to melt, because it had the lowest melting point and was the softest of the three waxes tested. This hypothesis was accepted, because the mean time for the soy candle to melt was 76 minutes compared to the paraffin wax's 309 minutes and the beeswax's 424 minutes. This experiment showed that solid beeswax candles melt for a very long time, with almost no visible dripping or smoke. It also showed that soy candles took a very short time to melt and were very messy.

The Effect of Different Metals on the Loss of Weight after Reacting with Hydrochloric Acid

Nikhil Bharani
George H Moody Middle School

From 1931, metals were one of the most important resources known to mankind, but they were also known for being corroded. Acids are known for causing damage, but more effectively on metals. This is typically through chemical reactions, caused by the metal's characteristics. For example, the corrosive resistance to acids of some metals may be higher than others. In addition, like this characteristic, many others remain for many other metals. Also, one of the most common results of a reaction would be weight

loss. Acids react with metals and generate bi-products with variable pH values. These pH values determine the acidity or base of a chemical compound. Hydrochloric acid is one of the most acidic acids having a pH value less than one.

The purpose of this experiment was to see which of the three metals, Copper, Iron, or Zinc would result in least amount of weight loss after reacted with Hydrochloric acid.

Each metal has its own characteristics, but they each are almost similar. Ten strips of Copper, Iron, and Zinc, with exactly the same size, were obtained and weighed. Once weighed, they were put in glass containers along with Hydrochloric acid. Each strip was weighed after ten minutes and then the weight loss was found. The results stated that Copper had the best resistance with a mean weight loss of 0.03 grams defeating Iron with a mean of 3.6 grams and Zinc with a Fmean of 8.7 grams. The hypothesis stating that if Copper, Iron, and Zinc are put in Hydrochloric acid, then the Copper will result in the least amount of weight loss because of its corrosive resistance when reacted with Hydrochloric acid was supported with the data and the research on the metal.

Based on the characteristics of each metal, there was a definite reaction between the metals and the acid. This reaction proved that none of the metals were 100% resistant but did resist. In conclusion the metal Copper is the most resistant metal as it had the least amount of weight loss.

The Effect of Various Types of Heart Burn Medication or Antacids on How Fast it Will Neutralize Hydrochloric Acid

Akhil Bharani

George H Moody Middle School

Heartburn, also known as pyrosis, creates a burning sensation in the chest. The burning sensation is sometimes unbearable but after the medication needed in order to stop it for a short period of time. It can radiate to other parts of the body such as the neck or the throat. This is also associated with the regurgitation of gastric acid, which is a major symptom of gastro esophageal reflux disease. This may also be a symptom of ischemic heart disease. Functional heartburn is of an unknown cause. It is connected with other functional gastrointestinal disorders. A permanent solution is under research and is yet to be discovered. Multiple cures for heartburn have been discovered. The purpose of this project was to determine which of three medicines could neutralize heartburn the fastest. A simulation for the heartburn was conducted by using hydrochloric acid. The three medicines, Tums, Prevacid, and Maalox were timed individually within three cups equally filled with hydrochloric acid and labeled A, B, and C organized in numerical order. Afterwards to ensure that the medicine worked, the acidity of each resulting solution was measured by pH strips. The results indicated that the third medication labeled C was the fastest with a mean of 4.6 minutes, the first medication labeled A was in-between with a mean of 9 minutes, and the second medication was the slowest with a mean of 12 minutes. The data supported the hypothesis that if the Maalox medication was used then, it would neutralize the acid the fastest. Based on the amount of time taken to neutralize that the acid determined in this research, the Maalox was the fastest because the ingredients in the medication reacted faster. Additionally, the results of the Tums were in between the three medications. Also, the slowest of the three medications, was the Prevacid. Before it can be concluded that it was these

medications that were the fastest and slowest, a graph will be made to confirm the results.

Effect of Sun Protection Types on How UV Beads Are Affected

Carolyn Bradley
Thomas Jefferson Middle School

The sun's rays are very dangerous, and people are always trying to find the best kind of protection. What type of sun protection works the best? This project looked at which type of sun protection worked the best; SPF 15, SPF 30, SPF 100, Sunglasses, D.V Shirt, Tanning Cream 1, Tanning Cream 2, or Baby Oil. The sun protection types were tested by spreading the protection over the top of 5 U.V beads left out in the sun for five minutes. The beads were measured by their color after they were left in the sun. If the beads were darker, that meant they were harmed more from the sun's rays than the beads that were lighter. The lighter the bead, the less they were harmed. The scale that was used to measure the beads was a scale from 1 to 6, 1 being the lightest and least harmed, and 6 being the darkest and most harmed. The researcher's hypothesis was SPF 100 would protect the best out of all the sun protection types. The experimental results did not support the hypothesis by showing that the D.V shirt protected the best. The experiment also showed that SPF 30 & SPF 100 protected the same. Both Tanning Creams protected less than the rest of the sun protection types; it seemed they were increasing the sun's harmful rays instead of preventing the rays.

The Effect of Chlorinated Water on the Tensile Strength of Hair

Polina Bukina
George H Moody Middle School

When the word chlorine is mentioned, it almost always relates to pool water and controlling bacteria in chlorinated water. It was officially discovered in 1810 by a British scientist and gets its name from its greenish and yellowish color, which in Greek, is Chloros. In the pool, chlorine produces a hypochlorous acid, which oxidizes the nitrogen and all the debris left by swimmers. Hair, on the other hand, consists of a protein called keratin. An average human head has about 150,000 hairs on their head. The purpose of this experiment was to determine the effect of chlorine on the tensile strength of hair at different intervals of duration time on the hair in the chlorinated water. 40 hair samples were taken and 10, as a control, were not placed in anything, 10 were placed in chlorinated water for an hour, 10 placed in the chlorinated water for 2 hours, and 10 placed in the chlorinated water for 3 hours. After the time was up, the breakage point of each of the hair strands was measured with paper clips. The results coincided with the hypothesis that if no chlorine, and hour of chlorine soaking, two hours of chlorine soaking, and three hours of chlorine soaking are used, then the group receiving no time in chlorine will be able to support the most weight. The hair with no time in the chlorinated water could support a mean of 29.4 grams, while the hair in the 3-hour period could only support 19.3 grams.

These results show that the longer the duration time for hair in chlorinated water, then the more damaged the hair becomes, and less healthy. The results would be more accurate if a machine was used to calculate the breakage point of each hair strand instead of attaching multiple paper clips until the hair strand snapped or broke.

The Effect of Sodium Chloride as an Electrolyte on the Rate of Electrolysis of Water

Julianne Carroll
George H Moody Middle School

Electrolysis occurs when electricity is used to separate a substance. It can be used to separate water into hydrogen gas and oxygen gas (Oxglade, 2002). However, an electrolyte, such as sodium chloride (salt, or NaCl), is required for electricity to pass through the water. Electrolysis of saltwater produces the chemical reaction $2 \text{NaCl} + 2 \text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{Cl}_2 + \text{H}_2$ (Tilley, 2004). Electrolysis is one way to create hydrogen gas, which does not occur naturally. The purpose of the experiment was to determine if the amount of sodium chloride was related to the rate of electrolysis. The hypothesis of this experiment was that if there was more salt added to the water, then the rate of electrolysis would be faster. One liter of distilled water was poured into a clean container. Either ten, thirty, fifty, seventy-five, or no salt was added to the container. Two new copper wires were placed in the mixture. These wires were attached to the terminals of a battery switch containing two AA alkaline batteries. A test tube with a one milliliter mark was filled with salt water and turned upside down over the cathode wire to collect the hydrogen gas. When the battery switch was flipped, electrolysis began, and a stopwatch measured the number of seconds to create 1 mL of hydrogen gas at the cathode. This time is the rate of electrolysis. When there were ten grams of salt in one liter of water, the mean time over ten trials were 991 seconds. When thirty grams were added the mean time was 588 seconds. With fifty grams the mean was 358 seconds, and with seventy-five grams of salt the mean was 287 seconds. None of the results were within one standard deviation of any other, indicating that the differences in time are significant. The results, therefore agreed with the hypothesis of the experiment: the more salt added, the faster the rate of electrolysis

Let's GetCooking

Isabella Choi
Kenmore Middle School

Milk is a liquid that mammals produce and is used in many cooking recipes. Different types of milk contain different levels of fat. The purpose of the experiment was to discover if the type of milk used in the blueberry muffin recipe would affect how tall they would rise. The hypothesis of the experiment was that using whole milk in the recipe would produce the tallest blueberry muffins. The blueberry muffins were baked in five different ways. Each time they were made, a different type of milk was used, while the rest of the recipe was kept the same. Using whole milk in the recipe produced the tallest blueberry muffins. The hypothesis that using whole milk in the recipe would produce the tallest blueberry muffins was accepted.

Which Group Will Win the Rotting Race?

Riittisha Choudhary
Thomas Jefferson Middle School

We've all tasted strawberries, right? The sweet, tart taste is delicious, but sometimes the strawberries go bad quickly and you're left to go "What happened? I bought these yesterday!" Maybe you've been placing them under the wrong conditions. This project's goal was to find out the effect of different conditions on how long strawberries take to rot. The researcher's method to find out the answer was to put strawberries in different groups under different conditions. The researcher wrapped 5 strawberries in aluminum foil, placed them in a bowl and put them in a freezer. Another group was to wrap 5 strawberries in plastic wrap, put it in a bowl, and on the windowsill. The last group was 5 strawberries in the box the fruit came in and place it in the fridge under a florescent light bulb, with the temperature at under 26 °C. The hypothesis was that the control group of strawberries would take longest to rot. Every day for a week, the researcher came back to check the strawberries in each group to see how rotten they were getting. The results of the experiment were that the hypothesis was accepted. The group of strawberries that took the longest to rot was the group that was in the fridge, under a florescent bulb, with the temperature at under 26 degrees Fahrenheit. The average amount of days it took that group, the control group to rot was 6 days, as opposed to the other two groups, one with the strawberries wrapped in aluminum foil and in the freezer and the other group of strawberries wrapped in plastic wrap and placed on a windowsill which the average amount of days they took to rot for both groups was 4 days.

Effect of Type of Insulation on the Temperature of Water

Marlee Cobb, Kelsey O'Malia and Olivia Wadzinski
Gunston Middle School

The purpose of this experiment is to see which form of insulation works best to maintain the heat of boiling water. In the future this experiment could help builders build more energy efficient buildings, such as geologic homes, by using good insulators. This experiment will also save homeowners money by better insulating their homes. The goal of this experiment was to find the best insulator for heat. This experiment was conducted by gathering 6 different types of insulation including old and new methods. After assembling the boxes, boiling hot water was poured into cans surrounded by different insulating materials. Then the temperature of the water was taken every minute for 15 minutes. As a result of our experiment it was found that spray foam was the best insulating material, with a can of water at a final temperature of 69.6 degrees Celsius and an average difference of 14.4. The worst insulator was the grass with a final temperature of 60.6 degrees Celsius. The objective of this experiment was to find the best heat insulator for a home. The objective was reached by finding the insulator that kept the water warmest for 15 minutes.

The Effect of Plant Type on Internal Voltage Generated

Sabrina Daglish
Sabot at Stony Point

The purpose of this experiment is finding the voltage generated by fruits and vegetables to see which one produces the most volts. Zinc and copper sheets were cut into 1 cm by 7.6 cm electrodes. After the fruit and vegetable was massed on the triple beam balance one piece of zinc, and one piece of copper was inserted into the fruit/vegetable 3 cm apart. The jumper cables of a multimeter were then clipped onto the protruding zinc and copper electrodes. Then the multimeter was used to determine the voltage of the fruits and vegetables tested. The hypothesis was if the fruits and vegetables are tested for voltage and massed, then the russet potato will produce the most volts per unit of mass. Based on the data the hypothesis was not supported. The lemon created the most volts per unit of mass.

Greener and Cleaner: The Same? An Experiment Using Organic Cleaning Products

Caroline Dioso
Kenmore Middle School

Organic cleaning products do not harm us or the environment. These products are made from all-natural ingredients. The purpose of this experiment was to find out if an organic cleaning product would work as well or better than a non-organic cleaning product. The hypothesis was if each material was sprayed with both the organic and non-organic products, the non-organic product would remove the Sharpie stain better. Each piece of glass, dry erase board, wood, and cloth was marked by a Sharpie. Then each material was sprayed with both the organic and non-organic product and wiped with a paper towel. The results were that the non-organic cleaning product removed the Sharpie better than the organic. The hypothesis that the non-organic cleaning product removes the Sharpie stain better than the organic product was accepted.

Chemical Science B

First Place:
The Effectiveness of Tooth-whitening Products

Emma Manring
Tuckahoe Middle School

“Tooth whitening has become the most common medical or dental cosmetic procedure in the United States today” (James Doundoulakis, 2004). Having white teeth is a good feeling; it makes a person feel good, have a pretty smile, and have positive self-esteem. However, there are certain foods and beverages that can create stains and cause teeth to look yellow. Dentists can bleach teeth, but this is often very expensive, so some people turn to less expensive at-home and over-the-counter tooth whitening products. The objective of the research was to evaluate and determine which tooth whitening product works the best at whitening teeth.

The hypothesis was if the types of whitening products are changed, then the whitening strips will work the best and have the greatest whitening effect. The independent variable includes the whitening products and the responsive variable was the strength of the products’ whitening power. This was measured by evaluating different shades of the color, white, at the beginning and throughout the experiment using paint sample color guides. The control in this experiment was the test group that used plain brushing with no specific whitening products added. Eggs, used to represent teeth, were boiled and then stained in coffee. Each tooth whitening product was applied to the eggs stained in coffee for 14 days.

The average, range, and standard deviation values for each of the whitening products was calculated and analyzed. The product that was the most effective in whitening teeth was the whitening toothpaste with the highest average color change and the lowest range and standard deviation. All of the other whitening products and the control showed change however, they also had high range and standard deviation values. The lowest change was seen by the control, plain brushing.

Second Place:

The Effect of Brand on the Amount of Soap Residue

Amanda Mier

Tuckahoe Middle School

Abstract:

Soap residue and soap residue buildup may cause dry skin, itchiness, eczema, breakouts, and additional skin conditions. Bar soaps (Dove, Ivory, Irish Spring, True Clean soap from Kroger, which were chosen because they were well known) were tested to see which left the most soap residue. It was hypothesized that if different soap brands are tested, then the Dove brand soap will leave the least soap residue.

The testing was done on a sheet of 14x14 Plexiglas, because it has been proven that Plexiglas is porous, like human skin, eleven times after the first trial for a total of 12 repeated trials. The experiment was performed in a bathroom in a residence. The data was qualitative, and was recorded using a system of soap-residue units ranging from one to five. 25 mL of water were poured on the Plexiglas square to dampen it. A gram of each bar soap was lathered onto the square by hand for 60 seconds. The remaining 225 mL of water were utilized to rinse off the soap. The hypothesis was supported, because it was discovered that Dove soap left the least amount of soap residue, with a mean of 1.58 residue units. It was found that the bar soap from a local grocery store, True Clean, left the most soap residue with a soap residue count of 4.00 residue units.

Based on the findings of this research, it is warranted for consumers with delicate skin or skin concerns to look into the residue accumulation from the bar soap they use.

Third Place:

The Effect of Storage Temperature on the Concentration of Vitamin C in Orange Juice

Katherine Harris

George H Moody Middle School

Abstract:

The purpose of this experiment was to determine the effect of storage temperature on the concentration of Vitamin C in orange juice. In this investigation, the different storage temperatures were the independent variables and the dependent variable was the concentration of Vitamin C in orange juice. The control group was the orange juice receiving refrigerated storage. Based on facts that Vitamin C is very unstable and easily affected by warmer temperatures[Hobbs, Haas,1999], it is believed that if room temperature, refrigerated, and frozen storage are used to store orange juice, then the orange juice group receiving frozen storage will contain the highest concentration of Vitamin C. Previous research stated that when Vitamin C had been exposed to warmer temperatures, the concentration of Vitamin C depleted at a steady, fast rate. When Vitamin C was placed in cooler temperatures, the naturally occurring degradation process slowed, thus it left the source that contained Vitamin C to have a higher concentration for a longer period of time.

Honorable Mention:

The Effect of Light on the Spoil Rate of Fruit

Sara Hamilton

Tuckahoe Middle School

Abstract:

The experiment on the freshness of fruit depending on where it's kept was completed to find the best way to store a banana, strawberry, nectarine, and cantaloupe by testing the effect of light in the fruit's environment on its freshness over a period of time. Fruits were tested in a dark environment and exposed to natural and artificial light. It was necessary to determine the difference in spoiling rates between the fruit because fruits from different categories are composed of different vitamins and nutrients, so the fruits banana, strawberry, nectarine, and cantaloupe were all used for the experiment. After research, it was hypothesized, "If the fruits banana, strawberry, nectarine, and cantaloupe are kept in a dark pantry, then their spoiling rates will be less than those kept on a kitchen counter-top with natural and artificial light exposure."

Three trials were run for the banana, strawberry, nectarine, and cantaloupe, in each location; and qualitative observations using touch, smell, and sight were recorded daily until a fruit spoiled as determined by the research done on the appearance, smell, and texture/tenderness of each fruit when spoiled. The number of days that each fruit took

to spoil was recorded in a quantitative data table. The results displayed that the banana spoiled quickest in the pantry, averaging 16 days on the counter and 14 days in the pantry. The strawberry, nectarine, and cantaloupe all spoiled quicker on the counter averaging 6 days on the counter and 8.3 days in the pantry for the strawberry, 14 days on the counter and 16.7 days in the pantry for the nectarine, and 8 days on the counter and 8.7 days in the pantry for the cantaloupe. However, the mean number of days taken to spoil for each fruit in each location had overlapping ranges, suggesting the possibility that the results happened by chance. It was also taken into consideration that there was no way of telling when each fruit had been picked when bought. The fruit would have had to be freshly picked at the same time rather than store bought for a more accurate experiment.

Honorable Mention:

The Effect of Cleaning Solutions on the Chemiluminescent Glow of Luminol on Blood

Dalton Lackey

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Manchester Middle School

Abstract:

This experiment was completed to attain knowledge as to which type of cleaning solutions criminals may be expected to use if cleaning blood from a crime scene with the intent to erase all evidence of a crime. The experiment was to aid forensic investigators to better apprehend deceiving criminals. Acquired research would contribute information which may lead to clues for crime scene investigators. These clues include finding which cleaning solution was used and where and when the solution was bought and by whom. The experiment was completed when a drop of blood was placed on a block of stained wood. The blood was then wiped away using a paper towel with a cleaning solution on it. The block of wood was then sprayed with luminol and the glow that was created was measured on a scale from one to five. As a result of the experiment, the control produced a result of 4.04 on the scale from one to five because each trial and its blood produced high brightness after being wiped clean with water and sprayed with luminol. The bleach solution resulted in an average brightness of 1.84 on the scale, showing that bleach created the best mask for the blood above all of the other solutions. The experiment concluded with the bleach disinfectant producing the least amount of glow of luminol due to its chemical composition. This conclusion supported the hypothesis.

Honorable Mention:

The Effect of Different Brands of Laundry Detergents on the Quality of the Cleaning of Pepsi-stained Cloth

Vignesh Mulay

George H Moody Middle School

Abstract:

In the common household, stains are frequent and recurrent on clothes. Because of this general problem, the majority of the US population buys laundry detergents on consistent basis. The purpose of the experiment was to figure out which popular liquid laundry detergent restores a Pepsi-stained white cloth's status, color and shade the best. The experimenter had predicted that if the Tide detergent is used on a stained cloth, the quality of the cleaning of the cloth will be used. The reasoning of this statement is because that Tide seems to have the best fit chemical formula to remove the caramel color of Pepsi and brighten whites.

The procedure used in order to conduct this experiment requires accurate measurements, sufficient tools, and specific techniques and methods. Measurements that must be executed beforehand include 1 mL of any of the 4 detergents (Tide, Wisk, Oxi-Clean, Woolite) and 10 mL of original Pepsi. Then, the measured Pepsi is slowly poured onto a 36 x 36 white cotton cloth (simulating common clothes), and, afterwards, the detergent is also poured. When the cloth is ready, place it in a washing machine (High Efficiency). Perform this process 9 more times for the detergent currently being used and then 10 more times for each of the other 3 detergents. Finally, record all 40 cloths in a data table by comparing the cloths to the prepared color scale.

The experimenter recorded all the cleaned cloths from the color scale. Based on the color scale, Wisk and Oxi-Clean scored the worst with an average of 3.8 (Wisk) and 3.8 (Oxi-Clean). After those two, Woolite averaged a 2.9 and was second-best among the detergents. The detergent who received top scores was Tide with 2.1. The experimenter concluded that despite the main color being better, the entire cloth must be accurately observed for colored spots and slight shades. Also, results may vary at the slightest change, so it is critical to follow the procedure exactly. Finally, the project resulted in a useful and helpful success.

Other Papers Chosen for Presentation:

The Effect of Burning Different Fuels on Water Temperature

Alanis Frantz

George H Moody Middle School

Abstract:

With fossil fuels running out fast, a new energy source is needed. Numerous alternatives have been discovered, and the one most commonly used is biofuel. But exactly how much more effective, or less effective, is bioethanol than other fuels such as gasoline, kerosene, and diesel? It was hypothesized that if bioethanol is burned then it will raise the water temperature the least.

To perform this experiment, 25 milliliters of bioethanol was measured using a graduated cylinder and then poured into a beaker. Next, after the cylinder was cleaned, 50 milliliters of water was measured and then poured into a test tube. Then, the test tube was placed into the stand and holder and a thermometer was then inserted into the test tube to record the temperature of the water. The temperature of the water was then recorded and the beaker full of bioethanol was placed under the test tube. Paper was rolled up and carefully ignited with a lighter, it was then dropped into the beaker filled

with bioethanol and the timer was started immediately. The timer was stopped when the fuel burned out, and the time was recorded, as was the highest temperature reached by the water above the burning fuel. Carefully, the beaker and test tube were cleaned. The steps were repeated a total of ten times for the bioethanol, and then another ten times for the other variables, kerosene, diesel, and gasoline using a different beaker and test tube each time.

It was found that diesel burned the longest, but had the second lowest effect on the water temperature. Kerosene raised the water temperature the most, and burned the second fastest. Gasoline burned very quickly, but the water temperature was raised to over 98 degrees. Bioethanol was significantly less efficient than the other fuels, not even raising the water to 90 degrees, and burning in about 20 minutes. The reason for the water temperature rising less when it was heated by burning bioethanol is that it inhabits a lower energy density than gasoline.

The Effect of Brand of Chips on Grease Stain

Abby Gallin, Gail Muggill and Hannah Russell-Hunter
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516 North Oxford Street Arlington, Va. 22203
Gunston Middle School

Abstract:

Advertisers are always proclaiming that their potato chips or crisps are the healthiest, but which potato chips/crisps really are the healthiest? The goal of the project was to find the effect of the brand of potato chips/crisps on the amount of grease. The amount of grease produced would be correlated with the amount of fat in the potato chip, the more grease, the more fat. The grease was measured first by pressing the different types of potato chips/crisps into graph paper with a rolling pin. The chips/crisps sat for a certain amount of time, so all of the grease would drain out and on to the graph paper. The number of squares that the grease stain covered was counted and then converted into square centimeters using the formula $f(x) = (x/16) 2.54$. The hypothesis was that Kettle Brand potato chips would contain the most grease. The experimental results did not support the hypothesis by showing that Pringles Original potato crisps had the largest grease stain. The average size for a Kettle Brand potato chip grease stain was 46.61 square centimeters, while the average size for a Pringles Original potato crisp grease stain was 60.38 square centimeters. The experiment also showed that Baked Lays Original potato crisps were the healthiest potato crisp, because they contained the least amount of grease. The average size for a Baked Lays Original potato crisp grease stain was 6.86 square centimeters.

Electric Liquids

Reiss Gidner
Kenmore Middle School

Abstract:

Sports drinks have electrolytes. They each have a different amount in them. The purpose of this experiment was to find the amount of electrical resistance, which led to the number of electrolytes, in different types of sports drinks. The hypothesis for this experiment was that Gatorade would have the least electrical resistance, therefore, the most electrolytes. Cups were filled with different sports drinks. A multimeter was used to measure the electrical resistance of the drinks. It was discovered that Gatorade had the most electrolytes out of the sports drinks. The hypothesis for this experiment was accepted.

Gay Lussac's Law Reconsidered

Aaron Hodges

Gildersleeve Middle School

Abstract:

The purpose of the experiment was to determine the pressure of a gas while varying the volume of a liquid and temperatures in a closed system. This experimental design is based off Gay Lussac's Law which states that when temperature increases, pressure increases at constant volume. For instance, if a scuba diver surfaces too quickly, this may cause health problems from the change in pressure (Decompression Sickness or "the bends"). Scuba divers, despite their experience level, must be diligent on the time spent descending underwater and time required to properly reach the surface. The problem to be tested was the effect of the volume of a liquid on the pressure of a gas. To test this relationship, the experimenter filled the apparatus with various volumes of water (25, 50, 75, and 100 mL of water), heated them at intervals 31.4, 33.4, 35.4, and 37.4 degrees Celsius and measured the pressure in millimeters per mercury (mmHg). The results demonstrated that as the volume of the water increased, the pressure of the gas decreased. The control (no water) had the greatest increase of pressure as compared to the other levels of the independent variable (25 mL, 50 mL, 75 mL, and 100 mL of water with the least amount of pressure) demonstrating an inverse relationship between the volume of water and gas pressure. In conclusion, the findings of the experiment help to clarify and give a basic understanding of decompression sickness.

The Effect of Time on Metal Corrosion Rate

William Hou

Manchester Middle School

Abstract:

Five types of metals (aluminum, carbon steel, copper, terne, and zinc) were placed in five liquids (bleach, baking soda, water, lemon juice, vinegar) for a period of six weeks.

For every two- week interval, the metals were taken out and measured on a triple beam balance. Corrosion rate was then calculated as milligram weight loss per day. At the end of the six weeks, corrosion rates were compared. All metals had shown some degree of corrosion. Copper in water had the least corrosion rate. Zinc had the highest corrosion rate when placed in bleach. In addition, corrosion rate was high at the beginning of the experiment, and then it slowed down and flattened out over time. This study can be used as a reference for choosing metals in different applications.

The Effect of Different Fruit and Vegetable Enzymes on the Dissolvability of Aspirin

Tanvi Kohli

George H Moody Middle School

Abstract:

Aspirin is an extremely versatile drug; it can relieve your headache, ease your aches, lower your temperature, and sometime even treat some of the deadliest diseases. It can even prevent your risk of a heart attack. Aspirin suppresses the action of the enzyme, cyclooxygenase, stops the production of prostaglandin, thus disrupting the pathways to pain, inflammation, elevated temperature, and stomach protection.

There are several different kinds of enzymes, such as those found in the stomach and even those that are found in foods. The enzymes used in this experiment were fruit and vegetable enzymes. Enzymes have a three-dimensional shape and must be stored in ice to maintain its shape. Enzymes are also catalysts in several chemical reactions and have the ability to speed reactions up without actually using itself up.

The purpose of this project was to determine which fruit or vegetable would aid in faster pain relief. Enzymes were extracted from four different kinds of fruit and vegetables, potatoes, apples, grapefruits, and limes. The enzyme solutions were split into 20 mL increments and placed in 10 different containers. One Aspirin tablet was dropped in each container and the amount of time it took to dissolve was timed. The results that came from this experiment were extremely unexpected. The results indicated that eating a lime before taking an Aspirin would best dissolve it to provide affective pain relief. The hypothesis for this experiment, If the experimenter puts Aspirin in potato enzymes, then the Aspirin will dissolve fastest, was proven wrong. The potato enzyme turned out to be the slowest in dissolving Aspirin. The lime was the fastest.

Data proves that lime was the most effective in dissolving Aspirin while potato was least efficient. When taking Aspirin, eating a lime, without the skin, will help the relief rate of pain, reduce fever, and many other things best.

The Amount of Oxygen in the Atmosphere

Shreyas Kulkarni

George H Moody Middle School

Abstract:

Glass can be traced back all the way to 3500 BCE in the Mesopotamia area (Elsea, 2009). Glass is an important element in everyday life as well as in this experiment. In

this experiment, the height of glass is tested on how much oxygen is in a concentrated area. The purpose of this experiment is to see whether or not oxygen is always 21% in the air of a concentrated area. The hypothesis for this experiment is that if the glass is at its tallest height, then there will be more space for the water to fill up in place of the used oxygen. The levels of the independent variable are a small glass, regular glass, medium glass, and large glass.

For preparing the control group, which is the regular glass group, a bowl, regular glass, container, a ruler, lighter, coins, room, candle, water, experimenter, pencil, open area to conduct the experiment, paper towels, towel, eraser, and a table. First the towel was placed on the table, which also stayed the same the whole time. Then the bowl was placed on top of the towel to hold the water during the experiment. Then the water was filled in the bowl to about 2/3 of the way. Then the coins which held the candle were put in the bowl of water. A candle was taken, lit, had some wax melted off which was then put on the top coin to hold the candle very steady. Then another candle was lit and put over the quickly drying wax, and it was quickly covered over with the regular sized glass, which stayed the same during the ten trials for the regular cup. The water level was observed and then the data was written down using the pencil and eraser.

The results where that the regular glass, the control, was the closest to the 21% of the air is oxygen statement, not the tall glass. That means the hypothesis had not been supported. When the graph was done, it showed that the regular glass, which was the control, sort of correlated with the research, and also showed that the hypothesis was wrong. The hypothesis supported the large glass, not the regular glass.

The Effect of Household Liquids on the Rate of Corrosion of Steel Wool

Ivan Lewis

George H Moody Middle School

Abstract:

The Effect of Different Forms of Vitamin C on Solubility

Nadine Lin

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Tuckahoe Middle School

Abstract:

Health is always a top focus in modern society. While physical exercise helps to keep the human body in shape, healthy nutritional diets, as well as vitamin supplements, help to prevent or even fight diseases. Vitamin C, also called ascorbic acid or ascorbate, is one of the most widely taken vitamins because humans, unlike most animals, have lost the ability to produce mega doses (thousands of milligrams) of vitamin C. In order for the human body to fully absorb and achieve the benefit effect, vitamin C supplements must first be broken down and completely dissolved. This experiment was designed to study the dissolving rate of three different types of vitamin C pills (liquid softgels,

gummies and tablets) in 5% acetic acid solution at 37°C. The acid solution was used to mimic the acidic environment of the human stomach. The results indicated that among the three vitamin C pills, softgels dissolved at a faster rate than gummies or tablets, and tablets were the slowest dissolved form of vitamin C in an acid solution at 37°C. Vitamin C is water soluble, so the solubility of vitamin C was also tested in various solvents (water, 15% and 70% isopropyl alcohol). In all tested solvents, vitamin C softgels dissolved the fastest, and tablets dissolved the slowest. When comparing 70% isopropyl alcohol with acid solution, water, and 15% isopropyl alcohol, all vitamin C pills dissolved much slower in 70% isopropyl alcohol than in acid solution, water, and 15% isopropyl alcohol. The data from this study supported the research hypothesis that among the solid forms of vitamin C pills, liquid softgels would dissolve faster than gummies and tablets. Different solid vitamin C pills have different coatings and inactive supporting ingredients, thus they have different dissolving patterns and behaviors in different test solutions.

The Effect of Different Drinks on the Amount of Iron Particles after Tea is Added

Taro Mandokoro
Manchester Middle School

Abstract:

The scientist was interested in this experiment because the scientist wanted to know which drinks contained the most iron. The scientist could then apply this knowledge to diets and people who are iron deficient so they could consume the iron levels they need. Iron affects everyone's daily lives so people should consume the amount of iron needed or they will face the consequences. Using this knowledge the scientist could create a table of how much of each drink they should consume daily so that their body is satisfied. The dependent variable in the experiment was the amount of iron after tea is added. The independent variables were different drinks, and the levels were: mineral water, Mountain Dew, apple juice, cranberry juice, pineapple juice, orange juice, and distilled water. Each juice was one hundred percent fruit juice. The control group of the experiment was distilled water because it has no iron. The scientist's hypothesis of the experiment was that the cranberry juice would have the most iron content out of each drink. The result was that cranberry juice had the most iron content.

The Effect of Deicer on the Rate of Ice Melting

Megan Mauro
George H Moody Middle School

Abstract:

A substance that is used to remove ice and to prevent ice from forming is called a deicer. One of the most common deicers is rock salt. However, calcium magnesium acetate and a combination of sand and salt are also used. A deicer has a lower freezing point than water, therefore it causes ice to start to melt once it contacts the deicer. So,

based on research that stated calcium magnesium acetate contains dolomitic limestone and acetic acid, it is believed that if no deicer, sand and salt, salt, and calcium magnesium acetate are used, then the group receiving calcium magnesium acetate will melt the ice fastest.

The purpose of this experiment was to display the effect of sundry deicers on the time taken to melt an ice cube. An ice cube tray was washed and filled with tap water and it was then placed in a freezer at -18°C for 5 hours. After the 5 hours the tray was taken out of the freezer, the ice cubes were taken out of the tray, and the deicer was applied to the ice cubes. The results were that the calcium magnesium acetate ice cubes melted the fastest and the ice cubes with no deicer melted the slowest. The means were 73.6 minutes for sand and salt, 60.1 minutes for salt, 48.5 minutes for calcium magnesium acetate, and 105.1 minutes for the control, which was no deicer.

There are certain reasons why the results turned out the way that they did. The ice cubes that received no deicer melted the slowest because there was nothing to assist the ice cubes. For the sand and salt trials, the sand turned damp as a result of sitting next to ice cubes, so the sand did nothing. Rock salt was slower than calcium magnesium acetate because turning the ice into a saltwater solution is more time-consuming than what calcium magnesium acetate does (Colucci, 2007). Calcium magnesium acetate melted the ice cubes the fastest because the way it works is by blocking snow and ice particles from clinging to each other or to the surface of the road (Dalecky, Temple, Tuccillo, 1999).

The Effect of Temperature on Water Distillation Speed

Justin McMahan
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Kenmore Middle School

Abstract:

Distillation is the process of cleaning liquids using heat. A liquid's boiling point is very important to distillation. The purpose of the experiment was to see if heated or chilled water would increase the amount of water distilled. The hypothesis was that heated water would distill the most water in the allotted time frame. Three sets of water, heated, chilled, and room temperature, were put under a heat lamp for a 12 hour time frame to be distilled. The heated water distilled the most water in the 12 hour time frame.

The hypothesis that heated water would distill the most water in the allotted time frame was accepted.

The Effect of Different Methods for Purifying Water on Bacterial Level

Jack McSorley
George H Moody Middle School

Almost all of America's waterways are unsafe to drink. Consuming this water is very dangerous and there are countless diseases in it. Bleach is commonly used in cleaning products as a disinfectant. Oxidizing bleaches remove color but can kill microorganisms as well. Iodine is used for many anti-bacterial purposes; Iodine tablets are used in radiation scares to remove any toxins from water. Boiling water at 100°C (212°F) causes the water to begin to turn its state, at this temperature most of the bacteria in water will die.

The purpose of this experiment was to determine the effect of different methods for purifying water on the amount of bacteria colonies left over from the water. If the creek water is treated using bleach, iodine, and boiling it, then the amount of bacteria colonies will decrease. One liter of creek water was treated. The treated water was removed using four separate plastic droppers. Five milliliters were taken and placed in a petri dish and this was repeated ten times per method of purification. Forty petri dishes were placed in an incubator for 48 hours.

Out of the forty trials, all petri dishes had at least one bacteria colony on it. Iodine was slightly more effective than bleach. The boiled experiment group saw the best results with an average of six thus group had a 99% loss of colonies. The findings agree with that boiling water to the point that it is almost turning into a gas kills most of the bacteria. However, using bleach to disinfect water was not proven majorly effective in the experiment, which differs from what Clorox® said. The iodine experiment group was not as effective as expected. Iodine is commonly used for disinfecting wounds, but did not significantly reduce water bacteria. Because iodine is only slightly soluble in water, it has an issue with dissolving. Improvements could have been using different purifiers such as chlorine or bromine both a common pool disinfectant.

What is the Effect of Shampoo Brand on Hair Quality?

Alexandra Michalowski
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Thomas Jefferson Middle School

Abstract:

The purpose of this experiment was to test the effect of different brands of shampoo on hair quality. Many people find it hard to decide what shampoo to buy and if price really affects the shampoo quality. The experiment was done by taking the same amount (2 grams) of hair and the same type of hair (a student got her haircut and brought it in to be tested for the experiment) and washing it with different brands of shampoo. The hypothesis was that if different brands of shampoo were used to wash hair then the hair being washed with Cibu, the most expensive brand, would produce the best results. The hypothesis was accepted because the shampoo that scored the best was Cibu, scoring about 17 out of 18. The shampoo brand that scored the worst was Pantene scoring about 12 out of 18. It was learned that Cibu had the most Glycol distearate (a wax-like substance that makes shampoo feel thicker and finer) which can help the hair's quality when being washed on a daily basis.

The Effects of Seed Changes in Sugar Crystals

Christopher Myers

George H Moody Middle School

Crystal growth is a key component for our society. Without the process of crystal growth, we would not be able to carry out many of our daily functions. A prime example is coal, without the crystal process coal would not exist. Therefore, the functions created by using coal as a power source would not exist. The purpose of the following experiment is to test the different ways of sugar crystal growth on different bases or seeds. After studying different research results, it was theorized that sugar crystal growth will have the greatest results on other metals, in this case a paper clip. After preparing three substances, (paper clip, golf tee and string) their crystal growth was studied for a week. Data was collected and the results were that the paper clip had the weakest amount of crystal growth, and the string had the highest growth. Once the data was studied it was proven that the hypothesis was not supported by the data. The metal seed (paper clip) had the lowest seed growth.

Chemical Science C

First Place:

The Effect of Liquid Temperature on Bread Height and Circumference

Meredith Polk

George H Moody Middle School

Fermentation is the process by which the leavening agent, yeast, in bread reacts with hydrated flour, causing the bread to rise (Dusanka, 2009). When liquid is added to the flour, the sugar that is released is consumed by the yeast and carbon dioxide is produced. Liquid at a temperature of more than 60 degrees Celsius kills the yeast and therefore, the dough will not rise as high (Masel, Blowers, 2007). The recommended temperature for liquid is 52 degrees Celsius. The purpose of this experiment was to determine the effect of liquid temperature on the height and circumference in centimeters of white bread with the liquid temperatures of 41, 46, 52, 57, and 63°C. The researcher predicted that, since the recommended temperature for the yeast is 52°C and temperatures higher than 60°C would kill the yeast, if the liquid temperature of 57°C was used, then the height and circumference of those loaves would be the largest compared to the loaves made with the temperatures of 41, 46, 52, and 63°C. Ten loaves of bread were made for each temperature of liquid and their heights and circumferences were measured, and the mean, median and modes of the data were found. The heights of the loaves were highest when the liquid temperature was 46°C with a mean height of 7.2 cm. The loaves made with a liquid temperature of 41°C had the shortest mean height of 6.2 cm. Since the mean height of the loaves with the liquid temperature of 46°C (7.2 cm) was taller than the mean height for the loaves with the liquid temperature of 57°C (6.7 cm), the hypothesis was not supported. The liquid temperatures of 57°C and 63°C were too high and started to kill the yeast. 41°C was too low to fully activate the yeast growth, so the bread did not grow as high as the loaves given the other liquid temperatures. Additional experiments could be conducted to find the volume and density of loaves made with liquid temperature at greater increments so the researcher could find the ideal liquid temperature for high bread heights.

Second Place:

The Effects of Temperature on Restriction Enzymes

Mihir Paithane

George H Moody Middle School

In 1953, two scientists, by the name of J. Watson and F. Crick discovered the molecular structure of one of our macromolecules of life, DNA. DNA has the most complex molecular structure ever discovered by humans and has opened up a whole new field and study in science. DNA is made up of thymine, guanine, cytosine, and adenine, four nucleotides. Scientists sometimes need to take a closer look at the double helix of a DNA, but with this macromolecule being so big it is near to impossible. To resolve this problem, scientists have discovered a sort of “scissors” called restriction enzymes that cut DNA at certain sites. The purpose of this project was to determine the effect of temperature on the restriction enzyme *EcoR1* at the following temperatures – 0°C, 18°C (room temperature), 37°C, and 100°C. For this project, 20 vials of the restriction enzymes *EcoR1* were collected and were mixed with lambda DNA and incubated at the respective temperatures for 1200 seconds. The mixture was pipetted into a gel electrophoresis chamber and tested for the distance the DNA fragments traveled. The results indicated that the DNA fragments traveled the furthest when cut at an incubation temperature of 37°C with a mean of 29.2mm and the DNA fragments traveled the least when cut at an incubation temperature of 100°C with a mean of 17mm. The data supported the research hypothesis that the restriction enzyme *EcoR1* is most active at 37°C. Based on the distance the fragments traveled determined in this research, there appears to be a bell curve between the incubation temperature and the distance the DNA fragments traveled. Before it can be concluded that the temperature is the sole cause of the varying distances the DNA fragments traveled however, more experiments will be done to determine if there are any other causes of this variance.

Third Place:

The Effect of Paper Liners on Cupcake Height

Elena Rogers

Tuckahoe Middle School

The hypothesis for this experiment was: if a paper liner was used, then the height of cupcakes will be greater than those baked without a liner. The cupcake industries are thriving in the culinary world. Everybody wants to have the best looking, dome shaped cupcakes to have the most successful business, but what is the best way to achieve this modern look? This experiment tests which level of the independent variable would make the cupcake rise higher with a more dome-like shape. There were twenty trials run, and two cupcakes were tested in each trial. There was one cupcake baked in paper liner and one cupcake baked without any liner that was tested in each trial. Measurements were calculated and recorded. After averaging all of the cupcake heights, the hypothesis was supported. The cupcakes baked with a paper liner rose to an average height of 44.1mm opposed to the cupcakes baked without any liner, which rose to an average of 41.5mm. Cupcakes baked with paper liners rose higher than those without a liner.

Honorable Mention:

Energy Production from Different Fuels

Steven Tate

Tuckahoe Middle School

The concern for acquiring clean sources of energy is an important goal in today's world. In addition, with energy costs on the rise, alternative sources of energy are in high demand. The United States Military is a huge driving force in the research and development of these alternative energy sources. Their goals are to produce a more cost-effective fuel source, depend less on foreign resources, and to decrease the harmful impact the Earth has sustained due to the present methods of fuel production. This research resulted in the discovery of using oil from the camelina plant to produce biofuel that is almost indistinguishable from petroleum jet fuel.

The primary objective of this study was to prove that camelina biodiesel creates more energy than other conventional fuels. The production of energy, measured in joules, for these fuels was compared to that of camelina biofuel. The fuels tested were biodiesel, gas, diesel, iso-propyl alcohol, and ethanol. Each fuel was added to a cotton ball that was ignited and covered with a calorimeter. Inside the calorimeter was a flask containing water. Changes in the temperature of the water were recorded and allowed the evaluation of energy production when each fuel was burned.

The data produced showed that diesel had the highest amount of joules produced of any fuel in all trials, and ethanol had the lowest. The mean energy production was greatest for camelina oil, but when the data was subjected to the t-test for comparing two means, the result was not significant. The hypothesis did not hold true for diesel, but camelina oil produced significantly more energy than all the other fuels tested. Although the hypothesis was not entirely supported by the results of the experiment, camelina oil as a source for biofuel has enormous promise. Camelina oil may indeed be the fuel of the future.

Other Papers Chosen for Presentation:

Baking Soda and Vinegar Again

Erik Paletzki

Thomas Jefferson Middle School

Have you ever seen the infamous baking soda and vinegar reaction? What would happen if you used a different liquid instead of vinegar? This project looked at the effect of different liquids of varying pH levels on the amount of CO₂ released from a reaction with baking soda (sodium bicarbonate).

This was tested by mixing sodium bicarbonate and solutions of various pH. The pH values tested were 1, 3, 5, 9, and vinegar (approximately pH 2.5) was used for comparison. The hypothesis was that the pH 1 (the strongest acid) would produce the most CO₂. The experiment results rejected the hypothesis by showing that vinegar and sodium bicarbonate had the largest reaction. The experiment also showed a steady incline of CO₂ after the first minute or so.

The Effect of Brand of Soap on Height of Bubbles

Produced Emily Parker
Manchester Middle School

When buying soap most people wonder whether or not they should buy the bargain brand soap or one the more expensive brands of soap. Then they start to wonder whether they soap work the same or produce the same amounts of bubbles. So, in this experiment the number of bubbles produced by the soap were measured. There were 25 trials run for each brand of soap. Then an average of all the trials for each soap was figured. Dawn brand soap did the best with an average of 19 centimeters. The control of this experiment was 0 centimeters when water with no soap was put in the blender. Dawn did the best due to the quality of the soap this was shown by the number of bubbles produced. This is most likely from the quality of the ingredients in the soap improving the soap ability to cohere with the water and air molecules to create bubbles. Thus, concluding that Dawn brand dish soap is the most efficient dish soap out of the ones tested in this experiment.

The Chocolate Challenge

Emily Platt
Kenmore Middle School

Chocolate is made from cacao beans, with cocoa butter taken from the beans. The amount of cocoa butter has an effect on the time and temperature at which the chocolate melts. The purpose of this experiment was to determine if different brands of chocolate melt at different speeds and temperatures. The hypothesis was that Hershey's chocolate would melt at a faster speed and a lower temperature than the other chocolates. Six types of chocolate were melted. The time and temperature were recorded. Trader Joe's chocolate melted at a faster speed and a lower temperature than the other chocolates. The hypothesis was rejected.

The Effect of Types of Fire Extinguishing Materials on the Time it Takes for the Fire to Go Out

Jack Provance
Tuckahoe Middle School

This study was designed to test the effectiveness of common household materials in extinguishing fire. The experiment was chosen because fires can be deadly. Without knowledge of fires, people can get hurt. On average, 374,000 fires happen each year; and, with proper knowledge, some of these can be prevented. The experimenter created contained fires and tested by pouring four times as much extinguisher as fire onto the fire. The experimenter let the fires burn for 30 seconds and then measured how long it took for the fires to burn out. The experiment tested three common household items as extinguishers: water, baking soda, and salt. The experimenter

hypothesized that water would put the fires out more quickly than baking soda or salt. After experimenting, the results showed no difference between extinguishing agents. All of the extinguishing elements suffocated the fires in the same way.

The Effect of Various Chemicals on pH

Henry Roberts

Tuckahoe Middle School

pH is a very important and interesting part of chemistry. In short, it is the measure of negative logarithm of the amount of hydrogen ions per molecule in an aqueous solution and is measured in moles per liter. pH is measured on a scale from zero to fourteen, with the lower numbers being acidic and the higher numbers being basic or alkaline, and seven being neutral. The question concerning pH levels was "How will the pH of an acid change when mixed with chemicals of varying pH levels." According to research, when an acid and a base are mixed together, they will cancel each other out. Following that, it was assumed that when two substances were mixed, they would cancel each other out and their pH levels would balance out. The purpose of this experiment was to see how the pH levels of acid and other substances would be affected by their mixing. The hypothesis was, "That an acid and another substance were mixed, then their pH levels would balance out." Five substances of varying pH levels were chosen to be mixed with lactic acid (pH 2), lemon juice (pH 3), black coffee (pH 5), baking soda solution (pH 8), ammonia (pH 11), and sodium hydroxide solution (pH 14). Five trials were run for each level of the IV, to make a total of 25 trials. In every trial, the acid controlled the pH level, holding the first three solutions to under two, and when mixed with the sodium hydroxide, the pH was five. These results did not support the hypothesis and suggested that acids controlled the pH level more than bases. Of course, there were some errors, including temperature of the substances, limited vision of the pH test strips, and some measurement errors. All of these factors would be fixed, and more trials could be run with all of the influencing factors gotten rid of so a clear conclusion could be made.

The Effect of Different Types of Light on the Grade of Visibility of Dollar Bills that Contain Phosphorus

Ryan Robinson

Manchester Middle School

This experiment was run to test whether or not dollars that had the phosphorus stripe glow under an ultraviolet light, would show up as good under different types of lights. It was accomplished by getting four different lights, which were ultraviolet, infrared, fluorescent, and incandescent. One-, five-, ten-, and twenty-dollar bills were then tested by placing them in a dark room with all other lights turned off that were not being used at the time so there would not be any interference or added variables. Any observations and the results were then recorded. Altogether, twenty trials were run. The ultraviolet light always made the phosphorescent stripe show up the best.

However, the control, which was placing the bills in indirect sunlight, made the stripe show up the least. The incandescent light got the next lowest grade of visibility, while infrared got a little bit higher, but the fluorescent light had the second highest grade of visibility. The five- and ten-dollar bills got about the same grade of visibility while the ten-dollar bills had the next highest grade. One-dollar bills had no grade of visibility at all. Ultraviolet is the only light that can make phosphorus actually glow.

The Effect of Food or Drink Type on the Amount of

Glucose Leah Schwartz

George H Moody Middle School

It is important to monitor the amount of glucose, a type of sugar, in foods. Glucose is turned into energy that the body can use, but if you have too much, it can be dangerous and can cause diabetes. The purpose of this experiment was to determine the effect of food or drink type on the amount of glucose. The hypothesis was that Fruit Punch Powerade would have the most glucose.

The experiment was conducted using five different food and liquid types (the independent variables) and the glucose level of each was measured with test strips. In total, seventy-five trials were completed (fifteen for each variable) in this study, which was carefully conducted, ensuring valid results.

The t-test was used to test the following null hypothesis at a 0.05 level of significance: food and liquid type has no effect on the amount of glucose. The null hypothesis was rejected in all comparisons ($t=127.45 < 2.101$; $t=2.16 < 2.101$; $t=127.45 < 2.101$; $t=2.16 < 2.101$; $t=10.53 < 2.101$; $t=2.16 < 2.101$; $t=10.80 < 2.101$ at $df = 18$; $p > 0.05$) except when two food or drink types with no variance were compared ($t=\text{undefined} < 2.101$; $t=\text{undefined} < 2.101$; $t=\text{undefined} < 2.101$ at $df = 18$; $p > 0.05$). Overall, the data in seven of the ten comparisons did support the research hypothesis that food or drink type would have a different level of glucose. The result of the experiment was that food or drink type does have an effect on the amount of glucose. This was consistent with the research gathered which stated the type of food or drink that you consume is highly related to the amount of glucose.

The Effect of Different Brands of Orange Juice under Sunlight on Vitamin C

Content Shreya Shetty

George H Moody Middle School

During the 1600s and 1700s, about half of the sailors who went out to sea died of an unknown disease. On such a ship, Dr. James Lind, a British Physician, conducted an experiment to find the cause of the mysterious and brutal sickness. The results pointed to a disease called Scurvy, which is caused by a lack of Vitamin C. Since those who spent time in the ocean were less likely to eat fruits that contained high levels of Vitamin C, the Royal Navy ordered all ships to take limes and oranges on voyages longer than one month.

As one of the best sources of Vitamin C, oranges and orange juice must be stored in carefully regulated conditions. This purpose of this project was to determine the effect of sunlight on the different brands of orange juice. During the twelve trials, each brand of orange juice was tested for the amount of Vitamin C using a testing solution made out of water and cornstarch. Then, the same brand of orange juice was placed out in the sun for two hours and tested using the same method as above.

According to the Vitamin C levels determined in this experiment, there seems to be a relationship between the brand of orange juice and the effect of sunlight on the Vitamin C content. However, many more trials must be conducted as well as the determination of other factors that may have affected the outcome of this experiment.

The Effect of Water pH Levels on the Changes in Mass of Steel Rods Resulting from Oxidation

Caroline Sindelar
George H Moody Middle School

Steel is used in a multitude of water construction structures, such as bridges and over water highways. Most steel that is in contact with water goes through special treatment to ensure that oxidation does not occur ("Steel and Coke Industry"). When oxidation is present it deteriorates steel, making it highly susceptible to weakening and instability. This is extremely dangerous in waterway structures, considering that these structures can fall with fatality of anyone on or underneath them. Therefore, the purpose of this experiment was to see which water pH level would cause the greatest decrease in mass of non-galvanized steel rods so that further measures can be taken to ensure the safety and reliability of waterway structures. Research supported the hypothesis that if non-galvanized steel rods were submerged in distilled water, they would oxidize the most and have the greatest decrease in mass.

Forty plastic cups were arranged on a table. Ten cups were filled with two hundred and fifty milliliters of one water pH sample: salt water, distilled water, lake water, or tap water. One cut steel rod was then completely submerged in each plastic cup containing one of the water samples. The steel rods were removed from the plastic cup from which they resided every twenty-four hours with plastic tongs to have the mass recorded. The process was repeated every five days over a fifteen-day experimentation period. Based on the oxidation measurements which were then calculated to the mean decrease of oxidation by water pH, ocean water had the greatest percentage of change with a total mean decrease of 1.66%. The ocean water had an average pH of 5.8 in a case when the lower the pH level, the greater the rate of oxidation.

The Effect of Density on How Fast a Marble Travels through Various Liquids

Jonathan Triesler
Manchester Middle School

The reason this experiment was performed was to find which liquids out of the choice liquid group were more viscous than others. It was hypothesized that if a marble was dropped into a glass containing a liquid, then the liquid that was the least viscous would have the marble reach the bottom faster. It was determined after collecting the data that the milk (1%) was the least viscous liquid with an average time of 0.11 seconds. It was followed by tap water (0.13 seconds) and vegetable oil (0.17 seconds). It was also determined that the liquid with the most viscosity was honey (32.65 seconds), which was followed by the molasses with an average time of 18.05 seconds. In the middle was salt water (0.19 seconds), then glycerin (2.28 seconds), and corn syrup with an average time of 16.17 seconds.

Drop, Fizz, Kaboom!

Beraki Yosief
Thomas Jefferson Middle School

DROP! FIZZ! KABOOM!!! What is that noise?! That is the sound of mint Mentos doing its magic in a 2-liter Coca Cola bottle! This project looks at which amount of mint Mentos makes the largest amount of soda spew out. Mentos candies were added to full 2-liter Coca Colas and the amount of soda that was left in the bottles was measured. Different numbers of mint Mentos were added for each group of sodas. The hypothesis was that if ten mint Mentos were put in a full 2-liter soda, then it will have the least amount of soda left. The experimental results supported the hypothesis by showing that the group of Coca Colas with ten mint Mentos dropped in had the least amount of soda left. The experiment also showed that the bottles with two mint Mentos candies added had the greatest amounts of soda remaining.

The Effect of Different Temperatures and Minerals on the Size of Crystals Samuel Zabel Robius Middle School

The rationale for this experiment is to find out how to grow the biggest and best crystals. The purpose of this experiment is to find out how to make good crystals so scientists can use them in their own experiments to make better products, such as medicines. My hypothesis is that salt crystals will make the biggest crystals when grown at room temperature. The independent variables are using borax, salt, and sugar to make into crystals and growing them in a room temperature area, a refrigerator, and a freezer. The dependent variable is the size that the crystals grow. There are 3 repeated trials for each level of the IV. Measured in millimeters, the means are sugar at room temperature-0 mm, sugar in refrigerator-0.5 mm, sugar in freezer-0 mm, salt at room temperature-6.5 mm, salt in refrigerator-5 mm, salt in freezer-0 mm, borax at room temperature-12 mm, borax in refrigerator-10 mm, borax in freezer-0 mm. For my inferential statistics, I used room temperature, refrigerator, and freezer. The standard deviations were 5.61248, 4.33333333, and 0, respectively. For my t-tests, room temperature vs refrigerator was 0.800535935; $p > 0.01$, room temp. vs freezer was 0.14932117; $p > 0.01$, and refrigerator vs freezer was 0.156198316; $p > 0.01$. I had a df of 4 and an α of 0.01, $t=2.132$ for significance. This data confirmed my null hypothesis. This information might possibly help scientists with creating new medicines and I may want to try different minerals at a later date to see if this gives me further knowledge.

The Effect of Different Acidic Juices on the Oxidation of Fuji Apple Slices

Annie Zhang
George H Moody Middle School

Keeping apple slices from browning has long since been a problem for marketers. Thus, a solution was invented to prevent the enzymatic browning of apple slices in salads, fruit cups, et cetera. This solution used sulfite as its main ingredient. However, since studies have shown that this method can be harmful to one's health, the method has been outlawed. The purpose of this experiment was to see if the acidity of different juices affects the prevention of enzymatic browning in apple slices. If lemon juice, prune juice, apple juice, and orange juice are used to soak apples in, then the apples soaked in the lemon juice will be the least oxidized. 10 apple slices were placed in 5 containers. Juice was poured evenly onto the apples and the results were recorded every 5 minutes for 30 minutes based on a homemade scale. In the end, the lemon juice proved to be the most effective while prune juice was the least effective. This supported the hypothesis. Based on the research, the juices that were higher in acidic levels were better at preventing enzymatic browning than the juices that were lower in acidic levels. Further experimentation regarding different brands of juices is suggested.

Chemistry A

First Place:

NOVEL BIOSENSOR CAPABLE OF SIMULTANEOUSLY SENSING MULTIPLE MARKERS IN A SINGLE SAMPLE

Richard Chong

James W. Robinson, Jr. Secondary School, Fairfax, VA

The purpose of this project was to develop and test advanced sensors capable of simultaneously monitoring multiple markers in a single sample such as blood, drinking water, or food. The hypothesis was that if multiple fluorescent dyes in a detection cell emit lights of different colors in 1,1'-oxalyldiimidazole chemiluminescence (ODI-CL) reaction, it is possible to develop an innovative biosensor capable of simultaneously detecting multiple markers in a single sample. To test the sensors, fluorescent dyes formed from different enzyme immunoreactions were put into a strip-well and trace levels of multiple fluorescent dyes in the strip-well were rapidly and simultaneously quantified using ODI-CL detection capable of separating and sensing different lights emitted from multiple fluorescent dyes. This confirms that the experimental results are consistent with the initial hypothesis because multiple fluorescent dyes interacted with high-energy intermediate formed in ODI-CL reaction can emit lights of different colors without any interferences and the relative CL intensity of individual light separated with a specific filter was measured with a photomultiplier tube.

Second Place:

Effects of Metal Suspensions on Radiation Shielding

Matthew Cedeno

Ocean Lakes High School

The purpose of this experiment was to test if a suspension of metal particles scattered throughout a polymer gel would have an increase of linear attenuation through radiation shielding. The research hypothesis was if metal particles were placed into a polymer gel, then the linear attenuation would increase. The null hypothesis was that the composition of a polymer gel would have no effect on linear attenuation. In this project, five groups of polymer gels were tested against two radiation sources, Cesium 137 and Cobalt 60. The control group was sodium polyacrylate without metal particles. The other experimental groups were 5:1 and 10:1 mass ratio of either powdered graphite or lead to the polymer. The suspensions were put into Petri dishes and placed between a radiation source and GM-tube. The ionizing radiation was counted over an interval for each group, for four trials each. Using the linear attenuation formula, the linear attenuation coefficients were calculated. The mean linear attenuation coefficient

increased when metal particles were added to the control gel. The highest mean linear attenuation coefficient of the five groups was the 10:1 mass ratio of lead (0.160 cm^{-1}), while the lowest was the control's coefficient (0.317 cm^{-1}). An ANOVA Test was performed on mean linear attenuation coefficients at the significance level of 0.05. The test had an F value of 49.1 and a p value of 1.92×10^{-8} . The data supported the research hypothesis as the metal suspensions clearly demonstrated high linear attenuation.

Third Place:

Dissolution of Coating of Diphenhydramine Pills in Stomach Acid

Lauren Hall Mozingo

Shenandoah Valley Governor's School

Pills are designed to dissolve quickly to provide relief from symptoms. The purpose of this experiment was to determine whether or not different coated pills dissolved at different rates when exposed to different pH levels and temperatures. Four types of pills, tablets, kapgels, capsules, and softgels, were tested at three different temperatures (room temperature (293 K), body temperature (310 K), and elevated (fever) body temperature (312 K)) and at two different pH levels (stomach acid (pH 2) and small intestine acid (pH7)). The dissolution times of the pills were measured and compared. The results showed that pills exposed to higher temperatures and acidity had faster dissolution times. Kapgels had the fastest dissolution time in all conditions, followed by tablets, then capsules, and softgels with the slowest dissolution time.

The dissolution, as observed, can be explained quantitatively as the breakdown of the coating materials into solutes in solutions which is controlled by the atomic diffusion process. The researcher concluded that high temperatures and acidity of the stomach acid, along with kapgel form of pill, speed up the dissolution time and therefore the time it takes to deliver symptom relief.

Honorable Mention:

The Release of Formaldehyde from Household Substances

Trevor Blair

Central Virginia Governor's School for Science and Technology

The purpose of this study was to test various samples of household materials (Urea-formaldehyde resin glue, laminate flooring, hardwood flooring, linoleum, and carpeting) for the release of formaldehyde. The samples were soaked in 50 mL of distilled water for 24 hours. After the soaking period, 5 mL samples of the water were tested for formaldehyde

content. The laminate flooring was observed to have 10 g/L of formaldehyde in the water samples tested, and the resin glue was shown to have over 100 g/L of formaldehyde in the water sample tested. The other samples showed insignificant results, showing measurements of less than 10 g/L for every sample. The hypothesis that the resin glue would have the greatest release of formaldehyde of all the samples tested was supported. In summary, most of the samples tested (besides the urea-formaldehyde resin glue) are quite safe, releasing very small and harmless amounts of formaldehyde.

Other papers chosen for presentation:

Burning Oils: Which Oil Type is Most Efficient When Burned?

James Blakely

Washington-Lee High School

The purpose of this experiment was to burn petroleum and vegetable oil and then to determine which released the most energy. Recently, there has been much debate surrounding this issue and it has become a contentious political issue. Petroleum is currently used for the majority of the world's energy sources and it is cheap to retrieve and ready for use. But it produces pollutants that many dislike and fear. Vegetable oil is the most logical solution oil to succeed petroleum, but it can be very expensive to research and expensive to use at a major scale. It is often determined that biofuel is just as effective as petroleum and therefore, if biofuel is placed on a cotton ball, and lit on fire, then it will burn as efficiently as regular petroleum oil, because even though it is not as flammable as petroleum oil, it still possesses the capability to release enough energy to significantly heat water. The experiment had a simple design. A ring stand was set up and a soda can holding water at a constant temperature was placed on the ring. Underneath the ring, a cotton ball was soaked in one of the two oil types. A thermometer was placed in the water to measure the rise in temperature. The cotton ball was lit on fire, and the temperature rise was recorded. This was done ten times to each of the oils. Following the experiment, the data was analyzed. It was determined through an ANOVA test that there was no significant difference between vegetable oil and petroleum oil when burned as the P value was greater than .05. This fails to reject the null hypothesis and shows that there is no significant difference between the two oil types.

The Effects of Electrolyte Levels on Conductivity Levels in Gatorade®

James Frisbie

Shenandoah Valley Governor's School

Hydration is important to athletes. Sports drinks offer fluids with electrolytes to help maintain hydration and replace fluids lost during activities. The purpose of this research study was to determine whether Gatorade® had the same number of electrolytes as a solution with the same amount of sodium and potassium concentration. Gatorade® was purchased from different grocery stores. Conductivity was then tested and compared to the conductivity of a solution with the same concentration of sodium and potassium. Results showed that statistic differences existed in conductivity levels between Gatorade® and the solution. Further tests were used to try to determine the other electrolytes present in Gatorade®. As a result, it was concluded that citric acid was responsible for higher conductivity levels in Gatorade®.

Which Orange Has the Most Vitamin C?

Christos Alpos
Washington Lee High School

Humans need many vitamins and proteins to survive. One of those vitamins is vitamin C. Vitamin C is not created by the humans in the digestive system, so humans have to get vitamin C from outside sources such as fruits and vegetables. One of the most abundant sources of vitamin C comes from oranges. The reason this experiment was conducted was to show which orange or citrus fruit had the most vitamin C. The tested fruits included navel oranges, Valencia oranges and tangerines. Valencia oranges are the most commonly used orange to make orange juice, which hopefully signifies that Valencia oranges have the most vitamin C. The vitamin C would be tested by titrating the juice by using iodine and comparing the results to the KI/I solution starch as an indicator which was used as the control group. However, the hypothesis of Valencia oranges having the most vitamin C was not supported. Navel oranges had the most vitamin C, Valencia oranges were close behind and tangerines had almost half the vitamin C that the navel oranges had. An ANOVA Test was taken, and the null hypothesis was rejected. Further researching of vitamin C levels should be done.

The Effect of Material on the Production of Coral

Reef Mallory Banton
Hanover High School

The purpose of this experiment was to determine what metal r alloy produces the greatest mass of calcium carbonate. Forty-five individual pieces of metal were tested using saltwater electrolysis with sea water. Fifteen pieces of copper, fifteen pieces of brass, and fifteen pieces of steel were all tested to determine which metal would produce the highest mass. Each metal had its original mass taken and recorded. It was attached

to a 9V battery using alligator clips. It was submerged in 500 mL of saltwater with a paper clip attached to the battery to create two electrodes. After two hours, the mass of the original metal was taken again, and the difference between the final and original mass was recorded. The metal with the highest average mass increase was copper at 2.42 g, steel had the second highest average at 1.72 g, and brass had the lowest at 1.05 g. Based on the results, copper provided the highest average increase in mass because of its high conductivity. High conductivity, or the ability to conduct electricity, allows more electricity to pass through a given conductor. The negatively charged conductor will then collect more positively charged calcium carbonate ions, thus giving it a higher mass.

The Number of Matches of Fingerprints When a Subject Has or Has Not Perspired

Rachel Becker
Shenandoah Valley Governor's School

Fingerprinting has been a method used by law enforcement for over 50 years and recently fingerprinting has become a main area of study for many investigators. The purpose of this study was to see if there was a difference in the number of fingerprints matches of a person who has not perspired and one who has. Fingerprints were taken from runners from a local high school and were analyzed using a Paired *t*-test. The results from this experiment were that the null was supported; there was no statistical difference between the fingerprints.

A Chemical Analysis of Orion S

Caroline Chun
Central Virginia Governor's School for Science and Technology

The purpose of this study was to analyze the chemical composition of Orion S. This study cataloged the information from approximately 50 emission lines, which are signals that can be transmitted from molecules, and 14 molecules (additional ~80 lines from emission of these molecules). In the first part of the analysis, Spectral Line Search Engine (SLiSE) and Splatalogue were used to gather information about line frequency, line intensity, line shape, species (molecules), chemical name, and LOVAS list. It was found that 12 molecules were responsible for the strongest emission in Orion S. Line widths and line shapes were used to infer location and motion of the molecules. In the second part of the analysis, 14 molecules were studied using the same methodology with SLiSE and Splatalogue, with the addition of comparing column density and excitation temperature using a series of Chi-squared (χ^2) test for each molecule. In conclusion, there were generally differences in characteristics and behaviors among different molecules. A majority of molecules in Orion S emitted weak line intensities between 0.5 and 2.5K. Their most common line widths were between 4.5 and 5.5 km/s. Molecules had different kinds of line shapes such as normal (a majority), blended, and asymmetric. It is also worthy of noting that C₃H₂ and H ¹³CO, a 2nd HC¹³CCN, HCC¹³CN, and ³⁴SO molecules had overlapping excitation temperatures and column densities.

The Effect of Protein Concentration on the Protein Folding

Rate Amanda Cortinas
Ocean Lakes High School

The purpose of this experiment was to test if increased protein concentration would decrease the protein's folding rate. The null hypothesis was that the protein concentration would not affect the protein's folding rate. The DNA that encodes the protein GB1 was cloned into a plasmid which was inserted into *Escherichia coli*. Once the bacteria were grown, isopropylthiogalactoside stimulated the bacteria to make the protein. The protein was then collected and purified using column chromatography. Stopped-flow fluorescence monitored the refolding rates of GB1 in solutions of 1 mg/ml, 5 mg/ml, 10 mg/ml, and 20 mg/ml that were denatured using 4.5 M guanidine hydrochloride in a 20mM sodium acetate buffer at a pH of 4.0 at 10°C. These solutions and a second buffer of 20mM sodium acetate with a pH of 4.0 with 30% glycerol mixed in a mixing chamber of the stopped-flow machine so that the second buffer diluted the denaturant, allowing the protein to re-fold. As the protein refolded, the protein's fluorescence was measured and inputted into a computer program, which created a graph of the protein's refolding. The double exponential regression line for each concentration was used to find the protein's folding rate for that concentration. The solution with 1 mg/ml of GB1 refolded in 22.47 ms, the solution with 5 mg/ml of GB1 refolded in 13.82 ms, the solution with 10 mg/ml of GB1 refolded in 16.92 ms, and the solution with 20 mg/ml of GB1 refolded in 19.74 ms. The difference between the folding rates was not significant, therefore the null hypothesis was accepted for all concentrations of protein.

The Effect of Sleeping Time on Tea pH Levels

Laura Cross
Douglas Southall Freeman High School

Abstract not submitted

The Effect of Storage Temperature on the pH of Lemon Juice

Ravneet Dhillon
Henrico High School

The purpose of this experiment is to determine whether storage temperatures increase or decrease the pH of lemon juice. It was hypothesized that as the temperature increases the pH of lemon juice will decrease. The independent variable will be the storage temperature. Levels of independent variable are 40 degrees (F), 50 degrees (F), 60 degrees (F), 70 degrees (F), and 80 degrees (F). There will be three trials per level of the independent variable. The dependent variable is the pH of lemon juice. The constants in this experiment are the type of lemon juice used, the beakers in which the juice is placed, the pH strips, the incubator, and the amount of time the lemon juice will

stay in the incubator. This experiment will take approximately 15 weeks to perform since the lemon juice will stay in the incubator for a week per level of IV for each trial. In order to perform this experiment, 50 ml of lemon juice was placed in a beaker and in the incubator for a week for each level of IV. Then, the pH of each lemon juice was determined using pH strip. The results of this experiment show that the storage temperature does affect the pH of lemon juice. As temperature increases, the pH of lemon juice decreases.

The Effect of Fat Content of Milk on Calcium

Content Susmita Gautam
Yorktown High School

The fat content of milk has been shown to vary calcium content. This experiment tested the calcium content of whole milk, two percent milk, one percent milk and skim milk. Ten milliliters of water was added to an Erlenmeyer flask containing ten milliliters of milk. One milliliter of pH buffer solution was added to the flask in order to hold the pH of the already present magnesium ions. Five drops of Eriochrome Black Indicator Solution were also added to the solution in order to signify a reaction by changing color. Five milliliters of magnesium Ethylenediaminetetraacetic acid (EDTA) solution was then added so the magnesium could bond with the Ethylenediaminetetraacetic acid solution and not interfere with the experiment. Drops of sodium hydroxide were added to bond to the remaining magnesium ions until the color of the solution in the Erlenmeyer flask turned pink. Lastly, drops of Ethylenediaminetetraacetic acid were used to titrate the solution in the flask until the color changed from pink to baby blue, signifying that all the Ethylenediaminetetraacetic acid solution had bonded to all the calcium ions and broken apart the bonds magnesium had made earlier, thus concluding the experiment. Five trials were done for each of the four types of milk. The milk with the highest fat content had the highest concentration of calcium. Whole milk had the highest concentration of calcium, followed by two percent milk, which was followed by one percent milk, and finally skim milk, which had the lowest concentration of calcium. The experimental results supported the hypothesis that, if tested, whole milk would have the greatest concentration of calcium.

What Influences Candle Brightness and Why Most Candles Have Similar

Brightness Andy Han
Woodberry Forest School

All candles appear to have about the same brightness. We determine what factors affect candle brightness and why all candles have similar brightness. Through experimental measurements of different candles' brightness with a light probe, we found candles do have brightness that varies by about 50%. The Capillary Action of the wick, which sends the wax particles into the flame, is related to the diameter of wick. Then the wax particles combust with oxygen to form soot particles which glow through the Blackbody Radiation. As a result, candle brightness is related to the diameter of

wick, and the access to oxygen. The difference in candles' brightness, however, is shown by observation to be not readily apparent to human eyes.

The Effect of Enzymes on the Amount of Juice Extracted from Apples

Sean Headley-Coleman
Hanover High School

The purpose of this experiment was to determine the effect of different enzymes on the amount of juice that could be extracted from apples. Four beakers were then filled with equal amounts of apple pieces. The beakers were then wrapped in plastic covering and were placed in a 45° C bath to incubate for 20 minutes. After the 20 minutes were over the beakers were taken out and the apple slices were gently mashed down with a wood craft stick. The apple enzyme mixture was then added to the appropriate funnel and the amount of juice produced for each beaker was recorded after a period of 5, 10, and 15 minutes. The apples treated with a buffer produced a mean amount of 0.16 mL of juice. This showed that the buffer was the least effective enzyme that was used in this experiment. The reason for this is that the buffer was ineffective in breaking down the cell wall of the plant cells found in the apple. The results that followed were that cellulase produced a mean amount of 2.4 mL of juice and the combination of pectinase and cellulase produced a mean amount of 4.08 mL. When pectinase was used it produced a mean amount of 4.22 mL of juice. Pectinase was shown to be the most effective enzyme as it most effectively broke down the cell wall of the plant cells in the apple which allowed for more juice to be produced.

The results of this experiment show that different enzymes have different rates of success. The buffer was shown to be the least effective and pectinase was shown to be the most effective.

What was being affected in this experiment was the apple cell walls. The higher the amount of the cell wall that can be broken down during production, the higher the amount of juice that can be produced.

Chemistry B

First

Place The Role of Conserved Cysteine Residues in Gloxysomal Malate Dehydrogenase

Rachel Jones
Mathematics and Science High School at Clover Hill

This project addressed roles of conserved cysteine residues in glyoxysomal Malate Dehydrogenase (gMDH). Cysteine residues 151, 152, 282, and 295 are conserved in gMDH; 152, 282, and 295 are also conserved in Mitochondrial Malate Dehydrogenase. In order to understand the roles of conserved cysteines; mutant enzymes were created using Stratagene Quickchange© protocol. Cysteine 282, 295 and a triple mutant; C145, 151, 152 were converted to serine; conserving polarity and size. A second C282 mutant was made to leucine to alter polarity. The relative activity of the mutants was determined under standard assay, using the Bradford assay to standardize protein concentration. Michealis Menten plots were used to determine effects of mutation on the binding of NADH and OAA; both important to the function of gMDH. Results showed C295S changed the binding of NADH making it linear and had a relative activity ten times lower than Native gMDH, suggesting a major role in activity. The Triple mutant had a relative activity three times higher than Native gMDH which could be related to gMDH inhibition. 282 Leucine and Serine resulted in minor changes indicating S282 does not play a significant role in activity.

Second Place

Role of cAMP-dependent Protein Kinase in Modifying the Enzymatic Activity of Histone Deacetylase 1

Andrea Li

10225 Cedar Pond Drive Vienna, VA 22182

Thomas Jefferson High School for Science and Technology

Abstract

Demyelinating diseases, such as multiple sclerosis and Guillain-Barré syndrome, can cause devastating outcomes including paralysis, autonomic dysfunction, and even death. Current treatments are primarily limited to stopping the progression of the disease, rather than initiating and accelerating remyelination and recovery. Histone deacetylases (HDACs) play an essential role in initiation and regulation of myelination; increasing the activity of HDACs poses a potential treatment option to accelerate recovery. HDACs themselves are affected by a variety of post-translational modifications, including phosphorylation; the effect of cAMP-dependent protein kinase (PKA) on the activity of HDAC1, however, is unknown. The goal of this experiment was to determine the role of PKA in modifying the enzymatic activity of HDAC1. After incubating the extract containing HDAC activity with varying levels of PKA, test samples were run through an activity assay. By comparing absorbance values with a standard, absolute concentrations of deacetylated substrate, reflecting the enzymatic activity, were determined. The major

finding was that lower levels of PKA significantly increased the activity of HDAC1, as evidenced by the results of an ANOVA test. These results suggest that optimizing levels of PKA may increase the enzymatic activity of HDAC1, thereby promoting remyelination. Equipped with this information, methods involving optimization of PKA and upregulation of HDACs may be formulated and applied to address demyelinating diseases in the clinical world.

Third Place

The Effect of Different Types of Additives on the Pour Point of Biodiesel

Arjun Jaini

Lee-Davis High School

Diesel fuel is a non-renewable energy source that has an increasing demand and decreasing supply. Biodiesel is a sustainable and renewable alternative fuel produced from vegetable oil; most commonly waste vegetable oil. Transesterification is the chemical reaction that converts vegetable oil into biodiesel. Despite its benefits, biodiesel can gel in cold winter conditions. Gelling can cause engine problems, decreased efficiency, and difficulty starting. For this reason, biodiesel is not a mainstream fuel.

Fortunately, fuel blending and additives can prevent biodiesel from gelling in low temperatures. Pour point is the lowest temperature at which a liquid can flow. This experiment's purpose was to determine which fuel blend, or additive would lower the pour point of biodiesel the most. These results could assist biodiesel producers in choosing the most effective additive and consumers could have access to reliable biodiesel. It was hypothesized that if the viscosity of the additive is lower, then the pour point of the biodiesel will decrease. For this experiment, vegetable oil was converted into biodiesel. Then, the biodiesel was treated with an additive, and the pour point was measured. The results and data analysis showed that kerosene, Diesel Power Complete, and Power Service Diesel Fuel Supplement were all equally effective at lowering the pour point of biodiesel. Since none of these additives had the lowest viscosity, the hypothesis was not supported. However, the purpose of this experiment was fulfilled. With an increase in biodiesel's reliability, widespread use of an economical and renewable alternative to petroleum-derived diesel is possible.

Honorable Mention

The Effect of Bleach Developer Used During the Bleaching Process on the
Approximate Tensile Strength of Hair

Selene Hess

Godwin High School

The purpose of this experiment was to see if the volume of bleach developer used during

the bleaching process of hair affects the approximate tensile strength of hair. It was hypothesized that if a higher developer number is used, the tensile strength of the hair will decrease. The experiment was conducted using a simple apparatus that used a fish weight scale to measure the kilograms force needed to cause hair treated with each level snap. Non-bleached hair was used as a control. It was found that there was a slight change in the mean force between developing numbers, supporting the hypothesis, but when a t-test was done, it was found that the only significant data pairs of independent variables was between the developing volumes and the control. There was found to be no significant data when each developing volume was compared with one another. It was concluded that bleaching hair does affect the tensile strength of hair, lowering it, but the developing volume used in combination with the bleaching agent did not affect the resulting tensile strength

Honorable Mention

The Effect of Types of Flue Gas Desulfurization Chemical on Sulfur Dioxide Output
Samuel Nowlin
Hanover High School

The purpose of this experiment was to determine which of the potential flue-gas desulfurization chemicals is more efficient. Having a more efficient flue-gas desulfurization chemical will reduce the amount of sulfur oxides in the Earth's atmosphere which will in turn reduce acid rain and other harmful events. The hypothesis was that if calcium carbonate was used, then sulfur dioxide output would be minimized. Sulfur dioxide of a known concentration was bubbled through each independent variable separately in impingers and the resulting gas was drawn through a sulfur dioxide analyzer to measure the sulfur dioxide in parts per million. The process was repeated fifteen times for every independent variable and after each trial of water, the water was tested for sulfuric acid using litmus paper. It was found that the hypothesis was incorrect, and magnesium hydroxide was a more efficient desulfurizer. This was because not only was magnesium bonding with sulfur dioxide in the reaction, but the hydroxide molecules would also bond with sulfur to produce sulfuric acid. This means that two separate molecules bond with sulfur in the reaction with magnesium hydroxide whereas only the calcium from calcium carbonate would bond with sulfur, yielding an increase in efficiency from calcium carbonate to magnesium hydroxide.

Honorable Mention

Properties of Molecules in Orion KL
Dongyeop Lee
Central Virginia Governor's School for Science and Technology

The purpose of this study was to study the chemical composition of molecules within the nebula Orion KL in the frequency range between 130GHz and 170GHz. Using two-star characteristic databases, Spectral Line Search Engine (SLiSE) and Splatalogue, frequently observed molecules in the Milky Way, and those with intensities higher

Than 1.00K were chemically analyzed. One hundred and forty-one high intensity lines of data were analyzed for their molecular composition. Fourteen different molecules were examined as their column densities and excitation temperatures were calculated through chi-squared minimization. The properties of the fourteen different molecules, including frequency, line width, line shape, molecular formula, and molecular transition, were recorded. The results obtained from this study revealed that the detailed chemical abundances of Orion KL and can be used to compare its characteristics with other star forming regions in the Milky Way.

Other papers chosen for presentation:

The Effect of the Chemical Solvent Used on the Amount of Oil Extracted from
Jatropha curcas Seeds

Denise Hull
Godwin High School

The purpose of the experiment was to determine the effects of different chemical solvents on extracting oil from the seeds of the *Jatropha curcas* plant. In recent years, there has been an increase in experimenting with biodiesels, such as Jatropha oil; however, the most popular solvent used to extract the oil, hexane, is regarded as a hazardous air pollutant and leaves traces of solvent in the oil resulting in increased experimentation with alternative solvents. The ground Jatropha seeds were heated, then mixed with the chemical solvent, and the amount of oil was measured. No control was used because there is no solvent that extracts all of the oil from the seeds which could be used as a comparison. It was hypothesized that hexane would extract more oil from the *Jatropha curcas* seeds than ethyl acetate or ethanol. The results showed that ethyl acetate extracted .398g more oil than hexane, and .770g more than ethanol. A t-test was performed on the data which deemed all data significant; however they did not support the research hypothesis. It is believed that the data was due to the fact that ethyl acetate and hexane are non-polar molecules, which are proven to be better extractors of non-polar oils, such as Jatropha oil. This could lead to further studies investigating the purity of oil extracted using ethyl acetate, and the effectiveness of combinations of different solvents.

The Effect of Lipid Class on Rate Lipase Hydrolysis

Elise Huppert
Yorktown High School

Abstract not submitted

The Effect of the Original Gatorade Series on Electrolyte Levels

Romina Jimenez Alvarez
Washington Lee High School

In the 2009 Super Bowl, Pepsi Co. the owners of the Gatorade Company spent a total of \$33 million advertising the benefits of the Original Gatorade Series. The Gatorade Series has revolved around 50 years of research and experimentation to perfect its scientifically calculated formula, and as result has revolutionized the sports drink industry. Like most sport's drinks, the Gatorade Series contains minerals that dissociate into ions called electrolytes. These electrolytes are lost through sweat during exercise, and if not replaced cause dehydration. The Gatorade Series creates specific drinks with particular amounts of these critical minerals for the appropriate time of before, during, and after intense physical activity. Furthermore, electrolytes produce electric current; therefore by using a digital multimeter the electricity within each drink of the series can be measured. The purpose of this experiment was to measure the electric current within each particular drink of the Original Gatorade Series to determine the amount of electrolyte concentration. The higher the electric current, the more electrolytes were within the drink and so fourth it could be concluded which drink was highest in electrolytic concentration and consequently which would ultimately be more likely in preventing dehydrating. The hypothesis of this experiment was that if Gatorade 03 was tested for electrical current, then it would contain significantly higher levels of electrolytes than the rest of the series because the classified electrolytic minerals are found most abundant in this drink. Later, the results revealed that the hypothesis was supported. Also, data confirmed that the amount of electrolytes within a sports drink is indeed proportionate to that that of the amount of minerals that dissociate into electrolytes in that drink for various reasons.

The Effects of Caffeine on High School Students

William Johnson
Godwin High School

Abstract not submitted

The Effect of Various Salt Spreading Techniques on the Melting Rate of Ice

Lauren Kesler
Hanover High School

The purpose of this experiment was to determine the effect of different salt spreading techniques on the amount of melted ice and their melting rates. This was tested using Food Lion Iodized Salt and 60 Smart Option Styrofoam cups. The cups were filled with 20 mL tap water and placed in the -17.8°C freezer for 40 minutes. The cups were then removed and immediately treated with their designated salt spreading technique and allowed to melt for 40 minutes at a temperature of 24°C . The first technique was dry spreading where 1.25 mL salt was poured into the sifter and sifted over each individual cup. The salt was slightly dampened for the pre-wetting technique spraying two mL of water over the salt as it was being sifted over the cup. A funnel and straw were used to replicate the chute technique. Then 1.25 mL of salt was poured into the funnel and slowly moved across the diameter of the cup. No salt was used to act as the control. The melted water was then measured and recorded in milliliters. From this data, the mean and standard deviation were found.

The average amount of water melted for dry spreading was 16.13 mL, pre-wet was 16.93 mL and 15.13 mL melted on average for the chute technique. An average of 14.53 mL melted when no salt was used. When salt is added to water, a solution is created. Solutions have lower freezing points than pure solvents because the solute disrupts the liquids ability to return to the solid state. More heat must then be removed to separate the molecules and melt the ice. The pre wetting technique results differed from the dry salt spreading because wetting provided moisture to make brine. This created a faster melting time which yielded more ice to melt.

The Use of Trisodium Phosphate with Boric Acid for Nuclear Chemistry Applications

Kelli Klingenfus

Central Virginia Governor's School for Science and Technology

The purpose of this study was to determine how the solubility limit and the pH of a boric acid (H_3BO_3) solution buffered with trisodium phosphate (TSP) change with an increasing concentration of TSP. A starting solution of boric acid with a 30,000 ppm concentration was mixed in a 250 mL beaker for each of the 6 tests that were conducted with different TSP concentrations. These concentrations were 0 ppm, 20,000 ppm, 40,000 ppm, 60,000 ppm, 80,000 ppm, and 100,000 ppm. For each test, the base solution was mixed with each different concentration of TSP and the initial pH

was recorded. Additional boric acid was added in increments of 0.5 grams until a precipitate was seen in the bottom of the beaker and the pH was recorded each time additional boric acid was added. The results supported the original hypothesis that if the TSP concentration was increased, the pH and solubility limit of the buffered boric acid would also increase. When the data was graphed, the trend lines showed that each increase in TSP concentration caused the pH and the buffered boric acid solubility limit to increase. The equations for the trend lines were $y = -9.383E-7x^2 + 2.752E-1x + 3.586E4$ with an R^2 value of 0.987 and $y = -8.980E-7x^2 + 2.750E-1x + 3.557E4$ with an R^2 value of 0.988 for solubility and $y = 4.400E-5x + 5.233$ with an R^2 value of 0.730 and $y = 4.414E-5x + 5.276$ with an R^2 value of 0.721 for pH. Overall, the increasing TSP concentration mixed with boric acid increased the pH and the solubility limit of the buffered solution which is important because this information can help improve pH control and not form a precipitate inside the nuclear reactor core or reactor vessel lower plenum.

Got Electrolytes? What Should You Drink after an Hour of Exercise?

Jeremy Kyle
H-B Woodlawn Secondary Program

Sweat is mostly made up of water and electrolytes, and sports drinks are designed to replace what is lost in sweat. This project was chosen to determine which drinks have the most electrolytes. It was hypothesized that electrolyte-enhanced drinks would have higher electrical conductivity than drinks that have not been enhanced. Conductivity of these drinks was measured using two methods: by measuring the current through a circuit with electrodes placed in each drink, and by directly measuring the resistance across the electrodes. In both methods, the same five drinks had the highest electrical conductivity: electrolyte-enhanced Powerade, Gatorade, and O.N.E. Coconut Water, along with non-enhanced Propel and Chocolate Milk. Other drinks tested were electrolyte-enhanced Vitamin Water, Essentia, and Refresh, along with non-enhanced Coca-Cola, tap water, Hi-Ball Energy, and Penta. Therefore, the hypothesis was not supported. Consumers should not rely on product labeling, as several of the drinks labeled as being infused with electrolytes had low electrical conductivity. Any of the top five drinks are recommended to replenish electrolytes after an hour of intense exercise. The researcher has a fairly high degree of confidence in the results, though additional testing is recommended.

The Effect of the G-Series Pro on the Amount of Electrolytes

Natalie Lemek

Washington Lee High School

The purpose of this experiment was to determine the number of electrolytes in different liquids. The liquids that were selected were from the G-Series Pro: Prime, Perform, Gatorade-Gatorlytes, Gatorlytes-H₂O, and Recover. The controls were Distilled Water and Tap Water. It was hypothesized that Gatorade-Gatorlytes would have the most electrolytes because it has the most potassium, magnesium, calcium, and sodium per serving size. The experiment was designed, and the multimeter was built first. Then, the current of each liquid was tested six times. There were four different rinses between each test so that any liquid from the previous trial would not get mixed into the results of the next trial. After all the data was collected, the current was converted into conductance because conductance is proportional to the number of electrolytes. The results showed that Gatorade with Gatorlytes had the highest conductance, (2.2×10^{-5} siemens) and therefore the most electrolytes. Distilled water had the least number of electrolytes with a conductance of 9.1×10^{-7} . However multiple T-Tests were done between close sets of data (Perform, Gatorade-Gatorlytes, Gatorlytes-H₂O, and Recover) and three of them found that the p-value was greater than the critical value 0.05, so the null hypothesis was not rejected. The data between the different types of Gatorades could not be analyzed because it was not statistically significant. The data that could be analyzed was between the control (distilled water) and the different types of Gatorades. It was found that each type of Gatorade had a significantly more electrolytes than distilled water. No other conclusions could be formed because the null hypothesis could not be rejected.

The Effect of Amount of Baking Soda on the Density of Baked Banana Muffins

Jordan Levine

Deep Run High School

Leavening agents, such as baking soda, affect density of baked quick breads, such as muffins. Baking soda, often called sodium bicarbonate, makes dough rise by producing air bubbles when placed under high temperatures. Sodium carbonate, the air bubbles that are produced, determine the density of baked quick breads. The purpose of this project was to determine how the amount of baking soda affected the density of baked banana muffins at the following measurements of baking soda: no baking soda, one

teaspoon, two teaspoons, and three teaspoons of baking soda. Each ingredient was mixed as recorded in procedure, but substitutions were made regarding the amount of baking soda used. Each muffin was put into the oven at a temperature of 350 degrees for ten minutes, and the mass and volume of each muffin was measured using a kitchen scale and a graduated cylinder, thus resulting in calculating the density of each muffin. The results indicated that the muffin with the three teaspoons of baking soda had the lowest mean density of 0.0208 g/mL^3 . A t-test of the data was conducted ($t = 6.58 > 2.07$; $t = 13.65 > 2.07$; $t = 14.81 > 2.07$; $t = 6.86 > 2.07$; $t = 8 > 2.07$; $t = 1.55 < 2.07$ at $\alpha=0.05$ and $df = 22$). The data did not support the research hypothesis that if no baking soda, one teaspoon of baking soda, two teaspoons of baking soda, and three teaspoons of baking soda were used, then the group receiving three teaspoons of baking soda will have the highest density. Therefore, the research hypothesis was rejected. Based on the density values determined in this research, there is an association between the amount of baking soda used and the density of the baked muffin. Before concluding that more baking soda decreases the density of baked muffins, an alpha less than the range of the means will have to be used; preferably by using professional equipment that takes precise measurements of every ingredient.

The Effect of Sugar Type on Cellular Respiration

Norah McDonald
Yorktown High School

The purpose of the experiment was to test if different isomers of sugar affect yeast respiration. The sugars used were galactose, lactose, fructose, sucrose, and maltose, (along with a control of heat and water). A 50 mL Erlenmeyer flask was filled completely with water then placed in a 1000 mL beaker (holding 900 mL of water). A rubber tube was placed into the Erlenmeyer flask and attached to a 250 mL flask filled with a solution of 60 mL of water, 4.77 g of sugar, and 9.6 g of yeast. The flask was lightly swished around 3 centimeters above a hot plate on level three. The water displacement in the Erlenmeyer flask was measured at 2.5 minutes and 5 minutes.

The hypothesis of the experiment was that the maltose would create the greatest production of carbon dioxide from the respiration of yeast. This was based on the premise that maltose was constructed of two molecules of glucose, whereas all the other sugars being tested consisted of no more than one. Glucose was the most important sugar in yeast respiration, as all sugars broke down to glucose molecules during the cellular process. The hypothesis was accepted as maltose had the greatest average water displacement of 25.52 mL at five minutes. The next greatest

displacement was fructose (23.78 mL), sucrose (1.44 mL), lactose (0.06 mL), and galactose and the control (0 mL). The null hypothesis was not accepted because the data was statistically significant. A Kruskal-Wallis test was run and showed a P-value 0.0012. The data supported the research that was conducted that if yeast can't ferment glucose, it can't ferment any other sugar; it also supported that glucose is fermented if yeast can't ferment fructose.

The Effect of Copper Sulfate Concentration on the Duration of the Luminol Reaction

Hannah Morris
Yorktown High School

Luminol is a chemical which, when combined with an oxidizing substance in the presence of a catalyst, is reduced to another compound whose electrons are in an excited state. As the electrons return to ground state, they give off photons of "cool blue light." With the iron in hemoglobin acting as a catalyst, luminol is also the substance forensic scientists use to detect blood at the scene of a crime. When a mixture of luminol and hydrogen peroxide are sprayed on the scene in question, any blood present lights up. Research has shown there to be a direct relationship between the concentration of copper catalyst and the initial light *intensity* of the luminol reaction (Iwata, 1998). This project establishes what, if any, relationship there is between the copper catalyst (CuSO_4) and total *duration of light* in the luminol reaction. It is hypothesized that as the concentration of CuSO_4 increases, the duration of light in the luminol reaction will decrease. Varying amounts of CuSO_4 (5, 10, and 15 crystals) were added to known, fixed quantities of luminol and perborate (an oxidizer), and the reaction initiated with 10 ml of distilled water. The light duration was timed and pictures taken at regular intervals. Results demonstrated an average decrease in duration of light emission (163, 104, and 81.5 seconds) with increasing amounts of CuSO_4 (5, 10, and 15 crystals per cup, respectively). Analysis of data illustrates a near-inverse linear relationship between concentration of catalyst and duration of reaction, and the data were statistically significant at 0.01 for each level of the independent variable. Error occurred in quantifying the catalyst (CuSO_4 crystals were counted rather than weighed) and determining the reaction's completion (with the naked eye rather than digital technology). Standardization of luminol's light duration with a catalyst such as CuSO_4 may have implications for the detection and quantification of metal cations in nature.

The Effect of Time on Vitamin C Content
John Nguyen
Washington-Lee High School

Many prefer drinking fresh squeezed orange juice over store-bought juice. For those who like freshly squeezed orange juice, preparing a new batch to get the recommended 75-90 mg of vitamin C a day is a hassle. The objective of the experiment is to determine whether vitamin C decreases in orange juice overtime. Since vitamin C is oxidized efficiently, the hypothesis was stated that if orange juice is not consumed, then the amount of vitamin C will decrease overtime. To find the vitamin C quantity in orange juice, an iodine titration method was used. Ten trials each containing 20ml of orange juice were tested weekly. The juice was titrated until a prolonged color change occurred. This was done for two weeks. The results supported the hypothesis by showing that vitamin C in orange juice does decrease overtime. Using a two-sample t-test, the comparison between the first and second week displayed a p-value of 0.48, stating that at any reasonable significant level, the null hypothesis was not rejected. In all likelihood inaccuracy was due to human error. The most significant improvement in the experiment would be to extend the time frame for testing. The short period of time showed that vitamin C in orange juice decreases over time, but a longer testing period would make the data more significant and would present more of a change in the vitamin C content. The project showed that if the vitamin C content in orange juice is sought, then it should not be stored away.

The Effect of Types of Flue Gas Desulfurization Chemical on Sulfur Dioxide Output

Samuel Nowlin
Hanover High School

The purpose of this experiment was to determine which of the potential flue-gas desulfurization chemicals is more efficient. Having a more efficient flue-gas desulfurization chemical will reduce the amount of sulfur oxides in the Earth's atmosphere which will in turn reduce acid rain and other harmful events. The hypothesis was that if calcium carbonate was used, then sulfur dioxide output would be minimized. Sulfur dioxide of a known concentration was bubbled through each independent variable separately in impingers and the resulting gas was drawn through a sulfur dioxide analyzer to measure the sulfur dioxide in parts per million. The process was repeated fifteen times for every independent variable and after each trial of water, the water was tested for sulfuric acid using litmus paper.

It was found that the hypothesis was incorrect and magnesium hydroxide was a more efficient desulfurizer. This was because not only was magnesium bonding with sulfur dioxide in the reaction but the hydroxide molecules would also bond with sulfur to produce sulfuric acid. This means that two separate molecules bond with sulfur in the reaction with magnesium hydroxide whereas only the calcium from calcium carbonate would bond with sulfur, yielding an increase in efficiency from calcium carbonate to magnesium hydroxide.

repeated fifteen times for every independent variable and after each trial of water, the water was tested for sulfuric acid using litmus paper.

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Investigating the Effect of TiO_2 on Mold and Yeast Growth under Different Lights

Anh On
Mountain Vista Governor's School

Titanium dioxide is a photocatalytic nanomaterial capable of oxidizing most organic materials it comes into contact with by the production of hydroxyl radicals when exposed to ultraviolet rays. Although it is manufactured for use indoors as well as outdoors, no specifications have been made as to how long Titanium dioxide needs to be exposed and what light achieves the most desirable effects in order to oxidize mold and yeast growth. This investigation tested both of these parameters as well as compared mold growth with and without the nanomaterial. A total of forty plates were used during the experiment and produced a total of one hundred and sixty quantitative data points. This data was then analyzed through a three-way ANOVA test. The results showed that although there was a significance between coated and uncoated plates, between plates under fluorescent and incandescent light, between plates exposed for zero hours, two hours, and five hours, Titanium dioxide did not reduce the amount of mold growth compared to uncoated plates. Further investigation could go into how Zinc factored into catalyzing mold growth as the Titanium dioxide was used in a Zinc solution.

The Effect of Home Remedies for Chemical Burns on the pH of Toilet Bowl Cleaner

Elena Parcell
Washington-Lee High School

The purpose of this experiment was to determine which home remedies for chemical burns bring the pH of toilet bowl cleaner closest to the pH of skin. This was accomplished by using toilet bowl cleaner to represent an acid that could cause a chemical burn. The toilet bowl cleaner was then mixed with various home remedies for chemical burns and the pH of the mixture was measured to see which variable raised the pH the most. The four variables used were water, aloe, green tea, and milk. The hypothesis for the experiment was if the Lysol Power toilet bowl cleaner were exposed to different home remedies for burns, then tea would bring the pH of the mixture closest to the pH of skin because it had the highest pH to begin with.

After the experiment was conducted, the results were analyzed. First, the mean pH for each independent variable and toilet bowl cleaner mixture and then the results were graphed. Following this, an ANOVA was conducted, which yielded statistically significant results. A two-variable t-test was also conducted between each of the independent variables and the control.

These results did not support the hypothesis that tea would bring the pH of the mixture closest to the pH of skin. Instead, aloe raised the pH of the mixture the most. Although the original hypothesis for the experiment was not supported, the pH of the toilet bowl cleaner was brought closer to the pH of skin by all of the independent variables.

Chemistry C

First Place

Effect of Organic Salts on Hydrogels

(R)-N-alkyl-12-hydroxyoctadecyl-1-ammonium Salts as Gelators

Hyae Seo

Thomas Jefferson High School for Science and Technology

Molecular gels made with low molecular mass organic gelators (LMOG) have attracted much attraction due to their unique properties. The structures of LMOGs are very broad as they can include molecules such as *n*-alkanes, steroids, or salts. The purpose of this experiment was to explore how various ion concentrations of inorganic salts affect the gel melting temperature and the structure of the hydrogels. Inorganic salts that were used included KCl, KBr, NaBr, KNO₃. Gels were made using both fast-cooling and

slow-cooling protocols. The gel melting temperature was then determined using the falling drop method.

Gels had different appearances based on the concentrations of the inorganic salts. Although gels were made with LMOGs of different N-alkyl chain lengths, all gels exhibited similar patterns regarding their gel melting temperature values. The effects of cations as well as anions on the gel melting temperature were also studied in this experiment. This study revealed that the addition of inorganic salts affect the gel melting temperatures of hydrogels.

Second Place

The Effects of Alternating Magnetic Fields on Ferrofluids

Jacob Schuster

Mountain Vista Governor's School

This research tested the relationship between alternating magnetic fields and the temperature change in a volume of ferrofluids, for possible future use as a treatment for cancer. This was done by subjecting 30 milliliters of ferrofluids, which are liquid containing small particles of iron and thus react to magnetic fields, to several frequencies of alternating magnetic fields. The ferrofluids that were used were of the commercial variety, and were bought online. The alternating magnetic fields were created by a setup involving coiled wire around the ferrofluid. These experiments were modeled after other experiments performed by Rosensweig in 2002. These experiments showed very little change in the temperature of the ferrofluids. The t-test for significance yielded a t-value far too low for the change to be significant. Thus, it can be concluded that, with the setup used, the alternating magnetic fields had no significant effect on the temperature of the ferrofluids.

Third Place

The Effect of Varying Amounts of Magnesium Sulfate on the Catalysis of Yogurt Fermentation

Sneha Reddy

Godwin High School

The purpose of the experiment was to determine the effect of different amounts of magnesium sulfate on the catalysis of yogurt fermentation. Yogurt is a healthy pro-biotic food choice which aids in providing daily nutrients and vitamins. In the recent past the yogurt industry has been expanding rapidly and now plays a crucial role in our bio-economy. In order to understand the catalytic effect, heat treated milk was

subjected to 0gm, 2gm, 4gm, 6gm, 8gm, and 10gm of magnesium sulfate in addition to the starter culture. During fermentation, the rate of change of pH was investigated for each reaction product sample to determine the augmenting effect of magnesium sulfate. It is shown that the catalytic effect increases with the increasing amounts of magnesium sulfate. Statistical analysis was performed and t-test showed that 10 gm vs. the control was significant, while the 2gm vs. the control was non-significant. This result could further lead to an enhanced understanding of the metal centered catalysts which in turn could provide tailored catalysts for such processes.

Honorable Mention

The Effect of Air Flow on the Rate of Combustion

Patrick Rhoads
West Potomac High School

The purpose of this experiment was to determine the effect of various air flow velocities on the rate of combustion of birthday candles. It was found that higher velocities of air increased the mass loss rate of the candles. The mass loss rate of candles of the trials with forced air flow under positive pressure was double the rate of the trials with no forced air. When the fan sucked air away from the candles, combustion could not be sustained. This experiment investigated the reasons for why these events occurred.

Honorable Mention

The Effect of Luminol on Different Types of Substances

Belinda Vu
Washington-Lee High School

In a crime scene, the police would sometimes use luminol to find any potential blood to for DNA evidence at the scene. Luminol reacts to blood very easily by glowing when blood is presented but it can also react to other substances like bleach, iron, saliva, rust, animal proteins, vegetable enzymes, and other organic tissues. The objective of this experiment is to find out which common substances beside blood, and organic tissues can have the brightest and longest reaction with luminol. Also to see if luminol reacts different to different kinds of substance and chemicals beside the normal reaction it has with blood and other organic tissues. This experiment will be using Bleach, Horseradish juice, Copper sulfate, and Perborate Mixture since they are substance common to the average household and said to react to luminol. Perborate Mixture was the control in the experiment because it was substance that had similar properties as blood meaning and it's what the kit says works the best. The independent variable is the different type of

chemical or substance and the dependent variable is the brightness of the light which is measured by three levels; Bright, Dim, and No Reaction. Also the length of time (in seconds) of the reaction between the luminol and the substance being used is measured. With the help of the "Cool Blue Kit", the results were found. The results of the experiment showed that the control group (Perborate Mixture) had the best reaction with luminol, best as in it had the longest duration and brightest reaction with luminol. Although, Bleach and Copper sulfate had a reaction with luminol, the reaction was not as long and bright as Perborate Mixture. Horseradish juice did not have a reaction at all with luminol. The hypothesis cannot be supported since Bleach did not have the best reaction with luminol, therefore the hypothesis is rejected. In the experiment, the variables that were tested did show that different substance did have differ in brightness but mostly in duration of the reaction with luminol.

The Effect of Temperature on the Brightness of Luminol

Kelsey Warner
Deep Run High School

Investigators have used a chemical named luminol to determine the location of blood in a crime scene investigation. When luminol was used, many characteristics of area of the location, where the luminol was used, have triggered different reactions causing the accuracy of the outcome to be jeopardized.

The oxygen in the substance acted as the catalyst from the chemical reaction, therefore it triggered the luminol to give off a soft blue glow. Temperature has, in many recent studies, been one of the characteristics that changed the outcome of the reaction. The purpose of this experiment was to determine which extremity of temperature would trigger more luminosity from the luminol when added to an oxidized substance, such as blood. Ten containers were used for each level of independent variable, temperature. Temperatures used were 72°F, 40°F, 80°F, 100°F, and 212°F, 72°F acted as the control group. The glow was measured on a scale of one to ten and then the ten repeated trials were averaged together. The results indicated that the warmer the temperature was, the brighter the glow of the chemiluminescent reaction would be, and the colder the temperature was, the less noticeable the brightness of the glow became. A t-test was performed on the data, showing a substantial difference between the averages of the independent variable groups ($t = 0.632 > 2.101$; $t = 0.872 > 2.101$; $t = 0.917 > 2.101$, $t = 1.034 > 2.101$, $t = 0.949 > 2.101$ at $\alpha = 0.05$ and $df = 18$). The research hypothesis was supported by the data that if the temperature is increased, then the mean brightness will increase.

Based on the average number, on the brightness scale, the data showed a direct influence and connection between temperature and the levels of brightness that were emitted from the luminol. Temperature has been proven through this experiment to have an influential effect on the outcome of the chemical reaction of luminol and the oxidized substance which sets off the reaction.

Also selected for presentation:

Comparison of the Amount of Free Chlorine, Total Chlorine, Total Hardness, Total Alkalinity and pH of Well Water and Treated Water

Andrew Peters
Mountain Vista Governor's School

The purpose of this experiment was to empirically test which type of water was cleaner, well water, or treated water. Well water services fifteen percent of the United States' population, making this research relevant. Samples were collected from twenty homes, ten for both well and treated water. Water was collected at each sample location from an outside tap, and a test strip was used for data collection. The strip tested for free and total chlorine, total hardness, total alkalinity, and pH. After the data was collected, a t-test was applied to the values. The null hypotheses are that the pH of tap water will be equal to the pH of well water, and the alternate hypothesis is that the pH of tap water will not be equal to the pH of well water. The next null hypothesis is that the hardness of tap water will be equal to the amount of hardness well water, and the alternate hypothesis is that hardness of tap water will be less than the hardness of well water. Another null hypothesis is that alkalinity of tap water will be equal to the alkalinity of well water, and the alternate is that the alkalinity of tap water will be less than the alkalinity of well water. Lastly, the null hypothesis is that the amount of total chlorine in tap water will be equal to the amount of total chlorine in well water, and the alternate is that the amount of total chlorine in tap water will be greater than the amount of total chlorine in well water. Well water was found to have lower values for free and total chlorine, and treated water had lower values for alkalinity and hardness. The average pH of well water was found to be closer to the ideal pH of 7.0 than the average pH of treated water. A test for chloroform bacteria was also applied to a sample from each source, both showing an absence of the bacteria. In future research, more accurate testing materials could be used in data collection, as well as further research on the source water of each type of sample.

The Effects of Different Types of Fuel on the Fuel Efficiency of a Car

David Peyman
Godwin High School

The purpose of this experiment was to find the effects of different variations of fuel on the fuel efficiency of a car. Diesel has been used mostly by trucks and other heavy vehicles that require fuel that's both durable and powerful. Recent innovations in biofuel, namely biodiesel, have driven the need for an ecological-friendly fuel source. A car that is capable of running on diesel, biodiesel, and vegetable oil was assessed on the number of kilometers it's able to go using 250mL of diesel, biodiesel, and vegetable oil. The control that was used in the experiment was diesel due to the fact that it's the

conventional fuel provided by fueling stations. It was hypothesized that the biodiesel group would have the highest distance to amount of fuel ratio while the vegetable oil group would have the lowest distance to amount of fuel ratio. The results revealed that the diesel group, on average, was 7.1% more efficient than biodiesel and was 8.8% more efficient than vegetable oil. Because of this, the results did not support the research hypothesis. It is believed that the results are due to the fact that diesel contains a higher percentage of carbons within its chemical composition than biodiesel and vegetable oil, resulting in more energy. This research could lead further studies that investigate the differences of the different percent-compositions of biodiesel and other fuel sources, including conventional gasoline and its variations.

The Effect Oil Has on the Egg Yolk While Placed around the Shell

Jessica Ratcliff
Southwest Virginia Governor's School

Eggs are an important food that provides many vitamins to people. Eggs alone provide all the necessary amino acids that humans need in their diet (Ryu, 2011). When people buy eggs, it is common that they have to throw some away because the eggs have spoiled. Since eggs are so important, you want them to last as long as possible. Coating the eggs in oil might help preserve the eggs from spoiling so fast. Forty-two eggs were randomly picked from three cartons of Sunny Meadow eggs and put into seven groups of six. The first group was the cracking group to establish an initial measurement. These eggs were cracked and their yolks were measured with a caliper to calculate the mean. Next, the rest of the eggs were massed with a scale. For each group, the mean of the egg masses were calculated. Each group was coated in their assigned oil, and the control group was left alone. The oils were canola, corn, sunflower, olive, and peanut. Once a week, the eggs were massed again and recoated. On the fourth week after massing the eggs, all the eggs were cracked, and their heights and widths were measured. The control group's mass dropped approximately one gram each week. Within one week, the olive oils mass dropped two grams but then stayed the same for the rest of the time. All of the other groups stayed within one gram of their beginning mass. The widths of all of the eggs were wider than the beginning widths, and all of the heights were shorter. The control group's yolk flattened and spread out the most. The peanut oil group had the smallest yolk at 41.66 mm, but the corn oil group had the tallest yolk at 12.05 mm. The results suggest that the oil kept the eggs from losing mass. There was a direct correlation between the elapsed time and the weight decrease in the control group. The results showed that the oil and the control group's differences were significant. The oil didn't prevent the yolk from flattening and spreading out, but the oil groups didn't have as big of a difference in their yolk compared to the control group.

Luminol: Giving a New Light to Criminalistics

Katelyn Rowland

Washington Lee High School

Luminol is a chemical discovered accidentally by a German chemist in 1928. Nine years later luminol made its true debut at a crime scene in Germany. This chemiluminescent compound reacts to the iron in red blood cells and changed the face of criminalistics and forensics forever. This experiment was to study the effects of three water temperatures on the brightness of luminol. Chemical kinetics state that hotter chemical reactions will generally occur quicker due to the collision theory. Collision theory states that the more collisions in a reaction, the more combinations of molecules will occur, and therefore the faster the reaction. Therefore, it was hypothesized that if water is heated up or chilled prior to mixing luminol, then the luminol reaction would be brighter or dimmer, respectively, because of chemical kinetics and rates of reaction. Throughout the experiment, luminol ingredients, room temperature, method of measurement, and procedure were kept constant. The independent variable to be changed throughout the experiment was the temperature of the water used to make luminol, and the brightness of the luminol was measured as the dependent variable. When this experiment was conducted, the luminol produced light meter readings of -1.7 and -2.0, the -1.7 luminol (room temperature and hot water) was brighter than the -2.0 cold water luminol. Therefore, the hot water and room temperature water were brighter reactions. However, it must also be taken into account that the hot water quickly lost its brightness as it used up the catalyst.

The Effect of Beeswax and Honey on How Well Lip Gloss Stays on Lips

Heidi Schmidt and Michelle Vu
Washington Lee High School

The purpose of this experiment was to find out if beeswax or honey had an effect on how well lip gloss stays on lips. If more beeswax is added into the lip gloss recipe than a stamp with the lip gloss on it will be able to make more prints on a piece of paper because it is an emulsifier which keeps lip gloss ingredients bonded together. If more honey is added into the lip gloss recipe than the lip gloss will make less prints because the stickiness of the honey will pull the lip gloss onto the surface it is touching. To test those hypothesizes, one recipe to make lip gloss was made 6 times and the amount of honey or beeswax was changed each time. The independent variable levels were 1/4 oz., 1/2 oz., and 3/4 oz. of beeswax and 1 tsp., 2 tsp., and 3 tsp. of honey. To measure how well lip gloss would stay on lips, an independent variable would be measured out to 1/2 cm of a straw piece and stamped on a piece of paper using a 5-pound book to insure the same amount of pressure is being added. The stamp would keep being stamped down until the lip gloss color could no longer be seen. That would count as

one trial. The mean for the independent levels were 5.0 for 1/4 oz. of beeswax, 4.0 for 1/2 oz. beeswax, 3.2 3/4 oz. of beeswax, 5.0 for 1 tsp. of honey, 2.8 for 2 tsp. of honey, and 2.6 for 3 tsp. of honey. The ANOVA p-value for beeswax was 4.02×10^{-14} and the p-value for honey was 2.14×10^{-22} . It was concluded that there was a significant difference between the data and the null hypothesis can be rejected.

The Effectiveness of Different Antacid Brands

Illana Shapiro
Washington Lee High School

The objective of this experiment was to find the most effective brand-name and type of antacid. It was hypothesized that the two liquid antacids, Pepto-Bismol and Milk of Magnesia, would be the most effective and absorb the most acid because research told that liquid antacids are believed to work much more effectively than tablets. The independent variable was the brand and type of antacid; the dependent variable was the amount of acid each brand of antacid could absorb before reaching a pH of 7.0. To test the hypothesis, 0.01 hydrochloric acid was diluted with water and added slowly to solutions of each antacid until the pH reached 7.0. The amount of HCL solution, in mL, needed to neutralize the antacid showed which antacid was most effective. The results of this experiment were as follows: the mean volume of HCL solution to neutralize the control group, plain water, was 0.7 mL. For the Tums, it was 1.1 mL. For the Alka-Seltzer, the mean volume was 0.0. The Milk of Magnesia had a mean volume of 8.8 mL. The Pepto-Bismol had a mean volume of 0.6 mL. It was concluded that the Milk of Magnesia was most effective at neutralizing antacids, and Alka-Seltzer was least effective.

The Effect of Amount of Baking Powder on Muffin Height

Natasha Smook
Deep Run High School

The purpose of the experiment was to test the effect of the amount of baking powder on muffin height. It was hypothesized that if the amount of baking powder is increased, then the muffin height will increase; while the null hypothesis was that the amount of baking powder has no effect on the muffin height. Group A received zero teaspoons, group B received one teaspoon, group C received two teaspoons, and group D received three teaspoons of baking powder were given. Group A was the control. Batches with lower amounts of baking powder ended up having lower heights than batches with higher amounts of baking powder. The null hypothesis was rejected in all comparisons ($p < 0.05$). The data, therefore, showed the hypothesis to be correct. These results were

important, because the knowledge of how baking powder and muffin height were related could increase the amount and quality of muffins within each batch.

Best Temperature Condition for Growing the Purest and Largest Crystals

Enkhjin Tuvshinzaya

Washington Lee High School

The purpose of the experiment is to find out which is the best temperature condition for growing the purest and largest crystal. The hypothesis of the experiment was that if the temperatures of the cooling conditions are changed, then the room temperature will create the largest and purest crystals because the quick cooling of the solution can trap impurities disturbing the pattern of the crystal and the most amount of time required makes more large crystals. In the experiment, the crystals grown in each independent variable; room temperature, refrigerator, and the ice bath, were weighed on a quad beam in grams to find out which one would weigh the least resulting it to be the purest crystal. It showed the crystal produced in the room temperature weight the least with an average of 5.3 g and range of 1.5 g. The crystal formed in the refrigerator weight an average of 6.03 g with a range of 0.8 g. The crystal formed in the ice bath weighed the most with an average of 6.87 g and a range of 0.5 g. It was discovered that the control, which is the room temperature weighed the least with an average of 5.3 g making it the purest crystal formed. The results did support the hypothesis which was if the temperatures of the cooling conditions are changed, then the room temperature will create the largest and purest crystal. The results matched the scientific principles. The rate in which the crystals form due to temperature change, affect the crystal to be either pure or impure. If the crystal is pure, the crystal size would be larger but weigh less than an impure crystal. Small crystals, which are impure crystals, have a large surface area to volume ratio. Therefore the impure crystals will be heavier due to the fact that it is denser given the information that the same mass of pure crystal as impure crystal has a larger volume. There could have been random errors at some point. By doing the experiment very carefully and paying close attention to every factor of the experiment would prevent these errors.

Qualitative Detection of Iron in Breakfast Cereals

Sushrruti Varatharaj

Henrico High School

Iron deficiency anemia is a common type of illness that is found in 15 percent of the human population, it is cured by eating iron rich foods. More than one milligram of iron should consumed every day, so one does not get iron deficiency anemia. Cereal is a popular food in the society because it can be eaten at any time with or without milk.

Keeping that in mind the major goal of this experiment was to test three different types of cereals to whether it's unhealthy or healthy. The amount of iron present in each cereal will define which cereal is healthy or unhealthy. Tests were conducted using the colorimeter method in John Tyler Community College. The tests were conducted using three different cereal ashes which resulted from a process in which they were burned. Each cereal was tested for iron concentration using Potassium ferrocyanide which produced blue color in the presence of iron. The color change in each sample was observed in a filter paper which also contained a sample of reaction when Potassium ferrocyanide combined with iron III chloride. The reaction that happened when potassium ferrocyanide combined with iron III chloride was a standard of comparison. The result was very surprising since oatmeal, which is thought to be a healthy cereal which contains a lot of fiber showed very few rays of blue. While the cereal that was considered most unhealthy, cocoa puffs or cocoa puffs, produced a lot of blue rays. Cheerios which was neither healthy nor unhealthy displayed a few rays of blue. When the nutrition facts were reviewed, it was found that the nutrition facts for cheerios were not in agreement with the research data collected.

Analysis of Molecules Found in the Interstellar Medium Near IRC 10216

Sean Warner

Central Virginia Governor's School for Science and Technology

The purpose of this experiment was to catalogue a list of molecules found near IRC 10216, a star that is in its final stages on the Asymptotic Giant Branch, a period of stellar evolution undertaken by low mass stars late in their lives, and to determine if commonly identified molecules are present in the gasses surrounding IRC 10216. The radio spectroscopy used in this study as the data found in the range of 130 to 170 GHz. This data was collected from the Arizona Radio Observatory 12-meter telescope. This data was analyzed on the Spectral Line Search Engine (SLISE), which is a database of radio spectroscopy from different radio wave sources. The data was used to determine the strongest emission lines above a minimum intensity of 0.05 K. Once the strongest emission lines were determined, Splatalogue, a spectral line database, was used to determine the possible molecule responsible for the emission line. A full catalogue was created of the molecules identified near IRC 10216. Two previously unobserved frequencies were measured for the C₄H molecule. The second part of the experiment was to determine if a group of fourteen well known to exist in molecular clouds could be identified near IRC 10216. The known frequencies of the molecules were observed, and it was determined that of the fourteen molecules, only seven could be identified.

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Ecology & Earth Science

First Place:

Is Greywater "Green"? The Relationship between Greywater Application and Earthworm Food Supply

Valentina Lohr
Williamsburg Middle School

Lawn irrigation with untreated greywater is considered environmentally sound, but research on short-term effects has suggested otherwise. Triclosan, a bactericide, is common in soaps and detergents found in household greywater. Changes in earthworm biomass in a previous experiment suggested that triclosan reduced the earthworms' food supply of bacteria and fungi. The hypothesis in the current experiment was that greywater application would result in significantly lower earthworm biomass gain and reduced food supply, measured as the number of cultured soil microorganism colonies. Three water treatments - greywater (0.5% solution of Dawn antibacterial dishwashing liquid in tap water), creek water (Donaldson Run, Arlington, VA), and tap water - were tested in three replications in pots simulating lawn conditions. Soil pH was measured at baseline and every three days for the 25-day period. At the beginning and end of the treatment period, earthworms were weighed, and microorganism colonies were counted using a grid square to sample Petri dishes containing cultured soil microbes. Analysis of Variance (ANOVA) and t-tests were conducted to test statistical differences across treatments. The worms in pots treated with greywater gained significantly less weight than worms in pots treated with creek water or tap water. The number of microbial colonies from pots treated with greywater declined, while the creek water produced statistically larger gains in number of microbial colonies. Recycling household greywater could actually end up doing more harm than good, since it destroys earthworm food supply and interferes with earthworm growth.

Second Place

Jumbo Jellies

Mohammed Eltaeb
Swanson Middle School

The purpose of the experiment was to find the effect of calcium concentrate on the mass of moon ephyra. The hypothesis was that if there was an increase in calcium then the mass would increase. To test the hypothesis the procedures were to find the mass of the moon ephyra with different amounts of calcium concentrate water in jars over eight days. The IVs were the normal amount of calcium in the ocean of 413 ppm, 10 percent of the calcium added to the control of 454 ppm, and 20 percent of the calcium added to the control of 496 ppm. In the end the hypothesis was supported.

Third Place

The Effect of Various Additives on Amount of Force Transferred

Abhishek Penumala
George H Moody Middle School

Earthquakes, the word alone provokes fear and panic to even the strongest of souls. A very sudden release of energy in the Earth's crust creates deadly lethal seismic waves which immediately lead to earthquakes. Earthquakes can also trigger landslides and occasionally volcanic activity. Earthquakes can cause soil liquefaction which is a phenomenon where saturated [soil](#) loses [strength](#) and [stiffness](#) in response to an applied [stress](#), usually [earthquake](#) shaking. Many scientists and engineers have been doing tons of research between soil liquefaction and adding additives to the soil to lessen the effect. The greatest earthquake ever witnessed was **Valdivia, Chile Earthquake in May 22, 1960 with a magnitude of 9.5** and killed 1,655 people, injured 3,000 and \$550 million in damage. The purpose of the experimentation/investigation was to determine if various additives Hydrated Lime, Hygrozeme, Humic and Fulvic acids, and Worm Castings would affect the amount of force transferred leading to soil liquefaction. A shake table was used to test the different additives. On the shake table, a PVC pipe was placed filled with soil and the various additives where 20 trials took place for each additive. The results indicated that the additive Hygrozme caused for the least amount of force transferred with a mean of 45N and with the additive Worm Castings allowed for the most force transferred of 118N. The data supported the researcher's hypothesis that if Hygrozeme, Hydrated Lime, Humic and Fulvic Acids, and Worm Castings were used then Hygrozeme will allow for the least amount of force transferred. Hygrozeme allowed for least amount of force transferred since it actually catalyze processes and reactions by lowering the [activation energy](#) ($E_a^\ddagger$) for a reaction, increasing the rate of the reactions/processes making the soil stronger. With this experiment and future research, we can predict earthquakes and rescue innocent people. One day that fear and panic of a tsunami will be annihilated from the hearts of humans forever.

Honorable Mention

What Is the Effect of the Type of Marine Plant on its Ability to Survive an Oil Spill?

Sophia Hays
Thomas Jefferson Middle School

Oil spills can have a deadly effect on marine habitats and animals around the world. However, what if it was possible to make habitats healthier with plants that have a better

durability against oil? Could this help habitats have a better chance of surviving in the face of an oil spill? The purpose of this experiment was to test the effect of the type of marine plant on its ability to survive an oil spill. To perform this experiment, the health of plants was taken before they were subjected to oil, and then after the oil had sat in the plants for 11 days, the health was taken again. The before and after was then compared to see which plant's health had changed the most, therefore becoming the unhealthiest after oil had been added. The results showed that the shaving brush plant had become the least healthy after the oil, while the green algae plant showed that it was the healthiest after oil, although the health of that plant also declined. The results indicate that there are plants that remain healthier during an oil spill than others. This means that plants could be used in habitats to improve their durability against oil. Hopefully this would cause oil to have a less dramatic effect on habitats, which means less environmental harm.

Honorable Mention

The Effect of Bottom Topography on the Height of Storm Surge

Sreekar Kandlakunta

George H Moody Middle School

In the summer of 2011, chills jolted down the spines of the residents of the east coast because Hurricane Irene was arriving. In New York City, residents were scared that the storm surge caused by Hurricane Irene would damage the city, and evacuation of some parts of the city had already commenced.

According to the National Oceanic and Atmospheric Administration, storm surge is the leading cause of property damage during hurricanes, and any way to lessen the damage would be helpful to victims of hurricanes. The purpose was to determine the effect of bottom topography on the height of storm surge. It was hypothesized that if a constant and gentle slope, steep and constant slope, irregular slope, gentle slope with elevated areas, and a steep slope with elevated areas are used, then steep and constant slope will result in the highest height of storm surge. Clay was used to simulate the various topographies and a leaf blower was used to simulate hurricane winds.

For the gentle and constant slope, the mean storm surge height was 27.8 cm. The gentle slope with elevated areas the mean storm surge height of 21.35 cm. Steep and constant slope had a mean storm surge height of 24.95 cm, while the steep slope with elevated areas had a mean storm surge height of 21 centimeters. Lastly, the irregular slope had a mean storm surge height of 17.25 cm. In this experiment group A had the highest storm surge height while group E had the lowest height. The hypothesis was supported by the results, and the results were supported by the research gathered. Gentle slopes have higher storm surges because the water is shallower and there is more time to amplify (Emanuel, 2005). The elevated areas lowered storm surge because they served as obstructions (Moran, 2011). The irregular slope had the lowest storm surge because they prevented the waves from amplifying (Emanuel, 2005).

Honorable Mention

The Effect of Runoff from Different Types of Mulch on *Lactuca sativa*

Katie Murphy
Short Pump Middle School

Abstract

Mulch is used to reduce moisture loss and reduce weed growth. Mulches can be organic, such as hardwood or natural red mulch, which is recycled waste wood. Mulches can also be inorganic, such as recycled rubber tires. The purpose of this experiment was to understand the impact of runoff from different types of mulch on plants in Virginia. The hypothesis was that if water treated with different types of mulch was added to *Lactuca sativa*, then the seeds exposed to the water from the recycled rubber mulch would have the lowest germination and shortest root length due to zinc runoff from the rubber. The independent variable was the type of mulch. The levels of the independent variable were: None, Natural brown, Natural red, Natural cypress, Rubber brown and Rubber red. The dependent variables were the number of lettuce seeds germinated and root length. There were 14 trials at each level of the independent variable.

The mulch solutions had a negative effect on lettuce seed germination and root length. The number of seeds germinated was highest for the control (mean 9.9), second highest for natural red mulch (mean 9.3) and lowest for the natural brown (mean 4.1). The radicle root length was greatest for natural red mulch (mean 2.5 cm) and shortest for the natural brown mulch (mean 0.8 cm). These results did not support the hypothesis. The natural brown mulch had both the lowest germination and the shortest root length. This is likely due to the low pH of the natural brown mulch solution. The recycled rubber mulches had shorter root lengths. Overall, the natural red mulch appeared to be the most environmentally friendly mulch, since it produced high germination and long roots, and because it used waste wood that would otherwise go to landfills.

Also selected for presentation

Effect of Different Temperatures on the Amount of Dissolved Oxygen

Zoe Edwards
Thomas Jefferson Middle School

This experiment was designed to determine the effect of different temperatures on the amount of dissolved oxygen in water. The hypothesis was if the two test tablets are placed in the warmest water (48.8°C), then there will be less dissolved oxygen than in

the colder water. To perform this experiment, LaMotte dissolved oxygen test tablets were placed in 5 test tubes of water at different temperatures. Each temperature was tested 5 times. The water was heated to a specific temperature, and the tablets were then placed into the water. The water was stirred and then left to sit for 5 minutes before measuring the results. The color chart was then used to determine the amount of dissolved oxygen in the water.

The results of this experiment showed that the higher the water temperature the less dissolved oxygen was found in the water. The highest water temperature, 48.8°C, had a dissolved oxygen level of 0.3 ppm. The coldest water temperature, 4.4°C, had a dissolved oxygen level of 2.3 ppm. The hypothesis was accepted, cold water held more dissolved oxygen.

The Effect of Types of Lawn Cover on the Volume of Runoff

Lock George
Kenmore Middle School

Erosion is the term for the surface of the earth slowly wearing away. Runoff water and erosion are environmental issues. The purpose of the experiment was to find out which types of lawn cover are the most effective at preventing erosion and runoff. The hypothesis was that topsoil with grass would retain the most water because the root system helped to hold the soil together better. Water was poured onto five different lawn cover samples. The runoff water was collected, and the volume was measured after one minute. Topsoil with grass was the most effective at preventing runoff water. The hypothesis was accepted.

Emission Superstition: Is Going through the Drive-thru Healthier for the Environment

Juliana Gruver
Williamsburg Middle School

To determine the impact on the environment of using the drive-thru versus “parking and going in.” The hypothesis is that using a drive-thru is worse for the environment because idling of the car results in more environmentally harmful emissions and creates more noise than stopping and re-starting the engine.

The two speed idle test (TSI), a tailpipe emissions test, was used to determine emissions. The TSI measures hydrocarbons(HC), carbon monoxide(CO), and nitric oxide(NO), the most common factors that make lung-damaging ground-level ozone. A decibel meter measured noise emission. Testing for the drive-thru was simulated using the duration of time in a drive-thru determined by timing cars as they enter and exit. Statistical analysis: one-way ANOVA and the paired-two group Wilcoxon Signed Rank test, $P < 0.05$ denoted statistical significance.

Of 297 cars timed, on average, cars that used the drive-thru were quicker than parking and going in by 4min 3sec. TSI was measured in eight cars, average values were CO 0.12%; HC 77.63ppm; NO 6ppm. HC emissions were significantly higher for those cars idling (average: 21579.8 ppm) than those at start-up (77.6 ppm, $P=0.02$). Decibel readings were taken on 25 cars. On average, idling was louder than starting up a car by 2.8 decibels (78.6 versus 75.8dB, $P=0.03$) and the duration of the noise was longer.

There is less noise and environmental emissions if cars park and go into a fast-food restaurant than going through the drive thru. It is better for the environment not to use the drive thru.

The Effect of Recycled Rainwater on the Growth of Garden Bean Plants

Kathryn Hardin
George H Moody Middle School

Abstract

Garden bean plants are commonly used in science projects because they grow in a short period of time. This characteristic enables research to be completed, and growth results obtained fairly quickly. Generally, rainwater is available and easily collected.

The purpose was to determine if using recycled rainwater would have an impact or affect the growth of plants. Recycled rainwater has the potential to be used in third world countries as an alternative to using well water or purified water, both limited resources, to provide water to grow vegetation and plants to feed their population. If recycled rainwater is used, then the garden bean plants will grow equal to garden bean plants where fresh rainwater is used.

The experimenter placed each of the pots, with seeds inside, in the windowsill which received full sunlight. Each garden bean plant was watered using a pre-measured cup, watering each pot with 2 ounces of water. The experimenter measured the garden bean plants, using a meter stick, from the base of the plant to the top of the tallest leaf, making sure that the measurements were taken in centimeters.

The average growth (mean) in this experiment was almost identical; surprisingly, the middle of the distribution (median) was higher with recycled rainwater than with rainwater. The hypothesis was supported in this experiment because the plants tested with recycled rainwater grew equal to the garden bean plants tested with rainwater. It is the experimenter's belief that the garden bean plants using recycled rainwater grew the same or more than those using rainwater because the recycled rainwater may have collected additional nutrients from the soil of the growing green bean plants as the water passed through to be used to water the recycled rainwater group of garden bean plants.

The Effect of Different Bioremediation Methods on the Breakdown of Gasoline

David Lu
George H Moody Middle School

For many years, bioremediation has been used to help clean up hazardous chemicals in contaminated soil or groundwater. Today, there are many different forms of bioremediation including Mycoremediation, Phytoremediation, and Microbial Bioremediation. The purpose of this project was to determine the best bioremediation method to breakdown gasoline. Based on the theories that Microbial Bioremediation is the best bioremediation method, it is hypothesized that if Microbial Bioremediation, Mycoremediation, Phytoremediation, and Plain Soil are used, then Microbial Bioremediation will break down the most amount of gasoline. For testing, each group of five pots had a different bioremediation method. Ten ounces of gasoline was poured into each pot and each pot was measured on a scale in ounces. All of the pots were left outside for six days. After the six days the pots were measured on the scale again in ounces. The weight after the six days with gasoline was subtracted from the weight before the six days to find the amount of gasoline broken down. After testing, Microbial Bioremediation broke down the most gasoline with a mean of 9.84 ounces of gasoline broken down. Plain Soil, the control, broke down the least gasoline with a mean of 2.86 ounces of gasoline broken down. Since the mean amount of gasoline broken down by Microbial Bioremediation is significantly higher than the other bioremediation methods, the hypothesis is supported. However, before it can be concluded that Microbial Bioremediation is broke down the most gasoline, another experiment should be conducted with the use of Parts Per Million, instead of weight, to measure the amount of gasoline broken down for more accurate results.

The Effect of Size of Sunspots on their Lifespan

Sydney Mabry

George H Moody Middle School

Before sunspots were ever recorded, over 400 years ago, people thought the sun was perfect and could not have any imperfections. However, our sun does have cool, dark spots on it which result from magnetic forces. The purpose of this experiment was to determine if size affected the lifespan of sunspots. The test was to see if large sunspots lasted longer than medium or small sized sunspots. The sun was safely viewed every day to see how long sunspots lasted. Each sunspot was recorded to see if any shrunk, vanished, grew, or formed that day. An approximation was made each time a sunspot grew or disappeared on the other side of the sun. Ten sunspots were recorded for each different size category. Results showed that large sunspots lasted on average about 22.2 days longer than medium, medium lasted 14.7 days longer than small, and large sunspots lasted 36.9 days longer than small. The hypothesis was supported in that large sunspots lasted longer in days than medium, and medium sunspots lasted longer than small. A formula is presented that relates sunspot size to lifespan for this study. A recommendation for improving would be using more accurate measures for size, rather than using the earth's diameter.

The Effect of Grey Water Source on the Growth of Pothos Plants (*Epipremnum aureum*)

Phebe Martin
George H Moody Middle School
Abstract

Fresh water is limited or unavailable in many parts of the world. Because of this, scientists are seeking out other sources for watering common house plants. Gray water is reclaimed or used water. It is used for a wide variety of tasks. Some places to find gray water, or sources of it are, bath water, dish water, and laundering water. Gray water can only be used for non-edible plants because the harsh chemicals found in some of the substances that are mixed into the water could not only injure the plants, affecting the taste or size of the plant; but also, could be harmful to the humans or other animals consuming the plants.

The purpose of this experiment was to determine the effect of gray water source on the growth of Pothos plants (*Epipremnum aureum*). Or in simpler terms, the purpose was to find which source of gray water is best for watering plants and to find if gray water could even be used at all for watering plants. The Pothos plants were watered and measured over a course of three weeks with different sources of gray water; bath water, dish water, laundering water, and tap water (control). Each was tested for its growth height (in cm). The results indicated that the group watered with tap water, the control, grew the most with a mean of 2.5 centimeters and the group receiving dish water grew the least with a mean of 1.6 centimeters. The data supported the research hypothesis that if reclaimed bathing water, dish water, laundering water, and tap water are used, then the group receiving tap water will have the greatest change in height (in cm).

Based on the growth height (in cm) determined in this research, there appears to be a direct correlation between the source of gray water to the growth of the Pothos plants. Before it can be concluded that tap water is the only source of water capable to water house plants however, a survey will need to be done to determine the other substantial sources of gray water.

The Effect of Type of Surfactant on the Amount of Oil Removed from Feathers

David Qin
George H Moody Middle School

The explosion of Deepwater Horizon that occurred in 2010 created the largest marine oil spill in history. Over ten people died in the explosion, but even more disastrous was the amount of wildlife affected. Millions of various animals, especially birds, experienced effects of the oil in their habitat. Birds died the most as a result of the spill because oil got in their feathers, disabling them from flying while also poisoning them. Therefore, the purpose of this experiment was to determine which surfactant mixed with water would clean the most oil from an oil-covered feather.

In this experiment, the independent variable was the type surfactants used to clean oiled feathers. They were Dawn detergent, liquid soap, and Head & Shoulders shampoo, with the control being plain water. Four large groups of feathers were created (one for each level of the independent variable with the control included) as well as four small groups (ten feathers per small group, with each small group being a trial) and each feather was soaked in oil. Each small group was then cleaned of oil with its designated surfactant or control and the amount of oil removed was measured in grams. The results indicated that the Dawn dish detergent was the most effective in removing oil from feathers with the average amount of oil removed being 9 grams per small group, while the plain water was the least effective, removing an average of only 6 grams of oil per small group. The data supported the hypothesis that if plain water, Head & Shoulders shampoo and water, liquid hand soap and water, and Dawn dish detergent and water were used to clean a group of oil soaked feathers, then the group that received treatment with the Dawn dish detergent and water will have the most oil removed from it.

Based on the results of this experiment, it can be concluded that the surfactants in Dawn greatly increase the amount of oil removed from feathers because of the surfactants' properties.

The Effect of Geotextiles and Other Techniques on the Amount of Runoff Produced by a Rainstorm

Lynette Sequeira
George H Moody Middle School

Storm water runoff can take place when any form of precipitation flows over ground. As the water flows, it picks up debris, chemicals, and dirt, as well as useful soil nutrients. This mixture would then either flow into a storm sewer or into a body of water. Storm sewage systems are released into water bodies that we use for swimming, fishing, and even drinking water. The sediments cause the water's turbidity to rise significantly; nutrients cause overgrowth of algae and dead zones, bacteria washed into swimming areas are a hazard, debris can choke aquatic life, and household chemical waste can cause both humans and animals to become sick from eating contaminated fish (USEPA, 2003). The purpose of this experiment was to test the effect of different techniques on the amount of runoff produced by a rainstorm. The hypothesis for this experiment was that if geotextiles were used, then the amount of runoff would decrease.

Four potting dishes that were exactly the same size (nineteen centimeters by nineteen centimeters by twenty centimeters), color, and shape were put in a constant environment. In each of these containers, grass was grown, pebbles were distributed, geotextiles was placed, or plain soil (no intervention) was placed above the base soil to an equal height. The containers were then given 300 milliliters of water and the runoff was measured and recorded in milliliters. The results indicated that the pots with the geotextiles had the least runoff with a mean of 29.3 milliliters, and the pots with the pebbles had the most runoff with a mean of 88.5 milliliters. The data supported the research hypothesis that if geotextiles were used, then the amount of runoff would

decrease. Based on these results, there appears to be a direct correlation between the amount of runoff produced and the technique used to prevent it. Further improvement to this experiment could be measuring turbidity of the runoff as well as the actual amount of sediment in the runoff in grams and comparing different varieties of geotextiles.

The Effect of Solar Radiation on Wind Speed

Oliver Shen
Manchester Middle School

The objectives of this research were to discover the effects of solar radiation, and solar flares, upon common meteorological effects, with wind speed representing them. This in turn would lead the world to be more prepared for the incoming Solar Maximum that happens around every eleven or so years. To conduct this experiment, a pyranometer was used to measure the strength of occurring solar flares, and an anemometer was used to measure the wind speed. However, the results of this experiment were unclear, as there seemed to be no direct or indirect correlation, and so, in conclusion, the results show no correlation between wind speed and the strength of solar radiation and flares.

The Effect of Soil Differentiation on Soil Capillary

Molly Strauchler
George H Moody Middle School

Abstract

Capillarity is a phenomenon of nature by which water rises in a cylindrical column. The narrower the column the higher the capillarity; similarly, the denser the substratum present in the column, the higher the capillary effect. Capillary action is the outcome of water adhesive and cohesion. Water adhesive is the way that water is attracted to solid surfaces, and cohesion is the way water molecules are attracted to other water molecules. Since water moves faster through soils with large sized pores, sand easily sucked up water through the tube. As the result of capillarity, a [concave meniscus](#) formed where the liquid touches the soil.

In this experiment the purpose was to determine the capillarity of the different soils; silica sand, natural silt, natural gray clay, and natural pea gravel. The hypothesis of this experiment was that silica sand would have the greatest capillarity. To find out whether this hypothesis would be supported the experimenter placed silica sand, natural silt, natural gray clay, and natural pea gravel in their own plastic tubes and placed them in a beaker of room temperature water. After surveying each tube for three hours to see in which tube the water would rise the highest, results were recorded. Silica sand had the highest capillarity and clay had the lowest.

The findings agree with the capillary conductivity rule that soils with larger pores, like sand, attract water faster than soils with smaller pores, like clay, which attract water

more slowly. If the soils had been left to soak for longer than three hours then the clay would have had a higher capillarity, because it has small pores. Soils with small pores, if left to soak for days, are able to keep pushing the water higher and higher, because of how close the particles are. Sand like soils would have eventually been spread too far apart by the moving water, and the water would have sunk back down into the bottom.

The Effect of Elevation on the Level of Particulate Deposition

Sasha Volodin
Williamsburg Middle School

The purpose for this experiment was to test how elevation above floor level affects the deposition of particulate matter (PM) on neutral agar plates. Depending on the results of the experiment, it might be determined at which elevation range filtration and/or disinfection should be targeted. Also, microbial bacteria growth on nutrient agar plates was measured to see if any grew off of fiber PM brought in from outdoors. The concern is that people could get sick from the inhalation of harmful particulates, especially those carrying bacterial cells or fungal spores. PM is easily trapped in carpet, and conventional vacuums tend to mainly spread the PM around. Children are in greater danger of taking in these harmful particulates because they often play on the floor and then put their hands in their mouths. The elderly and people with respiratory/hear problems are also affected because inhalation of harmful particulates could worsen their condition. Only fiber PM was counted and examined because it is easiest to monitor and large enough to count. There was a large decrease in the number of particulates as the elevation levels increased. The mean for the number of fiber PM at the lowest level is 563 fibers/petri dish and the mean at the highest level is 134 fibers/petri dish. After incubating the dishes for three days and making observations of the plates, no correlation was found between the fibers and the microbial bacteria colony formations. Carpets need to be professionally cleaned often as well as areas lower to the ground. It is not recommended that outdoor shoes and clothing are worn indoors. Even though no correlation was found between bacteria and fiber PM, it may be associated with other, smaller types of PM.

Water Pollution Solutions

Graham Weinschenck
Kenmore Middle School

Water treatment can be used to turn undrinkable water into drinkable water. The purpose of the experiment was to see what system of water purification worked best. The hypothesis is that if a natural filter is used to purify polluted water, then the water will be cleaner than it would be with distillation. One cup per trial of polluted water was purified using either the distillation or natural filter method during three separate trials. Natural filters eliminated more pollution elements than distillation. The hypothesis that if a natural filter is used to purify polluted water, then the will be cleaner than it would be with distillation was accepted.

Engineering A

First Place

Creating a Smart Bandage: A Nanoparticle-embedded Polymer to Detect Local Oxygen Levels in Wounds

Charlotte Keeley and Emily Keeley
Charlottesville High School

The usage of nanoparticles in modern medicine is truly vast with possible applications in drug delivery, tissue engineering and cancer imaging. Novel nanoparticles used in this study react to various oxygen levels by fluorescing. The goal of this project was to combine polymers with oxygen-sensing nanoparticles into a thin film and have nanoparticles read out oxygen levels.

Thin films were made with different combinations of two polymers, polycaprolactone (PCL) and polyethylene oxide (PEO). These two polymers were combined in five different ratios, 100:0, 75:25, 50:50, 25:75, and 0:100. Physical performance tests were conducted in addition to imaging the films under ultraviolet light. Differing amounts of nanoparticle solution were added (100, 250, and 500 microliters), and the films were observed under nitrogen and ambient air to simulate hypoxic and normoxic conditions, respectively. The films fluoresced different colors when subjected to a purely nitrogen environment in comparison to ambient air due to the oxygen-sensing capabilities of the nanoparticles. The percentage of defect area was measured, thus finding both the optimal polymer combination and the most effective nanoparticle ratio.

The researchers concluded that the 100% PCL thin film embedded with 500 microliters of nanoparticles would be best suited as a bandage that could indicate oxygen levels in a wound both on the physical level and the effectiveness of its response to different amounts of oxygen. This cost-effective, comfortable bandage employs new nanoparticle technology and may ultimately revolutionize the healing of wounds by providing a diagnostic tool to evaluate local oxygen levels in wounds.

Second Place

The Effect of Barrel Length on Spudgun Range

Samuel Douthit
Washington Lee High School

Abstract not submitted

Third Place

The Relationship Between Cross-sectional Geometry and Properties of ABS Plastic Structural Beams

Derrick Blakely
Washington Lee High School

The experiment was conducted in order to determine whether or not a relationship existed between a structural beam's cross-sectional shape and properties. The properties analyzed included the beam's ultimate tensile strength, the ratio between mass and ultimate tensile strength, resistance to deflection and deformation, and the yield point of linear elasticity. The hypotheses of the experiment were that the ultimate tensile strength, the resistance to deformation and deflection, and the yield point would contain significant statistical differences; there would be a real difference between shape and the mean values for the data. The I beam group was projected to have the greatest strength in these categories. Five groups were tested, each varying in cross sectional shape. The shapes tested were I's, U's, T's, rectangles, and squares. The experiment was conducted by applying weight to the center of each beam, with five trials being conducted for each group. For each trial the tested beam was nailed and clamped on both sides to two stands with a space of 50cm in between them. The weight was applied in increments to the center progressively until the beam snapped. In between the increments, the deflection was measured visually and then calculated to strain. The yield strength was determined based on the linear relationship between stress and strain. The experiment revealed that the groups were statistically different, indicating a significant relationship between the shape of a structural beam and its properties.

Honorable Mention

The Effect of a Rotating Helix on Drag in the Nose-cone

Jeffrey Alvarado
TC Williams High School

The focus of my research was to determine whether a cone with a helical thread could reduce drag. I created a wind tunnel and made three models to test: a hemisphere, a cone, and a cone with a helical thread. I used electronic force sensors to measure the drag force on each model as the wind pushed it back. The results showed that the cone was the most aerodynamic having a force increase of .035N. However, when the cone with helical thread rotated the helical thread reduced force by .03N compared to the stagnant helical thread. The results did support my hypothesis that a cone-shaped nose cone with helical thread would reduce drag more than the hemispherical shape. Some variables that might have affected my results were that: the sphere was larger, and the cone was not able to rotate as smoothly as intended, which may have affected its efficiency.

Honorable Mention

The Effects of Flap Modifications on Aircraft Wings

Robert Breeden
Mountain Vista Governor's School
Abstract not submitted.

Also selected for presentation

The Effectiveness of Fire Safes in Regard to Protecting Data

Thomas Blankinship

Central Virginia Governor's School for Science and Technology

The purpose of this study was to determine the effectiveness of different brands of “thirty minutes” fire safes at protecting flash drives and CDs from a fire with a minimum peak temperature of 650°C for thirty minutes. In addition, the effectiveness of three waterproof “thirty minutes” fire safes at protecting items from water damage after complete submersion for five minutes was also tested. Four fire safes were tested, three of which were also rated to be waterproof. The three waterproof “thirty minutes” fire safes were locked and placed in water for five minutes, removed, and opened. The Sentry Safe® waterproof “thirty minutes” fire safe did not maintain the integrity of its water seal after these five minutes period, but the First Alert® and Honeywell® safes did. CDs and flash drives were then placed in the safes, and the safes were locked. All four safes were placed into a fire with a peak temperature that exceeded 650°C, the maximum possible reading of the thermal camera used to detect the temperature of the fire. After thirty minutes, the safes were removed and the contents checked. All safes were effective at protecting the CDs and flash drives from the temperature of the fire. The original hypothesis that the Honeywell® safe would be ineffective at protecting CDs and flash drives from a fire for thirty minutes, as well as ineffective at protecting items from water damage after five minutes of complete submersion, was not supported. In conclusion, the Honeywell® and First Alert® safes were effective as fire safes, and as well as waterproof safes, as advertised.

The Effect of Blade Pitch Angle on a Windmill's Electrical Output

Jesse Chung

Washington Lee High School

As conventional fuels such as oil and natural gas become more expensive and more publicly criticized for their effects on the environment, progressive, more sustainable energy sources such as wind power become more in demand. The modern wind turbine is powered by two main forces: the lift from its airfoil-shaped blades, and pressure exerted on it by the wind directly. Thus, the purpose of this experiment was to explore which of the two factors played a greater role in powering a wind turbine, through the effect of the change in blade pitch angle of a miniature wind turbine on the electrical output of the turbine. These changes in pitch angle would hypothetically represent different combinations of the two forces, and pitch angles of 0°, 30°, 45°, 60°, 75°, 85°, and 90° were tested. As the airfoil's lift is widely acknowledged to do the majority of the work in full-size wind turbines, the hypothesis for the experiment was that if the blades of the turbine are set at a pitch angle of 30° (0° being parallel to the direction of the wind), the electrical output of the wind turbine (in millivolts and milliamps) would be

the greatest. This angle would hypothetically rely more on the airfoil than on the wind directly. To test, the blades of the wind turbine were set at each pitch angle opposing a fan, and the milliamps and millivolts produced by the turbine were recorded in turn. The results of the experiment very clearly did not support the hypothesis, as the 75° pitch angle had the highest electrical output, followed in order by 85°, 60°, 45°, 30°, 0°, and 90°. A possible explanation for this outcome is simply that the turbine used in this experiment was a miniature, and the wind's direct force had a much larger effect on these lighter blades than it does on a full-size turbine.

The Effects of Surface Roughness on the Sliding Angle of Fluids on Metal Plates

Ryan Davis

Central Virginia Governor's School for Science and Technology

The purpose of this study was to determine whether surface roughness, as well as the properties of aluminum and steel, have an effect on the sliding angle of water, oil, and antifreeze for use in nuclear facilities. This study was conducted in a testing lab in a local pulp and paper mill. Using a Coefficient of Friction Tester, plates of aluminum and steel with 4 levels of roughness were placed on the tester, and 40μL of water, oil, and antifreeze were placed on the plates, respectively. The measured angle at which the drops of fluid began to run was recorded and entered in a table. A two-way ANOVA with replication and an alpha level of .05 was conducted to analyze the data. The null hypothesis (H₀) stated there was no significant difference between fluids or sliding angles. The alternate hypothesis (H_A) stated that there was a significant difference between surface roughness and fluids. All three ANOVA's, water, oil, and antifreeze produced significant p-values of 3.54E-09, 1.39E-18, and 1.39E-23 respectively. A Tukey test, which determines where the significant differences lie, was performed, which showed a significant difference among fluids and different roughness levels, therefore, the alternate hypothesis was accepted. The statistically significant results support the alternate hypothesis, in which the higher the roughness of the surface, the higher the sliding angle of the droplets. In conclusion, steel and aluminum plates with finer surface finishes showed lower sliding angles, and antifreeze showed the lowest sliding angles, followed by oil, then water

The Effect of Blade Angle on Propellor Efficiency

Raymond Dulman

Washington Lee High School

The purpose of this project was to investigate the most efficient angle of attack for propellers. This was done first by sawing a blade off model propellers. Then, these blades were placed in a Jetstream 500 wind tunnel, which calculated the lift and drag forces acting on the propeller. This information was calculated as a lift/drag ratio. The angle of attack with the greatest lift/drag ratio was determined to be the most efficient. In this case, the angle of 20 degrees had the greatest lift/drag ratio, so it was the most efficient. Also, the angle of 0 degrees had the lowest lift/drag ratio, so it was the least efficient. This information can be used to better understand the principles of design and aerodynamics.

The Effect of Antenna Director Type on Wireless LAN Signal Strength over Distance
Stuart Geipel
Deep Run High School

In a Wi-Fi enabled device, the antenna is one of the greatest factors put into consideration. Due to the inverse-square law, signal from Wi-Fi sharply decreases over time. As the signal strength decreases, speed decreases as well. For a permanent wireless link between two locations, a directional antenna can be used, which greatly increase gain. Developing countries use mesh networks that have directional antennas as backbones. A “spider web” of routers each share Internet with each other, however, directional antennas are the only way to get signal between further distances. The purpose of this experiment was to determine the effect of directional antennas (or lack thereof) on the signal strength between two routers at a set distance apart. The hypothesis was that if the 5-inch parabolic mirror was chosen, then the connection between the routers would have the highest signal strength. This was chosen because of research done of parabolic reflectors. To complete the experiment, two routers were laid 100 feet apart, the base station with the selected director. Then the percent strength as displayed by the access point was recorded 20 times. The results were insignificant. The hypothesis was neither supported nor rejected out of lack of information. All of the mean signal strength were nearly equal across all IVs. Further, more accurate tests must be conducted in order to be able to make any conclusions. There were multiple improvements that could have been made to this experiment. Instead of two different and cheap routers, two middle class, identical routers could have been used. Also, an antenna could have been made if time and resources permitted.

The Effects of a Change in the Environment on the Accuracy of Global Positioning System
Stephen Good
Shenandoah Valley Governor’s School

Changes in the environment can affect the accuracy of a Global Positioning System (GPS). The purpose of this study was to determine if rocks, wood, or soil would have an effect on the accuracy of a hand-held GPS. An experiment was conducted where 54 samples were taken. The results were analyzed using an ANOVA and no statistical difference was found in the accuracy when a change in the environment was introduced. Although not statistical difference was found by the ANOVA, there was a strong correlation between the density of the material and the changes in accuracy of the GPS. Because of design of the experiment, few conclusions were made about why the experiment yielded certain results.

The Effect of Pillar Dimensions on Resiliency Towards Earthquakes
Alicia Huggett
Washington Lee High School

The purpose of this experiment was to determine the effect of changing pillar dimensions on how it would impact resiliency towards earthquakes. Different combinations of pillar height and diameter were cross tested in order to attempt to determine an ideal combination. Dimensions were scaled down as to allow the paper pillars to fit on a shake table. A textbook was placed on top of the pillars to simulate the weight of a building. The contraption was shaken while being recorded, and results were ascertained afterwards.

Data analysis found height to be an insignificant factor and deemed diameter to have an effect on resilience towards earthquakes. Analysis further showed that the difference between the low and median diameters were not significant, as well as between the median and high diameters. Significance was shown between the low and high diameters. Both pillar height and diameter can be selected and adjusted according to space, cost, function, and availability of materials.

Engineering B

First Place

The Effect of Nail Angle on a Joint's Torque Strength

Seth Peacock

Lee-Davis High School

Nails are the most common method of joining lumber. A nail's holding power is the force required to pull it directly out of the wood and is the most common measurement of a nail's efficiency. A nail joint must also have torque strength; the ability to withstand force around a certain axis. Torque in wood joints has not been widely studied.

Previous experimentation showed that diverging nails give a joint more torque strength as opposed to parallel or converging nails. This experiment was performed to determine what specific angle of diverging nails provided the most torque strength, thus allowing carpenters and engineers to create stronger products. This was tested by mounting wooden 2x4 effort arms horizontal to the ground on a vertical base. Nails were hammered into pre-drilled guide holes to insure accurate angles. Water was poured at a constant pressure into a bucket at the end of the effort arm. When the effort arm dropped 20 degrees, the weight of the bucket was converted into Newton-Meters (Joules) of torque. Nails diverging at 10, 20, and 30 degrees were tested, with 0 degrees (parallel) as a constant. The data was run through a One-way Analysis of Variance (ANOVA) test, which determined that the difference between independent variables were statistically significant. It was hypothesized that at 30 degrees the wood would splinter and collapse, but this hypothesis was disproved. Torque strength increased consistently with nail angle. In steeper angles than were tested, splintering could weaken the joints. In the tested 30-degree joints minimal splintering was observed. Torque strength increased with nail angle, as the torque is redirected to push the nails into the wood. 20- and 30-degree joints collapsed more suddenly than 10 and 0 degree joints.

Second Place

The Effect of Skyscraper Shape on Sway

Jordan Schwartz
Deep Run High School

Skyscrapers come in all shapes and sizes and serve a myriad of purposes. As buildings get taller, forces such as wind, seismic activity and gravity have a greater impact on them. This experiment was designed to test how different shaped skyscrapers affect their sway when faced with strong wind. The hypothesis was if a hexadecagonal building was placed in front of a fan, then it would sway less than the other buildings. The shapes tested were a rectangular prism (the control), a hexadecagonal prism, a triangular prism, a five-pointed star shaped prism, and a pyramid. The skyscrapers were made out of Polypro Intepro Foam Board. To keep them as constant as possible, all had a 1 ft. x 1 ft. x 2 ft. rectangular prism shaped base and 4 ft. tall total.

The rectangular prism and the five-pointed star shaped prism both had a high level of sway at 17.4 mm and 18.0 mm respectively, while the hexadecagonal prism, triangular prism and pyramid all had a low level of sway at 1.4 mm, 2.8 mm and 0.7 mm respectively. The null hypothesis was rejected in all comparisons ($t=18.47>2.101$; $t=16.47>2.101$; $t=19.63>2.101$; $t=3.51>2.101$; $t=9.41>2.101$; $t=2.43>2.101$; $t=8.59>2.101$; $t=5.89>2.101$; $t=9.85>2.101$ at $df= 18$; $p>0.05$) except when the rectangular prism (control) was compared to the five-pointed star shaped prism ($t=0.27<2.101$ at $df= 18$; $p>0.05$). Overall, the data did support the research hypothesis that skyscraper shape affects its sway. Specifically, the data did not, however, support the hypothesis that if a hexadecagonal prism shaped skyscraper was placed in front of a fan, then it will sway less than the other skyscrapers. In conclusion, the results turned out differently than expected. For example, the pyramid had little surface area because it tapered at the top and created the least sway. One of the main challenges for this experiment was the cutting of the towers because all the towers originated from their own board.

Third Place

The Effect of Wind Concentrator Design on Energy Generated by a Wind Turbine

Stephen Klem
Yorktown High School

The purpose of this experiment was to determine whether the addition of a laminar wind concentrator to a Vertical Axis Wind Turbine (VAWT) would increase the mean voltage generated by the VAWT. Wind concentrators funnel the wind toward turbine blades and can result in cheaper alternative energy with improved generator performance. Two laminar wind concentrators, one turbulent wind concentrator and the control were tested by placing them in between a high velocity fan and the VAWT. Voltage generated by the turbine was measured and the mean voltage calculated for each treatment. The laminar flow designs were closed conduits that generated a constant wind velocity. The

turbulent flow designs were the control (no treatment) and the open, curved design. These turbulent designs produced variable wind speed when applied to the VAWT. The hypothesis for this experiment was if laminar flow design wind concentrators are applied to a vertical axis wind turbine, then the mean voltage generated by the wind turbine will increase. The results showed that the turbulent concentrator treatments generated 33.92 volts and 34.60 volts while the laminar concentrator treatments generated 31.61 and 15.99. The data did not support the hypothesis. The laminar designs had low variability while the turbulent designs had greater variability. A one sided ANOVA was performed on the data with a 95% confidence level supported that the concentrators had an effect on the mean voltage generated by the VAWT. Even though the laminar flow design did not perform as expected, the conclusion drawn from the results was that applying a wind concentrator to a VAWT could improve energy performance. Harvesting wind energy effectively will benefit society.

Honorable Mention

The Effect of Repair Methods on the Shanks of Pointe Shoes

Naomi Moore

Central Virginia Governor's School for Science and Technology

The purpose of the research was to determine the effect of repair methods on the shanks of used pointe shoes when compared to new pointe shoes. Six new shoes were collected from a local dance store to be used as the control. Eighteen used shoes were collected from a ballet company and various local dancers to be used as the experimental groups. The used shoes were randomly assigned to groups by the following repair method: jet glue, gorilla glue, and floor wax. All shoes underwent initial testing, which was done by taking pictures of each shoe clamped to a table, then adding a 500g hanging weight to simulate a dancer standing in the shoe and taking an additional picture. Then, the experimental groups were repaired with their assigned method and allowed to sit overnight. The same testing was then done on the repaired shoes. All shoes then underwent a repetitive motion test, where each shoe was bent to 90° 50 times. Then, each picture was analyzed in ImageJ software to gather the angle bend of each shoe. The results revealed that the repair methods were effective, shown statistically by a p-value of 0.0447. Of the repair methods, the Jet glue was the most effective repair method. The repetitive motion test, however, was not statistically significant, revealed by a p-value of 0.7448. This shows that the original hypothesis was partially supported by the repair methods. In conclusion, all the repair methods re-strengthened the shoe, and the jet glue was most effective.

Also selected for presentation

The Effect of Sewage Treatment on Water Quality of a Receiving Stream

Emily Larson

Yorktown High School

The purpose of this project was to test the effectiveness of sewage treatment on water quality of a receiving stream. The reason for sewage treatment plants is to make clean water; the objective of this experiment was to prove the treatment to be effective or not. Biochemical oxygen demand (BOD) was measured. In a body of water, it is extremely important for the BOD to be a certain level: for this experiment 7 or 8mg/L is ideal.

First, a small-scale treatment plant was built. The first bucket was filled with water and 4 cups of dry dog food. The water flowed into the second bucket which had an air bubbler, and in the third bucket, the water went through a sand filter and underwent chlorination. After chlorination the water went into the fourth bucket. The water, both before and after treatment was tested 3 times, the results for the water before cleaning was 10, 9, 9 mg/L, the water after cleaning was 8, 11, 7 mg/L. The water was left to sit for 5 days then tested again, the water before treatment tested 2, 2, 3 mg/L, and the water after cleaning was 7, 8, 7 mg/L. For the water tested before neither of them tested to be ideal, on the primary day the BOD was too high and after 5 days the BOD was too low. Both of the after measurements were ideal, except for the second measurement on the primary day which was caused by experimental error. The p-value was 0.054 which means that the results were significant.

This experiment proved that sewage treatment plants are effective in keeping the BOD levels ideal. The hypothesis was accepted. When waste was first dropped into the water, the BOD rose and after a few days dropped to an unsafe low. After the treatment the levels were ideal.

The Effect of Different Water Sources on the Power Density Output of a Microbial Fuel Cell

Rohan Mathew
Godwin High School

The purpose of the experiment was to find the effect of different natural waters on the power density outputs of a microbial fuel cell. For the last several decades, global energy consumptions have increased multifold. Demand for energy is only expected to increase and scientists are exploring renewable energy sources to supplement the growing demand. One such technology is Microbial Fuel Cell technology which uses organic waste to create energy. The experiment focuses on how to create energy from organic waste and bacteria in natural waters. Three MFC systems were set up using different natural water sources. The water sources were James River, Chickahominy Wetlands and Echo Lake. Twice a day, each MFC system was tested for voltage to ensure the system is working properly. Every third day each system was tested for power output. It was hypothesized that the If natural waters are used to operate a Microbial Fuel Cell, then James River operated MFC will have the highest power density reading. There was no control group for the experiment, because there is no average or ideal MFC system which can be used for comparison. A hypothesis was formulated that if natural waters were used to operate a MFC system, then the James River powered MFC would have the highest power outputs. The results showed that the mean power densities for the James River powered MFC were significantly higher than the outputs generated by the Chickahominy and Echo Lake powered systems. A t-test was performed on the data to support the significant difference of each system output. The

James River vs. Echo Lake and the James River vs. Chickahominy were both shown to have significant difference in output, but the Echo Lake vs. Chickahominy test was not significant. It is believed that the results are due to the fact that the James River contains more organic sediments and bacteria. Though MFC systems do produce electricity, research on scaling up the MFC to power wastewater system is still at its infancy. More research is needed to increase power output and clean water generation.

Effects of Altitude on the Power Output of Small Autonomous Aerial Solar Power Systems

Gage Morrow
Mountain Vista Governor's School

In the past, unmanned aerial vehicles (or UAV's) were used to perform relatively simple surveillance and surveying missions, but during these ever-changing times UAVs are taking on more and more advanced roles. Most UAVs carry a useful payload, and they currently have a wide range of applications including geological surveys, military reconnaissance and strategic strikes, surveillance, electronic warfare, radio and data relay, search and rescue, wildfire suppression, law enforcement, transportation planning, city planning, environmental studies, and homeland security (Sarris, 2001). Because UAVs are being employed in so many different areas, they require ever more powerful means of completing tasks. At the fore front of the needs of UAVs is the need for greater endurance and an ability to perform longer missions. One of the newer ways of increasing the stamina of UAVs is using solar cells to add to the UAVs power supply in flight. It was found that even for small solar UAVs at low altitudes, the difference of just a few tens of feet could make a significant difference in the power the UAV was able to harness from the sun.

The Effects of Joint Angular Motion During Gait on Piezoelectric Energy Output

Veronique Nazareno
Ocean Lakes High School

The purpose of the project was to determine if certain elevated angles created by the hip during gait had an effect on the energy output harvested by piezoelectric transducers. An angle was defined as the orientation of the limb and the foot with respect to the vertical upright along the hip joint axis of rotation, or the hip flexion-extension angle. The research hypothesis was that as this angle decreased during gait, the higher the voltage released. The null hypothesis was that there would be no relationship between the angle of impact and the voltage released. A swinging pendulum acted as a swinging "leg", which consisted of a long, thick metal wire "dressed" in one-half of a pair of jeans filled with kitty litter. The leg was hung against a medium density ply board for support, and a shoe was attached to the bottom of the metal wire to withstand the impact of the heel strike. Each trial consisted of the "leg" being swung from different angles and its heel colliding against a transducer placed beneath the shoe and screwed onto a block of wood. The wood was secured with a vice that varied the angle at which the wood faced the heel with a spirit level. Data was collected with a Parallax USB Oscilloscope and complementary computer

software that showed the mV measurements for each trial. The angles used ranged from 0°-25° in 5° increments, and there were 10 trials for each angle. Using an ANOVA test, the F value was 6.47 and the p value was .0000882, meaning the null hypothesis was rejected. Although there was a statistical difference in data, the research hypothesis was not supported through the results. The mean voltage displayed no trend as the mean values for each angle as 0° released 246 mV, 5° released 326 mV, 10° released 277 mV, 15° released 356 mV, 20° at -115 mV, and 25° released 71 mV. This could have been attributed to a flaw in the design of the model as not all of the important joint lower extremities were represented, such as the knee and the ankle. Each trial was also done manually, meaning each trial could have been slightly different.

Electricity Benefits of Pedal Powered Generators at Gold's Gym in Front Royal, Virginia

Kendra Patrick
Mountain Vista Governor's School

"Going green" is the latest hot topic to be concerned about. At the same time, physical health is a concern as well. As an attempt to be conscientious of both simultaneously, research was conducted involving hypothetical manipulation of two variables of electricity for Gold's Gym in Front Royal, Virginia. The first was determining whether or not pedal powered generators being attached to the bicycles would save enough electricity within 2 years to pay off the cost of buying them. It resulted that they would cost much more than they would save. However, by manipulating the second variable the gym would be able to pay off the generators. The second variable researched was to simply unplug the treadmills in the gym. This would change the way the treadmill is used, but it would provide a better workout for the gym member and save electricity as well. If Gold's Gym unplugged their treadmills, they would save enough money within 2 years to purchase 3 pedal powered generators and still have \$226 left over. At the time of this research, during September of 2011, the time spent on the bicycles was not enough to produce much electricity. Maybe once the generators were implemented, people would have more of an incentive to use the bikes.

The Effects of Different Cleaning Cloths on the Scratching of Eyeglass Lenses

Amber Puffenbarger
Shenandoah Valley Governor's School

Lenses in eyeglasses are often cleaned with abrasive materials that are easier to access than the microfiber cloth used by many Optometrists. The purpose of this study was to determine which materials were more abrasive after repeated use. Reading eyeglasses from a local department store were tested with a light sensor to measure the intensity of light passing through the lens before and after being scratched with different materials. The intensity of light was recorded, and the gain score was tested through an ANOVA that yielded no difference in the intensity of light after cleaning with the paper towels, tissues, t-shirt, or microfiber cloth. The researcher concluded that the cleaning materials are equally effective which support findings of previous research.

Electrolysis of Tungsten in Different Solutions for a High Energy Production

Thomas Rardin
Shenandoah Valley Governor's School

The process of Low Energy Nuclear Reactions has become a driving force for many researchers in the past 20 years. One experiment, as performed by Pons and Fleischmann, consisted of electrolyzing palladium in a heavy water solution, and another, performed by Jean- Louis Naudin, shows a cheaper alternative by using tungsten and a baking soda solution. These experiments were used to test the plausibility of energy being created and plasma electrolysis. Both had positive results. The observed reaction resulted in the tungsten cathode being melted in the time frame it was suspended in the solutions. The phenomenon that occurred would seldom produce a Coefficient of Performance greater than 1.00 but would come very close to 1.00 when the potassium bicarbonate solution was used. The only way energy could have been produced would be through fusion, but no radiation was emitted during the experiment. This is evidence of a different kind of reaction or an unexplained phenomenon that can be explained by the theory of "Cold Fusion".

The Efficiency of Different Eco-friendly Oils in a Wooden Hydraulic Robotic Arm

Ashton Reid
Central Virginia Governor's School for Science and Technology

The purpose of this experiment was to determine which of the three eco- friendly oils (grapeseed, canola, and safflower) performs better in a simulated wooden hydraulic robotic arm. The wooden robotic arm was built in a workshop and then the data was collected in a lab. First the oils temperatures were measured before putting the oils in the system. Then the oils were put into the hydraulic system and the robotic performed a set number of movements. Then the oils were taken out of the hydraulic system and their final temperature was measured. Finally, the change in temperature of the oils was calculated to determine which oil was more efficient. These steps were performed eight times for each of the oil groups. The hypothesis for the experiment was that if safflower oil was tested then it would run more efficiency in the hydraulic robotic arm. The hypothesis was not supported because an ANOVA test was performed on the data collected using an alpha value of 0.05 and the result of the test was a p-value of 0.091. The results show that there is no significant difference between the oil's efficiency.

Comparison of Drag Between Varying Gap Widths behind Nose Cones on Model Rockets

Zachary Scandalis
Mountain Vista Governor's School

This paper explores the effect of a gap between a nose cone and body of a rocket. Full-scale rockets use a significant amount of fuel to carry themselves. Drag has a huge impact on fuel efficiency, and therefore cost. Full-scale rockets also have tolerances in their measurements that can lead to parts of the hull not fitting together exactly right. This research shows the importance of consistent measurements between different parts of a rocket and the effect on aerodynamics. The research was conducted using a model rocket in a wind tunnel. Two experimental designs, one with a quarter-inch gap and one with an eighth-inch gap, were used and compared to a control with no gap. Using the data collected, two paired t-tests were conducted. The results suggested that with both experimental designs, drag was significantly higher than the control. This shows that even a slight discrepancy in measurements or tolerances can lead to significantly more drag, and therefore, more fuel consumption and higher costs.

Designing and Building a Musician's Companion

Andrew Storms
Southwest Virginia Governor's School

One common hindrance among musicians is turning the pages of a piece of music while playing his/her instrument. Therefore, the goal of this project was to create a Musician's Companion, a device that could automatically scroll an entire piece of music at the correct speed that the song is played. Though there are electronic solutions to this problem, they are pricey and do not have every song in their databases. The central controlling mechanism for the Musician's Companion is an Arduino Uno microcontroller. In the initial version of the device, small motors and the EasyDriver stepper motor driver were not powerful enough to allow proper function. Therefore, a Big Easy Driver stepper motor driver and larger motors with a higher torque to current ratio were acquired which enabled the device to function as it was originally intended. Once the new components were integrated, it was found that the device functioned and performed the desired task successfully. Various improvements have been planned that will further improve the device's functionality. The Musician's Companion has shown the feasibility of this system and could already be utilized as a great tool for many musicians. Future refinements will be shared with other musicians so that they may further test the Musician's Companion.

Robotic Vehicle Efficiency in Varying Water Conditions

James Van Eaton
Central Virginia Governor's School for Science and Technology

The purpose of this study was to determine whether varying water levels and types of water affect the efficiency of a robotic vehicle to traverse water. First, a robotic vehicle resembling a wheelchair was designed using Vex robotics kit v.5. Then, the efficiency of the vehicle was measured by timing how long it took the vehicle to complete four different sets of motion in a container filled with gradually increasing levels of tap water and then salt water. The minimum r-value for the regression of individual sets of motion

was 0.2319 and for the type of water as a whole was 0.1946. The t-critical values for the t-test of the water types were 1.7613101 for the first tail and 2.1447867 for the second tail. The hypothesis that vehicle efficiency would lower significantly if the water level was raised was not supported in the test using tap water but was supported in the test using salt water. This also supports the hypothesis that the decrease in efficiency would be more evident in the salt water as compared to the tap water. In conclusion, there was a significant decrease in efficiency with respect to salt water but not with respect to tap water.

Environmental Science A

First Place

The Effect of Carbon Dioxide on the Mass of Calcium Carbonate Shells

Brady Brown
Godwin High School

The purpose of this experiment was to determine the effects of different levels of carbon dioxide on the mass of oyster shells. Recently, a phenomenon known as ocean acidification has become a large problem, because of increasing levels of carbon dioxide in the atmosphere and oceans. Oyster shells were exposed to no carbon dioxide, 1x amount of carbon dioxide, 2x amount of carbon dioxide, and 3x amount of carbon dioxide, where x= one tube emitting a constant flow of carbon dioxide, with 3x being the highest level of carbon dioxide. The mass of the shells was measured at the beginning of the experiment and after every week for four weeks. The control was the group receiving no carbon dioxide. It was hypothesized that the group receiving the 3x level of carbon dioxide would have the greatest decrease in mass. The results showed that on average the control group gained 1 gram, 1x gained 0.04 grams, the 2x group lost 0.8 grams and the 3x groups lost 1.28 grams. T-tests done on the data revealed that the data was significant for all groups except 2x versus 3x. The results supported the research hypothesis. It is believed that the results are due to the fact that carbon dioxide lowers the pH of water and decreases the amount of carbonate ions in the water. This research could lead to further studies that investigate different species of oysters' or other marine calcifying organisms' responses to varying levels of carbon dioxide.

Second Place

The Effect of Nitrogen on the Growth of *Pediastrum boryanum*

Colin Fenster and Jack Lohmann
Douglas Southall Freeman High School

Third Place

Assessing Oil Spill Cleanup: The Ecological Ramifications of Chemical Treatments

Andrea Green and Catherine Mitchell
H-B Woodlawn Secondary Program

Since the *Deepwater Horizon* explosion in 2010, much research has been conducted concerning oil spill cleanup technologies. Dispersants, a common method of oil spill chemical cleanup, have been shown to be highly toxic. Bioremediation agents, although considered less toxic than dispersants, require specific environmental conditions to effectively remove oil.

This experiment examined the toxicity of several bioremediation agents and dispersants. The toxicity of four bioremediation agents (DualZorb, Micro-Blaze, RemediAde, and S-200) and two dispersants (Accell Clean DWD and Sea Brat #4) was tested by measuring the survival rate of *Artemia salina* over a five-day testing period. The chemicals were tested in environments with and without motor oil to replicate the two most common conditions found in their natural application. Two controls, one with oil and one without, were tested for comparison purposes.

Overall, both types of chemical treatments had a significantly ($p < 0.00002$) negative effect on *Artemia salina*. In addition, bioremediation agents were less toxic than dispersants on average. However, two bioremediation agents, DualZorb and S-200, were more toxic to *Artemia salina* than oil. This indicates that both dispersants and bioremediation agents have the potential to negatively impact the environment and further testing of oil spill cleanup chemicals is required.

A concentration study was also conducted on S-200 and Accell Clean DWD, in order to determine the LC50 value of the two chemicals. Nine different concentrations were tested using the same experimental method as the first phase. It was determined that the 48-hour LC50 value of S-200 was 633 ppm, while that of Accell Clean DWD was 15.4 ppm, further supporting the claim that, on average, bioremediation agents are less toxic than dispersants.

Honorable Mention

The Effect of the Type of Rock on the Flow Rate of Water

Anika Anjum and Azeb Yirga
Henrico High School

The purpose of this experiment was to determine how the type of rock affects the flow rate of water. The flow rate of water is important to understand because it is a determining factor of how quickly an aquifer will be recharged. An aquifer is a water-containing geological structure from which a well can draw water, and recharging refers to the refilling of an aquifer with water. Additionally, it is integral to containing contaminated groundwater. Two important characteristics of rocks that affect the flow rate of water are porosity and permeability. The three types of rocks that were tested were sand, aquarium gravel, and pea gravel. The experimental hypothesis was: if the flow rate of water through different rocks is tested, then aquarium gravel will have the highest flow rate. This was hypothesized because aquarium gravel had well-sorted, medium-sized particles, which allowed it to have a high porosity, and a high permeability. The hypothesis was tested by creating a simulated aquifer. After plastic bottles were filled with one type of rock and straws were inserted near the bottom of each bottle, the volume of the output water was measured after the water flowed out through the straw. The flow rate of water through a specific aquifer was calculated by dividing the volume of its output water by the

time it took to collect the water. The mean flow rates of water for sand, aquarium gravel, and pea gravel were 0.0297 mL/s, 6.659 mL/s, and 5.474 mL/s respectively, which supported the hypothesis. An ANOVA test was performed that showed a significant difference in the mean flow rates of the three levels. The data of this experiment would be a useful resource to well users and scientists attempting to determine a location to install a new well.

Honorable Mention

The Effect of Algae's Habitat on the Oil Extraction Ability

Sathya Areti
Henrico High School

The purpose of this experiment was to investigate the habitat in which algae can yield the largest possible amount of oil. The three levels of investigated algae were freshwater, terrestrial, and marine algae. The hypothesis was that the freshwater algae would have the highest extraction ability because of the relatively clean biome, low salt concentration, physical features such as vascular tissues, and separation from a larger variety of organisms and natural disturbances. First, each sample of algae was weighed. After the algae were pressed, it was combined with ethyl acetate, an ester, to further extract leftover oil. After being weighed again, the initial and final masses were recorded. Statistically observing the results, the largest mass difference allowed for more extraction, and thus, had the greater oil extraction ability. Since the greatest mass difference was found in the freshwater algae, the hypothesis was supported. The differences, however, were not drastically different (t-tests) but were consistently greater than the other trials. This concept was tested so that it could be employed in greater situations such as the current national energy crisis for biodiesel. Researchers have found algae as a possible source; knowing which habitat of algae will yield the greatest amount of oil could be vital to our economy.

Honorable Mention

The Effect of Oil Contamination Time on the Amount of Oil Removed

Katharine Hines
Godwin High School

The purpose of this experiment was to determine how contamination time effects oil removal from feathers. This research is beneficial for birds that can possibly survive with a rehabilitation program after being affected by an oil spill. Feathers were dipped in oil and allowed to sit for either one day, one week, or three weeks. The feathers were then washed and the amount of oil lost was calculated by mass. It was hypothesized that if oil contamination time increased, then oil removal would decrease. The results showed no significant difference in the amount of oil removed among the different contamination times as each level of the independent variable yielded similar averages of 60%, 56%, and 60%, respectively. The results did not support the research

hypothesis. The results of this study are most likely due to error, since other researchers have found that oil does become harder to remove as contamination time increases (Tegtmeier, 2007). Improvements such as a more sensitive scale, more consistent washing method, and better method for determining the amount of oil removed. This research could lead to future studies that investigate how oil contamination time affects the removal of oil from other wildlife and the ideal washing methods for oil-affected bird rehabilitation.

Also selected for presentation

The Effect of Zinc Concentration on Average Life Span of *Artemia*

Andrew Azdell
Godwin High School

The purpose for this study was to discover if the amount of zinc dissolved in water affected the average life span of brine shrimp. Brine shrimp are used in the world of science as biological testers for substances in water. Due to their tough internal systems, these crustaceans can handle more salinity or pollution than a human can based on body mass. A hypothesis that was devised stated that the IV level of 0.1 gram of dissolved zinc would result in the average life span. A solution of salt-water and brine shrimp was added to each petri dish. 25 were left untouched as the control, 25 were given a 0.1-gram amount of zinc, and 25 were given 0.2 grams. Results were formulated in the number of days at least 50% of each petri dish sample lived.

The results showed that the average for the control was 9 days, while both levels with zinc only had an average of 1 day. A t-test was performed for this experiment. The t-test for the control vs. the variables was not significant, and therefore the research hypothesis was not supported. The results may have been due to the lack of food, oxygen, or space that the brine shrimp did not have in the dishes. The results may also be due to too much zinc. In repeating this experiment, a smaller amount of zinc should be used, and the space should be bigger for the brine shrimp.

The Effect of the Salinity of Water on the Efficiency of Desalinating that Water

Jarrett Bender
Deep Run High School

This research was driven by the world's need for clean water and its limited availability. Water needs to be 100 – 1000 ppm salinity to be potable, and yet two-thirds of Earth is ocean water that is 7000+ ppm salinity. The most common desalination technique is reverse osmosis, which involves pushing water through a membrane that does not allow salt and many other impurities to pass. The purpose of this science experiment was to determine the effect of starting salinity of water on the efficiency of the desalination process.

Common table salt was used to salinate the water at three different levels: 0 grams, 3 grams, and 7 grams of salt per liter of water. A bike pump was used as a source of pressure, and the water was pumped through a commonly available, residential reverse osmosis membrane. The amount of clean water and brine were measured to determine the efficiency, and a Total Dissolved Solids meter was used to measure the salt content of the initial and the product water.

The hypothesis predicted that if the salinity of water increases, then the efficiency of desalination will decrease. This was directly related to the cost, which is the primary concern of countries needing the desalination. The student t-test was used to reject the null hypothesis, and it was found that the efficiency of desalinating water decreased exponentially as the salinity of water increased.

Reverse osmosis is the most popular means of desalinating water across the world, and therefore it is important to learn more and to study its processes in detail. In conclusion, even though the cost of desalinating water increases exponentially as salinity increases, using reverse osmosis is still the most economic and straight-forward technique in existence.

Effect of Conservation Education on Private Water Usage

Annie Bennett

Mountain Vista Governor's School

Abstract

Earth's Urban Heat Island Effect – Year Two

Wyatt Booth

Hampton High School

The Urban Heat Island Effect has always been considered to be a major factor of temperature variations within civilizations; the official concept states the phenomena depends on surrounding areas and their urbanization factors. In objection, the theory has consistently been questioned due to temperatures not being monitored constantly within varying locations, both urban and rural. Since the temperatures have remained superficially unknown, there cannot be exact interpretation as to whether or not temperatures majorly alter depending on an area's natural and man-made characteristics. Daily temperatures taken from three distinct zones and multiple other variables were used in proving the natural and artificial effects of the phenomenon. As such, the temperatures collected showed 37°01'27.54"N, 76°22'57.71"W to be the warmest, 37°00'27.41"N, 76°26'47.67"W as the second warmest, and 37°08'14.64"N, 76°34'24.87"W to be the coldest. Among all localities, these three appeared most realistic in comparison to other cities, world-wide.

The temperatures were consistently measured through the use of infra-red thermometers both on mornings and afternoons, several days every week on surrounding plots of grass and asphalt (of equal size, to attribute equal surface absorption of environmental factors). Weather conditions were also recorded as being either moist or dry. Once recorded, the temperatures were compared and analyzed to one another, proving the Urban Heat Island Effect correct. Once proved to occur

adequately at even the smallest areas of urbanization, the long-ago preparation of civilizations for different climate alterations/zones world-wide could be better understood.

In conclusion, the data supported the urban heat island effect and the hypothesis in question. 37°01'27.54"N, 76°22'57.71"W, being 1.44 miles from the central point of town, was the warmest, followed by 37°00'27.41"N, 76°26'47.67"W, being 2.70 miles, and then 37°08'14.64"N, 76°34'24.87"W, being 13.09 miles. Due to the variations of urbanization within the city limits, temperatures were capable of fluctuations, as detailed in the data collected. The year two excess localities and perimeters are greatly considered in relativity to the James River (37°04'07.29"N, 76°37'05.28"W) and the Chesapeake Bay (37°35'02.95"N, 76°10'42.15"W) in general. Being so, the localities of 37°07'46.95"N, 76°30'09.47"W and 37°42'39.22"N, 76°42'20.61"W were chosen to best reflect the water and air influences of both the Chesapeake Bay and the James River as oppose to more inland areas or even the marshland areas in which 37°08'14.64"N, 76°34'24.87"W reflects.

The Density of *Lactuca sativa* (Butterhead Lettuce) Grown Using a Hydroponics System in Contrast to Conventional Farming Methods

Tessa Crews
Mountain Vista Governor's School

Hydroponics is a form of cultivation that has been developed in order to increase the sustainability of agriculture. As the quality of the crops produced is pertinent when referring to the effectiveness of this system, the objective of this research was to examine the density of crops grown using two different farming methods. In the study of *Lactuca sativa*, it was hypothesized that the density of crops grown in a hydroponics system would be greater when contrasted to those grown using traditional farming methods. The sample population consisted of ten plants that were grown conventionally and ten that had been grown using hydroponic technology. The independent variable was the farming method from which the crops were grown, and the dependent variable was the density of the lettuce. The difference between the volume and mass in the hydroponically grown lettuce suggests that despite a limitation on growing space, a direct control in nutrients positively affects the density. This led to the acceptance of the alternate hypothesis, with hydroponic crops reaching an average density of 1.854 grams per cubic milliliter while conventional lettuce yielded an average of .971. Higher plant concentration and a p-value of .0001326 support the prospective productivity of hydroponics.

The Effect of Different Household Cleaners on the Removal of Motor Oil from a Bird Feather

Cailin Dyer
Washington Lee High School

A large problem facing the world currently is the frequency of oil spills in open waters and their effects on the wildlife. More specifically, many birds get the oil stuck in their feathers, preventing them from swimming properly as well as flying. This experiment will determine an efficient way to clean these birds without harming them or the environment. Five common household cleaners were used including Dawn dish soap, Green Works Laundry Detergent, 409 all-purpose cleaner, Suave shampoo, and an all-purpose biodegradable soap. It was hypothesized that if Dawn dish soap was used then the motor oil would be removed from the feather because dish soap is used to breakdown tough grease and oil on dishes. Each cleaner was tested on 10 mallard feathers that had been soaked with used motor oil. After rinsing the feathers and letting them dry, an average percentage of the amount oil removed from each feather was calculated. In the end, the cleaner that was most effective was the Dawn dish soap, as hypothesized, removing 82 percent of the motor oil from the feather. Dawn was followed by 409 cleaner, which removed 78% of the oil soaked into the feathers. It was concluded that it is extremely difficult to remove oil from feathers. Also, the more environmentally friendly cleaners like the shampoo and all-purpose cleaners which were both biodegradable, did not effectively clean the feathers. This means that much more research is needed to discover methods to clean feathers of birds, aside from this experiment, which tells what types of ingredients are effective.

What is the Effect of Natural Ground Cover on Contaminant Run-off in our Water Supplies?

Hannah Fitzmaurice
Washington Lee High School

The problem this project tried to solve was what is the effect of natural ground cover on contaminant run-off in the water supply. It was hypothesized that if the degree of ground cover was increased, then the amount of contamination in the water supply would decrease. First, five watersheds were constructed with the different types of ground cover, ranging from heavily grassy to dirt. Then, the soil-contaminated water was poured down the watersheds and was collected in a container at the bottom. Finally, the collected water was tested with a phosphate test kit and the phosphates level was recorded. This was done ten times per watershed. The collected data showed that as the degree of ground cover increased, there was less phosphate contaminating the water. Therefore, the hypothesis was supported and showed that increased ground cover does in fact serve as a filter for absorbing contamination in the water supply. The data was significant.

The Ability of a Green Roof to Insulate a Container among *Hemigraphis alternata*, *Chlorophytum comosum*, and a Container Without Vegetation

Jordan Good
Shenandoah Valley Governor's School

Green roofs are extensions of an existing roof that consist of vegetation and attempt to increase energy efficiency. Green roofs are commonly used in office buildings, schools, and houses. Urban areas are particularly attracted to this form of roof because of its ability to reduce the effects of the urban heat island. Plants used in a green roof should be able to withstand changes in temperature and survive through different types of weather. The null hypothesis for the experiment was rejected. There was a significant difference among the types of plants used. It can be concluded that the vegetation with the most shade coverage is able to insulate better than vegetation with a smaller amount of shade coverage. This study was conducted using two different types of plants, *Hemigraphis alternata* and, *Chlorophytum comosum*. The control was soil without vegetation. The internal temperature of each container was compared when heat was added to the plants. The purpose of the experiment was to determine which type of plants are the most effective in insulating a container.

The Effect of Different Types of Water on the Amount of Iron, Hardness and pH

Rebecca Haeseker
Deep Run High School

In this experiment water was tested to see how much iron, pH, and hardness was in the water. The purpose for doing this project was to determine the amount of iron, pH, and hardness in different types of water. Iron levels in water determine how healthy the water is compared to other kinds of water. Hardness of water determines if the water cannot be drunk or if it is okay to drink. The hypothesis was, "If the filtered/treated well water was tested then it would have the most amount of hardness, iron, and pH." All the water had to be collected and then the water was tested. Then a t-test was conducted to determine if there were any significant differences between the group means. The results from the experiment were for the well water that was not treated has a higher content of pH then the other waters tested(7.6gpg). The water that was non-treated well water had a higher amount of hardness(59.9gpg), and iron(0.75ppm). There was no real big significance in variation for the iron, hardness, or pH groups. From this experiment the null hypothesis was accepted, therefore, the data did not support the research hypothesis.

The Effect of Sustainable Material on Absorbing Hydrophobic Liquid

Jonathan Hall
Mountain Vista Governor's School

There has been a marked increase in oil transportation and though not an increase in spills, the risk is still as high as it has ever been. The purpose of this experiment was to determine if the latest "green-revolution" idea, that sustainable material could outperform traditional synthetic materials in absorbing more oil per water, was statistically supported or if there was not enough of a difference to support the idea. The hypothesis was that there would be higher oil to water absorption amount in sustainable materials than in non-sustainable material. All absorbents had to absorb ten mL of oil that was in 200 mL of water. After ten minutes of absorption time the remaining mixture was measured in a graduated cylinder. The differences in three groups were measured. The standard deviation for the non-sustainable group was 0.04, the standard deviation for sustainable material was .24. T-test analysis resulted in p-values for the difference of the two materials. The P-value was .244 for this difference in the absorbent materials. The T-test analysis and p-values for the absorption differences support the null hypothesis and rejected the alternate hypothesis. This research could be expanded into more absorbents both sustainable and non-sustainable. It could also focus on returning oil in a usable form once it absorbed it from the water.

Environmental Science B

First Place

Antibiotic Resistance in the Fecal Coliform *Escherichia coli* in Wildlife

Eric Moran
Mountain Vista Governor's School

This paper presents research that tests to see if small mammals whose ranges lie in near proximity to farmland contain fecal coliforms that exhibit antibiotic resistivity at a higher rate than animals not affected by farmland. Sixteen fecal samples were collected from sixteen different individuals, and *Escherichia coli* isolated from each. The disk diffusion technique of resistance testing was conducted, using the drugs Tetracycline, Ampicillin, Neomycin, Streptomycin, Bacitracin, Penicillin, Chloramphenicol, Erythromycin, Sulfisoxazole, and Ciprofloxacin. The data was examined by way of the Chi-squared test for association; it was found that there was no association between farm proximity and resistance to any of the ten drugs. However, several of the individuals sampled contained multi-drug-resistant *Escherichia coli*, which indicates that drug resistance is somehow spread through the environment to wildlife.

Second Place

A Novel Water Quality Monitoring System for the Chesapeake Bay Using Landsat 5 Thematic Mapper

Darwin Li

Thomas Jefferson High School for Science and Technology

Landsat remote sensing can be used to infer detailed water quality information, but it has not been yet applied to the water quality monitoring of the Chesapeake Bay. This study has two objectives. The first is to develop algorithms that relate the water quality parameters (chlorophyll and turbidity) to Landsat 5 Thematic Mapper (TM) data; the second is to use these algorithms to create a web-based water quality monitoring system for the Chesapeake Bay.

TM data were obtained from USGS for six cloud-free scenes. In-situ water quality data were obtained from the Chesapeake Information Management System. For each TM scene, in-situ stations with measurements within three days of the satellite overpass date were matched up with corresponding pixels. Significant chlorophyll and turbidity algorithms were derived using multivariate regression analysis with correlation coefficients of 0.45-0.65 for chlorophyll and 0.73-0.89 for turbidity.

Based on these algorithms, a web-based, user-interactive monitoring system has been created. It allows users to navigate around the Bay and view the spatial patterns and computed values of chlorophyll and turbidity. See <http://www.monitorthebay.com/>

Third Place

Use of Algal Floway as a Tool for Removing Suspended Solids and Improving Water Quality

Ashley Meredith

H-B Woodman Secondary Program

The purpose of this project was to determine whether algal floways could be used as a tool for removing excess nutrients and pollutants from water. The primary goals of this project were to determine any variations based upon concentration of total suspended solids (TSS) in incoming versus outgoing water, nutrient and sediment levels based on the accumulation of algal biomass, and nutrient and sediment levels by location of the floway. Floway water was analyzed for TSS, nitrogen (PN) and particulate organic carbon (POC) concentrations at low, mid and peak algal biomass. Floway algae were analyzed for percent mineral versus percent organic content at mid and peak algal biomass. While there was a general trend of lower concentrations of TSS on the lower floway relative to the top of the floway, differences in TSS concentrations were too small for statistical analysis. The POC/PN analysis supported the idea that algal floways can remove particulate nutrients from the water. The LUDOX results showed that there was a higher percent mineral at the bottom of the floway than there was at the top. The ludox extractions also indicated a smaller proportion of mineral matter in the samples collected at 3-days relative to samples collected at 7 days. No differences were found between TSS and PN removal by geographic location. The data indicate that the algal floway may be a useful tool for improving water quality through removal of TSS, POC and PN.

Honorable Mention

Carbon Sequestration in Northern Virginia Groundcovers

Benjamin Jenks
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Washington Lee High School

Abstract

Plants sequester carbon during photosynthesis. Some plants sequester more carbon than others. This experiment was designed to determine which commonly planted groundcover in northern Virginia sequesters the most carbon. The three plants tested were Liriope, English Ivy, and Tall Fescue. Four of each plant were put in individual growth chambers, with one left plant-less as a control. The concentration in parts per million of carbon dioxide was measured in the morning and early evening to determine how much carbon dioxide was sequestered during photosynthesis each day. The result, as hypothesized, shows English Ivy sequesters the most carbon of the three plants, although none of the plants produced a net decrease in carbon, most likely because of CO₂ produced by the soil in each chamber. This author recommends that English Ivy be recommended to citizens of northern Virginia as a “climate friendly” groundcover, one that will remove more carbon dioxide from the air than Liriope or Tall Fescue.

Honorable Mention

Comparison of Fish and Macroinvertebrate Species Richness Relative to Water Quality in Forest and Urban Streams

George Maurakis
Mathematics and Science High School at Clover Hill

Species richness and functional feeding groups (FFG) of macroinvertebrates and fishes have been used to measure the ecological health of streams. Objectives of this study were to determine effects of ammonia nitrogen, alkalinity, substrate pebble size and human population on fish and macroinvertebrate species richness in an urban stream (Roberts Branch, Chesterfield Co., VA). A forested stream, Jones Creek, Powhatan Co., VA was the control. The hypothesis was if ammonia-N, alkalinity, substrate pebble size and human population increase, then fish and macroinvertebrate species richness will increase. Independent variables were ammonia-N, alkalinity, substrate pebble size and human population. Dependent variables were fish and macroinvertebrate richness, and macroinvertebrate FFG richness. Ammonia-N was positively correlated with population. Both ammonia-N and population were inversely correlated with numbers of macroinvertebrate FFG and taxa. Substrate pebble size was positively correlated with macroinvertebrate taxa richness and FFG richness. Average macroinvertebrate taxa (22.6) and FFG richness (9) in Jones Creek were significantly higher than those (6.0 and 6.0, respectively) in Roberts Branch, where FFG occurrence (30) and total taxa (15) was about four times less than occurrence (115) and total taxa (51) in Jones Creek. Increased population in Roberts Branch associated with higher ammonia-N, and smaller pebble size

resulted in lower taxa and FFG richness of macroinvertebrates. The null hypothesis is rejected as taxa and FFG richness of macroinvertebrates decreased with increased ammonia-N and population. As there were no differences in fish richness between the two streams, the hypothesis for fish is accepted, indicating macroinvertebrates are less tolerant to water pollution than fish.

Also selected for presentation

Ultraviolet-B Protection of Different Cloths Assessed with *Dugesia dorotocephala* Regeneration

Jacob Jaminet

Central Virginia Governor's School for Science and Technology

The purpose of this study was to identify how well different types of cloth protect against ultraviolet-B (UV-B) radiation as assessed with *Dugesia dorotocephala* regeneration. The study was done at a local high school during December of 2011. The *Dugesia dorotocephala* were divided into four groups of seven. There were two control groups. Neither was covered with cloth, but one was exposed to radiation and the other was not. The experimental groups were covered with cloth, one with cotton cloth and the other with sun protective cloth. The *Dugesia dorotocephala* were measured by determining whether or not they displayed head formation after six days. A Chi-Square Test of Independence was run on the data. For this test, the planarians were divided by their experimental group, and whether they displayed eye formation or not after six days. An alpha-value of 0.05 was used, and the test resulted in a p-value of 0.58. Therefore, the alternate hypothesis was not supported, and the original hypothesis that there would not be any difference in the cellular regeneration between the experimental groups, was supported. In conclusion, this study did not show any difference between different types of cloth and their respective protective value against ultraviolet-B radiation on *Dugesia dorotocephala* regeneration.

The Effect of Pollutants (Grey Water and Road Runoff) on the Nitrogen Content of the Legume *Triflorum repens*

Allison Johns

Godwin High School

The purpose of this experiment was to investigate the effects of pollutants (road-runoff and grey water) on the nitrogen content of the legume, *Triflorum repens*. Pollutants found in the soil and water are known to effect plant grow and cause various other health and environmental threats (Magani, 2005). It was hypothesized that plants exposed to road-runoff would have the least nitrogen content and those watered with rain water would contain the most. Pollution could have a negative effect on nitrogen fixating bacteria in legumes such as clover; this could lead to a decreased nitrogen for other organisms which negatively affect the entire ecosystem.

The results revealed that clover watered with grey water had an average nitrogen content less than that of road-runoff and rain water. A t-test was performed on the data, it showed the results for grey water versus rain water were significant at a level of significance of

.001. Though the average of the second level was less than that of the control, road-runoff versus rainwater was not significant at .001. These results partially support the hypothesis.

These results are possibly due to the break-down of lipids in the nodule walls by the soap (Eriksson, 2001). It is also possible that nitrogen found in road-runoff masked damage done to the nodules. This experiment could lead to further investigation of the effects of other pollutants and environmental factors on legumes or on free-living rhizobia's nitrogen production.

The Source of Light Pollution in Fauquier County, Virginia

Virginia Johnson
Mountain Vista Governor's School

Light pollution, an effect of waste light, is an increasing problem in Northern Virginia. Sky glow, one of the few types of light pollution, is the most concerning form of light pollution because it obscures the view of the night sky for astronomers. The focus of this study was Fauquier County, Virginia. To measure the intensity of the light pollution in that area, a camera with adjustable exposure time was used to capture images of the night sky in eight different directions. Then, each pixel in the images was assigned a color according to the intensity of the light, which showed what direction had the most intense light, suggesting the presence of light pollution. The image taken of the northeasterly direction presented the most severe light pollution. Poisson statistics were used to assess error. This research can be used in the future to hopefully reduce the signs of light pollution. This will be done by using different lighting fixtures or ordering times in which lights should be cut-off.

The Effect of Nitrate Concentrations on Simulated Lake Water Ecosystems

Bless Jung
Central Virginia Governor's School for Science and Technology

Nitrate pollution in freshwater ecosystems has been affecting the water quality and the organisms. The purpose of this study was to determine if sodium nitrate concentrations had an effect on conductivity, *Pomacea bridgesii* growth, and *lemna* reproduction in a simulated lake water experiment. 0.95 L were placed in water columns constructed of 2 liter bottles, and 50 mL of sodium nitrate solution was placed in each of the four columns. The sodium nitrate solutions were set to 0 ppm (control), 250 ppm, 500 ppm, and 750 ppm. The *Pomacea bridgesii* and *lemna* were placed in the ecosystem simulating columns. Every three days, each water column was checked for conductivity, dissolved oxygen, pH, temperature, *Pomacea bridgesii* growth, and *lemna* reproduction. After eleven data collections, thirty-three days, a one - way ANOVA was performed for each independent variable. The conductivity was affected by the sodium nitrate because the p-value was 1.22577E-52, which is lower than the alpha value of 0.05. The conductivity means of each concentration suggested that sodium nitrate has a negative effect since if any nitrates are added the conductivity exceeds the suggested conductivity. Sodium nitrate did not affect *Pomacea bridgesii* growth since the p-value was above the alpha value. The statistics supported the original hypothesis, which was that sodium nitrate

concentrations had an effect on conductivity and did not change the *Pomacea bridgesii* growth, and *Iemna* reproduction. Also, after all the testing more algae, *Odeogonium* was found in the lower nitrate concentration columns. In conclusion, the nitrate pollution had negative effects on water quality by increasing the conductivity levels.

A Water Quality Study of Otter Creek and Lake, Amherst County, VA

Wyatt Kline

Central Virginia Governor's School for Science and Technology

The purpose of this study was to assess the water quality of Otter Creek and Lake, Amherst County, Virginia, and to determine if Otter Lake has a significant effect on the water quality of Otter Creek. This study was conducted on three sites, site one, just upstream of Otter Lake on Otter Creek, site two, in Otter Lake, and site three, just below Otter Lake on Otter Creek. Data collection was conducted for six weeks throughout November 2011 and January 2012.

The measured variables recorded in this study to determine water quality were dissolved oxygen in mg/L, conductivity in $\mu\text{S}/\text{cm}$, pH, temperature in $^{\circ}\text{C}$, and *E. coli* concentrations in a 1:100mL dilution. Single factor ANOVA statistical tests were conducted with alpha values of $\alpha=0.05$ in order to determine if a significant difference between sites exists. The results indicated that Otter Lake water parameters had no effect on the water quality of Otter Creek, with p-values ranging from 0.65 to 0.84. The original hypothesis that both Otter Lake and Creek will meet VADEQ and EPA water quality standards, was not supported by the results of this study. In conclusion, Otter Lake had no effect on the water quality of Otter Creek, and Otter Creek and Lake did not meet respective standards for pH and *E. coli* concentrations, while meeting respective standards for dissolved oxygen, temperature, and conductivity.

The Correlation Between Earth's Sand Dune Features and Titan's Sand Dune Features

Stephanie LaFever

Mountain Vista Governor's School

This experiment's aim was to see whether or not Earth's sand dune features were like another planet or moon's sand dunes. Many planets are said to be similar to Earth in different ways: weather, landscape, atmosphere, etc. Titan, one of Saturn's moons, was similar to Earth in many aspects and in doing some research the sand dunes had a lot of numbers recently configured. The experiment was conducted using these numbers from NASA's website. By calculating the different features of Titan and Earth using the Mann-Whitney U test the results received on comparing these two masses. Using this test the P values show that the null hypothesis was incorrect, and the alternative wasn't disproved. There were numerous errors that could have and did occur in this experiment though. There weren't a lot of data on Titan's land features. Sand dunes on Titan were scarce and there was barely enough to do the test. Also the fact that Earth is bigger than Titan made it hard to compare it overall and in later studies of other features.

With this experiment you can get a better idea how close Titan's land features are like Earth's land features. This experiment could lead to testing other land features on Titan to compare to Earth. After multiple trials in different land features, it can be hypothesized even further how alike Titan is to Earth.

The Effect of Insect Repellant Applied Times on Zucchini Height

Emily Lawrence
Deep Run High School

Botanical insecticides are one type of pesticides and pose little threat to the environment or to human health; they are alternatives for synthetic chemical insecticides for pest management. Only a handful of botanicals are currently used in agriculture in the industrialized world, however, because they can be expensive compared to other pesticides. Zucchini is usually easy to grow, but can be easily affected by pesticides, such as insecticides. A large extent of insecticides are not only absorbed into the soil but are introduced in plant tissue. This depends on the type of soil, plant, and the nature and concentration of the insecticide. The purpose of this experiment was to determine the effect of insect repellant on zucchini plants at different stages of growth. Holder A was fed with water that is mixed with insecticide (1 teaspoon) before plant growth and only for one of the days. This was repeated with holder B, but 11 days into growth. This was repeated with holder C, but after the plants grew for 21 days. Holder D was the control and was not fed the insecticide. Based on the ideas that stated that zucchinis intake a lot of insecticides if they come in contact, it is believed that if the insecticide is applied to the zucchini plants before, during, and after growth, then the plant receiving the insecticide after growth will be affected the most. The t-test was used to test the following null hypothesis at a 0.05 level of significance: The insect repellant applied at different stages of growth has no effect on the zucchini plant height. The null hypothesis was accepted when the insect repellant was applied before growth compared to no insect repellant applied ($t = 1.66 < 2.110$ at $df = 17$; $p > 0.05$). The data did not support that zucchini plants that received insect repellant after growth would be the most affected.

The Effect of Type of Absorbent on the Amount of Oil Collected

Margaret Lenz and Ann May
Warwick High School

The experimenters conducted this experiment to create a general conclusion on what material would be effective absorbing oil in an oil spill cleanup. Before experimenting, the students gathered a bucket of James River water and inexpensive materials (human hair, dog training sanitary pads, kitty litter, cotton, wool, and newspaper) that they believed would be effective in absorbing oil.

The students made an oil and James river water suspension with 3 cups of water and $\frac{1}{4}$ cup of oil, and then measured it on an electric scale. Prior to testing they let the suspension sit for five minutes so the oil could spread on the surface of the water. Then, they cut 12 inch long strips of packaging tape and applied the selected absorbent to test and weighed it. They laid it over the oil/water for 30 seconds and weighed it again to see how much oil it collected.

Out of all of the materials tested the experiment found that newspaper was the most effective absorbent. Next came cotton, followed by wool and dog sanitary pads tied for third and then human hair. The experiment found that kitty litter absorbed the least amount of oil.

The Effects of Different Nitrate Concentrations on *Spirogyra* Growth

Brian Leveque

Central Virginia Governor's School for Science and Technology

Abstract not submitted

The Effect of the Environment on the Amount of Time Hairstyle Lasts

Ashton Lim-Wilson and Darby Smith

Deep Run High School

People use different straightening crème every day. Whether the crème was bought based on the quality, price, or just by looks there is not any scientific proof that shows that it is the best one to use. Buyers don't pay attention to the credibility the product really has, or if it even works; the product is just bought in hopes that it works. But some people might like to know if the product that was bought is actually worth the money that was spent.

The purpose of this project was to determine if the Pantene straightening crème worked, and whether it kept hair straight while in changed environments. In this experiment, Pantene straightening crème was used in four different environments for a certain period of time with the Pantene straightening crème in ten test subjects' hair to test if and how long the hair remained straight. Each test subject was placed in the four environments for one hour. The humidity and temperature levels were recorded as well as the condition the hair was in after an hour had passed. For each environment a mean was recorded of the amount of time the hairstyle lasted. Indoors the mean was sixty minutes. Outdoors the mean was fifty-two point three. In an automobile the mean was sixty minutes. Near a body of water, the mean was forty-one point one minutes. A t-test performed on the data indicated a significant difference between the means of the groups ($t=0<2.101$ at $df=18$; $p>0.05$). The data supported the research hypothesis that while being in a car, the hairstyle lasts longer and remain uncontaminated than being in the other tested environments.

Based on the means recorded in this experiment, indoors and automobiles had the highest length in which the hairstyle lasted versus outside and by a body of water. It has been concluded that Pantene is a straightening product that does its job with a slight imperfection, which is the outdoors. Once the product can avoid the different elements in the atmosphere, it could truly be the top straightening product.

Heating Water with Recycled Boxes and Chip Bags

Gracia Luoma-Overstreet
Washington Lee High School

The purpose of this experiment is to examine the practicality of capturing and exploiting renewable energy, using recycled materials. Energy scarcity is a persistent problem in today's resource-based economy. This experiment examines three different solar ovens constructed of recycled materials: one made primarily of insulating materials (black material and a double layer of boxes), one made of reflective material (the inside, shiny part of used, clean chip bags), and one made of both insulating and reflective material. The hypothesis is that the oven made of both reflectors and insulation will heat a cup of water to a higher temperature than either of the other two or the control (with no solar oven), because more light will be captured and concentrated than any of the other configurations. After ten days of trials heating the water in each experiment for eighty minutes, the data showed that the oven with insulation and reflective materials consistently heated to the highest temperature. The mean for the primarily-insulated configuration was 5.3°C, the reflective configuration was 6.3°C, the configuration with both was 15.3°C, and the Control - simply a cup in the sun - was 4.5°C after eighty minutes. ANOVA tests showed that there was a significant difference between the four experiments, and therefore, the hypothesis is supported. This means that while the limited temperature rise suggests that an alternate construction might be required for such an oven to be practicable, using insulation and reflectors heats a substance faster than either reflectors or insulation would on its own.

Environmental Science C

First Place

The Effect of Varying Concentrations of Acetaminophen on the Reproduction of *Daphnia magna*

Lindsay Riordan
Central Virginia Governor's School for Science and Technology

The purpose of this study was to determine the effects of varying acetaminophen exposure on the reproduction of *Daphnia magna*. *D. magna* in the juvenile stage of life were placed in glass jars filled with varying concentrations of acetaminophen solution (0mg, 18mg, 36mg, and 72mg). *D. magna* were observed for 14 days and their population was counted on the final day. While the control group nearly doubled its population, the groups exposed to acetaminophen were all killed. Linear regression analyses were run, showing a significant difference between the control group and the three test groups. From analyzing the slopes of the lines of best fit, the 0mg group had a p-value of 9.55E-17, the 18mg group had a p-value of 1.96E-06, the 36mg group had a p-value of 1.33E-3, and the 72mg group had a p-value of 3.91E-3. The slopes were thus assumed correct

with regard to their statistical significance. An analysis of the confidence intervals for the slopes of the lines of best fit indicated a statistically significant difference between the control group and the three test groups, but not between the three test groups themselves. The original hypothesis that, "if the amount of acetaminophen exposed to *D. magna* increases, then the number of *D. magna* living after the exposure will decrease," was supported by the data. In summation, the presence of acetaminophen in aquatic environments significantly affects the reproduction of *Daphnia magna*.

Second Place

The Effect of Wind on the Water Level of a Wind-tidal Marsh

Caroline Robinson
Ocean Lakes High School

The purpose of this experiment was to investigate the effect of wind duration, direction, and speed on the water level of a wind-tidal marsh. The research hypothesis was if the wind (addressing wind speed, duration, direction) increased, then the water level of the wind-tidal marsh would increase. The null hypothesis was that the wind would have no effect on the water level variation. Water level data was recorded for five months in a well installed at West Neck Marina, a site on the upper end of a wind-tidal marsh. The water level was measured with a pressure transducer and a barologger. Wind data collected at three surrounding weather stations were combined in various running-average calculations using Excel spreadsheets. A t-Test was used to contrast the water levels created by Northerly and Southerly winds. The p value for this test was 1.52×10^{-14} which was much less than a 0.05 level of significance indicating that there was a strong significant difference in water level when winds blew from the north versus the south. This t-Test rejected the null hypothesis. Two key findings of this study were that winds that blew from the south resulted in high water levels and winds that blew from the north resulted in low water levels, and duration caused an effect on water level in both northerly and southerly winds. In conclusion, several formulas were developed using wind speed, direction, and duration to predict the water level at a wind-tidal marsh which supported the research hypothesis.

Third Place

The Effects of the Condition of the Pacific Ocean on the Number of Landfalling Hurricanes on the East Coast of the United States

Michael Spagnolo
Atlee High School

This experiment was conducted to determine if the condition of the Pacific Ocean, specifically El Niño and La Niña, affect where hurricanes make landfall in the Atlantic Ocean. This project is a continuation of a previous project on which condition in the Pacific Ocean causes more hurricanes to form in the Atlantic. Being able to accurately and consistently predict where hurricanes will go in a certain year is key to preparing the

public in order to preserve life, property, and the environment.

During an El Niño and La Niña, the water temperature changes in the Pacific Ocean. This affects worldwide weather, including the wind currents in the atmosphere. It was hypothesized that if a La Niña is occurring, then the number of hurricanes that strike the east coast, Georgia through Maine, will go up. This is due to the more likely formation of Bermuda Highs over the central Atlantic Ocean. There were three independent variables in this experiment, years with an El Niño, a La Niña, and those where the water temperature was average. Depending on these conditions, hurricanes appeared to take different tracks around the Atlantic. The experiment was completed by looking at past data in a NOAA computer database. Data from four water basins were looked at and were included in every test: the East Atlantic, the West Atlantic, the Caribbean Sea, and the Gulf of Mexico. The control of this experiment was the number of hurricanes that made landfall in a neutral year. Appropriate options such as pressure, hurricane intensity, ocean basin, and most importantly, timeframe were selected in the computer database. Then the number of landfalls from Georgia to Maine was recorded. Means were calculated and graphs were created to compare the data. A t-test and R-value was also calculated, and the null hypothesis was rejected when comparing El Niño years to La Niña years but accepted when comparing neutral years to El Niño and La Niña.

Honorable Mention

The Effect of Water Quality on the Growth of *Spongilia* gemmules

Zachary Roman
Langley High School

Spongillidae, freshwater sponges, are sessile, benthic macro invertebrates that filter large amounts of water in their feeding process. For this reason, and due to anecdotal evidence, freshwater sponges are assumed to be highly sensitive to water quality. This experiment was designed to test the hypothesis that if freshwater sponge gemmules were grown in water from high water quality streams then they would reach a further stage of development, on average, than the stage of development reached by freshwater sponge gemmules grown in water from poor water quality streams. The waters from the streams were designated as either “high quality” or “poor quality” based on assessments made by environmental monitoring personnel. Water quality parameters were also tested independently. The hypothesis was supported by the experiment. In addition, a higher percentage of gemmules expressed any growth in the high-quality water than in the poor-quality water. Gemmules in poor quality water ended development before the water vacuole system developed with a single exception. One gemmule grown in water sampled from the Potomac River, designated as poor-quality water, reached the final stage of development. This result indicates that, although sensitive, freshwater sponges can tolerate either low levels or different types of pollutants.

Honorable Mention

The Effect of Wastewater Treatment Plants on the Concentration of Estrogen in the James River

Meghan Stewart
Atlee High School

The James River represents a source of both economic and ecological significance to the surrounding region and the protection of aquatic communities from the introduction of pharmaceutical contaminants into bodies of water by means of wastewater treatment plants is an issue that must be addressed. Each level of independent variable or water sample was collected and analyzed by means of spectrophotometer in order to determine percent transmittance of each sample. The resulting values were compared with a baseline concentration graph in order to determine the concentration of estrogen in water samples taken along the James River. It was hypothesized that if a sample is taken near the wastewater treatment plant, then the concentration of estrogen in that sample will be higher than samples taken from areas farther away from the treatment plant. In each instance, with the exception of C versus E, the null hypothesis stating that wastewater treatment plants did not contribute to the estrogen concentration of the James River was rejected ($t=2.94>2.26$; $t=7.01>2.26$; $t=9.73>2.26$; $t=5.18>2.26$; $t=10.66>2.26$; $t=6.58>2.26$; $t=12.38>2.26$; $t=3.62>2.26$; $t=12.66>2.26$; $t=3.88>2.26$; $t=2.1<2.26$; $t=14.51>2.26$; $t=5.74>2.26$; $t=15.66>2.26$; $t=13.64>2.26$). The research hypothesis was supported by the outcome of this experiment. From these results it was concluded that Richmond's Municipal Wastewater Treatment Plant was responsible for an increase in the concentration of estrogen in the James River.

Honorable Mention

Recycling Water Using Household Purification Methods

Sierra Swisher
Shenandoah Valley Governor's School

Water crisis and shortages of available freshwater force people all over the world to discover innovative methods to recycle water. The purpose of this research was to explore effective and convenient methods of recycling used water at home. The used water was collected from a single person's shower. Water samples were tested using Hach® Test strips and Watersafe® bacteria test kits for Alkalinity, Hardness, pH, Nitrates, Nitrites, and bacteria before and after a boiling, distillation, or filtering process. Then the effect of each purification method was compared to see which removed the most impurities. The results, based on ANOVA and Tukey tests, showed a statistically significant decrease in the levels of Total Hardness, Total Alkalinity, pH, and Nitrate present in the water after the filtering, boiling, and distilling processes; however, the decrease was far less significant following the boiling process. The researcher concluded that filtering lowered the Total Hardness and pH significantly, and distilling lowered the

Total Alkalinity and Nitrate levels significantly and killed bacteria, while boiling only killed bacteria. Therefore, the researcher inferred that a combination of filtering and distilling would create a source of recycled water that is healthy for using within the household.

Also selected for presentation

The Effect of Various Salinities on Algae Growth

Anna Peyton
Mountain Vista Governor's School

The objective of this experiment was to test the effects of salinity on the growth of green hair algae. The hypothesis was if the salinity is increased, then the amount of algae growth will decrease. There were six experimental groups, each with different salinity levels. The algae was then left to grow for five weeks in an environmental chamber to see if the salinity had an effect on the algae. The growth of the algae was measured in terms of absorbance, which was measured by a spectrophotometer. The optical density of each culture was measured at the same time once a week. The algae showed more growth in the high salinity solutions. The average final absorbance for solutions above 1.020 SPG was higher than that of those below. Therefore, the hypothesis was rejected. The results suggest that algae is more tolerant of high salinity water.

The Effect of Location on Potomac River Water Quality
Lara Phillips
Yorktown High School

The purpose of this experiment was to test the water quality of the Potomac River relative to the location along the river being sampled. The independent variable in this experiment was the location on the Potomac River in which water was sampled, and four different testing sites were selected: Brunswick, Maryland (60 miles northwest of D.C.), Great Falls, MD (17 miles northwest of D.C.), Key Bridge, D.C, and a marina near Alexandria, VA (6 miles south of D.C.). The dependent variable in this experiment was the water quality of the tested locations on the Potomac River. Six different water quality tests were used: dissolved oxygen content, pH, total nitrate content, total phosphate content, total dissolved solids, and temperature.

It was hypothesized that overall water quality would be best among the four locations on the Potomac River in Brunswick, Maryland, because this was the farthest upstream location selected. One value was obtained for nitrate content, phosphate content, and dissolved oxygen content, whereas 10 trials were performed to collect measurements of temperature, pH, and total dissolved solids. The hypothesis was only supported by measurements of total dissolved solids content: the farthest downstream location, the marina, had a statistically significant higher TDS data value than the other locations. All temperatures of each location fell within an acceptable range, as did pH. Measurement tests of nitrate content indicated contamination at all four sites. All four locations, except for Key Bridge, had a phosphate content level below the maximum limit. Dissolved oxygen content at each site was within the acceptable range, or better.

The Effect of Pollutant Salts on Rotifer Survival

John Ryan
Hanover High School

The Chesapeake Bay is currently an environmental disaster, poisoned by runoff pollution from farms and cities. These pollutants boost algae population, which corrupts the bay ecosystem, killing fish and other organisms. It is possible that pollutants are also depleting the food web in the bay, which enhances algae growth. Rotifers are a natural algae predator. Previous work on this project found that at the 60ppt concentration, KCl and NaCl killed all rotifers in three hours, while $MgCl_2$ and $CaCl_2$ required 24 hours to reach maximum toxicity. The purpose of the current experiments was to test the effects of runoff pollutant salts on rotifer mortality and reproduction. There were three hypotheses tested. The first was if rotifers are exposed to KCl and NaCl at 60ppt, these salts will be rapidly toxic. For the reproduction experiment, the hypothesis was if rotifers are treated with KCl at non-lethal concentrations, then KCl will slow rotifer reproduction. For the temperature experiment, the hypothesis was if rotifers are treated with KCl at non-lethal concentrations, then KCl will become toxic when combined with heat stress. The results showed that KCl and NaCl were rapidly toxic at 60ppt. At lower concentrations, KCl did not affect rotifer reproduction or mortality due to heat stress. The data can determine the number of certain salts that are dangerous for the environment, such as NaCl used in road salts and KCl used in fertilizers. These results demonstrate that runoff pollutant salts can be toxic to members of the food web and show that some salts are more toxic to rotifers than others.

Groundtruthing Side Scan Sonar Images for Oyster Restoration in the Chesapeake Bay

Anita Shammee and Shannon Smith
Thomas Jefferson High School for Science and Technology

Oyster populations in the Chesapeake Bay have been reduced to one percent of their historic number. The low numbers can be attributed to overharvesting, disease, and pollution. Restoration efforts are aimed at improving current oyster population levels by using side scan sonar images as a baseline map of potential restoration sites. Groundtruthing the acoustic data with video footage is essential to obtain a better understanding of where oysters are most likely to succeed at settling and forming new reefs. The National Oceanic and Atmospheric Administration (NOAA) vessel R/V Bay Commitment visited 25 potential restoration sites in and surrounding the Miles River sanctuary in the Chesapeake Bay in early February. Video footage of the bottom was recorded and used as the primary tool to identify the type of substrate found at each site. A Ponar bottom grab sampler was used to supplement the video data at 7 of the 25 sites. Sites with shell fragments from previous reefs and little to no evidence of sedimentation are the strongest candidates for oyster restoration efforts. 16 of the 25 sites exhibited conditions most suitable for restoration. Though there is no clear definition of restoration, it is important to protect existing oyster reefs and promote future growth so that the overall health the Chesapeake Bay can experience positive changes. Further research into

substrate materials best suited for establishing an oyster reef foundation is necessary to preserve monetary resources and to cut down the hours wasted on failed restoration attempts resulting from improper substrate conditions.

The Effect of Rain on the pH of the Stream in Woodland Park

Julia Simon
Wakefield High School

The ecosystem of a stream is extremely delicate. Even the smallest things can have catastrophic effects on the life that lives in the stream. This experiment was performed to find the effect of rain on a stream. The effects of rain were measured by measuring changes in the pH of the water. Data were collected and recorded every day for 30 days every afternoon in Woodlawn Park. The pH was measured using a Vernier pH meter. Measurements were taken at the same place, about 2 feet away from the bank. The pH meter probe was stuck in the water about 3 cm deep. The weather conditions were also recorded for each individual measurement. It was found that there was a statistically significant difference between the pH of the stream water when it rained and the pH of water when it did not rain. The pH averaged 6.28 when it rained, and 5.74 for when it did not rain. The difference may not seem very large, but it could very well affect the type of organisms that can inhabit the stream.

The Effects of Manual and Chemical Removal of Japanese Stiltgrass

Bryn Sonnett
Mountain Vista Governor's School

This research investigates the effects of the manual and chemical (glyphosate) removal of invasive species, *Microstegium vimineum*, on soil quality by testing the overall nutrient and pH levels of the soil compared to a control grow bed of undisturbed indigenous plants and soil. The participants were a grow bed of indigenous plants and *Microstegium vimineum* sprayed with glyphosate, a grow bed of indigenous plants and *Microstegium vimineum* manually weeded from the bed, and a control bed containing both undisturbed indigenous plants and invasive species *Microstegium vimineum*. By examining the Phosphorus, Potassium, Nitrogen and pH levels of these grow beds, this paper compares the results of manual weeding and pesticide removal. The null hypothesis predicted that the compared grow beds would demonstrate no differences in nutrient content or pH level of the soil. Six weeks of nutrient and pH testing revealed p-values of 0.11 for pH, 0.64 for Potassium and 0.46 for phosphate. Nitrogen tests were not evaluated due to insufficient readings. These p-values were all close or below the significance level, therefore concluding the rejection of the null hypothesis because the alternate could not be fully supported.

The Effect of a Stream's Proximity to Urbanization on Water Quality of the Stream

Austin Wash
Hanover High School

The purpose of the experiment was to determine whether or not a close proximity to mild urbanization had a substantial influence on the health of a nearby tributary and how far the effects, if any, are carried. The purposes of the experiment required the use of a tributary that flowed in the opposing direction of urbanization, and the stream's health was determined by testing multiple water samples from three locations for pH, dissolved O₂ concentrations, temperature, and clarity, and by analyzing the water samples for their inhabitants. Trial one, a location within 20 feet of urbanization, exhibited a mean pH of 7, 6 ppm of dissolved O₂, a mean clarity of 10 JTU, and a mean temperature of 12.67 degrees Celsius. This is perhaps due to a large rain influx before the data were collected, along with a stable temperature and the fact that the stream runs through coarse clay rather than fine sediment. Trial two, located 100-200 yards away from urbanization, boasted a mean pH of 8, 5.67 PPM of dissolved O₂, a mean clarity of 20 JTU, and a mean temperature of 12.67 degrees Celsius. Like the first site, location 2 was analyzed during a stable period of heavy rain and relatively cool temperatures, though the sediment in location 2 is clearly finer and more easily carried downstream. Location three was located 500 or more yards away, and had a mean pH of 7.33, 5 ppm of dissolved O₂, a mean clarity of 40 JTU, and a mean temperature of 13 degrees Celsius. Location 3 was considerably larger than the other two and was bedded with sand rather than clay, leading to a higher turbidity and less dissolved O₂. Site 4, a spring fed stream with no immediate association with urbanization, featured a mean pH of 7.33, 6 ppm of dissolved O₂, a turbidity of 40 JTU, and a mean and constant temperature of 12 degrees Celsius. The spring was bordered by soil rather than clay which may explain its turbidity, and the groundwater that fed this tributary is obviously colder than surface water.

The Effect of Nitrates on Well Water and Stream Water

Madeleine Wirth
Shenandoah Valley Governor's School

The purpose of this study was to determine if there is a difference between the nitrate levels of well water and stream water. The samples were collected from the same general geographic area, and a *t*-test was conducted on the data. The water's nitrate levels are important because of the physical health effects that nitrates can incur. With a *p*-value of .000212, the results rejected the following null hypothesis: there is no difference between the nitrate levels of well water and stream water.

MATH, STATISTICS, & COMPUTER SCIENCE

First Place:

A STUDY OF FINANCIAL VIABILITY BETWEEN WATER RECLAMATION AND DESALINATION PLANTS

Jonathon Morrissey and Gene Rhee

Godwin High School

This paper compares the financial viability between water reclamation and desalination facilities. Data including investment costs, plant capacity, and its treatment method were obtained from various plants and used in statistical analysis. A two-sample t test and two chi-square goodness-of-fit tests were performed to evaluate the statistical significance of the data. It was found that although the means would suggest that water reclamation had a lower investment in water capacity the finding was proven to be not statistically significant, thus rejecting the research hypothesis. However, through this research, water reclamation has proven to be just as viable, if not more viable, financially than desalination. This may encourage investment into water reclamation despite its public unpopularity.

Second Place:

HOW THE METHOD OF SHUFFLING AFFECTS HOW WELL A DECK IS SHUFFLED

David Casey

Shenandoah Valley Governor's School

There are two very common and similar ways for shuffling a deck of cards that have completely different effects on a deck of cards. One way to measure how effective a method of shuffling is by looking at the spread of each initial pairing. The purpose of this test was to determine which method of overhand shuffling, stripping or alternating, increased the spread of the deck the most quickly. A value was determined that showed how quickly shuffling causes a deck to grow to the average spread. A t-test was then used to compare the value of rate of growth. The results showed that the spread of a deck shuffled with alternating grows about twice as quickly as a deck shuffled by stripping.

Third Place:

CPI-T: A CONSUMER PRICE INDEX AND INFLATION FROM THE TEENAGE PERSPECTIVE

Daniel S. Winter

Ocean Lakes High School, Virginia Beach, VA 23454

The United States Bureau of Labor and Statistics releases a monthly publication known as the Consumer Price Index, or CPI, that is highly regarded as a track on inflation rates and an overall market indicator. The CPI tracks the effects of inflation for adult, American salary workers but neglects to try and understand the inflation affecting millions of teenage consumers across the country. The purpose of this research was to determine the general spending habits of Virginia Beach's urban, teenage population and use that information to create a demographic specific Consumer Price Index to track inflation on teenage spending. The hypothesis was stated: if teenage spending habits in Virginia Beach are used to create a demographic specific Consumer Price Index, then the inflation rates illustrated will have increased much more rapidly over the last 10 years than those described in the national CPI.

Students were surveyed by a randomized, cluster method using a questionnaire that divided personal spending among sixteen sub-categories belonging to six major categories. Each category's relative importance was weighted, the CPI equation created, and data was extrapolated over the last decade to track inflation.

Over the experimental timeframe, the experimental index inflated more rapidly than the control, government index. It grew by a net decade percentage of +29.71% compared to the control which grew only +23.13%. This differential was significant enough to support the research hypothesis; inflation and its relative effects on urban teens increase more rapidly than inflation relative to adult, urban consumers.

Honorable Mention:

EFFECTS OF THREE CONSTANT ALGORITHMS AND INFINITE PERMUTATIONS TO SOLVE RUBIK'S CUBE

Miceile Barrett

Fauquier High School, Warrenton, VA 20186

Now known as a puzzle that can be found in almost every household, the Rubik's Cube is an advanced mathematical test containing a variety of challenging games. This paper discusses a potential theory that can be used to reduce the number of steps needed to complete the cube from a scattered position. Group theory, even permutation properties, arrays, crossing number diagrams, combination analysis, and Rubik's Cube languages were used to analyze the effects of three created algorithms with infinite permutation

possibility. This mathematics research showed that the Rubik's Cube could be solved within the limit of only using the three algorithms. Maplesoft 12 software was used to account for the letter and symbol language of the Rubik's Cube and for the 4.3×10^{10} possibilities of movements. To create visual images and test the initial algorithmic sequencing, CubicRubiks software was used with a numeric representation of Rubik's Cube's language. As a result of the procedure mentioned in this paper, a new Maplet, (fully functional with Maple 5 – 14) was created for the 3x3 Rubik's Cube based on the Maplet designed for the 2x2 cube in 2000. This described theory of solving the cube could allow the player to solve the cube from any position without a reference to a previous solution and without relying on certain sequential sequences. The Rubik's Cube is comprised of a unique shape that contains fifty-six possible faces. This paper discusses the possibility, currently being studied at Massachusetts Institute of Technology, of sending Rubik Cube like structures into space as small and extremely powerful memory devices.

Honorable Mention:

AMYLOID-BETA ONSET Ca^{2+} INFLUX AND COUPLING PRODUCE DELTA BURSTS IN EEGs: A MATHEMATICAL APPROACH

Archis R. Bhandarkar

Thomas Jefferson High School for Science and Technology Alexandria, VA 22312

The purpose of this experiment had been to biophysically model the electrophysiological factors associated with Alzheimer's Disease (AD) pathogenesis. Namely, the localized calcium cation influxes and network amyloid beta coupling that are associated with AD had been focused on in the modeling process. The Hodgkin-Huxley model (a biophysical series of differential equations that model the action potential), alongside additional equations modeling the action of calcium channels, had served as the basis of the single neuron model. The single neuron model characterizes the behavior of single neurons treated with amyloid beta, exhibiting the neural silencing behavior attributed with AD. A network model had been constructed with over 150 of these models interacting with each other to produce a time graph of a theoretical local field potential. Similarly, this local field potential captures the delta rhythm behavior associated with the EEG of AD patients. In conclusion, the model manifests itself as a biophysically significant correlate to the electrophysiologic patterns associated with AD pathogenesis.

DO HOMEOWNERS AND RENTERS PAY THE SAME AMOUNT OF PROPERTY TAX PER STUDENT PER YEAR?

Alex Saxerud

2006 N. Taylor St. Arlington, VA 22207

Washington-Lee High School, Arlington, VA 22201

The purpose of this experiment was to find if homeowners paid more in property tax per student per year than renters. The hypothesis was: Renters pay less in property tax per student than homeowners. In this experiment, data on renters and homeowners were analyzed. Since the data was collected from the US Census Bureau and Arlington County, there were no tests or trials. The analysis was done on Microsoft Excel after all data was collected. The homeowner data was collected from the Arlington County Department of Community Planning, Housing, and Development (CPHD). The tax data was from the Arlington County Treasurer's Department, and the number of school age children from the Census Bureau. All miscellaneous data was from the Census Bureau and the Arlington County Profile and Report to the Citizens. The data was collected for 1990, 2000, and 2010.

Renters paid on average \$2,739, \$4,009, and \$8,376 per student for the years 1990, 2000, and 2010 respectively. Homeowners paid \$5,201, \$6,234, and \$13,327 per student for 1990, 2000, and 2010 respectively. The conclusion was that homeowners were paying more per student. It is also shown that what homeowners pay per student is accelerating. Because a full data population was used, there was no need to do statistical analysis; therefore, all conclusions could be drawn based on the actual data. In that regard, it was shown that renting an apartment is the more affordable way to live concerning property tax. It is especially beneficial for renters with children.

THE EFFECT OF DIFFERENT CIPHER CODES ON THE LENGTH OF TIME A BRUTE-FORCE ATTACK WILL TAKE TO BREAK THROUGH

Steven Adriano

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Mountain Vista Governor's School, Middletown, VA 22645

Abstract:

This paper examines brute force attacks on different ciphers and the length of time it will take to break through them. The five ciphers that were tested in this research were the

Advanced Encryption Standard (AES) 128-bit, Advanced Encryption Standard 256-bit, Data Encryption Standard (DES), Triple Data Encryption Standard (3DES), and Rijndael. These were tested on the null hypothesis that there is no difference between the ciphers and the length of time, and tested on the hypothesis that AES 256-bit would take the longest to be broken through. These hypotheses were tested by calculations made based on optimization of values for the cipher and eight character keys, workload, and time. The results showed that the null hypothesis was rejected and the hypothesis was supported. This research supports that AES 256-bit is the strongest of these ciphers against a brute force attack.

Keywords: Advanced Encryption Standard, Data Encryption Standard, Triple Data Encryption Standard

THE EFFECT OF KEYBOARD LAYOUT ON FINGER MOVEMENT

Kelvin Chen

Deep Run High School

Abstract:

The keyboard has been in use since the invention of the typewriter, and many different keyboard layouts have emerged since then. Each keyboard layout places the keys in different locations, and this project was started to determine the optimal layout. The hypothesis was that if different keyboard layouts were used, then the Dvorak layout would require the least finger movement. This hypothesis was tested using a computer program to calculate the finger movement required for a text. The text used in this investigation was The First Folio. Ten repeated trials were used. The experiment revealed that the data was significant ($t = 7005.56907348 > 2.101$; $t = 8911.32253397 > 2.101$; $t = 46.2610757872 > 2.101$; $t = 938.92712446 > 2.101$; $t = 8962.21981703 > 2.101$; $t = 12847.0872821 > 2.101$ at $df = 18$; $p < 0.05$). Although Dvorak did not have the least finger movement, it held a close second against the Colemak layout. This may be due to their efficient separation of the vowels and consonants. Before it can be concluded that keyboard layout affects finger movement, a more detailed investigation should be conducted.

THE EFFECTS OF SAFETY PRECAUTIONS ON THE AMOUNT OF ACCIDENTS IN EMERGENCY TRANSPORT

Amy Conner

Abstract:

Lights and sirens may have an effect on the safety during emergency transport. The problem comes when drivers become distracted, and do not see the lights, hear the sirens, and in all of cases, the distracted drivers do not realize that there is an emergency vehicle rushing towards them. The purpose of this study was to determine if the use of lights and sirens increase the safety of emergency transport. Data from the Greater Augusta County were tested with a Chi-Squared statistical test. The data of the number of accidents with the use of lights and sirens and without the use of lights and sirens were compared and their results were analyzed with a Chi-Squared test that yielded no difference in the number of accidents with lights and sirens and those without lights and sirens. The researcher concluded that using lights and sirens is no safer than not using lights and sirens.

THE EFFECT OF TEMPERATURE AND QUANTITY OF REACTANTS ON THE RATE OF NEUTRALIZATION OF HYDROCHLORIC ACID AND SODIUM HYDROXIDE

Kimberly Farmer and Chase Greco

Atlee High School

Abstract:

The purpose of this experiment was to design a simulation for a chemical reaction, for example the common reaction of the neutralization of hydrochloric acid and sodium hydroxide.

The independent variables were the quantity of the reactants within the simulation and the simulated temperature. The dependent variable was the rate of the reaction. The research hypothesis was: If the simulated amount of reactants is increased as well as the simulated temperature, then the simulated rate of the reaction would increase. The null hypothesis was: If the simulated amount of reactants is increased as well as the simulated temperature, then the simulated rate of the reaction would not increase.

To test the effect of temperature and quantity of reactants on the rate of neutralization of HCl and NaOH a simulation of the neutralization was programmed in GML. The simulation was run for each level of the independent variable 10 times. The data was then compared to calculated values for how long it would take the reaction to occur in the physical world as well as lab data from the physical world to determine the validity of the simulation. T-tests were then conducted for each level of the independent variable.

The major findings of this experiment were that raising the temperature increases the rate of the reaction. However, increasing the amount of acid to be titrated reduces the rate of the reaction. This partially accepts the research hypothesis. However, this proves that the simulation was valid. This experiment could be improved by adding more levels of the independent variables in order to obtain more accurate rate curves.

THE DIFFERENCES IN TYPES OF ACCIDENTS CHARGED TO CONCRETE TRUCK DRIVERS AND TO OTHER DRIVERS

Adam Hawes

Shenandoah Valley Governor's School

Abstract:

Determining the differences in accidents charged to concrete truck drivers and to other drivers may help prevent accidents in the future. The purpose of this study was to determine what the most probable cause of an accident is and whether it was caused by the truck driver or another driver. A chi-squared analysis was used to determine if there was a difference between the types of accidents caused by the different drivers. Using this test, no statistical difference was found. This study found that the driver charged with the accident has an effect on what type of accidents it is.

ORIGAMI-FOLDING ALGORITHMS WITH UP AND DOWN FOLDS TO PRODUCE ANGLES, POLYGONS, AND POLYHEDRA

Meagan Leonard

Mountain Vista Governor's School

Abstract:

Previously thought of as only an art form, recent studies have revealed Origami to be a useful tool for demonstrating mathematics and solving real-life problems. A particular type of Origami demonstrated in Build your own Polyhedra by Hilton and Peterson relates to how certain fold algorithms employing up and down folds in a strip of paper can show convergence to certain angles. These can then be used to fold regular polygons and polyhedral by manipulating the folded paper strip. This paper examines whether any sequence of up and down fold will converge to a specific angle, and whether any regular polygon or polyhedron can be folded using the strips. By proof of the U^1D^1 angle convergence, and examination of different folding algorithms resulting angles, in particular the D^3U^1 sequence, the alternative hypothesis that any folding

sequence will converge to a specific angle was supported. As well the folding of regular polygons and all five platonic solids (polyhedral) supported the alternative hypothesis that any regular polygon and polyhedron can be folded from paper strips. Further research may investigate how quickly convergence of the different up and down sequences is obtained, or whether any repetitive folding process demonstrates convergence.

THE EFFECT OF USING CONTENT-BASED IMAGE RETRIEVAL ON THE ACCURACY OF SEARCH RESULTS

Vladislav Martin

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Washington-Lee High School, Arlington, VA, 22201

Abstract:

In this paper, the advantages of content-based image retrieval (CBIR) are discussed. To allow users to query a string of text and find related images, developers of many large corporations invented text-based image retrieval. Very quickly, problems with this approach to image retrieval were found. IN the 1980's, a technique known as CBIR emerged. Now, multimedia companies such as Verizon, CNN, and others use image retrieval systems to find accurate matches to images that contain security, medical, or other information. Such image retrieval systems all had one problem: efficiency. CBIR is a new innovative technique, publicized by IBM's Query By Image Content (QBIC), that is still being revised to fully harness its possibilities. If CBIR is implemented in an image retrieval system, then the image retrieval system will return more precise results.

In this experiment, images were queried separately in a collection of forty two-dimensional, geometric images. Filters were applied to the images within the database to remove all differences between the query image and the collection of geometric images except for shape. Five query images containing one of five different geometrical shapes in this collection of images were queried into the CBIR system. The images were ranked based on the number of pixels they shared with the query image. Results were collected, revealing a near 100% accuracy rate of search results. This showed that basing the search algorithm of a CBIR system on the shape moment of the queried image will result in accurate and precise search results.

A STUDY OF FINANCIAL VIABILITY BETWEEN WATER RECLAMATION AND DESALINATION PLANTS

Jonathon Morrissey and Gene Rhee

Godwin High School

This paper compares the financial viability between water reclamation and desalination facilities. Data including investment costs, plant capacity, and its treatment method were obtained from various plants and used in statistical analysis. A two-sample t test and two chi-square goodness-of-fit tests were performed to evaluate the statistical significance of the data. It was found that although the means would suggest that water reclamation had a lower investment in water capacity the finding was proven to be not statistically significant, thus rejecting the research hypothesis. However through this research, water reclamation has proven to be just as viable, if not more viable, financially than desalination. This may encourage investment into water reclamation despite its public unpopularity.

THE EFFECT OF FIBONACCI RATIOS ON FACIAL PROPORTIONS

Rudraksh Roy and Rohan Tomer

Henrico High School

Mathematicians, artists, and physiologists alike have often searched for a correlation between nature and proportions. Leonardo da Vinci, an artist and architect, constructed the drawing *The Vitruvian Man*, which depicted and discussed the proportions of the human body and face. It often had a certain ratio shown throughout the body. This ratio, the Divine Proportion or Golden Ratio, approximately equals 1.61803399, is constructed when there are two segments, a and b, and $a + b$ is to a as a is to b. The purpose of the experiment was to determine if certain ratios derived from the Fibonacci sequence are shown in the human face. Ten volunteers were asked to participate and then twelve key facial measurements were taken for each of them. Then, proportions were derived from these measurements, and the residuals of these proportions from the ratios of, 1:1, 3:2, 8:5, and the golden ratio (ϕ) were taken. The residual closest to 0 was taken and recorded, and in the end, the frequency of the closest residual was calculated. The results indicated that the ratio of 1:1 occurred the most (30%) in the face of all of the volunteers, while 8:5 occurred the least (6%). The control level, ϕ , occurred (19%) of times. A chi-square test indicated a significant difference between the mean of the groups ($\chi^2 = 13.571$

> 9.488 at $df = 4$; $p < 0.05$). The data rejected the null hypothesis but did not accept the research hypothesis that the golden ratio would have the highest frequency of residuals closest to zero. Based on the data collected in this research, it appears to be that the ratio 1:1 is naturally appearing the most in human facial proportions.

THE EFFECT OF WEB BROWSER TYPES ON THEIR OWN EFFICIENCY IN CERTAIN WEB BROWSING ASPECTS

Peter Samuel

JR Tucker High School

Computer science is a subject that is fresh in the world of science. Only recently (1950's) was Computer Science acknowledged by universities and institutions as a science. This experiment was fulfilled, and during the time that this experiment was conducted, a computer was used to conduct certain tests. This included the test of JavaScript, Flash, Microsoft Silverlight, Web Page Loading Speed, and the new technology of HTML5. The reason this project was conducted was to test the overall efficiency of the top 5 web browsers, on a Windows 7 operating system; Microsoft's Internet Explorer, Mozilla's Firefox, Google's Chrome, Apple's Safari, and Opera. The tests were recorded and compared; the averages of the tests were considered the most. The results showed that Microsoft's Internet Explorer was the most efficient and reliable, winning three test; Web Page Loading Speed, Microsoft Silverlight, and Hardware Acceleration Stress Test. The data did not support the hypothesis, which was that Google's Chrome would come out as the most efficient web browser. The rejection of the hypothesis was resulted most likely because Microsoft's Internet Explorer was engineered and designed to excel in these aspects of web browsing; Web Page Loading Speed, Microsoft Silverlight, and Hardware Acceleration Stress Test (a test of graphics, measure in FPS). The science behind this solely lies in the infrastructure and coding of Internet Explorer. The application is made up of multiple virtual engine systems, that each plays a role in accelerating and controlling the aspects of the web browsing experience. Some virtual engine systems are very well coded and engineered, while others lack compared to the other four web browsers. Windows 7 is also programmed and constructed by Microsoft, and Internet Explorer is also constructed and engineered to work hand in hand with Windows 7, and perform better than other web browsers, such as Google Chrome, Mozilla Firefox, Apple Safari, and Opera.

DO HOMEOWNERS AND RENTERS PAY THE SAME AMOUNT OF PROPERTY TAX PER STUDENT PER YEAR?

Alex Saxerud

Washington-Lee High School, Arlington, VA 22201

The purpose of this experiment was to find if homeowners paid more in property tax per student per year than renters. The hypothesis was: Renters pay less in property tax per student than homeowners. In this experiment, data on renters and homeowners were analyzed. Since the data was collected from the US Census Bureau and Arlington County, there were no tests or trials. The analysis was done on Microsoft Excel after all data was collected. The homeowner data was collected from the Arlington County Department of Community Planning, Housing, and Development (CPHD). The tax data was from the Arlington County Treasurer's Department, and the number of school age children from the Census Bureau. All miscellaneous data was from the Census Bureau and the Arlington County Profile and Report to the Citizens. The data was collected for 1990, 2000, and 2010.

Renters paid on average \$2,739, \$4,009, and \$8,376 per student for the years 1990, 2000, and 2010 respectively. Homeowners paid \$5,201, \$6,234, and \$13,327 per student for 1990, 2000, and 2010 respectively. The conclusion was that homeowners were paying more per student. It is also shown that what homeowners pay per student is accelerating. Because a full data population was used, there was no need to do statistical analysis; therefore, all conclusions could be drawn based on the actual data. In that regard, it was shown that renting an apartment is the more affordable way to live concerning property tax. It is especially beneficial for renters with children.

WHICH SOCIAL AND ECONOMIC FACTORS CONTRIBUTE TO HIV/AIDS PREVALENCE RATES?

Sarah Sears

Washington-Lee High School, Arlington, VA 22201

The purpose of this study was to examine the relationship between HIV/AIDS prevalence rates and per capita income, median age, urbanization, literacy rate and opioid drug use. The hypothesis for this observational study was that there may be correlations between HIV/AIDS prevalence rates and each of the factors.

Thirty countries were randomly selected, and data regarding HIV/AIDS prevalence rates and each of the independent variables were gathered from databases on the United Nations and United States Central Intelligence Agency's websites. Linear regression and linear regression T-tests were run for each pairing of HIV/AIDS prevalence rates and a social or economic factor to determine the strength and significance of a possible linear relationship between the two variables.

The statistical analyses showed that there was a linear relationship between HIV/AIDS prevalence rates between 0.01 and 24.8% and median age, but there was not a statistically significant relationship between median age and HIV/AIDS prevalence rates greater than or equal to 0.01% and less than 5%. This suggests that there is a stronger link between HIV/AIDS prevalence rates and median age when HIV/AIDS prevalence is greater than or equal to 5%.

There were also significant linear relationships between per capita income, urbanization, literacy rate and opioid drug use for HIV/AIDS prevalence rates greater than or equal to 0.01% and less than 5%.

MORE LOTTERY PLAYERS DO NOT AFFECT ODDS OF MAKING PROFIT ON THE POWERBALL LOTTERY

Simon Vogler

Mountain Vista Governor's School

Many people play the lottery each year, most commonly the Powerball. This is because of the belief that playing the lottery at different times improved the odds of making profit. The purpose of this research was to find if the more lottery players affect the odds of winning in the Powerball lottery. This is important because many people who live in poverty in the United States gamble their money, with almost no chances to win a substantial amount of money. The odds of winning the lottery based on the number of participating players was found by taking the total amount of Powerball tickets sold each year in two different states, and the amount given out by the companies. This was averaged to find the average amount earned each year by lottery players. That average was tested on a sample population of ten million people playing the lottery, with the total amount won based entirely on the probability of winning each amount of money. This yielded average winnings of 48 cents. The results of the experiment supported that the amount of people playing the lottery do not affect the odds of making profit.

MEDICINE & HEALTH A

First Place:

THE EFFECT OF PERCEIVED STRESS ON THE PERCEIVED SEVERITY OF ACNE VULGARIS IN ADOLESCENTS

Eileen

Eileen F. Breslin

Washington-Lee High School, Arlington, VA 22201

The objective was to determine the effect of perceived stress on the perceived severity of acne vulgaris in adolescents. It was hypothesized that there is a positive correlation between the perceived stress and the perceived severity of acne vulgaris in adolescents because types of hormones called androgens, mineralocorticoids, and glucocorticoids are released into the bloodstream in response to stress.

Surveys regarding perceived level of stress, perceived severity of acne vulgaris, and extraneous variables were administered to 55 subjects in September, early in the school year. The subjects filled out the surveys again, during an examination period in November. Data analysis consisted of a Chi-squared test, bar graphs, and paired t-Tests.

The results showed there was a statistically significant increase in the mean acne vulgaris grades as well as in the mean perceived stress scores during the study. A Chi-squared test was run. The null hypothesis was rejected, indicating a significant difference between the observed and the expected frequencies of the acne vulgaris grades exhibited throughout the study. Furthermore, t-Tests were run to determine if there was a statistically significant difference between the means of each extraneous variable for which data was collected: hours of sleep, perceived quality of sleep, average number of meals per day, and perceived quality of diet. Because the differences in the means of the extraneous variables were not statistically significant, while the differences in the mean acne vulgaris grades as well as in the mean perceived stress scores were statistically significant, the hypothesis was supported

Second Place:

THE EFFECTS OF SALINE INFUSION ON INTERSTITIAL PRESSURE CHANGE POST-HEMORRHAGE**Eric Carlson**

Central Virginia Governor's School, Lynchburg, VA 24502

The purpose of this study was to establish the point at which fluid-resuscitation causes interstitial pressure to become positive, with a given amount of blood loss, using innovative methodologies of experimentation. A linear mathematical model of the cardiovascular system was constructed to simulate hemorrhagic shock and treatment in *Homo sapiens*. In this model, the infusion of saline is used as the form of resuscitation for hemorrhage. In this model, the total blood lost is completely replaced with saline. The model was then used to predict the change of pulmonary interstitial volume in

response to different severities of hemorrhage. The mathematical model was created using modeling software named STELLA®. The results outputted by the model suggest that approximately 1600 mL of saline cause enough dilution of the proteins in the blood plasma to cause interstitial pressure to rise above 0 mmHg. Linear regressions were run on the results for interstitial pressure and volume. A positive slope indicated a proportional relationship between interstitial pressure/volume and saline infusion. - aligning with the original hypothesis, which suggested this relationship. An R-value of 1 indicated that the linear model outputs linear data. The regressions show a perfect correlation between saline infusion and edema. In addition, the values generated by the STELLA ® model match up with previously reported resuscitation amounts, validating that the model outputs values that have behaviors representative of the system.

Third Place:

THE EFFECT OF BEET ROOT JUICE ON DOXORUBICIN-INDUCED CARDIOTOXICITY

Sayantane Das

Mills E. Godwin High School, Henrico, VA, 23238

Doxorubicin (DOX) is a well-established chemotherapeutic drug widely used to treat a variety of cancers, though its clinical use is restricted by irreversible cardiotoxicity. Earlier studies show beetroot juice (BRJ) as a potent chemopreventive agent, however its cardioprotective function is yet to be established. The purpose of this experiment is to determine the protective effect of BRJ against DOX-induced cardiotoxicity. It was hypothesized that higher concentrations of BRJ, applied to cardiomyocytes, will provide better cardioprotection against DOX; and simultaneously increase cell death of MDA-MB-231, breast cancer cells, in combination with DOX. Adult rat cardiomyocytes and MDA-MB-231 cells were exposed to different concentrations (0.5, 5, 50, 250, 500 µg/ml) of BRJ with or without DOX, with a control of growth medium; cell death, reactive oxygen species (ROS) (after 24 hours) and apoptosis (after 48 hours) were determined. BRJ and DOX co-treatment significantly reduced cell death in cardiomyocytes, measured by trypan blue staining; whereas it significantly increased MDA-MB-231 cell death. Cell viability was also significantly reduced after BRJ and DOX co-treatment in MDA-MB-231 cells. Using a TUNEL assay, DOX-induced apoptosis of cardiomyocytes was significantly reduced with BRJ. In contrast, in cancer cells, BRJ significantly increased DOX-mediated apoptosis. ROS levels, measured after 2',7'-dichlorodihydrofluorescein diacetate staining using a spectofluorometer, were increased with DOX in both cells, and further increased in the presence of higher concentrations of BRJ. In conclusion, lower concentrations of BRJ with DOX

demonstrate the most effective combination of cardioprotection and chemoprevention. These findings provide insight on the possible cardioprotective ability of BRJ in cancer patients treated with anthracycline chemotherapeutic drugs.

Honorable Mention:

INSTANT TEMPERATURE EFFECT OF COFFEE ON TEENS' VITAL SIGNS

Abigail L. Armstrong

Shenandoah Valley Governor's School, Fishersville, Virginia 22939

Millions of people wake up to a cup of coffee every morning; however, coffee drinkers don't always think of the effect this cup of coffee has on their health. Previous studies show the caffeine in coffee is susceptible to people's pulse rate and the blood pressure. The purpose of this experiment was to determine instant changes in the coffee drinkers' vital signs due to temperature. 20 subjects were selected from a family Christmas party. All of the subjects were coffee drinkers. Their pre-blood pressure and pulse rates were taken before and after drinking hot coffee and cold coffee. It was found that there were instant significant changes in their blood pressure and pulse rate when drinking coffee or water, either hot or cold. These results suggest that the temperature is the primary instant factor for the change of vital signs rather than the caffeine content.

Honorable Mention:

THE EFFECT OF MELANLEUCA ALTERNIFOLIA ON STAPHYLOCOCCUS AUREUS

Joshua David

Hanover High School

The purpose of this experiment was to determine if Tea tree oil had the same inhibition factor as ceftazidime. The hypothesis of this experiment was that if *Melaleuca alternifolia*, or tea tree oil, was applied to *Staphylococcus aureus*, it would have an equal or larger zone of inhibition.

Staphylococcus aureus was inoculated onto fresh blood agar plates using sterile water broth. The agar dishes were divided into eight quadrants each, and each quadrant was considered a trial. One ml of Tea tree oil and sterile water were absorbed into the coffee filter disks respectively for 55 seconds. The ceftazidime, tea

tree oil, and sterile water disks were all placed onto their quadrants. Twenty four hours passed. The zone of inhibition around each disk was measured and recorded.

After conducting this experiment, it was found that although tea tree oil did have bacteriostatic properties against *Staphylococcus aureus*, it was not nearly as affective as ceftazidime. It is believed that ceftazidime is so affective because it is not susceptible to an protein called β -lactamase that is produced by *Staphylococcus aureus*. Because the enzyme would not stop the ceftazidime from working, the ceftazidime was able to work effectively. Although it is unknown whether or not tea tree oil is susceptible to β -lactamase, it is believed that the reason why tea tree oil works is because of a chemical it contains called terpin-4-ol. It is believed that this chemical re-arranges the membrane structure around the bacteria and eventually kills it.

Honorable Mention:

THE VARIANCE IN ACTIVITY LEVEL AMONG MEMBERS OF DIFFERENT VOCATIONS

Amanda Hayes

H-B Woodlawn Secondary Program

How healthy a person is can be partially attributed to their level of activity while at work. Jobs today require lower levels of physical activity than even a few decades ago. This project investigated the variance in activity level among members of different professions. The three professions examined were teachers, office workers, and plumbers/roofers. The hypothesis was that the plumbers and roofers, whose jobs require higher levels of manual work, would take the most steps while at work. Each subject involved (five in each category) wore a pedometer for four hours on three separate days, recording their steps for each time block. The results showed that in four hours, the plumbers and roofers had an average of 3,808 steps, teachers had an average of 2,345 steps, and office workers had an average of 1,526 steps.

DAILY SPINAL SHRINKAGE IN RELATION TO A TEENAGER'S HEIGHT

Rebecca Alexander

Shenandoah Valley Governor's School

Shrinking is normal. Not only does it occur over the years as a person ages, but it occurs every day. There are many contributing variables that could determine what causes shrinkage in the younger population, but the purpose of this experiment is to test height. The null hypothesis is there is no relationship between spinal shrinkage and height. In this experiment, fourteen subjects from the Shennandoah Valley Governor's School between ages sixteen and seventeen were measured once in the morning and once at night. The data was then put into tables and a correlation between shrinkage and height was found. The data gathered shows a very promising correlation that supports the hypothesis of the experiment.

THE EFFECT OF TOUCHABLE VERSUS NONTOUCHABLE ANIMALS ON THE RAISING/LOWERING OF BLOOD PRESSURE

Katelin Askins and Kelsey Bales

Deep Run High School

It is scientifically proven that petting dogs and cats or even watching fish can lower a person's heart rate, thus lowering their blood pressure. This is due to the fact that petting or watching an animal calm and makes the person observing less stressed. The purpose of this experiment was to test the different blood pressures depending on the touching of animals or the observing of animals. The hypothesis was if the test subjects are exposed to touchable animals such as dogs and cats, then their blood pressure will decrease. Ten subjects were asked to have the subject's initial blood pressure measured and recorded as the initial blood pressure. After that, each subject observed or petted one animal (the bird, fish, dog, or cat) and had the blood pressure recorded after petting or observed after petting one animal. This was repeated until a blood pressure after petting each animal had been recorded. The results showed that a person's blood pressure decreased the most when observing the fish, which had a mean of 116 mmHg. The null hypothesis was accepted when the blood pressures taken after petting dogs was compared to that after petting cats, petting dogs compared to that of watching birds, petting dogs compared to watching fish, petting cats compared to watching birds, petting cats compared to watching fish and watching birds compared with watching fish ($t = 1.20 < 2.262$; $t = 0.86 < 2.262$; $t = -2.61 < 2.262$; $t = 0.23 < 2.262$; $t = -1.91 < 2.262$; $t = -1.55 < 2.262$ at $df = 9$; $p < 0.05$). The null was rejected when the control was compared to the blood pressures after petting a dog and cat as well as the blood pressures after observing a bird flying and fish swimming ($t = 2.66 > 2.262$; $t = 3.00 > 2.262$; $t = 2.90 > 2.262$; $t = 2.34 > 2.262$ at $df = 9$; $p > 0.05$). Therefore, the data did not

support the research hypothesis that if the test subjects are exposed to touchable animals such as dogs and cats, then their blood pressure will decrease, so the research hypothesis was not accepted.

A STUDY OF WATER SOURCE AND CARINOGENS IN GILES COUNTY

Josalyn Buchanan

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The cancer rate in the United States and Giles County, Virginia is rapidly growing. The water that the residents of Giles County use and drink could be a carcinogen. Is there a relationship between the drinking water source and cancer of Giles County residents? Could the drinking water in Giles County be linked to the high cancer mortality rate? The hypothesis of this study suggested that there is a relationship between the drinking water source and cancer in Giles County. If there is a relationship between the drinking water and cancer, then the water could be purified and treated to eliminate the carcinogens from the water. Giles County residents were given a survey concerning water source and usage. A sample of 52 residents was taken. The variables included age, sex, water source, race, smoker/nonsmoker, and location in Giles County. Excluded variables include adolescents 18 and younger and residents that have not lived in Giles County for 5 years or more. A chi-square test of the difference in proportion of cancer cases in households of Giles County between well/spring water and town water produced a p value of 0.6774, and the cancer cases that have always used either well/spring water or town water while at the residency had a p-value of 0.3074. The results showed no relationship between water source and cancer in Giles County. Since there is not a relationship between the drinking water and cancer other possible suspected carcinogens should be studied and tested. Future research considerations would be to test for other environmental carcinogens.

THE DIFFERENCES IN SHIN SPLINTS ON SEVERAL VARYING GYMNASIUM FLOORS

Jarrett Donkle

Shenandoah Valley Governor's School

Many student-athletes play sports on gymnasium floors. This can give rise to a condition known as shin splints. The purpose of this study was to examine which type of gymnasium floor causes shin splints the least. Twenty-four deer bones were impacted with a 10-pound weight on three different gymnasium floors. These floors were oak, maple and bamboo. The splits in the bone were counted before and after the bone was impacted. The results were tested using an ANOVA and found that there was a difference between the three groups.

THE EFFECT OF PSEUDOEPHEDRINE ON THE HEART RATE OF *DAPHNIA MAGNA*

Sabrina Gerlich

Central Virginia Governor's School, Lynchburg, VA, 24502

The purpose of this study was to determine the effect of the decongestant drug pseudoephedrine on the heart rate of the model organism *Daphnia magna*. The study was conducted at a local high school over a three-week period during December 2011. Three experimental groups composed of eight *D. magna* were exposed to various concentrations of pseudoephedrine, 0.35 µg/mL, 0.7 µg/mL, and 2.1 µg/mL. A control group was not exposed to the drug. Each *D. magna* from the experimental groups was suspended in its designated solution for two minutes before the heart rate was collected using a microscope with a camera attachment. The videos were slowed to half speed to allow the heart beats to be manually counted. The control group had a mean heart rate of 327.25 bpm, the experimental group exposed to 0.35µg/ml solution resulted in 285.88 bpm, the 0.7µg/ml solution resulted in 278.38 bpm, and the 2.1µg/ml solution 267.63 bpm. A One-Way ANOVA test, with an alpha value set at 0.05, was performed on the data. The returned p-value of 4.21E-07 revealed statistical significance within the data, making a Tukey test appropriate. The data failed to support the original hypothesis that pseudoephedrine would cause an increase in *D. magna* heart rate, as an overall decrease was shown. In conclusion, pseudoephedrine exposure causes a decrease in the heart rate of *Daphnia magna*.

THE EFFECT OF FOOT PRONATION ON THE RUNNING SPEED OF CROSS COUNTRY RUNNERS

Darius Hossainian

Godwin High School

Every time a runner starts off their block, they face a plethora of variables affecting their odds of winning the race, height, weight, and even the clothes they wear have important roles in their running ability. Another important factor is the pronation of the foot, which is the motion in which the runner's foot goes after initial impact. This experiment was done to test this factor of foot pronation on the running speed of cross country runners. Runners with over-pronation were predicted to have faster running times than those with under-pronation. This statement was found to be true, at least by the data found, but it could not be said that it was statistically significant when compared with the other foot pronation types. Some sources of error were the small sampling size, different footwear worn by the runners, height, weight, and other biomechanical features of the runner.

A COST COMPARISON BETWEEN FRESH, LOCALLY PURCHASED FOODS VERUS PROCESSED FOODS

Natalie Kloo

Mountain Vista Governor's School

Most Americans believe that choosing fresh, locally purchased foods is more expensive than purchasing processed foods at grocery stores. With the research done in this project, that statement was attempted to be proven false. It was believed that by purchasing freshly grown foods at grocery stores, one can save money rather than purchasing the same processed foods at grocery stores. During the first week of June, July, and August in the summer of 2011, this research was conducted. Before going to the actual grocery store, the proper amount of healthy and unhealthy food products was designated for one adult, eating breakfast, lunch, and dinner, along with two different snacks and a dessert for three days. The food was then purchased at the grocery store, with the nutritional facts and price of each item recorded. By analyzing the results using the Wilcoxon test, the null hypothesis was supported. Purchasing fresh, locally grown foods was more expensive than purchasing processed foods at grocery stores. There may have been error in this project because there was no way to eliminate bias in choosing the foods.

THE EFFECTS OF PLAYING MUSICAL INSTRUMENTS ON THE LUNG CAPACITIES OF STUDENTS

Victoria Leche

Shenandoah Valley Governor's School

A number of things can affect a person's lung capacity, including playing a musical instrument. The purpose of this study was to determine if playing a musical instrument, either brass or wind, affects a person's lung capacity. A group of thirty student volunteers from a local school in Central Virginia were tested for lung capacity with an incentive spirometer. The subjects' lung capacities were tested and their results were analyzed with a two way ANOVA that showed differences among those students who played a brass instrument, a wind instrument, and a non-breathing type instrument (control group). A Tukey test was then conducted which showed there was a difference between subjects who played brass instruments and wind instruments, and subjects who played brass instruments and the control group. This study concluded that playing a musical instrument, especially a brass instrument, has a significant effect on a person's lung capacity.

THE EFFECT OF MUSIC ON HEART RATE AND BLOOD PRESSURE IN MALES AND FEMALES

Kaitlin Moore

Appomattox Regional Governor's School for the Arts and Technology; Petersburg, Virginia 23803

Music is said to have healing qualities on humans. In some previously conducted studies, it was found that the individual's heart rate and blood pressure were directly correlated to the tempo of the music. Other experiments found that music tempo had little if no effect on the heart rate and blood pressure of individuals. The objective of this experiment was to test the correlation between the heart rate and blood pressure of an individual to the tempo of a selection of music. Human participants were asked to listen to two songs, one fast tempo song and one slow tempo song, having their heart rate and blood pressure recorded after both songs. Although no statistically significant results were found in this experiment, it was found that the average heart rate for males and females did decrease after the fast tempo song was played.

MEDICINE & HEALTH B

First Place:

CHARACTERIZATION OF ELECTROSPUN DENDRIMER-GELATIN SCAFFOLDS ENCAPSULATED WITH SILVER: A STUDY OF SILVER RELEASE IN NOVEL METHODS OF WOUND DRESSING

Natasha Sheybani

Appomattox Regional Governor's School for the Arts and Technology; Petersburg, VA
23803

Throughout history, silver dressings for wounds have found more frequent and practical applications, due to their antimicrobial properties and efficacy. Wound dressings containing silver have experienced resurgence in use for treating chronic wounds, burns, incisions from surgical procedures, and wounds resulting from diseases like diabetes. With an increased use in antiseptic agents, prior scaffold studies have depicted the development of bacteria with antimicrobial-resistant characteristics, detrimental to complex wound healing processes. These studies further proved silver to be an efficient biocide and wound management agent, due to its ability to attach to multiple sites simultaneously and inhibit infection-inducing bacteria in proximity to wound sites.

In this continued study, the competence of silver within electrospun tissue scaffolds containing pure gelatin and divergently derived half-generation polyamidoamine (PAMAM) dendrimers was explored as a common material for wound dressing. This study targeted the rate and degree of silver release in vitro when a silver dressing is applied directly to a chronic wound site. It was hypothesized that if the amount of silver was increased in crosslinked scaffolds with G3.5 dendrimers present, the release of silver would be faster and an overall proliferation in silver ions would occur. After synthesis of scaffolds, methods of characterization included swelling/absorbency ratios and fiber diameter of scaffolds through scanning electron microscopy. Inductively coupled plasma optical emission spectrometry (ICP-OES) was used for the silver release studies. The observations indicated a need for further research; therefore, future implications of this study will include further antimicrobial and release studies in advancement of retail silver dressings and the ultimate perfection of the wound healing process.

Second Place:

THE EFFECTS OF GENDER ON THE TIME NEEDED FOR BONE FUSION**Maria Wnorowski**

Southwest Virginia Governor School Christiansburg, VA 24073

The effect of gender on the rate of bone healing in *Canis lupis familiaris* does not have much published research dealing with the subject. However, due to the need for calcium, estrogen deficiency, and the higher chance of being diagnosed with osteoporosis there are reasons to believe that females may take longer than males for complete bone healing. In order to measure the amount of time needed without having too many variables, such as the location and method of correction, Tibial Plateau Leveling Osteotomy (TPLO) surgeries from the Virginia-Maryland Regional College of Veterinary Medicine were examined. A TPLO surgery is a method of fixing cranial cruciate ligament tears in the stifle joints of the canine; in the surgery, a plate and screws are attached to both the tibia bone and a fragment of the tibia bone, which is cut and rotated in order to correct the mechanics of the ligament. By increasing the angle of the tibial plateau, there is a greater cranial force that can be exerted on the tibia. The dogs are radiographed following the surgery, and then radiographed again six to twelve weeks later to check the healing and ensure there are no complications. To measure the differences between males and females, the length of the gap between the fragment and tibia bone was measured at the widest spot on both the lateral and caudal-cranial views. All of the cases of TPLO surgeries from the past three years were examined, and the ones who had all of the correct and useable information were used to determine the mean and standard error of each gender in both the lateral and caudal-cranial views. A two-sample T-test was used to compare the data. The lateral data had a p-value of 0.7745 (a p-value of .05 would disprove the null hypothesis); so based on the gathered information, the females and males did not have a significant difference in the width of the gap. In the caudal-cranial view, there was a p-value of 0.6352, meaning again that the null hypothesis that males and females have a fairly equal healing time period was not disproved. The lateral gap mean for females was 1.56+/-1.11 mm and 1.64+/-1.22mm for males. The caudal-cranial view had a mean value of 1.41+/-0.92mm for the female dogs and a mean of 1.53+/-1.11 mm for the males. Based on these results, it is concluded that there is no significant difference between male and females in the length of time needed for bone fusion.

Third Place:

THE EFFECT OF CONCENTRATION OF BASIC FIBROBLAST GROWTH FACTOR (Bfgf) ON THE QUANTITATIVE ANALYSIS OF THE UNDIFFERENTIATED STATE OF HUMAN EMBRYONIC STEM CELLS (hESCs)

Mythili Pulavarthi

Godwin High School

Stem cells are currently a new field of study in which research is being done possibly so that they can be used in clinical applications of humans. The goal of stem cell usage is to try and regrow the cells and organs of patients that are not working. The purpose of this experiment was to study the quantitative analysis of the effects of different concentrations of basic fibroblast growth factor on human embryonic stem cells. It was hypothesized that hESCs coated with a layer of the 20ng/mL concentration of bFGF would have more undifferentiated cells than 0ng/mL, 4ng/mL and 10ng/mL. hESCs were treated with 0ng/mL(control), 4ng/mL, 10ng/mL and 20ng/mL concentrations. The cells were grown for 5 days and then observed using a staining method. A t-test was performed and it was found that the data was significant for all of the tested concentrations except 10ng/mL vs. 20ng/mL. It is believed that the 20ng/mL concentration had the most undifferentiated cells because higher concentrations of the growth factor caused increased undifferentiated cells. A source of error is that the hemocytometer was placed in ethanol before and after use and this could have affected sterilization. This research could lead to further experiments that study the effects of different feeder layers on hESCs, and other fibroblasts or proteins on the differentiation of hESCs.

Honorable Mention:

THE RESISTANCE OF E. COLI 0157: H7 TO ANTIBIOTICS

Christopher Robbins

Mountain Vista Governor's School

Infections by *Escherichia coli* 0157:H7 are fairly infrequent, but this bacterium is common enough to where they could become more frequent. This is why it is important to discover which antibiotics combat this bacterium more effectively than others in order to give those infected with E. coli 0157:H7 the best possible chance of regaining health. To accomplish this, over thirty samples were taken from local areas where there was a high likelihood to discover E. coli 0157:H7 and any of this bacterium found was separated for further testing. The antibiotics Gentamicin, Ciprofloxacin, and Cefotaxime were then tested for their effectiveness at inhibiting the growth of this bacterium, thus determining the best possible antibiotics from those used in this study. Ciprofloxacin ended up having the greatest effect on the bacterium, as supported by the raw data and a Kruskal-Wallis test which showed that the variance between Ciprofloxacin's results and those of the other two antibiotics was enough to be considered mathematically significant. These results rejected the null hypothesis, as there was actually a rather significant difference in effectiveness among the antibiotics studied.

Honorable Mention:

THE EFFECTS OF VARIOUS COMPRESSION BANDAGES ON OXYGEN LEVELS THROUGHOUT THE LOWER BRACHIAL REGION OF THE BODY

Angela Sheffer

Shenandoah Valley Governor's School Fishersville, VA 22939

The type of compression bandage a person may use could have an effect on the healing process and oxygen levels of their body. The purpose of this study was to determine if different compression bandages increase or decrease oxygen levels in the lower arm when applied; the results may determine which compression is best for healing injuries or improving the condition of the area it is applied to. Students from a local high school were tested with a pulse oximeter during the application of short stretch compression and long stretch compression bandages. The subjects' oxygen levels were taken before and after the bandages were applied, and the results were analyzed with a t-test that yielded no difference in those students treated with an Ace® long stretch and those who were treated with a Comprilan® short stretch compression wrap. The researcher concluded that both types of compression have equal effects on oxygen levels due to either confounding variables or calculation errors. The long stretch compression bandage was expected to cut off oxygen levels due to its high resisting pressure and low working pressure (Zuther, 2010). The short stretch was expected to improve oxygen levels because of its low resting pressure and high working pressure (Zuther, 2010). Overall, the results did not match up with the researcher's hypothesis in this experiment.

Honorable Mention:

THE EFFECT OF FINGER USED ON ACCURACY IN READING BRAILLE

Claire Spaulding

Washington-Lee High School, Arlington, VA 22201

The purpose of the experiment was to find the effect of finger used on accuracy in reading Braille. The independent variable was the finger of the dominant hand used to read Braille: thumb, index, middle, ring, or pinky. The dependent variable was the percentage of time that the test subjects, who were kindergarten students, could accurately identify the single different letter in a line of otherwise identical Braille letters. The hypothesis was that the highest degree of accuracy would be reached when the test subjects used their index fingers.

The experimenter had each blindfolded test subject run their fingers, one at a time, along four rows of Braille per finger. For each row, the test subject had to say which letter was different from the others. The experimenter recorded the number of times that the test subject was correct and incorrect. This was repeated with all five fingers on the test subject's dominant hand. The whole experiment was then repeated with the other test subjects.

There were eleven test subjects total. The test subjects had an average of 50% accuracy when the index finger was used, 34% accuracy with the middle finger, 36% accuracy with the ring finger, 27% accuracy with the pinky, and 34% accuracy with the thumb. The data were inconclusive, so the hypothesis was not supported.

THE EFFECT OF MUSIC WHILE RUNNING ON HEART RATE

Nicholas Paraiso

Douglas Southall Freeman High School, Richmond, VA 23229

In 2002, Matesic & Cromartie concluded that music lowers heart rate when subjects run at their own pace. However, Copeland & Franks (1999) found that music has no significant difference when running. These results were reinforced in another study by Ciccomascolo et al. (1995), who found that music has no physical effect on the body. The purpose of this experiment was to see if music affected heart rate while subjects ran at a constant pace. The hypothesis was that if different genres of music are tested to find effects on heart rate, then soft/inspirational would decrease heart rate the most. The null hypothesis was that music would have no effect on heart rate. Ten experienced subjects, regardless of age or gender, ran six miles at a 9:30 min/mi pace. Each mile, they listened to a different genre of music (control – no music, classical, hip-hop/rap, rock, soft/inspirational, and pop). At the end of each mile, heart rates were calculated and recorded. The data found that pop music yielded the greatest mean heart rate (149.4 bpm) while rock produced the lowest mean heart rate (144 bpm). A t-test determined that the data was not significant in any comparisons ($t = 0.817 < 2.101$; $t = 0.790 < 2.101$; $t = 0.927 < 2.101$; $t = 0.932 < 2.101$; $t = 0.486 < 2.101$; $t = 1.000 < 2.101$; $t = 0.757 < 2.101$; $t = 0.883 < 2.101$; $t = 0.708 < 2.101$; $t = 0.722 < 2.101$; $t = 0.868 < 2.101$; $t = 0.669 < 2.101$; $t = 0.864 < 2.101$; $t = 0.432 < 2.101$; $t = 0.565 < 2.101$ at $df = 18$; $p < 0.05$). The data supported the null hypothesis that music has no effect on heart rate.

Based on the data found, it can be concluded that music has no significant effect on heart rate while running. However, subjects did comment that the music distracted them from fatigue and made running more enjoyable. Research should be extended to find effects on untrained subjects and to determine any difference with additional genres of music, e.g. jazz or country.

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RELATION BETWEEN PEOPLE'S EYE VISION AND THEIR EYE COLOR

Melisa Pilipovic

Shenandoah Valley Governor's School, Fishersville, Virginia 22939

Eye color is a trait that is directly determined by the genetic background of a person. The ability to have good vision is subjected to many different aspects that most likely can't be established as early as birth. The purpose of this study is to determine if there is a difference in a person's vision in terms of their eye colors. Subjects were taken at random in local schools. The visualization test was conducted on those subjects with different eye colors. The results, based on proportional analysis, indicated that people with brown eyes have more visualization ability over all the color range, and the blue and green-eyed subjects were more likely to misread the orange-red combinations.

COMPARING CHEMICAL AND NATURAL ANTACIDS' EFFECTIVENESS TO NEUTRALIZE EXCESS STOMACH ACID

Olivia Prosak

H-B Woodlawn, Arlington, VA 22207

This project determines and compares the effectiveness of chemical and natural antacids to neutralize excess stomach acid to a healthy stomach pH range of 2.0-3.0 pH. The hypothesis was that the chemical antacids would be more successful than the natural antacids in neutralizing excess stomach acid to the ideal range because they were made specifically for that purpose. Among the natural antacids, chamomile tea, ginger root, and the milks were expected to do the best. This was because research showed that chamomile and ginger can be used to ease stomach discomfort and because milks have high levels of calcium, a common component in chemical antacids. The hypothesis

was not supported by the experiment's data. Neither group of antacids was more effective at neutralizing the acid to the healthy range of 2.0-3.0 pH, within 0.25 pH. However, each group had some successful samples.

Maalox and Gelucil brought the acid pH to a healthy range while all of the other chemical antacids were too potent, making the acid far too basic for a stomach. The natural antacid hypothesis was partially supported because all of the milks were successful, but the chamomile and ginger did not raise the acid pH high enough. Despite its acidity, cinnamon made the greatest impact of the natural antacids. The turmeric, all of the teas, and all of the natural mixtures did not make a significant impact on the pH of the acid.

THE EFFECTS OF CHLORINATED POOL WATER ON THE COLORATION OF HUMAN TEETH

Kathleen Quillen

Shenandoah Valley Governor's School

Chlorinated swimming pool water may have a negative effect on the color of a swimmer's teeth. The purpose of this study was to determine if swimming for six or more hours each week could cause a darkening in the color of teeth. Ten teeth were submerged in water with a chlorination level of 3 and the color of the teeth was measured with a tooth shade guide, similar to previous research. The color changes in the teeth were analyzed using a Pearson Product Moment Correlation test which allowed the conclusion that there is a relationship between the number of days a person spends in chlorinated water and the coloration of teeth to be drawn.

THE EFFECT OF AN ADOLESCENT'S STRESS ON GLUCOSE LEVELS

Sruthie Rathnam

Godwin High School

The purpose of this experiment was to determine the effects of adolescents' stress levels on glucose levels. It has been found excessive psychological stress can cause behavioral, physical, cognitive, and emotional problems as well as lead to health issues. Seventy-five adolescents were given a questionnaire with questions involving how often a stress symptom was felt in the past six months. A glucometer was used to determine the glucose level of twenty-five adolescents of low stress, normal stress, and high stress. The control that was used in this experiment was adolescents with normal stress. It was hypothesized that the adolescents with high stress would have higher glucose levels than those with less stress. The results revealed that there was no correlation between stress and glucose levels. A t-test was done on the data and it revealed the data wasn't significant for low stress versus normal stress, low stress versus high stress, and normal stress versus high stress. The results did not support the research hypothesis. To improve this experiment, all subjects could be tested at the same time of day to avoid diurnal fluctuation. This research could lead to further studies that investigate the type of stress: acute, chronic, and traumatic on glucose level and a year-long study to determine stress on glucose levels over a long period of time.

THE EFFECT OF STRAIN ON KNEE JOINT ON THE FUNCTION OF ANGLE OF KNEE

Simron Richard

Deep Run High School, Glen Allen, VA 2305

Knees are a vital part of a human body, and injuries often occur in the knee. A lot of knee injuries occur while playing soccer, because it involves a lot of knee movement and bending the knee in various angles. The purpose of the experiment was to determine whether more strain was put on the knee if the angle became either more acute or more obtuse. The hypothesis was that if the angle of the knee bend became more acute, then the strain released on the quadriceps muscle will increase. Mechanical model knee was built to conduct the experiment. Five different groups were tested. Each group had different angles in which the knee was bent. The quadriceps muscle is represented by the spring, and the quadriceps tendon is represented by the nylon string. As the knee joint was placed into different angles, the "quadriceps tendon" stretched the "quadriceps muscle" and the amount it pulled was used to calculate tension. The results indicated that group D, with the most acute angle of knee bend (30 degrees) with a mean of 9.4cm had the most amount of strain released on the "quadriceps muscle." Group A, which formed an obtuse angle (120 degrees) had the least amount of tension on the "quadriceps muscle." A t-test performed on the data indicated a slight difference between the means of the groups ($t=10.451>2.101$; $t=10.041>2.101$; $t=11.357>2.101$; $t=3.385>2.101$; $t=5.827>2.101$; $t=7.564>2.101$ at $df=18$; $p<0.05$). The data supported the research hypothesis that if the angle of the knee joint became more acute, then the strain released on the quadriceps muscle will increase. Based on the results of the experiment, there seems to be a direct correlation between the amount of strain placed on the knee and the function of angle of the knee.

THE EFFECT OF DIFFERENT WII VIDEOGAMES ON HEART RATE

Kyle Rogers and Griffin Smith

Deep Run High School

Videogames have been a major part of American culture ever since their creation. Though videogames have increased illiteracy, weight, and lethargy in humans, there is now a new videogame, known as the exergame, which can actually increase fitness and health. The goal of this experiment was to determine which exergame, out of five, would increase heart rate in a subject the most during play. To document data in this experiment, heart rate in beats per minute (bpm) was recorded. Another purpose of this experiment is to find the ideal active videogame that people can use as a substitute for traditional exercise. The hypothesis of the experiment was, out of the five exergames tested, Wii Boxing would increase heart rate the most in the participants because it requires a large amount of bodily movement. To test the validity of this hypothesis, 20 trials were performed for each independent variable by finding heart rate post-activity. The resting heart rates of the participants were taken, then, after playing each game, the increase in heart was recorded. Wii Boxing, as predicted, had the highest increase in heart rate, at a mean of +16.75 bpm. From research, it was discovered that Wii Boxing is equivalent to moderate intensity walking (Graf, et. al. 2009).

The null hypothesis was accepted ($t=0.21 < 2.024$ at $df=38$; $p < 0.05$) therefore the data did not support the research hypothesis in the comparison between Wii fit strength training and Wii fit aerobics. Also, in the comparison between Wii Fit Strength Training and Wii sports boxing, the null hypothesis was accepted ($t=1.47 < 2.024$ at $df=38$; $p < 0.05$). In the research hypothesis, Wii boxing was presumed to increase heart rate the most. However, in the t-test, this was found to be false. Though Wii Boxing, as well as other exergames, cannot truly compare to actual games and exercise in all cases, it is still a viable and exciting way to stay healthy.

THE RELATIVE RISK FACTORS OF CORONARY ARTERY DISEASE

Kathryn Snyder

Shenandoah Valley Governor's School

Hyperlipidemia, hypertension, and diabetes mellitus may have an effect on a person's likelihood or risk of acquiring coronary artery disease. The purpose of the study was to determine if these are the relative risk factors for coronary artery disease. A database of patients from the University of Virginia and Parkland Memorial Hospital was analyzed using the relative risk formula. The results were evaluated to determine the relative risk factors. The researcher concluded being of male gender, use of clopidogrel, and peripheral vascular disease were the greatest risk factors of coronary artery disease.

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EROSION OF TEETH BY POPULAR ACIDIC BEVERAGES**Courtney Stout**

Shenandoah Valley Governor's School

Dietary factors in human life such as high contents of sugar and acid found in foods and beverages are clearly linked with the progression of dental caries, or the decay and loss of the calcified tissues of teeth. The purpose of this research was to examine if there is a link between consumption of popular acidic beverages and dental enamel loss. In this study, three extracted teeth were placed in Coke, Diet Coke, Monster energy drink, orange juice, beer, and distilled water and the mass loss was observed. The pH of each beverage was determined using pH electrodes. It was found that the Monster energy drink resulted in the highest average percentage mass loss. Coke was the next most harmful beverage to teeth, followed by Diet Coke, orange juice, beer, and water was virtually not harmful. The erosion effect on teeth can be related to the acidity of the beverages as indicated by a linear regression with the R value of 0.87 between pH and mass loss of the teeth. Higher acidity (lower pH) led to greater mass loss of teeth.

MICROBIOLOGY & CELL BIOLOGY

First Place:

EXAMINATION OF ALTERNATIVE OXIME AND NANOPARTICLE THERAPEUTICS FOR POST-TREATMENT AGAINST NERVE AGENT EXPOSURE**Rachel Chuang**

Thomas Jefferson High School for Science and Technology, Alexandria, VA 22312

Pesticide and organophosphate (OP) chemical warfare agents (CWAs) are potent inhibitors of acetylcholinesterase (AChE) that pose a major threat to both military personnel and civilians. Once inhibited, AChE can no longer hydrolyze acetylcholine (ACh), leading to seizures, paralysis, or death. Currently, 2-pralidoxime (2-PAM) is an AChE reactivator used as a post-exposure treatment for the OP-inhibited enzyme. However, 2-PAM reactivates only peripherally inhibited AChE, as the drug cannot pass through the blood brain barrier (BBB). In this study, Hartley guinea pigs were used to determine the efficacy of experimental therapeutics for OP poisoning, including pro-2-PAM (the pro-drug form of 2-PAM) and the reactivator MMB-4 in nanoparticles, both designed to travel across the blood brain barrier. Blood and brain samples were obtained from guinea pigs treated with nerve agents followed by 2-PAM, pro-2-PAM, or MMB-4 nanoparticles and then analyzed using a spectrophotometric enzyme assay. In conclusion, pro-2-PAM and nanoparticles encapsulating MMB-4 were able to successfully cross the BBB and act as post-treatments for nerve agent exposure, by directly reactivating the AChE in the CNS. This study will aid in the progression of protection against chemical warfare agents and ensure the safety of the United States military and civilian populations.

Second Place:

THE EFFECT OF DIFFERENT METHODS OF STERILIZATION ON THE MECHANICAL STRUCTURE OF CANE REEDS CONSTRUCTED FROM *ARUNDO DONAX*

Destiny Barnett

Central Virginia Governor's School for Science and Technology, Lynchburg, VA 24502

The purpose of this study was to determine which method of sterilization caused the least amount of damage on the mechanical integrity of cane reeds. Four groups of cane reeds constructed from *Arundo donax* were tested for accuracy of frequency and tone quality. Three groups of reeds were sterilized using UV-C light, 65% ethyl alcohol (found in hand sanitizer), and steam. The reeds were then played by the researcher and analyzed by Audacity 1.3 Beta, sound analyzing computer software. The ANOVA test for frequency revealed a p-value of 0.019 with an alpha value of 0.05, revealing a statistically significant difference in the frequency between the groups of reeds sterilized with different methods. The accepted value of the frequency of a "G" note on the clarinet is 349.23 Hz. The hand sanitizer showed the closest average value of frequency at 349 Hz. The Chi-square test for whether or not the note was in tune indicated a p-value of 0.96, therefore showing that there was no

statistically significant difference. The greatest difference in the results of this study was shown between the reeds soaked in hand sanitizer and the reeds that were sterilized with UV-C light. The original hypothesis, that 65% ethyl alcohol would cause the least amount of damage on the reed, was supported. From the data it can be concluded that hand sanitizer is the most effective method of sterilization that could maintain the integrity of the reed.

Third Place:

THE EFFECT OF NATURAL ANTIBIOTICS ON BACTERIA

Mishu Barua

Washington Lee High School

Honorable Mention:

THE EFFECT OF PH ON BACTERIAL GROWTH AND THE EFFECT OF SESAME OIL ON THE INHIBITION OF S.MUTANS

Kaixin Chen

Godwin High School

The purpose of this experiment was to study how oral bacterial growth is affected by sesame oil and pH. The experiment was derived from the ancient practice of oil-pulling, which has faced a decrease in practice due to the discovery of synthetic antiseptics and antimicrobials. With common use, these synthetic substances are becoming less potent against inhibiting growth.

In this experiment, different levels of pH as well as sesame oil were used to simulate the role of sesame oil in oil-pulling. The transmittance of light through oral sample swabs in BHI broth were used to study the density of growth of oral flora, especially *S. mutans* at various pHs and zones of inhibition were measured to study the effect of sesame oil on bacterial inhibition. The null hypothesis was, "Sesame oil and pH have no effect on bacterial inhibition."

The results demonstrated that the density of bacterial growth decreased as the pH deviated from neutral (7) and the zone of inhibition decreased as the pH deviated from neutral. It was concluded that pH and sesame oil both have an effect on the growth of *S. mutans*.

Honorable Mention:

THE EFFECT OF DIFFERENT DILUTIONS OF HEALTHCARE-ASSOCIATED GERMICIDES ON THE DEVELOPMENT OF HEALTHCARE-ASSOCIATED BACTERIAL RESISTANCE

Tyler Laredo

Washington-Lee High School, Arlington, VA 22201

Healthcare-associated infections are one of the most discussed issues in the medical landscape. They account for high mortality rates and increasing healthcare costs, and most of these infections are caused by bacteria; 70 percent of which show resistance to at least one drug used to treat them. The purpose of this study was to determine the effect of different dilutions of hospital-grade germicides on the development of bacterial resistance. It was hypothesized that if *Escherichia coli* is treated with different dilutions of hospital-grade germicides, then a resistance will most likely develop against an ethyl alcohol (EtOH) hand sanitizer at a 6.25% concentration. To test this, three dilutions of four different germicides (CaviCide, Clorox bleach, Hibiclens, and an EtOH hand sanitizer) were applied to Petri dishes of *Escherichia coli* via sterile filter paper disks impregnated with the diluted germicide. Over the period of growth, a zone of inhibition formed around each filter paper disk, displaying the area of inhibited bacterial growth. The measurement of the diameter of this zone (in millimeters) was the dependent variable. In order to properly display the process of natural selection, *E. coli* was exposed to each germicide dilution for a total of five rounds. At the end of the five rounds of exposure, statistical analyses of the data were done using ANOVA and t-tests to determine if bacterial resistance occurred. After data analysis, it was determined that *E. coli* displayed resistance to EtOH hand sanitizer 6.25%, 12.5%, and 25%, and Hibiclens 6.25% and 12.5%. *E. coli* did not show resistance to Clorox and CaviCide. Thus, the hypothesis was supported that bacteria would show resistance to an ethyl alcohol hand sanitizer at low concentrations.

Honorable Mention:

THE EFFECTS OF ERUCIC ACID/CANOLA OIL ON RAT HEPATOCYTES

Jordan Sheehan

Appomattox Regional Governor's School for the Arts and Technology

The purpose of this experiment was to analyze and evaluate the possible effect erucic acid, which is an element in all canola oil, has on hepatocytes. Canola oil was manufactured in Canada in 1995 and ever since the FDA approved it, scientists and society have been arguing whether or not canola oil is toxic food oil due to having erucic acid in it. The purpose of this experiment was to show what physically occurs when erucic acid is placed in culture with hepatocytes. Hepatocytes make up 80% of the liver and are largely responsible for detoxifying the liver, which is why they are used for most toxicology experiments. Erucic acid was added at different concentrations starting at 1 μ M ending at 100 μ M for up to 96 hours within a controlled tissue culture environment (35 mm culture dishes containing 1 x 10⁶ hepatocytes). Based on the results, it was observed that erucic acid is toxic to hepatocytes within all the different concentrations. More importantly, even at the lowest concentration, toxicity was evident in several ways. The first evidence of toxicity was that some of the primary hepatocytes had double nuclei and not a single nucleus as demonstrated in the control plates. Secondly, some vesicular formations were being formed and lastly there was evidence of increased cell debris when compared to the control plates. The conclusion of this experiment is that erucic acid, which is present in canola oil, is toxic to rat hepatocytes and thus may be toxic to human hepatocytes.

THE EFFECT OF UVA LIGHT ON THE NUMBER OF BACTERIA IN CONTAMINATED WATER

Sarah Angell

Washington-Lee High School, Arlington, VA 22201

The purpose of this experiment was to find the effect of time of exposure to ultraviolet light on the number of bacteria in contaminated water. The hypothesis was if contaminated water is exposed to ultraviolet light for longer periods of time, then more bacteria will be destroyed, and the area of bacterial growth will decrease. Water samples were collected from a local stream, Four Mile Run, and divided into 17 plastic PET

water bottles. A lamp with a U.V. bulb was placed over a metal sheet to simulate the SODIS (solar disinfection) procedure. Four water bottles were placed under the lamp for 6 hours. Four were placed under for 12 hours, four were left for 24 hours, and four were left for 48 hours. Two nutrient agar plates were prepared for each bottle, plus one for the control, for a total of 33 plates. Water samples were placed on the plates, which were incubated for 48 hours, and then the area of the bacteria on each plate was calculated. The measurements were averaged and put into a bar graph. Time clearly did have an effect, but the hypothesis was not supported. There was a direct relationship between amount of time and area of bacterial growth after 6 hours. The mean area for 6 hours was 205.7 cm^2 , for 12 hours the mean was 261.2 cm^2 , for 24 hours it was 370.7 cm^2 , and for 48 hours it was 259.4 cm^2 . The range in the four trials for each time period was high. For example, in the 6-hour time period, one bottle had 406.8 cm^2 of bacterial growth, and another had 50.6 cm^2 of bacterial growth. A possible source of error could be that the plates were accidentally contaminated during the procedure. One explanation for the results could be that after 6 hours of exposure, the U.V. light loses its effectiveness as a bacteria-destroying agent. Further experimentation could include changing the independent variable to be the surface the bottles are on, the source of the water, or the method of water sterilization.

THE EFFECT OF UVB RADIATION ON EICOSANOIDS AND SPHINGOLIPIDS IN ADULT HUMAN KERATINOCYTES(HEKa)

Lakshmi Bodapati

JR Tucker High School

UVB radiation is known to be a level one carcinogen. In this experiment, the changes in 43 lipids of human skin cells when exposed to two different levels of UVB radiation intensities were compared with the unexposed under a controlled environment using a mass spectrometer. The purpose of this experiment was to conduct a broad study on lipids in Human Keratinocytes (HEKa) which were exposed to UVB radiation in order to explore opportunities for further detailed investigations. These studies can help find drugs that can potentially inhibit biosynthetic pathways and thereby prevent and/or cure skin and other forms of cancer.

One million HEKa cells per plate were subjected to three different types of treatments. The first group, which was the control group, had no UVB exposure. The second and third groups were exposed for five seconds to UVB radiation at 50 kJ/m^2 and 500 kJ/m^2 intensities respectively. The independent variable in this experiment was UVB exposure. The dependent variables were the level of each Eicosanoid, and each Sphingolipid being tested. Three categories of Eicosanoids were observed: Arachidonic Acid,

Prostaglandins, and HETEs. Three different types of Sphingolipids were observed: Ceramides, Sphingomyelin, and Monohexosyl Ceramide.

The lipid synthesis patterns were studied under a mass spectrometer, and the data was analyzed. It was found that 40 of the 43 lipids were up-regulated when exposed to UVB radiation. The experiment provided insight into different lipid biosynthetic pathways that need further specific investigation.

The Effect of Disinfectant Sprays on Bacterial Growth

Victoria Castro

Washington-Lee High School Arlington, VA 22201

According to a clinical microbiology and immunology director, humans encounter about 60,000 different germs a year. Some bacteria that are brought into homes and begin growing are good for people, but there are harmful bacteria that give humans illnesses that can be deadly. Many people want to know which type of disinfectant spray would decrease the growth of bacteria, which led to the experiment of the effect of disinfectant sprays on bacterial growth.

Lysol, Oust, vinegar and water, and Walgreens brand disinfectant sprays were tested for their efficacy in killing *Escherichia coli* bacteria. It was hypothesized that Lysol would have the largest zone of inhibition because it's particular contents. To test this hypothesis, Petri dishes that contained nutrient agar were inoculated with E. coli. All the dishes were split into quadrants and then treated with the independent variable that was required and were incubated at 42°C for 48 hours. The zones of inhibition for each dish quadrant were measured. They were then averaged and were compared using a bar graph.

Lysol had the largest zone of inhibition of the disinfectant sprays tested. Lysol killed the most E. coli and therefore the hypothesis was supported by the data. Using an ANOVA statistical test, the p value was less than the critical value of 0.05. It can therefore be concluded that the null hypothesis can be rejected and the data is conclusive.

THE EFFECT OF DIFFERENT BRANDS OF DISINFECTANT WIPES ON THE NUMBER OF BACTERIA REMOVED

Stephanie Dowdy and Emily Emerson

Deep Run High School

In many households, hospitals, and classrooms, disinfectant wipes are used on a daily basis. They can be used for normal everyday usage or to clean vital sources that can influence lives. All packages of disinfectant wipes say “kills 99.9% of germs.” But, is that really true? Or does one brand work better than another? This is a question many teachers, moms, doctors, or normal people want to know. This sparked the investigation of different brand of disinfectant wipes. The purpose of this project was to determine whether or not it mattered on the brand of wipe used to clean a surface. The experiment was performed in a normal everyday environment: a classroom. Before the experimenting, the tables were swiped with swabs and recorded. Ten different spots on science desks were wiped with a different brand of wipe including: Lysol, Clorox, Target brand, or none. After letting the desk completely dry, they were swabbed and recorded on a petri dish. After each brand was tested, they were put into an incubator for six days. After they had incubated, the amount of bacteria was measured using cm^3 . Then, a t-test was made to compare the difference in bacteria for each brand of wipe ($t=7.65 > 2.101$; $t= 9.29 > 2.101$; $t= 18 > 2.101$; $2.196 > 2.101$; $t= 7.696$; and $df= 18$) The data did not support the hypothesis that if Lysol wipes were used, then the most bacteria would be removed from the desks. According to the experimentation, Clorox wipes got rid of the most bacteria.

INVESTIGATING THE MICROBIAL COMMUNITY ASSOCIATED WITH RAPID TISSUE LOSS IN *ACROPORA CERVICORNIS* USING LASER CAPTURE MICRODISSECTION.

Adrienne Gillevet

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Coral reefs, a vital ecosystem to the health of both our planet and human business enterprises, have been declining due to numerous causes including climate change. In staghorn coral, *Acropora cervicornis*, one prevailing problem is rapid tissue loss (RTL). It is not clear whether predation or a bacterial disease causes this new phenomenon. Coral samples taken from reefs off Broward County, Florida, and analyzed during summer 2011 as part of the Aquarius Coral Restoration/Resilience Experiment (ACRRE) were preserved in formalin, embedded in paraffin, sliced into thin sections with a microtome, and then stained for histological examination. The copious amounts of mucus and loss of structural organization in the mesenterial filaments observed in RTL samples could be an indication of an immune response to harmful bacteria. By using laser-capture microdissection (LCM), the affected areas of filament were excised from the

surrounding tissue. DNA was extracted from these samples and the microbial community was amplified using a standard set of bacterial primers then fingerprinted on a fluorescent sequencer. In this way, the normal bacterial community could be compared to that of a coral expressing rapid tissue loss. Preliminary results show the potential for this method, but additional studies are needed identify specific bacterial agents.

THE DIFFERENCE IN THE ZONE OF INHIBITION OF GERM-X STORED AT 50 C AND ROOM TEMPERATURE ON DIFFERENT TYPES OF BACTERIA

Hannah Harris

Shenandoah Valley Governor's School

Americans use hand sanitizers every day. The most common problem with using hand sanitizer is the improper storage of the product. The purpose of this study was to determine the zone of inhibition of Germ-x® hand sanitizer stored at different temperatures on different types of bacteria. Each sample was heated or allowed to be at equal temperature with the temperature of its surroundings. A disk was used to soak up the treatment and then put into incubated bacterium and allowed to work. After a 12 hour period, the diameter of the bacteria that didn't grow was measured.

THE EFFECT OF IONIZING RADIATION ON THE GROWTH AND CARBON DIOXIDE EMISSIONS OF *SACCHAROMYCES CEREVISIAE*

Erik Hames

Central Virginia Governor's School, Lynchburg, VA, 24502

The purpose of this study was to determine the effect of ionizing radiation on the growth and carbon dioxide emissions of *Saccharomyces cerevisiae*. In the study, yeast media were prepared using YEPAD agar. YEPAD broth was made and yeast cultures were grown and transported to a local cancer center to be irradiated with doses of 50cGy, 300cGy, and 700cGy of ionizing radiation with a Varian 23iX Trilogy electron linear accelerator. Carbon dioxide emissions were tested by combining 1mL of each culture's broth with 15mL of glucose solution in Durham Fermentation Tubes. The tubes were incubated at a constant temperature of 35 degrees Celsius with measurements taken at intervals of 2, 4, and 24 hours. At each interval the displacement of solution lost was measured. Three one-way ANOVAs were performed on the data, with a stated alpha value of 0.05. The time interval of 24 hours showed statistical significance, with a p-value of 0.004246, prompting an acceptance of the alternate hypothesis and a Tukey test, which showed difference within the means of the control and 700cGy irradiated cultures.

The time intervals of 2 and 4 hours resulted in p-values of 0.947249 and 0.448051, and an acceptance of the null hypothesis. So, the original hypothesis that the carbon dioxide emissions would decrease as the amount of radiation increased was supported, but only for the 24-hour interval. In conclusion, the results show that as the time interval and amount of radiation increased, the difference between the means of the carbon dioxide emissions increased as well.

A COMPARISON OF DIFFERENT PORTABLE WATER FILTRATION METHODS BOTH ALONE AND IN COMBINATION ON BACTERIA COUNTS IN STREAM WATER

Alex Kohlroser

Godwin High School

The purpose of this experiment was to explore the effectiveness of different water treatment methods both alone and in concert. In much of the world there are problems, not just with water shortages, but with the sources of water being not potable. To this effect several inexpensive water treatment methods were compared. 10 samples of 50 microliters of untreated water were used to compare 10 samples of each ultraviolet light, iodine tablets, and a water filter. Each treatment method was tested both by itself and with the other two methods, leading to 70 samples including the control. Iodine was the most effective treatment method, eliminating 100% of *E. coli*, the next effective method was filtered water treated with ultraviolet which eliminated 99.98% of *E. coli*. The least effective method was the filter by itself, which eliminated only 66.18% of *E.coli*. A t-test found that all water treatment methods were significantly more effective when compared to the untreated water. The results supported the research hypothesis in that the filter was the least effective treatment method but did not support that the ultraviolet light was most effective. It is possible that the one colony of *E. coli* that grew out of the ten plates of water exposed to ultraviolet light got onto the plate as a result of experimental error. For further studies it is recommended that the effectiveness of methods against viruses is tested and that more advanced methods are used to determine the level of water contamination.

THE EFFECT OF THE VARYING LEVELS OF AMPICILLIN SOLUTION CONCENTRATIONS ON THE RESISTANCE LEVELS OF THE BACTERIA *ESCHERICHIA COLI*.

Naveen Chandra Kotha

J.R. Tucker High School, 2910 Parham Road, Henrico, VA 23294

In recent years, there have been a significant number of bacterial infection outbreaks all around the world, such as the German *E. Coli* Outbreak of 2011, which have been difficult for medical professionals to cure through the use of standard antibiotics. In order to engineer more efficient antibiotic compounds, it is important to analyze and understand the levels of antibiotic resistance of the bacteria causing these infections. The purpose of this experiment was to determine the effect of the various levels of ampicillin solution concentrations on the resistance levels of the bacteria *Escherichia coli*. The different ampicillin to water solution concentrations used in this experiment include a 1 ml to 10 ml ratio, a 3 ml to 10 ml ratio, and a 5 ml to 10 ml ratio. Three groups of three petri dish environments containing the *Escherichia coli* bacteria were each introduced to a differently concentrated ampicillin solution. Over a two-week period, these three groups of *E. coli*-containing petri dishes were each allowed to incubate in a controlled environment. The results of this experiment indicated that the bacteria cultures in the third stage of the experiment that were introduced to a 5 ml to 10 ml concentration of antibiotic solution had produced the smallest inhibition zones with an average diameter of 22.01 millimeters. The data supported the research hypothesis that the *E. coli* that incubate for three days with a solution of 5 ml and 10 ml will have greater levels of antibiotic resistance than those that incubated with solutions of 3 or 1 ml and 10 ml. Based on the diameters of the bacteria cultures' inhibition zones measured in this experiment, there appears to be a direct correlation between the concentration of the solution and the bacteria's levels of resistance over time. Before it can be concluded that higher concentrations of antibiotic solutions increased antibiotic resistance over time, similar experiments in which different strains of the *E. coli* bacteria are used must be conducted to determine whether higher concentrations of antibiotic solutions increase bacterial antibiotic resistance over time in all types and strains of bacteria.

WHICH NATURAL ANTIBACTERIAL SUBSTANCE KILLS THE MOST BACTERIA

Chloe Lewelling

Washington-Lee High School, Arlington, VA, 22201

This experiment shows which natural antibacterial substance tested is the most effective at killing *Escherichia coli* bacteria. This was tested, because of the new strains of bacteria developing resistance to commonly used antibiotics. The substances tested were garlic extract, astragalus root extract, and tea tree oil. It was hypothesized that if garlic extract was used, then the most bacteria would be killed. This hypothesis was tested by exposing a Petri dish containing *E. coli* to the different substances mentioned. Then the Petri dishes containing *E. coli* were put in an incubator for two days. After, the zone of inhibition diameter was measured to get the results. The Petri dish treated with Astragalus root's zones of inhibition had an average diameter of 6.7 mm. Tea Tree Oil had an average of 45.0 mm. Garlic extract had an average of 8.7 mm. The experiment was able to reject the null hypothesis. The evidence supported that tea tree oil kills the most bacteria.

The Effect of Various Wavelengths of Ultraviolet Radiation on *Escherichia coli* Growth Inhibition

Pranay Nuvvala

Mills E. Godwin High School, Richmond, VA 23238

Bacterial resistance to common antibiotics poses a great hazard to human health. Ultraviolet radiation can be used to kill bacteria, but various sources contradict each other on the precise wavelength of ultraviolet radiation to be used. The purpose of this experiment was to determine which wavelength of ultraviolet radiation is most effective in inhibiting bacteria cell growth. A research hypothesis was formulated that *Escherichia coli* exposed to a lower wavelength of ultraviolet light would exhibit higher inhibition of bacteria cell growth. Lower wavelengths of ultraviolet light have greater amounts of stored energy that can easily break down chemical bonds in the bacterial cell wall leading to inhibition of cell growth and division.

To perform this experiment, a nutrient agar broth and an *Escherichia coli* broth were created and applied to petri dishes. The bacteria samples were then irradiated at 302 (UVI) nanometers, 360 (UVII) nanometers, and the control which did not receive any ultraviolet light. The bacterial cultures exposed to UVII demonstrated the highest inhibition of growth while UVI inhibited moderate bacterial growth and the control group exhibited minute amount of bacteria growth. As a result, the research hypothesis was not supported. The calculated t-values for this data were all greater than the t-table value and therefore the significant. The data was slightly flawed as air bubbles may have been mistaken for colonies and interfered with the results. This data will be able to assist in the development of new bacterial cell growth inhibition processes such as sterilization and medications.

THE DIFFERENCE IN NUMBER OF BACTERIOPHAGE TYPES BETWEEN BIOSOLID TREATED AND UNTREATED SOIL

Hannah Owen

Central Virginia Governor's School Lynchburg, VA 24502

The purpose of this study was to isolate bacteriophage types found in farm soil treated with biosolids and farm soil not treated with biosolids. A preliminary test trial was performed using the Phage Demonstration Kit from Carolina Biological Supply Company; the Phage Demonstration Kit produced open, opaque areas, called plaques, where bacteriophages preyed on the bacterial host. The original procedure used in this study was a combination of methods provided by Carolina Biological Supply Company, a commonly used college laboratory, and a laboratory developed by the research mentor within the 2010-2011 school year. Bacteriophages from both the treated and untreated soils were isolated by filtering the samples of large particles and bacteria using the double layer agar method. The samples were then amplified using K-12 *E. coli* and diluted to 10^{-5} and 10^{-7} dilutions. The dilutions from each sample were added to a soft agar layer with a drop of K-12 *E. coli* to pour on top of an agar plate. The agar plates were incubated for

24 hours at 37° C. Bacteriophages isolated from biosolid treated soil produced an uncountable number of plaques while the bacteriophages from the untreated soil produced a small number of plaques in comparison. The results supported the original hypothesis which stated that there would be more bacteriophage types within biosolid treated farm soil than with untreated farm soil, numerating the bacteriophage types without identifying the strains. All the results taken together show that biosolid treated soils contain more bacteriophage types than untreated farm soils.

THE EFFECTS OF ANTIBIOTICS ON THE AQUATIC PLANT LIFE OF THE CHESAPEAKE BAY

Daniel Wood

Ocean Lakes High School, Virginia Beach Virginia, USA

The purpose of this project was to determine whether the antibiotic tetracycline had an effect on an aquatic plant's (elodea) protein, glucose, and/or oxygen concentration. The research hypothesis was that if the tetracycline concentration was increased, then the protein, glucose, and/or oxygen concentration would decrease. The null hypothesis was that the tetracycline concentration would have no effect on protein, glucose, and/or oxygen concentration. Nine 1.5 L aquarium tanks were filled with tap water. Then different concentrations of tetracycline (0.5 mg, 1.0 mg, 2.0 mg, 3.0 mg, 5.0 mg, 7.0 mg, 9.0 mg, and 11.0 mg) were placed into eight of the nine tanks. Three elodea sprigs were massed and added to each tank. Each day the oxygen concentration was calculated for each tank, and the biomass was calculated for each elodea. At the end of the fifth day of testing, each sprig was shredded in a blender on high speed and placed into a labeled container. Then each sprig was tested for protein concentration and glucose concentration. The range of means for the protein experiment was 0.00036 to 0.0011 g/mL/gram of Elodea. One key result was a p-value of 0.129 for the control vs. 11 mg tank during the protein experiment. The range of means for the glucose experiment was 0.00019-0.00081 g/mL/gram of Elodea . All p-values of the glucose experiment were over 0.05. The range of means for the oxygen experiment was 0.423 to 1.16 parts per million. The p-values for the oxygen experiment were 0.025 for the 0.5 mg tank, 0.020 mg tank, 0.0060 for the 5.0 mg tank, and 0.011 for the 7.0 mg tank. The null hypothesis was rejected for the 11.0 mg tank for the protein experiment and for the 0.5 mg, 2.0 mg, 5.0 mg, and 7.0 mg tanks for the oxygen experiment, but wasn't rejected for the glucose experiment. The research hypothesis was supported generally in the terms of data, but there wasn't a big enough difference to be a statistical difference.

PHYSICAL SCIENCE, ENGINEERING, AND MATH A

First Place:

THE EFFECT OF ROOF ANGLE ON THE AMOUNT OF LIFT ON A ROOF

Collin Carder

Moody Middle School, Richmond, VA 23232

During high wind events such as hurricanes or tornados, the part of a building that is first to fail is the roof. This is because suction or negative pressure builds over the roof while a pushing force or positive pressure builds underneath. The negative pressure builds because the air moving over the roof is at a higher velocity than the air under the roof. The air with the higher velocity has a lower pressure than non-moving air therefore

the roof lifts. This principle, discovered by Swiss mathematician Daniel Bernoulli, states that as the velocity of air increases, pressure decreases. This principle explains why roofs act like airplane wings during hurricanes or other similar high wind events. The question is: What is the best way to prevent roof failure? One approach to this problem is to attach the roof to the structure with reinforcing clips. This solution counters the lifting force, but what if this lift could be reduced so they could not act upon the roof in the first place? The purpose of this experiment was to test the effect of roof angle on the amount of lift on the roof. Based on Bernoulli's principal, the experimenter hypothesized that a gable roof at a forty-degree angle would have the least amount of lift. A wind tunnel and a small-scaled model roof were built to test this hypothesis. The weight of the roof was measured with a digital scale before and after wind was applied. The roof was set to zero degrees during the testing. The fan was turned on for thirty seconds, and then the second weight was recorded. This procedure was repeated for the roof at ten degrees, twenty degrees, thirty degrees, forty degrees, and fifty degrees. The difference in the two weights was calculated, and a mean was computed. The results showed that as the roof became steeper it became more wind resistant. The roof at fifty degrees had the least amount of lift, and the roof at ten degrees had the greatest amount of lift. While the hypothesis was not completely supported by this data the idea that steeper roofs are more wind resistant was true.

Second Place:

LIQUID CONDUCTORS

Bilguunzaya Battogtokh

Kenmore Middle School Arlington, Virginia 22204

Electricity can be created through conductivity. Producing the same energy through liquid conductors is called electrolysis. The purpose of this experiment is testing four liquid substances and discovering which substance generated the most electricity. The hypothesis was that potassium chloride mixed with water would produce the most electricity. The experiment involved creating an open circuit, connecting a battery and a LED light. The substances were put through the open circuit and the voltage, resistance, and current were measured and recorded. The results were 5 teaspoons of sodium chloride mixed with water generated the most electricity. The hypothesis that potassium chloride mixed with water would produce the most electricity was rejected.

Third Place:

THE EFFECT OF DESIGN MODIFICATIONS ON HELMET SHOCK

Juliana Bain

Swanson Middle School, Arlington, VA 22205

Previously, the effectiveness of thin, inexpensive cushioning on the outside of helmets was tested, which demonstrated significant reduction over the control in peak shock to the brain during helmet-to-helmet collisions (Bain, 2011), the cause of thousands of traumatic brain injuries yearly (Marshall, 2009). The present experiment built on those findings by testing three helmet design variations (which required fabricating a total of six prototypes). Starting with the materials that had previously performed best (moleskin with PETG plastic) (Bain, 2011), the design of these materials was tested for their effect on peak acceleration during collisions. Specifically tested was whether creating a plastic shield with a shape to provide structural resistance and texture (giving greater surface area) could further reduce peak acceleration during collisions. None of the design modifications extended more than 1 cm off the original helmet shell because of the practical need for the design to not be bulky. Vacuum thermoforming of PETG plastic (thanks to how-to YouTube videos) was used to build the needed prototypes (Stanford University Transformative Learning Technologies Lab, 2011). The accelerometer was mounted on wood inside the helmet and dropped (from a pulley at a height of 0.7m) requiring analysis of only the sensor data from the initial collision and not subsequent bounces. The data supported the hypothesis that shock can be reduced through designs maximizing structural resistance and surface area of plastic shields (peak shock was reduced by 83%). It was also observed that changes to the plastic after heavy hits could help show when players' brains have been exposed to stresses.

Honorable Mention:

THE EFFECT OF LAUNCH ANGLE ON PROJECTILE DISTANCE

John Abribal

George H Moody Middle School

Honorable Mention:

THE EFFECT OF TEMPERATURE ON THE CONDUCTIVITY OF A SET RESISTOR

Allen Baiju

George H. Moody Middle School

Alessandro Volta made the first great discovery in electricity when he proved that electricity flows through a material. Electricity is a form of energy that exists due to the fact that there are charged particles in atoms. Electrical conductivity is the ability of an object to allow electric current to flow through it. Electrical resistance is a measure of how strongly a material opposes the flow of electric current; it is measured in ohms. This experiment was conducted to find whether temperature affects the resistance of a set resistor. The experimenter's hypothesis stated that, if the temperature of the resistor is brought down to freezing (0°C), then it will have the lowest level of resistance. The experiment required copper wire (22 gauge), a breadboard, two AA batteries and a battery holder for them, a multimeter, a thermometer, three bowls, clothespins, a 100 ohm wire-wound resistor, an LED with a rating of 3.5 V (30 mA), a safety apron, safety gloves, and safety goggles. Using the materials above, a series circuit was constructed and was used to test if the resistor was working. Then the resistor was submerged in various temperatures of water. The acquired results stated that the room temperature resistor tested, had the lowest average level of resistance and the boiling temperature resistor had the highest level of resistance. Therefore, the lowest level of resistance will belong to room temperature, not the freezing temperature. This did not support the experimenter's hypothesis as it stated differently. More analysis must be done to ensure that the results acquired are accurate, along with the fact that more temperatures should be tested.

Honorable Mention:

THE EFFECT OF DIFFERENT TYPES OF LIGHT SOURCES ON THE AMOUNT OF POWER GENERATED BY A SOLAR CELL

Colin Bailey

George H. Moody Middle School, Henrico, Virginia 23228

Solar cells, also known as photovoltaic cells, are very thin and between 2 and five inches long. They are primarily made of silicon and thin wire and when placed in the sun generate electricity. Solar cells produce about .5 volts of electricity each no matter how big or small they are. To produce more voltage the individual cells are connected together to make a solar cell.

Scientists have determined that for a solar cell to produce the most electricity it needs to be located in full sun and pointed toward the sun. The purpose of this project was to

determine the effect of different types of light sources on the amount of power generated by a solar cell. Four trials of each of the different types of light sources were tested and the voltage generated by the solar cell was measured with a voltage meter and recorded. The types of light sources used were natural (sunlight), fluorescent, LED and incandescent. From the tests that were run, the best results of all the trials were the ones with the incandescent light bulb. This type of light generated a mean of 8.013 volts of electricity. The sun came in with the second best results out of all the trials. The sun generated a mean of 7.321 volts of electricity.

The data did not support the research hypothesis that the natural light (sunlight) would generate the most volts of electricity. Based on the volts of electricity recorded in this research, it was determined that the incandescent light produced more volts of electricity than the natural light. It was concluded that the incandescent light had a light frequency that was easier for the solar cell to generate into electricity than the natural light which has many frequencies.

THE MAGNETIC PULL STRENGTH OF VARIOUS CONFIGURATIONS OF BUCKYBALLS

James Armstrong

Tuckahoe Middle School

Buckyballs® are popular desk toys consisting of 216 shiny, spherical, 5 mm neodymium magnets. They are used to design various shapes and can be studied to illustrate the effect of compound magnetic fields. A magnetic pull test was designed to compare the breaking strength of ten different arrangements of a chain of 40 Buckyball magnets. Each arrangement was attached to the undersurface of a baking pan. Weights were suspended from the arrangements. The magnetic pull force was defined as the highest mass supported by the magnetic chain for ten seconds without breaking. The single chain held a mass of 333.2 +/- 5.4g. When the chain was folded in half, the magnetic strength increased by 79% to 595.1 +/- 9.2g. When folded in half again the quadruple chain held 1081.4 +/- 25.5g. By contrast, a pair of overlapping chains with polarity in the same direction was 20% weaker than one single stranded chain. Configurations assembled with the magnetic poles oriented horizontally, such as stacked squares, circles and spirals were the weakest of all. When a cylinder was created by rolling a sheet of vertically oriented magnets the strength differed depending on whether or not the structure was assembled in contact with the metal pan. It is believed that the spherical magnets reorient during the assembly of certain structures. The experiment supported the hypothesis that the magnetic strength of a chain of Buckyballs is dependent upon the arrangement of the spheres and the orientation of their magnetic fields. It appears that the magnetic force can be increased by assembling multiple small magnets side by side with alternating polarity.

AIRPLANE CHALLENGE

Nicholas Augustus

Hines Middle School

The airplane challenge was selected because the experiment involved aerodynamics, and this was an area in which the student had an interest. The first step was to answer the problem: how will the design of the plane change the distance it travels? The independent variable of his project was the design of the plane. The resulting dependent variable was the distance the plane traveled. The hypothesis was "If an airplane's wing has enough curve, then the air pressure underneath will allow the airplane to glide." In the procedure of making the plane the student cut the wings out of cardboard into shapes of triangles and rectangles. In order for the design to work the student had to insert side wings and tail wings/stabilizers and attach the wings to the body with duct tape. He also included popsicle sticks in one wing design. Finally, he conducted flight trials. What the student discovered was that different designs yielded very different outcomes. The student had five prototypes, and each prototype had three trials. The wing profile which flew the furthest distance was a rectangular design with a 2 tier-wing, which was supported by popsicle sticks. The other 1-tier wing designs did not travel as far. The student concluded that his hypothesis was correct, and the design of the plane does affect the distance traveled. He also thinks a way to improve this experiment is to allow the use of more materials and take away the weight restrictions.

THE EFFECT OF LAUNCH ANGLE ON THE ACCURACY OF A BASKETBALL SHOT

ANNEMARIE BERAN

George H. Moody Middle School

Athletic accomplishments and academic aptitude are not necessarily mutually exclusive. A simple basketball shot involves laws of physics and other scientific principles. An athlete's academic understanding of the scientific basis of the "bucket" can improve one's game. Forces acting on a basketball during its flight are buoyancy, drag and Magnus. The ball travels upward until it reaches its top height and gravity then causes the ball to fall. Other variables that impact a basketball shot are launch speed, arc, and launch angle. Launch speed is dependent on the shooter, and arc determines incoming angle as a ball enters the hoop. Launch angle is the angle at which the athlete pushes the basketball towards the basket. Physicist Peter J. Brancazio opined that there was an optimum shooting angle. Upon learning of the potential for improving one's basketball game, the experimenter desired to determine if launch angle impacted a shot at her competition level. Eight basketball teammates shot from a marked spot with two hands, using minimal back spin, from chest, chin and top of head levels, twenty times from each

position. The independent variable was the height at which the shooter shot the ball. The dependent variable was the number of made baskets. The experimenter predicted that, if the launch angle was increased, the accuracy of a shot (number of made shots) would improve.

As the angle was increased from above 41 degrees (going from an over the head shot to the chin shot), more baskets were made by each participant. However, if the angle was increased too much (beyond approximately 50 degrees) (a chest shot for all participants), the number of made shots decreased significantly for each participant. The launch angle impacted percentage of shots made. Before the optimal launch angle could be articulated, other shot variables would have to be isolated or removed.

FREEZING WATER: AN INVESTIGATION INTO THE MPEMBA EFFECT

Joseph Berger

Kenmore Middle School Arlington, Virginia 22204

The Mpemba effect is the phenomenon where hot water will freeze faster than cool. Possible causes are evaporation, convection, concealed gasses, and super cooling. The purpose of the experiment was to see if the starting temperature of water affected its freezing rate. The hypothesis was if the water is warmed before freezing, then the warm water will freeze faster than cooler water. The procedures were to heat or cool the water to the desired temperature, then pour 50 mL into the graduated cylinders. The graduated cylinders were then placed in the freezer until they froze. The warmer water froze the slowest, and the cooler water froze the fastest. The hypothesis if the water is warmed before freezing, then the warm water will freeze faster than cool water, was rejected.

WHAT DETERMINES THE PITCH OF A STRING?

Steven Bluestein

Kenmore Middle School Arlington, Virginia 22204

String pitch can be analyzed using scientific instruments and equations. Different things can affect the pitch, such as string tension, length, and density. The purpose of this experiment was to determine if string pitch is affected more by string tension or string length. The hypothesis was that string length would affect string pitch more than tension would. One string was tested for pitch while the tension and length were changed. The results were recorded. String length affected string pitch more than tension. The hypothesis that string length would affect string pitch more was accepted.

CAN A SUSPENSION BRIDGE HOLD MORE WEIGHT THAN A TRUSS BRIDGE?

Alexander Brown

Kenmore Middle School Arlington, Virginia 22204

Truss bridges are made up of many triangles, to support the deck, which are the strongest geometrical shape. Suspension bridges have strong cables to support the deck. The purpose of this experiment was to find out which was stronger. The hypothesis was that the truss bridge would hold more weight. First the three truss and three suspension bridges were built. Then they were tested using a bucket, a ruler, a spool of string, and some cans of food. The suspension bridges held more weight overall than the truss Bridges. Therefore, the hypothesis was rejected.

VAULTING ADVENTURES

Lizzie Brown

Hines Middle School

The problem in the experiment is: Does the height of a vaulting table affect the successful landing of a front handspring? The original hypothesis was if the height of the vaulting table is changed, then the percentage of the successful front handsprings landed will increase. In order to complete this experiment first the vaulting table height was set to 100 cm. The gymnast then began running, jumped on the sprint board and pushed off the vault. The gymnast then completed a front handspring and landed the stunt. The vaulting table height was changed to 105cm, 110cm and 115cm. The data recorded was whether or not the landing was stuck successfully. Three other gymnasts were used to complete this experiment. The data shows that there were 12 trials, 4 different heights, and 3 attempts made at each height. The results were accepted because the hypothesis stated that if the height of the table is changed, then the successful landing of the front handsprings stuck will increase. This was proved when all of the gymnasts landed the vaults, so the percentage landed increased. The hypothesis was if the height of the vaulting table is changed, then the percentage of the front handsprings landed will increase. According to the data, with respect to the hypothesis, the hypothesis was accepted. It is important to note that for the data the researcher only used people that were the same skill level, similar height and similar weight as the writer of this paper. If the researcher used other people then the results would have been skewed because they would not have been the same height or weight. The researcher would also like to note that the speed of the run cannot be a constant because you cannot control the speed of your run, so it would neither be considered as a constant, but a variable that could skew the results.

THE EFFECT OF FOOTWEAR ON RUNNING SPEED

Molly Bruce

George H. Moody High School

Research has shown that barefoot running is the most natural way of running and increases running speed. Experiments have been performed to support this idea. Barefoot running automatically puts runners in perfect position, and when runners wear shoes it adds unnecessary weight, and it puts them in an unnatural position. The purpose of this experiment was to determine the effect of footwear on running speed. It was hypothesized that if different types of footwear were used to test running speed, then barefoot running will create the fastest running speed. A healthy male was selected to run in each type of footwear. Ten trials were performed for Nike® running shoes, Nike® turf shoes, and bare feet, thirty trials in all. In each trial, the runner ran twenty meters and was timed by a stopwatch. The results showed that when the runner ran in the Nike® running shoes, his average running speed was the fastest, and when the runner ran barefoot, his running speed was the slowest. The hypothesis in this experiment was not supported. Many factors contributed to why the results did not agree with the prior research that was obtained.

THE EFFECT OF THE NUMBER OF LAYERS OF FABRIC IN A PARACHUTE ON HOW LONG IT TAKES TO HIT THE GROUND

Corinne Burch

George H. Moody Middle School

Parachutes, though of ancient age, are always growing and developing to adapt to new needs. Whether delivering people and packages to the military or delivering a screaming skydiver to the ground, parachutes must be extremely reliable. To ensure this, parachutes are tediously designed to be practically fool proof. Algebra, engineering, physics, and meteorology are all factors in the success of a parachute's journey. One way to change the effectiveness of a parachute is to alter the number of layers of canopy. This increases the air resistance, but it also increases the mass of the parachute. Which factor, air resistance or mass, outweighs the other? The following experiment was designed to find out. After researching, my hypothesis was as follows. If the number of layers of canopy/fabric on a parachute is increased, then the time the parachute takes to land will also be increased. Each parachute was made with a paperclip, one to four sheets of

muslin measuring twenty centimeters by twenty centimeters, and four lengths of embroidery floss, each twenty-five centimeters long. The sheets of fabric were snipped at the corners and tied with the embroidery floss, which was then connected to the paperclip. A mark was made at two meters high, from where the parachutes were dropped. After each parachute's descent was timed, the results were averaged out and recorded. Surprisingly, the longest average descent belonged to the group of parachutes with one layer of canopy fabric. My hypothesis was not supported, but not altogether disproven. It is possible that a thinner fabric, such as chiffon, would have presented a different set of results. The reason for the results I received was that the greater number of layers made the canopy slope inwards, decreasing air resistance. Thinner fabric would not have as much of a problem.

THE EFFECT OF THE SHAPE OF THE FINS ON HOW LONG A MODEL ROCKET STAYS IN THE AIR

Sean Copenhaver

George H. Moody Middle School, Henrico, VA 23228

In model rocketry, one of the most crucial parts of the model rockets are the fins, and the shape, size, and weight of them can completely change the rocket's flight. The fins on a model rocket can affect the stability, aerodynamics, and even the flight time of the rocket, so the fins have to be chosen carefully. The purpose of this project was to find out if the shape of a model rocket fin will affect how long that the model rocket stays in the air. The shapes that were used for the fins in this project were triangular fins, elliptical fins, rectangular fins, and parallelogram shaped fins. Four model rockets were launched, and each had differently shaped fins. A stopwatch was used to collect the data, the number of seconds that each rocket was in the air. The results indicated that the rocket that stayed in the air the longest was the one with elliptical shaped fins, with a mean of 19.19 seconds in the air and the rocket that stayed in the air the shortest time was the one with parallelogram shaped fins, with a mean of 13.15 seconds in the air. The data did not support the research hypothesis that if four differently shaped fins were put on four model rockets then the rocket with the parallelogram shaped fins will stay in the air the longest. Based on the means of the times of the different rockets, the rocket with elliptical fins stayed in the air the longest and had the best flight. Also, another major finding was that the rocket with the parallelogram shaped fins stayed in the air the shortest.

THE EFFECT OF STRUCTURAL DESIGN ON HOLDING STRENGTH

Cal Costic

Stonewall Jackson Middle School: Mechanicsville, VA 23111

There are many different ways to construct a skyscraper. A major obstacle when constructing a skyscraper, regardless of location, is the weight of the tower itself and everything in it. Because of this, architects have used many different designs to construct towers. This experiment was performed to compare some tower designs. In this study, three towers of varying design were constructed out of balsa wood, then put under a load to determine how much weight they were capable of holding. Weights were added to this load until the tower collapsed. The tower with no diagonal support held the most weight but shattered violently upon breaking. The tower with diagonal supports in alternating directions held the second-most weight and broke more evenly. The third tower, with diagonal supports, also broke more evenly than the strongest tower. Although the tower without diagonals held the most weight, the two towers with diagonal supports broke more safely. The best overall tower was the one with alternating diagonals.

HOW HIGH WILL THAT ROCKET FLY?

Emily Dawson

Gildersleeve Middle School, Newport News, VA 23606

The purpose of this experiment was test the effect of the amount of water in a water rocket on how high it will fly. The scientist filled water rockets with different amounts of water and then added 60 pounds per square inch of pressurized air for each launch. Then, the rocket was launched and an altitude finder was used to record the angle in degrees. Each angle was recorded from a distance of 150 feet from the base of the rocket launcher. A tangent table was then used to calculate the altitude of the rocket's flight. The results showed that a rocket with no water and only pressured air went, on average, 125 feet high, a rocket with 10 percent of water went 155 feet, a rocket with 20 percent of water went 158 feet, a rocket 30 percent of water went 155 feet, a rocket with 40 percent of water went 113 feet, a rocket with 50 percent of water went 117 feet and a rocket filled with 60 percent of water went 101 feet. The results show that adding 20 percent of water to a water rocket went the highest. Adding more water to the rocket made it heavier and reduced the amount of air available. After a mix of 20 percent water and 80 percent pressurized water, as more water was added, the altitude of the rocket's flight decreased.

THE EFFECT OF BOW LENGTH ON THE DISTANCE AN ARROW TRAVELS

Parker DiPaolo

George H. Moody Middle School, Richmond, Virginia, 23228

When the first written historical records were developed, the bow was classified as the first killing machine. Since the Paleolithic Era, hunters have used the bow to obtain food because it has revolutionized hunting in every time period by giving hunters the advantage of stealth. The strength of a bow comes from how far the bowstring is pulled back, which changes the amount of energy stored in the bow. The potential energy stored in the bow is released into the arrow once the string is released. Although bows commonly weigh about four pounds, their draw weight can be between sixty and seventy pounds. This allows more energy to pass into the arrow if the bowstring is fully pulled back, while the type of arrow also determines how well it flies. The purpose of this investigation was to determine what effect the length of a bow would have on how far it shot an arrow when the bows had lengths of 97 cm, 112 cm, 127 cm, and 142 cm. Four bows were constructed at lengths of 97 cm, 112 cm, 127 cm, and 142 cm. After an arrow was shot from one bow, its distance from the starting point in a straight line was measured with a meter stick and was repeated nine more times for that bow. The process was repeated for the other three bows. Once the data was gathered, the results indicated that the shortest bow, with a length of 97 cm, shot an arrow the farthest distance on average compared to the other three bows. The data did not support the hypothesis that stated if bows with different lengths shot an arrow, then the longest bow would shoot an arrow the farthest. Based on the distances that the arrows traveled when shot from the bows before landing, there appears to be a relationship between the distance the arrow traveled and the bow length. However, before it can be concluded that bows with a relatively short length shoot an arrow a farther distance than long bows, more professional and scientific testing by archers and scientists alike will need to be conducted to determine if bows with short lengths generally shoot arrows farther than bows with long lengths.

THE EFFECT OF BURNING MATERIALS ON AN IONIZED SMOKE ALARM

Andrea Eichenberger

Tuckahoe Middle School, Henrico, Virginia 23229

In this experiment, the question being tested was whether the different types of materials being burned would affect the time it takes for a smoke alarm to react. The hypothesis was that if fast-burning (paper, cotton) and slow burning (thick plastic, thin plastic, cardboard) objects were set on fire underneath an ionized smoke alarm, then the fast-burning or combustible materials would set off the alarm faster than the slow-burning or smoldering materials. The hypothesis is tested by burning different, everyday household materials (paper, cotton fabric, cardboard, thin plastic, and thick plastic) 3 feet below an average ionized smoke alarm. The levels of the independent variable were tested three times per level. Each reaction time for the smoke alarm was written down, and then all three times were averaged together. The experiment proved the hypothesis right, by showing that thick plastic did not set off the alarm at all and showing that the plastics melt and do not burn well. Cardboard, not being a plastic, did not melt, but still did not burn well either and was very thick and dense. These all prove the hypothesis because since they don't burn well, they had high times. The paper and cotton had the two fastest times which suggests that more combustible materials do in fact burn faster and more noticeably than smoldering ones and as a result will set off an ionized alarm quicker than slow burning objects. There was little data, and it was variable which made it hard to conclude strongly. However, the data showed that the hypothesis was correct and fast-burning materials do set off ionized smoke alarms faster than slow-burning ones.

COMPUTER PROGRAMMING FOR A TEACHING ENVIRONMENT

Andrew Elgin

George H. Moody Middle School, Richmond, VA 23233

Computer code and programming are two key components in the functioning of computers. Different programs are what tell the parts of the computer hardware to perform their function as needed. Many well-known programs are operating systems; operating systems like Windows 7, Mac OSX, and Linux. These operating systems are all programs that were written with one of various different types of programming terminals.

The purpose of this project was to determine whether or not the Python programming terminal was capable of producing a program that could scramble test questions. The reason this program was written was to eliminate cheating in a classroom, as a student cannot look at another student's work if they are not on the same question. To run this experiment, first a piece of code was written that held the function of scrambling five instances of user input. Then the program was run through a series of trials, confirming that it was possible for the Python terminal to produce such a program. It was found that the program functioned with approximately a 90% success rate over all based on the combined scores from each trial.

Based on this experiment, it was found that it is possible for Python to produce a simple test scrambling program. However, it was also found that the program had a few irreparable bugs. Before it can be stated that Python is the best terminal for writing this sort of program, it needs to be tested on a variety of different programming platforms, such as Java.

WHERE WOULD YOU LIVE?

Bridget Escobar

Jefferson Middle School, Arlington, VA 22204

Lately, there have been many natural disasters around the world. Lives were lost, and damage has occurred to hundreds of buildings. There are many different types of methods to build houses, but which is best? This experiment was done to learn which roof would be less damaged. After building all houses with the help of the drawings the testing was begun. To test the houses in a hurricane a leaf blower 3300 set on high was used with a pressurized water hose. After a minute of testing, the houses were placed in an Orbital Shaking Incubator to stimulate an earthquake. The incubator was set on high and the houses sat for a minute. Once the testing was completed a Likert scale was used to rate the roofs accordingly. This procedure was repeated to all houses. The hypothesis was that the gable roof would hold up best in natural disasters.

According to the results, gable roof houses were more stable than slant roof houses. Rating mostly in 4 out of 5, 5 meaning the house was in perfect condition, the gable roofed houses had very few problems. With just a few frame sticks out of place and a couple missing windows, the houses weren't really damaged. Rating mostly in 3's, the shed roof house did have some damages. With most or all windows missing and around 20 frame sticks out of place, the houses were pretty damaged, but it could be fixed. According to the results, the hypothesis was accepted.

PHYSICAL SCIENCE, ENGINEERING, & MATH B

First Place:

THE EFFECT OF A BARRIER ON THE TRANSMISSION OF LIGHT

Anastasios Karles

George H Moody Middle School

In 1907, the British experimenter H.J. Round made an LED, or light emitting diode. Nick Holonyak, Jr. invented the first practical light emitting diode in 1962 while working for the General Electric Company. The first LEDs became available in the late 1960s, and were the color red. They were mostly used as replacements for incandescent indicators, and in expensive equipment such as laboratory and electronics test equipment, then later in common home appliances such as TVs, radios, telephones, calculators, and even watches.

Later, other colors became available. When the LED materials and technology became more advanced, the light output was increased, and soon LEDs became bright enough to be used for illumination. Much later, photodiodes were invented. Photodiodes detect light and convert it to current. Once photodiodes were invented, they could be used with LEDs to develop sensor technology. Sensors work by varying the light falling on the photodiode depending on the material between the photodiode and the LED.

The purpose of this experiment was to determine the effect of a color barrier on the transmission of light. Barriers were formed by different colors of clear plastic paper and also for different thicknesses of color paper. The results show that the relationship between the diode current and the phototransistor output can be modeled as a linear function, and also that the farther away on the frequency scale the color of the barrier was from the color of the LED, it blocked more light. The data supported the hypothesis that if an LED is blocked from the sensor using different barriers, then the output from the sensor can be used to identify what kind of barrier was used. There is a direct correlation between the color of the LED and the response of the detector when a barrier is present.

Second Place:

THE EFFECT OF TUBE COMPOSITION ON THE TIME IT TAKES FOR A MAGNET DROPPED FROM THE TOP OF THE TUBE TO REACH THE BOTTOM

Zachary Stenzler Green

Moody Middle School, Richmond, VA 23228

Magnets produce a magnetic field, and this can interact with the surrounding environment. Materials that freely allow electrons to flow through them are electrical conductors. Faraday's law, stated first in 1831, indicates that a moving magnetic field will induce an electrical current in a nearby electrical conductor. In 1835 Heinrich Lenz stated that an electric current induced by a moving magnetic field would create its own magnetic field that opposes the magnetic field that created it. The purpose of this experiment was to examine the effect tube composition had on the time it takes for a magnet dropped from the top of the tube to reach the bottom. A magnet was dropped through tubes made of copper, aluminum and polyvinyl chloride (PVC), and no tube. Attempts to drop the magnet through an iron tube failed due to magnetic attraction to the tube wall. The electrical conductivity of the tubes ranged from none for the PVC to large for copper, with aluminum being intermediate. The results indicated that the travel time was longest for the copper tube with a mean of 4.28 seconds and shortest for the PVC tube with a mean of 0.59 seconds, with aluminum in between at 3.92 seconds. The data supported the research hypothesis that for a magnet dropped through a tube, the time for the magnet to travel through the tube will be longer for the tube that is an electrical conductor when compared to a tube that is not. Based on the transit times of the magnet in this research, there is a definite effect of tube composition on the time it takes a magnet dropped from the top to reach the bottom. The data indicate that the electrical conductivity of the tube influences the transit time. The greater the conductivity of the tube, the slower the magnet traveled.

Third Place:

THE EFFECT OF FILTERED SUNLIGHT COLOR ON AMOUNT OF ENERGY PRODUCED BY SOLAR CELLS

Isha Gangel

George H Moody Middle School

Renewable energy is rapidly expanding part of today's world and economy. Solar cells play a big part because fossil fuels cannot be used forever and the sun can provide limitless energy. Many people are trying to move towards cleaner, greener energy, and by the end of the century solar power could be the most useful energy source. When light waves hit a solar cell, only certain wavelengths cause electrons to move which would then create an electric current that can be converted into energy. Only some energy is absorbed by the solar cell, and of the energy absorbed only some causes the electrons to move. Different colors of light have different wavelengths and amounts of energy. Red has the longest wavelength and least energy, violet has the shortest wavelength and the most energy. The purpose of this experiment was to test if different colors of filtered sunlight are used on solar cells, then the energy produced by solar cells with violet light will have the highest volts. For each color, the solar cell was prepared by putting a piece

of colored plastic on top of the cell. The experiment was done by going outside with the prepared solar cells, voltmeter, and notebook. Number of volts produced was measured 25 times and recorded in a notebook. The hypothesis was not supported by the results because the results showed the solar cell with white light produced the highest voltage. Red light had the next highest number of volts produced, followed by orange light, green light, and finally purple light produced the least amount of energy. All of the different filtered colors reduced the amount of energy produced compared to the control. Further study on this topic could be to test different materials to change the color such as cloth, semitransparent paper, or a form of paint that could be applied directly on top of the cell to see which is the most efficient and cost effective.

Honorable Mention:

THE EFFECT OF VARIOUS MATERIALS ON SOUND ABSORPTION

Suyeon Kim

George H Moody Middle School

All materials, including concrete, rubber, grass, and cotton, have sound absorbing properties. Many scientists have noticed the importance of reducing unwanted sound by using various materials. The purpose of this experiment was to determine the effect of various materials on sound absorption. Based on Mun's experiment that stated that porous concretes are known to absorb and attenuate sound and Gleason's idea that stated that rubber is known for its durability, it is believed that if rubber is used in walls, then the rubber will absorb the most sound and have the lowest intensity in decibels. Concrete, rubber, cotton, and grass were tested for its sound absorbency using a decibel meter. The results indicated that concrete absorbed the most sound with a mean of 47.8 decibels, and rubber absorbed the least amount of sound with a mean of 59.9 decibels. Based on the dB values determined in this research, concrete appears to have absorbed the most sound. Before it can be concluded that concrete was the best sound absorbent, the experiment will need to be tested again where sound intensity in the environment is constant.

Honorable Mention:

THE EFFECT OF DIFFERENT COLORS ON THE AMOUNT OF COLOR DISTORTION THROUGH A YELLOW FILTER

Grant Klich

George H Moody Middle School

Abstract: Sunglasses with yellow filters are known for their ability to increase color contrast on a blue background, such as the sky. They are used widely for some outdoor sports, but since they're colored, they are bound to distort color. Yellow filters block out blue and UV light. The purpose of this experiment was to find how distorted each color of the rainbow will be through a yellow filter. The hypothesis was that if violet is viewed through a yellow filter, then it will be the most distorted color, because it is thought that the lower the color wavelengths are, the more distorted the color will be through the filter. Each color of the rainbow, red, orange, yellow, green, blue, and violet, was printed and pictures were taken of each outdoors with and without a filter with a digital camera. The average change of each color was found, measured with red, green blue component values on a computer. The blue component value lowered the most for each color. The results showed that blue was the most altered color, most likely because it is made up of mostly blue values anyway. Blue changed by 164 component values. The results of blue answered why yellow filters increase contrast on a blue background, because the blue color will weaken, making the target objects become more visible. The color yellow changed the least with a 52-value change, most likely because it matched the filter color itself. The results did not support the hypothesis because blue was the most altered color, not violet which changed by 120 values. The results show that there is no direct correlation between the wavelengths of visible light and how distorted it becomes through a yellow filter.

Honorable Mention:

THE EFFECT OF DIFFERENT MATERIALS' REFLECTIVITY ON THE AMOUNT OF LIGHT CAPTURED

Zachary Long

George H Moody Middle School

The snow and ice all over the world has been melting each year faster than the last. Recent observations show the snow and ice has been melting away at a faster rate. Snow and ice are one of the earth's natural reflectors. The snow and ice were used to reflect the heat of the sun from earth, acting like "super reflectors." The constant increase of the earth's heat has been melting the ice away making the earth warmer and warmer every year. The purpose of this experiment was to find out what type of materials reflected light the best. Each material was placed in or on a glass container inside a "shade." The different materials, ice, water, glass, and aluminum, were all tested by aiming a flashlight at the material and capturing the reflected light on the other side with a light meter. At the end of the test of each variable's ten trials the data was analyzed and then the averages were found. The experimenter predicted ice (a natural reflector found all over the world) to be the best reflector. However, ice turned out to be the worst with an average of 192.4 lumens. The second worst reflector was water (also a common natural reflector). Its

average was 246.4 lumens. Glass was the second-best reflector with an average of 254.7 lumens. The best reflector was aluminum foil. The average was 409.6 lumens. Based on the data collected and the averages of the different materials, the metalloid material was the best reflector. The fact that the ice was the lowest reflector in the experiment was concluded to be because it was not the color that is usually found on mountains and ice caps. Also, the ice was uneven and cracked. Therefore, there are many alterations to the experiment needed in order to find a “super reflector.”

THE EFFECT OF WATER ON THE STRUCTURAL STABILITY OF DIFFERENT TYPES OF SOIL

Ethan Guenther

Kenmore Middle School Arlington, Virginia 22204

Structural stability is the soil's ability to support an object and ensure that the object does not sink into the soil. Structural stability of soil is reduced by water. Different types of soils are affected differently by water. Knowledge about the effect of water on the soil of an area where a foundation will be built is necessary for building a stable foundation. It was predicted that the structural stability of organic soil would be the most affected by water. To test the structural stability of different types of soil, a rod was sunk into the soils, and the soils that the rod sunk into the least were the most structurally stable. Of the different types of soil tested, clay was affected most. The hypothesis was rejected.

THE EFFECT OF KIND OF POTATO ON AMOUNT OF VOLTAGE PRODUCED IN A BATTERY

Bridget Hart

Williamsburg Middle School

The purpose of this project was to test the effect of the kind of potato on the amount of volts produced in a potato battery. The hypothesis was if a sweet potato was used in a battery then it would produce the most voltage. To test my hypothesis I made a simple circuit with the potato as the source, a nail and a penny as the ions, and insulated wire that served as the conductor. The voltmeter was attached to the wire. I tested six halves of each variety of potato in the circuit. After I analyzed the results, it turned out that my hypotheses was proved wrong. The russet potato produced the most voltage and the sweet potato produced the least voltage. I can infer that sweet potatoes don't contain the same chemicals that russet potatoes do. The chemicals that a sweet potato contains probably don't react as well in a circuit as the chemicals in a russet potato.

TICK TOCK! THE EFFECT OF TIME ON A SILICON WAFER

Serena Heims

Stonewall Jackson Middle School Mechanicsville, VA 23111

The purpose of this experiment was to ascertain how the manipulated variable of time would affect the responding variable which was the silicon wafer's oxidation level. The control was 100 seconds with the levels of 30 seconds, 60 seconds, 90 seconds and 100 seconds. Each level was tested with three trials. Through research, interesting and useful facts were found. Those of which helped consider the possibilities in the hypothesis made. Some of which are Silicones in general have a strong resistance to heat, moisture, and the action of many other chemicals. Robots perform the same repetitive industrial task hundreds of times each day. The materials used were a computer with a robotic unit inside called a Rapid Thermal Processing Unit, a total of nine silicon wafers, a clean room and three different setting temperatures called recipes. The hypothesis was if a silicon wafer was placed in this Unit for a longer time then the oxide level will be thicker was supported through the results. The resulting oxidation levels were measured in Angstroms. Heat was measured quantitatively. The results expressed that one minute gave the lowest oxide level, two minutes had the second highest oxide level and three minutes gave the highest oxide level. This supported the hypothesis completely.

THE EFFECT OF TEMPERATURE ON THE ELASTICITY OF RUBBER BANDS

Lauren Hevron

Tuckahoe Middle School, Richmond, VA 23229

Abstract:

This experiment was conducted to test the elasticity of rubber bands in controlled temperatures. Elasticity is when the atoms in an object can have pressure applied to them, so atoms are spread apart and the force between them is weakened. Objects with more elasticity are able to return to their original shape after the applied pressure is taken away. Through this experiment, rubber bands were tested to see if the temperature made a difference in the rubber band's elasticity. There were three test groups. The rubber bands at 0°C were in test group A, the rubber bands at 20°C were in Group B, and the rubber bands at 100°C were in Group C. The results of the experiment supported my hypothesis, "If rubber bands are stretched at 0°C, 20°C, and 100°C, then the rubber bands at 100°C will stretch the farthest." Test Group C stretched

the greatest, the mean was 17.84cm. Test Group A stretched the least with a mean of 8.4 cm. Group B stretched 13.204cm. This experiment supported my hypothesis and research by providing additional information about temperature and how it changes the elasticity of an object.

THE EFFECT OF BLADDER COMPOSITION ON AIR RETENTION.

David Hill

Tuckahoe Middle School, Henrico, VA, 23229

The soccer ball is a very interesting mechanical breakthrough in the modern day era with new technology being invented every year. The question asked about the hi-tech soccer balls was if the bladder composition of the ball made an effect on the ball's air retention. In research, it was observed that the Nike T90 Tracer Soccer Ball contains a high quality carbon-latex bladder. The carbon-latex bladder contains carbon powder to cover micro-pores (microscopic pores in the latex material that leak air) so, it was inferred that the Nike T90 Tracer would let out the least amount of air and therefore have the highest air pressure after a trial had been completed. In the experiment, four Nike T90 Soccer Balls were tested by sitting them on an unmoved surface for 12 hours. The amount of air pressure in the ball after 12 hours was tested with a sports specific air pressure gauge. The hypothesis was, "If soccer balls with carbon-latex, rubber reinforced and latex bladders are placed on a carpet at an altitude of 65 m above sea level for 12 hours, then the carbon-latex bladder will retain the highest air pressure of all the bladders." There were ten trials run and a conclusion was made after analyzing all of the data. The results varied from trial to trial, but by a small margin, The Nike T90 Strike Soccer Ball kept the most air in. Therefore, the hypothesis was not supported because the Nike T90 Tracer Soccer Ball kept in less air than other levels of the independent variable. In the experimentation, it was observed that the air pressure rose in trials three and eight. Some research was performed, but more research would be necessary in order to understand what exactly happened with the air pressure outside of the ball and how this might have affected the internal air pressure.

PINEWOOD DERBY ON STEROIDS

David Hughes & Tristan Oaks

Swanson Middle School, Arlington VA, 22205

The purpose of this experiment was to find the effect of the design of the frontal area on the speed and aerodynamic drag of the CO₂ dragster. It was hypothesized that if the "pyramid" shaped frontal design was tested and raced, it would outperform the other designs because it would move through the air the smoothest and push the displaced air away from the car, reducing aerodynamic drag. To test this hypothesis, the procedure was to build four different dragster designs; control, "top point", "bottom point", and "pyramid". Then the dragsters were tested in two categories; speed and aerodynamics. When building each dragster, parts were cut off to see which design was the most aerodynamic. In doing so, each cut changed the mass of the car. In the end it turned out that the car with the least mass had the fastest speed, which was the "top point" design, not the car with the least aerodynamic drag, which was the "bottom point" design. The results do not support the hypothesis because the "pyramid" design performed the third best.

THE EFFECT OF ROCKET LENGTH ON DISTANCE FLOWN

Karan Jacob

George H Moody Middle School

Abstract:

Ever since Mercury 7 launched, and even years before that, mankind has been interested in space. But as space exploration continued, all different kinds of rockets went up, and more designs for rockets appeared. Sizes of the rockets were especially debated, and scientific laws came to argue and defend these designs, such as the drag equation. As scientific study of energy in different size bodies continued, experiments of these theories were conducted not only by scientists but by children and adults as well for a pastime.

The purpose of this project was to determine how the size of a rocket would affect the distance flown when the rocket measured 52.705 centimeters, 26.3525 centimeters, and 75.565 centimeters. Each rocket was launched eleven times, and the results indicated that the rocket measuring 26.3525 centimeters flew the farthest distance. The data supported the hypothesis that if an average sized, a half sized, and a large sized rocket are launched, then the half size sized rocket will fly higher.

Based on the results determined in this research and experiment, it appears that the smaller a rocket is, the farther it will fly. As this was the result of the experiment it cannot be directly concluded that this is true as experiment was conducted by youth.

THE EFFECT OF THE TYPE OF PADDING INSIDE A STIMULATED HELMET ON THE NUMBER OF CRACKS ON AN EGGS SHELL AFTER HITTING THE WALL

Virginia Justis

G.H. Moody Middle School, Richmond, VA 23228

As the National Football League gets more popular, the games become more serious, resulting in longer and harder games and practices. With this comes a higher rate of injury in the NFL. But the NFL is not the only group affected by head injuries, every activity that has the risk of head/brain injury is at risk, which is why more research needs to be done. Traumatic Brain Injury is a serious issue that is being researched by more and more doctors every day, and having the wrong type of helmet or helmet padding can cause a lifetime of paralysis, amnesia, or even death. A concussion is one of the most common forms of a Traumatic Brain injury and is defined by the tearing and stretching of nerve fibers throughout the brain caused by a “shaking” of the brain and it is one of the leading causes of having unfit head protection.

The purpose of this project was to determine which type of helmet padding would protect an egg, representing a head, the best by causing the smallest number of cracks. To find out what the answer to the purpose was, an experiment was conducted by attaching a piece of rope to a wall and having an egg, protected by a different brand of football helmet padding, attached to the free end of the rope. The egg and rope were then released and the egg then hit the wall; after hitting the wall, the number and length of the cracks was recorded after repeating the trials fifteen times. The results indicated that the Universal Firm Football Helmet Jaw Pads were the most protective and elicited the least amount and smallest length of cracks on the egg after hitting the wall with a mean amount of cracks at 4.33 cracks per egg and a mean of 0.94 cm for the length of the cracks. The data was supportive of the hypothesis that if Universal Firm Football Helmet Jaw Pads used, then the egg would have the least amount of cracks after hitting the wall. Based on the results, it can be stated that the type of football helmet padding affects the protection and safety of the football player. More tests will be needed to confirm this project.

THE EFFECT OF WHERE YOU PUT THE POSITIVELY CHARGED PLATE IN AN ION ENGINE ON HOW MUCH THRUST IS GENERATED

Parth Kotak

George H Moody Middle School

Recently, a new type of space propulsion has been discovered by NASA scientists. This began a study on a topic called “ion propulsion”. Xenon atoms are ionized and then blasted through the back of an engine using positive and negatively charged plates. The negatively charged plate in an ion engine attracts the positively charged xenon ion towards it. These ions gain speed. Then they crash into the positively charged plate, which repels the ions to generate thrust. Though the thrust produced isn’t much in terms of millinewtons, the frictionless environment of space enables this method to be a possible option in the future. The purpose of this project was to determine where the positively charged plate in an ion engine should be placed to generate the most thrust. The positions at which the plate was placed was at 10°, 50°, and 90° in the engine, with 90° being the farthest toward the exit of the engine and the plate charge remaining a constant 50. Each location was tested ten times. The data and results showed that the plate placed at 50°

generated the most thrust and therefore supported the research hypothesis. Based on the thrust amounts, there is no direct correlation between the location of the plate and the amount of thrust generated. The placement of the plate is what generates the most thrust. Before the results can be concluded, an experiment using an actual ion engine will be required. The effect of where you put the positively charged plate in an ion engine on how much thrust is generated.

THE EFFECT OF STEPPING ON THE DISTANCE A BASEBALL TRAVELS

Jacob Lafoon

Tuckahoe Middle School Richmond, Virginia 23229

The ability to hit a baseball a great distance and score runs is the key to being successful in the sport of baseball. One theory proposed by little league coaches is that stepping into the ball, toward the pitcher, will make the ball travel farther. The purpose of the experiment was to determine whether stepping into the ball, as opposed to standing flat-footed, really would make the ball travel a greater distance. Based on previous research regarding how to hit a baseball, the research hypothesis was formed that, "If a baseball batsman performed two types of swings (stepping and flat-footed), then stepping toward the pitcher would make the ball travel farther." The independent variable was the type of swing. Eleven male test subjects, ages eight through fifteen, with heights ranging from 145 centimeters through 176 centimeters, and skill levels of rookie to advanced, were assigned numbers and put through ten trials of each level of the independent variable. The distance was measured after each ball hit came to a standstill. The data was recorded, studied, and put into graphs. The results of the data showed that the ball did travel a greater distance for almost every batter when the batter stepped forward, which supported the research hypothesis.

THE RATIO OF THE NUMBER OF BLADES TO THE POWER OF THE WIND TURBINE

Jacob Larsen

Swanson Middle School

The purpose of the experiment was to find the effect of the number of blades on the rotor on the maximum mass lifted by the wind turbine. It was hypothesized that if the number of blades on the rotor was doubled, the maximum mass lifted would less than double. To test this hypothesis the procedures were to construct a wind turbine and attach different numbers of blades to the rotor. The maximum mass lifted by the wind turbine for each number of blades on the rotor was recorded and graphed. In the end it turned out that the overall ratio of blades to maximum mass lifted by the wind turbine was 1 : 1.13. This

means that when the number of blades doubled, the maximum mass lifted more than doubled. The hypothesis was not supported.

THE EFFECT OF HUMAN CELL TYPE ON THE AMOUNT OF FRACTAL PATTERNS

John Li

George H Moody Middle School

Mandelbrot's discovery of Geometry in Nature in the 1980's is applied to many present-day unsolved problems. This began with the study of how traces of fractals were found in nature and that some parts of the human body have fractal architecture. Fractals are repetitive irregularities. Cancer holds mutative characteristics that are the reason why cancer is still an unsolvable issue. Since these both are abnormalities, there is a way to compare them to each other.

The purpose of this experiment was to determine how human cell type would affect the amount of fractal patterns found in breast, lung, and prostate. Ten photographs of cancerous lung, breast, and prostate and normal lung, breast and prostate were collected from the Virginia Commonwealth University. Each was tested for traces of fractal irregularities. The results indicated that the lung cancer cells were the highest ones with an average of 2.9 fractals found per cell and that the breast cancer cells were the lowest ones with an average of 2.7 fractals found per cell. The data did not support the research hypothesis that if cancerous and normal body cells were collected, then the breast cancer cells would have the highest amount of fractal behavior. Based on the number of fractals found in each cell during this research, there appears to be a connection between the number of fractals and the type of cell. Before it can be concluded that the number of fractals is the only reason for cancerous behavior, additional research will need to be made to determine the age and ethnicity of the test subjects. This is necessary because of the variation in biological structures. The fractal dimension will also need to be tested for to determine the size of each fractal and how that affects the results.

SOUNDPROOFING

Sam Libberton

Jefferson Middle School, Arlington, VA 22204

You might never have thought that a single decibel of excess sound could ruin your favorite music recording. The reduction of sound and the study of acoustics is important for not just music producers and construction workers, but also many other fields. The goal of this experiment was to find the effect of the type of soundproofing material used on the amount of sound that is measured through the material. To do this, boxes were

made out of the materials (wood, foam, cloth, and the combinations of wood and foam, wood and cloth, and foam and cloth). They were then placed over a speaker with the measuring device, an iPhone 4 with a sound meter application, 0.5 meters away. Sound was played through the speaker and the level of sound detected by the meter was measured. It was found that without soundproofing, 99.83 decibels (dB) were detected. Wood was the best single material, with 92.67dB of sound measured, 7.16dB less than the amount of sound measured without soundproofing. Foam was the second-best single material (95.17dB), and cloth the least effective (99.50dB). Wood and foam made the best combination, with 90.67dB measured. The combination of wood and cloth measured at 92.50dB. Foam and cloth were the worst combination, with 94.00dB of sound detected. The hypothesis was supported by these results, though it was somewhat surprising how little sound the soundproofing blocked.

THE EFFECT OF HARD DRIVE TYPE ON COMPUTER SPEED

Ryan Lucia

Stonewall Jackson Middle School Mechanicsville, VA 23111

New types of hard drives, known as Solid-State Drives (SSD) are becoming more common in the USA, but are they truly faster than traditional Hard Disk Drives (HDD)? What about Hybrid drives, which are a combination SSD and HDD? How do all of these drives perform in everyday tasks, not benchmarking software? This project looked at how well SSD, HDD, and Hybrid drives perform in a series of everyday tasks. This project attempted to see if type of drive (independent variable) influenced the speed of a computer (dependent variable) in a series of common tasks. The hypothesis was that when different hard drives were tested, the greater percentage of solid-state memory that was present in the drive, the faster the drive would perform. This was proven to be true by the experiment. This project demonstrated that SSDs and Hybrid drives truly are noticeably faster than a traditional HDD for users performing everyday tasks.

PHYSICAL SCIENCE, ENGINEERING, & MATH C

First Place:

FROM FAST FOOD TO CHEAP RIDES: THE EFFICIENCY OF BIODIESEL

Sophia Moses

Swanson Middle School Arlington, VA 22205

The purpose of this experiment was to evaluate whether an internal combustion engine will operate as efficiently consuming biodiesel as it would if petroleum diesel were used. It was hypothesized that if unrefined biodiesel (used cooking oil) is used as a fuel in an internal combustion engine, then the engine will run as long as it would if #2 petroleum diesel were consumed. To test this hypothesis, procedures were developed to measure the amount of time an engine consumed 100mL of petroleum diesel and 100mL of various

biodiesel blends (2% biodiesel, 20% biodiesel, 50% biodiesel, and 100% biodiesel). Biodiesel blends were produced by mixing biodiesel and petroleum diesel (i.e., 2mL of biodiesel combined with 98mL of petroleum diesel produces 100mL of 2% biodiesel). Five trials were conducted for each fuel (e.g., diesel, 2% biodiesel, 20% biodiesel, 50% biodiesel, and 100% biodiesel) with the engine operating under a constant load. The data indicated that an internal combustion engine operated as long, or longer, consuming biodiesel as it operated consuming petroleum diesel. An internal combustion engine operated for an average of 499 seconds consuming petroleum diesel. The average of all biodiesel blends running in an internal combustion engine was 525 seconds, five percent longer than the engine operated while consuming petroleum diesel. A slight upward positive trend was seen in the data. A diesel engine generally ran longer when fueled by biodiesel than fueled by diesel. The engine ran 6% longer with B20 (20% biodiesel), 9.8% longer with B50 (50% biodiesel), and 10.4% longer with B100 (100% biodiesel). The results supported the hypothesis that an internal combustion engine would run as long consuming biodiesel as it would consuming petroleum diesel.

Second Place:

PASSIVE COOLING ON THE PERFORMANCE OF SOLAR CELLS

Swapnil Pande

Moody Middle School, Richmond, Virginia 23228

Of the approximate 1.049×10^{20} J of energy consumed by United States annually about 84% comes from fossil fuels. Due to increasingly growing demand for energy, depleting supplies of conventional fuels, and pollution caused by use of fossil fuels, it has become necessary to focus on renewable sources of energy.

The objective of this project was to investigate the effect of passive cooling on the performance of solar cells. The rationale behind this research is that solar energy could be more widely used if high performance solar panels could be built at lower cost. The goal of the project was to devise an effective as well as inexpensive method to cool a solar panel. Heat sinks of the area 1, 1.5 and 2 times the area of solar panel were used against no heat sink control group. The hypothesis was if a solar panel is mounted on a heat sink, its performance will be better. Also, a larger heat sink will perform better.

To conduct the experiment, four solar panels were constructed, and three were mounted with Aluminum heat sinks of 1x, 1.5x and 2x sizes. A halogen lamp was used as light source and rise in solar panel temperatures as well as voltage and current generated were recorded for 90 minutes. Five trials were conducted for all experiments. The experimental data showed that heat sink helped control the rise in solar panel temperatures. 1x heat sink configuration showed best thermal performance. Chi-Square analysis was conducted to establish statistical significance of data. An attempt was also made to develop a mathematical model to evaluate the effective heat sink configuration.

The results of the experiment partially support the hypothesis. The use of heat sink helps maintain the solar panel temperature lower, but larger heat sink did not prove to be more effective.

Third Place:

THE EFFECT OF DIFFERENT INSULATIONS ON A CONTAINER'S ABILITY OT MAINTAIN TEMPERATURE

Hallie Miller

George H. Moody Middle School, Richmond, VA, 23228

The term heat transfer refers to the movement of heat from an area of high temperature to an area of low temperature. A material that allows heat energy to move is called a conductor. Insulators are materials that keep heat from transferring. When a container of food or water is left sitting on a counter, it will lose heat very quickly. This is an example of a heat transfer. When insulations are used on containers, the heat transfer is lessened causing the substance inside the material to hold its temperature. The purpose of this experiment was to determine the effect of different insulations on a container's ability to maintain temperature. Four containers, each insulated with a different house hold material, were tested to see which material would make the best insulator. The different materials were fleece, spray foam, neoprene, and no insulation. The water temperature was measured in each insulated container every 15 minutes for one hour. The results indicated that the water in the neoprene insulated container dropped the least, dropping a mean of 4.97° over the course of an hour. The water in the container without insulation dropped the most over the course of an hour with a mean drop of 8.84° . The data supported the hypothesis that if neoprene insulation is used then it will maintain water heat the longest. Because good insulators do not allow heat transfer, maybe the neoprene did not allow as much heat transfer as the other materials. An improvement that could be made for this experiment would be to use more precise thermometers, or maybe just bigger thermometers that are easier to read. Additional experiments could be performed to see how the results would vary from these, if the containers were tested for a longer period of time or if the starting temperature of the water was higher.

Honorable Mention:

THE EFFECT OF DIFFERENT SKYDIVING POSITIONS ON HOW FAST THE DIVER PLUMMETS

Deema Meguid

George H Moody Middle School

Abstract not submitted

Honorable Mention:

JAVA VERSION ON THE SPEED OF A PROGRAM

Uday Patil

George H Moody Middle School

Abstract not submitted.

Honorable Mention:

THE EFFECT OF LENGTHENING A CATAPULT ARM ON THE DISTANCE THE PROJECTILE TRAVELS

Stefan Pruessmann

Moody Middle School Henrico, VA 23228

Catapults had been used since ancient times. Catapults were important weapons in many medieval sieges. The purpose of a catapult is to throw a projectile against a target. A lot of factors can influence the distance that the projectile travels: For example, catapult size, spring type and strength, projectile type and weight and many more. The purpose of this project was to determine the effect of lengthening a catapult arm on the distance the projectile travels. A small-scale catapult was built from erector set parts and the catapult arm was designed so that the effective arm length (distance of the projectile from the pivot point) was easily adjustable. The other parameters were kept constant, including the projectile (type and weight), catapult spring, release point etc. The distance a projectile traveled was measured for various arm lengths through several trials. The results showed that if the arm length is increased the projectile travel distance will also increase. But this is only valid if the mass of the arm itself is not increased. Adding extra segments to the catapult arm to extend the arm length resulted in a decrease in projectile travel distance because the added mass slowed down the catapult.

THE EFFECT OF WEIGHT DISTRIBUTION ON THE DISTANCE IN CENTIMETERS A PAPER AIRPLANE COULD FLY.

Joy Ma

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Paper airplanes, although toys, are extremely similar to real airplanes in many ways, for instance the flight of a paper plane, just like a real plane, is affected by its weight distribution.

Weight distribution, in this case, is the apportioning of weight on a paper airplane; this can greatly affect the distance a paper airplane flies. As a result, the purpose of this investigation was to find how weight distribution would affect the flight of a paper plane. This was tested by placing four pennies at the following positions on the plane, four at the tip, and four in the center, two on the back of the left and right wings, and one plane with evenly distributed pennies.

To conduct this experiment the paper airplane model “the dart” had to be folded using cardstock paper. The pennies were the glued into place using a hot glue gun, and a hook was created from a hard piece of plastic using scissors and a permanent marker. The hook was then poked through the center of the plane and glued into place, creating a launching system. A rubber band was then hooked on the hook, and the plane was pulled back; the experimenter then released the plane and let it fly and measure the distance it flew. The results indicated that the plane with all the pennies near the tip flew the furthest with a mean of 249.5 centimeters, and the plane with two pennies on the back of each wing had the lowest mean of 157.35 centimeters. The data supported the hypothesis by saying that if four pennies were placed close to the tip of a paper plane then the airplane would fly the greatest distance.

Based on the research and the experiment, it can be concluded that when the pennies are placed ahead a plane’s center of gravity, it is likely to fly a further distance than if the weight was put near the back of the paper plane. However, in order to insure this data accurate, the experiment should be done again using a more constant, and reliable launching method.

THE EFFECT OF DIFERENT HAND POSITIONST AND LENGTH ON A LACROSSE STICK’S THROWING DISTANCE

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In the sport of lacrosse there are many different reasons for why the defense stick is longer than the short stick, the most common stick used by players. Primarily, this is because the Defensemen needs to be able to reach out and either hit or control another player. The defenseman can use the length of the stick to be the first to the ball during ground balls, and to extend the length of a throw. Attackmen and midfielders use short sticks that can move faster and quicker to build up more momentum and get the ball flying faster and more accurately. To test the throwing distance of a lacrosse ball based on the hand position and length of the stick, an experiment was conducted to test throws by a trebuchet which uses different lacrosse sticks and different positions of the fulcrum to assess the efficiency of varied “throwing” positions. The experiment was conducted in an open yard with a one-gallon jug of water tied to short length of rope that was then attached to the base of the different sticks. The stick was attached to a pipe that acted as a pivot. While preparing for the experiment and building the trebuchet, it became

apparent that the ball would not go far enough to get accurate data. The test was modified so the water was dropped vertically. This created more velocity which created more momentum, and hence, more distance to be measured. The results suggested that when a player throws a lacrosse ball the easiest way to throw the lacrosse ball is to use the long stick and have the top hand in the middle not just below the middle. The mean of the short stick data was 4.141 meters while the defensive stick was 4.547 meters. The defensive pole's throws were generally farther than the short sticks.

WHAT TYPE OF FABRIC HOLDS DYE THE BEST?

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Have you ever wondered what kind of fabric you should use to tie-dye a t-shirt? This experiment showed how different types of fabric held dye after being washed. The goal of the project was to find the effect of the type of fabric on how much the dye faded. To figure out what type of fabric held dye the best, 4 pieces of 100% cotton, 100% polyester and a blend of 50% cotton 50% polyester were gathered. The fabrics were dyed with Rit dye, placed in plastic bags for 24 hours and then rinsed of extra dye. Three of the fabrics were washed ten times to see which fabric held the dye the best, the other piece of fabric was left unwashed to compare to the washed fabrics.

After the fabrics were washed ten times, the color strength was rated on a lickert scale from 1 to 5, with 1 being white and 5 being the color of the unwashed fabric. After washing, the 100% cotton held the dye the best and was rated 4 out of 5. The 50% cotton 50% polyester blend held up pretty well and received 3 out of 5. The 100% polyester did not hold up well and was almost white after ten washes, so it received 2 out of 5. That this project helped show that 100% cotton is the best fabric for holding dye by comparing it to other fabrics that were washed the same number of times.

THE EFFECT OF THE GRIP PLACEMENT OF THE FIELD HOCKEY STICK ON THE DISTANCE THE BALL TRAVELS

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The objective of this experiment was to figure out which grip on a field hockey stick would make a field hockey ball travel the farthest. The grips were a choke grip, where the two hands are close together in the middle of a stick, the basic grip, where one hand is at the top of the stick and one is closer to the bottom, and the push grip, which is the same placement as the basic grip, except it only pushes the ball along.

This experiment was tested on a dry, flat, grassy surface keeping all constants the same. There were ten trials per level to make sure that the results came out accurate. The final results were that the choke grip hit went the farthest, with a mean of 19.78 meters, the basic grip went the second farthest, with a mean of 12.04 meters, and the push grip went the least far, with a range of 8.61 meters.

The results of this experiment turned out the way they did because on the choke grip, two hands are placed on the top of the field hockey stick, where most of the force was exerted, which made the field hockey ball accelerate easier and travel a farther distance than the push or basic grip.

This experiment was a success. It determined which grip helps to move a field hockey ball across a field with the most distance and acceleration.

THE EFFECT OF TEMPERATURE ON BATTERY VOLTAGE

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People use batteries in everyday life. Batteries power toys, games, lamps, phones, and other everyday life necessities. Many people take batteries for granted, but when the battery goes out and there is no more power that is when it's realized that batteries really are important. So the question popped up, "If batteries are put in different temperature will the batteries last longer or shorter?" In the early days people would store their batteries in refrigerators or freezers to conserve the batteries power, so it was hypothesized that if batteries were kept in colder temperature then those batteries would last longer.

First, twenty batteries were put into different temperatures: the freezer (0 degrees Celsius), next to the hot water pipe on the water heater (86 degrees Celsius), and in a room temperature environment (control, 37 degrees Celsius). After a month each set (two batteries from the same environment) of batteries, from each of the different temperatures, were put into a flashlight, recorded, and finally tested (with a voltage meter). The batteries were tested every fifteen minutes until the battery was dead. After death, each battery was able to recover for fifteen minutes without being in the flashlight. Then all the results were recorded and put into charts and graphs.

The results were very interesting. Before the test it was concluded that batteries will leak some power when heated, but when cooled batteries would preserve the power. The room temperature batteries were thought to stay in the middle. The batteries from the freezer and the room temperature (control) were close to the same. There was a huge difference in the heated batteries though. Those batteries went out a full 15 minutes before the others, but they recovered faster.

In the end all of the results were very successful. The freezer batteries held out like they were supposed to and the heated batteries went out quickly like they were supposed to. Even though the project went very slow it was still a lot of fun to see the results. It does not matter if batteries are stored in a fridge or a room; just do not store it in a hot place.

THE EFFECT OF THE TYPE OF LACROSSE STICK ON BALL FLIGHT

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Lacrosse sticks are intended for a specific gender, men or women. And women's lacrosse sticks are slightly different from men's. The men's throwing pocket is deeper, the cross is wider, and the shaft is narrower, but do these differences affect how long each stick can throw? When a ball is thrown, the pockets are where it sits before it is airborne. The biomechanics of a lacrosse shot in men's and women's lacrosse are very similar but not the exact same. Men tend to throw side arm, meaning instead of throwing in a straight up and down arch, they throw a sideways arch because the pocket keeps the ball in until the last second before it needs to be released in order to make it into the goal. Women tend to throw in a straight up and down arc. Because the pocket is shallower, if they try to throw side arm, the ball is released way before intended, causing the ball to miss the goal or strike off target. The purpose of this experiment was to see if using a catapult to launch a lacrosse ball with women's and men's lacrosse sticks affected how far the ball was thrown. Based on previous research, the experimenter hypothesized that if the type of lacrosse stick changed (men's and women's) when testing for how far the lacrosse ball was thrown using a Wyvern Catapult, then the women's lacrosse stick would throw further. A catapult was created to apply to the different lacrosse sticks to have the same amount of force. Twenty trials were run using this catapult per level of the independent variable. Some of the results such as trials six, eight, nine, ten, thirteen, and sixteen, which had distances of 134.75, 135.5, 134.625, and 141 centimeters for the women's stick, and 104, 99.125, 108.5, 94.5, 106, and 106 centimeters for the men's stick. Since the women's lacrosse stick threw substantially further than the men's, the experimenter's hypothesis was supported.

THE EFFECT OF LIQUID DENSITY ON INDEX OF REFRACTION

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Refraction is a simple concept of light bending through a liquid, and it does not have to be light—it can be sound, a straw, or even a pencil. Index of refraction is a measurement for the speed of the object through a medium, and it causes that object to “bend” through the medium. Index of refraction can be measured for many things—vacuum, diamond, salt, flint glass, sugar solutions, sapphire, and various others. A vacuum’s index of refraction is exactly one. Density takes part by affecting the speed of the object passing through the medium. This concept was developed by a scientist named Willebrord Snell, and it became known as Snell’s law, or the law of refraction. He had developed a formula regarding the angle of incidence and the angle of refraction. Angle of incidence is the angle at which the light enters the medium, and angle of refraction is the angle at which the light refracts or bends in the medium. His law states that the angle of incidence divided by the angle of refraction equals to the sine of the angle of incidence divided by the sine of the angle of refraction. Based on these laws and data collected in the past, if apple juice is used, then it will have the highest index of refraction. The purpose of this project was to determine the effect of liquid density on index of refraction. The index of refraction was calculated by shining the laser through a glass microscope prism and locating the specific points it hit on a piece of paper facing directly. String, ruler, and tape were main materials used to identify those points. Results supported the hypothesis because the highest density liquid used, apple juice, had an average index of refraction of 1.7, which was the highest mean index of refraction out of them all. On the other hand, plain water, the lowest density liquid used, had an average index of refraction of 1.4. It was the lowest mean index of refraction out of the variables tested. These findings do agree with the principle of refraction and relate to Snell’s law.

THE EFFECT OF DIFFERENT BRIDGE STRUCTURE ON THE WEIGHT BEARING CAPACITY

Murari Parasu

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About 2,500 years ago, a sturdy wooden bridge was created above the Tiber River and led into the city of Rome. This bridge allowed horses, carts, and many people to safely cross the river. Unfortunately, an army tried to use the bridge to their advantage and tried to raid Rome. The Romans were forced to break their bridge to stop the army from attacking them.

Romans were the first people to build bridges. There had been bridges before, but they were just trees or logs placed across ditches and streams. Romans created the Arch Bridge, which is a bridge that curves. These bridges were built by fitting stones

together. In 1841, Squire Whipple created the Truss Bridge. He was an engineer, but he also studied the problem of carrying a heavy load over a long bridge. Truss Bridges are made of a series of triangles locked together; this shape is efficient because the weight of the load is distributed to each of the triangles.

The purpose of this experiment was to test the effect of different bridge structures on the weight bearing capacity. The two independent variables in this experiment were Truss Bridges and Arch Bridges. The experimenter created the bridges out of popsicle sticks. A bucket was hung on each bridge and weight was added into the bucket until the bridge broke. This process was repeated 10 times for each bridge design. It is believed that if the design of a bridge is being tested, then truss bridges will hold the most weight. The average amount of weight supported was 1,850 grams for Truss Bridges and 1,215 grams for Arch Bridges. According to the results, the hypothesis was supported because Truss Bridges supported more weight than Arch Bridges.

THE EFFECT OF WEIGHT DISTRIBUTION ON THE SPEED OF A REMOTE-CONTROLLED BOAT

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The effect of weight distribution on the speed of a remote-controlled boat was tested in this experiment due to the scientist's interest in the mechanics of boats. The results could help in the speed of transporting goods across large bodies of water due to where the load is placed. One 100 gram weight was placed on three different spots on the remote-controlled boat and was driven 721 cm of water. The placement of the weights was at the front of the boat, the middle of the boat, and the back of the boat. The results were measured in seconds, and the average for the front was 10.34 seconds, the average for the middle was 9.42 seconds, and the average for the back was 8.17 seconds. From this I can conclude that the original hypothesis, if the weight is placed on the front of the boat, then it will go fastest, was proven incorrect. This was because as the weight was placed on the front, the nose dipped into the water, causing it to be slow as the boat was designed to skim across the top of the water.

THE EFFECT OF ARM DIAMETER ON THE SPEED OF A CHAÎNÉ

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For centuries, the art of Dance has been studied, performed and perfected. Thousands of Dance legends as well as amateurs know what a *chaîné* turn is. It is characterized by its name, which, in French, means chain. It consists of a one-hundred and eighty degree turn on each foot, in either full *relevé* or on full pointe. The purpose of this research project was to determine the correlation between the distance flanked by elbows (arm diameter) on both sides and the speed of a *chaîné*. The diameter was maintained by a cardboard circle that the dancer held as she was turning. The dancers held these circles by wrapping their arms around them, with the edge touching the base of the sternum. The dancers then crossed an area of 6.096 meters producing a large amount of time and speed results. Four diameters were used, 0.3 meters, 0.46 meters (the control), 0.61 meters, and 1.22 meters. Because of this, the research hypothesis was that if the distance between elbows was wider, the speed would be greater. The dancers performed an average of 1.2 revolutions per second, with an average of 6.5 seconds to cross 6.096 meters. The hypothesis was disproven, while a data trend ensued the experiment. This data trend was the exact opposite of the research hypothesis. The trend showed that the smaller the arm diameter, the higher the speed. Improvements that could have been made during this experiment are the timing of the experiment, as well as certain parts of the procedure. Based on all of the results of this experiment, it is show that there is a direct correlation between arm diameter and speed, nevertheless, further experiments would have to be conducted to show the correlation between the dancer's skill level and the speed of a *chaîné*.

THE EFFECT OF MIRROR QUANTITY ON SOLAR PANEL OUTPUT

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In the past, humans have been able to harness solar energy for hundreds of not thousands of years, but it was not until the early 1800's before a physicist, Edmond Becquerel discovered that in some items, an electric current would jump if it touched sunlight (Photovoltaic). This later was expanded by the world-renowned theoretical physicist, Albert Einstein, who won a Nobel Peace Prize award on this research (Make it Solar, 2005.) Ever since then, Solar Panels have been studied, and more research is being done to improve the efficiency on them and thus came the idea to use mirrors to reflect more sunlight on them.

The purpose of this project was to determine how and if the number of mirrors reflecting light onto a solar panel would affect the amount of electricity produced by a solar panel, with one mirror, two mirrors, four mirrors, and the control of no mirrors. The four variables, by the number of mirrors, one mirror, two mirrors, four mirrors, and no mirrors, were placed so that sunlight would reflect off of it and hit the mirror. Each variable was tested ten times separately and tested for the amount of current was produced by

using a multi-meter. The results indicated that the number of mirrors do have an effect on the current production of a solar panel, and with no mirrors, the average current produced was a mere 33.5 mA, compared to the solar panel that used four mirrors which produced on average, 99.5 mA. These results support the hypothesis that if the number of mirrors used to reflect sunlight onto a solar panel increases, then the amount of current produced will increase.

With the established results during this experiment, a correlation between the number of mirrors and the amount of current production emerges, as with a greater quantity of mirrors, a greater output by a solar panel. Before any conclusions, more testing must be done to make sure that these results are correct, so it can be hundred percent accurate.

THE EFFECT OF DIFFERENT ATMOSPHERIC TEMPERATURES ON THE AMOUNT OF ENERGY PRODUCED BY SOLAR PANELS

Malavi Ravindran

George H Moody Middle School

Solar panels are devices that harness the sun's energy and use it as a form of electricity. Solar energy is produced when any light shines on a solar panel. Solar panels are starting to be used to charge electronics. Solar energy is renewable, it will never run out. Because of this, solar panels are helping the world become greener, more energy efficient, and will reduce our use of fossil fuels and natural resources. Devices such as calculators are already being powered using solar energy. Solar energy could revolutionize our world. The purpose of this project was to determine the effect of different atmospheric temperatures on the amount of energy produced by solar panels. To conduct this experiment, a solar panel was used. The four temperatures that were used were 2.78, 20, 25, and 37.78 degrees Celsius. It was hypothesized that if the panel received a temperature of 37.78 degrees Celsius, then it would produce the most energy. This hypothesis was constructed because it was believed that more heat would result in more energy produced. The solar panel was placed in each desired temperature and was tested 15 times, by turning on a light that directly faced the panel. The results concluded that the panel produced the most energy, recorded in milliamps, with a temperature of 2.78 degrees Celsius. At 2.78 degrees Celsius, a mean of 46.4 milliamps produced by the solar panel. The data did not support the hypothesis that if the panel received a temperature of 37.78 degrees Celsius, then it would produce the most energy.

As the temperatures increased, the amount of energy produced decreased. The results came out the way they did because the colder temperatures enhance the conductivity of metals and wires. An improvement for this project would be to use more trials and temperatures to justify results.

THE EFFECT OF LIGHT INTENSITIES ON PHOTOVOLTAIC CELL OUTPUT

Praveen Ravishankar

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Man has always been curious about the works of “electricity”; why a shock occurred, or why an item has clung to another item. The word “electricity” was defined as the force that certain substances exert when rubbed against each other in the year 1600 by English physician William Gilbert. Conductors are substances that have a low resistance to electricity, while insulators are substances that have a high resistance to electricity. The conductivity of semiconductors lies between the conductors and insulators. Solar power is useful energy derived from our sun that is later converted to heat or electricity. Photovoltaic cells, or solar cells, are made out of small semiconductors, mostly silicon. When light strikes the cell, the semiconductors in the cell absorb a fraction of the light and create a current that can be drawn off for external uses.

The purpose of this project was to determine how different light intensities affected the output of photovoltaic cells. A light-emitting diode (LED) was connected in series with the solar cell and the digital multi-meter. Afterwards, one 40W light bulb was connected to the clamp-on lamp and was placed 10 cm directly above the solar cell. The same procedure was followed with the 60W, 75W, and 100W light bulbs. The results indicated that the 100W light bulb produced the most photovoltaic cells and lit up the LED the brightest, with a mean of 26.4 mA, while the 40W light bulb produced the least cells, with a mean of 12.64 mA. The data supported the research hypothesis that if the 100-watt light bulb is used, then the group receiving that light bulb will produce the most photovoltaic cells (in milliamps or volts).

Based on the number of cells produced in this experiment, there appears to be a correlation of the wattage of the light bulb and the reading, with the highest wattage producing more photovoltaic cells. Before it can be concluded that the high wattage of the light bulb was the primary cause of the highest reading, multiple experiments will need to be conducted.

THE EFFECT OF INCREASING BLADE NUMBER ON VOLTAGE PRODUCED

Ben Rhoades

Robious Middle School, Midlothian, Virginia, 23113

The rationale behind this experiment is to solve the issue of low oxygenated areas in the Chesapeake Bay using wind power and pumps. This experiment tested the number of blades on a wind turbine to find which is the most efficient at producing electricity. It was believed that if there is a higher number of blades on the wind turbine then the volts

produced would be higher. The independent variable tested was the increasing number of blades used on the wind turbine, two, three, and six; the experiment controls were, instrument used to measure electrical output, motor/generator, material used to build blades, wind turbine design (height, size, material, etc.), general shape of blade, wind speed, time exposed to wind, device used to produce wind, distance between wind turbine and wind source and external wind speed. The dependent variable was the electricity produced by the turbine, which was measured in volts. For every level of the independent variable there were five repeated trials conducted. The findings for the means of the repeated trials for this experiment were 0.057 volts produced by the two-blade design, 0.063 volts by the three-blade design and 0.085 volts by the six-blade design. The research hypothesis was supported in the experiment, and the six-bladed design produced the highest number of volts. The results of this experiment show that that as the blades increase the electricity produced by a wind turbine also increases, so the more wind to blade contact on a wind turbine means the more electricity one can produce with the turbine. This experiment can be taken further by experimenting with other ways to increase the voltage produced by a wind turbine and also the amount of dissolved oxygen can be produced if one was to power an air pump with a wind turbine.

IS LIGHT A PARTICLE OR WAVE?

Eleni Riris

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The purpose of this experiment is to study the effect of the distance (d) between two slits on the separation between bright bands (x) when an interference pattern is observed on a screen a distance (L) away, and to understand how well it agrees with the theoretical predictions according to the formula . In order to test this, a laser pointer was placed behind and a slide with four pairs of slits. The interference pattern observed on a screen behind the slits was photographed, and the distance from the central fringe to the first, second, and third fringes was calculated in pixels. This number was then converted to cm, and using the formula , the experimental data was compared to the theoretical predictions and the difference between those numbers was calculated (in percentages).

The slits with 0.50 mm between them was the closest to the theoretical predictions. Second most accurate was the 1.00 mm slits, third most accurate was 0.75 mm slits, and last was 0.25 mm slits. The hypothesis was rejected, because the original hypothesis was that the 0.25mm slit would be the most accurate, and it was not.

PHYSICAL SCIENCE, ENGINEERING, & MATH D

First Place:

THE EFFECT OF BOAT HULL SHAPE, HEIGHT OF CENTER OF GRAVITY, AND DEGREE OF INCLINE ON AMOUNT OF TORQUE PRODUCED

Camille Yoke

Manchester Middle School, Richmond, VA 23235

The objective of this experiment was to test the stability of different boat hulls at different tip angles with higher and lower centers of gravity. Three boat hulls with different bulkhead shapes were built from fiberglass and set in a tub of water connected to a torque meter. It was concluded that the V-Keel boat had the most secondary stability. The Box Hull had good primary stability but had less righting force after its peak. The Round Hull had the least stability. It was also concluded that the higher the center of gravity the less stable the boat. Using center of buoyancy calculations and the center of mass numbers it was shown possible to accurately predict boat stability for different hull shapes. The Hypothesis was proven correct.

Second Place:

THE EFFECT OF DIFFERENT MOBILE COMMUNICATION SYSTEMS POWER SENSITY EMITTED**Robert Zhang**

Tuckahoe Middle School Richmond, Virginia 23238

The purpose of this experiment was to determine which mobile communications system cellphones emitted the least Radiation Frequency (RF) radiation. RF radiation is a type of electromagnetic radiation. The two mobile communication systems are GSM and CDMA. GSM is divided into timeslots for each person. There are eight radio timeslots which are grouped into a Times Division Multiple Access (TDMA) frame. CDMA uses spread-spectrum technology and a special coding scheme where each transmitter is assigned a code to allow multiple users to be multiplexed over the same physical channel. Based on this previous research, the research hypothesis was formed that, "If a CDMA phone makes a call, then it will emit the less radiation compared to the GSM phones." The CDMA phones were the Intensity II and the Cosmos 2 which ran on Verizon and the SPH-M300 and IPHONE 16GB which ran on Sprint. The GSM phones were the HTC Inspire, IPHONE 4 16GB, IPHONE 4s 16GB and the Nokia N-Series N85 which all ran on AT&T. To test the hypothesis a phone call was made and an antenna was used to pick up the signal made from the call. Then a spectrum analyzer processed the frequency and a formula was used to convert frequency to power. Then another formula was used to find the RF radiation peak power density. The results of the experiment indicated that CDMA phone emit less radiation that GSM phones and that

amount is about 20mW/cm^2 . The hypothesis was supported by the data and the Sprint phones were excluded from the results because of an uncontrollable factor. An experimental error was the distance from the cell towers compared to each other, to the testing area. The accuracy of the device is within three decibels(dB). There is a list of unknown terms in the Appendix.

Third Place:

UP ON TOP

Thomas Sheehy

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In various parts of the world, roofs are made of different materials. Each serves a purpose of durability, cost or efficiency. The purpose of this experiment was to test which roof material was best at maintaining a constant temperature. The different types of roofs tested were tin sheet metal, asphalt shingles, and a sad roof. Metal roofs tend to reflect the sun's rays, asphalt shingles are inexpensive, and sad roofs, also known as green roofs, use evapotranspiration to cool the air by using heat from the air to evaporate water from the plants' roots. The hypothesis was that if different roof materials were tested then the sad roof would be most effective at maintaining a constant interior temperature.

A wooden cube was constructed, which allowed different roof materials to be tested as the roof. Two experiments were conducted, first testing how quickly the air cooled inside the box (heat loss through conduction) from a starting temperature of 30 degrees, and a second testing how quickly the inside of the box heated up when a lamp was placed outside the box radiating heat onto the roofing material. The results showed that the sad roof was the best at maintaining a constant temperature in both experiments.

Honorable Mention:

THE EFFECT OF SURFACE ON KINETIC FRICTION

Jake Sitison

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The following report describes the data derived from an experiment in which a shoe was dragged along multiple surfaces to determine which one would create the most friction. The experiment's results could be useful to people such as runners trying to decide what surfaces to run on, track designers deciding what type of track to make, cross-country course designers deciding if they want to make a faster or slower course, and athletes from other sports, such as baseball or basketball, trying to learn how much friction they can get on their field or court.

Two pieces of data were collected: the amount of force required to pull the shoe up a surface and the coefficient of friction between the shoe and the surface. The six surfaces that were tested were dirt, gravel, wood, mulch, brick, and rubber.

The results for the amount of force required to pull the shoe up a surface, listed from least to greatest, were wood, gravel, mulch, dirt, brick and rubber. The results for the coefficient of friction between the shoe and the surface created, listed from least to greatest and followed by the amount of force required to pull the shoe across the surface and then the mean coefficient of kinetic friction, were wood at 33 N and 1.0, gravel at 33 N and 1.0, mulch at 38 N and 1.2, dirt at 39 N and 1.2, brick at 44 N and 1.4, and rubber at 46 N and 1.4.

It was hypothesised that if different types of running surface (wood, gravel, dirt, brick, and rubber) were tested, then the rubber surface will create the most friction. The hypothesis for this experiment was supported.

Honorable Mention:

INSULATION VALUE OF STRAW COMPARED TO OTHER NATURAL BUILDING MATERIALS

Katherine E. Witmer

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There is a growing interest in the use of natural materials in building construction, especially those materials that will save money and the environment through greater energy efficiency. The purpose of the research presented in this paper was to test and compare the insulation effectiveness of three natural materials (straw, packed earth, mulch), by determining which material would keep 500g of ice from melting the longest. The experimental apparatus used consisted of 25L lidded plastic crates containing the selected insulating materials packed around 1.2L plastic food storage containers that contained 500g of ice. Holes drilled through the lids of both containers allowed a thermometer probe to be inserted to determine when the ice melted and attained a

temperature of 2 degrees Celsius, while a timer calculated the length of time for the ice to melt in a 20 degree C room.

In this experiment, straw consistently had better insulation value than either packed soil or mulch. The mean elapsed time for the ice to melt was substantially longer for the trials using straw (1297.1 min.) than for the trials of packed earth (880 min.) and mulch (935.2 min.). The hypothesis that in a comparison of different natural insulating materials, straw would perform better than packed soil or mulch in preventing heat transfer to a quantity of ice was supported by the results of this research experiment.

Honorable Mention:

THE EFFECT OF WING MATERIAL ON GLIDERS' FLIGHT DISTANCE

Anna Woodward

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Human flight has transformed modern life and the fundamentals of flight are evidenced even in the most basic hang glider. Hang gliding is the only current means of unassisted human flight, which people have strived to achieve for hundreds of years. The purpose of this experiment was to test the effect of wing material on gliders' flight distance. The experiment used the independent variables of tissue paper, aluminum foil, plastic wrap, and foam board. The gliders were built with a frame made of small wooden craft sticks placed at an angle slightly less than 90 degrees and held together by all-purpose Elmer's glue. The trials were held at Striker Park in Glen Allen, Virginia on the same day with the same conditions. Ten trials were conducted for each material, while keeping factors like height, design, wind, temperature, and weight constant. The hypothesis, if tissue paper was used as the wing material on gliders that they would fly the farthest, was supported by the results achieved. Even though the tissue paper did not achieve the record longest flight, it had the overall best average. The experimenter concluded that tissue paper had the right weight in proportion to the frame and had the right flexibility to survive the windy conditions.

THE EFFECT OF THE PRESENCE OF A BASKETBALL NET ON FREE THROW ACCURACY

Stephen Russell

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The first basketball nets were used in 1912- 13 to replace peach baskets. Many experiments have been done on free throws and free throw accuracy but few have been conducted on the effect of the use of a net on free throw accuracy. Some players have to practice on courts without a basketball net present and since free throw shots are such an important part of the game of basketball, knowing the effect of the presence of a net on free throw shooting is very useful.

The purpose of this experiment was to determine the effect of the presence of a basketball net on the number of free throws made out of twenty shots. The hypothesis of this experiment stated that when free throws are taken, if a net is present, then the free throw accuracy will be higher. In this experiment ten thirteen to fourteen year old male participants shot ten free throws using a basketball hoop with a net attached and then shot ten free throws using a basketball hoop with no net attached. An average of approximately two shots more were made out of ten when a basketball net was present. Since the mean number of free throw shots made with a basketball net present was over twenty percent higher than the number of shots made without a net, the hypothesis was supported. The presence of a basketball net does positively affect free throw accuracy. These findings agreed with research that states that the basketball net enables a shooter to better assess the distance from the foul line to the basketball hoop and therefore improving his depth perception. Depth perception is important in successful basketball shooting and the presence of a net on the rim allows for shooters to have more accurate depth perception.

THE EFFECT OF DIFFERENT MATERIALS ON SOUND ABSORPTION

Amanda Sasina

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Abstract:

Frequencies and vibrations rebounding through the air and human's ears are defined as sound. Sounds can trigger any kind of emotion, pleasure, anger, frustration, etc. To measure the volume of sound humans, use decibels; dB is the abbreviation. Insulation is used in many homes in the United States of America. Fibers can successfully absorb sound because they trap layers and sometimes bubbles of air (Pinna, Fairclough, 1998). Drywall is also used for soundproofing at times, as well as green glue. Green

glue is a new product that supposedly takes away 90% of sound traveling from room to room. In this experiment, the effect of different materials on sound absorption is being tested. The experimenter's hypothesis is if the green glue is used, then the dB level will be the lowest.

First, the experimenter created a box to put speakers inside of. Next, the speaker was placed inside of the box and the volume outside of the box was measured in dB's (However, this is where the project became complicated. The experimenter measured seven different volume levels because different frequencies travel through mediums differently, therefore testing only one frequency would have been inaccurate). This was repeated 10 times with each frequency. The mean of the results for the Bose speakers alone was 99.99429 dB's, the mean for the drywall was 74.62 dB's, the mean for the insulation was 60.54 dB's, and the mean for the green glue was 63.85571 dB's. Overall, Insulation performed the best throughout the experiment.

THE EFFECT OF THE MATERIAL SURROUNDING A SPEAKER ON THE DECIBELS OF SOUND

Rowan Saydlowski

The urban world is simply too loud. This noise pollution produced from car horns, powerful stereos, and other obnoxiously loud sounds penetrate walls and stifle productivity and thinking. If only there was a material to block these sounds completely, then everyone could have a more peaceful life. The purpose of this experiment was to find this perfect material.

My hypothesis was that if Styrofoam is used for insulation, then the number of decibels will be lowest. The procedure consisted of a few meticulous steps repeated many times. First, a wooden frame containing two speakers was covered with no material and set 60 cm away from a decibel meter. A tone was produced from the speakers, and the number of decibels was recorded. This was repeated in 9 more trials. Next, the frame was covered with pieces of plywood. The number of decibels was recorded. This repeated for 9 more trials. This process was repeated for the remaining materials: Styrofoam, high-density foam, and denim.

Once the data had been collected, it was noted that the number of decibels of sound did not differ greatly between the different materials but still had an obvious best. With no material covering the speakers, the mean was 91 decibels. For the wood, the mean was 97 decibels. For the Styrofoam, the mean was 87.8 decibels. For the high-density foam, the mean was 89 decibels. For the denim, the mean was 86 decibels. Therefore, the denim blocked the most decibels from being released into the surrounding world.

The results did not support the hypothesis that the Styrofoam would be the best, because the denim was the best at insulating sound. In future experimentation of this kind, I would improve by using a frame with spaces in all sides, test more materials, and use a completely unoccupied space to better the preciseness of the data.

THE EFFECT OF DIFFERENT FUELS/OILS ON THE DIAMETER OF THE INTERFERENCE ON WATER

Collin Shumaker

George H. Moody Middle School

If one were to walk down the car filled road on a rainy day, that person would notice a light interference. One would see this interference because of the thin film of oil or gasoline. This thin film reflects light waves into one's eye. Since the light reflects both the inner and outer edge of the film, the light waves intertwine making their combination light wave bigger. These films are only 10 to 100 molecules thick, so it is impossible to see how thick it is with the human eye. The more different the individual light waves are when they combine, the more colorful it seems to the eye. (Cobb, 1993)

The purpose for this experimentation is to investigate the effect of different types of oil and gasoline, on how large the film would be on water. The independent variable will be the type of oil; Group A is gasoline, Group B is used car oil, and Group C is new car oil. The dependent variable will be the area of the thin film interference. The hypothesis for this experiment was that if new car oil were placed on water then its thin film would be the largest of the three variables. This hypothesis was made assuming that used car oil had engine residue left in it after use.

The procedure for this experiment is simple. First, fill a bucket up with water and drop a milliliter of the substance into the bucket. Then, take the measurements of the interference, record them, and repeat the process with the other groups. The results of this experiment were interesting. Group B had the overall largest average area of 230.4cm^2 , and the largest overall area of a trail was 335cm^2 from Group A. In conclusion, Group B had the largest average area because since the car oil is used, the engine of the vehicle has soaked in all of the lubricating molecules that were there. This makes the oil thinner which helps it spread across the water's surface.

SPEED COMPARISON OF DIFFERENT PELLET BRANDS

Ben Stanley

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The purpose of this experiment was to find the effects of different brands of BBs on the feet per second (FPS). I was trying to figure out whether it was worth spending extra money to get “better” BBs or to get cheaper ones. The goal of the experiment was to find the effect of different brands of BBs on the FPS. I gathered all of my materials and set up in my basement. I then measured the FPS of the airsoft gun using a radar gun. After getting all of the means of the FPS, I recorded them down. Using the means I had collected I figured out that it is better to actually get cheaper pellets. Crossman and TSD (the two cheaper brands) got a higher mean than King Arms and Air Ventur (the high-priced ones). Crossman and TSD got 250.5 FPS (mean) while King Arms and Air Ventur got a disappointing 247.5 mean FPS. My experiment helps airsoft players realize that it is *not* worth it to get expensive BBs, and it *is* worth it to get cheaper BBs. Even though my hypothesis was off, I met my objectives because I found out information about airsoft pellets being worth it or not.

THE EFFECT OF THE TYPE OF MATERIAL ON THE AMOUNT OF FRICTION

Alex Stopkey

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The research objective for this scientific experiment was to discover which material (athletic gloves, athletic tape, cloth gloves, and chalk) would create the most amount of kinetic friction when in contact with a hard surface. This would be useful to determine what the best material would be for gripping a rock face during rock climbing. The experiment was conducted by using a flat part of an asphalt driveway and dragging an 8cm x 15cm glove of the material with a 13.34 N weight on top of the material and measuring the force required to move the material and weight. It was hypothesized that if each of the four materials being tested (athletic gloves, athletic tape, cloth gloves, and chalk) were weighed down and dragged across an asphalt driveway, then more force would be required to move the athletic tape the same distance as the other three (*climbing friction*). The athletic glove has a rubber coating on the palm for grip. The athletic tape and cloth gloves are made of cotton, and the chalk is Bison Competition Chalk. The athletic tape was wrapped around a glove so that it had a form, and the chalk was applied to a rubber athletic glove to simulate it being applied to a hand. The results were that the athletic gloves produced the most amount of kinetic friction (1.08 kg on average), followed by the cloth gloves (1.03 kg on average), followed by chalk (1.03 kg on average), and athletic tape had the least amount of kinetic friction (0.92 kg on average). In conclusion, the hypothesis was not supported. The athletic gloves produced the most amount of kinetic friction, and the chalk produced the least.

THE EFFECT OF WIRE GAUGE TYPES ON THE SPEED OF HOMOPOLAR MOTOR

Nitish Vaidyanathan

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In 1821, Michael Faraday made the first electric motor. However, it was only useful as a demonstration device, because though it does use electrical force to impart motion, there was no practical use for the motor because the only part that moved was a stiff wire. Now, nearly two centuries later, there are much more efficient designs for motors, though not working on that work on different principles. The purpose of this experiment was to investigate which wire gauge would create the most effective research.

Based on research, the hypothesis was: If the 18-gauge wire was used, then the motor will run the fastest. A homopolar motor was constructed, and the wire gauge was changed as a means of manipulating the resistance.

The results did not support the hypothesis. The mean of the 18-gauge wire was 116.6 rpm, the 22 gauge was 337.5 rpm, the 24 gauge was 359.7 rpm, the 26 gauge was 451.1 rpm, the 30 gauge was 643 rpm. This did not agree with Ohm's discovery, the possible reason being radio waves or temperature fluctuations. In order to fully declare this experiment as valid, a temperature-controlled faraday cage should be utilized.

THE EFFECT OF GRAVITY ON A PROJECTED OBJECT AFTER BEING LAUNCHED UPWARDS

Grant Villanueva

Tuckahoe Middle School

Does weight affect jumping height? Does acceleration affect the airtime of an object? What happens when force is applied to an object? All of these questions were answered in the experiment which tested the effect of weight on a ball's airtime when launched. "Launching a ball in the air was man's first step into traveling to other planets" (Maya Gottfried et al., Chronicles Apollo Mission). That quote and NASA's rocket science inspired this test of Newton's theories on motion and the laws of gravitation.

Initially the experiment was going to utilize a spring as a launch force, however, that attempt failed. The spring could not be compressed enough to launch the heaviest ball (Ball III 75 grams). The experiment then changed from a spring to a rubber band. This acted more like a sling shot and the experiment was easier to conduct. As resulted it was easier to come to a conclusion and the sling shot identified the difference between the levels of the independent variable more clearly.

Results of the experiment may have been inaccurate because of possible human error and the balls had areas on the surface that was not completely sealed (there were holes on each ball). However, the results suggested that the ball with the least amount of mass remained in the air the longest after being applied the same amount of force for each level of the independent variable.

THE EFFECT OF VIDEO GAME REVIEW SCORES ON AMERICAN VIDEO GAME SALES

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At least once a week, new video games are released. The reviewers of these games are constantly working to assess the newest games and post views online. Do these reviews affect sales? This experiment studied 100 different titles to check the correlation between the two dependent variables: the review scores and the sales data. Metacritic critic ratings, Metacritic user ratings and Gamerankings critic ratings were chosen, while sales data from VGChartz were also used. The data was analyzed with *Minitab*. The hypothesis was that video game reviews have no correlation to American video game sales. Data related to the top 100 games of 2010 were analyzed, excluding the downloadable titles and iOS (iPod) titles. The experiment validated that the hypothesis was correct. It was also observed that the data from any single data set has a stronger correlation than of the three data sets averaged. The average received a -0.018 on the Pearson's Correlation rating scale, which gave it a No Correlation. The others produced 0.248, -0.314 and 0.377.

THE EFFECT OF DIFFERENT SUBSTANCES ON MELTING ICE

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The purpose of this experiment was to test alternatives to melting ice. Rock salt is the substance usually used to melt ice on our roadways. This experiment tested four other substances, and research gave insight to other qualities of the substances such as their traction ability and their impact on the environment. The constants during the experiment were the same size of ice blocks containing 200mL water, the same size container (18cm), the volume of substance (112g) treating the ice block and the temperature during the experiment (4 to 7°C). A control containing no substance was tested, as well as salt (sodium chloride), baking soda (sodium bicarbonate), limestone grit, and fertilizer (containing Urea NH_2CONH_2).

The hypothesis tested through this experiment was, "If alternatives substances were used to melt ice, then limestone grit would be the most effective." After conducting five trials with each substance, the hypothesis was not proven correct. Data collected showed salt was the most effective (mean melting time 2:02), followed by baking soda (3:34), limestone grit (4:12), the control (4:24) and finally fertilizer (4:64).

If the experiment was to be done again, the experimenter would run the trials in reverse. This would involve putting the substances in the water and testing how long it would take it to freeze. This would prevent the ice from forming in the first place. Fertilizers containing a higher concentration of Urea could also be tested to see if the melting times decreased. The experimenter could also test varying amounts of each substance. The volume of each substance was constant (112g) in this experiment. Increased volume of the substances may decrease the amount of time it took to melt the ice.

THE EFFECT OF DIFFERENT WEIGHTED ARROWS ON THE AMOUNT OF PENETRATION INTO STYROFOAM

Charles Yang

George H. Moody Middle School

Is the heavier or lighter arrow better for penetration? Does the heavier and slower moving arrow or does the faster, lighter arrow have more penetration? The purpose of this experiment was to determine whether heavier arrows or lighter arrows were better for penetration. The hypothesis is that if the weight of the arrow is increased, then the amount of penetration will increase. Firearms support the hypothesis that the heavier arrows have more penetration because heavier bullets are used for more penetration. Also, faster arrows have more air drag. Gravity actually helps heavier arrows because they have a higher apogee which allows for gravity to pull it down and increase its velocity. Lighter arrows have less energy storage as well which is why the light arrows, when fired, have a twanging noise. This is stored energy being converted into sound instead of flight. This is why the hypothesis is if the weight of arrows is increased, then the amount of penetration will increase. A Styrofoam block $48,121.68\text{cm}^3$ was placed 5.7912m away from the experimenter. The experimenter would notch the arrow with the nock in between the second and third finger with the fourth finger pulling back the string as well. There were two levels of independent variable (IV), 85 grains and 100 grains. The experiment was repeated 25 times for each level of IV. The 100 grain broad head had an average penetration of 9.91235cm. The 85 grain had an average penetration of 9.83615cm. It appears that the heavier the arrow the more penetration, but further experiments will have to be done to verify this.

THE FINANCIAL EFFECT OF BUYING VERSUS RENTING A PROPERTY OVER A PERIOD OF TIME

Lora You

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Buying one's home is one of the ultimate American dreams. Owning a home may have many benefits including tax savings and also can act as a forced saving if the prices of the properties increase at a rate higher than the interest rate.

However, the experience of buying a home can be clouded with monetary commitments such as down payment, mortgage commitments over a period of time, home insurance, and property taxes. Especially in the down-falling economy, ever since 2008, many are losing homes because of no available income for mortgages and dues. There are many different types of properties that are on the market for renting, and it is said to be a simpler and cheaper way to live: no down payment involved, not bound to a long-term contractual mortgage, no property taxes or insurance, and only requires the monthly rent payment.

The purpose of this experiment was to determine the financial effect of the comparison of buying and renting fifteen properties over a period of thirty years. Fifteen houses' sale prices that were 10% +/- of the Virginian median house price, \$247,100, were found, along with their monthly rent payments for each property. The results indicated that the buying group spends fewer payments than the renting group, from savings of the buying group compared to the renting group of \$24,508.63 to \$330,481.71. The data supported the research hypothesis that if buying and renting were compared over a period of time, then buying of a property will have more savings over a period of time.

Based on the total payments of buying and renting groups over a period of thirty years that were determined in this research, it appears to show that buying is better for all properties, which is not always the case. Before it can be concluded that the buying has less payments than renting, more factors are needed for both groups to make the results more realistic. Additional factors include annual maintenance and general inflation for the buying group.

THE EFFECT OF TYPES OF BRIDGES ON CAPACITY

William You

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A young student noticed that there were many types of bridges in the United States. This began the study of designs of bridges on capacity. The bridges are made stronger by adding the strongest shape, triangles. Also, the bridges do not always include triangles.

It matters on how and where the tension flows to and how smoothly it moves because if the bridge is ridged and rough, the tension will collapse and the bridge will fall. The experimenter thought, if types of bridges were tested, then the suspension bridge will have the largest capacity. The purpose of this project was to determine which type of bridges, arch, beam, cable-stayed, cantilever, suspension, or truss, will hold the most capacity. First, the experimenter found the length of the bridge, type of bridge, the number of lanes, span length, the average length and weight of a car. Then the experimenter divided the length by the length of a car to see how many cars can be on the bridge when there is no traffic flowing. After, the result was multiplied by the average weight of a car and the number of lanes to see how much weight the bridge can hold. This procedure was done to all of the bridges that were researched.

Based on the results, the hypothesis was supported by the suspension bridges holding the average of 7930 tons of weight, cantilever with 7029.2, cable-stayed with 6508.1, truss with 3134.9, arch with 2667.8, and beam with 404.1. A few of the assumptions that were made were because of some correlations. The reason the beam bridges have such a low span length and holds less weight is because it has no supporting parts to make it efficient. Also, the materials were concluded, that they do not make a difference in the capacity because it is the same length, and capacity, but just will last longer than a weaker material.

THE EFFECT OF PAPER TYPE ON WATERCOLOR DRYING TIME

Mary Lawrence Young

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Watercolor paints are one of the most widely used forms of paint. Many famous artists have used watercolor paints. Two artists known for their use of watercolors were Paul Cézanne and Frank Wilcox ("Watercolor painting.com,"). Research indicated that knowing the absorbency of paper is critical in making the correct choice for a watercolor painting. The more absorbent a paper is and the longer it takes to dry will result in the paint pigment being absorbed into the paper along with the water. Therefore, a faster drying time will produce a more brilliant application of the paint. ("Choosing watercolour paper,").

The purpose of this experiment was to determine what type of paper had the fastest drying time out of hosho paper, denril paper, rice paper and watercolor paper. Based on previous research, the hypothesis was "If four different papers (watercolor paper, denril paper, hosho paper and rice paper) were tested to see which had the fastest drying time, then the watercolor paper will have the fastest drying time." In this experiment four types

of paper were tested to see which had the fastest dry time. Nine trials were conducted. All the trials were conducted using the same brand of paint, painting location, same brushes and artist. During each trial the scientist laid out one sheet of each paper. The same picture was painted on to each paper and the time each painting was completed was noted. Once each trial was completed the scientist checked every five minutes to determine if one of the paintings was dry and the final dry time was noted. The results determined that the watercolor paper dried in an average of 15.2 minutes, 20 minutes faster than the other papers. The data supported the hypothesis that the watercolor paper dries fastest.

SOLAR POWER

Katherine Zetkulic

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Three solar ovens were built to test the effect of solar oven type on the solar ovens effectiveness. The shapes of the ovens tested were, one in the shape of a box, one in the shape of an umbrella (parabola), and one in the shape of a panel. Each solar cooker was placed outside in the middle of the day when the sun was highest for a period of one hour. A container with water was placed in the oven and the temperature of the water in the cookers was taken every ten minutes.

It was found that the largest temperature change was produced by the panel-shaped cooker, which raised the water an average of 8.3 degrees Celsius. The second was then the parabolic cooker which raised the water temperature and average of 7.2 degrees Celsius. And finally, the box cooker, which raised the water temperature an average of 4.4 degrees Celsius. The data rejected the hypothesis that the parabolic cooker would be the most effective.

PHYSICS A

First Place:

A STUDY OF THE OIII TO VISIBLE FLUX RATIO OF ASTRONOMICAL OBJECTS

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Data collection in astronomy relates exclusively to the observation and measurement of light: the type of light, the amount emitted, and its spectral distribution. When observing blackbody radiators like a star, there is an expected range of emission. However, some objects have abnormal levels of emission at specific, unexpected wavelengths. This effect can be observed by looking at these objects through different filters. The purpose of this study was to analyze various astronomical objects – stars, globular clusters, and nebulae – calculate their OIII to visible flux ratios ($[OIII]/[V]$), and search for any inherent patterns. It was hypothesized that the sample of nebulae would exhibit a significantly higher variability than globular clusters or individual stars. This study used photometry for its data collection and analysis by means of a Ritchey-Chrétien 14.5-inch telescope and OIII and visible filters. Data from each object was collected with an STL 11000M Camera, then analyzed in the computer program *MaxIm DL*. Their magnitudes were recorded through each filter and analyzed to compare the type of object with their OIII to visible flux ratios. The data displayed a relatively linear $[OIII]/[V]$ relationship for stars and globular clusters. A Levene's test for the equality of variance was conducted to show that emission nebulae (including planetary nebulae) demonstrated a higher variability in $[OIII]/[V]$ when compared with stars and clusters ($F=3.62$, $p=0.0361$). There is an implied mechanism behind this variation suggests that $[OIII]/[V]$ can be used to determine parameters of interest, including age, luminosity, or other characteristics. The results of this study could potentially be used to help improve understanding of the planetary nebula luminosity function (PNLF) as well as the general formation of planetary nebula.

Second Place:

A CORRELATION STUDY BETWEEN THE JET LOCATIONS, MASS ACCRETION RATES, AND JET POWERS OF 14 RADIO-LOUD AGNS

Cassandra Brown

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Observations have shown that relativistic jets are commonly associated with radio-loud Active Galactic Nuclei (AGNs), and that the presence of the jets is connected with an accretion disk. Recently, the estimated observed mass accretion rate and jet power of several radio-loud supermassive black holes have been obtained; and there is not yet a study to investigate a correlation between the initial jet locations of these sources and their mass accretion rates and jet powers. A self-consistent disk/jets model has been constructed for an inviscid advection-dominated black hole accretion disk containing centrifugally supported isothermal shock waves in which particles are efficiently accelerated up to relativistic energies before escaping from the disk to form the observed jet outflows. Using estimated observed jet power, the mass accretion rates, and the initial jet locations of nine selected radio-loud sources were calculated. Results suggest that there is a correlation between the jet power and the jet radius, and that jets/outflows occur at radii further away from the event horizon for strong jets.

Third Place:

THE EFFECT OF THE TYPE OF RADIOPROTECTANT ON THE MORTALITY RATE OF *DROSOPHILA MELANOGASTER*

Brandon Buncher

Godwin High School

Ionizing radiation is a major obstacle to long term space travel and has been proven to cause human harm. Because most radioprotective shielding is expensive and heavy, they cannot be used in spacecraft. Therefore, identifying a lightweight and inexpensive radioprotectant is needed for long-term space flight. Previous research has determined ingestion of antioxidants, including flaxseed, is effective at preventing cellular damage after irradiation, while nickel foil significantly shields ionizing radiation in a vacuum. The purpose of this experiment was to determine the most effective protectant against radiation, contrasting nickel foil and a 50% flaxseed diet. It was hypothesized that a flaxseed diet would cause the greatest reduction in fruit fly death as compared to a control of no shielding with radiation treatment. Samples of male fruit flies were exposed to ionizing radiation with no shielding, nickel foil shielding, and a flax seed diet. One of six flies died in the nickel foil treatment, while none of the 21 died in the flaxseed treatment. When compared to the control, the flaxseed was found to cause a significant decrease in the mortality rate of the flies at a 95% confidence level, while the nickel foil did not. The results of this experiment indicate that dietary flaxseed could be used as a radioprotectant for long-term space travel because it is cheap, effective, and consumable by astronauts. In conclusion, though it supports previous experimentation, more research should be performed on the potential uses of flaxseed in long-term space travel.

Honorable Mention

A COMPARISON OF ATOMIC EMISSION LINE RATIOS OF GALAXIES WITH AND WITHOUT MEGAMASERS

Yuri Bang

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The purpose of this study was to determine whether or not the difference in the atomic line ratios of two characteristic types of emissions ($[\text{NII}]/\text{H}\alpha$ and $[\text{OIII}]/\text{H}\beta$) is present between galaxies with and without megamasers. $[\text{NII}]/\text{H}\alpha$ and $[\text{OIII}]/\text{H}\beta$ are line intensity ratios on which to base the classification of emission line galaxies. The study was conducted through collaboration with the University of Virginia Astronomy Department in November 2011 through January 2012. To complete the study, emission line spectra from established megamaser galaxies were used. Calculated areas of NII, H-alpha, OIII, and H-beta were divided to produce the emission line ratios of $[\text{NII}]/\text{H}\alpha$ and $[\text{OIII}]/\text{H}\beta$. An emission line is a feature in the spectrum of an object which is created when an element's atoms or molecules return to a lower energy state. The collected data was plotted in the Baldwin, Phillips, & Terlevich (BPT) diagram to classify these galaxies. Two two-tailed t-tests, with an alpha level set at 0.05, revealed p-value of 0.01407668 and 5.92839E-10. This statistically significant value revealed support for the original hypothesis, which was that there will be difference between the line ratios of $[\text{NII}]/\text{H}\alpha$ and $[\text{OIII}]/\text{H}\beta$ for galaxies with and without central megamasers. In conclusion, the line ratios indicate that megamasers are found in galaxies with line ratios consistent with having Active Galactic Nuclei (AGN), and having little indication of active star formation.

Honorable Mention:

WHY DO GALAXIES HAVE MEGAMASERS

Brian Carey

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The purpose of this study was to determine if a galaxy's characteristics dictate whether or not it has a megamaser at its core. This study was mainly conducted using a computer and with help with the Astronomy Department of the University of Virginia. A list of control galaxies was made using the given characteristics given from a list of known megamaser galaxies. With this list, a comparable list of megamaser galaxies was created using the NASA Extragalactic Database. Using different galactic surveys, statistical analyses were conducted comparing the two lists in Microsoft Excel. The only tests that were found to have significant results were the intrinsic size in the 2MASS K survey and the minor/major

axial ratio for the RC3 Blue Light survey. For those tests, the alpha value was found to be less than 0.05, thereby making them significant. Therefore, the null hypothesis should be eliminated. The data supports the alternate hypothesis which is that the size of a galaxy is a good indicator of whether or not a galaxy will have a megamaser.

Honorable Mention:

The Effect of Tire Air Pressure on Vehicle Fuel Economy

Franklin Gergoudis

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Many automobiles in the United States are operating with tires that are improperly inflated. Improper tire inflation pressure increases the risk of motor vehicle accidents and wastes billions of dollars annually. Under inflation of tires increases rolling resistance and previous studies have suggested that a ten percent increase in rolling resistance reduces fuel efficiency by one to two percent. In view of rising fuel costs and an uncertain global economy, it seems particularly relevant to investigate ways in which individuals might help to save fuel and energy.

In this study it was hypothesized that if tires were under inflated, then fuel economy would be decreased. The experiment was performed to investigate whether reduced tire pressures in a typical daily commute would have a significant impact on fuel efficiency. The experiment was designed for ten trials each for three levels of tire pressure, including control group C with the manufacturer's recommended pressure of 32 psi, experimental group B with 28 psi, and experimental group A with 24 psi. Fuel economy in miles per gallon was measured by the onboard fuel economy calculator in a sport utility vehicle and recorded for daily commute from home to work in a suburban community. Individual trials within each experimental group lasted seventy-two hours, and the ten trials were conducted over a period of thirty days. Results of this study demonstrated a decrease in fuel economy with decreased tire air pressure. In fact, the data showed a maximum average fuel economy of 16.6 miles per gallon at the recommended 32 psi versus 15.4 and 14.0 miles per gallon at 28 and 24 psi respectively. A t-test performed on the data indicated a significant difference between the average fuel economies of the groups and confirmed statistical significance for all comparisons at $\alpha = 0.05$ and $df = 18$. This study clearly supported the hypothesis that decreased tire pressure decreased fuel economy.

EFFECT OF BATTERY VOLTAGE ON SENSITIVITY OF REMOTE CONTROL

Helen Boyd-Pratt

Shenandoah Valley Governor's School

Countless times, lounging television watchers have reached for the remote only to have nothing happen; frustration and anger exudes as the television watcher must interrupt his or her television watching to fumble through drawers in search of batteries. The purpose of this experiment was to determine how the distance of the remote control from the television corresponds to the battery voltage for functionality of the remote control. In order to determine the distance the remote controller will work with a given voltage, pairs of batteries with varying voltages were used in a remote and distances between five and twenty feet with increasing increments of roughly two feet were used to move farther from the television. The number of times the remote would work out of ten clicks was recorded. This experiment was done to determine the sensitivity of the remote as defined by the number of times it would work out of ten. It was found that sensitivity as defined by effective distance is linearly proportional to battery voltage; high voltage gives larger effective distance. The trend line for the graph of the effective distance compared to the battery voltage gave an R-value of .968, which means the trend line fits the data very closely and therefore that the positive slope is a good representation of the increase in distance. This relationship can be explained by consideration of the physics of electromagnetic waves.

THE EFFECT OF ANGLE ON THE ACCURACY OF THE SHOT

Jenna Burns

Deep Run High School

The accuracy of certain shots in soccer has been determined by the various angles from which the shots have been taken. Soccer is a very competitive sport around the world, and it is the most played sport throughout as well. The purpose of the experiment was to see whether or not the accuracy of the shot was affected by the angle from which the shot was taken. The research hypothesis was if the angle of the shot was decreased, then the accuracy will decrease as well. 30 shots were taken from three different angles on the field, 90°, 45°, and 0° by three different people the same age with relatively the same skill level. Overall, 83% of the shots taken at 90° went in, at 45°, 80% of the shots went in, and at 0°, 3% of the shots went in. A t-test performed on the data showed that the information gathered was able to support the research hypothesis ($t=6.55 > 2.042$ at $df = 58$; $p < 0.05$). Based on the data from the experiment, it was shown that the angle of the shot does affect the accuracy of the shot. Research should be conducted to see whether or not age or skill level has an effect on the accuracy of certain shots.

AN INVESTIGATION OF GROUND EFFECT

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In this experiment, ground effect was investigated. Ground effect is the increase of lift in a vehicle when operating close to the ground because of the compression of air; it is a main component in air-cushion vehicles, such as hovercraft and helicopters (Post, 2010). This experiment is an investigation to discover if the force of ground effect drops off as a fan cart's distance from the "ground" increases. Materials used in this experiment included: Frictionless track inclined at five different angles (2.0, 2.5, 3.0, 3.5 and 4.0 degrees; white board (1.5 meters x 1 meter); fan cart; meter stick; angle indicator; bubble level tool; motion detector; stand; laptop; Logger Pro software; force probe; and calculator. The fan cart was placed on the track and against the white board ("the ground"); the white board was propped up against a stand to keep it straight throughout the experiment. The fan car was turned on and the distance between the fan cart and white board was measured. We found the equation for thrust, acceleration, and ground effect through analyzing a free body diagram. Our hypothesis was, if the distance is increased between the fan cart and board, then ground effect will become less effective because there will be a decrease in air pressure decreasing the amount of drag. Our findings did not support our hypothesis. As the angle increased, ground effect became more effective until it reached a maximum angle where the effect was no longer present. As the distance between the fan cart and the "ground" or whiteboard increase the force of ground effect exponentially decreased. Ground effect works similarly to the strong nuclear force in that it only is present in short distances between objects (Pistolessi, 1937). Our null hypothesis was also diminished because our p value was: $p = 8.58 \times 10^{-44}$. This proves that our data was significant and effective since the p value is less than .05.

WHY DO GALAXIES HAVE MEGAMASERS

Brian Carey

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The purpose of this study was to determine if a galaxy's characteristics dictate whether or not it has a megamaser at its core. This study was mainly conducted using a computer and with help with the Astronomy Department of the University of Virginia. A list of control galaxies was made using the given characteristics given from a list of known megamaser

galaxies. With this list, a comparable list of megamaser galaxies was created using the NASA Extragalactic Database. Using different galactic surveys, statistical analyses were conducted comparing the two lists in Microsoft Excel. The only tests that were found to have significant results were the intrinsic size in the 2MASS K survey and the minor/major axial ratio for the RC3 Blue Light survey. For those tests, the alpha value was found to be less than 0.05, thereby making them significant. Therefore the null hypothesis should be eliminated. The data supports the alternate hypothesis which is that the size of a galaxy is a good indicator of whether or not a galaxy will have a megamaser.

RELEASE ANGLES FOR DIFFERENT SHOT-PUTTING TECHNIQUES

Jacob Cash

Shenandoah Valley Governor's School

Different shot-putting techniques may have an effect on the release angle of the shot. The purpose of this experiment was to determine if the release angle changes with each technique of throwing. Volunteers from a local high school were videotaped while performing the basic throw, the slide, and the T-gather. The release angles were measured using analysis software Kinovea. ANOVA and Tukey tests indicated that there was no significant difference between the basic throw and the slide for any of the subjects, but for every subject, a significant increase was found in the T-gather. The researcher concluded that the T-gather technique yields a generally higher release angle than the basic throw and the slide techniques.

ANALYSIS OF SPLASH HEIGHT OF VARIOUS VISCOSITIES OF WATER USING CLAY MODELS

Duval Corral

Godwin High School

Every day, the body releases waste as a natural part of life. Defecation is the process of removing waste or feces from the body. Sometimes, the body releases the waste so fast that it creates a splash high enough to touch the bottoms of the individual. The purpose of this project is to eliminate that splash.

The Bristol Stool Chart clearly categorizes feces into seven types. Types three and four are the healthy and ideal form and will be the main focus of this experiment. Clay models were formed to represent the type three and four. They were dropped from a set height and video analysis was done to record the splash height. To eliminate the splash, the viscosity of water was increased using toilet paper and cornstarch.

It was hypothesized that the use of toilet paper will eliminate the splash. After the results have been analyzed, it was found that one type of model splashed higher than the other. Fluid dynamics was suspected, and further investigation should be done to account for the splash patterns of each stool. A further understanding of this will lead to a better way of eliminating the splash.

THE STUDY OF THE EFFECT OF SPARK GAP BREAKS-PER-SECOND ON TESLA COIL STREAMER LENGTH

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The Tesla coil is an air cored resonant inductance transformer that produces high voltage, low current electricity in the form of streamers. Research was conducted to determine the effect changes in spark gap breaks per second would have on the length of streamers discharged from the top-load terminal. The research was inconclusive due to the problems that occurred during the construction and operation of the Tesla coil, ultimately resulting in no streamed discharges. Observations were made regarding the power of the spark gap breaking at variable primary circuit capacitances that may result in future research.

THE EFFECT OF SUNSCREEN SPF ON UV RADIATION

Rachelle Downs and Danielle Moore

Deep Run High School

SPF shows how strong a sunscreen is. It is the ratio that compares how long it takes for the skin to redden with sunscreen, to how long it takes for the skin to redden without sunscreen. Radiation is energy traveling through space. Everyday radiation that humans are exposed to is not dangerous; however large doses of radiation can be very harmful. While choosing a sunscreen, it is important to look for a sunscreen that contains ingredients with UVB and UVA protection, as both can cause damage to the skin, and it is also important to note the SPF.

The purpose of this experiment was to test the effect of different sunscreen SPF values on the amount of UV radiation. Four sunscreens with SPF values of 15, 30, 80, and 100 were each spread on a sheet of glass. The amount of UV radiation was measured using a UV meter, and the results were compared to the control, which used no sunscreen.

The results indicated that the sunscreen SPF blocked against ultraviolet radiation, but the increasing values of SPF did not increase the amount of radiation that was blocked. The average UVR measurement when sunscreen was used was 0 mW/m². However, the average UVR measurement when no sunscreen was used was 16.7 mW/m². A t-test performed on the data indicated no significant differences in the amount of UV radiation between the groups that tested sunscreen when SPF values 15, 30, 70, and 100, were used ($0 < 2.101$ at $df=18$; $p > 0.05$). The data did not support the research hypothesis that sunscreen increasing SPF values decrease the amount of UV radiation. Based on the measurements determined in this research, increasing SPF values do not decrease the amount of UV radiation. Before it can be concluded that differing SPF values do not change the amount of UV radiation, however, further testing should be completed during the proper time of day, and perhaps using more advanced equipment.

The Effect of Tire Air Pressure on Vehicle Fuel Economy

Franklin Gergoudis

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Many automobiles in the United States are operating with tires that are improperly inflated. Improper tire inflation pressure increases the risk of motor vehicle accidents and wastes billions of dollars annually. Under inflation of tires increases rolling resistance and previous studies have suggested that a ten percent increase in rolling resistance reduces fuel efficiency by one to two percent. In view of rising fuel costs and an uncertain global economy, it seems particularly relevant to investigate ways in which individuals might help to save fuel and energy.

In this study it was hypothesized that if tires were under inflated, then fuel economy would be decreased. The experiment was performed to investigate whether reduced tire pressures in a typical daily commute would have a significant impact on fuel efficiency. The experiment was designed for ten trials each for three levels of tire pressure, including control group C with the manufacturer's recommended pressure of 32 psi, experimental group B with 28 psi, and experimental group A with 24 psi. Fuel economy in miles per gallon was measured by the onboard fuel economy calculator in a sport utility vehicle and recorded for daily commute from home to work in a suburban community. Individual trials within each experimental group lasted seventy-two hours, and the ten trials were conducted over a period of thirty days. Results of this study

demonstrated a decrease in fuel economy with decreased tire air pressure. In fact, the data showed a maximum average fuel economy of 16.6 miles per gallon at the recommended 32 psi versus 15.4 and 14.0 miles per gallon at 28 and 24 psi respectively. A t-test performed on the data indicated a significant difference between the average fuel economies of the groups and confirmed statistical significance for all comparisons at $\alpha = 0.05$ and $df = 18$. This study clearly supported the hypothesis that decreased tire pressure decreased fuel economy.

THE EFFECT OF THE TYPE AND LOCATION OF MAGNETS USED IN THE MAGNETIC PICKUP OF AN ELECTRIC GUITAR ON THE AMPLITUDE OF THE SOUND WAVE OUTPUT

Charles Jones

Godwin High School

A magnetic pickup is a device that consists of a magnetic core surrounded by one or more coils of very fine wire that tracks and transforms the changes in the magnetic field of the coil caused by the strings of a guitar into an electric signal. Their purpose is to amplify the sound of an electric guitar through the transmission of this electric signal to an amplifier as opposed to the acoustic resonance of an acoustic guitar. It was hypothesized that if the pickup with neodymium magnets is used at a distance of three-eighths of an inch from the strings, then the amplitude of the sound wave output will be the highest compared to other magnets/locations. Three pickups were made, and their sound wave outputs were recorded using the program Audacity on a Dell laptop computer at distances of $\frac{3}{8}$ " and $\frac{1}{2}$ " from the guitar strings. One pickup had neodymium magnets, another had samarium cobalt magnets, and the last had alnico magnets. The pickup that used neodymium magnets yielded the greatest mean amplitude at both distances and all the pickups yielded their highest average amplitudes at the distance of $\frac{3}{8}$ " from the strings. The hypothesis was supported and the pickup with neodymium magnets at $\frac{3}{8}$ " from the strings produced the loudest sound.

THE EFFECT OF FUEL RATIO ON THE EFFICIENCY OF WATER BOTTLE ROCKETS

Malec Kennedy

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The study was conducted in order to find the most efficient ratio of water to tank size in a water bottle rocket that would propel it to the greatest altitude, based on the null hypothesis that 3/10th full was the most efficient. Three participants were used to conduct the experiment. They were placed strategically in different positions in order to measure the maximum height the rocket reached after being launched by using cross reference points, a tape measurer, and clinometer. Ten trials were conducted for ten different increments of water to tank ratio, resulting in a total of 100 launches, each with a pressure of 30 PSI. After the data was recorded, a T-test was conducted for each increment of fuel ratio. As a result of the T-test, and using 29.28 meters as the hypothesized maximum altitude, all increments were rejected except for the 3/10th and 4/10th increments. This showed that those two fuel ratios propelled the rocket the highest. When the average heights for each increment were compared, it was shown that when the rocket was filled 4/10th of the way full, the rocket traveled higher than when it was filled 3/10th of the way full. Therefore, even though the hypothesized 3/10th increment was not rejected, the statistics support 4/10th as the most efficient fuel ratio for bottle rockets.

THE EFFECT OF THE TYPE OF INSTRUMENT ON THE AMOUNT OF CHANGE IN TUNE WHEN EXPOSED TO COLD TEMPERATURES

Yeji Kim and Lillian Tan

Deep Run High School

Since the commencement of ensemble music-making, the importance of correct tuning on the overall quality of sound was discovered. Generally, as supported by the findings of Thomas Rossing in 2000, cold air lowers the tone of all wind and brass instruments. The purpose of this experiment was to determine whether a flute, an oboe, a saxophone, a trumpet or a synthesizer (control) are more affected by changes in temperature, more specifically a drop of 18° Fahrenheit. Five players were gathered and tuned their horns at room temperature before they were moved to a significantly colder environment. There, their instruments were left for twenty minutes before they played their tuning note, and a tuner was utilized to accurately display how many cents out of tune they became. For accuracy, each musician played eleven notes and the averages were calculated. A t-test performed on the data indicated a significant difference between the means of the groups ($t = 12.20, 7.21, 11.35, 7.64, 30.04, 6.87, 4.46 > 2.086$ at $df = 20$; $p < 0.05$), supporting the research hypothesis that if a flute, an oboe, a saxophone, a trumpet, and a synthesizer were exposed to cold, their changes in tune would be disparate in magnitude.

Based on the way the instruments exhibited differing cents out of tune when exposed to the same change in temperature, it can be concluded that the type of instrument matters when expecting a change in pitch after exposure to colder environment. Woodwind instruments are less prone to shrinkage of its materials, but this does not apply to the oboe, which displayed the largest number of cents off tune in this experiment. Electronic instruments, instead of becoming flat, have been discovered to have a tendency to become sharp after exposure to a cold environment. Before it can be concluded that the oboe is the most vulnerable instrument, additional trials with other instruments need to be performed.

The Optimal Condition for Astroblaster

Hyundong Lee

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When a large ball with a smaller ball stacked on top is dropped, the top ball will rise higher than the height from which it was dropped (Mellen, 1968). We investigate this phenomenon in order to find an optimal condition in which the ratio of heights of the top ball before and after the collision is highest. Our theory suggests that one can create the optimal condition by increasing the number of balls used, using balls with higher coefficient of restitution, maximizing the mass ratios among the balls, and setting those ratios equal to one another. Our experiment uses a four-ball system with varying masses of balls in the middle. Our results show that the mass ratio of each set of two consecutive balls has to be maximized and be equal to one another in order to create the optimal condition in which the ratio of heights of the top ball before and after the collision is the highest.

ALTERNATIVE FILLINGS FOR SANDBAGS

David Chasteen-Boyd, Zachary Rosen

The Governor's School for Science and Technology, Hampton, Virginia, 23666

In recent years, flooding has become more prevalent and multiple sources have indicated a wide variety of recommended substances that block the advancement of floodwaters and prevent water-related disaster. Several commonly suggested materials were sand, wood shavings, clay, gravel, and soil. This project aims to find the most effective filling for sandbags in terms of flood prevention. The ideal material would be able to block a large amount of water from passing it as well as be lightweight for ease of carrying the bags in emergency situations. In this experiment sand, Styrofoam, wood shavings, gravel, and soil were tested. Five bags were filled halfway with each substance and duct-taped shut. Each one was then placed across the middle of a paint tray, held back by two nails and a block of wood. The tray had a small gap in the bottom edge, and as water was poured at

the top of the tray with a steady flow using a hose, any water that passed the bag fell through the gap and into a measuring cup. In this way, the volume of water that passed the bag after ten seconds could be measured. Each bag was also soaked, and then weighed. Once data was analyzed, both the weight and permeability were ranked and compared. It was found that wood shavings had the best water blockage-to-weight ratio of the substances tested, followed by sand, soil, gravel, and Styrofoam, respectively.

PHYSICS B

First Place:

THE EFFECT OF SOLAR FLARES ON RICHMOND CLIMATE

Elisha Rudolph

Deep Run High School

As Global Warming becomes a more prevalent issue, some scientists have questioned whether solar flares, an explosion of magnetic energy on the Sun's atmosphere, have an effect on the Earth's climate. This began the study to decipher whether X-class solar flares affect regional climate, specifically the climate in Richmond, Virginia. It was hypothesized that if there is a change in the frequency of X-class solar flares between the years 2002 and 2011, then there will be a resulting climate change. X-class Solar flare and climate data was collected from the years 2002 to 2011. The experiment determined that there is no relationship between X-class solar flares and Richmond climate. Days without solar flare intervention exhibited only a slightly higher mean temperature (62.5°F) than the mean temperature of days in which X-class solar flares occurred (61.2°F). The null hypothesis was accepted ($t = 0.314$ at $df = 54$; $p > 0.05$), therefore the data did not support the research hypothesis that the frequency of X-class solar flares during the years 2002-2011 affects Richmond climate. The findings were consistent with similar research, in that solar flares have extremely little or no impact on the climate, and that any pattern is just coincidental (Hines et. al., 1977; Reid, 2000).

Second Place:

The Effect of Airfoil Shape on Lift Height

Samantha Rafalowski and Kern Sharma

Henrico High School

The objective of this experiment was to determine the effect of different shaped wings on the resulting lift due to the effect of Bernoulli's Principle. Three different wing models were tested, including the conventional airfoil shape model, the reverse airfoil shape model, and the symmetrical shape model. Because Bernoulli's Principle states that an increase in the velocity of a fluid causes a decrease in the pressure within the fluid, the conventional airfoil shape model was predicted to have the greatest lift force and therefore the highest lift height. This was hypothesized due to the curved top of the conventional airfoil shape, which allows for the velocity of the air fluid passing over to increase and therefore the pressure of the air fluid to decrease. This was subsequently predicted to result in an increase in pressure under the wing and therefore a greater lift height. In order to test the hypothesis, the conventional airfoil, reverse airfoil, and symmetrical airfoil wing models were created from balsa wood. Individually, they were each attached to a mechanical fan by a string and the flight pattern was monitored so as to record the lift height. Positive lift height was present if the model flew above the center of the mechanical fan, while negative lift height was present if the model flew beneath the center of the mechanical fan. Each model was tested three times, so each of the three levels of independent variable had three trials. After experimentation, it was determined that the conventional airfoil model, as predicted, had the most lift height, as it was the only model to actually have positive lift height. However, its flight pattern was erratic in comparison to the symmetrical model, which had a consistent flight pattern but negative lift height. Therefore, it was concluded that the curve in the design of the conventional airfoil model resulted in a pressure differential over the model, causing slightly erratic flight patterns, but a higher lift height. The straight design of the symmetrical model resulted in a consistent pressure and therefore a consistent flight pattern but a negative lift height.

Third Place:

GOLF CLUB HEAD SPEED IMPACT ON THE COEFFICIENT OF RESITIUTION

Ian Nakayama

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This experiment examined the coefficient of restitution (COR) as it relates to golf club speed. The COR is a measure of the efficiency of velocity transfer in an impact between bodies. For a two body collision COR was defined by Sir Isaac Newton as the differences in velocities of the bodies after impact divided by the differences in velocities before the impact. The COR has a value of one for a perfectly elastic collision and a value of zero for a perfectly inelastic collision. The hypothesis of this experiment was that as club speed increases, the COR will also increase. A reverse torsion catapult with the club firmly attached to a 2" x 4" firing arm was constructed to generate impacts between the club and golf ball in a repeatable manner. Video footage from a camera recording 240 frames per second was used to calculate the pre- and post- impact club and ball velocities. The torsion on the catapult ropes used to propel the firing arm (and attached golf club) and hit the ball was gradually increased to generate a range of club speeds. The results generally confirmed the hypothesis showing increases in the COR with club speed, with slight increases and decreases at the higher speeds tested. The COR also remained below the United States Golf Association (USGA) limit of 0.83. The USGA is the official sanctioning authority for golf in the United States

Honorable Mention:

DOUBLE SLIT EXPERIMENT (WATER VERSION)

Daphne Martin

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This experiment collected and analyzed data in a water version of Young's Double Slit experiment. In his experiment, he cut two slits into a plate and put another plate a certain distance behind the first. He then shone a laser light on the two slits. If photons were particles, you would expect to see two bands of light mimicking the slits. However,

if the photons acted like waves you would see multiple bands of light relative to where the waves interfered constructively or destructively (Davidson, 1998).

In this experiment the effect of the number of slits on the number of constructive interference points will be measured. To clarify, this means that there will be a wooden plank submerged in three inches of water. The plank of wood will have a certain number of slits (either one, two, three, four, or five) cut into it for each IV level. The hypothesis states that if the first wooden plank has two slits than the greatest number of constructive interference points will be created. The hypothesis both was and was not supported by the data. In the experiment, five types of interference points were encountered: trough trough, crest crest, trough crest, crest crest trough, and trough trough. However, only the first three types of interference points are present at the double slit interference. If the constructive interference points are only calculated with these slits in mind then the double and triple slits are tied for the greatest number of constructive interference points. Once the remaining two types of interference points are added in, the ripple slit IV level has the greatest number of constructive and destructive interference points.

Honorable Mention:

THE EFFECT OF TEMPERATURE O THE CURRENT OUTPUT OF A SOLAR CELL UNDER THE SAME AMOUNT OF SUNLIGHT

Dillon Ngoh and Simranpreet Singh

Deep Run High School

The overall efficiency of a solar cell (that is, a semiconductor electronic device used to transform light energy into electric output) is the amount of load current supplied by the solar cell. Wavelength of the incident light photon is the main contributor to current output. Long wavelength radiations have less energy and are not able to release an electron whereas very short wavelength (ultraviolet) photons have so much energy that they pass straight through the solar cell without releasing an electron.

The purpose of this project was to study the output current of a solar cell by varying the surrounding temperature while keeping it under the same amount of sunlight. The engineering objective was to assemble the apparatus to surround the solar cell with varying temperature and connect the circuit to measure output current in mA while striking same amount of sunlight on it. The hypothesis was that if the amount of sunlight stays the same, then the output will stay the same as well.

The experiment was designed to measure the effect of the independent variable (temperature) by surrounding the solar cell with water at different temperatures varying from 0°C to 45°C, on the dependent variable (current output). The results indicated that

the solar cell produced higher current outputs at lower temperatures and higher surrounding temperature caused the current output to decrease.

The engineering objectives were met but hypothesis was not supported. The null hypothesis that the output current will not vary with the temperature was rejected in most of the comparisons as t in the range of 2.4 to 13.2 was >2.101 at $df = 18$ and $\alpha = 0.05$. The results suggest that efficiency of a solar cell can improve in colder temperatures.

Honorable Mention:

AUTOMATED RESISTIVITY SURVEY

Andrew Vaccaro

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Resistivity surveys are used to analyze subsurfaces. The use of a simple Wenner array to perform a resistivity survey involves running alternating current through electrodes inserted into the ground. Current is measured across two electrodes, while voltage is measured across a pair of unpowered electrodes. The resistivity of the subsurface can be correlated to characteristics such as water content, porosity, or clay content. An automated resistivity survey allows continual data collection over a long period of time with little to no researcher input. The primary focus of this project is to develop a fully automated data logging system to measure resistivity as conditions change over time. To accomplish this, an open-source Arduino microcontroller was used in conjunction with a DS1307 Real-Time Clock, an OpenLog data logger, and a relay to turn on an AC converter as specified intervals and take current and voltage readings using one LM358 op-amp to increase the signal detected from the system. Controlled tests with a wall-sourcing power supply were used to calibrate the system. However, it is not yet known if the system is accurate enough for real-world use as a disconnected wire and damaged AC inverter prevented testing in the field. Further studies are needed to determine its viability as a research tool.

PARAMETERS FOR A MAXIMUM RESOLUTION FOR A PINHOLE CAMERA

Kane Li

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We described how to achieve optimal image quality with a pinhole camera by varying the focal length or aperture radius for the corresponding given parameter. According to Matt Young, resolution depends on the size of the aperture and on the size of the camera itself. A computer model was used to theoretically predict resolution based on light wave propagation through a circular aperture. Both the computer simulation and the experimental photo result agreed with Young's proposition. Therefore the conclusion was that Matt Young's proposed equation does give us ideal focal length values for different aperture radii.

THE EFFECT OF THE TYPE OF FIELD HOCKEY STICK ON HOW MANY METERS THE BALL TRAVELS

Jenny Limoges

Deep Run High School

The future of field hockey and how the game is played could be changed forever. Not with a more powerful shot or better players, but with research that could change the way players hit. The hypothesis for this experiment was, "If a composite stick is used, then the ball will travel the farthest (in meters)." Three balls were set up on the same line a grassy open field then was hit by each of the stick types, composite, fiberglass, and wood. This was repeated 10 times to ensure proper accuracy. The end result of this experiment was the fiberglass stick that went the farthest with a 27.5-meter mean. The composite stick came in second with a 24.8-meter mean. Lastly, the wooden stick came in at a 21.03-meter mean. These results show that the most expensive stick (composite) is not always the best choice to hit a field hockey ball the farthest.

CORRELATION BETWEEN COMPRESSION FORCES ON THE SIN AND MEDIAL TIBIAL STRESS SYNDROME

Michael Maneval

Shenandoah Valley Governor's School

Commonly referred to as "shin splints", medial tibial stress syndrome is a common ailment among runners and other athletes. To identify a possible cause of shin splints, an experiment was conducted using a video and mechanics analyzed. A t-test was calculated to determine the correlation between shin splints and the forces and angles in the leg. It was found that there was a strong relationship between the angles of the runner's ankle and runners who experience shin splints. There was a correlation between the angle of the foot to the shin and frequency of shin splints.

DIFFERENT SWIMSUITS: A NOTICEABLE DIFFERENCE?

John Matthews, Darren Murray, Jennifer Pandolf, Conner Silveria

New Horizons Governor's School for Science & Technology, Hampton, VA 23666

Hundreds of thousands of swimmers spend money on suits to help them train harder in practice and perform better in competitions. By increasing the resistance of a swimsuit, a swimmer can increase the workout in training. Also, companies such as Speedo® are designing faster, slicker suits for competitions. However, these suits can add up to a fair amount of money. The goal of this experiment was to see if the swimsuits being bought were truly necessary by determining the effect each swimsuit had on a swimmer's resistance through the water. The experiment was set up to measure the force used to pull a swimmer through the water wearing each of four suits: a Speedo® Brief, a Speedo® Brief with a Speedo® Mesh Training Suit (referred to as drag suit), a Speedo® Jammer, and a Speedo® Fastskin® FSII Jammer. Five trials per suit were performed, using a winch to pull the swimmer through the water at a constant velocity, and measuring the force required to pull the swimmer with a force gauge. There was a 1.33% difference between the Speedo® Brief and the Speedo® Brief with a drag suit, which indicates that the drag suit only minimally increases resistance, and thus would not contribute greatly in training. By contrast, there was an 18.8% difference between the competition suit and the Fastskin® which indicates that the Fastskin® significantly decreases the resistance of the swimmer.

THE EFFECTS OF DIFFERENT VALVE COMBINATIONS ON THE RESISTANCE OF AIR FLOW THROUGH A TRUMPET

Renna Nouwairi

Shenandoah Valley Governor's School

A change in the direction of air flow may cause air resistance in a trumpet. The following null was tested: there is no difference among the resistance of air through a trumpet when eight different valve combinations are used. Three trumpets selected from a local band were tested with a wind meter. The air speed through a trumpet was measured, and a two-factor ANOVA yielded that no significant amount of resistance was caused by the change in the direction of air through a trumpet. The researcher concluded that the null was supported. Air resistance was not caused by different valve combinations.

THE EFFECT OF LIGHT SOURCE DISTURBANCE ON A SECONDARY INTERFERENCE PATTERN

Alex Place

Yorktown High School, Arlington VA, 22207

The purpose of this experiment was to determine how light which was already interfered with reacted when it was interfered with a second time. How light handles being interfered with twice gives a deeper look into its particle-wave duality to see if its wave properties are consistent through multiple interference patterns, or if it reacts differently than a normal wave and its particle properties manifest themselves. Two stands were created, each with slits on them which were approximately 0.3 millimeters wide. A laser was directed through the first, which created an interference pattern. The second stand was placed in this interference pattern, having its slit create a secondary interference pattern from a specific position in the primary pattern. The position of the secondary slit was the independent variable, and the dependent variables were the wavelength and brightness of the secondary interference pattern. The interference pattern which the secondary slit produced without the primary slit was also measured, as a control. After the data was collected and analyzed it was determined that there was no significant difference between the wavelengths of the interference patterns which were interfered with twice. However, the wavelength of the interference pattern which was created from only one slit was statistically different than the twice interfered with interference patterns. In terms of brightness, the interference pattern which was created from the primary pattern's largest peak had the most intense light, making sense because its light had the largest intensity before it was sent through the second slit. In conclusion, the position of the secondary slit in the primary interference pattern affected the brightness of the secondary interference pattern, though not the wavelength. However, the number of times light was interfered with did affect the wavelength of its interference pattern.

THE EFFECT OF VARYING THICKNESS OF INSULATION ON THE COOLING TIME OF A WIRE

Karthik Ramesh

Godwin High School

This study was conducted in order to assess whether the thickness of High Density Polyethylene (HDPE) insulation on electrical wire would affect the amount of time it takes it to reach room temperature, after being integrated in a circuit for one hour. This experiment was conducted using three different thicknesses of HDPE insulation: 0 mm, 3 mm, and 6 mm, with the 0 mm group being used as a control group. The temperature of

the wire was taken, then using a 9-volt battery, a series circuit was made. After the circuit ran for 1-hour, final temperature was noted, the circuit was disconnected, and the wire was timed until its temperature cooled to the initial. The experiment was a success with the average times for the 0 mm, 3 mm, and 6 mm groups being 33.54 min, 12.585 min, and 6.81 min respectively. The final results supported the hypothesis that wire insulated with 6 mm HDPE would yield the lowest time to cool. In addition, the null hypotheses, “the mean 0 mm group’s cooling time will not be significantly greater than the 3 mm or 6 mm groups” and “the 3 mm group’s cooling time will not be greater than that of the 6 mm group” were rejected, after 3 two sample t-tests with 38 degrees of freedom and an alpha level of .01 were conducted comparing the three groups. The 0 mm mean time was significantly the largest followed by the 3mm and 6 mm groups respectively.

THE EFFECT OF PITCHER’S ARM LENGTH, STRIDE LENGTH, AND HEIGHT ON PITCH VELOCITY

Matthew Rowe

Shenandoah Valley Governor’s School

Baseball pitchers are always looking for ways to increase their velocity on their fastball. The purpose of this study was to determine if there is a prime combination of factors that will affect the velocity of a fastball. Arm length, stride, and height were the factors being studied. Six pitchers were selected from a local high school. The velocities of their fastballs were measured using a Bushnell Radar Gun. Correlations were then found that showed arm length (R-value=0.4461) and height (R-value=0.4321) had weak relationships with the maximum velocities of each pitcher. However, stride length (R-value=0.7063) and stride to height ratio (R-value=0.6928) showed strong correlations with the maximum velocities of each pitcher. A higher R-value represents a stronger relationship between the two variables. After analyzing each correlation, it was clear that a longer stride length should lead to a faster velocity. Also, a stride to height ratio closer to eighty percent should lead to a faster velocity.

ULTRAVIOLET BLOCKING FILM AND THE ENERGY ABSORPTION OF SOLAR CELLS

Matthew Stephens

Menchville High School, Newport News, Virginia 23602

The purpose of this experiment was to determine the effect of ultraviolet blocking film on the energy absorbed by solar cells. Ultraviolet light is the part of the electro- magnetic spectrum that has shorter, more rapid wavelengths than that of visible light. Ultraviolet light accounts for about 8.3 % of the solar produced electromagnetic spectrum reaching the earth. The solar cell panel was taken outside and placed on an 87.6 centimeters tall box and placed in the sun's rays. Then, voltage produced by the solar cell was measured and recorded for each of five trials. Each trial performed three measurements of the cell's voltage. The first with ultraviolet blocking film applied to a clear glass pane which completely covered the cell, the second with a clear glass pane completely covering the cell and finally with no glass covering the solar cell. The average voltage for the trials with the ultraviolet film covered glass pane was 16.876, the average voltage for the trials with the clear glass was 19.588, and the average voltage for the trials with no glass was 19.856. The conclusion was that the trials with no glass created the most energy and the trials with the ultraviolet blocking film created the least amount of energy; approximately 15% less than the trials with no glass. The hypothesis was supported in that there was a greater than 8.3% reduction in the energy produced by the solar cell with the ultraviolet blocking film glass covering it.

HOW DOES ADDING SOLUTES TO WATER AFFECT HEAT CAPACITY?

Zach Vernon

The New Community School, Richmond, VA 23227

The purpose of the experiment was to see if the heat capacity of water increases when mixed with a solute to make a solution. The results were interesting. The rates of change ranged from .4 to .5 degrees of temperature change per second over all the solutes. Water, the control, had a rate of change .5 degrees of temperature change per second and had a standard deviation of 0 .09189. Potassium chloride had a rate of change .5 degrees of temperature change per second and had a standard deviation of 0.1032. Calcium chloride had a rate of change of .4 degrees of temperature change per second and a standard deviation of 0.0875. Lastly, sodium chloride had a rate of change of .5 degrees of temperature change per second and had standard deviation of 0.0948. So all but one treatment had a slight difference in rate of change. All the treatments overlap a great deal with each other. This indicates that there was little change in the heat capacity over all. The experiment neither rejects nor accepts the hypothesis that adding a solute would increase the heat capacity of water because there was more matter to store the heat. The experiment had one major error in it, controlling the amount of heat applied to the beaker. The data collected showed that calcium chloride has the slowest rate of change and therefore the highest heat capacity. Those results could be flawed if the beaker had less heat applied.

THE EFFECT OF DIFFERENCE IN TEMPERATURE ON WIND SPEED

Thuy Vuong

Yorktown High School

The objective of this experiment was to examine whether there was a relationship between the difference in temperature between two partitions and the wind created by the difference in temperature. Two Styrofoam boxes with similar volumes were connected together with a wind meter positioned between them. One partition was heated on the inside with a heating object; in this experiment it was a lightbulb. The lightbulb was controlled by a dimmer in order to limit the amount of heat created. The temperature was recorded for both partitions as well as the wind speed. This recording was repeated every 5 minutes for 3 hours. This procedure was repeated for the two independent variables, when the lightbulb was at half power and then the lightbulb was at full power. The data collected was similar where it was an almost non-existent wind but slight movement for the wind meter. At a point, the wind meter would start spinning at a constant rate and continue in that rate for a long period of time, rarely fluctuating. When the lightbulb was at 50% power, the wind speed was at 0.4 meters per second. When the lightbulb was at 100% power, the wind speed was at 0.5 meters per second.

The results were analyzed with a one-way ANOVA test. The results had a statistical difference of -0.0816 , therefore accepting the null hypothesis. The data was not statistically significant enough to be labeled as significant.

In conclusion, the experiment's data supports the idea that the temperature difference between two partitions is positively correlated, however there's not enough significance in the data to prove so.

THE EFFECTS OF STIRRUP LENGTH ON THE NATURAL POSITION OF CENTER OF GRAVITY OF HORSEBACK RIDERS ON AN ENGLISH SADDLE

Allison White

Shenandoah Valley Governor's School

Horseback riding is a sport that is enjoyed by thousands of people around the world. In horseback riding, there are several different styles of riding where balance is a key element to success in position, appearance, and stability. The center of mass of the horse and the center of mass of the rider need to be aligned in such a way as to allow the horse free movement. The length of the stirrups guides the balance of the rider. In this experiment, subjects were asked to sit on a horse and allow me to take a picture of their position. After the picture was taken, the stirrup length was adjusted and another picture was taken. Each subject went through three stirrup lengths with three corresponding pictures. The pictures were then uploaded to a C.A.D. program in order to find body

segment coordinates. These coordinates became a part of an equation that provided the researcher with a coordinate system to locate the center of mass. The distance between each student's center of mass from a fixed reference point was calculated and recorded. An ANOVA statistical test was run and the null hypothesis that there is no difference among the effects of stirrup length on the natural position of center of gravity for beginner horseback riders on an English saddle was supported because no statistical difference was found. The researcher concluded that in order to determine the true cause of imbalance, other experiments on various saddle types must be conducted.

WHAT IS THE EFFECT OF A ROWING BLADE'S CHARACTERISTICS ON ITS EFFECTIVENESS AS A FULCRUM AS A BOAT MOVES IN WATER?

Matthew Zetkulic

Washington Lee High School

The purpose of this experiment was to test the effect of a rowing blade's characteristics on its effectiveness as a fulcrum as a boat moves through the water. An oar being rowed in a rowing shell is a second-class lever, where the blade is the fulcrum, the boat is the load, and the force exerted on the handle is the force. The less a blade moves in the water during a stroke, the less force that will be wasted moving the boat in the wrong direction. Five different blades were tested, including the Macon Blade, the Big Blade, the Smoothie, the Smoothie Vortex, and Fat Blade, all produced by Concept2. Each was rowed off the side of a dock. When rowed, the handles were attached to an ergometer in order to measure the watts produced by the movement of the oar through the water. The less watts produced by a blade, the more resistance on the blade, and therefore the more effective as a fulcrum. Watts were recorded. The hypothesis stated that if the five blades were rowed, the Fat2 blade would yield the least watts. Indeed, the Fat2 Blade provided the most resistance, yielding 3.6 watts on average. The Smoothie2 Vortex generated 3.77 watts, the Smoothie2 generated 3.8, the Big Blade generated 4.8, and the Macon generated 6.6.

PLANT AND CELLULAR SCIENCES

First Place:

THE EFFECT OF DIFFERENT PERCENTAGES OF ETHANOL ON THE SURVIVAL OF LIVER CELLS

John Min

George H. Moody Middle School, Richmond, VA, 23233

Ethanol is transparent and has no color with an agreeable odor and is part of the alcohol beverages one drinks today, and damages the liver as well. Thus began the study of the problem of liver inflammation. The inflammation is produced by ethanol toxin, and when consumed, the body disposes immediately, because it kills liver cells, and damaged the surviving liver cells. The purpose of this investigation was to determine the damaging effect of the different percentages of ethanol on the survival liver cells at the 0%, 1%, 5%, and 10% of ethanol. Based on previous investigations, it is believed that if ten percent of ethanol is used to supplement the cells, then the liver cells receiving the ten percent of ethanol will have the least amount of remaining liver cells of all the levels of IV.

Hepatocytes were cultured back to life and counted, then were supplemented with ethanol based on the percentages in the ten six-wells plates that were obtained and was checked for remaining cells and IL-8 mRNA expression levels. The result indicated that the liver cells that were supplemented with the most ethanol had a mean of 2,300 cells surviving and the liver cells that were not diagnosed with any ethanol had a mean of 310,950 cells surviving. The data supported the hypothesis that if hepatocytes were supplemented with 0ul, 20ul, 100ul, and 200ul, then the hepatocytes with the most amount of ethanol supplemented will have the least amount of remaining liver cells. Based on the remaining liver cells, there appears to be a direct correlation between the liver cells death rate and the RNA quantity by the cell viability. Before it can be concluded that the highest ethanol percentage was the cause of the high IL-8 mRNA expression levels and a high hepatocyte death rate, an investigation will need to be made to determine the IL-8 mRNA expression and hepatocyte death rate for an actual human subject.

Second Place:

THE EFFECT OF FERTILIZER APPLICATION LEVEL ON ALGAE YIELD FOR BIOFUEL PRODUCTION

Kayla Peterson

George H Moody Middle School

Abstract not submitted

Third Place:

THE EFFECT OF ULTRAVIOLENT LIGHT RADIATION ON THE SURVIVAL RATE OF *P. SYRINGAE* AS COMPARED TO *E. COLI*

Fizzah Shaikh

George H Moody Middle School

Ozone depletion has resulted in dramatic changes in climate, because chlorofluorocarbons, or CFCs, are inhibiting the ozone's efficiency to block UV light. These molecules eventually reach the polar regions where they are broken down into chlorine atoms by ultraviolet light. Due to the freezing temperatures, these atoms bond with ozone molecules and form ice crystals, thereby removing ozone from the atmosphere. Though the most widespread and prominent natural ice nucleator, *Pseudomonas syringae*'s role in atmospheric processes such as cloud formation has often been overlooked, this biological ice nuclei works by serving as a nucleation point for water, catalyzing a phase change faster than water without a nucleation site. The protein becomes a "magnet" for the ice crystals to form, and as the surface area of the compounded ice crystals grows larger, more ice is formed on it. The purpose of this experiment was to determine if *P. syringae*, a major factor in nucleation, is affected by increased levels of UV light. *P. syringae* and *E. coli* were cultivated, exposed to ultraviolet light for four hours, and then diluted by 1×10^6 . The colonies were grown overnight and then counted by hand. With both bacteria, there was a vast difference between the control and the plate with three filters, as much as 85 colonies versus 3. This shows that even the slightest degradation of the ozone layer influences survival rates drastically. The results indicated that both bacteria grow the most with no exposure to UV light, which did not support the research hypothesis that the culture receiving the lowest amount of UV light would have the highest survival rate.

Based on the survival rates determined in this experiment, it can be concluded that UV-B light let in through the hole in the ozone layer is adversely affecting *P. syringae*, thereby contributing to decreased precipitation.

Honorable Mention:

THE EFFECT OF DIFFERENT CLASSES OF ANTIBIOTICS ON THE SUSCEPTIBILITY OF PATHOGENIC BACTERIA FOUND IN DIFFERENT LOCATIONS

Reshini Premaratne

George H. Moody Middle School

Several classes of antibiotics have been developed over the years capable of treating a plethora of bacterial infections. It has also opened the door to antibiotic resistance. The purpose of this project was to help educate the public of the presence of pathogenic bacteria in common areas and which antibiotics can successfully treat the infections they cause. Over-prescription of antibiotics coupled with poor patient compliance has resulted in a bacterial resistance.

The experimenter hypothesized that the antibiotic Gentamicin would be most effective at destroying the bacteria because it is a relatively newer drug compared to the other antibiotics. The fact that it is newer means the bacteria have had less time to adjust and resist it. The designated amount of agar powder and deionized water was mixed thoroughly and autoclaved. The autoclaved solution was allowed to cool and then treated with the various antibiotics as per protocol. The solutions were then poured into the plates and allowed to solidify. The petri dishes remained sealed until areas to be tested were swabbed and plated. The plates were incubated overnight at 37 degrees Celsius and counted for bacterial colonies.

Results obtained from this experiment confirmed the hypothesis. For the purposes of reporting, the bacterial count was categorized not based on absolute numbers but on range. It became evident that the antibiotics Gentamicin and Ampicillin were most effective in killing the bacteria. The least effective antibiotic was, in fact, Kanamycin. These results suggest that certain antibiotics are far more effective than others in the treatment of different strains of bacteria.

THE EFFECT OF AMBIENT TEMPERATURE ON THE GROWTH OF AIRBORNE BACTERIA

Andrew Bui

George H. Moody Middle School

American scientists found in 2003 that the air harbors thousands of strains of bacteria, including some potentially harmful species. The diversity of airborne species was found to be equal to that of species in soil.

The purpose of this study was to determine if ambient temperature affected airborne bacterial growth. It is thought that if ambient temperature was to rise, then the bacterial growth would increase. In this study, agar Petri dishes were exposed outdoors to 4 different ambient temperature ranges: 30's °F, 40's °F, 50's °F, and 60's °F. For each temperature range, ten Petri dishes were exposed for 4 hours then incubated at 37 °C for 72 hours. The colony count was done for each batch of 10 Petri dishes. Colony counts at different temperature ranges were compared using Students t-test.

The mean colony counts for 4 ambient temperature ranges (30's °F, 40's °F, 50's °F, and 60's °F) were 3.50, 20.70, 10.30, and 38.10, respectively. Colony counts were significantly higher at high ambient temperature ranges 40's °F, 50's °F, 60's °F comparing to lowest ambient temperature range 30's °F ($p < 0.001$). Within the high ambient temperature ranges, colony count was highest at 60's °F and was significantly higher than colony counts at 40's °F and 50's °F ($p < 0.001$). However, colony count at 50's °F was significantly lower than colony count at 40's °F ($p < 0.001$).

Bacterial growth was significantly higher at high ambient temperature ranges 40's °F, 50's °F, and 60's °F comparing to the lowest ambient temperature range 30's °F. There seems to be a correlation between high ambient temperature and increased airborne bacterial growth. However, more studies with stricter control on other environmental factors must be performed.

THE EFFECT OF DIFFERENT WATER SOLUTIONS ON PLANTS' GROWTH

Kimberly Castro-Barrios

Kenmore Middle School Arlington, Virginia 22204

Plants need water and minerals to grow. The roots of the plant take in the water and minerals from the soil. The purpose of the experiment was to discover plants' growth with different water solutions. The hypothesis was if salt water and sugar water and fresh water were given to the plants then they will grow equally but the one with salt water will have a shorter life span. Thirty ml of water were put on plants for 4 days. Five measurements were recorded. Plants with salt water did not grow but did survive but plants with sugar water did not grow and did not survive. The hypothesis was rejected because the plant with sugar water had a shorter life span.

THE AFFECTS OF OIL SPILLS ON AQUATIC PLANTS

Ethan Downing

Manchester Middle School, 7401 Hull Street Road, North Chesterfield, VA 23235

The reason for this research is to show real-life application of how oil spills can ruin the environment. The studies of four different oils, ranging from very light oil to heavy oil, were used to replicate what would happen to aquatic life in real-life oil spills. Each level of oil was placed in a container with a hydrilla aquatic plant to measure how much oxygen was produced by photosynthesis. The measurement of oxygen was charted every eight hours. The results of these findings proved the hypothesis correct that if heavy oil is spilled into water, then the hydrilla plant will produce the least amount of oxygen. With these findings, it was a noticeable decrease in the amount of oxygen produced from the very light oil to the heavy oil. A control of water only was measured,

and the measurement of oxygen was approximately double than the very light oil. When the very light oils' oxygen was measured, that was approximately double than the heavy oil. During oil spills, especially ones that contain heavy oils, the damage to aquatic life is severe and fast acting. Oil spills need to be treated as environmental emergencies and must be cleaned up thoroughly. This study showed that photosynthesis is affected immediately and possibly irreversible. The only way to truly deal with oil spills is prevention.

THE EFFECT OF FERTILIZERS ON THE GROWTH OF PEA PLANTS (*PISUM SATIVUM*)

Lillian DuVal

Tuckahoe Middle School Richmond, Virginia 23229

The purpose of conducting this experiment was to provide evidence that the use of manmade fertilizer, which has caused, and continues to cause, serious damage to our rivers, streams, and bays, especially the Chesapeake Bay, is not necessary for plant growth. An example of the damage that has been caused to the Chesapeake Bay and its tributaries by manmade fertilizers, which has been well documented over the years in many publications, is the runoff of the nitrogen and phosphorous rich manmade fertilizers which have created large algal blooms that cause dead zones in the Bay. To test the hypothesis that manmade fertilizers are not necessary for the growth of plants, three trials were run using Little Marvel pea seeds (*Pisum sativum*). In each trial the Little Marvel pea seeds (*Pisum sativum*) were planted in five different nutrient mediums: compost, manure, potting soil only, peat moss, and manmade fertilizer added to potting soil. For each nutrient medium, there was exactly 150 mL of the particular medium placed in identical size cups with each cup placed in a separate plastic ramekin to prevent the cross contamination of the individual nutrient mediums. In each cup, one Little Marvel pea seed (*Pisum sativum*) was planted exactly one inch beneath the surface of the nutrient medium. Each cup was watered the exact same amount on a daily basis; and once the seeds sprouted, exact measurements were taken in centimeters on a daily basis. In all three trials, the results of the experiment indicated that the Little Marvel pea seed (*Pisum sativum*) planted in the manmade fertilizer medium did not outgrow all of the seeds planted in other nutrient mediums. The resulting data provides evidence that the use of manmade fertilizers, which contain nitrogen and phosphorus that runs off from farms, lawns, and golf courses into our water sources is not necessary.

WHAT IS THE EFFECT OF DIFFERENT FOOD STORAGE TYPES ON FOOD SPOILAGE?

Bryn Edwards

Jefferson Middle School, Arlington, VA 22204

Companies are always bragging about how their container can hold the most food, keep out the most bacteria, has the best seal and/or helps food last the longest, but which container type really keeps out the most mold and bacteria? The goal of the experiment was to find the effect of different food storage types on food spoilage. This project looked at which food storage container; Ziploc bag, Glad ClingWrap, Reynolds Wrap aluminum foil and Rubbermaid plastic food storage containers; can keep food the freshest by keeping out bacteria and mold. These brands were put to the test by putting two small 1 cm. by 1 cm. pieces of bread in each container for eight days. After the eight days the bread was swabbed, and the swab was used to inoculate a petri dish with agar. The two pieces of bread were then placed inside a separate petri dish. The hypothesis was that the Rubbermaid container would keep out the most contaminants because of the container design. The experimental results rejected the hypothesis. The bread stored in Ziploc grew the least colonies and grew an average of 1.9 colonies per petri dish. The Rubbermaid grew 2.3 colonies; aluminum foil grew 2.4 colonies and ClingWrap grew 3 colonies on average. The experiment showed that containers with a seal, such as Rubbermaid container and Ziploc bag, seemed to prevent more growth, while containers without a seal, such as aluminum foil and ClingWrap, were unable to prevent as much growth.

THE EFFECT OF DILUTION OF DISINFECTANTS ON BACTERIAL SURVIVAL

Allison Herrity

Jefferson Middle School, Arlington, VA 22204

This project put Listerine mouthwash to the test. The hypothesis drawn was, if different dilutions of disinfectants are tested on bacterial survival, then the 100% dilution series would kill the most bacteria. This experiment was performed two ways, once by plating the bacteria, and then adding the disinfectant, and once by adding the disinfectant, then plating the bacteria. The results of the experiment were 100% survival rate for every single trial performed. The results rejected the hypothesis. The project may have worked better if bacteria from the mouth had been used, because Listerine is manufactured to kill that kind of bacteria. Another way to improve the experiment could be to use a disinfectant designed to kill a wider range of bacteria.

THE EFFECT OF THE POSITION OF A MAGNET ON THE GROWTH RATE OF PLANTS

Omar Karim

George H. Moody Middle School, Henrico, Virginia, 23228

In 1963, scientists G. Baule and R. McFee reported the first successful measurements of a magnetic field surrounding the human heart. In 1969, scientists at the Ford's Research Center created a SQUID (superconducting, quantum, interference, device) which is used to accurately find and measure the magnetic field surrounding any living organism from insects to plants. Knowing this, scientists are now trying to find new, positive potential by using magnetism, called biomagnetism. The purpose of this experiment was to determine if a bar magnet had an effect on the growth rate of wax beans by placing the bar magnet in different positions, which were the North Pole (Group A) facing the plant, the South Pole (Group B) facing the plant, the magnet lying flat (Group C), and a control group (Group D) with 10 simultaneous trials to ensure accurate results. The experimenter's hypothesis was that if South Pole faces towards the plant, then the plants will grow the tallest because the South Pole of the magnet will repel from the South Pole of plant. For every group, 10 pots were placed with two seeds, each 15 cm apart and a magnet placed beneath them. Every day, each plant was individually measured, and then all the sums of each group were divided 20 to attain the average of each group per day. By the end of the project, the control group (Group D) maintained the highest average of 30.17 cm, meaning the hypothesis was not supported because the group with the South Pole (Group B) facing up had an average of only 25.11 cm. However, Group B did maintain the highest average compared with the other groups that received a level of the independent variable. Based on the data collected, the position of a magnet does not have a positive influence on the growth rate of plants. Before anything can be concluded, additional tests will have to be run in part that the magnets may have been too small to interfere with the very weak magnetic field of the plants.

THE EFFECT OF AUDITORY STIMULUS ON PLANT GROWTH

Jake Karton

Kenmore Middle School Arlington, Virginia 22204

Plants are affected by different auditory stimulates. Various types of auditory stimulus also have multiple effects on the growth rate of plants. The purpose of this experiment was to discover which type of auditory stimulus speeds up plants' growth rates the most. The hypothesis was that plants in the environment with classical music would

grow at a greater rate than plants in an environment with hard rock, or the plants in the control group with no music. Plants were placed in three different areas where classical music was played, hard rock was played, and no music was played. Plants put in the environment with hard rock averaged the greatest growth rate with approximately 3.8 cm, next the control with around 3.2 cm, and finally the plants placed by classical music averaged the least growth rate with close to 2.8 cm. The hypothesis that classical music would increase the growth rate of plants the most was rejected.

THE EFFECT OF SUGAR ADDED TO CULTURED MILK ON THE pH AND DENSITY OF THE RESULTING YOGURT

Johanna Klein

Jefferson Middle School, Arlington, VA 22204

Yogurt is made when special bacteria eat lactose, and lactic acid forms. This experiment was designed to find if adding sugar could thicken homemade yogurt by increasing the number of bacteria that grow in the milk and the amount of lactic acid they produce. The experiment tested the effect of the amount of sucrose added to cultured milk on the pH and density of yogurt created from that milk. Sugar was stirred into twelve sterilized jars of milk cultured with commercial yogurt in amounts of 0 grams (control group), 5 grams, 10 grams, and 15 grams. The cultured milk was incubated for one day, placed in a refrigerator for two days, and then measured. Because there was no known way to measure thickness of yogurt, the yogurt's volume, and mass were measured; the volume of the separated whey was measured, and the density of the yogurt was calculated. The pH of the yogurt and whey was also tested as a way to find if more lactic acid was produced. It was found that as the amount of sugar added increased, the volume of whey decreased. It was also found that as the amount of sugar added increased, the mass of the yogurt increased. The mean volume of the yogurt was between 50.1 cm^3 and 50.4 cm^3 for all of the levels except for the yogurt with no sugar added, which was 54.9 cm^3 . The mean density of the yogurt ranged between 2.4 and 2.6 g/cm^3 . The pH stayed at 5 for all trials. The hypothesis that pH decreases and density increases as the amount of sugar added increases was rejected. This experiment showed that adding sucrose does not thicken yogurt or decrease the pH of yogurt.

THE EFFECT OF VARIOUS COMMON HOUSEHOLD HERBS/SPICES ON THE INHIBITORY ACTIVITY OF THE BACTERIA *ESCHERICHIA COLI*

Ishani Pendse

George H. Moody Middle School

The purpose of this experiment was to determine the effect of the different types of herbs and spices on the zone of inhibition of the bacteria *E. coli*. Garlic, cinnamon, and oregano have all been proven to inhibit the bacteria *E. coli* in previous experiments due to their antimicrobial properties. The bacteria *Escherichia coli* are a large and diverse group of bacteria. There are hundreds of strains of *E. coli*. While some are harmless, others can cause diarrhea, urinary tract infections, or other illnesses (CDC, 2011)

The experiment was done in a laboratory at VCU. Colonies of *E. coli* bacteria were placed in plates filled with LB agar. Samples of the extracts of garlic, cinnamon, oregano, and 50% ethanol (control) were placed on pieces of Whatman filter paper on the plates and the zone of inhibition was recorded using a metric ruler the next day. The results indicated that the plates with samples of garlic had the largest zones of inhibition with a mean of 19.5875mm while all of the others did not have a zone of inhibition. The data supported the hypothesis that if various common household herbs and spices are used on the bacteria *E. coli*, then the group receiving garlic will have the largest diameter of the zone of inhibition.

Only the samples of garlic had zones of inhibitions. This may have happened because there are hundreds of strains of *E. coli* that react to different herbs and spices in different ways, but only one type of strain was used by the researcher (CDC, 2011). Another reason could have been that the samples of extract used combined with the 50% ethanol may not have been strong enough to create zones of inhibitions. Based on the measures of the zones of inhibition, garlic seems to be the most effective in killing *E. coli*. All of the independent variables were diluted with the 50% ethanol, but the garlic extract still managed to have a zone of inhibition.

The Effect of Container Material on the Effectiveness of the Solar Disinfection Method**Anirudh Prabu**

George H. Moody Middle School

The Solar Disinfection (SODIS) method was developed to provide clean and safe drinking water to those who do not have it. It is designed so that even the poorest can afford to have clean drinking water. Scientists propose that by exposing bottles of water to sunlight, the water can be disinfected. The water is disinfected or irradiated because

the ultra-violet rays in sunlight kill the dangerous pathogens, bacteria, and viruses in the water. This happens since the ultra-violet rays react to the dissolved oxygen which produces a highly reactive form of oxygen that kills the bacteria and pathogens by causing fatal DNA damage. The infrared portion of sunlight can affect the SODIS method as well. The infrared light causes the water to heat up and can speed the disinfection process up by three times if the water temperature rises above fifty degrees Celsius.

The purpose of this project was to determine how container material affected the effectiveness of the SODIS method using the variables polyethylene terephthalate (PET), glass, and untreated water. Water samples were collected at Echo Lake in Richmond Virginia. The water was then poured to the brim for all the bottles and placed under a UVA Daylight Blue Reptile Bulb. Each was tested for its bacteria content by counting the number of bacteria colonies on a tryptic soy agar plate. The results indicated that PET had an average of 6.6 colonies per plate, glass had an average of 15.4 colonies per plate, and the untreated water had an average of 31.2 colonies per plate. The data supported the research hypothesis since the mean amount of bacteria colonies from the water placed in PET bottles (6.6 colonies) are significantly lower than the glass and untreated water.

Based on the amount of bacteria colonies found from each bottle of water the SODIS method clearly worked using the UVA light bulb. Hopefully, the results of this project will help the SODIS method become better and more effective in providing clean water to everyone.

THE EFFECT OF CONTAINER MATERIAL ON THE EFFECTIVENESS OF THE SOLAR DISINFECTION METHOD

Anirudh Prabu

George H. Moody Middle School

The Solar Disinfection (SODIS) method was developed to provide clean and safe drinking water to those who do not have it. It is designed so that even the poorest can afford to have clean drinking water. Scientists propose that by exposing bottles of water to sunlight, the water can be disinfected. The water is disinfected or irradiated because the ultra-violet rays in sunlight kill the dangerous pathogens, bacteria, and viruses in the water. This happens since the ultra-violet rays react to the dissolved oxygen which produces a highly reactive form of oxygen that kills the bacteria and pathogens by causing fatal DNA damage. The infrared portion of sunlight can affect the SODIS method as well. The infrared light causes the water to heat up and can speed the disinfection process up by three times if the water temperature rises above fifty degrees Celsius.

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Based on the amount of bacteria colonies found from each bottle of water the SODIS method clearly worked using the UVA light bulb. Hopefully, the results of this project will help the SODIS method become better and more effective in providing clean water to everyone.

THE EFFECT OF CONCENTRATION OF HYDROGEN PEROXIDE ON HEIGHT OF *SOLANUM LYCOPERSICUM*

Vishnu Pulavarthi

George H. Moody Middle School

The purpose of this project was to see if the chemical hydrogen peroxide, H_2O_2 , would affect the growth of plants. The chemical would react with the soil and alter the growth pattern of the *Solanum Lycopersicum* showing that the reaction would either help the plants grow or to damage the plants and prevent them from growing tall. Genetic Evidence shows that tomato plants originated in South America. For this project there many materials needed and resources to record and prove the legitimacy of the scientist's project. The independent variable was the concentration of hydrogen peroxide, and the dependent variable was the height of the tomato plant. The result of the project was that the fourth group was actually the shortest while the first group was the tallest. The pattern followed as the first group was the tallest, the second was the second tallest, the third was the third tallest, and the fourth was the shortest. This proved my hypothesis incorrect as the researcher initially predicted that Group 4 would be the tallest. The trend was that the more hydrogen peroxide that the plant received the shorter it was. In the experiment the fourth group also went down in the growth chart and then came back up in height. As shown in the graph and the data table, on day 6 the plants average height was 4cm. On the next day, day 7 the plants average height was 3.84cm. On the last day the average height of the plants was again 4cm. On day 7 there was a dip in the plant's height, and the plants grew back the next day.

In group 1 the plants had the tallest height overall, but the plants were not extremely tall. The plants together as a group beat all the other groups though. Group 4 had the tallest plants but since so many died the group ended up being the shortest overall group. This project used science in many ways. It showed that chemical reactions do take place, and they have provable results in nature and can influence ecosystems and other things. These results are amplified in real life and nature, but the principle remains the same.

EFFECT OF DIFFERENT AMOUNTS OF GENERIC FERTILIZER ON POTATOES

Benjamin Redfern

George H Moody Middle School

Cultivated centuries ago by the Inca civilization of the Andes Mountains, potatoes now form a part of the daily diet (Van Wyk, 2006). Belonging to the Solanaceae family, potatoes and their cousins mainly grow in tropical and subtropical areas of southern America (Heywood, 2007). A fertilizer can affect many aspects of plants. If it is a flowering plant, for example, then some fertilizers maybe designed to increase the number of blossoms on the plant.

The purpose of this project was to see how different amounts of generic brand fertilizer affect the physical properties of potato plants. There were three IV groups and one control group. The five plants in Group A were given a total 40.22 g of generic fertilizer. Approximately 78.07 g of fertilizer was added to each of the potato plants in Group B. The plants in Group C received 158.51 g of the generic fertilizer. The control, Group D, didn't receive any fertilizer. Over a period of one month, all of the plants were recorded for their stem height, stem diameter, and the shade of the plant's leaves.

After the recording period had ended, it became apparent that the most vigorous plant group was indeed Group D. Their plants grew the highest, had the thickest stems, and had the richest leaf shade. The next most vigorous group was Group B. The following was Group A and the least healthy plant group was plant group was Group C. The data did not completely support the research hypothesis that if different amounts of generic fertilizer were added to three groups, then the group which had received 78.07 g fertilizer would grow the highest, have the thickest stems, and have the richest leaf shade as the control group had in fact achieved all of the above criteria. Based on the results, it is concluded that potato plants are best left to their own devices when growing is concerned. But when the other properties of the plants are concerned, it would be best to try different brands of fertilizers before determining the final conclusion.

THE EFFECT OF ELECTROMAGNETIC FIELDS ON CYANOBACTERIA ALGAE CELLS

Akshita Sharma

George H Moody Middle School

The problem in my experiment is how electromagnetic fields would impact algae cells? My experiment tests different amounts of electromagnetic fields on the *Cyanobacteria* algae. My experiment tested the different the different temperatures of the cells before and after the experiment and also the cell structure. The purpose of my experiment was to show the good and bad things that electromagnets can do. Exposition to too much electromagnetic activity can be very harmful to whatever is exposed to it. For instance, microwaves release a lot of electromagnetic fields, so standing next to a microwave for a long period of time is not advisable. In this experiment I wrapped different number of coils of electrical wires on test tubes to see how it would impact the algae. The independent variable in this experiment was the number of coils wrapped around the test tubes, which produces electromagnetic fields. The dependent variables were the temperature of the cells and the appearance of the cells after the experiment. The constant was the test tube that was not exposed to the electromagnetic fields, which was test tube 7. My hypothesis stated that if electromagnetic fields were increased on the test tube that contained algae, then the temperature of the algae would increase. In my research I found that if I were to increase the number of coils I would also be increasing the number of bacteria on each cell. In my conclusion my hypothesis was proven correct. By increasing the number of coils wrapped around each test tube the temperature of the algae increased! Also, when observing the cells under a microscope I also observed that the bacteria that grew on the cells also increased.

THE EFFECT OF HERBS/SPICES ON THEIR USAGE AS PRESERVATIVES

Goutham Thiagarajan

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Spices and herbs are a constituent part of many different civilizations in the world. Their importance has been recognized from ancient time to the present as they have culinary, medicinal, and cosmetic values. An important property some species of spices and

herbs have is the ability to preserve samples of food from bacterial growth. The information from this study as to which spices could counteract the effects of bacteria is very beneficial to humans as some species of bacteria can cause deadly diseases, which can prove extremely harmful to human life. The main purpose of this project was to determine how various herbs and spices would affect their usage as a natural food preservative against bacteria; cinnamon, cumin, and black pepper were used in the experiment. The spices were prepared by being ground into a fine powder and then mixed with distilled water and rice to create a paste-like substance. Then, a hot solution of nutrient agar was created and poured into petri dishes for use as a medium that could sustain bacterial growth. After the agar solution had cooled down to a lower temperature, a small sample of the paste was then swabbed in a zigzag motion onto the surfaces of the agar plates using a sterile cotton swab. The lids of the dishes were closed, and the samples were then observed for a period of five days for bacterial growth. The results indicated that cinnamon was the spice that had the least colonies with a mean of 5.4 colonies that grew on those plates and that black pepper was the spice with the most colonies with a mean of 43 colonies that grew on those plates. The data supported the research hypothesis that if the spices and herbs, black pepper, cinnamon, and cumin were used, then the group that would receive cinnamon would have the highest chance of preventing bacterial growth. Based on the number of colonies that appeared in this experiment for each spice, it appeared that cinnamon was the best preservative. However, on the other hand, it appeared that black pepper was rather promoting bacterial growth rather than inhibiting it.

THE EFFECT OF COLORED LIGHT ON MUNG BEAN GROWTH

Priya Verma

George H Moody Middle School

Although it is common knowledge that direct sunlight supports the growth of plants, the relationship between various colors that make up sunlight and their impact on plant growth is less well-known. The purpose of this experiment was to establish how red, blue, and yellow colored light as well as direct sunlight affected mung bean growth. Ten seeds were grown in each kind of light to a height of at least 2.5 cm. The results indicated that the highest number of mung beans grew in direct sunlight with a mean of 5.7 seeds. For red, yellow, and blue light the mean of seeds grown were 3.4, 3.1, and 1.4 respectively. The data supported the research hypothesis that if red, yellow, blue, or direct sunlight was affecting the growth of mung beans, then the largest number of beans growing to a height of at least 2.5 cm would be in direct sunlight.

Based on the results, there appears to be a direct correlation between the color of light and mung bean growth. Before it can be concluded that direct sunlight is the best for mung bean growth, more experiments should be conducted using other color light, different types of plants, and other climates.

PSYCHOLOGY A

First Place:

THE EFFECTS OF A BREATHING ROUTINE ON THE REDUCTION OF STRESS LEVELS IN HIGH SCHOOL RUNNERS

Rachel Cote

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The purpose of this study was to determine the effects of a breathing routine on the stress levels of high school runners. The null hypothesis was that the breathing routine would have no effect on stress levels. The research hypothesis was that the breathing technique would reduce perceived stress levels. Male and female high-school-aged participants took daily heart rate, hand temperature, and blood pressures tests, and completed a perceived stress evaluation survey. These numbers were used to calculate the stress level, using the equation: $\text{systolic blood pressure} + \text{diastolic blood pressure} + \text{heart rate} + \text{perceived stress score} - \text{hand temperature} = \text{stress level}$. After monitoring high and low stress levels and subsequent performances over a week, participants performed a breathing routine prior to stress evaluation and monitoring performance. The breathing routine involved taking ten deep breaths, engaging the diaphragm, not the chest. To analyze the data, three two-sample t-tests were performed to relate the mean high stress level, the mean low stress level, and the mean stress level obtained after performing the breathing routine. The mean high stress level was 299, the mean low stress level was 246, and the mean stress level obtained after performing the breathing routine was 247. The t-test was evaluated at an alpha level of 0.05. The p-values produced for the t-test comparing the high stress levels to the low stress levels, the high stress levels to the variable stress levels, and the low stress levels to the variable stress levels were 2.0876×10^{-6} , 6.3375×10^{-5} , and 0.43752, respectively. This supported the hypothesis that the breathing routine would reduce stress levels to a relaxed state, as there is a difference between high stress levels and relieved stress levels, yet no difference between relieved stress levels and low stress levels.

Second Place:

THE EFFECT OF WORKING MEMORY TRAINING ON WORKING MEMORY IN OLDER ADULTS

Katherine Claunch

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The purpose of this study was to determine whether or not working memory training with older adults, specifically the loci method, is an effective way to improve working memory capability. Participants were given three minutes to study and memorize a list of words in order, then asked to write down as many of the words as possible in their proper space in the list. Scoring was a one-to-one ratio. Volunteers were randomly assigned to either the control or experimental group, where the control group practiced independently. The training participants were taught the loci method to assist them, and they used this method to practice. After practice was completed, participants took a post-test. An alpha value of 0.05 was used in the data analysis. Though a p-value of 0.476 was produced for the control group in the comparison of the pre and post-test, indicating no original improvement, a p-value of 0.015 for the training group suggested the training had a statistically significant impact. A two-sample t-test conducted on the pre-test values of the control and training groups yielded p-values of 0.171, supporting the null hypothesis that the pre-test scores of the two groups were not significantly different. Thus, the alternate hypothesis that training would produce a significant difference between the pre-test and the post-test scores was supported. In conclusion, the results suggest that the working memory training improves short-term memory capability in older adults.

Third Place:

THE EFFECT OF MINT EXTRACT ON THE RETAINMENT OF NEW INFORMATION**Devon Clapp**

Jefferson Forest High School, Forest, Virginia

The purpose of this research study was to determine if a peppermint scent effects the memorization of new material in college-aged students. This study was collected at a local college in January of 2012. In order to accurately measure the amount of new material learned, the experimental group was exposed to peppermint essential oils soaked into a cotton ball which was placed into a vial. A control group were also given vials with no essential oil soaked into their cotton balls. During a 75-minute lecture from a professor in Psychology on *Classical Learning*, the students were instructed to inhale their specific vial approximately once every five minutes. After the lecture, all of the students were given a ten-question multiple choice memorization test to determine if the olfactory influence posed any significance on their short-term memory retention. The results showed that the addition of a peppermint scent during the learning process does not affect the memory retention of college-aged students. Using a two-sample t-test, with the alpha value set at 0.05, the p-value was revealed to be 0.85. Therefore, the original hypothesis that peppermint extract enhances the memorization process in storing new

information to then be recalled in the presence of that same scent was not supported and the null hypothesis was retained. In conclusion, all of the data collected shows little correlation between the olfactory system and the retention of new material as first placed into short-term memory.

Honorable Mention:

HOW DECISION-MAKING AFFECTS VIEWS ON NEGATIVE CAMPAIGNING

Mark Carpenter

Shenandoah Valley Governor's School

Negative and positive campaigning has been used for hundreds of years, but many do not know exactly how it affects humans. There are differing opinions on whether negative and positive information affect humans in different ways. There are some studies that show there is no significant difference between positive and negative campaigning in how one votes. Certain studies, however, differ with this opinion, stating that negative stories have more affect than positive stories. The purpose of the study was to determine if negative campaigning had differing effects on certain types of decision makers. Volunteers from a local middle school, in the first part of the experiment, were given a version of a Myers-Briggs test to determine what type of decision maker they were. After this, the subjects began watching campaign videos and voting on ballot sheets in five "elections". A comparison was done between the number of negative campaign votes and the type of decision maker with a Chi-Square Test for Independence. The results supported the null hypothesis, which was that there was no difference between an emotional and logical decision maker and how they react to negative campaigning.

Honorable Mention:

THE EFFECT OF MUSIC ON MEMORIZATION

Rebecca Good

Shenandoah Valley Governor's School for the Arts and Technology

Many people enjoy listening to music while reading or doing school work, but they may not realize that it could be having a positive or negative effect on their learning efficiency. The purpose of the experiment was to figure out if listening to music at an average or exaggerated volume affects memorization of words and numbers, and if it is more difficult to learn while listening to a song with lyrics or an instrumental song. Student volunteers were tested by memorizing lists of words and numbers in silence and then while under different music conditions. The results were analyzed with an ANOVA test and Tukey tests. In the averages for the memorization of words there was a significant difference between silence and a lyrical song at a normal volume, between silence and a lyrical song

at an exaggerated volume, between silence and an instrumental song at an exaggerated volume, and between an instrumental song at a normal volume and a lyrical song at an exaggerated volume. Regarding the memorization of numbers, a significant difference was found between silence and all parts of the testing done in the presence of music, including average and above average volume as well as lyrical and instrumental music. It was concluded that lyrical and instrumental music affects a students' memory at a normal and high volume.

Honorable Mention:

THE EFFECT OF MUSIC TYPE ON HUMAN MEMORIZATION

Kelly Hart

Yorktown High School

The experiment tested the effect of different music types on how helpful they were in a memorization test. The four types of music were pop instrumental, jazz instrumental, Baroque instrumental, and no music. Subjects were given three minutes to memorize ten definitions of words. Music was played in the background. It was hypothesized that if subjects listened to Baroque music while taking the test, then their scores would be higher. Baroque music is from the classical time period and has been suggested to improve concentration as well as memorization. It was also supposed that the Baroque music would yield to a higher production of alpha waves, thus slowing the heart rate and calming the mind. The results showed Baroque to have an average score of eight correct out of ten, higher than any other genre. Baroque was ten percent better than the second highest scorer; no music. Both pop and jazz lead to poor scoring, having averages of 6.75 and 6.469. The music was too distracting, which resulted in poor performance. The repeated pattern and relaxed tempo of the Baroque music generated relaxation, as well as improving concentration. The calming effects of the music also lead to a higher production of alpha waves. These alpha waves helped to slow the heart rate and to connect the structured left side, and creative right side of the brain. This cohesive interaction between both hemispheres for the brain deepened concentration as well as improving memory.

VARIATIONS ON THE STROOP EFFECT

Shalma Akther & Nevyat Gebru

Washington-Lee High School, Arlington, VA 22201

The purpose of the study was to identify whether or not there was a significant difference between the Stroop Effect and rotating words tests on the amount of time taken to complete the tests. The hypothesis was when the Stroop Effect and the Stroop Effect on

rotating words were compared, then the differences in the time of the tests would be less for rotating words and counterclockwise would take less time than clockwise. The reason why the rotations were supposed to annul the Stroop Effect was because the rotations would strain the eyes and would make it harder to read the word. Counter-clockwise rotation was supposedly easier because it was the improper way of reading; since reading is done from left to right. The differences in time between the averages for Test 1 - No change in font color or word and Test 2 - Font color and word are different was 24.3 seconds, Test 3 - Clockwise rotation font color and word were the same and Test 4 - Clockwise rotation font color and word are different was 15.0 seconds, and for Test 5 - Counter-clockwise rotation font color and word are the same and Test 6 - Counter-clockwise rotation font color and word are different the difference was 11.3 seconds. The conclusion was that adding rotations made it easier to distinguish between the color and the word. All of the results were significant except for the test that showed the direction of the rotations' significance. The conclusion was that the direction of the rotation does not matter as much. The hypothesis was supported since the first Stroop tests where the participant was tempted to read the word took the longest and counterclockwise took the least time.

THE EFFECT OF COLOR ON MEMORY RETENTION

Robeel Bhatti and Christian Taylor

Deep Run High School

Many experiments have been conducted on the effect of color on memory retention. The colors red and orange have been a paradigmatic color choice for this kind of experimentation due to them being warm colors. The purpose of the experiment was to determine whether or not color has an effect on memory retention. The null hypothesis was that the students who received the ten words in red/orange would remember fewer words on average than the student who received their ten words in black text. The research hypothesis was that if the ten words were written in red/orange, then the students who received their words in red/orange would remember more words. The students were split into two equal groups in the classroom. One group was given their ten words in black text, while the other group received their ten words in red/orange text. Each group was then given two minutes to study and then their papers were collected. Each group was then given a sheet with twenty words written on them. The students were asked to distinguish which ten on the list was from the original paper. 9.8 words remembered on average by the students who received their words in black text, while the students who received the text in red/orange remembered on average 8.7 words. A t-test performed on the data showed that the data was significant enough to reject the research hypothesis ($t=2.82 > 2.074$ at $df=22$; $p < 0.05$).

Based upon the data drawn from this experiment, it was concluded that the experiment was close to other experiments with the same procedure. More research should be regulated to determine whether or not this conclusion remains true in a more complex experiment, such as words in different colors.

THE EFFECT OF LABEL SWITCHING ON PREFERENCE OF BOTTLED WATER BRANDS

Jordan Carrier and Elena Porter

J. R. Tucker High School, Henrico, VA 23294

Recently, there has been a steady rise in the amount of bottled water that is consumed worldwide. Though the standard of tap water had also increased, consumers generally believe that bottled water is more preferable and contains a higher mineral content. To choose a brand of bottled water, consumers are influenced by several factors. According to studies, label switching affects the preference of consumers. Generally, the more expensive label was chosen, despite the labels being switched, due to the perception that a more expensive brand meant higher quality, based on production location and the general idea of the product. The purpose of this project was to determine what would affect peoples' preferences of bottled water brands. Based on research, it was believed that if two water bottle brands are given to the subject and the labels are switched, then the brand identified as the most preferred when the labels were not switched will be chosen. Twenty subjects were given two samples of water; one labeled Fiji® and the other labeled Deer Park® and then asked to complete a survey asking which brand the subject preferred. Another group of twenty subjects performed the same tasks, but the labels of the samples had been switched. The results indicated that label switching had some effect on preference of bottled water brand, but there was not a significant difference, and therefore the research hypothesis was not supported, and the null hypothesis was accepted ($X^2=0.3711>0.05$ at $df=1$; $p>0.05$). Based on the data from this experiment, subjects preferred the more expensive brand over the less expensive brand. However, the data did not show a large enough significance for the research hypothesis to be accepted. Before it is concluded that label switching has an effect on preference of bottled water brand, more people could be tested to have a more significant difference between those who preferred Deer Park® and those who preferred Fiji®.

THE EFFECT OF TELEVISION VIEWING ON THE ABILITY TO CARRY OUT A CONCURRENT MENTAL TASK

Alex Chiu and Cameron Price

Deep Run High School

With the growth in the use of electronic media such as television, as well as cell phones and other mobile devices, students have increasingly been multitasking. Some observers have been concerned that this multitasking may interfere with the students' ability to concentrate and learn. The purpose of this project was to determine whether television viewing affects performance of a concurrent mental task. The hypothesis was that when the participant watches television, the participant will take a longer time to complete the concurrent mental task. Participant were timed in the completion of two puzzles (connect-the-dots and crossword puzzle) with no distractions and were timed in the performance of two other similar puzzles while viewing a television program. A t-test performed on the data for the connect-the-dots puzzle indicated a significant difference between the means of the tests in terms of completion time in seconds ($t = 1.96 < 2.101$ at $df = 18$; $p > 0.05$) and the null hypothesis was rejected; therefore, with regard to the first puzzle, the data supported the research hypothesis that television viewing affects the ability to carry out a concurrent mental task. A t-test performed on the data for the crossword puzzle did not indicate a significant difference between the means of the tests ($t = 2.97 > 2.101$ at $df = 18$; $p > 0.05$) and the null hypothesis was not rejected; therefore, with regard to the second puzzle, the data did not support the research hypothesis. Based on the completion times found in this research, television appears to have a significant effect on the ability to carry out certain concurrent mental tasks, but not others. Before the cause of this difference between different mental tasks can be determined, further experiments using other mental tasks will be needed.

THE EFFECT ON CLOTHING COLOR ON EMOTION

Mark Falamoun and Gabriel Solomon

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The problem studied was whether or not clothing color effects emotional reaction by others. This would help people to choose what colors to wear to make a certain impression on others, if clothing colors made other people have reactions to them at all. The experiment was set up in a survey with 5 pictures of a man wearing blue, red, yellow, black, and white outfits, with 5 more pictures of another man wearing a suit with ties of those colors. Underneath each picture, there was a survey for six emotional reactions (happiness, sadness, excitement, anger, calmness, and fearfulness). The hypothesis was that if the outfit is completely yellow, then people will be happier about this person because studies have shown yellow elicits positive responses and that, if the outfit is blue people will show sadder responses to this person. After 46 subjects

took the survey, the means were taken for each color and their respective emotional reactions. Yellow had the highest excitement and happiness means, and black had the highest mean sadness and fearfulness. Red was found to have the highest mean angeriness. The data was proven to be significant by an ANOVA test that showed for each emotion group each color's data was statistically significant. Some major conclusions were that the hypothesis was partially supported – yellow did induce the most happiness, but blue did not lead to the highest mean sadness. It was also found that for angeriness, four colors (black, white, blue, and yellow) all scored a 1.5 out of 5, showing that angeriness is not affected by color, or at least not the colors chosen. Research has already been done on this subject, but this project aimed to continue the research and find out the opinions of teenagers, all of whom were subjects.

THE EFFECT OF RACE ON FACEBOOK STRANGER ACCEPTANCE

Danny Foley

Godwin High School

The Purpose of this study was to find the effect of race on Facebook stranger acceptance. Recently Facebook users have been receiving friend requests from random accounts that are either complete strangers or fake accounts of hackers who use the fake accounts to gain access to the user's computer. For this study, three profiles were created of different races on Facebook, one White profile, one Black profile, and one Asian profile. Each profile was a teenage male approximately seventeen to eighteen years old. All three profiles sent out sixty friend requests to the same sixty people of equally proportionate races to insure constant results and a chi-Square test provides evidence that showed that the data was insignificant at all three races. Expansions to the experiment could have been made for more data points and also to be given a bigger time period for the people to respond to the three friend requests.

THE EFFECT OF VIEWING AN UNCOMMON ACT OF GOODNESS ON EMPATHETIC AND ALTRUISTIC BEHAVIOR

Emma Green

Central Virginia Governor's School for Science and Technology

The purpose of this experiment was to test the effects of viewing a video of an uncommon act of goodness on empathetic and altruistic behavior as defined by results

of a questionnaire and an altruistic activity. The independent variable was the video shown to the participants. The conditions of the variable was a video depicting an uncommon act of goodness and a video categorized as simply “positive” by a previous study. The dependent variable was the participant’s empathetic and altruistic response to the video. The control was a group of participants who did not watch a video. The participants from a local high school were randomly assigned to either watch one of the two videos or to the control group. All the participants then completed a questionnaire measuring empathetic behavior and were asked if they would like to participate in a future experiment to test altruistic behavior. Each questionnaire was then averaged and an Analysis of Variance was performed on the data. The group who viewed the video depicting an uncommon act of goodness had an average questionnaire score of 4.18, the positive video had an average of 3.87, and the group without a video had an average of 3.55. While these differences mirrored the hypothesis, the ANOVA p-value of 0.062 compared to the alpha value of 0.05 indicates the differences between the groups were insignificant.

The altruistic response showed no difference among groups, or even among participants: all participants were willing to participate in a similar study again.

THE EFFECT OF ENGLISH AS A SECOND LANGUAGE ON STUDENT’S SAT SCORE

Li Huang

Deep Run High School

After the introduction of the SAT reasoning test in 2005, the gap between ESL and non-ESL students are widening and has become an important topic to discuss by the public. ESL refers to English as Second Language, means English is not the major language by certain students. The purpose of this project was to determine how the effect of English as second language would affect student’s SAT score. Ten ESL students and ten non-ESL students’ SAT score were collected, and the scores were put into groups of two, one group contains ESL students’ SAT score, and another group contains non-ESL students’ SAT score. Two groups with different SAT score were being tested to determine the differences between the groups, whether the ESL student’s SAT score was higher than the non-ESL student’s SAT score or not. The results indicated that the ESL students’ SAT score had mean of 1607, and non-ESL students’ SAT score had a mean of 1988; ESL students’ SAT score were lower than non-ESL students’ SAT score by the mean of 381 points. A t-test performed on the data indicated a significant difference between the means of the groups ($t = 3.419 > 2.101$ at $df = 18$; $p > 0.05$). The data supported the research hypothesis that if an ESL student is taking a SAT reasoning test, then the student’s average SAT score will be lower than the non-ESL student’s average SAT score.

Based on the SAT scores determined in this research; there appears to be a direct correlation between whether the students were ESL or non ESL and the SAT scores. Before the results can conclude that the effect of English as second language would affect the student's SAT score however, an experiment should be made to test and collect more SAT scores to determine the accuracy of the experiment.

THE EFFECT OF ANSWER CHANGING ON ACCURACY

Therese Igharas and Maggie Zhang

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Throughout the educational journey, students are required to take many tests. Although there are a variety of tests, the multiple-choice tests are more widely used. When taking a multiple-choice test, students are faced with a decision as to which answer choice is the best one. Students often change their answer throughout the course of the test. Studies suggest that the changed answer often improves the test score. The decision-making process is affected by culture, and perception. The changing of a decision is a shift in perception. The independent variable was answer change. The dependent variable was the test score. The control was the initial test score.

The test used for the method was a previous SAT grammar test. There were two versions of the SAT grammar test that consisted of fifteen multiple choice questions. The participants would take the test with blue pen the first time around. Each student had six minutes to take the test. After the student was finished they would raise their hand and red pens were passed around while the blue pens were handed back. The participants would then have four minutes to change any previous answers.

The mean of the initial test score was lower than the test with changes score. The variances of the test scores were similar. The t test supported the null hypothesis. ($t = 1.9822 > 0.8578979393$ at $df=108$; $p>0.05$).

The research hypothesis was not supported; however there was area for statistical error and psychological error. The increase in mean test scores after changes agrees with the results of studies by Lehman, Mathews, Lowes and Crawford.

PSYCHOLOGY B

First Place:

THE RELATIONSHIP BETWEEN SELF-MONITORING AND CONFORMING TO A MAJORITY

Diana Milea-Ciobanu

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The purpose of this study was to determine whether there is a relationship between levels of self-monitoring and peer pressure influence induced by a majority. The study was conducted at a local high school in December of 2011. The 41 participants from three different class periods were subjected to two tests. First, they were given a self-monitoring test, to assess if they are high or low self-monitoring. For the second part of the test, they viewed a chart which presented a multiple-choice question; then they answered the question on their answer sheets. Next, they were shown a chart showing percentages of college students who chose each answer, with a clear majority picking one of the choices. After viewing the chart, the students were given another answer sheet on which to answer the same question again. The relationship between whether the participant was influenced by the majority vote and changed his/her answer, and the participant's level of self-monitoring (low or high) was examined using a Chi-Square Test of Independence. A p-value of 0.79 was found. Because the p-value was clearly larger than the alpha value of 0.05, the null hypothesis was supported. In summary, there appears to be no relationship between self-monitoring levels and giving in to peer pressure induced by a majority.

Second Place:

VIDEO GAMES: GOOD OR BAD?

Alexander McMillian

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Numerous countries and individuals have tried to find ways to better their education and improve their minds. Some have turned to video games, believing that games progress their learning, while others have not considered that video games may improve learning. In the United States, video game players make up 50% of the population. Education is a \$50 billion expense for the United States, and often games are used as teaching tools in classroom settings. Learning is difficult to test conclusively because the human mind is extremely complex. The purpose of this study was to test the effects of video games on the human mind's problem-solving, logic, and fast analysis skills. 16 individuals were tested: eight in the control and eight in the experimental. Both groups took a two-section, 20 question test, but the experimental group played the game "Blocks," a puzzle-based computer game, for 20 minutes before being tested. The number of correct answers was recorded as well as each participant's gender. Gender groups were also compared to see if there was a difference between males and females. A student's t-test was used to statistically compare the means of the control and experimental groups, yielding a p-value of 0.8961. This p-value is greater than 0.05, indicating that the means were not significantly different. Therefore, the beneficial effects of video games cannot be determined.

Third Place:

THE EFFECT OF BILINGUALISM ON AN INDIVIDUAL'S ABILITY TO IGNORE IRRELEVANT STIMULI

Yvanna Pantner

Central Virginia Governor's School for Science and Technology Lynchburg, Virginia
24502

The purpose of this study was to determine if fluency in two languages affects a person's ability to ignore irrelevant stimuli during a short-term memory test. Participants recruited from CVGS were tested two times via a computerized short-term memory test in the fall of 2011. The first test was made up of a five by five grid filled with images that were to be memorized within a two minute and thirty second timeframe. After the computerized portion was completed, participants filled out an empty hard copy of the grid with the names of images they could remember. The second trial was identical to the initial control test, with the exception of a pop-up message that appeared at the one minute and fifty second mark. This pop-up served as the distractor. A statistical analysis using a two-sample t-test revealed a p-value of 0.79, exceed the pre-set alpha value of 0.05. Therefore, the results of the study supported the null hypothesis, indicating that there is no statistical difference between a monolingual's ability to ignore distractions versus a bilingual.

Honorable Mention:

THE EFFECT OF CHILD PROOF CONTAINER ON THE TIME IT TAKES CHILDREN TO OPEN THEM

Paige Koetter

Deep Run High School

The use of child-proof containers goes back to the early 1970s. The use of containers, such as pharmaceutical bottles, helps prevent childhood poisonings. Children often get into medicine when the containers are left open or are in non child-proof containers. The purpose of this project was to determine which of three different types of bottles would be the hardest to open for children, therefore the most childproof.

Children ages 4 and 5 were asked to open three different types of childproof containers, top push down and twist, side push in and twist and arrow line up and pop. The children's times were recorded for each bottle. The results showed that the side push in and turn bottle was the most childproof with a mean of 186.57 seconds compared to the other bottles, which each had a mean of 300 seconds. A t-test was performed on the data and it reject the null hypothesis in one bottle but accepted it in the other. ($t=0<2.101$; $t=2.45>2.101$ at $\alpha=0.05$ and $df=18$) The data largely supports the research hypothesis that if type of bottle is changed then the times will vary on how long it takes to open each bottle.

Based on the times gathered in this project there seems a direct correlation between types of bottle and the time taken to open each bottle. Bottles A and C couldn't be opened by any child, therefore those bottles are the most child-proof out of the three. Before it is concluded that there is a direct correlation between types of bottle and the time taken to open each bottle, a separate experiment should be conduct on more different types of bottles to make sure the findings of this experiment are valid.

Honorable Mention:

THE EFFECT OF THE REMOVAL OF COSMETICS ON THE SELF-ESTEEM OF HIGH SCHOOL FEMALES.

Dustin Lape

Central Virginia Governor's School, Lynchburg, VA, 24502

The purpose of this study was to determine if not wearing makeup for several days would affect the self-esteem of high school females. This study was carried out at a local high school in December of 2011. The eight participants were divided into control and trial groups based on preference. Both groups were surveyed on their self-esteem and the amount of cosmetics they typically used. The trial group then went without makeup for ten days, while the control was asked to continue to use makeup as they would under normal conditions. After the trial period, the two groups were assessed again on their self-esteem. All of the measured variables were then analyzed for any significant differences. Analyses included looking for differences between the amount of makeup worn by the control and trial group, between the self-esteem of the control and trial groups, and between the self-esteem before and after the experiment for each group. In addition, a correlation analyses between makeup worn and self-esteem was conducted. No statistically significant difference was found between any of the variables: a p-value of 0.90 suggested no difference in the trial group's self-esteem before and after the trial period; no difference was shown between the control and trial groups for amount of makeup worn – p-value of 0.188 – or self-esteem – p-value of 0.90; and a correlation of only 0.043 was not enough to show a relationship between cosmetics used and self-esteem. In conclusion, the data supported the null hypothesis in all cases, and the research hypothesis that an absence of makeup would affect self-esteem was not supported.

Honorable Mention:

THE EFFECT OF SEMANTIC PRIMING ON RESPONSES

Anna Mendelson

Washington-Lee High

The effect of semantic priming on responses to questions was studied in an experiment involving two hundred human subjects (one hundred for each sample) and two sample groups; one semantically primed group and one group that was unprimed. The hypothesis stated that if semantic priming affects responses to questions, then the most popular answer will be zebra, because of the relativity to the questions asked. One hundred people (the unprimed group) were asked to name the first animal that came to mind. One hundred different people were asked to name the continent in which Kenya

is located, to name the two opposing colors in chess, and then to name the first animal that came to mind. The results did not reflect the hypothesis, as the responses dog and cat were much more common. However, priming was somewhat reflected in a comparison of the results, as African animals (including zebras) were more commonly mentioned after priming. The data was not statistically significant. The hypothesis was not supported, as zebra did not receive the most responses.

THE EFFECT OF MUSIC ON BIKING DISTANCE

Rachel Kaplan

Deep Run High School

Scientists noticed that listening to music has some positive effects. They observed that people were able to focus and think more clearly while listening to music. It was also shown to motivate and encourage people while exercising and helped them focus on their physical activity. Exercise was shown to help people think more clearly and make the body and mind stronger. The purpose of this project to determine how music would affect the distance a person biked on a stationary bike machine with one group biking and not listening to music and another group biking while listening to music. Ten sixteen-year-old boys and ten sixteen year old girls cycled on the stationary bike machine for ten minutes, one time while listening to music and a second time without listening to music. The distance they biked was recorded. The results indicated that the group listening to music biked a greater distance with a mean of 2.87 miles than the group not listening to music with a mean of 2.42 miles. A t-test performed on the data indicated an insignificance between the means of the groups ($t = 1.50 < 2.228$ at $df = 9$; $p > 0.05$). The data did not support the research hypothesis that if a person is listening to music, then that person will bike farther than a person not listening to music.

CONNECTING MASS MEDIA INFLUENCE TO PHYSICAL GENDER IDENTITY

Maria Kapral

Ocean Lakes High School

The purpose of this experiment was to investigate the effect of mass media consumption on gender perception. The research hypothesis was that as consumption of mass media increased, the percentage of male responses would also increase. The null hypothesis was that consumption of mass media would have no effect on gender perception. This experiment was a survey created through Paint software and the

program Survey Monkey which collected responses to the survey and allowed the results to be extracted to another format. Participants were asked to fill out an Informed Consent Form and a Demographic Questionnaire which included information such as age, ethnicity, gender, and the amount of television consumed prior to participating in the experiment to ensure that the information collected was correct and could be used. The experiment consisted of nine images which the participant had to classify as male or female based on body shape. Excel was used for analysis, especially for the descriptive statistics, and the Chi-squared test was used as the statistical test at the 0.05 level of significance. The Chi-squared value found was 50.672 which was less than the acceptable value for the p and df values (in which $p=0.053$ and $df=36$). Therefore, the null hypothesis was rejected because this showed that there was a relationship between the amount of time spent watching television and gender perception; the data also showed the possibility of a relationship between the gender of the participant and gender perception.

EFFECTS OF RELATIONSHIP LENGTH ON COOPERATION

Corwin Kelly

Washington Lee High School

This experiment examined whether the iteration of longer relationships effects cooperation and whether gender effects cooperation. It was hypothesized that people who knew one another 3 or more years would be more likely to cooperate than individuals in shorter-term relationships due to the expectation of future interactions. It was hypothesized that female subjects would be more likely to cooperate than male subjects. A survey was distributed to test subjects who were organized in pairs but not allowed to communicate during the experiment. Overall, there were no significant differences in the rate of cooperation by males versus females. Females who knew each other for 3 or more years, however, cooperated significantly more often (Z-test) than did females who knew one another for shorter periods. There was no significant difference in the frequency of cooperation by males who knew each other for three or more years and males who knew each other for a shorter period. It was concluded that the increased likelihood of iteration in longer relationships encourages females to cooperate.

THE EFFECT OF MULTILINGUALISM ON MEMORIZATION RATE OF FOREIGN WORDS

Sejeong Kwon

Deep Run High School

As the world has become a huge, interconnected community, people from all different countries are now able to meet and share their unique cultures. International trades and political visits have increased dramatically, and as a result, the current education system emphasizes the importance of multilingualism and encourages students to take foreign language classes. The purpose of this experiment was to determine how multilingualism would affect the memorization rate of foreign words of control and experimental groups. These groups consisted of monolingual(control), bilingual, and trilingual students' groups. Three groups were gathered and asked to memorize ten Greek words and English translations in five minutes. After five minutes, the three groups were asked to recall the English definition of each Greek word, and the number of Greek words that each student memorized was recorded. To produce accurate results, students who learned their foreign languages more than five years were only considered as bilingual group and trilingual group. The results revealed that the trilingual group memorized the most number of foreign words with a mean of 9.5, and the monolingual group memorized the least number of foreign words with a mean of 5.8. A t-test performed on the data indicated a significant difference between the means of three groups ($t = 2.868 > 2.101$; $t = 4.255 > 2.101$ at $df = 18$; $p > 0.05$), but the difference between bilingual and trilingual groups was not significant ($t = 1.767 < 2.101$ at $df = 18$; $p < 0.05$). The data supported the research hypothesis that if multilingual students were asked to memorize foreign words, they would get a higher score than monolingual would get. Based on this experiment, there appeared to be a positive correlation between multilingualism and memorization rate of foreign words. Before it can be concluded that multilingualism helped multilingual students to do better at memorization test, individual's intelligence difference needs to be minimized.

NON-WORD REPETITION TEST PERFORMANCE AND ITS EFFECT ON SECOND LANGUAGE PROFICIENCY

Joseph Patrick Kyle

Mountain Vista Governor's School

Tests of non-word repetition have been used in different manners to predict proficiency in a target language. The reliability of results of test of non-word repetition has been proven when used in certain capacities in different studies. This research attempted to determine how strong the relationship was between the proficiency of students who have already begun learning a second language and their performance on an appropriately designed test of non-word repetition. The "target" language for this study was English, and three differently aged test groups were randomly assembled. All of the test subjects were Chilean students who were learning English as a second language outside of the home. To calculate correlation in this study the test results were compared with pre-determined factors indicative of language proficiency. The results of this study can be

used to determine the optimum circumstances for administration of a test of non-word repetition and its relative accuracy.

THE EFFECT OF NOISE OF DIFFERENT FREQUENCIES ON MEMORIZATION

Emily Lovekamp

Shenandoah Valley Governor's School

Noise can be distracting when a person is trying to memorize information. The purpose of this research was to determine which frequency of a monotonous noise affects people's memorization the most. Twenty students from the local Governor's School and/or high schools volunteered to take a Cambridge Brain Science test called Paired Associates while listening to silence and the frequencies 100 Hz, 300 Hz, and 500 Hz with the same volume used throughout. The experimental data, based on an ANOVA and Tukey test, showed that there was a statistically significant difference in the subjects' ability to memorize the information between the silence and each of the different frequencies.

PITCH PERCEPTION ABILITIES OF STUDENTS AT GILES HIGH SCHOOL

Briana Massaro

Southwest Virginia Governor's School Pulaski, VA 24301

Musical training could possibly explain why people have differentiating pitch perception abilities. This study compared the effects of musical instruction on one's pitch recognition skills. In this experiment, testing was done to determine if musical training, such as band or chorale could be effective at bettering one's pitch perception skills. If this is the case, it could potentially provide reasons to supply funds to keep or increase music programs in public schools. Three different groups of students at Giles High School were tested to determine their pitch recognition abilities: band members, chorale members, and a group of students with no musical training. Students were asked to take a brief online test that consisted of two pitches being played and choosing whether the second note played was higher or lower than the first. After completing the test, the student's score, grade level, and years of musical training were recorded. JMP was then used to do an ANOVA to compare the scores of the groups. Years of instruction were also looked at versus score to do a linear regression to see if there was a correlation. The results showed that there was no relationship between type of musical training and pitch perception score. There was also no linear relationship between score and years of musical training. The scores of chorale students, band students, and non-musically

trained students were not statistically different. These results suggest that musical training cannot help improve pitch perception. The sample sizes were not as large as hoped, especially for the chorale. This could have had an effect on the results. Also, the test might not have been an accurate way to measure pitch perception. In the future, an experiment that studies more advanced musicians, perhaps at the college level, might present more accurate findings. This work increased our understanding of the relationship between musical training and the pitch perception abilities of high school students.

THE EFFECT OF LENGTH AND PROVIDER FAMILIARITY ON THE ACCEPTANCE AND READING RATE OF UNFAVORABLE TERMS OF USE CONTRACTS

Elizabeth McDonald

Yorktown High School

The purpose of the experiment was to determine if length or familiarity of the contract provider affected the acceptance and reading rates of terms of use contracts. There were four terms of use contracts attached to identical surveys: a long contract and short contract associated with the New York Times and a long contract and short contract associated with EZ-Surveys. The New York Times was the familiar provider. It was hypothesized that if the terms of use were short or were from a less familiar provider then they are more likely to be read. The readability of different contracts should be established to help provide guidelines for the Federal Trade Commission to help protect the consumer.

130 strangers were asked to take one of 4 separate but identical surveys that asked the participant to provide their full name and email address and answer four questions involving their internet habits involving terms of use contracts. Each survey included one of the four different terms of use contract. Participants were timed from when their terms of use contract were opened till when the terms were accepted, and whether or not they clicked accept or decline was recorded using a python code. After looking at the results ten additional people were asked the same four survey questions with the shorter terms contract that was split up.

There was a significantly higher reading rate for the shorter contracts but the familiarity of the provider did not have a significant effect on the acceptance rates. It was also found that overall people answered the survey questions more conservatively then their actions showed.

THE EFFECT OF MUSIC ON THE SPEED AND ACCURACY OF TYPING

Taylor Palkovics and Eleni Poulos

Deep Run High School

Through many experiments it has been noticed that music limits the concentration for any activities such as typing. Music affects the speed and accuracy of typing because a person's concentration is impaired. The purpose of this project was to determine how the speed and accuracy of typing was affected by the four genres of music: classical, country, rap and hip-hop, and no music. It was hypothesized that if instrumental, country, rap/hip-hop, and no music are applied, then the rap/hip-hop music will show the most significant decrease in the speed and accuracy of the typing. Students were to type a given paragraph and then told to listen to a song from a certain genre of music. After listening to the music they were instructed to retype the paragraph. The results were then compared to see if the concentration was altered due to the music. The results indicate that rap and hip-hop music made the students concentration decrease. The data collected accepted the hypothesis that rap/hip-hop music will show the most significant decrease in the speed and accuracy of the typing.

BODY IMAGE PERCEPTION OF CHILDREN IN RELATION TO AGE AND GENDER

Tiani Pannell

Central Virginia Governor's School, Lynchburg, VA, 24502

The primary purpose of the study was to determine if larger body images are still viewed negatively. Secondary purposes included determining if younger children have a more negative perception of a larger body image when compared to teenagers, and to see if there are differences between the genders. A high school student and an elementary school student participated in the study at a local high school and elementary school, respectively, during the months of December 2011 and January 2012. Four different groups, boys and girls in elementary school and boys, and girls in high school, took a friendship analysis test. The test consisted of rating four silhouettes that ranged from a slight frame to a heavy frame on a scale from one to ten, with one indicating the participant would absolutely not befriend that person and a ten indicating he or she absolutely would. The results of the study showed no significant differences in the perceptions of the larger body images between groups, and no significant difference between the perception of the slight frame and the heavy frame. The overall amount yielded a p-value of 0.1613, larger than the accepted alpha value of 0.05. The null hypothesis was supported, signifying no relationship between age and gender in the perception of a larger body image.

THE EFFECT OF DIFFERENT TYPES OF CHILD PROOF CONTAINERS ON THE ABILITY OF FOUR-YEAR-OLD CHILDREN TO OPEN THEM

Haley Plotz

Hanover High School

The purpose of this experiment was to inform about how childproof containers are not always child resistant. In many cases, young children have been able to raid medicine cabinets and ingest anything that is able to be opened. The experimenter first took three widely used medicine bottles—ibuprofen, aspirin, and a generic pill bottle. The experimenter numbered each container as #1, #2, and #3. Ten children, all of the age of four, five girls and five boys, were sat down three at a time and asked to open each of the bottles. Once given the bottle, the stopwatch was started. They were all given an allotted time of two minutes maximum. If the child was able to open the container, the timer was stopped and the time was recorded, if the child was not able to open the bottle, it was marked as “No”.

The results were that out of ten children, none were able to open the ibuprofen or aspirin containers, and only three out of the ten were capable to open the simplest of bottles, the generic pill bottle. In order to open the ibuprofen container, two arrows on the lid must be lined up, and then it can be lifted and opened. The children were only able to figure out that the lid turned, but none of them could pry the top off. As for the aspirin bottle, the sides must be pinched and the lid lifted. With the lid not being able to turn, the children became frustrated. For the generic pill bottle, all it took to open it was an easy twist and lift. Two children were able to open this particular bottle in around ten seconds. The third child opened it in about a minute and 20 seconds. Through this experiment, the experimenter helped prove the security of childproof containers and that the motor skills of young children are less than that of those adults, who can open them in no time flat.

PSYCHOLOGY C

First Place:

THE EFFECT OF THE NUMBER OF CLICKS REQUIRED TO CLOSE A POP-UP ADVERTISEMENT ON SUBJECT RECALL

Erica Snook

Shenandoah Valley Governor's School

The use of online pop-up advertisements has proven to be a popular and effective way of generating brand recall in subjects. The purpose of this study was to determine if the number of clicks required to close a pop-up advertisement enhanced subjects' recall ability. Volunteers from a local Governor's School in Central Virginia were tested using a number sequence memory test. The subjects' ability to successfully recall a number sequence was tested and their results were analyzed using a paired *t*-test. The results determined that there was a statistical difference in subjects' ability to recall the number sequence. When only having to click once to close down the advertisement, subjects were able to recall the number sequences more successfully than if they were to click multiple times to close the advertisement. Possible reasons for these results include increased feelings of annoyance towards the pop-up as well as a majority of subjects' focus going towards closing the pop-up instead of memorizing the sequence.

Second Place:

THE EFFECT OF SOCIAL PRESSURE ON GENEROSITY

Maria Winchell

Washington-Lee High School, Arlington, VA, 22206

The purpose of this experiment was to determine the effect of social pressures on generosity. The hypothesis was that if social pressure is applied to a subject, then the subject will react more generously. In order to test this hypothesis two test groups were tested. The first was made up of individuals, who were individually asked to read a hypothetical situation and respond to it. The hypothetical situation was meant to test their generosity. The second test group was made up of groups of three, who were asked to respond to the situation and told that their response would anonymously be written on a white board. The results were analyzed by finding the generosity percentage of each individual, the higher the generosity percentage, the less generous the individual. The generosity percentage could range from 0 to 100. The average generosity percentage for the first group was 40.80, and for the second group, 37.21. However, the results were found to be insignificant, and thus the hypothesis was unsupported.

Third Place:

THE EFFECT OF GENRES OF MUSIC ON THE SHORT-TERM MEMORY OF INTROVERTS AND EXTRAVERTS

Anna Yoon

Central Virginia Governor's School, Lynchburg, VA 24502

The purpose of this study was to determine the effect of different genres of music on the short-term memory of introverts and extraverts. Data collection was conducted in January of 2012 at local high schools in Central Virginia. Students were first asked to take a personality test. Then, ten introverts and ten extraverts were randomly selected to continue participating in the study. The participants were asked to take a memory test under three different conditions: one while listening to classical music, another with hip-hop beats, and the last in silence. The various musical conditions were presented in different orders to control potential sequencing effects. A two-way Analysis of Variance (ANOVA) resulted in a p-value of 0.27 for the interaction effect. Since the alpha value was set to 0.05, this p-value was found to be insignificant. The same was true for the variation between introverts and extraverts (p-value of 0.13) and for the variation between genres of music (p-value of 0.59). Therefore, the statistical analysis showed that the research hypothesis, if hip-hop beats were played, then the extraverts would show better results on recalling information than the introverts, was not supported. In conclusion, there were no statistically significant findings regarding the effect of different genres of music on the short-term memory of introverts and extraverts.

Honorable Mention:

THE EFFECT OF AGE OF CONSUMER ON THE TASTE AND APPEARANCE PREFERENCE OF DIFFERENT TYPES OF SWEETENERS

Delaney Rousseau

Deep Run High School

Many people love chocolate chip cookies, yet not everyone like the fact that cookies are full of sugar and “bad” for you. People have used sugar (sucrose) in their cookies and other baked goods for centuries. Today, many alternative sweeteners have been discovered that can eliminate many of the calories in the cookie. Now the question arises, “Which sweetener (sucrose or alternative sweetener) tastes the best?” Does the healthier cookie have a better taste, or is there a difference in taste? The effect of types of sweeteners in chocolate chip cookies on the appearance and taste preferences of different age groups was tested. The hypothesis of this experiment was to determine if the age of the consumer changed, then the preference of taste and appearance of cookies with different types of sweeteners was affected. The chocolate chip cookies were made with regular sugar (sucrose), a Splenda/sugar blend, and Truvia/sugar blend. Each participant was given a questionnaire in which they ranked each cookie on its taste and appearance: Cookie A, B, and C as a single-blind test with the order of evaluation randomized. Overall cookie preference, appearance and taste criteria were evaluated statistically. The null hypothesis was accepted for the data when the t-test was used. The results indicated that there was no significant difference between the taste preferences comparing responses; however, the Chi-Square analysis results showed that the adults preferred the cookies sweetened with regular sugar and the under-five and teens did not show a preference.

Honorable Mention:

THE EFFECT OF COLOR ON MEMORY RETENTION

Emily Tu

Deep Run High School

At school thousands of students learn through teachers' PowerPoints. The main objective from these presentations is to retain that information. A factor in this process is color. The purpose of this experiment was to determine how color would affect memory retention with color versus black. The hypothesis was if color was used, memory retention will be the highest. A set of sixteen vocabulary words were split with eight words containing color, and the other eight containing black. Students took two minutes to look over the words, had a ten minute break, and took another two minutes to write down as many words remembered from the list. The results indicated that color obtained the higher memory retention, although this was not significant, with 30.625 as the average percentage of correct words, while black received 29.375 as the average percentage of correct words. A t-test was performed on the data. The null hypothesis was accepted that color had no effect on memory retention ($t=0.312 < 2.262$ at $df=9$; $p>0.05$). Based on the data, a conclusion was reached that color did not affect memory retention since the students being tested had already seen the same exact words from the previous year's English vocabulary list. To continue this ongoing research an experiment could take place on how various fonts on text affect memory retention.

Honorable Mention:

WHAT GENDER GROUPS IN HIGH SCHOOL ARE BEING TARGETED IN DIFFERENT TYPES OF CYBER BULLYING?

William Whitesell

.Central Virginia Governor's School, Gladys, Virginia, 24554

The purpose of this study was to investigate whether cyber bullying occurs in middle and high school populations, paying special attention to the gender of the surveyed students. The groups that participated were from a local high school in two different classes from the grades nine and eleven. Groups were separated based upon gender. A survey created by a local college professor interested in the effects of cyber bullying was adjusted for this study. A two-tailed t-test was used to analyze statistical significance between males and females. The alpha value was set at 0.05. A p-value of 0.585 was generated which supported the null hypothesis that there was no difference in cyber bullying victimization between the males and females. A Chi-Squared Test of Independence was run to find the significant differences in the data of how common cyber

bullying occurred through different technologies. The resulting p-value of 0.027, showed statistical significance, with cyber bullying most commonly occurring on social media websites, like Facebook and MySpace. The research hypothesis that if cyber bullying is occurring in high school students, then female high school students are more likely to be targeted than male high school students was not supported in respect to the males and females in high school. In conclusion, the results from this study showed that cyber bullying did occur through definite forms of media but did not affect one gender more than another in this study.

THE EFFECT OF NON-CORRESPONDING COLORS OF COLOR WORDS ON THE SPEED OF RECOGNITION OF THE PRINTED WORDS

Kensey Plotz

Hanover High School

The purpose of this experiment was to prove that it will take a person more time to name the color of a color word than to name the word itself. The procedure for this experiment began with creating three testing forms. Form A contained twenty random color words printed in black and white. Form B and Form C contained twenty random color words printed in non-corresponding colors. Though Forms B and C were similar, Form C contained the same words as Form B, just in a different order. Ten ninth grade students were given a form face-down. When they were told to begin, they were given 45 seconds to name aloud the words, like on Forms A and C, or the color of the words, as on Form B. Each student was tested individually in the pod area outside of the classroom, free of distractions, such as other students on all three forms. An identical form was kept by the experimenter to record any mistakes made by the student. A watch was used to keep times for each student tested. The times were then recorded.

The results of this experiment showed that the majority of ninth grade students took longer to name aloud the color of color words than to name the word itself, which proved the hypothesis. The results of Form A, where students named the color word printed in black and white, showed that the fastest time recorded was 7 seconds and the slowest time was 15 seconds. There was mean of 9.8 seconds. For Form B, students had to name the color of the color words. The fastest time was 16 seconds and the slowest was 23 seconds. There was mean of 19.2 seconds. For Form C, where students were asked to name aloud the word itself, the fastest time was 8 seconds, and the slowest was 20 seconds. There was mean of 11.6 seconds. The results of this experiment showed that it is more difficult to name the color of a color word than it is to name the word itself. This is because it is more natural for a person to read than to name colors, as proved by John Ridley Stroop in his original experiment.

THE COMPARISON OF THE MORAL STAGES OF TEENAGE MALES AND FEMALES USING KOHLBERG'S METHOD

Lauren Romanzak

Central Virginia Governor's School, Lynchburg, VA 24502

This study was conducted to examine the possible differences in moral stages between teenage males and females using the scale developed by Lawrence Kohlberg and to see if these results supported the controversial results from decades ago. Four males and four females from a regional high school were randomly selected from among the volunteers for the study. Each participant gave his or her responses concerning what should be done in four different moral-testing scenarios. The individual responses were then assigned a moral development score from Kohlberg's scale by four different scorers. The scores were separated by gender, and a two tailed t-test was performed; a p-value of 0.015 was produced. Given the alpha value set as 0.05, the data supported the alternate hypothesis that there was a significant difference between the moral stages of teenage males versus females. Males had a mean stage value of 2.79, and the females had a mean value of 3.16, showing that the research hypothesis that the males would have a higher average score was unsupported. In conclusion, the results of this study do not support previous research which claimed a male advantage hidden within the Kohlberg morality rating scale, although the data did reveal a statistically significant difference between the genders.

THE EFFECT OF FLUORESCENT LIGHT VERSUS INCANDESCENT ON HUMAN COMPREHENSION

Joseph Sarver

Southwest Virginia Governor's School, VA 24301

With the upcoming shift around the country from incandescent to fluorescent bulbs the topic of how we light up our world has flourished. Besides environmental factors many areas of this subject remain untested. It is unknown how different lighting may affect our vision, comprehension, or even physical well-being in day-to-day activities. The researcher has set up an experiment to compare fluorescent and incandescent lights and how they affect human comprehension. This project included having subjects sit down under different lighting conditions and take a brief test of mathematics questions. They were allotted 15 minutes to complete the test. Their scores were analyzed and compared to spectrographs of the two different sources of light. The spectrograph images gave readout of the visible light and ultraviolet light produced by fluorescent and incandescent bulbs. This provides for an understanding of why these bulbs either

improve or impair our comprehension. Fluorescent scores were highest with the mean being 5.7 compared to Incandescent being 3.1. Significance testing showed the project was significant at the 0.05 level with a p-value of 0.003. The null hypothesis is rejected and the alternate hypothesis which stated that there will be a difference is accepted. There is sufficient evidence to state that there is a difference between fluorescent and incandescent effects on human comprehension. This research provides backing for the switch across the globe from incandescent to fluorescent lighting. Further long term studies could be done to show the effect on vision over a lifetime.

THE INSTANT EFFECT OF PHYSICAL EXERCISE ON MEMORIZATION

Grace Sheridan

Shenandoah Valley Governor's School

Recent studies lead researchers to delve into the positive effects of physical exercise. A focus has been placed on the relation between exercise and cognitive abilities; this study focused on the correlation between physical activity and memorization. The goal was to determine the relationship between brief bouts of exercise and memorization. Randomly chosen students participated in an online memory test before and after performing two minutes of aerobic jumping jacks exercise. The memory test consisted of clicking irregularly placed numbered boxes in numerical order after the numbers had disappeared. The results were analyzed with a t-test, and it was concluded that the physical activity had no instantaneous effect on memorization.

SAY IT TO MY FACE: *THE EFFECT OF VISUAL CONTACT ON DECISION MAKING*

Natalie Slater

H-B Woodlawn Secondary Program

The purpose of this project was to find the effect of being face to face on decisions made during a money-based ultimatum game between two people. The hypothesis was that higher offers would be made face to face and lower offers would be made when subjects were in separate rooms. Also, subjects would be more likely to accept unequal offers face to face than from separate rooms.

The experiment included more than 100 subjects divided into two equal groups. The first half went through the money-based ultimatum game face to face; the second from separate rooms. The first player made an offer of how to divide \$100 to the second

player who could accept or decline the offer. If the offer was declined, no one received any money. When the players were in separate rooms, the offer was recorded and relayed to the second player. When players were face to face, the mean offer was \$43.80 out of \$100. When players were in separate rooms, the offer dropped to \$36.20. This supports the first part of the hypothesis. When face to face, people accepted 91.7% of unequal offers. When in separate rooms, only 50% of unfair offers were accepted. This supports the second part of the hypothesis.

THE EXTENT TO WHICH THE GOLDEN MEAN INFLUENCES ART

Zachary Stull

Mountain Vista Governor's School

The purpose of this research is to support the idea that the golden mean has an aesthetic appeal to it. The research investigates the major Renaissance artists to determine how widespread the use of the ratio was used in creating beautiful works during the era. Each artist is individually researched to see if they ever incorporated the golden mean into any of their works. Most previous research done on the golden mean looks at its aesthetics in relation to modern society. This research was meant to show that a significant amount of artists used to golden ratio purposefully to increase the beauty of their works.

THE EFFECTS OF LIGHTING ON READING COMPREHENSION

Olivia Varah

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The purpose of this study was to understand how natural and fluorescent lighting affects the reading comprehension scores of second grade students. This study was conducted at a local elementary school during December of 2011. A group of second grade students from the same class were tested under both natural and fluorescent lighting. The group was first tested during a period of natural lighting. After one week, the same group of students was tested for a second time during a period of fluorescent lighting. These tests were scored using the total points method, and a paired t-test was used to analyze the data collected. The p-value was revealed to be nearly one, which was compared to an alpha value of 0.05. Therefore, there was no statistically significant data and the original hypothesis, which stated that if natural lighting is used during test taking, then a student's reading comprehension score will be higher, was not supported. One possible consideration regarding the statistical analysis was that the instrument used in testing the reading comprehension of students included only six questions, and only seven students were included in the sample. In conclusion, this study showed no effect on the reading comprehension of second grade students based upon the difference between natural and fluorescent lighting.

ELECTRIC POWERED CARS VS. GASOLINE POWERED CARS

Danielle Williams

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People know that gasoline powered cars contribute to the growing CO₂ emissions and global warming. But has anyone thought about the problems with electric cars? Electric cars use electricity, which in turn burns coal, which also releases greenhouse gases that contribute to global warming also. But mainly both of these cars are consuming the earth's nonrenewable resources. The question that was asked is which vehicle conserves more natural resources. What was being tested was if their opinion changed after being presented with pros and cons of each vehicle. A survey was created that asked the initial question of which car they thought conserved more resources then allowed the participants to read the pros and cons and then asked if their opinion was changed. There were 35 teachers from Narrows High School that agreed to participate in this survey. The survey was left with the teacher throughout one school day and then picked back up at the end of that day. The results for the initial question said that 23 people chose electric, 7 chose gasoline, and 5 said they conserved about the same. The results for the second question said that 18 people chose electric, 10 chose gasoline, and 7 said there was no difference. A chi square test showed that the results were not significant at the 0.05 significance level with a p-value of 0.2183, but it was interesting because 21.74% of the people who chose electric cars first had changed their opinion. Although the null was not rejected, this information could lead to further studies to see if people who think that electric cars conserve more natural resources change their opinion when provided with information. It could also be useful in figuring out what helps to determine peoples mind about which car conserves more resources, and future advertising for improved cars based on people's opinions.

THE PERCEPTION BY TEENS AND ADULTS ON THE BURGLARY RATE BY THE APPEARANCE OF A NEIGHBORHOOD

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The perceived risk of crime has been studied; however, those studies looked at gender as the variable. The perceived risk of crime is based on the experiences of people; as a result, this study observed age as a factor for the perceived risk of burglary from the appearance of the neighborhood. The photographs of 10 neighborhoods were taken in the Town of Blacksburg using data maps from the police department. The safety ratings provided were: very strong safety, strong safety, moderate safety, poor safety, and very poor safety, and there were two photographs for each safety rating. The photographs were taken under the same constant conditions. The pictures were then rated by a sample

size of 30 adults and 30 teenagers. The teenagers were juniors and seniors, while the adults were teachers. The response to the pictures by adults and teenagers were then compared to the actual rate of burglaries in each neighborhood. The results suggest that there was a statistical difference in the proportion correctly identified by adults and teenagers. The results indicate that the experience of adults did give them advantages for locating safer neighborhoods over the young adults; however, the teenagers were able to locate the neighborhoods with lower safety better than the adults. The differences indicate that this research will direct further studies to the experiences and reasoning used in perception by adults and teenagers. This will give a better understanding of the perceived risk from experiences using different interaction methods, and their effect on neighborhoods' aspects to humans.

ZOOLOGY

First Place:

THE EFFECTS OF HIGH FRUCTOSE CORN SYRUP AND MONOSODIUM GLUTAMATE ON THE HEART RATE OF DAPHNIA MAGNA

Margaret Doyle

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Heart rates of over 120 *Daphnia magna* were counted three times each, before, during and after exposure to one of six concentrations (from 10 % to 0.3125 % weight/volume) of high fructose corn syrup (HFCS) and monosodium glutamate (MSG) solutions and a mix of both solutions. The purpose of this experiment was to determine if higher concentrations would result in higher heart rates and slower recovery. Rates during and after exposure were compared with baseline rates, the mean of the three rates before exposure. With MSG, heart rates decreased with increased concentration and showed no clear recovery to baseline rates. Sharp drops between 2.5 % and 5 % MSG suggested threshold levels near 2.5%. For HFCS and the HFCS-MSG mix, rates over time showed no clear correlation to concentration. While some heart rates appeared to head toward baseline rates, only 0.3125 % HFCS leveled out near the baseline rate after exposure. Overall, the variation in response, as measured by the standard deviation increased over time and with concentration. A one-way analysis of variance (ANOVA test) for the control showed no statistical difference in *Daphnia* heart rate with time. ANOVA tests showed that MSG and HFCS concentrations significantly affected heart rate after, but not during exposure and the HFCS-MSG mix affected rates during and after exposure. The data did not support the hypothesis that heart rates would increase, and recovery would be slower with increasing concentration.

Second Place:

THE EFFECT OF PROLONGED ULTRAVIOLET IRRADIATION ON THE REGENERATION OF PLANARIANS

Benjamin Cherian

Godwin High School

This experiment was conducted in order to investigate how ultraviolet irradiation affects planarian regeneration. Scientists have been studying the biology of human stem cells and the developing field of regenerative medicine. Planarian regeneration is similar to the regeneration of human stem cells and could be used as a small-scale model. One hundred planarians were divided equally into four petri dishes. Each was bisected and then irradiated for varying amounts of time. The amounts of time that were used included: zero hours, eight hours, sixteen hours, and twenty-four hours. The control in this experiment was the group that was exposed to zero hours of ultraviolet light. The planarians were given fifteen days to regenerate. It was hypothesized that the planarians that were irradiated the longest would exhibit the poorest regeneration. The results revealed that the planarians that were exposed the longest to ultraviolet light displayed the poorest regeneration. A chi-square test was performed to determine data significance. The results revealed that the data was significant in two levels ("zero hours" and "eight hours") and not significant in the remaining two ("sixteen hours" and "twenty-four hours"). The results supported the hypothesis but were not significant. It is believed that a longer exposure time affected the planarian's DNA and inhibited its regeneration. Some error sources in this experiment included variations in the location where the planarians were initially bisected and the height of the ultraviolet lamp. This study could lead to future studies on how other freshwater organisms are affected by ultraviolet radiation.

Third Place:

THE EFFECT OF AGE ON OLFACTORY DISCRIMINATION AND OLFACTORY SENSITIVITY

Madeline Mitchell and Emily Wu

JR Tucker High School

Age is the amount of time a living being has existed. Odors are distinctive smells that are inhaled through the olfactory system of living organisms (Firestein, 2002). Many animals rely on their olfactory systems to locate a specific food source, which is a tool often used for survival. In addition, olfactory senses are used to discriminate between different odors and to detect olfactory sensitivity levels. This experiment was to determine whether

olfactory discrimination and sensitivity in laboratory rats was affected by age. The hypothesis stated: if two different age groups (two months and four months) of laboratory rats are given a series of tests, then the younger set of rats will have a more distinct olfactory discrimination and sensitivity. Prior to the experimental trials testing discrimination, odorized solutions 10^{-4} for vinegar and strawberry extract were prepared, as well as pure water. Next, a petri dish containing two pieces of filter paper – one with water and one with strawberry extract solution – was placed into the center of the enclosure area. The rats were placed into the course and given a five-minute opportunity to sniff the odors however many times they wished. After four trials of testing olfactory discrimination with the odor of strawberry extract, it was replaced with the vinegar solution to see if the rats could differentiate between the two smells. For the sensitivity trial, solutions of strawberry extract with concentrations of 10^{-4} , 10^{-6} , and 10^{-8} were prepared. The trials were set up similarly as the discrimination trial; however, each rat trial was tested using filter papers of different concentrations. Data was recorded based on how many times the rat sniffed the odors. Results showed that because no P value was less than 0.05, the null hypothesis was accepted ($t = 0.5694 < 2.228$ at $df = 10$; $p > 0.05$). Based on the results determined from this research, this experiment did not have enough significant data; therefore the null hypothesis was accepted.

Honorable Mention:

THE EFFECT OF KERATEX HOOF HARDENER TREATMENT ON THE HARDNESS OF EQUINE HOOVES

Beverly Gordon

Shenandoah Valley Governor's School

Supplementary hoof dressings, such as Keratex Hoof Hardener® may have an effect on the strength of equine hooves. The purpose of the study was to determine if Keratex Hoof Hardener® strengthens the hoof wall of an equine. Specimens collected throughout the state of Virginia by a Certified Farrier over a period of one month were tested using Mohs Hardness Scale. The specimens' hardness was tested and their results were analyzed with a *t*-test that yielded no difference in those specimens treated with Keratex Hoof Hardener® and those that were not treated. The researcher concluded that Keratex Hoof Hardener® did not affect the strength of equine hooves.