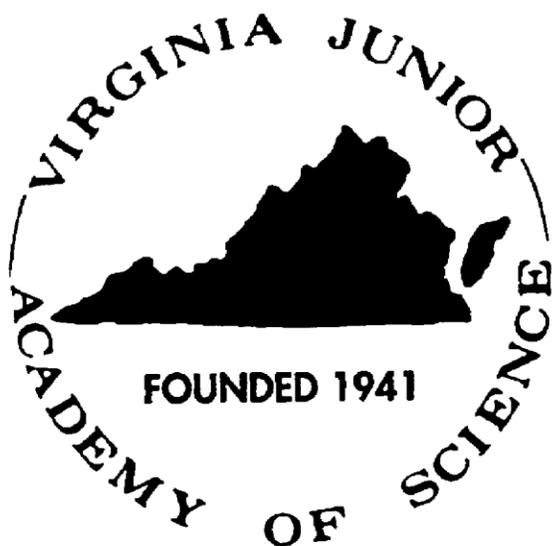


Proceedings of the



**Virginia
Junior
Academy
of
Science**

Volume 49

May 2011

Richmond, VA

**The Virginia Junior Academy of Science
of the Virginia Academy of Science**

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For the Financial and Personal Assistance

Which Make VJAS Activities Possible

**Proceedings of the
Virginia Junior Academy of Science
of the Virginia Academy of Science**

70th Annual Meeting

May 24-26, 2011

**University of Richmond
Richmond, Virginia**

Volume 49

Richmond, Virginia

May, 2011

Editor: Carolyn M. Conway

Assistant Editor: Hillary E. Stewart

TABLE OF CONTENTS

	Page
Contributor’s List.....	inside cover
2011 Paper Submission, Acceptance and Presentation Statistics	iii
Virginia Junior Academy of Science Committee	iv
Virginia Junior Academy of Science Officers	v
 Section Awards and Abstracts	
Agriculture and Animal Science	1
Animal Behavior	9
Botany	18
Chemistry A	27
Chemistry B	35
Computer Science	43
Consumer Science A	49
Consumer Science B	57
Earth and Space Science.....	66
Engineering	73
Environmental Science A	81
Environmental Science B	90
Environmental Science C	99
Environmental Science D	107
Genetics and Cellular Biology.....	115
Mathematics	120
Medicine and Health A.....	121
Medicine and Health B.....	129
Medicine and Health C.....	137
Microbiology A	144
Microbiology B	153
Physical Science A	162
Physical Science B	170
Physics A.....	179
Physics B.....	187
Psychology - General	196
Psychology - Learning and Perception A	204
Psychology - Learning and Perception B	212
Psychology - Social	220
Statistics	228
Zoology	233
 Special Awards	 239

2011 PAPER SUBMISSION, ACCEPTANCE and PRESENTATION STATISTICS

Of the 970 papers submitted by March 1, 2011, 612 papers were selected (after evaluation by the Readers) for presentation at the Annual Meeting.

The number of papers selected for each category was as follows:

Agriculture and Animal Science	22
Animal Behavior	22
Botany	22
Chemistry	43
Computer Science	17
Consumer Science.....	43
Earth and Space Science	19
Engineering	22
Environmental Science	88
Genetics and Cellular Biology	10
Mathematics.....	4
Medicine and Health	56
Microbiology	41
Physical Science	44
Physics	44
Psychology - General.....	22
Psychology - Learning and Perception	44
Psychology - Social.....	22
Statistics	12
Zoology	15

Of the 612 paper selected in April for presentation, 577 were presented on May 25 during the 2011 Annual Meeting at the University of Richmond.

Selected papers from each category were subsequently presented to Senior Academy Sections on May 26.

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AGRICULTURE and ANIMAL SCIENCE

FIRST PLACE

The Effects of Age, Gender, Location, and Year on the Number of Cases of Lyme Disease in Canines

Jennifer Heyward

Shenandoah Valley Governor's School, Fishersville, VA 22939

Lyme disease is a painful and crippling disease that affects canines all over the country. This study was performed to determine what factors (including age, gender, location, and year) could make a dog more susceptible to Lyme disease. Files were gathered from a local veterinarian and organized into a survey sorting them by the factors listed above. Then the data was analyzed using chi-square goodness of fit and difference of two proportions tests. The results stated that the only elements which made a statistical difference in how many dogs were diagnosed with Lyme disease were location and age. Since there was a statistical difference, it was concluded that where a dog lives and how old it is have the largest influences, of the factors tested, on a dog's susceptibility to Lyme disease.

SECOND PLACE

Ultraviolet Decontamination of Bacterially-Infected Hydroponic Systems

Clayton Geipel and Jason McAleese

Specialty Center for Science, Math & Technology at Mills E. Godwin High School, Henrico, VA 23238

The purpose of this study was to determine if bacterial infection of hydroponic systems can be eliminated through the use of germicidal ultraviolet radiation. Hydroponics is the study of growing plants without soil. The practice is already in use in many farms and could serve as a source of food and oxygen for astronauts. The hypothesis for this study was that if *Brassica rapa* specimens are hydroponically grown in water open to environmental contamination while being disinfected with germicidal ultraviolet radiation, then they will contain a smaller concentration of bacteria at maturity than similarly exposed specimens grown without disinfection. Forty-eight *Brassica rapa* specimens were germinated and grown in two open hydroponic systems with continuously circulating water. The water of one system was exposed to germicidal ultraviolet light for eight hours a day, five days a week, for two weeks, while the other system served as a control. After reaching maturity, the specimens were separated from roots, weighed, pulverized, diluted, and incubated on agar plates. Gram stains of colonies from both systems revealed a multitude of species, consistent with environmental contamination. The mean bacterial concentration in the experimental group was 1.7386×10^5 CFU/g, much lower than the control mean of 7.8177×10^5 CFU/g. A t-test confirmed the statistical significance of this difference with a p-value of 0.0452. Therefore, the hypothesis was supported. In addition, the mean mass of the experimental plants was significantly greater than that of the control plants, perhaps because of a reduction in the intake of harmful bacteria. These data could therefore indicate that germicidal decontamination is a viable method for increasing hydroponic plant growth and ensuring the safety of hydroponic consumers. Future stages of this experiment will be improved through the use of a more sterile environment and larger sample size.

THIRD PLACE

Aquaponics: Building a Sustainable Closed Loop Eco-System

Ryan Boles

Chesapeake Bay Governor's School, Tappahannock, VA 22560

In ancient times sophisticated civilizations had developed an agriculture system that was smart; and most importantly sustainable, known as aquaponics. Aquaponics is the integration of hydroponics with aquaculture where

the waste products of one biological system serve as the nutrient for the second biological system. This study was done to see if such an aquaponics system actually worked better than a typical system when done by an amateur similar to a home garden. Two tanks were set up and filled with tilapia, but one tank received floating rafts of mustard and char lettuce. At the end the fish in the tank with plants were 14% larger than the fish in the control tank with no need for filters or water changes. With the growing prevalence of soil degradation, water scarcity, deforestation, climate-related challenges; and the future demise of oil and fertilizer production, aquaponics is a system that can address these issues that plague modern industrial agriculture. The intelligent use of these natural resources and the promising economic gains from an aquaponic system is undeniable. This study was conducted to see if an average American could construct an aquaponic aquaculture system themselves with little cost and much to gain. The study focuses on sustainability and the potential for local farming business or even personal food production.

HONORABLE MENTION

The Effect of Irrigation Type on Plant Growth

Mallory Banton

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The purpose of this experiment was to determine which irrigation technique produces a higher yield of seed germination. Sixty *Phaseolus lunatus* were grown, and watered using 200 mL of water and different irrigation techniques to determine which was the most effective. Fifteen were watered using a flood technique as a control, fifteen were watered using a spray technique, fifteen were watered using a drip irrigation system, and fifteen were watered using a subirrigation technique. These plants were then grown for fifteen days, watered every three days, and on the fifteenth day they were checked for their germination status based on a scale of zero to three, zero being no germination, one being germination without shoot growth, two being growth under 5 cm, and three being plant growth of over 5 cm. The technique with the highest germination average was the drip technique at 93.3%, subirrigation had the second highest average at 80% germination, spray irrigation had the third highest average at 73.3%, and flood irrigation had the lowest germination average at 66.7%. Based on the results, drip irrigation provided the highest germination average because of its application of water directly to the plant's root zone. Less water is lost due to evaporation and wind, allowing more to be effectively used by the plants.

HONORABLE MENTION

The Effect of the Pheromone *Cis*-Vaccenyl Acetate as a Population Regulator for

Drosophila melanogaster

Kintora Chapman

Central Virginia Governor's School, Lynchburg, VA 24502

The purpose of this study was to determine the effect of the pheromone *cis*-Vaccenyl Acetate on the larva count of *Drosophila melanogaster* commonly known as the fruit fly. In order to conduct this experimental study, a Central Virginia Governor's School student collected the overall population count for couples from an experimental group of fruit flies exposed to the pheromone *cis*-Vaccenyl Acetate and for couples from a control group not exposed to the pheromone for six days in December 2011. Pairs of fruit flies were placed into separate vials, after exposing the experimental females to ten μL of cVA for a total period of three days. Once the couples had mated, the larvae from each couple was counted, and a total was taken for the experimental and control groups. The results of this experiment show that the pheromone *cis*-Vaccenyl Acetate did not have a significant effect on the reproduction of the experimental group. A two-sample t test was performed. The calculated p-value was 0.22. The set alpha value was 0.05. The original hypothesis, which stated if male *Drosophila melanogaster* were to mate with female *Drosophila melanogaster* that were exposed to the pheromone cVA, then these couples would produce less offspring, was not supported. In conclusion, the pheromone *cis*-Vaccenyl Acetate had no significant effect on the reproduction activities of the experimental group as determined by larva count. Therefore, the pheromone cVA was not able to suppress courtship behavior in this study.

HONORABLE MENTION

A Comparison of the Effects of Alpaca Manure, Chicken Manure and Chemical Fertilizer on Sunflower (*Helianthus annuus*) Growth

Haven Headley

Chesapeake Bay Governor's School, Tappahannock, VA 22560

Fertilizers, both organic and chemical, enable plants to grow more productively than those without it. Chemical fertilizers are made for certain plants needs which include specific nutrient amounts. Chemical fertilizers have shown harmful effects on the Chesapeake Bay. Nitrogen run off from chemical fertilizers is bad for waterways and its inhabitants. Common organic fertilizers used to stimulate plant growth include cow, horse and chicken manure. This study compared the effectiveness of an alternate organic fertilizer, alpaca manure, to more commonly used fertilizers. The study tested the effects of alpaca manure, chicken manure, chemical fertilizer, and unaltered soil on sunflower (*Helianthus annuus*) growth. The effectiveness of the fertilizers was compared and contrasted on the basis of sunflower plant height. Test plots with 14 plants each were grown and measured for fourteen weeks and results were compared to determine the effects of each fertilizer type on sunflower growth. A single ANOVA test calculated a p-value of 0.772, which is insignificant. However, the results showed higher plant growth with alpaca manure. The sunflower heights with chicken manure and unaltered soil were closely related. After fourteen weeks, the final height averages were 1.50 meters for plants grown in alpaca manure, 1.27 meters for plants grown in chicken manure, and 1.21 meters for plants grown in unaltered soil. Based on the results, alpaca manure can be used as an effective alternative organic fertilizer. Alpaca manure is cheaper, can contribute less nitrogen pollution, and doesn't require as much maintenance as some more commonly used fertilizers.

The Effect of Decibels on Milk Production **Brett Alvis, Amanda Conley, and Sarah Schwartz** Goochland High School, Goochland, VA 23063

Dairy farmers are constantly searching for ways to increase milk production. When cows are in a relaxed environment, it has been proven that they yield more milk. Scientists and farmers have been conducting experiments to discover new ways of relaxing dairy cows, in hopes of increasing milk yield. A previous experiment was conducted to see if music genre affected milk production. To expand on that project, the highest yielding genre, country, was played at different volumes to see if it affected milk production as well. The purpose of this experiment was to determine how varying decibel levels of zero decibels, eighty decibels, ninety decibels, and 100 decibels, would affect total milk production. 100 Holstein dairy cows were obtained and milked while country music was played at the different decibel levels. Total milk from each cow was measured in pounds and recorded. For extended data, with more controlled variables, the data was also recorded divided into a sample size of twenty-six cows, which were chosen from the original data. The results for the sample size of twenty-six cows indicated that group D, the control group receiving zero decibels, had the greatest mean milk production with a mean of 73.269 lbs. The results for all of the cows tested indicated that group A, receiving eighty decibels, had the greatest mean milk production with a mean of 66.98 lbs. The data did not support the research hypothesis that if cows are milked while country music plays at decibels levels of zero decibels, eighty decibels, ninety decibels, and 100 decibels, then the cows will yield the most milk with the decibel level of ninety decibels. According to the decibel levels used in this research experiment, the varying in volume did not have a significant impact on total milk production. It is expected that the data would be more drastic and show significant change, if different decibel levels were used and variables such as weather, feed, and environment were more controlled.

Effects of Vitamin A on O₂ Consumption in *D. magna*

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Vitamin A, known to improve vision and, in excessive amounts, harm the skeletal system, may have detrimental effects on oxygen consumption at a molecular level. The purpose of this experiment was to determine the effect of the concentration of vitamin A on the rate of oxygen consumption in *Daphnia magna*. The hypothesis was as the concentration of vitamin A increases, the rate of oxygen consumption would increase. The levels of the independent variable were 0 (control), 0.05, 0.1, 0.15, and 0.2 µg/mL concentration of vitamin A, with ten trials for each level. Containers with five *D. magna* each were set up with a specific concentration, and the oxygen levels were measured with an oxygen probe daily for five days. To accurately control other variables such as position of probe and duration of time in the container, a device called the “Vmeter” was created. The major finding was that as the concentration of vitamin A increased, the rate of oxygen consumption decreased ($p = 0.0149$), and both the null and experimental hypotheses were rejected. The study at hand may show that the effects of vitamin A are not limited to bone structure, but may also impair respiration at a cellular level, prompting investigation into new standards for vitamin A intake. These results are consistent with findings that vitamin A can cause oxidative damage to mitochondrial membranes. A recommendation for further study is to test oxygen consumption in various organisms with a greater range of vitamin A concentration.

The Effect of Different Artificially Colored Mulches on the Net Yield of *Phaseolus vulgaris* var. *humilis*

Luke Bieryla

Mountain Vista Governor’s School, Warrenton, VA 20187

This paper details an experiment that tested regular mulch and artificially colored mulch to determine which has a greater effect on the net yield (overall weight) of a set group of common bean plants, formally known as *Phaseolus vulgaris* var. *humilis*. The experiment used 4 planter boxes filled with topsoil, fertilizer, and 18 bean plants with a different color of mulch in each box. Red light is what bean plants use during later cycles of photosynthesis that help them flower and reproduce, so the different light spectrums reflected off of each type of mulch were the factors that changed the yield of each box of plants. The hypothesis states that if red pigmented artificially colored mulch is used it will provide a greater net yield than the naturally colored mulch. The analysis of the averages and total weights taken from each planter box found that the artificially colored mulch with red coloring had a higher yield than the normal oak mulch, verifying the hypothesis. The tools of statistical analysis used on the data were the mean, median, and total bean count for each of the 4 boxes. Artificial red mulch had the highest yield of 714.42 grams, followed by artificial brown at 406.92 grams, artificial black at 365.07, and the natural mulch at 335.15 grams. In this experiment, the artificial mulch, especially red, was seemingly the better mulch for producing a much greater net weight of beans.

The Effect of Method of Shortening and Location on the Growth Rate of the Mane of *Equus caballus*

Julie Forino

Shenandoah Valley Governor’s School, Fishersville, VA 22939

Sixteen horses (*Equus caballus*) were used to compare the growth rate of the mane based on method of shortening. The null hypothesis tested was that there was no difference in the in the growth rate of the mane between method of shortening or the location in which shortening took place. The methods tested were pulling and cutting. The locations tested were 23 cm from the height of the withers and 5 cm behind the ears. Each horse’s mane was pulled and cut at both locations. The manes were shortened to a length of 15 cm long and measured four weeks later after being shortened. The mean increase in length for the pulled method was 1.32 cm behind the horse’s ears and 1.12 cm near the withers. The mean length for the cut method was 1.20 cm behind the ears and 1.34 cm near the withers. The level of significance was set at $p < 0.05$ and a two-way ANOVA was used. There was no significant difference found between the method, $F(1, 52) = 0.10$, ($p = 0.84$). There was no significant difference in location

either, $F(1, 52) = 0.04$, ($p=0.852$). The results show that the method of shortening the mane makes no difference to the growth rate of the mane hairs.

The Effect of Seed Spacing on Shoot Growth

Osscar Gonzalez-Sandoval

Yorktown High School, Arlington, VA 22207

In this experiment the aim was to look at the effect of seed spacing on shoot growth. Four seeds were spread across. Seeds were spaced 0.5 cm, 1 cm, 2 cm, and 2.5 cm apart. Three trials at each spacing were conducted. These were grown for 5-7 days, the length of the shoots were checked. A table was created to record results, putting the different lengths of the shoots on the table. When the experiment had ended the results were plotted on a graph. Then using the graph the growth rate of each group of seeds was compared. A one-way ANOVA test was conducted on the data. The results show that distance does affect the length of the shoots, as there is a drastic change in the length of the shoots between distances. The longer the distance, the longer the shoots grow. The statistical analysis showed significant correlation between seed spacing and average height per day, and growth rate. As a result of this experiment we can apply the results on how the exponential growth of the human population affects how some areas, which are sparsely populated, receive medical care and a consistent supply of food; compared to more crowded areas.

The Effect of Caffeine Concentration on the Respiration Rate of Planaria

Vivek Gorijala and Zach Hosseinipour

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

The brown flatworm, *Dugesia tigrina*, or planaria, respire through integumentary exchange, the exchange through the skin of carbon dioxide for oxygen. This process is similar to humans breathing. The role that caffeine, a widespread and potentially harmful drug, can have on respiratory rate is uncertain. The hypothesis was that the respiration rate of planaria will increase and then decrease with increased caffeine concentration. In experimentation, concentrations of caffeine up to the lethal dose of planaria were given. The respiration rate was determined by finding the oxygen consumed in 24 hours and measured using an oxygen probe. The trendline was not linear, but curved. The data values increased initially, but significantly (5.2979×10^{-6}) decreased towards the lethal dose. The dosage that yielded the greatest respiration rate was 1.38×10^{-7} milligrams of caffeine per milliliter, and the lethal dose of 3.04×10^{-7} milligrams per milliliter yielded the lowest. The results showed that caffeine stimulated cellular responses in the central nervous system by increasing oxygen concentration. The results are similar to studies of caffeine affecting human respiration rate. The findings show that planaria could be a model for future research to find other effects of caffeine on humans. Caffeine, being consumed more and more frequently, may bring humans to the same unhealthy dose that the planaria faced.

Chicken Egg Size Relative to Brand of Feed

Benjamin Hill

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The size of a chicken egg is important because it is directly proportional to the cooking yield and monetary value of the egg. Eggs have been a source of food as long as there has been recorded history, and different brands of chicken feed could possibly influence egg size because of the different nutritional makeup. It is important to know which brand of chicken feed will produce the largest eggs. To obtain these results, Purina Layena Pellets and Southern States brand feed were fed to three chickens and the masses of the eggs laid were compared. The objective of this experiment was to determine which brand of feed produces the largest chicken egg. Purina brand was fed to the chickens for one week before measurement so that it was the only feed in their digestive system, then the mass of first 30 eggs that were laid for the next two weeks were recorded. This process was repeated for the Southern States brand feed. The mean mass of the Purina eggs was 79.69 g with a standard deviation of 7.42 g. The mean mass for the Southern States eggs was 79.45 g with a standard deviation of 4.81 g. The rounded mode of the Purina eggs was 71 g, and the rounded mode of the Southern States eggs was 79 g. The median of the Southern States eggs

was 79.17 g, and the median of Purina eggs was 78.48 g. This difference in medians indicates a possible skew towards the larger masses of the Purina eggs. With a p value of 0.883, the two means are not significantly different. There was not enough evidence to reject the null hypothesis of the two means being equal. Based on the cheaper cost, lower standard deviation of egg size, and failure to reject the null hypothesis, it would be more cost efficient to use Southern States brand chicken feed.

The Effects of Canned Dog Food and Dry Dog Food on Cancer in Canines

Ashton Knighton

Shenandoah Valley Governor's School, Fishersville, VA 22939

The type of food eaten by dogs and age may affect the kind of cancer they can get. The purpose of the study was to determine if there was a frequency between the kind of food eaten by dogs, their age, and the type of cancer. A local vet provided data which included the kind of breed, age, weight, type of food, and type of cancer they had. There was a statistical difference among the diet of the dog and kind of cancer. The research concluded that age plays an important factor among the type of cancer that dogs can get.

Can Horses Develop a Resistance to Dewormer?

Virginia Reasor

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Many horse owners keep giving horses the same dewormer year after year without knowing that the horse may have developed a resistance to it, causing strongyle parasites to invade its system. The main goal of the research project was to determine if horses (*Equus ferus caballus*) can develop a resistance to dewormer. Strongyle were counted in six samples of horse feces prior to ingestion of ivermectin and moxidectin dewormer. Ivermectin was given to three randomly selected *Equus ferus caballus* and moxidectin was administered to the remaining three. After one week, feces samples were gathered from all horses and were analyzed for the amount of strongyle. The data revealed that after ingestion of dewormer, both kinds eliminated all strongyle from the horses' feces. The results suggested that horses do not develop a resistance to dewormer since both treatments were equally effective in eliminating the strongyle eggs. The significance of these findings suggests that both dewormers were equally effective, therefore the alternative hypothesis was rejected and the null hypothesis failed to be rejected.

Growth and Immunity Response to Trace Mineral Supplementation in Holstein Calves

Emma Reeves

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Healthy calves are essential for maintaining a productive herd of dairy cattle. Therefore, dairy calves are commonly given a multi-mineral supplement to encourage faster growth and a stronger immune system. This project examines two questions: will administering Multimin 90 improve a calf's growth rate? and will these calves develop fewer cases of Scours and respiratory diseases than those who do not receive it? Starting on December 23, 2010, any calves born that had not already been supplemented were paired according to gender and similar birth dates and measured with a weight tape. Then, a calf from each pair was given either 1 cc of Multimin 90 or 1 cc of Mu-se, a simple selenium shot. This procedure was repeated exactly one week after the first testing date on calves born during that week, and again two weeks after the first testing date. Two weeks after each treatment date, each calf was measured with the weight tape to determine total weight gain and herd records were checked for Scours or respiratory treatments in each group. A total of 19 calves were tested in the experiment. In the heifer group, those who received Multimin 90 gained an average of 3.13 +/- 2.616 SE kilograms while those who received Mu-se gained an average of 2.04 +/- 2.980 SE. In the steer group, calves that received Multimin 90 averaged a 1.97 +/- 2.004 SE kilogram gain while calves that received Mu-se averaged a 0.6 +/- 1.172 SE kilogram gain. A two-tailed T-test was performed using InStat which proved these results insignificant. Seven calves that received Multimin 90 were treated for Scours or a respiratory illness compared to six calves from the Mu-se group. Seeing as these results are not significant, no definitive conclusion can be drawn about the advantages or disadvantages of Multimin 90. A

larger sample size and a longer time frame are needed to obtain more conclusive results; this can be pursued in a future study.

The Effect of Type of Archaeological Preservations on their Rate of Substrate Decomposition

Zoe Siepert

Hermitage High School, Richmond, VA 23228

The purpose of this experiment was to test what preserves pig fat the best; vacuum sealing, bandage gauze, salt, or nothing at all. The hypothesis was that the vacuum sealing of the substrate will preserve the pig fat the best. Vacuum sealing seems to be the best way to keep out bacteria or moisture, which is why it will most likely work better than the other forms of preservation. The independent variable in this experiment was the type of preservation such as vacuum seal, salt, bandage gauze, and no preservation. The dependent variable was how the wrapping preserves the tissue, which was measured in grams. Some constants in this experiment were the type of pig fat used, the time of year the substrate was preserved, and the environment the substrate preserved in. The control in this experiment was the pieces of pig fat without any wrapping. The sample size of the experiment was six per type of substrate. There was one repeated trial. The p-value of this experiment was 0.000 which means that there was a statistically significant difference in the means of the independent variable groups. The vacuum seal pig fat weighed the closest to its original weight than the other pieces of pig fat with different types of preservation. The results supported the hypothesis made that the vacuum sealing of the substrate will preserve the pig fat the best. Some errors that could have been possible in this experiment could have been human error, calculations, small sample size, or numerous other factors. The reason vacuum sealing worked the best was due to the scientific fact that by sealing it the oxygen that microbes need to break down food are taken away.

The Effect of Soil pH on the Growth of *Phaseolus lunatus* Plants

Megan Talej

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The approach to experimentation was simple. To test the effect of soil pH on the growth of *Phaseolus lunatus* plants. The control would be neutral soil, and the other types of soil would be basic and acidic. The hypothesis was: If neutral soil is used to grow *Phaseolus lunatus* plants, then the plants will grow taller. Using the same dimensions of pots, the lima bean seeds would be planted in the same location in the pot as the other plants that contain different soil pH's. The different pots would receive the same amount of water and sunlight. The experimentation would last twenty days, and would have five trials to ensure that data collected is valid. The results concluded that the hypothesis was proven correct. The mean of the results for neutral soil was 5.4 centimeters. A conclusion was drawn that *Phaseolus lunatus* plants grow best in neutral soil. Neutral pH can range from 6.5, to 7.5. Acidic soil grew the *Phaseolus lunatus* plants slightly smaller than the neutral soil-grown plants.

Perlite Compost Takes in the Phosphorous Nutrients

Rabia Wase

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All of the plants around the world need three types of nutrients in the soil; nitrogen, phosphorus, and potassium. The soil of many countries on the continent of Africa lack these essential nutrients, which causes the farmers trouble in raising crops. The solution of this problem may be found in household compost composed of banana peels, coffee grounds, and/or onion skins which contain very highly organic phosphorus. This costs the farmer very little money. The importance of this compost is that it provides the rich organic nutrients in the soil. Perlite soil is similar to the African soil, because it is dry, hard, and has no nutrients in the soil. Thirty trials were tested of each of the composted materials: banana peel, onion skin, and coffee grounds. The results showed that after one week of compost, the banana peels added medium amounts of phosphorus to the soil. After two weeks, the composted banana peels added high levels of phosphorus to the soil. This data was compared to a cup with just perlite soil.

The Effect of Soil Saturation on Product Yield of Tomato Plants

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The purpose of this study was to determine if plants could be watered less than an average amount and still have an active productivity yield. In this experiment, the plants studied were cherry tomatoes (*Solanum lycopersicum cesariforme*). The experiment was set up using two experimental groups and one control, with 6 plants in each group. The control group received 1.4 mL of water per day. The two experimental groups were given 1 mL and 2 mL, respectively. The hypothesis was that the experimental group receiving 1 mL of water per day would bear an equal amount of fruit as the control group. The results of the experiment showed that the tomatoes receiving 1 mL of water only had 3 surviving plants out of their group of six and produced an average of 2.3 tomatoes per plant. The control group had an average of 11.9 in (inches) of growth height and produced about 9 tomatoes for each plant. The last group which received 2 mL of water had the largest amount of growth with each plant reaching an average of 10.9 in. There was an average of 10.8 tomatoes for each plant in the last group. This data rejected the alternate hypothesis that the group of tomatoes receiving the least amount of water (1 mL) would produce an equal amount of fruit as the group receiving 1.4 mL.

ANIMAL BEHAVIOR

FIRST PLACE

The Effect of Sleep Deprivation on the Memory of *Drosophila melanogaster* as Determined by Odor Training

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The purpose of this study was to address whether sleep deprivation affects the memory of *Drosophila melanogaster*, otherwise known as the common fruit fly. This study was conducted by a high school student between November and December, 2010, in a high school lab. In order to conduct this experiment, mutant fruit flies, otherwise called *fumin* (sleep deprived), and wild type fruit flies were exposed to two different odors, cherry and banana. The vials in which the fruit flies were contained in were coated with the cherry odor first. Twenty wild-type flies and twenty mutant flies were left in separate cherry coated vials for one day then shocked through extreme temperature change (quickly dipping the room temperature flies into ice water) and shaking the vials for 10 seconds. The same procedure was followed with the same group of flies while they were exposed to the banana odor, except they were not shocked. Once both groups of flies had been exposed to the two different odors, they were placed in a y-maze built by the researcher. One side contained the cherry odor and the other side contained the banana odor. The fruit flies then chose which side they preferred and a count was taken. Cherry denoted poor memory, while banana denoted good memory. A chi-squared test of independence showed that there was no correlation between the memory of *fumin* fruit flies and wild type fruit flies ($p\text{-value} = 0.42$, $\alpha = 0.05$). The original hypothesis that if *D. melanogaster* are sleep deprived (*fumin*), then their memory will be inferior to *D. melanogaster* that are not sleep deprived (wild type), was not supported. The null hypothesis that the wild type population and *fumin* population would occur with equal frequency was retained. In conclusion, all of the results taken together show no significance between sleep deprivation in fruit flies and their memory.

SECOND PLACE

Various Diets on the Fat Content and Growth of Rail +/- Mouse Mutants

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Due to the phenotypic effects of Smith-Magenis Syndrome (SMS) and the increasing prevalence of obesity, a further understanding of the effect of diet on fat distribution and weight is important. A weight study consisting of thirty-five mice of wild type and *Rai1*^{+/-} genotypes was conducted using three different diets: Normal Chow (NC), High Fat (HF), and High Carbohydrate (HC). Mice were weighed each week, plotting growth. Eighteen of the thirty-five mice were euthanized and fat was collected, and the proportion of fat calculated. The growth curves of the mice with different diets gave evidence that High Fat mice with the *Rai1*^{+/-} genotype weighed the most, supporting the hypothesis. Fat proportions were also highest in heterozygote mice fed High Fat diets. Behavioral observations included barbering, the placement of cotton bedding into food, and scattering of food throughout cage. Along with behavioral observations, diet has an effect on overall health of the mice. The implications of the data could prove to help treat the obesity within the phenotype of humans with SMS, improving their quality of life.

THIRD PLACE

The Effect of Social Facilitation on Egg Laying Behavior in *Drosophila melanogaster*

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The purpose of this study was to observe and determine the effects of social facilitation on egg laying behavior in *Drosophila melanogaster*. This study was conducted by a Central Virginia Governor's School student in December. Model female *Drosophila melanogaster*, which are representations for focal *Drosophila*, laid their eggs on food sources chosen by the researcher (media, grape, or banana), while focal female *Drosophila melanogaster* watched. Focal female *Drosophila melanogaster* are observers which experience novel food together with mated females (models). Focal female *Drosophila* were put into the test phase, where they decided to lay their eggs on either the food source they watched in the previous stage or on another food source. If the female *Drosophila melanogaster* noticed the fruit on which the other females laid their eggs, then the *Drosophila* will also lay their eggs on the fruit. The data collected was the amount of larvae laid in a particular food source. The alpha level was set at 0.05. The statistical test, chi-square for independence was performed and the p-value obtained was 3.02E-05. The results of this experiment show that social facilitation and experience has an effect on the egg laying behavior of *Drosophila melanogaster*.

HONORABLE MENTION

The Preference of Fish to Different Habitat Shapes and Textures

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Artificial reefs are man-made habitats for fish that are created by materials not naturally found in the marine environment, which can be common, from rubber tires and cement bricks, to uncommon, like derelict oil rigs and scuttled ships. Artificial reefs are placed in environments that have a featureless bottom, which has resulted in an increased amount of fish activity. The hard surfaces of artificial reefs also provide a habitat for sessile animals, which is especially important due to the loss of habitats over the past few centuries. This study in particular investigated what specific types of structures and textures attract fish the most; one structure contained a hole, another structure mimicked the shape of a rock, one that displayed the features of a trench like object, and the last structure that was tested was a bridge. Texture may also be instrumental in the decision of a species of fish to choose a particular artificial reef; this study also tested a hard texture and a very soft texture. Tests were conducted to see whether fish have a particularly explicit attraction to one shape and/or texture over the other. Knowing this information could possibly allow reef makers to create structures optimum to fish attraction thus creating a higher yield in fish activity within a particular area. The study used structures of equal volume. The fish were put through twelve experiments to test their preferences to the structures. The study then concluded that the local schooling fish proved no avail to the experiment for the study's p-value yield only a mere 0.677 for the texture and a 0.599 for shape, which concluded that local fish will school to habit rather than find a habitat for living. These numbers could be due to the schooling instinct of the fish rather than looking for habitat for protection. Also these results could have occurred due to the short amount of time that the fish were left to adapt to the environment or even the structures were not similar to the structures preferred by the local fish.

HONORABLE MENTION

The Effect of Perimeters on Ability of Group of Boid Agents to Avoid Predators

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Boids are group agents that move in unison, similar to a flock, herd, or school. Though they appear to move as one object, as if they know where the other boids will go, in reality they do not; each boid thinks separately. The

movement of the boids were calculated by averaging three vectors representing movement together with weights: Collision avoidance, velocity matching, and flock centering. In collision avoidance, each boid tries to pull away from the others it can see (they are its neighbors). Velocity matching tells the boids to match the velocity of its neighbors. Flock centering tells each boid to move toward the average positions of its neighbors. These three variable's weights were the parameters of the experiment. The reason why flocking evolved is because boids that flock got eaten less often. The purpose of this experiment was to find if the weights of the three parameters affect the amount of boids that are eaten by predators. The hypothesis was that if the velocity matching and flock centering parameters were increased, then the amount of predator kills would decrease. To run the simulation, the amount of levels for each independent variable and the amount of trials were selected. The application would run each combination of the three independent variables with the selected amount of trials. The application would then output each simulation results and a table of the results. Although there were certainly trends in the results, it is unclear what the trends were. A better way to analyze the results than t-tests would have been to use ANOVA or multi-variable linear regression tests. More trials would be needed to correctly analyze the data. Though the null hypothesis, parameters do not affect the amount of predator kills, was rejected, hypothesis was not quite accepted, because a problem occurred in results where the predator would ignore obstacles and hit them. In future testing this will be fixed.

HONORABLE MENTION

The Effect of Vitamin C on Oxygen Consumption of *Drosophila melanogaster*

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Vitamin C, also known as ascorbic acid, has been known for boosting immunity in humans, but does this antioxidant have beneficial effects on other organisms such as fruit flies (*Drosophila melanogaster*)? The purpose of this experiment was to determine the effect of vitamin C on the oxygen consumption of *D. melanogaster*. The null hypothesis was if vitamin C levels increased, oxygen consumption would not change. Five levels of vitamin C were used, with ten trials per level. During experimentation, an oxygen probe was inserted into each vial for two minutes, as measured by a timing device. The results indicated no significant difference (ANOVA, $p = 0.488$); therefore the null hypothesis was not rejected. These results contradicted previous studies where vitamin C was found to decrease respiration in fruit flies. Respiration produces reactive oxygen species (ROS) causing stress and increasing oxygen consumption in animals. In humans, this buildup of ROS can be eliminated with vitamin C. The results from this experiment imply that vitamin C does not have this same effect in fruit flies. Recommendations for future studies include using higher concentrations of vitamin C and fruit flies at the same stage of life during experimentation.

The Effect of Exercise on Memory in Mice

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This experiment was done to find out if there was a difference in the long term memory in mice that received exercise and mice that didn't receive exercise. The hypothesis tested was that mice who exercised would remember their way through the water maze for a longer period of time. The mice were tested using the Morris water maze test with three distinct visual cues set up around it to help the mice remember where the hidden escape platform was located. The two-way ANOVA test that was done found that their times through the maze didn't differ significantly for the different times they were tested, $F(4,90) = 1.32$, $p = 0.27$. There was also no difference in their times through the maze between the exercised mice and the nonexercised mice, $F(1,90) = 1.48$, $p = 0.23$. Most importantly there was no effect of exercise on the ability of the mice to remember over time, $F(4,90) = 0.93$, $p = 0.45$. It was concluded that the null hypothesis that long term memory in mice is not affected by exercise could not be rejected.

The Effect of Different Deterrents on *Sciurus carolinensis* Behavior

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The purpose of this project was to investigate the effect of different liquids on how much pumpkin is eaten by animals. It was chosen because every year pumpkins are destroyed by not-so-innocent *Sciurus carolinensis* and rotting. The question asked was what kind of liquid would deter *Sciurus carolinensis* the best. It was hypothesized that hot sauce would deter the *Sciurus carolinensis* better than the other tested liquids. The materials needed were 12 pumpkins of relatively equal weight and size. First, an initial weight was recorded and the insides of the pumpkins must be removed. Then every three days for 15 days the weight was recorded and the pumpkins were coated with the assigned liquid. Each liquid should coat three pumpkins and it should be the same pumpkins each time. The control pumpkins, not coated with anything, retained an average of 35% of the original weight. The pumpkins coated with apple juice retained an average of 77% of the original weight. The pumpkins coated with hot sauce retained an average of 99% of the original weight. The pumpkins coated with liquid soap retained an average of 101% of the original weight. The most likely reason for this was liquid soap is a relatively heavy liquid. That combined with the rain that occurred between the second and third recordings, added to the weight. The pumpkins coated with hot sauce and apple juice also acquired large amounts of mold. Out of the liquids tested, it is best to use liquid soap to protect pumpkins because it retained the most weight and did not acquire mold. However using any liquid was better than using nothing, although the quality of the pumpkin definitely changed the outcome of the experiment.

Looking into the Horizon

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Since 1942, oil has caused untold oceanic disasters. If a foreign substance were suddenly introduced into an ecosystem, would organisms have their behaviors decrease negatively? An experiment was accomplished that simulated the Gulf of Mexico in July 2010. The main goal of this project was to measure the response time of *Homarus americanus*, before, during, and after the oil was spilled. The delayed response time signified that neurological effects were just as detrimental to the organisms as was the environment after the oil was spilled itself. There were decreasing levels of interactions. Interactions appeared to be constant during the first two hours (antennae height around five-and-a-half inches, three tail-shakes), but decreased dramatically following contamination (two inches, one tail-shake). Steps must be taken to ensure that organisms in the Gulf of Mexico have not been affected, and if they already are, to rehabilitate their natural behaviors. To combat this dilemma, scientists have been looking towards bioremediation, and microbial organisms as a plausible solution, however, it is important to distinguish how much of an effect those microbes will have on the neurological systems of multiple organisms, as this experiment states, maybe the microbes will increase delayed response time to freshwater fauna.

The Effect of Notes D and E on Mating Behavior in *Drosophila melanogaster*

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The purpose of this experiment was to determine whether or not note E, D, and no note have an effect on *Drosophila melanogaster*. Fruit flies were extracted from a wild type environment and placed into six separate cultures. Each culture was exposed to the auditory stimulus that was performed on the electric piano for five minutes. Data was recorded every thirty seconds. The fruit flies were relatively more active during note E and no note. This contradicts the hypothesis which stated, "If the note E is played at 164.81 Hz in room temperature then the majority of *Drosophila melanogaster* will be inactive." In fact, the most inactivity came from the note D with a frequency of 146.83 Hz. There was a sufficient difference in activity between notes E, D, and silence. Therefore, the null hypothesis was rejected. These results are accurate since the frequency of note E is similar to a frequency the fruit flies use in courtship. Since the fruit flies are used to this sound, they are least likely to respond differently towards it. However, the frequency of note D is not similar to their natural environment or the communications between the flies, and therefore the flies became more stationary. A *Drosophila melanogaster* has a natural tendency

to remain active and against gravity. A change in this behavior supports a response directed by the addition of a auditory stimuli, which happened to be note D.

The Effect of Magnetic Fields on Ladybug Behavior

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A natural phenomenon that occurs approximately every 300,000 years is a shift in the earth's magnetic poles. Currently, the earth is in the midst of such a shift. This shift has been a topic on news reports, magazine articles, and scientific journals and has caused some alarmists to postulate dire consequences. The purpose of this experiment was to determine the possible outcomes, if any, of such a magnetic shift on animal behaviors. The question that was addressed is how a magnetic field would affect ladybug behavior. The behavior was measured as movement within a defined area. Equal numbers of ladybugs were placed into two separate cages; each cage was divided into quadrants. Observations were made of the ladybugs with no electromagnetic field every two minutes for a total of twenty minutes. The movement of the ladybugs was captured through the use of pictures. Next, an electromagnet was introduced and the same procedures were used to collect data on ladybug movement. The electromagnet was reversed and data collection was repeated. Once the photos were analyzed and quantitative data was collected, it was determined that ladybugs gravitated towards the electromagnet as compared to the control group (91% moved to the quadrant with the electromagnet). There was minimal movement in the control group. When the electromagnet was reversed, 69% of the ladybugs remained in the quadrant with the electromagnet. In conclusion, the data recorded supported the hypothesis that the introduction of a magnetic field would affect ladybug behavior.

The Effect of Dinoflagellate's Exposure to Light and Dark on its Bioluminescence

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Bioluminescence is affected by the dinoflagellate's exposure to light and the exposure to the dark. Dinoflagellates are single-celled, planktonic organisms that do not have histones. Dinoflagellates often emit bioluminescence and are photosynthetic. Bioluminescence is basically when an organism produces light as a result of chemical energy being transformed into light energy. Dinoflagellates are often exposed to a 12 hour light-12 hour dark cycle (the control for this experiment) in the sea. The purpose of the experiment was to figure out how varying the cycles will affect the bioluminescence of these dinoflagellates. Bioluminescence is a result of enzyme-catalyzed chemoluminescence reaction. The word luminescence means light. The word bio means living. The luminescence of these organisms is caused by mechanical stress. Mechanical stress is basically the movement of the water and the waves of the ship. It was hypothesized that 6 hour light-18 hour dark group will emit the most amount of bioluminescence. For this experiment, 30 test tubes containing 10 ml of water + dinoflagellates were obtained from Sunny Side Sea Farms in California. They were kept at three different places for a week. Lights were turned either on or off based on their cycles. To determine the bioluminescence, each test tube was shaken and was ranked from a scale of 1 to 10. The bioluminescence emitted by these dinoflagellates was recorded as qualitative from a scale of 1 to 10. It was found that 6 hour light-18 hour dark group emitted the most amount of bioluminescence. A luminescent spectrometer can be used in future to calculate the intensity of light. Apart from that, the sun could have been used instead of light bulbs (considered, as artificial light).

The Effect of Hydrocarbon Molecules on Ant Behavior

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Pesticides are used at an abusing rate. Even if they accomplish killing and keeping away insects from crops or households, its toxic formula harms the environment and consumers. The purpose of this experiment was to determine if hydrocarbon molecules had an effect on ant behavior. It was believed that a higher number of hydrocarbon molecules would result in a greater repelling of ants. In the experiment ants crossed through essential

oils containing different numbers of hydrocarbon molecules into a prepared bait. The number of ants crossing over was recorded. The control used in this experiment was no essential oil. The results revealed that hydrocarbon molecules do repel ants. The t-test revealed that the data was significant for monoterpenes, diterpenes, and triterpenes versus control but not significant for monoterpenes versus diterpenes, monoterpenes versus triterpenes, and diterpenes versus triterpenes. However the results did not completely support the research hypothesis because monoterpenes did have a higher repellent rate than triterpenes. It is believed that ants do have a reaction with hydrocarbon molecules and this research could lead to studies investigating the reaction between natural substances and pests.

The Effect of Different Spices on How Long it Takes for a Dog to Distinguish/Recognize Them

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Dogs have such a keen sense of smell that they are used to sniff out contraband and some can sniff out different cancers. The more different scents placed in front of a dog, the harder it will be to find a specific one. The purpose of this experiment is to find the effect of different spices on how long it takes for a dog to distinguish/recognize them. The hypothesis was that if the scent the dog is trying to distinguish from the others is paprika then the time it takes to find it will decrease. The procedure was to place four containers with different spices in them, then have the dog smell one, tell it to search for it and time how long it took to find the right spice. The means were, in decreasing order, black pepper with 30.2 s, paprika with 27.8 s, ginger with 27.4 s, and cinnamon with 22.9 s. The hypothesis was not supported because cinnamon was distinguished the fastest. The reason cinnamon was found faster rather than paprika is that dogs do not like spicy foods and paprika is made from peppers. Future studies could include different brands of the same spice or toys.

Are You Smarter Than a Golden Retriever?

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The experiment's purpose was to figure out which dog breed is the most intelligent. The eight dog breeds in the experiment were the Golden Retriever, Yellow Lab, Chocolate Lab, Collie, Lab/Greyhound, Lab/Husky, Corgi/Basset Hound, Maltese, and Pekingese/Hound. The materials needed are two chairs, three cups, a stopwatch, a chicken treat, a piece of paper and a pencil. The Cup Shuffling Test tests the dogs' smell. The student placed the cups on the ground and let the dog see which cup the treat went under. The student mixed up the cups, started the stopwatch and had the dog pick which cup it thought the treat was under. When the dog finished, the watch was stopped. The Obstacle Course tested the dogs' common sense. First, the chair cushions were set next to each other, leaving a large space the dog could get through on the opposite side. He/she dropped the treat in the space between the chairs. The student started the stopwatch and let the dog go. He/she stopped the watch when the dog went past the chairs and ate the treat. Each test was done five times to each dog. On the first test, the Yellow Labrador received the best score with a 9.136 seconds Avg. and the Yellow Lab/Greyhound Mix did the best on the second test with a 4.457 second Avg. These results could find dogs that fit for certain people. For example, a hunter would need a dog with a good nose, so he'd want a Yellow Lab.

The Effect of Different Wavelengths of Light on the Attraction of Moths

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Nocturnal animals are greatly affected by artificial lights used by humans. Moths especially experience this, as they use the moon as their guide and get confused by lights used by humans. Artificial lights can be very distracting and disorienting to their natural cycles and life processes. Therefore, an experiment was designed to determine if different wavelengths of light (white, yellow, red, and blue) had an effect on the amount of attracted moths. The hypothesis was that if the moths were presented with blue lights, then they would be attracted the most.

Four light bulbs, one of each level of the independent variable, were obtained to conduct the experiment. One light bulb of one color was set outside for fifteen minutes at night, and any moths that came to the light during this time were recorded. This was repeated ten times for each color. The data concluded that the moths were attracted to white and blue light the most. A t-test performed on the data indicated a significant difference in the following: ($t=9.32>2.101$; $t=17.65>2.101$; $t=6.65>2.101$; $t=7.19>2.101$ at $df 18$). Based on the data from the experiment, it was concluded that moths are attracted to white and blue more than any other color. A possible explanation for this result was because moths are able to see blue and white light better than yellow and red light. Also, more research could be conducted to determine if temperature affects the amount of attraction to different wavelengths of light.

Squirrel Fest **Valeria Pietra**

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The purpose of this experiment was to study the effects of different types of liquids/chemicals on bite marks on the pumpkins. The control is the pumpkin that was not sprayed with any liquids. The experimenter wanted to learn which liquid would keep the squirrels away from the pumpkins. The hypothesis was if different liquids were sprayed on pumpkins then the squirrels would not eat the jalapeno “flavored” one. The approach was to spray each pumpkin (not the control) everyday. The squirrels would come up to them and start eating. The three liquids that were sprayed on them were jalapeno pepper, lemon, and vinegar. Every day the pumpkins were looked at and measured with coins. The key results were that the normal pumpkin got eaten the most. The lemon and vinegar hardly got eaten. The bites in the lemon and vinegar sprayed pumpkins were both smaller than a nickel (2 cm). On the last day they got eaten more because the rain washed all the liquid off them. The jalapeno pumpkin never got eaten. Even after the rain the squirrels didn’t want to eat it. The mean for the lemon pumpkin was 3 or as big as a nickel. The mean for the jalapeno pumpkin is 1 or was not eaten at all. The mean for the normal pumpkin is 6 or bigger than a fifty cent piece. And the mean for the vinegar pumpkin is 3 or as big as a nickel. The conclusion is that the jalapeno pumpkin didn’t get eaten at all. The hypothesis was accepted because the jalapeno pumpkin did not get eaten. However the lemon and vinegar were very close. If it never rained then they would come in second place. Now when ever a pumpkin is set outside during Halloween time then you can spray jalapeno pepper juice on it and the squirrels wouldn’t eat it!

Response of Mosquitos to Chemical Stimuli **Gabriel Rosario**

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The purpose of this experiment was to investigate whether or not mosquitoes would go toward an odor that was a known attractant of mosquitoes over another odor that is not an attractant. A dual-port olfactometer was used to evaluate the responses of mosquitoes to different odors or chemicals. Observations like when mosquitoes entered a specific arm, a specific arm end, the object that is emitting the odor being tested, and any specific behavior or pattern that the mosquitoes might be doing were recorded. Each experiment trial lasted at least two hours. The chemicals used were: Carbon Dioxide, Air, Regular Di Water, 1-Octen-3-ol, and Lactic Acid. The carbon dioxide was produced with a mixture of Alka-Seltzer tablet and regular Di (deionized) water. The tablet was placed in a small plastic cup with 5 mL of Di water. 1-Octen-3-ol, also known as mushroom alcohol or octenol for short, was poured onto a cotton ball using a volumetric pipette. Only 10 microliters of octenol were used per trial. The controls included the exact same materials except it didn’t include the object creating the odor. The data was then analyzed by comparing the odors to each other. Di water was the chemical that attracted the largest percent of mosquitoes. Overall most of the experiment showed no significant difference between the odors. Only Di water in one of the experiments rejected the null hypothesis with a p value of 0.0458, meaning that the mosquitoes were actually attracted to it.

The Effect of Environment Colors on Beta Fish Behaviors

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Animals such as Beta fish have been kept as household pets for many years and many owners like to observe these colorful fish. The purpose of the experiment was to see if the change of the color of a Beta fish's surroundings would affect its behavior. The hypothesis stated that the colors in a Beta fish's environment would have an effect on how it behaved and reacted towards other fish. Four Beta fish, two red, and two blue females, were placed in two different tanks (the two blue fish in one dividing tank and the two red females in the other dividing tank). These fish were then observed for five minutes every day so that their behavior could be recorded. They were put in three different environments: in an environment in which the rocks and walls were the same color as their scales, an environment in which the rocks were the same color as the fishes' scales and the walls were not, and an environment in which neither the walls nor the rocks were the same color as a fish. Each of these variables were tested for three days for each fish. The data supported that if a Beta fish's habitat was changed, the behavior would change as well. Based on the research and the data, the Beta fish's behavior changed, and it seemed as though aggression towards their tank companion lessened when they were put in an unfamiliar and uncomfortable area, perhaps creating a need to be with fish of its own color to create a sense of comfort.

***Halyomorpha halys* Trap Design**

Madonna Yoder

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Increasing numbers of United States homeowners have noticed a flying, smelly nuisance around their homes: the Brown Marmorated Stink Bug (*Halyomorpha halys*). It reproduces during the spring and summer and hibernates in homes over the winter and all of the offspring reach maturity before they hibernate. *H. halys* is difficult to remove from an area once it has taken up residence and emits a pungent stench when disturbed. The purpose of the present study was to design a simple insect trap to capture *H. halys*. Two trap prototypes were constructed. One trap design featured small dark spaces imitating observed hibernation preferences of *H. halys* (Hibernation Imitation trap) and the other featured the appeal of bait (Ball jar trap). The Hibernation Imitation trap emerged as the more effective of the two prototypes. In each of three trials, the Hibernation Imitation trap caught at least half of the 30 bugs in the population while the Ball jar trap only caught two bugs out of 25 in one trial and was not able to keep those in the trap. The Hibernation Imitation trap may be constructed with less material by changing the dimensions without affecting effectiveness. Effective bait needs to be found if the Ball jar trap is going to work at all. The Hibernation Imitation trap is easily made and could be used by all homeowners affected by the Brown Marmorated Stink Bug to reduce the number of these bugs in their homes.

The Effects of Different Music Tempos on the Exercise Rate of Russian Dwarf Hamsters

(*Phodopus campbelli*)

Tiffany Young

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Music has been shown to help people during physical exercise. This study investigated if the music tempos of no music, 70 bpm, 120 bpm, and 170 bpm caused Russian Dwarf Hamsters (*Phodopus campbelli*) to run a wheel. The average rotations for the control no music was 121, the average rotations for 70 bpm was 125.3, 120 bpm 146 and the average rotations for 246.7 for the tempo of 170 bpm. The data was run through an Analysis of Variance test and the p-value that was calculated was 0.0008, and that showed that there was a difference between the means. This experiment is significant because the data from this shows that if people were to play a faster song while exercising, they would be more active than music with a slower tempo.

The Effect of Caffeine on Heart Rate of *Daphnia magna*

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Caffeine is an alkaloid with the chemical compound of $C_8H_{10}N_4O_2$. Caffeine can cause positive and negative effects. It is said that caffeine helps enhance performance, cure some diseases like Parkinson disease and can help lose weight and boost energy. Caffeine is found in NoDoz, coffee, tea, some soft drinks, and analgesics. The average American consumes 230 milligrams of caffeine per day. Doctors recommend limiting caffeine consumption to 200 milligrams per day. *Daphnia magna* are small crustaceans. *Daphnia magna* are transparent so you can see the beat of their heart and can measure their heart rate easily. *Daphnia magna*'s heart rate and eating quantity measures the stress of the *Daphnia magna*. The purpose of the experiment was to find the effect of caffeine on heart rate of *Daphnia magna*. The null hypothesis was if caffeine amount is increased, the heart rate of *Daphnia magna* will stay the same. The research hypothesis was, if caffeine amount is increased, then the heart rate of *Daphnia magna* will also increase. In order to test this experiment, a solution with caffeine was made and the *Daphnia* sat in the solution for thirty minutes. Then their heart rate was found using a microscope. The null hypothesis was rejected when comparing amounts with a 50 mg/L difference, for example 0 mg/L (control) and 50 mg/L, or 25 mg/L and 75 mg/L, ($t = 2.306 < 2.49$ at $df = 8$; $p > 0.05$), ($t = 2.306 < 4.57$ at $df = 8$; $p > 0.05$), ($t = 2.306 < 3.858$ at $d = 8$; $p > 0.05$), but was accepted when comparing 0 mg/L to 25 mg/L, or 25 mg/L to 50 mg/L, or 50 mg/L to 75 mg/L. This suggests that the minimum amount needed for caffeine to have an impact on the heart rate of *D. magna* is 50 mg/L. The research hypothesis was accepted.

BOTANY

FIRST PLACE

The Effect of Ultraviolet Radiation and Nitrogen Fertilizer on Nodulation and Growth of *Phaseolus vulgaris*

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The purpose of this experiment was to determine if ultraviolet radiation and nitrogen fertilizer affect nitrogen fixation and growth of *Phaseolus vulgaris*. The hypothesis stated that the plants with no ultraviolet radiation and no fertilizer would show the most nodulation, height, leaf area, and chlorophyll content and the plants with UV-B radiation and fertilizer would show the least nodulation, height, leaf area, and chlorophyll content. The *Phaseolus vulgaris* seeds were inoculated with *Rhizobium leguminosarum*, placed in autoclaved soil, and were allowed to grow under identical conditions. Once the plants had grown for 21 days, the plants were divided into experimental groups, each plant receiving UV-B, UV-A, or no radiation and either nitrogen fertilizer or no fertilizer. After 32 days, the height, leaf area, chlorophyll content, and nodule mass were measured. The results supported parts of the hypothesis. There were significant differences in nodulation between the plants with and without fertilizer and in height between plants with UV-A radiation and plants with UV-A or no radiation. There was a significant difference between the plants with UV-B radiation and fertilizer and the other plants; however, it was opposite of the hypothesis. The null hypothesis was supported in the leaf area results.

SECOND PLACE

The Effects of Cold Storage and Different Fertilizer Treatments on Venus Flytraps (*Dionaea muscipula*) Germination and Growth

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Venus Flytraps (*Dionaea muscipula*) are carnivorous plants that are native to North and South Carolina. These plants have been listed by the International Union for the Conservation of Nature's (IUCN) Red List as a vulnerable species. In order to sustain this rare species, cold storage is a common method for preserving plant germplasm. Therefore, the first part of this study tested the effects of the length of cold storage on Venus Flytrap's germplasm germination. In this experiment, it was found that the Flytrap seeds' germination rates decreased for every year spent in cold storage. Furthermore, since Venus Flytraps obtain the most essential nutrients from their prey, an understanding of the optimal fertilizer treatment for these plants has attracted little research in the past. A test was conducted on the mean growth rates of Venus Flytraps cultivated outside of their natural habitat under different fertilizer regimens. It was found that a mixture of nitrogen, potassium, and phosphorus compounds was most beneficial to Venus Flytrap growth, followed by nitrates and potassium fertilizers. Phosphate fertilizers were shown to have little effect on Venus Flytrap growth.

THIRD PLACE

The Effect of Electricity on the Growth of Plants: 2

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Electricity is used in many everyday needs, but has anyone ever thought of using electricity for plant stimulation and growth? The purpose of this study was to determine the effect of AC (alternating current) and DC (direct current) electrical current on the growth of radish sprouts. Overall, 30 trials were present in the experiment;

ten pots each for the control, AC group, and DC group. Each pot contained one radish sprout. Both the AC and DC pots were connected to their own parallel circuits, which were hooked up to variable power supplies and a timer. The control pots were left alone, without any circuit. All pots were watered equally for 14 days and exposed to direct sunlight. The AC and DC circuits ran for an hour each day. At the end of the 14-day experiment, the DC plants grew at about 20 percent of the control plants. This result was significant due to an ANOVA test. Also, the results statistically showed that plants exposed to AC current had no effect compared to the control. Thus, the hypothesis was rejected that if AC current were applied to the plant, then it would stunt the growth, and if DC current was applied to the plant, then it would stimulate the growth. One explanation is that DC electrical current electrocuted the radish plants, therefore damaging the cells of the plant, and stunting the growth.

HONORABLE MENTION

The Effects of Synthetic versus Non-Synthetic Mulches on the Growth of *Beta vulgaris*

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The amount of mulch necessary to be applied to soil can significantly vary. Mulch can consist of any synthetic or natural material. It is useful when applied to *Beta vulgaris*, which has the common name of the beet. Although non-native to the U.S., beets are a popular food source. The purpose of this project was to determine how synthetic mulches and non-synthetic mulches affect the growth of *Beta vulgaris*. It was hypothesized that if the hardwood mulch was used, then the growth of *Beta vulgaris* increased. The null hypothesis stated that the type of mulch had no effect on the growth of *Beta vulgaris*. In the procedure, soil and seeds were applied to each of 100 cups. To all cups except the control, mulches were applied. The experimental groups were no mulch (control), paper mulch, rubber mulch, and hardwood mulch. The plants were watered periodically. After 42 days, the plants were measured according to their height, their canopy, the length of their root, the length from the root to their longest leaf, and their combined length. The control produced the tallest, longest plants, and the plants with the greatest combined length, with means of 2.79, 5.09, and 7 centimeters. The non-synthetic hardwood mulched proved to be the most effective in the canopy and root length tests, with means of 1.98 and 2.34 centimeters. The null hypothesis was usually accepted in half of the t-tests. The research hypothesis was accepted only in the canopy and root length results. The varied moisture retention levels led to the varied results. The hardwood mulch allowed for a nearly perfect amount of water to permeate through the surface and the control allowed the most water to evaporate; this kept both from being overwatered.

HONORABLE MENTION

The Effect of Presence of Barley Straw on Growth of *Chlorella vulgaris*

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It was experimented to see the results of presence of barley straw on *Chlorella vulgaris*. Eutrophication is the process in which excess nutrients in water cause major harm to an ecosystem, resulting in algal blooms and ultimately killing the fish in the water. The purpose of this experiment was to see if barley straw-soaked water would stop the growth of *C. vulgaris*. The control was barley straw, because it stopped algae growth by the previous year's project. First, barley straw and algae were grown in water for one week. Then, five grams of barley straw was put into one pan of algae. The barley-soaked water was put into another pan with algae. Algae had starting absorbance of 0.9 absorbance units (AU). The absorbance was taken for 25 of normal barley straw and 25 of barley-soaked water with a spectrophotometer after first week and second week. Both barley straw and barley-soaked water reduced the absorbance of the algae, so both reduced algae growth. However, the barley-soaked water was not as effective during the second week. The null hypothesis was that barley-soaked water did not have any effect on algae growth. This was rejected because the calculated t was higher than the table t. Also, the data was statistically significant, so it was probably not due to chance. The barley soaked water probably lost effectiveness because it ran

out of chemicals. Barley straw had a consistent supply. For the future, there should be a better method of measuring growth of algae.

HONORABLE MENTION

Phytoremediation: To Mutate or Not to Mutate?

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The purpose of this project was to determine whether tomato plants with the brt mutation phyto remediate more effectively than wild-type tomato plants and if phyto remediation has any detrimental health effects to either type of plant. The hypothesis was that tomato plants, mutated to increase root length and size, would phyto remediate more effectively, with greater negative health effects, when 5 mg of dicofol was applied, than wild-type tomato plants. Phyto remediation ability was measured using a mustard bioassay and laboratory analytical testing. Plant health was determined by measuring chlorophyll concentration, leaf area, and plant height tests. Results showed that phyto remediating did not significantly affect plant health of mutant or wild-type plants. The average chlorophyll concentration of the mutant was 1.4353 mg, while the wild-type tomato had a value of 2.628 mg. Differences between the data sets were statistically significant. The bioassay and GC/MS both showed that phyto remediation did not occur in either type of tomato plant. There was 0.63 mg/kg concentration remaining in wild-type plants, and 0.29 mg/kg in mutant plants, showing that the mutant plants had the least amount of dicofol remaining in the soil. However, the soil controls had only 0.52 mg/kg and 0.19 mg/kg, suggesting that microbe bioremediation may be at work. Roots remaining in the soil after plants were removed may explain this finding. Significantly more dicofol was removed in the mutant tomato plants when compared to wild-type plants. A potential reason for this phenomenon was the branching and quantity of roots in the mutated tomatoes.

The 'Shrooms Have Ears

Bryna Butt

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This experiment was based upon a combined interest in music and mushrooms. There have been numerous studies on mushrooms previously, but few have dealt with music, unlike the many studies that have investigated the effects of music on plants. A hypothesis was made based on knowledge gathered from other sources that said mushrooms grow better with thunder. So, music was selected to play to the mushrooms based on the amount and intensity of their beats. In the end, as expected, the mushrooms did not grow any better with the soothing beat-less tunes than they did in the control without any music at all. They grew best with Rave and Rock and Roll. It cannot be said that this experiment will change the world, but for those out there who grow mushrooms commercially or for fun, perhaps they can help their 'shrooms by playing some cool Rock or Rave tunes.

The Effect of a Heat Shock on the Height, Leaf Number and Dry Weight of Mutant and Wild Type *Arabidopsis thaliana*

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The purpose of this experiment was to see the effect of a heat shock on mutant and wild-type *Arabidopsis thaliana*. This experiment was conducted by a high school student in Virginia during November and December of 2010. All of the plants were grown under the same conditions for fifteen days. On the sixteenth day three pots of wild-type and mutant *Arabidopsis thaliana* were exposed to a heat shock. This heat shock took place for two hours in a 45 °C incubator. The plants were then taken out and grown under normal growing conditions for the remainder of the five weeks. The plants were given about 20 ml of water three times a week; the leaf number and height were

also collected three times a week. The dry weights of the plants were collected after five weeks. Three one-way ANOVAs were used to analyze the leaf number, height (cm), and dry weight (g) of the mutant and wild-type *Arabidopsis thaliana*. The ANOVA on the leaf number produced a p-value of 0.526844 which is larger than the alpha level of 0.05; these results supported both the original and null hypotheses. The ANOVA on the height produced a p-value of 5.39277E-11. The original and null hypotheses were not supported by the height data. The final ANOVA on the dry weight had a p-value of 0.008865. The original and alternate hypotheses were supported for the dry weight. In conclusion, heat shock had a significant effect on the dry weight and height of *Arabidopsis thaliana* causing lower p-values for both, but had no effect on the leaf number.

The Effects of *Pseudomonas fluorescens* on the Effectiveness of Inorganic and Organic Fertilizers in *Vigna radiata*

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The purpose of this project was to determine the effects of *Pseudomonas fluorescens* (*P. fluorescens*) on the effectiveness of inorganic and organic fertilizers in *Vigna radiata*. *P. fluorescens* is a nonpathogenic saprophyte (organism that obtains nutrients from organic matter). Inorganic fertilizers (fertilizers composed of synthetic compounds) have gained popularity because inorganic fertilizers make essential nutrients to plants readily available sooner than organic fertilizers are able to. The hypothesis tested was if *Vigna radiata* plants are given inorganic fertilizer, organic fertilizer, inorganic fertilizer with *P. fluorescens*, or organic fertilizer with *P. fluorescens*, the plants given organic fertilizer with *P. fluorescens* should fare just as well, or better than those in the inorganic fertilizer groups in terms of their heights, root lengths, and masses because *P. fluorescens* should aid the plants in decomposing organic matter present in the soil. The groups requiring bacterial treatments were inoculated with *Pseudomonas* by means of a nutrient broth solution. After the soil was inoculated, three germinated *Vigna radiata* seeds were placed in each pot. The pots were left to grow in plant labs for two weeks. After the growth period, the root length, stem length, and mass of each plant were measured and analyzed using an analysis of variance. The average root length, stem length, and mass for the plants in the *Pseudomonas* organic group were higher than those of the organic control and the inorganic groups. The soil type was significant ($p < 0.001$ for all the data sets), but the bacterial treatment was not significant. The hypothesis was rejected.

The Effect of Microwave Radiation on the Germination of Radish Seeds

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The beginning of development in a seed is called germination. The seed begins to germinate after a resting period, called dormancy. Light, temperature, time, moisture and genetic factors can determine the length of dormancy in a seed. The percentage of seeds that survive can decrease due to temperature increase. Microwaves use microwave radiation to heat polarized molecules inside the food. Microwave radiation effects on seeds could depend on the frequency of radiation, exposure period and environmental conditions of the seed. The purpose of this project was to determine the effects of microwave radiation on the germination of radish seeds. Six groups of twenty radish seeds were each microwaved at different time intervals, 15 seconds, 30 seconds, 60 seconds, 120 seconds and 240 seconds, except for the control group which received no radiation. The seeds were observed and counted after two weeks to determine the results. A chi-square test performed on the data indicated that less radiation is healthier for a germinating plant, (Chi-square=4.15<11.070 at df= 5; $\alpha=0.05$), shown by means of eighteen seeds germinating out of twenty for both the control group and the group receiving 15 seconds. From there, the seeds means decreased except for the group receiving 120 seconds of radiation, which had a mean of 17 seeds. The data was proved not significant by the chi-square test and supported the null hypothesis that microwave radiation had no effect on radish seed germination. Therefore, the data did not support the research hypothesis. It can be concluded that microwave radiation has no correlation with radish seed germination. Based on the amount of radiation and the means of the data, there appears to be a slight correlation between the two. Before it can be concluded that microwave radiation does not assist germination, further studies need to be conducted to prove that radiation is not good for all seeds, not just radish seeds.

The Effect of Irradiation on the Germination Time of Radish Seeds

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Irradiation is the exposure of matter to radiation. Plant germination is the process in which a plant seed sprouts. Irradiation is known to have certain effects on how plants seem to grow and develop. More specifically, irradiation can affect how long it takes a seed to germinate. The purpose of this experiment was to determine the effects that irradiation can have on the amount of time it takes for a radish seed to germinate. Germination time is thought to increase with the increase of irradiation doses that are deposited in the seeds. The research hypothesis stated that if the amount of irradiation in the seeds was increased, then the seed germination time also increased. The independent variable in this experiment was the amount of irradiation that was deposited into the seeds. The levels in the experiment were the radish seeds with no irradiation (control) and the ones with 50 mrads, 150 mrads, and 500 mrads of irradiation. The dependent variable was the germination time of the seeds, which was measured in days. A specific set of steps was then used in order to successfully conduct the experiment and test the hypothesis. Seeds that were treated with the highest amount of irradiation (500 mrads) exhibited a greater mode (8 days) than seeds without irradiation (4 days). The t-test was used to test the following null hypothesis at a 0.05 level of significance: the mean germination time of irradiated seeds is not significantly different from the mean germination time of non-irradiated seeds. The most important comparison was that of the control group and the final experimental group, which contained seeds with 500 mrads of irradiation ($t = 33.874 > 2.011$ at $df = 48$; $p < 0.05$). Therefore, the data supported the research hypothesis that if the amount of irradiation in the seeds was increased, then the seed germination time also increased.

The Effect of Gibberellic Acid on the Carbon Dioxide Consumption of *Brassica rapa*

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Gibberellic acid (GA_3), a plant hormone that promotes growth, can be applied to the leaves of plants, which are the structures involved in the uptake of carbon dioxide (CO_2) during photosynthesis. The purpose of this experiment was to determine the effect of GA_3 on the CO_2 consumption of *Brassica rapa*. The experimental hypothesis was that if the number of drops of GA_3 increases, then the CO_2 consumption increases was not supported. The null hypothesis that as the number of drops of GA_3 has no effect on CO_2 consumption was rejected. Ten trials were conducted with the levels of zero, one, two, three, and four drops of gibberellic acid. After the proper volume of gibberellic acid was applied, a carbon dioxide probe was used to measure the volume of carbon dioxide. The major finding was that CO_2 consumption was significantly greatest at the level with two drops of GA_3 (ANOVA, $p = 0.0001$). A possible explanation for the findings is that two drops of GA_3 , when applied to the leaves of *B. rapa*, causes the leaves to expand, therefore creating more stroma to take up carbon dioxide during the light-independent reactions of photosynthesis. The results support the idea that GA_3 could help slow global warming.

The Effect of Seed Size on the Dispersal Distance of the Seeds of Twelve Plant Species in the Dyke Marsh

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The Dyke Marsh, located in Alexandria, Virginia, is a freshwater tidal marsh and is a recipient to the flowing of the Potomac River. Although numerous surveys and experiments have been performed with plants in the Dyke Marsh, little is known about the seeds that produce these plants. The purpose of this experiment was to study seeds from the Dyke Marsh in Alexandria, Virginia and to determine if the size of the seed varies with the seed dispersal distance with consequences on the dispersal pattern. This study incorporated the use of the seeds of 12 plant species prevalent in the Dyke Marsh. The terminal velocity, which has implications on the dispersal distance, was measured by a seed dropping method. The time it took the seeds to complete a fall of 2.4384 meters was measured and divided by the height that the seeds were dropped from. The major findings of this experiment were that as the seed size, as determined by the mass and the length, increased, the terminal velocity also increased. *Hibiscus moscheutos* exhibited the greatest mean terminal velocity (3.36 m/s) and *Sagittaria latifolia* exhibited the

lowest mean terminal velocity (1.33 m/s). The implications state that if the terminal velocity is greater, then the horizontal dispersal distance will be less and the seed will fall closer to the adult plant.

The Effect of the Different Types of Acidic Solutions used in the Process of Scarification Prior to the Sowing of Lettuce Seeds on the Seeds' Germination Rate

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In recent years, there has been a significant growth in the human population. In order to accommodate for this notable growth in the human population, it is important to produce an efficient surplus of food using natural resources. The purpose of this experiment was to determine the effect of the different types of acidic solutions used in the process of scarification prior to the sowing of lettuce seeds on the seeds' germination rate. The different acidic solutions used in this experiment include no solution, distilled water, vinegar, and hydrogen peroxide. Four groups of ten lettuce seeds were each soaked in an acidic solution for ten minutes and individually planted in twenty ceramic planting pots. Over a three-week testing period, these four groups of lettuce seeds were each allowed to germinate in a controlled environment. The results indicated that the group of lettuce seeds that were soaked in hydrogen peroxide prior to being sowed had the greatest germination rate with a mean of 8.4 seedlings. The data supported the research hypothesis that soaking lettuce seeds in an acidic solution prior to sowing increases their rate of germination. Based on the germination rates of the lettuce seeds determined in this experiment, there appears to be a direct correlation between the acidity level of the solutions and the seeds' rate of germination. Before it can be concluded that soaking the seeds in hydrogen peroxide prior to sowing increased their rate of germination, similar experiments in which different types of seeds are used must be conducted in order to determine whether the process of scarification using hydrogen peroxide promotes germination in all types of plant seeds.

The Effect of Time Variance during Soaking on the Speed and Frequency of Bean Germination

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Beans are used worldwide as a major food staple. They provide much needed protein needed for bodies to function. A more efficient way to grow bean seeds could significantly decrease world hunger and increase the world food supply. The purpose of the experiment was to find how long beans should be soaked in order to grow faster and more prolifically. The hypothesis was if the bean seeds were soaked in water for 24 hours prior to being planted, then they would germinate more prolifically and with greater frequency than seeds that were soaked for other amounts of time. This hypothesis was chosen because seed directions usually instruct gardeners to soak seeds overnight (roughly 12 hours). However, more soaking time would soften the seed even more, which could help speed the germination process. To test this hypothesis, 120 bean seeds were separated into 4 groups of thirty and soaked for zero, 12, 24, and 36 hours, respectively. They were then placed on a tray with damp paper towels and covered with plastic wrap to contain moisture. They were lightly misted daily. A chi-square was used to determine the significance of the data. The null hypothesis was rejected ($\chi^2 = 28.56 > 3 = df$). When the final results were tabulated, the seeds soaked for 36 hours were the most prolific, followed, in order, by the seeds soaked for 24 hours, 12 hours, and zero hours. It was concluded that as the time spent soaking increased, more water infiltrated the permeable seed membrane, causing the seeds to begin to grow from the inside of the coating. This allowed them to break through the seed coating early, or in many cases, at all. Another experiment on this topic could measure data such as masses before and after planting. Another possible improvement could have been to use soil as a medium for sprouting instead of paper towels.

The Effect of Soil Salinity on the Height of *Achillea millefolium*

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Achillea millefolium is a plant that is commonly used for herbal practices as medication for the sick. These perennial shrubs are known for growing in cold weathers in the Northern American region. The purpose of this experimentation was to figure out the effect of soil salinity on the height of *Achillea millefolium* (yarrow plant). The independent variable levels were 0 grams (control), 12.5 grams, 30 grams, 55 grams, and 75 grams of Epsom salt. To complete the experiment, first the appropriate amounts of Epsom salt were added to the soil mixture. Then, throughout the two week period of experimentation the yarrow plants were checked on multiple times to determine the plant growth since the first day the seeds were embedded in the soil. The results of the experimentation did not support the research hypothesis of if 12.5 grams of Epsom salt were added to the soil mixture, then the *Achillea millefolium* plant will have an increase in the height. The results indicated that the less Epsom salt added to the plant (control), the more increased height it would obtain. A t-test was conducted to display the significance between the means of all the independent variable groups ($t=30.39583>2.101$; $t=39.73495>2.101$; $t=35.0421>2.101$; $t=35.18671>2.101$ at $df=18$; $p<0.05$). Based on the research and the experimentation, the correlation between the amount of Epsom salt and *Achillea millefolium* is not a very heavy link. There are higher chances for yarrow plants to survive if the condition it survives in involves less Epsom salt. Just like conducted in the experiment the control with no Epsom salt had the highest mean for plant growth compared to the other plants with more Epsom salt added to it.

The Effect of Melatonin Concentration on *Brassica rapa* Pollen Production

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Does melatonin have similar effects on plants, as the hormone does on mammals? The purpose of this experiment was to determine the effect of melatonin concentration on *Brassica rapa* pollen production. The experimental hypothesis was that as melatonin concentration was increased, *Brassica rapa* pollen production would decrease, and the null hypothesis was that pollen production would not change. The levels of the independent variable, melatonin concentration, were 0.0, 0.002, 0.004, 0.006, and 0.008 milligrams per milliliter (mg/mL) of melatonin in the water given daily, and the control was 0.0 mg/mL. For each level, 15 plants were treated. The dependent variable, pollen production, was measured by the mass of a random stamen chosen from each trial. A single *Brassica rapa* plant was grown in each basin of an egg carton, and the plant was watered with melatonin for 23 days after germination. After all flowers had bloomed, they were picked off and stored for six days to dry, and then a random stamen was chosen to be weighed. The major finding was that as melatonin concentration increased, *B. rapa* stamen mass did not significantly change ($p=0.2823$). A possible explanation for the findings is that melatonin does not affect the pollen production of this specific genetically engineered species. According to the data, releasing melatonin into an environment will not produce an abnormal volume of pollen, and this knowledge can be useful to scientists studying melatonin effects on plants and animals in the field to be sure the vegetation will not be affected.

The Effect of the Number of Companion Plants on Height of Wisconsin Fast Plants

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The purpose of this experiment was to test which number of companion plants made Wisconsin Fast Plants grow the tallest. Wisconsin Fast plants are genetically engineered plants that complete their life cycle in three to four weeks, making them ideal for small projects. Companion planting is when two plants are grown together so that they benefit from each other's nutrients, making each one grow taller and healthier. There were four dependent variables in this experiment: zero (the control), one, two, and three sweet potato seeds used as the companion plants. The hypothesis stated that if three companion plants were used, then the Wisconsin Fast Plants would grow the tallest. The experiment was conducted in a classroom at Washington- Lee High School, in a controlled environment. Each plant was placed under direct light. The plants were planted, measured, and watered every day. In the end the

hypothesis was proven wrong. In fact, the group with three companion plants had the lowest average height of 7.275 centimeters. The group with the highest average was the group with two companion plants with an average of 10.805 centimeters. This may have occurred because there were too many companion plants for the one Wisconsin Fast Plant. The nutrients being exchanged between the two plants may not have been balanced. There may have been too many nutrients coming from the sweet potato seeds, and not enough from the Wisconsin Fast Plant. In conclusion, growing Wisconsin Fast plants with two sweet potato seeds as the companion plant will make the Fast plants taller and healthier.

The Effect of Chlorine on Soy Bean Germination

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In Asia, soybeans are consumed as fries are today, but the growing process is extremely slow for private gardeners and farmers. The study of enhancing germination in the hopes of speeding productivity has been going on for centuries, though chlorine had not been present in Asian well waters until recently. Chlorine takes away many plant micronutrients that are beneficial for growth, but also performs a cleaning effect on liquids that it mixes with. The purpose of this experiment was to clarify whether the element aids or hinders soy bean growth, as it is present in most farming waters all over the world. It was conducted with a research hypothesis of chlorine will stunt germination time of soy beans. Each trial consisted of six levels, each with a 5% increase in chlorine level from the one preceding it, starting with the control of 0% chlorine and 100% pure water. Two-hundred milligrams of liquid were present in each of six clay bowls, with a hundred soy beans used for experimenting per level. Two trials were conducted at each time, with a total of ten trials that lasted for ten days – two days per trial. After forty-eight hours, the bowls were checked for germination and data was recorded based on how many soy beans displayed split cotyledons and a sprout. The results indicated that chlorine created a significant difference between the means of the groups ($t=3.179 > 2.101$ at $Df= 18$; $p < 0.05$), supporting the research hypothesis that chlorine affected growth. Based upon the results, chlorine insignificantly affects soybean germination by stunting it in small quantities and aiding it in large quantities. However, the soybeans receiving no chlorine displayed the swiftest growing. Before it could be concluded that chlorine is not harmful to soy crops, this experiment should be performed in a laboratory with soil and pure water instead of tap water. Then, all external influences that affect plant growth would be greatly reduced.

The Effect of Radiation and Soil Composition on the Growth of *Arabidopsis thaliana* Wild Type and Mutant

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The purpose of this research was to analyze the effects of the deactivation of the p80 gene and variable soil conditions on the growth of *Arabidopsis thaliana*. This research was conducted by a high school student from November 2010 thru December 2010 at a local high school. Mutant p80 and wild-type *A. thaliana* were grown in Sun-Gro 300 series and composted soils which were both radiated and unirradiated and measured for widest rosette width for a five week period. A two-way ANOVA performed using an alpha level of 0.05 after the experiment produced significant p-values of 2.5017E-07 and 1.5212E-08 for the p80 mutant and soil conditions respectively, but found no interaction between them. The p80 mutant *A. thaliana* was shown to have less general growth than the wild-type and, after a follow-up one-way ANOVA and Tukey Test using a Dmin value of 8.2, radiated composted soil was shown to cause significantly less rosette growth than all other soil conditions. These results supported the original hypothesis that the p80 mutant *A. thaliana* would exhibit decreased growth as compared to the wild and supported the hypothesis that *A. thaliana* would experience a change in growth in soil exposed to radiation but only in respect to the 2/3 composted soil. In conclusion, it was found that the p80 mutant *A. thaliana* showed decreased rosette growth in comparison to the wild-type and that *A. thaliana* showed less rosette growth in composted soil grown exposed to gamma radiation.

The Effect of Seed Scarification on Germination of *Cercis canadensis* Seeds

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The purpose of this experiment was to find the effect of seed scarification on germination of *Cercis canadensis* seeds. Recently, studies have been conducted on *C. siliquastrum* seeds to increase germination by breaking physical and physiological dormancies; these tests could be used on the similar *Cercis canadensis* seeds, which are important because they can live in semi-arid and high pollution areas. It was hypothesized that if the seeds were exposed for 90 minutes of seed scarification, then they would have the highest germination rates. Seeds were put into 5 groups of 25 seeds. Each group was subjected to 0, 30, 60, 90, and 1440 minutes of scarification. The seeds were checked for germination every other day for a 28 day period. The control used in the experiment was the seed group that received 0 minutes of scarification. The results revealed that scarification had little impact on the seeds. The mode for each level was ungerminated and each level had 0 seeds ungerminated and 25 germinated. A chi-square test was performed on the data and it revealed that each level versus the expected was statistically significant. The results did not however support the research hypothesis. It is believed that the results were caused by the amount of time for the experiment. The seeds needed to be scarified for a longer period of time before they could germinate. The research could lead to further studies like the effect of scarification on germination of *Cercis canadensis* and how scarification affects other seeds.

The Effect of Water Temperature on Germination Rates of *Raphanus sativus* Plants

Yichen Yang

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The *Raphanus sativus* plant is a member of the Brassicaceae family of edible root vegetables. It is a hardy plant that germinates quickly and is often the preferred choice for beginning gardeners. The recommended soil temperature for these plants is around 60-70 °C, however nothing is stated about the ideal water temperature. Water that is too hot may cause the roots to wither, and water that is too cold will shock the seed and prevent it from germinating. The purpose of this experiment was to determine the effect of water temperature on germination rates of *Raphanus sativus* plants. Forty seeds were planted in forty plastic containers that contained 5.5 centimeters of fertilized soil. The seeds were watered every other day with varying water temperatures of 16 °C, 27 °C, 38 °C, and 49 °C. The results were recorded into the data table each day. The results indicated that the mean rate of germination for plants watered with 16 °C was 3.5 days. The mean rate for the water temperature of 27 °C was 4.2 days, for 38 °C was 4.6 days, and for 49 °C was 4.7 days. Based on these results, the researcher can conclude that the data supported the research hypothesis, which states that if the water temperature is 16 degrees Celsius, then the rate of *Raphanus sativus* plant germination will increase. Therefore, the most suitable water temperature for *Raphanus sativus* plants is 16 °C. This is relative to the recommended soil temperature, which is also around 16 °C. From these results, the experimenter can conclude that while the water temperature may rise or cool after being poured into the soil, its original temperature should not bear a sharp contrast from the soil temperature or else it may shock the seed, thus preventing it from germinating. Further experimentation with different types of plants and temperatures should be conducted before determining a general water temperature that is recommended.

CHEMISTRY A

FIRST PLACE

The Pharmacophore Guided Identification of Novel Inhibitors of Neurotoxin Biological Threat Agents **Prasana Joshi**

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The primary purpose of this project was to find novel inhibitors of the botulinum neurotoxins serotype A light chain (BoNT/A LC) using database mining and pharmacophore mapping techniques of an inhibition template. Botulism is a rare but serious paralytic illness caused by *Clostridium botulinum* bacteria. Due to the lethal properties of the botulinum neurotoxins serotype A (BoNT/A LC), they are listed as a category A biothreat agent by the Centers for Disease Control and Prevention. Hence, there is increasing interest in discovering and developing small molecule drugs to treat the symptoms and counter the proteolytic activity in the neuronal cytosol caused by the SNARE complex. The pharmacophores employed in this study were designed and used to database mine a variety of novel inhibitor chemotypes from a commercially available database containing 50,000 compounds. An original pharmacophore was established with distance constraints and a search query was executed, followed by a secondary substructure search query to find novel inhibitors of BoNT/A LC. The high-throughput screen found that compounds 406-2_F004, 403-2_C009, and 047-2_C005 were the most effective inhibitors of the deadly neurotoxin BoNT/A LC with a percent inhibition of 100%, 56%, and 50% respectively. It was believed that the high percent inhibition of the novel inhibitor compounds found by the two-process search queries could be possibly due to their similar substructure cores. The novel inhibitor chemotypes identified during the study form the basis for the development of new, and potentially viable therapeutic counter measures to treat the most deadly of biological toxins known to humans.

SECOND PLACE

Effect of Filters on Hydroxide Concentration in Biodiesel Production **Arjun Jaini**

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Diesel fuel is a non-renewable energy source that has an increasing demand and a decreasing supply. Biodiesel is a sustainable and renewable alternative fuel chemically produced from vegetable oil, and most commonly, waste vegetable oil. Transesterification is the chemical reaction that converts vegetable oil into biodiesel. Byproduct contaminants (glycerol and soaps) are also formed during transesterification and must be removed by filtration. Water washing, the traditional method of filtering biodiesel, is being replaced by ion exchange resins (IERS). IERS are filters that trap contaminants by exchanging ions. This experiment's purpose was to determine which commercially available IER could remove more contaminants by testing the effect of filtration material on the Hydroxide Ion concentration in biodiesel production. The results could assist biodiesel producers in selecting the most effective IER to filter biodiesel. For this experiment, the Hydroxide Ion concentration of biodiesel was measured by converting waste vegetable oil to biodiesel, and then filtering the biodiesel using IERS. The amount of biodiesel the IER was expected to clean was called the "Ionic Resin Washing Ratio". The hypothesis tested was if the Ionic Resin Washing Ratio was higher, then the amount of Hydroxide Ion contaminants removed from biodiesel would increase, as measured by the pH. Amberlite BD10 was the most effective ion exchange resin although it did not have the highest Ionic Resin Washing Ratio. Thus, the hypothesis was not supported. The results showed that Amberlite BD10 is more effective than the other commercially available ion exchange resins tested in this experiment.

THIRD PLACE

The Effect of Electroplating Keys with Different Metals on the Mass of the Keys

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This experiment was conducted in order to determine the most effective metal to use for electroplating. The most effective metal was determined by which one added the most mass to the brass keys serving as the cathode, or the object being plated. It was believed that copper would be the most successful, accumulating the most metal on the brass keys. All materials were gathered, including the batteries, metal salts, metal cathodes, and brass keys. The keys were massed and all of the battery and electrolyte apparatuses were prepared. Wires were attached to each end of the batteries and firmly taped. Basins were filled with a mixture of acetic acid and distilled water. Five grams of copper (II) sulfate were added to each of the electrolyte solutions and the copper anodes and keys were submerged for fifteen minutes. The same process was repeated for the zinc and nickel trials. The control trials were simply keys submerged in water and acetic acid with no anode. After time reached fifteen minutes, the keys were removed from the electrolyte, dried, and massed. Data was recorded and chemicals were disposed of. The copper plated keys had the highest mean difference from their original masses, meaning copper was the most effective. The nickel plating trials had the lowest mean, but were the most precise data in the experiment, because the standard deviation and variance were the lowest. The t-test revealed that the mean mass difference between copper and nickel was significant and the difference between zinc and nickel was significant. The difference between zinc and copper was not significant, however. This occurred because copper has a simple transfer process from the anode to the cathode; whereas the other two metals were either unpredictable or difficult to work with because of Faraday's Law of Electrolysis.

HONORABLE MENTION

The Effects of Solutions of Various *Camellia sinensis* Subspecies on the Accumulation of Minerals on Eggshells

Kaixin Chen

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The purpose of this experiment was to study how dental enamel accumulation on teeth is affected by varying fluoride concentrations in tea. Fluoride is important because, many dental problems occur when there is an excess or lack of fluoride. In this experiment, different varieties of tea and distilled water were used to induce the development of minerals on egg shells, which were used to simulate teeth. This was measured by calculating the changes in mass of egg shells. It was hypothesized that, "There is a positive correlation between the relative concentrations of fluoride in varying types of tea and the accumulation of minerals on the eggshells." The control group, distilled water, had the least change in mass, and the black tea group had the greatest. Green tea had the second greatest, followed by oolong tea and white tea. Statistical analysis of the data indicated that that the results were statistically significant. The results supported the research hypothesis. It was concluded that each tea produced a different mass change due to the growing conditions and time of growth of the tea plants. The fluoride in the tea replaces the hydroxyls in hydroxyapatite, resulting in the formation of fluorapatite.

HONORABLE MENTION

Caspase-3 Induction by Staurosporine and Spermine NONO-ate

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The purpose of this experiment was to determine which chemicals induce apoptosis and which ones induce necrosis in rat lung macrophage cells. Previous researchers had already found that Staurosporine induces apoptosis and Spermine NONO-ate induces necrosis so this research was conducted to potentially verify their findings. The

hypothesis was that Staurosporine would cause apoptosis and Spermine NONO-ate would cause necrosis. Whether apoptosis or necrosis occurred was determined through the use of a caspase-3 assay. After the cells were cultured and had sufficient time to grow, either Staurosporine or Spermine NONO-ate was added to them at different concentrations. Then the cells were treated with the caspase assay and run through either a Fluorostar microtiter plate reader or a Cary Eclipse Fluorescence Spectrophotometer. Regardless of which instrument was used, it reported the amount of caspase activity in the rat lung macrophage cells. For the trial involving Staurosporine, 1.135 AU of caspase activity was found in the cells containing no Staurosporine while the cells that received the highest concentration of Staurosporine (3 μm) had a caspase activity of 61.313 AU. This meant that there was caspase activity and that apoptosis did occur. For the trials involving Spermine NONO-ate, there was hardly any caspase activity in the cells in either of the trials no matter what concentration was added. This indicated that necrosis occurred and that conclusion was supported by standard deviation and an ANOVA test. The final conclusion was that the initial hypothesis was correct - Staurosporine causes apoptosis and Spermine NONO-ate causes necrosis.

HONORABLE MENTION

Gadolinium (III) Polymer Nanobeads for Potential MRI Contrast Agents

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Nanoparticles are known to have a variety of applications, such as therapeutic, contrasting, and imaging agents. In the medical field, drugs are held inside nanoparticles to prevent the drug from degradation when it is inserted in the human body. Recently, it has been known that gadolinium complexes increase the contrast efficiency of magnetic resonance imaging (MRI) contrast agents. Gadolinium nitrates are soluble in water, which enables the compound to easily alter the relaxation of hydrogen, increasing viscosity, and thereby, increasing contrast efficiency. T1 Relaxivity shows brightening effects, whereas, T2 shows darkening effects. Gadolinium is toxic, and therefore, is made into chelates, where it binds between two polydentate ligands. The purpose of this project was to synthesize a $\text{Gd}_2(\text{MA})_6(\text{cphen})_2$ nanobead. In order to synthesize the nanobead, a bulk polymerization was conducted to find the appropriate ratio of the monomer solvent to the $\text{Gd}_2(\text{MA})_6(\text{cphen})_2$ complex powder for the miniemulsion to take place after the polymerization. The infrared of spectra, powder x-ray diffraction pattern, and thermogravimetric analysis indicated that the gadolinium complex was successfully synthesized because it contained both necessary ligands, enabling the nanobead to be made correctly as well. The TEM image also showed that the nanobead was about 50 nm, an appropriate size for it to be inserted into the human body. Future work for the $\text{Gd}_2(\text{MA})_6(\text{cphen})_2$ nanobead project includes investigating whether this nanobead can actually increase contrast efficiency. One step for this process is to investigate whether the nanobead is water-soluble. Luminescence can also further contribute to the nanobead development.

Manipulation of Water States on the Contact Angles/Cleanness of Superhydrophobic Surfaces

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Recently there has been a great interest in the development of superhydrophobicity on a wide variety of surfaces. Water is one of the main causes of corrosion problems on most materials. The maintenance from corrosion caused by water often costs millions of dollars per year. The use of superhydrophobic coating would significantly reduce the probability of materials corroding. A superhydrophobic surface provides both a non-wettable membrane and a way for self-cleaning. Water that comes in contact with a superhydrophobic surface slides across the membrane with a larger contact angle than along a regular surface. The larger the contact angle with the surface the more clean a surface becomes. A water droplet along a superhydrophobic surface acts like Velcro; as a water droplet slides across, particles attach to it, cleaning the surface. The purpose of this experiment was to determine if manipulating water would produce different contact angles. It was hypothesized that room temperature tap water would produce the largest contact angle. De-ionized water, room temperature tap water, and boiling temperature tap

water were compared based on their contact angle along a superhydrophobic surface. One droplet of water was placed upon the surface and a picture taken. A program, ImageJ, with contact angle plugins measured the contact angles of twenty five separate trials for each independent variable. The hypothesis was supported and t-test showed that the mean value of the tap-water contact angle was significantly greater than that of de-ionized water and boiling temperature water. This research could lead to further study on how other liquids affect the cleanliness of superhydrophobic surfaces. Also further research on the flexibility of the membrane of superhydrophobic coating in order to incorporate this coating on items such as space suits, lab equipment, and lab garment.

Effects of Black Powder Mixture Ratios on Rocket Engine Thrust

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This investigation examined the effects of different black powder mixture ratios on the thrust, impulse, and burn time of black powder rocket engines. Six different mixtures were selected, primarily from historical ratios. Each mixture of Potassium Nitrate, Sulfur and Charcoal were measured by weight and mixed together. Individual rocket engines were hand rammed (packed) using a standard volume of the propellant mix and firework rocket ramming tools (ram rod, spindle and paper-based tube). Data collected from the rocket engine testing was acquired by use of a Vernier Duel Range Force Sensor and the Logger Pro program. The investigation found that there the historical mixtures of black powder had varying performance characteristics of Peak Thrust, Total Impulse, and Burn Time depending on the mixture ratio. The mixtures with higher Potassium Nitrate concentrations deliver higher acceleration levels are better suited for use in rockets where the payload is not fragile. Mixtures with lower Potassium Nitrate concentrations deliver low accelerations and are better suited for uses other than rocketry.

How Long Can You Glow?

Abby Boshart

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At the scene of a crime, the presence and location of blood can often lead criminal investigators to important clues that aid them in an investigation. One of the many ways that these investigators locate blood is with the chemiluminescent reaction of luminol. If investigators were looking for blood in a hot room, would they still find it? What about in a cold room? The purpose of this experiment was to find the effect of temperature on the amount of light produced by and the length of a luminol chemiluminescent reaction. The hypothesis was that if 50 °C water is used, then the amount of light produced will be greatest and the length of the luminol chemiluminescent reaction will be the shortest. This was hypothesized because of research found that explained how heat speeds up the rate and increases the intensity of a reaction. Luminol reactions with Hydrogen Peroxide and a Peraborate Mixture were tested with 50 °C, 30 °C, and 5 °C water. Two different oxidizing agents were used to show that changes in a reaction due to temperature were not exclusive to one type of reaction. The amount of time was measured with a timer in seconds and the amount of light was measured in lux with a light meter, built for this experiment. 50 °C water produced the greatest amount of light, a mean of 3.8 and 3.2 lux of light, the shortest reaction length, a mean of 18.7 and 130.6 seconds, and the hypothesis was accepted.

The Effect of Boiling on the Vitamin C Concentration in Broccoli

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The purpose of this experiment was to determine the effects of different boiling times on vitamin C concentrations in broccoli. Recently studies have shown that vitamin C may aid in the protection against cancer. Broccoli contains a high amount of vitamin C, but after cooking it has been thought that the vitamin C may leach out of the broccoli. Broccoli was boiled for 0 minutes, 3 minutes, 6 minutes, and 9 minutes, put in a food processor, and the broccoli juice was tested for vitamin C concentration. The broccoli boiled for 0 minutes, the raw broccoli, was the control. The hypothesis stated that broccoli boiled for 0 minutes would result in the highest vitamin C concentration. The results revealed that the broccoli boiled for 3 minutes contained the most vitamin C, with an

average of 0.385 mg/mL. This group was followed by the broccoli boiled for 6 minutes, with an average of 0.171 mg/mL of vitamin C. The next highest amount of vitamin C was found in the broccoli boiled for 9 minutes, which had an average of 0.147 mg/mL of vitamin C, followed by the broccoli boiled for 0 minutes, with an average of 0.071 mg/mL of vitamin C. A t-test performed on the data indicated that the results were significant and the research hypothesis was not supported. The results of this experiment may be due to the fact that vitamin C is water soluble, which caused it to leach into the water in which the broccoli was cooked. This research could lead to further studies in how other nutrients are affected by boiling or how other methods of cooking affect vitamin C concentrations.

The Effect of Different Additives on the Surface Tension on Water

Ray Dulman

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The purpose of this experiment was to determine the effect of different substances on the surface tension of water. The hypothesis was that pure water would have the greatest surface tension, because its hydrogen bonds would not be tampered with. An apparatus was constructed to test how much weight was required to break the surface tensions of the bowls of water mixed with different substances. The needle of this apparatus was placed just under the surface of each liquid ten times, and then weights were placed in a basket on the opposite side of the apparatus, until the needle pulled free of the liquid. The findings were that, in general, pure water had the greatest surface tension. Wisk laundry detergent had the second greatest surface tension, and salt had the least surface tension. Therefore, salt is most effective in breaking the hydrogen bonds between water molecules, which constitute surface tension. The data collected in this experiment was relevant, because the p-value found using the ANOVA statistics test was 6.76×10^{-9} , which was less than the agreed standard in class, which was $\alpha = 0.05$.

Ink Death

Aliana Gungor

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The purpose of this experiment was to find out the effect of a different kind of berry juice on the length of the streak that it left on a piece of printer paper. It was hypothesized that if the pomegranate juice was used, then the length of the streak on the printer paper would be the longest. This was believed because it was known that pomegranate juice requires the harshest stain removal, hydrogen peroxide. To test this hypothesis the procedures were to measure the length of the streak left by a pomegranate, blueberries, strawberries and blackberries in centimeters. In the end it turned out that the blackberry had the longest streak, followed by the pomegranate, blueberries and strawberries, respectively. The results did not support the hypothesis.

The Effect of Different Types of Cloth on How Fast They Burn

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Changing the type of cloth can have a significant effect on how fast it burns. Previous studies suggest that silk burns the fastest. Silk tends to be very thin, allowing more oxygen to come in contact with the cloth, increasing the combustion rate. The purpose of this experiment was to determine the effect of different types of cloth on how fast they burned. Five types of cloth were tested: silk, cotton, polyester, wool, and acetate. Nine 25 cm by 2 cm strips of each cloth were burned one at a time. Each cloth was hung with the bottom end 10 cm above the bottom surface of the burn hood. A Bunsen burner was then lit and moved under the each strip of cloth. The timer was started at this time. At 10 seconds, the Bunsen burner was removed and turned off. The timer stopped when the flame extinguished. Changing the type of cloth had a significant effect on how fast the different types of cloth strips burned. The results suggest that silk burns the fastest. The wool and polyester did not burn completely, so the burn times for those two types of cloth were inaccurate. The wool hardened, choking off the oxygen supply, and the polyester melted, causing the flaming part of the strip of polyester to drop off. In the future, the strips of cloth could be burned horizontally with a moving flame underneath to avoid the problems with the wool and the polyester.

The Effect of the Particle Size of the Reactant on the Rate of Chemical Reaction

Amy Le

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The purpose of the experiment was to find the effect of the particle size of the reactant on the rate of reaction. It was hypothesized that if the particle size was decreased, increasing the surface area, the rate of reaction would increase as well. This was tested by dropping an Alka-Seltzer® tablet into a gas collection apparatus, which consisted of a 15 ounce plastic bottle with a wide mouth and screw-on plastic cap with a hole drilled into the center. A plastic tube was inserted into the hole and connected the bottle to a 10 ml syringe. An Alka-Seltzer® tablet was dropped into the bottle, filled with 10 ounces of water and the cap was quickly replaced. The amount of time it took for 10 ml of CO₂ to be collected was recorded. The independent variables were a whole tablet, a halved tablet, a quartered tablet and a powdered tablet. An ANOVA test, as well as multiple t tests, were conducted which concluded that the results were significant and supported the hypothesis. The whole tablet (largest particle size) took an average of 26.98 seconds longer than the powder (smallest particle size) to produce 10 ml of CO₂. This shows that by decreasing the particle size, the rate of reaction increases.

The Effect of Different Shapes on Amount of Carryover Cooking

Cecilia Matos

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This experiment had the sole purpose of determining whether the shape of dough affected the amount of heat it retained and how much it carryover cooked. This information would be very favorable to cooks and people dealing with food. The factor of surface area can also be applied in different subjects such as math, so this experiment has useful information for many different interests, likes, and professions. The data shows that the rectangular prism was able to retain the most amount of heat, the sphere retained the least amount and the pyramid was in between both of them. These results prove that the hypothesis was accepted.

The Effect of the SPF of Sunscreen on the Shade of Photoreactive Paper

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The purpose of the experiment was to find out the effect of the SPF level of sunscreen on the amount of light that can penetrate through it to the photo-reactive paper below. It was hypothesized that, out of the five different SPF-level sunscreens tested, the photo-reactive paper would turn the lightest shade when the highest SPF level (100) was used, because the 100 SPF sunscreen has the highest quantity of the active ingredients. To test this hypothesis, the procedures were to spread sunscreen on a piece of glass, and then to take all of the materials into a darkroom. The glass was placed on the paper, it was exposed to light, and then it was developed in developer solution. Lastly it was hung up to dry and then the results were measured on a grayscale. After ten trials, the results showed that the 100 SPF sunscreen allowed the least amount of sunlight to penetrate it, with an average shade of 13 on the 20-shade grayscale. The 15 SPF sunscreen allowed the most sunlight to penetrate it (besides the control, which was no sunscreen), with an average shade of 16 on the grayscale. The 55 SPF sunscreen let in the second least, and the 70 SPF and 30 SPF sunscreens let in the third least, with average shades of 14 and 15, respectively. Therefore, the results support the hypothesis, even though the data was very close together.

The Effect of Fat Content of Milk on the Production of Foam

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The effect of the amount of milk fat on the production of foam was examined in a experiment involving sixty trials (fifteen trials for each sample) and four samples: skim milk (0% milk fat), 1% milk (1% milk fat), 2% milk (2% milk fat), and whole milk (3.25% milk fat). The hypothesis stated that if the amount of milk fat affected the production of foam, then the whole milk would produce the most foam. One hundred milliliters (mL) of milk

were heated to fifty five degrees Celsius, and then frothed for thirty seconds with an Aero Latté milk frother. The volume was taken in a graduated cylinder. The results showed that whole milk did produce the most foam and skim milk the least. An increasing pattern in foam volume and total volume (foam and remaining milk) was seen as the milk fat content increased. The remaining milk, for the most part, decreased as the fat content of milk increased, though the data for 1% milk disrupted this pattern. The data was shown to be statistically significant. The hypothesis was supported, as whole milk produced the most foam.

The Effect of Temperature on the Amount of Vitamin C in Red Bell Pepper

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The bell pepper is a good source of ascorbic acid, or vitamin C, a nutrient essential for the normal functioning of various aspects of the human body, including: immune response, collagen formation, and anti-oxidant protection. It is known that cooking vegetables can significantly deplete their vitamin C content. Freezing fresh vegetables may not diminish their vitamin C content to the same extent. To accommodate the modern lifestyle, there has been more reliance on food preparation and storage. And, many have recently taken an interest in the nutritional value of prepared foods. Bearing these issues in mind, this experiment set out to determine the effect of temperature (refrigerator, freezer, and sub-boiling) on the amount of ascorbic acid in the red bell pepper. Red bell pepper purée was frozen (0°C), refrigerated (3°C), and heated to scalding temperatures (54°C). These three temperatures were chosen as the levels of the independent variable (IV). Using an iodine titration method, the concentration of vitamin C was determined, by applying a ratio of the amount of iodine required to detect vitamin C at each level of the IV. Vitamin C concentration (in mg) was the dependent variable (DV). For each level of the IV (0°, 3°, and 54°C), the average vitamin C concentrations were: 19.1 mg, 23.1 mg, and 14.3 mg, respectively. Analysis of Variance (ANOVA) was applied and data comparisons found to be significant at the 0.01 level. Thus, the null hypothesis was rejected and, both freezing and scalding temperatures deplete vitamin C levels, though less at freezing than scalding. Further investigation into the length of time frozen vegetables maintain their relatively robust vitamin C content would require more time than allotted in this project.

The Effects of Different Types of Antacid Dosage Forms on the pH of a Simulated Gastric Solution

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Acidity and heartburn occurs because the acidic content of stomach comes out of the stomach and irritates the esophagus region above the stomach. Antacids are commonly used over the counter medicines to treat acid indigestion and heartburn. Antacids are medicines that work by increasing the pH balance in the stomach. The objective of this experiment was to find out which antacids increase the pH level of the stomach to the greatest extent. The hypothesis was that, if Advanced Maximum Strength Liquid Maalox Antacid (MLiq) is used, then this antacid medicine will increase the pH level of the hydrochloric acid solution the greatest extent. Hydrochloric acid solution was prepared by adjusting the pH level to approximately 1.8. The different antacids used were MLiq, Advanced Maximum Strength Maalox Chewable Tablets (MTab), Walgreen Maximum Strength Comfort Gel Liquid (WLiq), Walgreens Calcium Rich Extra Strength Antacid Tablets (WTab), Pepto-Bismol Original Liquid (PLiq) and Pepto-Bismol Original Chewable Tablets (Ptab). Water was used as a control. The pH level was measured every minute for up to 60 minutes. Statistical analysis was done by comparing the pH levels at the end of the experiment using a Student's t-test. The statistical analysis showed that the tablet dosage forms resulted in a statistically significantly ($p < 0.05$) higher pH than the liquid dosage forms. The average \pm standard deviation values of the pH at the end of the experiment for MTab (7.89 ± 0.15) and WTab (7.61 ± 0.34) were greater than MLiq (5.82 ± 0.31) and WLiq (4.76 ± 0.18). The PTab and PLiq dosage forms did not increase the pH at all. The original hypothesis was not supported based on these results. MTab but not MLiq had the greatest increase in pH. The lack of a significant difference in the increase between the WTab and MTab suggests that immediate relief from acidity may be seen by using the cheaper generic brand antacid.

The Effect of Different Biomasses on the Production of Biogas

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The purpose of the experiment was to test the effect of different types of fruit (blueberry, banana, and lemon) on the production of biogas. It was hypothesized that when blueberry was added to cow manure then biogas production would be the greatest. This was hypothesized because the blueberry has a neutral pH (6.3), providing an optimal food source for the mesophilic bacteria producing the biogas. To test the hypothesis, bottles filled with cow manure, blueberries, bananas, and lemons were set up in a hot room. The circumference of balloons attached to the top of the bottles was then measured every five days, along with the flammability of the gas inside the bottles. At the end of the experiment, it was shown that the hypothesis was not supported by the data, because the control (pure cow manure) had the greatest mean circumference, while the blueberry had the second highest circumference, and the banana and lemon produced the third highest and the lowest circumference, respectively.

The Effect of Solvent Type on R_f Value

Nora Walls

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The purpose of this experiment was to investigate the effect of solvent type on R_f value in chromatography, using pigment from spinach leaves. The three solvents used were isopropyl alcohol, water, and acetone. The research introduced the idea that a solvent with stronger polarity would result in a lower R_f value, and less polar solvent would result in a higher R_f value. The hypothesis was that if isopropyl alcohol was used as the solvent, then the R_f value would be highest, because isopropyl alcohol was least polar. Ten trials were conducted for each experimental group. For each trial, crushed spinach leaves were soaked in the solvent for 24 hours. The pigment that resulted was placed near the bottom of a chromatography strip, which was then placed in a jar containing about a centimeter of the solvent. The chromatography strip was taken out after a few hours, and the R_f value was calculated using the formula [distance traveled by the sample component/distance traveled by the solvent]. The results of the experiment supported the hypothesis. Using isopropyl alcohol, the least polar solvent, resulted in the highest R_f value, while using water, the most polar solvent, resulted in the lowest R_f value. An ANOVA test was conducted, and the results showed over 99% confidence that the results of the experiment were statistically significant.

CHEMISTRY B

FIRST PLACE

The Effects of Different Cooking Methods and Origin of Red Peppers on the Amount of Vitamin C

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The purposes of this study were to find out which cooking method would be more efficient in retaining vitamin C and to determine if organic or non-organic red peppers retain different amounts of vitamin C after cooking. The research was conducted at a local high school during the months of November and December of 2010. The data was collected by titration; the red peppers were blended, filtered, and had starch solution added. The liquid was then titrated with an iodine solution until it reached the endpoint. This process was repeated eight times for every group of red peppers. The results suggested that red peppers retained more vitamin C when they were steamed, rather than boiled. Furthermore, the average amounts of vitamin C found in organic red peppers were less than the amounts found in non-organic peppers. A two-way ANOVA showed significant difference (p -value = 0.005867, α = 0.05). The follow-up Tukey Test indicated that most of the data was significant; the only insignificant difference was between the organic boiled peppers and the non-organic boiled peppers. The original hypothesis that the organic steamed red peppers would retain the most vitamin C was supported in regard to the steamed aspect, but not with regard to the organic aspect. In conclusion, the amounts of vitamin C in steamed red peppers retained a significant amount of more vitamin C than the boiled peppers, but the difference in vitamin C of boiled organic and the boiled non-organic peppers was insignificant.

SECOND PLACE

The Effect of Various Berry Juices on the Oxygen Radical Quenching Capacity

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Oxidative stress is caused by an insufficient capacity of biological systems to neutralize excessive free radicals, which can contribute to cardiovascular disease, neurodegenerative disease, and age-related cognitive decline. Recently there has been a great deal of interest to search for natural remedies, like berry juice, that can reverse the oxidative damage. The objective was to determine whether the type of berry juice used would quench more oxygen radicals. *The hypothesis in this research project was that if Acaiberry juice is used, then the oxygen radical quenching capacity would be the greatest.* The Oxygen Radical Quenching Capacity (ORQC) was measured for the fresh-frozen Acaiberries (AC), Blackberries (BLK), Blueberries (BLU), Cranberries (CR), Pomegranates (PO), Raspberries (RAS), and Strawberries (ST), prepared freshly. The control group was Trolox. The control Trolox's average Area Under the Curve (AUC) of the relative fluorescence units (RFLU) was 16.42 ± 0.814 . AC was 29.26 ± 0.814 . BLK was 27.5 ± 0.738 . PO was 27.4 ± 0.579 . CR was 26.68 ± 3.228 . RAS was 24.94 ± 0.513 . BLU was 24.36 ± 0.643 . ST was 23.92 ± 2.104 . Each berry juice had significantly higher activity than Trolox control ($p < 0.05$). AC was significantly higher than Raspberry, Blueberry, Pomegranate, Cranberry juice ($p < 0.05$). It can be concluded that the antioxidant capacity of Acaiberry juice was the highest and the least for strawberries. All the berry juices had significantly higher antioxidant activity than the control. Based on this study it can be recommended that while consuming any berry juice is good, Acaiberry might be most effective of all the berries.

THIRD PLACE

The Effect of Developer Bath pH on Photograph Quality

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When developing photographs, many things need to be considered to ensure the photographs are of high quality. The time a photograph remains in each stage of the developing process can have enormous effects on the final product. Other factors include the time the photograph is exposed to light and various qualities of the baths used to develop photos. The purpose of this experiment was to determine if the pH level of a developer bath has an effect on the quality of the photograph being developed. Photographs were developed by exposing them to sunlight with both a translucent applesauce container and an opaque quarter placed on top of the photo paper. The photographs were then developed using the traditional process of first being placed in a developer bath, then stop bath, then fixer bath, and finally being rinsed off. Developer bath pH levels 4, 7, 10, and 14 were tested. The control, pH 7, was distilled water. Ammonia and muriatic acid were added to distilled water to vary the pH. The results indicated that the photographs developed in a bath with a pH of 7 had the highest average rating, a 4.6, while the most extreme pH, pH 14, had the lowest average rating, a 3.3. A chi-Square test performed on the data indicated the data is significant in all cases ($\chi^2 = 16 > 9.488$; $\chi^2 = 11 > 9.488$; $\chi^2 = 11 > 9.488$), except for the level pH 10 ($\chi^2 = 9 < 9.488$). The data supported the research hypothesis that if the pH of the developer bath is changed, the photographs developed in the bath with a pH of 7 will be of the highest quality. Based on the pH values used in this experiment, there appears to be a correlation between the quality of the photograph and the pH of the developer bath it was developed in. Before it can be concluded that the pH of the developer bath was the only cause of a change in photograph quality, more related research and experiments need to be carried out.

HONORABLE MENTION

The Effect of the Ripeness of *Capsicum annuum* on the Amount of Vitamin C

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The purpose of this experiment was to determine the amount of Vitamin C in *Capsicum annuum* selected by ripeness. *Capsicum annuum* is a vegetable known for its great amounts of Vitamin C and its benefits for inflammatory and respiratory diseases. The amount of Vitamin C for each kind of *Capsicum annuum* was found using iodine. After each independent variable was blended in a grinder, 10 mL of the solution was mixed in 10 mL of Vitamin C indicator solution. After mixing for a few seconds, the color changed. Iodine was then dropped into the changed solution until the color returned to normal. This number was recorded and the more drops it took for the solution to return to its original color, the more Vitamin C there is. At first, it was hypothesized that the green pepper would have the most Vitamin C. Since it was a raw form of food, it would not have had the chance to be exposed to natural effects and lose Vitamin C. After conducting the experiment, with 20 trials for each independent variable, it was observed that the red *Capsicum annuum*, in fact, had the most Vitamin C. The plausible reason for this alteration in the hypotheses was predicted to be because of more time for the fruit to enrich its vitamins. Since it had the longest time to ripen, it would grow more with more Vitamin C in the process.

HONORABLE MENTION

Total Antioxidant Measurement of Green Tea

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This study was conducted to compare the total antioxidant measurement of two green teas from Japan and one green tea from the United States. It was hypothesized that Japanese tea would have higher antioxidant concentrations than American tea because Japanese have more experience in growing and processing tea. Another

aspect of this study was determining the effect of longer brewing time on the concentration of antioxidants in tea. The hypothesis here was that longer brewing time for a tea will increase its antioxidant concentration due to longer extraction time for preparing the tea. A Colorimetric Microplate Assay for Total Antioxidant Power (Kit) from Oxford Biomedical Research was used to conduct the experiment. A standard calibration plot of absorbance versus concentration of uric acid was prepared and used to analyze the samples. The results were reported as total antioxidant in mMol of uric acid equivalence. The results indicate that American green tea had from 16-30% higher total antioxidant equivalent concentration than the two Japanese teas tested. Therefore, this hypothesis was rejected. American teas are normally less expensive than imported teas and since the American tea studied offers the better levels of antioxidants at a lower price, it would be preferred by people who value tea for its cost and health benefits. The second hypothesis, that longer brewing times would increase antioxidant concentration, was accepted because doubling the brewing time led to a 22% increase in antioxidant concentration, tripling the brewing time gave a 45% increase in total antioxidant concentration measured.

HONORABLE MENTION

The Effect of Different Types of Alka-Seltzer on the Speed of Carbon Dioxide Released when They Are Dissolved in Water

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Heartburn is one of the various symptoms of gastro esophageal reflux disease (GERD). Americans spend much of their money on trying to find a cure to their heartburn, such as using antacids like Alka-Seltzer. Popularly used effervescent, Alka-Seltzer, is mostly used by people who want to relieve themselves of heartburn or acid indigestion, and is mostly made out of citric acid and sodium bicarbonate, which are both antacids. Alka-Seltzer bubbles because the neutralization between the baking soda and citric acid forming carbonic acid which decomposes to water and carbon dioxide. The more bubbles released, the more CO₂ released, causing the person taking Alka-Seltzer to burp more. The purpose of the experiment was to see how much gas was released when Alka-Seltzer was dissolved in water and the levels of the independent variable were Alka-Seltzer Gold, Original, and Heartburn. Originally, it was predicted that the hypothesis would have been if Alka-Seltzer Heartburn was dissolved in water, then the amount of carbon dioxide released would have increased. The gas was read from a graduated cylinder, with a tube connected to it, flipped upside down in a large aquarium tank filled with water. When the tablet was broken into pieces, dropped into a bottle filled with 120 mL of water and immediately had its cap placed on, which had the other end of the tube attached to it, the water level in the graduated cylinder lowered. The means for the amount of gas released for Alka-Seltzer Gold was 63.53 mL, Heartburn was 48.7 mL, and Original was 66.5 milliliters, meaning that Alka-Seltzer Original released the most gas. Instead of supporting the hypothesis, the results actually showed that the hypothesis was not supported because Alka-Seltzer Original actually released the most gas, not Heartburn.

The Effect of Fermentation Time on Glucose and pH Levels in Kimchi

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Kimchi is a traditional fermented cabbage dish from Korea. Kimchi is a well-liked dish, served year round, and enjoyed because of its spicy taste and that it contains loads of vitamins B and C. Kimchi also has a very pungent and sour smell to it, so it is an acquired taste. In this project, Kimchi was made from scratch and left to ferment for several weeks. pH and glucose were observed in order to see the chemical changes that occur during fermentation in a dish that has a very strong and tart smell. The purpose of this experiment was to see the changes in pH and glucose in fermented Kimchi over a 15, 30, and 45 day period. It was found in this experiment that pH did not increase or decrease, it remained around the range of 3-5 pH. Data was found after the experiment was finished, that revealed that Kimchi was ready to eat at a pH of 3.5, so the results of the pH were accurate to traditional Kimchi. The glucose

decreased throughout the experiment. The 45 day period of fermentation for glucose was the only independent variable that was significant, therefore a greater amount of time allows for the glucose in Kimchi to decrease.

A Gas Chromatography Analysis of Phthalates in Water Bottles

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Phthalates are a group of plasticizers that are often added to vinyl and plastics but may cause harmful effects if ingested or absorbed through the skin. The Consumer Product Safety Improvement Act of 2008 prohibits the sale or distribution of children's toys or child care articles containing concentrations greater than 0.1% of phthalates, especially di(2-ethylhexyl) phthalate (DEHP), dibutyl phthalate (DBP), and benzyl butyl phthalate (BBP). Although these chemicals were banned in toys and other objects that might come in close contact with children or that children might put into their mouths, there is currently little knowledge about phthalate content in water bottles. The student researcher was expecting to find high concentrations of phthalates in the hiking bladder, with lower levels of phthalates in the disposable and reusable water bottles. The phthalate content was analyzed in one multiple-use water bottle, one pre-filled water bottle (intended for one use) and one hiking bladder. The solid samples were cryoground, combined with tetrahydrofuran (THF) and cyclohexane, and tested for phthalates in a gas chromatograph. Before the solid samples were cryoground, distilled water was stored for 24 hours in the containers from which the solid samples were prepared, and then samples of that water were prepared and analyzed by gas chromatography/mass spectrometry. The resulting chromatograms were analyzed using Xcalibur Instrument Control and Data Acquisition Software. Low levels of dibutyl phthalate (DBP) and di(2-ethylhexyl) phthalate (DEHP) were detected in some of the samples, but these compounds were also detected in the method blank, which may indicate that they were not present in the water bottles at all, but that their presence was due to laboratory contamination.

The Effect of pH on Tooth Corrosion

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Scientists have found that the pH of various liquids affects the corrosion of teeth. Acidic substances have been noted to corrode teeth the most, whereas alkaline substances corroded them the least. The acids break down the enamel of the teeth, and then eats away at the main tooth, and alkaline substances are used naturally in the mouth to balance out the acids. In this experiment, the effect of pH on tooth corrosion was being tested. The purpose was to see whether or not acidic substances corroded teeth more than alkaline substances over a period of four weeks. If teeth are exposed to different substances, then the substances with the lowest pH will be the most corrosive. For the experiment, 40 teeth were obtained and weighed. The teeth were then placed in groups according to which drink they would be in. The cups they were placed in contained various drinks and were labeled Coke, Orange Juice, Water, and Mouthwash. One tooth was placed in each cup, and there were ten cups for each drink. The liquid in the cups was changed every other day. Once a week, the teeth were observed, and were weighed in groups at the end of the four weeks. The data supported the hypothesis, and the teeth soaked in orange juice, with a pH of 3.5, corroded the most, and the teeth in water and mouthwash, which had a pH of 7 and 8, corroded teeth the least. The teeth soaked in Coke, which had a pH of 2, didn't corrode the least; however that may have been because of plaque and residue buildup on the teeth. Based on the results of the experiment, it can be stated that the null hypothesis was rejected and liquids with a lower pH cause more tooth corrosion. However, the other substances in the liquids, such as sugar content, may have changed the results. More tests with liquids with less outside factors will have to be performed to conclude that lower pH alone directly causes corrosion.

What's Salt Got to Do With It?

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In this experiment, different amounts of salt were tested to see how high an egg would float in two and a half cups of water. The hypothesis was that different amounts of salt were added to a cup with water and an egg,

then ten teaspoons of salt would have the most effect. The experiment was done by adding salt to 2.5 cups of water in increments of 2 teaspoons from no salt to a maximum of 10 teaspoons of salt. Next, the salt was stirred until dissolved. Lastly the grade A egg was added to the cup and a ruler was used to see how high the egg floated, if the egg had floated at all. In result, the egg in the water with ten teaspoons of salt had the best average flotation. Eggs in water with zero and two teaspoons did not float at all. With four teaspoons, the eggs floated 2.3 centimeters on average, 3.6 centimeters for six teaspoons of salt, 6.6 centimeters for eight teaspoons of salt, and lastly 8.6 centimeters for ten teaspoons of salt. In conclusion, the hypothesis was accepted; the ten teaspoons of salt had the highest egg flotation.

The Efficacy of Aloe Vera in Comparison to Over-the-Counter Antacids in Raising pH Levels of Hydrochloric Acid

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Because of the public demand for more natural medical remedies, versus synthetic pharmaceuticals, there is increased interest in the science behind natural remedies. The gel from *Aloe vera*, a succulent plant native to Africa, has long been used for treating many ailments including gastric distress caused by hyperproduction of hydrochloric acid (HCl). This experiment tested whether or not Aloe vera gel could raise the pH of HCl, and if the difference could be comparable to the pH differences resulting from HCl and the over-the-counter (OTC) antacids. Both Aloe vera gel freshly taken from a plant and gel purchased in a store were tested against two OTC antacids. The store bought antacids did raise the pH of the HCL more dramatically, but the pH levels of the HCl samples and the Aloe vera gels rose enough to support further investigation of the gel as a treatment for gastritis.

The Effect of Color on the Rate of Desalination

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Throughout history humans have searched for fresh clean water. People are suffering from water shortages and so many scientists are looking for innovative ways to create fresh water from the ocean. This is called desalting, or taking the salt out of salt water. There are many ways to do this but the most common is reverse osmosis. This is a method that removes large molecules and ions from a solution. Lakes generally have high concentration of salt in the water because they do not have a place to put the salt unlike rivers that transport the salt into the ocean. Salt concentration increases because salt rocks are broken down and dissolved in the water, an example of this Caspian Sea. Scientists today are looking at ways to try and replicate the natural water cycle to produce drinkable water. The purpose of this experiment was to determine how color affects the rate of desalination. Four different common colors were tested; clear our control, blue, red, and green. Each was tested 10 times in a homemade desalinator. The results turned out to be surprising with yellow having the highest average and clear coming in second. Based on the results in this experiment, colors do have an effect on the rate of desalination.

The Effect of Organo-Metallic Catalysts on the Formation Time of Yogurt

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Yogurts are formed from heat treated milk by the enzymatic action of lactic acid bacteria that convert lactose to lactic acid. The catalytic effect of various magnesium rich food ingredients on the rate of yogurt formation was investigated in this work. During fermentation, the rate of change of pH was tracked for each reaction product sample to determine the augmenting effect of the organomagnesium complexes present in the various food ingredients. It is shown that the samples containing cashews, cornmeal and navy beans exhibit a substantial increase in activity at later stages of fermentation. The intriguing nature of inactive pumpkin seeds is highlighted through a discussion on the ionic site occupancy and the corresponding structural motifs or ligations.

The Effects of pH on the Color Change of Red Grape, Strawberry, and Red Onion Indicators

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This experiment, The Effects of pH on the Color Change of Red Grape, Strawberry, and Red Onion Indicators, was performed in order to answer the question “If natural indicators, all containing anthocyanin, are tested, at what pH will they change color?” Anthocyanin is found in many plants, such as red grapes, red onions, red cabbage, hydrangeas, strawberries, and beets. The original research hypothesis stated that if strawberry, red onion and red grape indicators are tested, then they will all change color from red to purple between 4 and 6 pH, from purple to green between 7 and 9 pH, and from green to yellow between 11 and 13 pH. The independent variables in this experiment were the different natural anthocyanin pH indicators, and the dependent variable was the pH at which a color change occurred. The constants for this experiment were the dilution of the indicator solution, the amount of solution tested, the temperature of the room, the pH meter used for testing, and the type of acid and base that was added. There was no control group for this experiment. In order to perform this experiment, three plants containing the natural indicator anthocyanin (Red Grapes, Red Onion, and Strawberries) were boiled to extract their anthocyanin. The extracted natural indicators were then each put in a beaker with a pH probe, and acid was added until they reached the acidic pH of 3. Base was then gradually added, and the mixtures were observed to watch for any color changes. When a color change occurred, the pH of the solution at which the change happened was recorded. A graphical analysis was used on the data, and it was found that the results disproved the original research hypothesis. In the next set of experiments to follow, more trials should be done, the experiment should be performed in a more controlled environment, more exact measurements should be used, and different natural anthocyanin indicators should be tested, in order to increase the sample size.

Effectiveness of Various Materials on Extinguishing a Small Fire

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The purpose of the experiment was to find out what material will most effectively extinguish a fire. This could save many homes in the future. Water put the fire out the fastest, but took the most materials. The ABC powder (the dry chemical used in ABC fire extinguishers) extinguished the fire with the least materials and the second best time. In the trials, water took an average of 6.93 seconds and 13½ mL to put out the fire. The ABC powder took 9.87 seconds and 6 ⅔ mL. Flour took 12.61 seconds and 9½ mL; and baking soda took 11.27 seconds and 8½ mL. The control, as expected, took longest to burn. The average was 14 minutes and 40.4 seconds. It can be concluded from the results that ABC powder is the best because it has the best balance between the two dependent variables. This means that a medium-sized bag of ABC powder, placed around the house in case of an inoperable or absent fire extinguisher will provide sufficient protection.

The Effect of Milk Type on Density of Chocolate Milkshakes

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There are many components in making a chocolate milkshake. One is the type of liquid used, which affects the milkshake’s density. Density is the measurement of how much mass of a substance is contained in a given volume. The purpose of this experiment was to figure out if milk type would affect milkshake density. The experiment was conducted using five milk types (the independent variables) as well as vanilla ice cream and chocolate syrup. Fifty milkshakes were made (ten for each milk type) with a commercial spindle mixer and the study was carefully conducted with the help of five others. The t-test was used to test the following null hypothesis at a 0.05 level of significance: Milk type has no effect on milkshake density. The null hypothesis was rejected when heavy cream was compared to half and half, buttermilk and fat free milk ($t=2.71>2.101$; $t=3.76>2.10$; $t=3.38>2.101$ at $df = 18$; $p>0.05$). The null hypothesis was accepted in all other comparisons ($t=0.83<2.101$; $t=1.20<2.101$; $t=0.70<2.101$; $t=1.01<2.101$; $t=1.27<2.101$; $t=0.30<2.101$; $t=1.17<2.101$ at $df = 18$; $p>0.05$), therefore the data did not support the research hypothesis that if buttermilk was used to make a milkshake, then it would have the highest

density. The result of the experiment was that milk type had no effect on the density of a milkshake. This was not consistent with the research gathered which stated that if you use a thicker liquid in one shake than another, then the shake with thicker liquid will be denser.

The Effect of Light on the Speed of a Chemical Reaction

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Iodine is naturally occurring nonmetal, that, when mixed with Oxalic Acid, Ammonia, and water, a chemical reaction occurs, and the solution forms into Iodide. A beaker was filled with 25 mL of water, $\frac{3}{4}$ teaspoons of oxalic acid, 25 mL of ammonia, and 3 mL of Iodine; then, the solution was equally distributed into four test tubes. Then, the test tubes were placed under an incandescent bulb, a LED bulb, a CFL bulb, or in a dark area. The purpose of this project was to determine the effect of various types of light bulbs on the rate of a chemical reaction (by determining the percent of iodine still present in the substance after three hours). In order for that to happen, the light had to react with the solution in order to create a chemical reaction. After three hours, the CFL light bulb had the lowest mean percentage of iodine at 13.05%, while the absence of light had the highest mean percentage of 95%. Based on research conducted on chemical reactions and light, it is stated that light steadily speeds up this reaction. The hypothesis that was determined was that if an incandescent light bulb was placed over the iodine solution, then the rate of the chemical reaction to iodide would be faster than the rate of the other bulbs. The incandescent bulb had a mean percentage of 22.5%, which had the second fastest rate of the chemical reaction. A t-test performed on the data showed that there was a significant difference of the groups ($t=11.73>2.101$; $t=14.20>2.101$; $t=2.61>2.101$; $t=5.32>2.101$; $t=6.58>2.101$ at $df=18$; $p<0.05$). The data rejected the null hypothesis that stated the mean percentage of iodine after three hours under an incandescent light bulb is not significantly different from the mean percentage of iodine after three hours under the other light bulbs. However, when the incandescent bulb was compared to the CFL, the null hypothesis was supported ($t=2.04<2.101$ at $df=18$; $p>0.05$).

The Effect of Temperature on the Amount of Corrosion on Aluminum

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Forms of aluminum have been used since ancient times, but it was only much later that people were able to use pure aluminum. Aluminum was first isolated in 1827 by Friedrich Wohler. From that time onwards aluminum has been used in many products from things as small as soda cans to things as large as airplanes. With its resistance to corrosion, Aluminum became very popular in many industries. Aluminum develops an oxide layer which is formed when it reacts with oxygen. This oxide layer protects it from corrosion. So now aluminum is used in many building endeavors. The purpose of this experiment was to see if high temperatures affected the corrosion of aluminum. The hypothesis of the project was: If the temperature is increased, then aluminum corrosion will increase. In order to prove this five aluminum plates were placed in separate beakers. These beakers were filled with a mixture of salt and water to help with the corrosion. Vegetable oil was poured over the solution after the aluminum plates were in the solution to ensure that the salt did not crystallize after the temperature was increased. The temperature was then increased using hot plates that were set to different temperatures: 60°C, 70°C, 80°C, and 90°C. The results indicated the higher temperatures created more corrosion on aluminum. The mean mass for each temperature level are as follows: 25°C= 0 mg, 60°C= 0 mg, 70°C= 15 mg, 80°C= 31 mg, 90°C= 52 mg. A t-test was also performed on the data: $t=8.98> 2.101$; $t=17.32> 2.101$; $t=20.88> 2.101$; $t=6.53> 2.101$; $t=12.33> 2.101$; $t=6.84> 2.101$ at $df=18$; $p<0.05$. Therefore the data supported the research hypothesis that higher temperatures increase the corrosion of aluminum. Through the data of this experiment, it is suggested the temperature has an effect on the oxide layer of aluminum.

The Effect of Different Liquids on the Average Rust Time of a Nail

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The purpose of this experiment was to determine the effect of different liquids on average rust time of a nail. The research hypothesis was if different liquids were used to see the average rust time of a nail, then the one with the highest salt content would cause the nail to rust the fastest. Different liquids were used to create ten 150 mL cups of distilled water, salt water, vinegar, and Coca-Cola. All 40 cups were allowed to sit in their bathes until they started showing signs of rust. The average time it took for each cup to rust, was used to determine the mean rust rate of each liquid. The experimental data revealed a mean rust rate of 394.900 hours for distilled water, a rate of 10.500 hours for salt water, a rate of 124.550 hours for vinegar, and a rate of 20.400 hours for coke. The trend of the mean values and statistical test revealed that the research hypothesis was supported. The results of the experiment are explained by rust needing water and oxygen to rust, and seawater acting like a catalyst to the corrosion because of the salt.

COMPUTER SCIENCE

FIRST PLACE

AMPED: A System for Usable Authentication

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When people communicate over a distance, they require effective, hard-to-forge methods of authentication, in order to prove that an action is actually being performed by the alleged individual on the “other side of the wire”. Unfortunately, unscrupulous people have found ways to assume others’ identities, which produces much mayhem. Traditional password authentication is familiar to most, with the password referred to in industry parlance as “something you know”. A number of large organizations and banking institutions are recognizing the importance of adding a second authentication measure, a physical token representing “something you have”. In this paper, I outline a novel secondary authentication factor of transactional “yes”/“no” approval, titled the *Authenticated Mobile Personal Encryption Device* (AMPED). I determined whether this system was more effective, in terms of time spent authenticating and perception of the same, than a factor based on a temporary PIN code. Participants tried out both methods and reported on their experience. More than 80% of the 37 participants preferred AMPED, and rated it better than the other on all axes measured. Based on a preliminary security analysis, AMPED should provide greater auditability and be more resistant to spoofing than the PIN method. AMPED was therefore deemed more effective. Further study is needed to determine its efficacy under daily usage, and a more thorough investigation is needed to establish the security level of the new system.

SECOND PLACE

The Effect of Infrastructure on Availability of Unsecured Wireless Networks

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The project’s goal was to identify where one would most likely be able to connect to an unsecured wireless network. This was measured in the ratio of unsecured networks available to total networks available. The hypothesis was that the ratio would be higher in an area composed of single family homes than in areas composed of commercial or multi-family buildings because the networks in the latter would be more likely to be set up by more knowledgeable professionals, also for the same reason the ratio would be lower in commercial regions than in a multifamily area. To find data collection points a map with a grid was used; the points were equally dispersed, then each of the points were identified as single family homes, commercial or multi-family homes. A random number generator was used to narrow the points from each kind of region to three before each data collection run. The runs were straightforward; drive to each predetermined site; wait for about two minutes and then measure the number of secured and unsecured networks. The results were: commercial areas had the highest ratio, 15.80%, followed by single family areas, 11.16%, and lowest were multi-family areas, 6.55% rejecting my hypothesis. The reason for this is probably that it is becoming “cool” for businesses to provide free access to the Internet to attract an Internet savvy crowd. The reason for single family homes being lower than expected was probably that with increased online activity, there is increased Internet safety awareness.

THIRD PLACE

The Relationship between the Efficiency of a Neural Network and Neural Network Size

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This study investigates the relationship between the prediction accuracy of a neural network and the neural network's shape. The shape of a neural network (for the purposes of this paper) is the length and width of the neural network. The purpose of this research is to determine the relationship between the shape of the neural network and the prediction accuracy of the neural network. The prediction accuracy is measured as the difference squared between the output of the neural network and the expected output of the neural network. It has been hypothesized that the prediction accuracy of the neural networks will not change when the shape of the neural network changes. This will be tested by training multiple artificial neural networks of different sizes and analyzing the number of cycles it takes for the neural networks to learn to model a set of test data. The results of this study do not support the hypothesis. It was demonstrated that the longer the shape of the neural network was, the longer the neural network took to learn. In fact, in a single layer neural network it only takes a few hundred cycles for the network to learn, but when the number of layers increases and the width decreases the number of cycles required to train the neural network increases incredibly quickly.

HONORABLE MENTION

The Effect of Noise on Edge Detection in Digital Images

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The purpose of this experiment was to test the effect of random noise in an image on the effectiveness of an edge detection algorithm. The hypothesis stated that if the amount of noise increases, the effectiveness of the algorithm will decrease because it will not be able to detect the true edges due to the reduced image contrast, which is reflected in the reduced variation in the contrast derivative. The edge detection algorithm was implemented using the Java programming language in the Eclipse development environment. The main procedures in the edge detection algorithm use loops, lists, derivatives, signal to noise ratio and other simple math functions. The data collected in the experiment was taken from calculating the signal to noise ratio after noise was added and the edges were determined by the algorithm. An ANOVA test showed that each experimental group was significantly different. The algorithm effectiveness for each noise level was found and graphed to clearly support the hypothesis and explain how the effectiveness of the edge detection algorithm decreased as the noise increased.

HONORABLE MENTION

The Effect of Virtualization on OS Interference

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IBM researchers discovered that virtualization technology produced certain performance anomalies. This prompted further research and was coined "operating system interference." It is caused by synchronization problems between the operating systems during virtualization. The purpose of this experiment was to discover how virtualization affected operating system interference. Virtualization was achieved using the Xen hypervisor running on a Linux machine, and a FWQ test was conducted to measure operating system interference. The results indicated that virtualization had a significant effect on operating system interference. A t-test performed on the data indicated a significant difference between the means of the groups and rejected the null hypothesis: virtualization has no significant effect on operating system interference ($t = 26.553 > 2.101$; $t = 8.231 > 2.101$; $t = 8.714 > 2.101$; $t = 21.389 > 2.101$; $t = 21.980 > 2.101$ at $df = 18$; $p < 0.05$). The data supported the research hypothesis that if an operating system was virtualized, then there will be more operating system interference. Based on the data extracted from the

research, there appears to be a direct relationship between virtualization and operating system interference. Before it can be concluded that virtualization caused increased operating system interference, a more detailed benchmarking utility will need to be used to measure the data.

HONORABLE MENTION

A Comparison Graph Search Algorithms in Java

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The purpose of this experiment was to determine the effect of different graph search algorithms on time taken to produce a path between two vertices. It was hypothesized that the A-Star algorithm would prove to be faster than the other two algorithms tested: Dijkstra's and Bellman-Ford. The three algorithms were each applied fifty times to three different graphs, resulting in a total of 450 trials. A-Star had a lower mean execution time on graphs one and two, however, Dijkstra's had a lower mean execution time on graph three by about 43.6 thousand nanoseconds (44 millionths of a second). The hypothesis was accepted. It was concluded that A-Star performs better except when not provided with a good heuristic function, as was the case here.

The Effect of the Shape of Parabolic Reflectors on Signal Strength and Download Speeds of a Laptop

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The purpose of this study is to determine whether or not a parabolic reflector can help to focus a wireless signal to a single area or device (thereby creating a more stable and faster connection) through physical obstacles, and if so which shape is most effective. It is thought that parabolic reflectors are effective in increasing signal strength because their geometric structure allows beams of energy to focus in one direction. Therefore a computer that towards the direction that the parabolic reflector is pointing should receive a strengthened signal as opposed to a router with no reflector. The hypothesis was that if a spherical parabolic reflector was used, then the signal strength would be higher and the average amount of time taken to download a one gigabyte file would be lower (as opposed to a square parabolic reflector and the control). The control was a router with no reflectors. Parabolic reflectors were constructed with cardstock, aluminum foil, and cardboard tubes. The antenna of the router was inserted through the cardboard tube. A one gigabyte movie file was downloaded from an application called iTunes. The amount of time required to download was kept for each of the levels of independent variable. T-tests were done to measure significance; the data was significant for the all three tests in the first experiment, and it was significant for only 1 test in the second experiment. There were a few sources of error, the most prominent being that there was most likely fluctuating traffic for the iTunes servers.

The Response of Computer Users to Linux

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The purpose of this study was to determine if Ubuntu Linux can be a suitable replacement for Windows on personal computers. Participants completed one set of tasks on Windows 7 and Ubuntu 10.10 and another set only on Ubuntu 10.10. The first set of tasks was timed on each operating system, and those times were analyzed using a paired t-test at the 95% confidence level. The second set of tasks was completed to give participants a better feel for how to use Ubuntu. Participants then completed a Likert-type 7-point scale questionnaire on their opinions of Ubuntu. The responses to the questionnaire were analyzed using a single sample t-test. The null hypothesis that there would be no difference in participants' times in completing a set of tasks on Windows and on Linux was tested by means of a paired t-test, and based on the results, $t(7)=2.30$, $p=0.0548$, the null hypothesis could not be rejected at a

95% confidence level. In the questionnaire, participants' responses only indicated a significant opinion that Windows was faster than Ubuntu ($t(7)=2.76, p<0.05$), but their responses did not indicate a significant opinion about any of the other questions, including questions about Ubuntu's ease of use and their preference of operating system. The results of this experiment indicate that, although most Windows users would not use Ubuntu Linux on their personal computers, Ubuntu could be successfully implemented in a school, business, or other similar setting.

Gulf of Mexico/Hypothetical Virginia Oil Spill

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The objective of this project was to accurately simulate the oil spill in the Gulf of Mexico. In order to accomplish this, a certain understanding of computer science and how different pieces came together in order to form the final executable file was needed. Research began through two C++ programming books. After completion of the reading, the project began. A program was created that not only graphically simulated the spill but mathematically simulated it as well. The program would add certain coordinates together and calculate area, distance, and overall money lost by British Petroleum due to the spill. The results received were compared to actual spill estimates. Later into the project, however, a second program was developed showcasing a theoretical spill off the coast of Virginia. This program was more experimental, so more variables were created and it ended up creating six programs, each with different end results. The results formed a sort of curve showing that spill growth may actually be exponential rather than linear. The final results showed that even though only one variable was being modified slightly each time, the fact that not all variables "spread" the same way meant that the growing size of the spill was only slightly linear in graph form. A chi-square test was run to prove this, and with a p value of 1.6507208×10^{-4} , accepting the hypothesis while rejecting the null hypothesis. It also showed how, theoretically, a spill would grow off the coast of Virginia until it fully managed to penetrate shores.

Development of a Real Time Chat System

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This paper looks at the past development of online real time chat systems. What improvements that have been made to chat systems over their existence. Along with some common problems with these chat systems. Then points out the current problem with online real time chat systems, that browser based real time chat systems do not easily integrate into small community web sites, allowing private chats, along with using that community's websites user and friends database. Then developing the three part solution, the server, the integration, and the client side as a possible solution to it. Finally talks about the problems and successes of the solution.

The Effect of Different Sorting Algorithms on Data Processing Speed

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The purpose of this experiment was to test the efficiency of different types of sorting algorithms. An algorithm is simply a set of logical instructions that tell how to accomplish a task. Sorting is a process of putting items in a pre-defined order, either from low to high, or high to low. The three most common types of sort algorithms are the selection sort, the bubble sort, and the merge sort. The research hypothesis was: If the list of numbers is large, then the merge sort algorithm will be the most efficient at sorting it. The independent variable was the type of sort (selection, merge, or bubble). The dependent variable was the efficiency of the algorithms in terms of time in seconds. The constants were the computer used, compiler used, powers source and stopwatch library used. The control was a pre-sorted list. To test the effect of different types of sorting algorithms on data processing speed each algorithm sorted a random list 10 times and a pre-sorted list 10 times. The data was organized in a table and a graph was made of the data. (T-tests were also performed.) It was determined that there were significant differences among mean sorting times, therefore the research hypothesis, which stated that the merge sort was the most efficient, was accepted. In order to improve this experiment, more algorithms could be tested and the amount of data processed by each algorithm could be increased.

The Effect of Evolution on the Tic-Tac-Toe Playing Ability of Artificial Neural Nets

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The term “Growing” is not often associated with the development of Artificial Intelligences, despite the fact that we ourselves are ‘grown intelligences’. However, disregarding issues of computational feasibility imposed by current hardware, there is enormous potential for problem solving systems which are ‘grown’ in a manner parallel to biological evolution. The intent was to determine and demonstrate the ability of an evolving system to solve a simple game system such as Tic-Tac-Toe under specific circumstances. Using a three-dimensional analogue of Tic-Tac-Toe, one hundred “Brains” competed against each other towards the development of a superior strategy. Results indicated that while possible, creating a system which would be capable of solving any complex problem would require a large amount of fine-tuning specific to the problem, potentially reducing the feasibility of application in radically more complex scenarios.

Forensic Recovery of Deleted Electronic Data Using Disk Recovery Software

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The purpose of the project was to simulate the recovery of data from a hard drive that had its files deleted, drive formatted, or was overwritten using a secure deletion program. It was expected that data could be recovered from the drive unless the entire space on the drive was purposefully overwritten and that less data would be recovered from drives that were partially overwritten. Prior to each experiment the hard drives were overwritten using the United States Department of Defense standard overwrite algorithm by the program Eraser. The drives were filled with approximately nine gigabytes of data to be recovered; the same data was placed on each wiped drive. The data was composed of text files, PNG and JPG pictures, and MP3 music files. The data was then deleted using the deletion method for the experiment and the program Pandora Recovery was used to regain as much data as possible. The number of files of each type as well as the number of partial and overwritten files was recorded to determine the efficacy of the deletion method. The results support the hypothesis that data must be overwritten before it is lost.

The Effect of Technology Use on Recording Speed

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When writings could not be copied and pasted, back when monks rewrote the Bible into many books, there were no computers. As a consequence of the “Technological Revolution”, our iPods, phones, and computers have become a part of life. Many people rely on computers today for their work, entertainment, or health. Robots can now perform operations in hospitals with surgeons as operators or overseers. Televisions are able to access wireless networks to surf YouTube or watch movies over Netflix. Modern printing presses and computers are used to make jobs easier and save time. This experiment was designed to test the human dependency on processors and software against that of contemporary tools. The purpose of this experiment was to compare the technologies of the past and present. The Independent Variable applies to the topic, by the fact that the progression of devices is astounding, and from abacuses to C++ (programming software), devices are still and always will be progressing.

The Effect of Web Browsers and Operating Systems on the Loading Times of the Top 25 Visited Web Sites Daily

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Computer Science is a very broad and complex subject. This science project incorporated computer science as well, as mathematics. This experiment was fulfilled, and during the time this experiment was conducted, a lot of transformation of information on the computer occurred. This included the navigation to the top 25 websites, the online load timer, and the use of Microsoft Excel to record the load times of the websites. Computer science was

first recognized in the 1950's, slowly universities accepted the fact that computers were very much so a form of science. The reason this project was conducted was to determine the effect of different web browsers (including Mozilla Firefox, Google Chrome, Opera, Apple Safari) and operating systems (Windows 7 Enterprise and Mac OSX Snow Leopard), on the load times of the top 25 daily visited websites. The load times were recorded and compared; the averages were the data that were mostly considered. The results showed that Google Chrome was the fastest web browser while using Windows 7 Enterprise, but Apple's Safari was the fastest using Mac OSX Snow Leopard. The means of the operating systems load times were Windows 7 Enterprise, 9.60982 seconds and Mac OSX Snow Leopard, 24.21791 seconds. A t-test was performed and the p-value was less than 0.0001, which meant that the data was extremely statistically significant. The t was 8.6707, and the DF was 198, also the standard error of difference was 1.685. The data did not support the hypothesis to the full extent, it did for half of the experiment, but on the other operating system the hypothesis was proven wrong. The rejection of the second half of the hypothesis was mostly likely due to the fact that the operating system being used was specifically built to boost the load time and performance of its specifically built web browser. The science behind this reason is that computers are devices/machines that run programs.

The Effect of Voice Program on the Time Completion of a Video Game

Alexander Saxerud

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The purposes of this experiment were to find the effect of a voice program on the time completion of a race in a video game and to see which voice program performed the best while in use with a video game. The hypothesis was if the voice program is Xfire, then the time completion of the race would be fastest. In this experiment three voice programs and a control were tested. They were tested 15 times each to achieve accuracy. The programs were Skype, Steam, Xfire, and no program (NP) as the control. The testing was done on a computer that was restarted before each trial to maintain accuracy. Excess programs were disabled so only base programs were running. The resources of the computer were checked for anomalies and a resource monitor was started to help prevent outliers. The game Star Wars: Knights of the Old Republic was started and the race was run and timed to the hundredth of a second. Skype averaged 55.93 seconds, Xfire had 55.94 seconds, and Steam and NP tied for 55.97 seconds. Skype was concluded to be the fastest of the programs but the main purpose was to see which voice program was the best to use while playing a game. Skype performed the fastest, but Xfire was only 0.01 slower. Statistically it was proven there was no difference for time so the best program would be determined by the clarity of the voice program. Xfire was determined to have had the best voice quality. Steam and Skype had even voice qualities, but Skype slowed the game visually. Skype was the fastest, but only by a hundredth of a second and had poorer sound clarity than Xfire. Xfire was determined to be the best voice chat program to use when gaming.

The Effect of Computer Utilization on Power Outage

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The purpose of this project was to determine the energy-efficiency of modern computers. To determine this, a computer was utilized to a specific amount of processor usage and the amount of power the processor used at that level was recorded. It was recorded that when the processor was utilized to 25%, the processor used 7.35 watts of power, at 50% 10.6 watts, at 75% 14.33 watts, and at 100% 17.6 watts, and at maximum utilization, 26.6 watts of power were used. All of the data sets were statistically significantly different. This indicated that when the processor was more utilized, it drew significantly more power.

CONSUMER SCIENCE A

FIRST PLACE

The Effects of Different Multi-Purpose Solutions on the Amount of Bacteria in Petri Dishes

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Contact lenses are widely used vision correcting products that are generally cleaned with multipurpose solution. They can easily be contaminated with various kinds of harmful substances and specimen including bacteria. The purpose of the study was to determine if there was a difference in the amount of bacteria killed with Opti-Free Replenish®, Equate®, and Aquify® multipurpose solutions. The study was done with *Pseudomonas fluorescens* and *Staphylococcus epidermidis*. Nineteen Petri dishes were used for *Pseudomonas fluorescens* and fourteen Petri dishes were used for *Staphylococcus epidermidis*. The Petri dishes were treated with the multipurpose solutions or water, depending on their category. The dishes were incubated and tested for zones of inhibition. For *Staphylococcus epidermidis*, a statistical significance was not found among the Opti-Free Replenish® group ($M = 6.938$, $S.D. = 1.124$), the Equate® group ($M = 7.469$, $S.D. = 2.370$), the Aquify® group ($M = 6.563$, $S.D. = 0.981$), and the control group ($M = 6.250$, $S.D. = 0.707$) so it was concluded that Opti-Free Replenish®, Equate®, and Aquify® multipurpose solutions were equally able to kill *Staphylococcus epidermidis*. None of the multipurpose solutions had an effect on *Pseudomonas fluorescens*.

SECOND PLACE

Varying the Direction in Which the Corron Building Faces and How the Direction Changes Affect the Building's Electrical Efficiency

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The purpose of this study was to take the Corron building at Lord Fairfax Community College and make a computer generated model, in the program Arch CAD, to be tested in EcoDesign in order to find the best direction around a 360 degree plain for the Corron building to face to achieve the maximum efficiency. The hypothesis was developed to test this question of: if the all glass face of the Corron building faces north then the building will achieve the best electrical efficiency measured in kWh/year and cost/year. To test this hypothesis, the Corron Building was first measured and then put into Arch CAD as a 3D model to be tested in EcoDesigner. In EcoDesigner, the building model is then tested every 30 degrees in order to find the best direction for the building to face for electrical efficiency. When the building is facing 90 degrees, or north, the electrical costs for one year was only \$52,211 making it the most efficient. The worst position for the building to face was 330 degrees with the electrical costs for one year being \$54,494.

THIRD PLACE

The Effect of Musical Key on Song Popularity

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The purpose of the experiment was to determine if a trend in popularity exists between the musical key of a song and the popularity of that song based off of the top ten rock songs of Billboard.com's music charts. The experiment determined if any specific key of music was more popular than other keys when compared over ten months. It was expected that there would be a significant trend in popularity for specific keys over others. During the first week of each month, for ten months, the top ten songs from Billboard.com's rock charts were recorded. Once the trial period ended, the key of each song was analyzed through the Mixed In Key 2.5 software. Once the

data was collected and the keys were distinguished, the Friedman Test was used to rank the keys in order of popularity. From this analysis, it was determined that the key of D Minor was the most popular. The key of D Minor was ranked as the most popular for nine out of the ten trial periods, and the key was often represented by more than one song in each trial period. Questions following this experiment include whether or not a trend in key would appear in other genres or decades of music.

HONORABLE MENTION

What Type of Beverage Contains the Highest Concentration of Electrolytes?

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The objective of this experiment was to find the best type of beverage to consume to replace lost electrolytes. Electrolytes play a key role in the functions of one's muscles, nervous system, and the repair of tissues. People often experience imbalances of electrolytes after strenuous exercise or because of illness, which may result in muscle weakness or difficulties with concentration. To resolve these problems, several beverages containing electrolytes have been created. The hypothesis was that if the amounts of electrolytes are measured for several different types of beverages, orange juice will contain the highest amount of electrolytes. The conductance was measured for each beverage with a multimeter. A conductance sensor was made with a 3 cm plastic tube and two 15 cm pieces of copper wire. An open circuit was created with a 9-volt battery, multimeter, and conductance sensor. Ten bowls were filled with 250 mL of the appropriate liquid. The liquids tested included distilled water, tap water, bottled water, smart water, SOBE life water, vitamin water, Propel, Gatorade, amp ENERGY, and orange juice. To measure the conductance, the multimeter was set to direct current; the conductance sensor was put into each of the liquids being tested. The current was recorded for each beverage. The conductance of each drink was calculated using the equation: $G=I/V$ where G = conductance measured in Siemens, I = current measured in amperes and V = volts. The hypothesis, if the amounts of electrolytes are measured for several different types of beverages, then orange juice will contain the highest amount of electrolytes, was supported by this experiment. On the average of all three trials, orange juice contained the highest amount of electrolytes, followed closely by Gatorade. The results from this experiment can be used to educate consumers on the concentration of electrolytes in available beverages and help them make informed decisions while purchasing sports drinks.

HONORABLE MENTION

The Effects of Different Heat Protectants on the Tensile Strength of Hair Subjected to Heat Damage

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Heat styling, like hair dryers, flat irons, and curling irons, can permanently damage healthy hair, making it look displeasing and more susceptible to breakage. Fortunately, many different hair product companies manufacture heat protectant sprays to help retain hair vitality, strength, and looks. The purpose of this study was to determine if different brands of heat sprays better protected hairs that were damaged with heat styling, specifically hair dryers. Hairs obtained from girls at a local high school were tested by first applying different brand heat protectants on them, heating them in a manner similar to using a hair dryer, and then testing their strength afterwards. The results were analyzed using an ANOVA test that yielded a difference between the groups and a Tukey test that yielded a difference between the control and two heat protectants with high glycerin content. The researcher concluded that heat protectants do protect hair from heat damage and that heat protectants with a high percentage of glycerin protect hairs to a higher degree.

HONORABLE MENTION

The Effect of Radar on the Accuracy of Readings of GPS Receivers

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Radar may have an effect on the accuracy of GPS latitude and longitude readings at different distances. The purpose of this study was to determine if radio waves from a radar device decrease the accuracy of latitude and longitude readings on GPS. Garmin GPS eTrex Vista devices were used to acquire latitude and longitude readings with and without the effects of radar, at three different distances. The data was analyzed to show that radar did affect the accuracy of the readings, and the effect of the radar was different at the different distances. The researcher concluded that radar interference has an effect on the accuracy of GPS readings due to a slight phase shift between the electromagnetic waves which causes the signal to the GPS device to be weakened.

The Effect of Brand of Popcorn on the Number of Popped Kernels

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The purpose of this project was to determine the effect of different types of popcorn brands on the amount of kernels popped. Twelve bags of popcorn were purchased for each of the four brands to be tested in the experiment. One bag from each brand was opened and the amount of kernels found inside were counted and recorded. Then, another bag of popcorn was microwaved in the microwave for exactly one minute and thirty-five seconds. After the bag was popped, the contents were poured into a bowl. The popped kernels were then separated from the unpopped kernels and then placed on a paper towel. The number of kernels remaining was recorded, and were placed inside a plastic bag and labeled with the brand, trial number, and number of kernels. The popped popcorn was then set aside and the process was repeated again. There were ten trials conducted for each brand of microwave popcorn. At the end of the entire experiment, the number of unpopped kernels found during each trial was divided by the amount of kernels counted from the one unpopped bag. The resulting number was the percentage of kernels unpopped. When the Orville Redenbacher's popcorn was popped, it produced the lowest amount of unpopped kernels with a mean of 24.1. That brand was followed by ACT II popcorn with a mean of 33.4, Pop Secret popcorn with a mean of 53.1, and Food Lion popcorn with a mean of 96.7. Food Lion's popcorn had the highest mean amount of popcorn unpopped. The reason for this is because Orville Redenbacher's popcorn consisted of higher-quality kernels than the other brands. These kernels contained the appropriate amount of moisture that allowed them to pop more efficiently. If kernels do not contain the right amount of moisture, they will not pop properly. With the use of healthier kernels, this brand achieved better results than the other brands in the experiment.

The Effect of Detergent Brand on Ketchup Stain Removal

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The goal of this project was to compare the Harris Teeter house brand of laundry detergent to national brands based on ability to remove ketchup stains. The hypothesis stated that if the detergent was more expensive, as the national brands are, then it would better remove the stain. To test this hypothesis five different brands of detergent were each used to wash 20 stained pieces of fabric. The clean fabric pieces were each categorized on a scale of one to seven based on their cleanliness, with one being completely clean and seven being completely stained. The results of a one-way analysis of variance test showed that the data was statistically significant. Tide, the second most expensive detergent at \$0.16 per fluid ounce, resulted in significantly less stain removal than the other detergents. The other detergents resulted in about the same amount of stain removal with Harris Teeter, the cheapest detergent at \$0.09 per fluid ounce, removing slightly more. The results do not support the hypothesis. The more expensive detergents did not remove stains significantly better than the less expensive detergents. This shows

that the price of detergent is not related to stain removal ability.

The Effects of Mascara on the Amount of Dust Particles Collected on Eyelashes

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Mascara might serve to enhance the ability of human eyelashes to collect dust. The purpose of the study was to determine if mascara increases the amount of dust particles collected by eyelashes. Fake eyelashes and different types of mascara were used to test the amount of dust collected. The weight of the each eyelash set was tested and the gain score was analyzed with an ANOVA test that yielded a significant difference in those eyelashes coated with the mascara and those which were not treated. The researcher concluded that mascara is effective in aiding in the collection of dust and protection of the eye.

Changes in Magazine Food Advertisements

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Magazines have changed the types of food advertised to be more unhealthy and less nutritious. The purpose of this study was to determine if there has been a significant difference in the food groups being advertised in *Life* magazine. The null hypothesis for this experiment was there is no difference among the amount of different food groups advertised over the last four decades as determined by *Life* magazine. Volumes of *Life* magazine were obtained from a local public library. Random issues of the magazine were then used to collect the data. The researcher then analyzed the data. The data analysis resulted in the fact that there was a significant difference in the amount of each food group advertised. Therefore the number of advertisements for each food group in *Life* magazine had changed.

The Effect of Vibration Dampeners on Tennis Racket Strings

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The sport of tennis has grown and changed in recent years. Professional and recreational players are looking for ways to optimize their equipment to obtain maximum performance. Vibration dampeners may be a solution. The purpose of this study was to determine if vibration dampeners have an effect on the frequencies of tennis racket strings. In this experiment, a force sensor was attached to a tennis racket that was clamped to a table. A tennis ball was dropped onto the racket and the maximum wave height that the impact produced was recorded. The results were analyzed using an ANOVA that yielded a difference among the control, Wilson Shock Trap, and Wilson Vibra Fun groups. The researcher concluded that the Wilson Vibra Fun dampener worked the best for reducing racket vibrations.

The Effect of Energy Drink Consumption on Performance

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In this study, experimental research was conducted to determine if performance was affected by the consumption of energy drinks based on the subjects' navigation times through a straight course. Four domestic mice were tested on a course. While two subjects were tested with Red Bull Energy Drink, the other two were tested with the same amount of water. The subjects' navigation times were recorded for twenty trials each and then compared. It was predicted that the mice that were given Red Bull would navigate the course significantly faster than the mice that were given water (H_1). Energy drink consumption ultimately had a small effect on the subjects' navigational times, but there was a general decrease in all four subjects' navigational times over the course of the study. The average time for Mouse A was 15.56 s, for Mouse B was 16.73 s, for Mouse C was 16.07 s, and for Mouse D 16.52

s. The t-test showed that the mean difference between navigation times with and without energy drinks ($M=0.1475$, $SD = 1.434$, $N= 20$) was greater than zero, $t=-1.793$, and two-tail $p = 0.302$, providing evidence that the effects of energy drink consumption were minimal. This may suggest that energy drinks could have a similar effect on humans. Recommendations for further research would call for experimental studies directly on humans.

The Effect of ADA Approved Whitening Toothpastes versus Regular Whitening Toothpastes on the Surface Color of Teeth

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When whitening toothpastes have the same main ingredients and are from the same company, there should be no difference in their whitening strengths whether approved by the ADA or not. The purpose of this study was to disprove the rumors that ADA approved toothpastes are the only toothpastes that will do what they claim to do be it whiten teeth, remove plaque and gingivitis, or protection from tartar and so on. Thirty-two extracted human teeth were brushed the same with two different whitening toothpastes and then measured using a Discus Dental Tooth Whitening Shade Guide to compare the whitening results. The effects in stain color changes were recorded and analyzed using a *t*-test that yielded no significant difference between the ADA approved toothpaste and the unapproved whitening toothpaste from within the same company.

The Effect of Type of Disinfectant on the Growth of *Staphylococcus epidermidis*

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The purpose of this project was to determine the effect of various disinfectants on the growth of *Staphylococcus epidermis*. Thirty milliliters of agar solution was placed in each Petri plate. The Petri plate was swabbed with *Staphylococcus epidermis* and allowed to grow. Pieces of paper that had been punched were dipped in the various solutions. One piece was placed in each of the four quadrants marked on the Petri plate. There were three Petri plates with four hole punches per plate, making twelve trials per disinfectant. The zone of inhibition, or where the bacteria did not grow, was measured in millimeters. By determining the zone of inhibition, it was possible to determine which cleaner was most effective. The zone where there was no bacterial growth was clear whereas spots of the plate containing bacteria were grayish. With Clorox, all twelve trials had 30 millimeters for their zone of inhibition, the highest amount possible. However, water and 7th Generation (green) both had all twelve trials containing zero millimeter zones of inhibition. Overall, Clorox regular cleaner was the dominant disinfectant by far. It killed all the bacteria on the plate. In second was Comet regular cleaner. It cleaned slightly more than half of what Clorox killed. Clorox Green Works had two trials where bacteria were killed; however the other ten trials had no bacteria killed. Water and 7th Generation both killed the same amount of bacteria, which was none. This data favored the purchase of Clorox by a very wide margin. It was blatantly obvious as to which one was the best disinfectant. One of the differences between green and regular cleaners is the pH of the solution. Regular cleaners have a higher pH. Since their pH is higher they are stronger bases. The farther away their pH is from seven, pure water, the stronger they are. Since they are stronger and contain more chemicals, they kill bacteria more effectively. The pH was not personally measured in this experiment, but this information was found during the research portion of the experiment.

The Effects of Vitamin Brand Type on the Rate of Dissipation in Stomach Acid

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It has been suggested that there is a difference in the rate of disintegration of multivitamins in stomach acid based on whether the vitamins are generic brand or name brand. The purpose of this study was to determine if there was such a difference between multivitamins. Products from a local drugstore in Staunton, Virginia were obtained and tested by measuring the rate of dissolution, in minutes, of the multivitamin in simulated stomach acid. The results of the experiment were analyzed using a *t*-test that revealed a significant statistical difference between the

generic brand multivitamin and the name brand multivitamin. The researcher concluded that the One A Day® brand vitamins dissolved about two times faster than the generic brand multivitamins.

The Most Fire Retardant House Siding **Garrett Diehl**

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The search for a less flammable house siding was the subject for this research. The selection of sidings for this research included vinyl siding, cement board, asphalt shingle siding, cedar shake, and cedar siding board. One piece of the selected sidings was used for each trial. A propane torch was the source of heat. This torch attained a max temperature of 3450 degrees Fahrenheit simulating the early stages of a house fire. It was important for the researcher to use the same method to test each piece of siding in order to yield comparable result. Key observations were made regarding the elapsed time it took for the piece of shingle to burn until it fell of the metal wire that hung it from a steel support; this was also referred to as Burn Time. Other details were recorded such as the ability for each siding to sustain a flame as well as the sidings' initial reactions to the external heat. All of these were key components in determining the safest house siding of the bunch. The null hypothesis was the cost of the siding would have no correlation to its flammability. The alternate hypothesis was if the cost of the siding was low it would yield a high flammability rating.

The Effect of Brand of Mouthwash on the Effectiveness of Killing *Staphylococcus epidermidis* **Anna Fornili**

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The purpose of this experiment was to determine what brand of mouthwash best kills *Staphylococcus epidermidis*. The rationale of this experiment was that people will be more informed when purchasing mouthwash. The hypothesis of this experiment was if Cool Mint Listerine is used then the zone of inhibition will be largest. Tryptic soy agar Petri plates were made by dissolving tryptic soy agar powder in boiling water. The agar was poured into 12 Petri plates and left to solidify. Then each Petri plate was divided into four quadrants and labeled. Next, 48 disks were punched out of filter paper using a hole punch. A culture of bacteria was emulsified in a test tube filled with distilled water. A sterile cotton swab was used to create a "lawn" of bacterial growth on each Petri plate. Each disk was dipped into the appropriate level of independent variable and placed in the center of each quadrant. The Petri plates were incubated at 37°C upside down for 48 hours. The zone of inhibition was measured and recorded. The Petri plates were disposed of in an appropriate manner. In this experiment cetylpyridinium chloride or a combination of cetylpyridinium chloride and alcohol were the most effective antibacterial agents. Distilled water and the combination of Eucalyptol, menthol, methyl salicylate, and thymol are ineffective as antibacterial agents. The results of this experiment show that the presence of cetylpyridinium chloride and/or alcohol is essential to the effectiveness of the mouthwash.

The Effect of Charcoal Type on Time to Boil Water **Maria Mandel**

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The purpose of this experiment was to investigate the effect of charcoal type on the time to heat water to boiling temperature. It was hypothesized that briquette charcoal would heat the water faster than lumpwood due to additives in the briquettes. To perform this experiment, 1500 cubic centimeters each of briquette and lumpwood charcoal were put in the top of separate charcoal chimney starters, and one sheet of crumpled newspaper was placed in the bottom of each starter. They were placed on a grill, with a metal rack on top. The newspaper was lit. When one minute had passed, pots with 250 ml of water were placed over each of the starters. The temperatures of both waters were recorded every minute, until each reached 100 degrees Celsius. Ten trials were completed. The results were not statistically significant even though the briquette charcoal average heating time was faster than the lumpwood. The average time for the briquettes to heat the water to boiling was 13.9 minutes, while the average time

for the lumpwood was 16.7. In addition, the standard deviation of the time to boiling for the briquette charcoal, at 2.73 minutes was much lower than the lumpwood, at 7.2 minutes. The high variability of the lumpwood may be due to its structure. While each briquette piece is a standard size, the lumpwood charcoal size varies greatly. This may have caused variability in temperature increase. Based on heating consistency, the briquette charcoal may be a better choice for consumers.

The Effect of Brand of Popcorn on the Number of Popped Kernels

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The purpose of this experiment was to determine which brand of popcorn popped the most kernels. Four brands of popcorn were purchased and popped one by one in a microwave. The popcorn bags were popped one trial (four bags of each brand) a day. The four brands were Orville Redenbacher, Pop Secret, ACT II, and Food Lion. After each bag was popped, the number of kernels popped was recorded. The results showed that ACT II popped the most kernels with a mean of 170.60 kernels popped. They were followed by Orville Redenbacher with of mean of 147.30 kernels popped and Food Lion with a mean of 136.50 kernels popped. Pop Secret had the fewest kernels popped with a mean of 128.00 kernels popped. The reason for this is because some popcorn companies focus on other things other than having the most kernels popped. Taste, the size of the kernels, and the fluffiness of the kernels are all areas that popcorn companies focus on. If tested on these other areas, the results may have been different.

A Comparison between the Amounts of Time Required for EcoSmart, TCP, and Philips Compact Fluorescent Lamps to Reach Full Luminosity

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Compact Fluorescent Lamps will soon replace the current incandescent light bulb as the standard compact light. However, fluorescent lights take a small amount of time to reach full luminosity, rather than the instantaneous lighting of their incandescent counterparts. The purpose of this study was to determine if there is a significant difference in the time required for three differing brands of Compact Fluorescent Lamp to reach maximum luminosity. Compact Fluorescent Bulbs obtained from a local hardware store were tested by using a PASCO model CI-6504 Light Sensor in a darkened environment to measure how much time expired before the bulbs reached their maximum luminosity. Results were analyzed in an ANOVA test that yielded no difference in the amount of time required between the three groups.

The Effect of Natural Preservatives on Apple Slices

Adriana Thornton

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The purpose of this experiment was to find a natural preservative that would prevent apples from browning. The hypothesis states: If natural preservatives are applied to apple slices then apple browning may not occur as quickly because lime's low pH level will inhibit it. Scientists suggest that lemon juice would be the best choice because it is the strongest acid in "your edible arsenal". However lemon has a pH level of 2.3 and lime has a pH level of 1.8-2. Because lime is lower on the pH scale then it will prevent against oxidation more effectively in apple browning. Apple browning is caused by the reaction of three chemicals: phenols, enzymes, and oxygen. Phenols and enzymes reside in different locations of the apple. When apples are cut these cells are broken open and the enzymes and phenols react with each other and the newly added oxygen. The product of this union is browning. The data was collected after three sprays of each designated liquid was sprayed on to the apple slice, the timer began and as soon as the apple slice began to show signs of browning, the timer would be stopped and the data would be collected. The independent variables used in the experiment were lime juice, lemon juice, and green tea while the control was water. The dependent variable in the experiment was the time (seconds) it took for the apple slices to

show signs of browning. The data collected from the experiment shows that lime juice prevented apple slices from browning most effectively out of all of the independent variables.

CONSUMER SCIENCE B

FIRST PLACE

EGCG/Caffeine Levels in Green Tea and Humans' Tea Taste Preferences

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Green tea has been known for its medicinal properties for thousands of years. One can receive numerous health benefits from it by ingesting four cups daily. The most beneficial antioxidant in green tea is epigallocatechin gallate (EGCG), a polyphenolic compound. One goal was to discover if different factors in the tea-making process could affect extraction such that the amount of EGCG and caffeine extracted by HPLC would be higher or lower depending on the factors. Another goal was to see if consumers enjoyed high-quality tea to low-quality tea by conducting a taste test using four different quality green teas. It was discovered following experimentation that the amount of EGCG extracted in green tea made with distilled water at 2, 3, and 4 minute steeping times were significantly higher than the amount extracted in green tea made with distilled water with 1.00 mg/ml CaCl₂ (common tap water salt). P-values were <0.01, <0.001, and <0.001 with means of 1945 +/- 15, 2619 +/- 14, and 3166 +/- 33 (mg/ml) for the distilled water, respectively, and 1580 +/- 46, 2046 +/- 54, and 2430 +/- 61 (mg/ml) for the CaCl₂ distilled water, respectively. As for the caffeine extracted, only the 3rd and 4th minutes' tea samples were significantly different. P-values were 0.015 and 0.025 with means of 6333 +/- 31 and 6992 +/- 38 (mg/ml) for the distilled water, and 6135 +/- 23 and 6740 +/- 12 (mg/ml) for the CaCl₂ water, respectively). The results of the taste test indicated that consumers enjoyed the lowest quality brand the best, then next lowest in quality, then second highest, and highest quality the least. It was also found that 42% of consumers who noted on a survey that they strongly care about their weight and food intake drank green tea more than once daily, whereas 0% of consumers who did not strongly care drank green tea more than once daily. As health foods are becoming increasingly more popular, this project is significant because the results could potentially make green tea bottling companies wealthier and people healthier.

SECOND PLACE

The Effect of UV Radiation on the Growth of *Saccharomyces cerevisiae*

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The purpose of this experiment was to determine if a high SPF (sun protection factor) increases the protection level against UV radiation. The testing was completed during late October through early December of 2010 in the microbiology lab of a local high school. The *Saccharomyces cerevisiae* was diluted to 1×10^{-12} cells/ml and then 10 microliters were inoculated using sterile glass beads into 24 sterile YED agar plates. Then three plates at a time were placed into a UV box without their lids. The lids were replaced by a plastic film that was supported by cardboard to allow placement on the Petri dishes. One of the films had 0.13 grams SPF 50 sunscreen, another had 0.13 grams SPF 70 sunscreen, and the last one had no sunscreen on it to represent the control. They were exposed to UVA and UVB light for 1 minute and then incubated at room temperature for 2 days. After incubation the colonies (CFU's) were counted. A single factor ANOVA test was conducted and it showed no statistical significance between the three groups. The p-value was 0.443461 while the alpha value was 0.05. The F critical value was 3.4668 and the F statistic value was 0.845459. The research hypothesis was if the SPF level was 50 then the yeast growth would be inhibited was not supported. In conclusion, this experiment showed, using the method developed, that there is no difference among using a high SPF sunscreen, a mid range SPF sunscreen, or no SPF sunscreen at all.

THIRD PLACE

Going Green at Home – Green versus Traditional Cleaners

Ciara King and Mariah Martin

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The cost, health impacts, environmental influence, and overall efficiency of cleaning products are all considered by consumers when deciding which cleaners to buy and use in their homes. The purpose of the study was to test whether or not green cleaners work as well as traditional ones and also if consumers prefer to use green cleaners because they pose less threat to health and the environment. The experiment used a blind test, and participants were given cleaning kits, each containing four green cleaners and four traditional cleaners, to be used for a one week period. The participants were also given surveys to record their preferences, state opinions on specific questions, and list side effects experienced while using the products. The results of the experiment showed that there was not an overall significant difference in the participants' preferences of the green versus the traditional cleaners. In addition, the top factors affecting consumers' choice of cleaning products were effectiveness, price, environmental impact, and healthiness. The hypothesis stating that green cleaners work as well as traditional cleaners was accepted. However, because there was no significant difference in the cleaning product choices of the participants, the hypothesis stating that consumers prefer green cleaners because they are less harmful was rejected. A continuation of the study becomes even more crucial as some of the chemicals found in many cleaners are known neurotoxins, carcinogens, and developmental toxicants that can have harmful effects on both the health of the users and the environment.

HONORABLE MENTION

Tough Times

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The purpose of this experiment was to study different methods of tenderizing beef to determine which was the most effective. The research objectives were to see which of the following methods of tenderizing beef would work best in both wet (braising) and dry (broiling) cooking methods: rubbing in salt, marinating in a dairy product, marinating with a protein enzyme, marinating with a mild acid, pounding with a mallet, or marinating in a combination of enzymes, acid, and salt. The hypothesis was that the combination marinade would be the most effective, because it combines three approaches to tenderization. The same tough cut of steak was used for each method of cooking and cut into seven smaller pieces -- one for each method of tenderization plus a control piece. Tenderness was measured by an average of the number of strokes it took to cut through each piece of beef through four trials. Key results were that the control piece of beef was the toughest: an average of 9 strokes to cut when braised and 10 when broiled. The combination marinade, as well as the milk marinade and mallet tenderizing, tied for best method in braising, with an average of 6 strokes. The milk marinade performed best when broiled with an average of 4 strokes, while the combination marinade tied for second worst at 9 strokes. The conclusion was that it is important to prepare beef before cooking to improve tenderness. Marinating in milk, which came in first in broiling and tied for first in braising, was determined to be the most effective tenderizing method. Pounding with a mallet, which tied for best in braising, and was second best in broiling, was also a consistently effective method of tenderization.

HONORABLE MENTION

A Comparison of the Cost-Efficiency of Ethanol-Added Gasoline and Ethanol-Free Gasoline

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Ethanol Fuel is the standard renewable fuel source currently used by the United States. Being derived from wheat grains, this type of fuel is cheaper to produce for the American government than buying straight gasoline from foreign companies. Also, since the content of oil is lower, the pollution rate of ethanol-added gasoline is lower and many like to label it as better for the environment. This study is to test the actual cost-efficiency of Ethanol Fuel compared to the cost efficiency of regular gasoline. Two types of four-doors were driven throughout the summer of 2010 on each type of fuel separately. At each of the five gas-ups, the amount of gas purchased as well as the cost (twenty dollar trials) was written down on a logbook. When the gas gauge hit "E" the distance driven from the time of the gas-up was read from the odometer and written in the logbook. This data was thrown in separate equations to determine the average miles-per-gallon and cost efficiencies of each fuel type for each vehicle. The results showed that ethanol-free gasoline had higher values for both numbers in each vehicle. Not knowing exactly when to gas-up presented an uncontrollable problem in the experiment as well as driving routes. The p-values confirmed that the data was highly significant, both being under 0.05. This study found that ethanol-free gasoline will give the consumer higher gas mileage than ethanol-added gasoline and with a slightly higher price that does not offset the difference in gas mileage.

HONORABLE MENTION

The Effect of Fingerprinting Lift Techniques on the Clarity of a Fingerprint

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The purpose of this study was to determine if there was a difference in the quality of fingerprints once they were lifted using either Lightning Lift Pads or Remco Clear Tape. This study was conducted by a Central Virginia Governor's School student on two Fridays in December of 2010 at the Central Virginia Governor's School. A thumb was pressed on a microscope slide leaving a fingerprint to be lifted. Immediately after the print was deposited, either the Lightning Lift Pads or Remco Clear Tape was used to lift the fingerprint. The lifted fingerprint print was then placed on an index card which was coded to allow for data analysis later but did not allow those working with the cards to identify the method used. Twelve prints were lifted with each technique. Once all the fingerprints were lifted, the index cards were given to police officers and other personnel to be ranked for clarity. The cards were ordered from the least clear fingerprint to the clearest fingerprint, resulting in a rating for each fingerprint from 1-24. The fingerprints were ranked eight different times. The mean ratings were averaged for each type of lifting method, and a two-sample t-test with equal variances was run. Using an alpha level of 0.05, the p-value was found to be 8.05E-26, indicating that the alternate hypothesis was supported and that there is a significant difference between the Lightning Lift Pads and Remco Clear Tape. The hypothesis that between Lightning Lift Pads and Remco Clear Tape, the Lightning Lift Pads would produce the greatest clarity of fingerprint was supported by the data. In conclusion, Lightning Lift Pads were shown to be more effective than the Remco Clear Tape when comparing the clarity of fingerprints lifted with each technique.

The Effect of Boneless Chicken Breast Size on Final Internal Temperature after Carryover Cooking

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Carryover cooking occurred when a food item was removed from the heat source. After removal from the heat source, the food product still continued to cook because of the high internal temperature. The temperature began to equalize throughout the food item, and the process slowed as time continued. Carryover cooking was a regular process for all cooked foods, and was unavoidable. In boneless chicken breasts, it continued to increase the meat's temperature and cooked it from the outside into the center because the rate of cooking depended on the size. The purpose of this experiment was to determine the effect of size on the amount of carryover cooking that occurred in boneless chicken breasts. It was hypothesized that if the meat was a smaller, more compact size, then the final temperature after carryover cooking would be higher. The theory was then tested with 5 different groups. The boneless chicken breast was placed at the center of the cooking pan and cooked until it reached the internal temperature of 73.89 degrees Celsius. An instant-read thermometer was placed at the center of the roast to measure the internal temperature. After all the data was collected, a t-test was performed on the data, but there was no significant data from 4 out of the 5 groups ($t=0.159 < 4.303$; $t=0.417 < 4.303$; $t=0.109 < 4.303$; $t=0.073 < 4.303$; $t=4.197 < 4.303$; $t=0.071 < 4.303$; $t=1.399 < 4.303$; $t=0.003 < 4.303$; $t=0.094 < 4.303$ at $df=2$; $p < 0.05$). Temperature increased with increased size of chicken for the first four groups, but the fifth group, the largest chicken, did not follow the trend. The data did not support the research hypothesis that one ounce boneless chicken breasts had a higher final internal temperature after carryover cooking than five ounce chicken breasts. Many aspects of the experiment affected the accuracy of the data. An improvement of this experiment would be to cook chickens that were as closely matched in color, density, texture, and moisture as possible to avoid many inconsistencies. Increasing the number of trials for each size of chicken breast would also increase the accuracy of the temperature results.

The Effect of Temperature on Number of Un-Popped Kernels

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Popcorn has been and still is one of the world's favorite snacks. However, many times people are upset with the large amount of un-popped kernels that is found at the bottom of the bag after the bag is popped. This experiment was designed to find out how to get the best results out of a bag of popcorn so that there will be fewer un-popped kernels in each bag, and more pieces of popcorn that can be eaten. For this experiment, popcorn bags were placed in different temperature environments to see whether that had an effect on the amount of un-popped kernels left in the bag after being cooked. Ten bags were placed in a freezer, ten bags were placed in a refrigerator, ten bags were placed at room temperature, and ten bags were placed under a lamp. After sitting in these temperature environments for twenty-four hours, the bags were put in the microwave at the same temperature for the same amount of time. Then, the un-popped kernels were counted for each bag. However, before the experiment was conducted, it was hypothesized that the popcorn that was placed under a lamp would have the fewest un-popped kernels left in the bag after being cooked. The results indicated that the null hypothesis was rejected in all but one comparison (A vs. B $t=5.27 > 2.101$, A vs. C $t=9.09 > 2.101$, A vs. D $t=9.67 > 2.101$, B vs. C $t=4.2 > 2.101$, B vs. D $t=4.75 > 2.101$, C vs. D $t=0.14 < 2.101$ at $\alpha=0.05$ and $df=18$). In other words, it showed that the popcorn placed under the lamp had the fewest average amounts of un-popped kernels left in each bag. In conclusion, in order for people to get the best results out of each bag of popcorn, the popcorn should be kept in a warm environment. Yet in order to make this experiment better, there could always be more repeated trials so that the results would be more accurate.

How Do Cordless Phones Affect Wireless Router Signals?

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Cordless phones can interfere with signals from a wireless router causing weaker signals to computers. This project was to find how two cordless phones with different frequencies and the distance between where the phone is being used and the wireless router affects the signals from the wireless router. The phones used were at 2.4 GHz frequency phone and 1.9 GHz (DECT 6.0) frequency phone, and they were tested with incoming and outgoing calls 0.5 meters, 1.5 meters, and 2.5 meters away from the wireless router. The signal strengths were measured for one minute on a computer. The signal strengths were compared to the signal strengths when the cordless phones were not being used between the router and computer. This experiment showed that there is a difference in wireless signal strength when using a DECT 6.0 phone and 2.4 GHz phone. This experiment also showed that there is not a difference in signal strengths when the phones are used at different distances from the wireless router, and there is not a difference in signal strengths while making and receiving calls. This experiment showed that the frequency of cordless phones does affect signal strength, but distance between the router and phone and using the phone to make or receive a call does not affect signal strength from a wireless router.

The Effect of Different Types of Insulation on Temperature Change

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The purpose of the study is to determine if a recyclable material can be up to par when compared to fiberglass insulation. If recyclable materials and fiberglass insulation are placed in a structure that measures their ability to maintain a certain temperature over one and a half hours, then scraps of denim jeans will have less of a temperature change than the other materials. The materials tested were plastic bags, denim scraps, and fiberglass insulation. The control for the project is no insulation. The independent variable is the type of insulation used, and the dependent variable is the temperature change after a two-hour period. The constants of the experiment include the structure, thermometers, and the types of insulation used. A structure was built to measure the temperature change of each material over one and a half hour intervals. The starting temperature and the final temperature were subtracted to find the temperature change. This was repeated nine times for a total of ten trials. Standard deviation and matched pairs t-test were used to analyze the data. According to the data collected, the plastic bags had the least temperature change causing it to be the better material for insulation. The mean of the ten trials for no insulation was 5.9 degrees Fahrenheit. The mean of the plastic bags was 2.1 degrees Fahrenheit, 2.4 degrees for denim scraps, 3.5 degrees for fiberglass insulation, and 28.8 for the bottom box. The data shows that recyclable materials can be used as insulation.

The Effect of Type of Sunscreen on Protection against the Sun

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The Food and Drug Administration created the term SPF which stands for Sun Protection Factor. SPF measures a sunscreen's ability to block out UV rays from the sun. All brands of sunscreen must be labeled with the SPF to let the consumer know how much protection they will receive from the product. Specially made beads called UV beads will capture the UV rays produced from the sunlight and turn them from their original clear color to a vibrant pink or purple color. The purpose of this project was to see if the type of sunscreen, lotion or spray, would have more or less protection against the sun. Three cups with two UV beads placed inside each one, covered with plastic wrap on top, and either no sunscreen, lotion sunscreen, or spray sunscreen placed on top of the Saran Wrap with a syringe, was used in the experiment. After an hour had passed, data was collected on how vibrant the beads were. This was repeated ten times. The results indicated that the lotion sunscreen and the spray sunscreen of the same SPF showed no substantial difference in the protection they gave skin. A t-test used on the data indicated an insignificant difference between the means of the groups ($t=1.36 < 2.101$, $t=0.94 < 2.101$, $t=2.23 > 2.101$ at $df=18$; $p > 0.05$). The data rejected the research hypothesis that type of sunscreen has an effect on protection against the sun. This means that the data supports the null hypothesis. Based on the data collected in this experiment, a conclusion

can be drawn that no direct connection exists between the type of sunscreen used, lotion or spray, and the protection received by using it. Consumers need only focus on the SPF advertised on the bottle, because previous research shows that if used in the recommended amount is the only indicator of the product's results.

The Effect of Water Purification on the Amount of Chlorine in Water

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In the United States of America, every source of drinkable water has to be purified in some way. Drinking water comes from a variety of places including lakes, rivers, streams, and even places such as oceans and sewers. The water obtained from local sources can contain several harmful contaminants. Chlorine is used to remove these contaminants, but if used in excess, it can lead to health concerns. The purpose of this project was to determine if tap water purification directly affects the amount of chlorine found in city water. Over the course of ten days, tests were performed on the amount of chlorine in city tap water before and after purification with a tap water purifier. Ten water samples, each 250 mL, were tested. The amount of chlorine present in each sample was recorded in parts per million, or ppm, on a scale of 0.0 ppm to 5.0 ppm. The non-purified water had an average chlorine content of 0.57 ppm while the purified water samples had an average chlorine content of 0.13 ppm. A t-test performed on the data indicated a significant difference between the chlorine content of purified and non-purified water ($t=5.26 > 2.101$ at $df=18$; $p=0.05$). The data supported the research hypothesis that if water purification was used, then the chlorine content in the water would be lower. Based on the results of this experiment, there seems to be a direct relationship between the chlorine content of the purified and non-purified water. To further improve this experiment, a larger group of water samples should be tested, thus increasing the accuracy in the data.

The Effect of the Different Types of Insulation on Heat Retention

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The effectiveness of insulation was questioned and the conclusion of which type would prove to be the most efficient was necessary. This began the experiment comparing insulation samples which include the following: cotton, aluminum foil, foam, Saran Wrap, and bubble wrap. Each of the samples was tested equally compared to each of the others with Saran Wrap being hypothesized to provide the most effective insulation. Ten plastic test cups for each type of insulation were filled with 100mL of boiling water and covered with a small sample of the type of insulation being tested. A total of sixty cups were used during the experiment. The temperature of each cup was measured and recorded every twenty minutes so as to calculate the difference in temperature change. The results of the average temperature change graphed after the final test are as followed: 74.5°C for bubble wrap, 75.8°C for cotton, 75.6°C for aluminum, 75.7°C for Saran Wrap, 74.5°C for foam, and 77.7°C for the control. A t-test taken on the mean data collected of all samples tested was used to provide further results of the experiment. The null hypothesis was accepted in nine out of fifteen comparisons ($t=2.06 < 2.101$; $t=0.37 < 2.101$; $t=0.21 < 2.10$; $t=1.93 < 2.101$; $t=0.35 < 2.101$; $t=0.18 < 2.101$; $t=2.14 > 2.101$; $t=1.52 < 2.101$; $t=4.67 > 2.101$; $t=1.73 < 2.101$; $t=6.83 > 2.101$; $t=0.71 < 2.101$; $t=5.92 > 2.101$; $t=4.56 > 2.101$; $t=2.56 > 2.101$ at $df=18$; $p > 0.05$). Using this information, it was concluded that the research hypothesis, which stated that aluminum foil would be most efficient, was proven incorrect. After finishing the final calculations, the least significant temperature change was displayed in the cups testing both the samples of bubble wrap and foam, which displayed that these were most efficient in the conducted experiment. The results were believed to be accurate based off previous information stating the capability of bubble wrap and foam to be efficient types of insulation.

The Effect of Material of Bag on Rate of Decomposition

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On April 22, 2010, Frito-Lay unveiled its new "100 Percent Fully Biodegradable Sun Chips Bag". According to advertisements, after 14 weeks in a hot active compost pile, the bag would decompose completely. The

purpose of this experiment was not only to test Frito-Lay's claims, but also to test those of other manufacturers and discover whether or not the new bags, made out of PLA, Polyactic acid, would really decompose more quickly than regular potato chip bags. 5 different types of bags, regular plastic grocery bags, paper grocery bags, Sun Chips PLA bags, Tostitos potato chip bags, and Biobag bags made out of MatterBi, a corn derivative, that also claimed to be decomposable, were tested. Five bags of each type were put in a compost bin that was filled with the recommended compost materials from Frito-Lay's website. Also, 5 bags of each type were placed outside in an enclosure to see if the PLA material would affect decomposition rates when the bag was placed in a natural environment. Every three weeks, the bags outside were examined and graded, and every 6 weeks the bags in the compost were evaluated. Every week the temperature was recorded outside, in the compost with bags in it, and in a control compost without bags that simply contained kitchen scraps and other materials found around the house. The results indicated that only paper bags in the compost were capable of completely decomposing within 12 weeks. No other material was close to decomposing. The data supported the research hypothesis that material of bag would affect the rate of decomposition of bag, as there was a significant difference between paper and the other materials. The paper bags decomposed most, followed by the Sun Chips, then Biobags, then plastic bags, and then Tostitos. Until a plastic substitute is found that can feasibly be composted in a home compost environment, it seems that compostable potato chip bags are a thing of the future.

The Effect of Different Diaper Brands on the Quantity of Water Being Absorbed

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In research found, Pampers was calculated to have the most polyacrylic acid leading viewers to believe Pampers would absorb the most liquid. Polymers are tiny which allows diapers to be smaller and more comfortable, while still absorbing a lot of liquid, so just a pound of polymers can absorb 50 gallons of water! The purpose of this experiment is to find out which brand of diaper (Huggies, Pampers, and Luvs) can absorb the most water. The hypothesis is that if Pampers diapers are used then the most liquid will be absorbed. To complete this experiment, place the three brands of diapers in separate bowls and measure which diaper absorbed the most water. The greatest mean of how much liquid was absorbed was Huggies with 250 ml (all of the water), followed by Pampers with 170 ml, and Luvs with 35 ml. The hypothesis was proven wrong. This experiment proves that Huggies absorbs more water than Pampers and Luvs. If anybody researches this topic again, the only thing needed to be researched more thoroughly is the parts of the diaper besides the polyacrylic acid.

An Experiment on the Effectiveness of Larvicides in Mosquito Control

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People hate mosquitoes. They just want to get rid of them. There are two main ways to reduce the mosquito population. One is predation, animals like bats and fish eat mosquito larvae and adults. The second is pesticides meant to kill or hinder the process of metamorphosis. An alternative to spraying pesticides are larvicides. This study tested how well two different types of larvicides Mosquito Dunks and Pre-strike granules worked killing mosquito larvae. Fifty mosquito larvae were added to each of three containers and 0.5 grams of each larvicide were added to each treatment container, and nothing was added to the control treatment. In both trials the Mosquito Dunks killed a greater percentage of larvae and killed them faster than the Pre strike granules. They both killed the mosquitoes over the course of the whole experiment and an ANOVA showed this was statistically significant $p < 0.001$. Mosquitoes are a big problem for people all over the world. People need an effective and inexpensive way to get rid of dangerous mosquitoes and this is one very productive way. If they were to use this method then the mosquito problem would go down and there would not be as many human illnesses and deaths.

The Effect of Amount of Nitrocellulose on Nail Polish Durability

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There are many scientists who believe nitrocellulose is a big contributor to nail polish durability. It helps the nail polish adhere to nails well while also allowing oxygen to the nail. The purpose of this experiment was to see if nitrocellulose has any effect on nail polish lasting by testing several nail polishes with varying levels of nitrocellulose. For this, five nail polishes were applied to five nails for 15 minutes. After, cotton balls with nail polish remover took the nail polish off each nail and the number of swipes was averaged. Results showed that the nail polish with the highest concentration of nitrocellulose had a mean of 7.44 swipes, while the lowest concentration, excluding the control (0), had a mean of 6.06 swipes. The null hypothesis was rejected in the following: ($t = 35.65 > 2.101$; $t = 24.85 > 2.101$; $t = 31.04 > 2.101$; $t = 46.5 > 2.101$; $t = 3.72 < 2.101$; $t = 6 > 2.101$; $t = 3.16 > 2.101$ at $df = 18$; $p < 0.05$). The null hypothesis was accepted in three of ten cases: ($t = 1.94 < 2.101$; $t = 1.07 < 2.101$; $t = 1.29 < 2.101$ at $df = 18$; $p < 0.05$). The data supported the research hypothesis that the amount of nitrocellulose affects the durability of nail polish. Nails vary with every person. Some have indentions, coloring, and/or diseases distorting them. Taking this into account, running multiple experiments with different nail types would be increase information accuracy. All of the data shows that nitrocellulose is a beneficial factor on nail polish adhering to nails. Testing other brands with the same levels used in this experiment would show that nitrocellulose has an effect on the durability of nail polish.

The Effect of Different Cooking Methods on the Deterioration of Vitamin C in Broccoli

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Vitamin C is a highly water-soluble nutrient that is vital in keeping the body healthy by producing collagen, metabolizing amino acids, and helping maintain the body's immune system. When vegetables are submerged in water while cooking, many water-soluble nutrients, such as vitamin C, can be leached out. The purpose of this experiment was to determine which cooking method, including boiling, steaming, and microwaving, resulted in the least vitamin C deterioration in broccoli. It was hypothesized that the vitamin C will deteriorate the most when boiled, second when microwaved, and third when steamed due to the solubility of vitamin C in water. Broccoli juice from the boiled, microwaved, steamed, and raw broccoli were dropped using a pipette into an iodine starch indicator solution. The broccoli juice that required the least number of drops to change the color of the iodine starch indicator solution had the least vitamin C deterioration. The results indicated that boiling caused the highest deterioration of vitamin C with an average of 8.4 drops. Steaming resulted in the lowest deterioration with an average of 3.3 drops. A t-test was completed in order to determine if there were any significant differences between the means of each group. The null hypothesis was rejected in all comparisons ($t > 2.101$ for all comparisons), and the data supported the research hypothesis. Based on vitamin C content after cooking, the deterioration of vitamin C in broccoli corresponded directly with the type of cooking method used. The results determined that the cooking method with the least direct contact with water resulted in the least deterioration of vitamin C.

The Effect of Different Surfaces on the Effectiveness of Mighty Putty Adhesive

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The purpose of the experiment was to see if the epoxy Mighty Putty worked as effectively as claimed on three different surfaces. The actual data collection happened February 2, 2011 at AREVA NP Inc. on Mount Athos Road in Lynchburg, VA. The facility's Instron 600DX Tensile Strength Tester was used twice during the course of experimentation. The aluminum, OSB board, and flat tile board dumbbells were sent to the facility and pulled apart beforehand. Mighty Putty was then applied to the samples at the CVGS facilities. After the Mighty Putty was applied and allowed to cure, the samples were sent back to AREVA to be pulled by the Tensile Strength Tester. The experiment measured the tensile strength (in psi) among the three different groups of dumbbells. The results of the experiment show that there is a significant difference between the groups. The one-way ANOVA p-value was 0.0000696328. A Tukey test was conducted to see between which groups there was a significant difference. The

dmin value was 567.9692. The hypothesis – if Mighty Putty is applied to aluminum dumbbells, then it will be able to resist at least 350 psi of force - was supported by the data because the mean aluminum psi value was greater than 350 psi, which was the limit claimed by the makers of Mighty Putty. In conclusion, the data show that Mighty Putty does work as effectively as claimed for some substances (aluminum) but not as effectively for other substances (OSB board and flat tile board).

EARTH and SPACE SCIENCE

FIRST PLACE

Extended Green Objects (EGO's) in the Vela Carina Region of the Milky Way

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The purpose of this project was to create a catalog of Extended Green Objects (EGOs) in the Vela-Carina Region of the Milky Way disk and to compare these EGOs to published catalogs of Class II Methanol Masers and IRAS Sources. The study was conducted in October 2010 through January 2011. To complete the study, the computer program DS9 was used to analyze data obtained from the Spitzer Space Telescope. In collaboration with the Astronomy Department at the University of Virginia, the researcher studied multi-wavelength infrared images covering forty degrees of longitude of the Vela-Carina Region. Using background and polygon region features in DS9, possible EGOs were outlined. From these region files, the researcher created a catalog of the positions and flux densities of possible EGOs. The positions of the EGOs were then compared to published catalogs of masers and IRAS sources using histograms. This data analysis showed that there was not a significant spatial correlation between EGOs and masers, contrary to the researcher's hypothesis. When compared to the IRAS sources, however, there was a significant relationship between the two catalogs, as was expected. In conclusion, the research showed that EGOs do not appear to be sources for masers.

SECOND PLACE

The Effect of Low Altitude Humidity on the Type of Contrails

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Contrails, or condensation trails, are the linear clouds trailing behind an aircraft. Contrails form similarly to clouds. Contrails form when the hot and moist aircraft exhaust mixes with the cold and dry ambient air in the troposphere. When the water vapor condenses and freezes, the contrail forms. There are three types of contrails: short-lived, persistent, and persistent spreading. The purpose of this experiment was to determine the effect of low altitude humidity on the type of contrails. It was hypothesized that if the low altitude humidity range [low (20%-40%); moderate (41%-60%); high (61%-80%); very high (81%-100%)] increased, then more persistent spreading contrails formed. For two months, data was collected at three times every day. At each observation time, the number of contrails of each type was recorded as well as the humidity. The humidity data were found using <http://www.wunderground.com/>, a weather archive. The results indicated that lower humidity is associated with short-lived contrails and higher humidity is associated with persistent and persistent spreading contrails. A chi-square test for independence was performed on the data and proved that there was significant evidence that the variables are not independent ($\chi^2=32.14 > 12.592$ at $df=6$; $p=1.53 \times 10^{-5} < 0.05$). Even though the null hypothesis was rejected, the research hypothesis was not supported because persistent spreading contrails were the mode type for only moderate humidity. Persistent contrails were the mode type for both high and very high humidity. However, based on the contrail types observed at different levels of humidity, there appears to be a positive correlation between low altitude humidity and types of contrails. Before it can be concluded that humidity was the only factor in contrail formation, other tests need to be performed testing contrail types and temperature, altitude, particulates, or aircrafts.

THIRD PLACE

A Search for Black Hole Accretion Events through Megamaser Line Structure Time Variability

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The purpose of this study was to investigate if time variability in megamaser emission could be correlated to black hole accretion events in the galaxy UGC 3789. The study was conducted at home, school, and the University of Virginia Astronomy Department over the course of several months. The data were obtained and processed by NRAO personnel prior to this research being conducted. A total of 38 spectral measurements were taken of UGC 3789 over the course of 1200 days. Each individual spectrum was divided into wavelength regions and the total energy was calculated using the GBTIDL software package. The results were plotted for each spectral window versus time to look for trends. The results showed that megamaser emission does vary over time and that variance shows trends across each of the spectral windows, however, matching those trends to accretion events was inconclusive. Future studies can be designed to explicitly seek out whether or not the trends can be matched to accretion events.

HONORABLE MENTION

The Effect of Oil and its Dispersants on Oyster Mortality

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The Deepwater Horizon Oil Spill of 2010 was devastating to the ecology of the Gulf. Not only did the oil significantly hinder the survival of most aquatic species in its surrounding areas, but it spurred on potentially destructive relief efforts. These efforts included the use of dispersants with potentially unforeseen effects. Therefore, the experimenter's objective was to examine the effects of oil and surfactants on the mortality rate of the Eastern oyster. At the start of this experiment, it was believed that if samples of *Crassostrea virginica* were exposed to oil, then they would have a higher mortality rate than oysters exposed to an oil-surfactant blend or regular Bay water. In previous research by the EPA and USFWS, it was found that oil affected marine invertebrates in a variety of ways, which included asphyxiation, the alteration of metabolic rates, and changes in shell formation. To conduct the experiment, the experimenter began with 20 oysters in each 10 gallon tank and then proceeded to add various chemical solutions in concentrations of 100 ppm or 500 ppm. At the end of every day, the sixteen tanks were examined for their mortality rates. By the final day of the trial runs, approximately 4 oysters had died in each tank. After statistically examining the data, it was shown that there was no significant difference in mortality between the solutions, however a difference did occur between the Oil 500 ppm group and the Control group. From this data, it can be evidenced that neither the ZI-400 dispersant, oil-dispersant blend nor oil slick had any significant effect on the mortality of *Crassostrea virginica*. This data supported the results of previous experiments, in which the Eastern oyster was shown to be extremely resilient to variations in its environment. With recent discussion in offshore drilling, this data would prove to be invaluable in the event of a Chesapeake Bay oil spill.

HONORABLE MENTION

The Effect of Plants with Different Root Systems on the Prevention of Soil Erosion

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Soil erosion is when soil from rock formations or large masses of land are weathered down and transported away from where it originally came from. A common type of soil erosion occurs by water. This type of soil erosion involves water flowing through the soil and carrying loose particles away with it. The water may then end up in other bodies of water polluting the water sources, and damaging the land where the soil was eroded. One promising

method of preventing soil erosion is to plant vegetation to hold the soil together. The purpose of this experiment was to determine which of the three plants, crabgrass, dandelion, or Kentucky-31 tall fescue, would hold the soil the best and reduce the amount of erosion. Three types of plants with different root systems were grown in aluminum pans filled halfway with soil. Water was poured into the soil-free side beside the plants and rocked fifty times. Water was drained and strained and the volume of eroded soil was measured. The eroded soil volumes from Kentucky-31, crabgrass, dandelions, and no vegetation control were 46.5 ± 6.69 ml, 72 ± 16.7 ml, 63.5 ± 9.87 ml, and 245 ± 28.38 respectively. T-test analysis revealed that while all three plants significantly reduced erosion ($p < 0.05$), Kentucky-31 was the most efficient. The data collected from the experiment rejected the null hypothesis. Based on the information gathered, it appears that vegetation significantly reduces soil erosion. It can also be concluded that Kentucky-31, with adventitious root system, held the soil significantly better than the other plants.

HONORABLE MENTION

The Effect of the Turbidity of a Solution on the Amount of Scattered Light

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The purpose was to learn about the components of light and how particles in a solution react to the light. For the light meter, the photoresistor was attached to the jar lid in order for the light meter to detect the light. Then the ten identical jars were placed on a flat surface and were filled up with a $\frac{1}{2}$ a cup of the same liquid. Then one of the jars was placed in front of the laser. The lid was placed on top and all the lights were turned off. The laser was turned on and pointed at the liquid so it was shooting a straight line through the jar. After the read out fluctuated, the laser was turned off. The read out number was recorded and was continued for all five of the different liquids. It was found that the James River water had the most turbidity and that the pure water had the least amount of turbidity. The ocean, sound, and creek water had very close readings. The James River water had the most scattered light since more turbidity or particles were present and the light scattered off of all those little particles or impurities. It was found that the James River had a mean of 0.771 and that the pure water had a mean of 0.476, which were the highest and lowest readings. The ocean had a mean of 0.611, the sound had a mean of 0.57, and the creek had a mean of 0.618. All of the data was measured in volts which detects electricity from the scattered light.

The Effect of Diversion Placement along a Simulated Stream on the Volume of Water Diverted

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Floods, disastrous natural phenomena which cannot be avoided easily, affect people worldwide in a destructive manner. Diversions, as proved in the preceding experiment, are definitely useful in preventing or delaying floods. The purpose of this experiment was to test the significance of diversion placement based on the volume of water diverted. The research hypothesis stated that if diversions were placed at different points along a simulated stream, then the volume of diverted water would be greatest when they were placed farthest away from the container. To simulate the stream, a large tube was used and two smaller tubes were utilized to simulate diversions to the stream. In the first trials conducted, the two diversions were placed closest to the water source. They were then moved for each level of independent variable. The water that was diverted was collected in two two-liter bottles, and then emptied into a measuring cup to calculate the volume of water diverted. The volume of water gathered in the container was also calculated through the same process. The data gathered were placed in a data table and then analyzed. The mean, median, mode, quartile one, quartile three, interquartile range, outlier maximum, and standard deviation were found for each level and put into a data table. T-tests were conducted for each level of independent variable to test the significance of the data. Though some t-tests accepted the null hypothesis, most rejected it. As a result, the data was proved to be significant. A graph was created for the mean volume of water for each level. The hypothesis was not supported due to the greatest mean volume of water belonging to the level of independent variable in which the two diversions were placed closest and farthest from the water source. Even

though diversions are proven to be effective, they may not be practical for all situations. The annual or centennial flood rate of a specific area can determine their usefulness.

The Use of Moon Illumination as a Predictor of Barometric Pressure

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The purpose of this study was to determine whether or not the appearance of the moon in the night sky can be associated with barometric pressure readings. Humans often used myths concerning the moon as early forecasting tools in attempts to study the weather, but the advent of technology has caused the use of mythology in meteorology to fall by the wayside. No empirical studies have ever supported or rejected the idea that the moon can be used as a tool with which to forecast the weather. It was hypothesized that either strong positive or strong negative trends will exist between moon illumination and barometric pressure measurements. Adobe Photoshop Elements 8.0 was used to calculate moon illumination proportions for images taken with a Nikon D50 camera. Barometric pressure measurements were recorded both in the morning and at night with a digital barometer. Only weak negative trends were discovered for both sets of data ($r = -0.1329$ for the morning model and $r = -0.2498$ for the nighttime model), though there was a stronger relationship between moon illumination and nighttime barometric pressure. Two t -tests for slope were performed on the data to further investigate the relationship between moon illumination and barometric pressure. These were both insignificant ($\alpha = 0.05$), so the null hypothesis of no relationship between moon illumination and barometric pressure could not be rejected. The research hypothesis was not supported by the results and was statistically insignificant. These results are most likely due to random chance. Further studies could investigate the relationships between moon illumination and other weather characteristics. The techniques for calculating moon illumination could be applied to other studies to improve quantitative data collection, as well.

Characterization of X-Rays in the NGC 3576

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To better understand the relationship between x-ray and infrared emission in newly-formed stars, astronomers need to characterize the properties that may contribute to their existence. This study was conducted for the purpose of appropriately describing the properties of sources with both infrared and x-ray emission and comparing the characteristics they share. It was carried out by a high school student in conjunction with astronomy graduate students attending an area university. The project began in October of 2010 and ended in January of 2011. For the study, data were collected from the *Spitzer Space Telescope* and *Chandra X-ray Observatory*. The data were then analyzed for spatial counterparts between the x-ray and infrared sources, matched to find pairs, and various attributes were plotted against each other to look for significance. After a deficiency of x-ray hardness was revealed in the "matched" data, a t -test confirmed that it was statistically significant. No other correlations were observed between xray and IR properties. In conclusion, the data show a significant x-ray hardness deficiency in sources with counterparts, while a lack of correlation in other plots point to a deeper understanding of the physics involved in the formation of Young Stellar Objects (YSOs) and stars in general.

Regime Shift Induced Climate Change in the Bering Sea: Evidence from the Benthic Ostracode Assemblage

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Abstract withheld at author's request.

Identification of YSO Candidates using IRAC Data from the NCG 3576 Star-Forming Region

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The purpose of this descriptive study was to find a correlation between properties of the infrared emission and the X-ray emission in Young Stellar Object (YSO) candidates in the NGC 3576 star-forming region. The study was conducted by a student researcher at the Central Virginia Governor's School campus and at home between the months of October and January. The point source catalog used in this study was developed using the Infrared Array Camera—or IRAC—on the Spitzer Space Telescope. Upon receiving the point source catalog, the researcher then sorted the data into colors. Point sources falling within the color ranges of Indebetow, then the color values which resulted from this analysis were plotted and analyzed. YSO candidates determined by this analysis were then matched to X-ray source positions. Finally, the infrared and x-ray properties of the YSO candidate sources were compared. Analysis of the data revealed the null hypothesis to be true. In conclusion, the data analysis of the various properties of infrared compared to the properties of X-ray emissions do not appear to have any correlation between these two emission types in YSO candidates.

The Effect of Wave Height on Wave Turbidity

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Tsunami, the word itself evokes fear and panic to even the bravest of souls. Unpredictable frightening forces of nature caused by earthquakes, volcanic eruptions, and other underwater explosions are seismic sea waves or in other words tsunamis. The understandings of tsunamis were very slim until the 20th century appeared where ongoing research was developed by geologists and oceanographer as the threat of tsunamis increased. Thus to prevent from losing so many lives and to warn people before a tsunami hits scientist discovered a formula of a relationship between the wave height on the wave velocity. Tsunami or tidal wave is a series of water waves (called a tsunami wave train) caused by the displacement of a large volume of a body of water. The greatest tsunami witnessed was the Indian Ocean Tsunami in 2004. The purpose of the experiment/investigation was to determine if the various wave heights of 2 cm, 4 cm, 6 cm, and 8 cm would affect the wave velocity and if the formula behind it was true. A water tank was used to test the different wave heights. In the tank water was filled with the different wave heights (2 cm, 4 cm, 6 cm, and 8 cm) where 32 trials took place for each wave height. Also, a stop watch was used to record the time the wave needed to travel from one side to another in the tank for each different wave height. The data supported the researcher's hypothesis that if wave height was 8cm then the wave velocity will be higher. The hypothesis was proven because as wave height was increased water waves moved faster as they reached the other end of the tank causing the wave velocity to increase as well. The research obtained from this experiment supports that there is a linear relation between wave height and wave velocity. This experiment also supported the formula between wave height and wave velocity. With this experimentation and future research we can predict tsunamis and save innocent people. Hopefully that fear and panic of a tsunami will be eliminated from the hearts of humans forever.

The Effect of Ocean Currents on Weather

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Scientists have looked at Sri Lanka to see if there was a current and the researchers found an eastward flow about 50-150 meters below the surface. The scientists did more research in 1993 and found nothing, but in 1994 the scientists did find a current. Other scientists have noticed that the seasonal cycle affects the currents. So the purpose of the experiment was to see if ocean currents had an effect on weather. The hypothesis was if the ocean currents near the coast are strong, then bad weather is likely to occur. To test the hypothesis, temperature, barometric pressure, and wind speed were recorded daily for four different cities for three weeks. Information was gathered from Gulfport, Florida, San Diego, California, Kodiak, Alaska, and San Jose, Philippines. T-tests were conducted for all of the temperatures, barometric pressures, and wind speeds for each city. For the data collected on

temperature, the null hypothesis was accepted in one case ($t=0.216 < 2.021$ at $df=40$; $p>0.05$). For the data collected for barometric pressures, the null hypothesis was accepted more than once ($t=0 < 2.021$; $t=1.86 < 2.021$; $t=0.45 < 2.021$ at $df=40$; $p>0.05$). When the wind speeds were looked at, the null hypothesis was accepted in all of the cases ($t=0.977 < 2.021$; $t=0.241 < 2.021$; $t=0.690 < 2.021$; $t=0.997 < 2.021$; $t=0.415 < 2.021$; $t=0.433 < 2.021$ at $df=40$; $p>0.05$). Overall, the null hypothesis was rejected in temperature, but the null hypothesis was accepted in barometric pressure and wind speeds. Because the null hypothesis was accepted in both the barometric pressure and the wind speed, it cannot be concluded that ocean currents have an effect on weather. However, the null hypothesis was rejected in the test for temperatures. It was concluded that ocean currents have an effect on temperature.

The Effect of El Niño on the Sea Surface Temperature of the Pacific Ocean

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Scientists from various research institutions across the world have been studying the effects of the El Niño – Southern Oscillation (ENSO) on weather patterns and the oceans as well as the indirectly affected animals that live around or in the ocean. ENSO is a powerful weather event in the Pacific Ocean that affects the wind and sea currents in such a way that weather factors such as climate and sea surface temperature are impacted in some way, although some event cycles are stronger than others. The potential effects of ozone and solar cycle on ENSO have also been studied to be able to better predict ENSO. Sea surface temperature data was compared with ENSO event years to determine the effect of ENSO on sea surface temperature (SST) using weather buoy data off the coast of San Diego, California. Data was averaged into two groups: ENSO event years and non-ENSO event years. The data was further divided into subgroups; the years 1990 through 1999 and the years 2000 through 2009. It was hypothesized that if an ENSO event cycle occurred over the Pacific Ocean then the SST would decrease. The results indicated that while there was a change in SST, it wasn't considered statistically significant. The null hypothesis, declaring that that data was insignificant, was accepted for the first level ($t=2.19386 < 2.447$ at $df=6$; $p<0.05$) and the second level ($t=0.388159 < 2.447$ at $df=6$; $p<0.05$). The null hypothesis was accepted because the change in temperature wasn't considered statistically significant. The research hypothesis was rejected because the experiment determined that ENSO did not have an effect on the SST of Pacific Ocean off the coast of San Diego. Many factors could have contributed to the insignificant result including the location of the weather buoy used in data collection, the severity of ENSO events during the two testing windows, and local weather patterns affected by other factors than ENSO.

The Effect of the El Niño and La Niña on the Occurrence of Hurricanes in the Atlantic Oceans

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This experiment was conducted to determine if the conditions of the Pacific Ocean, specifically El Niño and La Niña, affect the occurrence of hurricanes in the Atlantic Ocean. Being able to accurately and consistently predict the number of hurricanes that will form in a certain year is key to preparing the public in order to preserve life and property. During an El Niño and La Niña, the water temperature changes in the Pacific Ocean. This affects the wind currents around the world which can help or hinder a hurricane's development. It was hypothesized that during an El Niño, there would be fewer hurricanes that form in the Atlantic. This is due to increased wind shear, which hinders the development of hurricanes. There were three independent variables in this experiment, years with an El Niño, La Niña, and years where the water temperature was average. Depending on these conditions, different numbers of hurricanes formed in 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 during years when the water temperature was normal. Appropriate options such as pressure, hurricane intensity, ocean basin, and most importantly, timeframe were selected. Then the number of hurricanes in that year was recorded in the data table. Means were calculated and graphs were created to compare the data. A t-test was also completed, and the null hypothesis was rejected, indicating a statistically significant decrease in hurricanes during El Niño years. Additionally, an R-value was calculated and showed that there was a moderate positive correlation

between lower water temperatures and greater numbers of hurricanes. Numbers don't tell everything, however, because it only takes one major land-falling hurricane to cause devastation. For future experiments, the researcher might look at the intensity of the storms, as well as wind and water currents.

ENGINEERING

FIRST PLACE

Applying the Mecanum Wheel to Electric Wheelchairs

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The purpose of this project was to experiment with methods of improving wheelchair mobility. We assessed this need after witnessing severe maneuvering difficulties with traditional manual wheelchairs in crowded areas. After researching methods of improving wheelchair mobility, we chose to experiment with mecanum wheels. Since no production-model mecanum-drivetrain wheelchairs exist for sale, one was designed and constructed from scratch. This wheelchair was then tested against traditional manual wheelchair. Testing participants navigated an obstacle course and then rated each chair on a number of different criteria: Speed, Precision, Comfort, Ease of Use, and Safety. The mecanum-drivetrain wheelchair scored higher in Speed and lower in the other four categories compared to a traditional manual wheelchair (score differences of 1.00, -1.72, -3.64, 1.63, and -2.81, in Speed, Precision, Comfort, Ease of Use, and Safety, respectively). This clearly rates the mecanum-drivetrain wheelchair inferior to a traditional manual wheelchair. However, the current mecanum-drivetrain wheelchair has several known flaws, and this rating is not necessarily reflective of mecanum wheels as a whole. This project will raise awareness of the mecanum drive system, leading to wider application. With further debugging of the current design, it is possible that a mecanum drivetrain wheelchair can be completed in the future that is superior to a traditional manual wheelchair.

SECOND PLACE

Strengthening a Neuronal Network through Long Term Potentiation

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The purpose of this experiment was to investigate the effects of long term potentiation (LTP) on a neuronal network maintained *in vitro* on a Micro Electrode Array (MEA). In addition, the ideal substrate and medium for the neuronal network was to be determined. Neurons were obtained from *Helix aspersa*. The snail was anesthetized with magnesium chloride and then pinned down on a silicon substrate. Its cerebral ganglion was located and removed from the snail. Neurons were then extracted from the ganglion using enzymatic and mechanical disassociation. The neurons were transferred onto various Petri dishes containing combinations of neuron media (either Ringer's or L-15) and substrate (either PDL or PEI). Adherence of the neurons to the substrate was evident in the dishes with PDL substrate, as neurons in PEI substrate were seen to be floating in the medium; this is indicative of cell death. To narrow the combinations between Ringer's/PDL and L-15/PDL, the neurons were observed over a period of a week. Although adherence and growth were initially observed in both cases, the L-15/PDL combination was the only one to promote neuronal survival and growth for an extended period of time as neurons in Ringer's/L-15 were eventually seen as floating. Neurons were then plated onto an MEA with PDL substrate and L-15 medium. Stimulation intended to evoke neuronal responses was attempted, however no responses were observed. This was attributed to lack of sufficient cell connectivity. Hemolymph from *Aplysia californica* was added to the L-15 solution in order to enhance growth. This was supported as neurons more easily formed networks *in vitro* as compared to neurons in L-15/PDL without lymph addition. From this experiment, the ideal substrate/medium was determined for neuronal growth, and stimulation methods were established.

THIRD PLACE

The Effects of Human Deflection on Piezoelectric Film's Ability to Convert Mechanical Energy into Electric Energy

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The purpose of this study was to determine if human locomotion would generate enough voltage to power a small electronic device by inserting a piece of piezoelectric film in a shoe. A local high school student conducted this study in a high school physics classroom in November 2010. The researcher measured the amount a shoe bends when a person walks and runs to determine the amplitude. A mechanical wave driver was used to bend the DT2-028K piezoelectric film at the previously determined amplitude and at two different frequencies, one representing a person walking, and the other representing a person running. A graph of the voltage produced by the deflection of the film was then analyzed to determine the average voltages. Two one sample t-tests were used to compare the voltage needed to power a small electronic device to the voltage produced from deflecting the film. The p-values of both tests (less than 0.0001) were significantly smaller than the set alpha values (0.05) showing the difference between the required voltage and the observed voltage. These results did not support the original hypothesis that if a piece of DT2-028K piezoelectric film was bent to simulate running, then enough voltage would be produced to power a small electronic device. In conclusion, the DT2-028K piezoelectric film was not able to power a small electronic device.

HONORABLE MENTION

The Effect of Incremental Payloads on the Altitude Achieved by Three Model Rockets with the Same Total Impulse

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Moving a payload in rockets to some height above the Earth's surface is one of the main goals of rocketry. Adding a payload can significantly change a rocket's weight and reduce the altitude it can reach. The purpose of this project was to determine the effect of incremental payload weight on the altitude achieved by a single stage rocket, a two-stage rocket, and a single stage cluster rocket with the same total impulse. This was a continuation of a previous project conducted by the researcher in 2009-10 that investigated which of these three rocket configurations reached the highest altitude with no added payload. Three model rockets, each having a total impulse of 10 Newton-seconds, were used. Two rockets were configured for a single stage launch (one with a single motor and one with a two motor cluster) and one rocket was configured for a two-stage rocket. Each model rocket was launched and the maximum altitude reached was measured at 0g, 20g, and 40g payload weights. The results showed that the altitude decreased with increasing payload in all three rockets. When no payload weight was added, the two-stage rocket reached the highest altitude. However, at the 40g payload weight, the cluster rocket reached the highest altitude. The data supported the hypothesis that if a single stage model rocket with a single motor, a single stage cluster rocket with two motors and a two-stage rocket, all having the same total impulse, were launched; then the altitude achieved by each rocket would decrease with increasing payload weights, in a manner that the cluster rocket would eventually achieve the highest altitude. The findings of this study demonstrated that, for this specific model rocket design, as the payload was increased, the single stage cluster model rocket became more effective than the single stage single motor and two-stage rockets in achieving the highest altitude.

HONORABLE MENTION

Celloidosomes: A Journey toward the Bioengineering of Artificial Micro-Glands and Micro-Bioreactors

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The cornerstone of this research project lies in the ability to design and fabricate 3D organized cell structures we call Celloidosomes® using similar methodology employed to obtain core-shell structures from colloids (Colliloidosomes). By definition, the Celloidosome is a “living capsule” with a biomembrane shell (tissue, biofilm) and a core that acts as container or reservoir. PDMS-Microfluidics and Capillary-Microfluidics were used as platforms to design and engineer unique multiple-emulsion templates and direct/facilitate the cell-assembly onto the liquid-liquid, liquid-gas or liquid-gel interfaces. This novel cell architecture process enables the design and engineering of biological structures using cell-self-assembling multicellular systems based on a “bottom-up strategy”. These systems are ideal-models for the design of Bio-Micro-Reactors, Artificial Micro-Glands and these 3D units could be used for scaffold-less Tissue Engineering. We developed several key strategies to drive and organize a variety of living cells (yeast, fibroblast, bacteria) by controlling the cells and template surfaces using Layer by Layer polyelectrolyte decoration, hydrophobic deposition, and/or chemotaxis. Aerotaxis was used as a driving force to produce 3D biofilm microbags. The use of Microfluidics allows for the full control and design of multiple emulsions to engineer high quality, uniform, and monodisperse bio-micro-containers that, by definition, are bio-microreactors. For the first time, we show evidence of a two-cell, two-layer Celloidosome, a unique symbiotic cooperation between algae and bacteria to create a hybrid-Celloidosome.

HONORABLE MENTION

The Effect of Design on the Absorption of Energy in a Collision

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Car safety is a very important aspect of the automotive industry today, and safety engineers are constantly developing new ways to protect passengers in a collision. The purpose of this experiment was to compare the latest major advancement in safety through design, the Pininfarina Nido Concept, to the crumple zone, a collapsible, energy absorbing section which is used in nearly every car on the road today. The Nido design is unique because it takes the deformable aspects of the crumple zone and places them inside of the vehicle. It was hypothesized that if the design with a collapsible front end strikes a solid object, it will absorb the most energy during the experiment, because all of the energy absorbing material is at the front. During the experiment, three frames were built, two of them incorporating energy absorbing foam that matched the designs of both the Nido and a crumple zone. Each frame was dropped from four feet and how much force was transmitted, and therefore not absorbed, was recorded from the collision. The results of the experiment did not support the hypothesis. The Nido design absorbed the most energy on average, followed closely by the crumple zone. All the data was consistent over the test. The results suggested two things, first, the use of energy absorb materials and designs is essential to keeping passengers safe in a collision, and second, the crumple zone may not be the best solution, as the Nido consistently outperformed it in this test.

The Effect of Experimental Insulation on Heat Loss

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The purpose of this experiment was to determine the relative efficiency of insulation made of spray foam insulation and straw layered insulation. The null hypothesis was that there was no significant difference between

spray foam insulation and straw layered insulation. The alternate hypothesis was that there was a significant difference. The hypothesis was tested using boxes with different insulations in the walls. The boxes were heated to 115 °F and then the temperature was tracked for 10 minutes. The final temperatures were compared using a two tailed t-test assuming unequal variances. It was found using a two tailed t-test assuming unequal variances that there was no significant difference between the straw layered insulation (mean; 78.5107, standard deviation; 2.0461) and foam insulations (mean; 79.8947, standard deviation; 2.1857). The t_{stat} value (-1.7904) was less than t_{critical} value (2.0484) therefore failing to reject the H_0 . Further experimentation needs to be done to determine the effects when implemented in a house rather than in an experimental situation.

Does the Elevation of a Plane Take Off and the Style of the Plan Affect the Distance a Paper Plane Airplane Will Travel?

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The purpose of the research project was to determine if the angle of takeoff and the wingspan of an airplane would affect the distance a paper airplane would fly. The hypothesis was if a plane with a small wingspan was launched at 45°, then it would fly farther than planes with wider wingspans launched at other angles. The jet plane (pink) had the smallest wingspan, the dart plane (blue) a wider wingspan and the glider plane (green) the widest wingspan. A launcher was made from PVC pipe. A rubber band with a string mechanism was used to launch each plane. Each plane was launched five times at five different angles; 00 (control), 150, 300, 45 and 600. The distance flown was measured and recorded. The angle of launch, aspect ratio, and area of the wing affected the distance the plane flew. The smallest wingspan flew the farthest at a 150 launch angle. The medium and widest wingspan planes flew the farthest at 30°. The medium wingspan plane flew farther than the other planes at 60°, 45° and 30°. The medium wingspan plane had the highest wing area and an aspect ratio between the other two planes. When the angle was too high, the planes stalled. The hypothesis was not correct. The smallest wingspan plane when launched at 45° did not fly farther than planes launched at other angles with wider wingspans.

The Effect of Natural Dyes and Titanium Dioxide Paint on the Amount of Electrical Energy Produced by Solar Cells

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The purpose of the experiment was to observe the effect of natural dyes and titanium dioxide (TiO_2) paint on the amount of electrical energy produced by solar cells. Since the Industrial Revolution, energy production has mostly relied on burning coal and natural gases, but these finite resources can cause global climate change. Finding a way to use renewable resources becomes important for future energy production. Solar cells are an efficient way to produce energy; however, production and installation costs make it difficult for these cells to compete in the global market. Each solar cell was painted with either a natural dye (blueberry, pomegranate, or spinach juice) or TiO_2 paint (purple, red, green), while the unpainted solar cell was the control. The cells were measured in volts at zero minutes, fifteen minutes, and thirty minutes. The hypothesis was, if titanium dioxide paint and natural dyes are used, then blueberry juice would produce the most volts. The results in this experiment were significant, with degrees of freedom of 38, and an alpha value of 0.05. However, the hypothesis was not correct, blueberry juice did not produce the most volts; pomegranate juice did. Some improvement that could be done to this lab include, painting the solar cells better, making sure it was a cloudless day, and keeping the same location of the cells when measuring. One future study includes observing the long time effect of natural dyes on amount of energy produce to observe the degradation of fruit juice.

The Effect of Wood Density of Screw Torque

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The purpose of this experiment is to find out whether screw torque is affected by wood density. The hypothesis for this experiment is the harder the wood, the higher the torque will be. The independent variable is the hardness of the wood. The dependent variable is how much torque is required to screw a screw into the wood. There is no control. There were three levels of the independent variables. The dependent variable was the amount of torque required to turn a screw. This was measured by using a torque-measuring screwdriver. The constants were the temperature of the wood, the thickness of the wood, the type of screw, the brand of screw, the thread count of the bolt, where each bolt started in the wood, and the size of the pilot hole. Ten lag bolts were screw into 3 different types of wood. The torque of each bolt was measured with a home-made apparatus that consisted of a wrench and a screw driver. The pine responded with the lowest torque of 1.85 ft-lb. The oak responded with the highest torque of 5.05. Then the poplar responded with a torque of 3.92. Screw torque increased as the wood density increased. As the p-value was 0.000 the ANOVA analysis found that there is a statistically significant difference between the means of the pine, the poplar, and the oak.

The Effect of Camber on Lift

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This project was designed to find out how the curvature of a wing, or camber, affects lift, and how much camber would be optimal for a model glider, at a constant wind speed and angle of attack. Camber is measured as a percentage of the wing's width. This is referred to as the degree of camber and is often expressed as a percentage. The assembly instructions for the model gliders recommended that the wings be cambered to somewhere between 3% and 6%. Three of the same model glider were constructed, one with wings cambered to 3%, one with wings cambered to 6%, and one with un-cambered wings, 0 degrees of camber. It was hypothesized that the glider with six degrees of camber would create the most lift, as a cambered wing will create more lift than a wing with no camber, and excessive camber leads to excessive drag, which was undesirable in this project. The gliders were then tested in a Pitsco Wing Tester to determine the amount of additional weight that they could individually support, and then that number was converted into Newtons. Each glider was tested five times, and then the results were averaged. The final results showed that the glider with three degrees of camber had, in fact, created the most lift, and thus the hypothesis was rejected.

The Effect of Barrel Length on the Distance an Air Cannon Projects a Projectile

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Lately Somali pirates have been taking many ships hostage and ransoming them to the companies they stole the ships from. It would be great if ships had a way to protect themselves from the pirates. All large ships have tanks of pressurized air to aid in steering, it is possible that these tanks could be attached to "gun barrels," and the tanks and barrels would effectively become air guns. The air guns would be a cheap, safe, and effective way of dealing with the pirates. This experiment was designed to determine the perfect ratio of barrel volume to air tank volume. It was believed that if an air gun with a 1:1 tank to barrel ratio, 1:1.5 tank to barrel ratio, and 1:2 tank to barrel ratio, then the gun with 1:2 tank to barrel ratio would shoot the farthest. For this experiment air guns with the aforementioned ratios were constructed and shot 12 times each. The results supported the hypothesis as the 1:2 air gun shot the projectiles an average of 63.83 feet further than the 1:1.5 air gun, and 128 feet further than 1:1 air gun. This is suspected to be due to the time the air pressure can expand. One unexpected result is that the 1:1.5 variance was the smallest. Further research must be done to determine how to offset that.

The Effect of Water-Isopropanol Injection on Fuel Efficiency

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The purpose of this study was to discover how water-isopropanol, or isopropyl alcohol, injection affects fuel efficiency, with the null hypothesis being if the engine's air intake was water-isopropanol injected, then the fuel efficiency of the engine would be equal to or less than the control, and the alternate hypothesis being if the engine's air intake was water-isopropanol injected, then the fuel efficiency of the engine would be greater than the control. A two cylinder lawnmower engine, equipped with a governor spring that regulates the throttle, was fitted with a water injection system and was tested for fuel efficiency while under a no load condition at full throttle. The control trials averaged 26.20 mL/min, but with the injection system, the engine averaged 29.06 mL/min. Three milliliters per minute may seem to be small, but it is an 11% improvement in fuel efficiency. The lawnmower engine draws in very little air compared to a car engine, and wind speed is directly proportional to the rate of evaporation. This suggests the water injection system has potential to be even more effective on cars, especially at higher engine speeds, higher car speeds, and with the use of forced air induction systems.

The Effect of Synthetic Fibers on Plastic Shrinkage Cracking in Concrete

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Beneath our feet lies a silent killer. In almost every structure we see in our day to day life contains some concrete. Concrete that is left to dry in this weather can produce plastic shrinkage cracking in concrete. This is a condition that occurs when the concrete dries in hot weather and cannot hold itself together. An experiment was performed to see if the use of synthetic polymer fibers can assist with reducing the plastic shrinkage cracking. Wooden frames were constructed and concrete was made. Genesis polypropylene fibers were added one of the concrete samples and Ny-Lok nylon fibers were added to another. These two were also tested against the control, which had no fibers. It was believed that if Ny-Lok nylon fibers were added to concrete it would decrease the amount of plastic shrinkage cracking. This is due to its strength and due to the fact that it is single stranded thus covering a larger area. This compares to the Genesis which is fibrillated. The results indicated that the control showed the most amount of cracking. The control displayed a total of 57 cracks in both trials combined. This compares with the Genesis which had ten cracks and the Ny-Lok which had three. A t-test that was performed indicated a difference in the means of the groups ($t=6.06 > 4.303$; $15.25 > 4.303$; $7.12 > 4.303$ at $\alpha=0.05$ and $df=2$). These results supported the research hypothesis that if Ny-Lok nylon fibers were added to concrete it would decrease the amount of plastic shrinkage cracking. The cracking indicated in this project proves that there is a direct correlation between the type of fiber and the amount of plastic shrinkage cracking in concrete. This resulted in the rejection of the null hypothesis: there is no correlation between the type of synthetic fiber and plastic shrinkage cracking in concrete. However, before this can be concluded, a further study will need to be performed with the concrete not only drying in a hot environment but a humid one as well.

Effect of Wind Turbine Blade Pitch on Voltage Output

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Lately, lower power rated wind turbines have seen a rise in popularity among power generation turbines. These smaller machines, without the budget for dynamic pitch regulation systems, have a fixed blade pitch — the angle between the blade angle of attack and wind. This angle may be a significant determinant of turbine efficiency. It was hypothesized that if five pitch angles were tested at three wind speeds, a 45° pitch would generate the highest output voltage. To test the hypothesis three blades and a hub with a pitch control were manufactured. This assembly was mounted on a DC motor in a wind tunnel. Ten trials of each pitch and wind speed combination was tested yielding 1500 data points per combination (150 per trial). The output voltage was captured in Logger Pro. The 15° blade pitch generated the highest mean voltage and smallest coefficient of variation for each wind speed indicating it to be the most precise data. In fact, the spread between 15° and the second best-performing was greater

than the spread between second and lowest performing angles. The data and statistical analysis indicate a 15° blade pitch consistently produced a higher output voltage than any other.

The Effect of Different Number of Mirrors on the Output of a Solar Panel

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Today, ninety-three percent of the energy produced in the United States comes from nonrenewable resources such as fossil fuels. Only seven percent comes from renewable resources, such as solar energy. Solar energy is a major form of renewable energy. However, one of the main problems is its lack of efficiency. The purpose of this experiment was to determine if adding different number of mirrors would affect the output (efficiency) of a solar panel. The energy output was measured by using a digital multimeter with its reading set to record volts. The results showed that adding three mirrors to reflect sunlight onto the solar panel yielded the highest energy output with a mean of 22.5 volts (V) and the solar panel by itself (control) had the lowest output with a mean of 21.6 volts. All the other combinations showed varying means of energy output. A t-test performed on the data showed significant difference between the means of the groups ($t=3.01>1.667$; $t=5.75>1.667$; $t=8.29>1.667$; $t=2.64>1.667$; $t=5.22>1.667$; $t=2.72>1.667$ at $df=68$; $p<0.05$). The data supported the research hypothesis that if the number of mirrors reflecting light on the solar panel was increased, then the output of the solar panel would also increase. Based on the output values generated in this research, there appears to be a direct correlation between the number of mirrors reflecting light and the output of a solar panel.

The Effect of Different Triangular Trusses on their Maximum Strength

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Different triangular trusses are used in bridges around the United States and around the world. Certain bridges need certain trusses to know that they are safe to drive upon. The effect of different triangular trusses on their maximum strength is the topic of the experiment. This experiment is trying to test three different types of triangle trusses (equilateral, obtuse, and acute) by hanging a 10, 5, and 2.5 pound weight from the truss and test how what the maximum weight that the truss can hold. The hypothesis for the experiment is the If the truss of the bridge is in the equilateral form then the bridge will be able to hold the most strength. A bridge was built with popsicle sticks. The bridge was built in the three different triangular trusses and then a 2/5, 5, and 10 pound weight were hung from the truss until the bridge broke. Once the bridge broke, the maximum strength was found. The results showed that the equilateral truss has the greatest maximum strength out of the other three triangular trusses. It had a mean maximum weight of 9. A t-test was performed to show a significant difference between the means of the groups ($t=0.49<2.101$; $t=7.04>2.101$; $t=5.77>2.101$ at $\alpha=0.05$ and $df=18$). The research hypothesis was supported because the data showed the when the bridge had an equilateral truss then the truss had its maximum weight. Based on the data shown, the data shows that the acute and the equilateral truss are recommended to use when building a bridge and the obtuse truss is not. Before this can be concluded, the location of the bridge where the truss is must be shown. This could flaw information because an equilateral truss could fail in Minnesota but be strong in Florida because of the weather conditions in each place. The hypothesis stated was supported by the data which proves that the equilateral truss is the strongest and most reliable truss to use.

The Effect of Floating Staircase Design/Structure on Strength

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The purpose of this experiment was to determine the most effective structure for a floating staircase that will be functional without compromising the aesthetic appeal of the construction in question. In order to execute this experiment, each level of independent variable or different staircase structures were constructed and then weight was applied to a stair until breaking point was achieved. This was repeated twenty-five times for each level of independent variable. The experiment demonstrated that the common staircase held the most weight of the structures

tested. The next level that produced favorable results was the floating staircase with risers and a handrail because the rails on the staircase off set the weight distribution and allowed a single stair to hold more weight. The strength of the staircases increased as each element was added because the weight that was applied was then distributed elsewhere as opposed to an individual element being the primary support as was seen in the completely floating staircase. In each instance the null hypothesis, that stated that floating staircase design/structure does not affect strength, was rejected ($t=51.496>2.101$; $t=52.408>2.101$; $t=91.819>2.101$; $t=6.469>2.101$; $t=29.230>2.101$; $t=19.395>2.101$). The research hypothesis was not supported by the outcome of this experiment. It was concluded that a floating staircase with certain provisions can in fact retain the structural integrity necessary in order to support the everyday use of the given structure.

The Effect of Insulation Geometry on Sound Absorption

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The research covered in the following paper was intended to offer an extension of knowledge in the field of Acoustical Sciences through the testing of sound insulation geometry. Conventional studio sound insulations were formed of polyurethane foam in different geometrical patterns. The connection between the geometrical surface of the insulation and the effectiveness of sound absorption was tested and analyzed as follows. A reverberation chamber was built to manipulate a controlled atmosphere in which insulations could be tested. A sinusoidal waveform was generated by a wave analysis program, reflected off the insulation, and measured by the program. Measurements were taken in decibels (dB SPL). If the insulation was geometrically formed in multiple wedges, then the sound absorption levels would decrease when compared to insulations with a flat geometry. H_0 : Wedge insulation would absorb more sound than flat insulation. H_1 : Flat insulation would not absorb a significantly less sound than wedge insulation. The 5-wedged insulation repeatedly held a reading of 87.65 dB compared to the insulation with a flatter geometric appearance's average reading of 89.32 dB. After considering the strong statistical data with standard deviations of 0.0 and 0.0053 and a t-score of 1722.52 the alternate hypothesis was rejected and the null hypothesis was confirmed. This represented a type I error which confirmed the absorption superiority of the wedge insulation.

ENVIRONMENTAL SCIENCE A

FIRST PLACE

Remote Sensing-Based Water Quality Monitoring System for the Chesapeake Bay

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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 was to develop algorithms that relate the water quality parameters (chlorophyll and turbidity) to Landsat 5 Thematic Mapper (TM) data; the second was 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.

SECOND PLACE

The Correlation between Air Pollution and the Magnetism in Leaves

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The purpose of this study was to compare the level of air pollution in Washington, DC to that of rural Fauquier County, Virginia. This was accomplished by measuring the magnetism in leaves collected from these two areas. This indicator system of measurement is capable due to plants' ability to uptake pollutants and other particulate matter (PM) through a process termed phytoremediation. A total of 40 leaves were collected, 10 from each of four locations: adjacent to busy roads in Washington, DC, adjacent to Route 29 (a busy road running through Fauquier County), a park in Fauquier County and the open area surrounding the Washington Monument. All the leaves were those from cherry trees. The leaves were measured for their magnetic susceptibility using a KLY Kappabridge. The original hypothesis was that the leaves collected from Washington, DC would have higher levels of magnetism than those from Fauquier County. The results showed that the samples adjacent to the Washington, DC roads had the strongest magnetism with a magnetic susceptibility mean of 6.88E-06. Those next to Route 29 had a mean of 3.37E-07 while those collected near the Washington Monument had a mean value of -2.65E-06. The samples from the park were able to serve as a basis for comparison with a value of -5.97E-06. A one-tail independent t-test was used to validate the data. The results support the original hypothesis that Washington, DC has higher levels of air pollution than Fauquier County.

THIRD PLACE

The Effects of pH, Salinity, and Water Temperature on *Palaemonetes pugio* Holthuis

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The objective of this research was to determine the effects of pH under different temperature and salinity ranges on *Palaemonetes pugio*. The hypothesis was that if water temperature, salinity, and pH change then heart rate and beats/mm will not change. Dependent variables were heart rate, metabolism, and oxygen consumption. Independent variables were salinity, water temperature, pH, and length of *P. pugio*. Length of *P. pugio* was

inversely correlated with heart rate ($R=-0.39583$; $p=0.0016$) and beats/mm ($R=-0.89194$; $p=0.0001$). At constant water temperature (24 °C) and salinity (22 ppt) average heart rate (266.7) of *P. pugio* at a pH of 6.5 was significantly lower than that (298 beats/minute) at pH of 7.5. Heart rate of *P. pugio* did not vary significantly over salinities of 10, 15, 20, and 25 ppt. At constant pH (8.0) and salinity (22 ppt) average heart rate (178) at 10 °C was significantly lower than that (320) at a water temperature of 25 °C. The null hypothesis that heart rate of *P. pugio* does not vary with a change in pH was rejected as average heart rate (266.7) at pH of 6.5 was significantly lower than that (298) at pH of 7.5. The null hypothesis that heart rate and beats/mm of *P. pugio* do not vary with a change in salinity was accepted because average heart rate and beats/mm did not vary significantly with changes in salinity. The null hypothesis that heart rate of *P. pugio* does not vary with a change in water temperature was rejected. This is the first study to determine that when length of *P. pugio* increases, heart rate decreases regardless of variations in pH, water temperature and salinity. Based on the inverse relationship between length of *P. pugio* and both heart rate and beats/mm, it is recommended that scientists in future studies measure length to calculate beats/mm of *P. pugio* and other species of *Palaemonetes*. Low pH (6.5) probably resulted in hemolymph acidosis (lowering of the pH of the blood) of *P. pugio*.

HONORABLE MENTION

The Effect of Vegetation Type on Nitrate Concentration in Runoff

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The purpose of the experiment was to determine if the type of vegetation impacts the effectiveness of buffer zones at removing nitrates from runoff water. Excess nitrates in water cause eutrophication, during which the excess nutrients create an algal bloom that blocks sunlight to underwater plants and deprives marine organisms of oxygen. The hypothesis was if the type of vegetation was changed, then the concentration of nitrate in the runoff would not be significantly different between the ryegrass, alfalfa, or clover plants, but would be significantly different between the control and the IV levels with vegetation. Equal amounts of ryegrass, alfalfa, and clover seeds were planted in twenty plastic trays, five trays per IV level and five for the control group of dirt only. After twenty days, a mixture of dissolved fertilizer and water was poured down the slope of the tray, simulating runoff. After the fertilizer and water mixture passed down the tray, the excess water was collected and tested for concentration of nitrate. The experiment was repeated with all the trays of plants once. The mean nitrate concentration in the runoff for the control was 3.8 ppm, for the clover plants the mean was 3.4 ppm, and for both the ryegrass and alfalfa plants the mean nitrate concentration was 2.8 ppm. At the 0.05 level of significance, the ANOVA test found that the different amounts of nitrate removed between the IV levels was significant. The t tests showed only that the alfalfa and rye plants removed significantly more nitrate than the control of just dirt. The hypothesis that the type of vegetation does not impact the effectiveness of buffer zones at removing nitrate was supported by the data. However, the data also showed that the presence of vegetation in general increases the effectiveness of nitrate removal from runoff than dirt without any vegetation.

HONORABLE MENTION

What Is the Effect of UV Radiation on Cyanobacteria?

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The problem in this experiment was to find the effect of ultraviolet radiation on cyanobacteria (*Spirulina major*). The hypothesis for this experiment was that if more ultraviolet radiation is applied then the cyanobacteria will have a lower population because cyanobacteria only requires a small amount of light to survive and excessive light will worsen the health of the bacteria. The population of the cyanobacteria was measured with a spectrophotometer. The population of cyanobacteria of the control group on was 10.04% higher after experimentation. The population of cyanobacteria of group B (the group that underwent 20 minutes of radiation)

was 9.54% lower after experimentation. The population of cyanobacteria of group C (the group that underwent 10 minutes of radiation) was 0.74% after experimentation. Therefore the hypothesis was supported.

HONORABLE MENTION

The Effect of Different Types of Biomass and pH Levels on the Amount of Biogas

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This experiment explored the relationship between kinds of biomass, pH levels, and biogas production. When biomass (organic material) is decomposed it produces biogas. Biogas is a mixture of methane and carbon dioxide. It is produced when anaerobic bacteria break down (or digest) biomass. This process is called anaerobic digestion. The scientists chose this subject to experiment to see what kind of materials, and with what level of acidity, were most efficient in the production of biogas. This is important to the scientists because fuel costs are beginning to rise and the world is in need of a cheaper, more environmentally friendly alternative source of energy. “Anaerobic digestion systems (non-landfill) treat waste naturally, require less land area than aerobic composting, reduce the amount of material that must be land filled, reduce waste odors, and produce sanitized compost and nutrient-rich liquid fertilizer.” Officials even say biogas production will reduce greenhouse gas emissions by 551 tons (492 metric tons) a year. Research shows that this alternative energy will pose less harm on the world environmentally and economically. To test what kinds of biomass and which levels of pH will lead to the greatest production of biogas. “Anaerobic digestion will occur best within a pH range of 6.8 to 8.0. More acidic or basic mixtures will ferment at a lower speed.” The scientists chose to experiment on this variable to see if this statement was true. Another variable the scientist wanted to test, along with the pH, to see how it affected biogas production, was the type of biomass. The scientists placed the organic materials (vegetable peelings and mashed bananas) with liquids of a different pH (2, 7, 12) into bottles allowing the biogas to inflate balloons that were sealed onto the bottles. Over a period of six weeks the scientists measured the circumference of each balloon; the bottles whose balloons had the greatest circumference produced the most biogas. The scientists created the hypothesis that if different types of biomass are combined with a different pH, then the bottles containing cow manure and mashed bananas with a pH of 7 would produce the most biogas.

Mushrooms versus Bamboo: Which Enzymes Speed Up Cellulosic Ethanol Production More?

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The purpose of this experiment was to compare the effects of enzymes extracted from mushrooms to those extracted from bamboo leaves on the amount of p-nitrophenol. Biofuel is a possible alternative to fossil fuels. Cellulosic ethanol is a biofuel derived from plant matter and is produced in three steps: physical reduction of biofeedstock, enzyme hydrolysis of sugar, and fermentation. This experiment was chosen due to the concern on the excessive greenhouse gas emissions, increase in demand, and decrease in supply of fossil fuels. Enzymes were extracted using extraction buffer. Twenty-five reactions were done at 2, 4, and 6 minutes for both the mushrooms and bamboo leaves. The mean absorbances were used to find the amount of p-nitrophenol formed using a standard curve. It was hypothesized that enzymes extracted from the mushrooms will speed up the enzyme hydrolysis more than enzymes from bamboo leaves. The results did not support this hypothesis because it was found that the enzymes extracted from bamboo leaves speed up the reaction more than enzymes extracted from mushrooms. The t-tests performed on the absorbances revealed that all of the data was significant and the results were most likely due to the independent variable. It is believed that these results are due to the many more varieties of enzymes available in bamboo, which increases the chance of one of them working to increase the reaction rate. Further studies could be done with alternative plant sources that could be used to help produce more biofuel.

Perceived Aural Differences of Acoustically Compensated Oboes

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The most common material used to make a woodwind instruments is wood. Due to traditional beliefs many musicians are unwilling to perform on an instrument made of different materials. However this is problematic because wood is not a very durable material in the long run and the rarity of the material also has led to illegal logging, which in turn creates many humanitarian and environmental problems. The purpose of this experiment was to see if wood does in fact have a perceivable effect on the tone quality of an oboe. The hypothesis was that the type of material used for the oboe would not have an effect on the oboe's tone quality. Two musicians sat behind a screen and played the fundamental notes A and D for four counts at forty on a metronome. Both of these musicians play for the United States Army Band, and have over forty years of experience between them. They waited 12 counts between every time they played. There were six comparisons between the three oboes. Comparison one was the oboe made of African Blackwood was compared to itself. Comparison two was between the oboe made of Cocobolo wood compared to itself. Comparison three was between the oboe made of Delrin plastic and itself. Comparison four was between the oboe made of African Blackwood and the oboe made of Cocobolo wood. Comparison five was between the oboe made of African Blackwood and the oboe made of Delrin plastic. Comparison six was between the oboe made of Cocobolo wood and the oboe made of Delrin plastic. Based on the results, the experimental group could not hear any perceivable difference in the different materials, however more data is needed to determine of the results are actually significant.

Which Materials Work Best at Cleaning Up Oil Spills?

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In 2010, amidst the largest marine oil spill ever recorded, British Petroleum (BP) rejected hair booms sent in from all around the country to help the clean-up effort. BP stated that hair absorbed too much water and too little oil to be a good sorbent. This experiment tested whether BP was right in its decision. Natural materials (hair and straw) were tested against the commercial product (polypropylene pads) to see how many grams of liquid, motor oil, and used motor oil (representing crude oil) each absorbed. The materials were put in nylon sacks, dipped into the liquid, and allowed to drip for a minute. Each trial was done ten times. The results were that the polypropylene pads absorbed the least water and both the most motor oil and used motor oil, making it the most effective sorbent. The hair was the second best sorbent, and the straw came in last. The outcome was based on the properties of the polypropylene—the pads are designed to be hydrophobic and oleophilic. The experiment is evidence which supports BP's decision.

Cleaning Oiled Birds' Feathers

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The purpose of this experiment was to see the effect of cleaning method on the percentage of vegetable oil removed from duck feathers. The hypothesis was if Dawn dishwashing liquid was used to clean the bird feathers, then the greatest percentage of oil would be removed. The masses of duck feathers were measured. Then, the feathers were soaked in vegetable oil and the masses were measured again. The feathers were cleaned with either Dawn dishwashing liquid, Seventh Generation Natural dish liquid, Pantene Classic Care Solutions shampoo, or water. The feathers were then rinsed, wiped, and dried, and the masses were measured again. Seventh Generation dish liquid had the greatest mean percentage of oil removed with 96.5%, and Dawn dishwashing liquid was second with 96.3%. Dawn and Seventh Generation had statistically significantly higher percentages of oil removed than Pantene Classic Care Solutions shampoo and the control, water, but the difference between Dawn and Seventh Generation was not statistically significant. Therefore, the results between Dawn and Seventh Generation were inconclusive and more experimentation is warranted. One of the main reasons Dawn and Seventh Generation were the most effective methods tested for removing oil from birds' feathers was because they both contain surfactants,

which reduce water's surface tension and weaken the barrier between oil and water, allowing them to unnaturally mix.

The Effect of Blade Angle and Speed on Amount of Voltage Produced

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The purpose of this experiment was to see whether or not the angle of the blade and the speed of the wind would have an effect on the amount of voltage produced. The hypothesis was that if the pitch of the blade was at ten degrees and the speed of the fan was 3, then the voltage produced would be highest. The hypothesis was also stated that as the angle increased voltage would decrease and for each angle, a greater wind speed would result in a higher voltage. The independent variable was the angle of the blade and the speed of the wind, and the dependent variable was the amount of voltage that was produced. The constants for this project were the distance from the fan that the turbine was kept, and the type of fan used to power the wind turbine. The control for this project was when the blade pitch was set at zero degrees and there was no movement. After doing this, it was found that when the blade angle was set at ten degrees and the wind speed was on its highest setting, the most amount of voltage was produced. The hypothesis was supported for this experiment. An ANOVA showed that the difference in the treatment groups was significant. It was also noted that the variance in the voltage between the three speeds decreased as the angle got larger. This blade angle and speed was perfect to obtain the most voltage for many reasons. For example, the blade must have the most air resistance without being entirely flat. The air current must be moving around the blades as fast as possible in order for the blades to spin at a fast enough speed. However the variability during the high voltages is an underlying factor that research shows is a significant consideration in wind turbine design.

The Effect of Fertilizer on Worm Migration

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Topsoil is an entity important to plant health. The underlying health of topsoil is a very important component in a garden. The topsoil's health determines both the quantity and the quality of all living things, which live and grow in the soil. The purpose of my experiment was to test the effect of fertilizers (organic or artificial) on the migratory pattern of red wiggler worms (*Eisenia foetida*). It was predicted that the worms would be repelled from the fertilizers inorganic ingredients, and move towards the organic fertilizers natural ingredients. This was not the case. To test this experiment, 20 worms were placed in a plastic shoebox with topsoil, and their movement between topsoil with water, topsoil with artificial fertilizer and water, and topsoil with organic fertilizer and water were observed. Another 20 worms were placed in a shoebox without any fertilizers added in order to observe regular worm migration. The materials and methods kept the experiment constant by regulating the controlled variables: amount of topsoil, worms, water, artificial fertilizer, and organic fertilizer in the shoebox. The amount of topsoil was seven cups per shoebox, there was ten worms per shoebox, there was 100 mL of water on the middle of the shoebox, there was 100 mL of artificial fertilizer and water on the right side of the shoebox, and there was 1 dry measuring cup of organic coffee grounds, the organic fertilizer, on the left side of the shoe box. The main experiment was tried 20 times and the control experiment was tried 20 times. The number of worms was counted by hand at the end of the experiment. The hypothesis stated: If an artificial fertilizer and an organic fertilizer are introduced into topsoil, then the worms will migrate to the topsoil with the added organic fertilizer. This hypothesis was proved false when 74% of the worms preferred the other side.

The Effects on Calcium Content in Soil Due to Acid Rain

Grace Day

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Calcium is connected to plant growth and development, which is absorbed from the soil. The purpose of this study was to uncover whether or not the amount of calcium found naturally in the soil was affected by acid rain. The null hypothesis being tested was "The amount of calcium found in the soil is not affected by the presence of

acid rain.” A laboratory experiment was conducted over the course of two weeks, with four groups of four soil samples: Acid-No Plants, Acid-Plants, Water-No Plants, and Water-Plants. Just as they were labeled, eight samples were watered with water and eight samples were watered with a dilute nitric acid, with four samples from each group growing plants. After the watering stage was over, the samples were each titrated with EDTA to account for the magnitude of calcium. The results were inconclusive, as the experiment was not conducted perfectly, showing the samples watered with tap water had an increase in calcium due to the water being from the tap instead of distilled, while the acid-watered samples showed no significant decrease in calcium. A two-way ANOVA was conducted on the results, showing in a p-value of less than 0.001. The null hypothesis was supported.

The Effect of Conventional and Green Roofs on Interior Temperature

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The objective of my project was to find out what effect green roofs have on interior temperature in relation to conventional roofs, such as slate and asphalt, and white roof, a polymer paint-on roofing substance. Green roofs are roofs with soil and plants on top. I wanted to find out if an expensive green roof really could mitigate exterior temperature fluctuations. The hypothesis states: if a green roof is used, the interior temperature in relation to the exterior will change more slowly. To test my hypothesis, I built 5 small (30 cm x 60 cm x 60 cm) houses using standard construction techniques. On each house, I installed a different roof; the roofs were asphalt shingle, slate shingle, white roof, a 15 cm deep green roof and an 8 cm deep green roof (the depth refers to the soil depth). I insulated the walls and floors of the houses with R15 rigid foam. USB thermometers were suspended at the end of a dowel in the interior of each house. One of the thermometers was suspended on the exterior of a house. Then, the thermometers were set to sample the temperature every two minutes, and the raw temperature data was recorded every three days. It was found that the interior temperature of the green roofs fluctuated much less than the conventional roofs, in relation to the exterior temperature, thus confirming the hypothesis. In order from best to worst, as a percentage of the change of the exterior temperature, the 15 cm green roof, with 29%, the 8 cm green roof, with 35%, the White Roof, with 156%, the slate shingle, with 223%, and the asphalt was the worst, with 271%. The green roofs were much more effective, with the asphalt having 9.3 times more shifting than the 15 cm. These great changes in temperature were probably caused by the dark color of the conventional roofs. Dark color absorbs more light and thus radiates more heat. If I were to do this experiment again, then I would do it for a longer period of time, and over a longer period of weather. As a future experiment, I would measure the runoff of the different roofs to see if some were better for the environment in that way as well.

The Effect of Soil on the Neutralization of Acid

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In order to discover the effect of soil on the neutralization of acid over time, an experiment with the purpose of discovering which potting mix, Miracle-Gro Potting Mix, Miracle-Gro Seed Starting Potting Mix, Miracle-Gro Moisture Control Potting Mix, or Miracle-Gro Organic Potting Mix, would neutralize acid more consistently over a period of ten days. No control was present due to the fact that each sample group contained unknown concentrations of a number of other substances. It was hypothesized that the moisture control mix would neutralize acid more consistently than the other mixes. Twenty-five samples of each potting mix were watered with a solution of distilled water and sulfuric acid with a pH of less than 4 for ten days. The first day's results and tenth day's results in pH change were measured. The key results were that the hypothesis was not supported. The regular Miracle-Gro Potting Mix was most consistent at neutralizing acid followed by seed-starting, moisture control, and then the organic potting mix. A t-test was used to discover significance. All instances were significant except when the regular mix was compared to the organic mix. It was concluded that the soil does affect its ability to neutralize acid over time. This may be used in real life to help consumers decide upon what type of soil to choose for home use. This experiment could be elaborated on by performing another experiment that tests to see if the brand of soil affects its ability to neutralize acid over time.

The Effect of Different Types of Oil Removal Methods on the Amount of Oil Left in the Water

Sylvia Monet

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This experiment was designed to replicate the conditions in the Gulf of Mexico after the BP oil spill and test the effectiveness of different oil removal methods. The five different methods were dog fur, straw, dispersants, skimmers and burning. These methods fell into four groups commonly used in the gulf oil spill: sorbent material such a dog fur or straw; dispersants; skimming; and burning. When the data was all collected, it was found that dog fur was by far the most effective method. Burning was omitted from the final results because it was impossible to collect accurate data. The conclusion of this project was that sorbent materials like dog fur and straw worked the best, followed by dispersants and skimming.

An Investigation Comparing Temperature Related Growth Rates on Three Species of Freshwater Mussels

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The experiment was conducted to find the correlation between temperature and three different species of mussels. The hypothesis stated if mussels are placed into an environment and keeps a normal, constant water temperature, then the mussels will grow at a constant rate but if the temperature either is too high or too low, then the growth rate will decrease and the mussels will suffer. The hypothesis was tested by recording the size of 20 random mussels from three pans of different species (Pan 3- *Leptodea ochracea*, Pan 7- *Villosa constricta*, Pan 8- *Lampsilis cariosa*). The size was taken every few weeks and a total of five times. The results showed that as the temperature decreased the percent increase also decreased, showing a direct correlation between the temperature and growth rate. The experiment produced significant results that supported the hypothesis. These results are useful to research because they show that if the temperature of the Earth's oceans rise or fall due to pollution, the sea life will be affected in both the areas of growth and survival rates.

The Effect of Fuel Type on Fuel Efficiency

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The purpose of this experiment was to investigate whether a biofuel could provide as much energy as the same quantity of a fossil fuel. It was hypothesized that if a fossil fuel (number 2 diesel) was used to perform work, then it would produce more energy than the same amount of a biofuel (canola oil). To test this hypothesis, 3 cm lengths of cotton wick were soaked with 1 mL of diesel fuel and canola oil. Each fuel-soaked cotton wick was ignited underneath a steel can holding 100 mL of water. The temperature of the water was recorded before the wick was ignited and after the wick burned itself out. The length of time the fuel burned also was recorded. Water was heated 17% higher by canola oil than diesel fuel, indicating that canola oil transferred 0.88 kilojoules more energy to water than diesel fuel transferred. Canola oil burned 142% longer than diesel fuel and produced a more even and long-lasting flame than diesel fuel. The results did not support the hypothesis that *diesel fuel* would produce more energy than *canola oil*. A number of uncontrollable dependent variables emerged as a result of performing the experiment outdoors. Initial water temperature was affected by rising and falling outdoor ambient temperatures due to changing weather conditions (e.g., sunny conditions shifting to cloudy skies). Fuel-soaked cotton wicks did not immediately ignite for each trial due to gusts of wind. As a result, multiple ignition attempts were needed for some trials. To improve the experiment, tests could be conducted indoors where wind gusts and changing ambient temperature would not occur.

The Effect of Cigarette Butts on the Length and Living Ratio of *Vigna radiata* Sprouts

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Cigarette butts are the remnants of humanity's deadliest habits that wrecks havoc on the health of both humans and the environment. This project was conducted in order to further investigate harmful effects of cigarette pollution on plants - specifically, mung bean sprouts (*Vigna radiata*). One hundred and fifty bean sprout plants were split into 6 groups of 25, and after germinated were exposed to varying amounts of cigarette butts. The 'Control Groups' were exposed to no pollution; fifty of the sprouts were exposed to 1 cigarette (1 cigarette per 25 plants) and the last fifty were exposed to 2 cigarettes (in groups of 25). Every other day, the length of each individual sprout was noted, as well as the ratio of living plants to the number of plants. It was hypothesized that increased exposure to cigarette butts would significantly have a negative impact on the lengths and living ratios of the sprouts. At the end of the experiment, the data summary and graphs of the lengths supported the data and were consistent with other studies, in that the lengths of the cigarette-exposed plants were shorter than those that weren't. However, the ratios were scattered and didn't support the hypothesis. In addition, the statistics didn't support the hypothesis either; according to the Chi-Squared Distribution, the lengths of the 'Control Groups' were not significantly longer than those of the sprouts exposed to pollution. Perhaps the statistics mean that some plants can withstand some amount of pollution.

The Effect of Vegetative Buffer Zones on the Amount of Nitrate in Farm Field Soils

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The Chesapeake Bay is the largest estuary in the United States. One of the main problems facing the Bay is increased nitrate levels in the water. There are many contributing sources of nitrogen that flow into the Chesapeake Bay. These include sewage treatment facilities, septic systems and agricultural wastes. Wetlands, riparian buffers, and small streams act as natural nitrogen traps. Buffer zones are important for good water quality. They help remove excess nutrients and other pollutants before reaching the waterway. The purpose of this project was to determine if vegetative buffers will have an effect on the amount of nitrate in the runoff from a farm field. The hypothesis was that if a buffer is present along the field, then the amount of nitrates will be decreased. A test site along a farm field in Isle of Wight County was chosen. The field drains to a small pond and also to a stream. Each has a different type of buffer – the stream has a heavy undergrowth buffer and the pond has a grass buffer zone. This area is part of the Chesapeake watershed. The soil was sampled and tested with nitrate test strips. In general, the nitrate levels decreased as the sample location moved away from the middle of the field. The nitrate levels were highest in the buffer zone with the heavy undergrowth (30 ppm) and lowest at the grass buffer (0 ppm). However, nitrate levels in both water sources were 0 ppm. The hypothesis was accepted. Vegetative buffer zones did decrease the amount of nitrates reaching the stream and pond. These types of buffers are useful in protecting water quality of local streams and they essentially protect the Chesapeake Bay.

The Effect of Different Roofs and Conditions on the Internal House Temperature

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Climate varies from region to region. People heat and cool their houses or buildings differently due to diverse weather conditions. Consequently, weather plays a crucial role in determining roof types. This research explored how shingled, metal, and green roofs affected the internal house temperature when exposed to various weather conditions. These environmental conditions encompassed a wide range of weather: humid, snowy, and hot climates, a cold environment where temperature was continually decreasing, and an environment where temperature was warmer outside than inside the house. Further, this project investigated how efficiently the different roofs could maintain temperature when the surrounding temperature either decreased or increased. A model house with Styrofoam inside was made to portray a real house. Located inside the model house was a temperature sensor, an LM34, mounted on a Kilroy board. Programs were written to measure and record the temperature. The model house was transferred to its designated environmental condition with one roof type on for a period of 90 minutes. This

research showed that temperature with the green roof on had the least change, indicating that it was the most effective in maintaining the original temperature. Following the green roof in performance was the metal roof, and finally the shingled roof. Therefore, in a region with many different weathers, the green roof is the best option. Heating and cooling especially during the summer and winter can use excessive amounts of energy and power. This problem is amplified globally because fossil fuels are running out.

ENVIRONMENTAL SCIENCE B

FIRST PLACE

The Effects of Pollutant Salts on Rotifer Mortality over Time

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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 system, killing off 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. The purpose of the experiment was to test the effects of runoff pollutant salts on rotifer mortality. If the salts are toxic, then their effects may be dependent on the concentration. Rotifers were cultured for with 4 different salts: NaCl, KCl, MgCl₂, and CaCl₂. These salts were at four different concentrations of 5 ppt, 10 ppt, 20 ppt, and 60 ppt. The procedures for measuring the results were to count the live rotifers remaining in the wells at 3 hrs, 6 hrs, and 24 hrs. All salts were found to be toxic at the highest concentration tested, 60 ppt. While at lower concentrations KCl was still the most toxic, it was not as profoundly deadly as the higher concentrations. At the 60 ppt concentration, KCl and NaCl killed all rotifers in three hours, while MgCl₂, and CaCl₂ required 24 hours to reach their maximum toxicity. 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. The data can determine the amount of certain salts that are dangerous for the environment, such as NaCl used in road salts and KCl used in fertilizers.

SECOND PLACE

Environmentally Sustainable Communities in Virginia

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This study was conducted in response to the environmental revolution of the past two decades, in hopes of shedding light on the truth about regulation of sustainable practices found in Virginia's private communities. The problem that Virginia is experiencing in regards to the environment is the fact that many communities around Virginia have regulations or policies that prohibit residents from practicing sustainable methods of living (i.e., using solar panels, wind turbines, growing vegetable gardens). Based on previous studies and current trends, it was predicted that more than 50% of the homeowner's associations around Virginia would have an eco-score in between 50% and 83% because of regulations prohibiting residents from taking advantage of the benefits offered by sustainable living. This research was conducted by collecting data from surveys that were mailed out to the managers of homeowners associations around Virginia. The content of the surveys was based on a pre-determined set of sustainable-living practices. The locations of communities that were surveyed ranged all across Virginia. It was determined that 70% of the communities received an eco-score within the range of 50% to 83%, indicating the presence of significant regulations that hinder sustainability. A standard paired t-test was also completed, which resulted in a p-value of 0.03, rejecting the null hypothesis. These results are potentially general, and could be similar to the results of future studies in other states.

THIRD PLACE

Effect of "Green" and Conventional Detergents on Champion Radish Growth

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For tapwater conservation and lowering expenses, arid regions recycle greywater (wastewater from kitchens and bathrooms, excluding human wastes) for agricultural irrigation. Despite benefits, greywater contains

detergents, of which, ingredients such as sodium and boron negatively affect plant growth by browning leaves and causing soil salinization. Since detergents are classified as Conventional or Green, it was unknown which caused environmental damage. Therefore, the purpose of this study was to determine negative effects of Conventional and Green detergents. The hypothesis - if Green and Conventional detergents were used, then plant lengths would decrease – was derived from research reporting both types of detergents in greywater caused plant growth stunting.. In experimentation (lasting 12 days), Champion radishes were given 0.1% concentration detergent-tapwater solutions of Palmolive and Seventh Generation dish-detergents in Conventional Detergent and Green Detergent Groups, respectively, and Control Group received tapwater. Data analysis was performed by one-way ANOVA, which compared lengths and determined significance. From Day 4 to Day 12, Conventional and Green Groups' lengths were significantly longer than those of Control ($p < 0.05$). In addition, from Day 4 to Day 6, Green Group lengths were significantly higher than those of Conventional Group ($p < 0.05$). In conclusion, the research hypothesis was unsupported and increase in radish lengths was caused by the relatively small 0.1% detergent dosage, which provided necessary amounts of phosphorus and nitrogen for stimulation of plant growth.

HONORABLE MENTION

The Presence of the Chytrid Fungus on Salamanders in Warren County, Virginia

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The purpose of this study was to determine whether or not the fungus *Batrochochytrium dendrobatidis* (Bd) was present on the salamander species *Plethadon cinereus*, also known as the Eastern Red-backed salamander in Warren County, Virginia. The hypothesis was that the Eastern Red-backed salamanders (ERB) would test positive for Bd. The null hypothesis was that the ERB salamanders would not test positive for Bd. Five ERB salamanders were swabbed for Bd in each of three different sites in Warren County Virginia in late November, the optimum time of year for Bd growth on amphibians, bringing the total number of samples to fifteen. Polymerase Chain Reaction (PCR) assay tests were used to determine whether Bd deoxyribonucleic acid (DNA) was present in the samples. The fifteen samples were pooled by location. All three pooled samples tested negative for Bd, supporting the null hypothesis and rejecting the hypothesis. This means that Bd was not present on any of the *Plethadon cinereus* specimens from all three locations. This research would be more accurate with an increased number of specimens collected and samples from other amphibian species to act as controls.

HONORABLE MENTION

What Is the Effect of #6 Heating Oil on the *Elodea densa* Aquatic Plant?

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The purpose for this experiment was to demonstrate the effect of pouring different amounts of #6 heating oil into five different bowls of ten *Elodea densa* aquatic plants. This experiment supports the event of the Gulf of Mexico oil spill in April 2010. The experimenter's hypothesis was that if no amount of #6 heating oil was poured into the fishbowl then the average growth of the plants in the category will increase. The procedures for conducting this experiment were, first the experimenter would set up 5 glass fishbowls with 1 liter of water and 10 *Elodea densa* plants that were exactly 10 cm in length secured inside 5 cm of gravel. Then the experimenter will wait exactly 6 days for the plants to settle inside the new environment. Each day of the experiment the experimenter will document new changes and findings in the plants. After the 6 day period the experimenter will now pour the oil into each of the containers, group one will receive no oil, group 2 will receive 25 ml of oil, group 3 will receive 50 ml of oil, group 4 will receive 100 ml of oil and group 5 will receive 200 ml of oil. You will observe these plants for days also and document the results each day. Last on the 6th day you will document the final results, the change in color, microscopic change and change in height. Then record the results. In this experiment group 1 no oil was added. There were eight plants that were placed in this group. Each of the eight plants in the control group showed significant growth of 2.54 centimeters after the six day period. This group of plants maintained its healthy vibrant

color. 100% of these plants were dark green at the end. Group 5 received the most oil with 200 ml of #6 heating oil. The oil affected the growth of the plants. At the end of the six day period all of the plants in this group had a significant discoloration and turned from its healthy green to a sickly yellow color. 100% of the plants in this group turned yellow. These were the results of the control compared to the highest amount of oil.

HONORABLE MENTION

The Effect of the Depth of Soil in Centimeters on the Amount of Lead in Parts per Billion in an Ex-Contaminated Site

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Hyman Viener was a lead smelting company and the furnaces they used gave off lead. This lead contaminated the soil and water in the surrounding areas. The EPA did “project cleanup” which excavated some contaminated soil and replaced it with sod. Lead poisoning is very dangerous and can cause serious illnesses or problems in people including hearing loss, loss of sight, nerve disorders, cancer, and other serious health issues. The purpose of this experiment was to find out if the EPA’s “cleanup” of the lead contaminated soil, lasted. I hypothesized that if the depth of the soil in centimeters increased the amount of lead in parts per million would increase. The experiment was completed by collecting soil samples and using a lead testing kit to find the amount of lead in each sample. 15.5 centimeters had the highest mean at 920 PPM, the data decreased in order of 7¾ (450 PPM) and 0 cm (290 PPM). The hypothesis was supported by the experiment because as the depth of the soil increased, so did the amount of lead in the soil. “To address this contamination, EPA will excavate, treat and/or dispose of the soils. The remaining soil will be covered with clean fill, gravel, or other materials. The cover will help to eliminate the potential for contact with the contamination. This quote from the EPA website shows that from the start, the EPA was not completely discarding all of the contaminated soil, they just covered some of it up. If the experiment could be studied more in depth in the future by varying the location at which the samples are taken because when original tests were taken by the EPA they were done in 500 yard increments starting at the Hyman Viener site.

The Effect of Forest Cover Type on Stream Ecology for *Salvelinus fontinalis*

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The purpose of this experiment was to determine what, if any, effect the type of forest cover of the drainages of streams supporting *Salvelinus fontinalis* had on their macroinvertebrate populations (specifically those macroinvertebrates whose presence indicate good water quality). It was hypothesized that a drainage with a higher percentage of coniferous forest cover would support larger populations (as a percentage of the total macroinvertebrate population represented in the sample) of macroinvertebrates that indicate good water quality. Geospatial data was gathered from a variety of sources and analyzed using ESRI software. The drainages of streams confirmed to support *Salvelinus fontinalis* were measured and then the patches of different forest types within the drainage were measured to calculate the percentage of the area of the drainage covered by each forest type (deciduous, pine, mixed). This data was then plotted against the percentage of three different macroinvertebrates (mayflies, stoneflies, and most caddis flies) of the total sample in a scatter plot. No significant correlation was found between any type of forest cover and any macroinvertebrate selected for analysis. The strongest correlation (although very weak) was between pine forest and the population of most caddis flies. These results suggest that the types of forest in the drainage area have little impact upon the macroinvertebrate population compositions in the drainage’s streams. Further research could analyze the composition of just the riparian forest and its impact on the macroinvertebrate populations of the stream.

The Effect of Varied Levels of Nitrogen on Compost Mass

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The objective of this research project was to find the benefit of added nitrogen in compost, specifically the efficiency of the decomposition process. Overuse of pesticides and fertilizers have resulted in increased nitrogen in soils, which could affect the decomposition process of organic matter. The hypothesis of this experiment was that if the amount of added nitrogen was increased, then the mass of the compost would decrease more rapidly. An experiment was designed using a base compost pile of mostly carbon-based products, which was stored in a garbage can with holes. A stock pile was divided into twelve smaller, 1000 g piles. There were four levels of independent variable, 0%, 10%, 25%, and 50% added nitrogen, each having three repeated trials. The piles were stored inside a garage and were weighed once a week for fourteen weeks. The greatest percentage of weight loss was exhibited by a 0 g nitrogen bin with 50.2% loss of mass. The least mass lost was shown by a bin with 500 g of nitrogen with only 21.4% weight loss. When the t-test was conducted, each level of nitrogen was compared to the control. The 100 g bin's t-stat was 0.00000054, the 250 g bin had a 0.0000022 as t-stat, and 0.00000037 was the t-stat for the 500 g bin. Results were found to reject the null hypothesis and support the alternate hypothesis. Nitrogen speeds up the decomposition process and allows soil to hold water; therefore, too little nitrogen is also detrimental to the soil.

The Effect of the Amount of Oil Present in Water on the Dissolved Oxygen Concentration

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With the recent British Petroleum oil spill in the Gulf of Mexico, much of the population became increasingly concerned with the effect that crude oil had on the environment. Previous studies led to an experiment in which the purpose was to determine the effect of the amount of engine oil on the amount of dissolved oxygen (mg/L) produced by an Elodea plant at 0 mL of oil, 5 mL of oil, 10 mL of oil, and 25 mL of oil. To complete this experiment, an Elodea plant was placed into a 600 mL container containing 500 mL of distilled water. Five mL of oil was then introduced into the environment after being measured in a graduated cylinder. The concentration of dissolved oxygen of the plant was measured at the introduction of the oil and was monitored for two hours every half hour. These steps were repeated for groups B, C, and D. Every independent variable was tested 10 times for accuracy and to ensure that no outside variables affected the initial results. The results indicated that the plant that was introduced to the highest amount of oil (25 mL) had the lowest concentration of dissolved oxygen after two hours with a mean of 1.50 mg/L when compared to the other amounts of oil. The null hypothesis stating that the amount of oil would not affect the dissolved oxygen concentration was thereby rejected ($t=57.05 > 2.101$; $t107.44 > 2.101$; $t1 16.62 > 2.101$; $t3.65 > 2.101$; $t=10.98 > 2.101$; $t=10.96 > 2.101$ at $df18$; $p < 0.05$). The data supported the research hypothesis that if oil was added in increments of 0, 5, 10, and 25 mL to an Elodea plant, then the plant introduced to the highest amount of oil will have the lowest concentration of dissolved oxygen. Based on the dissolved oxygen concentration measured by this research, there appears to be a direct link between the amount of oil in a plant's ecosystem and the concentration of dissolved oxygen produced by said plant.

The Effect of Location on Soil pH

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Scientists have noticed differences between the pH levels of different areas because some showed to be higher or lower than others. This was as a result of the minerals that were present in each location. Some nutrients caused the soil to be more acidic than others. However, the acidity of certain areas of soil could affect many different factors, such as the growth of different plants or the lives of small organisms living within that soil biome. This happens because pH can affect the amount of nutrients that are in the soil. Some nutrients are only present under basic conditions while others are only present under acidic conditions. So, if the conditions are not right, a certain nutrient that a plant needs may not be present. The purpose of this experiment was to determine the effect of location on the pH of a soil sample. This could help determine what areas provide the best conditions for certain types of life. The hypothesis for the experiment was as follows: if soil samples are taken from different locations,

then the samples taken from the city will have the lowest pH. Ten soil samples each were collected from an urban yard, a suburban yard, a riverbed, a forest and by a lake. Then a pH meter was inserted into the samples and a pH reading was recorded. The results were averaged together and a t-test was used to compare and analyze the data. It was found that the data proved significant for groups A through E, B vs. D, C vs. D, and D vs. E ($t= 4.564 > 2.101$; $t= 3.733 > 2.101$; $t= 12.095 > 2.101$; $t= 3.781 > 2.101$; $t= 6.977 > 2.101$; $t= 4.802 > 2.101$; $t= 4.253 > 2.101$ at $df= 18$; $p>0.05$), and the data proved insignificant for B vs. C, B vs. E, and C vs. E ($t= 0.640 < 2.101$; $t= 0.900 < 2.101$; $t= 0.254 < 2.101$ at $df= 18$; $p>0.05$). In most cases the data supported the research hypothesis and rejected the null hypothesis. Based on the pH values, it can be concluded that the location soil samples are taken from does have an effect on pH levels.

The Effect of Various Soils on the Mass of Soil after Erosion

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Soil erosion is a huge issue that affects everything from drinking water to aquatic life. Soil comes in many different forms. A few common forms are loamy soil, mulch, and sand, each with different sized particles. The purpose of this experiment was to determine the effect of various soils on the mass of soil after erosion. If 226.8 grams of mulch are exposed to one liter of water, then the mass of mulch after erosion will be less affected than those of the other varieties of soil. One liter of water was poured over 226.8 grams of the various soils to determine how easily they erode. The levels of the IV and their means were as follows: mulch, 240.1 grams; garden soil, 168.2 grams; and sand, 36.2 grams. The hypothesis was supported by the experiment's data. Mulch has larger particles and pores that allow it to absorb some of the water and therefore is not moved as easily as sand or garden soil, which both have smaller particles. Future studies could include experiments on what plants are the most effective barriers for stopping runoff and which varieties of mulch absorb the most liquid.

The Effect of Different Types of Wood on Burning Time

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Wood has been used as fuel and in construction for many years, with various types ranging from balsa to maple, each with different properties and uses. It is not always clear which type to use to get the job done, or which type burns the way that you need it to for the project. The purpose of this experiment was to determine the lengths of time it takes to burn different types of wood. The null hypothesis was that if different types of wood were burned, then there would be no effect on the amount of time in seconds it took for each to burn. The research hypothesis was that if different types of wood were burned, then the different types would burn at different speeds. The wood was burned, using a flame, and the time it took for the wood to burn was recorded. The data was then analyzed using prior knowledge from research on the densities of each wood. When a softer type of wood was burned, there was a significant increase in the number of seconds it took for this wood to burn over the number of seconds of burning time for a harder wood. There was a 0.5% increase from an average of 27.63 seconds out of five types of wood. A t-test performed on the data showed that the data was significant enough to support the research hypothesis ($t=7.31 > 2.306$; $t= 11.12 > 2.306$; $t= 21.81 > 2.306$; $t=12.55 > 2.306$ at $df=9$; $p>0.05$). Based upon the data drawn from this experiment, it was concluded that different types of wood do have different burning times. More research should be conducted to determine whether or not this conclusion remains true with different types of wood, such as wood types more closely related, or whether or not density and other factors such as texture, color, and weight have an effect on the rate of burning time.

The Effect of Liquid Pollutants on Grass Height

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Soil contains many essential micronutrients essential for the soil. Plant growth depends on soil fertility and drainage in the soil. A little too much trace elements can be toxic to the plants or animals eating them and just as harmful to the soil as a deficiency. Motor oil, paint, and pesticides are some of the main liquid pollutants for soil pollution. The purpose of this experiment was to determine the effect of liquid pollutants on grass height. If grass with no pollutants is grown, then it would have a greater mean height than grass with liquid pollutants. Group A was added with a spoonful of paint in each, group B was added with a spoonful of insect repellent in each, group C was added with a spoonful of motor oil in each, and group D had nothing added. The groups were measured with a ruler (mm) every day on *F. arundinacea*, fescue grass's height. The data was collected and recorded onto a data table and graph. Grass with insect repellent exhibited a greater mean height (7.86 mm) than grass with paint (2.2 mm), grass with motor oil (4.78 mm), and grass with no pollutant (5.8 mm). The null hypothesis was accepted when the control was compared to grass with motor oil ($t=1.55 < 2.074$ at $df=22$; $p>0.05$). The null hypothesis was rejected when the control was compared to the grass with paint and the grass with insect repellent, when the grass with paint was compared to the grass with insect repellent and motor oil, and when the grass with insect repellent was compared to the grass with motor oil ($t=5.38 > 2.074$; $t=3.32 > 2.074$; $t=11.8 > 2.074$; $t=4.8 > 2.074$; $t=6.55 > 2.074$ at $df=22$; $p<0.05$). The data supported the research hypothesis in certain comparisons that grass with no pollutants would have a greater mean height than grass with liquid pollutants. When paint was added, it affected the grass height the most, resulting in shorter and more polluted grass.

The Effect of Amount of Heat on Velocity of Water

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Three scientists named Kushner, Held, and Delworth discussed how a rise in temperature affects the wind currents, ocean currents, and the areas of convection in the ocean. When a certain hemisphere, such as the southern hemisphere, was closer to the sun the water moved at a more rapid rate, including the areas of convection and surface currents. The purpose of this project was to see how an increase in temperature affected the velocity of the water. A glass dish filled with water was heated at five different levels: no heat, 70°F, 76°F, 124°F, and 155°F. After a few minutes of heating at each level, measurements were taken and the velocity was calculated. The results indicated that the velocity of the water was the highest at 155°F with a mean velocity of 0.502 centimeters per second. The lowest velocity of water was the control, no heat, with a mean velocity of 0 centimeters per second. The null hypothesis was if the amount of heat was increased, then the velocity of the water would not be affected. A t-test on the data showed that all of the data rejected the null hypothesis and supported the research hypothesis that if the amount of heat was increased, then the velocity of water will increase ($t= 3.75 > 2.101$, $t= 3.37 > 2.101$, $t= 10.44 > 2.101$, $t= 17.85 > 2.101$, $t= 2.83 > 2.101$, $t= 10.31 > 2.101$, $t= 17.53 > 2.101$, $t= 5.90 > 2.101$, $t= 15.07 > 2.101$, $t= 11.08 > 2.101$ at $df= 18$ and $\alpha = 0.05$). Based on the mean velocities of the water there seemed to be a direct correlation between the amount of heat and the velocity of the water. Before an increase in heat can be dubbed the only cause in an increase in velocity, other factors must be added into the experiment such as, wind and/or salinity.

The Effect of Elapsed Acid Rain on Brick Strength

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Acid deposition, a major environmental problem recognized globally, has contributed to the architectural and scientific awareness of masonry retrogression. This contention has raised the study of scientists from many countries, thus yielding the experimentation and sampling of brick strength. This concern was due to if acid rain, cause by natural and man-made occurrences, was affecting the support structure of the globally adopted brick. The purpose of this experiment was to test the effect of elapsed acid rain applications on brick strength. This experiment was solely engaged to expand the discernment of an important topic not widely recognized. Synthetic acid rain was mixed to a precise pH of 4.0. Forty bricks containing the most common constituents of all brick were separated into

four groups, each receiving a showered application of acid rain. The groups were assessed by application intervals. The bricks were then examined in strength by being measured in breaking force (kg). The results connoted that brick that had an acid rain application interval more frequently, the less breaking force it needed; meaning that the brick was much weaker when in the frequent presence. A t-test performed on the data indicated a significant difference between the means of the groups. The null hypothesis was accepted ($t=6.7 > 2.102$ at $df=18$; $p > 0.05$) The data did support the research hypothesis that acid rain applied more frequently to brick would result in a weaker brick, needing less force to break. Based on the research conducted, there is a conclusive reciprocity between the elapsed application of acid rain on bricks and the brick's strength. To conclude that the acid rain had superior responsibility for the weakening of the bricks stature, surveys must be held accountable.

The Effect of pH on Dissolved Oxygen Levels in Abram's Creek

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This paper focuses on an experiment that tests the effects of pH on dissolved oxygen levels in Abram's Creek. Abram's Creek is located in Winchester, Virginia, and is a critical part of the local ecosystem. Rainwater is often found within the pH range of 5.5-6.5. Acidic rain that has been polluted from emissions has an average pH range of 4.0-5.2. The null hypothesis for this experiment was that pH has no effect on dissolved oxygen levels in Abram's Creek. The alternative hypothesis of this experiment was that pH does have an effect on dissolved oxygen levels in Abram's Creek. In order to test this hypothesis, readings were taken from Abram's Creek once a week from July of 2010 to November of 2010. At waypoint 1, pH levels fluctuated between 7.88 and 8.80, while dissolved oxygen levels shifted between 6.7 mg/L and 9.8 mg/L. At waypoint 2, pH levels oscillated between 8.09 and 8.85, while dissolved oxygen levels shifted between 5.9 mg/L and 7.5 mg/L. At waypoint 3, pH levels shifted between 8.28 and 8.77, while dissolved oxygen levels shifted from 5.9 mg/L and 8.2 mg/L. The 2-sample t-test used to analyze the data resulted in a p-value of 0.0109 for waypoint 1, $8.711E-11$ for waypoint 2, and $5.081E-8$ for waypoint 3. These values show that the null hypothesis of pH not having a connection to dissolved oxygen levels in Abram's Creek can be rejected with a 95% confidence interval, thus supporting the alternative hypothesis of pH having an effect on dissolved oxygen in Abram's Creek.

The Effects of Silt Fences and Straw Bales on Run Off

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Straw bales and silt fences are both used as a way to prevent runoff. The purpose of this study was to determine whether straw bales or silt fences were better at preventing run off. A trough filled with soil was used to simulate an environment where a straw bale and silt fence may be used. Water was run through the soil to simulate a rainstorm. The results were collected and a t-test was performed to analyze the results. The test yielded a significant difference between the two groups. The researcher concluded that silt fences are a better form of runoff control.

The Effect of the Amount of Motor Oil on the Growth of Lima Bean Plants

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Oil spills in the ocean and run-off's from farms and factories are occurring more and more in today's environment. Plants and animals have suffered from these catastrophes due to the harmful chemicals in oil and other toxic elements. This led to the experiment of motor oil and common day plants, such as the lima bean plant. The purpose of this project was to determine how much motor oil a plant can take before the chemicals take over and kill it. Four groups (A, B, C) of ten seeds per each group were planted, and three of the groups were watered with water and motor oil. The fourth group (D) was the control so that group only received water. Every three days the plant's growth was recorded and after three weeks the data was collected. The results indicated that the group with the highest amount of motor oil watered to it was dead before any of the other groups. This group (A) had a mean of 11.58 while the other groups (B, C) had means of 12.17 and 8.54. Group D had a mean of 17.43. A t-test performed

on the data indicated a significant difference between the means of the groups ($t=2,375>t=202.2$; $t=182.9>t=2.18$; $t=2.16>t=1.6$ at $\alpha=0.05$ and $df=18$). The data supported the research hypothesis that if more motor oil is watered to lima bean plants, the quicker they will die. Based on the height of the plants after three weeks, there appears to be a direct correlation between the motor oil and the growth of lima bean plants. Before it can be concluded that the motor oil was the sole cause of the decrease in growth of the plants however, a survey will need to be made to determine the effects of motor oil on other types of common day plants.

A Relationship between Nitrates and Conductivity in Water Samples from Christian's Creek

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The purpose of the study was to determine whether nitrate and conductivity are correlated in water as they have been shown to be in previous studies of soil. The null hypothesis tested was that there was no correlation between nitrate and conductivity. Sixteen water samples taken from the same location on Christian's Creek over a 2-3 week period were tested for nitrate content and conductivity using a colorimeter and conductivity probe respectively. The readings varied more than was expected for both nitrate ($M = 5.57$, $S.D. = 1.40$) and conductivity ($M = 519$, $S.D. = 48.6$). During testing, temperature was controlled to prevent invalid conductivity readings. However, microbial activity may have affected the nitrate content in the time period between collection and testing. Overall, nitrate and conductivity had a poor correlation in the Pearson correlation test completed ($r = 0.106$). This finding agreed with previous studies. Nitrates and conductivity, therefore, did not exhibit the same relationship in water as in soil.

Molecular Characterization of Lab-Generated Biomass-Burning Products using Ultra-High Resolution Mass Spectroscopy

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Air pollution poses a significant threat to our environment and to our health; however, there is not much information as to the reasons why. This project was carried out to study the chemical composition of fine particulate matter in lab-generated smoke pollution and to compare it to prior data collected from a natural fire and from urban dust pollution. The focus of the study was on water-soluble compounds from the particulates due to the fact that these particles are the ones that can get into the lungs and move into the blood stream easily causing health risks. For this research project, peat and pine straw were burned in the lab for collection of smoke samples, which were analyzed using a Fourier Transform Ion Cyclotron Resonance Mass Spectrometer (FTICR-MS). The smoke samples were collected onto a filter using a vacuum to direct the air flow. The samples were then sonicated and extracted using acetonitrile, extracted again using a C-18 disk, and finally run through the FTICR-MS. The FTICR-MS analysis was used to determine the molecules present in the smoke sample and the relative quantities of each. Accurate data from the FTICR-MS was compared with analyses of particulate matter samples collected from the two other sources: a previously researched Norfolk, VA fire sample and an urban dust sample collected from Washington, DC. The peak lists generated by the FTICR-MS were then put into Van Krevelen diagrams through data analysis. This showed that the lab-generated biomass samples were very similar to previous data from the Norfolk fire of 2008, but considerably different from the urban dust sample. It is suggested from this research that the suite of chemical compounds found in the lab-generated samples were similar to those present in the Norfolk fire sample, but not similar to those present in the urban air sample. More research is necessary to determine the specific similarities and differences.

The Effect of Different Types of Oil on the Amount of Oil Absorbed by an Elodea Plant

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Oil spills are happening more often than they used to. The purpose of this project was to see if plants could absorb oil from oil spills to help the cleanup and spreading of the oil. Corn oil, engine oil and gasoline were poured into a container with an Elodea plant and water in it. The containers were left to sit out in the sun for a week to let the water evaporate. The results indicated that no oil was absorbed into any of the Elodea plants. A t-test was performed and the data did not support the research hypothesis that the Elodea plant would absorb more of the corn oil than any other oils. The null hypothesis was accepted in all comparisons ($t=0 < 2.101$ at $df= 18$; $p>0.05$). The results showed that the Elodea plant would make no difference in the amount of oil cleanup or how much oil would spread in an oil spill. The oil just harmed the Elodea plant and if the plant had stayed in the oil and water any longer it probably would have died.

The Effects of Oil on the Water Repellency of Goose Feathers

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The feathers of a bird are complex structures that are vital to the bird's survival. For waterfowl like geese, they provide insulation, buoyancy, and water repellency. There are many factors that can damage feathers, thus inhibiting their functions. The purpose of this experiment was to determine the effect of oil on the water repellency of goose feathers. Water was dropped onto two groups of ten goose feathers, one with oil on the surface and one without. The contact angle of the water droplet on the feather surface was measured with a protractor and the naked eye. The feathers with oil on their surfaces had a lower mean contact angle (63.7°) than feathers without oil (100.4°). Variations within the groups were similar with oily feathers having a standard deviation of 5.08 and non-oily feathers having a standard deviation of 5.66. The t-test was used to test the following null hypothesis at a 0.05 level of significance: The mean water droplet contact angle of oily feathers is not significantly different from the mean water droplet contact angle of non-oily feathers. The null hypothesis was rejected ($t= 15.26 > 2.101$ at $df= 18$; $p<0.05$). The data supported the research hypothesis that oil affects the water repellency of goose feathers. Because the addition of excess oil changed the delicate interlocking barbule structure of feathers, their water repellency was greatly reduced. This is often fatal to the birds. To improve the measurements of the water contact angles on the feathers, a goniometer could be used.

ENVIRONMENTAL SCIENCE C

FIRST PLACE

The Effect of Turtle Excluder Devices on the Catch of the Blue Crab (*Callinectes sapidus*) in Pots in the Monroe Bay Tributary of the Potomac River

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Since the 1970's, environmentalists have been concerned about the effect blue crab (*Callinectes sapidus*) harvesting has on the population of diamondback terrapins (*Malaclemys terrapin*). A solution to turtles getting trapped in crab pots was proposed with the invention of the turtle excluder device (TED), which is designed to prevent turtles from entering the pots but still allows blue crabs to enter. Local governments are attempting to regulate the use of these TEDs on commercial and recreational crab pots in the Chesapeake Bay. If enacted, crabbers would be required to attach a TED on each opening of each crab pot they use. This study analyzed the catch of crab pots with and without TEDs to determine if TEDs limit the primary catch of crabs. The research was conducted on a recreational fishing vessel every other day for approximately six weeks. Crabs were analyzed for size and gender, and all the crabs were totaled each day from each type of pot. All bycatch was observed and recorded. The data was analyzed to determine if TEDs reduce the number and size of crabs caught. The average number of crabs caught in the TED pots was 15.61 while the non-TED pots had an average of 24.56 crabs. These averages produced a p-value less than 0.01. It was also found that the average size of crabs caught in the TED pots was 13.17 cm and the average from non-TED pots was 13.44 cm, producing a p-value of 0.026. In regards to gender, the average percentage of females caught in the TED pots was 13.16% and the average for non-TED pots was 14.10%. This created an insignificant p-value of 0.433. The negligible amount of bycatch caught may prove that TEDs aren't required in the Bay. These results could also potentially convince marine legislators that requiring the use of TEDs on commercial crab pots would produce dire consequences on the Chesapeake Bay's fisheries economy.

SECOND PLACE

A Comparison of Benthic Indicators of Water Quality between Cockrell's Creek and Crane's Creek, Tributaries of Ingram Bay

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To assess water quality, scientists commonly rely on an index of biotic integrity. This system rates aquatic regions on their overall "health" based on what organisms inhabit the area. Different organisms have different tolerances of water quality, keeping this in mind; one can determine the average water quality of an area. Species inhabitation is often a more reliable indicator of water quality and health than traditional water quality parameter tests because benthic organisms provide insight into the average water quality, rather than water quality at just one instance. This project aimed to show the validity of using benthic organisms for indicators of water quality by comparing the organisms found in an allegedly polluted water body with a similar, yet less developed water body. Crane's Creek and Cockrell's Creek are both tributaries of Ingram Bay. However, Cockrell's Creek has had a long history of housing the most productive and lucrative watermen in the Chesapeake Bay watershed, and is rumored to be heavily polluted. Benthic samples of both Crane's and Cockrell's Creek were collected in similar areas. The samples were then sifted in search of organisms living in the sediment. The organisms were weighed and identified to compare biomass and calculated using the Shannon Index to compare biodiversity in the two different creeks. The hypotheses of this project were that Crane's Creek would have more biodiversity and biomass than Cockrell's Creek. The results of the project supported the hypotheses. Although there were no major differences in the biomasses of the two creeks, the difference of biodiversity found in the two creeks was highly significant. This project displays the validity of using benthic organisms as indicators of water quality by testing to see if two similar creeks had different levels of benthic life.

THIRD PLACE

The Effect of Filter Type on the Efficiency of Filtration of Toxic Heavy Metals from Soil

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It is noted with concern by environmental scientists that many industrialized yet underdeveloped nations have been and still are being heavily polluted by several toxic metals like cadmium, mercury, and lead. With few prospects in sight for a cheap yet efficacious filter to remove lead from soil, it was determined that several common filters should be experimented upon to see whether any of them had a measurable effect fighting off lead. These filters were alumina, charcoal, diatomaceous earth (AKA Celite), and silica. It was hypothesized that, due its porous nature, charcoal would be the best filter. The holes would be large enough to allow the solvent through, but too small for the lead atoms to pass too. Samples of each of the filters were obtained and measured, as were several liters of lead/nitric acid solution (at 1000 ppm Pb+2 to 1% HNO₃ in deionized water). Enough volumetric flasks were found to measure of the solution with great accuracy, and an AAD (an Atomic Analysis Device) was obtained to measure the concentration of lead with sufficient preciseness. In each of the five trials for each filter, 2 mL of the filter were put in a volumetric containing 50 mL of the Pb/HNO₃ solution and shaken. Three controls, which had been subjected to the entire preparation procedure except the addition of the filter, were used. After waiting one day and priming the AAD with deionized water, a trial's solution was sucked up and analyzed to yield the remaining percentage of lead. Upon performing t tests on the results at $\alpha=0.05$, it was determined that alumina (t statistic of 5.741389835 vs. table t of 2.447 at df=6) was the only significantly better filter than the control. Charcoal at df=5 and celite and silica at df=6 came in, respectively, at $t=1.252262061 < t=2.571$, $t=-1.457786934 < t=2.447$, and $t=1.773167379 < t=2.447$.

HONORABLE MENTION

The Effect of Type of Shoreline on Amount of Soil Eroded

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Erosion is the displacement of rocks or soil by wind, water, or any other natural force. This process is very prevalent throughout the Chesapeake Bay Watershed, where erosion rates can be as high as 1.5 feet per year. Two main solutions have been developed to decrease erosion: a natural shoreline consisting of the roots of strategically placed plants, and a man-made shoreline consisting of a wooden bulkhead. The purpose of this project was to determine the effect of type of shoreline on the amount of soil eroded in a simulated watershed system. It was hypothesized that if the natural shoreline was used, the amount of soil eroded would decrease. An inclined structure was built, first holding a living shoreline on one side consisting of *Festuca rubra* anchored strongly into the soil by its roots. After pouring water down the incline ten times, and measuring the amount of erosion for each trial, the same procedure was followed for the man-made level. Based upon the two-sample t-test conducted, the null hypothesis was rejected, ($p=1.73 \times 10^{-5} < 0.05$ at $df= 10.774$.) Despite previous data, the research hypothesis was not supported by the data gathered, as the amount of erosion for the man-made shoreline was 7.27 mLs, while the amount of erosion for the natural shoreline was 27.67 mLs. These results contradicted tests done by the Chesapeake Bay Foundation as well as the Navy. Perhaps the trend in data was due to the fact that the natural shoreline did not provide a direct barrier between the flowing water and the soil. Before a final conclusion is drawn, tests should be performed with other varieties of man-made and natural shorelines, being subjected to other common means of erosion.

HONORABLE MENTION

The Relationship between the Populations of Phytoplankton and Copopods (*Acartia tonsa* and *Eurytemora affins*) in Morattico Creek during the Phytoplankton Spring Bloom

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Phytoplankton are the lowest of the aquatic trophic levels, and therefore act as the bottom of the food chain. They are then consumed by copepods and other zooplankton to begin to move the energy to higher levels. This, being the first chain, is very important. The population of copepods during the spring phytoplankton bloom has been speculated to be directly linked to the phytoplankton population. This study was conducted to test the relationship between the phytoplankton and copepod populations at the mouth of Morattico Creek at Belle Isle State Park in Lancaster County, Virginia. A standard phytoplankton net with a mesh size of 150 μm was towed for five thirty second intervals once a week from March 28th through May 25th. This data was used to test the validity of the hypothesis that during the spring bloom the number of copepods is directly correlated to the number of phytoplankton. Five samples were taken at each date and then each sample was split into eighths, with one eighth of each sample being counted. The phytoplankton were quantified by the chlorophyll A content, the numbers of which were taken from the collective data and archives of the Chesapeake Bay Interpretive Buoy System, run by NOAA. The results showed a strong correlation between the chlorophyll A levels and copepod population. They followed very similar trends, but not everything could be accounted for by the relationship between the two. The water temperature and salinity had a large impact on the copepod levels, while the plankton levels had a large impact on the dissolved oxygen. The p-value was significant, giving the study importance. This study shows the first step of the aquatic food chain, which sets the tone for the higher up trophic levels.

HONORABLE MENTION

A Comparison of Filtration Rates between the Eastern Oyster (*Crassostrea virginica*), Atlantic Ribbed Mussel (*Geukensia demissa*) and the Hard Shell Clam (*Merceneria merceneria*) in Varying Turbidities

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In the eighteenth and nineteenth centuries, several oyster reefs were so large they posed navigational hazards to ships. This large amount of oysters could filter the entire Chesapeake Bay in less than a week. Today, it would take about a year to do so. The oyster population is a mere two percent of what it was in the eighteenth and nineteenth centuries. The decline in the oyster population is due to factors such as overharvesting, diseases, and pollution. In correlation with the decline in the oyster population, the health of the Chesapeake Bay has also declined. A main response to the decline in the oyster population has been to restore the oyster population in the Chesapeake Bay in hopes of restoring the fishery as well as improving the overall health of the Bay. Each year, millions of dollars are funded for oyster research and restoration in the Bay area. However, although a vast amount of money has been funded for oyster research and restoration effort, the success of the overall restoration efforts has been trivial. Because success has been trivial, other alternative native organisms, such as the mussel and the clam, may prove to be better in aiding the Chesapeake Bay's health than the oyster. This study compared the sediment filtration rate of the Eastern Oyster to the Atlantic Ribbed Mussel and the Hard Shell Clam taken from the Lower Machodoc Creek, a tributary of the Chesapeake Bay, in varying turbidities. Using a two-way ANOVA, statistically highly significant p-values $\ll 0.05$ concluded that each experimental group had a different filtering ability when compared to one another. It was then further concluded that the Atlantic Ribbed Mussel had the greatest filtering ability followed by the Eastern Oyster, the Hard Shell Clam, and finally a control. Building the Atlantic Ribbed Mussel's population in the Chesapeake Bay may prove to aid the Bay's health quicker and better than the Eastern Oyster if money, time, and research were put forth on the Atlantic Ribbed Mussel rather than the Eastern Oyster.

The Effect of Eco-Friendly Detergent on Worm Survival

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Method detergent was founded by Eric Ryan, an advertiser, and Adam Lowry, a chemical engineer. This product became available to consumers in the middle of 2001. Method detergent is advertised as an eco-friendly product. Tide detergent has been around since 1946. It is a very popular detergent used in many households. The purpose of this experiment was to test eco-friendly and conventional detergents on worm survival. Worms were used because they live in the soil which works out in this experiment. Two trials were performed in the experiment. The worms were placed in the garage for the first trial and in the second trial, they were placed the refrigerator. The eco-friendly detergent environment allowed few worms to survive than in the conventional detergent environment. A chi-square test was performed on the data for the experiment ($df=1$, $\alpha=0.05$, table $\chi^2=3.841$). Based on the amount of worms that survived in each environment, it is concluded that eco-friendly is not so eco-friendly. More worms survived in Tide than in Method, which is said to be healthy for the environment. Before it can be thoroughly concluded, more tests will need to be made to determine that eco-friendly is not safe for the environment.

The Effect of Oysters on Turbidity and Dissolved Oxygen in the Rappahannock River

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The Chesapeake Bay's water quality has been faltering for the past century. This decline in the water quality is affecting the populations of species vital to the Bay's ecosystem. Organizations attempting to improve the Bay's health are constructing oyster reefs to restore the Eastern Oyster, *Crassostrea virginica*, to provide habitat, filter the water and remove excess nutrients. For this study, water quality was tested at a commercial oyster grounds to see how the presence of the Eastern Oyster affects water quality in the lower Rappahannock River. Turbidity, dissolved oxygen, salinity, and temperature were tested nine times between the dates of May 20 and August 27, 2010 at a site on the oyster grounds and a site away from the oyster grounds using a Hydrolab CTD. Data showed no significant difference in turbidity on and off the oyster grounds, but a t-test showed a significant decrease in dissolved oxygen saturation over the oyster reef, $p = 0.008$. There was no significant difference found in the turbidity data between the two sites, $p = 0.956$. Oysters are using oxygen on the on-grounds site, where there is less oxygen respiration at the off-grounds site. If this result is holds true to all oyster reefs, they could actually be negatively affecting the water quality of the surrounding water. These findings are significant if the stated goal of oyster restoration is focused on improving water quality in the Chesapeake Bay where dissolved oxygen values are already critically low.

The Habitat Preference of Freshwater Fishes in Rivers and Ponds

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Biological indicators are key species that can help detect dangers in the environment. If better techniques to obtain these species are executed in the field, damages to the environment could be foreseen before much damage is done to the environment. To obtain a general basis of the diversity from multiple habitats four main types of habitat were chosen in three local aquatic ecosystems and then tested. The three areas were a man made pond, a shallow beaver pond and a section of a local river. The four habitats tested in each of the three locations are aquatic vegetation, sunken logs, open water, and brush. Twelve torpedo traps were checked daily for fish. The data was analyzed with a two-way ANOVA (without replication) after being synthesized from a Shannon-Wiener diversity index. The three different testing locations had significant differences with a p-value of less than 0.05; this value states that the testing sites are significantly different diversity of fish in each habitat. The overall most diverse location was the aquatic vegetation trap; the most diverse area was the Mattaponi River site. The data suggests that the most prevalent place to place torpedo traps for the collection of species would be to place the traps in an aquatic vegetation bed in a river. Information about the habitat preferences of fishes would help to assist with determining the fitness and condition of aquatic ecosystems.

The Effect of Environment on the Decomposition Rate of the Sun Chip Compostable Bag

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The Sun Chips packaging was made from more than 90% renewable, plant-based materials, will completely break down into compost in an active compost pile in approximately fourteen weeks. Rather than being made from petroleum, a non-renewable resource, the plastic used to make the compostable chip bags is derived from plant material. The compostable plastic breaks down in a compost pile, as opposed to most conventional oil-based plastics that do not decompose, and simply pile up in landfills. The purpose of this experiment was to determine the effect of environment on the decomposition rate of the Sun Chip 100% compostable bag. This project was chosen to determine that if the bags wound up as “litter” in various environments how well would they decompose. If the environment of a chip bag was changed, then the compostable bag decomposed fastest in an active compost bin. Ten bag samples attached to a wooden dowel were placed in different environments, underwater, on driveway, household, compost, buried in dirt garden, and on grass, not covered. After one week, the decomposition rate was recorded for each sample. The environment was checked to make sure it was still intact; adjustments were made as required. The decomposition rate of each sample was recorded for eight weeks and the collected data was graphed. The null hypothesis was rejected when group A bags, submerged in water, were compared to all other groups ($t = 6.18 > 2.101$, $t = 5.56 > 2.101$, $t = 3.55 > 2.101$, $t = 5.3 > 2.101$, $t = 6.33 > 2.101$ at $df=18$; $p>0.05$). The null hypothesis was accepted in all other cases. The data did not support the research hypothesis that the active compost bin would be the most efficient environment for the compostable Sun Chip bags. The bags submerged in water decomposed the most with a mean of 4.3. The active compost bin samples were next with a mean of 3.

A Comparison in the Growth of *Crassostrea virginica* between Carter’s Creek and Corrotoman River

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The Chesapeake Bay is known for serving as a nursery for young fish and aquatic life. One species that plays vital role in this nursery is the eastern oyster (*Crassostrea virginica*). While the oysters are resilient to a dynamic marine environment, they may be adversely affected by poor water quality and pollution. Since the 1950’s, overfishing and disease have caused the Chesapeake Bay oyster population to drastically diminish. Oyster restoration efforts such as the Chesapeake Bay Foundation and the Tidewater Oyster Gardeners Association have restored natural oyster reefs, created artificial reefs, and grown oysters in small-scale floats. Restoration efforts promote a growing oyster population and allow sample populations to be studied. This study compared the growth of two oyster populations along the Rappahannock River. The Western Branch of the Corrotoman River is a quiet area with few residences on its shores. Carter’s Creek is a developed area with a year-round boat marina and high residency. These two areas were chosen for the study because they represent two different environments in terms of water quality and activity. Oyster floats were mounted on piers at both sites, where the lengths, masses, and water quality were recorded for three months. The rate of growth of the oysters in Carter’s Creek was greater than in the Corrotoman River. The dissolved oxygen, water clarity, and salinity were higher in Carter’s Creek. While not statistically significant, the results show that the oysters grew larger in the developed environment that was closer to the mouth of the Bay. The constant flow of algae and nutrients from the Bay provide a plentiful source of food. Since oysters grew as well, if not better, in Carter’s Creek’s it demonstrates the significant contribution oyster restoration efforts might have in the oysters’ ability for filtering pollution and sediment in high activity environments.

The Effect of General Hardness on Guppy *Poecilia reticulata* Growth

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This experiment tested whether or not guppies (*Poecilia reticulata*) express a difference in growth performance in terms of length when raised in three different levels of general hardness (GH) – 214.8, 268.5, and 322.2 mg/L. The guppies were measured every four days over a 32 day time period. Afterwards, a linear regression

was performed for each treatment. The Analysis of Covariance performed using the results of the linear regression to compare the slopes found the results to be non-significant. However, a trend was apparent – the lower the GH, the higher the average length of the guppies. Also, observations after the experiment hinted towards hardness playing a role in the rate of sexual maturity, which could provide a base for a future study.

The Effect of Car Exhaust on the Height of Plant Growth

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One of the main causes in air pollution is from car exhaust. The harmful gases which are exerted from the tailpipe swiftly shoot up into the air and are absorbed by plants in the environment. Harmful substances that can be found in car exhaust are nitrogen, dirty water vapor, carbon dioxide, carbon monoxide, nitrogen oxides, hydrocarbons, ozone, lead and soot. When plants are exposed to these harmful chemical it harms or hinders the germination process and gets deep inside the cell causing death or growth defects such as height and brown discoloration on the plant.

The Effect of Houseplants on Indoor CO₂ Levels

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During the American energy crisis there was a boom in research for new ways to save power. One of the new innovations was better insulation materials that successfully kept hot or cold air from escaping. The materials helped to maintain room temperature without the need for constant air conditioning. People were asked to insulate their homes and were given tax incentives to do so. Houses became more energy-efficient, but were now prone to sick home syndrome. This syndrome occurs when the house/building is prone to large amounts of bacteria, synthetic materials, bio-effluents, and disease. The bacteria inside the house began to grow due to the lack of ventilation, and many citizens became sick. The purpose of this experiment was to prove that normal house plants can decrease indoor CO₂ levels and create fresh air. Four groups of a set number of plants were kept in a sealed tank. The groups were ordered as follows; zero plants, one plant (Golden Pothos), two plants (Golden Pothos & Mint Kolibri Ivy), and three plants (Golden Pothos, Mint Kolibri Ivy & Micans Philodendron). Each group was tested over an eight day period using a CO₂ monitor. The results showed that there was a great difference in reduction between each group and that the group with three plants showed the highest reduction in CO₂. The results of the experiment supported the research hypothesis that if plants were kept in an enclosed environment with no ventilation, then the plants would generate fresh air and carbon dioxide levels would decrease. Based on the research, plants have the capabilities to reduce CO₂ levels within an enclosed environment.

The Effect of Motor Oil on the Germination and Radical Root Length of Lettuce Seeds

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Water pollution is a hazard to the environment, and improperly disposed used motor oil is a significant source of non-point water pollution. One gallon of used oil can contaminate one million gallons of water. Used motor oil is the single largest environmentally hazardous recyclable material. The purpose of this experiment was to understand the impact of improperly recycled motor oil on plants native to Virginia. The hypothesis was that if different concentrations of motor oil were added to *Lactuca sativa* (lettuce seeds, sourced from Monticello), then the concentration of 1% will have the highest germination and longest root length. The independent variable was the concentrations of used motor oil solutions. The levels of the independent variable were 0% (spring water used as the control), 1%, 2%, 3% and 4% used motor oil solutions. The dependent variables were the number of lettuce seeds germinated and radical root length. There were 20 trials at each level of the independent variable. The used motor oil solutions had a negative effect on lettuce seed germination and root length. The number of seeds germinated was highest for the 1% solution (mean 9.4) and second highest for water (mean 9.3). The lowest rate was for the 4% solution (mean 8.6). The radical root length was greatest for both water (mean 3.0 cm) and the 1%

motor oil solution (mean 3.0 cm). The shortest radical root length was found for the 4% motor oil solution (mean 2.0 cm). These results supported the hypothesis that the number of seeds germinated and the radical lengths would be greatest with the 1% motor oil solution versus all other motor oil solutions tested. This experiment was worthwhile because it showed that dumping of motor oil into the aquatic environment is harmful to plants in Virginia.

The Effect of Different Areas of a Lake on pH Levels

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How is the pH of a lake changed? In this experiment, the pH levels were tested in six separate areas of the lake at Bryan Park. The pH of an area such as this one is extremely important for the survival of the plants and animals in the surrounding environment. Slight changes such as animal population, plants, minerals in the soil, and human construction and litter can greatly affect an area. Based on research, the hypothesis is that if the area of the lake is further downstream, then the pH level will increase. Data was retrieved by going to each site. Water was then put into a test tube, and three drops of pH testing solution were put in to determine the pH. The results of this experiment support the hypothesis; the pH level slightly increased as the areas tested were further downstream. Overall, the research and results of this experiment were relevant and could potentially be helpful in the future.

The Effects of Crab Pot Soak Times on Marine Organisms

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Blue crabs (*Callinectes sapidus*) make up the largest commercial fishing industry in the Chesapeake Bay area. This fishery is responsible for millions of jobs; if the industry took a negative turn, many people would suffer. The prominent method for catching blue crabs is the crab pot. Some crabbers either leave their crab pot in for very short amounts of time or for very long periods of time. Likewise, people who own weekend homes on the water sometimes tie a crab pot to the side of the deck and leave it there until they decide to come back, which usually isn't for weeks at a time. This study attempts to find the soak time with maximum catch and minimum mortality. Finding the right soak time may improve overall harvest for both recreational and commercial fishermen. If the crabbers know when they should check their crab pots it could save them time and money and increase their catch. Also, a set soak time would help the environment, because less unwanted organisms would get trapped and die in the crab pots. Four crab pots were baited and placed in the water in the same area so as to experience the same weather and water conditions. All four crab pots were checked every twenty-four hours for twenty-six days, and were rebated every ten days. The maximum catch occurred at day fourteen; however, the greatest rate of catch occurred within the first three days. Crab catch varied based on escape, mortality and a low number of crabs due to the study occurring in the late fall. This study suggests it would be more beneficial to check a crab pot every three days, based on catch per haul, rather than leaving it in for a full fourteen days without checking it. Determining an optimal soak time will also be beneficial to crabbers; if they know when they should check their crab pots time and money would be saved. Also, a set soak time would help the environment; less unwanted organisms would get trapped and die in the crab pots.

A Comparison of Soil Nutrient Runoff Composition in the Colonial Beach Area of Westmoreland County, Virginia

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In order to maintain a healthy ecosystem for plants and animals, many factors have to work together. A major component of this balance that has the ability to affect plant growth and animal habitats is soil. When water is run through soil, there is potential that nutrients such as nitrogen and phosphorus can be transferred to the water. When precipitation runs through the soil and collects different levels of nutrients or pollutants in the water, these components can then be transferred into the watershed in the form of runoff. This experiment tested transferability

of soil properties including nitrogen, phosphorus, and pH. Different locations such as an urban home site, a vacant lot, an agricultural storage area, and an agricultural field were all tested to obtain replication of the experiment and also different soil compositions. The leachate contained more nitrogen and phosphorus than the water before it had been run through the different soil samples. The soil did transfer nutrients to the water going through it, and the soil also affected the pH of the water. The comparison of soil and runoff between each site in regard to nitrates produced a p-value of 0.897087, with no significant difference between the four sites. In regard to phosphates the p-value was 0.125613, showing no significant difference between the four sites. In regard to pH the p-value was 0.746586, showing no significant difference between each site. Overall a t-test for both nitrates and phosphates proved that enough nutrients are collected in runoff water to be significant, but a comparison of sites did not prove any different results. Studies like this are important to try and understand the relationship between soil composition and nutrients in runoff water to help better ensure that harmful runoff water can be kept at a minimum by locating problem areas such as in the Chesapeake Bay.

Impact of the Totopotomoy Wastewater Treatment Plant on *Escherichia coli*, Dissolved Oxygen, and Nitrogen in the Pamunkey River

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This study proposed to observe the number of *Escherichia coli* colonies, nitrogen, and dissolved oxygen in water samples taken up stream, next to, and downstream of the Totopotomoy Wastewater Treatment Plant sewage discharge site. Data was analyzed to determine whether *E. coli* was more prevalent in water that had passed by the discharge site and/or whether the nitrogen and dissolved oxygen concentrations were higher or lower downstream of the discharge site. Although large numbers of *E. coli* were detected, no statistically conclusive patterns in connection with the discharge site could be determined. Similarly inconclusive results were found with dissolved oxygen and nitrogen concentrations. It's felt that more conclusive data on the potential impact of the Totopotomoy WTP may be derived by establishing sample locations further upstream and downstream of the outfall and conducting additional replicates at each of those sampling locations.

The Effect of the Salinity of a Solution on the Germination Rate of *Pisum sativum* Plants

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The *Pisum sativum* (pea) plant is a relatively inexpensive and nutritious food source, easy to grow on almost any land, but affected by the amount of salinity in the soil. Therefore, the purpose of this experiment was to determine the effect of the amount of salinity on the germination rate of *Pisum sativum* (pea) plants. The hypothesis for this experiment was that if the seeds were given a zero percent salinity solution (regular tap water), then these seeds would have a greater germination rate than those watered with a higher saline concentration solution. Six solutions of one percent, two percent, five percent, ten percent, twenty percent, and a control of zero percent (tap water) were prepared. In six potting dishes, ten pea seeds were placed equidistant from each other and an equal amount of soil was placed under and above the seeds. The plants were then labeled with one of the solutions and watered with them each day at a constant time respectively and the number of sprouts was counted on day seven. The results indicated that the seeds given the least amount of salinity (zero percent salinity) germinated the most with a mean of nine sprouts or 94% of the seeds germinated and the seeds that were given the highest salinity (twenty percent salinity) grew the least with a mean of zero sprouts that germinated or 0% of the seeds germinated. The data supported the research hypothesis that if a solution with zero percent salinity is given to the pea plants, then the group receiving zero percent salinity water will have the greatest germination rate. Based on the germination rate of the pea plants with different levels of salinity in this experiment, it was determined that there appears to be a direct correlation between the amount of salinity given to a plant and the germination rate of that plant. Further improvements would be to measure the root and stalk length, number of leaves, and germination rate after rewatering with distilled water.

ENVIRONMENTAL SCIENCE D

FIRST PLACE

Nearshore Sedimentation and Deposition of Organic Carbon in the Lower Chesapeake Bay

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Over the past century, the Chesapeake Bay has faced two major problems: sedimentation and nutrient loading. Sediments and excess nutrients in the water column severely degrade habitats for marine organisms, affect light attenuation, and lower dissolved oxygen levels. Sedimentation was measured in this study to determine the load of inorganic sediments and the percentage of organic material settling to the bottom in the nearshore benthos. Sediment traps were used to collect sediment as it fell through the water column; they deployed at three locations in Mathews and Middlesex Counties - New Point, Lily's Neck, and Stingray Point. The sediment was collected monthly from April to July and the masses of the sediment loads were recorded. A wet sieve and wet pipet analysis were used to determine the grain size percents and samples were burned to determine the amount of organic carbon in the sediment load. The total sedimentation did not vary significantly with month and location, a two-way ANOVA revealed $p = 0.28$. However, the portion of organic carbon in the sediment load did vary significantly with an ANOVA result $p < 0.001$. The organic carbon load in Stingray Point was the highest with a significant portion of the organic matter being coarse woody debris and other allochthonous materials. The engineered shoreline and high boat traffic of Stingray Point account for a large amount of resuspension of sediments. Background inputs from the terrestrial ecosystem should be quantified when considering eutrophication and sedimentation.

SECOND PLACE

The Short-Term Effect of Greywater Application on Earthworm Biomass

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People who water their lawns with recycled household wastewater, or greywater, may be doing more harm than good if this practice hurts earthworms at the expense of saving water. This project tested the short-term effect of greywater application on change in biomass of *Lumbricus terrestris* (Canadian nightcrawlers) in a simulated lawn setting. The hypothesis was that the *Lumbricus terrestris* in lawns treated with greywater would gain less weight than worms in lawns treated with natural or tap waters. Three water treatments – greywater (0.5% solution of antibacterial dishwashing liquid in tap water), tap water, and natural water (creek water) – were tested in two replications using six 2.8 liter (L) pots containing 2.72 L of untreated topsoil covered with a fescue sod plug. Each pot was stocked with six *Lumbricus terrestris* worms and watered every three days for 17 days with 900 milliliters (mL) of the randomly assigned water treatment. Soil pH and soil moisture were measured at baseline and at each treatment. Changes in average weight per worm were calculated to assess biomass changes. Worms in pots treated with greywater experienced the lowest biomass gain at 25.2%, as compared with 26.5% for tap water and 60.7% for creek water, and were skinnier and more sluggish. Statistical analysis suggested soil pH was not affected by greywater and was not responsible for the differences. The results could be due to negative effects of chemicals in the greywater and positive effects of organic matter in the creek water on soil biota that comprise the worms' food supply.

THIRD PLACE

The Acute Toxicity of Commercial Bioremediation Agents on *Artemia salina*

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On April 20th, 2010, the Deepwater Horizon explosion caused an estimated 200 million gallons of crude oil to gush into the Gulf of Mexico. The effects of the agents used to clean up this oil spill, as well as other spills, are largely unknown. This experiment was designed to test the toxicity of bioremediation agents currently being used to clean up oil spills. *Artemia salina* (brine shrimp) were used to test the toxicity of three different bioremediation agents: Oil Spill Eater II (OSE-II), Micro-Blaze, and S-200. Two controls were also used, one with crude oil and one without. There were four trials for each testing variable. On days one, three, and four of testing, the number of *Artemia salina* living and dead was determined for each trial. All of the *Artemia salina* were dead on the fourth day of testing, with and without oil, for OSE-II and S-200. Without oil, Micro-Blaze averaged a 60.5% survival rate of *Artemia salina* on the fourth day of the testing period. With oil, Micro-Blaze averaged a 16.8% survival rate of *Artemia salina* on the fourth day of the testing period. Comparatively, the control without oil averaged a 78.5% survival rate of *Artemia salina* on the fourth day of the testing period. The control with oil averaged a 37.6% survival rate of *Artemia salina* on the fourth day of the testing period. Micro-Blaze was the least toxic bioremediation agent, while both OSE-II and S-200 were equally toxic. All data was statistically significant at $p < 0.01$.

HONORABLE MENTION

The Effect of Ocean Acidification on the Growth of Juvenile American Oysters, *Crassostrea virginica*

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The purpose of this experiment was to analyze the effects of a decrease in pH on the Eastern oyster, *Crassostrea virginica*. An increase in carbon dioxide in the atmosphere causes the ocean to absorb more CO₂. This in turn causes an increase in acidity (decrease in pH) in the oceans and other large marine environments. This experiment tested the results of a more acidic body of water on the Eastern American oyster. The pH of water from the Chesapeake Bay was lowered in small increments to test likely future pH changes in the Bay. Oysters were grown in these unfamiliar habitats and measured for growth. The results indicated that oysters preferred their natural habitat more than any altered pH habitats. Results from this experiment proved to be accurate with results from other experiments, showing that an increase in acidity stunts the growth of marine calcifying organisms. This experiment also shows that oysters are a signal species to the Bay, showing that the falling pH levels will soon affect other Bay inhabitants.

HONORABLE MENTION

The Effects of Water Column Placement on the Growth of the American Oyster (*Crassostrea virginica*) in Mattox Creek, a Tributary of the Potomac River, in Westmoreland County, Virginia

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It is well known throughout the Chesapeake Bay that the American Oyster (*Crassostrea virginica*) is incomparably valuable. In addition to the cash value of harvested oysters for watermen, oysters are necessary for natural maintenance of the bay and its tributary waters. They are filter-feeders, straining out their food from the water around them. This removes many organic materials from clouding the water with excessive nutrients, allowing

sunlight to penetrate to further depths and increasing clarity. In order to maintain a profitable business for watermen without contributing to the detrimental effects the plummeting oyster population has had on the Bay, farmed oysters must be raised as quickly as possible. To aid this endeavor, this study examined the growth rates of oysters at various locations in the water column in order to determine the ideal placement for maximum growth of *Crassostrea virginica*. This was accomplished by means of multiple rafts of oyster spat being established in the photic zone (surface of the water column), benthic zone (floor level), and a mid-depth layer of Potomac River tributary Maddox Creek's water column. Oysters were measured for growth over four months and data was compared to determine where in the water column oysters grow the most rapidly. It was predicted that the higher flow rates closer to the top of the water column would bring more plankton and nutritional detritus to the developing oysters, resulting in more rapid growth. This study found that oysters grew faster at the bottom of Mattox Creek than on the surface, however it was not statistically significant. Late summer salinity, dissolved oxygen and algae amounts most likely contributed to the growth trends.

HONORABLE MENTION

On the Potential Change in the Wind Regime of Coastal Virginia and North Carolina

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Analyzing historical wind data can provide a better understanding of how both surface winds and the frequency of high wind events have changed in response to a changing global climate. This study analyzed winds along the coasts of Virginia and North Carolina to look for changes in the coastal wind regime. Wind data for the period 1985 to 2009 were collected from ocean buoys from the NOAA National Data Buoy Center at three offshore sites: Cape Henry, Virginia; Diamond Shoals, North Carolina; and Cape Lookout, North Carolina. Wind frequency data at each site were sorted into ranges based on the Beaufort Wind Speed Scale, allowing the wind conditions to be categorized and analyzed statistically using an ANOVA statistical test. The results varied by site: Cape Henry, Virginia trended significantly toward overall higher wind speeds, $p < 0.05$; Diamond Shoals, North Carolina trended significantly toward overall lower wind speeds, $p < 0.05$; no trend was observed at Cape Lookout, North Carolina, $p = 0.35$. A statistically significant increase in the frequency of high wind events was observed at Cape Henry, Virginia, while no trend was observed in the frequency of high wind events at Diamond Shoals or Cape Lookout, North Carolina. A known climatic boundary exists between Cape Henry, Virginia and Diamond Shoals, North Carolina, and these results suggest a northward shift in this boundary. Wind power has been highlighted as a natural resource of economic importance in coastal Virginia and North Carolina. Trends in wind data should be considered when planning future investment in wind energy and potential locations of wind farms as well as when developing emergency response plans for this coastal region.

The Effect of Drag Racing Fuel Exhaust on the Green Bean Plant, *Phaseolous vulgaris*

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Drag racing is a sport that many men and women compete in. The various types of cars used for racing release many air pollutants like soot particles, carbon dioxide, carbon monoxide, hydrocarbons, sulfur oxides, and nitrogen oxides. These pollutants affect plants in fields around roads and raceways. A high amount of any of these toxins can seriously injure plants and maybe even kill them. This study tested the effects of two types of exhaust, C12 and methanol, on the green bean plant (*Phaseolous vulgaris*). The plants were kept in plastic containers exposed to the same sunlight, same amount of water, but different types of atmospheres. The racing exhaust was released into the containers through a small hole in the balloons and results were recorded according to stem height and number of leaves. In the entire experiment, C1 2 had a lower overall stem height growth. Atmosphere and methanol were closely related in the fact that they both grew about the same amount throughout the experiment. A single ANOVA was used to analyze the data. It showed to have a p-value of 0.58 which accepts the null hypothesis.

Habitats, Predators and Prey – Survivorship of the Juvenile Blue Crab, *Callinectes sapidus*

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The Atlantic Blue Crab, *Callinectes sapidus*, population has declined over the past eighty years since 1930; it is only fifteen percent of what it used to be in 1990. Most of this decline is due to habitat loss, increased rates of predation, and overharvesting. For this experiment, wire enclosures were built, containing the main natural habitats found in the Chesapeake Bay, submerged aquatic vegetation, oyster beds, and a no habitat control. These provide juvenile blue crabs with a refuge from predators while analyzing which is most vital to juvenile blue crab survival. Juvenile blue crabs were placed in treatments with combinations of three different habitats and three different predators, adult blue crabs, adult croaker, and pufferfish; survivorship was measured. The seagrass habitat proved to be the best refuge followed by the oyster bed and then control, $p < 0.05$. Blue crabs were the most effective predator followed by pufferfish and then croaker, $p < 0.05$. The results showed that survival for juvenile blue crabs improved in the complex habitats (oyster beds and seagrass) over no habitat at all. This provides evidence that the key to blue crab population restoration lies with restoring natural habitats of the Chesapeake Bay.

Stinging Nettles and Oysters in the Chesapeake Bay – A Complex Relationship

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Over the years, the population of stinging nettles (*Chrysaora quinquecirrha*) in the Chesapeake Bay has been declining. This study looked at the population of stinging nettles throughout the summer in the lower Chesapeake Bay by looking at the medusa and polyp stages to compare them to the predictor model of temperature and salinity. Oysters provide the hard substrate needed for the polyp stage of the stinging nettles and with declining oyster population the stinging nettles have less substrate for reproduction. Models indicate temperature and salinity determine when the abundance of stinging nettles will be high. Oyster shells were placed out to serve as a substrate for nettle polyp settlement. Oyster shells were placed on bread trays in Mobjack Bay, Mathews, Virginia to see if polyps would land on the oyster substrate. Visual surveys were made to observe the medusa stage of the nettles. The data obtained were then compared to a model which predicts stinging nettle abundance based on temperature and salinity. The temperature and salinity during the months from June to August were outside the optimal sea nettle abundance prediction ranges of 26- 30° Celsius and 10-16 ppt. The results of this study were inconsistent with the model because stinging nettles were still abundant during the months when the temperature and salinity were outside the predicted ranges. The oysters and the stinging nettles are very closely related in the food web and understanding their complex relationship helps us to further understand the complex ecosystem of the Chesapeake Bay.

Water Quality of Blackwater Creek and Lynchburg College Lake

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The purpose of this descriptive study was to measure the pH, dissolved oxygen, conductivity, and water temperature from Blackwater Creek and Lynchburg College Lake in order to evaluate the overall water quality and compare how the data from both sites differs. The study was conducted by a high school student in December 2010. The water quality parameters used were pH, dissolved oxygen, conductivity, and temperature. Each parameter was measured five times over the course of one month. There was no significant difference between the pH, dissolved oxygen, and conductivity of the two sites tested, indicated by their p-values of 0.45, 0.24, 0.78 respectively, which is greater than the alpha value of 0.05. The results did indicate a significant difference between the water temperatures of the two sites, since the p-value of 0.01 was below the alpha value of 0.05. The original hypothesis, if water samples were collected at Blackwater Creek and Lynchburg College Lake, then the tests would show a significant difference between the water quality indicators of the two sites, was not supported. Although there were some significant differences visible in the data, all means excluding conductivity, which was slightly lower, were within the Virginia Department of Environmental Quality standards for healthy water quality. In conclusion, the results indicated that both sites reflected good water quality and did not significantly differ.

The Growth Rate of Juvenile Spadefish Exposed to Three Different Temperatures

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This study was conducted to determine whether or not the water temperature of a spadefish's environment has any effect on its growth; or, do warmer temperatures cause spadefish to grow faster than they would normally. Spadefish are found in the Western Atlantic Ocean, and they are popular among sports fishermen. The study was conducted using fish raised in aquaculture, also known as fish farming. The changes in spadefish growth rate in response to changes in temperature were measured. Three tanks had a water temperature of 20°C, another three had a water temperature of 25°C, and a final three had water temperature of 30°C. This was a comparative study, and there was no control. The trial ran for eight weeks. During that time, fish were measured and weighed once every two week. The spadefish in the cold water were expected to grow the least, and the spadefish in the warm water were expected to grow the most. The hypothesis, that the spadefish in warm water will grow the fastest, was supported, although extensive follow-up research is necessary before any changes can be implemented in spadefish aquaculture. The hypothesis was supported by the results, and the p value was 0.000. The fish in the warmer tanks grew the most and the fish in the colder tanks grew the least. The mortality was 0% throughout the study. The fish in the 20°C tanks had a higher FCR, which means they required more food to grow the same amount.

The Effects of Salinity on Blue Crab (*Callinectes sapidus*) Yields in Nomini Creek, a Tributary of the Potomac River

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Blue crabs are credited with being the most important fishery in the Chesapeake Bay. Their harvesting supports many businesses and individuals economically and is vital to the economy of local coastal areas. In order for the crab fishing industry to be a success, crabbers must be aware of the ideal water qualities for catching crabs. One factor that influences water quality is salinity. Salinity is defined as the amount of dissolved salt content in the water. Blue crabs, like most marine organisms, have certain salinities that are tolerable and others that are not. This experiment was conducted to determine the ideal salinity for catching blue crabs during the month of August. The salinity was used as an indicator of where was the most suitable location to harvest blue crabs. Data was collected by attempting to catch blue crabs in varying salinities and comparing the relationship between salinity and number of blue crabs harvested. The alternative hypothesis (H_a) suggests that as salinity of the water decreases the number of blue crabs harvested will also decrease. The site of this experiment was the Nomini Creek, a tributary of the Potomac River, a tributary of the Chesapeake Bay. The experiment was conducted for a two week period and produced results suggesting that salinity had an effect on the location of the blue crab population. However there are other factors, such as dissolved oxygen, that also influence the blue crab population and these factors must be taken into consideration as well.

Remote Sensing in Inner Space – Can ROV'S be Used as Marine Satellites?

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Traditional methods for sampling marine data are invasive, destroying the natural habitat and loading the water column with sediments. Remote sensing is a method for gathering data without physically coming in to contact with the object you are studying, having no negative impact on the environment. Remotely Operated Vehicles are traditionally used in commercial fields to repair pipelines and do welding work underwater, but they have great potential to be used to gather oceanographic data. To test the feasibility of using an ROV as a non invasive data collection tool, or marine satellite, an ROV was constructed, and two experiments were conducted. The first experiment found a correlation between the amount of SAV present and the number of fish seen. When there was more submerged aquatic vegetation, there was an increase in the number of bluegill (*Lepomis macrochuris*). The purpose of the second experiment was to determine if patches of varying turbidity existed in the horizontal water column. There were patches of differing turbidity in the two sites tested, however the data collected did not prove to be statistically significant. Despite not being able to reject both null hypotheses, two very different

experiments were carried out, suggesting the implications of ROVs and proving that they can gather useful data without a negative impact on the aquatic environment.

Correlation between GDP and Number of Endangered Animals

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The number of endangered animals worldwide is increasing dramatically every year. This threat to Earth's biodiversity and many intricate ecosystems is important, but not always easy to take care of. Many of the countries with large numbers of endangered animals have comparatively low gross domestic products (GDPs). It is also sometimes nearly impossible to enforce protective measures for wildlife for a variety of reasons. The study sought to answer the question, "Is there a correlation between gross domestic product and the number of endangered animal species in a country?" The question was explored by gathering relevant data, such as national GDP in 2008 and number of endangered animals, for 30 countries and comparing them in a scatter plot using linear regression, with GDP as the x (explanatory) variable and number of endangered animal species as the y (response) variable. The 30 countries were first compared as a whole, and then divided up into 3 groups of 10, grouped by size, and compared again. For all 30 countries, $r^2 = 0.2352$. For all countries except the U.S., $r^2 = 0.0394$. The small group, medium group, and large group had r^2 values of 0.0086, 0.0907, and 0.2175, respectively. None of the groups displayed any significant linear correlation, showing that there is no relationship between GDP and number of endangered animals. This information can be used to make environmental policy more effective and help direct the efforts of ecologists. Further research on factors possibly impacting endangered species count, such as population, is recommended. This study increases our understanding of how to fight animal extinction.

Nitrate Testing

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Nitrates are necessary for all forms of life. However, those same nitrates can cause significant harm, especially when they are found in elevated levels in bodies of water such as creeks. Nitrates have also been proven to cause the deaths of infants, wildlife, and other living organisms. Therefore, the presence of nitrogen that is greater than 10 mg in creeks is of great interest. Finding nitrates in creeks could help to make sure that the creeks are safer to the wildlife in the area. The objective of this study was to examine two questions: first, does the majority of the creek's water have a trace of nitrates greater than 1 ppm? And second, is the mean level of nitrates in the water significant enough to disprove the creek's safety? To examine these questions, thirty water samples were taken from a creek and tested using the persulfate oxidation (digestion) method. The results show that the mean level of nitrogen is less than 10 mg/L. All of the samples analyzed have a nitrogen presence of more than 1 microgram. This discovery suggests that the creek is safe because of the low level of nitrogen. Future studies that could be done include testing for more contaminants in the creek or breaking down the total nitrogen test in order to test for nitrates, nitrites, or ammonia. However, studying this path further would not likely be useful. The results only apply to the creek; it is not a representation of the whole area.

The Impact of Golf Courses on Water Quality – Up to Par?

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Public perception is that golf courses are a major pollutant of water quality and ecosystems. However, recent reforms have led to best management practices for golf courses, allowing for better treatment of the environment. In recent years, golf courses have been scrutinized for fertilizer use and resulting runoff pollution in water systems. A local golf course was tested to determine the impact of fertilizers on bodies of water on and around the course. Two ponds adjacent to the Piankatank River were tested for nutrient pollution. The ponds were tested for nitrate and phosphate levels, the two most common nutrients in fertilizers and runoff pollution. Results were compared to a published Water Quality Index (WQI) to determine the healthiness of the pond water. The

results indicate that the water quality in the ponds was very high during the study period. This study shows that golf course management can lead both high water quality and a “green” course.

The Effect of Roundup as an Aquatic Pollutant on the Population and Development of *Artemia salina*

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The purpose of this study was to investigate the effect of the herbicide Roundup® as an aquatic pollutant on the population and development of *Artemia salina*, commonly known as brine shrimp. A student in Virginia conducted this study between October and December 2011. Three tanks contained differing levels of Roundup® pollution: a control with no pollution, a 4.2 mL/L concentration of Roundup®, and an 8.4 mL/L concentration of Roundup®. Twelve 1 mL samples were taken daily from each group, and the development and population abundance was noted. The results revealed that brine shrimp did not develop past the nauplius stage. A single factor ANOVA comparing the populations of brine shrimp calculated a value of 0.45 (with the alpha level set at 0.05). The high p-value did not support the hypothesis that Roundup®, as an aquatic pollutant, would negatively affect the population and development of brine shrimp. In conclusion, there were too few data points to see the effect of Roundup® on the development of brine shrimp and there was no significant difference in the brine shrimp populations exposed to differing levels of Roundup®.

The Levels of Iron and Conductivity Found in Well, Dasani™, and Free-Flowing Water

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The purpose of this experiment was to compare the amount of iron present and the level of conductivity of well, Dasani™, fountain, and free flowing creek water, and to compare those levels to the published secondary standards. In December 2010, in a high school analytical lab, a student tested the amounts of iron present and the level of conductivity of several samples of water. To test the amount of iron present, the Hach FerroMo method 8365 was executed. A Hach sensION meter was used to test the conductivity of the water samples. Two ANOVA tests were performed; one was to determine if there was a statistical difference among the amounts of iron present, and the other on the conductivity data. The p-value for the amount of iron present was 2.302E-22. The p-value for the level of conductivity was 3.45E-14. Post-hoc Tukey tests showed that statistically significant differences existed in the iron data among all the groups except for the fountain and well water, and among all the groups in the conductivity data. The research hypothesis that the samples of creek water would have different iron and conductivity levels when compared to the other samples was supported. In conclusion, the source of water does have an effect on the amount of iron present and the level of conductivity.

Is it Hot in Here?

Eleni Riris

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The purpose of this experiment was to study the effects of the amount of carbon dioxide on heat retention. The hypothesis was that if the carbon dioxide level is increased, the air will retain more heat. To test this, the temperature of three empty boxes was taken. Then, carbon dioxide was pumped into the three boxes. Each box had a varying amount of carbon dioxide, one had none, one had a small amount, and the last had a large amount. Each box was placed under a heat lamp for one hour. The temperature was measured before and after the heat lamp exposure and the change in temperature was recorded. The box with a large amount of carbon dioxide had a difference in temperature (after it was heated) of 4.5 degrees Fahrenheit, compared to the difference in temperature of the box with a small amount of carbon dioxide, of 4.6 degrees Fahrenheit. The box with no carbon dioxide had a mean temperature of 3.6 degrees Fahrenheit. The hypothesis was not accepted.

Weather Water River Water

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The purpose of this experiment was to determine the effects of changing weather on water quality in Four Mile Run, Arlington, Virginia. Interest in water quality led to this experiment. The hypothesis was that the change in weather from fall to winter would increase the turbidity and dissolved Oxygen (DO) in the stream while the nitrate and pH levels decrease. The turbidity will increase as leaves and sediment accumulates in the water, while falling temperatures would cause more gas to dissolve, thus increasing DO levels. Tannic acids in decaying leaves will make the pH level more acidic. The nitrate level will be highest in the early weeks of fall as yard fertilizer runs into the stream. Water samples were taken from Four Mile Run over eight weeks in late fall to early winter. A LaMotte testing kit was used to test the samples for nitrate, turbidity, pH, and DO levels. The results were as expected. The most extreme data was in weeks five and six after heavy rainfall in weeks two and three. A very low DO level throughout the experiment indicated an unhealthy ecosystem. The hypothesis was accepted because the data showed that as leaves fell, the turbidity increased. Consequently the pH became more acidic due to the amount of tannic acid in the water. The DO level was highest on the coldest days. The nitrate level also followed the expected trend but with a sudden drop in week six. High precipitation in weeks two and three and other unknowns caused spikes in the data.

The Effects of Sewage Effluent on the Growth and Survival of *Crassostrea virginica* in Carter's Creek

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Sewage plant discharge into the water causes a serious problem for water quality because of eutrophication and algal blooms. Carter's Creek in Irvington Virginia has several water treatment plants that flow directly into it. Samples of *Crassostrea virginica* triploid spat were placed in close proximity to two of these pipes. The first pipe was operated by the Tides Inn, the second pipe came off of the Tides Lodge subdivision; a third group was placed in a section of the creek without any direct exposure to sewage treated water. The growth rate was measured at all three sites as a comparison to see if the excess nutrients in the water stimulated faster growth in the oysters. The growth rate of the *Crassostrea virginica* will demonstrate the effect that eutrophication can have on a key stone species in the Chesapeake Bay. The results proved the null hypothesis. The oysters grew in varying water quality. The p-value from the two-tailed t-test proved to be insignificant.

GENETICS and CELLULAR BIOLOGY

FIRST PLACE

The Effect of Cholinergic Stimulation on the Assembly of the D2 Receptor Complex in the Striatum

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Parkinson's disease (PD) is a debilitating neurological disorder that progressively impairs the motor and cognitive abilities of approximately 1 million people in the United States alone. The motor symptoms of PD – bradykinesia, rigidity and tremor - are primarily attributed to an underlying degeneration of dopaminergic nigrostriatal neurons and the ensuing dopamine depletion in the striatum. The current pharmacological treatments, therefore, focus on replacement of endogenous dopamine using its precursor L-dopa or mimicking its action by dopamine agonists. These 'dopamine replacement' strategies are highly effective in controlling the motor deficits of the early phase of PD. The current therapies, however, do not alter the PD progression from motor to cognitive and affective disorder. The recent identification of oligomeric machinery in striatal membrane required for the D2R signaling provides a new avenue for development of PD treatments. The purpose of this study was to determine whether the MR in the striatum interacts with the D2R signaling machinery. Plasma membranes were prepared from striatal neurons and the membranes were stimulated concurrently with DA and Ach or DA alone. The membrane proteins were separated according to their molecular size using SDS-PAGE, transferred to Immobilon membrane, and probed for phosphorylation of PKAc using Western blot procedures. The results indicated that concurrent stimulation of MRs and D2Rs influenced the first level of dephosphorylation, the third level of dephosphorylation, and the half-time of the third level of dephosphorylation of the catalytic subunit of PKA. A t-test performed on the data indicated that the values for the three parameters were significantly different from that detected upon D2R activation alone ($t=5.409 > 2.101$; $t=2.403 > 2.101$; and $t=3.804 > 2.101$ respectively at $df=18$; $p < 0.05$). These data supported the research hypothesis that different receptors are interconnected in a large signaling network in the striatal neurons. Future studies will determine how this network could be exploited to develop new treatments for PD.

SECOND PLACE

***In Silico* Evaluation of the Tyrosine Kinase Domain of the Met Proto-Oncogene in Hepatocellular Carcinoma**

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Mesenchymal-epithelial transition factor (MET) is a proto-oncogene that encodes a transmembrane tyrosine kinase of 190 kDa (p190MET) also known as hepatocyte growth factor receptor (HGFR) or c-Met. c-Met receptor gets activated by the binding of HGF. The binding of HGF/SF to c-Met triggers autophosphorylation of the cytoplasmic domain of c-Met. It stimulates mitogenesis, motogenesis, and morphogenesis in a wide range of cellular targets including, epithelial and endothelial cells, hematopoietic cells, neurons, melanocytes, and hepatocytes. The elevated expression of the HGF/c-Met system plays a role in tumorigenesis. Tyrosine kinase domain mediates c-Met biological activity and is responsible for cancer proliferation. In our study we have proved through *in silico* docking studies that c-Met receptor tyrosine kinase is a therapeutic target in hepatocellular carcinoma. The tyrosine kinase domain region of c-Met protein has been modeled and validated using bioinformatics software. Docking studies with cancer drugs such as Temozolomide, and Sorafenib were carried out. The comparative analysis of these drugs shows that Temozolomide has splendid ability to dock the target protein c-MET signaling.

THIRD PLACE

The Effect of Monosodium Glutamate on the Growth of THP-1 Human Monocytes

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Monocytes are one of the phagocytes of the innate immune system. They are found in human blood and differentiate into macrophages when they enter tissues. These macrophages ingest and destroy microbes through the process of phagocytosis. Monosodium glutamate (MSG) is a salt that can enhance the flavors of some foods, but has been reported to cause nausea and other ailments. The purpose of this investigation was to test the effect of monosodium glutamate on the growth of THP-1 human monocytes. The research hypothesis was that the greatest concentration of MSG would result in the lowest population of cells, since previous studies have shown that MSG is a neurotoxin and is dangerous to some types of cells. The independent variable in this study was the concentration of MSG to which the cells were exposed. The dependent variable was the number of live cells per milliliter of medium. The cells were grown in solutions of RPMI-1640 medium and MSG, which were placed in two 12-well plates. Six trials were conducted for each level (0, 1, 10, or 100 μM MSG). The cells were then counted; samples from each well were separately mixed with a solution containing Trypan Blue, a dye that is used to count dead cells. The results of the study showed that the control group (0 μM) had the highest concentration of cells (2.17×10^6 cells/mL). The group with the 10 μM concentration had the second highest number of cells, followed by the group with the 100 μM concentration. A t-test was conducted in order to test the significance of the results, and the null hypothesis was accepted for most of the values. Therefore, monosodium glutamate does not cause any significant effects on the growth of THP-1 human monocytes.

HONORABLE MENTION

Homozygous Achondroplasia in the Netherland Dwarf Rabbit

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The purpose of this project was to determine which organs were most affected by *homozygous achondroplasia* (double dwarf gene) in Netherland Dwarf rabbits. This experiment can help breeders of dwarf rabbits understand why the *homozygous* dwarfs die in infancy, as well as other undesirable traits caused by *achondroplasia*. The materials for the study were four pairs of *heterozygous* (single dwarf gene) Netherland Dwarf rabbits and their offspring. At the time of death, three *homozygous* kits and one stillborn were preserved in formaldehyde solution. *Post mortem* examination and *necropsy* were performed, including x-rays and tissue samples. Tissue samples of the liver, intestines and spinal cord were submitted to a commercial laboratory for *histopathology* (cellular analysis). Visual observations were also recorded about the limbs, stomach, cecum, trachea, lungs, kidneys, and diaphragm. All data and observations were compared to determine a cause of death for each kit. Liver failure showed the highest incidence at a 33.33% average and intestinal failure was second at an 8.33% average. The average for cause of death as undetermined was 58.33%. The *necropsy* was informative though there was not enough data to determine a specific cause of death in all kits. There are not many published studies on achondroplasia in the rabbit, so this contributes additional information from actual *post-mortem* examination and laboratory results. No vertebrate animals were euthanized to conduct this research. All subjects died of natural causes due to genetic condition being investigated.

HONORABLE MENTION

The Effect of Different Percentages of Agarose Concentration in a Gel on the Separation of Similar Sized Fragments of DNA during Gel Electrophoresis

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Genetic engineering enables the manipulation of genes including the transfer of specific sequences from one gene to the next. In these experiments, it is essential to identify the pieces of DNA based on size and shape. Agarose gel electrophoresis is a universal method used for this purpose. When pieces of DNA of similar sizes are to be separated, it is necessary to adjust the percentage of agarose so that similar sized DNA fragments can be clearly separated. Percentages from 0.6% (0.6 g per 100 mL of buffer) to 1.2% were used. In this project, the experimenter hypothesized that if a higher percentage of agarose was used in the gel, then it would enhance the separation of DNA bands, particularly of smaller sizes. Additionally, the reverse of this was also tested, which is where a lower percentage of agarose would be beneficial in the separation of heavier DNA bands. To complete this experiment, the experimenter, first, had to properly clean the experimenting area and follow all necessary safety precautions, such as, wearing safety gloves, goggles, covering shoes, and keeping the working environment clean and dry. Then, the experimenter prepared the gels by mixing in the designated amount of agarose concentration, followed by creating the loading wells for the DNA and staining the DNA with Ethidium Bromide. After running the gels for the appropriate time, a Polaroid picture was taken very quickly while it was under the Ultra-Violet Light. This procedure was repeated five times for each independent variable (0.6%, 0.8%, 1%, and 1.2%) agarose concentration. Results that were obtained from this experiment confirmed the experimenter's hypothesis. It became evident that the gels with the highest amount of agarose concentration separated the smaller sized DNA more efficiently, while the gels with lower concentrations of agarose separated the heavier bands of DNA more efficiently.

The Effect of Sodium Concentrations on Elodea Cells

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The experiment conducted tested to see the effect of sodium concentrations on Elodea plant cells. The purpose of the experiment was to see if there was an effect when sodium concentrations were added to plant cells that are not able to survive in saltwater condition. This experiment highlighted how salt affects all living things on Earth. If sodium concentrations are added to Elodea cells then the Elodea cells will decrease a significant amount in size. The independent variable in this experiment was the amount of salt in each salt concentration that was placed on the Elodea plants. The salt concentrations in the experiment were: one molar which was 58.45 grams of salt and 1000 milliliters of pure water, 0.75 molar which was 750 grams of salt water with 250 milliliters of pure water, 0.50 molar which was 500 grams of salt water with 500 milliliters of pure water, 0.25 molar which was 250 grams of salt water and 750 milliliters of pure water. The dependent variable was the degree of change that occurred after the salt concentration had been applied on the Elodea plants. The dependent variable was measured by the degree of change by using a number scale from zero to ten; zero being no change and ten being a large visible change. The constants in the experiment were the Elodea plants, the type of salt, and the view on the microscope, which was on the highest lens objective. The control was the water that was being used on the Elodea plants. The results from the effects that water had on the Elodea plants cells acted as a foundation for the rest of the experiment. The p value at the end of the experiment was 0.000, meaning there was a significant difference numerically between each of the means of each sodium concentrations, which ranged from one molar to 0.25 molar. In conclusion the results were conclusive and the hypothesis stating that the Elodea plant cells would be affected by the addition of sodium concentrations was accepted. This experiment was important to study the role that salt plays on all forms of life on Earth.

Comparison of Genes and Chromosomal Regions Linked to Nicotine Dependence in Genome-Wide and Gene-Specific Studies

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The purpose of this experiment was to compare findings from gene specific analysis and genome-wide linkage on nicotine dependence (ND) to determine if the findings are consistent with one another. Chromosomal location data was collected from both gene specific analysis and genome-wide linkage. The gene specific analysis studies identified genes thought to be linked to ND and their locations. Genome-wide linkage studies identify chromosomal regions/patterns common to people with high rates of ND. Fourteen genes, 19.44%, were found to be correlated to ND in both gene specific analysis and genome-wide linkage. The fourteen genes were FMO1, FMO3, FMO4, CHRNA9 GABRA4, HTR1A, DRD1, TAS2R38, TH, TPH1, BDNF, HTR2A, ADRBK2, and CHRNA4. This experiment suggests that these fourteen genes should be studied more thoroughly than the genes that were not found to be correlated with ND in both gene specific analysis and genome-wide linkage.

The Gene of the Crime

Diana Iraheta

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This experiment was done because of an interest in fingerprints. It helped understand the purpose of fingerprint and to see if there are chances that fingerprint are inherited. The goal of the project was to find the similarity of fingerprints between related and non-related people. Different fingerprint were compare to one original set, to see which had the highest percent of patterns that matched, the ones that were related or the ones that were not. The first fingerprint matched 84% of the time, second 46%, third 53%, fourth 69% and the fifth a 92%. The last two were related to the original set and the first three were not. This project's hypothesis was rejected because the first set of fingerprint had a higher matching percentage than one of the related sets. The area of this experiment is genetics. In order to confirm the result this project should be done again with more volunteers.

Observing the Effects of Ampakine CX1837 on the Gene Expression Levels of *Bdnf* in *Rail* Haploinsufficient and Wild Type Mouse Models

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Smith Magenis Syndrome (SMS) is a genetic disorder that occurs when a gene called *Rail* is mutated or deleted. It is rare and under diagnosed. Major symptoms include mild to moderate mental retardation, obesity, cranial and skeletal abnormalities, and speech and developmental delay. Recent studies have indicated that an experimental drug called Ampakine is effective in increasing levels of a gene called *Bdnf*, which is associated with obesity and reduced cognitive ability. The purpose of this experiment is to see whether an Ampakine (CX 1837) can be used to increase *Bdnf* levels in *Rail* haploinsufficient (denoted as *Rail* +/-) mice by extracting RNA from mouse brains and conducting real-time PCR to measure gene expression levels of *Bdnf*. A *Rail*+/- mouse that was not given any treatment will be used as a control. Two other *Rail*+/- mice were used that were given a vehicle (placebo) and the Ampakine drug. Two wild type mice that were given the same treatments were also be used. The results revealed that the Ampakine was ineffective, due to the increased *Bdnf* levels in the *Rail*+/- vehicle mouse. Since this particular mouse was given a placebo, it was not expected that there would be an increase in *Bdnf* levels. Studies indicate that increased *Bdnf* levels may be a stress response. Four t-tests were performed using the *Rail*+/- control mouse as the control, and the resulting p-values were all essentially zero. Exploring different therapy techniques will allow scientists to improve the quality of life for these patients.

Are Fingerprint Patterns Inherited?

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The purpose of this experiment was to take fingerprints of related test subjects of two families, and see if their fingerprints had any similarities or patterns. Basically, the student used a black inkpad, hand lens, and sticky notes to take the fingerprints. The student pressed the left index finger and thumb into the ink pad and rolled them onto the sticky notes. Then the student used the magnifying glass to make out any similarities in the fingerprints of the two families. Test subjects A2 (oldest generation male) and A3 (youngest generation female) in family "A" had the same fingerprint patterns but the sizes and location on the fingers and thumb differed. Test subjects B1 (oldest generation male) and B4 (youngest generation female) in family "B" again had the same fingerprint patterns, but the sizes and location on the fingers or thumb differed. The student therefore concluded that the fingerprint patterns are inherited because of the results with test subjects B1, B4, A2, and A3. Also, that possibly the fingerprint patterns could be dominant and recessive genes; depending on the family. In family A there were mostly loops, and in family B there were mostly whorls. Finally, the similarities could skip every generation to the opposite sex as shown above. But to come to this conclusion, the student would need to test the oldest generation female and youngest generation male from more families and find the same similarities as test subjects A2, A3, B1, and B4.

MATHEMATICS

FIRST PLACE

The Effect of Different Types of Cancer on the Fractal Dimension of Each Type of Cancer

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Cancer is a harmful disease in which cells from the body expand, split uncontrollably, and infect areas of the body. There are many different types of cancer which all have unique characteristics. Fractal geometry is one way that scientists are working on to identify cancer. Included in this is the use of fractal dimensions. Fractal dimensions are a measurement of the irregularity and complexity of an object. The purpose of this project was to determine if different types of tissue, breast cancerous and normal tissue, prostate cancerous and normal tissue, and skin cancerous and normal tissue, had different fractal dimensions using the box-counting method. Twenty pictures were collected of each type of tissue. Each picture was tested for its fractal dimension. The results show that the breast cancerous tissue had the largest fractal dimension with a mean fractal dimension of 1.55. This supported the first research hypothesis that if cancerous tissue from breast, prostate, and skin areas are examined, then the breast cancerous tissue will have the largest fractal dimension. The results also indicate that the cancerous tissues normally have a larger fractal dimension than the normal tissues. This supports the second research hypothesis that if the fractal dimensions of the normal tissues and the cancerous tissues were compared, then the cancerous tissues would have larger fractal dimensions. Based on the fractal dimensions determined in this research, there is a slight connection between cancerous tissues and their fractal dimensions. Before it can be concluded that fractal dimensions are a reliable way to detect cancer, more types of tissue will need to be tested.

SECOND PLACE

The Effect of Move Sequence on the Timing of Rubik's Cube

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Rubik's cube, a toy and a puzzle from the 1980s, was founded and named after Erno Rubik. The goal of solving the Rubik's cube was to find the sequence of the moves and match the same color. This sequence of the moves was called an algorithm. An algorithm was a specific set of instructions for solving a problem, usually with the requirement that has been already set from the beginning of the problem. Knowing the algorithm was very effective in the solving the Rubik's cube because the algorithm reduced the time consuming in the solving the Rubik's cube. The purpose of this project was to determine how three sets of move sequences affected developing an algorithm for the Rubik's cube. Three different move sequences were used to solve the Rubik's cube and the timing was recorded for solving the cube. The results indicated that move sequence 2 was the most effective move sequence with a mean second of 224.67 and move sequence 4 was the least effective move sequence with a mean second of 288.5. A t-test performed on the data indicated a mostly significant difference between the means of the groups ($t = 3.23 > 2.074$; $2.52 > 2.074$; $9.23 > 2.074$; $8.41 > 2.074$; $2.27 > 2.074$ at $\alpha = 0.05$ and $df = 22$). The data supported the research hypothesis that each of the three move sequences accomplished a specific function in solving the Rubik's cube. However, the data did not support how to combine each move sequences and develop an algorithm. Based on the role of algorithm shown in this experiment, the experiment could be improved by focusing more on developing and planning an algorithm. The more research conducted on planning an algorithm is needed for more effective result on combining different move sequence in the Rubik's cube.

MEDICINE and HEALTH A

FIRST PLACE

Competitive Exclusion and Intestinal Bacteria: A Model for a Possible Treatment for *Clostridium difficile*

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The anaerobic rod *Clostridium difficile* is part of a community of bacterial flora in the intestines. When this balance is disturbed by antibiotics, opportunistically pathogenic bacteria such as *C. difficile* have the ability quickly grow, multiply, and infect the host, leading from a mutualistic to a parasitic relationship. Treatments for *C. difficile* involve administration of probiotics, or other “healthy” bacteria. The experiment conducted used the concept of probiotics to find a new treatment by using the less pathogenic *C. sporogenes* as a model for *C. difficile*. *Escherichia coli*, *Enterobacter aerogenes*, *Citrobacter freundii*, *Enterobacter cloacae*, and *Pseudomonas fluorescens*—all of which are facultatively anaerobic bacteria found in the intestines—were set in competition test tube experiments against *C. sporogenes*. In order to account for different starting population counts, the bacteria were diluted in media and also were placed in nutrient agar plates to compare the colony forming units to the results of the test tube experiments. It was hypothesized that *E. coli* would successfully outcompete *C. sporogenes*. Bacterial population counts (after 24 hours of incubation) were taken at the top, middle, and bottom of the test tubes via gram staining and microscopy in collaboration with Motic software. Statistical analysis showed that the bacteria that outcompeted *C. sporogenes* were *E. aerogenes*, *E. cloacae*, and *C. freundii*. These bacteria show the potential to be possible treatments for future *C. difficile* infections.

SECOND PLACE

Assessing the Role of Alcohol Use to Address Gender Differences in Adolescent Depression

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Depression affects nearly 19 million Americans each year, and is the most globally prevalent psychiatric disorder. The average age of depression onset, now at 14.5 years, has decreased dramatically over the past three decades. Since early-onset depression recurs in later life, it is important to first understand adolescent depression for the effective prevention and treatment of general depression. A phenomenon known as the “gender shift,” the doubling of female susceptibility to depression as compared to males, occurs during ages 13-15 and continues through adulthood. This cross-sectional study analyzed data from a sample of 2202 adolescent twins to assess the effects of alcohol-related risk factors on depression by gender. Alcohol problems, age, cigarette use, and peer alcohol use were determined to be the major risk factors for depressive symptoms. In the male model, increased age decreased the probability of depression by 26%. In females, peer alcohol use indicated a 20% higher probability of depression. The results suggest that the prevention and treatment of adolescent depression should be targeted by gender. Recommendations for future study include replicating model results in longitudinal studies and utilizing twin data to perform research into genetic associations.

THIRD PLACE

The Relationship between the Concentration of PSA in Blood and the Pathological Stage of Primary Prostate Cancer Tumors

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One of the most common methods used in predetermining the severity of prostate cancer is the prostate-specific antigen test. While this method is often used in conjunction with other clinical tests, there is presently much debate over its validity and accuracy. The purpose of this study was to determine if data obtained from the PSA blood test alone is an accurate indicator of the severity of prostate cancer. The concentration of PSA in patients' blood was determined by means of a PSA blood test. The severity of the patients' cancer was determined by means of pathological surgery and analysis of the prostate. Data from male hospital patients was collected concerning these two variables. The concentration of the patients' PSA and the pathological cancer staging received afterwards was analyzed, and their relationship was tested by means of a Pearson Product Moment test. The researcher concluded that the PSA blood test is not an accurate representation of the severity of prostate cancer.

HONORABLE MENTION

The Effect of Different Fruit Extracts on Prostate Cancer Cells

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Prostate cancer currently is the most invasive cancer in men which associates with inflammation due to oxidative stress and reactive oxygen species (ROS) generation. Fruits are enriched with high amounts of polyphenols that exert anticancer effects due to its antioxidant properties. The anticancer properties of many fruits have been studied separately; therefore the purpose of this experiment was to compare the effectiveness of different fruit extracts on prostate cancer. Several studies reported that pomegranate has strong antioxidant activity and health benefits; therefore it was hypothesized that if acai berry, cranberry, and pomegranate extracts are applied on PC-3 prostate cancer cells, then pomegranate will induce the most cell death. Cell death was determined by Trypan blue staining after 24, 48, and 72 hours of treatment with five different concentrations of acai berry, cranberry, and pomegranate extracts with the control of dimethylsulfoxide treatment. ROS levels were measured after 2',7'-dichlorodihydrofluorescein diacetate staining using a spectofluorometer. The same experiments were conducted on H9C2 cells, rat myoblasts, to determine the effect of fruit extracts on normal cells. All fruit extracts displayed significant PC-3 cell death with increasing concentrations; however pomegranate showed significant H9C2 cell death at slightly higher concentrations, which suggests that this extract has disadvantages towards healthy cells. All fruit extracts showed decreasing trends in ROS production in both cell lines. In conclusion, this study revealed that acai berry, cranberry, and pomegranate extracts efficiently kill PC-3 cells, however acai berry and cranberry are the safest extracts with chemotherapeutic effects. This finding provides new insights on possible chemopreventive activity of fruit extracts on cancer cells.

HONORABLE MENTION

The Effect of Antioxidants on the Lifespan of *D. melanogaster*

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The purpose of this experiment was to determine if various antioxidants influenced the lifespan of *D. melanogaster* through free radical quenching. *D. melanogaster* were provided food enriched with three antioxidant extracts: Resveratrol, *Olea europaea*, and *Camellia sinensis*. The control of the experiment was basic *Drosophila* medium without antioxidant content. Lifespan was measured in terms of days and experimentation occurred over the course of one month. A research hypothesis predicted that if *D. melanogaster* was exposed to Resveratrol, then an

increase in lifespan would be observed. Compiled data indicated that flies fed food with Resveratrol lived significantly longer than those who were provided *Drosophila* medium without antioxidant enrichment. Moreover, flies exposed to *Olea europaea* lived longer than those to *Camellia sinensis*, although both fared better than the control. Flies fed food with Resveratrol also lived longer than those given *Olea europaea*. Thus, the research hypothesis was supported, as Resveratrol extended the lifespan of *D. melanogaster* the most. The acquired data was applied to a t-test to determine statistical significance. All but one t-test indicated the data was indeed statistically significant, as a t-test conducted for Resveratrol versus *Olea europaea* produced a value less than the critical “t”. The information achieved could ultimately be used to encourage antioxidant consumption in the average person to prevent against disease caused by free radicals. Similar studies could concern examining the specific cells of the specimens from the control group for free radical damage and compare them to the cells and damage of the antioxidant specimens.

HONORABLE MENTION

Severity of Obstructive Sleep Apnea and Upper Airway Morphology

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The purpose of the following research was to determine a correlation between the anatomical morphology of the soft palate length and width, narrowest palatal diameter, pharyngeal wall to tongue diameter, and the severity of obstructive sleep apnea. It was hypothesized that if patients have an increased soft palatal dimensions, decreased retro-palatal diameter, and decreased pharyngeal diameter than their apnea-hypopnea index (AHI) number will also be elevated. The null hypothesis was that there is no correlation between the sleep apnea severity and the upper airway anatomy. This can be used to diagnose patients by viewing magnetic resonance images (MRI), instead to sleep test. The hypothesis was tested by collecting twenty-five patients with magnetic resonance images, and polysomnography sleep test, to measure the soft palate length (SPL), soft palate width (SPW), narrowest palatal diameter (NRPD), and the pharyngeal wall to tongue diameter (PTD). The Pearson two tailed test with a 0.05 alpha level, and linear regression was used to analyze the data. The research resulted in a Pearson correlation ($r=0.0867$), is less than the critical value of r (0.396) in the soft palate length, accepting the null hypothesis. It also resulted in a correlation ($r=0.0790$) in the pharyngeal wall to tongue diameter, which less than the critical value of r , also accepting the null hypothesis. No correlation was found in the soft palatal width ($r= 0.2463$), where the r value was within the critical r values. The narrowest palatal diameter ($r= -0.3974$), in which the r value was beyond the negative critical r value by 0.001, thus accepting the alternate hypothesis. Due to the weak correlation and further testing needed, it can be concluded that MRI measurements in sleep apnea patients can be used to establish appropriate treatment for sleep apnea patients, but should not be used for diagnosis.

The Effects of High Heel Height on Weight Distribution

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The change in distribution of weight between the heel and ball of the foot was measured for shoes with different heel heights: flats, and shoes with one-inch, two-inch, three-inch, and four-inch heels. The control was bare feet so weight was distributed without any interference. Weight on the balls and heels of feet were measured with a subject standing on Terrion® scales in each high heel height; weights were measured thirty-two times for each heel height and the control. The results showed that heel height is inversely related to the weight on the heel of the foot. In the control and flat shoes more weight was applied to the heels of feet than the balls. A two-factor ANOVA showed that there is a significant difference in the weight distribution on foot part ($F(1,1) = 3174.6$, $p = <0.0001$) and among the heel height ($F(5,5) = 9.94$, $p = 0.0129$) The interaction of foot part and the heel height on weight distribution was also significant ($F(5,5) = 10652.5$, $p = <0.0001$). The null hypothesis, all high heel heights have the same weight distribution on feet, was rejected at the 95% confidence level. All heel heights except the flats were significantly different from the control group. The biggest difference in weight distribution occurred when the

weight on the ball and the heel of the foot were equal instead of having the majority of the weight on the heel of the foot. When that shift happens, a change in posture and the center of balance begins. Other effects of the shift in weight are discussed.

The Effect of Running with or without Shoes on Different Running Surfaces over Different Distances on Running Times

Gino Basso and Alexander Kohlroser

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In hopes of aiding current scientific research on improving running times, this experiment sought to analyze the increasing trend of running barefoot to improve running times. More specifically, this experiment studied how barefoot running versus shoe running, different running surfaces, and various race distances affect running times. It required a hundred volunteers to each run with and without running shoes on three different surfaces (asphalt, grass, and synthetic rubber) over two separate distances (twenty meters and fifty meters). Their results were collected and statistically analyzed. The research hypothesis speculated that running with shoes on would be faster than running without shoes, and that the track would be the fastest surface. This experiment found that the average running time for the twenty meters on all running surfaces was 3.56 seconds for shoe-wearing runners and 3.68 seconds for barefoot runners. The average running time for the fifty meter on all surfaces for shoe-wearing runners was 6.5 seconds and 6.65 seconds for barefoot runners. Although these results appear to support the research hypothesis, an analysis of variance test on the different types of experimental trials showed almost all of the results were statistically insignificant. Therefore, the research hypothesis was rejected. Despite the statistical insignificance of the results, improvements such as longer race distances and better measurement tools could yield more accurate and statistically significant results. Additionally, further studies could focus on the effects on running times due to experimental trials with just one individual versus experimental trials with multiple individuals.

Comparing the Bacteriology of Bile from Gallbladders with Dysmotility and Gallbladders with Gallstones

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This research was conducted in order to determine if a correlation existed between the type of diagnosed gallbladder affliction (stones or no stones) and the type of bacteria found in the bile samples (gram positive or gram negative). It was hypothesized that there would be a difference in amounts of gram positive and gram negative bacteria between the two types of samples. The null hypothesis was that there would be no difference in gram stain results of bacteria between the two types of gallbladder diseases. Using 56 samples (13 without stones, 15 with stones, and a duplicate made of each), it was found through gram staining that, for samples with stones, there were 6 bacteria that were gram positive, 10 that were gram negative, and 15 plates that allowed no growth. For samples without stones, 12 instances of bacteria were gram positive, 12 instances were gram negative and 5 plates allowed no growth or were contaminated. Two tailed Fisher statistical tests found the P values between the gram positive/negative data bacteria between the two types of gallbladder bile samples to be 0.5255 and the growth/no growth of bacteria data between the two sample types to be 0.0538. Both of these numbers were higher than the statistically significant mark of 0.05, and so the null hypothesis that there would be no significant difference between the gram stain results of bacteria in the two types of gallbladder bile samples was supported, and the alternate hypothesis that there would be a significant difference between them was rejected.

The Effect of Food Preparation on Vitamin C

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The purpose of the experiment was to investigate the effect of various methods of food preparation on vitamin C in red bell peppers. Vitamin C is essential in maintaining one's health and it is important to know how best to conserve it in food. Red bell peppers were used in the experiment because they are particularly abundant in vitamin C. The independent variable levels were frozen, microwaved, boiled, and raw (the control) peppers. Titration with iodine and starch was used to determine the amount of vitamin C in each. The hypothesis was that if the pepper is boiled, it will have the least amount of vitamin C. The raw pepper had the highest vitamin C content, as predicted. The frozen-and-then-thawed pepper had the second highest amount of vitamin C. The microwaved and boiled peppers had the lowest amount of vitamin C remaining after treatment; however, there was no statistically significant difference between the two. In short, cooking or otherwise preparing peppers significantly decreases their vitamin C content.

Basal Cell Carcinoma: A Retrospective Records Review

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The purpose of this retrospective records review was to find which method of treating basal cell carcinoma is more effective: electrodesiccation and curettage or surgical excision. Basal cell carcinoma is a common form of skin cancer. Electrodesiccation and curettage involves using a curette to scoop out the cancerous cells and a laser to burn off any leftover cells. Surgical excision involves going in with a scalpel to remove the cancerous legion. It was hypothesized that patients treated with surgical excision would have a lower recurrence rate than those treated with electrodesiccation and curettage. The study was conducted by examining medical records in a dermatology office. Charts for patients treated for basal cell carcinoma during the years 2003 and 2004 were pulled and studied. Of the 688 patients treated for the cancer during that time period, 455 were excluded from the study, 200 were treated with electrodesiccation and curettage, and 35 were treated with surgical excision. Six point one percent of the patients treated with surgical excision saw the cancer recur, while six point five percent of the patients treated with electrodesiccation and curettage saw the cancer return. While the hypothesis was supported, the difference in the recurrence rates was very small. If further research were conducted, perhaps more patients could be added to the study, or more treatment methods could be examined.

The Effect of Acidity in Kids' Beverages on Teeth as Portrayed by Calcium Pills

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The experiment's purpose was to determine the effect of the acidity in flavored beverages on teeth, as portrayed by calcium vitamin pills. The model used to represent a tooth in this study was oyster shell calcium pills because they are made of calcium carbonate, a material close to what is in real teeth. The hypothesis was that of all the flavored beverages tested – bottled water, Orange Juice, Coca-Cola, Sprite, Vitamin Water Zero (lemonade flavor), and Gatorade (lemon-lime flavor) – Gatorade would erode the calcium pills the most because the latest research, published in Academy of General Dentistry (AGD) journal *General Dentistry*, reports that drinking any type of soft drink hurts teeth due to the citric acid and/or phosphoric acid in the beverages. To test the hypothesis, this procedure was followed: first, each calcium pill was placed in a weight boat and weighed (the boat was zeroed out, to find the exact pill weight) Next, 1 mL (20 drops) of the respective beverages was dropped on their pills in the weight boats. This was repeated 59 times. After removing the dried solute from around and on the pills, the calcium pills were then re-weighed, to determine the difference between their initial and final mass. Data was recorded after each weighing, to see how the beverages had eroded the calcium pills. The Independent Variable (I.V.) bottled water had the greatest effect on the pills, and the I.V. Vitamin Water Zero (lemonade flavor) had the second greatest. The results did not support the hypothesis. The experimental error was the calcium pills were water soluble. Both I.V.s of bottled water and Vitamin Water Zero (lemonade flavor) had greater impacts because they contain large

concentrations of water. In the future, utilizing less water-soluble forms of calcium may yield more accurate results by which to judge the acidity effect on teeth.

The Effect of Maternal Age and Length of Gestation Period on Number of Fetal Deaths **Sierra Kiser**

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This study was conducted with the purpose of determining whether age of mothers affected the length of gestational periods among infants that died perinatally. The null hypothesis tested was that there is no relationship between maternal age and gestation periods among infants that died perinatally. A chi-square test of the overall data yielded a p-value ($X^2(8) = 437.4$, $p < 0.05$) which suggested that perinatal death rates were not distributed the same between the gestational periods for mothers in different age groups. However, there was a relationship found between gestation period and maternal age among infants who died perinatally. Because of this significance, three follow-up Chi-square tests were conducted. The middle group of mothers (ages 20-29) was added to the upper (ages 30-45 plus) and lower (under 15-19 years) age groups in two separate tests to determine whether there was significance in the upper and lower age ranges. The resulting p-values of these tests were ($X^2(1) = 5.26$, $p > 0.05$) for the middle group, ($X^2(4) = 242.2$, $p < 0.05$) for the lower group, and ($X^2(5) = 55.9$, $p < 0.05$) for the older age group. It was found that there was significance in both the upper and lower ranges, indicating that there are more premature births associated with fetal deaths among mothers in those age ranges.

The Effects of Soccer Player Position and Ambient Temperatures on Lung Capacity **Jacob Miller**

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The purpose of this research project was to determine the extent by which lung capacities differ between striker and midfield soccer players in warm and cold ambient temperatures. The lung volumes of eight striker and eight midfield soccer players from U-13 and U-14 travel soccer teams were measured using a manual Voldyne volumetric spirometer. The total lung capacity of each player was calculated before and after exercising for twenty-five minutes in an indoor middle school gym with a temperature of 21.6 °C and on an outdoor soccer field with a temperature of 9.4 °C. After using a t-test analysis, a significant difference, $t(10) = -2.74$, $p = 0.02$, was noted between striker and midfield players' baseline total lung capacities and the null hypothesis that there is no difference in the lung capacities of soccer players in the striker and midfield positions was rejected. In addition, a two-way ANOVA statistical analysis was used to determine the effect of soccer player position and ambient temperatures on total lung capacity. The two-way ANOVA analysis showed that ambient temperature was not significant, $F(1,28) = 2.17$, $p = 0.15$, in predicting total lung capacities of soccer players. In addition, there was no evidence to suggest that there was a significant interaction, $F(1,28) = 0.82$, $p = 0.37$, between soccer player position and ambient temperature on total lung capacity. Hence, the null hypothesis that there is no difference in total lung capacities of striker and midfield soccer players indoor and outdoor before and after exercise was not rejected.

The Effects of the Weight of a Child's Backpack on their Balance **Maired Pettit**

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Overloaded backpacks may cause back problems later in life for students. The purpose of this study was to determine whether male or female students were more likely to carry backpack weights over the recommended backpack to body weight ratio and whether backpack weights affected a student's balance. Volunteers from a local high school were tested using the Nintendo Wii Fit® system which measures a user's center of balance. The subjects' center of balance with and without a backpack on was tested as well as their body weight and the weight of their backpack. The data was analyzed using a difference of two proportions test for determining whether male or females were more likely to carry more weight and a t-test to determine whether greater backpack weights affected balance. The difference of two proportions test yielded a statistical difference between the backpack weights of male and female students. The researcher concluded that female students are more likely to carry a backpack weight over

the recommended backpack to body weight ratio. The t-test yielded no difference in balance of those students who carry over or under the recommended backpack to bodyweight ratio.

The Effect of Gatorade Prime on Times of a 400-Meter Run

Lauren Sheridan

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The purpose of the present study was to study the effect of sports drinks on running, particularly the popular sports drink Gatorade Prime™. Fourteen male and female high school track athletes ran two 400-meter laps on a track with four minutes of rest between each lap for four consecutive days. On the first and third days, the subjects drank 237 mL of Nestle Pure Life® water 15 minutes before running the two 400-meter laps, timed using a Seiko System Stop Watch S129™. On the second and fourth days, they drank 119 mL of water and 118 mL of Gatorade Prime™. The average 400-meter time with the consumption of only water was 85.91 seconds ($SD = 11.81$), and the average time for subjects who consumed both water and Gatorade Prime™ was 86.32 seconds ($SD = 11.78$). The hypothesis that the consumption of Gatorade Prime™ prior to running two 400-meter laps would improve individuals' 400-meter times, compared to their times when drinking only water prior to running, was not supported by the experimental results. A paired t-test was done to determine that the subjects' 400-meter times were not significantly different when consuming Gatorade Prime™. The results suggested that Gatorade Prime™ does not have the advertised effect on physical and athletic performance.

The Effect of Different Stimuli on the Heartbeat of Daphnia

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The purpose of this experiment was to determine which stimuli (caffeine, adrenaline, or aspirin) would have a greater effect on Daphnia. Then, in turn, it could help to determine which has a greater effect on the human body. To test this, first, an equal concentration of each stimulus was measured. The first group to be measured was the control group, and five trials were collected. The next stimulus to be tested was adrenaline, then caffeine, and last was aspirin. For every independent variable, 5 trials were collected. All of the data was recorded. For the control group, the data collected (in number of heartbeats in ten seconds) was 21, 21, 21, 22, and 22. For adrenaline, the data was 28, 27, 28, 28, and 27. The data collected for caffeine was 26, 26, 26, 27, and 27. For aspirin, the data was 30, 29, 30, 29, and 29. An ANOVA test was run which demonstrated that there was a statistical difference between all of the groups. The conclusion made was that aspirin has the greatest affect on Daphnia.

Comparing Chemical Composition and Consumer Attitudes of Organic and Conventional Milk

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The experiment was conducted to determine if organic milk consistently has higher levels of alpha linolenic acid than conventional milk, for the purpose of finding a way to easily remove fraudulent organic milk from stores by performing a simple test. It was predicted that if the amount of alpha linolenic acid was tested in organic and conventional milk, organic milk would always have a greater amount. In conjunction with the chemical analysis of the milk a survey, of one hundred and twenty participants, comparing consumer attitudes of organic and conventional milk was conducted. In order for chemicals to be run through a GC-MS they must be volatile. The milk was put through an extraction procedure to make it volatile and then the esterification of the α -linolenic acid took place. After the esterification of alpha linolenic acid the samples were placed in to the gas chromatograph-mass spectrometer for analysis. The results of this experiment were: Horizon organic milk had an average of 448 $\mu\text{g/g}$ of α -linolenic acid in the milk. The Natures Place organic milk had 441 $\mu\text{g/g}$ of α -linolenic acid in the milk. Food Lion brand conventional milk had an average of 193 $\mu\text{g/g}$ of α -linolenic acid in it and PET had 167 $\mu\text{g/g}$ in it. The hypothesis was supported by the results of the experiment. Both organic milks had higher levels of alpha linolenic acid than either of the conventional milks. The survey suggested that males believe regular milk offers more

benefits, and females believe that organic milk offers more health benefits. In contrast, more males than females are aware that the diet of an organic cow contains pasture food and less grain than that of a conventional cow. However, according to the survey more females than males believe that organically raised cows are raised differently than conventionally raised cows. Overall, health benefits and production methods have a greater influence on a female's choice in milk, than a male's.

MEDICINE and HEALTH B

FIRST PLACE

Innovative Cancer Vaccine Complex: Nanoparticle-Based Intracellular Delivery System of Immunomodulatory Agents for Initiation of an Anti-Tumor Immune Response

Riley Ennis

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Fraught with chronic side effects, the current paradigm of cancer therapy includes chemotherapy and radiation. Advancements in nanomedical techniques have led to the emergence of a new field of research, cancer immunotherapy, which is the study of stimulating the human immune system to elicit an anti-tumor response through the proliferation of cytotoxic T lymphocytes (CTL) and, the more recently discovered killer dendritic cells. The present research proposes an innovative vaccine delivery system of tumor associated immunomodulatory agent CpG oligodeoxyribonucleotide (CpG ODN) conjugated to poly(lactic-co-glycolic-acid) nanoparticles all encapsulated within a human-derived mannose glycoprotein. Together, this vaccine complex promotes CTL clonal expansion through the innate immunological pathways of dendritic cells in order to breach the immunological barrier posed by tumor cells. Experimental studies on the vaccine *in vivo* showed the localization of immune cells to the area of injection with 100% efficacy in organisms with a closed vasculature, while *in vitro* experiments showed the direct phagocytosis of the vaccine complex and morphogenesis of 92% of post-vaccine treatment dendritic cells. RT-PCR of vaccine-treated dendritic cell mRNA output showed a 4-fold and 17-fold increase in mRNA expression levels of IL-12 and IFN- γ , which are specific interleukins associated with the anti-tumor immune response. Taken together, the proposed vaccine complex elicits a tumor-restricted immune response in order to proliferate CTLs that will be able to recognize and destroy tumor cells.

SECOND PLACE

Preventing Tumor Cell Proliferation and Healthy Cell Apoptosis through the Application of *Cordyceps sinensis*

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To combat cancer, most patients receive chemotherapy and/or radiation to reduce cancerous tumor cells. However, these methods involve destroying healthy cells and lead to harmful side effects. Many studies fail to find an alternative to these methods of cancer treatment. The purpose of this study was to investigate if *Cordyceps sinensis*, a species of endoparasitical fungi prominent in oriental medicine, has the ability to reduce cancerous cells while preventing healthy cell apoptosis. Cordycepin (3'-deoxyadenosine) in *Cordyceps sinensis* was found to prevent tumor cell proliferation. It was hypothesized that Cordycepin extracted from *Cordyceps sinensis* would inhibit the growth of cancer cells while leaving healthy human cells unharmed. First, HeLa cervical cancer cells and Peripheral Blood Mononuclear Cells (PBMC) were cultured *in vitro* separately in 200 μ L of growth medium. Secondly, the cells were separated onto a 96 well microplate, 20 wells each allotted for both cells. Cordycepin diluted in water was then added in ten concentrations from 20 μ g/mL down to 2 μ g/mL to ten wells each of HeLa and PBMC cells, leaving the remaining cells to act as the negative control. Once dimethyl sulfoxide (DMSO) was added to the cells, MTT assay was performed for viewing at 490 nm in an automated spectrophotometer. The data collected showed the amount of cancer cells decreased with higher concentrations of Cordycepin, while the number of PBMC (healthy) cells remained constant throughout. The hypothesis was supported, and it was clear that Cordycepin was able to prevent tumor cell proliferation, along with leaving healthy cells unharmed.

THIRD PLACE

Effects of Vocal Training on Lung Functionality

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This report wished to serve the purpose of identifying the differences in lung functionality between those who have received vocal training ("vocalists") and those who have not ("non-vocalists"). While vocalists cannot control the volume of air held in their lungs, they can master control over it and use it more efficiently. This report sought to discover whether these differences in usage were statistically significant. Experiments were carried out on 20 male and female subjects, with and without vocal training. The experiment in question was a basic spirometry test, which primarily measures Forced Vital Capacity, among other indicators. The vocalists, both male and female, were found to have significantly greater levels of Inspiratory and Expiratory Reserve Volume, which represent their control over inhaling and exhaling large amount of air. They were also shown to have much higher measurements of Forced Vital Capacity, a similar measurement which is the most important singular reading in spirometry tests. In addition, their ratios of Residual Volume to Total Lung Capacity were significantly lower, meaning that they utilized much more of the available air in their lungs. A t-test and null hypothesis were used to analyze the data, with the result that the findings were quite unlikely (only a 1-5% chance) to be the product of a coincidence. The conclusion was reached that it is possible, through vocal training and exercises, for certain aspects of lung function to be increased in functionality.

HONORABLE MENTION

A Statistical Comparison of Two Confederate Hospitals

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The Confederate medical service was unprepared for the onslaught of the Civil War in almost every way. The hospitals were understaffed, what staff they had were underpaid, and most of the employees themselves were woefully inexperienced in military medicine to care for the tens of thousands of sick, wounded, and dying soldiers, civilians, even prisoners, with whose lives they were charged. This study observed and compared the level of health care provided by two Confederate hospitals: one a small, rural hospital and one a much larger trauma and prison hospital. The purpose was to see if the two hospitals, very different in size and medical facilities, provided the same level of health care for their patients. The original raw data from the Pearisburg General Hospital and the Danville General Hospital, obtained from the National Archives, were analyzed. Using Microsoft Excel (2010) and Minitab 15, four two-proportion tests were conducted comparing the proportions in both hospitals of patients that died, deserted, were returned to duty, or furloughed, against the total number of patients that visited the hospital between May 31, 1864 and January 21, 1865. These two-proportion tests indicated that the proportions of patients that died, were returned to duty, or were furloughed from the two hospitals were significantly different (all p-values <0 .001) from one another. The proportions of patients that deserted from both hospitals were not significantly different (p=0.469). The examination of the data from the Pearisburg Hospital is original research, and confirms not only that a hospital existed in Pearisburg, but that it provided adequate health care for its patients when compared with the Danville General Hospital.

HONORABLE MENTION

Accuracy of Glucometers

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Each year, over 1.6 million people are diagnosed with diabetes, putting the gross number of people currently diagnosed with this disease in America at 23.6 million. In 2005, 233,619 people died from diabetes and this number continues to grow, due in part, to the fact that in home glucometers are failing to give accurate readings.

The purpose of this experiment was to show which glucometers are most accurate and precise with different levels of blood glucose. Based on previous research it was determined that in home glucometers may be precise (within range of its own results), but not accurate (within range of the actual value). Knowing which devices are most accurate will help people with diabetes to manage their blood sugar levels and reduce the possibility of complications. The second purpose of this experiment was to show how reliable labels on packages are. If the label on a meters box says “most accurate of all,” and the experiment results show the device is not accurate, it can be concluded that advertising cannot always be trusted. It was hypothesized that if different glucometers: FreeStyle Lite, Bayer Contour, ACCU-CHEK Compact Plus are tested for accuracy and precision then, based on previous research, all of the glucometers will be precise but will not be accurate. To start the study, known control solutions of low, normal, and high levels of glucose were tested with each glucometer 10 times and the results were recorded for each. The FreeStyle Lite's low control solution was 40-70 mg/dL and the average result for the FreeStyle Lite was 60.3 mg/dL so the results were well within the parameters of the control solution. The FreeStyle Lite's normal level for the control solution was 83-125 mg/dL and the average result for that level was 113.3 mg/dL. The high level control solution was known to contain 248-372 mg/dL and the meter gave an average reading of 346 mg/dL. It was concluded that the readings for the FreeStyle Lite are accurate. The next glucometer tested was the Bayer Contour and the solution used for this glucometer had known levels of 34-48 mg/dL, 105-145 mg/dL, and 306-423 mg/dL for the low, normal, and high levels respectively. The average results for the low, normal, and high solutions were 41.1 mg/dL, 132.4 mg/dL, and 382.6 mg/dL. All of the results for the Bayer Contour can be considered accurate. Finally, the last glucometer tested was the ACCU-CHEK Compact Plus. These glucometers solutions were known to contain 72-102 mg/dL, 174-236 mg/dL, and 331-447 mg/dL for the low, normal, and high glucose levels, respectively. The average result for each level was 82.2 mg/dL, 203.3 mg/dL, and 378.5 mg/dL. It can be concluded that the ACU-CHEK Compact Plus is accurate. Based on these results the hypothesis can be accepted as true, but though the control solutions were proven accurate this may allude to the fact that actual blood tests may not be so correct.

HONORABLE MENTION

The Effect of *Ginkgo biloba* on the Short Term Memory Performance of *Drosophila melanogaster*

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The purpose of this study was to determine either *Ginkgo biloba* extract (GBE) has a significant effect on a short-term memory of *Drosophila melanogaster*, which would support the validity of this widely used traditional oriental medicine. This research was conducted by a high school student in a lab located in Central Virginia Governor's School (CVGS) over a three-week period in December 2010. Two groups of twenty *Drosophila melanogaster*, commonly known as fruit flies, were given GBE daily through their food media, and two control groups were given no additional GBE. After twenty-one days, the flies were exposed to an apple odor for 5 minutes; then, they were transferred to a grape odor, and were given a temperature shock. For half of them, this trial was conducted twice. Each individual group of flies was put into a Y-maze created by the researcher, which contained the two fruit odors previously exposed by the flies on either side of the apparatus. The assumption was that flies who avoided the fruit odor linked to the temperature shock had a good short-term memory. The number of flies that chose each apparatus was counted, and Chi-squared tests for independence were conducted. The inferential statistic analysis resulted in the p-value of 1.41E-1. The original hypothesis that “if the fruit flies are fed with GBE, then their short-term memory will improve” was not supported by the data. In conclusion, *Ginkgo biloba* extract did not have a significant effect on the short-term memory of *Drosophila melanogaster*.

The Effects of Celiac Disease on a Person's Susceptibility to other Extraneous Allergies or Intolerances

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Celiac Disease, an autoimmune disease, affects millions across the world and has done so for thousands of years. The disease disrupts the functionality of the entire digestive system upon the patient's consumption of the prevalently used protein, gluten. Because Celiac Disease causes the immune system to attack the gastro-intestinal tract upon its encounter with gluten, the condition can leave the person vulnerable to the development of several intolerances and allergies. The purpose of this experiment was to determine the correlation of multiple food allergies with Celiac Disease which could be enormously advantageous in the discovery of Celiac in patients demonstrating otherwise ambiguous symptoms. Also this project assisted in heightening the interest in Celiac Disease throughout the community in correlation with the rapid elevation of awareness and increase in diagnoses of this disease. A survey was created and distributed to a control group of thirty people without Celiac Disease and a group of thirty people with Celiac Disease in order to determine a correlation between the condition and the possession of other food allergies or intolerances. The results indicated that a person possessing Celiac Disease was significantly more likely to also have other food allergies or intolerances. The null hypothesis of this experiment was rejected, for these statistics support the research hypothesis that a person suffering with Celiac Disease will possess a greater number of food allergies. Based on the likelihoods of demonstrating the aforementioned extraneous allergies determined in this research, there appeared to be a direct correlation between the possession of Celiac Disease and the demonstration of other food allergies and intolerances. Before it can be concluded that this correlation exists however, the tested age group must first be narrowed down and specific to one age and the family history as well as gender should be more consistent among the test subjects.

The Effect of *Beta vulgaris* and *Spinacia oleracea* on the Iron Content (mg/L) of *Lumbricus terrestris*

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The purpose of this study was to see if the iron levels (mg/L) of *Lumbricus terrestris* would increase after exposure to a diet of *Beta vulgaris* or *Spinacia oleracea*. The experiment was conducted in Virginia over a period of five weeks in a high school research lab. The entire study was conducted between October and December 2010. Each group of *Lumbricus terrestris* was fed 100 grams of its respective iron-rich food source, *Beta vulgaris* and *Spinacia oleracea*. A control group was also set and provided with only soil. After the completion of five weeks the dry weight of the worms (100 degrees Fahrenheit for 10 hours) was taken, a 3 mL nitric acid digestion procedure was performed, and the iron contents (mg/L) were tested using a spectrophotometer. The results of this experiment showed that *Beta vulgaris* and *Spinacia oleracea* do not have a significant influence on the iron content of *Lumbricus terrestris*. A one-way ANOVA was performed on the data collected from the three groups of *Lumbricus terrestris*. An alpha value of 0.05 was set when conducting this procedure and a p-value of 0.137 was returned. The researcher's overall hypothesis that if *Lumbricus terrestris* were exposed to *Beta vulgaris* and *Spinacia oleracea*, then their iron levels (mg/L) would increase was not supported. In conclusion, the results gathered show that of the diets *Beta vulgaris* and *Spinacia oleracea* do not have a significant effect on the iron levels (mg/L) of *Lumbricus terrestris*.

The Effect of Disinfecting Table Services on Number of Bacteria

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In the United States, infections afflict more than three million people every year. As early as 1825, medical personnel discovered that bacteria were present on surfaces, hands, and instruments and the bacteria led to disease. The purpose of this project was to determine whether bacteria were present on table surfaces of fast food restaurants, and if there was a difference in the number of bacteria when comparing surface pre cleaning to post cleaning. The null hypothesis of the study was that there was no difference between the number of bacteria on the table surfaces when comparing the surfaces before they were cleaned to surfaces after cleaning. Forty samples were collected

using sterile cotton tipped swabs to collect surface samples pre cleaning (ten at Restaurant 1 and ten at Restaurant 2) and post cleaning (ten at Restaurant 1 and ten at Restaurant 2). After table surfaces were swabbed, each swab was rubbed on a culture plate and cultures were allowed to grow for five days. The null hypothesis for Restaurant 1 was rejected ($t=-3.64 < 2.262$ at $df=9$; $p < 0.05$) when using a paired t-test to compare the number of bacteria present on surfaces pre and post cleaning. In this restaurant, the number of bacteria increased after cleaning the surfaces with a wet cloth that was not rinsed or changed between cleaning numerous surfaces in the restaurant. The null hypothesis was accepted for Restaurant 2 ($t=1.80 < 2.262$ at $df=9$; $p > 0.05$). In this restaurant there was not a statistically significant difference in the number of bacteria post cleaning when using a dry cloth to clean the table surfaces between customers. The results of the study show that bacteria live on table surfaces of fast food restaurant and cleaning of table surfaces does not provide for a bacteria-free surface. Before it can be concluded that these bacteria spread infections, the type of bacteria would need to be identified because some organisms may not spread disease.

The Effect of Sitting Surface on Flexibility

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The effect of sitting in chairs can have a major impact on flexibility and a root cause to back pain. Previous studies and research suggest that sitting on the floor instead to chair increases flexibility. The goal of this project was to find the effect of sitting surface on flexibility. To determine whether chairs or floors do affect flexibility children were measured on how far they could sit and reach before school started and after school ended. Throughout the day one group sat on the floor and one sat in chairs. The next day the groups switched. After all the data was recorded, on average the floor increased flexibility by a 0.33 cm. But the chair decreased flexibility by 0.8 cm. The results suggest that chairs have a negative effect on flexibility while floors have positive impact on flexibility.

The Effect of Caffeine on Heart Rate of an Athlete

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Athletes are told from numerous sources, including parents, coaches, and especially advertising that they need extra energy to perform and enhance their natural abilities. This “energy” can be found in a plethora of mediums including liquid beverages. These drinks contain caffeine, a drug that blocks adenosine and causes the pituitary gland to release a hormone know as adrenalin. As the levels of this hormone increases, the heart beats faster and the liver releases sugar into the bloodstream. This combination provides the sensation of “more energy.” The purpose of this project was to determine if caffeine contributed to heart rate variability in an athlete. Using water as the control, and four popular brands of energy drinks (the sugar-free product), the athlete drank a cup of designated liquid. Forty-five minutes later, the subject performed jumping-jacks for one hundred twenty seconds. Immediately thereafter the athlete’s pulse was measured and recorded. The process was conducted ten times for each designated beverage. The average heart rate of the athlete without any supplement was 120.4 beats per minute. The athlete’s average heart rate was 236.8 beats per minute after consuming the energy drink with the largest amount of caffeine. The results indicated that the athlete’s heart rate increased significantly upon the consumption of the energy drinks. The data supported the research hypothesis that upon the consumption of an energy drink containing caffeine, an athlete’s heart rate will increase. Based upon the pulse’s increase, there appears to be a direct correlation between an athlete’s heart rate and the amount of caffeine consumed. Before the exact correlation can be determined, other ingredients in the energy drinks would have to be isolated or removed.

The Effect of Interleukin-S Treatment Frequency on the Growth of p19 Mouse Teratocarcinoma Cells

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The purpose of this research was testing whether or not the frequency of treatment had any effect on interleukin-2 as a cancer treatment for p19 mouse teratocarcinoma cells. The study was conducted by a Central

Virginia Governor's School student at Sweet Briar College in January 2011. The cells were divided into three groups. One group was allowed to grow freely for 48 hours as the control. The second group was treated once with a concentration of 1 μL per mL of IL-2, then allowed to grow for 72 hours. The third group was treated once with a concentration of 0.5 μL per mL, grown for 24 hours, treated again, then grown for another 48 hours. The results of this experiment show that there is no difference in p19 cancer cell survival if treated once with a 1 μL per mL dose or twice with a 0.5 μL per mL. With an alpha value of 0.05, an ANOVA test was run on the data, which returned a p-value of 0.0599. This does not support the researcher's hypothesis if p19 mouse teratocarcinoma cells are treated with interleukin-2 more frequently, then their growth will be stunted. According to this study, the frequency of treatments makes no difference in the effectiveness of interleukin-2 as a cancer treatment. Also, there was no difference between the control group and the groups treated with interleukin-2.

Sensory and Perceptive Testing for Children with Asperger's Syndrome

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The purpose of this study was to determine if the sensory function of a child with Asperger's Syndrome is normal by comparing it to the sensory function of a child without Asperger's Syndrome. The study was conducted by a local high school student at the Lynchburg College Physical Therapy Department during February 2011. One individual with Asperger's Syndrome and four individuals without Asperger's Syndrome were tested using six different sensory tests: vibration sensation, Weinstein Enhanced Sensory Test (WEST), Functional Acuity Contrast Test (FACT), visual acuity test, balance test, and two perception tests. A tuning fork of 256 Hz was used to test vibration sensation and the children were asked to tell the researcher when vibration began and ended when the tuning fork was placed on their skin. For the WEST, monofilaments with weights of 0.07 g, 0.16 g, and 0.60 g were tested on four areas on each of the children's feet. The children were asked to tell the researcher when they could feel the monofilaments touching their feet. For the FACT, a card with pictures of different shades was placed in front of the children and they were asked to tell the researcher which one was clearest. For the visual acuity test, the children were asked to hold an eye chart and read the smallest line of letters that they could. For the balance test, the children were asked to stand still with their hands by their sides, their eyes open, closed, on the floor, on a foam pad, both feet on the ground, and one foot on the ground. This test consisted of eight trials and the children were timed for a maximum of thirty seconds. The parents of the children were given two different perception tests to fill out according to the behavior of their child. These tests were graded on a scale that determined whether or not the children had normal perception. There was not enough data to implement a test for statistical significance; however, the data show that children with Asperger's Syndrome have abnormal sensory function.

The Effect of Different Amounts of Static Stretching Time on Muscle Elasticity

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Exercises to stretch muscles are commonly used before a workout or sports activity in attempts to improve performance and reduce the risk of muscle injury. Muscle elasticity describes the flexibility and range of motion of the muscle-tendon units of the body. The purpose of this experiment was to determine the effect of different amounts of static stretching time on muscle elasticity. The research hypothesis was that if a greater amount of stretching time is performed, then there will be increased muscle elasticity. Ten girls performing the hamstring test that required muscle elasticity were observed in the experiment. Stretching times for each girl were varied from zero to forty seconds at ten second intervals. Each girl was measured on the hamstring test after each of the stretching times. Data was collected from repeated trials and the measurements of all the girls were averaged for each stretching time. The results from the experiment showed that increased stretching time caused an increase in muscle elasticity as observed by increased mean distance reached in Hamstring Tests. The shortest mean distance of 17.0 cm occurred with the control group measurements taken after the shortest independent variable stretching time of zero seconds. The greatest mean distance of 21.7 cm occurred after the longest stretching time measured of forty seconds. A t-test analysis of the data indicated a significant difference of the means when the control was compared to each of the levels of independent variables ($t=2.14>2.101$; $t=2.43>2.101$; $t=3.18>2.101$; $t=3.31>2.101$ at $df=18$; $\alpha>0.05$). The data supported the research hypothesis that if a greater amount of static stretching time is performed,

then there will be increased muscle elasticity. The results supported the hypothesis and previous related research on this topic.

The Effect of Accuracy on Temperature Measuring Devices

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As a result of testing five different types of temperature measuring devices, results were obtained to identify the accuracy of each device. The five different types of devices tested included the electronic oral, glass non-mercury, temporal, plastic forehead strip, and the electronic ear. The purpose of this project was to determine the accuracy of the five most widely used temperature measuring devices. It is believed that the outcome of this project has the potential to affect the type of thermometer used in the Henrico Public School System. If the accuracy of the temperature measuring devices is tested, then the electronic oral thermometer will be the most accurate. Ten healthy people had their temperature measured by the experimenter using all of the five devices in the same order. The glass non-mercury thermometer, electronic oral, electronic ear, temporal, and the plastic forehead strip were the temperature measuring devices used. All results were collected on a piece of paper, then entered into a spreadsheet and graphed. Both the electronic oral and electronic ear thermometers provided consistent measurements for all subjects. Measurements obtained from the glass non-mercury oral and temporal thermometers were higher and the forehead strip was lower than the results obtained by the electronic oral and electronic ear temperature measuring devices. More accurate measurements were obtained using both the electronic oral and electronic ear thermometers than the other thermometers. The electronic oral thermometer was much easier to use than the electronic ear thermometer and was less expensive. In conclusion, when having to choose a device that was easiest to use and cheaper, the electronic oral thermometer was the best option.

The Effect of Vitamins on Planarian Regeneration

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For some time scientist have been studying a flatworm also known as planaria. These studies have made scientists curious because the planarians can regenerate lost body parts. The purpose of this experiment was to test whether planarians might need the extra help from supplemental vitamins to regenerate faster than normal. Planaria need water and food as a base for regeneration. This experiment helped to define that planarians do not need the assistance of vitamins to regenerate faster or more easily. The hypothesis stated that if planaria are submerged in vitamin D, then the planaria will regenerate twice as fast than being in vitamin A. The procedure of this experiment was to have the appropriate labeled materials needed to begin the experiment. The next step was to fill all of the Petri dishes with 6oz. of water using the medicine dropper. Next vitamin A was added to two Petri dishes, as well as vitamin D. A microscope and scalpel were used to help see clearly and cut the bodies easily. Ten of 100 planaria were placed in each Petri dish. The remaining planaria were stored in the original container in a dark, low temperature room. The results of this experiment were negative proving that planaria are independent flatworms. The mean or average of the results for water, the control of the experiment was 6.7 ml. Vitamin A was 6.0, and vitamin D was 6.2. These results show that vitamins A and D had close to the same effects yet spring water had the most significant effect. The conclusion of this experiment was that all of the three null hypotheses for this experiment were accepted. The results for water were ($t = 6.7 < 2.101$ at $df = 18$; $p > 0.05$), vitamin A were ($t = 6.0 < 2.101$ at $df = 18$; $p > 0.05$), and vitamin D, ($t = 6.2 < 2.101$ at $df = 18$; $p > 0.05$), therefore the data did not support the research hypothesis. This data concludes that this particular experiment was insufficient.

What Is the Effect of Glycemic Index Level on Number of Words Found on a Word Search in 8 Minutes

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Have you ever wondered what food to eat before a huge test? This project looks at the effect of glycemic index level (glycemic index level is measured by how long it takes for sugar to enter your blood stream.) on how

many worlds could be found in a 25 word, word search. In this project, three variables, as well as a control were tested. The variables tested were a high glycemic index food (donut), medium glycemic index food (ice cream) and a low glycemic index food (chocolate). The control was no food at all. The project was conducted by giving eight test subjects each level of glycemic index (independent variable) and counting the amount of words subjects found in an eight minute period of time (dependent variable). The project showed that when subjects were given foods with a higher glycemic index level before completing a word search, they found more words in the word search. The hypothesis was that the foods with higher glycemic index levels would produce a higher word count. The hypothesis for this experiment was proven. The conclusion for this experiment was that if you wish to complete a task on the short term, you should consume a food with a higher glycemic index. On the other hand, if you wish to complete a longer task, you should consume a food with a higher glycemic index.

The Effect of Surface on Running Speed

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Scientists have researched how a runners speed and performance will have a lot to do with the type of surface the runner is running on. From the five surfaces, concrete, grass, asphalt, track, and sand, many conclusions have been made as to why a runner would produce a greater or worse speed on each. While surfaces like concrete and asphalt produced around the same speeds, surfaces such as, track and sand, were different. The purpose of this project was to determine the effect a running surface has on the runner's speed. Ten runners were used and each ran thirty yards on all of the surfaces and the times were recorded. Once the results were graphed, track was seen to produce the fastest running times and sand created the slowest. A t-test performed on the data indicated a significant difference between the means of the groups. The research hypothesis, that states that if the runner runs track then they will produce the fastest time, was accepted when sand was compared to concrete, grass, asphalt, and track ($t = 7.28 > 2.101$; $t = 7.08 > 2.101$; $t = 7.13 > 2.101$, $t = 8.35 > 2.101$ at $df = 18$, $p < 0.05$). The null hypothesis was accepted when the concrete, asphalt, grass, and track were compared to each other ($t = 0.16 < 2.101$; $t = 0.08 < 2.101$; $t = 0.82 < 2.101$; $t = 0.08 < 2.101$; $t = 0.59 < 2.101$; $t = 0.7 < 2.101$ at $df = 18$, $p > 0.05$). Based on the data and results recorded from the experiment, the track is the best surface for speed and sand is the worst due to unevenness and a soft terrain. The similarities between the two surfaces, concrete and asphalt, showed why the runners' times on the surfaces were alike. Concrete and asphalt are very hard surfaces with little give and an even surface. The mean of grass times was less than the times of concrete and asphalt; this is surprising because grass is also uneven, but is softer on the runner's legs. A track is made to help spring the runner back up when landing, and is very soft, which supports why the times were the fastest on this surface.

The Effect of High Fructose Corn Syrup on Caloric Intake in *Vanessa cardui*

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The purpose of this study was to determine the effect of high fructose corn syrup as compared with sucrose on caloric intake in *Vanessa cardui* to help determine the dietary implications of using high fructose corn syrup as a sweetener. A student at a local high school conducted the study from October 2010 to December 2010. Two groups of *Vanessa cardui* were studied. One group's food supply was a solution of high fructose corn syrup; the other group consumed a solution of sucrose. Both solutions were prepared to equal caloric concentration, 4.1×10^{-4} kilocalories per μL . A two-sample t-test returned a p value of 0.24, greater than the alpha value set at 0.05. The original hypothesis that if *Vanessa cardui* consumed a solution sweetened with high fructose corn syrup, then they would consume more calories than *Vanessa cardui* that consumed sucrose solution, was not supported. In conclusion, the null hypothesis that the two groups would consume approximately the same amount of calories regardless of whether the solution consisted of high fructose corn syrup or sucrose was retained.

MEDICINE and HEALTH C

FIRST PLACE

The Effect of Quercetin on the Inhibition of the Cytochrome P450 3A4 Enzyme

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It has been reported that ingestion of grapefruit juice inhibits the liver enzyme, cytochrome P-450 3A4 (CYP3A4). Since this enzyme is responsible for metabolism of many important drugs, this inhibition can result in undesirable side effects because the metabolism is blocked and drug is not removed from the body as quickly and can accumulate in the body. It has been suggested that quercetin, a flavonoid present in grapefruit juice might be responsible for this inhibition. However this inhibition has not been systematically evaluated. The purpose of this project was to determine the effect of varying amounts of quercetin on the inhibition of CYP3A4. The hypothesis was that if the highest concentration of quercetin was tested, then the inhibition of the CYP3A4 enzyme would be the greatest. Human recombinant enzyme expressed in Baculosomes was used in this experiment. The substrate was fluorescein, chemically blocked such that fluorescence would result only after being metabolized by CYP3A4. Concentrations of quercetin used were: 1 mM, 100 μ M, 10 μ M, 5 μ M, 1 μ M, 0.5 μ M, and 0.1 μ M, which were pipetted into a 96-well microplate. Enzyme, substrate and cofactors were added to the plate and fluorescence results were recorded from three such repeated trials. A lower fluorescence value indicated a stronger inhibition of CYP3A4. Statistical analysis was conducted using nonlinear regression analysis (using Sigmaplot V11.0). A single site competitive inhibition model was fitted to the data. Based on this inhibition plot, the IC_{50} value (the concentration for 50% of the maximum inhibition) was estimated to be $4.8 \pm 0.32 \mu$ M, suggesting that quercetin is a relatively potent inhibitor of the CYP3A4 enzyme. The results using recombinant enzyme need to be further validated in an intact liver system, but this experiment does provide mechanistic insight to the inhibition reaction. It can be concluded that grapefruit juice should not be consumed if there is a possibility of the drug is metabolized by the enzyme CYP3A4.

SECOND PLACE

The Effect of Various Potato Extracts on Muscle Movement in Wild-Type and Mutant

Caenorhabditis elegans

Sreemoyee Som

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Wild type and two different acetylcholinesterase-gene deficient *Caenorhabditis elegans* mutants were studied to assess their motility and protein-expression in response to increasing concentrations of chemicals (especially glycoalkaloids) found within the skin of *Solanum tuberosum*. Each strain of nematode was placed upon the surface of a nematode growth media (NGM) containing 5 mL of a 25% concentration of *S. tuberosum* skin using the agar-plaques method. *E.coli* were used as a food source. After an approximate 48 hour period, their unprovoked motility was assessed using 40x magnification and Motic Software to capture video. An electrophoresis protein gel was run in order to compare the protein expressions of wild-type *C. elegans* in various glycoalkaloid concentrations. Image J software was used to approximate the movement pattern from the video of one randomly selected nematode from each environment. Frequencies of movement were approximated from this data. The introduction of potato extracts with supposed higher glycoalkaloid concentrations within the nematode environments resulted in the motility of wild-type strains approaching that of the acetylcholinesterase-gene deficient mutants.

THIRD PLACE

The Effect of Different Styles of Swimming on Lung Function

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Our health is paramount in each and every one of us, and in part, exercising helps to keep our body in check. Swimming is one sport that engages all the muscles in the body, and also actively improves pulmonary functions because the swimmer is mainly underwater. This study was designed to explore the relationship of swimming and lung function. The purpose of this study was to examine the effect of different styles of swimming on lung function for both males and females. Before the swimmer swam, the Heart Rate, Breath Rate, Tidal Volume (TV), Ventilation Rate (VR), Inspiratory Capacity (IC), and Forced Vital Capacity (FVC) were measured. Each swimmer was then asked to swim a consecutive six laps (300 meters) with maximal speed. Immediately after swimming, the same measurements as the control were then taken again. The results indicated that all of the swimming strokes increased lung function, but freestyle and breaststroke increased the lung function the most compared to the control. FVC dramatically increased after swimming in both freestyle and breaststroke, but it didn't significantly change in backstroke for both genders. However, IC had a slight increase in all three strokes, but the increase was not statistically significant. All of this data supported the research hypothesis that if a male and female swam 300 meters, then freestyle and breaststroke would have the greatest lung function. Swimming greatly increased lung function. Each different swimming style involved in different arm/body movements, different air availability, different breathing patterns, and different energy consumption that contributed uniquely to improve lung function. These factors attributed in the increase in lung function after swimming.

HONORABLE MENTION

The Effect of pH Level of a Beverage on the Hardness of Smokers' versus Nonsmokers' Teeth

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The purpose of this experiment was to investigate how common, everyday beverages could affect a person's tooth enamel when combined with the dental decaying habit of smoking, resulting in poor dental care. Because of overexposure and prolonged consumption of any beverage or cigarette smoke ingested through smoking, can cause plaque and eventually tartar build up it was fascinating to see how one's teeth might have been effected. The hypothesis was that if the pH level of a beverage is increased, then the hardness of smokers' teeth will decrease more than those of nonsmokers. The procedure for the experiment involved bleaching twenty-five smokers and twenty-five nonsmokers' teeth for two minutes then submerging the teeth into separate cups of beverages such as water, which was the control, milk, Coke, lemonade, and orange juice as well. Every week for one month, the beverages would be changed and any observations would be recorded. At the end of one month's time, the teeth were taken to a dental office and drilled for their hardness, which was measured in PSI, or pressure per square inch. As a result of the experiment, a t-test was performed on the data and indicated an insignificant difference between the means of the groups. The data supported the null hypothesis that if the pH level of a beverage was increased, then there would be no effect on the hardness of smokers' versus nonsmokers' teeth. Based on the results, it was concluded that there is no effect on the hardness of a tooth when the factor of smoking versus nonsmoking is concerned.

HONORABLE MENTION

The Effect of Fat Type on Enzymatic Degradation

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Scientists have been studying fats and their effects on the human body for dozens of years. Various correlations have been found between the saturation of fats digested and health problems in a given patient. Fats are triesters of fatty acids classified by their saturation. The saturation of a fat tells the types of bonds that exist in the fat, reflecting stability and resistance to degradation. The purpose of this project was to determine which fat degraded easiest in a stimulated digestive system. Four fats were tested - butter, margarine, vegetable shortening, and lard. Each fat was combined with pancreatic enzymes at 37°C and mixed on a magnetic stirring hot plate. Then, the percentage of the fat that dissolved in the indicator, gasoline, was calculated. This told the amount the fat had degraded under the given conditions. The results indicated that the largest percentage of butter degraded best with 12.44% of the butter decomposed. Margarine degraded the least with 1.96%. A t-test performed on the data indicated a significant difference between the four groups ($t=9.64 >2.306$; $t=8.22 >2.306$; $t=-6.74 >2.306$; $t=4.25 >2.306$; $t=7.43 >2.306$; $t=4.0 >2.306$ at $df=8$; $p<0.05$). The null hypothesis that fat type had no effect on enzymatic degradation was rejected; the research hypothesis was accepted for all comparisons. The data supported the research that fats with a lower iodine value, degree of saturation, degraded better and quicker than fats with higher iodine values. Both butter and lard, which degraded best, had low iodine values while vegetable shortening and margarine had high iodine values. Another factor was the difficulty to digest trans fats present in both vegetable shortening and margarine but not lard and butter. Additional experiments without the presence of trans fats and using other methods of hydrolysis would substantiate the result that butter degraded significantly better than other fats.

HONORABLE MENTION

Physical Mechanism of Calcium Transport Inhibition by Peroxynitrite

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Peroxynitrite (PN) is a reactive oxidizer that inhibits the Ca^{2+} ATPase enzyme (Ca^{2+} pump). The effects of PN on the cardiac muscle Ca^{2+} pump have been studied, but it is unknown how PN affects the skeletal muscle Ca^{2+} pump. Due to similarities between enzymes, I proposed that PN will cause the same amount of inhibition for the skeletal and cardiac muscle Ca^{2+} pump enzymes. Using skeletal muscle Ca^{2+} pump samples, enzyme activity assays were conducted at increasing PN concentration to determine the PN-dependent enzyme inhibition. $[Ca^{2+}]$ -dependent activity assays were completed to understand how PN affects enzyme Ca^{2+} sensitivity, and gel electrophoresis and immunoblotting were performed to test for physical effects of PN on the enzyme. The PN results were compared to control, untreated samples using a t-Test for significance. The percent inhibition of the skeletal muscle enzyme was $86\% \pm 8.9\%$ compared to $60\% \pm 2.0\%$ for the cardiac muscle enzyme at 100 mM of PN; which were not significant ($\alpha = 0.05$), but at lower levels of PN, there was less inhibition shown than in the cardiac muscle. The $[Ca^{2+}]$ curve results showed that PN did not affect Ca^{2+} sensitivity between the control and PN treated group, similar to the cardiac enzyme. The gel electrophoresis and immunoblot data showed that there may be some physical damage by PN to the enzyme, which was not observed for the cardiac enzyme. Further studies may be performed to determine the physical cause of PN damage in the enzyme.

Skin Deep
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Is it really safe to write on yourself with a marker even if the label says its non-toxic? Or could doing this be a potential hazard to your health? Could that brief reminder to pick up the dry cleaning that was written on your hand be shortening your life? The goal of this project was to find the effect of different types of pens on how far the ink would penetrate into the skin. Pork skin samples were written on with the different types of pens and the depth of the ink penetration was measured. It was found that the ink from a Sharpie penetrated the furthest, with an average of 15 microns; the ballpoint pen was next, with an average depth of penetration of 4.8 microns; and the Expo marker was last, with an average depth of penetration of 1.68 microns. While these markers say that they are “non-toxic,” that only means that the concentrations of chemicals in them will not make a person sick during normal usage. The markers used in this experiment did have chemicals in them that, in high concentrations, could make a person sick.

The Effect of Different Types of Soda on the Rate of Tooth Decay

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According to the CDC, about 78% of Americans have had at least one cavity by the age of 17, mainly due to the amount of sugar the average American consumes. Cavities form from repeated attacks by bacterial acid on the tooth’s surface. The purpose of this experiment was to find out how long it would take for teeth to decay if they were constantly exposed to different types of sodas. Twenty teeth were collected and distributed among twenty plastic containers. Each container contained one of four different liquids, Coke, A&W Root Beer, 7-Up, or water (control). The results showed that Coke, the soda with the most amount of sugar, caused teeth to decay at the fastest rate with a mean of 5 days and the liquid in which the teeth showed the least amount of decay was the control, water. The teeth exposed to water did not show signs of rot or decay during the testing process.

The Effect of a Person’s Visual Field (cm) on the Time to Move through an Obstacle Course (sec)

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To be blind your peripheral vision must be 20 degrees or less. When peripheral vision is taken away people do not have a full visual field. The purpose of this experiment was to see how affected ones vision must be to show a difference in how they act, move, and walk. It was hypothesized if a person’s visual field (cm) decreases, then they will increase the time to move through an obstacle course at maximum efficiency (sec.). Build an obstacle course to test the peripheral vision of people then you have people put on goggles to restrict their vision and measure the time it takes them to get through the obstacle course. For restricted to 5 mm of vision the mean was 20.885, then for restricted to 20 mm of vision it was 16.539 and for restricted to 10 mm of vision it was 16.232; non restricted vision was 14.797. My information supports my hypothesis in the experiment with the exception of 20 mm because when peripheral vision decreases the times get longer. The results were what they were because it has been shown that if a person has greater vision loss then they will take more time to make their way through anything. It also states that peripheral vision is essential for movement. For future studies I would suggest using the goggles in a real life setting.

Contrast Perception and Light Temperature

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In 2007, Congress passed a bill that will completely eliminate the use of incandescent light bulbs by the year 2014, and replace them with the more energy-efficient Compact Fluorescent Lights (CFL). This changeover will affect thousands of American households, as these CFL bulbs differ from the common incandescent in energy efficiency, cost, and in lighting quality. There are varying temperature scales for CFL's where higher temperatures equal brighter light and lower temperatures equal softer, more orange colors. In this experiment, three different CFL light bulb temperatures (2700K, 3500K, and 6300K) were tested to determine which temperature provided the best contrast visibility for the human subjects. Using a set of twenty-five contrast cards which differed in amount by percentages between 5%-45% and three lamps containing one of the three light bulbs, subjects were asked to be seated underneath a makeshift darkroom to view the cards and determine which of the squares were darker. Each subject viewed the stack of cards (rearranged in a predetermined order for each light temperature) under each of the three lights. The number of incorrectly identified contrast cards in each light was tallied for each subject, and a trend was discovered in the results. Results showed that those subjects with glasses or contacts saw better in the lower light temperature approximately 97% of the time, and those without a visual aid saw better in the brighter light temperature 97% of the time. These results are not significant at the 0.05 level as p for those with glasses equals 0.106 (meaning that there is not a strong relationship between light temperature and contrast perception), and the p value for those without glasses was 0.103. As America moves forward towards these new lighting options, this information will help homeowners decide which light is best for both them and their families.

The Effect of Number of Hours Sleep on Hand-Eye Coordination

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An alert mind improves hand-eye coordination and motor skills. One of the best ways to make sure the mind is alert is by getting a good amount of sleep. Sleep deprivation was the common problem that was tested. The purpose of this experiment was to prove the best amount of sleep for a teenager to receive in order to have the best hand-eye coordination. The hypothesis was stated as followed: If one received 8 hours of sleep, then they will have the best possible hand-eye coordination. The procedure to test the hypothesis was to receive varying amounts of sleep and have passes thrown to the participants. The amount of passes caught was recorded and this data was what was used to determine the hand-eye coordination. The more passes caught proved better hand-eye coordination. Nine hours of sleep resulted in the best hand-eye coordination with a mean of 9.3 passes caught. Eight hours was slightly lower, exhibiting a mean of 9 passes caught. The lowest amount of passes caught was when 6 hours of sleep (mean=6.8) was received. The experiment rejected the research hypothesis due to the fact that 9 hours resulted in the best hand-eye coordination. A t -test performed on the data indicated a significant difference between the means of the data ($t=0.46 < 2.101$; $t=1.94 < 2.101$; $t=0.76 < 2.101$; $t=1.8.101$ at $\alpha=0.05$ and $df=18$). The research hypothesis was rejected because 9 hours of sleep was what resulted in the best hand-eye coordination (mean=9.3 passes caught). In the experiment, there proved to be a direct change in hand-eye coordination based on the amount of sleep received. Lack of sleep and too much sleep ended up with the worst hand-eye coordination, whereas an average and balanced amount of sleep proved the best results. Before this experiment, it was assumed by many people that 8 hours of sleep was the ideal amount (which is true for adults). Based on the experiment, it was proven that 9 hours of sleep was the best amount for a teenager in order to improve hand-eye coordination.

The Effect of Type of Antacid on the Neutralization of Hydrochloric Acid Simulating Stomach Conditions

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More than 95 million Americans suffer from frequent heart burn/acid-reflux. Antacids are used to neutralize the pH level of stomach acid relieving heart burn. Hydrochloric acid is stomach acid at the pH of one. In labs it is mostly used to test the effectiveness of antacids. Some common antacids are TUMS, Pepto-Bismol, Zegrid

OTC, and Pepcid AC. The purpose of this experiment was to determine the effect of type of antacid on the neutralization of hydrochloric acid simulating stomach conditions. Based on the ideas/theories/experiments that stated that antacids caused a neutralization reaction, it is believed that if Tums is used, then the hydrochloric acid will neutralize or make the pH level increase the most. This is probable because Tums contains the active ingredient of calcium carbonate and magnesium hydroxide. Calcium carbonate has been proven to be highly alkaline. To conduct this experiment the experimenter crushed one dosage of each antacid and added them separately to the hydrochloric acid. Then the experimenter tested and recorded the pH level of the mixture. The results indicated that Pepto-Bismol was the most effective with a mean pH of 6.1; this was probably because Pepto-Bismol contains the active ingredient bismuth subsalicylate (a strong stomach relief agent), and Pepcid AC was least effective with a mean pH of 4.2. The data did not support the research hypothesis that if Tums was used, then the hydrochloric acid will neutralize or make the pH level increase the most. Based on the pH values determined in this experiment, there seems to be a direct correlation between bismuth subsalicylate and the neutralization of hydrochloric acid. Before it can be concluded that bismuth subsalicylate was the sole source of the neutralized acid however, every active ingredient in each antacid will have to be analyzed.

The Effect of Sucrose Ingestion on the Autonomic Nervous System

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Sugar is a carbohydrate, which provides immediate energy for the human body, but it is often ingested in extremely high doses. The autonomic nervous system is the part of the peripheral nervous system that controls many of the body's processes without the conscious effort of a person. The presence of excess amounts of sugar in the blood stream is known as hyperglycemia, which is known to have negative effects on body function. The purpose of this experiment was to determine the effect of sucrose ingestion on malfunction within the autonomic nervous system. The hypothesis for this investigation was: If the amount of sucrose consumption is increased, then there will be more malfunction in the autonomic nervous system. A group of ten test subjects was assembled for the experiment, and a baseline reading was completed using computerized infrared thermometry to determine the malfunction of the autonomic nervous system. This test was then repeated on each subject two more times per subject, using 30 grams of sucrose for the second test and 60 grams for the third test. The results indicated that there were fewer average standard deviations, which correlates to less malfunction of the autonomic nervous system, as the amount of sucrose ingested increased. A t-test was performed to test the following null hypothesis at a 0.05 level of significance: The ingestion of different levels of sucrose does not cause malfunction within the autonomic nervous system of a person. The null hypothesis was accepted when all different tests were compared to each other. ($t=0.1604 < 2.101$; $t=0.3167 < 2.101$; $t=0.1677 < 2.101$ at $df=18$; $p > 0.05$) The results of the experiment were not consistent with the research hypothesis, nor were they consistent with previous research. In order to produce clearer results that are more consistent with previous findings the test should be completed every hour for a period of eight hours with test subjects who were more similar in body type and health.

The Effect of Iris Color on Pupil Diameter

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Optometrists began recording patient's pupil diameters to see if the size had any effect on the vision. This sparked the idea that iris color may have an effect on pupil diameter. The iris is a spherical, pigmented area of the eye and the dark opening of the iris is called the pupil. The purpose of this project was to determine if iris color had any effect on pupil diameter. The levels of the independent variable were dark brown, light brown, blue, and green. Students were asked to sit in a chair and look down a narrow hallway. The iris color was noted and the pupil diameters of the participants were measured with a pupilometer. A t-test performed showed that the greatest differences of variances were dark brown irises (2.64) and blue irises (0.62). The means of the group were also very haphazard ($t=0.5 < 2.179$; $t=0.21 < 2.179$; $t=1.07 < 2.179$; $t=1.00 < 2.179$; $t=0.48 < 2.179$; $t=1.84 < 2.179$ at $df= 12$; $p > 0.05$), therefore the data did not support the research hypothesis that if the pigment of the eye is darker in color, then the pupil will be smaller in size. Since the null hypothesis was accepted, it was shown that iris color has no true

effect on pupil diameter (mm). Doctors need to correlate on a standard on grouping iris colors before continuing with further experimentation.

The Effect of a Person's Age on their Lung Capacity

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Lungs are an extremely important part of the human body, and without them, people would not be able to survive. The age of someone may affect a person's lung capacity because of how many more times that person's lungs have been used. The older someone grows, the more that person's lungs are used. This could lead to the weakening of lungs. The purpose of this experiment is to see how age will affect a person's lung capacity. The hypothesis of this experiment is that if the age of the person is higher than 18, but lower than 29, then their lung capacity, measured in centimeters cubed, will be greater than those whose ages are higher than 29. For the experiment, volunteers blew once into a balloon and filled it with as much air as they could. This was repeated with each volunteer. The results of the experiment showed that the age group 18-29 had the greatest lung capacity. This showed that the hypothesis of the experiment was supported. This experiment happened the way it did most likely because as a person ages, the person's lungs are used more and more, causing them to weaken over time. In the future, using the data from this experiment, I could do a further experiment to see the background of each person like where they live, if they smoke, and how often they exercise.

The Effect of Equestrian Events on a Rider's Heart Rate

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When a person does physical activity, their heart rate will increase. Equestrian eventing competitions have been around since the 1800s and some people have yet to believe that these competitions cause the rider to exert physical work. This experiment tested which competition, dressage or jumping, caused a greater increase to a rider's heart rate. This experiment was also designed to inform people about the effects of horse competitions on a rider's heart rate and to prove that horseback riding is a sport. The hypothesis was if the rider is competing in a jumping competition then the rider's heart rate will increase more than in a dressage competition. This experiment was held at the Commonwealth Dressage and Combined Training Association (CDCTA) Horse Trials and five horseback riders participated. Each rider competed in the dressage, show jumping, and cross country competitions and their heart rate was measured before and after each competition. Many t-tests were performed to test the null hypothesis. The null hypothesis was rejected ($t=5.94 > 2.571$; $t=8.803 > 2.571$; $t=2.97 > 2.571$; $t=2.71 > 2.571$; $t=2.915 > 2.571$ at $df=8$; $p < 0.05$), therefore the data supported the research hypothesis that the rider's heart rate would increase more in a jumping competition than in a dressage competition. Many people do not believe that horseback riding is a sport because people believe that "the horse is doing all the work." Based on these results, it can be concluded that equestrian events do affect horseback riders' heart rates. Even though the research hypothesis was proven correct, that jumping increases heart rates more than dressage, a horseback rider in any competition will still have a significant heart rate change. In conclusion, equestrian eventing is a physical activity because it causes an increase in heart rate. However, the increase in the rider's heart rate will vary in the different competitions involved in eventing.

MICROBIOLOGY A

FIRST PLACE

The Effect of Roundup on the Growth of Cyanobacteria

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Cyanobacteria are photosynthetic prokaryotes that also have the ability to fix nitrogen. This experiment was conducted using the cyanobacteria *Nostoc punctiforme*. Roundup, or glyphosate, is a very commonly used herbicide. This experiment was conducted to determine whether or not Roundup in varying concentrations killed cyanobacteria. The hypothesis was if Roundup is applied to cyanobacteria then the growth of the cyanobacteria will be severely inhibited. Six different concentrations of glyphosate were tested on the cyanobacteria, including a control with no glyphosate. These concentrations were 10 mM, 2 mM, 1 mM, 0.2 mM, 0.1 mM and the control. The growth in the cells was determined by measuring chlorophyll concentration with a spectrophotometer. Chlorophyll was measured immediately before adding glyphosate, after 4 days, and after 9 days. After four days the 10 mM and 2 mM concentrations of glyphosate had completely killed the cells, the 1 mM cells were 50% dead, and the cells in the 0.2 mM concentration were starting to die. After 9 days all the cells had died except 0.1 mM and the control, which had grown. However, the cells kept from the first data collection were growing back in the 0.2 mM concentration. The hypothesis was supported because most of the cyanobacteria had died after being exposed to glyphosate. The concentration of glyphosate when applied to the soil is approximately 21 mM to 40 mM. Knowing that cyanobacteria are quickly killed by even a 10mM concentration of glyphosate, it can be inferred that if cyanobacteria are on the surface of the ground, they will be killed by Roundup.

SECOND PLACE

The Effect of Different Carbon Food Sources on the Output of a Microbial Fuel Cell

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The research conducted analyzed the energy output of Microbial Fuel Cells created using sediment from a nutrient rich benthic bacteria environment. The research looked at how changes in carbon food sources affect the total output of the fuel cell. This research provides information about the efficiency and viability of fuel cells created from natural energy sources. Microbial Fuel Cells could provide an alternative source of energy as well as creating clean water for remote locations throughout the world. The hypothesis of the study stated that a glucose food source would create the fuel cell with the highest output. The conclusion was that the glucose created the highest output fuel cell with the vinegar fed fuel cell giving promising results for further study. To test the hypothesis four fuel cells were created and had identical samples of sediment added to the cells. Three of the cells were fed with different carbon food sources and the fourth was a control sample. The electrical output was read twice daily in millivolts and then organized in an Excel spread sheet and graphically compared. This showed that all test cases produced consistent output as well as supporting the original hypothesis confirming that glucose provided the highest output. This provides a basis for possible larger scale research on the effective use of Microbial Fuel Cells as an alternative energy source.

THIRD PLACE

The Effectiveness of Natural Antibacterials against *Escherichia coli* and *Staphylococcus epidermidis* in an *in Vitro* Environment

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Staphylococcus epidermidis and *Escherichia coli* were tested for susceptibility to natural antibacterials in comparison to hydrogen peroxide and sterile water using a Kirby-Bauer test. The purpose of the experiment was to determine if these antibacterials perform comparably to hydrogen peroxide and if they are suitable for medical use. Manuka honey, grapefruit seed extract, and aloe vera gel were tested in medical concentrations: 100%, two drops per ounce, and 100%, respectively. Hydrogen peroxide was tested in a 1.5% concentration. Each antibacterial and control was tested twelve times with each bacterium in 25 μ L amounts. Statistical analysis showed that none of the antibacterials other than grapefruit seed extract performed comparably to hydrogen peroxide in plates of *E. coli*, $F(3, 41) = 1268.13$, $p < 0.001$, which contained mean zones of inhibition of 24.52 mm. Peroxide produced immeasurable zones in plates of *S. epidermidis*, while grapefruit seed extract produced immeasurable zones in plates of *E. coli* and mean zones of 21.72 mm in plates of *S. epidermidis*. Statistical analysis showed that the zones for hydrogen peroxide with *E. coli* and grapefruit seed extract with *S. epidermidis* are not comparable, $t(9) = 5.49$, $p < 0.001$. Honey and aloe vera gel did not perform significantly differently from water except for the trials utilizing honey in plates of *E. coli*, which produced mean zones of 10.39 mm. The causes for these measurements were also investigated.

HONORABLE MENTION

The Effect of Mouthwash Alternatives on the Growth of *Staphylococcus aureus*

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The purpose of this experiment was to find the natural antibacterial agent that provided the most efficient means to prevent the growth of *Staphylococcus aureus*. Twelve trials of each of the natural antibacterial agents (grapefruit seed extract, oregano oil, and garlic) were set up, placing a paper disk saturated with each level of independent variable in the center of the trial quadrant in a sterile Petri plate containing tryptic soy agar that had been streaked with a culture of *S. aureus*. The cultures were left to grow for forty-eight hours, and the diameter of the zone of inhibition caused by the presence of the natural antibacterial agent was measured and recorded. The level of independent variable that produced the largest zone of inhibition revealed the substance that was the most efficient at preventing the growth of *S. aureus*, as the zone defines the area in which the bacteria are not able to grow, or are killed in. Grapefruit seed extract proved to be the most efficient, with the average diameter of its zone of inhibition being 3.2 cm. The oregano oil yielded an average diameter of about 0.81 cm, and the garlic yielded an average diameter of 0.15 cm. The grapefruit seed extract most likely had the greatest effectiveness due to its ability to disrupt the membrane of the bacteria, and liberate the cytoplasmic contents within fifteen minutes of exposure, therefore almost instantly killing the bacteria and making it bereft of any enzymes that it may have needed to function. While the carvacrol in oregano oil only killed the bacteria by producing heat that dehydrated them, and the allicin in garlic only blocked the enzymes that facilitate the movement of the bacteria into a cell's tissues (of which there is no organism present in this experiment for the bacteria to act on); the more instantaneous manner in which the grapefruit seed extract affected the bacteria performed the job of both the carvacrol and the allicin by releasing the water located in the cytoplasm (thus dehydrating the bacteria), along with any enzymes that may be essential to its livelihood.

HONORABLE MENTION

The Effect of Sugar Substitutes on CO₂ Production of Yeast

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The purpose of this experiment was to determine if different sugar substitutes had an effect on the CO₂ production of yeast. The controversy around artificial sweeteners and insight into the process of fermentation was also discovered. A water displacement system was created to collect and measure the gas produced by the yeast in a gas collector tube and data was collected in 5 minute intervals. It was hypothesized that if the CO₂ production of yeast reacting to different sweeteners is compared then sucrose would have the highest CO₂ production followed by Honey and Sugar in the Raw respectively. It was predicted that the artificial sweeteners would not cause any yeast fermentation to occur because they were thought to be only non-nutritive or no calorie sweeteners. The results partially supported this hypothesis. Sucrose had the highest CO₂ production after 30 minutes closely followed by Equal, Sweet N' Low, Splenda, Honey, Sugar in the Raw, and then Truvia. The artificial sweeteners produced a surprising amount of CO₂ gas. A one-way ANOVA statistical test concluded that the overall p value was 0.00000. Therefore, there was a statistically significant difference in the data. A Multiple Piecewise Comparison showed that there was significant overlap between sucrose and Equal, Honey and Sweet N' Low, Honey and Splenda, Sweet N' Low and Equal, Sweet N' Low and Splenda, and Equal and Splenda. After further research, it was discovered that the artificial sweeteners were actually combinations of both non-nutritive and nutritive ingredients, which allow yeast fermentation to occur.

HONORABLE MENTION

The Effect of Ground-Up *Gryllus assimilis* Head Extracts on *E. coli* (K-12) Bacteria

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The purpose of this experiment was to determine the effect of ground-up *Gryllus assimilis* head extracts on *E. coli* (K-12) bacteria. Recently, antibiotics have diminished in effectiveness for treating bacterial infections and scientists have turned to the research of "natural" antimicrobials found in organisms especially insects. It was hypothesized that the *Gryllus assimilis* heads would kill a portion of the *E. coli* (K-12). Briefly, 25 nutrient agar plates were plated with $\sim 10^3$ *E. coli* (K-12) that had been serially diluted 10^6 , while another 25 plates were plated with the same bacteria mixed with the head extracts that had been filtered. These plates were incubated overnight and the number of colonies on each plate was determined with the plates without the extract serving as the control to determine if the extract killed any bacteria. The results revealed that the extract did in fact kill a large portion of the bacteria, with a mean percentage of 84.95% of the bacteria. A t-test was conducted on the data, which proved that it was indeed statistically significant. The results supported the research hypothesis. It is believed that the results are due to the fact that insects contain microbial peptides, such as cationic peptides and they have an innate immune system due to living in filthy conditions. Future studies could investigate the potency of the extract and the effect other types of insects have on the same or different kinds of bacteria.

The Effect of Different Mouthwashes on Oral Bacteria

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This experiment was conducted to observe if mouthwash had a negative effect on oral bacteria. If mouthwash had a negative effect on the oral bacteria then society would be less susceptible to diseases such as periodontal disease and gingivitis. The following diseases are both caused by untreated levels of bacteria in the mouth. These are far more serious and sometimes unnoted than halitosis which is the first clue to the existence of

these diseases. The hypothesis was, “If one rinsed with Listerine, then the least amount of oral bacteria would grow.” The experiment was conducted with a total of thirty research subjects. Each research subject was placed into one of three groups. In all, there were three groups of ten. Each group was swabbed before rinsing with mouthwash and after rinsing with the factory recommended amount and for the factory recommended period of time. Research subjects in the first group, who rinsed with Listerine, had the least amount of bacteria grow after use of mouthwash in the experiment with an average of -0.1 colonies. This was the only group with an average that decreased the amount of bacteria in the mouth. The research subjects in the second group rinsed with ACT and had the highest gain in the amount of oral bacteria with an average of 2.2 gained colonies. This mouthwash was proved to be the least successful. The final group’s research subjects rinsed with Lavoris, and had the mediocre outcome with the average gain of 1.9 colonies of oral bacteria. At the close of the experiment the hypothesis was supported by the results. Therefore, to successfully remove bacteria from one’s oral cavity, one must rinse with Listerine. This shows the importance of properly taking care of one’s mouth and the need for everybody to rinse with mouthwash.

The Effect of Natural Antimicrobials versus Prescribed Antimicrobials on Bacterial Growth

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Three antimicrobials, grapefruit seed extract (GSE), colloidal silver, and tetracycline were tested to see which has the greatest effect on *Escherichia coli* k12 and *Staphylococcus epidermidis* growth. Two questions were: which of the three antimicrobials inhibited bacterial growth most effectively as compared to the control and which of the two natural antimicrobials, GSE and colloidal silver, was more effective inhibiting bacteria growth. Petri dishes containing agar were swabbed with the two types of bacteria and then discs containing antimicrobial substance or distilled water (control) were placed onto the agar. One day later, the zones of inhibition were measured. In regards to the first comparison (each antimicrobial versus control), tetracycline inhibited the growth of *Staphylococcus epidermidis* the best with an average zone of inhibition of 43 mm. For the second comparison, GSE inhibited the growth of *Staphylococcus epidermidis* the best with mean zone of inhibition of 35 mm. Colloidal silver had little effect on *Escherichia coli* k12 (M=10, S.D.=0.235) and *Staphylococcus epidermidis* (M=6, S.D.=0.000000127). The ANOVA test results were F(3,3)=164.3312, p<.0001 for the interaction of bacterium and antimicrobials, F(3,3)=437.8505, p<.0001 for just the antimicrobials, and F(1,1)=329.6819, p<.0001 for just the bacteria

Endospores versus Magnetism: The Effects of a Magnetic Field on Endospore Coat Proteins

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Endospores are differentiated cells that allow certain bacteria to survive sanitation and pasteurization processes. With these bacteria remaining in a live state, they were able to cause food contamination and sickness among human and animal populations. This study analyzed the effects of magnetism on the endospore coat proteins: CotJC, CotA, and others that play a role in endospore resistance. The research hypothesis was that an exposure to a magnetic field would inhibit protein synthesis, alter coat protein size, and decrease vegetative cell density after exposure to adverse environments/stimuli. To analyze the effects of magnetism, endospores were initiated, subjected to external stimuli, allowed to return to their vegetative states, and analyzed with a turbidity sensor to measure any differences. In addition, tests which involved SDS-PAGE electrophoresis, Bromophenol Blue, and Benedict’s reagents were conducted to measure protein concentration and size. The results revealed that exposure to a magnetic field increased endospore resistance towards UV rays and certain caustic chemicals, such as lysozyme and hydrogen peroxide, and decreased resistance toward protein denaturation. A two-way ANOVA was conducted to verify the null hypothesis at the P= 0.05 (level of significance): exposure to a magnetic field would neither increase nor decrease vegetative cell density after exposure to adverse stimuli/environments. The *Interaction P* value was 0.048 and therefore rejected the null hypothesis. Also, magnetism did not affect protein concentration/synthesis. A t test was conducted to verify the null hypothesis at the P= 0.05: a magnetic field would have no effect

on spore coat protein synthesis. The calculated P value was 0.96. The null hypothesis was proven correct. Electrophoresis did not produce any feasible data. In conclusion, magnetism did not affect the synthesis of CotJC, CotA, or any other spore coat protein, but endospore resistance was altered. Therefore, it can be suggested that magnetism affected coat protein size.

The Effect of Diesel Oil on CO₂ Production of *S. cerevisiae*

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Uses of yeasts include bioremediation and ethanol production. One species of yeast, *Yarrowia lipolytica* is able to degrade palm oil effluent, TNT, and some hydrocarbons, while ethanol is a valuable alternative fuel. Diesel fuel is a hydrocarbon consisting 10 to 15 carbon atoms and 20 to 28 hydrogen atoms. A relationship between the fungus *S. cerevisiae* and petroleum diesel fuel can be found. A study conducted in Nigeria indicated that a strain of bacteria local to the site of a recent oil spill was able to degrade 79% of its diesel oil media, indicating that the bacteria may have been able to utilize the oil as a source of carbon and energy. As Fungi and Eubacteria are closely related kingdoms, *S. cerevisiae* may share characteristics of the bacteria. The purpose of the experiment was to determine the effect of diesel oil on the carbon dioxide production of *S. cerevisiae*. The hypothesis was that if amounts of diesel oil were added to *S. cerevisiae*, then the carbon dioxide production of the organism would increase. Gas production of yeast near diesel oil was tested and recorded. The results indicated that greater amounts of diesel oil increased amounts of gas, although a t-test was performed and the results were found to be experimental error. The data supported the null hypothesis that diesel oil had no effect of the gas production of *S. cerevisiae*. Drawing from the information, *S. cerevisiae* appears to share no capabilities of hydrocarbon-reacting microorganisms, and is neither adversely nor beneficially influenced by diesel oil. Before an absolute judgment can be formed, a more comprehensive experiment should be performed.

The Effect of Percentage of Moisture Content in the Air on Time Taken for Microfungi to Grow a Colony Visible to the Unaided Eye

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Microbes are fundamental for life on earth; without these microscopic creatures, the human race would terminate. Most people believe that microbes are harmful and can cause serious problems, but only one in every 30,000 microbes is harmful. Compared with the statistic that one in every 17,000 people is a murderer, microbes do not seem so bad. Plants also require the help of microfungi because 90% of all plants need microfungi to grow. Humidity plays a big role in controlling the habitats of many microfungi. The minimum of 20% moisture content in the air is needed for most microfungi to grow. While 20% may be the minimum amount moisture needed for most microbes, what is the humidity at which microfungi grow fastest? The purpose of the investigation was to determine the effect of different percentages of moisture content in the air on the time taken (days) for microfungi to create a colony that is visible to the unaided eye. It was hypothesized that if the moisture content is increased then time it will take for some type of microfungi colony to appear on bread will decrease. Forty squares of white-wheat bread were placed in airtight plastic bags with different moisture contents (20%, 30%, 40%, 50%; ten for each level of the independent variable). The trials were observed twice daily, and moisture content was maintained. At the end of 18 days it was determined that the 50% moisture content grew colonies first. Data supported the research hypothesis. Based on the time taken for different moisture contents, it is shown there is a relation between the microbe growth and humidity. However, improvements could be made by adding more levels of the independent variable before it is concluded that a higher humidity will lead to more microbe growth. Further research could be conducted on moisture contents above 50% to determine a trend in the data. Also, methods of controlling humidity inside packaging could be a cheap way of extending the expiration date.

The Effects of Natural Antibiotics on Killing Bacteria through Agar Plate Testing

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This paper explores the ability of natural antibiotics to kill bacteria compared to that of synthetic antibiotics. Background research on the paper asserted that bacterial resistance to synthetic antibiotics is becoming problematic in modern medicine. The purpose of the project was to determine whether natural antibiotics were effective in killing bacteria. The experimental component of this project tested the effectiveness of several alleged "natural antibiotics" and their bacteria-killing abilities through the measurement of the zone of inhibition resulting from a spot treatment of each antibiotic on an agar plate brewed with bacteria (by radius in mm). Antibiotics used included Echinacea & Goldenseal, Goldenseal Root, Garlic 500, Thyme, Olive Leaf, and Green Tea Complex, and data collected from these sets of trials were compared to those of the positive and negative controls Ampicillin and water, respectively. Five sets of trials were conducted on four separate occasions between September and November 2010. The null hypothesis stated that the natural antibiotics would show no difference in killing bacteria from the synthetic antibiotic, while the alternative hypothesis stated that there would be a difference between the abilities of the two types. Z tests were conducted on the data to determine the deviation of results from the mean, with Garlic 500 receiving scores ranging from -1.54 to 1.03 and Ampicillin receiving scores ranging from -1.22 to .83. The other supplements all received z-scores of 1, simply because there was no deviation from the mean (which was zero, due to the lack of a zone of inhibition). Though Garlic 500 was the only tested natural antibiotic containing a zone of inhibition, it displayed more consistency than Ampicillin, as there was a zone of inhibition in all five of the Garlic trials, while the zone was present in only 3 of the 5 Ampicillin trials.

The Effect of Garlic in Killing *E. coli* Bacteria

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Home remedies such as garlic were used by our ancestors to fight and prevent diseases. Dr. Tariq Abdullah, a garlic researcher, proved that garlic was antiviral and antibacterial. The purpose of the experiment was to determine if garlic was able to kill *Escherichia coli* (*E. coli*^{K12}) bacteria. Smashed clove, garlic powder, garlic oil, and garlic extract juice were tested. Mixtures of 20 ml of milk along with 1 g of each type of garlic and *E. coli* were prepared and were incubated for two hours. Then, 1 g of each was placed on several agar plates and the growth of bacteria was observed for a week by recording the percentage coverage of *E. coli*^{K12} in agar plates. At the end of the week, results showed that smashed clove was most successful in preventing the growth of bacteria with 0% average bacteria coverage. Garlic powder had a 20% average bacterial coverage, and garlic extract juice had a 16.7% average bacterial coverage. Garlic oil resulted to be the least successful in eliminating the growth of bacteria with 36.7% average bacterial coverage. Two controls were used; one with pasteurized homogenized milk on the agar plate (0% average bacterial coverage after a week), and one with milk and *E. coli*^{K12} (46.7% average bacterial coverage after a week). These results suggest that smashed clove was more successful in preventing the growth of bacteria because garlic is a natural product and there is more allicin, which gives garlic more healing benefits than the other substance tested.

The Effect of Silver Nitrate on Growth of *Saccharomyces cerevisiae*

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The effect of silver nitrate on growth of *Saccharomyces cerevisiae* was studied by evaluating changes in light absorbance over the course of six hours. Two different concentrations were compared to a control containing no silver nitrate. The rationale of this experiment was to determine whether or not a connection exists between silver in the body (i.e., amalgam fillings) and an increase in yeast growth. A research hypothesis was formulated which stated that if *S. cerevisiae* is cultured in the presence of silver nitrate, then mean light growth of tubes treated with 0.5M will be greater than the mean growth in tubes exposed to 1 M. A heavy metal solution was added to a culture of yeast and incubated at 30°C. Light absorbance was measured by a Genesys 20 Visible Spectrophotometer at two hour intervals for six hours. Statistical analysis consisted of a t-test which compared the average differences in light

absorbance between the two and six hour intervals for the two levels of the independent variable. All the statistical analysis performed showed the data to be statistically significant, and the research hypothesis was supported. These results may be due to pH changes caused by the silver's presence, in turn creating a better environment for the *S. cerevisiae* to proliferate. In addition, *S. cerevisiae* is also known to benefit metabolically from heavy metals such as silver, thus encouraging greater growth.

The Effect of UV Light Exposure on Mutation Rates in *Staphylococcus*

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In my experiment I am going to see if the UV light (like the UV used in tanning beds or exposure to the sun) can lead to mutations in *S. epidermidis* that will allow it to become resistant to the antibiotics Naladixic Acid and Ampicillin. I wanted to do this project because many of my friends use tanning salons or do not wear sunscreen when they go out in the sun and I wanted to show them that there might be other consequences besides skin cancer to UV exposure. The purpose of the experiment was to see the effect of UV light exposure on mutation rates in *S. epidermidis*. My hypothesis for the experiment was that if *Staphylococcus* bacteria were exposed to increasing amounts of UV light mutations in the bacteria will occur that may lead to antibiotic resistance. Alternatively, increasing exposure to UV light could lead to killing the bacteria. The independent variable in my experiment was the length of exposure to the UV light the bacteria were exposed to. For the levels it was the amount of time each bacteria was under the UV light. The control was the same bacteria not exposed to UV light. Each level had three repeated trials. My dependent variable was the amount of bacteria that was resistant to antibiotics after the treatment.

The Rate of Hydrophobic Interactions on the Structure and Stability of Glyoxysomal Malate Dehydrogenase

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Glyoxysomal malate dehydrogenase (gMDH) is an enzyme that is crucial to the Krebs cycle. The purpose of this experiment was to assess the role of hydrophobic interactions and their impact on the structure and stability in isoleucine 140 mutants. It was hypothesized that if an enzyme has a lower activity rate, then the structure of that enzyme would change from its original state causing the enzyme to be more stable. The rationale for testing this was to study how the mutations changed the activity, structure and stability of the enzyme. Isoleucine 140 appears to interact with nonpolar residues around it. To assess the role of these hydrophobic interactions, I140 was mutated to glutamine, alanine, and glutamate. Mutants were created using Stratagene® QuickChange protocol. Expressed protein was purified using Ni-NTA chromatography and kinetic constants were obtained by fitting the data to a Michaelis Menten Equation to give K_m and V_{max} values. The results show the K_m and V_{max} values of OAA and NADH. They also indicate the secondary structure which is tested by circular dichroism (CD) using polarized light. The thermal melt testing shows the tertiary structure and stability. The data depicted that I140E, I140Q and native all had a similar activity structure and stability while I140A did not follow the same trend. Since I140A had a lower activity rate and was stable, it shows the connection between lower activity rates and stability. Future studies could further develop these findings and better support this hypothesis.

The Effects of Bamboo Fiber on the Amount of Bacterial Growth in Bed Sheets

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Bamboo sheets are a very controversial topic about their antibacterial properties. Bamboo itself is antimicrobial but the discussion is whether those properties carry into the manufacturing of the sheets. The purpose of this experiment was to discover if there is a significant difference in the bacterial growth of two types of sheets. An experiment was done to determine the zone of inhibition in the experimental group, bamboo sheets and the control group, cotton sheets. *S. epidermidis* was placed on a Petri dish with the circular pieces of sheets for 36 hours and the growth of the bacteria was measured with a scientific ruler. A significant difference was discovered by using

a t-test on Excel. The null hypothesis that there is no difference in the antibacterial properties of bamboo and cotton sheets was rejected. A similar test done in China found results that also support the theory of antibacterial properties in bamboo sheets.

The Effect of Disinfectants and Antiseptics on *Escherichia coli* Growth

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The purpose of the experiment was to see if disinfectants really killed bacteria on surfaces or whether advertising simply distorted their capabilities. The hypothesis stated that if the *Escherichia coli* bacteria were exposed to different disinfectants, then fewer and smaller colonies would grow because the disinfectant would suppress or terminate bacteria growth. The independent variable in the experiment was the brand of disinfectant (Clorox 409 all-purpose cleaner, Swiffer WetJet antibacterial cleaner, Lysol disinfecting spray, and Germ-X). The dependent variable was the size of the zone of inhibition (the area on which no bacteria grew because it had been killed by the disinfectant). Sterile technique was used to inoculate Petri dishes with the bacteria and the independent variables. An ANOVA was run on the raw data collected and it yielded an F-value of 122.788 and a p-value of 2.714×10^{-59} , making the results statistically significant. These findings supported the hypothesis.

Effect of Different Hospital Surfaces on the Viability of *B. thuringiensis*

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This experiment was performed to determine the effect of copper compared to other commonly contacted metals in a hospital setting on the viability of bacteria. If copper or any of the other surfaces show antimicrobial potential, it can be used on commonly contacted surfaces to reduce the bacterial load and the potential for bacterial transfer between individuals. This would reduce the number and high cost of nosocomial infections. For example in the United Kingdom it costs a billion pounds annually to deal with the effects an estimated 300,000 nosocomial infections. It was hypothesized that the copper and zinc would show a similar detrimental effect; while a nickel-silver alloy would show a less significant detrimental effect; and aluminum would show no effect. To determine the viable bacteria after exposure on test tickets, the bacteria were quantified in 2 experiments. In both experiments the period of exposure was 180 minutes. After exposure they were washed using solutions of Luria-Bertani (LB) broth. A dilution series of the bacteria was diluted and plated. Copper and zinc in this experiment showed an approximate ten-fold antimicrobial effect against the bacteria *Bacillus thuringiensis* with an ANOVA analysis result of 76.34 with a requirement for a significant result being 5.185. This and the antimicrobial effect of copper suggested last year suggest that copper is an effective bactericidal surface, for gram-negative and gram-positive bacteria, and shows potential for use in hospitals to reduce nosocomial infections. As zinc also showed an antimicrobial effect; there is the potential in concert with copper as the alloy brass.

The Effect of Varied Acne Medications on Bacteria Colonies' Inhibition Zone

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Acne is a skin disease that affects virtually all people at some point in their lives. Acne is initially caused by an oily substance called sebum mixing with the lining cells of a hair follicle, called keratin. This mixture is due to a buildup of both substances, caused by poor exfoliation of the skin. Once the sticky mixture creates a "plug" in the top of the follicle, acne causing bacteria accumulate underneath. This bacterium (*Propionibacterium acnes*) attracts white blood cells to the scene of infection, which makes the area swollen and inflamed. This process is the reason for the whiteheads, blackheads, and pustules that occur on a person's face, chest, or back. The purpose of the following experiment was to determine which of four acne treatments would kill the most *E. coli* bacteria. The hypothesis was that the treatment with the highest amount of salicylic acid would kill the most bacteria, and therefore have the best effect on destroying acne. Ten trials of the four treatments were performed. The *E. coli* was grown in ten Petri dishes, then paper cutouts were dipped in the medicines and applied to the bacteria. The dishes

were observed every 24 hours for 3 days in an incubator, to record visual changes and the measurements of each cutout's inhibition zone. At the conclusion of the experiment, the hypothesis was neither accepted nor declined. Due to either too weak of treatments used, or too much time in the incubator before the treatments were applied, none of the medicines created incubation zones.

MICROBIOLOGY B

FIRST PLACE

Interactions between Nonhost Plants and Nitrogen Fixing Bacteria (*Nostoc punctiforme*)

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Some cyanobacteria are able to fix nitrogen (turn atmospheric dinitrogen gas into the more useful ammonium), an ability that other organisms take advantage of by forming symbioses with the cyanobacteria. The genus *Nostoc* is the most common cyanobacterium in plant symbioses. Plants that have formed symbioses with nitrogen-fixing bacteria do not need environmentally harmful nitrogen-based fertilizers, which is why scientists would like to modify plants to allow them to form these symbioses. The purpose of this project was to investigate how different plants make contact with cyanobacteria, a crucial first step in initiating symbiosis. Mungbean, radish, and alfalfa plants (all three to four weeks old) were placed on the center of Petri dishes, each of which had a colony of *Nostoc punctiforme* on it. The day after the plant was put on the plate, the distance from the colony to the hormogium (a motile filament of *Nostoc*) that had travelled the furthest in each of four directions was measured. The distance travelled towards the plant was compared to the other three distances in a ratio. Roots grown towards and away from the cyanobacteria were also measured after 4-8 days. Ratios of distance travelled by *Nostoc* were highest for radish plants and slightly lower for mung beans. Alfalfa ratios and the ratios of the negative control of no seedling were half those of the other two plants, though all measurements had low t-values and high standard deviations. Later, chemoattraction to one radish and two mungbean plants was visible to the naked eye. Mungbean and radish plants also tended to grow roots towards the *Nostoc* more often than they did in the opposite direction, probably in order to take advantage of the nitrogen produced by the cyanobacteria. Possibilities for future investigation include allowing the cyanobacteria greater time to move, testing older plants, and growing plants in liquid and then testing the chemoattractant ability of that liquid.

SECOND PLACE

The Phytoplankton (*Nanochloropsis*) to Zooplankton (*Artemia*) Ratios which Lead to a Microbial Loop and their Effect on Dissolved Oxygen Levels

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The microbial loop, an offset of a normal aquatic food chain, is an important way for carbon to be used in aquatic environments, but can also be devastating when eutrophication occurs. Developing a way to monitor and predict occurrences of the microbial loop has multiple benefits. This information is important for the Chesapeake Bay because of the many dead zones that develop due to eutrophication. Waters become hypoxic and anoxic affecting the multitude of organisms living there. This study compares the effects of the microbial loop on water quality. In order to test the hypothesis that the microbial loop by itself can in fact cause hypoxic and anoxic waters, a controlled experiment was conducted. Tests of different phytoplankton to zooplankton ratios were conducted to see what ratio would lead to a microbial loop resulting in a lower dissolved oxygen level. After testing five different ratios, a phytoplankton to zooplankton ratio of 2880384211:1 led to a microbial loop, and the dissolved oxygen decreased dramatically. The dissolved oxygen decrease was probably due to the bacteria using the dissolved oxygen to decompose the dead and decaying phytoplankton and zooplankton. Other possible explanations could be that there were additional factors leading to the decrease in dissolved oxygen such as nitrates or phosphates.

THIRD PLACE

The Effect of Essential Oils from Cinnamon, Cloves, and Garlic on Inhibition of Growth Rate of K-12 *Escherichia coli*

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The purpose of this experiment was to analyze the effect of essential oils from cinnamon, cloves, and garlic on the inhibition of growth rate of K-12 *Escherichia coli*. The study was conducted by a high school student at Central Virginia Governor's School during November and December of 2010. Filter discs soaked in essential oils from cinnamon, cloves, garlic, and nothing (control) were applied to plates of K-12 *Escherichia coli* and incubated for twenty-four hours. The zone of inhibition created by the various essential oils was then measured in millimeters using a ruler. An ANOVA was performed and produced a p-value of 1.79E-39. Because the alpha level was set at 0.05, the data were considered to be statistically significant. A Tukey Test was performed as a follow-up, and significant differences were found between each group. The results showed that when cinnamon, cloves, and garlic were applied to K-12 *Escherichia coli*, the growth of the bacteria was inhibited. Garlic had the greatest inhibitory effect. This does not support the researcher's hypothesis that if essential oils from cinnamon, cloves, and garlic were used to inhibit growth of K-12 *Escherichia coli*, then cinnamon would be most effective in inhibiting the bacterial growth. In conclusion, there was a significant interaction between the type of spice applied and the measured zone of inhibition of K-12 *Escherichia coli*.

HONORABLE MENTION

Effects of Different Sweeteners on the Cellular Respiration of Yeast

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Sugary foods and beverages are known to cause metabolic disorders, such as obesity. However, research studies have suggested that some types of sugar substitutes or zero-calorie sweeteners do not produce any energy when broken down by the human body and, therefore, do not contribute to obesity. Although zero calorie sweeteners will reduce obesity risk if eaten in moderation, recent studies suggest that those sweeteners might increase craving and contribute to obesity. This study branched out of these two controversial claims. The objective of this study was to test whether commercially sold sugar substitutes produce energy for the body. Six sweeteners (white sugar, brown sugar, aspartame, sucralose, saccharin and stevia) were used to test the amount of carbon dioxide produced during the cellular respiration of baker's yeast, *Saccharomyces cerevisiae*. The more carbon dioxide meant that more energy was produced by the yeast. Two sets of experiments were conducted to test the amount of carbon dioxide produced by yeast, one with the same quantity of sweetener and another with different quantities of sweeteners needed to give the same sweetness. For each experiment, three trials were conducted. For each trial, yeast mixed with water and sweeteners were kept under a light source for a four hour period. The circumference of the round balloons attached to the test tubes were measured every 20 minutes and the volume of carbon dioxide was calculated. The results varied over the three trials, but all six sweeteners produced carbon dioxide in both the experiments. The zero-calorie sweeteners produced less carbon dioxide than the two natural sugars in the second, same sweetness-experiment.

HONORABLE MENTION

The Effect of Different Bactericides on Bacterial Kill Rate

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One of our biggest current concerns is the seeming failure of our 'miracle drugs' that are used to combat bacterial infections. With severe overuse, antibiotics have become less effective as bacteria have evolved to resist

their attacks. One solution, bacteriophages, was tested in this experiment. First discovered in 1915, bacteriophages are viruses that attack certain bacteria, while avoiding human cells and non-targeted bacteria completely. Two popular antibiotics, Amoxicillin with clavulanic acid and Streptomycin, and the T4r bacteriophage were tested on *E. coli* K12 bacteria for kill rate over time. It was hypothesized that the T4r bacteriophage would produce the largest kill radius. However, the phage did not produce results comparable to the antibiotics. There was some thinning in spots on the phage trials, but the phage did not produce any kill “zones”, or areas void of bacteria. The Amoxicillin trials resulted in the largest kill radius over time for the two antibiotics, with an average of 0.9 cm. However, many bacterial colonies appeared within the radius, evidently resistant to Amoxicillin. These ‘regrowth colonies’ did not crop up in Streptomycin, which had an average kill radius of 0.77 cm. The experiment showed that Streptomycin was the more effective of the two antibiotics. Even though it had a lower kill radius, the Streptomycin did not allow regrowth in the *E. coli* bacteria. The phage was mostly ineffective. This seems to be because it was originally keyed for *E. coli* B, not *E. coli* K12.

HONORABLE MENTION

The Effectiveness of Antibiotic Combinations

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The purpose of this experiment was to determine if there is a pattern in the effectiveness of antibiotic combinations on the growth of gram positive and gram negative bacteria. The antibiotics Ampicillin and Cefotaxime inhibit bacterial cell wall formation; the antibiotics Chloramphenicol and Streptomycin affect bacterial protein synthesis. If different combinations of these antibiotics are used to inhibit bacterial growth, then some combinations will prove more effective than others. This experiment compared different dosage combination for their effects on bacterial growth and plating efficiency after 24 hours of exposure to the antibiotics. The first step in the experiment was determining antibiotic doses of equal strength. The optical density of the solutions was measured using a spectrophotometer and the bacteria count was measured by plating the solutions on agar. The dilutions of Ampicillin and Cefotaxime had similar results and therefore were equally as strong. Equal doses of Ampicillin and Cefotaxime were then combined and put into eight cuvettes. The effects of the antibiotics, Ampicillin and Cefotaxime, on *Escherichia coli* were determined using spectrophotometric and plating techniques. The growth of the bacteria was measured by determining the optical density of the broth cultures. The antibiotic combinations prohibited growth of bacteria over the entire 6 hour period, while the bacteria treated with single antibiotics was able to grow in the first 2 hours and decreased in the final 4hours. The plate count results were inconclusive. The optical density of the different antibiotic combinations shows that antibiotic combinations are more effective than single antibiotics. Future tests are underway to see if there is a pattern in the effectiveness of antibiotic combinations.

The Antibacterial Effect of Colloidal Silver as an Additive to Water-Based Polyurethane Applied to Wood

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The purpose of this research was to determine the effect of colloidal silver as an antibacterial additive to water-based polyurethane applied to wood. This research was conducted in the Central Virginia Governor’s School laboratory between November 19, 2010 and January 24, 2011. Different concentrations of colloidal silver were mixed with water-based polyurethane to create mixtures with colloidal silver concentrations of 1 ppm, 25 ppm, and 100 ppm. A control group was created without the addition of any colloidal silver. The researcher applied the polyurethane mixtures to wood samples and inoculated them with a diluted Tryptic Soy broth medium of *Escherichia coli* K-12. After 24 hours, the bacteria on the surface of the wood samples were transferred to agar plates with two different methods. In Phase I, the researcher accomplished this by using a wood stamping method; in Phase II, a sterile buffer rinse technique was used. The bacteria on the agar plates were cultured in an incubator for 24 hours, and the colony forming units on each plate were counted. A single factor ANOVA of the results from

Phase II produced a p-value of 0.264, which was significantly greater than the alpha value of 0.05. This suggested that the original hypothesis—that the highest concentration of colloidal silver would result in the least number of CFU's—was not supported. In conclusion, the inferential statistics showed that colloidal silver does not have an antibacterial effect; however, descriptive data trends indicated that the silver concentrations may have impacted bacterial growth.

The Effect of Different Mouth Washing Agents on the Amount of Mouth Bacteria

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Bacteria have a strong ability to survive among human hosts, and its endurance in the mouth can cause unwanted infections. Oral hygiene aids play a significant role in the survival of mouth bacteria, and certain mouth washing methods can contribute to breaking down bacteria colonies. The purpose of this project was to determine how bacteria colonies from the human mouth would be affected by the different types of mouth washing methods such as saltwater, mouthwash, and toothpaste. Another purpose for this experiment was having an interest in the study of bacteria. The research hypothesis was if saltwater was used then there would be less bacteria colonies. The null hypothesis was the different mouth washing methods have no effect on the amount of mouth bacteria colonies. When participants woke up in the morning without any prior cleaning, the control was taken. Each day, the participants used a different washing method and recorded the data. When the oral cavity of each participant was brushed with a toothbrush and toothpaste, there was a significant decrease in the amount of bacteria in the mouth. However, the mouth bacteria increased significantly when the oral cavity was rinsed with saltwater. The multiple t-tests performed on the data showed that the majority of the data was significant enough to disprove the research and null hypothesis. The null hypothesis was rejected when the control was compared to tooth brushing for participants 1, 2, and 3 ($t = 15.3 > 2.306$; $t = 7.6 > 2.306$; $t = 8 > 2.306$ at $df = 8$; $p < 0.05$). Based on the data taken from this experiment, it was determined that tooth brushing with toothpaste is the most effective method in practicing oral hygiene. The saltwater increase may have been due to a fondness of salt by bacteria. Furthermore, the results may have been more conclusive if each of the other mouth washing agents had a stronger direct contact with the bacteria, like the toothbrush, instead of simply being swished around the mouth.

The Effect of Garlic on Bacteria Growth

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Through the past centuries, people have noticed that garlic has medicinal properties. The clove of the garlic is the part of the plant that seems to be able to eliminate bacteria. *Escherichia coli* are bacteria that create an infection in the stomach. Garlic has been noticed to be effective at killing bacteria and lessening the effects of diseases from infection. The purpose of this project was to see if garlic had any true effect on bacteria such as *Escherichia coli*. It was predicted that garlic would inhibit the growth of *E. coli*. Ten Petri dishes were filled with plain agar and ten more Petri dishes were filled with agar and 0.6 grams of garlic mixed together. The bacteria were spread in the Petri dishes, allowed to grow, and then bacteria growth on each plate was observed and recorded. The Petri dishes with no garlic showed a definite growth of bacteria, whereas the plates with garlic had absolutely no growth of bacteria. A chi-square test was then performed on the data to determine the significance of the experiment ($X^2 = 10 > 7.815$; $X^2 = 10 > 7.815$ at $\alpha = 0.05$ and $df = 1$). The data accepted the research hypothesis and rejected the null hypothesis that if garlic is added to Petri dishes, then it will have no effect on the bacteria. Based on the lack of bacteria growth, there seems to be a direct relationship between garlic and bacteria growth. Before it can be finally concluded that the garlic was the only cause for the bacteria not growing, more experiments will need to be conducted to see if the bacteria would grow with garlic if given more time.

The Effect of Different Foods on Bacteria Colonization

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Bacteria have been found in nearly every corner of the world. The unicellular organisms have been known to reproduce rapidly through a process called binary fission. Studies have shown that bacteria can have a 200% increase in growth per month due binary fission. Most large colonies of bacteria have been found in pH levels around 6-8. The purpose of the experiment was to determine whether or not different types of food affected the bacteria colonization. The null hypothesis was: different foods had no effect on the colonization of bacteria. The research hypothesis was if chicken was placed in the incubator then the bacteria growth would be the greatest. The different levels of the IV, carrots, chicken, apples, and bread, were swiped by a sterile swab and then the swab was rubbed onto a Petri dish with nutrient agar. Afterwards, the Petri dishes were placed into an incubator for five days. The carrots had the most overall growth increase with the average being 0.479 and apples showed the least with an average of 0.162. The null hypothesis was accepted ($t = 0.552 < 2.101$; $t = 0.051 < 2.101$; $t = 1.006 < 2.101$; $t = 1.745 < 2.101$; $t = 0.954 < 2.101$; $t = 1.481 < 2.101$ at $df = 18$; $p > 0.05$), therefore the data did not support the research hypothesis that different foods affect bacterial colonization. Based upon information gathered from the experiment, the result was concluded that the carrots had the most increase in growth due to the residue left from the soil. Further studies should be conducted to verify that the soil remains affected the bacteria growth or that bacteria are affected by more acidic conditions such as apples.

***Panicum virgatum* and Nitrogen-Fixing Bacteria**

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The purpose of this experiment was to determine if *Panicum virgatum* (switchgrass) could have an association with nitrogen-fixing bacteria, since *Panicum virgatum* is a potential biofuel source and with an association with nitrogen-fixing bacteria could thrive in nitrogen poor soil. The research was conducted at the Central Virginia Governor's School between November 12, 2010 and December 13, 2010. A group of switchgrass plants was grown in a nitrogen-free media hydroponically to see if any plants would grow, therefore suggesting that nitrogen-fixing bacteria were associated with the plants. Height measurements and survival counts were recorded. Out of the 180 switchgrass seeds planted in the nitrogen-free media, 42 survived throughout the entire experiment. A chi-squared test of independence was run to determine if any one of the five cultivars planted in the nitrogen-free media survived better than the other cultivars. The test returned a p-value of 0.068, suggesting that no certain cultivar was more susceptible to an association with the bacteria. The researcher's original hypothesis that if a large sample of switchgrass was grown in a nitrogen-free media, then a small cohort of the switchgrass seeds would survive and grow was supported. In conclusion, it is possible for *Panicum virgatum* seeds to have an association with nitrogen-fixing bacteria.

The Effect of Different Acne Medicines on Bacteria Growth

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Acne is a common condition of the skin, with many possible treatments. This condition most commonly occurs in the hair follicles and sebaceous gland, which are known to generate oils. This condition offers a number of different possible treatments and medications. The purpose of this project was to determine which of the following acne medications prevented the most bacterial growth in a zone of inhibition: benzoyl peroxide, sulfur and salicylic acid. Each treatment was tested by placing a paper disk in the medication and then setting on the Petri dish and leaving in the incubator overnight. The zone of inhibition around the disk was then measured. The results indicated that the agar treated with salicylic acid showed the greatest mean diameter of zone of inhibition at 11.30 mm and the agar treated with no medication had the smallest mean zone of inhibition at 0.90 mm. A t-test performed on the data showed significant difference between the results ($t = 2.76 > 2.101$, $t = 3.22 > 2.101$, $t = 8.31 > 2.101$, $t = 3.38 > 2.101$ at $\alpha = 0.05$ and $df = 18$). The data did not support the research hypothesis that if the zone of inhibition was measured after being treated with benzoyl peroxide, sulfur, and salicylic acid, then benzoyl peroxide would prevent the most

bacterial growth. Based on this research, there seems to be a direct relation between the bacterial growth prevention and type of medication applied. It can be concluded that all three of these medications successfully prevent bacterial growth, but salicylic acid most successfully does this.

The Effectiveness of Reusable Air Filters in Preventing the Spread of Airborne Pathogens

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The purpose of this study was to compare the effectiveness of a reusable filter to a non reusable filter in the prevention of the spread of airborne bacteria. Reusable and non reusable air system filters were tested against one another for the effectiveness of the prevention of the spread of airborne bacteria. Filters were placed in an air filtration system for 2 weeks and were then sampled for bacteria which were allowed to grow for 48 hours of incubation. The number of significant colonies found from each sample was then averaged for each of the filters in colony forming units/ ml (cfu/ml). The amount of bacteria found on the reusable filter was 125.2 cfu/ml and the amount of bacteria found on the non reusable filter was 222 cfu/ml. The results were insignificant despite there being a difference in average amount of bacteria. The p-value of this experiment was 0.180, much above the set alpha value of 0.05. The original hypothesis that if bacteria found on a reusable and non reusable air system filter were counted after two weeks of use, then the non reusable filter would have a more significant number of bacteria present on it, was not supported. In conclusion, the results support that filter type does not determine the effectiveness of the prevention of the spread of airborne bacteria

The Effect of Different Cleaning Solutions on the Amount of Bacteria on the Interior Surface of a Hockey Glove

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Bacteria are microbes, microscopic organisms that cannot be seen with the naked eye. Some types of bacteria are harmful to humans, which is why different disinfecting solutions are used to reduce the amount of bacteria which may or may not be detrimental to the human body. Bleach, soap, alcohol, and Betadine solution are all examples of disinfectants. When looking for a cleaning solution, the ideal solution would be bactericidal. Bactericidal solutions actually kill the bacteria. Bacteriostatic solutions inhibit or slow down the growth of bacteria. Bleach, alcohol, and Betadine solution (povidone iodine) are bactericidal, whereas soap is bacteriostatic. To rid bacteria, cleaning solutions such as bleach, soap, and alcohol are commonly used. Because microbes can be detrimental to the human body, cleaning agents (either bactericidal or bacteriostatic) are used to reduce the amount of bacteria exposed to humans. The purpose of this project was to determine which cleaning solution was the most effective at killing bacterial growth. The interior surface of a hockey glove was swabbed and dipped in a certain cleaning solution for a set amount of time. The swab was then swabbed onto the Petri dish and the bacterial colony growth was observed and counted for three days. The results indicated that bleach was the most effective cleaning solution. A t-test performed on the data showed that the null hypothesis, cleaning solutions have no effect on bacterial growth, was rejected in these situations ($t = 0.97 < 2.101$; $t = 1.12 < 2.101$ at $df = 18$; $p > 0.05$). The data supported the research hypothesis that if various cleaning solutions are applied to the swab samples, then the bleach solution will result in the smallest amount of bacterial growth. Based on the amount of bacterial growth, bleach, alcohol and Betadine solution are the most effective solutions at killing bacteria. These solutions are bactericidal and are far superior agents than soapy water, which is an example of a bacteriostatic solution.

The Effect of Gymnastics Equipment on the Presence of *Staphylococcus aureus*

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Staphylococcus aureus is a bacterium commonly found in the nose, on the skin, and on inanimate objects and may be harmless or cause a variety of infections. A fraction of these organisms are a drug-resistant form called Methicillin-Resistant *Staphylococcus aureus* (MRSA), which has become an "emerging epidemic". Athletes

involved in several contact sports are at a higher risk of acquiring MRSA. The purpose of this study was to evaluate for the presence of *S. aureus* and MRSA on gymnastics equipment to determine if gymnasts are at increased risk. It was hypothesized that if the vault table, uneven parallel bars, and balance beam were tested for the presence of *S. aureus* and MRSA, then the balance beam was expected to be colonized the heaviest. In the contact area of each piece of equipment, a 6x6 cm square was swabbed then used to streak selective media plates. To identify MRSA, *S. aureus* colonies from mannitol salt plate were inoculated onto additional mannitol plates, with and without Oxacillin, and then incubated. Growth on the Oxacillin-containing plate indicated that the *S. aureus* was MRSA. The uneven parallel bars had the highest density of *S. aureus*, with a mean of 7 colonies, but this difference was not significant by t-test ($t = 0.51 < 2.447$; $t = 0.11 < 2.447$; $t = 0.50 < 2.447$ at $df = 6$ $p > 0.05$), and the research hypothesis was not supported. One colony of *S. aureus* each from the beam and vault grew on the Oxacillin-containing plates indicating the presence of MRSA. While there were no reports of MRSA infection in a gymnastics gym, the literature contains numerous reports of MRSA infection in common contact sports that involve skin to skin contact. These results indicate that *S. aureus* and MRSA may be present in the gymnastics environment. Additional studies to confirm this finding and to protect gymnasts from *S. aureus* are recommended.

The Effect of the Age of Purse on the Amount of *E. coli* Growth

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The purpose of this study was to determine whether there was a difference in the amount of bacteria collected from new purses, which were six months of age or newer, versus old purses, which were more than six months of age. This study took place in the Central Virginia Governor's School analytical lab and lasted for three weeks between November and December 2010. Purse of the two different ages were swabbed using a swab kit and then left to incubate for 72 hours; the number of bacterial colonies was then counted. A two-tailed t-test showed that there was not a statistically significant difference between bacteria on new purses and bacteria on old purses, since the p-value was 0.29 which was higher than the alpha level of 0.05. The original hypothesis that if purses were swabbed for *E. coli* levels, then a purse older than six months would have more bacteria than a purse six months of age or newer, was not supported. In conclusion, the difference between the bacterial counts on new purses versus old purses was not significant; therefore, age does not have an effect on the amount of bacteria on a purse.

Speedy Little Critters...Speeding to their Deaths

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The purpose of this project was to find the effect of the amount of caffeine *Paramecia* are given on how long their life spans are. The hypothesis was if *Paramecia* are given different amounts of caffeine, then the *Paramecia* that are given 10 mmolar of caffeine, or 1/2 of a caffeine pill, will live the longest. The *Paramecia* were given different concentrations of caffeine up to 20 mmolar. Before the actual experiment, the *Paramecia* were cultured for two weeks. Afterwards, they were put into their individual groups and given their varying amounts of caffeine. Then, the *Paramecia* were videotaped periodically in the 10x and 60x view (every 8 hours or so) until they all died. Then, the videos were analyzed using Logger Pro on the computer. The group of *Paramecia* that was given a 10 mmolar concentration of caffeine lived the longest, and the *Paramecia* that were given a 15 mmolar concentration and the *Paramecia* that were given a 20 mmolar concentration had the shortest life spans. In a previous study, it was found that *Paramecia* that received a 20 mmolar concentration of caffeine had very low speeds, leading to the conclusion that too much caffeine had a negative effect on *Paramecia*. The hypothesis was formed based on the thinking that too little caffeine would make the caffeine a non-significant stimulant, but too much caffeine could be harmful for the *Paramecia*. Some problems encountered during the experiment were that the first culture of *Paramecia* was eaten by rotifers while being cultured, so new *Paramecia* had to be ordered. If this experiment were performed again, the *Paramecia* would be put into a 9 mmolar concentration, a 10 mmolar concentration, and an 11 mmolar concentration to test whether or not the result of the 10 mmolar concentration was valid, and whether or not concentrations closer to 10 mmolars would have similar results. . Also, the *Paramecia* would be put in bigger jars during the experiment to maximize the possible lifespan. It was concluded that the hypothesis was accepted.

Antimicrobial Activity of Homemade Mouth Rinses

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Mouth rinses are an important adjunct to regular oral hygiene because they increase consumer's overall oral health. There are commercial mouth rinses; however, there are also many kinds of cheap and easy-to-make homemade remedies. Because it is important for consumers to know which type of mouth rinse is most effective at reducing bacteria, this study tested the efficacy of homemade mouth rinses with the use of the following ingredients: hydrogen peroxide, sodium bicarbonate, vinegar, normal saline, and cetylpyridinium chloride (CPC). CPC was found to be the most effective commercial rinse from previous experimentation. The first three ingredients were used because they are the most popularly suggested homemade mouth rinses. The normal saline was used to establish a control. One hundred human subjects had their mouths swabbed to sample for bacteria before and after using the mouth rinse. Blood agar plates were inoculated with the swabs and then incubated for 24 hours between 37 and 38°C. The bacterial reduction count (BRC) of the bacterial colonies was used for analyzing after counting the bacteria. The means of each mouth rinse were compared using a one-way ANOVA and Tukey's tests and a p-value less than 0.001 was generated because the sodium bicarbonate was found to be significantly worse than the rest of the solutions, except for normal saline. It was hypothesized that none of the mouth rinses would be significantly better at reducing microbes with a p-value less than 0.05 excluding the Crest brand. There was insufficient evidence to reject the hypothesis. Improvements to the experiment include using at least thirty volunteers for each rinse and using different combinations of ingredients (i.e., sodium bicarbonate combined with normal saline). The results show that none of the homemade mouth rinses were significantly better at reducing microbes in respect to normal saline. Conclusively, it is more efficient for consumers to buy Crest mouth rinse rather than make their own.

The Effect of Dish Detergents on the Number of K-12 *Escherichia coli*

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The purpose of this study was to test the effectiveness of antibacterial and bleach alternative dish detergent on the amount of colony forming units per milliliter (CFU/ml) of K-12 *Escherichia coli*. The study was conducted at a high school in January 2011. The researcher grew K-12 *E. coli* bacteria, diluted it, and then exposed the bacteria to four different dish soaps: Ajax antibacterial, Ajax plus bleach alternative, Dawn antibacterial, and Dawn plus bleach alternative dish soaps. The bacteria were grown on Easygel® plates and left to incubate for 48 hours. The bacteria were then counted in cfu/ml. After the experiment, a single factor ANOVA test was performed. The results from the ANOVA test indicated that the p-value (6.49×10^{-11}) was less than the set alpha value (0.05). In conclusion, the antibacterial dish soap had a great effect on killing bacteria and demonstrated the best results. The original hypothesis, that the amount of cfu/ml would be the same when comparing the antibacterial and the bleach alternative dish soaps, was not supported.

The Effect of Human Contact on the Transfer of Bacteria at Surfaces

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Bacteria are diverse organisms and can be found virtually anywhere. Certain qualities have allowed bacteria to attach and live on surfaces for varying periods of time. Different bacteria are found to attach to different surfaces depending on certain variables such as surface material and surface temperature. The purpose of this experiment was to determine which surface in a school environment contained the highest number of bacterial colony forming units. Four different surfaces were swabbed over the course of ten days, the surfaces being the front door handle of the school, a nurses' door handle, a railing on a staircase, and a laptop computer keyboard. The swabs were then respectively swabbed into corresponding quadrants in Petri dishes. The bacteria were allowed to culture for forty-eight hours. The results indicated that the highest mean number of bacterial colony forming units was found on the laptop computer keyboard (22.2 CFUs) and the lowest mean number of bacterial colony forming units at the staircase railing (4.3 CFUs). A t-test performed on the data resulted in a rejecting of the null hypothesis

when A was compared to C ($t=3.10 > 2.101$; at $df\ 18$; $p<0.05$). The data did support the research hypothesis that bacterial colony forming units would be most abundant at the surface of the front door handle of the school. Based on variations in the data, surface seems to be related to amount of bacterial colony forming units. This is thought to be true based on the knowledge of variations in temperature (bacteria seem to thrive best in higher temperature), and surface material (bacteria reproduce highest on plastic surfaces). Cleaning products that are used more on surfaces thought to be used the most could also be a contributing factor; but before that can be concluded, data would have to be collected on whether this is true or not.

PHYSICAL SCIENCE A

FIRST PLACE

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

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Carpentry is the joining of lumber to create buildings and furniture. Nails are the oldest and most popular method of joining wood pieces. Once pounded into the wood, the wood fibers grip the long body of the nail, thus creating friction that holds the nail in. Nails can be tested for holding power, the amount of force it takes to pull a nail straight out of the wood. It is known that angling the nails give a joint more holding on strength - the amount of rotation force around a give axis the joint can support. This experiment was performed to discover if angling nails in a joint gave the joint more torque strength, or rotation force around a given axis. Five independent variables were tested: parallel straight nails, parallel up nails, parallel down nails, diverging nails, and converging nails. It was hypothesized that converging and diverging would have the most torque strength and all parallel variables would perform identically. To test the torque strength, a 1.2192 meter long two-by-four board was nailed at one end to an upright beam, horizontal to the ground. A two-by-four actually measures 6.35 by 8.89 centimeters. A bucket was hung from the end and filled with water at half-liter intervals. When the two-by-four dropped 20 degrees, the amount of water held was recorded. The weight of the water could then be added to that of the bucket, which could be converted into Newton-Meters of force. Diverging nails provided the most stable joint, with almost twice the torque strength as parallel straight, the runner up. Parallel up and parallel down performed identically. Converging could not hold up the wood length on any trial but trial three. Carpenters creating a joint that needs torque strength could best do so by using diverging nails.

SECOND PLACE

The Effect of Color of Lids of Boxes on the Change in Temperature in the Boxes

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The purpose of the experiment was to find the effect of paint colors of lids of boxes on the change of temperature inside boxes. It was hypothesized that darker colors would let the boxes retain more heat, since dark colors absorb more light and heat energy than light colors. To test this hypothesis, boxes were lined with tin foil, their lids were painted with black, grey, white and no paint, and the boxes were left outside in the sun for an hour. The initial and final temperatures were recorded. In the end it turned out that boxes without paint retained the most heat, followed by black paint, grey paint and white paint in that order. However, the data were somewhat inconclusive. The results did not support the hypothesis.

THIRD PLACE

The Effect of Wire Length on Effectiveness of Solar Panel Shutoff

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Photovoltaic electricity generation using solar panels is becoming more common in Virginia and around the world, but is it safe? Can solar panels be shut down in an emergency such as a fire? This project looked at the ability for a device to automatically disconnect solar panels when a fire is detected by the standard smoke alarm system in residential homes. For maximum benefit, the panels should be isolated into small enough groups so that the voltage in one area after disconnection is low enough not to injure or kill someone. This project attempted to see if length of wire (independent variable) influenced the ability for a device to successfully shut down (dependent

variable) the solar panels. The length of wire represented the distance from a smoke alarm to the shut off device (PowerInterrupt) within the home. The hypothesis was that all lengths of wire up to 121.92 m (400 ft) would allow the panels to be shut down. It was supported 100% by the experiment. This project demonstrated that a device is capable of disconnecting solar panels when activated by a smoke alarm.

HONORABLE MENTION

The Effect of Wind on Car Speed

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The purpose of the experiment was to find the effect of the speed of a fan (in fan levels) on the average speed of a car (a FOSS Dot Car with four non-motor-powered wheels) (in centimeters per second). It was hypothesized that if the speed of the fan was increased then the average speed of the car would decrease because of air resistance and fluid friction in the air around the car. To test this hypothesis the procedure was as follows: place a car at the top of a ramp and record the amount of time it took for the car to go down the 150-centimeter ramp 10 times for each IV level (off, low, medium, and high). In the end, it turned out that the average speed of the car did, in fact, decrease as the fan speed increased, though the only IV level that was very repeatable and precise was the “off” speed level. It is suspected that this is true because of different experimental errors including different heating and air conditioning in the trial area. The results supported the hypothesis.

HONORABLE MENTION

The Effect of Type of Insulation on the Temperature of a Solar Oven

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Solar ovens are increasingly necessary as an alternative to the use of wood as cooking fuel, because that use is a major cause of deforestation. The purpose of this experiment was to find out the effect of type of insulation on temperature of a solar oven. The different levels of the independent variable -- no insulation, scrap cardboard, denim, and spray foam insulation -- were tested in four solar ovens. The solar ovens were placed under a heat lamp, and the internal temperature was measured after sixteen minutes, starting from a constant temperature. The hypotheses were that if spray foam insulation, denim, scrap cardboard, and no insulation were used, then the temperature of the solar oven would be the highest, second highest, second lowest, and lowest, respectively. The data supported all of the hypotheses. Spray foam insulation is designed to reduce the flow of heat. The performances of the other types of insulation were directly correlated with the densities of the types of insulation. The denim performed surprisingly well, and unexpectedly similarly to spray foam insulation. Denim could be an effective and affordable alternative to chemical-based insulation.

HONORABLE MENTION

The Effect of Different Volleyball Approaches on the Vertical Jump of an Athlete

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In the sport of volleyball, an approach is a quick and fast moving attack used when someone wants to hit a ball. Studies have shown that attacks that end with the forefoot touching the ground allow the player to jump higher than when the heel contacts the ground last. Also, it was found that the trunk of the body is where most of the energy when doing the jump is stored. Greater jump height was found in a study to be dependent on horizontal velocity rather than vertical velocity. Finally, it was found that the vertical jump of each athlete is dependent on the athletic abilities of the player. The purpose of the experiment was to determine how different approaches affected

the vertical jump of an athlete for a no step, one-step, three-step, and four-step approach. The hypothesis was that if the three-step approach was used then the vertical jump would be the greatest. Twenty-nine volleyball players were measured for their height and then they took an approach from each of the designated lines that were set out on the floor for each of the approaches. While in the air the subjects hit the vertical challenger which is a device that measured the height of each of the jumps. The results indicated that the four-step approach resulted in the highest vertical jump and that the no step resulted in the shortest vertical jump. The data did not support the hypothesis that stated that the three-step approach would produce the highest vertical jump. Based on the data there is a direct correlation between horizontal velocity and vertical jump. It was also determined that the height of the leap is also dependent on the athletic ability and gender of the participant. This was found because the data varied immensely due to the athletic abilities of all of the different participants.

The Effect of Resistance on Current

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Electricity is caused by a flow of electrons, which may then travel through a load causing it to activate. Insulators, which resist the electron flow, have a high resistance, which will make it harder for electricity to flow through it. The purpose of this experiment was to determine the effect of resistance on current. It was hypothesized that if the resistance increases, then the current will decrease. A circuit designed to allow varying resistances to be inserted into it was used to collect data for this experiment. The means for each level are 2.72 V for zero ohms, 2.59 V for 1 ohms, 2.39 V for 2 ohms, 2.21 V for 3 ohms, 2.01 V for 4 ohms, 1.89 V for 5 ohms, 1.75 V for 6 ohms, 1.61 V for 7 ohms, 1.50 V for 8 ohms, 1.37 V for 9 ohms and 1.20 V for 10 ohms. The data supported the research hypothesis. The values above prove Ohm's Law, known as $V=I \cdot R$ to be correct. The knowledge gained from this experiment could be used to assist with future experiments involving the concept of electricity.

Will a Springboard or a Mini-Trampoline Work Better?

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The problem in the experiment was will a difference in the type of board affect the outcome of whether or not the gymnast sticks the landing of a front handspring over the vault? The purpose of the experiment is to find out which board, a spring board or a mini-trampoline, will have the gymnast landing more efficiently. The first thing was choosing the right setting for the vault. The gymnast then would chose the right setting for both boards. Then was the actual running to the vault to do the skill, and then the gymnast approaching the vault. Next was pre-flight vaulting position and then the mid-air flight position. Lastly, step ten was sticking the skill. The data shows that there were eight trials, four using the springboard and four using the mini-trampoline. Surprisingly, there was only one stick for each board. With the mini-trampoline there was more spring and greater height but not good placement on the vault, so it really did not help as much. Using the springboard there was not as much height but there was more control of the placement on the vault. In conclusion the hypothesis was wrong. Changing the springboard to a mini-trampoline does not help with the landing of the skill. There were equal landings for both the springboard and the mini-trampoline. Changing the springboard to a mini- trampoline made it a little harder because the table was moved up to keep the experiment constant. It did not go as well as the springboard but surprisingly, there were landings for both.

The Force Absorbed by Cushioning Materials

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The purpose of this experiment was to see if common house hold items, such as cotton balls or facial tissue, would work just as well as bubble wrap to cushion items inside a package. These items were chosen because facial

tissue and cotton balls are easier to obtain than bubble wrap and because they are safer, as well as biodegradable. Bubble wrap takes many years to break down, which makes it bad for the environment. Not only can it be bad for the environment but environmental toxins (such as plastics getting into water supplies) are listed as a possible reason for the higher cases of asthma and allergies and even childhood cancers. Cotton balls, facial tissue and bubble wrap were each tested to determine the amount of force they were able to absorb. Force is the push or pull on an object. For example, when an egg is dropped it is being pulled down by the gravitational pull. It will eventually hit whatever is under it, and if it hits with enough force, it will break. The hypothesis was that the more flexibility a material has, the more it will be able to absorb the force of the egg. The bubble wrap and tissue absorbed more than the cotton for the same thickness. When the egg landed on the bubble wrap and tissue, the material was able to absorb the egg's force without causing it to break. This experiment was useful outside of plain research because it proves that other options for packaging are available. Facial tissue works just as well as bubble wrap at absorbing forces. Cotton balls did not work quite as well because the cotton was not packed tightly enough; when the egg fell on the cotton balls, the cotton balls separated and allowed the egg to fall to the container and fracture.

The Effect of Pollution on Light Reaching a Solar Panel

Cal Costic

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The purpose of this experiment was to test if a laser can measure air pollution. A laser was set up so it was shining through a pipe and pointing at a solar panel connected to a voltmeter. The purpose of the solar panel was to measure how much laser light was reaching it. Baby powder, simulating particulate air pollution, was poured into the pipe to test if it partially blocked the laser and resulted in a lower reading on the voltmeter. The results showed that a significant amount of powder did give a lower reading on the voltmeter. However, the smallest amount of powder (1 teaspoon) was higher on average than the control.

The Effect of Varying Types of Wood on the Height Water Rises

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The space that the object takes up is called the mass of the object, also if it sinks it will continue to sink in water until the outside force acting upon it is equal to the amount of force it puts on the object, this is called buoyancy. The independent variable for this experiment was the density and the type of wood. This experiment required Poplar, Oak, Pine, and Balsa wood; the density of Poplar wood dried is between 22 lbs/ft³ and 31 lbs/ft³. The purpose of this was to determine the relationship between density and buoyancy by measuring the height the water rises in millimeters (mm); the hypothesis for this experiment was if the density of the wood increases then the height the water rises (mm) will also increase. The greatest buoyancy can be seen in the balsa group with buoyancy of 0.009g/cu mm this was followed by the poplar, pine and oak groups each having a buoyancy of 0.014 g/cu mm, 0.015g/cu mm, and 0.028g/cu mm respectively. It can be observed from the data collected that as the density of the woods increases the buoyancy of the wood decreases, creating an inverse ratio as the hypothesis said, "If the density of the category of wood increases then the height the water rises (mm) will decrease." In the future the experiment could be conducted by using an increased number of independent variables, i.e. types of wood. Also, to gain a more complete understanding of the best type of wood the experiment should use more trials of information. A similar project would include using another independent variable of varying salt concentrations in the water.

The Effect of Different Wheels on a Robot's Performance

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The purpose of this experiment was to determine how different types of wheels affect the performance of a robot. It was chosen because of interest in the subject of robotics. The robot was built the same way for all the tests to make the data accurate. The tests were navigating a maze and running a straight track to a finish line. For both tests, 30 trials were performed. Fifteen of these trials were done with wheels and fifteen were done with tank-like

treads. The terrain was changed during the maze tests. The hypothesis for this experiment was that if the maze was done with treads then it would be completed at a slower rate. After analyzing the results, it was noted that if the robot was equipped with treads, it completed the maze. The robot equipped with wheels, overshot the walls of the maze; therefore, none of the maze tests with wheels were successful. During the second test with no turns, the robot with wheels was more successful than when it had treads. It finished the trials 1 to 2 seconds faster. After the experiment, it was concluded that when the robot was equipped with wheels, it was faster on average (during the race tests) 5.00 seconds, but less maneuverable than when it was equipped with treads; therefore, robots that have jobs that require moving around on rough terrain should be equipped with treads. Robots with jobs that require fast moving, with minimal turns on flat terrain, should be equipped with wheels.

Let Me See You Shoot the Moon

David Hughes and Jacob Larsen

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The purpose of the experiment was to find out the effect of the length of the barrel and the angle at which the shot was fired on the distance shot. It was hypothesized that if the barrel was short and the angle of the shot was 45 degrees then the shot would go the farthest. To test the hypothesis the procedures were to shoot the gun with varying barrel lengths and varying angles at which the shot was fired. The investigators then recorded the data. In the end it turned out that the 60 degree shots for the short barrel performed the best overall while the 45 degree shots performed the best for the long barrel. The results partially supported the hypothesis.

Does a Stainless Steel or Plastic Spoon Catapult Work Better?

Kayla Jillson

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The purpose of this science project was to test whether a plastic spoon or a stainless steel spoon works better when catapulting a marble. This experiment, clearly, is not the kind of thing people think about on a day-to-day basis. The prediction is that if a stainless steel spoon and a plastic spoon were to be used as catapults, then the plastic spoon will be the victor of the two due to its flexibility. In order to test this, the catapults were assembled. Next, the marble was placed in the head of the spoon. The head of the spoon was then pulled back to a forty-five degree angle. Finally, the head of the spoon was released and the distance that the marble traveled was measured. For every trial, the marble went farther with the plastic spoon catapult, and after five trials, the average came out to 319.82 centimeters. As for the stainless steel spoon, the five trials that had been conducted averaged out to 202.9 centimeters. In the end, there was only one winner: testing proved the hypothesis to be correct. After analyzing the data, it was concluded that indeed a plastic spoon made for a better catapult than a stainless steel spoon.

The Effect of Colored Filters on Laser Beam Power

Bailey Key

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Laser stands for light amplification by stimulated emission of radiation. All light is part of the electromagnetic spectrum and consists of waves. Because the energy of electromagnetic radiation (i.e., the photon) is inversely proportional to the wavelength, red light (longest in wavelength) is the lowest in energy. As wavelengths contract toward the blue end of the visible region of the electromagnetic spectrum, the frequencies and energies of colors steadily increase. This experiment was conducted to determine if the intensity of a laser beam emitted by a laser pointer would be reduced by passing it through a colored filter. It was hypothesized that if a laser beam were passed through a colored filter of lesser energy on the electromagnetic spectrum, the power output would be reduced. After completing multiple trials measuring laser power with and without colored filters, it was noted that with all three laser pointers the blue filter had the greatest impact on the watts produced by each laser. Both the red and green filters also reduced the wattage output significantly, however, the red-red, blue-blue, and green-green combinations resulted in the least change in wattage output. None of the colored filters magnified the power emitted from any of the lasers. The experiment had a dichotomous outcome. The hypothesis was supported in that when

the laser beam was passed through a colored filter of lesser electromagnetic energy it did indeed lessen the watts produced by the pointer. With all three laser pointers, the power produced was less when passed through a filter with a color at the opposite end of the electromagnetic spectrum. However, the hypothesis was supported in that the power output was still reduced when passing the laser beam through a filter of similar energy color but it was reduced significantly less.

What Is the Effect of Frequency on Signal Strength?

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The purpose of the experiment was to discover if any pattern existed between the frequency of any given signal and its signal strength. The experiment requires a radio, either with a built-in otherwise connected S-Meter (or Signal Strength Meter), and an antenna capable of tuning to the entirety of the 20-meter band. A "screwdriver" antenna was used for this experiment. The experimenter must first remove or turn off every electrical filter on the radio, and then tune to every fifth frequency, in kilohertz, on the 20 meter band, which ranges from 14000 KHz to 14350 KHz, listen for thirty seconds, and record the high and low of each signal in S units, the standard unit on an S Meter. In this experiment, no pattern was found. The signal strength seemed to be completely random, which it rather was, as there were many people broadcasting on these frequencies, and their transmissions added to the signal strength. One thing, however, was indeed learned. Trial two took place in a different location than the other two, in a parking lot, as initially the locations were to remain inconstant, as some locations may favor certain frequencies, depending on where the transmission is coming from. But the recordings at the parking lot were almost constant as S5-S6, compared to many lows being S0 on the other trials. It was concluded that either the neon signs or the lights in the parking lot were creating these radio waves.

The Effect of Side Panel Distance from Focal Point Temperature over Time

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Solar cookers come in many types, and have many applications, including being used to cook for impoverished people who don't have access to firewood. The strength of sunlight hitting the focal point is a large contributor to the results because it directly correlates to the heating of the focal point. The purpose of this experiment was to determine the effect of different mirror distances from the focal point on the temperature of water over time. It was hypothesized that "if the mirror distance (measured from the focal point) decreases, then the rate of temperature increase will increase) To conduct the experiment the solar cookers were illuminated by a light which was simulating the sun, and the temperature of the water being heated by the solar cookers was measured a three minute intervals over a period of thirty minutes. The means for each level start at 20 °C and increase to 22.6 °C for the three and seven decimeter levels, and 22.3 °C for the five decimeter level. The data did not support the hypothesis. The reason for the results being as they were is probably because the light source used was not powerful enough. If this experiment were to be done again some improvements could be for it to be done in the summer when the sun is out more often, having a longer duration for the experiment, more repeated trials, and more IV levels.

How Does Position Affect Fins on a Submarine

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The topic of this project was how fins affect a submarine. The researcher wanted to do this project because he was interested in hydrodynamics, and physics. In doing this project he wanted to answer these questions: How do the fins on a submarine affect the submarine? What happens to a submarine with the absence of fins? As well as, what components make a submarine work? The researcher's hypothesis was if there are no stabilizing fins, then the submarine will move forward, but with no control. Also if the fins of the submarine are placed at the center of gravity, then the submarine will move forward in a straight line. What happened to the submarine was when there were no fins, it spun as a counter action of the propeller. When the fins were positioned in the center it stayed at the

same depth. When the submarine's fins were positioned towards the back or front that end of the submarine was dragging or leading downward. As a conclusion, the hypothesis was accepted. When the fins were moved to a certain side, they made the sub curve to that side. When the fins were positioned to the front or back of the sub, when the fins were in the front the front went down because of the weight of the fin, and when the fin was in the back, the nose rose because it was so light compared to the back.

My Battery Will Never Run Out of Juice!!!

Alexandria Smith

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The purpose of this experiment was to test the effect of the type of fruit on how much voltage it produces. Some procedures for this experiment were to squish the fruit to get its juices flowing without the skin breaking, then sticking the zinc nails and the stripped copper wire, leaving 2 cm sticking out of the fruit. Next the experimenter clamped one end of the lead to the zinc nail and the other end to the black clip of the voltmeter, and clamped one end of the other lead to the red clip of the voltmeter. Next the student read the voltage amount and recorded the data, after that compared the results and created a conclusion. The lemon came in first with an average voltage of 0.967, the orange came in second with an average of 0.953 while the lime and grapefruit came in last with averages of 0.943. The lemon was known to have the most acid out of all the fruits making it produce more voltage than any of the other fruits. With knowing the outcome of the experiment, the student made a battery connecting 16 lemons in a circuit which produced 6.36 volts, and was able to power a string of single Christmas lights.

The Effect of Parachute Canopy Shape on Egg Impact Crater

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The purpose of this experiment was to determine the effect of different parachute canopy shapes on the diameter of the impact crater on the shell of a hardboiled egg. The independent variable was the shape of the parachute and the dependent variable was the diameter of the impact craters that appeared on the egg once it hit the ground. Four trash bags were cut into four shapes (square, circle, triangle and rectangle), each with an area of approximately 2,826 cm². The parachutes, with eggs attached to 60 centimeter strings (that were attached to the parachute canopy), were then dropped from a height of 3 meters. The results were that the eggs attached to the circular parachute had the lowest average crater diameter out of 5 trials (3 cm²) followed by the square (4.14 cm²), triangle (4.56 cm²) and rectangle shaped parachutes (6.6 cm²). The conclusion was that the circular-shaped parachute canopy caused impact craters of the lowest diameter in the eggs (and was thus the safest) of all the parachute canopy types tested.

Energy Efficient Rooftop Gardens?

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The purpose of this experiment was to find the effect of the fraction of the roof of the box covered in sod on the change in temperature of the box. It was hypothesized that if the fraction of the roof of the box covered in sod was changed, then the box with the whole roof covered would have the least change in temperature. To test this hypothesis, the procedures were to measure the temperature of a box covered with a roof shingle and entirely covered with sod, then put the box outside, and after one hour, measure the temperature of the box again. Then, repeat the procedures with one half of the box covered in sod, and none of the box covered in sod. In the end, the results were inconclusive, possibly due to either inherent or human error. The results did not support the hypothesis.

The Effect of Speed of a Magnet on the Voltage Produced by a Stationary Coil

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In 1831 Michael Faraday discovered a scientific law which would be later known to be known as Faraday's Law. Faraday's Law states that the voltage generated is proportional to the rate of change of the magnetic flux. The purpose of the experiment was to determine the effect of speed of a magnet on the voltage produced by a stationary coil. The hypothesis for the experiment was if the rpm is increased then the voltage between the terminals of the coil will increase proportionally. Seven different speeds were taken and tested to see if the voltage produced was proportional to the speed. The results indicated that when Faraday's Law was put to the test it worked exactly as Faraday had thought when the speed increased the voltage increased. The experiment had basically no faults as the graph shown was almost completely linear. Based on the data the hypothesis was supported.

PHYSICAL SCIENCE B

FIRST PLACE

The Effects of Different Types of 9 mm Cartridges (Ammunition) on How Many Simulated Walls Spaced Three Meters Apart Will Be Penetrated

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Choosing the correct ammunition for self-defense is very important since a bullet fired in self-defense should penetrate only into an attacker. Ammunition commonly used for self-defense is designed to expand when it hits an object, but some expanding ammunition can penetrate through an attacker and also through other objects like walls. The purpose of this experiment was to determine the effect of different types of 9 mm ammunition on how many simulated walls spaced 3 m apart would be penetrated by the bullets. It was hypothesized that if a bullet is designed to expand and lose energy when it contacts an object, the bullet will go through fewer walls than a bullet that isn't designed to expand. Four simulated interior house walls (1.22 m by 1.22 m) were constructed and spaced 3 m apart in a row at an outdoor handgun range. Six different types of 9 mm ammunition (four test and two control) were studied by firing the ammunition using the same pistol into the front wall from a distance of 3 m. All of the different types of bullets studied penetrated all four walls and the average sizes of the holes that the test bullets made were 13.9 mm, 10.4 mm, 10.2 mm, and 8.4 mm. Only one type of test bullet broke apart and made more than one hole in some of the walls, but all four types of test bullets broke into fragments that made indentations in some of the walls. The control bullets did not break apart into fragments. However, the study hypothesis was not supported because all of the test bullets went through all of the walls. Only four of the many different kinds of 9 mm self-defense ammunition that are available were tested in this experiment. Other kinds of self-defense ammunition may have given different results. A way to improve the experimental design and an idea for future experiments would be to look at different calibers of self-defense ammunition fired from different types of guns, since those things may affect how bullets expand, how fast they travel, and how many walls they penetrate.

SECOND PLACE

The Effect of Temperature on Magnetic Strength

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Based on current research, it is understood that atoms of magnetic materials have magnetic moments, which when aligned in the same direction gives the magnet its magnetic poles and associated strengths. However, when heated, the atoms gain energy and move more. Thus, it was hypothesized that their magnetic moments will be less aligned as temperature increases and the magnetic material will lose magnetic strength. Conversely, cold will reduce this movement, thus increasing alignment and thus, the strength of a magnet. The purpose of this project was to determine the effect of different temperatures on the magnetic strength of a magnet. The following temperatures were selected for measuring the magnetic strength: -21°C, 93°C, 149°C, and 204°C. Ten rare earth neodymium cube magnets were heated/cooled in an oven/freezer at the respective temperatures. Each magnet was tested for its magnetic strength using a gauss meter mounted atop a locomotive moving at constant speed. The results indicated that the magnets that were cooled to -21°C had the strongest magnetic strength with a mean gauss of 15.2 and the magnets heated to 204°C had the weakest magnetic with a mean gauss of 5.06. The data supported the research hypothesis that if magnets were cooled, then the magnetic strength will increase. The coldest set of magnets at -21°C was observed to have the strongest magnetic strength. Based on the magnet strengths measured, it can be concluded that temperature is the primary cause of fluctuating magnetic strength. However, because of environmental ambient magnetic fields, further experiments will need to be done to obtain more accurate results for higher risk projects involving varying temperatures and the use of magnets.

THIRD PLACE

The Effect of Different Shaped Coils on the Propulsion of a BB from an Electromagnetic Coil

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Danish physicist, Hans Christian Oersted, first discovered electromagnetism. When electric current runs through copper wire, it creates a magnetic field which can be used to propel objects. The magnetic field is dependent on the shape of the coil. The purpose of the experiment was to test the effect of different shaped coils on the propulsion of a BB from an electromagnetic catapult. The hypothesis was that if different shaped coils were used, then the circular coil would propel the BBs the farthest. Four catapults were constructed, each with a square, circular, triangular, or organic shaped coil. Each catapult shot 25 BBs, and the distance they traveled was recorded in centimeters. The results indicated that the square coil had the highest mean, with a mean of 13.256 cm. The hypothesis was that if different shaped coils were used then the circular coil would propel the BBs the farthest. This data disproved the hypothesis. Based on the data collected, the shape of the coil has a direct correlation with the distance the BB travels. Thus, it can be concluded that if different shaped coils are used to propel a BB using an electromagnetic catapult, the square coil would propel the BBs the farthest.

HONORABLE MENTION

The Effect of Golf Shaft Stiffness on Golf Ball Distance

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Nothing is more pleasing than hitting a nice, clean shot in golf. However, when it comes down to golf clubs and their components, very few people really understand what to look for and the importance of each part in the game. The club shaft is possibly the most misunderstood and unnoticed part of the club. There are many different views on how the club shaft affects a shot, from both golf professionals and manufacturers. The purpose of this study was to investigate whether or not the stiffness of the shaft would affect the distance traveled by the ball once it had been struck. By theory, the distance of a flying golf ball should have a small amount of relationship with the stiffness of the club if the ball is hit from the same launching angle. Also, it is theorized that the softer the club shaft, the longer distance the ball would travel. It was hypothesized that proper stiffness of the club shaft would allow for the golf ball to travel a greater distance. In this experiment, four drivers with different stiffness and the same head angle were tested in a laboratory setting. Data from the launching of the golf balls were then recorded using the Callaway Performance Analysis System with Doppler Radar technology. The data was analyzed with Microsoft Excel. Data taken from the experiment showed that the stiffness of the shaft only affected the total distance of a shot by a miniscule amount, and that total distance change depended on the personality of the player. Factors of the player that contribute to different distances include swing tempo, balance, flexibility, overall strength, and swing speed.

HONORABLE MENTION

The Effect of Arm Length of a Trebuchet on the Throwing Distance of a Tennis Ball

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In this experiment, effect of the length of throwing arm on the throwing distance of a tennis ball in a trebuchet was studied. The trebuchet has been used for battle for many years. Since Dionysius the Elder invented it in about 400 BC the catapult has evolved and changed into many different types of catapults. The trebuchet is basically used by attaching ammunition on to the throwing arm side and a counterweight will fall and launch the ammunition. The purpose of this experiment was to find out if the length of the throwing arm of the trebuchet

would affect the distance of ammunition thrown. Because of Newton's Second Law the hypothesis was that the longer the throwing arm the farther the ammunition, in this case tennis balls, would travel. To test this experiment the experimenter would have to build a trebuchet. The experimenter would record where the tennis ball landed. The results of my experiment were what the experimenter might expect. The longer the throwing arm the farther the tennis ball will travel in the air. The experiment overall was very successful. One way to improve this would be is to get rid of the human error. The results agreed with the information I got from research. My hypothesis was supported by the data collected from the experiment. Based on the results of this experiment the experiment was a success.

HONORABLE MENTION

The Effect of Shape of Dimples on a Golf Ball's Roll

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Dimples reduce the drag on a golf ball, in other words, a golf ball without dimples won't fly as far as a golf ball with dimples. Many experiments have been done on the effect dimples have on the flight of a golf ball, but very few experiments have been done on the effect dimples have on the roll on a golf ball. Since research concludes that dimples impact the flight characteristics of the golf ball, the roll of the golf ball could also be impacted by dimple construction. The purpose of this experiment was to determine the effect of different shapes of golf ball dimples on the distance the golf ball would roll in centimeters. The hypothesis for this experiment stated that if golf balls with circular and hexagonal dimples are rolled down a ramp then the golf balls with circular dimples will roll the furthest. In this experiment two different types of golf balls were rolled down a small plastic ramp. Ten trials were conducted where each of the ten golf balls of each dimple type were rolled down the ramp onto the putting surface, one time each. The hexagonal dimpled golf ball rolled a mean of two centimeters further than the circular dimple golf ball. Since the mean distance that the hexagonal dimple ball rolled (183 cm) was slightly farther than that of the circular dimpled ball (181 cm), the hypothesis was not supported. Although the golf balls with hexagonal shaped dimples rolled a mean of three centimeters farther than the circular shaped dimples balls, the results were not conclusive that the golf balls with hexagonal shaped dimples would consistently roll further. It is therefore concluded that the shape of the dimples on a golf ball will not significantly affect the distance the golf ball will roll.

Urban Heat Island Effect

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The Urban Heat Island Effect was one reason behind different temperatures within civilizations depending on the amount of urbanization within the area. This theory has been questioned due to temperatures not being monitored constantly within varying locations. Since the temperatures were unknown, there could not be exact results as to whether or not temperatures really do change depending on an area's characteristics. When daily temperatures were taken from three distinct zones each measured from a central location within a three hour time constraint, the temperatures collected showed Hampton High School (Hampton) was the warmest, Trinity Lutheran School (Newport News) was the second warmest and Twin Lake Circle, Newport News was the coldest. The temperatures were measured with infra-red thermometers morning and afternoon, several days every week on surrounding grass and asphalt. Weather conditions were also recorded as being either moist or dry. Once the temperatures were recorded they were compared and analyzed to prove the Urban Heat Island Effect correct, which in turn would allow itself to be used to understand how civilization may be better equipped for different uses in various climate zones world-wide. In conclusion, the data supported the urban heat island effect and the hypothesis in question. Hampton High School being 1.44 miles from the central point of town was the warmest, followed by Trinity Lutheran School being 2.70 miles and then Twin Lake Circle being 13.09 miles. Due to the variations of urbanization within the city limits, temperatures varied and fluctuated as detailed in the data collected.

The Effect of a Pivot Point Location on the Average Distance a Lacrosse Stick Can Throw a Ball

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The purpose of this experiment was to determine which placement of the pivot point on a lacrosse stick gave the greatest competitive advantage by throwing a ball the farthest. The hypothesis was that if three placements were tested the placement 60 cm from the head would throw the farthest. A throwing device was constructed that throws the ball with a consistent amount of torque. The ball was thrown and distance measured 10 times for each of the three pivot point placements. The collected data showed that Placement A of the pivot point (60 cm from head) had the largest mean distance thrown (214.4 cm), followed by Placement B (77 cm from head), which threw a mean distance of 211.1 cm, and Placement C (94 cm from head), which had the lowest mean distance (182.4 cm). The mean values supported the hypothesis, but a t-test revealed no statistical difference between Placements A and B. These results have shown that the placement of the pivot hand 60 cm away from the head of the lacrosse stick gave the maximum throwing distance, and therefore, the maximum competitive advantage.

The Effect of Time of Day on Amount of Energy Produced by Solar Panels

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For the past 15 years, the earth has been getting “greener”, using less harmful materials, and thinking more about the economy. One of the new “green” measures that people are taking are installing solar panels to their home. These devices save money and don’t use electricity, making them the perfect simple machines for any household. The purpose of this experiment was to see that if a solar panel were placed in the sun at different times of the day, at which time the voltage would measure the highest. The hypothesis was: If a solar panel is placed in the sun at different times of the day, then at 12 pm the voltage would measure the highest. After assembling the solar panel by taping and soldering a piece of wire to the back of the solar cell, then twisting the wire into a circuit board, bring the ten solar panels outside. Then lay them in the sun, move the Multimeter range selector to two volts, and press red lead against the wire showing on the circuit board and the black lead against the part of silver on the front of the solar panel. After the numbers settle, record the results then repeat with the other panels. Every two hours after that, measure every solar panel again. The results indicated that the voltage gained from the sun was highest at noon, with an average of 0.5536, the second highest average was 0.5452 at ten, the third highest was at two with an average of 0.5401 volts, the fourth highest was at eight with an average of 0.4732 volts, and the last highest was at four with an average of 0.4477 volts. Based on the data determined in this experiment, it seems like the height of the sun in the sky has an effect on the amount of voltage gained by solar panels. In order to conclude that the results in this experiment are valid, then other people must perform this experiment again. To further verify these results, someone should test this experiment again in a different habitat, making the final results as valid as they can be.

The Effect of Drag on Average Altitude of Model Rockets

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The purpose of this experiment was to measure the effect of drag on the distance, or maximum altitude, a model rocket will achieve. The research hypothesis for this experiment was if the drag increased, then the distance travelled (altitude) would decrease. Three different nose cones (flat, rounded, and sharp) were attached to the same model rocket, and each nose cone was launched five (5) separate times. The sharp nose cone had the least drag, the rounded nose cone had the second least drag, and the flat nose cone had the most drag. An altimeter was included in each rocket and the maximum altitude each rocket achieved was recorded. The altimeter also measured altitude over time, and a graph was generated by the computer showing the entire flight path of each rocket. Fifteen launches were completed using B engines for each launch. The hypothesis for this experiment suggests that the sharp nose cone rocket would achieve the highest maximum altitude. Results obtained for this experiment supported the original hypothesis because an increase in drag caused a decrease in maximum altitude. The mean maximum altitude achieved by the flat nose cone was 68.8 meters, the mean maximum altitude achieved by the rounded nose

cone was 71 meters, and the mean maximum altitude achieved by the sharp nose cone was 73 meters. The altimeter's reading of altitude over time also indicated that the higher the maximum altitude achieved by the rocket, the longer the rocket took to return to earth.

The Effect of Different Materials on the Rate of Heat Loss in Water

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Insulators are materials that do not easily transfer thermal energy or heat between its particles. Porosity is an important factor contributing to insulation. High porosity materials are able to retain thermal energy for the longest. A material with high porosity yet a large distribution of fibers contains more space for air, which is a poor conductor and will contribute to insulation quality of the material. The amount of thermal energy in a material is determined by how much energy the particles in the material contain. Insulation is used to limit and retain the thermal energy escaping from a material. Conduction and convection are two methods used in the process of heat transfer. Conduction is the process of transferring heat energy without the movement of matter and convection is the method of moving thermal energy by the movements of currents within a liquid or gas. The purpose of this experiment was to find a common insulator that retains heat energy the longest. Three containers of water were individually wrapped with the materials cotton, wool, and polyester. One container of water was left without a source of insulation. The results of the experiment suggested that the temperature of the water insulated with cotton dropped the quickest out of the other insulators. Water insulated with wool sustained its temperature for the longest. The resulting data supported the hypothesis that "If wool is tested, then the rate of heat loss will decrease". Wool and polyester dry quickly when wet and the materials had the slowest rate of heat loss in water. This belief that quick drying materials have the highest insulation quality could be a factor in determining the insulation quality of any material.

Effect of Magnets and Coils on Energy Produced

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Can we obtain more output energy through magnets and coils than what is put in? The hypothesis is, if the magnetic field moves faster, then more energy will be produced. The first group, which is the control group, did not do anything; the second group had a frequency of 50 times per second; the third group had a frequency of 100 times per second. The dependent variable was the amount of energy produced; it was measured in volts with a voltage tester. The constants that were the same were the same type of magnets used, the distance between the magnets, and same type of wires. The control was the group with no frequency. The group of 100 frequency had a mean of 4.17 v; the group of 50 frequency had a mean of 2.07 v; the group of no frequency (the control group) had a mean of 0 v. The P value of this experiment was 0.000. The results supported the alternate hypothesis, because the p-value was less than 0.05.

The Effect of Aerosol Combustibles on a Potato Cannon's Shot Range

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The purpose of this experiment was to determine the most effective aerosol combustible to be used in a potato cannon. The research hypothesis was that if White Rain hair spray, Axe body spray, and Off! insect repellent were used in a potato cannon, then the White Rain hair spray would result in the greatest average shot range. Axe was sprayed into the combustion chamber of the potato cannon and then the cap was screwed on. The potato cannon was then positioned at a 45° angle and fired. The distance of the shot was then measured in meters. This process was repeated 10 times for each level of the independent variable. The experimental data revealed a mean shot range of 126.100 m for White Rain hair spray, a mean shot range of 114.200 m for Axe body spray and a mean shot range of 0.000 m for Off! insect repellent. The trend of the mean values and statistical tests revealed that the research hypothesis, if White Rain hair spray, Axe body spray, and Off! insect repellent were used in a potato

cannon, then the White Rain hair spray would result in the greatest average shot range, was supported by the experimental data. The results of the experiment are explained by the flammability of chemicals such as propane, butane, and alcohol 40-B (contained in the White Rain hair spray). Therefore the chemicals contained in the independent variables directly affected the mean shot range.

The Effect of Temperature on the Amount of Electrical Output from Solar Cells

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The purpose of this experiment was for the experimenter to find out how temperature affected the amount of volts that were output from a solar cell. This knowledge could be used to help solar cells produce more power in a much simpler way. The experimenter thought that if the temperature of the solar cell increased, that the electrical output from the solar cell in volts would increase. To perform this experiment, a small stand was formed out of two logs. In between the logs, a small portable fan was placed to increase or decrease the heat. And to help it even further, a thin metal plate was positioned above the fan. The metal plate conducts heat making the solar cell heat up faster and with more efficiency. The photovoltaic cell was put on top of that and then the fan was turned on, heating the cell to its desired temperature. After reaching the desired temperature of fifteen degrees Celsius, the volts and milliamps were recorded using a multi-meter. Then the experiment was repeated with twenty, twenty-five, and thirty degrees Celsius. Then the experimenter started over until ten samples of data were collected and recorded for each independent variable. In the end, it was discovered that as the temperature increased, the electrical output decreases. It is more effective to create electricity from a solar cell in a colder environment. In future experiments, the experimenter could use larger solar cells because the small solar cells aren't as practical for large masses of electricity. Also the experiment could be performed in an area where the amount of light is easier to control. This is a necessary change so that the amount of light does not change and therefore change the results making them invalid.

The Effect of Different Materials on the Amount of Decibels Heard

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From the Cavemen ages to present day, everybody has been annoyed by sound (except deaf people). This began the study of controlling sounds or more commonly known as "acoustics". Which in term, created soundproofing and sound absorbing materials, such as acoustic foam and blankets. Sound absorbing/proofing materials reduce sound by absorbing and changing the sound's energy into a different form, while also reflecting sound and dispersing it randomly, so it is too weak to hear. The loudness of a sound is measured in decibels. The purpose of this project was to determine the best material to block out sound. Acoustic foam, blankets, aluminum foil, and nothing (also known as the control) were gathered to be tested to see which material absorbs the most sound. Each in turn, were put on the inside walls of a cardboard box. The cardboard box's lid was put back on top of the box and then ten different sine waves were played on a speaker which was also inside the box. The amount of decibels heard was measured by a sound level meter and recorded on a piece of paper. The results indicated that acoustic foam absorbed the most sound with a mean of 63.3 decibels heard. Blankets had a mean of 64 decibels heard. Aluminum foil had a mean of 69.9 decibels heard, and the least sound absorbed was with the material, nothing (the control) which had a mean of 71.3 decibels heard. The data supported the hypothesis that if acoustic foam, blankets, nothing (control) and Reynolds Aluminum Foil are used then the group with the acoustic foam will absorb the most sound. Based on the results of this experiment, we can conclude that out of all the materials (acoustic foam, blankets, Reynolds Aluminum Foil, and nothing); acoustic foam absorbed the most sound.

The Effect of Temperature on a Basketball's Air Pressure

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Temperature has a major effect on air pressure of anything. When heat is applied to the air molecules they go crazy and that makes the ball bounce higher and higher. The purpose of this experiment was to determine temperature's effect on a basketball's air pressure. The hypothesis for this project was if room temperature is used then the basketball will have the highest air pressure and the results supported the hypothesis. Throughout all of my procedures safety was the main key. Safety always comes first when a lab is taking place. The results showed that when temperatures are at their greatest, air molecules move basically, at the speed of light. Before conclusions were made about "what temperature would produce the greater bounce", the experiment was completed in its entirety.

The Effect of Various pH Levels on the Corrosion of Iron

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The infrastructure of the United States of America and many other countries is built of steel. Steel is an alloy of iron which is a metal that corrodes much faster than most substances. The results of this project could show us that acid rain or having a pH imbalance in our water supply can cause most steel structures to corrode and possibly be destroyed over the course of time. The process of the corrosion of iron can become faster if there is a higher amount of hydrogen ions in a liquid. Also, having a higher amount of dissolved oxygen affects the rate of corrosion in iron. Because acids have more hydrogen ions they react better with the electrons of different metals. The purpose of this investigation was to determine the effect of different pH levels on the corrosion of iron. Fifty milliliters of hydrochloric acid, lemon juice, water, and soap were poured individually into four beakers. Then four iron nails were placed, one in each beaker. The nails were soaked in these solutions for ten days. The results indicated that a pH of 0 or hydrochloric acid corroded the most iron with a mean of 2.056173 grams and the results with the highest pH or soap corroded a mean of 0.01708 grams. The data supported the research hypothesis that if pH levels are decreased then the corrosion of iron will be increased. Based on the data recorded, there appears to be a correlation between the pH levels of a liquid and the amount of corrosion of the iron. Hopefully, the results from this project help us all see that the impact of having a pH imbalance in our water will cause our country's infrastructure to be destroyed over the course of time.

The Effect of Different Gear Ratios on Distance Traveled by a Bike

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Gears have been in use for heavy machines going back as far as 300BC. The earliest known bicycles go back to about 200 years from present day. The desire to travel longer distance on a bike was met by incorporating gears in them. For the same work effort, the gears allow the bike to travel further distance or climb a steep terrain. This makes the bike ride more popular. The purpose of this project was to determine which gear combination would affect the number of revolutions made by the bicycle's tire the most using the following gears, chain ring 1 cluster gear 1, chain ring 1 cluster gear 4, chain ring 1, cluster gear 7, chain ring 2 cluster gear 1, chain ring 2 cluster gear 4, chain ring 2 cluster gear 7, chain ring 3 cluster gear 1, chain ring 3 cluster gear 4, chain ring 1 cluster gear 7. The results indicated that the gear combinations of chain ring 3 and cluster gear 7 made the tire take the most revolutions. Each gear combination was tested 10 times; they were tested to see how many revolutions the tire would make with each 360 degree turn of pedal on each gear combination. A one-way analysis of variance (ANOVA) was calculated on the number of revolutions made by the bicycle tire of each specific gear combinations. The analysis was significant, The null hypothesis was rejected ($F = 33730.875 > 2.054881624$ at df between groups=8, df within groups=81; $p < 0.05$), and the data supported the research hypothesis that if the gear combination is chain ring 3 and cluster gear 7, then the bike's tire will make the most revolutions. Based on the number of revolutions made by the tire in this research, there appears to be a direct correlation between the manipulating of gears and the number of revolutions made by the tire. Before it can be concluded that the chain ring 3 and cluster

gear 7 was the one that had the tire make the most revolutions, it should be tested on a different bike or a different set of gears.

The Effect of Different Materials Simulated on an Artificial Body on Pellet Resistance **Bhargav Sathish**

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There are American troops in Afghanistan fighting for our country. Some return home as war veterans, while others die in the line of duty. The reason for the casualties in war was traced back to flaws in the armor the soldiers were wearing. In order to reduce the number of casualties in any war, a study was done on the armor worn by soldiers to find any flaws in the material. While the design of the armor had an impact on how strong the armor was, the flaws all came down to the material that was used. The purpose of this project was to determine the material that had the highest pellet resistance. The four materials tested were polycarbonate, polystyrene, Plexiglas, and plastic. Each was tested for its pellet resistance by first placing the material on an artificial body and then firing thirty conical pellets from fifteen feet away for each material. An artificial body was used so that the experiment would simulate a soldier in baffle and it was also used to make the results as accurate as possible. The pellet resistance was determined by the cracks in the material and the impact on the artificial body. The results indicated that polycarbonate was the most pellet resistant material with a mean crack length of 1.0795 centimeters and Plexiglas is the least pellet resistant material with a mean crack length of 2.763 centimeters. A t-test performed on the data indicated a significant difference between the means of the groups. The standard deviation for both the groups only had a range of 0.20 and the degree of freedom was 58. The two tail confidence level for the t-test was 100%, which shows significance between the two groups. The pellet resistance of all the materials goes down to the chemical makeup of each material. Before it can be concluded that the chemical structure of the material determines its pellet resistance, more repeated trials will have to be done.

The Effect of Temperature on the Solubility of Salts in Water **Goutham Thiagarajan**

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The salinity of the ocean water is one of the important factors in determining the global weather patterns. The direction of the ocean currents can be greatly affected by the salinity of the ocean water. The more salty the water is, the denser it is and it sinks to the bottom compared to the less saline waters and causes the change in the ocean currents. The salinity of the ocean water is influenced by the higher the temperature is. Temperature plays a crucial role in determining the salinity of the water. The main purpose of this project was to determine how different temperatures would affect the solubility of common salt (sodium chloride). The different temperatures used in the experiment were ten degrees Celsius, room temperature, thirty-eight degrees Celsius, and sixty-six degrees Celsius. One hundred milliliters of tap water were poured into a measuring cup at different temperatures depending on which specific temperature. Then, five grams of common salt were added into the water and stirred with a spoon until it was dissolved completely. Next, additional amounts of salt were continuously added in increments to the saltwater solution and dissolved completely. Lastly, the amount of salt added to the water was noted, which found the solubility of salt at that specific temperature for the group. The results indicated that the group with the highest temperature had the highest solubility with the mean of 41.5 g of salt and the group with the lowest temperature had the lowest solubility with the mean of 19.1 g of salt. The data supported the research hypothesis that if salt was dissolved in different temperatures of water, then the group with the highest temperature will dissolve the most salt. Based on the solubility of salt collected in this experiment, there appears to be a direct correlation between the temperature of the water and the solubility of the salt. So, if the temperature increases, the solubility of the salt in water increases.

Electricity from Mud

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Microbial fuel cells (MFCs) have been used to produce electricity from various sources including acetate, lactate, and glucose. Electricity's ability to be made from mud was proven by a scientist in the year 2008 and there is continuous research about the production of electricity made from water. The major goal of this project was to observe the differences in voltage produced by the benthic mud sample taken from two different low order streams. Another main goal of this project was to gain an understanding of the causes for the range in voltages. Tests were conducted using a two chamber microbial fuel cell containing an electrode (anode) and a single air cathode. The mud samples were taken from the floor of two local lakes which was Deep Run Lake and Echo Lake. Both the wastewater sample and the benthic zone mud sample contain anaerobic bacteria that are electrochemically active. In fact, anaerobic bacteria are commonly found in wastewater and in benthic mud zones. Two of the fuel cell systems were operated for two different mud samples. Power generation in these two systems were analyzed and compared for producing electricity. The benthic mud sample A (Echo Lake) produced a higher initial voltage as compared to mud sample B (Deep Run Lake). This result was expected since sample A was collected from an old and large lower order stream and sample B was taken from a recently constructed manmade lower order stream. MFC technology may provide a new method to offset wastewater treatment plant operating costs, making advanced wastewater treatment more affordable for both developing and industrialized nations.

The Effect of Mass on the Distance Traveled by Spheres when Catapulted

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Catapults are one of the oldest of mass destruction in history. Catapult is a term used to describe any machine that hurls projectiles. This can include a slingshot used to hurl pebbles, a machine that launches airplanes off of airplane carriers, and the ancient weapons of smash destruction! The ancient weapons include Ballista, Onager, and the oldest, Trebuchet. The Trebuchet was invented in China, the Onager and Ballista was invented by the Romans. Balls come in almost every shape or size and are used in almost every sport. The most popular ball is probably the soccer ball because soccer is the most popular sport in the world. The purpose of this experiment was to see which ball went the furthest when catapulted. The hypothesis for this experiment was that the ball with the most mass would go the farthest. The hypothesis was not supported, the heaviest ball, which was the golf ball, went the least distance which was 215 cm. One major finding was that the stress ball went the furthest consistently and went the farthest distance at 342 cm.

PHYSICS A

FIRST PLACE

The Correlation between Core Strength and Balance

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The purpose of this study was to record or present any possible connection that may be found within the core strength of an individual and their capability to balance. A growing amount of elderly die from fall related deaths each year, and past research has shown that the effects of physical reinforcement in the abdomen and core area have improved overall balance of the body. Because a person is able to find balance through the alignment of the abdomen and other core muscles, it was predicted that those with greater core strength would also have a better balance in relation to equilibrium. Participants' balance was taken by measuring the distance away from equilibrium on the Wii Fit Board, and their core strength was determined by the length of time each was able to complete the plank exercise. It was observed that there is in fact a fairly strong negative linear correlation between core strength and balance, and that the more core strength one possessed the better balance they had. Further implications of this study may include the causes of different conditional training in various sports on balance, how gender affects the body's development of core strength, and how different races relate in the core strength-balance correlation.

SECOND PLACE

Difference in Angular Velocity of Fouetté Turns when Center of Gravity Is Changed

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Holding the center of gravity may have an effect on the angular velocity of *fouetté* turns. Dancers from a local dance school did three sets of turns while holding their center of gravity and three sets without holding their center of gravity. The null hypothesis for this experiment was there is no difference in angular velocity when body orientation is changed. The turns were captured on video and the number of turns was counted. Separate t-tests were then performed comparing the number of turns, angle of the body, the time per second, the angle of the raised leg and the angular velocity. The t-tests came out as the following: angular velocity was $t(29) = 1.54$, $p = 0.067$, the number of turns was $t(29) = 3.94$, $p = 0.00024$, and the angle of the leg was $t(29) = 2.22$, $p = 0.017$. It was concluded that while holding the center of gravity does not affect the angular velocity, it does affect the number of turns the dancer could accomplish and also the height of the extended leg. Also the dancer's turns were aesthetically more pleasing when they held their center of gravity.

THIRD PLACE

The Effect of Magnetism on the Behavior of Ferrofluid

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There are many uses for ferrofluid in modern electronics and new technology using the liquid is developed every year and to put the properties of ferrofluid, which is a type of magnetic colloid, to best use it is important to understand how it behaves under varying conditions. This experiment tested how the friction of a magnet, with ferrofluid bonded to it changed as it slid down a ramp. Ferrofluid is composed of nano-scale magnetic particles suspended in a neutrally charged carrier fluid, which means that when the magnet is immersed in ferrofluid, the particles attempt to conform to the magnetic field and align along the lines of force. This property creates a film of fluid that separates the magnet and any surface it happens to be touching meaning the magnet can glide with very low friction across a surface. In the experiment, magnets of varying strengths (in Gauss) were gathered and their

friction was tested when slid down a straight track, after the dry times were recorded, ferrofluid was applied to the magnets and they were again slid down the ramp, to test for the time difference. Across all of the trials and levels, the application of ferrofluid halved the time it took for the magnets to slide down the track, suggesting that while ferrofluid is an excellent lubricant for permanent and electromagnets, the strength of the magnet in question does not significantly affect the change in friction or behavior of the fluid.

HONORABLE MENTION

Reducing Peak Shock in Football Helmet Collisions

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The purpose of the experiment was to find out the effect of the type of material on the exterior of the helmet on the peak acceleration (m/sec^2). It was hypothesized that if the type of material placed on the exterior of the helmet was changed, then the peak acceleration would be the least when the Vibram Fivefingers shoe sole was placed on the exterior of the helmet. Vibram Fivefingers sandal soles were used because of information the experimenter found about the unique shock absorbing qualities of their material. To test the hypothesis the experimenter collided helmets with watermelons inside (simulating a human brain) with a simple accelerometer inside. The experimenter's zip line gave the experimenter a way to smack the helmets in a consistent way. Using different padding the reduction in peak acceleration ranged from 11% to 58% over the control. Moleskin with a bit of plastic on the exterior performed the best with an average peak acceleration of 194.809 m/sec^2 and the control performed the worst with an average 469.765 m/sec^2 . The IV levels were, in order of performance from best to worst as follows: moleskin with plastic, moleskin, Vibram Fivefingers sandal soles, Dr. Scholl's shoe insert, Bubblewrap, and the control. The results did not support the hypothesis, but did reveal a promising new idea for helmet design.

HONORABLE MENTION

The Effect of the Angle of Guitar Headstock on Sound Quality of a Plucked String

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A study was done to determine if the angle of a headstock on a guitar affects the harmonics and sound quality of the plucked string. The null hypothesis tested was that there is no significant change in the harmonics or amplitude of a plucked string attached to a headstock at various angles. An apparatus was made for the guitar. A plucking apparatus was also constructed to ensure consistency in strums of the string. The guitar apparatus, made with an adjustable headstock, was plucked ten times at headstock angles of 15, 20, 25, and 30 degrees. The amplitudes of the fundamental and first 6 harmonics were observed and recorded using the computer software, Audacity®. There was a significant change in the amplitudes of the tones at the different headstock angles, $F(3, 216) = 282, p < 0.001$. The harmonic structure was affected by the changed headstock angle as shown by the Two-Way ANOVA, $F(15, 216) = 55, p < 0.001$. Harmonics define the sound of an instrument. Therefore, the overall sound quality was affected when the angle of the headstock was adjusted. The null hypothesis was rejected at the 95% confidence level.

The Effect of Varying Temperatures on the Surface Tension of Distilled Water

Patricia Alcala

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The purpose of this experiment was to understand the combined effects of varied temperatures and detergent on the surface tension of distilled water. Through collected research, it was understood that detergent would reduce the surface tension of a distilled water sample when combined. However, it was uncertain if the surface tension of the distilled water sample would continue to decrease when placed in varied temperatures. To clear doubt the experiment was designed to have a solution of distilled water, and *Ultra Dawn* dish detergent at various temperatures. The independent variables were a solution at 1° Celsius and 81° Celsius, with the dependent variable being the measure of surface tension. The controls were a solution at room temperature of 20° Celsius, and a distilled water sample at room temperature of 20° Celsius. It was hypothesized the 1° Celsius solution would have more surface tension than solutions of 81° Celsius or the controls. Surface tension was measured by use of the “Drops on a Penny” procedure that calculated surface tension by determining the total amount of drops of solution that fit on a penny, without overflow. All solutions were 240 milliliters and had an equivalent amount of 5 milliliters of *Ultra Dawn* dish brand detergent, while the distilled water sample had no detergent. Temperature variations were achieved by use of a microwave and refrigerator. Results of the “Drops on a Penny” procedure contradicted the hypothesis and showed the solution of 82° Celsius had the highest surface tension. T-tests and ANOVA supported the results, and affirmed data was accurate significantly different to derive conclusions. Since results of the experiment contradicted research information and similar studies done on surface tension it could not be concluded that high temperatures provide for high surface tensions. It was concluded however, that detergent and variable temperature affect surface tension of distilled water since results of the independent variables differed from results of the controls.

Which Species of Wood Creates the Most Resonant Sound Board?

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The purpose of this experiment was to determine the ability of different species of wood to resonate sound. The soundboards represented the soundboards of acoustic guitars. Soundboards made of four species of wood were tested resonating the constant vibrations from an electric sound generator and a digital sound level meter was used to measure the decibels of the sound amplification created by the soundboards. The volume produced by each independent variable was compared with the volume emitted by the sound generator without a soundboard to reach a conclusion. A t-test of the data showed that the spruce soundboard produced significant data and was most resonant and amplified the sound produced by the sound generator more effectively than the other groups with significant data.

The Effect of the Type of Shielding on the Amount of Ionizing Radiation Detected

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Radiation is a very deadly force, and can cause serious diseases quite quickly. It can cause many illnesses in humans and animals, such as cataracts and cancer. Radiation is one of the main barriers to long-term deep space travel. This experiment was performed to try to find an efficient and cheap material that would shield against radiation in a vacuum, to simulate the effects of shielding astronauts against radiation in a space suit or spacecraft. Nickel, copper, and aluminum foils, along with polyethylene film, were compared to the control (no shielding) to determine which would shield best against alpha, beta, and gamma radiation. To do this, three radioactive disks (polonium-210, strontium-90, and cobalt-60) were hung from the top of a bell jar, and a Vernier Labquest with a Geiger counter attached was placed at the bottom. The air was removed from the bell jar, and the Labquest recorded the number of radioactive particles that contacted it each second for 750 seconds. A mean was obtained from the data sets, along with a range, variance, and standard deviation. Through a t test, it was determined that the nickel and copper foils caused a significant decrease in the amount of radiation. No prior research was located that used copper or nickel as a radiation shield, so this experiment could not confirm previous results.

Correlation of Cosmic Rays with Climate

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Cosmic rays are high energy particles that are constantly streaming through Earth's atmosphere. Climate is the measure of meteorological variables, such as temperature and dew point, over a long period of time in a certain region. It is still of interest whether cosmic rays have an influence on the global climate, so there have been numerous studies conducted to evaluate the association, however, the detection of cosmic rays may possibly be affected by the climate, leading to a different number detected than what actually is there. In Henrico, VA, weather data was downloaded and correlated with cosmic ray data collected at a public high school and evaluated by the Cosmic Ray c-Lab. A correlation coefficient of 0.11092 for temperature versus cosmic ray counts, -0.1507 for dew point versus cosmic ray counts, and -0.1492 for humidity versus cosmic ray counts was found. The regression data found through this study can be applied to the analysis of raw cosmic ray data. Extensions for this study include the consideration of more weather variables.

The Effect of Different Motor Oils on the Deposit Formation of an Internal Combustion Engine

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The purpose of this experiment was to determine which brand of SAE 5W-30 conventional motor oil would prevent deposit formation within the first 10-minute startup period in an internal combustion engine by showing the greatest temperature increase. Motor oil is the lifeblood of a car's engine. An engine's performance is heavily dependent on the state of its oil. Oil serves many purposes, such as reducing engine noise, carrying away heat, and preventing deposit formation and sludge. Oil must heat to a high enough temperature within the first ten minutes of engine startup to minimize condensation of engine deposits on cool cylinder walls. The oils tested in this experiment were subjected to 100 °C for ten minutes via a hot plate. After the ten minutes, the oil's temperature was recorded. Castrol GTX averaged a temperature of 82.9 °C, Valvoline averaged 82.8 °C, Pennzoil averaged 79.3 °C, and Quaker State averaged 70.1°C. These results were directed from the aspect of driving these oils were specialized. Castrol GTX and Valvoline claimed superior deposit protection, Pennzoil offered protection under stop-and-go driving, and Quaker State claimed it helps protect against deposit formation. This experiment is directed towards circumstances such as initial startup and stop-and-go driving where engine temperatures are coolest and where deposits from burned gasoline can condense.

The Effect of Different Soundboard Materials on Sound Intensity

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Many different woods are used in the process of making musical instruments, but only some woods have the perfect qualities to create a superb instrument. The purpose of this experiment was to discover what wood projects sound the best and which wood makes the best soundboard. Six types of woods were selected for the experiment: soft maple, walnut, redwood, Engelmann spruce, mahogany and plywood to test which woods project volume the best. It was hypothesized that if a variety of woods were used as soundboards then, spruce would have the highest sound intensity. After a total of 30 trials, five trials on different six wood types, the hypothesis was not supported by the data collected. The redwood had a sound intensity of 78.6 decibels, while the spruce had a sound intensity of 78.4 decibels and the soft maple an intensity of 77.2 decibels. It was discovered that the density of each wood type had an effect on the sound intensity of the woods. The redwood had the lowest density of all the woods, which explained why this wood type had the highest sound intensity as well. Overall it was concluded that the redwood created the most effective soundboard for any instrument that must project sound.

The Effect of Foot Placement on Balance when Lifting Cheerleaders

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Foot position of a person lifting a weight may have an effect on the person's balance. The purpose of this study was to determine if foot placement enhances the balance a base has while lifting a flier into the air while performing a cheerleading stunt. A convenient sample of cheerleaders from a local high school was tested by raising a weight over their head while standing on a force platform in order to replicate the motions of lifting a cheerleading stunt. The subjects' change in force while lifting the sand bag was tested and their results were analyzed with an ANOVA test that yielded a difference in the foot position of one foot slightly in front and the foot position of both feet parallel. The researcher concluded that foot position while lifting does not affect the balance of the person which rejects similar studies performed by universities across the nation.

Shaken Soda: The Fun Phenomenon

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Soda is made by mixing carbon dioxide with syrup. The purpose of this experiment was to see if different brands of soda had different amounts of carbonation. The hypothesis was that Sierra Mist would have a higher concentration of carbonation than the other sodas. This hypothesis was accepted. Pepsi and Coke lost almost as much as Sierra Mist. Mountain Dew and Dr. Pepper lost the least amount of soda. People can use this information if they want to drink soda that won't give them a huge stomachache.

The Effects of Pipe Angle on Heat Energy

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Friction is utilized all the time to get things heated up; whether it be rubbing one's hands together to keep them warm or performing a burnout in a car to show off. The purpose of this experiment was to explore what angle of pipe would cause the most heat energy to be produced due to friction if lead pellets were rolled down the pipe. Data was collected when the pipe made a 30, 37.5, 45, 52.5, and 60 degree angle with the ground. It was hypothesized that the pipe held at a thirty degree angle would produce the most heat energy. The amount of heat energy produced by friction of the pellet of the pipe was found two different ways. The first method was to calculate the energy of a pellet before and after it fell down the tube by calculating the distance it traveled after leaving the pipe and using knowledge of kinematics to calculate energy. The second method used a temperature probe which graphed the change in temperature of the insulated copper pipe as 900 pellets were rolled down it. In the first set of tests, which used the distance the pellet traveled, the mean heat energy produced due to the friction was 0.00032 J at 30°, 0.00029 J at 37.5°, 0.00027 J at 45°, 0.00022 J at 52.5°, 0.00019 J at 60°. In the second set of tests, which used a temperature probe, the mean amount heat energy of heat energy produced was 0.0471 J at 30°, 0.05618 J at 37.5°, 0.04171 J at 45°, 0.04909 J at 52.5° and 0.05647 J at 60°. An independent t-test was performed on both data sets, but only the kinematics data was proven to be significant. This data supported the hypothesis that the pipe held at the lower angle would produce the most heat energy. The reason the lower angle produced more heat energy was because the amount of work done by friction was greater. It was greater because the amount of frictional force on the pellet was greater because the normal force acting on the pellet is greater at smaller angles.

The Effect of Different Types of Liquid on Wine Glasses' Vibration

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Vibration, in mechanics, is the rapid to-and-fro motion of an object. Many sounds are produced by vibrating objects, such as rubbing one's finger along the rim of a wine glass. The purpose of this experiment was to find if different liquids had different effects on the frequency and tone of a wine glass. The hypothesis was that all liquids used in the experiment, water, soda (Coca-Cola), and milk, would all produce the same tones when measured and put into a wine glass. Each liquid was measured as 50 mL, 75 mL, 100 mL, and so forth until the glass was full of liquid at 260 mL. Water and soda made the same tone and frequency, while milk barely produced one. Consequently, the hypothesis that each liquid would produce the same tone and frequency was rejected.

The Effect of Time of Day on the Distance a Golf Ball Rolls

McKaella Grow

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The purpose of this experiment was to learn the effect of the time of day on the distance the golf ball rolls. In golf, putting is one of the most important elements of the game. A golf ball was rolled at 8 AM, 12 Noon, 4 PM, and 8 PM and the distance each ball rolled was determined. There was no control in the experiment. The independent variable is the time of day and there is no control because there is no typical or standard time of day. It was hypothesized that the golf ball would roll the farthest at 8 AM. The results revealed that there was a difference between each time of day. As the day progressed, the distance the golf ball rolled decreased. A t-test was performed on the data between each level of independent. The test disclosed that the data was significant. The golf ball rolled the farthest at 8 AM. The results supported the hypothesis. It is believed that the results are due to the growth of the grass throughout the day and phototropism. The experiment can be extended in several ways. Research can be conducted to determine different types of golf balls on the distance the ball rolled. Research could also be tested to investigate the effects of different types of turf grass on the distance the golf ball rolls.

Lubricant Performance in Cold Weather

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Construction companies rely on machinery to build buildings, excavate land, and perform other tasks. Reliable machinery requires diligent care, which includes lubrication. Lubricants are manufactured differently so they will perform differently. For example, some are manufactured to be thinner so they have higher viscosity. Temperature can also have a big effect on lubricant performance. For example, cold winter weather can reduce viscosity. This experiment tested the performance of three lubricants and no lubricant in cold weather. It was predicted that the Valvoline Max Life lubricant and STP additive combined would perform best. The independent variable was the type of lubricant, and the dependent variable was the amount of water required to move the testing sled. Four trials were conducted at different temperatures. The lubricants did not perform to expectations in cold weather.

The Effect of Air Pressure on the Coefficient of Restitution of a Pressurized Ball

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The purpose of this experiment was to investigate the effect of air pressure on the coefficient of restitution, using a volleyball. The hypothesis was that if the air pressure is at 4.5 psi then the coefficient of restitution will be greatest. The experiment was conducted by rolling the ball off of a 2.25 meter platform onto a concrete surface. A meter stick was placed behind the area at which the ball was to be dropped, for recording the bounce height measurements with a video camera. The ball was dropped 6 times at 13 different air pressures between 0 psi and 6 psi. The average height of the ball at each air pressure was converted from meters to coefficient of restitution. These

data points were graphed. The coefficient of restitution means of 0.0 psi (0.382) to 4.0 psi (0.709) steadily increase until 4.5 psi, which had a significantly less mean of 0.705. At 5.5 psi and 6.0 psi the mean coefficient of restitution was the same, 0.723. The research data did not support the hypothesis that the air pressure at 4.5 psi would produce the greatest coefficient of restitution.

What Suit Is More Suitable for Surfing?

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Aqua suits need a thick neoprene fabric, not just a neoprene lamination. This experiment was done to see which aqua suit would best conserve heat while also giving the surfer flexibility in the needed areas to perform the motions required to surf successfully without too much constriction. It was shown that the Dry suit held the most heat, but it didn't give the surfer the flexibility needed to perform the movements for wave riding. The Oceanic dive suit retained the next most heat; it also allowed the surfer to perform the required movements. Both the Xcel and the Dive skin lost the same amount of heat, which was considerable; a 21 °C drop from the initial heat. It is known that while the surfer is surfing, heat is being created, but this heat is also being lost by heat flow from the surfer's body because without the proper amount of insulation, the heat is flowing away from the body rather than being conserved. It was shown in this experiment that neoprene is a much better insulating fabric than the other fabrics contained in various aqua gear. Therefore, when purchasing a wetsuit one must be sure that there is a high content of neoprene in the fabric rather than simply a thin neoprene lamination.

The Effect of Bat Type on Distance Traveled by Softballs

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New technological advances have provided many types of softball bats. The purpose of this experiment was to determine whether the type of bat influenced the distance traveled by softballs. The null hypothesis for the experiment was there is no difference in the distance traveled by softballs using an aluminum and composite bat. The experiment was performed on a regulation size softball field. Each bat was set into a Black and Decker Workmate 200® and positioned in the batter's box of home plate. While the bats were set in the Workmate, each bat was struck eight times by softballs traveling at 55 mph (24.59 m/s). The distance which the ball stopped was measured by a tape measure. The average distance traveled by softballs hit by the aluminum bat was 6.84 m while the average distance traveled by softballs hit by the composite bat was 7.77 m. With the level of significance set at $p < 0.05$, a two-sample t-test was conducted and it showed that there is no difference between the distances traveled by softballs. When struck by both bats, $t(10) = 0.75$, $p = 0.47$, which supports the null hypothesis. The information provides that the traveling distance of softballs have no effect on which bat a player uses.

The Ability of a Simulated Blanket to Retain Radiated Heat and Serve as a Survival Blanket

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The purpose of this project was to determine if an improvised blanket, one using the reflective properties of a common potato chip bag, would effectively serve as survival blanket in an emergency situation. In this experiment, a blanket was created using a standard chip bag and then tested to determine if it could serve as a survival blanket. The inspiration for this experiment came from instructional survival video seen on the Internet. Mylar blankets advertised as "survival blankets" are created from material developed for use on the space shuttles and satellites. The material is designed to reflect heat. According to the video, the inside of a standard chip bag has these same properties. In a survival situation with extreme cold temperatures it is important to retain body heat in order to avoid frostbite, hypothermia, or possibly death. This experiment tested whether 5 materials could retain radiated heat. Heat transfer by radiation takes place when energy is transferred by electromagnetic waves. The waves carry energy through empty space and matter. Thermometers were wrapped with each of 5 materials and

placed in a freezer to simulate outside freezing conditions. A reading was taken on each of the thermometers at specific time intervals to determine if radiated heat was captured. My hypothesis was that the chip bag, having the same reflective properties as a Mylar blanket, would retain heat. The readings from the chip bag blanket showed that it was a poor insulator in that it did not adequately reflect the radiated heat from the thermometer and maintain the temperature. One flaw to the process that may have had an impact on the results is that even though the thermometers were heated, they did not contain continuously generate heat or radiate it for a long enough period of time to gather adequate data.

PHYSICS B

FIRST PLACE

The Effect of Different Filler Materials on the Efficiency of a Solar Water Heater

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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 different filler materials on the effectiveness of a solar water heater. The rationale behind this research is that solar energy could be used for water heating if solar water heaters with high rate of energy absorption and storage could be built. The use of filler material around the copper coil used for circulating water may help trap more solar energy and store it longer. Sand, soil, and fiberglass were tested as filler materials against a no filler material control group. The hypothesis was that filler material will improve the effectiveness of the water heater, and that soil will be the best filler material. To conduct the experiment, four solar water heaters were constructed, and three were filled with equal volumes of sand, soil and fiberglass. The experiment was conducted for a total of five hours on five consecutive days. The experimental data showed that filler material groups had higher rises in temperatures compared to the control. The sand group had the highest temperature rise and the control group had the lowest. Chi-square analysis and engineering analysis were conducted to establish statistical significance of data and the effectiveness of the solar water heaters for the four groups. The results of the experiment partially support the hypothesis. The use of filler materials helps improve the effectiveness of solar water heaters, but sand group had the most effective water heater.

SECOND PLACE

Corked?

Thomas Sheey

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In baseball, hitters have been caught illegally corking baseball bats in the hope of hitting more home runs. Does this method work? The distance a baseball travels when hit is affected by swing speed and bat weight. When a bat is hollowed out the cork disguises the sound of a lighter, hollow bat. Cork's sponge-like texture may be beneficial by adding spring to a hit, but it could also absorb impact. The hypothesis was that if a baseball bat were corked then it would hit baseballs farther in the air than when baseballs were hit with an uncorked bat. The procedure consisted of preparing three bats. Bat C served as the control, Bat B was hollowed with a 9 cm deep bore that was 2.5 cm in diameter, and Bat A was hollowed with an 18 cm deep bore that was also 2.5 cm in diameter. Both hollows were filled with cork shavings. The bats were used to hit baseballs thrown from a pitching machine. The distance the balls traveled in the air was recorded, using 5 m wide zones, from zone 1 (0 m - 4.9 m) through zone 12 (55.0 m - 59.9 m). The mean average zone reached was 7.1 for Bat B, 6.7 for Bat A, and 6.0 for Bat C. The median zone reached by Bat A and Bat B was 7, while Bat C's was 6. The percentage of balls reaching the outfield was 30.9% for Bat B, 23.6% for Bat A and 20.0% for Bat C. The longest ball hit was by Bat B to zone 12. In all categories, Bat B hit the baseball farthest. The purpose was to test if a corked bat could hit the ball farther than an uncorked bat. The data supported the hypothesis, as the corked bats performed better than the uncorked bat.

THIRD PLACE

The Effects of Different Brands of Golf Clubs on the Distance a Golf Ball Travels

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The purpose of this project was to see if using different brands of golf clubs to hit a golf ball would change the distance each ball traveled. In December 2010, a Central Virginia Governor School student performed this experiment. A machine was built, that held golf clubs and produced an artificial swing to hit a ball. The golf ball was hit at the same place each time off a tee one inch of the ground. Ten Callaway Big Bertha balls were hit with each club. The ANOVA and Tukey test supported that the golf club used to hit golf balls, does determine how far the ball travels. The p-value was 4.63×10^{-07} , which means that the researcher accepted the alternate hypothesis that stated the brand of golf club used does determine how far the ball travels. The original hypothesis was that the brand of club used to hit a golf ball, determines how far the ball travels. In conclusion, the different brand of golf club used does affect the distance a golf ball travels.

HONORABLE MENTION

The Effect of Temperature on the Height of Golf Ball Bounce

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The purpose of this project was to determine whether or not changing the temperature of a golf ball had an effect on the height of its bounce. Two brands of golf balls were tested to determine if ball brand made a difference in height, as well. The hypothesis was that if golf balls of different temperatures were dropped from a height of two meters, then the hottest ball would bounce the highest. A room with a tile floor and a controlled temperature was selected to be the testing area. A ladder was erected next to a pre-decided area on the floor, and a three-meter piece of tape was placed on the wall to aid the measuring process. Next, ten low-priced balls at 0° C, ten balls at 22 °C (room temperature), and ten balls at 50 °C were dropped from 200 cm onto the tile area on the floor, and each ball's bounce height was recorded. A high-speed camera was programmed to record 600 frames per second, and was placed at the bottom of the bounce to help explain the results. This process was then repeated using a higher-priced, different brand of golf ball. After the results were compiled and analyzed, the data supported the idea that a hotter ball, in this experiment, bounced higher on average than a room-temperature ball or a cold ball. Even though this project was mainly about the effects of different ball temperatures, different brands of golf balls were also tested, and the ball with only two pieces instead of three bounced higher on average. This information can help golfers (especially beginners) make more educated decisions about what type and temperature of golf ball they should use to achieve the most success.

HONORABLE MENTION

The Effect of Induced Electric Currents on the Stopping Time of a Spinning Wheel

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The objective of this research was to determine whether a spinning wheel could be made to stop by it generating an electric current in a coil of wire, a solenoid. This was accomplished by arranging magnets around the rim of a wheel and surrounding the wheel with six of these solenoids. The actual purpose of the experiment was to observe how different quantities of solenoids affected the stopping time of the wheel, and it was observed that the greater the number of solenoids, the shorter length of time it took for the wheel to come to a complete stop. Up until this point, the solenoids had been connected into a circuit with six capacitors. It had been assumed that an increasing charge would be measured on the capacitors as the wheel slowed down, but the voltage reading on the capacitors remained mostly steady. This observation led to the second part of the experiment. In this part the

solenoids were not connected into a circuit with the capacitors, and it was found that the wheel still slowed down faster without the capacitors than it did with no solenoids or capacitors. It was concluded that both the solenoids and the capacitors contributed to slowing down the wheel, and that this information might be of some use concerning advancements in the topic of regenerative braking.

HONORABLE MENTION

The Effect of Mass and Rim Thickness on the Accuracy of a 0.22 Caliber Bullet

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The purpose of this study was to discover if the mass and rim thickness of a bullet are related to the accuracy of the bullet. Experimentation was conducted at the shooting range of Mr. John Bell and occurred on December 24th, 2010. A 0.22 caliber rim-fire rifle was used to conduct experimentation. Twenty five bullets of the same caliber were measured for rim thickness and mass. This was done before shooting began, and the data was recorded on the targets intended for each individual bullet. After several days of practice with the same brand of ammunition, the selected bullets for experimentation were fired into their targets at fifty yards. Horizontal, vertical, and linear displacement of the bullet entry to the center of the target was then recorded. Six linear regressions were run to analyze the collected data. With an alpha level set at 0.05, the null hypothesis was retained all six times with p values ranging from 0.33 to 0.9. Visual inspection verified the regression analysis, as the points of entry on the target were scattered and appeared to have no patterns as the regressions suggest. The r-values were significantly less than one, which implies poor correlation. However, several factors, including human error, reliability of the weapon, and visual acuity, might have been confounds. In conclusion, although rim thickness and mass may be related to accuracy, the data from this study suggests otherwise.

Ellipsometric Characterization of Spreading Thin Films

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This project used an ellipsometer to look at spreading of liquids caused by three effects, the Marangoni effect, interfacial energies effects, and capillary action. An example of the Marangoni effect is when wine is poured into a glass; the alcohol evaporates faster than the water, causing an area of high surface tension above the wine. The wine climbs up the walls of the glass. This continues until the wine collects in drops above the wine, and falls due to its increased weight. These drops are sometimes referred to as "Tears of Wine". The purpose of this project was to find the thickness of these "tears" and of a thin film caused by the spreading of a siloxane compound on glass. Capillary action was also put to the test, by simply putting dyed water in a gap on the ellipsometer and allowing it to crawl up. Finding the thickness was done by putting the sample, such as wine, onto the ellipsometer in a glass sample holder made by the researcher, pointing the beam above the liquid reservoir, and adjusting the dials until the resistance was at the lowest point possible. The ellipsometer used in the experiment was a PCSA (in order from left to right, the components were polarizer, compensator, sample, analyzer). The ellipsometer was held up approximately 45° from horizontal. The project functioned by taking data from the ellipsometer and plugged them into equations to get theoretical values. These values were used to fine tune estimates made by the experimenter to get precise measurements. The wine tear film thickness is roughly around 0.25 μm , or microns, and the siloxane film very similar at 0.21 μm . This is done using both the real and imaginary parts of the refractive index determined for the glass substrate. In the case of capillary action, the imaginary part of the refractive index was determined to be -0.00492, close to the value calculated using UV-Vis spectrometer on a more dilute solution of the same dye (methylene blue).

The Effect of Wing Design on the Lift Produced

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This experiment addresses the effect of airplane wing designs on the lift that they produce. The independent variable of this experiment was each wing design, while the dependent variable was the lift produced by each wing tested. The levels of the independent variable were dihedral, polyhedral, and a flat wing. The constants of this experiment were the fuselage of the airplane, the catapult, the environment, the experimenter, the video camera, the software used to compare the plane's flight plan, and the temperature. The alternate hypothesis of this experiment was that if the polyhedral wing was used, that the most lift would be obtained. The null hypothesis of this experiment was that there was no connection between the wing design and the lift produced. Each level of the independent variable was tested ten times. Using an ANOVA test, the p-value was determined to be 0.000, which would show a significant difference. The results of this experiment showed that the dihedral wing produced the most lift, followed by the polyhedral wing, with the flat wing close behind that. This experiment has many uses in the aeronautic engineering field, such as travel, defense, and recreational fields included in commercial aircraft, military aircraft, and remote control aircraft. Aeronautic engineers use information like this to further understand what a specific aircraft needs and what type of wing would meet the needs of that aircraft best. Also, this information can help designers who work in the model fields by allowing them to outfit the slow, park flyers with a stable and high lift wing, and a fast war bird with a less stable wing with medium lift.

The Effect of Distance between Hands and Body on Speed of Pirouettes

Elise Burns

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Of the many steps in dance, a pirouette is one of the most difficult to perform. Performing pirouettes involves not only leg work but also the strategic use of the arms. While completing a pirouette the distance between the dancer's hands and body can vary, in this particular experiment the hands were held 50 centimeters, 15 centimeters, and 0 centimeters away from the body. The purpose of this experiment was to determine the effect of different distances between the hands and body on the speed of a single pirouette. Based on one effect of the conservation of momentum that stated changes in the shape of a spinning object will change its speed of rotation, it was believed that if arms are held 50 centimeters away from the body, then the speed of a pirouette will decrease. The experimenter measured the exact amount of distance between the dancer's hands and body for the duration of the single pirouette. The dancer was prepared in forth position of the legs and arms. The dancer then pulled the arms into a first position and pushed off into an 'en dedans' single pirouette, at which point the start button on the stop watch was pressed. When the dancer completed the single pirouette, the stop button on the stop watch was pressed. The results showed that when hands were held 50 centimeters away from the body, the speed of the pirouette was the slowest, when hands were held 25 centimeters away from the body the speed was faster, but when the hands were held 0 centimeters away from the body the speed was the fastest. Based on this research, if one wanted to complete a pirouette quickly, then it would be more beneficial to bring the hands in closer to the body. To support these results, experiments should be done on the effect of hand position on the steadiness of the pirouette. Then it will be evident to dancers when one should hold their hands closer or farther away from the body.

Carnival Mechanics

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Newton's laws of motion describe the movement and momentum of projectiles. Newton's first law, or Law of Inertia, states that objects like to keep their current motion because of inertia, which is an object's tendency to resist change in motion. Newton's third law states that for every action force, there is an equal and opposite reaction force. When a moving object hits a resting object, the velocities of both objects change because of the unbalanced forces from the moving object's action force and the resting object's reaction force. The purpose of this experiment was to study the effects of block formation on the mean number of blocks successfully knocked off a pedestal. The experiment tested four different block formations using three stacked blocks and changing the formation by 1 cm

either forward, backward, to the left or to the right (thrower's view). The hypothesis was that if three blocks are set up with different formations on a pedestal, then the 1 cm forward formation would have the least mean number of blocks successfully knocked off the pedestal. The experiment involved three 6.35 cm cubes, a 1.2192 m tall pedestal with a 30.48 sq cm top platform, a meter stick, a black Sharpie marker and a baseball. The throwing spot was marked 3.6576 m away from the pedestal with the blocks placed in the center of the pedestal. A baseball was thrown at the blocks for ten trials. These procedures were used for each of the four block formations. The 1 cm forward formation had a mean number of 2.2 blocks knocked off; the 1 cm backwards had a mean number of 2.7 blocks knocked off; the 1 cm towards the right had a mean number of 2.3 blocks knocked off and the 1 cm toward the left had a mean number of 2.5 blocks knocked off. The hypothesis was supported.

Where's The Sweet Spot?

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If you have been struggling with tennis, especially with feeling odd vibrations in your hands, it could be because of where the ball hits the racket. The goal of this project was to find the effect of locations on a tennis racket on the amount of vibration. The vibration was measured by taping a card to the racket and counting the number of times the card flipped. A tennis ball was thrown at four different locations on the racket: the dead spot, the node, the center of percussion (COP), and an area just below the COP. The amount of times the card flipped was measured for each spot; this was done six times at each location. The mean number of times the card flipped when the dead spot was hit was 5.33 card flips. The mean number of times the card flipped for the node was 4.33 card flips. The mean number of times the card flipped for the COP was 5 card flips. The mean number of times the card flipped when the area below the COP was hit was 6 card flips. This project contributed to the area of sports science because the vibration for each spot on the tennis racket has been discovered. Tennis players can now know what area on the racket they want the tennis ball to hit. The hypothesis was if different spots on the racket are tested, than the COP will have the least amount of vibration.

Chronological Crystal Orientation of Formation of Ice Structures

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Understanding ice is very important to our society, it holds the majority of the worlds fresh water, has a huge impact on global weather. Yet our understanding of ice is still very lacking. This project investigated development of a method for viewing the formation of ice crystals and their orientation over time. This method would allow a better way to research and analyze ice formation over time and make it easier to ascertain links between the crystals formation and the conditions it has formed under. To be able to view the individual crystals polarizers where used. When the polarizers are oriented perpendicular to each other they block all light, unless it is partially reconstructed in between the two. Ice thus being a crystalline structure means that when it forms crystals they can be seen as different wavelength of the visible depending on their orientation and composition. Many configurations were attempted in creating a working setup for this objective. All of which consist of a light source shining through a ½ inch diffuser block on top of which sat a Petri dish with water in it situated between two perpendicular polarizers. Originally a medical freezer with an expansion strapped to it was used which would allowed for plenty of workspace, however this failed to get cold enough. A fan, extra insulation, and positioning of the sample were all used but either took too long to freeze or didn't at all. The expansion was decided to be too inefficient and removed. Freezing the water sample in the isolated system of the freezer proved to be easier but had constraints on room causing many issues that disrupted the image quality. Finally a walk in freezer was used with a card board rig to hold all the parts in place including the polarizers, fan, light, camera, Petri dish, and diffuser block. This allowed for the system to be isolated in respect to light but not to air flow which greatly helped in both image quality and time necessary to freeze.

The Effect of Different Building Materials on the Attenuation of Sound

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Sound is a complex, yet simple idea that has many variables. The purpose of this project was to find out what material was the best at attenuating sound at 1000 Hz and 20,000 Hz of sound. The attenuation tube was set up so that the speaker was on one end, the barrier was put in the middle and the microphone recording the sound was on the other. The sound was first measured with nothing in the tube for the control. After the control, materials such as a cloth hand towel, a garbage bag, and a sponge were tested to see which one would attenuate the sound the best. The results indicated that the garbage bag was the best at attenuating the sound at 1000 Hz and 20,000 Hz. However it was tied with hand towels at 20,000 Hz. At 1000 Hz the garbage bag had a mean of 62.1 and at 20,000 dB the hand towel and garbage bag both had 82.3. The t-test on the data (1000 Hz) indicated a significant difference between the means of group B versus D ($t = 6.5895 > 2.101$ at $df=18$; $p>0.05$). The t-test on the data also indicated no significant difference between the means of group B versus C ($t = 1.2684 < 2.101$ at $df=18$; $p>0.05$) and C versus D ($t = 0.3254 < 2.101$ at $df=18$; $p>0.05$). The t-test on the data (20,000 dB) indicated a significant difference between the means of group B versus C ($t = 6.5895 > 2.101$ at $df=18$; $p>0.05$) and B versus D ($t = 5.8314 > 2.101$ at $df=18$; $p>0.05$). The t-test on the data also indicated no significant difference between the means of the group D versus C ($t = 0 < 2.101$ at $df=18$; $p>0.05$). Based on the results for both sets of data the sponge was the best at attenuating sound, then the hand towel, and then the garbage bag. The results showed that the sponge and hand towel were more susceptible to sound. The sponge was thicker than the garbage bag and towel. Even though it was thicker, it did not stop as much sound as the garbage bag.

The Effect of Frequency of Light on Energy Generated by a Solar Panel

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Visible light is made up a full range of energy wavelengths and frequencies. It is possible to separate white light into the colors of the rainbow, from red to violet, using a prism. Each color has a slightly different wavelength and frequency. The purpose of this experiment was to determine the effect of the frequency/wavelength of light on the power generated by a solar panel. It was found that the lower the frequency of light (and thus the longer the wavelength), the more power was generated by the solar panel. The hypothesis was that if the frequency of light was higher, and the wavelength shorter, then the amount of power generated by the solar panel would be increased. In the process, a solar panel board was set up to enable the capturing of light, and light from the sun was directed onto the solar panel, where the electricity that was generated was measured by a volt meter before the light was manipulated by the introduction of a glass prism to determine the effect of differing frequencies of light on the solar panel. The results indicated that the lower the frequency (and the longer the wavelength) of light, the more power was generated, disproving the previous research hypothesis. The average DC volt recording of violet, the color with the highest frequency, was 2.80, while red, the lowest frequency, was recorded with an average DC volt reading of 3.49. The rest of the colors followed the same trend of lower frequency corresponding with higher energy. The null hypothesis was rejected ($t = 14.4536 > 2.101$ at $df = 18$, $p>0.05$). Based on the information garnered from this experiment, there appears to be a direct correlation between the frequency and wavelength of light and the energy generated by a solar panel. The most potent and effective color was red, with the lowest frequency and highest wavelength.

The Effect of Heat Differential on Peltier Voltage Output

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This project was chosen because the researcher loves this planet and wants to do his part to preserve it. The objective of this experiment was to determine the effect of temperature differential on Peltier voltage output, to see if it could be used to generate electricity in real world situations. The hypothesis was that the voltage produced would increase with the temperature differential, up to a certain point. To test this hypothesis a slab of aluminum was placed in the oven and a block of aluminum in the freezer. A Peltier was placed in between and the highest

voltage was recorded. This was repeated with the block and slab in different combinations of cold, hot and room temperatures. A block was used to ensure a consistent and direct heat flow to the Peltier and a slab to act as a thermal mass to prevent the other side of the Peltier from reaching the block temperature. At a low temperature differential, about 70 degrees Fahrenheit, the results were consistent, at 885 millivolts. At a medium temperature differential, about 135 degrees F, the results were very consistently at 1524 millivolts, and at a high temperature differential, about 200 degrees F, the results averaged 1902 millivolts but were not at all consistent. The hypothesis was supported, and the conclusion is that because Peltier devices can generate steady voltage they have real world applications. To generate electricity one could place a Peltier over a fire, with radiator fins on the far side of the heat source to dissipate heat, and adjust its proximity to create a medium temperature differential.

The Effect of a Projectile's Velocity on its Ability to Penetrate Bullet-Resistant Material

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The experiment was completed to inform the public and the military/law enforcement work force on the penetration of Kevlar. Using projectiles of varying velocities, they were fired at a range of seven yards seeing if the projectile had passed through the Kevlar. The hypothesis "If the projectile's velocity increases then the chance that the projectile will penetrate the bullet-resistant material will increase" was created and supported by the results of the experiment. The two calibers with the highest velocities had at least one penetration in their set of trials. The reason the higher velocity projectiles were able to penetrate the Kevlar is answered by how Kevlar works. When Kevlar is hit by a projectile it stretches and catches the bullet not allowing it to penetrate the armor. When the velocity is high enough it tears the bullet-resistant material not allowing the fibers to stretch to stop the bullet.

Effect of Passenger Mass on Roller Coaster Speed

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The largest changing variable involved in the use of a roller coaster is the passenger load that the coaster takes on while in use. Newton's second law of motion involves the movement of the coaster and contains aspects (e.g. friction, air resistance) not defined in that principle. The experiment tested these aspects by varying the degrees of additional passenger mass and measuring the speed at which the roller coaster car completes its motion around the track. Using an N-scale model of a roller coaster, the results were compiled as to the meters per second the car traveled. The results showed that the roller coaster car showed no general trend from the amount of passenger mass because the increased friction was overcome by the inertia of the additional mass, in compliance with Newton's second law of motion. This result shows that roller coasters operating at maximum capacity prove ergonomically beneficial to the roller coaster operator as the same general speed will be obtained at any level of passenger load that the roller coaster car takes on.

The Plasma Whistler

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For this research two ring like Cobalt-Samarium magnets were placed around a flowing plasmoid. The hypothesis of the research was that when the two circular magnets were placed at a distance equal to the radius of the magnets, they would produce the strongest and most consistent field. The field created by the magnets was measured at different points for different separations of the magnets. Points were measured on all three dimensions, then the separation between the magnets was changed and the measurements were repeated. Then, the field was calculated at these same points to validate the accuracy of the measurements. After the measurements and calculations were compared, the separation that produced both the strongest maximum field and the most consistent field was determined. It was found that as the separation increased between the magnets, the maximum field produced by the magnets decreased. The field consistency also increased as the distance between the magnets decreased. The strongest field was produced when the magnets were as close as possible to each other. The results

disproved the hypothesis, showing that the strongest field was not produced at the separation equal to the radius of the magnets.

What Is the Effect of Humidity on the Coefficient of Restitution for a Baseball?

Christopher Seymour

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The purpose for this experiment was to study the effects of humidity on the Coefficient of Restitution for a baseball. Coefficient of Restitution is the ratio of how high an object bounces compared to the height from which it was dropped. Humidity is the amount of moisture held in the atmosphere. This project was chosen because the Colorado Rockies, in their home stadium, Coors Field, put the baseballs in a humidifier for two weeks before the game to reduce the number of home runs. It is also said that it is easier to hit a home run in Coors Field due to the elevation of the stadium. Each ball, after removal from the humidifier, was dropped from a height of 100 cm and the bounce was measured. The results showed that the ball stored in the humidifier had a larger Coefficient of Restitution than the control. The humidifier baseballs bounced 5 cm higher on average.

Using Plasma to Light your World

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The purpose of this experiment was to understand how neon lights, fluorescent bulbs and technologies like plasma TVs worked. This came about after researching the purchase of a plasma TV. The question came up, how does the plasma TV work? It turned out plasma was a major part of the equation (the fourth state of matter). A plasma bulb/plasmoid was created to try and replicate the light and colors created in these technologies. The experiment tested the effect of different gases on the color of the light in a plasma bulb/plasmoid? Wooden blocks, Pyrex measuring cup, skewers, corks, a lighter and a microwave were used to test this. The rotating platform was removed from the microwave. A skewer was lit and put in the microwave under an inverted Pyrex measuring cup. The microwave was set for twenty-five seconds and started. A plasmoid was generated. Different gases were dispersed into the inverted measuring cup to explore the changes to the color of the light. For the first plasma bulb/plasmoid no gas other than standard air was used. The experiment was repeated using Argon and then again using Helium. Each was tested five times. The results were recorded. The mean of the results were as follows. Argon colors: predominately blue, with traces of red and green at a wavelength of 6,350 angstroms. Helium colors: predominately yellow, with traces of green at a wavelength of 7,270 angstroms. Air color: predominantly white with traces of red and blue at a wavelength of 5,040 angstroms. The hypothesis was that if different gases were used when creating a plasma bulb/plasmoid, then different colors would appear when using the spectrometer to measure. The hypothesis was proven correct.

The Effect of Solutions in Water on the Index of Refraction

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The purpose of this experiment was to determine how the index of refraction of water was affected by solutions containing different concentrations of salt or sugar using a laser pointer. I wanted to do this project because I had recently learned about the index of refraction and Snell's Law in the classroom and I wanted to expand my knowledge on the topic through practical application. The hypothesis was if the index of refraction is measured in water, water with solutions of salt, and water with solutions of sugar, then the index of refraction will be greatest in water with solutions of salt. This hypothesis was supported by the results. This experiment began by placing a clear box containing one of the solutions on a sheet of paper with an XY coordinate system, and shining the laser pointer through it at a constant angle of thirty degrees to the normal, the normal being the vertical line to the surface of the box. The points at which the laser beam entered and left the box were marked on the paper, and a straight line was traced between the points. By using the angles the laser beam made to the normal on entering, the angle of incidence, and the angle after entering the water, the angle of refraction, and the index of refraction of the box, the

index of refraction of the water was found using Snell's law. The materials needed were paper, a pencil, distilled water, a laser pointer, a graduated cylinder, sugar, salt, a clear container, a ruler, and a protractor. The results of this experiment supported the hypothesis as the 100% solution of saltwater had the highest index of refraction, with 1.4971 as the mean. It can be concluded that salt increases the index of refraction more in water than sugar and that the index rises as more salt or sugar is added because it increased in both salt and sugar as it went from 33% to 66% and lastly to 100%.

PSYCHOLOGY – GENERAL

FIRST PLACE

The Effect of Suggestion on the Memory of Adolescents

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The recollection of observed facts can be influenced by the correct or incorrect suggestions received subsequently. Suggestions influence memory in children more than in adults. Adolescents are neither adults nor children; therefore, studying the effect of suggestion on adolescents' memory will provide new insight into the way adolescent minds work. In this study, the effect of suggestion on the memory of 100 randomly selected adolescents was analyzed. These adolescents were divided into four equal groups and were shown a video clip and then quizzed. The first group took the test directly after watching the clip (Group A - the Control Group), the second was read an accurate description of the events before taking the test (Group B), the third was read a false description of the events before taking the test (Group C), and the last took the test that included false suggestions implied by the way the questions were phrased (Group D). The percentage of correct answers scored by each person was analyzed. Group B had the highest and Group C had the lowest test scores. This may have been because correct suggestions reinforced and the wrong suggestions misled the recollection of facts. Also, Group C had the highest variability within its test results. This may have been because some adolescents can be child-like (getting affected by the suggestions) and the others can be more adult-like (not getting as affected by the suggestions.) This study has shown that suggestions significantly affect the memory of adolescents.

SECOND PLACE

The Effect of Countermeasures on the Outcome of a Polygraph

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The purpose of this experiment was to determine if the uses of countermeasures affect the outcome of a polygraph exam. The null hypothesis of this experiment was that the use of countermeasures will not affect the outcome of a polygraph exam. The alternate hypothesis of this experiment was that the use of countermeasures will affect the outcome of a polygraph exam. In order to do this, six subjects were given a set of two polygraph exams: one in which they used a countermeasure and one in which they did not. The baseline jump in pneumograph readings, the amplitude in electro dermal activity (EDA) readings, and the amplitude of cardio readings were then evaluated according to chart divisions. These measurements were then compared using the Wilcoxon test to evaluate the significance of difference between the two groups. It was found that the use of a countermeasure significantly increased the baseline jump present in the pneumograph channels and significantly decreased the EDA amplitude in a polygraph. The Wilcoxon tests also supported that using a countermeasure does not have a significant effect on the cardio channel of a polygraph exam. Therefore, the alternate hypothesis was supported by two of the three Wilcoxon tests performed.

THIRD PLACE

The Effect of the Golden Ratio on Beauty Perception

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The golden ratio, a ratio of 1:1.618, is an irrational mathematical constant. It is found in the Fibonacci sequence, an integer sequence that begins with 0, 1, and each subsequent number is the sum of the previous two. As the sequence approaches infinity, the ratio between two consecutive numbers will begin to reach a limit of the

golden ratio. Many things in nature, art and architecture tend to have patterns in the Fibonacci sequence or have measurements in the golden ratio, such as da Vinci's Mona Lisa and Phidias's Parthenon. It is important to study the golden ratio to find out how to construct beauty and determine the mathematical and natural patterns of the golden ratio. It was hypothesized that objects in the golden ratio are considered more aesthetically appealing than others because of how often it is found, and this project was designed to test whether this hypothesis is correct. The hypothesis was tested by asking research subjects to identify the picture that they thought was the most aesthetically appealing in each of the following categories: male faces, female faces, nature, and architecture. Each category contained three pictures, each with objects in ratios ranging from close to the golden ratio to far from the golden ratio. In every category, research subjects chose the picture closest to the golden ratio, which supports the hypothesis that the golden ratio is aesthetically pleasing.

HONORABLE MENTION

Difference in Response to an Ethical Dilemma Based on Age

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What is it that makes people more or less ethical than those around them? No one person is the same ethically, but what affects the ethicality of the actions of the average person? This study was performed in order to examine one possible factor that influences how ethically a person thinks: age. It was hypothesized that, if people being of different age were confronted with the same ethical dilemma, there would be a difference in how ethical the responses were between both groups. In order to test said hypothesis, a study was designed. In this study, 60 test subjects were taken, thirty ages 18-25 and thirty ages 40-60. These participants were faced with an ethical quandary and asked to answer a single question about that dilemma, responding with one of four choices. Once all subjects had responded to the dilemma, the data was put into the form of a graph in order to effectively view any differences in the number of times each option is chosen. A chi-square was conducted with the data, showing that responses did not differ greatly enough and that the results were not significant, with a p-value of 0.304. It was seen that there is a moderate but not substantial difference in the ethicality of the responses given, with the 18-25 group answering more ethically about 24% of the time. It can be concluded that statistically, the data is not significant, however, through further study and analysis, people of different generations may respond ethically differently to a dilemma depending on factors affected by it. The cause of this could be one of many things, none of which are definitive through this simple survey. Further study of this variable could be done, with the addition, for example of examining brain activity as the dilemma is stated or modifying the dilemma to more specifically target different areas of the person's life. This would show on a deeper level the true difference in response by showing difference in brain activity as they respond and also show what most directly affects the subject's decision making process.

HONORABLE MENTION

Effect of Cultural Conditioning on Musical Emotions

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Music theory in many classical systems discussed the emotion context of a musical piece to its listener. However, the emotion experienced by the listener may not entirely agree with the intended one. Factors other than pure music theory influenced the listener's emotion. The hypothesis was that if listener groups without prior cultural conditioning in a given musical culture were exposed to such music, they would not agree with the prescribed emotion of the music. In simpler terms, one would need to belong to the culture of the music itself to understand its emotional content. Four pieces of music were composed to rigid standards laid out by the Indian music system. They did not contain any lyrics so as to nullify the effect of emotion through words. They were composed to convey anger, sadness, happiness and calmness, as laid out by Indian classical musicology. Two sets of listeners were selected, one from the Indian cultural background and one that was from a non-Indian culture. The responses were gathered. The number of matches between the prescribed and observed emotions for each group

was gathered under the four emotional categories. Data analysis revealed that westerners did not feel the same emotions as prescribed by the Indian musicologists. The average match was 5.35 on a total of 20, with a statistical significance of 166. Based on these results, it was concluded that cultural background did significantly affect the emotion invoked when listening to music. The same musical content evoked the prescribed emotions in listeners that were familiar with the Indian culture. However, further research needs to be conducted to analyze the depth of these influences.

HONORABLE MENTION

The Effect of Short Mindfulness Meditations on Heart Rate, Blood Pressure, and Anxiety Supreeti Sharma

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The purpose of this experimental research was to determine if three, twenty-minute sessions of guided Mindfulness Meditation (MM) would have a positive effect on blood pressure (systolic and diastolic), heart rate, and self-reported anxiety. The sessions were taken on three consecutive days at the same time each day. Twenty radiology students acted as subjects; each student was randomly assigned a number, and the students with odd numbers were assigned to the control group with the even numbered students assigned to the experimental group. The control group spent each twenty-minute session silently reading or doing class work in a separate room from the experimental group. The experimental group listened to a guided MM audio recording from UCLA's Mindfulness Awareness Research Center (MARC). All participants filled out the State-Trait Anxiety Inventory for Adults (STAI-AD) anxiety questionnaire prior to and after the completion of all three sessions. The heart rate and blood pressure (systolic and diastolic) were recorded twice for each participant before each session and after each session for the three days. The hypothesis that blood pressure, heart rate, and anxiety will decrease was rejected, and the null hypothesis that no change would occur was accepted. An Analysis of Variance (ANOVA) was performed with two groups (meditation and non-meditation) and five factors (State (S) scores, Trait (T) scores, day 1 and day 3, pre and post, heart rate, systolic, and diastolic blood pressure). The ANOVA resulted with no significant changes from any of the factors, thus concluding that the experiment did not show a measureable difference in the physiological and anxiety parameters between the two groups; however, with a higher frequency of meditation sessions and larger sample size, the same experiment may in the future show to be more conclusive.

The Beautiful Mind and Soul

Jasmine Baker

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The objectives of this project were to determine accuracy between two tests. The tests were "Blue, Gold, Green, and Orange" personality test and "Left Right Brain Hemisphere" personality test. The color test determined personality through a series of multiple choice questions which consist of various character traits. The answers are calculated to determine which "color" or personality of the test taker. The brain test uses virtually the same method, choosing a trait that best fits. However, the results correlate to the brain hemisphere the test taker uses most. The test determines a percentage to show which side of the brain, left or right, is dominant when thinking. The hypothesis for this project was the "Left Right Brain Hemisphere" personality test proves more accurate than the "Blue, Gold, Green, and Orange" personality test. The experiment used ten subjects to determine which test was more accurate. All subjects met in a designated area to test. Each was required to take each test then a survey questioning the subject's opinions of accuracy, difficulty, the test taking environment, etc. Accuracy results were determined from the statements and ratings of the test subjects. From the surveys it was determined that the brain test was rated 30% higher than the color test. In consideration of these results, the null hypothesis was rejected. In conclusion, though the brain test was considered more accurate, further study of different researches discredits the validity of personality tests in general. The human mind is found to be too complex for the restrictiveness of the assessments' one-dimensional results.

The Effect of Playing a Musical Instrument on IQ Scores

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In other studies, it has been shown that playing a musical instrument will increase a persons' IQ score. The purpose of this experiment was to determine the effect of people who play or do not play a musical instrument on their IQ scores. In this experiment, the effect of people who play a musical instrument and people who do not play a musical instrument on the percentage of an IQ Test Score was tested. The research hypothesis was that if a person plays a musical instrument, then that person's IQ test score will be higher than one who does not play a musical instrument. The null hypothesis is that the playing of a musical instrument has no effect on an IQ score. High school students were asked to voluntarily participate in this study. Each volunteer was separated into either of the two groups: the control group (group A) and the music group (group B). Each group was given the same eleven question IQ test with the highest score being eleven. Group A had an average score of 4.65% whereas Group B had an average score of 5%. Variations within the groups were similar, with people who play a musical instrument (group B) having a standard deviation of 2.12 and people who do not play musical instruments (group A) with a standard deviation of 2.03. People who do not play a musical instrument had a variance of 4.11. The variance for people who play musical instruments was 4.63. The null hypothesis was rejected ($t = 5.91 > 2.021$ at $df = 38$; $p < 0.05$); therefore, the data supported the research hypothesis that a person who plays a musical instrument has a higher IQ test score than a person who does not play a musical instrument. One explanation of these results might be the Mozart Effect, which is the notion that a person can increase that person's intelligence by listening to music. Since playing a musical instrument requires the use of the brain, the Mozart Effect occurs, making the brain more developed, thus getting a higher IQ score.

Effect of Position on a Page on an Adult's Recall Ability

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Those people who were not born into the digital world but have at some later point in their lives, become fascinated by and adopted many aspects of the new technology are Digital Immigrants. When reading a visual, the eyes of this older generation unconsciously finds intersection about 1/3 of the way down the page and 1/3 of the way in from the left side. This intersection is known as the Golden Mean by the Greeks and the Z curve by scientists. This experiment was meant to determine the location on a two-page layout that is recalled more frequently by an adult. In this experiment the independent variable was the placement of pictures on the page. The dependent variable in this experiment was the number of correctly recalled pictures in each position expressed as a percentage. In the experiment the subjects were given one minute to study a booklet with 12 equally spaced pictures on the inside. After the minute was up, the booklet was closed and it was switched out with a blank booklet with twelve equally spaced squares. In these squares the subjects wrote down the name of the pictures they recalled from the other booklet. Position 2 had the highest mean with 89 percent. Position 1 had the next highest mean of 86 percent. The t-test was used to test the following null hypothesis at a 0.05 level of significance: The mean percentage score of one position was not significantly different from any other position mean percentage score. A majority of the data was not significant with t values < 2.447 . However, position one through four had significant data compared to the other positions in the booklet. In general the data supported the research hypothesis that if an adult was asked to recall pictures on a two page layout, then he/she recalled the picture about 1/3 of the way down the page and 1/3 of the way in from the left side more often than any other picture.

The Effects of Playing Violent Videogames on Human Aggression

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Video games have become exceedingly popular in the 21st century for children and adults alike. With such an abundance of new technology available at such an early age, one can only wonder what types of adverse effects are influencing behavior. One of the most violent and controversial game titles ever created was the Grand Theft Auto series. Known for its intense violence and sexual themes, the game has been a target of constant bombardment

by parents, worried that exposure to the game increases violent tendencies and behaviors in children and teenagers. Knowing this, the following experiment was created with the purpose to test the effect of violent video games on human aggression. Six test subjects were monitored playing video games in a controlled environment. Each test subject played 25 minutes of FIFA 07, a non-violent sports game, and then recorded their heart rate. That test subject then played Grand Theft Auto 4 (GTA4) for the same amount of time and repeated the process of recording their heart rate. The data was then compiled into percent of anger after playing the non-violent video game and playing the violent one. The results showed that percent of anger, as shown by heart rate, was 6.7% less after playing GTA4 than it was after playing FIFA 07. This, along with the fact that 5 of the 6 test subjects all displayed a drop in heart rate after playing GTA4 having first played FIFA 07, represent the major findings. This led to the conclusion that violent video games do not increase aggression.

The Effect of Age on Genres of Television Shows People Watch

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Television is a major part of the American lifestyle. Invented in the 1920s, the television brought stories to life on a screen inside of people's homes. Now, there are thousands of television shows viewed in people's homes on television. The purpose of this project was to determine how age affected the genres of television shows people watch. If people from the age groups 5-15, 16-26, 27-37, 38-48, 49-59 are surveyed, then they will usually watch reality television programming. In this experiment, 50 people were surveyed, ten in each of the following age groups: 5-15, 16-26, 27-37, 38-48, and 49-59. The results indicated that age does affect the genres of television shows people watch. A chi-squared test performed on the data showed a significant difference in the means of the group. The data supported the research hypothesis that if people from the age groups of 5-15, 16-26, 27-37, 38-48, 49-59 were surveyed, then they will usually watch reality television programming. Based on the survey results, there appears to be a direct correlation between age and the genres of television shows people watch. Before it can be concluded that age affects the genre of television shows people watch, more people need to be surveyed.

The Effects of Gender on Hearing While Distracted

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According to one poll, 12% of Americans suffer from hearing loss. This translates to 38 million Americans with hearing loss or bad hearing. This experiment tested the effect of gender on the quality of hearing while being temporarily distracted. To test this problem, a hearing test was administered to both male and female subjects. In this test, five beeps of different tones and volumes were played while watched a muted movie clip from The Phantom of the Opera as a "distraction". It was determined that there was no difference in hearing between male and female, since the averages of the two different sets of data were equal. A t-test was calculated and it was determined that the difference in gender was not significant. Further studies into this area include testing gender with a distraction and without a distraction. Another study could include testing different types of distractions on subjects.

The Cause in the Difference in Music of the Classical Period and the Romantic Period

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The purpose of this project was to explore the differences in music from the Classical Period to the Romantic Period and discover the reason for these changes. The null hypothesis was there is no historical relation to the musical change. It was hypothesized that there would be a significant difference in musical style from the Classical Period to the Romantic Period and it would be caused by a time of change in the world. The tests were completed by comparing the chord changes in songs from these periods. The chord changes were marked as conventional or unconventional based on whether they were common for the key of the song. The percentage of conventional chord changes was then plotted. The results showed that there was a clear change in music from the Classical Period to the Romantic Period, thus rejecting the null hypothesis. The Classical Period had a conventional

chord progression percentage of 80.5%, the Romantic Period had a conventional chord progression percentage of 62.5%, and the transitional period between the two had a conventional chord percentage of 70%. However, this change was not able to be linked to any specific historical reason. Therefore, the alternate hypothesis was only minimally supported.

The Effect of Technostress on the Generation of Individuals

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Previous research indicates that adolescents often have a positive reaction to new information and communication technologies and that adults often have stress related to these technologies. The objective of this experiment was to discover if technostress were more likely to occur in adolescents or in adults. To do this, twenty individuals were selected to participate: ten high school students and ten faculty/staff members. Directions were read to each individual on how to participate in the experiment. Then, each individual was shown ten photographs of different types of technology, once at a time. The individuals were to write down on the given Reaction Sheet their reactions from a given list of words to each photograph. Then, each individual listened to ten different technology-related sounds, once at a time. The individuals were to write down on the given Reaction Sheet their reactions from a given list of words to each sound. The data indicated that seven out of the ten photographs caused students to have a positive reaction towards technology, and seven out of the ten sounds caused students to have a positive reaction. Data also indicated that seven out of the ten photographs caused the teachers to have a positive reaction towards technology. However, only four of the sounds caused the teachers to have a positive reaction to them. Since teachers were more inclined than students to have a negative reaction to newer technologies, the results indicate generational technostress.

The Effect of Sleeping Conditions on Dream Recall

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Dreams are a mysterious outlet to the minds of human beings. Lucid dreaming is the process by which a person realizes that he or she is dreaming during a dream, and with enough practice, can learn to remain in this state and control this dream. The first step in developing this skill is dream recall. The purpose of this experiment was to determine how listening to music, leaving the television on (on mute), eating, and drinking water affect dream recall and the vividness of recalled dreams. Four test subjects were given forms detailing what they would be required to do for each test. These forms were then collected and the data was compiled into a chart and graph. The results indicated that average sleeping conditions produced the most vivid dream recall, with a mean of 3.25 vividness rating (on a scale of 0-5). Drinking water resulted in the second highest rating, with a mean of 2.75. Eating, music, and television resulted in the lowest scores, with means of 2, 1.5, and 2 respectively. The data did not support the hypothesis that drinking water would result in the most vivid dream recall. While average conditions got the highest mean rating, drinking water still produced a mean rating in the upper range, and was only 0.5 lower than the average conditions. Food, music, and television seemed to simply disturb the sleep cycle of the subject, resulting in less dream recall. With a larger number of trials, one might see different results.

The Effects of Visual and Auditory Distractions on the Attention and Memory of Second Grade Students

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The purpose of this study was to determine whether visual and auditory distractions affect a second grader's ability to stay on task to complete a simple addition worksheet. This study was conducted by a CVGS student from October 2010 to December 2010 at Heritage Elementary School. The students were given a 100 problem, simple addition worksheet to complete in three minutes without any distractions. Then, on a separate day, the same students were given another addition worksheet of equal difficulty while three planned interruptions

occurred. The distractions consisted of people walking in the door and talking to the teacher two times during the test for fifteen seconds each and a fifteen second call over the intercom. This was to determine if the students' scores on the worksheet were affected by the distractions. The average score of the students on the test without distractions was 63.2 and the average score on the test with distractions was 62.2. A two sample, paired t-test resulted in a p-value of 0.74 which is greater than the alpha level set of 0.05, therefore the null hypothesis that the two groups would not have significantly different scores was supported. In general, the results show that visual and auditory distractions do not have a significant effect on a second grader's performance on a simple addition worksheet.

The Effect of Personality on Smell Preference

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Throughout the ages psychologists have attempted to categorize individual attitudes and behavior patterns in order to clarify the differences between people. It is believed that personality traits, preferences, and choices are related through a decision-making program carried by DNA. The purpose of this project was to determine the relationship between smell preference and personality type. The hypothesis was "If introverts, ambiverts, and extraverts are tested then each personality group will have a unique and individual smell preference." To test the hypothesis sixty students were chosen based on the personality they portrayed and divided into three groups of twenty. All participants were then given a consent form that briefly precaution against the risks of the experiment. Next, each participant was given a "sniff test" constructed as follows; four essential oils lavender, eucalyptus, orange, and peppermint were gathered and presented to the test subject. The test subject then wafted the scent of a ten ounce bottle of the essential oil into his or her nostril; this was repeated with every essential oil. Next the test subject was given a moment to choose which essential oil they preferred best and were instructed to write that oil on a piece of paper along with their personality type. The results indicated that there were small variations amongst different personality types but these differences were insignificant. The chi-square was used to test the following null hypothesis at a 0.05 level of significance: The smell preference of introverts, extraverts, and ambiverts is not significantly dependent on the personality type. The null hypothesis was accepted (calculated chi-square=2.301<table chi=19.675; df=11; p<0.05). In conclusion, the data did not support the research hypothesis.

Science or Suggestion

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Have you ever wondered if the Power Balance bracelet is an expensive piece of rubber or a good piece of technology? The purpose of this experiment was to find out the effect of different types of silicone bracelets on the time a person can balance on a balance board. The hypothesis of this experiment was that if silicone bracelets are worn, then the balance time of the test subject would increase when using a Power Balance bracelet. This experiment was tested by having each of the five test subjects perform timed trials of standing on a circular balance board with their eyes closed. Each participant completed three trials on the balance board. In the first trial the subject had no bracelet, in the second they wore the Power Balance bracelet and the third trial they wore a placebo silicone bracelet. The overall mean balance time for the control wearing no bracelet was 11.09 seconds, the mean balance time for the Power Balance bracelet was 15.17 seconds, and the overall mean balance time for the placebo bracelet was 14.91 seconds. The hypothesis was rejected because the balance time with the Power Balance bracelet did not increase, however the placebo bracelet created a similar effect and the difference between the results was not significant.

The Effect of Stressors on Levels of Teen Stress

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Stressors are factors that cause stress and are the way the human body prepares for a threat. Different stressors, which are the Independent Variables in this experiment, can be, for example, school, family, and friend stress. The purpose of this experiment was to determine the most common cause of stress in teenagers. The hypothesis of this experiment was "If the stressor is school, then the level of stress will be the highest". For the procedure, the experimenter made questionnaires to give to teenagers to fill out, and then to tally up the answers and displays them in graphs and tables. The modes were as follows: School, 2; Friends, 1; Family, 0; Health, 0; Race or Religion, 0. The hypothesis was supported because the highest level of stress was for school. School stress could be identified as the most stressful because every teenager given a questionnaire attends school and has stress and family, health and race or religion stresses could be identified as the least stressful because some teens are not affected by the categories. The effects of music on the ability to do work could be a future experiment involving human behavior.

The Difference between the Appeal of Random Color Patterns Versus Patterns Based on Color Theory Rules

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Design companies, including Microsoft®, have spent much time and effort trying to pinpoint exactly what colors help to promote their products the best. This experiment was designed to determine if there is a preference between randomly created color patterns and patterns based on color theory. The null hypothesis was that there is no difference between the number of times a color theory pattern is chosen versus the number of times a random pattern is chosen. A total number of 14 subjects, three males and 11 females, participated. Each subject was shown a presentation that contained 8 slides, each with two patterns, one random and one color theory pattern. The subjects were asked to choose which color pattern they preferred on each slide in 20 seconds or less. After the data were collected, a chi-square test was done, $\chi^2(1) = 0.01786$, $p = 0.8937$, and it was found that there was no significant difference between the number of times a random pattern was chosen versus the number of times a color theory pattern was chosen.

Comparison of Left and Right Brain Hemisphere Dominance and Reaction Time among High School Students

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This study proposed that reaction time is influenced by a person's dominant brain hemisphere. In this study, students at Chesapeake Bay Governor's School and Caroline High School were tested in order to determine brain hemisphere dominance and with hope to find a correlation to average reaction time. The subject's brain hemisphere dominance is the independent variable and their reaction time to the stimulus is the dependent variable. The constants in this experiment were the surveys used to determine brain hemisphere dominance, the environment used to conduct the tests, and the tests used to determine reaction time. After testing sixty-six students this study showed that average reaction time of right brained students was lower than both neutral and left brained students.

PSYCHOLOGY – LEARNING and PERCEPTION A

FIRST PLACE

Novel Chimeric NR2 Subunits May Explain the Molecular Basis of Learning and Memory

Michael Nguyen and Kevin Zhou

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Abstract withheld at authors' request.

SECOND PLACE

The Effect of Test Type on Test Scores Achieved by Teenagers

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The purpose of the experiment was to determine if students' test scores fluctuated depending on what type of test was taken, paper-based or computer-based. This project was relevant today because many standardized tests are becoming computerized and tests should be given in the most helpful format. Permission slips were distributed. Two tests, Test A and Test B, were created with eight questions each. The questions were publicly available SAT questions to ensure equal difficulty. Once forty students turned in their signed permission slips they were split into two sets and given a representative number. Participants in Set A took the paper test first, half took test A and half took test B. Each participant was allowed ten minutes to complete the tests. Participants in Set A then took the computer-based test on the Dell laptops provided. The participants who had taken Test A on paper took Test B on the computer and vice versa. Participants in Set B were tested in the same way but took the computerized test first. Again, half the group took Test A on the computers and Test B on paper and vice versa. The data was collected, analyzed using the program WinStatz. The p-value was over 0.05 therefore the null hypothesis could not be rejected. The data did not support the hypothesis, if the test given is given on paper, then the test score will increase because teenagers are more used to taking paper-based tests. The data concluded that the type of test taken by teenagers, paper-based or computer-based, has no significant effect on standardized test scores. This conclusion was supported by a previous study by Person Science. However, it was noticed that participants took different amounts of time on their test depending on whether it was computer-based or paper-based even though the questions were of equal difficulty.

THIRD PLACE

The Effect of Suggestion on the Ability to Give an Accurate Eyewitness Testimony

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People are influenced by others every day, sometimes enough for memories of certain events to be changed. A person's memory of an event can change drastically between the time an event is witnessed and the time the event is recounted to another person. The purpose of experiment was to determine whether suggestion affected the ability to give accurate eyewitness testimony. Participants, divided into three groups, were shown a video of a 'crime scene' and were quizzed on what they saw. Group A received verbal suggestion that an item was left unidentified, Group B received visual suggestion that an item was left unidentified, and Group C received no suggestion. The test subjects retook the quiz to determine whether the participants remembered to include the suggested item. The hypothesis was that if the authoritative figure suggested to the subject that he/she had forgotten information that was previously given, then he/she would believe that the authoritative figure's information was valid. For every success in "remembering" the hand sanitizer, the result was given a 1. If the test subject did not "remember" the hand sanitizer, the result was given a zero. Therefore, the mean for verbal suggestion was 0.7, the

mean for visual suggestion was 0.8, and the mean for no suggestion was 0. The answers given were statistically significant when comparing visual suggestion to no suggestion and verbal suggestion to no suggestion. The calculated t-test was, showing that the null hypothesis was rejected ($t= 5.97 > 2.101$; $t= 4.856 > 2.101$; $p<0.05$). The findings were consistent with related research, in that people can influence others enough to convert memories or change a person's memory of a certain event. Also, the findings agreed with the statement that between the time an event is witnessed and the time the event is recounted to another person, a person's memory of the event can change drastically.

HONORABLE MENTION

Do Your Eyes Always Tell the Truth?

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The purpose of the experiment was to find which form of eyewitness testimony questioning has the best accuracy of answers. The scientist got the test subjects to sit down at desks in a classroom. Then, she told the subjects to memorize as much as they could about the pictures on the SmartBoard screen and wait for further instructions. While they were focusing on the pictures, the suspect walked in front of their view (in between them and the SmartBoard), picked up a box, and left the room. Immediately following the exit of the suspect, the test subjects were divided equally into three groups. Each group was given four surveys (one for each person). One group got the blank sheet survey, the multiple choice surveys for another and the police line-up survey for the last group. When the test subjects were finished, the scientist collected and graded the surveys. The result of this experiment was that a police line-up had the highest correct accuracy. The average of the police line-up was 100%. The next highest survey was the blank form with 84.725% accuracy. Next is the multiple choice survey with 60.4% correct answer accuracy. The hypothesis, that the police line-up survey would have better accuracy than the others, proved to be correct. The conclusion of this experiment was that the police line-up survey had the highest accuracy of each form of questioning.

HONORABLE MENTION

The Effect of Gender on the Perception of Optical Illusions

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This experiment was designed to test the effect of gender on the perception of optical illusions. Its purpose was to discover if a correlation between gender and perception exists and if one did, assess if there was a separate hemispheric dominance between genders. Using gender as the independent variable and perception time in seconds as the dependent variable, subjects were asked to view a PowerPoint of optical illusions and to say aloud what they perceived each image to be. Answers were recorded in an audio program, Audacity, and were timed and recorded in seconds into a lab notebook. It was hypothesized that, if males and females viewed optical illusions, females would take longer to perceive the illusions. However, male's and female's averages had similar means, ranges, and standard deviations, showing little difference in perception times. Boxplots of image one through image five had similar medians within the sets, while medians in boxplots of image six through image eleven were less similar. Two-sample t-tests were performed and produced p-values above 0.05, indicating the perception times were not significantly different. However, there appeared to be a difference in what images were perceived first when viewing double image illusions. When viewing image eight, four females perceived birds first, opposing eight males that viewed birds first. In conclusion, there is no difference between male and female perception times when viewing optical illusions, but there may be a difference in what each gender perceived first.

HONORABLE MENTION

The Effect of a Spelling Technique on an Adolescent's Learning

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The hypothesis was that if high school adolescents completed a survey assessing right or left brain dominance and took a spelling test while using a technique designed to assist right brain dominant individuals, then those that were right-brained according to the survey would score higher on the test than those that were left-brained. The purpose of this experiment was to determine whether or not right brain dominant individuals could spell words better when utilizing a visual technique designed for right brain dominant individuals than left brain dominant individuals. In performing the experiment participants completed a survey assessing left or right brain dominance. Subjects were presented with "words" and instructed to use a visual spelling technique to learn the spellings of the "words." Subjects were asked to spell the "words" following a brief study period using Scrabble tiles. Participants repeated this process for five "words." The spellings were then evaluated and scored. The hypothesis was rejected, because when a two sample t-test was performed it produced a p-value of 0.117 indicating that there was no significant difference between the group's scores.

The Effect of Environmental Temperature on Memory

Morgan Anderegg

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Temperature has been found to be a contributing factor to the function of many mental and physical processes. This experiment tested the effect of temperature on memory. A memory test was designed for participants to test their memory using color memorization. These tests were then scored and recorded. Tests were administered at three different temperature ranges: 16-19.9 °C, 20-23.9 °C, and 24-27 °C. It was hypothesized that the test administered at the highest temperatures would have the highest scores. Statistical analysis was done on the results and determined that the results were insignificant. No correlation was found between temperature and memory. Therefore the research hypothesis was not supported. While the results provide no evidence that temperature influences memory, further research could be done to test the effects of temperature on biological processes such as sleep and eating habits.

The Effects of Learning through Song on Memorization

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An experiment was performed to determine whether teaching children through music is a more effective aid to memorization than traditional teaching. The null hypothesis tested was that there was no difference in the amount of memorization by students learning traditionally versus learning through song. A subject pool of 16 third graders was used for this experiment. A pre-test was given to test the students' knowledge before the teaching and then these students were taught sixteen vocabulary words and definitions from the Virginia Standards of Learning test provided by the teacher. They were taught these words and definitions traditionally and then tested for the amount of memorization. The same was done for musical teaching with sixteen different words and definitions of equal difficulty. The mean gain score for the traditional teaching ($M=0.38$, $SD=0.36$) was compared to the mean gain score for musical teaching ($M=0.32$, $SD=0.30$). Mean gain scores for the two teaching methods were compared by means of a paired t-test ($t= 2.98$, $p=0.03$), which showed that there was a significant difference between the two. The traditional teaching method test scores were significantly higher than the musical teaching scores. This may be due to the fact that the students were already accustomed to the traditional way of teaching, and had not been exposed to the musical teaching for a long enough period of time.

Memory and Television
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The brain uses twelve watts of power each day, the amount of energy contained in two bananas. The purpose of this experiment was to determine how much the subjects remember about what they saw on television. The hypothesis was that the more information viewers have prior to watching a television show, the more they would remember afterwards. Groups One and Three were given hints. Group Three had already seen the show as well. Group Two did not have information on the show at all. The independent variable was the oral instructions given to the subjects. The dependent variable was the scores that the subjects got on the written test. Group Two got the most right answers on the written test. The hypothesis was rejected.

More than Words: A Study into the Human Thought Process
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The purpose of this experiment was to find the effect of language on human cognitive capabilities. Prior research has shown that language is essential to a human's ability to piece together information; without it, it is thought that humans cannot put two separately categorized pieces of information together. For example, humans in this test had to watch a video with colored squares in it and remember the order of the the colors. This uses the subject's recognition and ordering faculties. Language was then removed through shadow speaking, a method that over stimulates the language center of the brain, to the point where language is not consciously available. Because shadow talking involves playing a recording of speech, another test was also performed where a speech recording was played but shadow speaking was not required. This ruled out the possible factor of distraction. The hypothesis was: *if language is removed, then the test scores will be the worst of the tests*. This hypothesis was accepted. The results displayed that language is necessary for cross disciplinary thought. It was found that subjects performed 37% worse without language. These results were supported by a one-way ANOVA. The data also found that subjects were more likely to remember the colors in the presented order with language, than without. However, subjects were nearly always able to recognize the colors, supporting the theory that information, such as color and placement in a series, can be recognized without language but cannot be woven together without it.

The Effect of Gender on the Accuracy of Reporting
Amanda Dickerson and Laurel Stout
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From an early age the differences in gender are present. Because of these differences, there was an increase in the amount of study of the male and female brains. Generally, females have a better long term memory and males have a better short term memory. The purpose of the experiment was to see if gender did in fact have an effect on the accuracy of reporting. The experiment was designed to see if males or females are better eyewitnesses. Since females have a better long term memory it could be said that the female has a better accuracy of reporting. A group of people, half male and half female, were tested on accuracy of reporting. These test subjects were watching a movie when a conversation was going on. Following the conservation, these subjects were given a test on that conversation. The results indicated that gender does not have an effect on accuracy of reporting. A t-test performed on the data showed that there was not a significant difference between the means of the groups ($t = 0.348 < 2.101$ at $df = 18$; $p > 0.05$). The data does not support the research hypothesis that gender affects the accuracy of reporting. Based on the test scores in the research, it is apparent that there is no difference between the memory of males and females. These findings were consistent with similar research; however there is more that is needed to be learned regarding this topic so more experiments should be done.

The Effect of Text Color on Ability to Recognize and Recall Memorized Words

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Memory can be defined as an organism's ability to recall and retain information and ability to reconstruct past experiences. Researchers have concluded that retrieval of information can be easier when given options as opposed to sorting through all of the information and picking out what is needed. Scientists have also inferred that color may have an effect on a person's ability to recall information. Certain colors have shown to arouse emotions in humans. The purpose of this study was to determine whether or not colored text has an effect on a person's ability to recall and recognize words. Subjects from a local high school were shown a presentation with words written in black-and-white, a natural green, and neon green text color. Subjects were then given fill-in-the-blank and multiple choice tests. The mean number of words recalled among black-and-white, natural, and neon colors were 7.0, 8.3, and 8.8 respectively. The mean numbers of words recognized were 11.9, 7.0, and 12, respectively. Results were analyzed using a two-way ANOVA with a significance level of 0.05 that tested the hypothesis of whether color has an effect on memory. These results indicated that there was a significant difference in ability to *recall* information that was written in colored text, but there was no difference in ability to *recognize* information that was presented in colored text. One can conclude that color does have a beneficial effect in ability to recall information, whether it is a natural color or an extreme color.

The Effect of Breakfast Type on the Score Received on a Standardized Test

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The importance of breakfast as an effective means of preparation before thought-provoking events has constantly been debated in society. The study of the usefulness of breakfast has therefore been the subject of several experiments from renowned scientists. The purpose of this experiment was to investigate whether or not breakfast has a positive effect on standardized test scores. Three types of breakfasts were tested to reach these conclusions: no breakfast, a nutritional breakfast, and a breakfast high in glucose concentration. It was hypothesized that if differing breakfasts were tested, than the nutritional breakfast would yield the best results on a standardized test. On three separate Saturdays, the same group of 10 sixteen year old students was given one of the three types of breakfast. The students were given three hours to digest, and then were administered a ten-question standardized test. Scores for each student's test were recorded and averaged to reach an average score for each breakfast type. The null hypothesis was rejected in two trials: no breakfast versus nutritional breakfast and nutritional breakfast versus the high-glucose concentration breakfast ($t = 3.04 > 2.101$ at $df=18$; $p < 0.05$, $t = 2.45 > 2.101$ at $df= 18$; $p < 0.05$), but was accepted when the control group was compared to the high glucose concentration breakfast group ($t = 1.19 < 2.101$ at $df= 18$; $p > 0.05$). The data supported the research hypothesis that breakfast would affect performance positively. Due on the findings determined in the research, there appears to be a relationship between the consumption, and health qualities, of different breakfasts and test scores. While it cannot be completely reported that breakfast is the sole cause of good test scores, it can be concluded that eating breakfast will help students perform better on assessments.

The Effect of Gender on Detail Notice and Remembrance

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Gender refers to the biological condition of whether one is male or female. A difference between males and females is the way the brain develops and works. The brain has about one hundred billion nerve cells with each nerve having a specific part in the memory of humans. A cell that is related to nerves sends electrical impulses that hold information, which is then transformed into chemical signals that are called neurotransmitters. Short-term working memory, or STM, is the way the brain remembers the information given to it that is "in use." Research has proven that women do memorize things better than men and that female related things are easier for women to remember, while male related things are easier for males to recall. Females were proven to succeed better at auditory tasks whereas males had higher performance rates on visuospatial tests. Research has also shown that women remember objects better when color is a possible predictor. Color also has an effect on the mood of females

and mood can be connected to memory. It is tested and verified that women are indeed better auditory learners whereas men are considered to be better visual learners. If these facts are taken into consideration when one is searching for a job then each field of science, politics, medicine, and etc. could be improved because of workers that would adapt accordingly to their specific role. In the experiment, the null hypothesis was accepted in all comparisons ($1.043 < 11.070$ at $df = 5$; $p > 0.05$). The data did not support the research hypothesis that if the gender of people is tested on the effect it has on detail notice and remembrance, then males will be more attentive to visual details than females.

The Effect of Fluorescent Lighting on Student Test Results

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The fluorescent light bulb was invented in 1896. This discovery caused scientist to question if this light was better than the traditional incandescent bulb invented by Thomas Edison. This started many experiments such as testing the effect of fluorescent light on Virginia SOL test results. The purpose of this project was to determine whether the intensity of fluorescent lights help or harm student's Virginia Standards of Learning test scores. The research hypothesis was that if fluorescent lights were increased then the student's test scores would also increase. Twenty students were giving a modified Virginia SOL practice test in a standard school classroom with full light, half-light, and lights off. Each student's results were then scored by the number of questions missed out of twenty questions for each light level. The results indicated that student's test results were the highest at half-light level with a class average of only 73 missed questions out of 400 total questions. The null hypothesis was rejected (calculated $\chi^2 = 6.557 > \text{table } \chi^2 = 5.991$ at $df = 2$; $p < 0.05$), therefore the data supported the research hypothesis that fluorescent lighting does affect SOL test results. Based on the test scores in this experiment, there appears to be a correlation between fluorescent lighting in the classroom and test results of students. Before it can be concluded that the fluorescent light was the main cause for the student's test scores a survey should be given to the participants to get their opinions and determine if it was the light or other variables in the test taking situation.

The Effect of Texting on Memory

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Text messaging is one of the most popular activities in which this generation's teenagers engage. New cell phones are created and sold each day around the world. These phones are becoming simpler to use, resulting in multitasking being easier too. One way people, especially teenagers, multitask is by texting and studying. Teenagers everywhere are texting and studying and are unaware of the effects on their schoolwork. Determining the consequences of texting, while simultaneously studying vocabulary words was the subject of this research experiment. The hypothesis of the experiment was if a person texts while memorizing a set of vocabulary words, then that person will not remember as much as he/she would if he/she did not text. The experiment consisted of 16 test subjects, each studying a list of 20 vocabulary words for 5 minutes, then recalling as many word definitions as possible for 5 minutes. Half of the test subjects (8 subjects) text messaged with the researcher. This experiment resulted in a rejection of the research hypothesis and the null hypothesis was accepted. The null hypothesis was if a person texts while memorizing a set of vocabulary words, then that person will remember as much as he/she would if he/she did not text. The t-test data from the experiment was as follows: $t = 0.9 < 2.145$. Although the texting group score average was higher than the non-texting group, the statistical result of the texting group was not high enough to accept the experimental hypothesis. However, the small size of the test subject group, and the short study duration time, the actual academic impact of texting while studying might not have been accurately measured.

The Effect of Hand-Eye Dominance on the Accuracy of the Shot of a Basketball

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Hand-eye dominance was tested in this project to see if it affected the accuracy of a basketball shot. The purpose was to see how hand-eye dominance affected the accuracy of a basketball shot. To begin, a measurement was taken from the basketball net to the free throw line. A bandana was then wrapped around the participant's head so only the dominant eye could see the net. The participant took the basketball in their dominant hand and shot a total of fifteen times from the free throw line. Next, the participant wrapped the bandana so the non-dominant eye saw the net. The basketball was taken in their dominant hand and shot fifteen times from the free throw line. Standing at the free throw line, the participant took the basketball in their non-dominant hand and shot another fifteen times, still seeing only with their non-dominant eye. Finally, the participant took the bandana and wrapped it accordingly, to see with the dominate eye. They took the ball in their non-dominant hand, stood at the free throw line, shot fifteen times, and recorded all misses and makes on a sheet of paper. The participant recorded making four shots out of fifteen tries when using both the dominant hand and the dominant eye, and making three of fifteen shots when using their dominant hand and their non-dominant eye. The participant also took note that both times when they used their non-dominant hand, no shots were made. With the throwing hand very closely associated with eye dominance, when one shoots with one's dominant hand, one is able to produce better shots because it links together well with one's eyes. This also explains why when both dominant features were used it produced the most accurate shots. With the throwing hand linked more closely with dominant eye than the non-dominant eye, they joined together to provide stronger accuracy.

Does the Stroop Effect Affect Age?

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This experiment was done on the Stroop Effect. It was on how the Stroop Effect affects different ages. The purpose of this experiment was to test the speed of different ages to react when different signals are sent to the brain. The procedures were to first take the subjects of one of the four age groups (ages 3-12, ages 13-24, ages 30-50, and ages 51-70.) and place them in a quiet room. Then one of the subjects is taken into another quiet room and is given the first test (words have same color as spelled). The subject was then given instructions and timed on how fast they finished the test. They were then given the second test (words have different colors than spelled) with same procedure. This was then repeated with the other test subjects. The steps above were then repeated with the other age groups. My conclusion is that teenagers have the least interference in their brain when reacting to different signals being sent.

Effect of Music Listening on Ability to Retain Vocabulary

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This quantitative study was an investigation to find if listening to music while studying will affect students' ability to retain and recall vocabulary. Current studies range from finding music to be helpful to finding it to be detrimental to learning. The findings indicate that listening to music positively impacts retention over time, but negatively impacts initial attempts at memorizing vocabulary. The vocabulary tests were created by the experimenter and administered by English teachers. Two groups of 8th grade students, non music listeners and music listeners, were divided and tested. These results were important in helping educators and parents to support the needs of students.

The Effect of Different Types of Chewing Gum on Academic Performance

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Academic testing is an intricate part of the modern educational system and is often used to monitor both teacher and student progress. Academic testing can be used to evaluate a student's understanding in a multitude of subject areas. The purpose of the experiment was to determine the most effective way to yield strong academic performance in high school students. The hypothesis of the experiment was if the students consumed caffeinated peppermint chewing gum, then the academic performance would improve. To test the hypothesis, students were given a general knowledge test which consisted of eighteen questions. Students in group A served as the control group received no chewing gum at all. Students in experimental group B were given a piece of peppermint chewing gum. Students in experimental group C were given caffeinated peppermint chewing gum. It was found that group C achieved the highest test scores of the three groups. A t-test performed on the data indicated that the null hypothesis was accepted ($t=0.02187 < 2.021$; $t=0.11208 < 2.021$; $t=0.10505 < 2.021$ at $df=38$; $p < 0.05$). The data did not support the research hypothesis because caffeinated peppermint chewing gum did not significantly increase the test scores. Based on the findings of the experiment, group C appeared to be the most effective chewing gum to use in order to achieve high academic scores; however, the difference between the peppermint chewing gum group and the caffeinated peppermint chewing gum group were not significant. A factor that may have skewed the results was that the students who participated in the experiment had varying academic capabilities. In addition to testing subjects, the shortage of questions on the test document, the array of questions used, and the number of repeated trials could all have contributed to flawed results. Modifying these aspects of the experiment could potentially make the results more reliable.

The Social Aspects of Autism and How Eye Contact Is Affected

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The research presented in this observational test was conducted in order to explore the amount of eye contact and social interaction apparent in different classroom settings. The observations consisted of attending both a self contained classroom and a mainstreamed classroom. There were three students observed in the self contained classroom and one student observed in the mainstreamed classroom. Each classroom was observed for an hour at a time five times each. All of the observations were measured in a qualitative sense and were based on the individual student. Each student was observed separately and notes were taken in order to capture what was needed for later analysis of the study. After conducting all the observations they were then analyzed to come to a conclusion by looking at when and where the eye contact and social interactions were used most. It was found that the original hypothesis was supported in saying that if an autistic child is exposed to more one on one experiences with the teacher, especially in a self contained classroom, then they will increase their level of eye contact and social interaction. The research conducted in this experiment will be useful in helping to discover the best educational option for students with autism. By looking at all the observations and the conclusions it was evident that for the majority of students with autism a self contained classroom would be the best choice for them because they are able to get more one on one experience in this setting.

PSYCHOLOGY – LEARNING and PERCEPTION B

FIRST PLACE

The Effect of Age and Different Types of Cell Phone Usage on Selective Attention

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Selective attention can cause inattentional blindness to unexpected events. Cell phone use while driving is an issue because drivers may not see hazards. Younger cell phone users, who are digital natives, may have a greater ability to be continually partially aware on multiple fronts. The purpose of the experiment was to understand the impact of age and cell phone usage (e.g., talking versus texting) on selective attention. The hypothesis was that if different types of cell phone use were tested on older and younger participants, then younger participants talking on the cell phone will have the highest attention level; though this attention level will not be equal to that those not talking on a cell phone. Ninety participants (45 teenagers, 45 adults) viewed the "Invisible Gorilla" video and counted the number of basketball passes. One-third of the group did not use a cell phone, one-third talked on the phone, and one-third texted. Chi-square tests were performed to test the null hypothesis that the type of cell phone use and age did not affect the ability to see the gorilla. The null hypothesis was rejected for texting ($\chi^2(1, N=60)=4.6, p<0.05$) and age ($\chi^2(1, N=90)=9.0, p<0.01$). Participants who texted were less likely to see the gorilla and teens were more likely to see the gorilla across all test cells. The null hypothesis was accepted for talking on a cell phone ($\chi^2(1, N=60)=3.4, p=0.07$), as this was not significantly different from the control. The data partially supported the hypothesis, since teens outperformed adults, and texters performed significantly worse on both counting passes and seeing the gorilla. Talking on the cell phone was directionally but not significantly worse than not using a phone. Future experiments could be conducted to test narrower age ranges, and greater sample sizes to refine the results.

SECOND PLACE

The Effect of Different Genres of Music on Memorization

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The purpose of this study was to determine the effect of different genres of music on the memorization ability of elementary school children. A student conducted the study at a local school in October of 2010. A group of Talented and Gifted (TAG) students from grades three, four, and five was administered a memorization activity in three trials. The group took the first trial of the test with rap music, the second trial with classical music, and the third trial with no music. Each trial included a showing a 3x5 chart of pictures, followed by a blank chart of the same size to be filled. The results of the study show that the average activity scores of students were highest with the second trial, classical music. The third trial, no music, held the median average, and the first trial, rap music, averaged the lowest scores. From these scores, a p-value of 0.41 resulted. Because the alpha value was set at 0.05, the null hypothesis was supported, signifying no significant relationship between the genres of background music and testing scores of elementary school students.

THIRD PLACE

The Effect of Various Flavors of Chewing Gum on Short Term Memory

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Memory is an organism's ability to store, retain, and recall information, including past experiences. There has been speculation that chewing gum has effects on memorization; subsequently, various scientists and professors have conducted research on the effect of chewing gum, more specifically, mint gum, and these studies pointed

towards increased activity in the pre-frontal cortex of the brain (which is responsible for an organism's short-term memory). The purpose of this project was to determine how different flavors of chewing gum would affect short-term memorization. It was hypothesized that if mint gum, cinnamon gum, fruity gum, spearmint gum, bubble gum were chewed and compared to no gum, then mint gum would increase memorization the most. Each subject was given a minute to memorize as many cards with pictures on one side and numbers on the other as possible while he/she chewed gum. The number of cards memorized was recorded. The results indicated that the subjects who chewed mint gum memorized the most number of cards at an average of 6.2 cards and those who chewed fruity gum memorized the least number of cards at an average of 4.7 cards. A t-test performed on the data indicated a significant difference when mint gum was compared with fruity gum and no gum ($t=2.51>2.101$; $t=2.40>2.101$ at $df=18$; $p<0.5$). A t-test performed on the data indicated an insignificant difference when mint gum was compared with cinnamon gum and spearmint gum. ($t=2.03<2.101$; $t=1.90<2.101$ at $df=18$; $p>0.05$). Based on the data collected in this experiment, there appeared to be direct correlation between chewing gum and memorization in some cases. Before it can be concluded that chewing mint gum affects short-term memorization changing the method of testing the subjects could have proved a change for the better; having random, unrelated pictures on the back of each card would have confused the subjects and made it much more difficult for them to be tested efficiently.

HONORABLE MENTION

The Effect of Television Distractions on Efficient Task Completion

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The purpose of this study was to see if television distractions affected the efficiency of task completion. This study was conducted by a student from Virginia during December of 2010. Two groups of subjects were each given two multiplication tests. On day one the first group was given the test with the television off, while the other group had the television on while testing. On day two the first group had the television on while testing and the second tested with the television off. The tests were then graded to see how many items the subjects got correct each time they were tested. A paired t-test was then run on all of the data. The data was found to be insignificant with an alpha level of 0.05 and a p-value of 0.57. In conclusion, it was found that the hypothesis if the television is off while taking a test, then the results of the test will be better than if the television is on was not supported.

HONORABLE MENTION

The Effects of Auditory Subliminal Messages on Students' Average Test Scores

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The purpose of this study was to investigate whether or not auditory subliminal messages can reveal test answer to students when the messages are provided before the test. In order to conduct this study, an eleventh grade student tested the susceptibility of other high school students to subliminal messages. The test was administered to two groups in a standard classroom. One group received the answers through an auditory subliminal message while the other did not. The subliminal message was created by using Garage Band® by Apple. The subjects were randomly separated into two groups. Each group was presented with a musical selection and then given the test. For one group the answers to the test were recorded at -19.0 dB along with musical selection; for the other group, they were not. The analysis of the data returned a p-value of 1.0, which was greater than the alpha value 0.05. The research hypothesis that if students receive an audio subliminal message with the test answers before the test, then their average test scores will be higher than students who have not received the subliminal message, was not supported. In conclusion, the subjects' scores showed no response to the presence of subliminal messages, suggesting that subliminal messages have no effect on student ability to answer test questions correctly.

HONORABLE MENTION

The Effect of Texting Distractions on Driving

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The purpose of this study was to determine the effect that texting has on simulated driving. This experiment was performed by a high school student at a local high school between December 3, 2010 and December 17, 2010. Fifteen high school juniors were tested with a driving simulator and were required to type and read text messages while driving a simulated car. The number of times that the car's tires went outside of the lane was recorded. The three groups, were compared with multiple paired t-tests. The t-test between reading and the control produced a p-value of $2.82E-07$ ($\alpha=0.05$). The t-test between typing and the control revealed a p-value of $1.25E-11$ ($\alpha=0.05$). The hypothesis that if the driver was typing a text message, then the car would travel outside of the lane more times was supported by the data. The results of this experiment show that that texting while driving distracts the driver by a very significant amount.

Fun in the Sun?

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The purpose of this experiment was to study the effects of exposure to sunlight on student's test grades. The hypothesis was that if students were exposed to different types of light, then tests taken while under sunlight would receive the highest grade. The scientist took interest in this subject because a renovation had just recently been completed to add more sunlight to the middle school. The scientist wanted to see if the students were really benefiting from the renovation academically. Eight student subjects were divided into two groups. One group took a test under an open skylight, and another group took a similar test under artificial light. The next day, the subjects switched lighting types. While the subjects were being tested, there was no communication. The results showed that the scientist's hypothesis was supported. The mean test score of the group in sunlight was 83.8 percent correct. The mean test score of the group without sunlight was 70.5 percent correct. It was also interesting to note that all tests taken without sunlight were finished before those taken under sunlight. The results show that if a community wants to have a smart school, lots of sunlight coming in through windows and skylights is needed. It is now obvious that the renovation done to the school will definitely have a positive impact on the students. Additionally, sunlight can keep the students awake and increase awareness. When a school has no sunlight, it feels dark and creates a difficult environment for doing work. Overall, the scientist learned that sunlight has a positive effect on students test grades.

The Effect of Rodent Species on Maze Time

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It has long been debated which is smarter, mice or gerbils, and the purpose of the experiment was to determine which species of rodent would be able to complete the maze the quickest. The hypothesis was that the gerbils would be able to complete the maze faster. The basis for this hypothesis was that gerbils are larger and more active and would have a physical advantage over the mice. For the experiment, a maze was constructed to test the mice in. Each specimen was tested three or more times to acquire accurate results. Some form of food was placed at the end of the maze to give the animals an incentive to complete the maze. We found in our data that the overall average of the gerbils was lower than that of the mice. However, one gerbils' average was higher than the average of the mice. In conclusion we found that the rodents were not very hungry and did not seem too interested by the food. This is a source of error in the experiment and probably skewed our results. If there was a way to get the rodents to focus on the task the gerbils would still be better at it because they have the physical advantage.

How the Implementation of Computers on the Classroom Environment Have Affected Students' Ability to Learn

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With the ever increasing amount of technology, computers in particular, flowing into schools as of late it is possible that this new tool is hindering the modern scholar. During the 21st century technology has progressed and thus the computer has become more common in all environments. Schools in particular have started to implement computers more and more in the classroom. Computers have become such a tool to education that many schools now have thrown out the human teacher interaction for strictly computer based courses. This study proposed that although seemingly a cheaper way to educate, computer courses are not an effective way to teach in public schools. The research was done using a comparison of the grades of students in computer courses without interaction with a teacher on a regular and accessible basis versus the grades of students in courses taught by a teacher present on a daily basis for instruction. The data was then used to assess if computer courses are effective in public school education. The result of this research showed that computer based courses were not an ineffective method of teaching. The amount of technology a student is exposed to may even help them progress. Thus the computer may be as applicable for the job of educator just as well as any educated scholar.

The Effect of Multilingualism on Cognitive Brain Functions

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A growing body of research has demonstrated that executive control develops earlier in bilingual children than in monolinguals. Bilingualism is associated with more effective controlled processing in children and the constant management of two competing languages enhances executive function. The purpose of this experiment was to determine the effect of bilingualism on the cognitive functions. For the purpose of this experiment, bilingualism was defined as the ability to speak two or more languages fluently. Ninth grade students in the IB program at Henrico High School were given the Birmingham Grid for Learning test on the internet in four groups on two separate days. The BGFL is a test for multiple intelligences which consisted of forty questions. Score for five of the eight intelligences were added to come up with a composite score for cognitive functions, namely; linguistic, logical, intrapersonal, visual/spatial, and kinaesthetic. The results indicated that the mean of logical, intrapersonal, visual/spatial, kinaesthetic and composite cognitive scores were higher for monolinguals than bilinguals. A t-test was performed to test the validity of the data. The calculations supported that the data was significant ($t=2.99 > 1.98$ at $\alpha=0.05$ and $df=120$). The null hypothesis was that cognitive functions for bilinguals are not significantly different from monolinguals. The null hypothesis was rejected; the data from the scores collected on this experiment indicated that monolinguals and bilinguals perform about the same on test for cognitive functions based on the BGFL test for multiple intelligences. This may be due to a classification bias on the subjects selected. A good number of students in the monolingual group were receptive bilingual because they can understand their parents' language but could not speak it fluently. In addition, all students who took the test can understand and speak another language to a certain extent because of three years of a world language classes. So, there were no true monolinguals in this experiment's test population.

The Effect of Being Left Handed on Artistic Ability

Anna Karabaich

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The purpose of this experiment was to study the common myth that people who are left hand dominant are more artistic. This experiment refers to the visual arts. The hypothesis, if left and right handed humans are tested, then the level of artistic ability will be greatest for the left handed. This experiment was conducted by giving test subjects a single sheet of paper with a photograph to draw and three boxes of the same size as the photo. Each subject was allowed to complete the three trials on their own time. Each paper was given to the same person of artistic merit to "grade" on a scale of 1-5. In this test, being left handed had no significant effect on artistic ability (3.08 ± 0.907 , 2.86 ± 1.19 , $p=0.52$, t-test). Thus the null hypothesis was supported and the alternate hypothesis was

rejected. The research hypothesis was not supported. Group A, right handed, had no scores of 1.0. Group B, left handed, had three scores of 1.0. Groups A and B both had one score of 5.0.

Recycling Education and its Effect on Middle School Students in a City and County School **Martha Karnes**

Central Virginia Governor's School, Lynchburg, VA 24502

The purpose of this study was to determine if an eighth grade student would know what to recycle given that their school has more recycling programs than another school. This study was conducted by a Central Virginia Governor's student at Brookville Middle School and Bedford Middle School in the winter of 2010. An eleven question survey was given to two different eighth grade classes, questions 1-10 were "yes" or "no" questions asking if a certain material was recyclable, question 11 was an open ended question asking about the school's recycling programs. The surveys were scored out of 100 points and compared to each other in a t-test; the resulting p-value was 0.088, which was statistically insignificant compared to the set alpha value of 0.05. In conclusion, these results did not support the hypothesis that if a school had more recycling programs then its students would know what to recycle more than a school that did not have recycling programs.

What Is the Effect of Time on the Creation of False Memories?

Zunair Khokhar

H-B Woodlawn Secondary Program, Arlington, VA 22207

The rationale for doing this experiment was to see whether time has an effect on the creation of false memories because of its real-life application in court cases. False memories, memories that are thought to have occurred in the past (but did not actually occur), can influence the turnout of a court case, making the accused person(s) vulnerable to receiving a punishment that s/he/they would not have received otherwise. To test the research question, the researcher created a GIF animation with images and image parts (from the images shown in the GIF animation). The GIF animation was played for different durations and then paused for twenty seconds. During the twenty-second intervals, the subjects memorized the paused image. After the twenty seconds were up, the subjects recreated the paused image using the image parts and template provided. It was hypothesized that that time does have an effect on the creation of false memories, because people generally tend to remember more information the closer in time they are to the last time they heard, saw, tasted, felt, or smelled something. Also, the information that a person has or acquires can affect their recollection of what really happened. In this experiment, the more time that passed the more information that was introduced to one's mind; the information (the GIF animation) was thought to have an effect on one's recollection of the paused image. The results showed that time does have an effect on the creation of false memories.

The Effect of Age on the Ability to Retain Short Term Memory

Chloe McGolrick

Glen Allen High School, Glen Allen, VA 23060

As age increases, one's ability to recall short term memory also grows because of the brain development. After a certain point though a person's brain stops growing and the ability to retain memory lessens. The purpose of this project was to determine which age group could remember the most objects in a short period of time. Ten people in each age group had twenty-five items placed in front of them and had one minute to look at the items and recorded as many as they could. The results indicated that age group thirty-six to forty-nine correctly identified the most items which was eighteen point one. The t-test identified that eleven comparisons rejected the null hypothesis and four accepted it. The data supported the research hypothesis that age group E of ages thirty-six through forty-nine would be able to retain the most memory. This was supported by the fact that more knowledge is retained once the brain is developed, but that conditions make the brain lose that ability as age increases.

The Effect of Musical Auditory Distraction on a Student's Ability to Perform a Short Term Memory Task

Adranna Moore

Appomattox Regional Governor's School, Petersburg, VA 23803

The purpose of this study was to show the effects of music as an auditory distraction on students' ability to perform short term memory tests, to call attention to the possible benefits of music as a study and test taking aid in the form of white noise, and to understand and take advantage of how students work with music as a part of their everyday life while learning. The argument presented in this study was that there is no significant difference in the level of work a student can accomplish while dealing with a musical auditory distraction. This was done by testing five students with music and five without music and averaging their scores together. The results of the experiments showed that both those with and without music achieved the exact same scores on average. In conclusion, the hypothesis was proven true and, though the data shows the obviously different levels of the students, shows that on average it was neither detrimental nor helpful to listen to music while studying and/or testing.

The Effect of Manipulation on the Negation of the Stroop Effect

Payal Shah

Henrico High School, Henrico, VA 23227

The purpose of this experiment was to find a manipulated word that would eliminate the Stroop effect. The Stroop effect states the reaction time it takes to name the ink color of the words. It states that it is supposed to take longer to read the word when the word is different from the ink color than when the word is the same as the ink color. The Stroop effect is a test used to measure a person's continued attention. This experiment was a variation to a Stroop Effect experiment. It was hypothesized that if the manipulations of words are counterclockwise and a different color, then the Stroop effect will be negated. To determine this, the researcher created a slideshow with different manipulated words of color in different ink and had it tested. The manipulated words were no transform (normal), clockwise, counterclockwise, mirror image, and scrambled. These were also the five levels of the independent variable. The counterclockwise and scrambled oriented words were missed the least. Only two questions each were missed for both the counterclockwise and scrambled oriented words. The clockwise words were missed the most. The mirror imaged and normal words were in between. The results supported the hypothesis, if the manipulations of words were counterclockwise, then it will negate the Stroop effect.

Reading Gets the Grade

Natalie Slater

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There are a lot off assumptions about reading. People say "read a book, turn off the TV, it will make you smarter!" But does reading actually help people with their schoolwork, does reading make you smarter? The purpose of this experiment was to find the effect of hours spent reading weekly on student's grades. The data used in this experiment was gathered from a school-wide survey. The survey asked students to circle their first quarter and interim quarter grades for their core classes, their grade and their gender. The survey also asked students to circle their estimate of their hours spent reading weekly. The options given for grades were A, B, C, D, and E. The options for gender and grade were male and female and 6, 7, and 8. The options for hours spent reading weekly were 0, less than an hour, 1-2 hours, 3-4 hours and more than 4 hours. The GPAs, or grade point averages, were then calculated and compared to the hours spent reading. The results showed a positive correlation between hours spent reading weekly and GPAs. People who responded that they didn't read at all during the week had a mean GPA of 2.17 for their report cards and 2.38 for their interims. People who said that they read more than 4 hours a week had a mean GPA of 3.28 for their interims and 3.31 for their report cards.

How Does Television Affect High School Students' Ability to Study?

Lindsey Trent

Southwest Virginia Governor's School, Pulaski, VA 24301

Does television detract from a student's reading comprehension? The objective of this study was to test the impact of television on high school students' ability to comprehend what they read. It was hypothesized that the presence of television while a student was reading would decrease their reading comprehension. Twenty-five volunteers were asked to read a page-long biography about Eleanor Roosevelt, and were then asked to answer a four question quiz that tested their comprehension. In the first trial, 12 participants were asked to read the biography with a television show playing in the background, and then take the quiz without distraction. In the second trial, the other 13 participants were asked to read the biography and take the quiz without the distraction of television. In each trial participants were given five minutes to read the biography, and then five minutes to take the reading comprehension quiz. After the quizzes were scored, the results were shown to be significant ($p\text{-value}=0.001$), with participants who were distracted by television while reading scoring lower on the comprehension quiz than participants who were not distracted by television. The data was also analyzed to determine if gender had an effect on reading comprehension, and it was concluded that there was not sufficient evidence to show that gender had an effect on reading comprehension while distracted. However, it was concluded that there was significant evidence to show that the distraction of television detracted from a student's reading comprehension.

The Effect of Testing Environment on Math Test Scores

Leah Woods

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Every person in the world multitasks at least once a day, but they don't know that multitasking can harm your brain instead of help it. Even many simple tasks could have the potential to harm the human brain. There have been numerous studies suggesting that multitasking should not be something to worry about because the fact that the brain can perform this action should show that there is no harm done. But there are also studies that suggest otherwise, saying that there should be more studies performed and that there is reason for concern. This purpose of this project was to determine the effect of a testing environment, music or no music, on math test scores to simulate multitasking. Five test subjects took a test with and without music. Each test was scored and the results indicated that the test without music scored lower, a mean of 55% correct, than the test with music, a mean of 66% correct. The data did not support the hypothesis that if music is played during a math test, then the test scores will be worse. Based on the results, there appears to be an unknown influence on the results. There are many possibilities such as lack of need for long hand mathematical skills with the recent introduction of calculators. To insure proper and uninfluenced results and professional study would need to be conducted. Multitasking is a part of everyone's lives. It is used in every aspect of life. It can be as simple as reading and talking and as complex as making dinner and doing homework. But research shows that multitasking can have harmful results on a person's ability to perform tasks and memory. Studies also show that the brain might not even be able to handle multitasking over a long period of time without side effects.

The Effect of Gender on Short Term Memory

Ajia Yearwood

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The purpose of this research project was to determine if male or female senior citizens have greater short term memory recall. A local high school student conducted the study at a local senior center and a local church in December 2010. Each senior citizen was administered a memory card matching test. The memory card matching recall test is a card game in which the subject has to find the pairs by turning over cards, two at a time, and remembering where a certain card is placed; each time the participant found a match, those two cards were placed aside as they finished the test. The amount of time it took each participant to find all three matches was recorded. The data was analyzed using a two sample t-test assuming equal variances, and the p-value obtained was 0.95; the alpha value was set at 0.05. Therefore no significant difference was observed between the two groups, and the researcher's hypothesis if fourteen elderly men and fourteen elderly women were given a timed memory test, then

the women would complete the task in the least amount of time-was not supported. All of this research taken together supports the theory that is no relationship between gender and short term memory recall in senior citizens.

PSYCHOLOGY – SOCIAL

FIRST PLACE

The Effect of Driver-Passenger Pairing on Stop Sign Compliance

Margaret Doyle

Williamsburg Middle School, Arlington, VA 22207

The purpose of this experiment was to determine the effect of a front seat passenger on a driver's stop sign compliance. Over 700 drivers were observed at an intersection with four way stop signs in Arlington, Virginia between 2 and 4 pm on weekends from October through mid-December. The genders and ages- teen or adult- of passengers and drivers were recorded. Drivers were sorted into four groups- male adult, male teen, female adult and female teen. Driver groups were then sorted by passenger gender and age. Controls for each driver group were drivers with no passengers. The percentage of stops for each group was then calculated. The hypothesis for this experiment was that a driver's stop sign compliance will be greater with dissimilar age passengers than with similar age passengers, regardless of gender. Adult males stopped most often when with teen females, least often when with adult females and nearly as seldom when with teen males. Adult females also stopped most when with teen females but least when with teen males. Male and female teen drivers stopped most when with adults of the same gender and least when with teen passengers of the same gender. The hypothesis was accepted for teen drivers but not for adult drivers.

SECOND PLACE

The Effect of Birth Order on Personality of an 11-14 Year Old Female

Alison Eddins

George H. Moody Middle School, Richmond, VA 23228

Personality traits are typically acquired at a young age, and are often influenced by experiences early in life, such as family conflicts. Many conflicts in families between siblings occur as a result of differences in birth order; thus, birth order directly influences the early development of personality traits. Previous studies and research have shown that first born children tend to exhibit traits showing responsibility as a result of having younger siblings. The purpose of this experiment was to determine how the birth order (only child, first born, middle child, last born) of an 11-14 year old female would affect the subject's results on a personality survey. Based on previous research, the research hypothesis was formed that "If personality surveys are given to human female subjects from the ages of 11-14, then the group of first-born children will have the highest "Responsibility" category rankings." Surveys were created in which subjects rated themselves 1 through 4 for 20 questions; there were 5 questions in each main personality trait category. The four main personality trait categories were: "Responsibility", "Sociability", "Empathy", and "Desire to Please Others". Forty surveys were distributed; ten to each level of the independent variable. The results indicated that last born children, instead of first born, had the highest "Responsibility" category rankings, which did not support the research hypothesis. The null hypothesis was accepted in all comparisons ($\chi^2 = 0.036 < 7.815$ at $df=3$; $\alpha=0.05$), ($\chi^2 = 0.33272 < 7.815$ at $df=3$; $\alpha=0.05$), ($\chi^2 = 0.06512 < 7.815$ at $df=3$; $\alpha=0.005$), ($\chi^2 = 0.0928 < 7.815$ at $df=3$; $\alpha=0.05$). Because there was no statistical significance, there appears to be no correlation between birth order and personality. However, there are factors that influence personality other than birth order, and more tests must be performed in which all other influencing factors are eliminated.

THIRD PLACE

The Effect of Time Spent Using ICT on Changes in Teenagers

Leah Dillard

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Information and communication technology (ICT) is a class of technology that has growing effects on the lives of youth around the world. As a result of this evolution of technological and connectivity, there are both positive and negative consequences on teenagers' lives. This experiment was conducted to find what effect time spent using ICT had on the physical, mental, and social changes of a 13-14 year old teenager. The hypothesis was that if teenagers spent zero hours, two hours, four hours, six hours, and eight hours using ICT, then four hours would be the level that yielded the least changes on the question sheet, as scored from 1 to 5 by the participants. The final number of participants was 15 males and 15 females (13 or 14 years old), which created 30 repeated trials. The question sheets were compiled with ten questions that related to the teenagers' mental, physical, social, and emotional well-being, and were the exact same for each level. All 30 subjects were instructed to go through their daily activities, but they had to keep track of and control how many hours they were using information and communication technology, so they could accurately complete each level of independent variable. The results indicated that the highest range from the average of three was the zero-hour level, with 2.47. The lowest range was 0.64 by the two-hour level, but because the four-hour level had an overall average of 3.12 and the two-hour average was 3.2, the four-hour level proved to have the least changes among teenagers. Therefore, the data supported the research hypothesis, and the null hypothesis, which was rejected, was that the number of hours teenagers spent using ICTs had no effect on teenagers emotional, socially, physically, or mentally.

HONORABLE MENTION

Social Networking Safety among High School Teenagers

Kelly Johnson

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Social networking safety is a growing concern among Facebook users. The purpose of this study was to determine whether there was a difference among the Facebook profile security of freshmen and sophomore, junior and senior and graduated high school students or a difference between gender and Facebook profile protection. The 120 Facebook profiles were analyzed using a Federal Trade's Commission based internet safety check off list. The student's age, gender, and safety rating were then recorded and analyzed using a single factor ANOVA and a student's t-test. The results yielded that there was no difference between Facebook profile security and gender; however, there was a statistical difference among the three age groups analyzed. The researcher concluded that the amount of profile security among Facebook users is based more on the factors of a user's personality than gender, and that differences of profile security among various age groups derive from the progression of internet safety curriculum in schools.

HONORABLE MENTION

Revised Asch Conformity Experiment

Katherine Mireles

Ocean Lakes High School, Virginia Beach, VA 23454

The purpose of the Asch line experiment was to test the effects of an in group and an out group bias on the levels of conformity. The procedure was to create paper test with twelve different boxes. Each of those boxes contained four lines; one was labeled x and the others were labeled 1-3. The participants, which were high school seniors, were given the tests and a set of numbers. One group was told that the numbers were from a group of high school freshman that had taken the same test, and the other was told that the numbers were from seniors that had taken the test. They were informed that the lines were to help them in their decision making process. They were

then told to write which line appeared the most like line x in length. The average number of correct responses from students who were told that the responses came from freshman was 11.6875 correct responses, and the average number of correct responses for the group that was told that the responses came from seniors was 11.625 correct responses. A T-test was used to test the following null hypothesis at the 0.5 level of significance: There would be no difference in the number of correct answers between students who received fake responses from their in group and students who received fake responses from their out group. The null hypothesis was accepted.

HONORABLE MENTION

The Effect of Relationship Length on the Level of Trust and Cooperation between Partners Lara Phillips

Yorktown High School, Arlington, VA 22207

The purpose of this experiment was to test if extending the length of two anonymous partners' relationship in a simple trust game would affect the level of trust and cooperation between them. The hypothesis was that the longer the trust game was played, the more cooperative and trustful subjects would be. To investigate this hypothesis, two levels were used: one where the game was played repeatedly, modeling an ongoing relationship, and one where the game was played once, simulating a brief human interaction. The trust game selected to model the two different types of relationships was based on the premise of trustful and cooperative decision-making, with points awarded to participants depending on the strategies they chose throughout the game. For the first level, subjects played six rounds, although they did not know how many rounds they would be playing, nor were they aware of their partner's identity. In the second level, participants played the game only once, this time knowing they would only be playing once, yet still not knowing who their partner was. Data were collected using 40 human subjects. An independent t-test was run on the data obtained. It was found that the results of the experiment were statistically significant, with a p-value <0.05 . The results supported the hypothesis that longer relationships led to more cooperative and trustful behavior. It was concluded that individuals in ongoing relationships tend to be more trustful and cooperative than individuals who interact only briefly. These results can be applied to real-world situations, including business, friendships, and spousal relationships.

Reality Bites: Genetic Engineering and You Katelyn Armbrister

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Genetically modified foods have become one of the most controversial topics within the past fifteen years because of the arguments surrounding the subject, but many people who eat these foods do not know the entire story about what they're consuming. The objective of this study was to determine whether subjects' opinions of GM foods would change or remain the same after reading an informative online article presenting both sides of the argument. It was hypothesized that if an article about genetically engineered food and organic foods was read, a person's opinion would change from the original. Participants were asked to complete a twenty question survey before and after reading the article, and were also asked to choose five foods from a list based on cost, need, and whether they wanted organic or GM products. Pre-survey and post-survey scores were compared using a matched-pair test in Minitab, and the difference in scores was considered significant with a p-value of (0.007). Seventy-five percent (75%) of participants changed their answers between the pre-survey and the post-survey. It was concluded from the results that many people would shift their original opinion of the argument after reading the online article and gaining an educated background of the pros and cons of organic and GM foods.

The Effect of Different Job Interview Sessions on which Interviewee Is Hired for the Job Position

Sara Bourdouane

Washington Lee High School, Arlington, VA 22201

For certain job positions, there are people that display almost perfect personality and appearance traits but lack in job experience. There are others who have great expertise and working methods for the job but lack other characteristics. Which would be hired? This aspect of the situation brings on other questions about judging facade versus skill. The purpose of this experiment was to test the effect of different job Interview sessions on whether or not the interviewee is hired. This experiment was tested using the position of a divorce lawyer for the purpose of the job interviews. There were three human subjects used as the independent variables. The control was a plainly dressed person with a bland personality and average experience in the divorce lawyer position. The other was a very loudly dressed applicant, who doesn't have the best appearance or presentation, but had 15 years of successful experience in the position. Lastly, there was a very outgoing candidate with a great appearance and presentation, but had little experience. Each interviewer interviewed each of these applicants and each interviewer selected one candidate for the position. Ultimately, the control was most chosen for the position of the divorce lawyer. The unskilled and outgoing applicant followed the vote count and the skilled and lacking in appearance applicant came in last. The results of this experiment supported the hypothesis in the sense that the control would have the highest hiring count. These results triggered issues in speculation about the validity of real life job interviews.

How Accents Influence Stereotypes of Education and Race

Katja Jackson

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The goal of this experiment was to find the effect of type of accent on the listener's perception of the speaker's race and level of education. This project was conducted to see if prejudices and stereotypes about race and education still exist in society. To investigate this issue, test subjects listened to one minute audio files of individuals speaking English with different accents and then filled out a questionnaire that asked them to identify the race of the speaker and their level of education. The British and German speakers were identified by the majority of test subjects as having attended university for three years and being awarded a Bachelor's degree. The Asian accented speaker, Irish-accented speaker, Hispanic-accented speaker, and the African American English speaker were identified by the majority of the test subjects as having graduated from high school. On average, the speakers with accents generally associated with whites were identified as such, and the speakers generally associated with non whites were identified as such. This science project contributes to linguistics and behavioral sciences because it displays that people associate accents directly with race and education level. This science project revealed that stereotypes regarding race and education level still exist within American society.

The Effect of Region on the Racial Identity of Female First Grade Students

Virginia King

Central Virginia Governor's School, Lynchburg, VA 24502

The purpose of this research project was to test if region affected the racial identity of female first grade students. Eighteen female first graders were tested between November and December 2010 at two local elementary schools (school #1 = suburban, female Caucasian majority of 68.75%; school #2 = urban, female African American majority of 88.64%). The researcher placed an African American doll, a biracial doll, and a Caucasian doll in front of one student at a time. Next they were asked to choose the doll that they like the most. Then they placed their hand beside the doll and a picture was taken. The researcher took the photos and regulated the white balance so that it was equal between all pictures. Then the researcher found the levels of red, green, blue, and luminosity in both the hand of the child and of the doll in each photo. Because there were multiple pictures for each child, the differences were averaged together. Then separate t-tests analyzed statistical significance between the red, green, blue, and luminosity scores. For these tests the alpha value was 0.05. The p-value obtained for the red was 0.0013, for the green was 0.0085, for the blue was 0.2226, and for the luminosity was 0.0124. The overall hypothesis that if one African American, one Caucasian, and one biracial Barbie doll were placed in front of female first-grade students from two

different elementary schools, then the students from school #2 would be more likely to choose the African American doll and the students from school #1 would be more likely to choose the Caucasian doll was supported at school #1 but unsupported at school #2.

Preference of Music and GPA

Erika Landgren

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Rock, rap, pop, classical, hip hop, jazz, country, bluegrass, and oldies; could these genres of music have anything to do with students' grades? The objective of this study was to find out if there was a relationship between preference of music and high school students' grade point average (GPA). It was hypothesized that there would be a relationship between preference of music and high school students' GPA. The null hypothesis was that the mean GPA for all groups was equal. The alternative hypothesis was that at least one music genre's mean GPA differs. A survey was made to hand out to various high school students. The survey listed several genres of music and a place for the participants' GPA. Random samples of 15 students were selected from seven high schools to participate in the survey. Eighty-five surveys were returned. The survey asked the participants to indicate the individuals' preference of music and to obtain the participants' GPA from the guidance counselor of the high school. Once the surveys were returned, the surveys were analyzed using a one-way ANOVA test to determine if there is a relationship between preference of music and high school students' GPA. After the experiment was complete, the p-value of 0.2065 was not statistically significant at the 0.05 level and it was concluded that there is not a relationship between preference of music and high school students' GPA. Perhaps a larger or more diverse sample would show a relationship since 0.2065 is rather small.

The Effect of Group Size on Conformity

Sang Ma

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Conformity was the term coined for the transduction of behaviors to align with the situation due to discomfort. From Solomon Asch's experiment on group pressure and conformity, social norms and people's attitudes were shown to be factors of conformity. The purpose of this experiment was to test whether the size of a group can affect one to conform. If the amount of people in the group was increased, then the chance of conformity was believed to also increase. Following the designed procedure, the group size gradually increased from the subject alone to two, three, four, and five people. Each was asked to answer the few questions that were based on a comparison of three different piano songs to the original one. However, the participants rather than the test subject had been directed to purposely give the wrong answer. As the test went on, the subject began to feel a mix of discomfort and answered the simple questions incorrectly. A chi-squared test performed on the data gave the p-value of 0.104. The results indicated that when three or more people surround the test subject, the more likely it was for conformity to occur. According to the data of this test, the number of people in a group is a major factor of one's chance of conforming.

The Effect of Age on Conformity

Chelsea Mills

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Conformity is an action that depicts an agreement with existing attitudes. A conformist behavior results from a human's needs: need for harmony, decreased conflict, upholding of general values, and assuming a general role. Influences of conformity include group size, academic levels, confidence, and age. Age acts as a major cause of conformity due to the idea that individuals conform to the norms of a particular age group. Multiple experiment findings present that conformity increases throughout adolescence then decreases throughout early adulthood. The purpose of this experiment was to establish the effect of age on conformity. Based on prior research, if different ages groups 8-11, 12-15, 16-19, and 20-23 are placed in a conformable environment, then conformity will result most in the 12-15 age group. Each experimental group and control group contained ten individuals. Each trial

group consisted of four confederates and one subject. Confederates were used to influence subjects' responses. The participants were directed to look at a slide and choose the letter that was equal in size to the sample letter shown. Confederates verbally stated the incorrect letter before the subject responded, then subject stated a letter, either conforming or contradicting the confederate. The t-test was used to compare the difference between the means of each group. The 8-11 age group conformed the most with a conformity rate of forty-seven percent. For the 8-11 control and experimental group, the null hypothesis was rejected ($t = 2.59 > 2.002$). The calculated-t accepted the null hypothesis for the 12-15, 16-19, and 20-23 control and experimental group ($t = 1.38 < 2.002$; $1.97 < 2.002$; $0.750 < 2.002$). The experimental groups were also calculated. Results accepted the null hypothesis on eight accounts and refuted on two; supporting that age, in some cases, significantly affects conformity.

The Influence of Emotional Bias on Moral Decisions

Alexa Monfort

Mountain Vista Governor's School, Warrenton, VA 20187

This research explored the extent to which emotion influences simple moral decision making. The purpose of the study was to survey the sample population inquiring about a series of hypothetical situations in which the surveyors would have to choose between a logical option, sacrificing emotional sympathy, or a more emotional solution to the problem at hand. The sample population was chosen from the 2011 senior class of Kettle Run High School in Nokesville, Virginia. One hundred students from the class of 221 were chosen at random using a stratified random sample. The participants were asked about their academic strengths, their spirituality, and their temperament, followed by a series of hypothetical situations in which they were asked to project a moral decision. Although most surveyors consistently chose the sympathetic options, the response variable showed a higher concentration of logical answers in those who identified themselves and strong quantitative learners, as well as those who identified themselves as spiritually weak. This ending result supported the hypothesis, which asserted that self-proclaimed math and science oriented learners, as well as those with a "weaker tie to organized religion" have a tendency to choose more logical options over sympathetic ones. The conclusion of the survey also supported the hypothesis as derived from the "Trolley Problem" that people are more likely to think sacrifice is morally permissible when they have no direct or tangible tie to the victim.

The Effect of Gender on Friendship Formation of Students in the Godwin Math/Science Center

Anthony Palesis

Specialty Center for Science, Math & Technology at Mills E. Godwin High School, Henrico, VA 23238

The purpose of this study was to determine the effect of gender on the number of friends students in the Math and Science Center make within the Center. A survey was developed and administered to students in the Godwin Math and Science Center. A control was not used because there is no standard gender. The results were not significant and the null hypothesis was not rejected. The calculated t-value of 0.523 was less than the table $t = 1.75$ with 15 degrees of freedom and $\alpha = 0.1$. This experiment showed that gender had no significant effect on the number of friends students in the Math and Science Center make within the Center.

The Effect of Persuasion using Fake Statistics on Preference of Water

Audrey Parrish and Courtney Wynne

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Peer pressure is common in most adolescents. Research shows that risky decision making is most often done in peer groups or by peer influence. The purpose of this project was to determine whether or not fake statistics on water (peer pressure) would affect an individual's preference of water. Each cup was filled half way full with water. No chart was shown as the control (group A). Another chart stated that 50% of people preferred cup A, and 50% of people preferred cup B (group B). The last chart stated that 80% of people preferred cup A over cup B (group C). Ten different people were in each group: Group A, Group B, and Group C. Each person was placed in front of the two cups of water and a chart. Every person was told to pick the cup of water they preferred after

drinking the water. The hypothesis stated that if a chart showing fake statistics with Cup A preference is applied, then there will be a greater number of individuals who choose Cup A. The results varied. When cup A preference was shown, the majority of individuals chose cup A. When equal or no preference was shown, the majority of individuals chose cup B. The chi-square test was used to test the following null hypothesis at a 0.05 level of significance: The distribution of fake statistics on peers' view of water has no effect on preference of water. The null hypothesis was accepted in all cases and comparisons (calculated χ^2 : 1.6 for no chart and equal preference and 0.4 for cup A preference < table χ^2 : 3.841 at df=1; $p>0.05$), therefore the data did not support the research hypothesis that persuasion using fake statistics would affect an individual's preference of water. The findings supported the research that most individuals try to fit in with others and that individuals make decisions based on others. Further experiments need to be done with more trials and making sure individuals cannot react with others during the experiment. Further research can determine whether or not age, gender, and ethnicity have an effect on preference.

The Proportion of Extrovert versus Introvert Participation in High School Athletics

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There are many athletes in the world who play various sports at various levels of skill and competition. It is important to know what drives athletes, high school athletes in particular, to participate in sports. Student athletes have been seen pushing themselves beyond belief, past blood, sweat and tears. This study was to discover whether or not it is a matter of personality that drives these athletes to be as diligent as they are. For time purposes, this study consisted of athletes that participated in 2010 fall and winter sports. The athletes were surveyed and information such as grade and gender were gained as well as information in order to differentiate between extroverts and introverts. The questions used to sort the two personalities came from the Keirsey and Bates Temperament Sorter. An equivalent number of students that did not participate in the fall and winters sports' seasons were surveyed and the same information was gained. These surveys were then evaluated and separated into the categories of grade and sex within the main two categories (extroverts and introverts) and statistically tested to show whether or not there was a trend in personality types as my hypotheses had predicted.

The Effect of Blood Typing Affects Pheromone Detection

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Pheromones are volatile, odorous substances which are released by an animal and identified by others, causing a physiological reaction. Pheromones can help detect the immunity genes found in our DNA that are called the major histocompatibility complex. However, our MHC is hard to measure and less well known, but blood typing is easy to understand. This experiment tested to see if blood typing can serve as an accurate proxy for a person's MHC. Volunteers' pheromones were collected in t-shirts, and then subjects smelled the shirts and ranked them from least to most attractive. The ranks that the test subjects had given were then written down in columns according to each volunteer's shirt. The numbers from each subject were assembled and used in a Friedman's test. The experiment failed to reject my null hypothesis, however further studies are needed for these results to be truly conclusive.

Judgmental Minds

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The purpose of this project was to see how different appearances of individuals affected the positivity or negativity of responses. The scientist had 5 male and 5 female volunteers go to the mall and ask ten females between the age of 30 and 45 "What time is it?" The scientist recorded the women's responses based on a scale of 0-10, ten being positive and zero being negative. The results of this project showed that gothic-looking people are responded to more negatively than people dressed unkempt, athletic, foreign, and casually. The most positive reaction was to the athletic male. The project proved that appearances can dramatically affect how people are reacted to.

Is Smiling Contagious?

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The purpose of this experiment was to determine whether or not smiling is contagious more in males or females. Research shows that men and women smile differently. When a woman smiles it can mean something totally different from when a man smiles, for example women associate smiling with being feminine. While when men smile a lot they think of themselves as sociable. In this experiment it took fifteen different males and females to see if smiling is more contagious in females or males. Each test subject was smiled at in the same location by the opposite sex. Two more females smiled back than males. Nine females smiled back and seven males smiled back. The experiment was repeated with fifteen different males and females only with the experimenter not smiling at them. This portion of the experiment was known as the control. Most of the test subjects did not smile back during the control portion of the experiment. Four females smiled back, and three males smiled back. There was only one female more who smiled back than the males. More females smiled back than males in both portions of the experiment. There was overall less males and females who smiled back during the control. This statement shows that smiling can be contagious. To improve this experiment more test subjects could have been used. More test subjects would allow the data to be more accurate. Also, to have the experiment performed in an environment that is not so hard to get people's attention. This would permit the experimenter to be able to make eye contact with the test subject, making the results more precise.

Public Opinion on World Government

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The purpose of this research paper was to show how the common man, or ordinary citizen in the United States, viewed a globalist world and the possibility of a world government. The world is coming closer together and people have many different opinions and ideas on whether or not there should be a central, world governing body. In order to gain the opinions and views of various citizens a twenty question survey was created and posted online on a social website and emailed to various people in the state of Virginia. After two months of the surveys circulating they were gathered and all the response compiled with the data and results into a graph and table. After receiving the completed surveys a total of 93 people responded. The tables represent how many people picked certain answers to each question and which answers in each question had the most responses. The hypothesis going into the project was that the Virginia citizens would agree that the world is coming closer and a world government is forming. However in the null hypothesis it was believed that there was no significant trend in thinking that the world is forming into a global government. The results and conclusion of the research will be revealed and discussed.

STATISTICS

FIRST PLACE

Determining the Effectiveness of Market Action Trading Strategies

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Technical analysis is one approach to generating profits in the stock market; it hinges on mathematical analysis of market action (price movement). The purpose of this research was to test the successfulness of a computerized trading strategy based on market action. It was hypothesized that if the strategy was implemented then its generated profits would be higher than a traditional (control) method of buying and holding a security for a set period. The strategy had three distinct technical indicators, based on price volatility, momentum, and averages. They all worked in conjunction to produce buy signals. Each indicator had a mathematical formula, which generated values that were then plotted. From the graph of each indicator, patterns and signals were identified. Securities were sold using a trailing stop method where a certain level of price decrease signaled an exit. The strategy was programmed using computer software, which then produced individual profit/loss data for each of the one hundred randomly selected securities from the S&P 500. From there, the raw data was analyzed to find net profits and other metrics, providing insight into strategy efficiency and success. The trading strategy produced a 9.41% profit on a theoretical account of ten million dollars over five years, while the traditional benchmark produced a 7.45% with the same initial parameters. Furthermore, the average trade was \$713.36 with the ratio of the average winning trade to the average losing trade being 1.88:1. The percentage of winning trades was 40.41% while the traditional method won 52% of the time overall. These results show that this specific strategy does indeed substantiate the hypothesis, with the computerized strategy outperforming the traditional method by 26.33%. While not a definitive proof of technical analysis as a whole, this research certainly supports the validity of market action strategies. Further research could involve different indicators within the strategy, or testing the strategy with more securities and for a longer period.

SECOND PLACE

Influences Economic and Political Factors Have on the S&P 500

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The stock market is known for its unpredictability. The world of the stock market is all about what one predicts the market will do in the future. Consumer confidence plays a big role as to whether investors are buying or selling stock. How could one increase confidence of the buyer so more stocks would be bought? Seven variables such as: percent of Republicans in Congress, Gross Domestic Product (GDP), Consumer Price Index (CPI), unemployment rate, interest rate, year, and gold price were researched to find the average value of each for the previous twenty-four years (1985-2008). These values were entered into Minitab, a statistical analysis program, to compare their effects on the Standard and Poor's 500 (S&P 500), a portion of the stock market consisting of five hundred stocks known to indicate the rise and fall of the stock market as a whole. The historical data of each variable was compared individually with the S&P 500 in a linear regression plot. Then all variables were compared simultaneously with the S&P 500 using a multiple linear regression that accounts for the influences each factor has on the S&P 500. A model was formulated using every variable to accurately predict the future trends of the S&P 500 ($S\&P\ 500 = 396076 - 153\ Unemp.\ \% - 86.4\ Int.\ rates\ \% - 200\ Year + 22.9\ CPI - 3.21\ \% \ Rep.\ Cong. - 1.33\ \$Gold/oz. + 0.308\ GDP$). When comparing each variable individually to the S&P 500 the linear relationship was not very strong, showing the highest r-squared value to be 85.1% with respect to the year and the S&P 500. Once all variables were compared together in a multiple linear regression, they showed an r-squared value of 96.2%. This study will contribute to the vast historical research of the S&P 500 and will show that the market can be somewhat predictable. This will help buyers in the stock market maximize their profits and minimize losses through the model obtained.

THIRD PLACE

The Effect of Swimsuit Technology on Swimming Time Improvements during National Competition

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The purpose of this study was to analyze the difference in the performance of swimmers using the new high-tech swimsuits at the 2008 United States Olympic Trials and those not using these swimsuits at the 2004 United States Olympic Trials. The effective application of the principles of hydrodynamics is an important factor in the performance of swimmers. Reducing drag or hydrodynamic resistance provides an opportunity for swimming performance improvement. The initial supposition of this study was that the time improvement would be greater in 2008 than in 2004. A random sample of 25 of the top 50 finishers in each event and their time improvements in these events at the 2004 and 2008 Olympic trials were collected. The mean time reduction for each event was calculated with a negative number indicating time improvement. The data was blocked based on gender and distance of event after examination of the distributions of the data using histograms and box plots. Two sample t-tests for a difference in means were conducted to compare the mean time reductions from 2004 and 2008. The results yielded evidence to support the alternative hypothesis and reject the null hypothesis. For each t-test the p-value indicated that the probability these observations would occur if the null hypothesis were true is less than 0.05 and that the probability that these observations occurred by chance is also less than 0.05. However, there was little evidence to support the claim that the time improvement was significantly different in the distance freestyle races.

HONORABLE MENTION

The Effect of Location and Forecast Model on Forecast Accuracy

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Many different computer model data systems are used throughout the meteorologist community. This experiment tested the accuracy of several of the systems commonly used. What the researcher wanted to find was a city that specifically stood out for being more accurate, or easier, to forecast for compared to the others used. The hypothesis was that Richmond city would be easier to forecast for because of the fact that less variables, such as mountains or the sea could affect it. The other cities used were Norfolk and Charlottesville, all of Virginia. The three systems used in the experiment were the Global Forecast System (GFS), North American Mesoscale (NAM), and (NWS) National Weather Service. All daily forecasts for highs and lows were recorded into its respective spot in a data table. After all data was collected (thirty days), the average absolute forecast error was calculated. Most systems were relatively the same. However, the city of Richmond did show a bit more of accuracy compared to the others. The NWS system also showed more accuracy throughout its predictions. The results of this experiment may help meteorologists decide which model they would prefer using while carrying out their work. It could also help them realize the average error of the model they are using.

HONORABLE MENTION

The Effect of Family Income on SAT Scores

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Scholastic Aptitude Tests have been an efficient way of measuring a student's readiness for college in many areas of study. With the importance of these tests in deciding a student's potential future, many factors leading to how well a student performs have been analyzed. The purpose of this project was to determine how family income would affect SAT scores with levels of the independent variable at less than \$40,000, \$40,000-\$80,000, \$80,000-\$120,000, \$120,000-\$160,000, and \$160,000-\$200,000. The hypothesis was that if students coming from a

household with a greater family income took the SAT test, then they would score higher than those from a household with a lesser family income. Research was conducted on both family income and SAT scores, including the gathering of graphs, charts, and statistics. The collected data was then recorded onto a data table and graph. The results indicated that students in families with a higher income exhibited a greater mean SAT score (with a mean score of 546.4/600) than in families with a lesser income (with a mean score of 461.9/600). A t-test performed on the data that the null hypothesis was rejected when the control was compared to all other levels of the independent variable and when level B (40,000-80,000) was compared to levels D (120,000-160,000) and E (160,000-200,000) ($t = 5.88 > 2.101$; $t = 3.09 > 2.101$; $t = 3.96 > 2.101$; $t = 4.04 > 2.101$; $t = 3.04 > 2.101$; $t = 3.11 > 2.101$) at $df = 18$; $p < 0.05$). The null hypothesis was accepted when the remaining t-tests were compared ($t = 2.08 < 2.101$; $t = 0.85 < 2.101$; $t = 1.47 < 2.101$; $t = 0.88 < 2.101$ at $df = 18$; $p > 0.05$). The research hypothesis was rejected when the mean SAT score of students from family incomes of (40,000-80,000) was compared to (120,000-160,000) and (160,000-200,000). The research hypothesis was accepted in all other comparisons. Based on SAT scores analyzed in this research, there appeared to be a direct correlation between family income and SAT scores. Before it can be concluded that family income has a direct effect on SAT score, more data should be obtained.

The Effect of Average Humidity on the Number of Homeruns Hit in Baseball

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A baseball's flight is known to be affected by multiple factors including, but not limited to, the movement of the pitch and force of contact the baseball has with the baseball bat. Baseball stadiums located in different atmospheric conditions create different statistics depending on the dryness of the air. The purpose of this experiment was to determine the effect of average humidity on the number of homeruns hit in Major League Baseball games. Ten non-consecutive seasons were selected as ten trials for each level of the independent variable. The data for number of homeruns hit each year during home games was recorded for the Colorado Rockies, and the same data was collected for the Florida Marlins, and the Boston Red Sox. The stadium with the lowest average humidity, Coors Field, exhibited a greater mean of homeruns hit (159.2) than the stadium with the highest average humidity, Sun Life Stadium, (142.7). The null hypothesis was accepted in all comparisons ($t = 1.951 < 2.101$; $t = 1.102 < 2.101$; $t = 1.105 < 2.101$ at $df = 18$; $p < 0.05$). The data did not support the research hypothesis that if the average humidity is lower, then there will be more homeruns. The findings were not consistent with ideas of air resistance or "drag" stating that as air resistance increases, air density increases. The number of homeruns hit may have been affected by the environment of equipment storage. When a baseball is kept in an environment with a higher density, it absorbs the moisture and thus becomes heavier. Improvement of this experiment with more reliable results could make the number of homeruns hit during games more predictable.

The Effect of Location on Accuracy of the Weather Forecast

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The purpose of this research was to study the effect different locations have on the one-day weather forecast. The hypothesis stated that among the ten selected beach locations along the East Coast in the United States of America, the location of Daytona Beach Florida will have the most accurate forecast. Since Daytona Beach is closest to the equator among the ten cities ranging from Maine down to Florida, it seems the temperatures would be the most even, due to the climate being close to tropical. To test this question, the one-day forecast for each location was recorded from the National Oceanic and Atmospheric Administration (NOAA) website as well as the actual high and low temperatures of the day, and for each location, the deviation from the actual temperatures from the forecast was calculated for three months. The results from the experiment partially supported the hypothesis, since Daytona Beach, FL did have one of the most accurate forecasts. Daytona Beach had the lowest standard deviation between the actual and forecasted high temperatures of 2.38 °F and a median difference between the forecast and actual temperatures of zero. However, Old Orchard Beach, ME had a more accurate forecast for the low temperatures since the average low temperature was the smallest among the ten locations (0.16 °F) and its median

difference between the forecast and actual temperatures was also zero. Therefore, both Daytona Beach, FL and Old Orchard Beach, ME seemed to have the most accurate forecast. Due to their relativity to the extremes of the Earth (North Pole or equator), Daytona Beach, FL's and Old Orchard Beach, ME's forecasts seem to show that forecasts are more accurate when temperatures are more consistent.

The Effect of Domes on Winning Percentage in Football

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The growth of sports grew rapidly in America in the twentieth century. The sport of football was one sport that had peoples' attention. With football being the main attraction, winning percentage of a team showed their success. Winning percentage varied over time and there was a great debate over the effect of domes on winning percentage. The research hypothesis was that teams that play in domes would have a higher winning percentage. Different statistics were recorded on each team in a specific National Football League division. After taking these, winning percentage was calculated and compared to the other teams in that division. In the division, the teams were the Green Bay Packers, Chicago Bears, Minnesota Vikings, and the Detroit Lions. The null hypothesis was accepted for Bears versus Packers, Bears versus Lions, Bears versus Vikings, and Packers versus Vikings ($t=1.3372 < 2.101$ at $df=18$; $p>0.05$, $t=1.7782 < 2.101$ at $df=18$; $p>0.05$, $t=1.1118 < 2.101$ at $df=18$; $p>0.05$, $t=0.3855 < 2.101$ at $df=18$; $p>0.05$). The null hypothesis was rejected for Packers versus Lions and Lions versus Vikings ($t=2.7405 > 2.101$ at $df=18$; $p<0.05$, $t=3.0851 > 2.101$ at $df=18$; $p<0.05$). Based on the results, the outdoor teams had a higher winning percentage than the dome teams.

The Effect of Game Time Temperature on the Total Score of NFL Games

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American football has origins in the European sport rugby. Formed in 1922, the National Football League has become an American past-time and favorite sport of millions. The game time temperature has a visible effect on the game, but debatably an underlying cause as well. The purpose of this project was to determine whether game-time temperature of an NFL game has an effect on the total score. If temperature is colder than 0 degrees Celsius, then the total score of games will be lower than that of warmer games. Ten of the most recent games from each temperature category were found and the total score was documented. The results indicated that the games played less than 0 degrees Celsius provided the highest total score per game. A t-test performed on the data ($t=2.0158 < 2.101$; $t=0.9658 < 2.101$; $t=0.2135 < 2.101$; $t=1.0104 < 2.101$; $t=2.2428 > 2.101$; $t=0.9152 < 2.101$ at $df=18$; $p > 0.05$) for further analysis. The data rejected that if the temperature is below 0 degrees Celsius, the average total score will be lowest. Based on the values found through research, there appears to be a correlation between game-time temperature and total score of games. In order to make the measures more accurate, a higher number of games should be used to promote higher accuracy.

The Effect of Baseball Stadium Size on Homeruns and Batting Average

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Throughout the history of baseball, many have examined what factors affect hitting. Two main hitting statistics from which these comparisons were based were home runs and batting average. As baseball evolves, so do the fields, the players, and the equipment. Almost all of these factors have been standardized by Major League Baseball. These included the pitching mound being 60.5 feet away from home plate, the base-paths 90 feet in length, and the mound height 10 inches. Although so much is controlled, one important factor has been left at the discretion of the stadium designers: the field dimensions. The purpose of this project was to determine the effect of baseball stadium size on batting average and home runs. Data was collected comparing the statistics of the three largest and three smallest stadiums in the American League during the 2010 baseball season. The results indicated that smaller parks had a slightly lower mean number of home runs, 73.2, than larger parks, which had a mean of 84.3 home runs.

A t-test performed on the data indicated no significant difference between the means of the groups, accepting the null hypothesis ($t = 0.95 < 2.228$ at $df = 10$; $p > 0.05$). The data did not support the research hypothesis that the size of baseball stadiums would have an impact on the number of home runs. The results also indicated that large stadiums had a higher mean batting average (269.5) than small stadiums (248.3). A t-test performed on the data indicated no significant difference between the means of the groups, accepting the null hypothesis ($t = 2.17 > 2.228$ at $df = 10$; $p > 0.05$). The data did not support the research hypothesis that baseball stadium size would have an impact on batting average. Based on the results in this research, stadium size appeared to have no effect on batting average or number of home runs hit. This may be the result of the newer stadiums being built with smaller dimensions, unlike older stadiums that were more diverse.

The Effect of Foul Territory Dimensions of Major League Baseball Fields on the Number of Pitches per Plate Appearance Earned Run Average

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The purpose of this experiment was to determine the effects, if any, of foul territory dimensions of 24 Major League Baseball stadiums on pitching statistics such as Pitches per Plate Appearance and Earned Run Average. The main hypothesis of the experiment was if field dimensions are increased in these 24 stadiums, then the pitching statistics will decrease in number (or increase in positive performance). In order to carry out the experiment, data was collected to determine both the foul territory dimensions of each individual field, as well as the two separate pitching statistics for the home team of each field. This data was then placed on separate scatter plots to find any correlation between the independent and dependent variables. What was found was a varying level of negative correlation between the field dimensions and P/PA, and almost no correlation of field dimensions and ERA. This was deemed to be a product of varying factors, such as weather conditions, elevation, and the overall performance of the home team, in comparison to their opponents, their division, and the rest of the league. Overall, it can be said that, while there was no obvious correlation between the statistics, further research into the different factors that affect baseball statistics could yield more suggestive results, and could provide insight as to why exactly no correlation was found in this “preliminary” experiment.

The Effect of Playing on a Team’s Home Court on Field-Goal Percentage for NBA Teams

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Home advantage in sports has been thought to enhance the performance of the home team. Playing at a team’s home venue could present many advantages, such as not having to deal with travel fatigue, unfamiliarity with the playing venue, or opposing crowd noise. In the NBA, each team plays 82 regular season games, 41 of which are played at home. The objective of an NBA team in each game is to score more points than their opponent in order to win the game. Because of this, a team’s shooting percentage is very important. The objective of my experiment was to evaluate the effect of home-court advantage on the shooting performance of NBA teams. In order to investigate the effect of home-court advantage on NBA teams’ shooting performance, the field-goal percentages of all NBA teams from the 2009-2010 season were used as a sample. A one-sided, one sample z test for a proportion was used to test the significance of the claim. A p-value of 0.4790 was obtained, which is greater than the level of significance ($\alpha = 0.25$). Since the p-value was greater than α , there was insufficient evidence that the field-goal percentages of NBA teams are increased when playing on their home floor.

ZOOLOGY

FIRST PLACE

Cortical Innervation of the Visual Sector of Thalamus during Early Postnatal Development

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The lateral geniculate nucleus (LGN) is a location within the thalamus of the brain that processes visual input between the retina and visual cortex. In early postnatal mice, signs of cortical innervation become apparent around P4-5, and an understanding of how these axons innervate the dorsal LGN (dLGN) has not yet been explored in three-dimensions. As a study to further expand upon previous two-dimensional analyses of corticogeniculate innervation, the purpose of this study was to analyze the innervation patterns between the visual cortex and dorsal LGN (dLGN) in Golli-tau mice, which express green fluorescent protein (GFP) in cells that make up the corticogeniculate pathway. Observations indicated that there was a pause between the point at which cortical inputs reached the LGN and time of innervation. Thus, it was hypothesized that corticogeniculate innervation follows a specific gradient when entering the LGN, and may also be awaiting a molecular signal to innervate. This experiment was performed through use of epifluorescent microscopy of sealed microscope slides with pre-prepared histological brain tissue sections, which, with GFP, allowed for visualization of where and when the corticogeniculate pathway innervated dLGN. Results indicated that cortical inputs await signals prior to innervation, although the signal has yet to be identified. Quantification of GFP innervation showed that cortical axons first innervate the most caudal aspect of the dLGN; additionally, there was a U-shaped medial-lateral gradient. Future studies will include the identification of potential molecular triggering mechanisms for cortical innervation and expansion upon statistical analyses of the innervation gradient throughout other early postnatal ages.

SECOND PLACE

How Small a Segment of a Planarian Can Regenerate a Whole Planarian?

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Animals with regenerative abilities generally only regenerate a tail or limb. In contrast, a planarian can regenerate any part of its body. This project investigated how small a segment of a planarian would regenerate following dissection. It was chosen because of an interest in the subject of regeneration. It was hypothesized that the half, third, and quarter segments would regenerate, but that the one-fifth segments would be too small. The hypothesis was tested with 40 whole planarians of the species *Dugesia tigrina*. Four groups of ten planarians were dissected into half, third, quarter and one-fifth segments respectively. The segments were maintained under the same conditions for 13 days. At the end of this time, the planarians were examined under a microscope to check whether they had regenerated. Results showed successful regeneration of 20/20 of the half segments, 26/30 of the third segments, 33/40 of the quarter segments, and 39/50 of fifth segments. The experiment showed that all the segment sizes could regenerate but that the probability of regeneration decreased as segments got smaller. Contrary to my hypothesis, a majority of the fifth segments regenerated.

THIRD PLACE

The Effect of Layering on the Growth of American Oysters (*Crassostrea virginica*)

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American oysters, *Crassostrea virginica*, can grow in massive oyster reefs containing hundreds of thousands of individuals. Gardeners of oysters throughout the Chesapeake Bay area normally stack oysters in

layers, leading to the question of how growing oysters in close proximity to each other affects overall growth. This experiment specifies the question even more, to how layered oysters perform. It was predicted that the group layered on top of the others, would have an increase in growth due to currents carrying growth-encouraging nutrients, which would be more accessible than with any other group. In order to obtain accurate results, 400 oysters were used in the experiment. They were divided into groups of 100, measured lengthwise to the centimeter, and placed in rigid mesh bags in order to keep them from mixing in any way. These bags were placed in one of two Taylor floats, which allow for free flow of water. Once every two weeks the bags would be taken out of the water and all oysters would be cleaned of mud, algae, and predatory animals. At the end of three months, just as the oysters started to hibernate, a second data collection took place. All data was analyzed with both basic and advanced methods, and said data provided the basis for a theory as to what had happened. As had been expected, group 1 performed the best, growing to an average of 3.86 centimeters. Following that, the control was very slightly ahead of group 2, with group 3 growing the least. There was no statistical difference between the groups prior to the experiment beginning, but by the end almost all of the groups had such differences. The exceptions were group 2 and the control, which had a difference of less than 0.05 centimeters with their means. However, reasons for this similarity were thought to be a slight difference in proximity to a nutrient-bearing current with group 2 being canceled out, so to speak, by a lack of competition with the control group. On the whole, growth was determined by access to nutrients in currents.

HONORABLE MENTION

Parasitism in American Oysters – Beyond MSX and Dermo Climothy Morris

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Oysters are under a lot of stress. Not only from changing temperatures and salinities, they deal with stress from parasites too. Parasites are some of the many troubles oysters face throughout their entire lives. The two most prevalent diseases are MSX and Dermo which come from parasites. MSX and Dermo are not the only two problems they face when affected by parasites. MSX and Dermo are the main effects of parasites that are studied, but there are other parasites that may be less lethal but still have an effect. Mud worms and pea crabs are two popular parasites found in the Eastern oyster. Mud worms are tiny worms that burrow into the oyster's shell. This can weaken it. These worms can create a blister in the oyster's shell. Oysters have developed a method to keep them out. They make layers and layers of shell to cover the mud worms that try to burrow into them. Pea crabs are tiny crabs that live in the oyster's shell. They are dependent on the oyster for food. The pea crab gets its food from the oyster's gills. Pea crabs harm the oyster by taking space. The meat moves around the area where the pea crab is. Sometimes the pea crab can damage the oyster's gills when getting food. Both pea crabs and mud worms have a negative impact on the infected oysters' conditions.

HONORABLE MENTION

Testing the Efficacy of Natural Flea Deterrents Alexander Schmitt

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This research was designed to test whether or not various substances reported to be effective at repelling fleas are truly efficacious. Many supposed deterrents are claimed to work, but very few have actually been concretely tested. The null hypothesis was that each supposed repellent tested would have no effect on the movement of fleas and would not be statistically significant from the control group. The alternate hypothesis for each repellent was that they would be significantly more repellent to the fleas than the control group. For each test, a choice chamber had one side treated with the different levels of the independent variable—peppermint oil, pennyroyal oil, clove oil, citronella oil, Frontline, cedar chips, and nothing (control). Five to eight fleas were then placed on the treated side and their locations were observed after 15, 20, 25, and 30 minutes. T-tests were then run on the data from the 25 and 30 minute observations. For both tests, peppermint ($p=0.001$, 0.013) and pennyroyal

($p=0.011$, $9.19E-6$) showed p values below alpha ($\alpha=0.05$) and had test statistics (t-Stats) greater than critical values (t-Crit). Therefore, the null hypotheses for peppermint and pennyroyal oil were both rejected. The null hypotheses were not rejected for cedar, citronella, clove oil, or Frontline. These results may now hopefully be taken for use in further research to devise a natural replacement for the massive amounts of chemicals released to the environment each year by flea control treatments. Further tests may determine how long pennyroyal oil and peppermint oil retain their repellency, and at what distance the repellency of the oils loses effectiveness.

HONORABLE MENTION

The Effect of Acidity on the Growth Rate Of *Mercenaria mercenaria*

Abhya Panya Vij and Jennifer Wang

Thomas Jefferson High School for Science and Technology

The purpose of this study was to determine the effects of acidity on the growth rate of *Mercenaria mercenaria*, a marine bivalve mollusk sporting two, joint calcium carbonate shells. The ever increasing carbon dioxide emissions have encouraged acidification of ocean water. Pollution in general has affected various forms of aquatic life, but this experiment was designed to examine chemiobiological outcomes of the gross abundance of hydrogen ions and carbonic acid, products of the carbon and water buffer reaction, on the calcium carbonate shells of *M. mercenaria*. Due to the chemical makeup of the shells, a hypothesis, as acidity increased, growth rate of *M. mercenaria* would decrease in accordance with the corrosion likely to accompany the addition of carbon dioxide, can be readily formulated. In order to test this hypothesis, carbon dioxide was pumped into the tanks via a chemically powered device designed specifically for this study at predefined intervals to simulate five levels of acidity. The clams were measured three times over a period of four weeks to determine individual, bimonthly growth rates. The null hypothesis was not supported, and the research hypothesis was not rejected. These results suggest that more acidic environments do negatively impact the growth rates of *M. mercenaria*.

The Effect of Sound Frequency on the Motor Skills of *Littorina littorea*

Morgan Cheatham and Ghazal Rashidi

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Concerns regarding the effects of human generated sounds on aquatic animals are rising, causing an increased need for research on the effects of sound on marine organisms, specifically gastropods. The purpose of this experiment was to determine the effect of sound frequency on the motor skills of *Littorina littorea*. The experimental hypothesis was that if sound frequency increased, then reattachment time increased. The null hypothesis was that as sound frequency increased, reattachment time did not change. The independent variable, sound frequency, was emitted at levels of 0, 100, 200, 500, and 1000 Hertz (Hz), with the control at 0 Hz. The dependent variable was motor skills, measured by reattachment time in seconds. The periwinkle snails were placed on a clear, polyvinyl chloride surface, while the SHz2010 emitted various frequencies in order to measure and record reattachment time. The major finding of this study was that as sound frequency increased, the reattachment time of *L. littorea* decreased. *L. littorea* hear using two statocysts that pass signals to the nervous system, specifically the pedal ganglia, which controls movement. The results from this experiment were consistent with former research, in that low frequency acoustic stimuli yielded decreased performance and motor activity in organisms. For further study, testing of sound frequencies above and between 500 Hz and 1000 Hz, along with an increase in the number of trials, is recommended.

The Feeding Habits of the Blue Catfish and its Effects on Benthic Invertebrates in Virginia Rivers

Cale Coryell and William Johns

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Blue catfish were first introduced to the Rappahannock River in the early 1970's. They are ever populating many habitats now and have become a nuisance. While they most commonly feed on other fish, they are also benthic feeders which mean they scavenge on bottom life such as clams, crabs, and mussels. The blue cat has resorted to, and been relying heavily on these bottom dwelling species and has brought many problems for watermen and the health of the Chesapeake Bay and its tributaries to the surface. Previous studies have shown that the overall clam, mussel, and blue crab population have been struggling since around the same time as the blue catfish's arrival to Virginia waters which causes a lot of trouble to local watermen trying to make a living. Along with the struggles that the declining benthic invertebrate population causes economically, environmentally it also takes a big toll as they are filter feeders who help in purifying or cleaning up the water in which they live. Without them water quality worsens which affects the amount of sunlight entering the water and can cause algal blooms and stop photosynthesis. The purpose of this project was to see which benthic invertebrates catfish are mainly consuming and speculate on why that is and what effect this could have on the environment and society. The chosen design was simple but effective; fish were caught from a tributary of the Rappahannock River and were given a supply of twelve mid-sized blue catfish from the Virginia Institute of Marine Science which were caught in the York River. All of the fish that were caught had their stomachs and intestines dissected and examined. By examining the diet contents of blue catfish and the p-values that were found, many of these benthic invertebrates were discovered and recorded to show that blue catfish feed primarily on benthic invertebrates that are sessile rather than on species that are able to move.

What Is the Effect of Food Type on Worm's Mass?

Bryn Edwards

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Worms are creatures that have always been out of sight, just a few feet under us, eating decomposable material and turning it into soil. What happens when worms are given different foods? Which food type will cause them to gain the most mass? This project looked at which food type (Pink Lady apples, iceberg lettuce, white bread and red maple leaves) would cause worms to gain the most mass over a period of time. The worms were put in a bowl and given the same amount and type of soil. They were each given one cup of one of the above mentioned food types. There were 8 worms in each bowl. The bowls were covered with a lid (saran wrap with holes poked in it) to prevent the worms from escaping. The hypothesis was if worms were fed different food types, then those fed bread would gain the most mass. The experiment showed that the worms fed iceberg lettuce gained an average of 0.375 grams. The group fed white bread gained an average of 0.325 grams. The group fed Pink Lady apples gained an average of 0.25 grams. The group fed red maple leaves gained an average of 0.2375 grams. The experiment showed that the group of worms fed lettuce gained the most mass. It showed that the group of worms fed red maple leaves gained the least mass. The hypothesis was rejected.

The Effect of Different Types of Music on the Maze Times of *Drosophila melanogaster*

Claire Etheridge

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The purpose of this study was to discover if music type affected *Drosophila melanogaster* navigation through a Y-maze. This research was conducted at a local high school from October to December in 2010 for *Drosophila* housed in a soundproof case, with four different types of music (country, rap, classical, and rock). One container had no music, and was used as the control. Individual flies were put through a Y-maze after four and eight days of exposure to music types. An ANOVA comparing the maze times of the flies that listened to different types of music had a p-value of 0.0717, more than the set alpha (0.05), showing no statistical significance. Maze times after four and eight days were compared using another ANOVA. A p-value of 0.0128 was obtained, smaller than the set alpha (0.05), indicating that the longer they were exposed to the music, the shorter their maze times were. The

original hypothesis—if *Drosophila melanogaster* were exposed to classical music, then they will take a shorter time to navigate a simple Y-maze than *Drosophila melanogaster* that were exposed to rock music, country music, rap music, or no music—was not supported. However, the other hypothesis, if *Drosophila melanogaster* were exposed to music, they will take a shorter time to navigate a Y-maze than *Drosophila melanogaster* not exposed to music, was supported. In conclusion, the type of music the *Drosophila melanogaster* were exposed to did not make a difference on maze times, but the length of time did.

The Effect of Light-Induced Phase Shifts on the Reproduction Rate of *Drosophila melanogaster*

Adryan Flores

Central Virginia Governor's School, Lynchburg, VA 24502

The purpose of this study was to determine if light-induced phase shifts had an effect on the reproduction rate of wild type and CRY^b mutant *Drosophila melanogaster*. The study was conducted in the research laboratory of a local high school from November to December of 2010. Four light cycles lasting six hours long were created by placing each light bulb inside four cardboard boxes. After establishing a baseline light cycle, a plug-in timer adjusted when that six hours of light was given; creating light-shifts based on the time when the light cycle was shifted. CRY^b mutant flies were used as a control due to their inability to process light as a method of regulating their circadian rhythm. Ten male and ten female flies were placed in each vial for one week. The larvae of the flies were counted after their first week to determine the rate at which the flies were reproducing. A two-way ANOVA test ($\alpha=0.05$) showed no statistical difference in the interaction between the CRY^b and the wild type flies with a p-value of 0.85. This indicated that both fly types reacted the same way to the light shifts meaning that the light-induced phase shifts had no effect on the reproduction rate of *Drosophila melanogaster*. The original hypothesis that if the circadian rhythm of the flies were shifted using light then their reproduction rate will be adversely affected was not supported. In conclusion, the results showed that light-induced phase shifts had no effect on the reproduction rate of *Drosophila melanogaster*.

The Effect of the Method of Oxygenation on Brine Shrimp

Katherine Hines

Specialty Center for Science, Math & Technology at Mills E. Godwin High School, Henrico, VA 23238

The purpose of this study was to determine the effects of the method of oxygenation on brine shrimp. Brine shrimp are the most common live food for aquatic organisms, and therefore need to be cultured for the market. Brine shrimp were placed in a tank with either no treatment, a “Bubble Wall” or a “Bubbling Airstone”. The shrimp were observed each day for the next 14 days and were recorded as dead or alive. The control was no treatment. The hypothesis was that if no aeration was used, then most of the brine shrimp would die. After the 14 days most of the brine shrimp in each tank were dead, however, there was only one more dead shrimp than live shrimp in the tank with the “Bubble Wall”. A chi-square test showed that the data for no treatment and the “Bubbling Airstone” versus expected distribution was significant, but the data for the “Bubble Wall” versus expected distribution was not. The results supported the research hypothesis. These results most likely turned out this way because no treatment and the “Bubbling Airstone” created a bad environment for the brine shrimp. The tank with no treatment did not provide sufficient oxygen to the water and the “Bubbling Airstone” was too forceful, killing many of the shrimp. The “Bubble Wall” provided a good environment in which oxygen was continually added to the water. This study could lead to future research that investigates how these methods of oxygenation affect other aquatic organisms.

The Effect of Twenty-Four Hour Light on Cricket (*Acheta domesticus*) Chirp Rate

Allison Johns

Specialty Center for Science, Math & Technology at Mills E. Godwin High School, Henrico, VA 23238

The purpose of this experiment was to investigate the effects of twenty four hour light on cricket chirping. In recent years light pollution rates have increased; this is known to have an effect on wildlife behavior. It was hypothesized that if crickets were exposed to twenty-four hour light, then their chirp rate would decrease. In order to

test this hypothesis, crickets were exposed to either twenty-four hours or twelve hours (control) of light. After two weeks, the chirp rate of twenty five crickets from each group was counted for thirty seconds. The negative effect of light on cricket populations could severely impact ecosystems where crickets play a large role in the food chain. The results of the experiments revealed that crickets exposed to twenty-four hours of light had an average chirp rate 8 seconds less than that of the group with twelve hours of light. A t-test was performed on the data and it showed that these results were significant at a level of significance of 0.01. These results supported the research hypothesis. These results are possibly due to the effect of light on nocturnal organisms' circadian patterns in correlation with environmental queues such as the moon and civil twilight. It is also possible that overexposure to light has generally disorienting effects on crickets. This experiment could lead to other experiments on different aspects of crickets' lives such as breeding, shedding, and female responsiveness to calls. The effects of twenty-four hour light could also be tested on other species of crickets, or other types of animals.

The Effect of Natural Substances on the Repellency of *Musca domestica*

Nivetha Saravanan

George H. Moody Middle School, Richmond, VA 23228

Musca domestica, the house fly, is a common insect that is capable of transmitting deadly diseases. Synthetic insecticides such as organochlorines and Spinosad have been used to control house flies. However, the flies began to develop a resistance to these pesticides, so several studies have focused on natural products for controlling flies. The purpose of this experiment was to determine the effects of rosemary, thyme, basil, mint, and garlic on the repellency of flies. The hypothesis stated if garlic was brought into contact with flies, then it repelled the greatest amount of flies. In all of the trials except for the control, a testing stick dipped in 10 mL of repellent was placed into a container containing the 60 house flies. The testing stick was left inside the bottle for 10 minutes, and the number of house flies that had not landed on the testing stick was counted. This procedure was then repeated for all of the levels of independent variable and the control. The results indicated that rosemary repelled the least amount of flies with a median repellency rate of 42 out of 60 flies, and garlic repelled the greatest amount of flies with a median repellency rate of 51 out of 60 flies. The data supported the research hypothesis that if rosemary, thyme, basil, mint, and garlic were applied, then the flies shall be repelled. Based on the repellency rates determined in this experiment, there appeared to be a correlation between the type of natural substance and repellency of flies. In other words, as the pungency of the natural substance's odor increased, the repellency of the flies also increased. Before it can be concluded that garlic was most effective natural repellent, more experiments will have to be conducted to verify the results.

SPECIAL AWARDS

AMERICAN CANCER SOCIETY AWARDS

This award is to recognize outstanding science papers related to cancer research. A certificate to each and to 1st place - \$100, 2nd place \$50, 3rd place \$25. These awards are provided by the American Cancer Society.

1st Place

Riley Ennis

Thomas Jefferson High School for Science and Technology

2nd Place

Sayantane Das

Specialty Center for Science, Math & Technology at Mills E. Godwin High School

3rd Place

Radha Venkatesan

York High School

BOTANY SECTION AWARD

Given by the Botany Section of the VAS to the best paper on a botanical subject.

Erik Zorn

Roanoke Valley Governor's School

DOMINION - W. W. BERRY AWARD

This award is given by Dominion Virginia Power in honor of Mr. W. W. Berry who was a past Chairman of the Board of Virginia Power. This award of \$500.00 is presented to the best engineering paper.

Andrew Gatow, Sherwood Lin and Robert Shock

Blacksburg High School

DR. AND MRS. PRESTON H. LEAKE AWARD IN APPLIED CHEMISTRY

Given to the author of a research paper which best exemplifies how chemicals, chemical principles, or chemistry have been used, are used, or might be used to enhance or even to save life.

Riley Ennis

Thomas Jefferson High School for Science and Technology

GAMMA SIGMA DELTA AWARD

Presented by the Virginia Tech Chapter of the Honor Society of Agriculture in recognition of excellence in research dealing with application of new technologies and/or concepts in agriculture, forestry, or veterinary medicine.

Jennifer Heyward

Shenandoah Valley Governor's School

MATHEMATICS AWARD

For the paper that evidences the most significant contribution in the field of Mathematics.

Agustey Mongia

George H. Moody Middle School

RODNEY C. BERRY CHEMISTRY AWARD

For the paper that evidences the most significant contribution in the field of chemistry.

Prasana Joshi

Specialty Center for Science, Math & Technology at Mills E. Godwin High School

ROSCOE HUGHES AWARD

For the best paper in the field of Genetics.

Rhiannon Edwards
Gildersleeve Middle School

SMITH SHADOMY INFECTIOUS DISEASE AWARD

Given to commemorate Dr. Smith Shadomy by the Virginia Chapter of the National Foundation for Infectious Diseases to the paper that evidences outstanding research in the field of infectious diseases.

Prasana Joshi
Specialty Center for Science, Math & Technology at Mills E. Godwin High School

SPELEOLOGICAL SOCIETY AWARD

Given by the Richmond Area Speleological Society for outstanding research addressing karst or topics related to speleology (bats, caves, carbonate geology, paleoenvironments, limestone fossils, sinkholes, etc.

Rachel Marzen
Thomas Jefferson High School for Science and Technology

STATISTICS AWARD

For the paper that evidences the most significant contribution in the field of Statistics.

Nitin Iyer
Ocean Lakes High School

VABE AWARD

This award is presented by the Virginia Association of Biology Educators and is given for outstanding research in the Zoology section.

Natasha Sheybani
Appomattox Regional Governor's School

VIRGINIA MUSEUM OF NATURAL HISTORY AWARD

Presented by the Friends of the Virginia Museum of Natural History in recognition of significant contribution in the study and interpretation of Virginia's Natural Heritage.

Rachel Corrigan
Chesapeake Bay Governor's School

VIRGINIA SEA GRANT COLLEGE PROGRAM AWARD

Given by the Virginia Sea Grant College Program for outstanding marine or coastal research

Rachel Corrigan
Chesapeake Bay Governor's School

ANNE M. HANCOCK MEMORIAL AWARD

This award is given to the best paper in cellular biology and is given in memory of Anne Hancock who retired from Patrick Henry High School in Hanover County and who gave many years of service to the Jr. Academy not only by teaching but also serving on the Jr. Academy Committee.

Nadine Nikolova
Deep Run High School

DOROTHY KNOWLTON AWARD

This award is given to the best paper in the Consumer Science section(s) and is given in honor of Dorothy Knowlton, former Science Coordinator of Arlington County Schools.

Lukas Mohnach
Chesapeake Bay Governor's School

JOYCE K. PETERSON AWARD

Presented for the outstanding paper by a middle school student. It is presented in honor of Mrs. Joyce K. Peterson who has been an outstanding teacher in the Arlington County Schools.

Valentina Lohr
Williamsburg Middle School

CATESBY JONES - RUSSELL J. ROWLETT AWARD

For the best research paper of the year.

Michael Nguyen and Kevin Zhou
Thomas Jefferson High School for Science and Technology

AAAS AWARD and HONORARY MEMBERSHIP

The AAAS Award is given for presenting an outstanding paper at this symposium. This student will also receive an honorary membership to AAAS and a cash award of \$200.

Prasana Joshi
Specialty Center for Science, Math & Technology at Mills E. Godwin High School

VAS HONORARY MEMBERSHIP

One year's membership, without cost, to the Virginia Academy of Science including a subscription to the Virginia Journal of Science.

Ana O'Harrow
Yorktown High School

BETHEL HIGH SCHOOL SCHOLARSHIP

This \$1,000 Scholarship Award comes from the interest earned from a \$10,000 endowment contributed by the students of Bethel High School, Hampton, Va., over a two year period. This award is based on both the student's presentation and paper.

Rachel Corrigan
Chesapeake Bay Governor's School

***HENRY MACKENZIE ENVIRONMENTAL SCHOLARSHIP
(VEE)***

This \$5,000 scholarship is awarded to the student whose paper evidences the most significant contribution in the field of Environmental Science dealing with the James River Basin and Chesapeake Bay. The Virginia Endowment and VJAS offer this scholarship in tribute to the outstanding and generous services of Judge Henry W. MacKenzie, Jr., one of the founding directors who had a great interest in the James River and the Chesapeake Bay.

Alan Booth
Hampton High School

***FRANCES AND SYDNEY LEWIS ENVIRONMENTAL SCHOLARSHIP
(VEE)***

A \$14,000 scholarship (\$3,500 per year for four years) for the best effort by a student in grades 9 to 12 in the field of environmental science. This scholarship is in the name of Frances and Sydney Lewis and is given by the Virginia Environmental Endowment.

Sarah Sisson
Chesapeake Bay Governor's School

E.C.L. MILLER SCIENCE TEACHER OF THE YEAR AWARD

Given to an outstanding science teacher.

Tim Criner
Gildersleeve Middle School

VJAS DISTINGUISHED SERVICE AWARD

This most prestigious VJAS award is presented to a person for exceptionally outstanding service to the VJAS.

Michael Lovrencic
Yorktown High School
