

**C. B. G. S.**

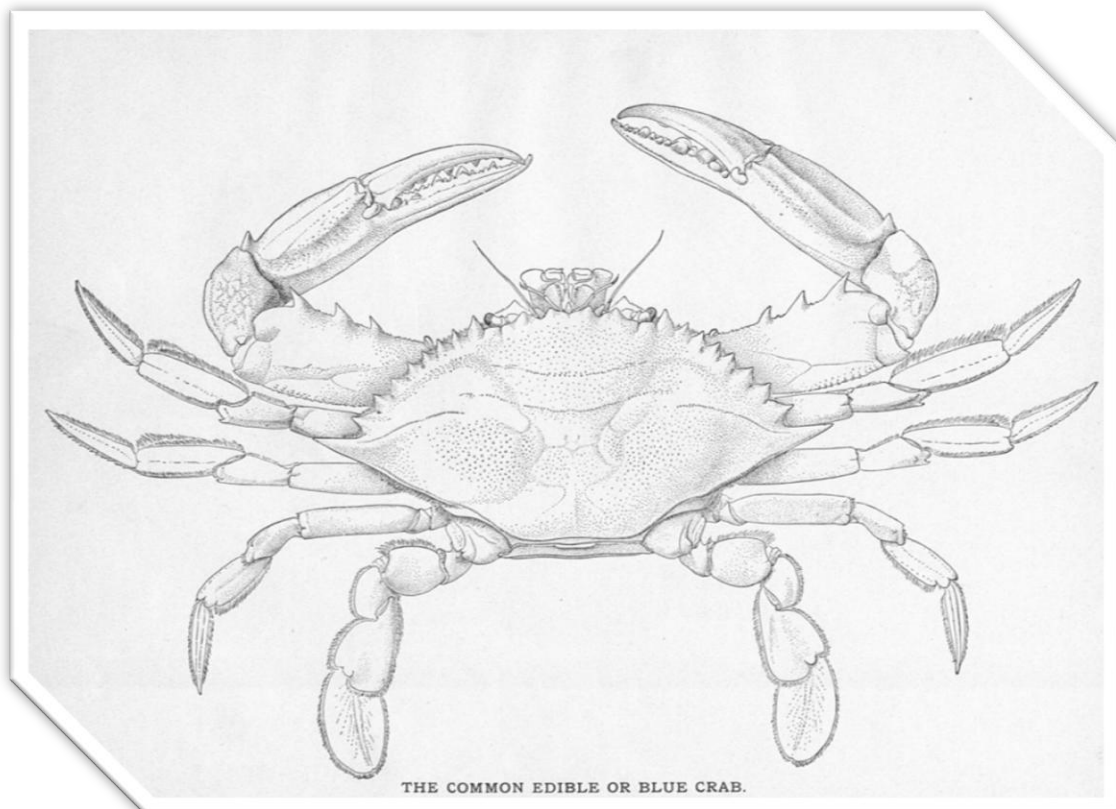
**R**esearch

**A**bstract

**B**ulletin



**Senior Research Project  
Abstracts from the  
Chesapeake Bay  
Governor's School  
Class of 2012**



THE COMMON EDIBLE OR BLUE CRAB.

**Volume 1**

**Spring 2012**

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## Abstract Symbol Legend

BG = Student from Bowling Green Campus

G = Student from Glens Campus

W = Student from Warsaw Campus

★ Exemplary Presentation Award at CBGS Science Symposium, March 2012

## Research Project Subject Legend

BOT = Botany

CON SCI = Consumer Science

EGR = Engineering

ENV = Environmental Science

MAR = Marine Science

MED = Medicine and Health

PHY = Physics

PSY = Psychology

ZOO = Zoology

# **Chesapeake Bay Governor's School**

## **Student Research Project Overview**

This bulletin contains the research of the Chesapeake Bay Governor's School Class of 2012. The student research project is an integral part of every CBGS student's experience. Starting officially in the Fall Semester of their junior year, each student delves into the scientific method through exploratory labs, collecting data on field trips, analyzing data graphically and interpreting results. At this time, students are also introduced to primary scientific literature that they read and discuss, and they learn how to do literature surveys themselves in online libraries and journals. By the end of their junior year students will put forth a written proposal with their research topic, hypotheses, plan of action and timeline for sampling.

Students work with a mentor, usually their Marine & Environmental Science teachers, but some can have multiple mentors, to set up their sampling and start collecting data. The student is responsible for maintaining their project, doing the sampling, analysis of samples and keeping records of this work. CBGS mentors facilitate this process, and help when needed, but the student is the principle investigator. Students also analyze their data and create graphs and generate statistics using Excel.

In the fall of their senior year, each senior will present their research and preliminary findings in a poster session for the underclassmen. During Spring Semester, papers are written, edited and revised. In March, all students convene at the Senior Research Symposium at Virginia Commonwealth University for oral research presentations in PowerPoint format by all CBGS seniors.

There are many goals of this project, the most basic are for students to learn how to create hypotheses and execute a plan using the scientific method and to generate and analyze data. Another very important facet of this process is that students learn effective communication both through genuine scientific writing and also by presenting their work to audiences at the poster session and in talks at the Science Symposium. Students learn to look at information with a critical eye, to discern reputable source material and analyze information more effectively. Students find out that science is a messy and creative process where the answers are not always what you would expect, perseverance pays off, and they stretch themselves farther than they thought they could go.

## **Photovoltaic Parking Lot, The Green Solution**

Carrie Adams<sup>G</sup>

### **Abstract**

Global warming is having a negative effect on the earth's well-being. The heat island effect is contributing to the warming problem. It is caused by the increased heat retention by parking lots and paved surfaces in developed areas. As an offset to the heat island effect, solar panels can be installed over the parking lot asphalt to reduce the heating effect and make renewable energy, and reduce CO<sub>2</sub> emissions. If the solar panel parking lot with rain gutters were installed at Rappahannock Community College it could offset energy usage and reduce the carbon footprint. If the solar panel parking lot also has rain gutters and is used at RCC it could provide the building with grey water to reduce the usage of clean drinking water. The amount of carbon dioxide saved if solar panels were installed at the site, the estimated net cost of installing 42,254 sq-ft of solar panels, the cumulative cash flow, and potential solar power offset were estimated using solarestimate.org. The data showed that with 50% of the energy offset, the solar panels could save 10,808 tons or 21,616,000 auto miles of CO<sub>2</sub>. For 50% of RCC's energy to be offset, only 42,254 sq-ft of panel space is needed when 90,000 sq-ft is available at RCC. The estimated net cost of installing 42,254 sq-ft of solar panels is \$ 2,070,446. The data showed that using a 50% offset will be financially doable while contributing less to global warming. It shows how this source of clean energy should be utilized at RCC.

EGR

## **Boys vs. Girls: The effects of Gender on Facial Perception**

Tahir Ahmad <sup>BG</sup> ★

### **Abstract**

The human brain controls the human body in many ways, including the ability to recognize faces, which is done with the fusiform. This study is to test whether the male or female brain is better in computing facial perception. The independent variable is the sex of the subjects, while the dependent variable is the ability of proper facial perception. The null hypothesis stated that the female brain would be better at computing facial perception than the male brain, due to the fact that females use both lobes of their brains, while males only use one. This experiment was tested through the process of flashing quick videos to two-hundred children in 2<sup>nd</sup> and 5<sup>th</sup> grade to determine whether or not these students were able to see ten specific faces. This was repeated five times, with three tests containing the ten pictures, and two tests not containing the ten pictures. Within the first three tests, females showed a slightly greater accuracy in facial perception, while in the final two males seemed to perceive faces better. The p-value was .76, indicating no significant difference between males and females when it came down to facial perception. This ultimately meant that the study failed to reject the null hypothesis. Age was also looked at with the tests. Within all five tests, the 5<sup>th</sup> graders showed higher levels of facial perception than 2<sup>nd</sup> graders. However, the p-value of this data was .32, signifying that age does not have a major effect on facial perception. The data may have proven to be insignificant due to the lack of total control within each human subject's life. Although this test proved to be insignificant, many others have shown major difference within male and female brains. This ultimately helps to benefit from areas such as the medical field, like brain operations, or social and political arguments, providing sources that can be credibly cited.

PSY

## The Effects of Egg Source and Type on Mercury Levels

Ingrid Argueta <sup>BG</sup> ★

### Abstract

Mercury is an element that is commonly widespread throughout Earth and comes in different states; large amounts are highly toxic. Additionally, mercury inhabits all types of substances, including foods humans consume. Commercial eggs are categorized differently based on the original chicken feed, so there is a high possibility Hg amounts will vary according to the type of egg. Mercury content was analyzed in conventional, free-range, organic, and omega-3 eggs with a Direct Mercury Analyzer 80. Overall, organic eggs contained the highest Hg concentrations and omega-3 consisted of the lowest level. Average concentrations ranged from four to 11 nanograms of mercury per gram of egg. Due to these results, the Two-way Anova test provided an insignificant p-value ( $p=0.07678$ ), which failed to reject the null hypothesis. Therefore, there were no significant variations in mercury amongst different types of eggs. However, treatments on individual egg brands confirmed otherwise. Differences in mercury content between brands could be linked to geographical locations, productions methods, and lifespan of hens from each company. Conclusively, mercury levels are well below the safe level of 0.03 mg/day and are not considered harmful to any human being.

ENV

## **The effect of spring size and barrel bore on precision and accuracy**

Nathan Ball <sup>BG</sup>

### **Abstract**

Airsoft guns were created in Japan after World War II, after real firearms were banned. Even though they have existed for over 30 years and have been improved upon constantly, Airsoft guns are not as efficient as they need to be for practical uses yet. If they achieve their maximum potential they can be used by the military as an efficient and realistic training method. Spring constant and Barrel bore were tested against each other to see how they affect accuracy and precision using a MANOVA ( $p \lll 0.05$ ). All nine combinations were tested and the tightest bore barrel with the largest spring was the most effective at both accuracy and precision. This shows that with even tighter barrel bore and airsoft guns that can handle bigger springs without being able to reach enough force to kill someone would make it an excellent training tool for the military.

EGR

## Controlling the Invasion of *Sorghum halepense*, Johnsongrass

Isaiah Beasley<sup>G</sup> ★

### Abstract

An invasive species is a species that is non-native to the ecosystem and whose introduction causes or is likely to cause economic or environmental harm to human health. The invasive species compete with the native species for food, habitat, shelter, and water, often causing the native species to die. Johnsongrasses, *Sorghum halepense*, is in the grass family *Poaceae*, which is native to the Mediterranean region of the world. The project was created to see if the spraying of herbicide in the late summer was an effective way to control the Johnsongrass. The data consisted of the Johnsongrass and Native Grass growing back over the 2 time periods at the 6 different site locations. The first period was the period after the County of Middlesex sprayed the Johnsongrass with herbicide. The second period was the period after the County of Middlesex sprayed the Johnsongrass with herbicide and mowed. During the first period a p-value of 0.4 was calculated, and the second period calculated a p-value of 0.1. Because the data values are greater than 0.05, this means that the spraying of the herbicide was not an effective way to control the Johnsongrass and more effective methods should be taken to control the invasive grass.

ENV



# **A Study of the Correlation of Daily Modern Day Technology of Teenage *Homo sapiens* and Education**

Kyran Belfield <sup>W</sup>

## **Abstract**

The omnipresence of technology plays a large role in modern education. Able to be either an advantage or hindrance, technology stands as a component that may be considered a less subtle factor in affecting a student's grade point average (GPA) and academics. Depending on the effects of all mediums of technology, school administrators should be aware of the possible effects on their students and decide whether or not to collaborate with a wired generation or remain adamant in schooling students without the use of much technology. Due to the massive influence of technology in modern society, many studies have been conducted in order to observe the impact and effects of technology. Both positive and negative results have been discovered.

PSY

## **Growth and Production Rates of Plants Grown at Various Angles to the Sun**

Josh Bell and Reggie Johnson<sup>W</sup>

### **Abstract**

Growth and production rates of plants can vary widely depending upon environmental factors such as amount of sunlight, composition of the soil, and climate in which the plants grow. It is important for people to discover what must be done in order to achieve the maximum yield cost efficiently. Increasing productivity will benefit both the producer and the consumer. By growing plants at varying angles to the sun, the slope of land that produces the best results for different types of plants can be attained. This study took into consideration how the changing angle affected factors such as amount of sunlight, water absorption rate, and erosion. Previous studies conclude that sunlight and water distribution are the main factors that affect the growth of plant life on a slanted surface. This study tested the hypothesis that the solar benefits from a slanted surface will outweigh the negative effects due to drainage issues. This study measured the growth of green beans, tomatoes, and grass in boxes of 0°, 20°, and 40°. Results indicated that the 0° box produced the greatest growth and germination rates. It was concluded that lesser amounts of water retained by the sloped boxes were the cause of these results. The rate at which the slanted boxes dried out was much greater than that of the 0° box. The 0° box provided an environment that enabled plants to achieve higher germination, growth, and production rates. From these results it can be determined that non slanted surfaces were the most conducive for growth.

BOT

## The Effect of the Ctenophore, *Mnemiopsis leidyi*, on the Chesapeake Bay Food Web

Rachel Boles<sup>G</sup> ★

### Abstract

Eutrophication within the Chesapeake Bay leads to phytoplankton blooms that deplete dissolved oxygen in the water column as they die and sink to the bottom. This leads to areas of anoxia and hypoxia that are known as dead zones. The removal of zooplankton grazers further allows for phytoplankton populations to flourish. The ctenophore, *Mnemiopsis leidyi*, lives in the Chesapeake Bay year round and is a suspension feeder that has been known to consume as many as 500 copepods per hour. In order to determine the effect of the ctenophore, an experiment to test their feeding rate was conducted.  $H_a$ = Ctenophores can remove a significant amount of phytoplankton grazers from the water column.  $H_0$ = Ctenophores have no significant effect on phytoplankton grazers. A tank was used to grow brine shrimp nauplii and ctenophores were caught from the Rappahannock River using a plankton tow. In the lab, a dissecting microscope was used to determine the concentration of nauplii and then water containing nauplii was added to 10ppt water made in the lab and put in beakers. 1 ctenophore was placed in each beaker and after a given amount of time, the amount of remaining nauplii was determined and recorded. After 30 minutes there was an average of 0.6 nauplii per ml and after 60 minutes there was an average of 0.3 nauplii per ml. A paired t-test was done and for the data values from 30 minutes and  $p= 9.63 \times 10^{-6}$  and for the data values from 60 minutes and  $p= 5.2 \times 10^{-6}$ . These p values are significant and show that in this experiment, ctenophores were capable of removing a significant number of nauplii from the water column and my null hypothesis can be rejected.

MAR

## **The Effect of Macroalgae (*Elodea canadensis*) on Nitrogen and Phosphorus Levels in Wastewater**

Jeremiah Brown <sup>W</sup>

### **Abstract**

Eutrophication prevention and averting nutrient runoff are major issues in environmental science. This significant problem requires a sensible and widely available solution. If algae can be used as an effective treatment for wastewater, harmful, nutrient-rich runoff could be deterred from entering our waterways. Additionally, algae grown on wastewater could be a possible source of algal biofuel for energy production. This project aims to further the knowledge required to form a sensible solution through the use of algal treatment methods, possibly progressing into a home application for the removal and recycling of pet waste. The effectiveness of *Elodea* at lowering nutrient levels in a controlled environment was tested and found to be unsuccessful at significantly reducing nitrates and phosphates ( $p > 0.05$ ). Future studies in the realm of algal waste water treatments could prove a promising and key component to protecting the environment from harmful nutrient levels, while simultaneously providing the possibility for clean-burning biofuel if an algal species is determined to be successful in the reduction of nutrients.

ENV

**“Paper or Plastic?”  
How about neither?**

Margaret Brown <sup>G</sup>

**Abstract**

The project consists of two surveys, one to see the average families’ use of the types of grocery bags, and to see the average families’ recycling habits. This study gave access to the general habits of the average family, when it comes to helping the environment. The surveys produced significant data on the average usage of the three main types of grocery bags, the amount of reusable bags used is the least amount used, and the plastic bags have the highest amount of bags used on average for a week for an average family. The survey on the habits produced that paper is the most commonly recycled item in a household and that if a person recycles one item they are more likely to recycle more than one. This information will allow the communities to make changes to the habits of the grocery stores, to allow for the more environmentally friendly actions.

## **The Effect of Pesticides on the Number of Leaves Eaten**

Mitch Brown<sup>BG</sup>

### **Abstract**

There are always pests and animals trying to get food from peoples gardens. People need to protect their plants in the most effective way possible. In this experiment, plants were grown with different concentrations of pesticides on them. Once they reached a three feet in size, Tomato Hornworms were placed on the plants and were allowed to eat for 24 hours. The data was collected and was recorded. The control group averaged 37.5 leaves eaten per plant. The half recommended pesticide group averaged 39 leaves eaten per plant. The recommended pesticide group averaged 20.5 leaves eaten per plant. The double recommended pesticide group averaged 12 leaves eaten per plant. The trend was that the greater the concentration of pesticide, the lower the number of leaves eaten. A linear regression was used to find the significance level of the results. A p-value of 0.012097 was found which was statistically significant also meaning there was a significant difference in the amount of leaves eaten based on the different concentration of pesticides. These findings allowed me to reject my null hypothesis. these findings can be used to help the people around the world that are going hungry by taking better care of their plants and crops and to teach these people how to protect their plants and crops from danger.

BOT

## **The Effectiveness of Tea, Miracle-Grow, Sugar Water, and Tap Water, on the Growth Rate of the French Marigold (*Tagetes patula*)**

Zachary Bullis<sup>W</sup>

### **Abstract**

Many people use different household items to have the healthiest, quickest growing plants. Some change the pH of the soil, and others add nutrients to the soil. This study investigated the effectiveness of adding tea, sugar water, and Miracle-Grow on the growth rate of the French Marigold (*Tagetes patula*). Experimental trials were conducted in a room where three walls were glass, allowing for ample access to sunlight. French marigold seedlings were watered with tap water every three days until day 13, when they were watered with their assigned experimental solution. This process continued for 65 days total. Plant height was measured every thirteen days, measuring from the base of the plant where it met the soil, to the top of the stem. Results were difficult to analyze, given that several plants died, namely the marigolds treated with tea. Results indicated that the French marigolds treated with Miracle Grow had the highest mean growth rate at .47 cm/day while plain water yielded the lowest mean growth rate of .44 cm/day. Data were analyzed using a one-way ANOVA to determine which treatment had the most increase in plant growth, however there was no significant difference in plant growth rates between treatments ( $P > 0.05$ ).

BOT

## **The Effect of Hurricane Irene and Tropical Storm Lee on Water Quality in the Upper Chesapeake Bay**

Megan Campbell and Kelly Umphlette<sup>W</sup>

### **Abstract**

All around the world people are polluting the atmosphere and water resources. This study is on the effect of pollution on water quality in the Chesapeake Bay Watershed from Hurricane Irene and Tropical Storm Lee. There are many types of pollution that get into our water systems as a result of rain runoff. Pollution comes in many forms such as pesticides, oil and fertilizers. In order to determine how drastically pollution effects water quality in the Chesapeake Bay data was collected from four buoys set in the upper part of the bay. This information determined the effect of pollution on water salinity, turbidity, water temperature, dissolved oxygen, and chlorophyll. Data was also analyzed to determine how different sites varied in reactions to the storms. After analyzing the data it was clear that Hurricane Irene and Tropical Storm Lee significantly altered water quality in Chesapeake Bay. Water salinity had an overall increase during and after the storms. Turbidity had an increase during the storms and a decrease after. Water temperature had an overall decrease during and after the storms. Dissolved oxygen showed a different trend for each site, and was altered significantly for most. Chlorophyll had an overall increase during the storms and a decrease after. For each parameter, some sites showed a more drastic change than others. However, there was no trend of which site was affected the most or least for all parameters. Although, these effects were only temporary they still demonstrated the negative effect that pollution is having on the upper Chesapeake Bay.

MAR



# **Forces While Running: Effect of the Type of Foot Landing While Running on the Amount of Ground Reaction Forces Acting on the Foot Validated by Electromyography Sensor on the Tibialis Anterior and Gastrocnemius to Monitor Gait Pattern**

Nicholas Cardwell<sup>BG</sup> ★

## **Abstract**

Running has 3 major styles that accommodate for different speeds and running conditions. The different styles are forefoot, which is used for running in sprinting or hills, preferred, used at medium speeds, and rearfoot, only used in long distance endurance running. This study measured the effect that the foot landing has on the amount of force is acting on the foot. Using a Zebris pressure measuring treadmill, the subject ran at 8.8km/hr while the treadmill was measuring force data for each footstep for 90 seconds. Before each test the subjects are set up with electromyography (EMG) sensors on the tibialis anterior and the gastrocnemius muscles. As the subject ran the EMGs measured the muscle contractions of these two muscles. the EMGs were used to know whether or not the data from that test was valid because the muscles were contracting at the right times of each of the gait cycles. The data was converted into Body Weights by taking the forces and dividing it by the runner's weight. The data followed the trend that forefoot strikes had the highest forces while rear foot had the lowest forces. The data were analyzed with a One-way ANOVA and received a p-value of  $8.88 \times 10^{-5}$ . This shows the correlation between the data sets are accurate and can be repeated and yield the same results. This test helps with knowing what kind of forces are acting on the runner's body. It also helps with understanding how the body reacts to these running styles including how the muscles contract and relax.

MED

## **The Comparative Effectiveness of Varying Shoreline Erosion Prevention Methods**

Abigail Clark and Justin Thibault <sup>W</sup>

### **Abstract**

Erosion is a significant threat to the Chesapeake Bay's shorelines. This study evaluated the long-term efficiency of various shoreline types, both natural and man-made, and their ability to help prevent changes in sediment elevation. Riprap, vegetation, a beach, and a bulkhead were tested, using a two-pole profiling method to measure elevation change along a steady transect at each site. Riprap was expected to fare the best, allowing for the least amount of sediment change to occur. The study demonstrated that the best way to prevent sediment change is to install a sturdy form of protection such as a bulkhead or riprap. This is because man-made structures are the least likely to be influenced by subtle changes in the environment, such as fluctuating temperatures that kill off vegetation or varying wave activity that destabilizes beach sediment. The results of this experiment revealed the most effective modification that landowners can make to their shoreline if they want to preserve it. This study also serves as a guide for conservationists who want to keep the Chesapeake Bay's precious shorelines from eroding away.

ENV

## **The Potential for Solar Oven Use in Third World Countries**

Brittany Clayborne<sup>G</sup>

### **Abstract**

The primary energy source in third world countries for cooking, heating water, and warmth is firewood. This massive usage of firewood has led to negative environmental and health issues such as: deforestation, soil erosion, an increase in CO<sub>2</sub> emissions, habitat loss, an increase in respiratory illnesses such as bronchitis and pneumonia, a decrease in the immune system, an increase in having a heart attack or stroke, and violence towards women who collect firewood. The study dealt with the potential for the solar oven to be an alternative to firewood, a carbon based fuel. The experiment tested the ability for the solar oven to cook food, the amount of CO<sub>2</sub> released compared to a charcoal grill, as well as the time it takes to cook on each source respectively. Corn, hot dogs, and hamburgers were cooked, both on the solar oven and the charcoal grill. The time it took to prepare and cook each of the meals was recorded, along with the amount of CO<sub>2</sub> released from each cooking source. The solar oven did not emit any fossil fuel emissions while it cooked the meals. An equation was used to discover the amount of CO<sub>2</sub> released as related to the pounds of charcoal burned. The experiment proved that food was able to be cooked on the solar oven, the solar oven produced no carbon emissions compared to the 3.67 pounds of carbon released per meal by the grill, and that the grill was more time efficient by the solar oven. The study concluded that solar ovens are a cheap alternative energy source for those in third world countries, where sunlight is plentiful. It dramatically decreases the environmental, social, and health impacts due to the burning of carbon based fuels.

ENV

## The Effects of Eastern Oyster (*Crassostrea virginica*) Seeding Methods On Oyster Growth and Survival

Karsten Coates <sup>W</sup> ★

### Abstract

Once an abundant source of food and a natural purifier of the water column, the Eastern Oyster (*Crassostrea virginica*) has been in great decline for years. Overharvesting and dredging practices have been partially to blame for the reduction in sustainable oyster harvests. In addition, oysters in Chesapeake Bay have been severely impacted by parasitic diseases such as Dermo (*Perkinsus marinus*) and MSX (*Haplosporidium nelsoni*). Various national, state, and local restoration efforts have been undertaken in an attempt to restore the oyster to its former abundance, but the population is still struggling. This study compared oyster growth and survival under three different seeding methods: cultchless, cultched, and remote set. Data indicate that more oysters survived and grew to larger sizes when they had a cultched seeding method, possibly because it provides both a substrate for oysters to attach to and places for oysters to avoid predation. However, the remote set seeding method had the greatest percent change in growth. This remote set result is significant ( $p < 0.05$ ) because it reinforces previous research that supports remote seeding as a quicker oyster growth method. These results lend support to oyster aquaculture focusing more on the cultched seeding method so that an even higher growth and survival rate can be obtained. A quicker growth rate means the oysters will be marketable sooner and before disease can cause mortality as well as provide them more surface area, allowing them to better benefit habitats, economy, and water purification.

MAR

## **Carbohydrate Loading on the Change in Blood Glucose**

Tyler Collins <sup>BG</sup>

### **Abstract**

Carbohydrate loading is a dietary practice that involves consuming large quantities of carbohydrate-rich food in order to saturate the body's carbohydrate stores. This has been known to allow users to avoid exercise induced conditions such as hypoglycemia and have more endurance than if this process had not have been applied. This study was executed in late October, 2011 at the King George YMCA. A group of 15 cross country runners were sampled during this study. The runners were told to intake 4g/kg/day, 7g/kg/day, and 10 g/kg/day with the lowest amount of treatment group being the controlled (recommended daily intake) group. The runners ran the day after consuming the set amount. Each group of treatment arrived at the YMCA at designated times and the subjects' fingers were pricked with a diabetic testing meter to record initial glucose levels. The subjects then ran two miles on a treadmill and immediately had glucose levels recorded upon completion. A change was found and the changes were averaged. The results of the study are as follows: (4g/kg/day) 51.8 g/dL, (7g/kg/day) 24.3 g/dL, (10g/kg/day) 10.2. The nu The group with the average amount of carbohydrate intake had the biggest change in glucose; this is because the energy storage in the body was not as much as the physical activity demanded and therefore more oxidation occurred. The group with the highest treatment had the least change because the muscles became supersaturated with carbohydrates which then broke down in to simpler sugars for energy.

MED

**The Effect of UV-B Radiation on the Dermal Coloration of the Eastern Newt (*Notophthalmus viridescens*)**

Taylor Coxon <sup>BG</sup> ★

**Abstract**

Amphibians, seen as environmental indicators, are facing serious threats to their existence. One of the most serious problems facing modern amphibian species is light pollution, more specifically, ultraviolet light pollution. This experiment studied the effects of increasing UV-B radiation on the melanophore activity of the male Eastern Newt (*Notophthalmus viridescens*) in a laboratory setting. Over a three month study, four groups of thirty subjects each were exposed to varying controlled amounts of UV-B radiation produced by light bulbs and filter treatments (measured in  $\mu\text{W}/\text{cm}^2$ ) for six days, and had their before and after coloration compared using photographic RGB color data provided by Adobe Photoshop. After testing, it was determined that, on average, the amount of skin darkening in each subject increases as the concentration of UV-B light increases. A lack of UV-B radiation resulted in subsequent skin lightening. A one way ANOVA performed on the results yielded a p-value of 0.005262, allowing the null hypothesis to be rejected. There seems to be a correlation between the dermal coloration of male *Notophthalmus viridescens* and the amount of UV-B radiation present in the environment. Ultraviolet radiation causes the formation of cyclobutane pyrimidine dimers which are cytotoxic and mutagenic photoproducts of DNA that impeded gene expression by blocking transcription. The photoreactivating enzyme, photolyase is the most important means for some organisms to repair DNA. When UV exposure prevents the production of photolyase, serious developmental and dermatological consequences result.

ZOO

## The Effect of Varied Amounts of Maxsea Fertilizer on Venus Fly Traps (*Dioneae muscipula*)

Erin Cushing<sup>BG</sup> ★

### Abstract

The Venus fly trap, *Dioneae muscipula*, is a monotype genus species that is part of a unique group called carnivorous plants. In addition to utilizing the nutrients found in soil and energy derived from photosynthesis, such plants also ingest carbon life forms. The purpose of this experiment was to see how well the Venus fly trap would grow when given a fertilized environment, and which concentration of fertilizer would cause it to reach its optimum growth rate the fastest. A cause behind this curiosity is the diminishing natural habitats of *Dioneae muscipula*, and the market demand for it as well. Two hundred juvenile Venus fly traps were collected from a biological research station and separated into five groups of eight containers. With only one group receiving no fertilizer as a control group, the other four groups were dosed regularly with increasing amounts of a fertilizer/water solution. They were measured on a weekly basis by diameter of the rosettes, and results were tested with a two-way ANOVA. Individual groups were also tested against each other with t-tests. Results of the two-way ANOVA were statistically significant ( $p = 2 \times 10^{-16}$ ); the t-tests showed only significant p-values for the group dosed with the highest amount of fertilizer. With this information, the null hypothesis was rejected, meaning increased amounts of fertilizer have a positive effect on the optimum growth rate of Venus fly traps. However, due to the small and heavily diluted dosages of fertilizer, more dramatic results could be achieved with a better fertilizer to water ratio. With the data gleaned from this experiment, fertilizer could be applied to manmade habitats for Venus fly traps in order to help them reach their optimum growth faster and thus devote more energy and time to reproduction.

BOT

## **Make It Rain: Does Roof Material Alter the pH Level of Acid Rain to a More Plant Friendly Level When Collected in a Rain Barrel?**

Tyler Daig<sup>BG</sup> ★

### **Abstract**

Rain can be collected in rain barrels for the use of several things, such as watering plants and preventing erosion. The rain water that is collected is commonly acidic that has a pH level ranging from 2.0 to 4.5. Plants prefer water that is non-acidic with a pH around 5.6. Roofing materials may play a role in altering the pH level of the rain. A 4' x 4' building frame made from PVC pipe with a gutter system leading into a mock rain barrel was made. Four roofs were made from asphalt shingles, cedar shakes, tin, and fescue sod. After that, 10 ppm of Sulfuric acid was added into one gallon of water and a pH level of 3.8 was reached. 1000 ml of acid rain was sprinkled over top of each roof over a period of two minutes and collected in the rain barrel. The pH of the water collected was tested by an electronic pH meter. The acid rain that passed over top of the asphalt shingled roof got altered the most. The acid rain that passed over top of the green roof got altered more than that of the wooden shingles and the tin roof. The acid rain that passed over top of the wooden shingles got altered more than the water that passed over the tin roof. The green roof altered the pH level of the acid rain to the most plant friendly level of 6.8. The changes happened on the tin roof because it is galvanized but it has a slick surface. The asphalt shingles have traces of zinc in them. The wooden shingles have a high amount of natural chemicals in them, such as cedar oil. The green roof has a filter effect and the soil has a cation exchange capacity that provides them with a buffering complex to absorb the excess protons from the acid rain. Also soils that are calcareous are alkaline, so they may be able to neutralize the acid rain. Since the chemicals that neutralize the acid from the asphalt, tin, and wooden shingles wear off over time, the green roof would be more recommended.

ENV



**Differences in the average size and count of Mummichogs (*Fundulus heteroclitus*) in multiple habitats of various complexities**

Heather Davis<sup>BG</sup> ★

**Abstract**

Artificial habitats attract many species, and increase catch for fishermen. One species, mummichogs, is able to survive in harsh conditions and thrive in areas with some covering. mummichogs were caught with baited fish traps and notes were taken of the average size and count. The data were then tested using an ANOVA to determine if there was indeed a difference in the average size and count among the habitats. The test illustrated that there was a difference ( $p= 0.0015$ ) in the average size of the mummichogs among the various habitats, rejecting the null hypothesis. There was not a significant difference ( $p= 0.0902$ ) in the average count, which means there was not a difference among the habitats, failing to reject the null hypothesis. Knowing the differences between the habitats could potentially lead to an increase in the population of these fish. If more people with waterfront property built artificial habitats, it would provide habitats for these unique fish along with numerous other organisms. Rip-raps and seawalls in particular, are diverse and abundant in aquatic life; they provide an artificial barrier between the land and the water, thus preventing the water from wearing away at the shore.

MAR

## **The Effect of Water Consumption on Body Weight**

Callie Dunn <sup>BG</sup>

### **Abstract**

Water is one of the key ingredients to life. You must consume a certain amount daily to stay healthy and not become sick. Everyone is not the same body size, so each person's ideal amount of water consumption varies. Medical guidelines suggest drinking half your body weight in fluid ounces daily. Testing body weight is an accurate way to determine whether you have consumed an appropriate amount of water daily. Exercise, temperature, and gender are factors that influence whether you may gain, lose, or stay at a constant weight. Each test subject's body weight was taken when they arrived and then they were provided either less than half, half, or more than half their body weight in ounces of water. After consuming the prescribed amount of water, test subjects did physical activity for an hour. Once the hour was up their weight was then taken again. The final weight was subtracted from the initial weight before the water was consumed, and then a percentage change was found. Once all three trials were completed a two way ANOVA was performed on the data. Results yielded a p value of  $8.45 \times 10^{-5}$  for differences between trials. A p-value of 0.228 was received for differences in gender. The different trials had a significant difference but the gender did not. Temperature had a great effect on the different trials. The three different trials had a variation in temperature which caused the subjects to not be able to sweat like they did in the previous test sessions. Overall, the results indicated that the recommended water consumption rate of half your body weight in ounces allows the body weight of someone to stay constant and prevents them from becoming dehydrated.

MED

## The Effect of the Angle of a Forward Swept Wing on Takeoff Distance

Quoc Duong<sup>BG</sup> ★

### Abstract

Aircraft wings are constantly modified in order to create aircraft that generate more lift therefore leading to more efficient aircraft. Aircraft that generate more lift have lower takeoff distances. Forward swept wings have not been extensively tested and this experiment was conducted to see if forward swept wings lowered the takeoff distance. The angles tested were 30°, 40°, 50°, and 90° (the control). Airflow over a forward swept wing flows from the wing tip to the wing root instead of from the wing root to the tip for a swept back wing. Because of the air is flowing from the tip to the root, the forward swept wing generates lift earlier than a swept back wing therefore leading to a lower takeoff distance. A Hobby Zone Ready to Fly Cub was used as the testing aircraft with three modified wings and a control, each tested four times. The center of gravity and mass of each aircraft was kept constant. The aircraft was set at full throttle, held in place, and then released. The takeoff distance was measured in meters and the time in seconds. The data was collected and averaged. A One-Way ANOVA statistical test was conducted and a p-value of 0.613 was generated. This meant that there was no statistical difference in the data. This experiment showed that forward swept wings do have effects on takeoff distance but more testing needs to be conducted in a controlled environment (wind tunnels) in order to see if forward swept wings actually affect an aircraft's flight characteristics and its takeoff distance. If forward swept wings are shown to generate more lift than conventional wing designs, it can be used by airline and shipping companies for more efficient aircraft thereby reducing the costs and increasing profits for the companies.

EGR

## **Investigating a Passive System for Growing Algae for Biofuel in the Chesapeake Bay**

Kristina Edwards <sup>G</sup>

### **Abstract**

In order to avoid a future energy crisis, scientists have begun to search for new potential energy sources that are renewable, feasible in production, and capable of fulfilling society's energy demands. Energy sources that could potentially satisfy these criteria are biofuels; this project focuses specifically on algae as a biofuel. Two primary hypotheses were created to test feasibility and growth related to the surface area of the substrate: benthic diatoms can be grown and harvested passively in a tributary of the Chesapeake Bay; the substrate with the most surface area will produce the most algae. Structures were made to stand vertically in the water column with differing substrate surface areas from low to high with burlap, upholstery, t-shirt, and shag carpet. Overtime the t-shirt substrate broke, eliminating further data collection from that structure. The data collected from the remaining structures did not show a reliable trend, giving a p-value of 0.72 from a one-way ANOVA test. To test surface area relative to growth, averages were taken of the data. The shag carpet yielded the most on average, and the burlap yielded the least on average. The project proved that high surface area yields more algae growth, but algae in a passive system do not support a reliable trend.

MAR

## **The Effect of Nutrients on the Growth of Radish Size**

Bailey Filkoski <sup>W</sup>

### **Abstract**

This study looked at the effects of nutrients on the development and growth of cherry belle radishes (*Raphanus sativus*) using various soil types and compost. The radishes were grown in three separate containers, using different soil enhancers in each container (MiracleGro Garden Soil and household compost). Radishes were measured for growth after a period of five weeks. Data indicate that radishes grew to be the largest in the MiracleGro Garden Soil, which is intended especially for aiding in the growth of vegetables. Results of a one-way ANOVA test indicate no significant difference in radish plant and radish bulb size between the MiracleGro Garden Soil, household compost, and control soil treatments ( $P > 0.05$ ). Although the results were statistically non-significant, the results are still beneficial. By determining which fertilizing unit gives the best results farmers and home growers can grow their crops more efficiently and obtain the best vegetables for the cost.

BOT

## **A Comparison of Length, Age, and Species of Fish in Farnham Creek Between Late Summer and Late Fall**

Josh Fones and David Furrow <sup>W</sup>

### **Abstract**

This study was conducted in order to compare the length, age, and species of fish caught during summer and fall in Farnham Creek, a tributary of the Rappahannock River. Fish were collected at two times of the year, summer (August) and fall (November) in order to compare the seasonal differences in species variety. Over the entire sampling period, 230 fish were caught and six different species were observed. It is predicted that species variety in fish will be greatest in the summer because of the warmer waters and abundance of food. Results indicate that a greater total number of fish were caught during the fall sampling versus the summer sampling (170 vs. 60 total fish). The number of different species caught was about the same (summer = 4, fall = 5). In both seasons, more adults were caught than juveniles of all types of fish. By determining the types and amounts of fish found in Farnham Creek fishermen may be better able to target a specific species and reduce their overall expenditure in terms of time, fishing effort, and money.

MAR

# **The Comparison of Oil-Based and Water-Based Antifouling Paints on Fouling Organism Growth in Chesapeake Bay**

Zach Gotschalk<sup>BG</sup>

## **Abstract**

Fouling has been a major problem for the boating world since boats have been created because, because fouling organisms can grow on anything, they can cause major economic and physical problems, such as increased fuel consumption and compromised mobility. The solution to that problem was the development of antifouling paint, but the oil-based worked too well and devastated the environment, so the introduction of water-based proved to be more environmentally friendly. This study was designed to compare the effectiveness of the two different paints. Three different groups of oil-based antifouling paint, water-based antifouling paint, and acrylic paint were placed in the Chesapeake Bay for two weeks. There was no growth on either of the two antifouling paints, but there was a average growth of 1.4 grams of fouling organisms per two weeks. A one-way ANOVA was used to give a p-value of  $1.47 \times 10^{-8}$ , showing that there was statistical significance between the type of paint and the amount of growth, thus rejecting the null hypothesis. This is important to helping people switch to different antifouling paints, preventing the growth of fouling and the growth of a healthy environment.

CON SCI

## **The Effect of Water Acidity on the Growth of Red Fescue (*Festuca rubra*)**

Emily Harris<sup>BG</sup>

### **Abstract**

Previous research has shown that acid rain has a negative effect on a variety of plants. This study researched such effects on a specific plant, red fescue. If there is a change in the acidity of the water given to red fescue, there may be a change in the growth of the plant itself. It was hypothesized that grass given slightly acidic water would have greater heights and growth rates than grass hydrated with neutral or basic water. Grass was hydrated with water with different pH levels ranging from a pH of five to a pH of 9 and the differences in growth were recorded weekly. After data was collected, it was evident that the red fescue hydrated with water with a lower acidity grew more profusely. The groups of grass given water with pH's of five and six had greater heights and growth rates than those given water with pH's of seven, eight, and nine. After running a Two-way ANOVA, p-values of much less than .005 were received. This showed that there was a significant difference between the growths of the red fescue at each week as well as between the growths of the groups. The null hypothesis was rejected. The results showed that slightly acidic water, or water with a pH of five or six, is more helpful than harmful for red fescue.

BOT



## **Biochar: Can it be used to sequester Carbon?**

Emma Hepworth <sup>G</sup>

### **Abstract**

Global climate change is caused by excess CO<sub>2</sub> in the atmosphere which increases the Greenhouse Effect. Trees are a critical carbon reservoir because they not only hold carbon in their organic structure, but also because they take carbon dioxide out of the atmosphere through photosynthesis and store it as glucose. The problem with trees is that they are only reservoirs which means they are only meant to hold the CO<sub>2</sub> temporarily, and when they are burned or when they decompose, the inorganic carbon escapes as CO<sub>2</sub> back into the atmosphere. Carbon sequestration is the process of locking up the carbon dioxide into Carbon sinks. One method of this is by creating biochar, which is formed by burning organic material without oxygen present and at a temperature hot enough that the CO<sub>2</sub> it releases is burned back into the biochar. Through this method the inorganic carbon in woody plant material can be turned into organic carbon and when mixed with soil it traps the organic carbon in the ground to be used by plants and other organisms. This experiment's alternative hypothesis is that the biochar will retain more mass (Carbon) than charcoal from a regular fire (control). Using a homemade pyrolyzing stove, organic material is turned into biochar and the percent change in mass is calculated. The biochar pine needles retained 27.37% of their mass on average compared to the 12.17% of the control. The biochar gumballs retained 24.78% of their mass on average compared with the 11.88% of the control. A one-way ANOVA statistical test yielded a p-value of 0.0116. Due to this p-value the null hypothesis is rejected and the alternative hypothesis is accepted. This indicates that biochar is a feasible method of Carbon sequestration along with having other environmental and social benefits.

ENV

## **The Effect of Grass Height on Stimp**

Craig Hicks <sup>BG</sup>

### **Abstract**

Stimp is referred to as the speed of the greens. If known, golfers can be more precise on the greens with putting. It is measured with a stimp meter and the distance the ball rolls is the stimp. This experiment showed the effect of grass height on stimp. The stimp was measured at six different grass heights. The grass heights were heights that could be putted on in real life scenarios. They included heights of the fringe, green and fairway. As hypothesised, the stimp decreased as grass height increased. The stimp ranged from 1.3 meters to 2.7 meters. A r-squared value of .95 was found in a regression. This shows that 95% of stimp variation is due to grass height. Golfers are able to take knowledge about height of the grass a make a good estimate of the stimp with information provided in this study. Since putts total about half of a golfers total strokes, knowing the stimp could help them to putt better and lower their total score.

BOT

**Mosquito Madness: The Effect of Plant Mass on Mosquito Fish (*Gambusia affinis*)  
Consumption of Mosquito Larvae**

Shelbie Hill<sup>BG</sup> ★

**Abstract**

It should come as no surprise to anyone that mosquitoes are terribly annoying. Not only is their buzzing sound obnoxious, but they are also known as “vectors” in the public health community. This means that they are of health significance and are capable of transmitting deadly diseases to humans. A common form of controlling the mosquito population is the use of the Mosquito Fish (*Gambusia affinis*), whose diet consists of mosquito larvae. An experiment was done to determine if plant mass affects the amount of larvae consumed by Mosquito Fish, to research a possible way to better control mosquito populations in areas where mosquito-transmitted diseases are common. Four 10-gallon tanks were used, containing various amounts of plants (three containing plants and one, as a control, containing no plants). The plant of choice for the experiment was Hydrilla, an invasive plant species known to take over any environment, found in a local lake. The same amount of fish and (thawed) mosquito larvae were placed into each tank, and the amount of larvae consumed after one hour was recorded. This was repeated three times, then results were analyzed. The average results, as predicted, were as follows. The same trend was generally seen, with consumption of larvae decreasing as plant mass increased. After utilizing a one-way ANOVA, a p-value of 0.027945 was obtained, which confirms the statistical significance of the experiment. This means that plant mass does, in fact, affect the amount (in grams) of larvae consumed by mosquito fish. We can conclude from this experiment that by controlling plant populations in areas where mosquito-transmitted diseases are rampant, we can limit the transmission of mosquito populations, thus limiting the transmission rates of these diseases.

ZOO

## **Comparison of Eastern Oyster (*Crassostrea virginica*) Growth Between the Great Wicomico River and Cranes Creek, Tributaries of the Chesapeake Bay**

Henry Hull <sup>W</sup>

### **Abstract**

The Eastern Oyster (*Crassostrea virginica*) is an important part of the Chesapeake Bay's economy and health. They provide vital ecosystem services including; cleaning the water and improving the water quality for other marine flora and fauna. Local, state, and national organizations have invested large amounts of money into finding suitable locations to rebuild the Chesapeake Bay's oyster population (Burreson et. al, 1999; Parsons 2007; Mann et. al, 2011). The intent of this study is to compare the growth and recruitment of juvenile oysters in different tributaries of the Chesapeake Bay. Recruitment of young oysters is a good measure of oyster health, and helps determine population size in the future. The two sites used were the Great Wicomico River and Cranes Creek, which are separated by a small stretch of land called Sandy Point. Scientists differ dramatically on the actual health and success of the Great Wicomico Reef (Blankenship, 1999; Nealon, 2011). Fifty spat-on-shell were placed in floating oyster cages and cages were deployed one in each water body, where they remained for two months. Final oyster sizes were compared with pre-deployment initial oyster sizes. Although no significant difference in oyster sizes was seen between the two sites ( $P > 0.05$ ), oysters placed in Cranes Creek started with slightly lower average size, and their average final size was slightly larger than oysters grown in the Great Wicomico River. These results suggest that Cranes Creek, which is more remote could have slightly better water quality and foster a better environment for oyster growth and recruitment.

MAR

## **Why Waste Waste? How Behavior Affects Household Waste Management**

Sydney James<sup>G</sup> ★

### **Abstract**

The average American produces about 4.3 pounds of waste per day, and with the population on a steady increase, we are quickly running out of landfill space. The solution to this problem is a zero waste environment. To obtain a zero waste environment, people need to pre-cycle, compost and recycle. This experiment tested subjects' changes in waste management behavior, to determine if this had an impact on the production of household waste. The independent variables in this experiment were time, and waste management education, whereas the dependent variable was behavior. For this experiment, 6 families were selected to participate, over a one month time span, from August 07, 2011-September 07, 2011. For the first 2 weeks, subjects were to weigh each bag of trash every time one was filled. They weighed their trash on an electronic calibrated bathroom scale. After Week 2 was completed, subjects were given the following guidelines: Start a compost pile (a how-to-manual was given to each family for assistance), start recycling glass, paper, plastic, and cardboard, reuse products as much as possible, and buy products that use less packaging. The subjects then followed the exact same procedure for two more weeks, continuing the guidelines. The paired t-test was ran to determine a significant difference in the results of the average weights of the waste from Families 1, 2, and 3, before and after the guidelines were put into effect. From the paired t-test, the one tail P-value was used. The statistical analysis gave a result of  $p= 0.013$ , showing a statistically significant change in waste management behavior.

ENV

## **Resisting Eutrophication in the Chesapeake Bay: Can an Algae Scrubber Work?**

Grayson Johnson<sup>G</sup> ★

### **Abstract**

The Chesapeake Bay is unhealthy largely because of the process of eutrophication or nutrient pollution. In order to reduce eutrophication, nutrient levels must be reduced in the Bay. A potential solution to the problem of eutrophication was investigated using organisms such as submerged aquatic vegetation or macroalgae in a self-contained apparatus to remove excess nutrients and increase dissolved oxygen as a counter to the symptoms of eutrophication. In the study, a float containing macroalgae and a float containing sub aquatic vegetation were placed in the Rappahannock River to determine the effects of the organisms on the nutrient levels as well as the dissolved oxygen in the direct vicinity. Additionally, tests were conducted in a tank experiment to observe the uptake rates of nutrients in SAV and macroalgae. In field study, it was discovered that the only measurable difference caused by the macroalgae and SAV was an increase in dissolved oxygen. Nutrients showed no statistical differences when compared to ambient water with p-values equaling .48 for SAV and .42 for macroalgae. The explanation for the ineffectiveness of nutrient removal by the organisms is likely the biomass. The quantities were probably too small to have an effect. Because the biomass required is large, the importance of preventing the addition of excess nutrients into the water column is much greater than thought before.

MAR

## **A Study on the Bioaccumulation of Mercury in Offshore Fish**

J. Zachary Jones<sup>G</sup> ★

### **Abstract**

Fish in oceans, rivers, and other bodies of water are bioaccumulating vast amounts of mercury, a naturally occurring element. Although it is naturally occurring, this toxic element is also a byproduct of various human activities, including industrial coal processing and trash burning. The goal of this project was to determine if there was a significant difference between the mercury levels between migratory and stationary fish. It was also designed to determine if the Food and Drug Administration's (FDA's) data accurately represents the oceans offshore fish population. Due to different ranges, behaviors, and ecological niches, it was predicted that there would be a significant difference between the mercury levels in migratory fish versus reef complex fish. The Gulf Stream off the coast of Cape Hatteras, North Carolina served as the location for this study. The independent variables were the location and type of fish, which were collected from April to October of 2011-2012. The fish included large migratory game fish like tuna and stationary bottom-dwelling fish like tilefish. The large migratory fish were collected by fishing offshore using the trolling method, which involves pulling ballyhoo (*Hemiramphus brasiliensis*) as bait behind the boat. The bottom-dwelling fish were collected offshore using the bottom drop method, which involved dropping cut squid with lead weight so that it sits on the bottom. Once collected, the tissue samples were evenly measured out and tested for mercury concentration using mercury test strips. Mercury levels were analyzed and a significant difference was found between collected migratory and stationary fish as well as collected samples and the FDA data.

MAR

## **The Effect of Distance Away From a Storm Water Discharge Site on Fecal Coliform Presence**

Zachary Jones<sup>BG</sup>

### **Abstract**

This study involves the testing of water around a storm water discharge site for pollution from animal waste. This was done through the testing of water samples for their concentration of the animal waste pollution indicator, fecal coliform. The particular site is located on the Outer Banks of North Carolina and empties off the beach into the Atlantic Ocean. Since this is a popular recreational body of water, the storm water discharge site poses the threat of causing water borne illness. The study aims to see if there is any correlation between the distance and direction away from the discharge site and the presence of fecal coliform in the water. It was hypothesized that there would be a succession of dilution of the coliform as position moved away from the discharge site. Ten positions were chosen around the discharge site to use as sampling locations. Water samples were processed in order to reveal their bacterial contents. After testing, each of the samples showed bacterial growth. The presence of fecal coliform was observed and recorded. Analyzing the collected data showed a general trend of decreasing fecal coliform content as the distance away from the discharge site increased. However the direction away from the discharge site only showed small variances. A two-way ANOVA was used to statistically analyze the data. This test put out three p-values. At  $3.34 \times 10^{-9}$ , only one p-value, the sample p-value, was significant. This p-value showed that there were significant changes between the levels of fecal coliform contents between the different distances of the sample sites. This allowed the null hypothesis to be rejected. However in relation to whether or not this water pollution poses any health risk, the answer was found to be: if the proper precautions are taken, there is no serious risk.

ENV



## Determining the Effects of Non-Point Source Pollution on a Freshwater Pond

Jennie Latane<sup>w</sup> ★

### Abstract

In many third world countries, fecal contamination of water sources is a major problem. It can lead to a number of diseases, many deadly. Although the U.S. does not include water contamination among its most crucial issues, in more rural areas contamination can go unnoticed. So too then, does the potential for cases of bacterium- caused diseases. This is the case with a small pond flowing into the Potomac River (a part of the Chesapeake Bay watershed) in Westmoreland County, Virginia. Visible signs (i.e. a green tint to the water, murkiness) and aromas suggest that perhaps the pond has fecal coliform (*E. coli*) contamination. To test this hypothesis, the water quality parameters of temperature, pH, fecal coliform, dissolved oxygen, and nitrates and phosphates were tested. The sampling took place over a period of twelve weeks at three different test sites and two depth levels. By the end of the experiment, coliform levels were not consistent enough to suggest the presence of the regular input of non-point source pollution (in the form of fecal matter) into the pond. However, a large discrepancy between surface and deep level oxygen suggests the possibility of another underlying effect, such as eutrophication.

ENV

## **The Change in Heart Rate at Various Distances**

Jaimee Layne<sup>BG</sup>

### **Abstract**

This study was conducted to identify the relationship between the changes in heart rate at different running distances. Heart rate has a close relationship with oxygen consumption, where the demand for oxygen rises with exercise intensity. It is also an indicator of effort and energy. Knowing specific heart rate can be very essential to an athlete's health. Running on a track was the type of exercise in this study and the types of running that were used in this study were sprinting and endurance running. Sprinting is a short, quick run that focuses on power and speed, whereas endurance running is a long distance run that is paced and focuses on the economy of movement. The objective of this study was to determine if distances affect the overall change in heart rate from resting to finishing and if it can reach a dangerous level of change. It was hypothesized that as distance increases, the average change in heart rate will increase as well. A finger heart rate monitor was used to record the resting heart rate of before they ran. Once recorded, each participant ran each distance of 100, 400, 1600, and 3200 meters on separate days and preceding each running event, the finishing heart rate was recorded. The average change in heart rate was calculated. The results showed significant difference in the change in heart rate in relation to the distance ran with a p-value of  $1.27 \times 10^{-37}$ . The change in heart rate was the highest at the furthest distance due to prolonged running and the higher demand for more oxygen. Breaths deepened and sped up which boosted heart rate. An abnormal heart rate can cause problems to arise such as fainting, blood clots, and/or heart attacks. This study showed that the distances tested did not cause heart rate to change at a dangerous level.

MED

## **The Effect of Bleach Concentrations on Bacterial Growth**

Claudia Lovo <sup>BG</sup>

### **Abstract**

Bacteria is found everywhere in the world. Some are more harmful than others. People try to get rid of as much bacteria in their homes as they possibly can. This experiment uses different concentrations of bleach mixed with water on bacterial growth from doorknobs. The experiment supports that watering down bleach extremely, is not as effective as following the directions on the bottle. It also supported that doubling the amount of bleach in the water does not have a greater effect. The bottle claims that the recommended dose kills 99.999% of bacteria on surfaces. In the experiment results we see support that claim is exaggerated. It uses the recommended amount, half of the recommended amount, double the recommended amount, and tap water as a control. Each level of bleach was out into a liter of tap water. Each solution was poured in to bacteria from the doorknob that was grown in petri dishes. The experiment supports that watering down bleach extremely, is not as effective as following the directions on the bottle. The p-value was 0.00166, meaning that it is significant. This significance says that the amount of bleach mixed in with water does have an effect on bacterial growth. Diluting ones disinfectant is useful, but it must be done carefully so one can always get the full effect.

CON SCI

## **A Comparison of the Wounding Patterns of 7.62x51 NATO and 7.62x54R Ammunition**

Jonathon McDaniels<sup>W</sup>

### **Abstract**

The overwhelming concern of militaries is whether or not the ammunition provided to troops is sufficient in stopping power. Firing said ammunition into ballistic gel gives an idea of the stopping power the ammunition is capable of. One overlooked category is the designated marksman/machine gun cartridges, 7.62x51 NATO and 7.62x54 Rimmed, used by NATO and the former Soviet Union respectively. This study aims to provide insight into the stopping power of these cartridges, by measuring the entry and exit point sizes. The ammunition variety used was light ball, a lightweight variant of standard ball ammunition, normally between 140 and 150 grain weight. The ammunition was fired from rifles that utilize similar actions, minimizing result skew. The intended target was a 32 ounce block of ballistic gelatin, a common ballistics test material. Measurements of entry and exit point size were determined after a hit was recorded in the ballistic gelatin. From these measurements, a basic idea of the stopping power provided can be determined, albeit against unarmored personnel. Results indicate that the entry and exit point sizes were not significantly different ( $p > 0.05$ ) between the two types of ammunition, indicating 7.62 NATO and 7.62x54R ammunition provides equivalent stopping power.

PHY

## **A Comparison of Yield Between Genetically Modified Corn Seed: Stacked vs Conventional**

Morgan Minor <sup>W</sup>

### **Abstract**

In recent years, scientists have begun using biotechnology techniques to identify and splice certain genes into plants to help them resist certain pests or produce other desirable traits. Today, somewhere around 99 percent of U.S. corn is grown from hybrid seed. The same is true for wheat, soybeans, grain sorghum, cotton, peanuts, and many other crops. This study focused on the success of several genetically modified corn hybrids in the Northern Neck of Virginia. It observed the growth and productivity of three pairs of a single modified trait and a seed with stacked traits. These GMO traits are for herbicide and insecticide-type resistance to the European Corn Borer and root worm. At the end of the ~100 day growing period, the corn was measured for yield ratio between the stacked trait and single trait conventional corn hybrids, as well as gross income and profitability. On average the stacked trait hybrids had higher yields and higher gross incomes, but were not more profitable.

BOT

## **The Effect of Greenies on Beagle (*Canis lupis familiaris*) Mouth Bacteria**

Katlyn Moss<sup>W</sup>

### **Abstract**

People in this day and age take extremely good care of their dogs. Probably the most ignored factor of canine health is their dental health. Dental health is known as an important factor of human health, as things like gum disease can lead to heart attack. So why is dental health in dogs so often ignored? There may be several possible explanations. People seem to ignore the mouth of a dog until it causes them a hindrance, such as by bad breath or the dog refusing to eat. This is when the owner finally realizes that their dog has many rotten teeth, ones that are loose, or even teeth that have already been lost. For years, the only known way to help prevent the decay of dog's teeth was daily brushing, much like humans. Lately, some improvements have been made in prevention of tooth decay in canines, such as specially formulated dog toothpaste, oral sprays that claim to "dissolve" away normal buildup on the teeth, and chew toys designed to wear off tartar. A treat, Greenies, claims to freshen the canine's breath. To test whether or not Greenies freshened breath by removing mouth bacteria, dog's mouths were swabbed before and after eating a Greenie treat. Dog sex, age, overall health, whether or not they drank any water, and the time it took them to eat the Greenie treat were also recorded. Bacteria swabs were cultured for 60 hours and then bacterial colonies were counted. Results indicate that consuming a Greenie treat significantly lowered the amount of mouth bacteria in the test subjects ( $P < 0.05$ ). Further breakdown of data by dog sex, age, and general health also provided interesting results.

ZOO

## **Got Gas? The Difference Between 87 and 93 Octane Gasoline**

Joe Nelson<sup>G</sup>

### **Abstract**

The common idea concerning the different types of gasoline is that high octane gasoline will yield a better miles per gallon (mpg) than the regular, low octane gasoline. An average control fuel mileage was determined by averaging the miles per gallon of 20 tanks of fuel per octane. In the end, 87 octane gasoline produced a 1.7 cent lower price/mile average than 93 octane gasoline produced. However, 93 octane gasoline produced a 0.84 better miles/gallon average than 87 octane gasoline produced. This means, if the entire population of light duty vehicles, 201 million, switched to 93 octane gasoline, then there would be approximately 6.7 billion gallons of fuel saved per year.

CON SCI

## **The New Old Fuel: The Effects of Static Electricity on the Charges of Battery Varying Types**

Carlos M. Ortiz Jr. <sup>BG</sup>

### **Abstract**

This study was conducted in order to determine if static electrical forces have an impact on batteries of varying composite make-ups, and if that impact positively or negatively affected the batteries charges. Static electricity can be described as an electrical discharge with little to no current; these can still possess a high voltage however. The battery types consisted of lithium rechargeable, NiMH rechargeable, alkaline, and alkaline coppertop. Using a standard classroom size Van de Graaff generator to induce the static electrical forces, the batteries were left in contact with the device and measured for differences in their charges from their initial charges measured with a voltmeter. Each of the four different types was determined to have no measurable change in charge after treatment. This points to the advancement of battery propelled devices since flammable liquid fuels such as hydrogen and gasoline can be ignited by a small static electrical discharge. The future may hold more of these battery operated vehicles since they would be unaffected by the discharge of forces that cause numerous fires every year.



## **The Filtration Difference Between Eastern Oysters and Atlantic Ribbed Mussels**

Trevor Penkwitz <sup>BG</sup> ★

### **Abstract**

The Chesapeake Bay's water quality is quickly declining. Decades ago, Eastern Oysters were able to filter all of the water in the Bay within three days. Now, it takes them over a year. To restore the bay to its original water quality, an alternative must be found. Atlantic Ribbed Mussels may be able to filter enough sediment out of the bay to restore its water quality. This project served to understand the filtration differences between Eastern Oysters and Atlantic Ribbed Mussels to see if Atlantic Ribbed Mussels could be a feasible alternative to Eastern Oysters in the Chesapeake Bay. Several of each specimen were collected and tested in a cornstarch/ saltwater mixture over the course of two and a half hours to find out the differences of absorbed light in each trial tank. Cornstarch was selected due to it being a fine sediment which could stay suspended in water for long amounts of time. Every 30 minutes, water was tested in a spectrophotometer to determine the absorbance of light from the control water of saltwater without cornstarch. In the end, both Oysters and Mussels, even though they vary greatly in size, had nearly identical amounts of absorbed light over the course of the experiment. This means that Atlantic Ribbed Mussels could potentially be added into the Chesapeake Bay to help clean the water. However, Atlantic Ribbed Mussels will not be effective in cleaning the Chesapeake Bay because they are not able to filter all day long like Eastern Oysters are. Since the Mussels will not be effective with cleaning the Bay, Oysters need to be protected in the Bay with Oyster Restoration Projects.

MAR

## **The Effect of Cycle Rate on the Growth of *Spinacea oleracea* in an Aquaponics System Containing *Carassius auratus***

Will Perkins <sup>W</sup> ★

### **Abstract**

This experiment on the relative effectiveness of different cycle rates in an aquaponics system could shed light on an important part of these systems. If one cycle rate proves to yield more desirable results, then it could narrow the zone to be searched for the “sweet spot” of cycle rates. Previous research has shown little about the effect of cycle rate, but it has revealed much about aquaponics, including the optimal pH range, proper fish feed to plant ratio, and the overall benefits of the practice in regards to water consumption and agricultural efficiency. The experiment involved two systems, each with thirty goldfish and seventeen spinach plants. The goal of the experiment was to see which rate would provide the greater growth and healthier plants. The two systems experienced nearly identical conditions, with the only difference being the total cycle rate. One system cycled two minutes slower than the other system. The plants in the slower system had a greater average number of leaves per plant and final mass. This was most likely a result of the plants in the slower cycling system spending more time in the nutrient rich water. The statistical analysis was significant enough to reject the null hypothesis that there would be no difference in growth. Based on these results, it can be speculated that the cycle rate is a key factor in the growth of plants in aquaponics systems, and that a slow rate is more effective than a fast one. Further studies could test different rates, and contain more precise instruments for controlling and maintaining these rates.

BOT

## **A Comparison of Level of Extroversion and Participation in High School Extracurricular Activities**

Bethany Love Pritchard <sup>w</sup> ★

### **Abstract**

The aim of this study was to find whether a correlation exists between the level of extroversion in high school students and the amount and type of participation in high school extracurricular activities. The effects of introversion and extroversion is in the back of the minds of educators as they attempt to find better ways to educate their students in using techniques students can relate to. Teachers often give students self-assessment surveys at the beginning of each year to help both the students and the teacher learn and teach better. The purpose of this study was much the same. By determining if there was a correlation between extroversion and extracurricular activities, more students may have been reached by finding ways to encourage the students that are unwilling to be active in extracurriculars to participate. It would be expected that the more introverted a student is, the likelihood of their participating in extracurriculars, especially those in a team setting, would be low. Students completed an online personality questionnaire and a paper survey telling which extracurriculars they participate in. This study found no correlation between a student's level of extroversion and the amount and type of extracurriculars they participate in through the course of their high school career. The possible reasons for these results are many and varied. The most probable is that students in high school, especially in a rural area, have become used to the students in all social levels, and therefore do not let that hinder them as they select clubs to participate in.

## **Mycorrhizal Fungi v. Chemical Fertilizer**

Jerrica Rawls<sup>G</sup>

### **Abstract**

The Chesapeake Bay suffers from eutrophication due to runoff from chemical fertilizers used to aid crop growth. The vast amounts of fertilizers lead to massive algal blooms that damage ecosystems both directly and indirectly, food webs are disrupted, the water becomes more acidic, and animals are negatively impacted. In order to solve the problems associated with overfertilization and eutrophication, mycorrhizal fungi, specifically arbuscular mycorrhizal fungi (AMF), were experimented with as a possible alternative for chemical fertilizers. An experiment was implemented to test whether AMF could serve as an alternative to the vast amounts of chemical fertilizers being used on crops every year. The hypothesis: The substitution of mycorrhizal fungi inoculants for chemical fertilizers will produce an equal yield of crops. Null Hypothesis: The substitution of mycorrhizal fungi inoculants for chemical fertilizers will not produce an equal yield of crops. Mycorrhizal fungi did not prove to be a successful alternative to chemical fertilizer. In fact, it did not seem to make any difference in the growth and production of the green bean plants. The substitution of mycorrhizal Fungi inoculants for chemical fertilizers did not produce an equal yield of crops. Plants treated with chemical fertilizer had much higher yields than plants treated with mycorrhizal fungi inoculants.

BOT

## **The Relationship Between Athletic Participation and Grade Point Averages of Males and Females**

Kaitlyn Rochelle <sup>W</sup>

### **Abstract**

The relationship between student academic performance (GPA) and athletic participation has been studied in numerous formats. Many studies of this nature have been done, and many end up with conflicting results. There are some variables that could possibly cause this variance. The GPA of a student athlete may possibly be higher than that of a non-athlete due to the simple fact that there may be a minimum GPA requirement for that student to be eligible to play. If, for some reason, it comes out exactly opposite, with the non-athletes having the higher GPA, it could be because that same GPA requirement has excluded some students from playing any sports. Another possibility could be that students who are athletically involved may be more competitive by nature, and bring this trait into the classroom, as well (Begnaud, 2007). To test this relationship, GPA and athletic participation surveys were passed out to 137 students in grades 9-12 at Northumberland High School. Surveys also included demographic information such as gender, and the type of sport played. Results indicate that on average non-athletes have higher GPAs than athletes (3.4 vs. 3.16 respectively). When looking just at athletes, baseball and softball players have the highest GPAs (3.36), while basketball players have the lowest GPAs (2.98). All GPA data collected is on a 4.0 scale. Results from this study could be used to enhance students' working habits and work ethic.

## **How Are Different Aquatic Animals, At Different Levels of The Water Column, Affected By An Oil Spill?**

Ashley Rose <sup>W</sup>

### **Abstract**

This study was conducted due to thoughts on how the recent oil spill affects organisms living in all parts of the water column. This study focuses on three different organisms, the Eastern Oyster (*Crassostrea virginica*), Minnow (*Cyprinidae sp.*), and the Ghost Shrimp (*Palaemonetesugio*). Throughout modern history, there have been many oil spills which have affected thousands of invertebrate and vertebrate organisms (Earthgauge, 2010). Based on the position in the water column an organism occupies, it may be more or less affected by an oil spill. Small fish such as minnows search for food near the top of the water column and may more readily get oil on them and eventually die because the oil clogs the minnow's gills. Ghost shrimp usually stay closer to the bottom in shallow water and they can be affected when the oil comes to the coast. Oysters and other bivalves may be affected over the long term. The study consisted of three trials conducted on each organism; all of the experimental tanks contained the same amounts of food, water, and oil. Observations of organism mortality were recorded daily. Results indicate that minnows had the highest mortality, then shrimp, with oysters experiencing the lowest mortality in a simulated oil spill environment.

ENV

## Natural vs. Artificial Submerged Aquatic Vegetation

Morgan Rudd <sup>BG</sup> ★

### Abstract

This study was performed within the lower area of the Chesapeake Bay at New Point Comfort in Mathews County. It was designed in order to test the habitability of artificial submerged aquatic vegetation (SAV) when compared to natural grasses found within the bay. Within the past sixty years, a drastic change in underwater vegetation has been noticed within the bay. Restoration programs have been implemented, but eventually fail. This is due to the fact that pollutants and various other factors that are causing the decline in growth are not being taken care of. This study was conducted as an attempt to find an alternative to restoration that would save the species that inhabit these grasses and the economy of the bay. Traps were modified and contained either sand, natural grasses, or the artificial grasses. These traps were left in Chesapeake Bay for a period of one week. Once collected, the species were placed into separate alcohol jars to be counted later. The total count of each trap, species' richness, and different number of species all contribute to the Shannon-Wiener Diversity Index (SWDI). Once the diversity was calculated, an ANOVA and multi-comparison test were run in order to see if the data was significantly different, and where the difference was. The statistics test for the diversity gave a P-value of  $3.589 \times 10^{-3}$ . The tests for the count comparison of the traps gave a P-value of  $7.16 \times 10^{-7}$ . According to this study, the incorporation of artificial grasses in the bay would serve just as well as the natural grasses that are already there. These man-made habitats would insure the stability of the species' populations and therefore the stability of the fishing industries of both Maryland and Virginia that catch a total of 500 million pounds of seafood every year within the bay.

MAR

## **Teen Health Behaviors and GPA: How Smart Are You?**

Libby Scales<sup>G</sup> ★

### **Abstract**

Across America, people are struggling with health complications. Obesity, smoking, alcoholism, and diabetes are becoming more common within in the population, but is there a way to stop it? This project focused on the correlations between different education levels, different Grade Point Averages (GPA), and a set of health parameters. A 19 question survey was produced pertaining to GPA, Body Mass Index (BMI), and other health behaviors. 260 copies were sent to Middlesex High School, the Glenns campus of Chesapeake Bay Governors School, and Longwood University freshmen. The study found a significant positive correlation between the different GPA ranges and health behaviors, but it did not find a significant correlation between the different schools and the health behaviors tested. From the survey, the data supports that the higher the education level and the higher the GPA, the more healthy they are.



## **Optimizing Energy Production: An analysis of sweet sorghum as a solution to the energy crisis**

John Shaw<sup>G</sup>

### **Abstract**

Sorghum bicolor (Sweet Sorghum) is a species of switch-grass native to sub-Saharan Africa and a possible localized solution to the energy crisis. Sweet Sorghum can be grown in arid environments with little to no fertilizers or additives. In addition, Sweet Sorghum juice contains far more sugar than other switch grasses. These characteristics make Sweet Sorghum a strong candidate for ethanol production. An experiment was carried out to determine if Sweet Sorghum could be grown locally. The hypothesis states: Sweet Sorghum can be grown in Middlesex County and is a viable solution the energy crisis. The null hypothesis states: Sweet Sorghum cannot be grown in Middlesex County. To conduct the experiment 6 plots of Sweet Sorghum where planted in a garden. Each plot was provide a different regimen of fertilizer and water. In conclusion, sorghum is a viable localized solution to the energy crisis. Plot number 6 was given no water or fertilizer, yet provided the highest volume of juice.

BOT

## **Simulating Integrated Systems Health Monitoring: The Effect of Friction on the Performance of a 12 V D/C Motor**

Bradley Sisson<sup>BG</sup> ★

### **Abstract**

This study stemmed from an eight-week engineering apprenticeship in the Science and Engineering Apprenticeship Program (SEAP). The task of creating a testbed for evaluating sensor technology was assigned and executed with the fabrication of a small-scale rotating gun turret. Initially, two questions arose: Is Integrated Systems Health Monitoring more effective than manual troubleshooting and how will friction affect the performance of the 12 V D/C motor? Both questions would be evaluated and tested upon in this study, with the first being of greater importance and implications. To do so, a seemingly endless strand of trial and error was used in the construction of the turret. After pre-testing both a 3 V motor and the current draw, it was clearly evident that the motor was not sufficient in the amount of torque and the multimeter showed impossible trends in current draw when friction was added. The motor was then swapped with a 12 V motor with more torque and the multimeter was replaced with a modified bicycle tachometer giving direct RPM readouts. Finally, a delrin bushing was machined to apply friction in increments using a hose clamp. The overall goal is to show how using sensors for troubleshooting is more effective by simulating how they can determine when a system fails to meet requirements and can be repaired in a more timely manner. The system requirement was set at 7.5 RPMs, and the motor was given a series of voltages and friction increments. As friction increased, performance decreased and at 12 V and 14 V, the goal of determining the point of failing to meet requirements was fulfilled. In short, friction has a negative effect on the performance of motors and Integrated Systems Health Monitoring is a more effective method of troubleshooting, saving time, energy, and money.

EGR

## **A Study on the Effect of EMT Calls on Stress Levels of EMS Personnel**

Grace Ellen Smith <sup>W</sup> ★

### **Abstract**

There is a rising concern of the health of our society today. From couch potatoes to hard-working men who rise with the sun and don't stop until the work is done, stress is part of everyone's lives. With stress related health problems on a rise, the research being done on stress management is a major focus of today's healthcare scientists. The increase of stress on employees in the workforce has been highly noticed in the EMS field due to the nature of the work. This project focused on the lifestyle of EMS workers versus their vital signs after five different types of calls – Medical, BLS, Trauma, Cardiac, and Pediatric – found by each EMS personnel completing a survey. Before and after vitals were compared to determine if certain parameters – blood pressure, respirations, or heart rate – may rise or fall due to high stress levels on the call. Results concluded that there was a statistically significant ( $P < 0.05$ ) rise in blood pressure, respirations, and heart rate on the trauma calls. These findings could lead to improvements of CISM (critical incident stress management), the current EMS stress management technique, or possibly the implementation of a new, more efficient stress management technique.

MED

## **Can Music Affect Learning Performance?**

Eric Speray<sup>G</sup>

### **Abstract**

Music is used for therapeutic purposes, entertainment, concentration, attention-grabbing, dramatic effects, and many other ways. Since music affects people in such dramatic ways, there is support for the assumption that music can affect how well a person studies, and theoretically, test scores. Today, American standardized test scores are dramatically lower than most European and many Asian countries. An experiment was produced to test whether the integration of music into studying would improve test scores. The knowledge of the Preamble was calculated. The scores after studying the Preamble were compared against the scores before studying, determining improvement. The primary hypothesis was that the Music Group would have better improvement in their scores than the Non Music Group. The null hypothesis stated that there would be no significant difference between the results. A secondary hypothesis was made, that studying in general would significantly affect test results. This would show significant improvement on test performance due to studying. The null expresses there would be no significant difference in test results before and after studying. After the experiment, a paired t-test assuming equal variance compared initial scores against the scores after studying for both groups. The null hypothesis was not accepted, because it stated that there is no difference in test performance due to presence of music in the studying environment. Both p-values showed that studying had a significant effect on performance, so the secondary null hypothesis was not accepted as well. Studying with music is shown to improve test scores significantly more than studying without music.

PSY

## **The Impact of Glyphosate on the Health of Non-target Submerged Aquatic Vegetation**

Kevin Speray<sup>G</sup>

### **Abstract**

The expected results of this project were that SAV exposed to higher levels of herbicide would fare worse than SAV in environments with less or no herbicide. It was assumed that dead vegetation had a smaller mass than living vegetation because it held less water. Therefore, the difference in masses of the vegetation in water containing the herbicide was expected to be higher than the difference in mass of the control sample. Native SAV were collected, weighed and placed in jars containing water and small amounts of Glyphosate. The ratios of the herbicide to water were one part per thousand, five parts per thousand, and ten parts per thousand. A control was set up that contained SAV in water with no herbicide. At the end of a week, samples were weighed and compared to the initial. At the conclusion of the experiment, the control group of SAV lost a total of 30% total wet weight. A single factor ANOVA was conducted on the percent weight losses of SAV in each trial, resulting in a P-value of 0.0755. This value is higher than 0.05 and therefore the results were not significant. The test groups exposed to the highest level of Glyphosate did not lose more weight than the test groups exposed to the lowest concentration of Glyphosate. Because of this, the hypothesis was rejected; because the experiment shows that Glyphosate will not harm the SAV tested, the herbicide is safe for use in areas immediately adjacent to water containing only SAV.

BOT

**The Role of Southern Oscillation in Augmenting the Abundance of the Skipjack (Katsuo pelamis) and Albacore (Thunnus alalunga) Tunas in the Western Pacific Warm Pool**

Savannah Stuart<sup>BG</sup>

**Abstract**

There is an area in the western Pacific Ocean called the Western Pacific Warm Pool (WPWP) that has been found to greatly affect the abundance of tuna—particularly the Skipjack and Albacore species. This warm pool has sea surface temperatures (SST) of 28° C, the highest to be found of the world's oceans. Because of this, one could assume that this jump in temperature is the cause for the tunas' preference to this area. However, it has also been theorized that the warm pool creates convection currents along the line at which itself and the surrounding cold water converges, and these currents bring about nutrients and phytoplankton from the cold water's upwellings. If this hypothesis were true, the phytoplankton would be the most attractive trait to the tuna, not the temperature change. However, this would only explain the Albacores' attraction to the convergence zone, not the Skipjacks' attraction to waters deep within the warm pool as well as their own attraction to the convergence zone. Therefore, a test to see if temperature alone affects the tuna distribution is necessary. The following study uses data mining of the average Southern Oscillation Index in relation to the catch relative to the ENSO cycle in the areas in which the warm pool shifts as well as in areas that contain a convergence zone that is unaffected by the ENSO cycled to determine if the temperature change has any major effect without the eastward flow of nutrients. It was found that all areas had no significance in the p-value except for in the albacore catch in the western pacific—failing to reject the null hypothesis, but further supporting the hypotheses that the tuna distribution could, in fact, be a result of the nutrient flow.

MAR

## **Optimizing Fertilizer Usage and Reducing Eutrophication in the Chesapeake Bay**

Carlyn Tillage<sup>G</sup> ★

### **Abstract**

Eutrophication is a major problem in the Chesapeake Bay, it causes algal blooms, which block sunlight and decrease oxygen availability. Excess nutrients from fertilizer are transferred to the nearest water system via runoff from farms, home lawns, and gardens, or fertilizer sinks into the groundwater. There is a solution for the nonpoint pollution: amounts of fertilizer should be reduced to match plant needs because roughly 300 million pounds of nitrogen enter the Chesapeake Bay per year, and 38% of nonpoint Nitrogen pollution is from agriculture. The goal of this project is optimizing nutrients for the best economic benefit while reducing nutrient impact on the environment. An 800sq ft. garden plot was designed with different fertilizer concentrations of 0%, 50%, 100%, and 125% based on soil test recommendations, and the dependent variable is the mass of fruit produced per fertilizer concentration plot and the mass of fruit produced per plant per fertilizer concentration plot. The results of this experiment showed that vegetable yield increased directly with an increase in fertilizer,  $r^2=0.984$ . Using the calculated amount of fertilizer did not optimize the vegetable yield, and the 100% fertilizer did, produce the most vegetable yield with little to no phosphorus residue.

BOT

## Competition Between Native (*Vallisneria americana*) and Invasive Aquatic Vegetation (*Elodea canadensis*)

Andrea Walker<sup>W</sup> ★

### Abstract

Hydrilla is a major aquatic invasive species in the Chesapeake Bay. Originally found in Asia and Australia, it is a master of competition and outcompetes native aquatic vegetation. Competition is defined as the act of striving against another or others to attain a goal or the advantage. As of 1950, Hydrilla had started invading coastal parts of the United States and has recently been found as far inland as Indiana; it can be found on every continent, excluding only Antarctica. Thus far, integrated management, which is any combination of physical, administrative, technical, and legal practices used to eradicate an organism, has been the most successful means of control. The purpose of this study was to monitor the effects of competition between an invasive, *Elodea canadensis* and a native, *Vallisneria americana* (Water Celery), aquatic species when they are introduced to each other under natural conditions. Both of these species are found commonly in the bay. This study found that *Elodea* reproduces more rapidly than Water Celery, which gives it a greater total leaf area for photosynthesis. Greater photosynthesis capacity facilitates even greater plant growth and healthiness, causing exponential growth in *Elodea*. The significance of this experiment is that it could lead further research in the right direction of evaluating how invasive species actually compete with their typically less adaptive, native counterparts.

ENV



## **The Effect of Colored Surfaces on Airborne Bacteria Growth**

Lauren Webb <sup>W</sup>

### **Abstract**

People across the world are exposed to bacteria each and every day, be it airborne, waterborne, or blood borne. The rate of bacteria growth is dependent on limiting factors such as light and temperature. Some bacteria species grow in warm, dark places while others do not have this requirement. Many different types of household cleaners have been created to disrupt bacteria growth and disinfect surfaces. But why keep disinfecting a counter top, floor, or other household surface that may be prone to accumulating bacteria fairly quickly? To test this question, four 6 inch x 6 inch colored ceramic tiles (black, brown, grey, and white) were used. Each tile was exposed to the same airborne pathogens and had the same amount of household activity around it. Tiles were swabbed once a month and then swabs were cultured overnight. Resultant bacteria growth was counted as a percent of the petri dish covered with bacteria since some bacteria did not grow in easily countable colonies. This process was repeated for four consecutive months. Data analyzed using a one-way ANOVA indicate that brown and black colored tiles grew significantly ( $P < 0.05$ ) more bacteria than grey and white colored tiles. These results could lead to a rise in awareness towards the harmful bacteria that cause problems for humans. If consumers knew what color surfaces bacteria were most likely to grow on, they could make more informed decisions about their purchases.

CON SCI

## **The Effect of Freezing Yeast (*Saccharomyces cerevisiae*) on its Carbon Dioxide Production.**

Rachael Webb<sup>BG</sup>

### **Abstract**

Yeast is defined as a tiny form of fungi scientists refer to as a "microorganisms". They reproduce through the simple splitting of a cell into two daughter cells (fission). The natural process of yeast growth includes fermentation, which produces useful end products, carbon dioxide and ethyl alcohol, which are released by the yeast cells into the surrounding liquid. The scientific name for one species of yeast is *Saccharomyces cerevisiae*, or sugar-eating fungus. In the project, yeast samples were frozen for a period of time, at the specific increment of time (every week); a sample was thawed and heated to the experimental temperature of 38° C. The amount of Carbon Dioxide (CO<sub>2</sub>) produced during the fermentation process displaced water, and was measured in milliliters. The average amount of CO<sub>2</sub> produced was 26.69 mL and the standard ranged was from 0.57- 40.15 mL. In week six, two samples produced Carbon Dioxide levels higher than the control group. Week eight produced no CO<sub>2</sub>. A P-value of 0.806 indicates that the experiment was insignificant because the amount of CO<sub>2</sub> that was produced stayed within a very small interval of each them no matter how long the samples were frozen. With the data I was given in the Regression statistical test, I failed to reject the null hypotheses. Yeast can be frozen for any amount of time, and produce the same amount of CO<sub>2</sub> during the fermentation process.

ENV

## **Anadromous Fish Return on the Rappahannock River after the Removal of the Embrey Dam**

Joseph W. Young<sup>G</sup>

### **Abstract**

The building of a dam generally has a major impact on fish populations: migrations and other fish movements can be stopped or delayed, the quality, quantity and accessibility of their habitat, which plays an important role in population sustainability, can be affected. In 1910, the 22 ft high Embrey Dam was built along the Rappahannock River in Fredericksburg, Virginia. Since the construction of the dam, anadromous fish populations in the Rappahannock River have plummeted. Anadromous fish live in the ocean but migrate back to freshwater, and depend on the accessibility of the Rappahannock to lay their eggs in the spring. In an effort to revive the American shad and blueback herring populations of the Rappahannock, city officials had a 100 ft section of the dam breached on February 23, 2004. The purpose of the study was to assess the overall success of the breaching of the Embrey Dam on anadromous fish. It was hypothesized that the destruction of the 100 foot section of the dam allowed the anadromous fish population to increase during the spawning season. Over the course of several weeks during the spawning season of shad and herring, fish were caught using shad darts and formatted into a creel survey. The data showed that the anadromous fish population of the Rappahannock was greater before the dam was breached than it was after the dam was breached. A p-value 0.054 showed that there was a significant difference in the anadromous fish population before and after the dam was breached. However, since the population was greater before the dam was breached I could not reject my null hypothesis. In order for anadromous fish populations to increase the problems they face must be eliminated on a global scale rather than a local.

ENV

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# **The Chesapeake Bay Governor's School**

## **Class of 2012**