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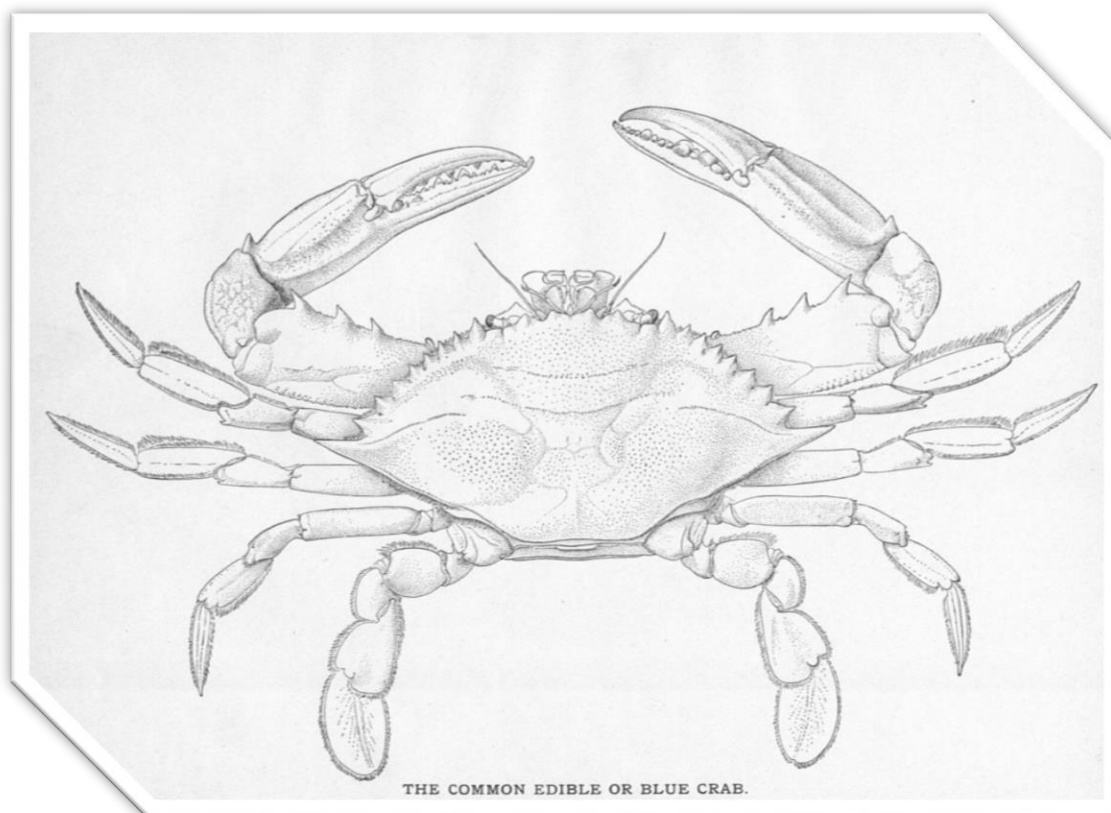
Research

Abstract

Bulletin



**Senior Research Project
Abstracts from the
Chesapeake Bay
Governor's School
Class of 2014**



Volume 3

Spring 2014

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Abstract Symbol Legend

BG = Student from Bowling Green Campus

G = Student from Glenns Campus

W = Student from Warsaw Campus

★ Exemplary Presentation Award at CBGS Science Symposium, March 2014

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 2014. 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.

The Effects of Force on Different widths of Neoprene Foam

Markia Anderson^{BG}

Abstract

Everyday fighters of all backgrounds and traditions are damaged by punishing strikes that can cause many concussions, even while wearing gloves. These challenges cause many issues for those in the professional fighting industry. This experiment is meant to find which thickness of neoprene foam would reduce force impacted. Neoprene foam, the most common form of padding in most MMA gloves, was used to test the hypotheses. The alternative hypothesis stated that as the width of the foam increased the force impacted would decrease. The set-up of the experiment was a stand that dropped 453.59 g weight onto the varying thicknesses of neoprene foam. The results showed that there was a significant difference in the effect of thickness on force registered. This trend line, which had a slope of -1.27, displayed that for every 1.27 cm of thickness increase the force reduced by 2.27989 N. For the p-value of 0.017, there shows that there was a significant difference and the null hypothesis could be rejected. Most concussions occur at force of at least 60 N, thus; the best thickness for prevention of concussions would be to have padding of at least 5.37 cm of thickness, or 2 in.

PHY

LOL: The Effects of Laughter on Stress

Breana Askew^G

Abstract

High School is not the same for teenagers as it used to be. Teenagers struggle daily with the difficulty of juggling school, school clubs, and other extracurricular activities. The amount of stress that they experience is significant. Since stress begins in the brain and affects the major body systems it can take on toll on a person's health (McEwen, 2008). Studies show that laughter serves as a tranquilizer for people. This project determines the effects of laughter on stressed students. Laughter is known to cause tissues that form the inner lining of blood vessels to dilate to increase blood flow. To test this, changes in student body temperature were measured. The hypothesis states that "If the students are experiencing stress and are introduced to a comedic video, they will show a physiological change of reduced stress. The Null hypothesis is that "if students are experiencing stress and watch a comedic video then they will not show a physiological change. There was a change that occurred in each trial for every class but the results varied from class to class on how the effects laughter had on a person's stress levels. After completing each trial for each grade of Chesapeake Bay Governor's School Glenns Campus the data was separated into categories based on gender. To analyze and understand the data a t-test was taken. There was no correlation between laughter and stress but the students did show some change. The tests were taken in the beginning of the school year so that could have been a factor of the anxiety they felt. A little laugh here and there can still make a physiological change for a person, so they are not over consumed with stress. The Null hypothesis was approved and the hypothesis was disproved.

MED

The Common Marsh Periwinkle *Littorina irrorata* Migration through the Marsh

Paige Augst^w ★

Abstract

Previous studies have been conducted in reference to the common marsh periwinkles' (*Littorina irrorata*) migrations through the marsh cord grass *Spartina alterniflora* in the Atlantic and Gulf coasts. A quadrat and transect system had been used in this experiment to measure the snails' movements on the shoreline. This research was conducted at Big Fleet Pond, Fletton, VA saltwater marsh and the quadrat was used to section off a piece of the marsh. The periwinkles found in the quadrat were counted, measured with calipers, and tagged with a permanent marker. Each quadrat had a certain color coded marker so the movements of the snails can be followed more accurately. This experiment also incorporated the lunar and tidal cycles. These cycles gave a better explanation on the periwinkles' movements through the marsh. At high tide the periwinkles climbed the stalks of the marsh cord grass, then at low tide they go back down closer to the substrate. Snails that were larger than 0.5 were mainly found in the high marsh zone, and those that were smaller than 0.5 were primarily in the low marsh.

ZOO

Psychometric Graphometry

Autumn Barrick ^G

Abstract

In recent years, mass shootings have become more frequent. If parents, teachers, and mentors of children and teenagers were taught the skill of handwriting analysis, juveniles could be monitored throughout their developing years for the Big Five personality traits. The idea for this experiment is to introduce a simple way to analyze handwriting repeatedly in order to determine if a child will become violent because of psychological issues that have been left unaddressed. To conduct this experiment, participants were surveyed based on the Big Five personality traits and their natural handwriting techniques. Analysis of the handwriting samples included looking at the shape of individual letters, measuring the average size of uppercase versus lowercase letters, measuring the degree of the slant of the letters to the left or right, and drawing in lines with a straightedge to determine whether or not participants were able to write in a straight line without a preset line guiding them, and they were asked to take a personality survey. In attempting to determine if handwriting is a reliable source to predict personality characteristics in a person, a p-value of 0.9 was found, indicating that the data collected holds no statistical significance. Nevertheless, examination of the graph created from the data collected in this study showed participants whose scores were on the lower end of the personality spectrum (from a 0 to a 3) were more likely to match on stated personality traits and those that were pulled from their handwriting characteristics. Analysis of personality traits versus handwriting characteristics could still be proven useful in determining if an individual is lower on the personality spectrum than others may be and if they need to be monitored to see how their personality progresses throughout their development.

PSY

The Effects of Site Location on Fish Species

Lee Beale^{BG}

Abstract

Creeks and streams near the eastern shore of Virginia are impacted by human growth and structures. This is causing populations and the diversity of fishes to decline. Here is an overview of a study examining longitudinal trends as a small stream moves closer to a populated area looking specifically at how fish diversity changes. Five sites were used in the study and at each site fish were caught, identified and released. The results that site location would have an effect of fishes diversity was not statistically significant because a p-value > 0.05 . A trend appeared where the sites that had more aquatic plants were the sites that also had the most species and a higher abundance of fish. This did not correlate with being close or far from the populated area. Concluding that the proximity to urban areas does not affect the diversity of fish but rather the condition of the habitat, specifically the amount of plants in the water column.

ENV

The Comparison and Analyzation of the Behavioral Movements and Paths of Tagged Great White Sharks (*Carcharodon carcharias*)

Hallie Berger ^W

Abstract

For this study data was collected from the Ocearch Team, which is an organization that collects data on Great White Sharks by tagging them and tracking them. The objective of this project is to interpret Ocearch's data, and study the sharks' paths they take and distances traveled based on gender, age, and location. The study of the amount of times they break the surface, "ping-in," will also be studied to analyze the frequencies of each group. This will be important to help us analyze the differences between the genders, ages, and locations. The distances travelled by the sharks will also be analyzed to compare each aspect of the sharks and if there is a significant different. Great Whites are greatly unknown so this study will hopefully help the public and future studies on this predator understand the significance and importance of the Great White in the oceans, also allowing the public to recognize the behaviors of these creatures to know where they may be heading during certain times of the year.

This study is comparing the distances travelled by Great White Sharks and also comparing the frequency of the sharks breaking the surface to determine if there is a significant path travelled by each shark groups: gender, age, and location. The results show, statistically, that most of the comparisons are not significant with p-values of more than .05. However, the graphs that are shown show full expression of true shark movement with each comparison of groups.

MAR

The effects of temperature and humidity on strikeout rate of pitchers

Timothy Blanton ^{BG}

Abstract

No studies have been conducted on temperature and humidity affecting the strikeout rates. Previous studies have mostly been conducted on shoulder or elbow injuries. Studies have been done on the effects of pitch count on injuries of pitcher. This study tests temperature and humidity on strikeout rates of major league baseball pitchers. For this study statistics from ESPN, and weather underground were gathered. The data found was for date, location, strikeouts, pitch count, time, temperature at the beginning of the game, temperature at the end of the end of the game, humidity at the beginning of the game, and humidity at the end of the game. For temperature the average was 21.0655 degrees Celsius. The average humidity was 64.4528 percent. The average strike out rate was 0.0624 strikeouts per pitch. After running multiple linear regressions it was found temperature and humidity do not have an effect on strikeout rate. After further testing pitch count does have and affect on the strikeout rate.

PHY

It's All Downhill From Here: The Effect of Different Erosion Controls on Runoff

Rebecca Bohlmann^{BG}

Abstract

Non-point source pollution is a major cause of eutrophication and decreased water quality in waterways. Sediments and nutrients are washed from land, causing dead zones, pollution, and cloudy water, consequently causing organisms in the water column to die. This study was conducted to simulate, measure, and evaluate the effect of different erosion controls on runoff. A lawn was simulated on three raised platforms, divided into lanes and equipped with sprinklers, topsoil, and sod. Five common erosion controls were implemented to determine their effects on the quality of runoff: a control of only sod (uncovered lawn), bare earth, mulch, pea gravel, and a buffer of pansies. One erosion control was placed at the bottom of each lane. Runoff was collected in containers at the end of each lane. The volume of the runoff was measured, as was the turbidity, and the concentration of nitrate and phosphate. Using a one-way ANOVA to evaluate each set of data, a p-value of less than 0.05 was received for the relationships between erosion controls and volume of runoff, turbidity of runoff, and the concentration of phosphate within the runoff. Therefore, the null hypotheses for volume of runoff, turbidity of runoff, and the concentration of phosphate within the runoff were rejected. When regarding the concentration of nitrate within the runoff in relationship to the different erosion controls, a p-value of greater than 0.05 was received, thus failing to reject the null hypothesis. After evaluations of the observations and data recorded throughout the study, it was concluded that erosion controls do have an effect on runoff. Mulch was determined to be the most effective erosion control from the study, as it absorbed volume and nutrients, as well as retained sediments.

ENV

The Effects of Time and Wash on Bacterial Growth on Lettuce

Hailey Bowler ^{BG}

Abstract

Lettuce is exposed to bacteria through growth, processing, shipping, and exposure. Over time bacteria will grow and change. Companies wash bagged lettuce for extending the length of freshness before the bag is opened. This study shows the effects of type of wash and exposure time on bacterial growth on lettuce. It was designed to help specify the optimal conditions for lettuce usage. It was conducted over 5 days using nutrient agar dishes to gather data. The average amount of bacterial growth on prewashed lettuce was overall lower than the amount of bacterial growth over five days. The averages of percent coverage of the agar plates ranged from 6.5% to 10.01% in bacterial plate coverage for washed lettuce and 6.7% to 28.95% of coverage on unwashed plates. There was a significant effect of the type of wash and exposure time on the amount of bacterial growth on lettuce. It was better to use washed lettuce within the first three days of opening the bag. It was better to use unwashed lettuce the third day after exposure.

CON SCI

Study on the Physical and Behavioral Effects of Electronic Radiation on Certain Insect Species

Tyler Brooks and Christian Blue ^W

Abstract

In the late 1900s, the expanding abundance of electronic-signal emitting devices gave rise to concerns over whether or not these signals were environmentally safe. Numerous scientific studies were conducted, ultimately coming to the conclusion that regulations must be placed on emissions so as not to cause harm to the surrounding environment or its organisms. This prompted the Federal Communications Commission to create a series of guidelines in an attempt to keep the strength of electronic emissions at levels deemed safe. However, there is still substantial evidence that suggests that even low-level electronic emissions can have adverse effects on biological systems. Electronic emissions have been proven to cause biological distress ranging from mild nausea to cellular damage, and have been theorized to be a main cause of the phenomenon of Colony Collapse Disorder, in which several species of insects have mysteriously began to die off or vanish entirely. This study was meant to provide some evidence in support of these theories, by exposing a common species of ant, *Pogonomyrmex occidentalis*, to various forms of common electronic emissions, and noting the physical and behavioral effects of the emissions on the test subjects. Five ant colonies, with two being exposed to normal signal emissions from a small cell phone, two exposed to signal from a home Wi-Fi router, and one control exposed to only normal background radiation, were observed for five days, with multiple trials being conducted for accuracy. The average number of ants in each of three transects within the colony were noted, converted to percentages, compared to the control. Ultimately, based on the p-values calculated from a two-way ANOVA test, it can be concluded that yes, the radiation does have an effect within the treatments, albeit not in a clear, observable way. ZOO

Cloudy with a Chance of Murder: Environmental Influences on Criminal Behavior

Emily Brown ^G ★

Abstract

In a world of crime, criminal behavior based on psychology as affected by weather has been frequently questioned. Western societies have long hypothesized that environmental factors, such as monthly trends of seasons, heat waves, storms, and lunar cycles have influence on the frequency of criminal acts. Using police and weather data from cities along the East Coast of the United States, this study examined these relationships. Statistically, this study showed a link between crime and monthly trends, but no link between crime and heat waves, crime and major storms, and crime and strong lunar phases. If this study were to re-examine those relationships yielding no statistical significance, there would need to be a larger dataset gathered to increase the statistical power of the numerical values being analyzed. Yet based on the results of this research, municipal police departments can still take all these trends into account when making decisions as to how to allocate manpower, when to cut back on staffing for officer leave and when to be particularly vigilant for spikes in criminal activity related to the environment.

ENV

The Flow of Life and Death

Nick Brown and Jay Jims

Abstract

In this study fish were placed in ten separate boxes. Each of these boxes were made out of clear plastic. Holes were drilled in at the bottom of each box in each corner and side to allow rain water to drain out of the box. One fish (croaker) was then placed into each box. A thin piece sheet of wire was then placed over top of the box and then clamped onto the top of the box with zip ties. The sheet of metal was intended to prevent larger mammals from reaching the fish and carrying them off. Five boxes were placed in a wooden environment (spaced evenly apart), the other 5 were placed in a wetland environment (also spaced evenly apart). The boxes were placed into holes with the top of the box exposed. Every box was then staked down to the ground to prevent any sort of disturbance due to larger mammals. Every week one box will be removed from each area. The metal sheets were removed and the contents of the box were scraped into a trash bag. The trash bags were then placed into a freezer to freeze the bugs for examination. They remained in the freezer for a full week. The contents were then taken out of the freezer and sorted through, picking out every type of bug found. The insects were then separated by the type of insect and counted. We hope to find a difference in the diversity of insects at each site. We are also seeing if a slight difference in elevation will have an effect on the insect diversity.

ENV

The Effects of the Environment on the Decomposition Rates of Plant Matter

Milan Bullock ^W

Abstract

This study compared the effects of soil temperature on the decomposition rates of bananas. Each individual sample was placed in 3 different conditions to determine which conditions provided the fastest decomposition rate (lowest percentage of mass left from starting week). Temperature was the independent variable for the experiment. The container type, type of soil, type of plant, and time for each trial were the constants of the experiment. The three various conditions included; a refrigerator (cold temp), deck outside (moderate temp), and container inside with a powerful light over the samples (high temp). The samples were weighed and placed in containers with the same amount and type of soil. From that point, samples were visited once every week. During each visit, the sample of each banana was taken out and the mass was recorded using a triple beam balance (grams). The samples were then placed back in their soil samples and not visited again until the same day of the next week.

Colder temperatures showed to have the high percentage of mass left from the original which meant that the decomposition rates were the slowest. The hotter temperatures had a very low percentage of mass left from the original which meant that the decomposition rates were very high. The p-value found was 0.080992 which proved to be insignificant because it was not less than .05. Therefore, the alternative hypothesis was not supported and the null hypothesis was supported.

ENV

Ready, Set, Recycle!

Emily Camlin ^W

Abstract

In recent years, the various nations of the world have not only been working on more technologically-advanced ways to conserve and recycle, but also have been studying methods on how to go about the processes and encourage people to participate. As the world grows more limited with its resources each and every day, there must be a source of control and recycling motivation. There must be something that will keep people willing and motivated to be cautious of this concept. Previous studies have shown that there are, in fact, multiple influential factors involved, especially involving convenience and awareness. Set in a high school, this project attempted to measure the accuracy of previously-stated conclusions, and was followed through in individual rooms. With the addition of bins for recyclable material and an increased amount of publicity on the subject, supporting results were acquired. Steep increases in recycled waste occurred among the different experimental sectors (eventually leading to a 9-week period of having over 80% of total waste recycled) and surveys showed that more people became educated and involved in the matter. A small study such as this could provide an example for a project on a larger-scale, perhaps involving a whole town, county, or state.

PSY

The Effects of Pesticide Runoff on Water Quality

Ruby Campos ^{BG}

Abstract

As population growth continues at massive scale the utilization of farms has led to great degradation of quality of water from runoff from agricultural areas. Runoff from pesticides has played a large part in the downgrade of water quality over time. Organic and conventional are the two major categories of pesticides. While organic pesticides are made of natural substances, used to prevent chemical harm to plants and soil, conventional pesticides are comprised of chemicals that are mainly focused on eliminating and controlling pests. The experiment was carried out to observe which pesticide runoff has a less harmful effect on overall water quality. Two farm models were created to represent an organic and conventional farm, where water samples were taken daily from each of the water sources where the pesticides would runoff to, over the course of about a month. After water samples were collected, testing kits were used to find the levels of dissolved oxygen, pH, nitrogen, and phosphorus. Paired T-Tests were then carried out to observe the significance of the data collected. From the results, it was unable to be determined which pesticide has an overall less harmful effect on water quality.

ENV

Running Off: The Effect of Erosion on Embedded Objects

Neal Carter ^{BG}

Abstract

The destruction of bridges has been a problem throughout the entire world. Some bridges have been claimed faulty before anything fatal happened and have been destroyed. Others have collapsed, ending numerous undeserving lives. Many bridges are surrounded by sand, so this influenced the test of seeing whether sand eroded bridges and caused them to be faulty. In this experiment, a log was used to simulate a bridge. Sand samples were taken from various spots both before and after the log. If there were finer sand grain particles further along the embedded object (Particles less than 60 μm), then the sand was eroded across. Once the samples were collected, they were put through a sand sieve and weighed separately. After the experiment, the trend was that before the log that there was no significant difference in sand grain size ($p = >.1$). After the log, however, the sand grain sizes gradually increased ($p = <.05$). The null hypotheses was rejected, but in a trend that was opposite of the alternative hypothesis. It was concluded that while bridges are not affected by erosion, burrowing animals are better suited before embedded objects where sand grains are finer.

EGR

Phragmites-Be-Gone!

Shane Chambers ^W

Abstract

A growing problem in the United States is the presence of *Phragmites australis*, an invasive species of reed that originated in Europe. This plant has been found to be able to reproduce sexually both in water (the organism has rhizomes that break off and reproduce aequously) and through wind currents (the plant's seeds are picked up and carried by gusts of wind). Without a clear, definite method of Phragmites removal that doesn't significantly harm the environment around it, a solution to this Phragmites problem is needed. This study proposes that five testing sites, each four square meters in size, be infested with *Phragmites Australis*. These testing sites are all to be within one acre, so that recording the Phragmite's conditions and making the necessary alterations to the species is manageable. For each different testing site, a different method of removal will be tested (burning, burning with gasoline, cutting the plant at knee height, restricting sunlight, and herbicides). After testing the subjects for 3 months, at a frequency of 1 days per week (recording each treatment date and other observations) the data were analyzed to determine if any treatment was effective in terms of ridding the site of Phragmites and maintaining healthy soil quality. A significant P-value of .00024 was obtained with respect to shoot density. This value helped me conclude that the best treatment with respect to shoot density was burning the treatment with gasoline. Soil quality measurements were taken immediately before and after the experiment was conducted and tested for nitrogen levels, phosphate levels, and pH, and these data were analyzed and compared, and the treatment that was deemed effective that also had low soil quality variation from the control was the treatment where the organisms were covered.

ENV

Barnacles Be-Gone! A Comparison of Environmentally Friendly Anti-Fouling Alternatives

Ronnie Cutler and John DeGaetani ^W ★

Abstract

Five newly developed environmentally-friendly treatments were researched and obtained for effectiveness testing against a control and one another on Pinewood and PVC substrates.

Barnacles settling onto boats, ships, piping, and many other submerged surfaces have many harmful practical consequences. In addition, the bioaccumulation of popular but toxic copper fouling technologies is posing a threat on marine life and the ecosystem. The target species seeking prevention, barnacles in the Chesapeake bay (*Balanus improvisus* & *Balanus subalbidus*), was shown to be inhibited effectively (zero settlement) by an ivermectin compound treatment and medetomidine treatment on both substrates. The other three treatments, ultrasonic sound waves, capcaisin, and a fungus extract from *Cladosporium sp.* showed variable effectiveness on both substrates.

MAR

Organism Effect on Overall Eastern Oyster (*Crassotrea virginica*) Health in the Potomac River

Zoë Davis ^W

Abstract

Crassotrea virginica, or more commonly known as the Eastern Oyster, is a staple of seafood caught by in the Potomac River by the watermen who inhabit the area. The oysters act as a filtering system to the river, cleaning out the sediments through their suspension system of feeding. In order to get the “best catch”, that is the oysters with the most meat, but still maintain the health of the river, watermen must be careful about which oysters to harvest. The factor that was tested in this experiment to see if it had any correlation to the meat weight inside the shell was the number of fouling organisms growing on the outside of the oyster’s shell.

To carry out this experiment, four groups of twelve oysters were retrieved from the Potomac River and measured by length and width, both in centimeters. Once measured, the number of fouling organisms attached to the shell was found. The oysters were then opened and their meat was weighed on a triple beam balanced, wet, in grams. All data was recorded and put into an excel chart, where a correlation graph was made comparing length versus weight and width versus weight, respectively. A linear regression test was run comparing the respective aspects, showing that length versus weight had a P-Value of 0.24 and that width versus weight had a P-Value of 0.03. Based on the P-Values, it is suggested that the width of the oysters will have an effect on the weight of the meat, but the length will not. Watermen can use this information to modify how they catch the Easter Oyster, looking more at width than length and not worrying at all about the number of fouling organisms attached to the shell of the oyster.

MAR

Help or Hurt: How Temperature Affects the Growth of Kudzu (*Pueraria lobata*)

Chiquita DeJesus^W ★

Abstract

In the late 19th century and early 20th century kudzu (*Pueraria lobata*) was introduced to the southern United States from Southeast Asia for multiple reasons including decoration and erosion control. However, it was soon realized that kudzu wasn't particularly adept for those things and became a highly invasive weed. It's a very resistant weed and very difficult to get rid of once it's been established in an area. While kudzu has begun to creep north, it's very predominate in the south and continues to present major problems. One thought as to why it's so much more prevalent in the South than in the North is the warmer temperatures. This hypothesis has been proven correct in other places where kudzu has planted itself, specifically in the places in the South where it was introduced. Testing of this hypothesis was done by starting with the same amount of kudzu in temperature-controlled areas and the height of experimental plants was taken regularly to monitor growth under different temperatures. This growth was compared that of the Virginia Creeper (*Parthenocissus quinquefolia*), a native Virginia vine that is known for being very problematic. This study aims to show that kudzu does, in fact, thrive in warmer temperatures and can outcompete even native species. Also that the colder weather can be used to the advantage of places and people trying to eradicate the infectious weed in conjunction with other tactics at getting rid of it. This study would only prove effective in areas where there is a seasonal temperature change does occur and is significant enough to make a difference. The study showed that kudzu did grow faster than Virginia creeper, but that Virginia creeper sustained itself longer under the colder temperatures.

BOT

Food for the Future? The Practicality and Feasibility of Aquaponics in Virginia

William Royall Drumheller, Jr. ^G

Abstract

Modern fossil fuel agriculture systems are large contributors to greenhouse gasses in the atmosphere. Aquaponics systems have the potential to offer numerous advantages in terms of efficient food production, while reducing such greenhouse gas emissions. This study tests the alternative of aquaponics as a cost effective and environmentally sustainable system for food production in Virginia. In this study, 12 juvenile Channel Catfish, *Ictalurus punctatus*, were grown in an aquaponic system with tomatoes, radishes, cucumbers, squash, rosemary, basil, lettuce, and green onion and their edible masses were measured. Costs were also recorded for materials and maintenance and factored into the efficiency rating of the system. There was a positive net yield in the market value of vegetables for the months of June, July, and August; however in September and October, the yield market value of the vegetables did not exceed the cost of operation. Therefore, there was a 3% gain financially due to a total electrical operating cost of \$31.90 and a higher total crop yield value of \$32.95. Based on these results, aquaponics was found to be a cost effective food production source. With further experimental attempts, aquaponics has the potential to become even more efficient and yield greater mass value, thus exceeding operating costs by a greater margin. Included in these more efficient practices would be taking advantage of warmer climate during earlier spring and summer months to maximize growth and yield while also reducing electrical maintenance costs.

ENV

The Effects of Climate Change on *Lycopersicon esculentum* Yield

Sarah Eacho^{BG} ★

Abstract

Plants rely on a particular climate, the specific conditions of temperature, precipitation, and sunlight during an extended period of time, in which to grow and produce optimal fruit. Conditions must be optimal in order to obtain full production; however, the weather is always changing and is becoming less optimal for some plants due to climate change. Climate change affects the temperature and rainfall in a given environment. Current climate change models predict increased temperature and decreased rainfall. Because temperature and rainfall are main factors in level of production, it is important to discover how a potential change in climate will affect production. This is even more necessary due to the reliance on agriculture for food and economic stability. In order to test the effects of climate change on plant production, the environment of the tomato *Lycopersicon esculentum* was manipulated to represent climate change conditions in 2050. These conditions consisted of increased temperature and decreased rainfall. A foliar nutritional fertilizer, Awaken, was also applied as a way to determine if the negative impacts of climate change could be countered. As temperature increased, production decreased and as water amount decreased, production also decreased. Plants receiving higher temperatures produced 138 tomatoes with a total mass of 16,229.8 grams less than plants receiving current Virginia temperatures. Plants receiving less water produced 26 tomatoes with a total mass of 7,611.71 grams less than plants receiving optimal water amounts. Plants receiving Awaken produced 26 tomatoes with a total mass of 2,565.6 grams more than plants that did not receive Awaken. A p-value was found that suggested a significant difference between the levels of water amount and yield. This suggested that water amount had an impact of tomato yield.

BOT

Effect of rainwater acidities on the growth rate and electrical properties of cherry tomato plants (*Solanum lycopersicum* var. *cerasiforme*)

India Eguiguren ^w ★

Abstract

The sources of elements that cause acidity in the atmosphere are numerous. Sulfur dioxide and nitrogen oxides—both very soluble in water—are gases that are two of the main contributors. Power plants, factories, volcanoes, and automobiles are some of the known emitters of these gases. Acid deposition is created when these pollutants are dissolved by water droplets or fall directly to the earth. Besides being detrimental to human health (especially dry deposition, which causes respiratory problems when inhaled), acid rain has a negative effect on the environment as a whole. In this study, the effect of acidic water on sun-gold cherry-tomato plants was investigated. The plants were irrigated with a water pH of either 3.5, 5.0, 6.5, or 8.0, and their growth rate and total fruit yield were recorded. Additionally, the electrical resistance and conductivity of each plant's stem was measured in the hope of finding a correlation between taking in acidic water and the electrical signaling taking place from cell to cell within the plant stems.

The average height of plants receiving more acidic water was slightly higher than of those in the other groups. Tomato yield was highest for plants in the group receiving less acidic water (pH 6.5, equivalent to rainwater). However, the results of the electrical tests varied greatly and appeared to follow no obvious trend, and none of the statistical tests done on the collected data provided evidence that the tomato plants were negatively affected by varying acidities in irrigation water.

BOT

The Secret Life of Bees: The Future of Pollinator Habitat Restoration and Agriculture

Laura Ellis ^w ★

Abstract

Although the North American honeybee, *Apis mellifera*, continues to decline, no effective population restoration strategy exists, causing scientists to research the original habitat of the six-legged creatures. Since agriculture and honeybees have been linked for centuries, the U.S. Department of Agriculture emphasizes enhancing hedgerows, strips of vegetation between fields that are known to house and attract bees, as a viable strategy. The woody vegetation, herbaceous wildlife, and flowering plants that comprise a hedgerow acts as habitat and food for pollinators, as well as riparian buffers that stabilize soil, buffer nutrient runoff, and cool surface water temperatures. This study aimed to pilot the effectiveness of three proposed hedgerow alterations—brush piles, additional native plantings, and natural independence -- on restoring native and domesticated bee populations and insect biodiversity. The cost effectiveness of each alteration was compared between the three treatments. Bee populations, determined using pan traps, served as an indicator of pollinator abundance, while the location of the traps served to quantify population distribution. Trends in this study are seen that indicate planted hedgerows attract the most bees, while brush hedgerows increase insect biodiversity. In reference to spatial distribution, unaltered hedgerows showed uniform distribution at each location, brush hedgerows concentrated at the outer field perimeter, and planted hedgerows concentrated at the inner hedgerow. Widespread implementation remains the only way to see notable health differences in the Bay and insect populations. Thus, it remains important to recognize brush hedgerows as the most cost-effective, both improving bee population and insect biodiversity without any additional cost to farmers.

ENV

Bioremediation: Hydrocarbon Degradation in the Lower Chesapeake Bay

Kristen Fauber^G

Abstract

Bioremediation is using the native microbial populations found in the sediments of local areas to biodegrade the oil. This study set out to observe if bioremediation and the combined abiotic and biotic environmental factors could biodegrade petroleum hydrocarbons in the lower Chesapeake Bay. The sites that were selected for this research were: a coastal site on the York River in York County, and a salt marsh in New Point in Mathews County. These two sites were chosen because of their proximity to a major oil refinery depot, making them highly susceptible to an oil spill.

Three 1L containers were filled with 500 mL of sediment from the intertidal zones of Yorktown Beach at Yorktown and New Point marsh nature preserve in Mathews; a Control treatment was made of sterilized Quikrete Play Sand. 100 mL of 10W30 motor oil was poured on top of the each treatment and the control. The treatment samples were left outdoors in an open air environment in the summer and winter seasons for 5 weeks and observations were made weekly. From the summer treatments, the Yorktown site had degraded the most oil, up to 1.6 mL. In the winter treatments the Yorktown site had, again, degraded the most oil, up to 26 mL. There was no difference in the amount of oil degradation between the New Point site and the Control with respect to both the summer and winter treatments. In the event of a major oil spill on the York River, the best option to clean the environment would be to let the native bacteria in the Yorktown sediments biodegrade the sediments. However, in the event of an oil spill in the New Point marsh, it would not be best to let the native microbes try to degrade the hydrocarbons because they does not have capabilities to rid itself of hydrocarbons.

ENV

The effect of Moonlight on the Catch Rate of the American Eel

James Ficklin ^W

Abstract

The North American eel (*Anguilla rostrata*), spends most of its life in the Chesapeake Bay and its tributaries, migrating to the Sargasso Sea to mate and spawn. It is a valuable resource for local fisherman to harvest, but the market is often limited. Most buyers will only buy certain times of the month, or a certain number of times per month. So it would be valuable information for watermen to know when it would be most profitable to harvest eels. The rumor among them is that the best time to set eel pots is when the moon is at its darkest, or during a dark night. This study attempted to determine if eel harvests vary over several complete lunar cycles. This was done by setting multiple eel pots out in multiple locations for two months, checking them every day and recording the amount of eels inside. Then data was received from NOAA that provided information about the cloud coverage for those days, and that data was then multiplied by the percent the moon was visible, to give an accurate amount of light for those nights. This data was then graphed with the amount of eels and tested with a linear regression. The tests came back as insignificant, but the graphs tended to indicate that this was because of a lack of data, and that had more data been collected, the results would likely have been different. However, graphical it was shown moon phase is not as related as overall moon light that hits the water. Thus, one important conclusion that can be made from this study is that the catch rate of eels is influenced by several factors, not just moon phase.

MAR

A Field Study on the Effects of Water Parameters on a Largemouth Bass Population in Relation to Physical Defects

Paul France ^W

Abstract

This study proposed to investigate the relationships between physical abnormalities of the largemouth bass (*Micropterus salmoides*) and its environment. The research was conducted through a series of experimental trips to a pond that has a population of largemouth bass via a small aluminum boat in three different areas of that pond. These tests were conducted on the water parameters of dissolved oxygen, turbidity, temperature, and pH. In addition to these tests, observations were recorded of largemouth bass caught via hook and line in these spots and physical abnormalities exhibited by them were recorded. Data was then analyzed in accordance to each successive month of testing to determine if the largemouth bass exhibited physical abnormalities more frequently throughout the tested months in relation to the changing water quality parameters of those months. It was concluded that the stratification of the water column, noting more extreme parameters and unfavorable conditions, is related to the decline in health of the largemouth bass population.

ENV

The Effects of Open and Closed Systems on the Mortality of Soft-Shell Crabs

Kate French ^W★

Abstract

Blue crabs (*Callinectes sapidus*) are a popular source of revenue within Virginia. Soft crabs, which are blue crabs in the process of shedding their exoskeletons, often experience mortality when they shed in stressful environments, making it crucial for crabbers to have controlled floats for them to shed in. The two most commonly used crab shedding systems are open and closed. Open systems pump water from a water source and are subject to weather conditions, while closed systems continuously pump the same water throughout, and water quality parameters are in a more controlled environment. In this study, data on the crab mortality in open and closed shedding systems was collected. With a p-value of 0.9523, there was no significant data collected that proved there was a difference between mortality within the open and closed systems. However, there was a significance among the number of days a crab was in a system and its mortality. There was also a significant difference of nutrient levels between the open and closed systems. By comparing the number of deaths of the crabs within each system, one can predict which system provides a better environment for soft shell crabs to survive. Lower mortality ultimately leads to higher profits for the watermen involved.

MAR

The Effects of Concentrations Silver Nanoparticles and Bleach on Bacterial Yield

Andrea Gayle ^{BG} ★

Abstract

Silver nanoparticles are non-toxic particles that control bacterial growth, can be used as an effective bactericidal material, and have increased in demand in various health industries. They are incorporated into various wound dressings and sprays to assist in proper sanitization and healing. Household bleach also assists in these areas but can bring about many harmful health effects that can cause respiratory problems if inhaled, and burns in the gastrointestinal tract if ingested. The purpose of this study is to locate an acceptable standard of bactericidal material that is safe and effective for use in the health industry that replaces common household bleach. The study was conducted by applying three concentrations of colloidal silver and bleach onto agar plates and measuring percent coverage of bacteria remaining on the plate. All controls, positive and negative, produced results of which were intended; which had no bacteria growth for negative controls, and significant growth for positive controls. For the concentrations of colloidal silver in addition to supernatant, the highest concentration of colloidal silver had an average bacterial surface area of 16.32% and a standard deviation of 34.04, and the lowest concentration of colloidal silver had an average surface area of 5.06% and a standard deviation of 7.56. With the addition of supernatant to bleach, the highest concentration of bleach had an average surface area of .24% and a standard deviation of .53, and the lowest concentration of bleach had an average surface area of 1.44% and a standard deviation of 1.99. The statistical test conducted suggested that there was no significant difference between colloidal silver and bleach or the three concentrations on bacterial yield. Therefore, because there were signs of inhibition from colloidal silver, it may be considered a substitute for bleach in various health industries.

MED

Can a Small Aquaponics System Achieve Sustainability In Virginia?

Matthew Geiger^G

Abstract

Aquaponics is a system of using fish waste to fertilize hydroponic plants, and the plants, in turn filter out the water for the fish. This study used the Virginia resident Channel catfish, *Ictalurus punctatus*, and lettuce, *Lactuca sativa*, in a Nutrient Film Technique (NFT) Aquaponics system. According to *Aquaponics: Protein and vegetables for developing countries*, a study by Nichols, an NFT system utilizes plastic tubing to support the plants' root system while nutrient saturated water pours over it and flows back to the tank. The catfish were fed a daily mix of night crawlers and catfish bottom feeder pellets; on October 19, lettuce was introduced. As of November 24, 3 catfish and 7 goldfish of the 7 catfish and 8 goldfish remain. None of these fish were harvestable or suitable for consumption. Aquaponics may lessen hunger in areas with a warmer climate.

BOT

The Effect of Lavender Aromatherapy on Equine Heart Rate Spikes

Grace Grossen^{BG} ★

Abstract

This study aimed to determine the effect of different concentrations of lavender on the equine spike in heart rate in order to explore using lavender as an aid to equine weight loss problems due to stress. Three different concentrations of lavender essential oil were each applied before a stressor to thirteen different horses. The results and additional observations indicated that using lavender before a stressor (loud noise) would decrease the horse's heart rate spike by 10.5 bpm compared to the control, but would not necessarily affect the larger spooked behaviors, such as tensing, head tossing, jumping to the side, or turning about to face the noise. The linear regression test on the heart rate spike data yielded a p-value of 0.0253, so the null hypothesis that there would be no difference in heart rate change based on different concentrations of lavender was rejected. Observations of equine behavior led to the conclusion that lavender would serve the purpose of an addition to a weight gain plan for a stressed horse better than as a safety precaution for a skittish horse, especially because the lavender treatment had the largest effect on specific breeds such as Thoroughbreds that are both the most susceptible to the weight loss and stress issues and most known for skittish or jumpy behavior as a result.

ZOO

The Effect of pH Change on the Oxygen Demand of Grass Shrimp,

Palaemonetes pugio

April Gutmann ^W

Abstract

Grass shrimp, *Palaemonetes pugio*, are well known for their use as an indicator of water quality and health in bodies of water along the East Coast of the United States. Without knowing the physiological traits of these shrimp including what pH levels they can tolerate, we cannot protect these vital water quality indicators of Chesapeake Bay and its tributaries. This study tested the variable pH by measuring the gradual use of dissolved oxygen by the grass shrimp using a dissolved oxygen probe. The Respiration Rate of the shrimp was then calculated, and can be used as an indicator for physical stress experienced by organisms. Grass shrimp were equilibrated to the various pH levels and dissolved oxygen use over time was determined. The grass shrimp were found to have the highest respiration rate over time at a pH of 5.

ZOO

Comparison of the Eastern Oyster (*Crassostrea virginica*), Ribbed mussel (*Geukensia demissa*), and Hard Shell Clam (*Mercenaria mercenaria*) filtration rates at varying pH levels

John Hemenway ^W ★

Abstract

In recent years dozens of federal, state and private organizations have attempted to “restore” the Chesapeake Bay to its former state. Combined, these efforts cost taxpayers billions of dollars each year. Many times the focus of restoration is on oysters as the most effective way to start a ripple effect in cleaning up the ecosystem. As oysters increase in biomass, their filtration decreases the accumulation of phytoplankton allowing sunlight to reach SAV’s, providing more dissolved oxygen and ultimately creating a prosperous and healthy Bay. Despite these valiant actions, water quality in Chesapeake Bay has improved very little. This study investigated the filtration capabilities of the Bay’s native mollusks, and to possibly find which species should be put where in the Bay to truly improve the ecosystem.

In this study, the effect of pH on a bivalve’s clearance rate found, as pH rises, the rate lowers. A two-way ANOVA test comparing this difference in rates was statistically significant ($p < 0.05$). Previous studies have observed such a result as well, the specimens are simply under more stress in a harsher environment, and the filtration rates at pH 6 and pH 12 differ greatly because of this fact. Also, it was found that *C. Virginica* filtered at a slower rate than *G. Demmisa*, while *M. Mercenaria* lagged behind both of these two. The differences in clearance rate, however, were not statistically significant. This raises the question, should *C. Virginica* be replaced in restoration efforts by *G. Demmisa*? An accurate answer to such a question cannot be determined by this experiment. The differences in the filtration of these three bivalves was not significant, therefore the null hypothesis cannot be rejected.

MAR

Beware of the Blooms: Anthropogenic Influences on Dissolved Oxygen and Primary Production in the Mattox Creek

Kora Herrod ^W

Abstract

Algae blooms are progressively frequent around coastal waters of the world. They can be a serious coastal issue by inflicting economic concerns for fisheries, stock, and degrading health or recreational locations. Accumulations of these organisms are primarily due to natural processes and anthropogenic loadings. Such occurrences along with biological processes also affect dissolved oxygen concentrations which are essential to aquatic organisms. With that being said, the study investigated how dissolved oxygen levels of algae were affected when steadily subjected to sources simulating anthropogenic influences (fossil fuels, agriculture, residential, nutrients, toxic contaminants) in light and dark reactions of photosynthesis over a period of time. In each trial, every other day, 6 bottles were introduced to an additional 40mL of their assigned pollutant while a dissolved oxygen probe was used to determine their DO concentrations when exposed to 12 hours of light and 12 hours of darkness. A one-way ANOVA was ran on Trial 1's collected data and produced a p-value of 1.4377763×10^{-4} while in Trial 2, a p value of 1.411×10^{-3} was resulted. Yielding a low p-value that is less than 0.01, the independent variables (treatment) does affect the response variable (dissolved oxygen concentration) and is highly significant. The null hypothesis was rejected. For each trial, the gross primary productivity of each 24 hour period was calculated from the sum of net primary production and respiration.

ENV

Wood Treatment Leaching on *Festuca arundinacea* Shoots, Height, and Lateral Root

Density

Nicholas Hipple ^W ★

Abstract

The United States Environmental Protection Agency (EPA) released a list of approved wood treatments in 2004, highlighting a few treatments that were determined to have been safe for surrounding plants and ground water. Four years later, this list was revised because further studies had shown that one of the chemicals, Copper Azole-Type A was not, in fact, safe for use. Chromated copper arsenicals had previously dominated the market, until the EPA found that this treatment was also not “safe.” This experiment aimed to analyze just what effect one of these approved chemicals may have on the physical properties of plants around it, specifically focusing on the shoots, height, and lateral root density of the plants.

To limit variables, one grass, *Festuca arundinacea*, was planted around Copper Azole-Type B treated wood, untreated wood, and in a control tray with no wood. After a week of preparation, and two weeks of growth, the grass was analyzed for the number of shoots, average shoot height, and average lateral root density using randomly placed quadrats. They were further analyzed with One-Way ANOVA tests, all of which yielded highly significant p values. It was concluded, then, that the presence of some leaching substance from the CA-B Treated wood was negatively impacting the grass growth. Properly cataloging how leachates from wood treatments impact surrounding plants can help to justify the use of certain treatments over others, especially in crop field fencing. Furthermore, damage to the base of the food chain (primary producers) yields more adverse effects for the top of the food chain, as biological magnification begins to affect the food chain.

ENV

The Effects of Different Concentrations of Caffeine over Time on *Daphnia magna*

Judy Ho ^{BG}

Abstract

Caffeine was used to determine the change in heart rate of *Daphnia magna*. Five stock solutions were used: 0 mg/mL, 0.1 mg/mL, 1 mg/mL, 10 mg/mL, and 100 mg/mL. Twenty *D. magna* were experimented within each level of caffeine and the heart rates were recorded at 0 minutes, 10 minutes, 35 minutes, and 50 minutes. In the control group, the heart rate decreased by 20 bpm from 10 minutes to 35 minutes. The heart rate rose back up by 10 bpm at 50 minutes. The irregular pattern of decreasing to increasing is the same for 10 mg/mL. In 0.1 mg/mL, the heart rate decreased from 198.7 bpm taken at 0 minutes to 160.9 bpm at 10 minutes. At 35 minutes, it increased by 8 bpm and continued to increase. This pattern is similar to the 1 mg/mL and 100 mg/mL. However, the effect of the different caffeine levels was not significant to individual *D. magna*. Multiple linear regressions resulted in a significant effect of caffeine over time on the heart rate of *Daphnia magna*. These results show that the amount of caffeine intake matters to the beats per minute on the heart, but not specifically different between the test subject of *D. magna*. The increase in concentration of caffeine affects the heart rate. As *D. magna* can be compared to humans, this continuation of increase in caffeine may lead to damage to the body and possibly death.

ENV

The Effects of Oceanographic Elements on Shark Displacement

Sara Honeycutt ^{BG}

Abstract

Sharks are at risk due to human impacts and ecosystem imbalanced. As a result of this shark populations are rapidly declining. Sharks are an important predator for the pelagic ocean, eating many organisms throughout the ocean and helping to maintain the population and the ecosystem. In order to do this experiment, data from the Ocearch's Shark Tracking database, was collected, which included 46 different sharks and their corresponding data; these data were processed and then analyzed by performing an ANOVA. This project was used to conclude if weight, length, location, gender, or species of a shark influenced the shark's travel. It also served as an insight to shark's normal travel patterns, and helped to eliminate if the independent variables impacted the dependent variable. The data showed that there was an increase in displacement per day on the length of the shark, and a decrease in displacement per day with the weight of the shark. Data that backed the research involved taking data for 14 sharks and then converting the data into metric units, and running a statistical test, an ANOVA. Only nine sharks had enough data to include both the 24 hour displacement and the 72 hour displacement. From the factors that were tested, all gave a value greater than .05, showing that there was little difference for each element tested. There were many factors that were not able to be as controlled as they should have been, the factors that could have varied this study were large, but overall, the study showed that each individual shark will travel as much as it needs to in order to feed, mate, and defend itself.

MAR

Oyster Spat Substrate Preference

Thomas Hyde ^W

Abstract

Over the past 200 years, Chesapeake Bay has experienced a mass overharvesting of a native benthic organism, *Crassostrea virginica*, the Eastern Oyster. Oysters are vital to the health of the bay, as are filter feeders, removing excess nutrients, sediment, and bio matter from the water column. Their reef building capabilities also help stabilize the shoreline and prevent erosion. The Bay has witnessed nearly a 75% decline in oyster abundance, over the last 50 years. Oysters are broadcast spawners, and after fertilization, search for a hard substrate to settle on, and turn into spat, which is the oyster's earliest stage of shell formation. Because of the destruction of much of the natural reef, this study proposes to advocate the creation of artificial reefs by finding which substances serves as the best substrate for oyster growth. Six different substrates were tested, glass, concrete, brick (clay), wood (pine), oyster shell, and steel. Each material was cut into a 10"x12" tile, and fit together in a 2x3 array and staked below the water line on an active oyster bed. Two different locations were used in this experiment, one on the Corrotoman River, and one in Morratoco, Virginia.

Besides oyster spat, barnacle and mussel recruitment was also examined. Oyster shell showed the highest recruitment for all three organisms. One-way ANOVA tests comparing recruitment between substrates for each organism resulted in highly significant p-values. In terms of artificial substrate: for oyster spat in the Rappahannock River, brick was the best artificial substrate, as opposed to glass, which proved to be the best in the Corrotoman River. The best artificial substrate for barnacle recruitment was glass, followed by steel, brick, concrete, and pine. The best artificial substrate was glass, followed by concrete, then pine.

MAR

Get In Touch: Kinesthetic Learning and Student Interest

Virginia Jarvis ^G

Abstract

Students need interaction in the classroom in order to maintain interest, because students who are interested in the material that they learn are more likely to retain the knowledge. Kinesthetic methods of teaching utilize the knowledge we have of brain function and help students remember the concepts they are taught in class. Kinesthetic learning is any type of learning that involves hands-on activities or physically engaging classroom exercises. This study seeks to determine the effectiveness of kinesthetic learning from the student's perspective. Advanced high school students were given a survey that measured their interest in learning correlated with the style of teaching that is typically used in the classroom. Also, in a fourth-grade classroom that uses hands-on activities (kinesthetic learning), students' attitudes were observed and test scores were compared to classrooms that use standard classroom learning. In the observed classrooms, students were more excited about learning when they were allowed to use hands-on, kinesthetic activities and there was a higher level of class participation than there was with standard classroom learning. The results of the survey taken by Governor's School students showed that a great majority of the students prefer kinesthetic learning over traditional classroom learning, such as with the use of lectures, textbooks, or worksheets. The statistics found in this study allow the null hypothesis to be rejected. Kinesthetic learning appears to motivate students more than traditional classroom learning techniques, such as taking notes and completing worksheets.

PSY

The Effects of pH levels on Stress of Fish

Ariana Johnson^{BG}

Abstract

The Chesapeake Bay has been through so much. It has experienced the introduction of human impact to poor water quality, especially changes in pH. These changes in pH have caused stress in the fish that have made the Bay its habitat. It has caused them to respire more or less because they are trying to maintain homeostasis. An experiment was done to find out if the *Notemigonus crysoleucas* would experience more stress by respiring more in acidic conditions or basic conditions. The pH levels were five, six, seven, eight, and nine and the stress was measured by the amount of times the *N. crysoleucas* would open its mouth to respire, or gill count. The averages were 127, 149, 141, 147, and 158 respectively. The averages show the connection between the different pH levels and the gill count. Multiple linear regressions tests were completed to find the overall impact on pH levels on the gill count resulting in a p-value of 3.88×10^{-4} , then two others to find the impact of acidic conditions on the gill count resulting in a p-value of 0.105, and the basic conditions on the gill count resulting in a p-value of 2.64×10^{-3} . The results of the experiment showed that there was an impact on pH on stress of *Notemigonus crysoleucas*, but this is only in pH levels of six, eight, and nine. It can be concluded that fish do experience stress under these conditions, but anything under six and above nine can be fatal to the fish.

ENV

The Effect of Lunar Day on Blue Crab Molting

Kelsey Johnson ^{BG}

Abstract

Soft-shell Chesapeake Blue Crabs are a very popular form of seafood and can be sold for more than hard-shell crabs. They use the molting process to grow. Some fishermen believe that the crab molting is affected by the lunar cycle and some believe it is only a legend. Since full and new moon cause the tides to be especially high or low, many believe that the Chesapeake Blue Crab will shed more during new and full moon. This is because the especially low or high tides will cause more or less aquatic grasses to be submerged in water. When they molt, the Chesapeake Blue Crab hides in these grasses for protection from predators. This theory needed to be tested. Tanks were set up and crabs were put into the tanks. They were monitored and their molts were recorded. The molts were then matched up to the days on a lunar month calendar. A linear regression gave a p-value of 0.389. The results showed that the day of the lunar month had no significant effect on crab molting. There were a few trends, but statistics showed no significance in the datum. Being inside, the moon did not shine directly on the tanks. There were no aquatic grasses placed in the tanks. The experiment also took place over the course of several months and two seasons. Many other factors also contributed to this. Crab molting did not vary during the different days of the lunar month. It is suggested that each crab simply stuck to its own personal molting cycle instead of conforming to the moon. Fishermen are encouraged to check their molting tanks frequently because lunar day is not a sufficient indicator of when the Chesapeake Blue Crab will molt.

MAR

Not All Eggs Are Created Equal: The Effect of Roosters, *Gallus domesticus*, on Hen Laying

Egg Production

Katie Johnson ^W

Abstract

Farmers are constantly looking for new ways to speed up the production level and increase the quality of eggs laid by hens. In carrying out this project, it could help in finding a way to do this. This study proposes to investigate the effect of having a rooster exposed to hens, on laying production of eggs. Scientists seem to believe that having a rooster exposed to a hen will not affect the production level of eggs. Other chicken owners feel otherwise. This project could help in answering this question. The research was conducted in three different pens with three different exposures to a rooster. There were three hens of the same breed in each coop/pen. In one pen, the hens were not able to hear, see, smell, or touch any rooster. Another pen was somewhat exposed to a rooster, they were able to see and hear it, but not able to touch it. The last pen actually had a rooster in it, and the hens were exposed to him at all times. The production level of eggs was tested once a day every day from June 1st – September 31st. The eggs were counted from each pen. This data assessed if a rooster really does affect the production level of eggs. At the conclusion of the project it was determined that the pen with no rooster exposure had the highest egg production levels. The p-values for each month were as follows; June: .000251, July: 7.21E-12, September: 4.01E-9. All p-values were significant; therefore, the null hypothesis was rejected in support of the alternate hypothesis.

ZOO

The Asian Clam, *Corbicula fluminea*: Are They Still Invaders?

Tyler Kelley ^G ★

Abstract

The purpose of this experiment was to observe the species *Corbicula fluminea*, and see if they should still be considered an Invasive species in the Mattaponi River. Many species that are considered invasive have been missed classified; they are simply called invaders because they were introduced into the ecosystem. From the Months of May to October samples for *C. fluminea* were collected from the Mattaponi River at the Walkerton Landing site. When the *C. fluminea* were collect there was also five core sediment samples taken each time. Each clam was measured in mm using a Vernier Caliper, and the core samples were wet sieved and the clams found were then measured in the same manner. The results indicated that *C. fluminea* have established a stable population in the Mattaponi River environment. Other studies show high densities of juveniles in the ecosystem, but in this study the environment had a high density of adults. Based on the size frequency distribution indicating a sustained population, integration into the Mattaponi food web, and the longevity in the river; *C. fluminea* should no longer be considered invasive in the Mattaponi, but rather naturalized.

ENV

Old Tricks: The Effects of Crop Pairing on Fruit Yield

Caroline Lancaster^{BG}

Abstract

The method of crop pairing was tested to see its effects on overall fruit yield. Ratios of different seed combinations of corn and beans were planted in a quarter of an acre growing plot in King William, Virginia. The ratios used were 100% corn, 66% corn/ 33% beans, 50% corn/50% beans, 33% corn/ 66% beans and 100% beans. After planting, all crops received the same care and the fruit was picked and weighed as it matured. Only the edible fruits were considered in this experiment due to the fact that these are what would be marketed to the public. After data were collected, it was seen that the ratio with the highest total fruit yield was the 50% corn/ 50% beans with a total combined weight of approximately 16,047 grams. The pairing that had the lowest total fruit yield was the 33% corn/ 66% bean ratio with a weight of approximately 6,945 grams. The ratio that had the highest total corn yield was the 100% corn ratio with a weight of approximately 13,522 grams and the pairing with the highest total bean yield was the 66% corn/ 33% beans ratio with a weight of approximately 5868 grams. A trend was seen given that for every one percentage increase in corn there would be a 21 gram increase in weight overall. This trend also suggests that for every one percentage increase in beans there would be a 6 gram increase in overall weight. A linear regression was run and provided a p- value of .0012 which suggests that crop pairing does have an effect on total fruit yield. The study shows that when crop pairing is done correctly it has positive effects on total fruit yield and in this experiment the ratio that had the highest total fruit yield was 50% corn/ 50% beans.

BOT

The Different Consistencies of Liquid and Powder Cosmetic Foundations and the Effect on Percent Coverage of Bacteria.

Josie Lewis ^{BG} ★

Abstract

Past case studies and Food and Drug Administrations have shown the lack of effectiveness in anti-bacterial agents in cosmetic foundations, but that they should not be kept any longer than the approximate six months, and because cosmetics are mostly an international trade; the FDA does not necessarily regulate but mostly recommends. When it comes to bacteria growing inside of your cosmetics the FDA had statements similar to the observations that the case studies had – that when cosmetics are placed on a shelf there is a possibility that the cosmetic is already contaminated with harmful bacteria before you even use the product. Also, that the preservative system or anti-bacterial agents within a cosmetic become less effective with the progression of time. A one-way Anova statistical test was ran against the data collected and a p value of less than 0.05 was obtained, a Bonferroni Multiple Comparisons Test was conducted. The Bonferroni Multiple Comparisons Test concluded that there was significant difference between used Transparent Three Blended face powder than Butterscotch-tinted Even Better Liquid Foundation, and no difference between new and used cosmetic foundation. This study tested the percent coverage of bacteria in liquid and powder cosmetic foundation consistencies, as well as new and used cosmetic foundation and the effect of percent coverage of bacteria. This study concluded that the heightened bacteria growth does not result in the consistency of the cosmetic foundation, but instead its containers.

CON SCI

Deriving Solar Energy Production Suitability for the Mid-Atlantic Region from NASA Earth Observing Satellites

John Lingenfelter ^G ★

Abstract

Solar energy has become increasingly prominent in the Mid-Atlantic region of the United States due to a reduction in cost and a rise in demand for renewable sources for the production of electricity. Currently, nonrenewable resources, such as natural gas, petroleum, and coal, are being used for energy in this region. Many recent government policies also reflect the rising acceptance of solar energy as one of the most abundant renewable resources, as exemplified by Maryland's Renewable Portfolio Standards (RPS). The RPS requires at least 2% of Maryland's electricity to be generated from solar energy. This project focused on identifying areas with the most advantageous climate and topography for placing solar panels in order to harness solar energy efficiently. This process involved the use of NASA's Earth Observing System (EOS) satellites, such as CERES sensor aboard the Aqua, Suomi NPP, and Terra satellites, and the Global Digital Elevation Model produced by the ASTER satellite. From the information gathered by the satellites, GHI maps were created, as well as a land cover map and aspect map. The four maps were then synthesized into a fifth map that took into account which areas receive the most solar irradiation and which terrain is most suitable for absorbing solar energy. Thus, the final map reflected the ability of an area to support solar energy production. This data was used to predict a possible Y value change for total power production throughout the Chesapeake region. This data was used to determine three different locations to be used in comparison to determine what role the cumulative factors (I.E. Slope, elevation, radiation) had in total solar production to be later determined by statistical analysis.

ENV

Silence of the Crickets: Does Frequency Affect the Rate of Continuous Chirping in Crickets

Rebecca Rieling and Dylan Melton ^{BG} ★

Abstract

Crickets are important to the ecosystem in large areas all over the world but are easily affected by noise pollution. An experiment was conducted to find out if changing the frequency of a sound would change the rate at which the *Acheta domestica* chirped, and thus interrupt their mating practices. Using several lots of crickets, frequencies were played aloud and the new chirping rates were taken. The chirping rates were taken by measuring pauses in the chirping. The frequencies were 0, 10495, 4500, 7500, and 25,000 Hertz. The averages were 11.99, 18.01, 8.44, 4.66, 2.92, and 33.01 seconds respectively. The averages indicated that there was a correlation between the frequency and chirping rate. A linear regression was done to determine to see if there was an impact of frequency changes on the chirping rate of house crickets, and yielded a p-value of 1.89×10^{-9} . The result of this study was that there was an impact of frequency on the rate at which crickets chirp. It can be said that certain frequencies affect crickets' chirping rate more than others, though it is unclear as to which decrease or increase chirping rates. However, using the average rates yielded from each frequency, the frequencies closer to 10,000Hz decreased the rate of chirping of the crickets.

ENV

Peak Performance: Is There Synergy between Academics & Athletics in High-Achieving Student Athletes?

Quinlan Moore ^G ★

Abstract

To confirm that sports are a beneficial part of young people's lives, sports habits and GPA were examined for students at the high school level. A 21 question survey was distributed to students at the Chesapeake Bay Governor's School and Middlesex High School. Responses were tabulated and data were analyzed based on high school students' home lives, classroom performances, and sports performances. There was a positive correlation between time spent on athletics and academics. Students with higher GPA's experienced higher stress levels during their sports season than lower achieving student athletes. It was also concluded that time management skills play a major role in separating the students producing 3.5 GPA's and the students producing 4.0 GPA's.

The conclusions drawn from this experiment could prove useful to parents and their decision-making with respect to sports/academic time management for their children. Exposing young people to athletics proves useful in future years because athletics positively affect performance in the classroom at a high school level, carrying over into their college years. If a child thrives in school at an early age, the child will very likely continue the trend throughout high school.

PSY

The Birth Date Effect and Historical Prominence

Victoria Moore ^W

Abstract

In the last couple decades scientists have researched and performed experiments to determine if birth month has any correlation with education and sports success. In both cases, it was shown that children born during x experienced greater success in academics and athletics. Therefore, one may be led to conclude that there will be a similar trend with historical prominence and birth month. What is meant by this is that there is an assumption that the world leaders from the sixteenth century through the twenty-first century will have been born in the later months. The main objective of this study was to test if birth month has any effect on whether someone becomes a world power. This was tested by researching three-hundred and eighty world powers between the 16th and 21st century, looking at their birth months, political position, and continent. However, due to the lack of documented birthday information for various political leaders in the sixteenth century when doing the statistics that century was not included due to the shortage of samples from that century compared to the others. The data used to do the statistics was the birth months, centuries, and different power tiers. A 2-way Anova and chi-squared were used as statistical tests for this study. The chi-squared tested the political leaders in relation to their birth months. The 2-way Anova tested the political leaders in relation to political tiers and centuries. Political tiers ranged from one to three, one included politicians, two mayors, and three shahs of Persia. The chi-squared and 2-way Anova proved to show no significance but the 1900s and 2000s on a graph showed similar trend lines. Therefore, if the study included 1,000 or more samples and looked at the 1900s and 2000s particularly then a correlation may have been found.

PSY

Flex Your Mussels: Byssus Growth of the Atlantic Ribbed Mussel, *Geukensia demissa*, on various substrates

Callie Morgan ^w ★

Abstract

Chesapeake Bay marsh environments have been degrading in the past years to the point of more than 60% loss of marshes. These habitats are important to the entire Bay ecosystem because of water filtration processes and flood and erosion control. Population growth directly increases development along the coasts contributing to changes in water flow and amounts of pollution affecting this fragile environment. Degradation of coastal environments is often replaced by man-made structures and many of the organisms that call the Bay home are very susceptible to these changes in their habitat. One of these marsh organisms, the Atlantic Ribbed Mussel (*Geukensia demissa*) is not only a food source, but also a cleansing force in marine ecosystems. This study looked at how man-made structures might affect Ribbed Mussels, specifically in their ability to attach byssal threads to different substrates. The experiment on these organisms and their byssal thread growth tested the effect of different substrates on the length and number of byssal threads grown. The substrates used included plastic, metal, wood, and mud. The experiment produced a significant p-value of 0.035 for length and a very significant p-value of 0.01 for the number of byssal threads. In both tests, the plastic substrate was preferred by the Atlantic Ribbed Mussel. In fact, all man-made substrates outcompeted the marsh sediment, suggesting that man-made structures may not adversely impact.

MAR

Herbicidal Tendencies: The Effects of Juglone on Growth and Germination of Grasses

Clay Moughon ^G

Abstract

Studies indicate that juglone, the active chemical in members of the Walnut tree genus, *Juglans*, could be an effective herbicide due to its ability to stunt growth of target plants. Therefore, an experiment was done that tested the ability of juglone to deter growth in plants. Tests were conducted on various types of grasses, including nimblewill, *Muhlenbergia schreberi*, and tall fescue, *Festuca arundinacea*, as to the effects of juglone on their growth and germination. A herbicide composed of black walnut solution was created and applied to the specimens. In the tests with nimblewill, the juglone compound was applied once at the beginning of the test and the plants were analyzed for changes in their outward appearance over a period of five days. Tests on the nimblewill were inconclusive, and no effect was observed on them. In the fescue tests, one group was tested with juglone compound from the time that the grass was planted to the time that the experiment ended, while another was tested from the time that the grass was planted to the point of germination using just water. Once germination had occurred, then juglone was applied from then until the time that the experiment ended. However, results for this test were also inconclusive, and no correlation was made between addition of juglone to the grass and non-addition of the grass.

BOT

Beer Cans and Sun: Not About Alcohol or Fun

Hughes Nelson ^G ★

Abstract

Saving money is a big focus of American households this year as prices rise for basic utilities. As prices for fuels rise, alternatives are being looked for to combat the rising cost of energy. A passive solar heater has no carbon pollution like wood, kerosene or natural gas. Solar does not produce waste, like wood, and it requires a simpler and safer system to harness the power than the traditional heating units. But there are some limiting factors, the amount of sun varies by region, in Virginia the average usable sunlight is only 4.8 hours, storms and cloud cover can reduce efficiency, and a solar heater does not work at night like traditional systems, so it cannot be used as a standalone system. A solar heater like the beer can heater used in the study can be built by using recycled building materials and electronics. The cost of the build varies between resource availability of the home and family. The solar heater produced an average raw heat of 150° Fahrenheit. The efficiency of the entire system was 83% for the testing period. The average ambient temperature during the trial with the heater was 33.5° Fahrenheit. The average maximum temperature of the room was 55° Fahrenheit and the average minimum temperature was 51° Fahrenheit. The room had an average change in temperature of 4 degrees. During the trial without the heater, the average ambient temperature was 40.5° Fahrenheit. The room had an average maximum temperature of 57° Fahrenheit and an average minimum temperature of 52° Fahrenheit. The room had an average change in temperature of 5 degrees. The Heater was successful in its mission to help save money as it would pay for itself within the year based on this study.

EGR

Low Level Radioactive Contamination of Aquatic and Terrestrial Vegetation

Beau Nickerson ^W ★

Abstract

The radioactive element thorium was introduced in the systems of both tomato plants and elodea in this experiment. The study hoped to find the effects of daily low level contamination on terrestrial and aquatic vegetation. The elodea plants were tested for total mass, total length, and radioactive uptake. The Tomato plants were measured for growth, germination percentages, and radioactive uptake. Thorium appeared to have a significant effect on mass and radioactive uptake on the elodea plants. It did not have a significant effect on the total length. Thorium also did not appear to have a significant effect on the tomato plant's growth and germination percentile. However, there did appear to be a significant difference on the radioactive uptake.

BOT

Effects of Sea Lettuce, *Ulva lactuca*, Fertilizer on the Growth of Sweet Basil, *Ocimum basilicum*

Alexandra Pitman ^W ★

Abstract

Chemical fertilizers used in agriculture boost crop production, but agricultural runoff is detrimental to the environment by increasing eutrophication of waterways. Organic fertilizers may decrease runoff by being better absorbed into the soil and taken up by plants than chemical fertilizers. Plants grown with organic fertilizers are also potentially safer for human consumption compared to those grown with high amounts of added chemicals and pesticides. The purpose of this study was to evaluate macroalgae as organic fertilizer. By removing excess algal growth from waterways for use in fertilizer, levels of eutrophication could be decreased. This experiment compared the effects of sea lettuce, *Ulva lactuca*, and Miracle-Gro on the growth of sweet basil, *Ocimum basilicum*, and the amount of nutrients each released in water. Overall, Miracle-Gro significantly increased plant growth, but *Ulva* aided growth when combined with Miracle-Gro and in comparison with the control. Blended *Ulva* initially released more nitrates in water than did non-blended *Ulva*. Statistical tests showed that Miracle-Gro released significantly more phosphates in water compared to other treatments. By removing *Ulva* from waterways as a plant growth aid, effects of eutrophication could be reduced and the amount of chemical fertilizers used in agriculture could be potentially decreased.

BOT

Effects on Monarch Butterfly (*Danaus plexipuss*) Decline

Darnisha Pitts ^W

Abstract

Monarch butterflies are unique migratory insects. They migrate from their spring and summer breeding habitats in North America, and Canada, to Mexico in the winter to escape the cold conditions. This experiment is to determine if temperature and rainfall has an effect on the monarch caterpillar and butterfly's growth indirectly by the milkweed plants. The female monarchs heavily depend on these plants to lay their egg and for food supply for their young when they hatch because that's all they feed on. The monarch butterfly population has experienced a steady decline over the past decade due to habitat lost with the advanced developments of the 21st century and climate change. This study investigates the how certain temperature and rainfall amounts can affect the growth and development of the monarch butterflies and how significance these two factors will be in their decrease. Throughout this study, Texas was used to collect data which was taken from Journey North for the number of monarchs counted and NOAA for rainfall and temperature averages. A linear regression was ran and both p-values for rainfall and temperature were significant which means that there is some correlation between rainfall and temperature and the number of monarchs where milkweed plays a role in their decline or in this case, their increase in population in Texas. This study can be used to see how rainfall and temperature has an effect on the milkweed population, which in turn affects the monarch population, either positively or negatively.

ENV

The Effect of Different pH Treatments on the Metabolic Rates of *Hydrilla verticillata*

Jennifer Radcliffe ^W ★

Abstract

Ecosystems are made more susceptible to invasive colonization by being stressed by factors such as global climate change. In addition, aquatic ecosystems are stressed by ocean acidification, a decrease in the ocean pH caused by increased levels of CO₂ in the atmosphere. This rise in acidity is detrimental to calcifying organisms, but may or may not have a negative impact on submerged aquatic vegetation (SAV) and its effect on freshwater organisms is not well studied. Since its introduction to the United States in the 1950s, the aquatic invasive species, *Hydrilla verticillata*, has overrun many aquatic ecosystems, particularly in the southeastern part of the country, including tributaries of the Chesapeake Bay. This study tested the respiration and production rates of *Hydrilla* under different pH conditions, in order to predict what kind of effect increasing water acidity might have on this invasive species. The apical tips of *Hydrilla* were incubated in water ranging from 8.2 to 5.7 pH units, in both the light and dark. *Hydrilla*'s metabolic rates, corrected for biomass, were computed from the change in dissolved oxygen during the incubations. The control treatment, 7.2, had both the highest respiration and production rates, followed by the most acidic and basic treatments, 5.7 and 8.2, then 6.7 and 6.2, although the difference in respiration rates was not significant. It is speculated that somewhere between 6.2 and 5.7pH, *Hydrilla* reaches a stress threshold that forces it to go into overdrive, possibly a survival strategy called phenotypic plasticity. Further studies to pinpoint this threshold may give an indication of how SAV in the Chesapeake Bay will handle stresses brought by increasing acidity or other stressful environmental conditions such as global climate change.

ENV

The Effect of 17 β -Estradiol on the Sex Ratio of *Poecilia reticulata* Offspring

Elizabeth Ransone^G ★

Abstract

In recent years, concern has arisen about the tainting of natural aquatic environments through anthropogenic means. As human populations have grown and pharmaceutical use has become more prevalent, the concentration of sex hormones that enter bodies of water has increased around the world. These sex hormones are especially problematic because they are still potent when they are excreted from the human body and can enter local ecosystems through wastewater. This study observed the effect of enhanced environmental concentrations of 17 β -estradiol on the sex ratios of offspring of exposed fish. This study had two trials; each used a control, a low dosage treatment of 17 β -estradiol (5 nanograms per liter or 5×10^{-6} parts per million), and a high dosage treatment of 17 β -estradiol (15 ng/L or 1.5×10^{-5} ppm) in tanks with the fancy guppy, *Poecilia reticulata*. The offspring were sexed by looking at their caudal fin formation: an elongated tail was considered characteristic of a male, and a rounded tail was classified as a female. All of the control and high treatment offspring were female in the first trial. The low treatment tank in the first trial yielded a ratio of 0.75 males for every female. The second trial saw the opposite results from the first trial, as all of the low treatment offspring were male and the high treatment had a ratio of 1.75 males per female offspring. A t-test with a result of $p=0.5$ found the results of the combined trials were not statistically significant. Further experimentation with a larger control population should occur before conclusions can be made about the effect of 17 β -estradiol on the sex ratio of *P. reticulata* offspring.

ENV

How Close is Too Close? The Struggles of the Native Pepper: Chiltepin

Hannah Rennolds ^W

Abstract

Throughout the last few decades the presence of unwanted, non-indigenous plant and animal species has caused a detrimental drop in the native populations of both plants and animals. The most prevalent of such effects in the plant communities is often the theft of available nutrients. Non –indigenous plant species disrupt the growth patterns of the pre-existing plants, causing habitat destruction for other types of organisms that call them home. The comparison of two separate pepper species, the Chilean Habanero and the American Chiltepin, will hope to prove the dangerous effects that non-indigenous plants have on their surroundings. The two plants were planted both in monoculture and in juxtaposition. The interaction between them was tested by determining the effect that physical proximity has on the growth rates, and available nutrients of each pepper species when grown in monocultures and when grown together. This study did not produce any significant p-values from the ANOVAs that were run determining the effect that the closeness of the Habanero had on the growth of the Chiltepin. The big picture of how close is too close was affected by such natural, environmental factors as the interspecific competition between the two as well as potential allelopathy can add to the adverse effects that non-native species can have on the environment.

BOT

**The Effects of Human Development on Dune Vegetation and the Atlantic Ghost Crab
(*Ocypode quadrata*)**

Hannah Richardson ^W ★

Abstract

The Outer Banks are a unique system of barrier islands that are inhabited by numerous plants and animals and are characterized by sandy beaches. In recent times as construction has increased on the Outer Banks, worries have risen about the effects of this development on the myriad of wildlife, and on the tourism industry. If increased human development were to impact an organism such as the Atlantic ghost crab (*Ocypode quadrata*), or plants such as dune vegetation, the food chain of the area would be detrimentally affected, which would ultimately affect the economy of the area. This study aimed to observe if human development on the sandy beaches of the Outer Banks in North Carolina will have a significant impact on the Atlantic ghost crab within different strata on the beach front and on dune vegetation. The research was conducted in an outdoor environment with the data collection being on the beach for both the ghost crabs and vegetation. The beach was separated into three strata with data being collected and quantified in each strata for the ghost crab data; while the plant data was only collected on the foredune, this process was repeated for the developed, Comfort Inn, and undeveloped site, New Inlet. The resulting data showed that there was a statistically higher percent plant coverage at the undeveloped beach, as well as a higher plant diversity. The undeveloped beach had a greater number of ghost crab burrows, mostly in the foredune area. This could occur because an increased human presence leads to the trampling of ghost crab burrows and vegetation, and increased pollution could lead to harmful chemicals penetrating the sand, causing harm to the plants and also to crabs within their underground burrows. The collected data could be used to predict future effects of human development on beaches like the Outer Banks. MAR

Effect of Hot Water Immersion on 40 Yard Dash Times

Freddie Romero- Baker and Taylor Buchannan ^{BG}

Abstract

Running 40- yard dashes can make or break a track athlete or football player. We examined whether hot water immersion would make 40- yard dash times faster. Our H_a was that the times with the heated treatment would be faster, because heat loosens muscles, which helps improve performance. Water that was 38.8° C was used on the runners' lower legs to loosen their muscles and improve their running times. The runners ran on a standard rubberized track to lessen variability because that is where this racing event takes place. The runners ran and they were timed and recorded. After a two- tailed T test was ran we received a p-value of 1.86×10^{-6} , this means we can reject our null hypothesis. We also found interesting differences between different groups of runners. Runners with times of 6+ seconds had a time change of .02 seconds, runners with times 5-5.9 seconds had a change of .17 seconds, and runners 4-4.9 had a change of .12 seconds. These time changes seem very miniscule but in the 40- yard dash these times can have a great impact of how high a player will get drafted, and therefore impact how much he is paid. We also found that if the runner was initially slower he had a greater change in time than a runner that was initially faster. Overall, hot water immersion does effect the 40- yard dash.

MED

Molecular Weight Effects on Proton Conductivity in 1H-Tetrazole Polymers

Kaitlin Saunders ^W ★

Abstract

This study aims to report comparative data of proton conductivity in a polystyrenic alkoxy 1*H*-tetrazole of lower molecular weight, corresponding with a low glass-transition temperature. The results were examined in contrast to a higher molecular weight polystyrenic alkoxy 1*H*-tetrazole previously analyzed. Synthesis of the polymer with an amphoteric 1*H*-tetrazole side chain, possessing the ability to behave as an acid or base, includes converting 4-acetoxystyrene to 4-vinylphenol, addition of an alkoxy nitrile via an ether linkage, and concluding with click chemistry following the polymerization. Proton conductivities of thin films were measured in both anhydrous and hydrated atmospheres utilizing electrochemical impedance spectroscopy. The study did not produce a significant difference in conductivity on decreasing the polystyrenic alkoxy 1*H*-tetrazole glass-transition temperature by 20 °C, suggesting that conductivity is not related to polymer viscosity (T_g) at all.

EGR

Reef Grief: Examining the Effects of Biogenic Reefs on Water Quality and Living Shorelines

Lindsey Saunders ^W

Abstract

The eastern oyster, *Crassostrea virginica*, has seen extreme decline in the past 200 years despite its ability to thrive in most coastal and estuarine waters, which has endangered the health and economy of Chesapeake Bay. With the decline of reef, natural habitats were destroyed and shorelines were negatively affected in a manner that could only be reversed through reef restoration. Living shorelines are one example of reef restoration. Ready Reef, Inc. established biogenic oyster reefs along various living shorelines in an effort to thwart negative side effects of natural reef decline. By decreasing erosive material on a gradual, yet significant scale, and thus improving water quality, the Bay gains a better chance of survival in years to come.

This study consisted of two trials of water quality testing and shoreline profile measuring along a Ready Reef biogenic reef and nearby shoreline where the reefs were not located in Taylor's Creek, Virginia. The site tests were conducted on November 6th and February 26th. The pH levels were substantially lower within the reef site waters. The natural living shoreline also showed an increasingly sloped sea floor while the artificial living shoreline was relatively uniform, maintaining a slight incline. Dissolved oxygen levels along the reef site were ~10 ppm higher in comparison to the treed site. P-values comparing dissolved oxygen and pH levels at the reef and treed sites were not significant in any case. P-values evaluating shoreline stability over time at the reef and treed sites were also not significant. Thus, there is not valid evidence to reject the null hypotheses.

MAR

The Effect of Fish Species of Length, Weight and Age

Hodan Seager^{BG}

Abstract

The age of a fish population is a crucial factor in stock management and assessment. Fish are mainly aged through using either the scale method (counting the annuli of the scales) or the otolith bone method (dissecting the otolith (ear bone) of the fish). In this experiment the scale method was used to classify age. After conducting the experiment it was found that the frequency of mature fish (those fish found to be aged 2+ or above) was greater than that of the juvenile fish (those fish found to be aged 1+ and below) amongst both collected fish sample species, Eastern Mud Minnow and Blue Spotted Sunfish. This was found to be due to the catch method of wading and dip netting used during this study. Upon this discovery a further study into the length to weight ratio of my fish samples. It was found that the Eastern Mud Minnow had a lower length to weight ratio than the Blue Spotted Sunfish. This was concluded to be due to the Eastern Mud Minnows streamlined body structure versus the Blue Spotted Sunfish's laterally compressed structure.

ENV

Safe or Dangerous: Mercury Levels in Bluefish (*Pomatomus saltatrix*), and Striped Bass (*Morone saxatilis*) in the Potomac River and Chesapeake Bay

Baine Self ^W

Abstract

The tidewater region of Virginia has an economy that is very dependent of the Chesapeake Bay and its tributaries. Not only are there thousands of people who fish these waters for commercial bounties, which can be shipped and consumed worldwide, but there are also many locals who fish off of boats and piers recreationally, as well as those who travel and pay charter boat captains to sport fish out in the deep waters. Fishing has always been a staple of the local community. But recently local crabbers and oyster fishermen, such as Ronnie Bevans, have had to worry about their shellfish stocks. Many reports are starting to flood local news of increased toxins in shellfish worldwide. More specifically scientists have sited mercury being found in the shellfish. Mercury can come from many places, such as fuels, small appliances, large appliances, batteries, lights, car parts, and most of our electronics. Though the mercury is not found in large amounts in these items, they do build up in landfills and dumping grounds overtime as more and more of these items are discarded. Once the rain comes the mercury is washed away into local tributaries and rivers. The shellfish try to filter it out but instead they end up taking in a keeping the mercury in their bodies. Small shellfish such as the crabs, oysters, scallops, and crawdads that are found in the bay and to contain mercury, are some of the favorite foods of Bluefish and Striped bass. This study was focused upon finding mercury in Striped bass and Bluefish caught in the Potomac River, by testing carcasses of fish caught by a local charter boat captain using a Home Health Chemistry mercury test kit, but unfortunately for the experiment, no traceable amounts of mercury were found in the tested fish carcasses.

MAR

The Colonization of Various Substrates by Biofouling Organisms in the Lower Machodoc Creek

Mary Sisson^W

Abstract

Organisms such as polychaete worms, barnacles, amphipods, and other boring or migrating creatures are considered to be bio fouling organisms due to the fact that such organisms inhabit structures underwater. These organisms create habitats and reproduce on structures such as dock posts and boats. Many factors contribute to the way that these organisms live and where they settle or create a habitat such as water quality and season. The biofilms and habitats that are created on a particular surface cause many problems with structures that have been underwater, including damage to those surfaces, the money spent on removing those organisms, and also the money and time spent preventing the spread of bio fouling organisms. This study compared the growth rate of bio fouling organisms on dock posts at four geographically different locations along the Lower Machodoc Creek in the Chesapeake Bay. It compared the growth on the original dock piling as well as a new dock piling. A new uncontaminated dock post and the original dock post at each location was scraped during the start of spring, summer, winter, and fall of 2013, and compared to water quality parameters taken as well. This study produced the result that each season, the number and type of bio fouling organism varies due to the change in season/temperature and water quality parameters. The seasons and water quality did not create unnatural results, but a significant and important difference was seen between the different dock posts. The results of this study allow for the monitoring of exactly when to expect an extended growth rate of bio fouling habitats on underwater structures and how the growth of those organisms continues to spread on surfaces.

MAR

Growing Mushrooms to Feed the Hungry

Ryan Six ^W

Abstract

The world is having trouble feeding itself; most countries outside the first world have serious issues with feeding their populace. *Pleurotus ostreatus* (Oyster Mushroom) is a type of fungus that grows easily in nearly all climates and areas around North America, Europe, Asia and parts of Africa. This fungus grows at a steady rate and is very edible, eaten in cuisine across most of Asia. These mushrooms could be used as a viable resource for food in these areas where it is hard to grow crops due to lack of fertile soil or rain. Contrast this with the first world countries that have issues with waste disposal and that are where this experiment was created. This experiment was designed as to show that compost or other trash could be useful in growing Mushrooms for consumption by areas where growing normal crops would be difficult. The alternate hypothesis being that the urban compost would cause faster mushroom growth than rural compost. The results show that there is no significant p value, and no significant difference in the two compost types.

BOT

Gasification as a Means of Carbon Sequestration and the Effects of Biochar

Gina Sledd ^G

Abstract

By only burning off certain volatiles and keeping the carbon trapped in the wood, Biochar fuel has the potential to act as a carbon sink. Biochar promotes the health of the soil by allowing soil to retain more nutrients and water due to its porous surface. This then allows plants to utilize the nutrients and healthy bacteria that latch on to the biochar. Biochar, when compared to regular compost, stays within the soil for a longer period of time. The study was conducted using a fire pit, three planting pots of equal size, pea and lettuce seeds, soil, and a gasification stove. Data, including heights and weights of the individual plants, was collected over five weeks. Also, 10 burns of each type (gasification and regular combustion) were performed and then the weights of the remnants were weighed thereafter. However, due to rainy weather, many seeds failed to sprout. This limited data resulted in a failure to run much statistical analyses on the plant tests. On the other hand, the burn test had enough data to run a t test. After the data was calculated, the study showed a difference in the weight of wood burned ashes to the ashes burned during gasification. This result portrayed that the process of gasification can possibly lead to carbon sequestration of organic materials.

BOT

Spat Out Dollars

Brad Smith ^W

Abstract

Currently in the State of Virginia, there are 1190 commercially licensed oyster fishermen and licensed oyster aqua culturists(VMRC, 2011). In addition there are 32 commercially licensed oyster shucking houses (VMRC, 2011). This means that there are roughly 2,000 people employed in the oyster field in the State of Virginia. That is 2,000 hard working oystermen that depend on the oyster in order to feed their families. These hard working oystermen meet their basic needs by harvesting oysters through various methods. Dredging, tonging and aquaculture are the most prominent methods of oyster harvest. This study is a statistical analysis of whether aquaculture or a traditional method of harvest is the most profitable. Data were obtained from the Virginia Marine Resources Commission as well as from local oystermen. The data showed the overhead of various oyster harvest methods as well as the amount of time and energy used. The research and study brought about a dollar overhead amount for each method to harvest a million oysters. This initial data showed that dredging had the lowest overhead cost for oyster harvest. A sensitivity analyses was also conducted to show which method would be the most robust to changes in the future. In the sensitivity analyses labor cost and the oyster population were changed. The sensitivity analyses showed that oyster cage diploid was most robust to changes in the environment. This study will help watermen dependent on oyster harvest to reach their profit potential providing economic flexibility and growth for the present and future.

CON SCI

The effects of tides on green sea turtle (*Chelonia mydas*) abundance in Kahaluu Beach Park

Paul Smith ^W ★

Abstract

The green sea turtle (*Chelonia mydas*). They can grow to be about four to five feet in diameter, and to weigh up to 400 pounds. The turtles occupy a couple of different habitats, convergence zones in the pelagic habitat, and benthic feeding grounds in relatively shallow waters. This study examines the potential correlation between tides and the sightings of green sea turtles in Hawaii. Turtle appearance at Kahaluu Bay have been almost entirely unpredictable. By determining patterns of turtle appearance, turtles can be better protected from harmful interactions with humans, and humans may better be able to observe the turtles with a more predictable frequency. It is possible that green sea turtles may appear in Kahaluu Bay in relation to tidal fluctuations that influence foraging behavior. By monitoring turtle abundance during different portions of the tidal cycle, correlations may be determined. During the research period it seems as though the appearance of turtles has been directly correlated to the phase of the tide. During periods of low tides locations received little to no turtle appearance, then during periods of increased tide activity turtle appearance increased. The Experiment produced a p-value of .0032 for turtle abundances.

MAR

Mechanical and Ambient Noise in Estuarine Environments

Samuel Spadaccini ^G

Abstract

Before mechanical noise was introduced into the marine environment, acoustic energy was limited to natural processes such as wave energy which is relatively quiet and periodical. In the study, ambient noise was recorded underwater using a hydrophone at various locations. The conditions defining “ambient” included no surrounding anthropogenic noise. Queen’s Creek in Mathews, Virginia was chosen because it is a shallow body of water with low boating activity. Kinetic energy reverberating from the Colman Bridge in Yorktown, Virginia and from the Gwynn’s Island Bridge were recorded to sample anthropogenic noise pollution. Select samples were then imported into *RavenLite: Interactive Sound Analysis Software*. The software digitized the sound and displayed it as an oscillogram; a graph that illustrates sound as a wavelength with amplitude on the vertical axis and time on the horizontal axis. Specific noises, both natural and anthropogenic, were isolated within the software and analyzed based on frequency and compared based on their corresponding pure tone. The three sets of data were analyzed using an ANOVA statistical test between the Coleman Bridge, the Gwynn’s Island Bridge and the *Micropogonias undulatus*’s samples and a statistical difference was found. This study has helped to identify and characterize sources of anthropogenic noise pollution. Many studies have already found adverse effects of anthropogenic noise on marine organisms such as whales, but the smaller organisms in shallow, estuarine environments may also be affected by prolonged and confined anthropogenic noise pollution.

ENV

Decomposition of Trees

Katie Thomas^W

Abstract

In March of 2013, a partially dead White Oak (*Quercus alba*) tree fell down. In April, the tree was cut into 12 sections. The sections were placed in four different areas (marsh, woods, full sun, and partial sun). This study looked at how the tree sections were colonized and decomposed in each environment by collecting insects and measuring the amount of fungi on the decomposing tree sections. This study aims to determine which environments are best for the decomposition of trees. Each tree section was approximately 6 inches tall, 13 inches in diameter, and weighed approximately 20lbs. This study tracked the decomposition of each tree section over 5 months. Once a month, the number and type of insects found on, in, and under each tree section was determined, and percent fungi coverage was also determined. At the end of the 6th month, the mass of each tree section was taken, to determine how much mass was lost to decomposition during the 6 month period. A One Way ANOVA test was run and the p-value was .2315; therefore insignificant. A Two Way ANOVA test was also run and the p-value was .9371 and therefore was also insignificant. A Shannon Diversity test was run and found that there was very few variances in the data between each site.

ENV

Do Plants Eat More In Large Numbers?

Christian Tinsley ^W

Abstract

This experiment focused on the relationship between an Aquaponics system's nitrogen assimilation and varying plant densities. The maximum nutrient uptake rate was determined for varying levels of plant density (low: 4 plants per square foot; medium: 8 plants per square foot; high: 12 plants per square foot). Data were analyzed to check for any relationships, trends, or unusual occurrences. It is predicted that the nutrient removal rate will increase linearly as plant densities are increased due to the amount of plants that are competing for the limited amount of nutrients per cycle. By determining the maximum nutrient uptake rate at various plant densities in, Aquaponics systems, the principle units of these systems could be optimized to produce the maximum production. By the end of the experiment the data was able to tell whether or not there is a certain number or ratio of plants to fish in which an Aquaponics system would be working at maximum output. This study could eventually lead to major breakthroughs in food production for third world countries. Aquaponics focuses largely on helping protect the environment as well as being a cheap and healthy way of producing food.

BOT

The Effects of Essential Oil on Bacteria Growth on Steak

Bailey Tyler^{BG}

Abstract

The purpose of this study was to test if essential oils could be used as an alternative preservative to salting, refrigeration, and other forms of preservation in the interests of maintaining nutrition as well as preventing bacterial growth. The test was conducted by introducing bacteria from a sample of top sirloin steak to an agar plate, coating with an essential oil, and then measuring bacterial growth in percent surface area of each plate. It was found that the average bacteria coverage in plates treated with essential oils, were the same to that of the positive control plate, suggesting that essential oils do not prevent bacterial growth. Not only this, but it was also found that plates treated with lemon and vegetable oil, were significantly different than all other oil treatments, actually encouraging growth.

CON SCI

**You Just Got Served: The Effect of the Arch of a Person's Back
on the Creation of Top Spin**

Tamia Walker-Atwater^{BG}

Abstract

This study was used to find the optimal arch of a tennis player's back to create the most topspin. Topspin is the fast forward spinning motion on a caused by friction, making a ball bounce lower .After conducting a series of three different trials, each done in an indoor tennis court, a total of sixty one different data points were collected. Based on the linear regression ran on these points, a p-value of 1.10406×10^{-3} was given. This p-value shows that there was significance between the arch of a player's back and the amount of topspin created when conducting a tennis serve. Other data collected shows that there was a height increase of the ball after initial impact of 0.762 meters for every degree that the arch of a player's back decreased. This was thought to be true because with an increased arch, a player is bending back more allowing them more time to watch the ball. With this increased eye contact with the ball the player has more time to adjust posture therefore making better contact with the ball.

PHY

The Effect of Soccer Ball Panels on Distance Traveled

Taylor Webb ^{BG} ★

Abstract

Since the first soccer ball constructed in Stirling Castle in 1570, it has been modified over and over again. These changes often require changing the number of panels that cover the surface of the sphere or the ball, therefore altering the shape slightly. Due to the alterations to these panels, this study was used to show if the number of panels on a soccer ball had an effect on how far the ball would travel, as if it was passed in a game. A wooden mechanism, that mimicked a passing action, was used on three different balls, each with a different number of panels. Beginning with the 20 panel ball, an average of 277.3 centimeter distance was found. The 24 paneled ball had an average of 288.6 centimeters traveled and the 36 paneled ball had an average distance of 284.8 centimeters. The relationship was for every panel there would be a change of .29 centimeters. After running a linear regression on the data that was collected, the p-value came out to be .14, which showed that the number of panels did not significantly affect the distance that the ball traveled, since there was more variability among the individual levels than between the different levels. Therefore, the number of panels does not impact the distance that the ball travels. This leads to the conclusion that all soccer balls, regardless of the number of panels that it has will not make passing in soccer and therefore, any soccer ball can be used internationally.

PHY

The Effect of Heat and Chemical Manipulation on Hair Damage

Daijah Wilson ^{BG}

Abstract

The Hair structure is a protein made up of amino acids that are composed of salt bonds, hydrogen bonds, and disulfide bonds. These bonds are broken by heat, moisture, and chemicals. This led to the experiment, which manipulation heat or chemicals of hair does the most damage to the hair strand. In this experiment the pH of chemicals that were used were 7, 10, and 13. The levels for temperature were 172, 187, and 201 degree Celsius. It was found that while heat does affect the hair pH levels do not. Per temperature there are a number of strands that are split from the hair strand. I ran a linear regression on my data and received two p-values. For heat I received a p-value of .04 meaning that heat does have a negative effect on hair damage. From the data I received a trend line that showed at 172° C was approximately 6.1 strands per 2 cm, 187° C was approximately 6 strands per 2 cm, and 201° C was approximately 5.25 strands. For pH I received a p-value of .06 meaning that heat does not have an effect on hair damage. From the data I received a trend line that showed the average damage of hair using a pH 7 was approximately 4.6 strands per 2 cm, a pH 10 caused approximately 5.2 strands, and a pH 13 caused approximately 5.5 strands to be damaged.

CON SCI

Magnetic Fields Effect on the Growth of Plants

Kristin Worrell ^W

Abstract

Plants are vital to human survival. Life as we know it couldn't exist without plants. Everything we eat comes directly or indirectly from plants, they give us oxygen to breath, and they help purify and distribute the planet's water, this is why they are important.

Previous studies show just how magnetic fields can affect the growth of plants. Dr. Albert Roy Davies, the father of modern bio-magnetics, used magnetics to treat seeds to stimulate plant growth. Another study would be Louis Pasteur's experiment on fermentation. He discovered that the magnetic field on Earth was having an effect on plants' growth and processes.

In order to find out for sure if magnetic fields would affect the growth of plants an experiment was conducted. The summer of 2013 four planters were filled with topsoil and placed on an enclosed porch. The four planters experienced the same conditions throughout the experiment. Each planter was filled with equal amounts of topsoil and contained the same amount of grass seeds per box. The boxes were exposed the same amount of sunlight and received equal amounts of water. The growth parameter that was measured throughout the experiment was the height in which the grass grew.

Results showed that there wasn't a large difference between the control and the other treatments. One could believe this is due to the fact that plants were not exposed long enough during fermentation and magnetic fields do not have a large enough effect on the plants growth to be used main scale to increase production rates. If the grass had grown better with the magnetic field it could have been away keep up with the growing population by producing food needed faster and in large amounts.

BOT

The Effects of Mycorrhizae Fungus on Growing Plants

Gloria Wyszynski ^W

Abstract

Mycorrhizae fungus is a symbiotic fungus that is naturally found in healthy soil. It attaches itself to a plant and grows within it and it is hypothesized that the fungus helps the plant access more water, increase plant growth, and excrete substances that break down elements such as phosphorus and nitrogen, making it easier for the plant to absorb. It is also hypothesized that the fungus is capable of creating webs of hyphae which help to stabilize the soil and prevent soil and nutrient runoff. This study compared the effects of basil, string bean, and kohlrabi plants that were treated with an arbuscular mycorrhizal fungus versus basil, string bean, and kohlrabi plants that were grown without the fungus. The plants were tested for plant height, water drainage, and dried root mass to determine whether or not the mycorrhizae helped the plant grow taller and whether it stabilized the soil. What was found was that the mycorrhizae increased the basil and string bean's height significantly but not the kohlrabi's height when compared with the non-mycorrhizal plants. The fungus increased the soil's capability of draining water without any puddles or runoff in all three mycorrhizal plant tubs. As far as root mass, the fungus significantly increased the basil and kohlrabi's root mass but not the string bean's root mass.

BOT

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